

Appendix C

Fauna Observations from the Field Investigation

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Scientific Name	Common Name	Location(s)	Fauna Observation Site(s)	Comments		
Birds						
Acanthiza nana	Yellow Thornbill	KP27	Z004			
Alisterus scapularis	Australian King-Parrot	KP25	Z009			
Bubulcus ibis	Cattle Egret	Avon R/DTpCk	Z003			
Chenonetta jubata	Australian Wood duck	KP29.2, KP67.1, KP76.2	Z008, DAM1, WLND3			
Corcorax melanorhamphos	White-winged Chough	KP10	Z005			
Cormobates leucophaea	White-throated Treecreeper	KP3.7	Z010			
Cracticus torquatus	Grey Butcherbird	Avon R/DTpCk	Z003			
Dacelo novaeguineae	Laughing Kookaburra	KP21, KP27, KP37, KP76.2	Z011, Z004, Z007B, WLND3			
Eolophus roseicapilla	Galah	KP10, KP29.2, KP76.2	Z005, Z008, WLND3			
Eopsaltria australis	Eastern Yellow Robin	KP29.2, KP37	Z008, Z007B			
Gallinula tenebrosa	Dusky Moorhen	KP76.2	WLND3			
Gymnorhina tibicen	Australian Magpie	Avon R/DTpCk, KP37	Z003, Z007B			
Hirundo neoxena	Welcome Swallow	KP27, KP37, KP76.2	Z004, Z007B, WLND3			
Larus novaehollandiae	Silver Gull	KP97.4	WLND14			
Macropygia amboinensis	Brown Cuckoo-Dove	KP27, KP76.2	Z004, WLND3			
Malurus cyaneus	Superb Fairy-wren	Lge Rem2	Z002			
Manorina melanocephala	Noisy Miner	Avon R/DTpCk, KP10	Z003, Z005			
Manorina melanophrys	Bell Miner	KP27	Z004	heard		
Meliphaga lewinii	Lewin's Honeyeater	KP29.2	Z008			
Neochmia temporalis	Red-browed Finch	KP3.7	Z010			
Pelecanus conspicillatus	Australian Pelican	KP76.2	WLND3			



Scientific Name	Common Name	Location(s)	Fauna Observation Site(s)	Comments			
Philemon corniculatus	Noisy Friarbird	KP14.4	Z006				
Platalea regia	Royal Spoonbill	KP91.7	WLND12				
Platycercus elegans	Crimson Rosella	Avon R/DTpCk, KP14.4, KP76.2	Z003, Z006, WLND3				
Platycercus adscitus	Eastern Rosella	Avon R/DTpCk, KP76.2	Z003, WLND3				
Podargus strigoides	Tawny Frogmouth	Lge Rem1, KP40	NIGHT1, NIGHT2				
Pomatostomus temporalis	Grey-crowned Babbler	KP 4, KP 36.9, KP 39.5	Z005, Z014B, OB54				
Porphyrio porphyrio	Purple Swamphen	Avon R/DTpCk	Z003				
Rhipidura albiscapa	Grey Fantail	Avon R/DTpCk, KP27, KP29.2	Z003, Z004, Z008				
Rhipidura leucophrys	Willie Wagtail	KP76.2, KP97.4	WLND3, WLND14				
Sericornis frontalis	White-browed Scrubwren	Avon R/DTpCk	Z003				
Sericornis magnirostra	Large-billed Scrubwren	KP27	Z004				
* Streptopelia chinensis	Spotted Turtle-Dove	KP49.5	Z012				
Threskiornis molucca	Australian White Ibis	Lge Rem1, KP97.4	NIGHT1, WLND14				
Reptiles							
Physignathus lesueurii	Water Dragon	KP76.2	WLND3				
Pogona barbarta	Bearded Dragon	KP19	BDRAG				
Frogs							
-	-	KP97.4	WLND14	no frogs heard			
-	-	Avon R/DTpCk, KP14.4, KP37, KP65.4, KP66.8, KP67.1, KP68.9, KP72.6, KP75.5	Z003, Z006, Z007B, Z018, DAM1, Z019, Z021, Z020	frogs heard – no ID			
Litoria ewingii	Brown Tree Frog	Lge Rem1	NIGHT1				



Scientific Name	Common Name	Location(s)	Fauna Observation Site(s)	Comments			
Mammals							
-	-	Lge Rem2	Z002	Echidna diggings in wider area			
-	-	KP25, KP27, KP29.2	Z009, Z004, Z008	Platypus reported in Karuah River			
-	-	Avon R/DTpCk, KP10	Z003, Z005	Rabbit warren			
-	-	KP27	Z004	Bandicoot foraging pits			
-	-	KP37	Z007B	Macropod diggings			
* Lepus capensis	European Hare	Lge Rem2	Z002				
Macropus giganteus	Eastern Grey Kangaroo	KP3.7	Z010				
Macropus rufogriseus	Red Necked Wallaby	KP33, KP34.2, KP41.1	Z007B, NIGHT2, Z0014B				
* Oryctolagus cuniculus	European Rabbit	KP10, KP56.5	Z005, Z015				
Trichosurus vulpecula	Brushtail Possum	Lge Rem1	NIGHT1				

* = exotic (human-assisted) introduction.

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Appendix D

Legislation Relevant to Ecological Aspects of the

Proposed Development

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D.1 Commonwealth Legislation

D.1.1 Environment Protection and Biodiversity Conservation Act (1999)

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) regulates Matters of National Environmental Significance, including the following matters:

- threatened species and ecological communities listed on the schedules of the Act
- National Heritage Places
- Ramsar wetlands
- Commonwealth Marine Areas
- migratory species
- World Heritage Properties
- Nuclear actions
- Actions on Commonwealth land
- Actions taken by the Commonwealth Government.

There are no World Heritage Properties, Commonwealth land or Commonwealth marine properties in the project area. Nuclear actions and actions taken by the Commonwealth are of no relevance to this proposed development.

The southern end of the pipeline lies about 1 km upstream of the Hunter Estuary Wetlands, which is listed as a RAMSAR wetland. Provided appropriate mitigation measures as proposed in this report are followed, the proposed development is very unlikely to have any significant impacts on this wetland.

The proposed development does not contain any protected ecological communities. The pipeline transects one population of Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*) listed as Vulnerable under the EPBC Act. The study area contains potential habitat for a further 9 nationally threatened flora species and 10 fauna species. Potential impacts on flora and fauna of conservation significance are assessed in accordance with the EPBC Act Policy Statement 1.1 Significant Impact Guidelines (**Table T15**, **Table T16**). The project was referred to DEWHA on 29 August 2008 (EPBC 2008/4432) and was considered to be a controlled action, as it is likely to have a significant impact on the following matters protected under the EPBC Act:

- The project involves disturbance of acid sulfate soils which have the potential to change the physio-chemical status of the RAMSAR-listed Hunter Estuary Wetlands
- The project potentially involves the disturbance of breeding populations of nationally threatened frogs including the Booroolong frog (*Litoria booroolongensis*) and the giant barred frog (*Mixophyes iteratus*).
- The present survey has also recorded a population of the nationally threatened Small-flower Grevillea (*Grevillea parviflora* subsp. *parviflora*) in a powerline easement at KP 65.5.



DEWHA has decided that the project will need to be assessed through state assessment under a bilateral agreement. It will include a public consultation phase and will require approval by the Minister for the Environment, Water, Heritage and the Arts.

A total of 21 species of birds listed as Marine and / or Migratory under the EPBC Act were considered to potentially occur in the study area, or for have potential habitat within the study area. The potential impacts to these species were assessed following the 'significant impact criteria' as outlined in the EPBC Act Policy Statement 1.1, Significant Impact Guidelines (DEH 2006).

D.2 State Legislation

D.2.1 Environmental Planning and Assessment Act 1979

The *Environmental Planning and Assessment Act* 1979 (EP&A Act) and the EP&A Regulations provide the framework for environmental planning in NSW and include provisions to ensure that proposals which have the potential to impact the environment are subject to detailed assessment and provide opportunity for public involvement.

This project has already been declared to be a major infrastructure development under Part 3a of the EP&A Act. Therefore, approval for the project is required under Part 3A of the EP&A Act, and the Minister for Planning is the approval authority for the proposed works.

Under Section 75U of the EP&A Act, the following authorisations (among others) are not required for an approved project (i.e. permission to carry out these activities is granted as part of the approval):

- the concurrence under Part 3 of the Coastal Protection Act 1979 of the Minister administering that Part of the Act
- a permit under section 201, 205 or 219 of the Fisheries Management Act 1994
- an approval under Part 4, or an excavation permit under section 139, of the Heritage Act 1977
- a permit under section 87 or a consent under section 90 of the National Parks and Wildlife Act 1974
- an authorisation referred to in section 12 of the Native Vegetation Act 2003 (or under any Act to be repealed by that Act) to clear native vegetation or State protected land
- a permit under Part 3A of the Rivers and Foreshores Improvement Act 1948
- a bush fire safety authority under section 100B of the Rural Fires Act 1997
- a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the Water Management Act 2000.

Under section 75JA of the EP&A Act, the proponent may be required to acquire and retire (in accordance with Part 7A of the *Threatened Species Conservation Act* 1995) biodiversity credits to offset any impacts to biodiversity values potentially arising from a major project.



D.2.2 Native Vegetation Act 2003

Clearing remnant native vegetation or protected regrowth generally requires approval under the Native Vegetation Act 2003 (NV Act) unless the clearing is a permitted activity. Remnant vegetation is defined under the NV Act (for this part of NSW) as being all native vegetation that was in existence on 1 January 1990. However, the NV Act does not apply to any clearing that is, or that is part of, a designated development within the meaning of the EP&A Act and for which development consent has been granted under that Act.

D.2.3 Threatened Species Conservation Act 1995 (TSC Act)

A separate license under the *Threatened Species Conservation Act* 1995 (TSC Act) can be required for clearing approved as part of a Development Consent. In most situations permitted activities can be undertaken without requiring a threatened species approval (i.e. "it is a defence to a prosecution for an offence against Section 118A of the TSC Act if the action was essential for the carrying out of development in accordance with a development consent within the meaning of the EP&A Act"). However, as some permitted activities do require consideration of threatened species, further advice should be sought from the local Catchment Management Authority.

The pipeline transects one population of small-flower grevillea (*Grevillea parviflora* subsp. *parviflora*) listed as Vulnerable under the TSC Act. The study area contains potential habitat for a further 14 flora and 47 fauna species protected under the Act.

D.2.4 National Parks and Wildlife Act 1974

The *National Parks and Wildlife Act* 1974 (NPW Act) provides for the establishment, preservation and management of national parks, historic sites and certain other areas and the protection of certain fauna, native plants and Aboriginal objects.

The Act allows for the reservation of land as a national park to protect and conserve areas containing outstanding or representative ecosystems, natural or cultural features or landscapes or phenomena. National parks are managed for numerous values, including:

- the conservation of biodiversity, the maintenance of ecosystem functions, the protection of geological and geomorphological features and natural phenomena and the maintenance of natural landscapes
- the conservation of places, objects, features and landscapes of cultural value
- the protection of the ecological integrity of one or more ecosystems for present and future generations
- the promotion of public appreciation and understanding of the national park's natural and cultural values.

Mining activities are not permitted in a national park or historic site, except as expressly authorised by an Act of Parliament. The *Mining Act* 1992, the *Offshore Minerals Act* 1999, the *Petroleum (Onshore) Act* 1991 and the *Petroleum (Offshore) Act* 1982 do not apply to lands within a national park or historic site.

Under Section 153, the Minister may grant easements or rights of way through, upon or in a national park, historic site, state conservation area, regional park, nature reserve or karst conservation reserve for the construction of pipelines, or for the erection of standards, posts, wires and appliances for the conveyance or transmission of electricity, or for any other purpose deemed necessary.



The proposed pipeline transects Wallaroo National Park from KP 59.7 to KP 63, following an existing electricity easement.

D.2.5 State Environmental Planning Policy 14 – Coastal Wetlands Protection (SEPP 14)

This policy aims to ensure that coastal wetlands are preserved and protected in the environmental and economic interests of the State. Clearing, filling, draining or constructing a levee on a SEPP 14 wetland requires consent of the council and the concurrence of the Director-General of the Department of Infrastructure, Planning and Natural Resources. However, the concurrence of the Director-General is not required for development that is declared to be a project under Part 3A of the EP&A Act.

The proposed pipeline transects one SEPP14 wetland for approximately 30 m at KP 68.9 and lies adjacent to several other SEPP 14 wetlands at KP 86 and KP 88.

D.2.6 State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44)

The State Environmental Planning Policy No 44--Koala Habitat Protection aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. It identifies local government areas and tree species that are known to support koalas, encourages the identification of areas of core koala habitat and requires the preparation of plans of management for areas identified as core koala habitat before development consent can be granted.

This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline, by:

- requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat
- encouraging the identification of areas of core koala habitat
- encouraging the inclusion of areas of core koala habitat in environment protection.

All six local government areas in which the project occurs (Dungog, Gloucester, Great Lakes, Maitland, New Castle and Port Stephens) are listed in Schedule 1 of SEPP 44. As such, all of the project area is in areas covered by SEPP 44.

Under the SEPP, "potential koala habitat" means areas of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. Three of the species listed in Schedule 2 were recorded in the project area: forest red gum (*Euc. tereticornis*), tallowwood (*Euc. mycrocorys*) and grey gum (*Euc. punctata*), but mostly at low densities. Two areas of the ecological community south coast shrubby grey gum contained grey gum in densities of 15 % or greater, making theses locations "potential koala habitat". These were a 0.7 km section of woodland along the proposed pipeline route between KP 14.6 and KP 15.25 and a 0.4 km section between KP 36.4 and KP 36.8.

Under the SEPP, "core koala habitat" means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings and historical records of a population. Evidence of a resident koala population was not found within the project area. Due to the small amount of "potential koala habitat" in the project area, it seems unlikely that an area of "core koala habitat" occurs in the project area. However, targeted surveys for koalas were hindered during the present field survey due to time constraints and inclement weather conditions.



D.2.7 Port Stephens Council Comprehensive Koala Plan of Management

The *Port Stephens Council Comprehensive Koala Plan of Management* (Port Stephens Council 2002; CKPoM) was prepared under SEPP 44, in close consultation with the NSW NPWS. Its purpose is to establish a management framework for Koalas and their habitat in the port Stephens LGA.

The principal objectives of the CKPoM are to:

- Evaluate and rank Koala habitat throughout the Port Stephens LGA.
- Identify priority conservation areas and strategies to protect significant Koala habitat and populations.
- Identify threats that impact on Koalas and Koala habitat.
- Provide for the long-term survival of Koala populations by devising conservation strategies to effectively address each of the threats impacting on Koalas and Koala habitat.
- Provide for the restoration of degraded Koala habitat areas.
- Ensure that adequate detail is provided with Development Applications in order to assess, minimise and ameliorate likely impacts on Koala habitat.
- Provide guidelines and development standards to protect Koalas and Koala habitat.
- Provide for effective public awareness and education programs concerning Koala conservation issues.
- Encourage appropriate eco-tourism programs.
- Provide a formal approach for the assessment, retrieval, rehabilitation and release of sick, injured, orphaned or distressed Koalas.
- Identify potential funding sources for implementation of the CKPoM.
- Facilitate targeted Koala conservation and management-oriented research projects within the Port Stephens LGA.
- Provide for the effective implementation and monitoring of the CKPoM.

The identification of koala habitat within the Port Stephens LGA involved a combination of field-based survey and community-based survey data, interpreted in the context of a detailed vegetation map. The resulting combined Koala Habitat Map identified and ranked Koala habitat as *Preferred, Supplementary* and *Marginal*. From this combined map, a Koala Habitat Planning Map was prepared. The Koala Habitat Planning Map provides the basis for identifying the areas that are considered to warrant the highest level of habitat protection. These areas include all Preferred Koala Habitat and Habitat Buffers. Supplementary Koala Habitat and Habitat Linking Areas also require protection. The CKPoM Consultative Committee recommended that the width of Habitat Buffers should be determined on a case-by-case basis using ecological criteria. These ecological criteria are detailed in Appendix 9 of the CKPoM.

With regard to the proposed Gas Pipeline project:

- Protection of Koala habitat is relevant during the construction period.
- Managing the Risk of Bushfires is relevant during the construction period and during maintenance of the RoW.
- Consideration of Koala Welfare is relevant during the construction period.



The other major aspects of the CKPoM (Habitat Restoration; Traffic Management; Dog Management; Feral Animal Management; Education; and Tourism) are not directly relevant to the proposed Gas Pipeline project.

D.2.8 State Environmental Planning Policy 71 – Coastal Protection (SEPP 71)

This policy aims to protect and manage the natural, cultural, recreational and economic attributes of the New South Wales coast.

This policy applies to land within 100 m of any of the following:

- mean high water mark of the sea, a bay or an estuary
- a coastal lake
- a declared Ramsar wetland or World Heritage property,
- land declared as an aquatic reserve under the FM Act,
- Iand declared as a marine park under the Marine Parks Act 1997,
- land reserved or dedicated under the National Parks and Wildlife Act 1974
- land to which SEPP 14--Coastal Wetlands applies.

SEPP 71 areas relevant to the proposed project include:

- Wallaroo National Park transected by the pipeline from KP 59.7 to KP 63.
- SEPP 14 wetland transected by the pipeline for approximately 30 m at KP 68.9
- SEPP 14 wetlands adjacent to the pipeline at KP 86 and KP 88.

D.2.9 State Environmental Planning Policy 26 – Littoral Rainforest Protection (SEPP 26)

This policy applies to all communities of littoral rainforest in NSW, including the Hunter Valley. However, the proposed project would not occur near or interfere with any littoral rainforest communities.



Appendix E

TSC Act Section 5a Assessment (Seven-part Tests) for

Threatened Ecological Communities and Species

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E.1 Introduction

Seven-part Test assessments are the prescribed standard method for assessing the potential impacts of proposed developments to species listed as threatened and ecological communities listed as endangered pursuant to the TSC Act Section 5A. Under most circumstances a species or community that fails to meet the standards set in the Seven-part Test will trigger a requirement for the preparation of a Species Impact Statement. However, developments that are assessed under Part 3a of the EP&A Act (i.e. State Significant Developments) do not require Seven-part Tests. Nevertheless, the Seven-part Test provides a rigorous and standardised format for assessment, so it used for that purpose in this report. In this case, however, the assessments cannot trigger a Species Impact Statement. The Seven-part Test is also used to assess potential impacts to species and ecosystems listed as threatened under the EPBC Act. The use of the Seven-part Tests in this way is recognised an accepted assessment approach to meet the requirements of the EP&A Act and through the bilateral agreement the EPBC Act (see the draft *Guidelines for Threatened Species Assessment under Part 3A of the Environmental Planning and Assessment Act 1979*, released by the Department of Planning, Department of Environment and Climate Change and Department of Primary Industries in November 2008).

The Seven-part Tests completed below for follow a standardised format. They open with a brief review of the ecology and habitat requirements of the subject species or community and the threats it faces. The majority of this information has been taken from the threatened species pages of the DECC website (<u>http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/home_species.aspx</u>).

This is followed by responses to the seven test criteria (a) to (g):

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

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

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: (i) is the proposal likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction; or (ii) is the proposal likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

(d) In relation to the habitat of 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; (ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat; and (iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

(e) Whether the action proposed is likely to have an adverse effect on critical habitat.

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

(g) 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.



Each test includes recommendations to mitigate any potential impacts to the species that were identified in the test. The mitigation recommendations given in the tests are expressed generally. The recommended mitigation measures are collated in **SECTION 5**, where more specific details are provided.

Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Freshwater Wetlands on Coastal Floodplains of New South Wales North Coast, Sydney Basin and South East Corner Bioregions are listed as Endangered in Part 3 of Schedule 1 of the TSC Act.

These wetlands occur in areas under 20 m elevation that are subject to periodic or semi-permanent inundation by freshwater (although there may be minor saline influence in some wetlands). Soils are generally silts, muds or humic loams. Typical landforms include depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Vegetation is dominated by herbaceous plants (e.g. sedges, reeds, herbs, grasses) with very few woody species. This community corresponds to LHCCREMS map unit 46 (freshwater wetland complex) and NSW map unit 56 (coastal freshwater lagoon).

The community is subject to a wide variety of threats, including land clearing, altered hydrology, reduced water quality and impacts from domestic and introduced species. Hydrology may be impacted by flood mitigation and drainage works and filling and excavation associated with urban and industrial development. Water quality may be affected by pollution and eutrophication from urban and agricultural runoff, dumping of landfill, rubbish and garden refuse soil, disturbance by pigs and activation of acid sulfate soils. Native vegetation maybe degraded by weed invasion and overgrazing and trampling by livestock. Native fauna may be threatened by predation, particularly by mosquito fish and cane toads.

This community is poorly reserved, with the closest reserve in Hexham Swamp. Some areas are protected by State Environmental Planning Policy 14. In the NSW North Coast bioregion, only 3% of the pre-European extent of this community was estimated to remain in the 1990s and an estimated 66% remained in the Lower Hunter Central Coast region. However, periodically inundated, treeless wetlands are difficult to map, so these figures may be relatively inaccurate. For example, several areas of this wetland type were mapped as non-remnant or forested wetland in existing mapping.

Freshwater Wetlands on Coastal Floodplains were recorded within or adjacent to the pipeline corridor at the following locations:

- an ephemeral wetland, which is dominated by sedges such as *Carex apressa* and *Juncus pallidus*, near the Williams River for about 0.9 km at approximately KP 67.8, including
 - transecting the wetland for about 0.15 km
 - transecting an artificial drainage channel, which is fringed by sedges for about
 5 to 10 m
 - passing through cleared pasture just east of the wetland for 0.7 km
- passing through cleared pasture that lies in a 100 m gap between Williams River and a sedge-dominated wetland for 0.5 km at approximately KP 66.5 (detailed site assessment at flora site 20)
- passing through cleared pasture just north of the Williams River and just southeast of a narrow strip of wetland with sedges and occasional paperbarks (about 10 m wide at approximately KP 69.2)



- passing to the east of Woodberry Swamp (mapped as an SEPP14 wetland) for about 0.8 km at approximately KP 86
- passing to the east of Tarro Swamp (mapped as an SEPP14 wetland) for about 1.2 km at approximately KP 88.
- (a) Not applicable
- (b) Not applicable

(c) (i) The proposed development would directly impact on an ephemeral wetland of approximately 24 ha. It would transect 150 m of ephemeral sedge-dominated wetlands and 10 m of sedge-lined drainage channel. If the full 30 m ROW was cleared, this would require the removal of 0.5 ha of wetland (approximately 2.1% of the entire 24 ha wetland). However, actual clearing area would likely be much less by minimising clearing and disturbance width through this section. For example, reducing width to 10 m would reduce clearing to 0.16 ha (0.7%).

Based on LHCCREMS mapping (which only covers the southern third of the study area), 2970 ha of freshwater wetland complex remains within 5 km of the proposed alignment (the buffer area). The maximum clearing of 0.6 ha proposed by this development therefore represents only 0.02% of the estimated total extent in the buffer area. This would not be likely to significantly increase the risk of extinction for this community. With effective revegetation and weed management, it would be likely that this wetland can be restored to its previous condition, resulting in no net loss of wetlands within several years after construction.

(ii) Construction works may also indirectly impact on adjoining upstream wetlands (2 ha) and downstream wetlands (22 ha) through altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds.

The proposed development also lies adjacent to several wetlands, so could have indirect impacts through altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds.. With appropriate mitigation as proposed above (e.g. construction during dry periods, sediment and erosion control, minimising use and passage of heavy machinery and vehicles in wetland areas, trench wildlife management, reinstatement of previous soil profile and topography, revegetation and weed management), the proposed development would be unlikely to modify these wetlands to the extent that the risk of extinction is significantly increased.

(d) (i) The proposed development would directly impact on approximately 160 m of an ephemeral wetland. If the full 30 m ROW was cleared, this would require the removal of 0.5 ha of wetland (approximately 2.1% of the entire 24 ha wetland). Actual clearing is likely to be less than this maximum figure.

The proposed development lies adjacent to several wetlands, which may be modified through indirect impacts such as altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds. With appropriate mitigation as proposed below, the proposed development would be unlikely to have significant impacts on these wetlands.

(ii) The small extent of clearing required for this proposed development would be unlikely to contribute to increased fragmentation or isolation from other areas of wetland, with appropriate mitigation as recommended below.



(iii) The wetland directly impacted by the proposed development is approximately 24 ha. This represents only 0.8% of the total estimated area of this wetland within the 5 km buffer area. Nevertheless, the mitigation strategies proposed in this report aim to rehabilitate cleared wetlands with the gaol of no net loss of wetland habitat.

(e) No critical habitat has been declared by the Director-General of the NPWS for Freshwater Wetlands on Coastal Floodplains.

(f) The action proposed is not inconsistent with the 13 priority action statements identified to help the recovery of Freshwater Wetlands on Coastal Floodplains (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development: the alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The mitigation strategies proposed in this report aim to minimise direct and indirect impacts on wetlands and rehabilitate impacted wetlands with the aim of no net loss or adverse alteration of wetland habitat.

Mitigation measures

Options to avoid or mitigate impacts on this wetland include:

- investigation of potential realignment of the pipeline to the east to pass upstream of wetlands (ongoing)
- investigation of potential HDD of the pipeline underneath the 150 m section of wetland (ongoing)
- investigation of the minimum clearing and disturbance width through wetland (ongoing)
- investigation for potential acid sulphate soils before construction and development and implementation of an appropriate management plan if detected
- construction and disturbance to be confined to dry periods (when wetland dry) as far as practical
- minimising construction time (especially period of open trench)
- minimising use and passage of heavy machinery and vehicles within and adjacent to the wetland during construction
- development and implementation of appropriate sediment and erosion control systems during construction
- appropriate wildlife bridges, ladders and shelters to be installed in open trenches
- qualified fauna handlers to remove any trapped wildlife from the open trench each day
- soil stockpiles to be stored outside the wetland and enclosed in appropriate sediment and erosion control devices
- reinstatement of previous soil profile and topography as far as practical to minimise impacts on natural hydrology
- stockpiling and respreading of topsoil in wetland
- revegetation of wetlands with native wetland species as soon as possible following construction
- development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction.



Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner

Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions is listed as Endangered in Part 3 of Schedule 1 of the TSC Act.

This community is found on waterlogged or periodically inundated coastal floodplains, generally below 20 m elevation. It has a dense to sparse tree layer, which is dominated by Swamp Oak (*Casuarina glauca*). It often forms mosaics with other floodplain forest communities (e.g. Freshwater Wetlands on Coastal Floodplains) and treeless wetlands (e.g. Swamp Sclerophyll Forest of Coastal Floodplains). This community corresponds to LHCCREMS map unit 41 (Swamp Oak sedge forest) and 40 (Swamp Oak rusAECOMnd forest), CRA map unit 143 (Swamp Oak) and NSW map unit 50 (coastal floodplain wetland).

In the Lower Hunter - Central Coast region, less than 30 to 40% of the pre-European extent was estimated to remain in the 1990s. LHCCREMS mapping estimates that the 5 km buffer surrounding the lower third of the proposed pipeline contains 539 ha of Swamp Oak forest. This contrasts with CRA mapping, which estimates that only 169 ha remains within a 5 km buffer surrounding the entire pipeline.

The community is subject to a wide variety of threats, including land clearing, altered hydrology, reduced water quality and impacts from domestic and introduced species. Hydrology may be impacted by flood mitigation and drainage works and filling and excavation associated with urban and industrial development. Water quality may be affected by pollution and eutrophication from urban and agricultural runoff, dumping of landfill, rubbish and garden refuse, soil disturbance by pigs and activation of acid sulfate soils. Native vegetation maybe degraded by weed invasion and overgrazing and trampling by livestock. Some areas may be threatened by excessive fire frequency.

Swamp Oak Floodplain Forests were observed along the pipeline at the following locations:

- passing through a 50 m wide cleared strip through an open forest dominated by Swamp Oak for about 300 m at approximately KP 86 (to the east of Woodberry Swamp)
- passing through cleared pasture just south of the Williams River and just southeast of a narrow strip of wetland with an open canopy of swamp oaks and a dense ground story of sedges (about 50 m wide at approximately KP 70).

a) Not applicable

(b) Not applicable

(c) (i) The proposed development would not directly impact on any Swamp Oak Floodplain Forest, so will not directly alter the extent of this community.

(ii) The proposed development lies adjacent to several areas of Swamp Oak Floodplain Forest, so could have indirect impacts through altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds. With appropriate mitigation as described below, the proposed development would be unlikely to modify these wetlands to the extent that the risk of extinction is significantly increased.

(d) (i) The proposed development would not directly impact on any Swamp Oak Floodplain Forest. With appropriate mitigation as described below, potential indirect impacts that could modify this community would be considered unlikely.

(ii) The proposed development is unlikely to significantly increase fragmentation or isolation of this community.



(iii) No significant impacts on this community are considered likely, with appropriate mitigation as described below.

(e) No critical habitat has been declared by the Director-General of the NPWS for Swamp Oak Floodplain Forest.

(f) The action proposed is not inconsistent with the 11 priority action statements identified to help the recovery of Swamp Oak Floodplain Forest (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development: alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The mitigation strategies proposed in this report aim to minimise direct and indirect impacts on wetlands and rehabilitate impacted wetlands with the aim of no adverse alteration of wetland habitat.

Mitigation measures

Mitigation to minimise potential impacts include:

- investigation for potential acid sulphate soils before construction and development and implementation of an appropriate management plan if detected
- construction and disturbance to be confined to dry periods (when wetland dry) as far as practical
- minimising construction time (especially period of open trench)
- minimising use and passage of heavy machinery and vehicles within and adjacent to the wetland during construction
- development and implementation of appropriate sediment and erosion control systems during construction
- appropriate wildlife bridges, ladders and shelters to be installed in open trenches
- qualified fauna handlers to remove any trapped wildlife from the open trench each day
- soil stockpiles to be stored outside the wetland and enclosed in appropriate sediment and erosion control devices
- reinstatement of previous soil profile and topography as far as practical to minimise impacts on natural hydrology
- stockpiling and respreading of topsoil
- development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction.



Swamp Sclerophyll Forest of Coastal Floodplains of the New South Wales North Coast, Sydney Basin and the South East Corner

Swamp Sclerophyll Forest of Coastal Floodplains of the New South Wales North Coast, Sydney Basin and the South East Corner bioregions is listed as Endangered in Part 3 of Schedule 1 of the TSC Act.

This community is found on waterlogged or periodically inundated coastal floodplains, generally below 20 m elevation. It is typically an open forest dominated by *Melaleuca quinquinerva* (paperbark) and / or *Eucalyptus robusta* (swamp mahogany). Soils are generally humic clay loams or sandy loams. Swamp Sclerophyll Forest of Coastal Floodplains corresponds to LHCCREMS map units 37 (swamp mahogany paperbark swamp forest) and 42 (riparian Melaleuca swamp woodland / Melaleuca scrub), CRA map units 142 (swamp mahogany) and 112 (paperbark) and NSW map unit 50 (coastal floodplain wetland).

In the Lower Hunter - Central Coast region, about 30 of the pre-European extent was estimated to remain in the 1990s. LHCCREMS mapping estimates that the 5 km buffer surrounding the lower third of the proposed pipeline contains 328 ha of Swamp Sclerophyll Forest. This contrasts with CRA mapping, which estimates that only 172 ha remains within a 5 km buffer surrounding the entire pipeline.

The community is subject to a wide variety of threats, including land clearing, altered hydrology, reduced water quality and impacts from domestic and introduced species. Hydrology may be impacted by flood mitigation and drainage works and filling and excavation associated with urban and industrial development. Water quality may be affected by pollution and eutrophication from urban and agricultural runoff, dumping of landfill, rubbish and garden refuse, soil disturbance by pigs and activation of acid sulfate soils. Native vegetation may be degraded by weed invasion and overgrazing and trampling by livestock. Some areas may be threatened by excessive fire frequency and removal of dead wood.

Swamp Sclerophyll Forest of Coastal Floodplains was recorded adjacent to the pipeline for 0.2 km and is transected for about 30 m, just north of the Williams River at approximately KP 69. A detailed assessment of this community was conducted at flora site 21. The transected area has been partially cleared for a powerline corridor (Plate P5). A 10 m wide strip directly underneath the powerline is totally cleared, while the areas 10 to 20 m on either side contain well-established regenerating paperbark trees characteristic of this community. The majority of this community lies to the southeast of the proposed pipeline, with a small area also extending about 50 to 100 m to the northwest. This wetland (including the section transected by the proposed pipeline) is mapped as an SEPP 14 wetland.

- a) Not applicable
- (b) Not applicable

(c) (i) The proposed development would directly impact on a Swamp Sclerophyll Forest community with a total estimated area of 5.3 ha, located just north of the Williams River at approximately KP 69. The proposed pipeline will transect through a narrow 30 m section of the wetland. This section has been partially cleared for powerline construction and maintenance. If the proposed pipeline is placed outside the existing cleared corridor, the 30 m ROW will require 0.09 ha of clearing (1.7% of the entire community). However, it is likely that the ROW width would be reduced and placed partially within the cleared corridor, so clearing would be substantially less. Several other areas of Swamp Sclerophyll Forest are known in the vicinity of the Williams River, so removal of this small area would not be likely to significantly increase the risk of extinction for this community.

(ii) Construction works may also indirectly impact on this community through altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds. With appropriate mitigation as proposed below, the proposed development would be unlikely to modify this wetland to the extent that the risk of extinction is significantly increased.



(d) (i) The proposed development would directly impact on a maximum of 0.09 ha. With appropriate mitigation as described below, potential indirect impacts that could modify this community would be considered unlikely.

(ii) The proposed development will temporarily isolate a small (about 0.3 ha) western section of the community from the larger (about 5 ha) eastern section of the wetland. However, with appropriate mitigation (including trench wildlife management), the proposed development would be unlikely to significantly increase fragmentation or isolation of this community.

(iii) Several other areas of Swamp Sclerophyll Forest are known in the vicinity of the Williams River. Estimates of remnant Swamp Sclerophyll Forest within the 5 km buffer surrounding the pipeline range were from 172 ha to 328 ha. The 5.3 ha community impacted by the present proposal therefore represents only 1.6 to 3% of the total area within the buffer and the proposed removal of 0.09 ha is only 0.03 to 0.05% of the total area. Nevertheless, the mitigation strategies proposed in this report aim to minimise clearance and other impacts on Swamp Sclerophyll Forest.

(e) No critical habitat has been declared by the Director-General of the NPWS for Swamp Sclerophyll Forest.

(f) The action proposed is not inconsistent with the 12 priority action statements identified to help the recovery of Swamp Sclerophyll Forest (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development: alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The mitigation strategies proposed in this report aim to minimise direct and indirect impacts on wetlands and rehabilitate impacted wetlands with the aim of no adverse alteration of wetland habitat.

Mitigation Measures

Options to avoid or mitigate impacts on this wetland include:

- investigation of potential realignment of the pipeline to the west to avoid this wetland (ongoing)
- investigation of potential HDD of the pipeline underneath the 30 m section of wetland (ongoing)
- investigation of the minimum clearing and disturbance width through wetland, including use of the existing 10 m cleared strip underneath the powerline (ongoing)
- investigation for potential acid sulphate soils before construction and development and implementation of an appropriate management plan if detected
- construction and disturbance to be confined to dry periods as far as practical
- minimising construction time (especially period of open trench)
- minimising use and passage of heavy machinery and vehicles within and adjacent to the wetland during construction
- development and implementation of appropriate sediment and erosion control systems during construction
- appropriate wildlife bridges, ladders and shelters to be installed in open trenches
- qualified fauna handlers to remove any trapped wildlife from the open trench each day
- soil stockpiles to be stored outside the wetland and enclosed in appropriate sediment and erosion control devices



- reinstatement of previous soil profile and topography as far as practical to minimise impacts on natural hydrology
- stockpiling and respreading of topsoil in wetland
- revegetation of wetlands with native wetland species as soon as possible following construction
- development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction.

Hunter Lowland Redgum Forest

Hunter Lowland Redgum Forest in the Sydney Basin and NSW North Coast Bioregions is listed as Endangered in Part 3 of Schedule 1 of the TSC Act.

This community occurs on gentle slopes arising from depressions and drainage flats on Permian sediments. It is generally an open forest with a canopy dominated by *Eucalyptus tereticornis* and *Eucalyptus punctata*. The sparse mid stratum may include *Breynia oblongifolia, Leucopogon juniperinus, Daviesia ulicifolia* and *Jacksonia scoparia* and the ground layer contains various grasses and herbs. This community corresponds to LHCCREMS map unit 19 (Hunter lowlands redgum forest), CRA map unit 47 (Redgum / apple) and NSW map unit 21 (Northern hinterland semi-mesic forest).

LHCCREMS mapping estimates that the 5 km buffer surrounding the lower third of the proposed pipeline contains 161 ha of Hunter Lowland Redgum Forest. CRA mapping estimates that 1243 ha remains within a 5 km buffer surrounding the entire pipeline. Only about 27% (less than 500 ha) of the pre-European extent of Hunter Lowland Redgum Forest was estimated to remain in the 1990s and this is highly fragmented. Less than 2% of this community is reserved in the Wereketa (previously Lower Hunter) National Park, with most of the remainder in private tenure. Threats include clearing and associated fragmentation, grazing, weed invasion, altered fire frequency and, locally, rubbish dumping.

A small area of Hunter Lowland Redgum Forest was recorded along Little Black Camp Creek at approximately KP 45.5 (**Plate 6**). The pipeline transected a 100 m wide strip of open forest dominated by forest red gum on alluvial soils. The community was dissected by a 20 m wide clearing associated with Black Camp Creek Road. To the west of the road, the community had been partially cleared with a canopy cover of about 10%, while the eastern side was much denser with a canopy cover up to 40%. The vegetation on the western edge of the road is considered to be regrowth, while the eastern side is remnant.

a) Not applicable

(b) Not applicable

(c) (i) The proposed development would transect a 100 m band of Hunter Lowland Redgum Forest. Clearing of the full 30 m ROW would require removal of to 0.3 ha of this community. However, this figure could be reduced by reducing the ROW along this short section. Impacts could be further reduced by aligning the ROW to follow the western side of the road, where the community was partially cleared. By following these recommendations, the proposed development would be likely to avoid clearing of any remnant vegetation and therefore would not be likely to significantly increase the risk of extinction for this community.

(ii) Construction works may also indirectly impact on this community through altered stream hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of riparian weeds. With appropriate mitigation as proposed below, the proposed development would be unlikely to modify this community to the extent that the risk of extinction is significantly increased.



(d) (i) By transecting regrowth vegetation on the western edge of Black Camp Creek Road and reducing ROW width through this 100 m section, the proposed development would be likely to avoid clearing of any remnant vegetation. With appropriate mitigation as described below, potential indirect impacts that could modify this community would be considered unlikely.

(ii) This community and other vegetation associated with Little Black Camp Creek and Black Camp Creek form a relatively continuous corridor between larger remnant vegetation blocks to the east and west. Black Camp Creek Road dissects this corridor in a cleared strip about 10 to 20 m wide. The proposed development will temporarily impact on connectivity along this corridor. However, with appropriate mitigation (including minimising construction time through this section, trench wildlife management and revegetation of the riparian corridor), the proposed development would be unlikely to significantly increase fragmentation or isolation of this community in the medium to long term.

(iii) The proposed development would be likely to avoid clearing of any remnant vegetation. With appropriate mitigation as described below, potential indirect impacts that could modify this community would also be considered unlikely. Revegetation and maintenance of the ROW following construction would aim to increase the area of remnant Hunter Lowland Redgum Forest in the medium to long term.

(e) No critical habitat has been declared by the Director-General of the NPWS for Hunter Lowland Redgum Forest.

(f) The action proposed is not inconsistent with the 19 priority action statements identified to help the recovery of Hunter Lowland Redgum Forest (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development: clearing of native vegetation. The mitigation strategies proposed in this report aim to avoid clearing of any remnant Hunter Lowland Redgum Forest and to revegetation the ROW with native species characteristic of this community.

Mitigation measures

Options to avoid or mitigate impacts on this community include:

- investigation of potential realignment of the pipeline to regrowth vegetation along the western edge of Black Camp Creek Road (ongoing)
- investigation of the minimum clearing and disturbance width through this section (ongoing)
- construction and disturbance to be confined to dry periods as far as practical
- minimising construction time (especially period of open trench)
- minimising use and passage of heavy machinery and vehicles within and adjacent to riparian areas during construction
- development and implementation of appropriate sediment and erosion control systems during construction
- appropriate wildlife bridges, ladders and shelters to be installed in open trenches
- qualified fauna handlers to remove any trapped wildlife from the open trench each day
- soil stockpiles to be stored outside the riparian area and enclosed in appropriate sediment and erosion control devices
- reinstatement of previous soil profile and topography as far as practical to minimise impacts on natural hydrology



- stockpiling and respreading of topsoil in riparian areas
- revegetation of the riparian area with native species characteristic of this community as soon as possible following construction
- development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction.

Lowland Rainforest on Floodplains of the NSW North Coast Bioregion

Lowland Rainforest on Floodplains of the NSW North Coast Bioregion is listed as Endangered in Part 3 of Schedule 1 of the TSC Act.

This community occurs on fertile soils in lowland river valleys in the NSW North Coast Bioregion. In an undisturbed state, it is characterised by a closed canopy with high species diversity and structural complexity. In disturbed stands, it may have a broken canopy or a canopy smothered by exotic vines. This community corresponds to some components of LHCCREMS map unit 3 (Hunter Valley dry rainforest) and NSW map unit 4 (dry rainforest).

This community has been reduced to less than 1,000 ha, primarily by clearing for agriculture. Existing and potential threats include clearing, invasion of edges and disturbed remnants by exotic plant species, disruption of plant regeneration (e.g. pollination, seed dispersal) from fragmentation, fire, grazing, rubbish dumping and dissection by tracks. Only a small proportion of the total area of this community is contained within conservation reserves.

Lowland Rainforest on Floodplains of the NSW North Coast Bioregion was recorded at three crossings of the Karuah River along the proposed pipeline corridor:

- 70 m riparian area from KP 19.23 to KP 19.29
- 60 m riparian area from KP 23.51 to KP 23.57
- 110 m riparian area from KP 24.29 to KP 24.4.

Other riparian vegetation recorded within the GFDA and the pipeline corridor was not considered to meet the diagnostic criteria for this EEC.

(a) Not applicable

(b) Not applicable

(c) (i) The proposed alignment transects three narrow bands of Lowland Rainforest on Floodplains, totalling approximately 240 m. Conventional construction methods would require clearing of up to 0.72 ha of this community. However, HDD techniques are proposed for all crossings of the Karuah River, which would avoid any clearing of this EEC. Therefore, the action is not expected to have any adverse effect on the extent of this EEC such that its local occurrence is likely to be placed at risk of extinction.

(ii) Construction works may also indirectly impact on this EEC through altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of riparian weeds. With appropriate mitigation as proposed below (e.g. construction during dry periods, sediment and erosion control, minimising use and passage of heavy machinery and vehicles adjacent to riparian areas, trench wildlife management, reinstatement of previous soil profile and topography, revegetation and weed management), the proposed development would be unlikely to have any adverse effect on the composition of this EEC such that its risk of extinction is significantly increased.



(d) (i) While conventional construction methods would require clearing of up to 0.72 ha, proposed HDD techniques would avoid any clearing of this EEC. Indirect impacts could include altered hydrology, movement of sediments, nutrients and pollutants, disturbance of wildlife during construction and introduction and spread of wetland weeds. With appropriate mitigation as proposed below, the proposed development would be unlikely to have significant impacts on this community.

(ii) The proposed development would be unlikely to contribute to increased fragmentation or isolation from other areas of this community, with appropriate mitigation as recommended below.

(iii) No habitat would be removed, modified, fragmented or isolated by the proposed development with appropriate mitigation as proposed below.

(e) No critical habitat has been declared by the Director-General of the NPWS for Lowland Rainforest on Floodplains of the NSW North Coast Bioregion.

(f) The action proposed is not inconsistent with the 21 priority action statements identified to help the recovery of Lowland Rainforest on Floodplains of the NSW North Coast Bioregion (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, four are relevant to the proposed development:

- invasion and establishment of exotic vines and scramblers
- invasion, establishment and spread of Lantana camara
- alteration to the natural flow regimes of rivers, streams, floodplains and wetlands
- clearing of native vegetation.

The mitigation strategies proposed in this report aim to avoid clearing and minimise indirect impacts on lowland rainforest with the aim of no net loss or adverse alteration of this habitat.

Mitigation measures

Options to avoid or mitigate impacts on lowland rainforest include:

- Use HDD techniques to place the pipeline underneath the three recorded sections of lowland rainforest on the Karuah River.
- Construction and disturbance to be confined to dry periods (when areas surrounding the Karuah River are dry) as far as practical.
- Minimisie the construction time (especially period of open tunnels and trenches).
- Minimise the use and passage of heavy machinery and vehicles adjacent to the riparian areas during construction.
- Developt and implement appropriate sediment and erosion control systems during construction.
- Install appropriate wildlife bridges, ladders and shelters in open trenches.
- Have qualified fauna handlers on site to remove any trapped wildlife from the open trench each day.
- Store soil stockpiles well away from the riparian area and enclosed in appropriate sediment and erosion control devices.
- Reinstate the previous soil profile and topography as far as practical to minimise impacts on natural hydrology.
- Stockpilie and respreadi topsoil in construction areas adjacent to Karuah River.



- Revegetate disturbed areas adjacent to Karuah River with appropriate species as soon as possible following construction.
- Develop and implement weed and phytophthora management protocols (including hygiene and control) during and for at least two years following construction.

Acacia pendula (Weeping Myall): Endangered Population

Acacia pendula is listed as an Endangered Population under the NSW TSC Act.

Acacia pendula is an erect or spreading tree 5-13 m high, which flowers mainly in summer and autumn. Seed pods can be from 3 to 9 cm long and 10 to 20 mm wide.

Acacia pendula occurs on the western slopes, western plains and far western plains of NSW, and south into Victoria and north into Queensland. A disjunct population of Acacia pendula occurs in the Hunter Valley at the eastern distributional limit of the species' range. This Hunter 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 been recorded in the local Government Areas of Mid-Western Regional, Muswellbrook, Singleton and Upper Hunter. Within the Hunter catchment Acacia pendula typically occurs on heavy soils, sometimes on the margins of small floodplains, but also in more undulating locations.

The Hunter population of *Acacia pendula* is fewer than 1000 individuals, from 6 locations - Jerrys Plains, Edderton, Wybong, Appletree Creek, Warkworth and Appletree Flat. It is not known to occur within any conservation areas - recent surveys on reserves where it could potentially occur have not detected it e.g. Belford National Park, Werakata National Park.

The threats to the population include:

- land clearing
- grazing of young plants
- demographic and enviromental stochasticity due to its small population size
- inappropriate roadside management.
- Acacia pendula was not recorded during field surveys.

(a) Not applicable.

(b) Acacia pendula has only been recorded in six locations in NSW. None of these locations are within the proposed development area and it is highly unlikely that this species occurs in the proposed development area. Therefore, it is unlikely that the lifecycle of this species will be adversely affected by the proposed development

(c) Not applicable.

(*d*) None of the current known locations of *Acacia pendula* populations occur within the proposed development area, therefore, (i) it is unlikely that potential habitat for this species will be modified; (ii) it is unlikely that any fragmentation or isolation of potential habitat will result and (iii) it is unlikely that the proposed development will modify or remove vital habitat for the populations' long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Acacia pendula.

(f) Acacia pendula is highly unlikely to occur in the project area.



(g) Key threatening processes are not relevant because none of the current known locations of Acacia pendula populations occur within the proposed development area.

Mitigation measures

Acacia pendula is highly unlikely to occur in the project area. No specific mitigation measures are required.

Cymbidium canaliculatum (Tiger Orchid): Endangered Population

Cymbidium canaliculatum in the Hunter catchment is listed as an Endangered population under the TSC Act. *Cymbidium canaliculatum* is a large epiphytic orchid that grows in the hollows of trees in dry sclerophyll forest or woodland.

Cymbidium canaliculatum has a scattered distribution in northern and eastern Australia from northeast NSW, through Queensland and the Northern Territory to Western Australia. In NSW it occurs within dry sclerophyll forests and woodlands of tablelands and western slopes, growing in hollows of trees. Within the Hunter Catchment, *Cymbidium canaliculatum* is most commonly found in *Eucalyptus albens* (white box) dominated woodlands, usually occurring singly or as a single clump, typically between two and six metres above the ground. It has been found, less commonly, to grow on *E. dawsonii* (Slaty Box), *E. crebra* (Narrow-leaved Ironbark), *E. moluccana* (Grey Box), *Angophora floribunda* (Rough-barked Apple), *Acacia salicina* (Cooba) and on some other species.

In the Hunter Catchment, *C. canaliculatum* is known to occur within Wollemi and Goulburn River National Parks but it is estimated that about 90% of the population occurs on land not managed for conservation.

Threats to the population include:

- land clearing and habitat fragmentation
- removal of remnant trees
- illegal collecting.

Cymbidium canaliculatum was not recorded during the field surveys. Potential habitats were recorded in dry sclerophyll forests and woodlands.

(a) Not applicable.

(b) Potential habitat for *Cymbidium canaliculatum* may occur in the project area; however, this species has only been recorded in Wollemi and Goulburn River National Parks which are not located in the proposed development area. Therefore, it is unlikely that this species occurs within the proposed development area and it is unlikely that the proposed development will adversely impact on the life cycle of the population.

(c) Not applicable.

(*d*) Given the known current locations of *Cymbidium canaliculatum* populations, it is unlikely that this species occurs within the proposed development area. However, potential habitat may exist for this species within the proposed development area. Therefore, (i) the proposed development would result in the removal of 15.6 to 18.8 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less; (ii) habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented; and (iii) only minimal modification of potential habitat is expected, so there is unlikely to be any long-term impact on the species' survival.



(e) No critical habitat has been declared by the Director-General of the NPWS for *Cymbidium* canaliculatum

(f) There is currently no recovery plan or threat abatement plan for the *Cymbidium canaliculatum*. No priority action statements have been prepared to help recover this population (DEC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and the *Cymbidium canaliculatum*: clearance of native vegetation. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise clearing.

Mitigation measures

To minimise potential impacts to *Cymbidium canaliculatum* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Cymbidium canaliculatum* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Avoid causing any significant changes to current fire regimes.

Eucalyptus parramattensis subsp. *parramattensis* (Parramatta Red Gum): Endangered Population

Eucalyptus parramattensis population in Wyong and Lake Macquarie local government areas is listed as an Endangered population under the TSC Act.

This species is a small to medium-sized woodland tree with bark which sheds in large plates to leave a smooth or matt mottled grey and white surface. Adult leaves are dull green, lance-shaped and 7 - 20 cm long by 1 - 3.5 cm wide. White flowers are clustered in groups of seven and the fruit is ball-shaped. The endangered population numbers approximately 1,300 trees.

The species usually occurs from the Goulburn Valley on the Central West slopes to Hill Top on the Central Coast. The endangered population in the Lake Macquarie and Wyong local government areas is at the north-eastern limit of the species range and is quite separate from other known populations. The majority of the population occurs within Wyong in the Porter's Creek and Wallarah Creek catchments. This species is associated with low moist areas alongside drainage lines and adjacent to wetlands. It is often found in woodland on sandy soils. The endangered population occurs on sandy alluvium within a floodplain community which also supports *Eucalyptus robusta* (Swamp mahogany), *E. tereticornis* (Forest Red Gum), *E. gummifera* (Sydney Bloodwood) and *Melaleuca* (Paperbark) species.

Threats include:

- habitat loss and fragmentation due to localised clearing and residential development
- habitat degradation resulting from altered hydrology / nutrient levels and grazing.

Eucalyptus parramattensis was not recorded during the field surveys. Potential habitats were recorded along drainage lines and adjacent to wetlands.

(a) Not applicable.



(b) Potential habitat for *Eucalyptus parramattensis* may occur in the project area. Provided that the proposed development avoids impact or damage to any preferred habitat and a pre-clearance survey is conducted for individuals prior to any vegetation clearing, the proposed project is unlikely to have an adverse effect on the lifecycle of the species.

(c) Not applicable.

(*d*) Provided that mitigation measures listed below are followed then: (i) only approximately 0.76 ha of potential habitat is likely to be removed; (ii) No fragmentation or isolation of habitat should result and (iii) it is unlikely that habitat vital to the long-term survival of the species will be modified or removed.

(e) No critical habitat has been declared by the Director-General of the NPWS for Eucalyptus parramattensis

(f) There is currently no recovery plan or threat abatement plan for the *Eucalyptus parramattensis*. No priority action statements have been prepared to help recover this species (DEC, 2005).

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the *Eucalyptus parramattensis*: clearance of native vegetation and alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise clearing and any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to *Eucalyptus parramattensis* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Eucalyptus parramattensis* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Minimise the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.
- Wherever the proposed pipeline crosses permanent streams, consider HDD techniques to avoid disturbance to hydrology, riparian vegetation and *Eucalyptus parramattensis*.



Eucalyptus seeana in the Greater Taree local government area is listed as an Endangered population under the TSC Act. *Eucalyptus seeana* is a medium to tall woodland tree to 40 m. Bark is smooth and mottled. Leaves are long, narrow and lance-shaped, up to 18 cm long and 2 cm wide. Buds are elongated, horn-shaped, 8-15 mm long. Fruit is hemispherical, 5 - 8 mm wide.

The species has a distribution from the north coast of NSW to south east Queensland. The Endangered Population within the the Greater Taree Local Government Area represents the southern-most occurrence of the species and is isolated from other populations of the species to the north. Within the Greater Taree Local Government Area the population is sporadic in distribution, consisting mainly of scattered trees but with some denser stands. A small part of the population occurs in a Council reserve. It occurs as scattered individuals in woodlands and open forests on low, often swampy, sandy soils.

Threats to this population include:

- clearing and fragmentation of habitat across the LGA due to clearing for agriculture, urban expansion and infrastructure development
- weed invasion
- forestry activities.

Eucalyptus seeana was not recorded during the field surveys. Potential habitats were recorded in woodlands and open forests.

(a) Not applicable.

(b) Potential habitat for *Eucalyptus seeana* may occur in woodlands and open forests within the proposed project area. Provided that the proposed development avoids impact or damage to any preferred habitat and a pre-clearance survey is conducted for individuals prior to any vegetation clearing, the proposed project is unlikely to have an adverse effect on the lifecycle of the species.

(c) Not applicable.

(*d*) Provided that mitigation measures listed below are followed then: (i) only 15.6 to 18.9 ha of woodland and open forest habitat is likely to be removed or modified; (ii) habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented and (iii) only a small amount of potential habitat is likely to be any long-term impact on the species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Eucalyptus seeana.

(f) There is currently no recovery plan or threat abatement plan for the *Eucalyptus seeana*. No priority action statements have been prepared to help recover this species (DEC, 2005

(g) Of the 31 key threatening processes listed in NSW, five are relevant to the proposed development and *Eucalyptus seeana*: clearance of native vegetation and four processes relating to the spread of invasive weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise clearing and implement practices to reduce to spread of weeds.

FCC



Mitigation measures

To minimise potential impacts to the *Eucalyptus seeana* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Eucalyptus seeana* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.

Rhizanthella slateri (Eastern Australian Underground Orchid): Endangered Population

Rhizanthella slateri is an endemic Australian orchid that has been described as a terrestrial saprophytic herb (i.e. grows on and derives its nourishment from dead or decaying organic matter) with a fleshy underground stem to 15 cm long and 15 mm in diameter. The flower heads mature below the soil surface but sometimes may extend 2 cm above the ground, and are about 2 cm in diameter. The receptacle has up to 18 bracts about 8 mm long and has up to 30 flowers which are tubular and purplish. The bracts are prominent, often branching, fleshy, whitish and overlapping.

Biologically, *Rhizanthella slateri* is of significant conservation value because of its unusual life cycle. It is one of only three Australian species, and a small number of species worldwide, that are capable of completing their entire lifecycle underground. Subterranean flowering plants such as these are extremely unusual and are of great scientific interest to biologists all over the world.

Rhizanthella slateri is restricted to New South Wales where it is currently known from fewer than 10 locations including Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. The *Rhizanthella slateri* population in the Great Lakes local government area (LGA) occurs at the known northern limit of the species' range and is disjunct from other known populations of the species.

Surveys conducted between 2002 and 2005 identified approximately 75 flowerheads at a site within the Great Lakes LGA, more than ten times the number observed at any other site. The *Rhizanthella slateri* population in the Great Lakes LGA is thus likely to be the largest and most extensive known population of the species. Other known populations of *Rhizanthella slateri* are fragmented and highly disjunct, comprising isolated individuals or small clusters of plants.

Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.

The ecology of *Rhizanthella slateri* is highly obscure given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore plants are usually located only when the soil is disturbed. *Rhizanthella slateri* flowers in October and November.

Rhizanthella slateri was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in sclerophyll forests in the project area.



Threats to the *Rhizanthella slateri* population in the Great Lakes LGA include:

- a proposal to construct a road through the population which will result in the direct removal of 4% of the known population, threaten 34% of the known population indirectly by altering drainage and soil moisture, and increase weed invasion
- illegal collecting
- environmental and demographic stochasticity due to its restricted area and small size.

Rhizanthella slateri was not recorded during the field surveys. Very liitle is known about the species habitat preferences although potential habitat in sclerophyll forests was recorded in the proposed development area.

(a) Not applicable.

(b) Potential habitat for *Rhizanthella slateri* may occur in the project area but due to the lack of information regarding the distribution of this species it is difficult to determine whether the proposed development will adversely impact on the species' life cycle. It has been recorded from sclerophyll forest, so the proposed development may result in the removal of 16 to 25 ha of potential *Rhizanthella slateri* habitat.

(c) Not applicable.

(*d*) Provided that the mitigation measures listed below are followed then: (i) only 16.7 to 25 ha of remnant vegetation will be removed, although this species may occur outside of remnant vegetation and therefore more potential habitat may be removed; (ii) habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented and (iii) given the lack of knowledge regarding the distribution of this species it is difficult to determine the importance of any habitat that may be removed.

(e) No critical habitat has been declared by the Director-General of the NPWS for Rhizanthella slateri.

(f) There is currently no recovery plan or threat abatement plan for the *Rhizanthella slateri*. No priority action statements have been prepared to help recover this population (DEC, 2005).

(g) Of the 31 key threatening processes listed in NSW, three may be relevant to the proposed development and *Rhizanthella slateri*: clearance of native vegetation and removal of dead wood and dead trees and infection of native plants by *Phytophthora cinnamomi*. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise clearing, replace dead organic matter wherever possible and avoid spread of *Phytophthora cinnamomi*.

Mitigation measures

To minimise potential impacts to the *Rhizanthella slateri* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should attempt to ensure that no *Rhizanthella slateri* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.



- Ensure topsoil is stockpiled and respread as soon as possible after construction.
- Develop and implement weed and phytophthora management protocols (including hygiene and control) during and for at least two years following construction.

Asperula asthenes (Trailing Woodruff): Vulnerable

Asperula asthenes is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. Trailing Woodruff is a low, trailing perennial herb with leaves in whorls of four around the stem. It has tiny fragrant white star-shaped flowers followed by tiny two-lobed fruit, only 1 mm long.

The small herb occurs only in NSW in damp sites, often along river banks. It is found in scattered locations from Bulahdelah north to near Kempsey, with several records from the Port Stephens/Wallis Lakes area.

Asperula asthenes was not recorded during the field surveys. The desktop survey revealed one previous record from within a 5 km buffer of the project area. Potential habitats were recorded along streams within the northern parts of the project area.

Threats include:

- disturbance from grazing stock
- invasion of habitat by introduced weeds, particularly near watercourses
- use of herbicides.

(a) The proposed development would result in the removal of potential *Asperula asthenes* habitat (up to 1 ha of wetland and rainforest stream habitats). This impact is expected to be minimal as HDD techniques are recommended wherever pipeline construction crosses wetlands and permanent streams and all construction should avoid riparian vegetation and hydrological and disturbance. Furthermore, provided pre-construction survey for *Asperula asthenes* is conducted, the proposed project is unlikely to have an adverse effect on the lifecycle of the species.

(b) Not applicable.

(c) Not applicable.

(d) A limited extent of potential habitat for *Asperula asthenes* (up to 1 ha depending on construction methods) could be encountered within the project area, and provided mitigation measures are adopted: (i) habitat would only be removed in short narrow strips and so potential habitat is unlikely to be modified; (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented and (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Asperula asthenes.

(*f*) There is currently no recovery plan or threat abatement plan for *Asperula asthenes*. Nine priority action statements have been prepared to help recover this species (DEC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, five are relevant to the proposed development and *Asperula asthenes*: clearance of native vegetation and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.


Mitigation measures

To minimise potential impacts to *Asperula asthenes* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Asperula asthenes* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Consider HDD techniques wherever pipeline construction crosses wetlands and permanent streams to avoid riparian vegetation and hydrological disturbance.
- Develop and implement a detailed weed management strategy that considers this species' sensitivity to herbicides.

Callistemon linearifolius (Netted Bottle Brush): Vulnerable

Callistemon linearifolius is listed as Vulnerable under the TSC Act. A shrub up to 3-4 m tall, with linear (long and narrow) to linear-lanceolate (lance shaped) leaves 8-10 cm long, and 5-7 mm wide with a sharp tip, thickened margins, and distinct lateral veins. Flowers are clustered into the typical "bottlebrushes" of Callistemons and takes place spring to summer. The brushes are red and usually 9-10 cm long and approximately 50 mm in diameter. The stem upon which the filaments occur are covered in a soft downy hair at flowering. The seed capsules are approximately 7 mm in diameter.

Callistemon linearifolius grows in dry sclerophyll forest on the coast and adjacent ranges and is recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Where this species was more widespread across its distribution in the past, there are currently only 5-6 populations in the Sydney area of the 22 populations recorded in the past. Three of these are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve, and Spectacle Island Nature Reserve. Further north it has been recorded from Yengo National Park.

Callistemon linearifolius was not recorded during the field surveys. The desktop survey revealed three previous records from within a 5 km buffer of the project area. Potential habitats were recorded in dry sclerophyll forest in the project area.

Threats include:

- continuing loss of habitat due primarily to urban development
- a high risk of local extinction due to low population numbers.

(a) The proposed development would result in the removal of potential *Callistemon linearifolius* habitat (15 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.

- (b) Not applicable.
- (c) Not applicable.



(d) (i) The proposed development would result in the removal of 15 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Callistemon linearifolius*.

(f) There is currently no recovery plan or threat abatement plan for *Callistemon linearifolius*. There are 13 priority action statements that have been prepared to help recover this species (DEC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and *Callistemon linearifolius*: clearance of native vegetation. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to *Callistemon linearifolius* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Callistemon linearifolius* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.

Cryptostylis hunteriana (Leafless Tongue Orchid): Vulnerable

Cryptostylis hunteriana is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. The Leafless Tongue Orchid has no leaf and it produces an upright flower-stem to 45 cm tall, bearing five to 10 flowers between November and February. It has small narrow green sepals and petals to 22 mm long, but is dominated by an erect narrow very hairy 'tongue' (the labellum). This is up to 33 mm long, maroon along the margins and at the widened tip, and with a black central band. All other tongue orchids have leaves; most have a downward pointing labellum.

The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. It is known historically from a number of localities on the NSW south coast and has been observed in recent years at many sites between Batemans Bay and Nowra (although it is uncommon at all sites). Also recorded at Nelson Bay, Wyee, Washpool National Park, Nowendoc State Forest, Ku-Ring-Gai Chase National Park, Ben Boyd National Park.



Cryptostylis hunteriana does not appear to have well defined habitat preferences and is known from a range of communities, including swamp-heath and woodland. The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*). Little is known about the ecology of the species; being leafless it is expected to have limited photosynthetic capability and probably depends upon a fungal associate to meet its nutritional requirements from either living or dead organic material. In addition to reproducing from seed, it is also capable of vegetative reproduction and thus forms colonies which can become more or less permanent at a site.

Cryptostylis hunteriana was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in woodlands in the project area.

Threats include:

- development pressure on coastal sites where it occurs
- road works.

(a) The proposed development would result in the removal of potential *Cryptostylis hunteriana* habitat (16 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 16 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Cryptostylis hunteriana.

(f) There is currently no recovery plan or threat abatement plan for *Cryptostylis hunteriana*. There are four priority action statements that have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and *Cryptostylis hunteriana*: clearance of native vegetation. The proposed development has the potential to contribute to this key threatening processe on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.



Mitigation measures

To minimise potential impacts to *Cryptostylis hunteriana* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Cryptostylis hunteriana* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.

Cynanchum elegans (White-flowered Wax Plant): Endangered

Cynanchum elegans is listed as Endangered under the TSC Act and Endangered under the EPBC Act. A climber or twiner with a highly variable form, mature stems have a fissured corky bark and can grow to 10 metres long and 3.5 cm thick. The leaves are paired (or rarely in threes), ovate to broadly ovate in shape, 1.5 to 10.5 cm long, and 1.5 to 7.5 cm wide. Flowering occurs between August and May, with a peak in November. Flower abundance on individual plants varies from sparse to prolific. The flowers are white, tubular, and up to 4 mm long and 12 mm wide. The fruit is a dry pointed pod to 8 cm long, which contains up to 45 seeds with long silky hairs attached to one end. The fruit can take up to six months to mature. Seed production is variable and unreliable, seeds are wind dispersed and it is considered to be unlikely that a soil seed bank for this species exists. Plants are capable of suckering from rootstock in response to occasional slashing or grazing. The fire response of the species is unknown.

The White-flowered Wax Plant is restricted to eastern NSW where it is distributed from Brunswick Heads on the north coast to Gerroa in the Illawarra region. The species has been recorded as far west as Merriwa in the upper Hunter River valley.

The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree *Leptospermum laevigatum* – Coastal Banksia *Banksia integrifolia* subsp. *integrifolia* coastal scrub; Forest Red Gum *Eucalyptus tereticornis* aligned open forest and woodland; Spotted Gum *Corymbia maculata* aligned open forest and woodland; and Bracelet Honeymyrtle *Melaleuca armillaris* scrub to open scrub.

Cynanchum elegans was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in the project area in Forest Red Gum, dry rainforest and Spotted Gum forests and woodlands.

Threats include:

- further loss and fragmentation of habitat, particularly through clearing for agriculture, quarries and residential development
- habitat degradation resulting from weed invasion, grazing, rubbish dumping, landfill, urban run-off, track construction / widening, and inappropriate fire management
- small numbers, which put the species at risk of extinction through natural catastrophes or environmental changes.

(a) The proposed development would result in the removal of potential *Cynanchum elegans* habitat (16 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.



(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 16 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Cynanchum elegans.

(f) There is currently no recovery plan or threat abatement plan for *Cynanchum elegans*. There are nine priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, six are relevant to the proposed development and *Cynanchum elegans*: clearance of native vegetation, consequences of high frequency fire and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats. Furthermore, the proposed development would not increase the frequency of fires in the study area.

Mitigation measures

To minimise potential impacts to *Cynanchum elegans* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Cynanchum elegans* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Avoid causing any significant changes to current fire regimes.
- Develop and implement a detailed weed management strategy.

Eucalyptus glaucina (Slaty Red Gum): Vulnerable

Eucalyptus glaucina is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. *Eucalyptus glaucina* is a medium-sized tree to 30 m tall. The bark is smooth and mottled white to slaty grey. The juvenile leaves are oval in shape and blue-green with a whitish bloom, and the buds and fruit are similarly coloured. The flowers are white, or occasionally pink, and are produced between August and December. The fruits are oval-shaped and 7– 10 mm long. The three to five raised valves are surrounded by a domed disk raised above the fruit.

Eucalyptus glaucina is found only on the north coast of NSW and in separate districts: near Casino where it can be locally common, and farther south, from Taree to Broke, west of Maitland. It grows in grassy woodland and dry eucalypt forest on deep, moderately fertile and well-watered soils.

Eucalyptus glaucina was not recorded during the field surveys. The desktop survey revealed two previous records from within a 5 km buffer of the project area. Potential habitats were recorded in grassy woodlands or dry eucalypt forest in the project area.



Threats include:

- clearing for agriculture and development
- timber harvesting activities
- lack of regeneration through grazing pressure.
- (a) The proposed development would result in the removal of potential *Eucalyptus* glaucina habitat (15 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.
- (b) Not applicable.

(c) Not applicable.

(d) Provided that the mitigation measures listed below are implemented, then: (i) the proposed development would result in the removal of 15 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Eucalyptus glaucina.

(*f*) There is currently no recovery plan or threat abatement plan for *Eucalyptus glaucina*. Eleven priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and *Eucalyptus glaucina*: clearance of native vegetation. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to *Eucalyptus glaucina* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Eucalyptus glaucina* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.



Eucalyptus parramattensis subsp. decadens: Vulnerable

Eucalyptus parramattensis subsp. *decadens* is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. *Eucalyptus parramattensis* subsp. *decadens* is a woodland tree, up to 15 m, but usually to about 8 - 10m in height. Its bark sheds in large plates to leave a smooth, granular and mottled white or grey surface. Juvenile and adult leaves are disjunct. Juvenile leaves are narrow-lanceolate to lanceolate, dull green both sides. Adult leaves are usually lance-shaped to about 15 cm long and 2 cm wide. Inflorescences are 7–flowered. Buds are ovoid $4 - 10mm \log_{10}, 4 - 6 mm$ in diameter with a scar present. Fruit is hemispherical or globose $4 - 9 mm \log_{10}, 5 - 9 mm$ in diameter, with the disc flat or slightly raised, usually with four exserted valves. This species is likely to be sensitive to over-frequent fire, however there is evidence (i.e. coppicing, epicormic shoots) that the species may be tolerant of low intensity fires. The species has a canopy-stored seed bank for dispersal after fire events.

There are two separate meta-populations of *E. parramattensis subsp. decadens*. The Kurri Kurri metapopulation is bordered by Cessnock—Kurri Kurri in the north and Mulbring—Abedare in the south. Large aggregations of the sub-species are located in the Tomalpin area. The Tomago Sandbeds metapopulation is bounded by Salt Ash and Tanilba Bay in the north and Williamtown and Tomago in the south.

E. parramattensis subsp. decadens generally occupies deep, low-nutrient sands, often those subject to periodic inundation or where water tables are relatively high. It occurs in dry sclerophyll woodland with dry heath understorey. It also occurs as an emergent in dry or wet heatAECOMnd. Often where this species occurs, it is a community dominant.

Eucalyptus parramattensis subsp. *decadens* was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Although deep sands were not recorded in the project area, dry sclerophyll woodlands could provide potential habitats.

Threats include:

- habitat loss and fragmentation resulting from development, particularly sand mining, road construction and residential/industrial developments
- weed invasion, in particular Lantana and Bitou Bush
- modifications of drainage regimes in deep, low nutrient sands through draining or filling
- over-frequent fire, which may prevent recruitment of new individuals to the population, leading over the longer term to decline and local extinction.
- (a)While the proposed development would result in the removal of potential *Eucalyptus parramattensis* subsp. *decadens* habitat (15 to 25 ha of timbered habitats depending on construction methods), the propsed development is both north and west of the known metapopulations of this species and no deep sandy soils were recorded. Therefore it is unlikely the the proposed development will have an affect on the life cycle of this species. Any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.
- (b) Not applicable.

(c) Not applicable.



(d) Provided that the mitigation measures listed below are implemented, then: (i) the proposed development would result in the removal of 15 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Eucalyptus* parramattensis subsp. decadens.

(f) There is currently no recovery plan or threat abatement plan for *Eucalyptus parramattensis* subsp. *decadens*. Nine priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, seven are relevant to the proposed development and *Eucalyptus parramattensis* subsp. *decadens*: clearance of native vegetation, consequences of high frequency fire, alteration to natural flow regimes and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats, spread weeds, increase the risk of fire or alter the natural flow regimes of creeks and rivers.

Mitigation measures

To minimise potential impacts to *Eucalyptus parramattensis* subsp. *decadens* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Eucalyptus parramattensis* subsp. *decadens* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.
- Avoid causing any significant changes to current fire regime.
- Minimise the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.

Grevillea guthrieana (Guthrie's Grevillea): Endangered

Grevillea guthrieana is listed as Endangered under the TSC Act and Endangered under the EPBC Act. It is a spreading shrub to 2 m high or occasionally to 4 m high. The branchlets are covered with long hairs when young and the leaf undersurface is also hairy. The narrow leaves are 2 to 6 cm long and less than 1 cm wide. The flowers are green and maroon and form at the end of the branchlets.

Grevillea guthrieana is known from the north coast of NSW, at Booral near Bulahdelah and on the Carrai Plateau, south-west of Kempsey. It grows along creeks and cliff lines in eucalypt forest, on granitic or sedimentary soil.

Grevillea guthrieana was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded along creeks or in eucalypt forests in the project area.



Threats include:

- clearing of habitat
- inappropriate fire regimes (too-frequent fires can inhibit regeneration)
- damage from grazing stock
- susceptibility to dieback caused by root rot fungus (*Phytophthora cinnamomi*).
- (a) The proposed development would result in the removal of potential *Grevillea guthrieana* habitat (16 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.
- (b) Not applicable.

(c) Not applicable.

(*d*) Provided that mitigation measures below are implemented, then: (i) the proposed development would result in the removal of 16 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Grevillea guthrieana.

(*f*) There is currently no recovery plan or threat abatement plan for *Grevillea guthrieana*. Seven priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and *Grevillea guthrieana*: clearance of native vegetation, consequences of high frequency fire and infections by *Phytophthora cinnamomi*. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats, spread weeds, alter the fire regime or spread plant diseases.

Mitigation measures

To minimise potential impacts to *Grevillea guthrieana* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Grevillea guthrieana* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Avoid causing any significant changes to current fire regime.
- Avoid the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.



• Develop and implement an equipment hygiene strategy to ensure that plant pathogens are not transported in soil on vehicles and equipment.

Grevillea parviflora subsp. parviflora (small-flower grevillea)

Grevillea parviflora subsp. *parviflora* is listed as Vulnerable in Schedule 2 of the TSC Act and Vulnerable under the EPBC Act. This low spreading to erect shrub, reaching up to 1.5m high, has crowded, narrow leaves (Plate 9). The small flowers are spider-like and clustered in groups of 6-12. The whole flower, both the tube and the protruding style, is white or pinkish. It suckers readily from rhizomes, which can make determining individual plants difficult.

This species is distributed sporadically within the central NSW coastal region from south of Sydney to the lower Hunter. It occurs in a range of vegetation types from heath and shrubby woodland to open forest. It generally grows in sandy or light clay soils, usually over thin shales. It often occurs in open, slightly disturbed sites such as along tracks and infrastructure easements. It is believed to be relatively resistant to infections by *Phytophthora cinnamomi* (Olde and Marriott, 1995). Most populations demonstrate a degree of vegetative spread, particularly after disturbance such as fire.

Olde and Marriott (1995) note that *G. parviflora* adapts readily to cultivation and can be grown from seeds and cuttings of half-hardened new growth in early Spring. No published information on translocation of *G. parviflora* could be located, but other species of *Grevillea* have been successfully translocated (e.g. Stack *et al.*, 2003).

Threats include:

- loss and fragmentation of habitat associated with clearing for urban development, agriculture and road maintenance activities
- habitat degradation as a result of weed invasion, inappropriate fire regime and uncontrolled access
- maintenance of roads and infrastructure easements
- high frequency fire that may impact on recruitment or low frequency fire that may lead to competitive exclusion by other species.

A population is reserved in Werakata (formerly Lower Hunter) National Park. The Wildlife Atlas database contains 46 records of small-flower grevillea from five localities within 20 km of the proposed alignment, all in the southern section. The majority of these records are from a population about 20 km west of the alignment.

The current survey recorded a population of small-flower grevillea within a previously cleared 25 m wide powerline corridor at approximately KP 58.9. The site supported a range of low forbs, shrubs, grasses and sedges, including *Pultenaea villosa, Daviesia ulcifolia, Themeda triandra, Entolasia stricta* and *Lepidospermum laterale*. The population extended approximately 200 m along the corridor and was estimated to contain several hundred to a thousand plants. An accurate population count was not made during the initial survey as its identity was not confirmed until a specimen was sent to Royal Botanic Gardens. It was also difficult to determine the extent of individual plants as they were coppicing extensively under the current regular slashing regime. An individual plant was recorded in remnant open forest approximately 0.5 km north of the main population. It is therefore likely that other populations exist in surrounding remnant vegetation (including the nearby Wallaroo National Park).

The population is regularly slashed during maintenance works for the powerline and is transected by a maintenance track. Plants were relatively prostrate and multi-stemmed, but appeared to be otherwise healthy, with most flowering at the time of survey. Several plants were observed growing between the wheel ruts of the maintenance track.



a) Not applicable

(b) Not applicable

(c) (i) The proposed development would transect a population of small-flower grevillea for approximately 200 m. Assuming that one half of the cleared corridor will be disturbed by the proposed development, this will directly impact on several hundred plants in an area of 0.2 ha. This species is also known from one site about 0.5 km to the north (present survey) and five other localities within 20 km (Wildlife Atlas data), so the proposed development would be unlikely to increase the risk of local extinction.

(ii) Construction and maintenance works may also indirectly impact on portions of the population uncleared by the proposed development and on other populations in remnant forest adjoining the powerline easement. Impacts could include movement of sediments, nutrients and pollutants, introduction and spread of weeds and altered fire regimes. With appropriate mitigation as recommended below, the proposed development would be unlikely to modify known populations of small-flower grevillea to the extent that the risk of extinction is significantly increased.

(d) (i) The proposed development would directly impact on approximately 0.2 ha of habitat supporting small-flower grevillea. This represents approximately half of the existing population area. This habitat is currently highly modified by previous clearing and regular slashing for a powerline easement.

(ii) This species occurs in highly scattered and isolated populations throughout its range. The proposed development will impact on approximately half of one small population, so would be unlikely to lead to increased fragmentation or isolation of this species.

(iii) With appropriate mitigation as recommended below, the number of small-flower grevilleas will not decrease, so the proposed development would be unlikely to significantly reduce the long term survival of this species in the local area. In the broader area, this species is known from one site about 0.5 km to the north (present survey) and five other localities within 20 km (Wildlife Atlas data). One of these populations has 37 records over an area of 6 km by 1 km, so is likely to comprise a much larger and more important population than the newly discovered site.

(e) No critical habitat has been declared by the Director-General of the NPWS for this species.

(f) There is currently no recovery plan for this species, but DECC has identified five priority actions:

- Captive husbandry or ex-situ collection / propagation investigate seed viability, germination, dormancy and longevity (in natural environment and in storage).
- Develop and implement protocols and guidelines liaise with land managers to encourage the preparation of site management plans and the implementation of appropriate threat abatement measures, particularly in fire management, bush regeneration, roadside management, weed control and fencing and signage.
- Monitoring monitor known populations, so that potential local extinctions are detected before they occur and mechanisms can be put in place to reverse trends.
- Research Investigate genetic variation in collaboration with BGT.
- Survey / mapping and habitat assessment Identify and survey potential habitat to detect new populations.



The mitigation strategies proposed in this report are consistent with these actions. An offset plan, if required, would provide valuable information on seed collection, propagation and establishment of this species (Action 1). A management plan would be developed for the existing population, which would contribute significantly to the development of protocols and guidelines that can be used by other land managers to manage populations of this species (Action 2). The management plan and offset plan would include ongoing monitoring of the existing population and the offset population, if required (Action 3). Surveys of the existing population and a suitable offset area, if required, would contribute to mapping and habitat assessment of this species (Action 5).

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and *Grevillea parviflora*: clearance of native vegetation and consequences of high frequency fire. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats or alter the fire regime.

Mitigation measures

Options to mitigate impacts of the proposed development may include:

- detailed survey of the small-flower grevillea population within the proposed ROW and adjacent area to determine population characteristics and assess likely impacts of the proposed development
- investigation of alternate routes to avoid or minimise impacts on the population
- liaison with relevant stakeholders and authorities (e.g. DECC, DEHWA, electrical authority that currently maintains the powerline easement) to develop an appropriate management plan (including construction and operational / maintenance phases)
- management of construction to avoid impacts on adjacent populations, including:
 - fencing of the population adjacent to the development to avoid accidental damage
 - development and implementation of appropriate sediment and erosion control systems
 - stockpiling and respreading of topsoil containing seeds of this species following construction
 - revegetation with native species as soon as possible following construction
 - development and implementation of weed management protocols (including hygiene and control) during and for at least two years following construction
- following construction, appropriate maintenance strategies will be developed and implemented to minimise ongoing impacts on the existing population (including monitoring of the population)
- avoid causing any significant changes to current fire regimes
- if part of the population must be removed, an offset strategy will be developed in consultation with DECC, including:
 - assessment of the area and number of plants that will be impacted
 - identification of an appropriate offset area where a population of this species can be established, preferably adjacent to an existing conservation area
 - propagation of sufficient plants to offset the number impacted by the proposed development (e.g. by seeds or cuttings)



- planting and maintenance of propagated plants (and translocated plants, if feasible) in the offset area for at least 2 years
- monitoring of the offset population for at least 5 years
- appropriate legislative protection of the offset area.

Maundia triglochinoides: Vulnerable

Maundia triglochinoides is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. *Maundia triglochinoides* is a perennial with rhizomes about 5mm thick and emergent tufts of leaves arising along their length. Its leaves triangular in cross section, to 80 cm long, 5 - 10 mm wide. Its inflorescences are 10 cm long and 2.5 cm wide. Carpels are 6 - 8 mm long, sessile, each with a spreading beak. This species flowers from November-January.

Maundia triglochinoides is restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct.

This species grows in swamps, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, in areas of low nutrients. It is usually associated with other wetland species such as *Triglochin procerum*.

Maundia triglochinoides was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in coastal swamps and freshwater habitats in the project area.

Threats include:

- further loss and fragmentation of habitat
- changes in hydrology and water quality
- weed invasion.

(a) Potential habitat for *Maundia triglochinoides* may occur in the coastal swamps in the southern end of the project area. Provided that the mitigation measures listed below are implemented then the proposed project is unlikely to have an adverse effect on the lifecycle of the species.

- (b) Not applicable.
- (c) Not applicable.

(d) Provided that the mitigation measures below are implemented, then: (i) the proposed development would result in the removal of 0.3 to 0.5 ha of wetland habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) Localised, short term alteration of wetlands will occur; however, because the alteration should only be temporary, it is unlikely to have a significant impact on the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Maundia triglochinoides*.

(*f*) There is currently no recovery plan or threat abatement plan for *Maundia triglochinoides*. Eight priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of wetlands is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.



(g) Of the 31 key threatening processes listed in NSW, six are relevant to the proposed development and *Maundia triglochinoides*: clearance of native vegetation, alteration of the natural flow regimes and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade swamp and freshwater habitats, alter the natural flow regimes of swamps and freshwater habitats and increase the spread of weeds.

Mitigation measures

To minimise potential impacts to *Maundia triglochinoides* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Maundia triglochinoides* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.
- Minimise the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.
- Wherever the proposed pipeline crosses permanent streams, consider HDD techniques to avoid disturbance to hydrology, riparian vegetation and *Maundia triglochinoides.*

Persicaria elatior (Tall Knotweed): Vulnerable

Persicaria elatior is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act.

Tall Knotweed is an erect herb to 90 cm tall, with stalked, glandular hairs (i.e. they are knobbed when seen under a lens) on most plant parts. Its leaves are up to 11 cm long and 30 mm wide. A sheath encircles the stem at the base of each leaf, which is characteristic of its plant family. Its tiny flowers are in long, narrow spikes to 5 cm long. The pink flower-segments are less than 4 mm long.

Tall Knotweed has been recorded in Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, Picton Lakes, Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests).

This species normally grows in damp places, especially beside streams and lakes. It occurs occasionally in swamp forest or associated with disturbance.

Persicaria elatior was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded beside streams and wetlands in the project area.

Threats include:

- inadvertent clearing from moist disturbed habitat
- damage to road and track populations through maintenance activities
- clearing of or hydrological changes to wetland vegetation.



(a) Potential habitat for *Persicaria elatior* may occur in wetlands and streams in the project area. Provided that the proposed development avoids impact or damage to any preferred habitat and a preclearance survey for conducted for individuals prior to any vegetation clearing, the proposed project is unlikely to have an adverse effect on the lifecycle of the species.

(b) Not applicable.

(c) Not applicable.

(*d*) Provided that the mitigation measures below are implemented, then: (i) the proposed development would result in the removal of approximately 1 ha of wetland habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) Localised, short term alteration of streams will occur; however, because the alteration should only be temporary, it is unlikely to have a significant impact on the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for Persicaria elatior.

(*f*) There is currently no recovery plan or threat abatement plan for *Persicaria elatior*. 1 priority action statement has been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and *Persicaria elatior:* clearance of native vegetation and alteration of natural flow regimes. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade stream and riparian habitats or alter the natural flow regime of streams and waterways.

Mitigation measures

To minimise potential impacts to *Persicaria elatior* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Persicaria elatior* are removed during construction.
- Minimise the amount of native vegetation to be cleared by employing the minimum construction footprint width in wetland and riparian habitats.
- Minimise the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.
- Wherever the proposed pipeline crosses permanent streams, consider HDD techniques to avoid disturbance to hydrology, riparian vegetation and *Persicaria elatior*.

Pomaderris queenslandica (Scant Pomaderris): Endangered

Pomaderris queenslandica is listed as Endangered under the TSC Act. Scant Pomaderris is a mediumsized shrub 2 - 3m tall. The stems are whitish with tiny star-shaped hair clusters. The leaves are oval to narrow elliptical, 2.5 - 7 cm long and 10 - 25 mm wide. They are shiny on the top and woolly underneath. The small creamy yellow flowers appear during spring-summer.



Scant Pomaderris is 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. It is found in moist eucalypt forest or sheltered woodlands with a shrubby understorey, and occasionally along creeks.

Pomaderris queenslandica was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in eucalypt forest, woodlands and along creeks in the project area.

Threats include:

- disturbance from roadworks and timber harvesting activities
- invasion by introduced weeds
- risk of local extinction because populations are isolated
- clearing of habitat for agriculture
- inappropriate fire regime.

(a The proposed development would result in the removal of potential *Pomaderris queenslandica* habitat (16 to 25 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests.

(b) Not applicable.

(c) Not applicable.

(*d*) Provided that the mitigation measures below are implemented then, (i) the proposed development would result in the removal of 16 to 25 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less and so potential habitat is unlikely to be modified. (ii) Habitat would only removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented. (iii) No modification of potential habitat is expected, so there is unlikely to be any long-term impact on species' survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for *Pomaderris queenslandica*.

(*f*) There is currently no recovery plan or threat abatement plan for *Pomaderris queenslandica*. Twelve priority action statements have been prepared to help recover this species (DECC, 2005). Provided that the mitigation methods listed below are implemented then, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, six are relevant to the proposed development and *Pomaderris queenslandica*: clearance of native vegetation, consequences of high frequency fire and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats, alter the fire regime and increase weed spread.



Mitigation measures

To minimise potential impacts to *Pomaderris queenslandica* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Pomaderris queenslandica* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.
- Avoid causing any significant changes to current fire regime.

Rhizanthella slateri (Eastern Underground Orchid): Vulnerable

Rhizanthella slateri is listed as Vulnerable under the TSC Act and Endangered under the EPBC Act. *Rhizanthella slateri* is an endemic Australian orchid that has been described as a terrestrial saprophytic herb (i.e. grows on and derives its nourishment from dead or decaying organic matter) with a fleshy underground stem to 15 cm long and 15 mm in diameter. The flower heads mature below the soil surface but sometimes may extend 2 cm above the ground, and are about 2 cm in diameter. The receptacle has up to 18 bracts about 8 mm long and has up to 30 flowers which are tubular and purplish. The bracts are prominent, often branching, fleshy, whitish and overlapping.

Biologically, *Rhizanthella slateri* is of significant conservation value because of its unusual life cycle. It is one of only three Australian species, and a small number of species worldwide, that are capable of completing their entire lifecycle underground. Subterranean flowering plants such as these are extremely unusual and are of great scientific interest to biologists all over the world.

Rhizanthella slateri is restricted to New South Wales where it is currently known from fewer than 10 locations including Bulahdelah, the Watagan Mountains, the Blue Mountains, Wiseman's Ferry area, Agnes Banks and near Nowra. The *Rhizanthella slateri* population in the Great Lakes local government area (LGA) occurs at the known northern limit of the species' range and is disjunct from other known populations of the species.

Surveys conducted between 2002 and 2005 identified approximately 75 flowerheads at a site within the Great Lakes LGA, more than ten times the number observed at any other site. The *Rhizanthella slateri* population in the Great Lakes LGA is thus likely to be the largest and most extensive known population of the species. Other known populations of *Rhizanthella slateri* are fragmented and highly disjunct, comprising isolated individuals or small clusters of plants.

Habitat requirements are poorly understood and no particular vegetation type has been associated with the species, although it is known to occur in sclerophyll forest.

The ecology of *Rhizanthella slateri* is highly obscure given that it grows almost completely below the soil surface, with flowers being the only part of the plant that can occur above ground. Therefore plants are usually located only when the soil is disturbed. *Rhizanthella slateri* flowers in October and November.

Rhizanthella slateri was not recorded during the field surveys. The desktop survey revealed no previous records from within a 5 km buffer of the project area. Potential habitats were recorded in sclerophyll forests in the project area.



Threats include:

- The *Rhizanthella slateri* population in the Great Lakes LGA is threatened by a proposal to construct a road through the population. The proposal will result in the direct removal of 4% of the known population and other individuals as yet undetected may become exposed after clearing or excavation works.
- A further 34% of the known population is indirectly threatened by altered drainage and changes in soil moisture, and by weed invasion associated with the road.
- The proposed road will remove 9% of known habitat and 29% of potential habitat for the species, fragmenting the population and potentially disrupting pollination and seed dispersal.
- Orchid collectors represent a further threat to the species due to its very unusual growth form and extreme rarity, and the publicity associated with the Bulahdelah site.
- The *Rhizanthella slateri* population in the Great Lakes LGA may also be threatened by environmental and demographic stochasticity due to its restricted area and small size.

(a) Potential habitat for *Rhizanthella slateri* may occur in the project area but due to the lack of information regarding the distribution of this species it is difficult to determine whether the proposed development will adversely impact on the species' life cycle. It has been recorded from sclerophyll forest, so the proposed development may result in the removal of 16 to 25 ha of potential *Rhizanthella slateri* habitat.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the mitigation measures listed below are followed then: (i) only 16.7 to 25 ha of remnant vegetation will be removed, although this species may occur outside of remnant vegetation and therefore more potential habitat may be removed; (ii) habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation or isolation would result in a landscape that is already fragmented and (iii) given the lack of knowledge regarding the distribution of this species it is difficult to determine the importance of any habitat that may be removed.

(e) No critical habitat has been declared by the Director-General of the NPWS for Rhizanthella slateri.

(f) There is currently no recovery plan or threat abatement plan for *Rhizanthella slateri*. No priority action statements have been prepared to help recover this species (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, three may be relevant to the proposed development and *Rhizanthella slateri*: clearance of native vegetation and removal of dead wood and dead trees and infection of native plants by *Phytophthora cinnamomi*. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise clearing, replace dead organic matter wherever possible and avoid spread of *Phytophthora cinnamomi*.



Mitigation measures

To minimise potential impacts to *Rhizanthella slateri* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should attempt to ensure that no *Rhizanthella slateri* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Ensure topsoil is stockpiled and respread as soon as possible after construction.
- Develop and implement weed and phytophthora management protocols (including hygiene and control) during and for at least two years following construction.

Tetratheca juncea (Black-eyed Susan)

Tetratheca juncea is listed as Vulnerable under the TSC Act and Vulnerable under the EPBC Act. Blackeyed Susan is a low shrub that grows in clumps of single or multiple stems. Its flowers face downwards and usually have four petals which range from white to pink to dark purple in colour. They are borne singly or in pairs along the stem. Stems are 30 to 60 cm long, usually leafless with 2 to 3 narrow wings that give them an angular appearance. Plants are usually sprawling and can be difficult to detect amongst other vegetation when not flowering.

Tetratheca juncea is confined to the northern portion of the Sydney Basin bioregion and the southern portion of the North Coast bioregion in the local government areas of Wyong, Lake Macquarie, Newcastle, Port Stephens, Great Lakes and Cessnock. It is usually found in low open forest / woodland with a mixed shrub understorey and grassy groundcover. However, it has also been recorded in heatAECOMnd and moist forest. The majority of populations occur on low nutrient soils associated with the Awaba Soil Landscape. While the species has a preference for cooler southerly aspects, it has been found on slopes with a variety of aspects. It generally prefers well-drained sites and occurs on ridges, although it has also been found on upper slopes, mid-slopes and occasionally in gullies. It usually spreads via underground stems which can be up to 50 cm long. Consequently, individual plants may be difficult to identify. It also reproduces sexually but this requires insect pollination.

Tetratheca juncea was not recorded during the field surveys. The desktop survey revealed two previous records from within a 5 km buffer of the project area. Potential habitats were recorded in the project area in open forests and woodlands with a mixed shrub understorey and grassy groundcover.

Threats include:

- habitat loss due to clearing for urban development
- habitat degradation resulting from frequent fire, weed invasion and stormwater runoff.

(a) The proposed development would result in the removal of a small amount of potential habitat (15 to 25 ha depending on construction methods). This impact is unlikely to have an adverse effect on the lifecycle of the species, provided that the proposed development minimises clearing and pre-clearance surveys are conducted.

- (b) Not applicable.
- (c) Not applicable.



(d) Provided that clearing is kept to a minimum then: (i) The proposed development would result in the removal of a small amount of potential habitat (15 to 25 ha depending on construction methods). (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented (iii) The habitat proposed to be modified is minimal when compared to the large area of suitable habitat in the surrounding area.

(e) No critical habitat has been declared by the Director-General of the NPWS for Tetratheca juncea.

(*f*) There is currently no recovery plan or threat abatement plan for *Tetratheca juncea*. 11 priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development will not be inconsistent with any of the priority action statements.

(g) Of the 31 key threatening processes listed in NSW, six are relevant to the proposed development and *Tetratheca juncea*: clearance of native vegetation, consequences of high frequency fire and four relating to the spread of exotic weeds. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats, alter the fire regime or spread weeds.

Mitigation measures

To minimise potential impacts to *Tetratheca juncea* from the proposed development, the following mitigation measures are recommended:

- Pre-clearance surveys should ensure that no *Tetratheca juncea* are removed during construction.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats and utilising cleared corridors wherever possible.
- Develop and implement a detailed weed management strategy.
- Avoid causing any significant changes to the current fire regime.

Zannichellia palustris: Endangered

Zannichellia palustris is listed as Endangered under the TSC Act. Zannichellia palustris is a submerged, monoecious, weakly rhizomatous, aquatic annual or perennial plant. Its leaves are 2-7 cm long and only around 1 mm wide.

In NSW, *Zannichellia palustris* is known only from the lower Hunter Region. It grows in fresh or slightly saline stationary or slowly flowing water. It flowers during warmer months and behaves as an annual, dying back completely every summer.

Zannichellia palustris was not recorded during the field surveys. The desktop survey revealed two previous records from within a 5 km buffer of the project area. Potential habitats were recorded in streams in the project area.



Threats include:

• changes to catchments resulting to changes in hydrological conditions and water quality.

(a) Potential habitat for *Zannichellia palustris* may occur in streams and wetlands in the project area. The proposed development would result in the removal of a small amount of potential habitat (approximately 1 ha). Provided that the measures for mitigating affects on hydrological flow regimes are implemented and pre-clearance surveys are conducted, then the proposed development is unlikely to have an adverse effect on the lifecycle of the species.

- (b) Not applicable.
- (c) Not applicable.

(*d*) Provided that clearing is kept to a minimum then: (i) The proposed development would result in the removal of a small amount of potential habitat (about 1 ha). (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented (iii) Localised, short term alteration of streams will occur; however, because the alteration should only be temporary, it is unlikely to have a significant impact on the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for Zannichellia palustris.

(f) There is currently no recovery plan or threat abatement plan for Zannichellia palustris. No priority action statements have been prepared to help recover this species (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and *Zannichellia palustris*: Alteration to the natural flow regimes of rivers, streams, floodplains & wetlands. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that alter hydrological regimes and water quality in freshwater streams.

Mitigation measures

To minimise potential impacts to *Zannichellia palustris* from the proposed development, the following mitigation measures are recommended:

- Wherever the proposed pipeline crosses permanent streams, consider HDD techniques to avoid disturbance to hydrology, riparian vegetation and *Zannichellia palustris*.
- Minimise the development footprint encroaching or impacting on streams, including indirect impacts such as erosion, down-stream sedimentation, pollution and eutrophication.
- Pre-clearance surveys should ensure that no *Zannichellia palustris* are removed during construction across streams.



Green and Golden Bell Frog (Litoria aurea): Endangered

The Green and Golden Bell Frog is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. It was formerly distributed from the NSW north coast near Brunswick Heads southwards along the NSW coast to Victoria (White and Pyke, 1996; Gillespie, 1996) and the ACT (Moore, 1961; Osborne et al., 1996). Population decline has been such that today the species exists as a series of isolated coastal populations within its former known range. In recent years, surveys of known sites have failed to find any higAECOMnd populations and fears are that these populations are now extinct. Many former coastal populations have also dramatically declined or disappeared altogether (White and Pyke, 1996).

The Green and Golden Bell Frog inhabits marshes, dams and stream sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.) Optimum habitat includes water bodies which are unshaded, free of predatory fish (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites available such as vegetation and / or rocks (White and Pyke, 1996). The Green and Golden Bell Frog is frequently active by day and usually breeds in summer when conditions are warm and wet (Cogger, 1992). Tadpoles feed on algae and vegetative matter and adults are voracious predators of insects and small vertebrates. Both tadpoles and frogs are preyed upon by birds, snakes and fish.

The main threats to the Green and Golden Bell Frog include:

- alteration of drainage patterns and stormwater runoff (White and Pyke, 1996)
- a fungal pathogen (Berger and Speare, 1998)
- changes to water quality (Goldingay, 1996)
- predation by feral animals such as foxes and cats (Daly, 1996)
- herbicides and other weed control measures
- road mortality where populations are already small due to other threats (Daly, 1996)
- predation by exotic fish particularly the Plague Minnow *Gambusia holbrooki* (Morgan and Buttemer, 1996)
- loss of suitable breeding habitat through alteration by infilling and destruction of wetlands (Morgan and Buttemer, 1996; Clancy, 1996).

The Green and Golden Bell Frog was not recorded during the field survey. The desktop survey revealed over 140 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in the study area at KP 67.8.

(a) Potential habitat occurs in the project area. Of concern are the open freshwater swamps along the Williams and Hunter Rivers. However, the pipeline alignment may avoid the wetlands by redirecting the route through pastureland adjacent to the wetlands or by HDD beneath the wetland to avoid disturbance. The proposed action is therefore unlikely to have an adverse effect on the lifecycle of the species.

- (b) Not applicable.
- (c) Not applicable.

(d) Provided that the construction footprint avoids wetlands (i) Potential habitat within the freshwater wetlands is unlikely to be modified. (ii) No fragmentation or isolation of habitat should result. (iii) No modification of potential habitat is expected.



(e) No critical habitat has been declared by the Director-General of the NPWS for Green and Golden Bell Frog.

(f) The action proposed is not inconsistent with the 33 priority action statements designed to help this species recover (DECC, 2005).

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and the Green and Golden Bell Frog: the alteration of open freshwater wetlands. The proposed development would be unlikely to increase the susceptibility of this species through habitat alteration or destruction with appropriate mitigation as recommended below.

Mitigation measures

To minimise potential impacts to the Green and Golden Bell Frog from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on Freshwater Wetlands on Coastal Floodplains identified in **Section 3.4.2**. This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Construction and disturbance should be confined to dry periods (when wetland dry) as far as practical.
- Emergent vegetation (e.g. sedges, spike rushes. bulrushes and reeds) fringing the wetlands should not be damaged or modified. Any disturbed wetland areas should be revegetated as soon as possible following construction.
- Appropriate wildlife bridges, ladders and shelters shoul be installed in open trenches.
- Qualified fauna handlers should be employed to remove any trapped wildlife from the open trench each day.

Stuttering Frog (Mixophyes balbus): Endangered

The Stuttering Frog is listed as Endangered on the TSC Act and Vulnerable under the EPBC Act. Stuttering Frogs occur along the east coast of Australia from southern Queensland to north-eastern Victoria. The species has suffered a marked decline in distribution and abundance, particularly in southeast NSW. It is the only *Mixophyes* species that occurs in south-east NSW.

The Stuttering Frog is found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and in the thick understorey vegetation on the forest floor. The frogs breed in streams during summer after heavy rain and lay eggs on rock shelves or shallow riffles in small, flowing streams. As the tadpoles grow they move to deep permanent pools and take approximately 12 months to metamorphose. The frogs prey on insects and smaller frogs.

The main threats to the Stuttering Frog include:

- modification and alteration of habitat
- changes in natural water flows and quality
- predation of eggs from introduced fish particularly the plague minnow (*Gambusia holbrooki*)
- disease (chytrid fungus).



`The Stuttering Frog was not recorded during the field survey. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in the study area on the Karuah River (KP 19, 23.5 and 24.2) and dense forest at Black Camp Road (KP 36.8-36.9).

(a) Potential habitat for the Stuttering Frog may occur in the project area in the forests along Black Camp Road and the Karuah River. Provided that the proposed development avoids impact or damage to streams (i.e. by HHD under permanent streams and their riparian vegetation) it is unlikely to have an adverse effect on the lifecycle of the species.

(b) Not applicable.

(c) Not applicable.

(*d*) Provided that the construction footprint avoids impacts or modification to riparian vegetation along the Karuah River and minimises clearing of timbered habitats at Black Camp Road, then: (i) Potential habitat within the freshwater wetlands is unlikely to be modified. (ii) No fragmentation or isolation of habitat should result. (iii) No modification of potential habitat is expected.

(e) No critical habitat has been declared by the Director-General of the NPWS for Stuttering Frog.

(*f*) There is currently no recovery plan or threat abatement plan for the Stuttering Frog. Seven priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development is consistent with all seven of these.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Stuttering Frog: clearance of native vegetation and alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise clearing and any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Stuttering Frog from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on streams. This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Clearance, damage or modification of riparian vegetation should be avoided, especially at the Karuah River.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats at Black Camp Road.



Giant Barred Frog (Mixophyes iteratus): Endangered

The Giant Barred Frog is listed as Endangered under the TSC Act and Endangered under the EPBC Act. It is found along the coast and ranges from Conondale Ranges in south-east Queensland to the Blue Mountains and western Sydney in NSW. The Coffs Harbour - Dorrigo areas are now considered to be the species stronghold where it is found in small disjunct populations.

The Giant Barred Frog can be found in rainforests, wet sclerophyll and nearby dry eucalypt forests where they utilize permanent flowing streams or slow moving rivers. Breeding takes place in late spring and summer. Eggs are laid in rocks or on the stream banks above water level, where the tadpoles will drop into the water after hatching. The tadpoles are up to 80 mm in length and can take up to 14 months to mature. They forage and live in damp and deep leaf litter. When the species is not breeding they can disperse hundreds of metres away from streams and feed on insects and spiders.

The main threats to the Giant Barred Frog include:

- predation on tadpoles and eggs by introduced fish particularly the plague minnow
- spraying of weeds along freshwater streams
- removal of leaf litter and fallen logs around freshwater streams through fire
- flow alteration to streams
- reduction in water quality through sedimentation and pollution
- timber harvesting and vegetation clearance
- the chytrid fungus.

The Giant Barred Frog was not recorded during the field survey. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in the study area on the Karuah River (KP 19, 23.5 and 24.2) and dense forest at Black Camp Road (KP 36.8-36.9).

(a) Potential habitat for the Giant Barred Frog may occur in the project area in the forests along Black Camp Road and the Karuah River. Provided that the proposed development avoids impact or damage to streams (i.e. by HHD under permanent streams and their riparian vegetation) it is unlikely to have an adverse effect on the lifecycle of the species.

- (b) Not applicable.
- (c) Not applicable.

(*d*) Provided that the construction footprint avoids impacts or modification to riparian vegetation along the Karuah River, and minimises clearing of timbered habitats at Black Camp Road, then: (i) Potential habitat within the freshwater wetlands is unlikely to be modified. (ii) No fragmentation or isolation of habitat should result. (iii) No modification of potential habitat is expected.

(e) No critical habitat has been declared by the Director-General of the NPWS for Giant Barred Frog.

(*f*) There is currently no recovery plan or threat abatement plan for the Giant Barred Frog. Five priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development is not inconsistent with these priority action statements.



(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Stuttering Frog: clearance of native vegetation and alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise clearing and any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Giant Barred Frog from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on streams. This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Clearance, damage or modification of riparian vegetation should be avoided, especially at the Karuah River.
- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats at Black Camp Road.

Pale-headed Snake (Hoplocephalus bitorquatus): Vulnerable

The Pale-headed Snake is listed as Vulnerable under the TSC Act. It is found from north-east Queensland to north-east New South Wales where they occur west of the Great Dividing Range.

Pale-headed snakes primarily inhabit dry eucalypt forests and cypress forests, although they have been recorded in rainforests and moist eucalypt forests. They are nocturnal and shelter during the day under bark on trees or in hollow limbs and trunks. They favour stream sides and prey upon tree frogs but mammals and reptiles will be taken.

The main threats to the Pale-headed Snake include:

- clearing and fragmentation of habitat
- inappropriate fire regimes that remove understorey and dead trees
- illegal removal of individuals.

The Pale-headed Snake was not recorded during the field survey. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered sections of the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and a number of hollow-bearing trees that this species could potentially utilise for breeding. This impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding ranges and forests. These areas are expected to support higher densities of hollow-bearing trees. The action will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.



(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat proposed to be lost is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Pale-headed Snake.

(*f*) There is currently no recovery plan or threat abatement plan for the Pale-headed Snake. Eight priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development is not inconsistent with these.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Pale-headed Snake: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Pale-headed Snake from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible;
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Stephens' Banded Snake (Hoplocephalus stephensii): Vulnerable

The Stephen's Banded Snake is listed as Vulnerable under the TSC Act. It occurs along the coast and ranges from southern Queensland to northern New South Wales. It inhabits a range of habitats including rainforest, wet sclerophyll forest and dry sclerophyll forest up to 950 m in altitude.

Stephen's Banded Snake is arboreal and shelters under loose bark on trees, in vines, among epiphytes and in rock crevices. It is nocturnal and feeds mainly on lizards, frogs, mammals and birds.

The main threats to the Stephen's Banded Snake include:

- habitat fragmentation
- alteration and clearing
- inappropriate fire regimes that remove vegetation
- illegal removal from natural habitats.

The Stephen's Banded Snake was not recorded during the field survey. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered sections of the study area.



(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and a number of hollow-bearing trees that this species could potentially utilise for breeding. This impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding ranges and forests. These areas are expected to support higher densities of hollow-bearing trees. The action will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat proposed to be lost is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for Stephen's banded Snake.

(*f*) There is currently no recovery plan or threat abatement plan for the Stephen's Banded Snake. Thirteen priority action statements have been prepared to help recover this species (DECC, 2005). Provided that clearing of timbered habitats is kept to a minimum, the proposed development is not inconsistent with these.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Stephen's Banded Snake: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Stephen's Banded Snake from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.



Magpie Goose (Anseranas semipalmata): Vulnerable

The Magpie Goose is listed as Vulnerable under the TSC Act. Magpie Goose is still relatively common in the Australian tropics, but had disappeared from south-east Australia by 1920 due to drainage and overgrazing of reed swamps used for breeding. Since the 1980s, there have been an increasing number of records in central and northern NSW. Vagrants can follow food sources to south-eastern NSW.

It is mainly found in shallow wetlands (60-100 cm deep) with dense growth of rushes or sedges. It is equally at home in aquatic or terrestrial habitats, where it is often seen walking and grazing on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off. Breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level. Most breeding now occurs in monsoonal areas and is unlikely in south-eastern NSW. Nests are formed in trees over deep water. It is often seen in trios or flocks on shallow wetlands, dry ephemeral swamps, wet grasslands and floodplains. It roosts in tall vegetation such as trees that are dead or alive.

The main threats to this species include:

- inappropriate hydrological regimes of wetland habitats through drainage of swamps, ponds, dams and other wetlands for agricultural and other human purposes
- degradation of habitat through water pollution (e.g. salinity, chemicals, eutrophication)
- modification of habitat and nest loss from trampling and overgrazing
- predation on eggs and goslings
- too-frequent burning of wetlands.

Magpie Goose was not recorded during the field survey. The desktop survey revealed 17 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in wetland habitats in the study area.

(a) Provided that the proposed development avoids impacts to wetlands and does not lead to the removal of roost trees near wetlands, it will not place a viable local population of this species at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(*d*) Provided that the proposed development avoids impacts to wetlands, it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not affect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Magpie Goose (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Magpie Goose (DECC, 2005). There are 14 priority action statements designed to help this species recover (DECC, 2005). Some of these relate to preventing further degradation of wetlands. Provided that the proposed development avoids impacts to wetlands then it will not be inconsistent with any priority actions.



(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Magpie Goose: alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; clearance of native vegetation; and removal of dead wood and dead trees. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Magpie Goose from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Native vegetation fringing the wetlands identified in **Section 3.4.2** should not be cleared.
- Dead wood and dead trees near the wetlands identified in **Section 3.4.2** should not be removed.

Australasian Bittern (Botaurus poiciloptilus): Vulnerable

The Australasian Bittern is listed as Vulnerable under the TSC Act. Australasian Bitterns are widespread but uncommon over south-eastern Australia. In NSW they may be found over most of the state except for the far north-west.

Australasian Bitterns favour permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.). They hide during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails. Feeding platforms may be constructed over deeper water from reeds trampled by the bird. Platforms are often littered with prey remains. Breeding occurs in summer from October to January. Nests are built in secluded places in densely-vegetated wetlands on a platform of reeds. Clutches usually contain six olive-brown eggs.

The main threats to the species include:

- drainage of wetlands and ponds
- reduced water quality due to siltation, pollution and salinity
- predation by foxes and cats
- use of herbicides, pesticides and other chemicals near wetland areas
- grazing and associated frequent burning of wetland areas.

Australasian Bittern was not recorded during the field survey. The desktop survey revealed six previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in open wetland habitats in the study area.

(a) Provided that the proposed development avoids impacts to wetlands and fringing vegetation of wetlands, then it will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.



(d) Provided that the proposed development avoids impacts to wetlands then it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not effect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Australasian Bittern (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Australasian Bittern (DECC, 2005). There are eight priority action statements designed to help this species recover (DECC, 2005). Some of these relate to preventing further degradation of wetlands. Provided that the proposed development avoids impacts to wetlands then it will not be inconsistent with any priority actions.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Australasian Bittern: alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; and clearance of native vegetation. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Australasian Bittern from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Emergent vegetation (e.g. sedges, spike rushes, Bulrushes and reeds) fringing the wetlands identified in **Section 3.4.2** should not be damaged or modified. Any disturbed wetland areas should be revegetated as soon as possible following construction.

Black Bittern (Ixobrychus flavicollis): Vulnerable

The Black Bittern is listed as Vulnerable under the TSC Act. Black Bitterns have a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region. The species also occurs in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.

It inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. It feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, it roosts in trees or on the ground amongst dense reeds. It is generally solitary, but occurs in pairs during the breeding season, from December to March. Like other bitterns, but unlike most herons, nesting is solitary. Nests are built in spring. They are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks. Between three and five eggs are laid and both parents incubate and rear the young.

The main threats to this species include:

- clearing of riparian vegetation
- predation by foxes and feral cats on eggs and juveniles
- grazing and trampling of riparian vegetation by stock.



The Black Bittern was not recorded during the field survey. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in wetlands and riparian habitats in the study area.

(a) Provided that the proposed development avoids impacts to wetlands and riparian vegetation, it will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the proposed development avoids impacts to wetlands and riparian vegetation, it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not effect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Black Bittern (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Black Bittern (DECC, 2005). There are two priority action statements designed to help this species recover (DECC, 2005). Of relevance is the requirement to retain and manage riparian vegetation. Provided that the proposed development avoids removal of riparian vegetation (especially along the Karuah River) then it will not be inconsistent with any priority actions.

(g) Of the 31 key threatening processes listed in NSW, two are is relevant to the proposed development and the Black Bittern: clearance of native vegetation and alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Black Bittern from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- The development footprint should avoid encroaching or impacting on streams. This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Clearance, damage or modification of riparian vegetation should be avoided, especially at the Karuah River.



Black-necked Stork (Ephippiorhynchus asiaticus): Endangered

The Black-necked Stork is listed as Endangered under the TSC Act. Black-necked Storks are widespread across coastal northern and eastern Australia, becoming increasingly uncommon further south into NSW, and rarely south of Sydney. Some birds may move long distances and can be recorded well outside their normal range.

The Black-necked Stork inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands. It can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries. It feeds in shallow, still water on a variety of prey including fish, frogs, eels, turtles, crabs and snakes. It breeds in late summer in the north, and early summer further south. A large nest, up to 2 m in diameter, is made in a live or dead tree, in or near a freshwater swamp.

The main threats to this species include:

- loss of wetland habitat through clearing and draining for flood mitigation, agriculture and residential development
- degradation of wetland habitats through pollution and salinisation
- modification of natural wetlands through changes in natural water flow regimes.

Black-necked Stork was not recorded during the field survey. The desktop survey revealed 81 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in wetland habitats within the study area.

(a) Provided that the proposed development avoids impacts to wetlands and does not lead to the removal or damage of a nest tree, then it will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) Provided that the proposed development avoids impacts to wetlands then it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not effect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Black-necked Stork (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Black-necked Stork (DECC, 2005). There are 14 priority action statements designed to help this species recover (DECC, 2005). Some of these relate to preventing further degradation of wetlands. Provided that the proposed development avoids impacts to wetlands then it will not be inconsistent with any priority actions.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and the Black-necked Stork: Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.



Mitigation measures

To minimise potential impacts to the Black-necked Stork from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Native vegetation fringing the wetlands identified in **Section 3.4.2** should not be cleared.
- Dead wood and dead trees near the wetlands identified in **Section 3.4.2** should not be removed.
- Pre-clearance surveys should identify nest trees in the vicinity of wetlands that are close to the development footprint to ensure that no nest trees are inadvertently removed or damaged.

Comb-crested Jacana (Irediparra gallinacea): Vulnerable

The Comb-crested Jacana is listed as Vulnerable under the TSC Act. They occur throughout coastal Australia and well inland in the north from the Kimberley to Sydney. Vagrants occasionally appear further south, possibly in response to unfavourable conditions further north in NSW. It inhabits permanent wetlands with a good surface cover of floating vegetation, especially water-lilies. Pairs and family groups forage across floating vegetation, walking with a characteristic bob and flick, or flying low with toes dangling behind. They feed primarily on insects and other invertebrates, as well as some seeds and other vegetation. It breeds in spring and summer in NSW, in a nest of floating vegetation. The male builds the nest, incubates the eggs and broods the young. Females defend up to four mated males and their territories (the floating vegetation around their nest) from other females. Young birds will dive and stay submerged with just their nostrils exposed for a very long time. Adults will also dive for safety on occasion.

The main threat to the species is loss of wetland habitat through clearing and draining for flood mitigation and agriculture (DECC, 2005).

Comb-crested Jacana was not recorded during the field survey. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in wetlands within the study area.

(a) Provided that the proposed development avoids impacts to wetlands then it will not place a viable local population of the species at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(d) Provided that the proposed development avoids impacts to wetlands then it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not effect the long-term survival of the species.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Comb-crested Jacana (DECC, 2005).



(*f*) There is currently no recovery plan or threat abatement plan for the Comb-crested Jacana (DECC, 2005). There are eight priority action statements designed to help this species recover (DECC, 2005). Some of these relate to preventing further degradation of wetlands. Provided that the proposed development avoids impacts to wetlands then it will not be inconsistent with any priority actions.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and the Comb-crested Jacana: alteration to the natural flow regimes of rivers, streams, floodplains and wetlands. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Comb-crested Jacana from the proposed development, the following mitigation measures are recommended:

• The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.

Painted Snipe (Rostratula benghalensis): Endangered

The Painted Snipe is listed as Endangered under the TSC Act and Vulnerable under the EPBC Act. In NSW the Painted Snipe has been recorded at the Paroo wetlands, Lake Cowell, Macquarie Marshes and Hexham Swamp. It is most common in the Murray-Darling Basin. It prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. It nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. The nest consists of a scrape in the ground, lined with grasses and leaves. Breeding is often in response to local conditions and generally occurs from September to December. It forages nocturnally on mud-flats and in shallow water for worms, molluscs, insects and some plant matter.

The main threats to this species include:

- drainage of breeding sites in wetlands
- reduced water quality from siltation and pollution
- predation by foxes and feral cats
- use of herbicides, insecticides and other chemicals near wetlands
- grazing and associated frequent burning of wetlands.

Painted Snipe was not recorded during the field survey. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and breeding habitats were recorded in wetlands within the study area.

(a) Provided that the proposed development avoids impacts to wetlands and surrounding vegetation, then it will not place a viable local population of the species at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(*d*) Provided that the proposed development avoids impacts to wetlands and surrounding vegetation, then it will not remove, modify, fragment or isolate any habitat important for the species. Therefore, the proposed project will not effect the long-term survival of the species.



(e) No critical habitat has been declared by the Director-General of the NPWS for the Painted Snipe (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Painted Snipe (DECC, 2005). There are two priority action statements designed to help this species recover (DECC, 2005). Neither of these have relevance to the proposed development.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Painted Snipe: Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; clearance of native vegetation; and removal of dead wood. The proposed development has the potential to contribute to this key threatening process on a small scale. Therefore, it will be necessary to minimise any potential impacts to the natural flow regimes of rivers, streams, floodplains and wetlands.

Mitigation measures

To minimise potential impacts to the Painted Snipe from the proposed development, the following mitigation measures are recommended:

- The development footprint should avoid encroaching or impacting on wetlands identified in **Section 3.4.2.** This should include indirect impacts such as down-stream sedimentation or eutrophication.
- Emergent vegetation (e.g. sedges, spike rushes. bulrushes and reeds) fringing the wetlands identified in **Section 3.4.2** should not be damaged or modified.
- Native vegetation fringing the wetlands identified in **Section 3.4.2** should not be cleared.
- Dead wood and dead trees near the wetlands identified in **Section 3.4.2** should not be removed.

Bush Stone-curlew (Burhinus grallarius): Endangered

The Bush Stone-curlew is listed as Endangered under the TSC Act. They are found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. However, it is common only in northern Australia. In the south-east, it is either rare or extinct throughout its former range.

It inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. It is largely nocturnal, being especially active on moonlit nights. The main food is insects and small vertebrates, such as frogs, lizards and snakes. The species nests on the ground in a scrape or small bare patch, during spring and early summer.

The main threats to the Bush Stone-curlew include:

- predation by foxes and cats
- trampling of eggs by cattle
- clearance of woodland habitat for agricultural and residential development
- modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, grazing and frequent fires
- disturbance in the vicinity of nest sites.


The Bush Stone-curlew was not recorded during the field survey. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging and breeding habitat (15 to 35 ha of timbered habitats depending on construction methods). This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Bush Stone-curlew (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Bush Stone-curlew (DECC, 2005). There are ten priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Bush Stone-curlew: clearing of native vegetation; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Bush Stone-curlew from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Pre-clearing surveys should ensure that no nests are located in the path of construction equipment.

Glossy Black-Cockatoo (Calyptorhynchus lathami): Vulnerable

The Glossy Black-Cockatoo is listed as Vulnerable under the TSC Act. It occurs in a wide coastal band from central Queensland to the Victorian border, with an isolated population occurring in South Australia on Kangaroo Island (NPWS, 1999c). In NSW, the species' distribution is patchy and localised reflecting the distribution of its moist and dry sclerophyll forest habitat. This species is locally nomadic, with small family parties (seldom more than ten individuals) roaming in search of feeding areas (NPWS, 1999c). It prefers woodland dominated by *Allocasuarina* or open sclerophyll forest or woodlands with a middle stratum of *Allocasuarina*, but also occurs in busAECOMnd remnants in agricultural and urban areas (Higgins, 1999). However, the species appears to occur in peak abundance in old growth forest.

Glossy Black-Cockatoos are considered ecological specialists, feeding almost exclusively on the seeds of Forest Oak *Allocasuarina torulosa*, Drooping She-oak *A. verticillata* and Black She-oak *A. littoralis*, although they also occasionally eat the seeds of Swamp Oak *Casuarina glauca* and Shrub She-oak *A. distyla*. In eastern NSW, Black She-oak *A. littoralis* is the main dietary component (Chapman, 1999). Glossy Black-Cockatoos are also highly selective about which trees they feed from.

They have been recorded feeding signs beneath only 24% of the 1672 cone-bearing trees examined near Eden in NSW. Mature, sparse trees between 2-10 m tall are favoured for foraging (Higgins, 1999), with birds showing a preference for trees with large seeds and with high seed mass / cone mass ratios and high seed mass per cone values (Pepper, 2000). Although trees are selected on the basis of the number of cones, feeding activity is unevenly distributed between trees, with birds settling for sustained feeding (> 4 hrs) in some trees and remaining for only a few minutes in others. They also select only the young russet cones (rather than older grey cones) which may reflect a preference for softer cones or the higher protein content of the seeds.

The Glossy Black-Cockatoo must forage for many hours every day to obtain sufficient food and apparently suitable habitat will not always provide adequate food to support the cockatoos, in particular during the breeding season (Garnett and Crowley, 2000). Breeding birds forage for about 80% of daylight hours, consuming seeds from up to 140 cones during this period. Non-breeding birds forage for about half the daylight hours and eat half as many cones (Chapman, 1999).

Large hollows in the trunk or limbs of living or dead eucalypt trees are required for nesting. Glossy Black-Cockatoos prefer deep (40-120 cm) nest hollows with wide entrances (approximately 21 cm) located 10-28 m above the ground (Higgins, 1999). Hollows of sufficient size for nesting generally do not form in eucalypt trees less than 150-200 years old (Mackowski, 1984).

Glossy Black-Cockatoos form strong pair bonds and are thought to pair for life (Chapman, 1999). Adults breed during the autumn and winter (NPWS, 1999c), mainly between February and April but as early as January and as late as August if earlier nesting attempts fail (Chapman, 1999). Incubation of eggs lasts for about 30 days and chicks fledge around 90 days after hatching. Only one young is raised per season.

These birds are mainly sedentary but are capable of travelling large distances to locate suitable foraging habitat. Permanent groups of up to ten individuals are formed. Roosting is usually communal in the canopy of live leafy trees (Higgins, 1999) and groups may form aggregations at food and water sources.

This species is threatened by a number of processes including reduction of suitable habitat through clearing for development, loss of tree hollows, excessively frequent fire which reduces the abundance and recovery of she-oaks, and illegal bird smuggling and egg-collecting (DECC, 2005).



The Glossy Black-cockatoo was not recorded during the surveys. The desktop survey revealed eight previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered areas within the study area. However, these areas are considered marginal habitat because the project footprint does not intersect any areas of forest where *Allocasuarina* species are dominant.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and larger numbers of *Allocasuarina* trees occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(*d*) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat proposed to be lost (15 to 35 ha) is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Glossy Blackcockatoo.

(*f*) There is currently no recovery plan or threat abatement plan for the Glossy Black-cockatoo (DECC, 2005). There are nine priority action statements designed to help this species recover. The proposed development is not inconsistent with these (DECC, 2005).

(g) Key threatening processes of relevance to the Glossy Black-cockatoo include the clearing of native vegetation, loss of hollow-bearing trees and excessively frequent fire (DECC, 2005). The proposed development would result in the clearing of native vegetation, resulting in a small loss of foraging habitat, and loss of potential breeding habitat such as hollow-bearing trees. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the adjacent ranges and forests. Furthermore, the proposed development would not increase the frequency of fires in the study area.

Mitigation measures

To minimise potential impacts to the Glossy Black-Cockatoo from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.



Gang-gang Cockatoo (Callocephalon fimbriatum): Vulnerable

The Gang-gang Cockatoo is listed as Vulnerable under the TSC Act. It ranges from southern Victoria through to central eastern New South Wales (DECC, 2005). In New South Wales, the Gang-gang Cockatoo is distributed from the southeast coast to the Hunter region, and inland to the Central Tablelands and South West slopes (DECC, 2005). It occurs regularly in the Australian Capital Territory, but is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee (DECC, 2005).

The Gang-gang Cockatoo is sedentary or seasonally nomadic, but partly migratory in autumn to spring. It occurs singly and in pairs to small flocks. It is found in tall mountain forest and woodlands, especially mature wet sclerophyll forests in summer. In winter, it moves to lower altitudes where it occupies drier, more open eucalypt forests and woodlands (particularly box-ironbark assemblages or dry coastal forest) and urban areas (DECC, 2005).

The Gang-gang Cockatoo favours vegetation with old growth elements for nesting and roosting. Birds nest in large hollows in the trunk or limbs of living or dead eucalypt trees (Gibbons and Lindenmayer, 2002). Hollows of sufficient size generally do not form in eucalypt trees less than 150 to 200 years old (Mackowski, 1984). Breeding usually occurs between October and January, and individuals are likely to breed from around four years of age (DECC, 2005).

It feeds mainly on the fruits of eucalypts and acacias but will feed on other seeds and fruit such as *Callitris*, garden fruits, hawthorn and *Callistemon* as well as some insects and their larvae.

This species is threatened by a number of processes including clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). Degradation of habitat may reduce the abundance of optimal foraging and roosting habitat, and climate change may alter the extent and nature of its preferred habitat (cool temperate vegetation) (DECC, 2005). Other threats include frequent fire which poses a threat to continued successful breeding, and the susceptibility of this species to *Psittacine ciroviral* disease (PCD), which is spread through contaminated nest chambers (DECC, 2005). PCD is known to have increased near Bowral in the southern higAECOMnds of New South Wales over the past decade (DECC, 2005).

The Gang-gang Cockatoo was not recorded during the surveys. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and a number of hollow-bearing trees that this species could potentially utilise for breeding. This impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding ranges and forests. These areas are expected to support higher densities of hollow-bearing trees. The action will not place a viable local population of the species at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat proposed to be lost (15 to 35 ha) is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.



(e) No critical habitat has been declared by the Director-General of the NPWS for the Gang-gang Cockatoo (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Gang-gang Cockatoo. Eight priority action statements have been prepared to help recover this species (DECC, 2005). One of these recommends the provision of supplementary hollows / nest boxes within primary habitat areas. Provided that clearing of timbered habitats is kept to a minimum, the proposed development is not inconsistent with all eight priority action statements.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Gang-gang Cockatoo: the clearing of native vegetation; loss of hollow-bearing trees; and infection by *Psittacine circoviral* (beak and feather) disease, which affects parrots (DECC, 2005). The actions proposed will result in the clearing of native vegetation and possibly the loss of a number of hollow-bearing trees, resulting in a small loss of foraging habitat and potential breeding habitat. This species is not expected to be reliant on this marginal vegetation, particularly when considering the large amount of surrounding habitat available in the adjacent ranges and forests. The proposed development will not increase the susceptibility of this species to infection by *Psittacine circoviral* disease. This disease is widespread and occurs naturally in Australia, with transmission occurring orally or in faeces or feathers.

Mitigation measures

To minimise potential impacts to the Gang-gang Cockatoo from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.

Swift Parrot (Lathamus discolor): Endangered

The Swift Parrot is listed as Endangered under the TSC Act and Endangered under the EPBC Act. Breeding occurs in Tasmania before migration to the Australian mainland in March and October (DECC, 2005). Birds disperse widely across south-eastern Australia but are largely confined to the box-ironbark forest and woodland on the inland slopes of the Great Dividing Range, where they forage on winterflowering eucalypts, such as *Eucalyptus robusta* (Swamp Mahogany), *Corymbia maculata* (Spotted Gum), *C. gummifera* (Red Bloodwood), *E. sideroxylon* (Mugga Ironbark), and *E. albens* (White Box) (DECC, 2005). Their diet includes nectar, pollen and lerps, but the fruits and seeds of native and exotic plants are eaten in suburban environments. Commonly used lerp-infested trees include *E. microcarpa* (Grey Box), *E. moluccana* (Grey Box) and *E. pilularis* (Blackbutt).

The Swift Parrot is threatened by a number of factors on the mainland, including loss of habitat through clearing for agriculture, and urban and industrial development (DECC, 2005). Collisions with wire netting fences, windows and cars, during the breeding season and winter migration (especially where such obstacles are in close proximity to suitable habitat) are also a major problem (DECC, 2005).

The Swift Parrot was not recorded during the surveys. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging habitats were recorded in timbered areas within the study area. The breeding range is confined to Tasmania.



(a) The proposed development would result in the removal of a small amount of foraging habitat (15 to 35 ha depending on construction methods) in narrow strips. This impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding ranges and forests. A local population of this species does not exist in the study area (they are non-breeding migrants to mainland Australia during May and August), and the proposed development will not place this species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of a small amount of foraging habitat (15 to 35 ha depending on construction methods) in narrow strips, including potential food trees. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like the Swift Parrot. (iii) The proposed loss of habitat is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Swift Parrot.

(*f*) There is currently no recovery plan or threat abatement plan for the Swift Parrot (DECC, 2005). There are ten priority action statements designed to help this species recover (DECC, 2005). The proposed development is not inconsistent with these.

(g) Key threatening processes of relevance to the Swift Parrot includes the clearing of native vegetation (DECC, 2005). The proposed development will result in the clearing of native vegetation, and therefore a small loss of foraging habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the adjacent ranges and forests.

Mitigation measures

To minimise potential impacts to the Swift Parrot from the proposed development, the following mitigation measures are recommended:

• Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.

Turquoise Parrot (Neophema pulchella): Vulnerable

The Turquoise Parrot is listed as Vulnerable under the TSC Act. The Turquoise Parrot's range extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. It lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland, where it is usually seen in pairs or small flocks. However, it has also been reported in flocks of up to thirty individuals. It prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. It forages quietly and may be quite tolerant of disturbance. However, if flushed it will fly to a nearby tree and then return to the ground to browse as soon as the danger has passed. Turquoise Parrots nest in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.



Threats to the species include:

- clearing of grassy-woodland and open forest habitat
- loss of hollow-bearing trees
- degradation of habitat through heavy grazing, firewood collection and establishment of exotic pastures
- predation by foxes and cats
- illegal trapping of birds and collection of eggs which also often results in the destruction of hollows.

Turquoise Parrot was not recorded during the field survey. The desktop survey revealed four previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding. This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(*d*) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Turquoise Parrot (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Turquoise Parrot (DECC, 2005). There are ten priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Turquoise Parrot: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.



Mitigation measures

To minimise potential impacts to the Turquoise Parrot from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Hooded Robin (Melanodryas cucullata): Vulnerable

The Hooded Robin is listed as Vulnerable under the TSC Act. The south-eastern form of the Hooded Robin is found from Brisbane to Adelaide throughout much of inland NSW, with the exception of the north-west. It is common in few places, and rarely found on the coast. It is considered a sedentary species, but local seasonal movements are possible.

It prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. It requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. It often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey. Territories range from around 10 ha during the breeding season, to 30 ha in the non-breeding season. The nest is a small, neat cup of bark and grasses bound with webs, in a tree fork or crevice, from less than 1 m to 5 m above the ground.

The main threats to this species include:

- clearing of woodlands, 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.

Hooded Robin was not recorded during the field survey. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding. This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.



(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Hooded Robin (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Hooded Robin (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Hooded Robin: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Hooded Robin from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Speckled Warbler (*Pyrrholaemus saggitatus*): Vulnerable

The Speckled Warbler is listed as Vulnerable under the TSC Act. It has a patchy distribution throughout south-eastern Queensland, the eastern half of NSW and into Victoria, as far west as the Grampians. The species is most frequently reported from the hills and tablelands of the Great Dividing Range, and rarely from the coast. There has been a decline in population density throughout its range, with the decline exceeding 40% where no vegetation remnants larger than 100 ha survive.

The Speckled Warbler lives in a wide range of eucalypt-dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat includes scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. The diet consists of seeds and insects, with most foraging taking place on the ground around tussocks and under bushes and trees. Pairs are sedentary and occupy a breeding territory of about ten hectares, with a slightly larger home-range when not breeding. The rounded, domed, roughly built nest of dry grass and strips of bark is located in a slight hollow in the ground or the base of a low dense plant, often among fallen branches and other litter. A side entrance allows the bird to walk directly inside.

Speckled Warblers often join mixed species feeding flocks in winter, with other species such as Yellowrumped, Buff-rumped, Brown and Striated Thornbills.



Threats to the species include:

- due to the fragmented nature of the populations and their small size the species is susceptible to catastrophic events and localised extinction
- clearance of remnant grassy woodland habitat for paddock management reasons and for firewood
- poor regeneration of grassy woodland habitats
- modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, heavy grazing and compaction by stock and frequent fire
- habitat is lost and further fragmented as land is being cleared for residential and agricultural developments. In particular, nest predation increases significantly, to nest failure rates of over 80%, in isolated fragments
- nest failure due to predation by native and non-native birds, cats, dogs and foxes particularly in fragmented and degraded habitats.

Speckled Warbler was not recorded during the field survey. The desktop survey revealed five previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Speckled Warbler (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Speckled Warbler (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Speckled Warbler: clearing of native vegetation; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.



Mitigation measures

To minimise potential impacts to the Speckled Warbler from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Diamond Firetail (Stagonopleura guttata): Vulnerable

The Diamond Firetail is listed as Vulnerable under the TSC Act. It is widely distributed in NSW, with a concentration of records from the Northern, Central and Southern Tablelands, the Northern, Central and South Western Slopes and the North West Plains and Riverina. It is not commonly found in coastal districts, though there are records from near Sydney, the Hunter Valley and the Bega Valley. This species has a scattered distribution over the rest of NSW. It is found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum *Eucalyptus pauciflora* Woodlands. It also occurs in open forest, mallee, natural temperate grassland, and in secondary grassland derived from other communities. It is often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. This species feeds exclusively on the ground, on ripe and partly-ripe grass and herb seeds and green leaves, and on insects (especially in the breeding season). It is usually encountered in flocks of between 5 to 40 birds, occasionally more. Groups separate into small colonies to breed, between August and January. Nests are globular structures built either in the shrubby understorey, or higher up, especially under hawk's or raven's nests. These birds roost in dense shrubs or in smaller nests built especially for roosting. The species appears to be sedentary, though some populations move locally, especially those in the south. It has been recorded in some towns and near farm houses.

Threats to this species include:

- clearing and fragmentation of woodland, open forest, grassland and mallee habitat for agriculture and residential development, and firewood collection
- poor regeneration of open forest and woodland habitats
- invasion of weeds, resulting in the loss of important food plants
- modification and destruction of ground- and shrub layers within habitat through: removal of native plants, litter and fallen timber; introduction of exotic pasture grasses; heavy grazing and compaction by stock; and frequent fire
- predation of eggs and nestlings by increased populations of native predators such as the Pied Currawong *Strepera graculina*.

Diamond Firetail was not recorded during the field survey. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.



(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(*d*) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Diamond Firetail (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Diamond Firetail (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Diamond Firetail: clearing of native vegetation; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Diamond Firetail from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.



Brown Treecreeper (Climacteris picumnus): Vulnerable

The Brown Treecreeper is listed as Vulnerable under the TSC Act. It is endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. The eastern subspecies lives in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys.

The population density of this subspecies has been greatly reduced over much of its range, with major declines recorded in central NSW and the northern and southern tablelands. Declines have occurred in remnant vegetation fragments smaller than 300 ha, that have been isolated or fragmented for more than 50 years.

It is found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range. It mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species. It is also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses. It is usually not found in woodlands with a dense shrub layer. Fallen timber is an important habitat component for foraging. It is also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains.

It is sedentary, considered to be resident in many locations throughout its range. It may be present and territorial all year-round at many sites, although some birds may disperse locally after breeding. Hollows in standing dead or live trees and tree stumps are essential for nesting.

They are gregarious and are usually observed in pairs or small groups of eight to 12 birds. They are terrestrial and arboreal in about equal proportions. They are active, noisy and conspicuous while foraging on trunks and branches of trees and amongst fallen timber. They spend much more time foraging on the ground and fallen logs than other treecreepers. When foraging in trees and on the ground, they peck and probe for insects, mostly ants, amongst the litter, tussocks and fallen timber, and along trunks and lateral branches. Up to 80% of the diet is comprised of ants, with other invertebrates (including spiders, insects larvae, moths, beetles, flies, hemipteran bugs, cockroaches, termites and lacewings) making up the remaining percentage. Other food items may include nectar from Mugga Ironbark (*E. sideroxylon*) and paperbarks, sap from an unidentified eucalypt, lizards and food scraps (DECC, 2005).

Threats to the species include:

- loss of ground litter from compaction and overgrazing
- fragmentation of woodland and forest remnants which isolates populations and causes local extinctions
- ongoing degradation of habitat, particularly the loss of tree hollows and fallen timber from firewood collection and overgrazing.

Brown Treecreeper was not recorded during the field survey. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.



(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(*d*) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Brown Treecreeper (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Brown Treecreeper (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Brown Treecreeper: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Brown Treecreeper from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Grey-crowned Babbler (Pomatostomus temporalis): Vulnerable

The Grey-crowned Babbler is listed as Vulnerable under the TSC Act. It is found throughout large parts of northern Australia and in south-eastern Australia. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. The Grey-crowned Babbler inhabits open forest and woodland, acacia shrubland and adjoining farmland (Garnett and Crowley, 2000), foraging for invertebrates on the trunks and branches of eucalypts and other woodland trees or on the ground amongst litter and tussock grasses (DECC, 2005). It inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains (DECC, 2005).

Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one, so they are generally unable to cross large open areas. Habitat fragmentation reduces breeding success as suitably sized family parties are unable to be maintained and the species eventually disappears from fragments (Garnett and Crowley, 2000).

They live in family groups of up to 15 birds that consist of a breeding pair and young from previous breeding seasons. They build and maintain several conspicuous, dome-shaped stick nests about the size of a football. A nest is used as a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones. Grey-crowned Babblers breed between July and February. Territories range from 1 to 50 hectares (usually around 10 hectares) and are defended all year (DECC, 2005).

The main threats to the Grey–crowned Babbler include:

- clearing of woodland remnants
- heavy grazing and removal of coarse, woody debris within woodland remnants
- nest predation by species such as ravens and butcherbirds may be an issue in some regions where populations are small and fragmented.

Grey–crowned Babbler was recorded three times during the field survey at KP4, 36.9 and KP 39.5. It is also reported to be common in parts of the GFDA (T. Laurie, AGL, pers. comm.). The desktop survey revealed 63 previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.



(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Grey-crowned Babbler (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Grey-crowned Babbler (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, two are relevant to the proposed development and the Grey-crowned Babbler: clearing of native vegetation; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Grey-crowned Babbler from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Regent Honeyeater (Xanthomyza phrygia): Vulnerable

The Regent Honeyeater is listed as Endangered under the TSC Act and Endangered under the EPBC Act. The range has declined dramatically, with its distribution extremely disjointed and a total population believed to contain fewer than 1,500 individuals (NPWS, 1999d). There are only three known key breeding regions remaining: northeast Victoria (Chiltern-Albury) and in NSW at Capertee Valley and the Bundarra-Barraba region (DECC, 2005). In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. However, in some years non-breeding flocks converge on flowering coastal woodlands and forests (DECC, 2005), including the Hunter Valley (Higgins, 2001).

Regent Honeyeaters occur in eucalypt woodlands and open forest. Most records of the species are from box-ironbark eucalypt forest and woodland, lowland coastal forests that are dominated by Swamp Mahogany (*Eucalyptus robusta*) and Spotted Gum (*Corymbia maculata*) and riparian forests of River She-oak (DECC, 2005). These woodlands have large numbers of mature trees, high canopy cover and an abundance of mistletoes (DEC, 2005). Bird movements are thought to be dependent on spatial and temporal flowering and other resource patterns (DECC, 2005).

Nectar comprises the main diet of Regent Honeyeaters, with 16 species of eucalypt and two species of mistletoe browsed. However, three species of eucalypt make up the predominant nectar sources: Red Ironbark (*Eucalyptus sideroxylon*), White Box (*Eucalyptus albens*) and Yellow box (*Eucalyptus melliodora*) (Webster and Menkhorst, 1992).



Lerps and honeydew comprise a large proportion of the diet when nectar is scarce. Insects comprise a smaller dietary component but are important for nestlings (DECC, 2005).

Breeding occurs between July and January in Box-Ironbark and temperate woodlands and riparian gallery forest dominated by River She-oak (DECC, 2005). Nests are frequently located in Red Ironbark and River Red Gum but may also be in other eucalypts, mistletoe clumps and casuarinas (DECC, 2005).

This species is threatened by a number of processes including:

- fragmentation and degradation of habitat, key habitat tree species and remnant woodlands from clearing for agricultural, residential development, and timber gathering (particularly fertile Yellow Box-White Box-Blakely's Red Gum woodlands -DECC, 2005)
- overgrazing that suppresses the regeneration of overstorey tree species and shrub species (especially riparian gallery forests - DECC, 2005)
- competition from larger aggressive honeyeaters (e.g. Noisy Miners, Noisy Friarbirds, Red Wattlebirds)
- egg/nest predation by native birds (DECC, 2005).

The Regent Honeyeater was not recorded during the current surveys. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and nesting habitats were not recorded in the study area. The project site is outside the known breeding range and none of the winter-flowering eucalypts that characterise the wintering areas were recorded in the proposed development footprint.

(a) The proposed development would only result in the removal of a small amount of timbered habitats (15 to 35 ha, depending on construction methods). This would not include any of the favoured winter-flowering eucalypt species. The proposed development footprint is outside the known breeding range so would not impact or disturb any known breeding sites, and therefore will not adversely affect the life cycle of the species, such that a viable local population will be placed at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha of timbered habitat; however, this does not include favoured winter-flowering eucalypts. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat loss (15 to 35 ha) is minimal when considering the large areas of preferable undisturbed habitat in the surrounding ranges and forests. The habitat is not a known breeding area, and this species is not expected to be reliant on habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Regent Honeyeater.

(*f*) There is currently no recovery plan or threat abatement plan for the Regent Honeyeater (DECC, 2005). There are 32 priority action statements designed to help this species recover (DECC, 2005). The proposed development is not inconsistent with these.



(g) Key threatening processes of relevance to the Regent Honeyeater includes the clearing of native vegetation (DECC, 2007). The proposed development would result in the clearing of native vegetation, resulting in a small loss of timbered habitat. This species is not expected to be reliant on this vegetation due to the absence of winter-flowering eucalypt species.

Mitigation measures

To minimise potential impacts to the Regent Honeyeater from the proposed development, the following mitigation measures are recommended:

• Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.

Black-chinned Honeyeater (Melithreptus gularis): Vulnerable

The Black-chinned Honeyeater is listed as Vulnerable under the TSC Act. The eastern subspecies of Black-chinned Honeyeater is widespread, from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, except for the Richmond River district. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions.

It occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*) and Forest Red Gum (*E. tereticornis*). It also inhabits open forests of smooth-barked gums, stringybarks, ironbarks and tea-trees. Feeding territories are large, making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 ha. The nest is placed high in the crown of a tree, in the uppermost lateral branches, hidden by foliage.

Threats to the species include:

- clearing of remnant open forest and woodland habitat
- poor regeneration of open forest and woodland habitats because of intense grazing
- exclusion from smaller remnants by aggressive species such as the Noisy Miner (*Manorina melanocephala*).

Black-chinned Honeyeater was not recorded during the field survey. Two previous records from within 5 km of the project site were revealed by the desktop survey. These are from woodland west of Beresford, which is to the west of the southern end of the proposed pipeline route and outside the proposed construction footprint. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.



(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Black-chinned Honeyeater (DECC, 2005).

(*f*) There is currently no recovery plan or threat abatement plan for the Black-chinned Honeyeater (DECC, 2005). There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.

(g) Of the 31 key threatening processes listed in NSW, one is relevant to the proposed development and the Black-chinned Honeyeater: clearing of native vegetation. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Black-chinned Honeyeater from the proposed development, the following mitigation measures are recommended:

 Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.

Barred Cuckoo-shrike (Coracina lineata): Vulnerable

The Barred Cuckoo-Shrike is listed as Vulnerable under the TSC Act. It occurs in coastal eastern Australia from Cape York to the Manning River in NSW, so its usual range is to the north of the study area. Barred Cuckoo-shrikes are generally uncommon in their range, and are rare in NSW. The species' main habitat is in rainforest areas, however, it also inhabits eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses (DECC, 2005). The species mainly forages in rainforest, feeding on seeds and fruit, swallowing them whole. The Barred Cuckooshrike breeds from October to January, nesting in horizontal forks of trees, 15 to 25 m above the ground.

Barred Cuckoo-shrike was not recorded during the field survey. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and breeding habitats were recorded in densely timbered areas at Black Camp Rd and Karuah River. However, the species' usual range is from the Manning River north, which is north of the subject site.

(a) The subject site is to the south of the species usual range, so no viable local population of the species is likely to be placed at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(d) Since the subject site is south of the usual range of the species, the proposed development will not impact on important habitat for the species.



(e) No critical habitat has been declared by the Director-General of the NPWS for the Barred Cuckooshrike.

(f) There is currently no recovery plan or threat abatement plan for the Barred Cuckoo-shrike (DECC, 2005). There are two priority action statements (DECC, 2005) of which one is relevant to the current proposal: retain areas of native forest particularly along roads and watercourses on private land, state forests and local government areas. Provided that clearance of vegetation is kept to a minimum, particularly riparian vegetation along the Karuah River, the proposed development will not be inconsistent with this priority action.

(g) The proposed development will not contribute to a key threatening process that is relevant to Barred Cuckoo-shrike.

Mitigation measures

In accordance with the priority action statements for the species (DECC, 2005), the works should aim to minimise clearance of native vegetation, especially streamside (riparian) vegetation and road-side corridors. These mitigation actions are most relevant to the riparian vegetation along the Karuah River and the more southerly sections of forest on Black Camp Road.

Square-tailed Kite (Lophoictinia isura): Vulnerable

The Square-tailed Kite is listed as Vulnerable under the TSC Act. It ranges along coastal and subcoastal areas from south-western to northern Australia, Queensland, NSW and Victoria. In NSW, scattered records of the species throughout the state indicate that the species is a regular resident in the north, north-east and along the major west-flowing river systems. It is a summer breeding migrant to the south-east, including the NSW south coast, arriving in September and leaving by March.

It is found in a variety of timbered habitats including dry woodlands and open forests. It shows a particular preference for timbered watercourses. It is a specialist hunter of passerines, especially honeyeaters, and most particularly nestlings, and insects in the tree canopy, picking most prey items from the outer foliage. Apparently, it occupies very large hunting ranges of more than 100 km². Breeding is from July to February, with nest sites generally located along or near watercourses, in a fork or on large horizontal limbs.

Threats to the species include:

- 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.

Square-tailed Kite was not recorded during the field survey. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.



(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Square-tailed Kite (DECC, 2005).

(f) There is currently no recovery plan or threat abatement plan for the Square-tailed Kite (DECC, 2005). There are three priority action statements designed to help this species recover (DECC, 2005). One of these (to Identify and protect nest trees, and monitor reproduction) is relevant to the proposal. Pre-clearance surveys should ensure that no trees containing nests of Square-tailed Kite are removed during construction.

(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Square-tailed Kite: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Square-tailed Kite from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Pre-clearance surveys should ensure that no trees containing nests of Square-tailed Kite are removed during construction.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Barking Owl (Ninox connivens): Vulnerable

The Barking Owl is listed as Vulnerable under the TSC Act. It is found throughout Australia except for the central arid regions and Tasmania. It is quite common in parts of northern Australia, but is generally considered uncommon in southern Australia. It has declined across much of its distribution across NSW and now occurs only sparsely. It is most frequently recorded on the western slopes and plains. It is rarely recorded in the far west or in coastal and escarpment forests.

It usually inhabits eucalypt woodland, open forest, swamp woodlands and, especially in inland areas, timber along watercourses. Denser vegetation is used occasionally for roosting. During the day it roosts along creek lines, usually in tall understorey trees with dense foliage such as *Acacia* and *Casuarina* species, or the dense clumps of canopy leaves in large Eucalypts.



It feeds on a variety of prey, with invertebrates predominant for most of the year, and birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding. Barking Owls live alone or in pairs. Territories range from 30 to, 200 hectares and birds are present all year. Breeding occurs during late winter and early spring. Three eggs are laid in nests in hollows of large, old eucalypts including River Red Gum (*Eucalyptus camaldulensis*), White Box (*E. albens*), Red Box (*E. polyanthemos*) and Blakely's Red Gum (*E. blakelyi*).

The main threats to the species include:

- clearing and degradation of habitat, mostly through cultivation, intense grazing and the establishment of exotic pastures
- inappropriate forest harvesting practices that have changed forest structure and removed old growth hollow-bearing trees
- firewood harvesting resulting in the removal of old trees
- too-frequent fire which causes degradation of understorey vegetation and reduces habitat and foraging substrate for prey species.

Barking Owl was not recorded during the field survey. The desktop survey revealed three previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of potential foraging habitat (15 to 35 ha of timbered habitats depending on construction methods) and possibly a number of hollow-bearing trees that this species could potentially utilise for breeding This impact is expected to be minimal when considering that any clearing would be in narrow strips in a landscape that is already fragmented, and there are large undisturbed areas of potential habitat available in the extensive surrounding ranges and forests, where higher densities of hollow-bearing trees and more diverse foraging habitats occur. The proposed development will not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of 15 to 35 ha of timbered habitats (depending on construction methods) in strips of 30 m wide or less. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result in a landscape that is already fragmented. (iii) The habitat proposed to be modified is minimal when compared to the large areas of more suitable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Barking Owl (DECC, 2005).

(f) A Draft Recovery Plan for the Barking Owl (NPWS, 2003) contains 5 objectives. Specific Objective 3 requires the undertaking of threat abatement and mitigation, which requires the protection of habitat and especially large hollow-bearing trees. There are seven priority action statements designed to help this species recover (DECC, 2005). The proposed development has no relevance to any of these and is not inconsistent with any of them.



(g) Of the 31 key threatening processes listed in NSW, three are relevant to the proposed development and the Barking Owl: clearing of native vegetation; loss of hollow-bearing trees; and removal of dead wood and dead trees. The proposed development has the potential to contribute to these three key threatening processes on a small scale. Therefore, it will be necessary to minimise activities that modify and degrade timbered habitats.

Mitigation measures

To minimise potential impacts to the Barking Owl from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without pre-clearance surveys undertaken for the presence of nesting owls.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Powerful Owl (Ninox strenua): Vulnerable

The Powerful Owl is listed as Vulnerable under Schedule 2 of the TSC Act. It is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria and occurs at low densities (DECC, 2005). In NSW it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains (DECC, 2005).

Powerful Owls occur primarily in densely vegetated gullies of open and tall open forest, but they are also found in a wider range of habitats, including forests and woodlands within the metropolitan regions of cities (Cooke et al., 2002). However, optimal habitat requires large tracts of forest or woodland habitat, including a tall shrub layer and abundant hollows supporting high densities of arboreal marsupial prey species (DECC, 2006a).

This species roosts in dense mid-canopy trees (such as Turpentines, She-oaks and rainforest trees), or tall shrubs in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines (DECC, 2006a). Nesting occurs in large hollows (greater than 45 cm wide and greater than 100 cm deep) in eucalypts in "unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines" (DECC, 2006a). Nest trees are typically emergent, and are often the largest and oldest in a stand (Debus and Chafer, 1994). Powerful Owls are faithful to traditional nesting hollows but can also use other hollows within the nesting gully.

Pairs of birds occupy large home ranges (300-1500 ha; DECC, 2006a), utilising various portions of this area at different times, depending on the local abundance of arboreal mammals as a food source (Debus and Chafer, 1994). Powerful Owls prey predominantly on arboreal mammals, particularly the Greater Glider and Ringtail Possum. The relative importance of prey items appears to vary regionally, with other prey such as Sugar Gliders, Brushtail Possums, Grey-headed Flying Foxes, insects and birds also used (Debus and Chafer, 1994; DECC, 2006a).

The level of understanding of the breeding biology and habitat use by Powerful Owls has not been defined in terms of a "viable local population" of the species. However, studies to date have shown that Powerful Owls can breed within urban areas, but the "degree of urbanization that the Powerful Owl can tolerate is still unknown" (Cooke, et al., 2002). Studies suggest that breeding is reduced in response to increased levels of urban activity. For instance one pair did not return to a nest site once a timber boardwalk was constructed under the nest tree (Cooke et al., 2002).



Similarly, habitat fragments less than 200 ha are generally not large enough to provide significant habitat for Powerful Owls in south-eastern NSW.

This species is threatened by a number of processes including loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development, which also affects the populations of arboreal prey species (DECC, 2005). Other threats include loss of hollow-bearing trees suitable for nesting, disturbance around nest sites (particularly during pre-laying, laying and downy chick stages), high frequency hazard reduction burning (affecting prey availability), secondary poisoning, road kills, and predation of fledglings by foxes, dogs and cats (DECC, 2005).

The Powerful Owl was not recorded during the field survey. The desktop survey revealed 11 previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in heavily timbered habitats in the Black Camp Creek area. The large hollow-bearing trees identified in the study area represent potential nesting sites.

(a) Factors likely to disrupt the life cycle of the Powerful Owl in the locality would include a substantial loss and / or fragmentation of foraging habitat and loss of suitable nesting and roosting habitat. The proposed development would result in the removal of a small amount (15 to 35 ha depending on the construction method) of potential foraging habitat and hollow trees with low potential for roosting and nesting. These areas do not provide optimal foraging, roosting or breeding habitat for the Powerful Owl, particularly when considering the available forest and woodland habitat in the surrounding ranges and forests, where more mature trees with hollows suitable for nesting, dense roosting vegetation and favoured prey species occur. The action will not place a viable local population of this species at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(d) (i) The proposed development would result in the removal of a small amount of habitat (15 to 35 ha depending on construction methods) in narrow strips. The species' home ranges are usually comprised of large areas of contiguous forest. The small amount of habitat that would be affected is already fragmented and does not represent suitable habitat for the breeding Powerful Owls. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like the Powerful Owl. (iii) The habitat loss would be minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Powerful Owl.

(*f*) A recovery plan for the Powerful Owl was produced by the Department of Environment and Conservation (DEC, 2006) with the following objectives or actions: 1. Model and map owl habitat and validate with surveys; 2. Monitor owl population parameters; 3. Audit forestry prescriptions; 4. Manage and protect habitat off reserves and state forests; 5. Undertake research; 6. Increase community awareness and involvement in owl conservation; and 7. Provide organisational support and integration. The proposed development may reduce a small area of potential foraging and nesting habitat which is inconsistent with objective 4. This objective expands to state that "impacts on large forest owls and their habitats should be adequately assessed during the environmental assessment process, and that significant owl habitat should be managed and protected". The significance of the area of habitat to be removed is being assessed pursuant to both state and national legislation (TSC Act, 1995; EPBC Act, 1999). This habitat is already degraded and this species would not be reliant on the habitat for survival, particularly when considering the large areas of preferable undisturbed habitat available in the adjacent ranges and forests where there are higher densities of prey species and hollow-bearing trees. Consequently, the removal of a small area of potential habitat adjacent to the current road is unlikely to result in a significant impact on the Powerful Owl in the study area.



(g) Key threatening processes of relevance to the Powerful Owl include the clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of a small amount of native vegetation and possibly some hollow-bearing tress. However, this habitat is not in large contiguous tracts of forest and is not considered to be important habitat for Powerful Owl. There are large amounts of more suitable habitat in the surrounding ranges and forests.

Mitigation measures

To minimise potential impacts to the Powerful Owl from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats. This is most relevant in forest at the southern end of Black Camp Road.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without specific clearance surveys undertaken for the presence of nesting owls.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Pre-clearance surveys should be conducted to assess hollow-bearing trees in the construction footprint for potential nests.
- Recycle any hollows that are removed and place them in trees in adjacent areas of undisturbed vegetation.

Masked Owl (Tyto novaehollandiae): Vulnerable

The Masked Owl is listed as Vulnerable under the TSC Act. The species distribution extends from the coast where it is most abundant to the western plains (DECC, 2005). Overall the records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner, and there is no seasonal variation in its distribution (DEC, 2005).

They occur in undulating wet-dry forests of the coast and dry eucalypt forests of the tablelands, with optimal habitat including a mosaic of sparse (grassy) and dense (shrubby) groundcover on gentle terrain (Kavanagh et al., 1995, Kavanagh, 1997). Roosts are located in live or occasionally dead hollow eucalypts, dense foliage in gullies and caves and recesses in cliffs (DECC, 2006a). They require mature forest or woodland with large hollow trees and dense trees or shrubs for fledglings to shelter in. Hollows greater than 40 cm wide and 100 cm deep in trees at least 90 cm DBH are used. Masked Owls are faithful to traditional nest trees but may use alternative hollows within the breeding territory in different years (DECC, 2006a). Home ranges are estimated to be 400-1000 ha, varying with habitat productivity (DECC, 2006a).

It is a specialist predator of terrestrial mammals, including rodents and rabbits in disturbed areas and dasyurids in forested areas (DECC, 2006a). Arboreal mammals (e.g. Sugar Glider), birds and bandicoots also supplement the diet. The species forages preferentially in ecotones within forests or along forest edges but also in open areas, and usually hunts from a perch at or near ground level, sometimes near the edges of roads (DECC, 2006a).

The Masked Owl is threatened by a number of processes including habitat clearing and fragmentation, loss of mature hollow-bearing trees, predation on fledglings, secondary poisoning from pesticides, disease, and being hit by vehicles (DECC, 2005). A combination of grazing and regular burning is also a threat, affecting the quality of ground cover for mammal prey, particularly in open, grassy forests (DECC, 2005).



The Masked Owl was not recorded during the field surveys. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging and nesting habitats were recorded in heavily timbered habitats in the Black Camp Creek area. The large hollow-bearing trees identified in the study area represent potential nesting sites.

(a) Factors likely to disrupt the life cycle of the Masked Owl in the locality would include a substantial loss and / or fragmentation of foraging habitat and loss of suitable nesting and roosting habitat. The proposed development would result in the removal of a small amount (15 to 35 ha depending on the construction method) of potential foraging habitat and hollow trees with low potential for roosting and nesting. These areas do not provide optimal foraging, roosting or breeding habitat for the Masked Owl, particularly when considering the available forest and woodland habitat in the surrounding ranges and forests, where more mature trees with hollows suitable for nesting, dense roosting vegetation and favoured prey species occur. The action will not place a viable local population of this species at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(*d*) (i) The proposed development would result in the removal of a small amount of potential foraging and nesting habitat. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like the Masked Owl. (iii) The habitat loss would be minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival, particularly when considering a pair of Masked Owls will occupy a home range of approximately 400 to 1,000 ha (DECC, 2006a).

(e) No critical habitat has been declared by the Director-General of the NPWS for the Masked Owl.

(*f*) A recovery plan for the Masked Owl was produced by the Department of Environment and Conservation (DECC, 2006a) with the following objectives or actions: 1. Model and map owl habitat and validate with surveys; 2. Monitor owl population parameters; 3. Audit forestry prescriptions; 4. Manage and protect habitat off reserves and state forests; 5. Undertake research; 6. Increase community awareness and involvement in owl conservation; and 7. Provide organisational support and integration. The proposed development may reduce a small area of potential foraging and nesting habitat which is inconsistent with objective 4. This objective expands to state that "impacts on large forest owls and their habitats should be adequately assessed during the environmental assessment process, and that significant owl habitat should be managed and protected". The significance of the area of habitat to be removed is being assessed pursuant to both state and national legislation (TSC Act, 1995; EPBC Act, 1999). The area of habitat being removed is already degraded and this species would not be reliant on the habitat for survival, particularly when considering the large areas of preferable undisturbed habitat available in the surrounding ranges and forests where higher densities of prey species and hollowbearing trees occur. Consequently, the removal of a small area of potential habitat adjacent is unlikely to result in a significant impact on the Masked Owl in the study area.

(g) Key threatening processes of relevance to the Masked Owl include the clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of native vegetation and possibly the loss of some bearing tress. This would result in a small loss of habitat marginal for the species. Masked Owl is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the adjacent ranges and forests.



Mitigation measures

To minimise potential impacts to the Masked Owl from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats. This is most relevant in forest at the southern end of Black Camp Road.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without specific clearance surveys undertaken for the presence of nesting owls.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Pre-clearance surveys should be conducted to assess hollow-bearing trees in the construction footprint for potential nests.
- Recycle any hollows that are removed and place them in trees in adjacent areas of undisturbed vegetation.

Sooty Owl (Tyto tenebricosa): Vulnerable

The Sooty Owl is listed as Vulnerable under Schedule 2 of the TSC Act. It occurs primarily in densely vegetated east and southeast facing mountain gullies of open and tall wet forest (Kavanagh and Peake, 1993) and rainforests of the escarpment and coastal areas (DECC, 2006a). This species is strongly associated with sheltered gullies, especially where there is a tall, dense understorey (DECC, 2006a; DECC, 2005). There is no seasonal variation in its distribution (DEC, 2005). It is widespread throughout its range but within the limits imposed by the distribution of its specialised habitat (DEC, 2005). Its range has been reduced or fragmented by forest clearing for agriculture and urban developments and by reductions in habitat guality (DECC, 2005). Sooty Owl home ranges are estimated to be from 200 to 800 ha, according to habitat productivity (DECC, 2006a). This species is a generalist predator of arboreal, scansorial and small terrestrial mammals such as the Ringtail Possum, Sugar Glider, Bush Rat and Brown Antechinus. Nesting and roosting occur in dense unlogged corridors in gully systems. Sooty Owls roost during the day in sheltered, dense vegetation (such as sub-canopy rainforest trees), in tree hollows or caves, cliff ledges and rock overhangs (DEC, 2006a; DEC, 2005). Nest sites are usually hollows in living old eucalypt or rainforest species within 100 m of streams, but can be in caves (DECC, 2006a; DECC, 2005). Hollows are in trees of at least 120 cm diameter at breast height, and are greater than 40 cm wide and 100 cm deep. Owls are faithful to traditional nesting hollows.

This species is threatened by a number of processes including loss of mature hollow-bearing trees, changes to forest and woodland structure, clearing of habitat for grazing, agriculture, forestry or other development and secondary poisoning from rodenticides (DECC, 2005). A combination of grazing and regular burning is also a threat, through the effects on the quality of ground cover for mammal prey, particularly in open grassy forests (DECC, 2005).

The Sooty Owl was not recorded during the surveys. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in heavily timbered habitats in the Black Camp Creek area.

(a) The proposed development would not result in an adverse effect on the life cycle of the Sooty Owl since this species is expected to be restricted to old growth gully habitats in the locality. The small area of clearing of timbered habitats in the pipeline footprint will not impact on the Sooty Owl, since the species would be unlikely to utilise the area for foraging or nesting.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha of potential food trees and nesting habitat. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result, especially for a highly mobile species like this. (iii) The habitat clearance (15 to 35 ha, depending on construction methods) is not important for the Sooty Owl, since the species will only occur in the wider locality within deep old-growth gullies outside the proposed construction areas.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Sooty Owl.

(f) A recovery plan for the Sooty Owl was produced by the Department of Environment and Conservation (DECC, 2006a) with the following objectives or actions:

1. Model and map owl habitat and validate with surveys; 2. Monitor owl population parameters; 3. Audit forestry prescriptions; 4. Manage and protect habitat off reserves and state forests; 5. Undertake research; 6. Increase community awareness and involvement in owl conservation; and 7. Provide organisational support and integration. The proposed development is consistent with all objectives or actions of the recovery plan. There would be no impact from the proposed development on primary Sooty Owl habitat (sheltered gullies), which is consistent with objective 4.

(g) Key threatening processes of relevance to the Sooty Owl include the clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of a small amount native vegetation and possibly the loss of some hollow-bearing tress. However, this vegetation will not be removed from large contiguous blocks of old-growth forests or deep sheltered gullies, which are favoured habitats for the Sooty Owl. On this basis, the proposed action will not increase the impact of a key threatening process.

Mitigation measures

To minimise potential impacts to the Sooty Owl from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats. This is most relevant in forest at the southern end of Black Camp Road.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without specific clearance surveys undertaken for the presence of nesting owls.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Pre-clearance surveys should be conducted to assess hollow-bearing trees in the construction footprint for potential nests.
- Recycle any hollows that are removed and place them in trees in adjacent areas of undisturbed vegetation.



Spotted-tailed Quoll (Dasyurus maculatus): Vulnerable

The Spotted-tailed Quoll is listed as a Vulnerable species under the TSC Act and Endangered under the EPBC Act. It occupies a range of environments within a disjunct distribution along the east coast of Australia, extending from south-eastern Queensland through NSW and Victoria to Tasmania. This species is found in a variety of habitats, including sclerophyll forest and woodlands, coastal heatAECOMnds and rainforests (Dickman and Read, 1992; Edgar and Belcher, 1995). Occasional sightings are made in open country, grazing lands, rocky outcrops and other treeless areas.

Prey items include gliders and possums, small wallabies, rats, birds, bandicoots, rabbits, insects and carrion. Although mainly terrestrial, the Spotted-tailed Quoll is an agile climber and may raid possum and glider dens and prey on roosting and fledgling birds. Nesting occurs in rock shelters, hollow logs, caves or tree hollows and they use numerous dens within the home range. Estimates of home ranges vary from 800 ha to 20 km² and individuals may move several kilometres in a night (Edgar and Belcher, 1995). Breeding occurs from April to July with an average litter size of five (Edgar and Belcher, 1995).

The Spotted-tailed Quoll is threatened by a number of processes including loss, fragmentation and degradation of habitat through clearing of native vegetation and subsequent development, logging and frequent fire (Edgar and Belcher, 1995; Dickman and Read, 1992). The loss of large hollow logs and other potential den sites (Scotts, 1992) is a major problem, as well as competition for food and predation by foxes and cats (Edgar and Belcher, 1995; Dickman and Read, 1992). Cats may also spread parasitic protozoan epidemics to Quolls (Edgar and Belcher, 1995; Dickman and Read, 1992). Persecution by humans is still an issue, because humans perceive Quolls as a predator on stock and poultry (Edgar and Belcher, 1995; Dickman and Read, 1995; Dickman and Read, 1995; Spotted-tailed Quolls and changes the composition of predators: reduced dingo numbers favours foxes which compete with quolls (Edgar and Belcher, 1995; Dickman and Read, 1992).

The Spotted-tailed Quoll was not recorded during the surveys. Thirty-nine previous records from within 5 km of the project site were revealed by the desktop survey. Potential foraging and breeding habitat was recorded in the study area along the Karuah River and in forested habitats at Black Camp Road and Wallaroo National Park.

(a) The proposed development would result in the removal of a small amount of timbered habitat and possibly a number of hollow-bearing trees, which this species could potentially utilise for breeding. Riparian forests on the upper Karuah River and eucalypt forests at Black Camp Road and Wallaroo National Park may constitute habitat for this species. Clearance and fragmentation of riparian vegetation should be avoided. Habitat clearance elsewhere would have less impact because it is not preferred habitat compared to the large undisturbed areas of potential habitat available in the surrounding forests and ranges, which probably support a higher density of prey species and den sites. If clearance of riparian vegetation on the Karuah River is minimised, the action would be unlikely to place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha of timbered habitats. Riparian forests on the upper Karuah River and eucalypt forests at Black Camp Road and Wallaroo National Park may constitute habitat for this species. (ii) The habitat would only be removed in narrow strips from areas already fragmented. This would not cause any further fragmentation or isolation, except if riparian vegetation is cleared alongside the Karuah River. (iii) The proposed loss of timbered habitat is minimal when compared to the large areas of preferable undisturbed habitat in the surrounding ranges and forests. This species is not expected to be reliant upon habitat in the study area for its long-term survival, except potentially beside the Karuah River where vegetation should not be cleared.



(e) No critical habitat has been declared by the Director-General of the NPWS for the Spotted- tailed Quoll.

(*f*) There is currently no recovery plan or threat abatement plan for the Spotted-tailed Quoll. There are 32 priority action statements to help this species recover (DECC, 2005). Provided that vegetation clearance is kept to a minimum (especially riparian vegetation in the upper reaches of the Karuah River) the proposed development would not be inconsistent with any of the priority action statements.

(g) Key threatening processes of relevance to the Spotted-tailed Quoll include the clearing of native vegetation, removal of dead wood/trees, and high frequency fires (DECC, 2005). The proposed development would result in the clearing of native vegetation (and possibly some dead wood), resulting in a small loss of potential foraging and breeding habitat. For the most part, this species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding forests and ranges, which would support a much larger number of prey species and den sites. A possible exception to this is the riparian forests of the upper Karuah River. The proposed development would not increase the frequency of fires in the area.

Mitigation measures

To minimise potential impacts to the Spotted-tailed Quoll from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without pre- clearance surveys undertaken for the presence of nesting Quolls.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Avoid clearing, modification or damage to riparian vegetation along the Karuah River.
- Recycle any hollows that are removed and place them in trees in adjacent areas of undisturbed vegetation.

Brush-tailed Phascogale (Phascogale tapoatafa): Vulnerable

The Brush-tailed Phascogale is listed as Vulnerable under the TSC Act. The Brush-tailed Phascogale has a patchy distribution around the coast of Australia, from near sea level up to 1500 m (Soderquist, 1995). Within NSW, the species appears to be most abundant in the north-east and south-east of the State, particularly within forest habitats on the Great Dividing Range (Dickman and Read, 1992; Ayers et al., 1996).

The preferred habitat of the Brush-tailed Phascogale is dry sclerophyll open forest, with a sparse ground over of herbs, grasses, scleromorphic shrubs or leaf litter (Soderquist, 1995). However, individuals may also inhabit heatAECOMnd, swamps, rainforest and wet sclerophyll forest (Dickman and McKechnie, 1985). The species occurs primarily where the annual rainfall exceeds 500mm (Traill and Coates, 1993).

The Brush-tailed Phascogale is an arboreal species foraging in the canopy for prey. The females inhabit territories of approximately 20 to 60 ha, while the males maintain territories of up to 100 ha (Soderquist, 1993). They nest and shelter in many different hollows over a short time with mating occurring between May and July.



The main threats to the Brush-tailed Phascogale include:

- loss and fragmentation of habitat through clearing for agriculture and urban development
- logging of hollow-bearing trees suitable for nesting
- inappropriate fire regimes leading to a reduction in foraging and shelter resources
- predation by foxes and cats
- competition for suitable nesting hollows with the introduced honeybee.

The Brush-tailed Phascogale was not recorded during the surveys. The desktop survey revealed 30 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in forested habitats at Black Camp Road and Wallaroo National Park.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and possibly a number of hollow-bearing trees, which this species could potentially utilise for breeding. However, little if any of this habitat would be in large contiguous areas of old growth forest. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(*d*) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss (15 to 35 ha) is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Brush-tailed Phascogale.

(*f*) There are seven strategy actions that have been identified to help recover this species: 1. Undertake a targeted community education program that raises awareness about threats such as predation by cats; 2. Undertake fox and wild dog control at priority sites; 3. design and implement an ecological burn (Dinner Creek) including habitat requirements of the species in Demon Nature Reserve; 4. 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 phascogale; 5. Establish a long term monitoring program targeting at least 30 populations across the known range of Brush-tailed Phascogale. The program will incorporate sites used for experimental fox control (as per Fox TAP); 6. Monitor the effectiveness of forestry threatened species licence conditions and refine and negotiate changes if required; and 7. Undertake research into the impact of hazard reduction burn practices.

The proposed development may reduce a small area of potential foraging and breeding habitat which does not correlate directly with any of the strategy actions, but does represent one of the major threats to the species. However, the area of habitat being removed is at best marginal habitat for the species and phascogales would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests.



Nonetheless, it is important to retain as many potential hollow trees as possible during construction of the pipeline, and to mitigate any impacts by providing artificial hollows in areas adjacent to where they were removed.

(g) Key threatening processes of relevance to the Brush-tailed Phascogale includes the clearing of native vegetation and the loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of native vegetation and a number of hollow-bearing trees, resulting in a small loss of foraging and breeding habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Brush-tailed Phascogale from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road and Wallaroo National Park.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible;
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Common Planigale (Planigale maculata): Vulnerable

The Common Planigale is listed as a Vulnerable Species on Schedule 2 of the TSC Act. The Common Planigale is distributed along coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its southern distribution limit on the NSW lower north coast (DECC, 2005).

The Common Planigale inhabits rainforest, eucalypt forest, heatAECOMnd, marsAECOMnd, grassland and rocky areas where there is surface cover, and usually in close proximity to water (Menkhorst et al., 2001). They forage on the ground looking for invertebrates and small vertebrates. Planigales are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks (Menkhorst et al., 2001).

The main threats to the Common Planigale include:

- predation by foxes and cats
- loss and fragmentation of habitat through clearing for agriculture and development in coastal areas
- frequent burning and grazing that reduces ground cover such as hollow logs and bark
- disturbance of vegetation surrounding water bodies (Menkhorst et al., 2001).

The Common Planigale was not recorded during the surveys. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered areas within the study area.



(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and disturbance to ground habitat, which this species could potentially utilise for foraging and nesting. However, this area will be in narrow strips alongside previously cleared routes when alternative routes through disturbed land are not possible. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges. The action would not place a viable

local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats and disturbance of ground cover. However, this area will be in narrow strips alongside previously cleared routes. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Common Planigale.

(*f*) There are eight strategy actions that have been identified to help recover this species. The main threat that the proposed development poses is the reduction of a small area of potential foraging and breeding habitat. However, the area of habitat being removed is at best marginal habitat for the species and planigales would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Nonetheless, it is important to retain as much of the habitat as possible during construction of the pipeline, and to mitigate any impacts by providing artificial corridors of debris across the clearings and replacing the groundcover (leaf litter and logs) removed.

(g) Key threatening processes of relevance to the Common Planigale includes the clearing of native vegetation and ground cover (DECC, 2005). The proposed development would result in the clearing of native vegetation and ground cover, resulting in a small loss of foraging and breeding habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Common Planigale from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.
- Replace groundcover (e.g. leaf litter and logs) in forested habitats following construction. If required, provide artificial corridors of debris across cleared corridors.



Eastern Pygmy-possum (Cercartetus nanus): Vulnerable

The Eastern Pygmy-possum is listed as Vulnerable under the TSC Act. It is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania (DECC, 2005). In NSW, it ranges from the coast to inland as far as Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes (DECC, 2005). It is found mainly in woodlands and heath, but can also occupy rainforest and sclerophyll forest (DECC, 2005).

The Eastern Pygmy-Possum is a small (24 g) possum that feeds on insects and the pollen and nectar of Banksia, Eucalypt and Bottlebrush flowers (Turner and Ward, 1995). Soft fruits may be eaten when flowers are unavailable, and it is an important pollinator of heatAECOMnd plants (DECC, 2005). It shelter during the day in small tree hollows, holes in the ground, spherical nests under the bark of eucalypts, empty birds' nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of vegetation (DECC, 2005). These habitat requirements mean that suitable shelter sites are located in the same plant communities as the possums' food trees (Turner and Ward, 1995; Bowen and Goldingay, 2000). Young can be born whenever food sources are available, with most births occurring between late spring and early autumn (DEC, 2005). Winter is spent in suitable shelter sites in torpor (DECC, 2005).

The Eastern Pygmy-Possum is threatened by a number of processes including loss and fragmentation of habitat through land-clearing for agriculture, forestry and urban development, changed fire regimes that affect the abundance of flowering myrtaceous shrubs (particularly banksias), declining shrub diversity in forests and woodlands due to overgrazing by stock and rabbits, predation from cats, dogs and foxes, and loss of nest sites due to removal of firewood (DECC, 2005).

The Eastern Pygmy-Possum was not recorded during the surveys; but it is typically a difficult species to detect and targeted surveys appropriate for the species were not conducted. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered areas within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and possibly a number of hollow-bearing trees, which this species could potentially utilise for breeding. However, little if any of this habitat would be in large contiguous areas of old growth forest. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable

(c) Not applicable

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss (15 to 35 ha) is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Eastern Pygmy Possum



(*f*) There is currently no recovery plan or threat abatement plan for the Eastern Pygmy Possum (DECC, 2005). The action proposed is not inconsistent with the seven priority action statements designed to help this species recover (DECC, 2005).

(g) The Eastern Pygmy Possum is threatened by a number of key threatening processes, including clearing of native vegetation, and predation by feral cats and the European Red Fox (DECC, 2005). The area of vegetation proposed for clearance is minimal when considering the larger areas of more suitable habitat available in the surrounding forests and ranges. Furthermore, the removal of this vegetation will not increase the susceptibility of this species to predation by feral cats or the European Red Fox in the study area.

Mitigation measures

To minimise potential impacts to the Eastern Pygmy Possum from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats.
- Avoid the removal of hollow-bearing trees, dead trees and fallen timber wherever possible. No large hollow-bearing trees should be removed without pre-clearance surveys undertaken for the presence of nesting possums.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Yellow-bellied Glider (Petaurus australis): Vulnerable

The Yellow-bellied Glider is listed as Vulnerable under the TSC Act. It is widespread in south-eastern Australia but is found at low population densities in habitat that is patchily distributed, and it is seldom locally abundant (Goldingay and Kavanagh, 1991). Preferred habitat comprises productive, tall open sclerophyll forests containing mature trees that provide shelter and nesting hollows, and a mixture of eucalypt species to provide year-round continuity of food resources (NPWS, 2003b). Plant and insect exudates, including nectar, sap, honeydew and manna, provide the bulk of the diet. The Yellow-bellied Glider also feeds on the pollen of winter-flowering eucalypts and on arthropods which are found under decorticating bark (Goldingay and Kavanagh, 1991). Foraging occurs at night across a wide range of canopy heights and the species is known to travel for over 2 km from dens for foraging purposes (Russell, 1995).

The importance of different food types in the Yellow-bellied Glider varies with location and season. However, sugar-rich phloem sap provides a primary energy source (Lindenmayer, 2002). A characteristic feeding behaviour of the species involves incising the bark of eucalypts to obtain the sap, with the incisions or 'sap sites' in the trunk of the tree often triangular or v-shaped (Mackowski, 1988). Sap use and sap tree selection appears to be a complex behaviour (NPWS, 2003b). More than 30 tree species are used as sap trees throughout the Yellow-bellied Glider's range (Lindenmayer, 2002), including Grey Gum Eucalyptus propingua and E. punctata, Forest Red Gum E. tereticornis, Tallowwood E. microcorys, Red Mahogany E. resinifera, Messmate E. obliqua and Red Bloodwood Corymbia gummifera (NPWS, 1999b). However, at any one location, sap tree use is restricted to a small number of individual trees of several particular species (NPWS, 2003b). Suitable sap trees may account for less than one percent of all trees in a given stand and the same trees are often used repeatedly year after year (Lindenmayer, 2002). Given that trees with suitable sap flows needed by the Yellow-bellied Glider may be uncommon, the species is likely to maintain a large home range to encompass sufficient resources for a family group of animals (NPWS, 2003b). In addition to providing critical food resources for the Yellow- bellied Glider, sap trees also provide important focal points for group social exchange (Russell, 1984).

Food availability and the importance of different food types at any given location are strongly linked to climatic factors and the phenological pattern of tree species in a forest (NPWS, 2003b). Consequently, flowering or bark decortication events can lead to seasonal patterns of foraging behaviour, resource exploitation and use of tree species (NPWS, 2003b).

Small family groups consist of three to eleven individuals (Lindenmayer, 2002), usually with two or more adults and one or more offspring (Goldingay and Kavanagh, 1991). These family groups occupy home ranges of between 20 ha and 85 ha (Goldingay and Kavanagh, 1991) that are virtually exclusive and have little overlap with adjacent home ranges (NPWS, 2003). Such a large home range is thought to be required to ensure that a continuity of dispersed and variable food resources remains available throughout the year (Goldingay and Kavanagh, 1991; NPWS, 2003b).

The Yellow-bellied Glider uses particular areas of its home range when given tree species are flowering or shedding their bark. As the availability of food resources changes throughout the forest during the year, the gliders move to exploit key resources (Lindenmayer, 2002).

Yellow-bellied Gliders occupy tall, large diameter trees with large hollows (den trees). Family groups use up to 13 den trees within their home range (NPWS, 2003b). The reasons for den-swapping behaviour are not well understood (Lindenmayer, 2002). However it is likely to be related to maintaining proximity to food resources whose spatial location within an individual's home range varies on a seasonal basis.

Studies have shown that gliders are more likely to occur in forest stands that support a large number of tree hollows (Lindenmayer, 2002). Not all trees with hollows will be suitable for occupancy and sites that support more trees with hollows have a greater chance of containing some that can be used. Consequently, requirements for multiple den sites will be more likely met in areas that support numerous trees with hollows and loss of hollows from known habitat is likely to decrease the suitability of areas for the Yellow-bellied Gliders.

The Yellow-bellied Glider has low breeding potential with a single young usually produced each year (between May and September) but sometimes only in alternate years (NPWS, 2003b). After birth the young remain in the pouch for 100 days after which time it is left in the nest and suckled for up to 60 days (Russell, 1995). Animal longevity is a maximum of six years in the wild.

Habitat loss and fragmentation, primarily through land clearing, is one of the major factors threatening the long-term conservation of the Yellow-bellied Glider (Lindenmayer, 2002; NPWS, 2003b). Yellow-bellied Gliders are sensitive to habitat fragmentation through degradation of existing habitat, including loss of critical habitat elements, and creation of dispersal barriers which restricts the ability of the species to persist and to colonise new or isolated areas (NPWS, 2003b). The Yellow-bellied Glider may be particularly susceptible to habitat loss and fragmentation because it is wide-ranging, occurs at low densities and has a complex social system (Lindenmayer, 2002). In addition, the species is dependent on particular sap trees that can be sparse and widely distributed throughout the landscape. Their strong affinity to their home range also makes them highly susceptible to habitat loss, as they will not shift into adjoining areas even when most of their home range is destroyed, but remain in the disturbed area until they die or are taken by predators (Lindenmayer, 2002).

The main threats to the Yellow-bellied Glider include:

- loss and fragmentation of habitat
- loss of hollow-bearing trees
- loss of feed trees.


The Yellow-bellied Glider was not recorded during the surveys. The desktop survey revealed one previous record from within 5 km of the project site. Potential foraging and breeding habitats were recorded in large areas of timbered habitats at Black Camp Road and Wallaroo National Park. The presence of specific eucalypt species and hollow-bearing trees are important habitat requirements.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and possibly a number of hollow-bearing trees, which this species could potentially utilise for breeding. However, little if any of this habitat would be in large contiguous areas of old growth forest. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(*d*) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss (15 to 35 ha) is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Yellow- bellied Glider.

(f) A recovery plan for the Yellow-bellied Glider was produced by the National Parks and Wildlife Service (NPWS, 2003b) with the following objectives or actions: 1. To co-ordinate the recovery of the Yellow-bellied Glider in NSW; 2. To encourage and assist in improving the protection and management of the Yellow-bellied Glider and its habitat; 3. To identify and monitor significant populations of the species; 4. To facilitate strategic research into the ecology of the Yellow-bellied Glider that is relevant to its conservation; and 5. To increase community awareness of the Yellow-bellied Glider and encourage community involvement in its conservation. The proposed development may reduce a small area of potential foraging and breeding habitat which is inconsistent with objective 2. However, the area of habitat being removed is at best marginal habitat for the species and Yellow-bellied Gliders would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Furthermore, the proposed works would not remove any known sap feed trees in the study area. Nonetheless, it is important to retain as many potential food trees and hollow trees as possible during construction of the pipeline, and to mitigate any impacts by providing artificial hollows in areas adjacent to where they were removed.

(g) Key threatening processes of relevance to the Yellow-bellied Glider includes the clearing of native vegetation and the loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of native vegetation and a number of hollow-bearing trees, resulting in a small loss of foraging and breeding habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Environment



Mitigation measures

To minimise potential impacts to the Yellow-bellied Glider from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Avoid the removal of hollow-bearing trees. No large hollow-bearing trees should be removed without specific pre-clearance surveys undertaken for the presence of den sites.
- Conduct pre-clearance surveys for feeding scars on eucalypt species that may be potentially used by gliders as sap feed trees.
- Recycle any hollows and logs that are removed and place them in adjacent areas of undisturbed vegetation.

Squirrel Glider (Petaurus norfolcensis): Vulnerable

The Squirrel Glider is listed as Vulnerable on the TSC Act. The Squirrel Glider is sparsely distributed along the east coast and immediate inland districts from western Victoria to north Queensland (DECC, 2005).

The Squirrel Glider inhabits dry sclerophyll forest and woodland and is generally absent from rainforest and closed forest. In NSW, potential habitat includes Box-Ironbark forests and woodlands in the west, the River Red Gum forests of the Murray Valley and the eucalypt forests of the northeast. Individuals have also been recorded in a diverse range of vegetation communities, including Blackbutt, Forest Red Gum and Red Bloodwood forests, Coastal Banksia heatAECOMnd and Grey Gum / Spotted Gum / Grey Ironbark dry hardwood forests of the Central NSW Coast. The Squirrel Glider requires abundant hollow-bearing trees and a mix of eucalypts, acacias and banksias. Within a suitable vegetation community, at least one flora species should flower heavily in winter and one or more of the eucalypts should be smooth-barked.

This arboreal species have estimated home ranges of 0.65 to 8.55 ha, in which they forage for nectar, pollen, flowers acacia gum and insects. During winter, when other food resources are scarce, the Squirrel Glider may obtain its energy from the winter flowers of the Coastal Banksia, Red Ironbark, River Red Gum, Grey Ironbark, Spotted Gum, Forest Red Gum and, in some areas, Blackbutt. Grass trees and mature acacias may also provide a valuable food source. Smooth-barked eucalypts are preferred as these eucalypts form hollows more readily than rough-barked species and support a greater diversity of invertebrates.

The main threats to the Squirrel Glider include:

- loss and fragmentation of habitat
- loss of hollow-bearing trees
- loss of flowering understorey and midstorey shrubs in forests
- individuals can get caught in barbed wire fences while gliding.

The Squirrel Glider was not recorded during the surveys. The desktop survey revealed 18 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.



(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and possibly a number of hollow-bearing trees, which this species could potentially utilise for breeding. However, little if any of this habitat would be in large contiguous areas of old growth forest. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(*d*) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result.

(iii) The habitat loss (15 to 35 ha) is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges where higher densities of hollow-bearing trees occur. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Squirrel Glider.

(f) There are nine strategy actions that have been identified to help recover this species: 1. Control feral horses at relevant sites to promote retention and growth of mid-storey shrubs; 2. 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; 3. 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; 4. Investigate the effectiveness of logging prescriptions; 5. Prepare a recovery plan for the Squirrel Glider; 6. 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; 7. Delineate boundaries of population to identify the extent to which populations are interconnected (to determine propensity to move across cleared land); 8. 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); and 9. Model and predict the distribution of Squirrel Gliders across the south west slopes.

The proposed development may reduce a small area of potential foraging and breeding habitat which is inconsistent with objectives 2 and 3. However, the area of habitat being removed is at best marginal habitat for the species and Squirrel Gliders would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Nonetheless, it is important to retain as many potential food trees and hollow-bearing trees as possible during construction of the pipeline, and to mitigate any impacts by providing artificial hollows in areas adjacent to where they were removed.

(g) Key threatening processes of relevance to the Squirrel Glider includes the clearing of native vegetation and the loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of native vegetation and a number of hollow-bearing trees, resulting in a small loss of foraging and breeding habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.



Mitigation measures

To minimise potential impacts to the Squirrel Glider from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation (timber) to be cleared by employing the minimum construction footprint width in timbered habitats, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Avoid the removal of hollow-bearing trees.
- Recycle any hollows and logs that are removed and place them in adjacent areas of undisturbed vegetation.

Koala (Phascolarctos cinereus): Vulnerable

The Koala is listed as Vulnerable under the TSC Act. It has a fragmented distribution throughout eastern Australia (Martin and Handasyde, 1995). In NSW, the Koala mainly occurs on the central and north coasts (Reed and Lunney, 1990), although some populations occur in the western region.

Koalas have been observed to feed on the leaves of approximately 70 species of eucalypt and 30 noneucalypt species (Phillips, 1990). 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 (Hindell and Lee, 1990). In the Greater Taree area, Rough-barked Apple *Angophora subvelutina*, Spotted Gum *Corymbia maculata*, Broad-leaved White Mahogany *Eucalyptus carnea*, Tallowwood *Eucalyptus microcorys*, Grey Box *Eucalyptus moluccana*, Grey Gum *Eucalyptus propinqua*, Grey Gum *Eucalyptus punctata*, Grey Ironbark *Eucalyptus siderophloia*, Forest Redgum *Eucalyptus tereticornis*, Broad-leaved White Mahogany *Eucalyptus umbra*, Snow-in-Summer *Melaleuca linariifolia*, and Broadleaved Paperbark *Melaleuca quinquenervia* (among others) are favoured by koalas (GTCCESP, 2007).

Although Koalas are often regarded as solitary, they actually live in complex groups and individual animals have overlapping home range areas (Martin and Handasyde, 1995). They favour individual trees within their home ranges which they visit often. Young eventually disperse and movements generally range from 1 to 11 km (Gall, 1980; Mitchell and Martin, 1990), but have been recorded in excess of 50 km.

The main threats to the Koala include:

- destruction of habitat by clearing for urban development, agriculture and mining, particularly on high nutrient content soils
- fragmentation of habitat by roads, urban development and agriculture, which creates barriers to movement, isolates individuals and populations, alters population dynamics and prevents gene flow and the ability to maintain recruitment levels
- mortality from attacks by dogs, road fatalities, fires, drought or other natural disasters, particularly in fragmented landscapes without suitable refuge areas
- degradation of habitat by fire, weed invasion, removal of important habitat trees and climate change
- in stressed populations, infection by CAECOMmydia, causing cystitis, keratoconjunctivitis, infertility and other symptoms.

The Koala was not recorded during the surveys. The desktop survey revealed 281 previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in the study area in timbered habitats within the study area.



(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha) depending on construction methods. However, little if any of this habitat would be in large contiguous areas of old growth forest. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges where higher densities of favoured trees occur. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest. (ii) Habitat would only be removed in short narrow strips where alternative routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss (15 to 35 ha) is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges where higher densities of preferred trees occur. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Squirrel Glider.

(*f*) There are 32 strategy actions that have been identified to help recover this species (DECC, 2005). The main threat by the proposed development is that it may reduce a small area of potential foraging habitat. However, the area of habitat being removed is at best marginal habitat for the species and koalas would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Nonetheless, it is important to retain as many potential food trees as possible during construction of the pipeline.

(g) Key threatening processes of relevance to the koalas includes the clearing of native vegetation and preferred food trees (DECC, 2005). The proposed development would result in the clearing of native vegetation and preferred food trees, resulting in a small loss of foraging habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Koala from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Pre-clearance surveys should include "Koala Spotters" working ahead of vegetation clearing activities. If Koalas are located, clearing activities should be halted temporarily until the animals relocate.



Parma Wallaby (Macropus parma): Vulnerable

The Parma Wallaby is listed as Vulnerable under the TSC Act. Parma Wallabies once occurred from north-eastern NSW to the Bega area in the southeast but now it is confined to the coast and ranges of central and northern NSW. Preferred habitat is moist eucalypt forest with thick, shrubby understorey, often with nearby grassy areas, rainforest margins and occasionally drier eucalypt forest.

The main threats to the Parma Wallaby include:

- predation by feral cats and foxes
- loss and fragmentation of habitat through clearing
- removal of the understorey and shrub layer by grazing stock
- frequent burning of understorey reducing shrub layer, particularly at forest margins
- collisions with vehicles.

The Parma Wallaby was not recorded during the surveys. The desktop survey revealed three previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and disturbance to understorey habitat, which this species could potentially utilise for foraging and shelter. However, this area will be in narrow strips alongside previously cleared routes when alternative routes through disturbed land are not possible. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges. The action would not place a viable local population of the species at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(*d*) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats and disturbance of understorey. However, this area will be in narrow strips alongside previously cleared routes. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Parma Wallaby.

(*f*) There are 11 strategy actions that have been identified to help recover this species and the main threat that the proposed development poses is the clearing of dense understorey of potential foraging and shelter habitat. However, the area of habitat being removed is at best marginal habitat for the species and Parma Wallaby would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Nonetheless, it is important to retain as much of the habitat as possible during construction of the pipeline, and to mitigate any impacts by placing removed cover to areas that have been previously been cleared.



(g) Key threatening processes of relevance to the Parma Wallaby includes the clearing of native vegetation and understorey (DECC, 2005). The proposed development would result in the clearing of native vegetation and understorey, resulting in a small loss of foraging and sheltering habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Parma Wallaby from the proposed development, the following mitigation measures are recommended:

• Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.

Long-nosed Potoroo (Potorous tridactylus): Vulnerable

The Long-nosed Potoroo is listed as Vulnerable on the TSC Act and Vulnerable under the EPBC Act. They are found on the south-eastern coast of Australia, from Queensland to eastern Victoria and Tasmania, including some of the Bass Strait islands. In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm (DECC, 2005).

The Long-nosed Potoroo inhabits coastal heaths and dry and wet sclerophyll forests. Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature. Individuals are mainly solitary, foraging on the ground for fungi, tubers and invertebrates in 2-5 ha home ranges.

The main threats to the Long-nosed Potoroo include:

- habitat loss and fragmentation from land clearing for residential and agricultural development
- predation from foxes, dogs and cats
- too frequent fires or grazing by stock that reduce the density and floristic diversity of understorey vegetation
- logging regimes or other disturbances that reduce the availability and abundance food resources, particularly hypogeous fungi, and ground cover.

The Long-nosed Potoroo was not recorded during the surveys. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would result in the removal of a small amount of timbered habitats (15 to 35 ha depending on construction methods) and disturbance to ground habitat, which this species could potentially utilise for foraging and nesting. However, this area will be in narrow strips alongside previously cleared routes when alternative routes through disturbed land are not possible. Therefore, this impact is expected to be minimal when considering the large undisturbed areas of potential habitat available in the surrounding forests and ranges. The action would not place a viable local population of the species at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.



(d) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods) of timbered habitats and disturbance of ground cover. However, this area will be in narrow strips alongside previously cleared routes. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat has been declared by the Director-General of the NPWS for the Long-nosed Potoroo.

(*f*) There are 19 strategy actions that have been identified to help recover this species. The main threat that the proposed development poses is the clearing of dense understorey that provides potential foraging and breeding habitat. However, the area of habitat being removed is at best marginal habitat for the species and potoroos would not be reliant on this habitat for survival, particularly when considering the large areas of undisturbed habitat available in the surrounding ranges and forests. Nonetheless, it is important to retain as much of the habitat as possible during construction of the pipeline, and to mitigate any impacts by placing removed cover to areas that have been previously been cleared.

(g) Key threatening processes of relevance to the Long-nosed Potoroo includes the clearing of native vegetation and ground cover (DECC, 2005). The proposed development would result in the clearing of native vegetation and ground cover, resulting in a small loss of foraging and breeding habitat. This species is not expected to be reliant on this vegetation, particularly when considering the large amount of surrounding habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Long-nosed Potoroo from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Recycle fallen timber in the construction footprint by relocating it in areas of undisturbed habitat adjacent to the construction footprint.

Grey-headed Flying-fox (Pteropus poliocephalus): Vulnerable

The Grey-headed Flying-fox is listed as Vulnerable under Schedule 2 of the TSC Act and Vulnerable under the EPBC Act. The species is endemic to the east coast of Australia with a distribution from Bundaberg (Queensland) in the north to Melbourne (Victoria) in the south, from the western slopes of the Great Dividing Range to the coast (Eby, 2000). The distribution of this species has recently suffered a southward contraction and a 30% population decline over the last ten years (Tidemann et al., 1999).

Grey-headed Flying-foxes are a highly mobile species whose migration patterns are determined by the availability of flowering food resources (Eby, 1991). The species is a canopy-feeding frugivore, blossomeater and nectarivore, and inhabits rainforest, woodlands, paperbark swamps and Banksia woodlands. This species feeds in particular on the nectar and pollen of native trees, especially *Eucalyptus*, *Melaleuca* and *Banksia*, and fruits of rainforest trees and vines. During times when native food resources are limited, Grey-headed Flying Foxes forage on fruit crops and cultivated gardens.



Grey-headed Flying-foxes congregate in large colonies of up to 200,000 individuals in the summer season (Churchill, 1998). Camp sites are generally located next to rivers or creeks, and occur in a range of vegetation communities including rainforest, wet sclerophyll forest, paperbark woodland, casuarina forest or mangroves (Eby, 2000). These sites have a dense canopy, providing them with the moist, humid microclimate they require. Campsites are critical for mating, birthing, rearing of young and as a diurnal refuge from predators (Tidemann et al., 1999). Urban gardens, cultivated fruit crops and roadside verges may also provide temporary roosting habitat for this species.

Grey-headed Flying-foxes breed annually commencing in January. Females give birth to a single young after a 6 month gestation and dependant neonates are carried by their mother during evening foraging flights for the first 3 weeks after birth. When the young can independently thermoregulate they remain in a 'crèche' at the camp while the adults forage (Eby, 1995).

The main threats to the Grey-headed Flying-fox include:

- unregulated shooting
- loss of foraging habitat
- disturbance of roosting sites
- electrocution on powerlines.

Grey-headed Flying-foxes were not recorded within the study area during the field surveys. The desktop survey revealed 12 previous records from within 5 km of the project site. All native timbered habitats in the study area can be considered potential foraging habitats, but no camp or roost sites were located in the proposed development footprint.

(a) The proposed development would remove a small area of potential foraging habitat (approximately 15 to 35 ha depending on construction methods) for the Grey-headed Flying Fox. It is unlikely that a viable local population of this species would be dependent upon this small area to be removed. The proposed development would not remove or disturb any known campsite or colony of the Grey-headed Flying-fox and would not create a barrier to movements between campsites and foraging areas for this highly and wide-ranging species. The proposed development is unlikely to disrupt the lifecycle of the Grey-headed Flying Fox such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(*d*) (i) The proposed development would result in the removal of approximately 15 to 35 ha (depending on construction methods of timbered habitats. However, little if any of this habitat would be in large contiguous areas of old growth forest and it would not include any camp or roost sites. (ii) Habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. (iii) The habitat loss is minimal when compared to the large areas of more preferred undisturbed habitat in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat of relevance to the Grey-headed Flying-fox has been declared by the Director-General of the NPWS.

(*f*) There is currently no recovery plan or threat abatement plan for the Grey-headed Flying-fox (DECC, 2005). The proposed development is not inconsistent with the 31 priority action statements designed to help this species recover (DECC, 2005).



(g) Key threatening processes of relevance to the Grey-headed Flying-fox include the clearing of native vegetation (DECC, 2005), and in particular the clearing of critical winter foraging habitat. Shortages in food supply lead to the starvation of animals, self-abortion by pregnant females (Dukelow et al., 1990) and high infant mortality in summer. Whilst the proposed development would involve the clearing of approximately 15 to 35 ha of timbered habitats, this is unlikely to constitute a process that threatens, or may have the capability to threaten, the survival or evolutionary development of the Grey-headed Flying Fox, given:

- the relatively small area of potential foraging habitat for this species to be removed from the study area in comparison to the large areas of potential habitat in the surrounding forests and ranges
- the absence of any camp site on the study area or in the locality
- the proposed development would not create a barrier to the movements between campsites and foraging areas of this highly mobile and wide-ranging species.

Mitigation measures

To minimise potential impacts to the Grey-headed Flying-fox from the proposed development, the following mitigation measures are recommended:

• Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.

Large-eared Pied Bat (Chalinolobus dwyeri): Vulnerable

The Large-eared Pied Bat is listed as Vulnerable under Schedule 2 of the TSC Act and Vulnerable under the EPBC Act. The species occupies a range of forested environments from dry sclerophyll forests and woodlands to rainforest and wet sclerophyll forest (Churchill, 1998). It mainly occurs in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern HigAECOMnds (DECC, 2005). It is generally rare in NSW, with only scattered records from the New England Tablelands and North West Slopes (DECC, 2005).

This species roosts communally during the day near the entrances of caves, crevices in cliffs, mines, tunnels, culverts, and disused mud nests of the Fairy Martin (*Hirundo ariel*) (DEC, 2005). Its flight pattern is relatively slow, direct and only moderately manoeuvrable. They forage predominantly below the canopy level and also low along creek beds (Hoye and Dwyer, 1995). Little is known about the preferred prey of this species, but they are insectivorous (Hoye and Dwyer, 1995).

It is uncertain whether mating occurs during early winter or in spring, but females have been recorded raising young in maternity roosts from November through to January, utilising roof domes in sandstone caves (DECC, 2005). They remain loyal to the same cave over many years and are likely to hibernate through the coolest months (DECC, 2005).

This species is threatened by a number of processes including clearing or isolation of forest and woodland foraging habitats near cliffs, caves and old mine workings, damage to roosting and maternity sites, and the use of pesticides (DECC, 2005).

The Large-eared Pied Bat was not recorded during the surveys. One previous record from within 5 km of the project site was revealed by the desktop survey. Potential foraging habitats were recorded in timbered habitats within the study area. Roosting and breeding habitats (i.e. caves) were not recorded in the project footprint.



(a) Whilst some tree-hollows in the study area may provide temporary roost sites for this species, they are not considered a primary or critical roosting resource for the Large-eared Pied Bat, as the species does not normally occur this far south. The proposed removal of a relatively small area of vegetation (15 to 35 ha) is not expected to significantly affect the lifecycle of this species, since it will not impact on any known maternity roosting caves. The proposed development will not impact on the accessibility of this species to any caves that exist in the study area, and will not result in the destruction of, or disturbance to, any primary roosting habitat. The proposed development is unlikely to disrupt the lifecycle of the Large-eared Pied Bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(*d*) (i) The proposed development would result in the modification of approximately 15 to 35 ha (depending on construction methods) of timbered habitats. However, the proposed development is south of the species usual range, and the development footprint does not contain any caves, which are the main breeding and roosting habitat. (ii) Potential foraging habitat would only be removed in short narrow strips where alternatives routes are impractical, so little additional fragmentation and isolation would result. In addition, the Large-eared Pied Bat is highly mobile and wide-ranging and is capable of travelling substantial distances in an evening of foraging, and is capable of utilising modified landscapes, roosting under bridges, in mines, and storm water drains (Schultz, 1998). (iii) Given the widespread distribution and high mobility of the Large-eared Pied Bat, it is highly unlikely that the proposed development would involve an area of habitat being modified or removed, particularly when considering the large areas of suitable habitat available in the surrounding forests and ranges. This species is not expected to be reliant upon habitat in the study area for its long-term survival.

(e) No critical habitat of relevance to the Large-eared Pied Bat has been declared by the Director-General of the NPWS.

(*f*) There is currently no recovery plan or threat abatement plan for the Large-eared Pied Bat. The proposed development is not inconsistent with the 17 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Large-eared Pied Bat include the clearing of native vegetation (DECC, 2005). The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, which may contain some hollow-bearing trees. This species is not expected to be reliant on this vegetation, particularly when considering the large areas of more suitable habitat available in the surrounding areas.

Mitigation measures

To minimise potential impacts to the Large-eared Pied Bat from the proposed development, the following mitigation measures are recommended:

• Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.



Eastern False Pipistrelle (Falsistrellus tasmaniensis): Vulnerable

The Eastern False Pipistrelle is listed as Vulnerable under Schedule 2 of the TSC Act. The species is wide-ranging, occurring along the southeast coast of Australia with records from South East Queensland, New South Wales, Victoria and Tasmania.

Preferred habitat is usually sclerophyll forests from the Great Dividing Range to the coast, while in Tasmania they are found in wet sclerophyll and coastal mallee (Churchill, 1998). They generally prefer wet habitats where trees are more than 20 m high. Roosting occurs in hollow trunks of eucalypt trees, usually in single sex colonies, but have been recorded roosting in caves, under loose bark and occasionally in old wooden buildings (Churchill, 1998). Their flight pattern is high and fast, often with sudden darting changes in direction and they forage within or just below the tree canopy. On the mainland they feed on a variety of prey including moths, rove beetles, weevils, plant bugs, flies and ants. Females are pregnant in late spring to early summer, with single young being born in December (Churchill, 1998). Lactation continues through January and February (Churchill, 1998).

The main threats to this species include:

- loss of trees for foraging and hollow-bearing trees for roosting
- disturbance to winter roosting and breeding sites
- application of pesticides in or adjacent to foraging areas (DECC, 2005).

The Eastern False Pipistrelle was not recorded during the field surveys. The desktop survey revealed no previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered habitats within the study area. It could potentially occur within the study area due to the presence of suitable foraging habitat and potential roost sites (e.g. hollow-bearing trees, abandoned buildings).

(a) The proposed development would require the removal of 15 to 35 ha of timbered habitats (depending on construction methods) and possibly a number of hollow-bearing trees which could provide potential roosting and foraging habitat for the Eastern False Pipistrelle. It is also possible that some of the younger trees in the study area contain small hollows of suitable size for this species. Consequently, the proposed development has the potential to adversely impact this species through habitat loss and the loss of potential roosting hollows. When considering the large areas of more suitable habitat in the surrounding forests and ranges, this species is unlikely to be reliant on the vegetation to be removed. Nearby habitats outside the footprint of the proposed development are less disturbed, and would contain higher densities of hollow-bearing trees. Consequently, the proposed development are less of potential is unlikely to disrupt the lifecycle of the Eastern False Pipistrelle such that a viable local population of the species is likely to be placed at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(d) (i) The proposed development would require the removal of a relatively small area of potential habitat (approximately 15 to 35 ha). (ii) The proposed development is unlikely to result in an area of known habitat becoming isolated from other habitat for the Eastern False Pipistrelle given that the stands of vegetation exist within an already fragmented landscape and the Eastern False Pipistrelle is a strong-flying bat which feeds predominantly above the canopy or in large openings (Phillips, 1995). The proposed development would not further isolate any area of foraging habitat for this wide-ranging and mobile species. (iii) The proposed development would require the removal of a relatively small area of potential habitat. This area could not be regarded as important habitat for the Eastern False Pipistrelle on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding forests and ranges.



(e) No critical habitat of relevance to the Eastern False Pipistrelle has been declared by the Director-General of the NPWS.

(*f*) There is currently no recovery plan or threat abatement plan for the Eastern False Pipistrelle. Sixteen priority action statements have been prepared to help recover this species (DECC, 2005). One of these states that attempts should be made to ensure the largest hollow-bearing trees, including dead trees and paddock trees are given highest priority for retention during land assessments. Provided the mitigation measures are followed, as identified below, then the proposed development would not be inconsistent with all sixteen priority action statements.

(g) Key threatening processes of relevance to the Eastern False Pipistrelle include the clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and possibly the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Eastern False Pipistrelle in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forests and ranges.

Mitigation measures

To minimise potential impacts to the Eastern False Pipistrelle from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.

Little Bent-wing Bat (Miniopterus australis): Vulnerable

The Little Bentwing-bat is listed as a Vulnerable species under Schedule 2 of the TSC Act. Little Bentwing-bats are small insectivorous bats with a body length of about 45 mm. They occur in coastal north-eastern NSW and eastern Queensland, where they favour moist eucalypt forest, rainforest or dense coastal banksia scrub. Little Bentwing-bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. They often share roosting sites with the Common Bentwing-bat and, in winter, the two species may form mixed clusters. In NSW, the largest maternity colony is in close association with a large maternity colony of Common Bentwing-bats and appears to depend on the large colony to provide the high temperatures needed to rear its young.

The main threats to the Little Bent-wing Bat include:

- disturbance of colonies, especially in nursery or hibernating caves may be catastrophic
- destruction of caves that provide seasonal or potential roosting sites
- changes to habitat, especially surrounding maternity caves
- Application of pesticides in or adjacent to foraging areas.

The Little Bent-wing Bat was not recorded during the field surveys. The desktop survey revealed 14 previous records from within 5 km of the project site. Potential foraging habitats were recorded in timbered habitats within the study area. There is little preferred roosting habitat and no known breeding habitat in the project site. The southern-most known breeding habitat (maternity cave) is in the Macleay watershed, well north of the subject site.



(a) The proposed development would remove only a small area of potential foraging habitat for the Little Bent-wing Bat. Whilst some trees with hollows are likely to be removed, these features are only occasionally used by the Little Bent-wing Bat and do not constitute primary roosting habitat for this species. No nursery caves exist within the proposed footprint, and the proposed development would not disturb any caves that may be utilised in the study area. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Little Bent-wing Bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.

(*d*) (i) The proposed development would require the removal of a relatively small area of potential foraging habitat (approximately 15 to 35 ha, depending on construction methods). (ii) The stands of vegetation within the study area that provide potential habitat for the Little Bent-wing Bat exist within an already fragmented landscape and modified. Consequently, the proposed development is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Common Bent-wing Bat. (iii) The proposed development would require the removal of a relatively small area of potential foraging. This area could not be regarded as important habitat for the Common Bent-wing Bat on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding ranges and forests. The proposed development would not impact on any known nursery caves critical for this species and is therefore not important to the long-term survival of this species.

(e) No critical habitat of relevance to the Little Bent-wing Bat has been declared by the Director- General of the NPWS.

(*f*) There is currently no recovery plan or threat abatement plan for the Little Bent-wing Bat. The proposed development is not inconsistent with the 25 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Little Bent-wing Bat include the clearing of native vegetation, predation by the European Red Fox, and predation by Feral Cats (DECC, 2005).

The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Little Bent-wing Bat in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forest and ranges. The development is unlikely to increase the susceptibility of this species to predation by the European Red Fox or Feral Cats.

Mitigation measures

To minimise potential impacts to the Little Bent-wing Bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.



Common Bent-wing Bat (Miniopterus schreibersii): Vulnerable

The Common Bent-wing Bat is listed as a Vulnerable species under Schedule 2 of the TSC Act. The species occupies a range of forested environments (including wet and dry sclerophyll forests), along the coastal portion of eastern Australia, and through the Northern Territory and Kimberley area (subject to subdivision of this species) (Churchill, 1998).

This species has a fast, level flight exhibiting swift shallow dives (Dwyer, 1995). It forages from just above the tree canopy to many times the canopy height in forested areas, and will utilise open areas where it is known to forage at lower levels. Moths appear to be the main dietary component (Churchill, 1998).

This highly mobile species is capable of large regional movements in relation to seasonal differences in reproductive behaviour and winter hibernation (Gilmore and Parnaby, 1994). It is reliant on large nursery caves for the rearing of its young, between October and February (Churchill, 1998), with substantial numbers of bats (up to 150,000 individuals) occupying a common nursery cave during the breeding season and often returning to the same site on an annual basis. Although roosting primarily occurs in caves, it has also been recorded in mines, culverts, stormwater channels, buildings, and occasionally tree-hollows (Churchill, 1998). It occupies a number of roosts within specific territorial ranges, usually within 300 km of the maternity cave (Churchill, 1998), and may travel large distances between roost sites (Dwyer, 1995).

The main threats to the Common Bent-wing Bat include:

- loss of foraging habitat
- damage to or disturbance of roosting caves (particularly during winter or breeding)
- application of pesticides in or adjacent to foraging areas
- predation by feral cats and foxes (DECC, 2005).

The Common Bent-wing Bat was not recorded during the field surveys. The desktop survey revealed 14 previous records from within 5 km of the project site. Potential foraging habitats were recorded in timbered habitats within the study area. It could potentially occur within the study area due to the presence of suitable foraging habitat, but there is little preferred roosting habitat and no known breeding habitat within the proposed development footprint.

(a) The proposed development would remove only a small area of potential foraging habitat for the Common Bent-wing Bat. Whilst some trees with hollows are likely to be removed, these features are only occasionally used by the Common Bent-wing Bat and do not constitute primary roosting habitat for this species. No nursery caves exist within the proposed footprint, and the proposed development would not disturb any caves that may be utilised in the study area. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Common Bent-wing Bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.



(d) (i) The proposed development would require the removal of a relatively small area of potential foraging habitat (approximately 15 to 35 ha, depending on construction methods). (ii) The stands of vegetation within the study area that provide potential habitat for the Common Bent-wing Bat exist within an already fragmented landscape and modified. Consequently, the proposed development is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Common Bent-wing Bat. (iii) The proposed development would require the removal of a relatively small area of potential foraging habitat. This area could not be regarded as important habitat for the Common Bent-wing Bat on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding ranges and forests. The proposed development would not impact on any known nursery caves critical for this species and is therefore not important to the long-term survival of this species.

(e) No critical habitat of relevance to the Common Bent-wing Bat has been declared by the Director-General of the NPWS.

(*f*) There is currently no recovery plan or threat abatement plan for the Common Bent-wing Bat. The proposed development is not inconsistent with the 25 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Common Bent-wing Bat include the clearing of native vegetation, predation by the European Red Fox, and predation by Feral Cats (DECC, 2005).

The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Common Bent-wing Bat in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forest and ranges. The development is unlikely to increase the susceptibility of this species to predation by the European Red Fox or Feral Cats.

Mitigation measures

To minimise potential impacts to the Common Bent-wing Bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.

Eastern Free-tail Bat (Mormopterus norfolkensis): Vulnerable

The Eastern Freetail-bat is listed as Vulnerable under Schedule 2 of the TSC Act. The Eastern Freetailbat is found along the east coast from southern Queensland to southern NSW, and is very poorly understood. They occur in dry sclerophyll forest and woodland east of the Great Dividing Range. They roost mainly in tree hollows but will also roost under bark or in man-made structures. They are solitary and probably insectivorous.

The main threats to the Eastern Freetail-bat include:

- loss of hollow-bearing trees
- loss of foraging habitat
- application of pesticides in or adjacent to foraging areas.



The Eastern Freetail-bat was not recorded during the field surveys. The desktop survey revealed 10 previous records from within 5 km of the project site. Potential foraging and roosting habitats were recorded in timbered habitats within the study area.

(a) The proposed development would require the removal of 15 to 35 ha of timbered habitats (depending on construction methods) and possibly a number of hollow-bearing trees which could provide potential roosting and foraging habitat for the Eastern Freetail-bat. Consequently, the proposed development has the potential to adversely impact this species through habitat loss and the loss of potential roosting hollows. When considering the large areas of more suitable habitat in the surrounding forests and ranges, this species is unlikely to be reliant on the vegetation to be removed. Nearby habitats outside the footprint of the proposed development are less disturbed, and would contain higher densities of hollow-bearing trees. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Eastern Freetail-bat such that a viable local population of the species is likely to be placed at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.

(*d*) (i) The proposed development would require the removal of a relatively small area of potential habitat (approximately 15 to 35 ha). (ii) The proposed development is unlikely to result in an area of known habitat becoming isolated from other habitat for the Eastern Freetail-bat given that the stands of vegetation exist within an already fragmented landscape. The proposed development would not further isolate any area of foraging habitat for this mobile species. (iii) The proposed development would require the removal of a relatively small area of potential habitat. This area could not be regarded as important habitat for the Eastern Freetail-bat given the large areas of suitable habitat that exist in the surrounding forests and ranges.

(e) No critical habitat of relevance to the Eastern Freetail-bat has been declared by the Director- General of the NPWS.

(*f*) There is currently no recovery plan or threat abatement plan for the Eastern Freetail-bat. The proposed development is not inconsistent with the 18 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Eastern Freetail-bat include the clearing of native vegetation, predation by the European Red Fox, and predation by Feral Cats (DECC, 2005).

The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Eastern Freetail-bat in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forest and ranges. The development is unlikely to increase the susceptibility of this species to predation by the European Red Fox or Feral Cats.



Mitigation measures

To minimise potential impacts to the Eastern Freetail-bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.

Large-footed Myotis (Myotis adversus): Vulnerable

The Large-footed Myotis (or Southern Myotis, *Myotis macropus*) is listed as Vulnerable under Schedule 2 of the TSC Act. This bat is considered to be widespread throughout the coastal regions of eastern and northern Australia, ranging from the Kimberley in Western Australia to Victoria and South Australia (Churchill, 1998). It is relatively common in tropical areas but uncommon further south (NPWS, 1994), and rare in Victoria (Menkhorst and Lumsden, 1995). Whilst regarded as having a primarily coastal distribution (rarely found more than 100 km inland), it does occur farther inland along major rivers (Churchill, 1998).

This species has been recorded in mangroves, paperbark swamps and in a range of forest and woodland habitats (Churchill, 1998). It is a cave dweller, but is also known to roost in tree hollows, under bridges, in clumps of vegetation, buildings, mine tunnels and stormwater drains (Menkhorst et al., 2001; Churchill, 1998). Roosts are usually in groups of 10-15, in close proximity to water over which the bats forage. The large feet and hind claws are used to rake the water surface for insects and small fish, and Large-footed Myotis is known to forage in small groups of three or four (Churchill, 1998). This species is also capable of foraging aerially (Menkhorst et al., 2001). In NSW, females have one young each year, usually in November or December (DECC, 2005).

The main threats to this species include:

- loss or disturbance of roosting sites
- clearing adjacent to foraging areas
- application of pesticides in or adjacent to foraging areas
- reduction in stream water quality affecting food resources (DECC, 2005).

The Large-footed Myotis was not recorded during the field surveys. The desktop survey revealed 10 previous records from within 5 km of the project site. Potential foraging, roosting and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would remove only a relatively small area of potential foraging and roosting habitat for the Large-footed Myotis. Whilst some trees with hollows would possibly be removed, the species is not expected to be reliant on these for survival, especially when considering the higher densities of hollow-bearing trees that would exist in the surrounding areas of ranges and forests. These areas may also exist closer to larger water sources such as major rivers, swamps and dams, which is the preferred location for roost sites for this species. If riparian vegetation (e.g. along the Karuah River) is protected, then the proposed development is unlikely to disrupt the lifecycle of the Large-footed Myotis such that a viable local population of the species is likely to be placed at risk of extinction.

- (b) Not applicable.
- (c) Not applicable.



(d) (i) The proposed development would require the removal of a relatively small area of potential habitat (approximately 15 to 35 ha). (ii) The stands of vegetation within the study area that provide potential habitat for the Large-footed Myotis exist within an already fragmented landscape and highly modified. Consequently, the proposed development is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Large-footed Myotis. (iii) The proposed development would require the removal of a relatively small area of potential foraging habitat.

This area could not be regarded as important habitat for the Large-footed Myotis on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding forests and ranges. Roost sites for the Large-footed Myotis generally occur close to large waterbodies in which they forage, such as major rives and swamps. Provided that riparian habitats (e.g. along the Karuah River) are protected, no impacts should occur to potential roosting habitat for this species.

(e) No critical habitat of relevance to the Large-footed Myotis has been declared by the Director-General of the NPWS.

(*f*) There is currently no recovery plan or threat abatement plan for the Large-footed Myotis. The proposed development would not be inconsistent with the 15 priority action statements designed to help this species recover (DECC, 2005).

(g) Key threatening processes of relevance to the Large-footed Myotis include the clearing of native vegetation, loss of hollow-bearing trees, and the alteration to natural flow regimes (DECC, 2005). The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and possibly the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Large-footed Myotis in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forests and ranges. The pipeline would cross several permanent streams. However, if HDD is used and riparian vegetation is protected there will be no impact on habitat of the Large-footed Myotis.

Mitigation measures

To minimise potential impacts to the Large-footed Myotis from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of native vegetation to be cleared, especially alongside large areas of contiguous vegetation such as Black Camp Road.
- Protect and retain riparian vegetation along the Karuah River.
- Use HDD techniques on all crossings of permanent streams to avoid impacts to riparian vegetation and flow regimes.



Yellow-bellied Sheath-tail Bat (Saccolaimus flaviventris): Vulnerable

The Yellow-bellied Sheathtail-Bat) is listed as a Vulnerable species under Schedule 2 of the TSC Act. Endemic to Australia, it is a wide-ranging species occurring throughout tropical Australia with many records extending into south-eastern Australia (Churchill, 1998). It is a rare late summer-autumn visitor to southern Australia (Menkhorst et al., 2001) with most records reported between January and June (Churchill, 1998).

The Yellow-bellied Sheathtail-Bat is found in a variety of habitats from wet and dry sclerophyll forests to open woodland, Acacia scrubland, mallee, grasslands and deserts. It roosts singly or in roosts of up to six, in tree-hollows and buildings, abandoned nests of Sugar Gliders and occasionally hanging from the outside walls of buildings in broad daylight (Churchill, 1998). In treeless areas it is known to utilise mammal burrows (DECC, 2005). Its flight pattern is high and fast and it forages above the canopy, which is probably why this species is rarely captured in traps and nets. Foraging occurs is most habitats across its very wide range, both with and without trees (DECC, 2005), and it feeds on a variety of prey including grasshoppers, bugs, flying ants, and beetles, which comprise approximately 90% of its diet (Churchill, 1998). Breeding has been recorded from December to mid-March, when a single young is born (DECC, 2005).

The main threats to the Yellow-bellied Sheathtail-Bat include:

- disturbance to roosting and summer breeding sites
- foraging habitats are being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions
- loss of hollow-bearing trees; clearing and fragmentation of forest and woodland habitat
- pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores.

The Yellow-bellied Sheathtail-Bat was not recorded during the surveys. The desktop survey revealed two previous records from within 5 km of the project site. Potential foraging, roosting and breeding habitats were recorded in timbered habitats within the study area.

(a) The proposed development would remove only a relatively small area of potential foraging and roosting habitat for the Yellow-bellied Sheathtail-Bat. The proposed development would possibly require the removal of a small number of large hollow-bearing trees, which could provide potential roosting and foraging habitat for the Yellow-bellied Sheathtail-bat. It is also possible that some of the younger trees in the study area contain small hollows of suitable size for this species. Consequently, the proposed development has the potential to adversely impact this species through habitat loss and the loss of potential roosting hollows. When considering the large areas of more suitable habitat in the surrounding forest and ranges, this species is unlikely to be reliant on the vegetation to be removed. Surrounding habitat that is less disturbed would contain higher densities of hollow-bearing trees. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Yellow-bellied Sheathtail-Bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.



(d) (i) The proposed development would require the removal of a relatively small area of potential habitat (approximately 15 to 35 ha). (ii) The stands of vegetation within the study area that provide potential habitat for the Yellow- bellied Sheathtail-bat exist within an already fragmented landscape and highly modified; Consequently, the proposed development is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Yellow-bellied Sheathtail-bat. (iii) The proposed development would require the removal of a relatively small area of potential foraging habitat. This area could not be regarded as important habitat for the Yellow-bellied Sheathtail-bat on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding forests and ranges.

(e) No critical habitat of relevance to the Yellow-bellied Sheathtail-bat has been declared by the Director-General of the NPWS.

(*f*) There is currently no recovery plan or threat abatement plan for the Yellow-bellied Sheathtailbat. Twenty priority action statements have been prepared to help recover this species (DECC, 2005). One of these states attempts should be made to ensure the largest hollow-bearing trees, including dead trees and paddock trees are given highest priority for retention during land assessments. Provided mitigation measures are followed, the proposed development would not be inconsistent with all twenty one priority action statements.

(g) Key threatening processes of relevance to the Yellow-bellied Sheathtail-bat include the clearing of native vegetation and loss of hollow-bearing trees (DECC, 2005). The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and possibly the loss of a small number of hollow-bearing trees.

This is likely to only result in a small reduction in the available foraging and roosting resources for the Yellow-bellied Sheathtail-Bat in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forests and ranges.

Mitigation measures

To minimise potential impacts to the Yellow-bellied Sheathtail-bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of vegetation to cleared by reducing the width of the footprint in timbered habitats.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.



Greater Broad-nosed Bat (Scoteanax rueppellii): Vulnerable

The Greater Broad-nosed Bat is listed as Vulnerable under Schedule 2 of the TSC Act. The species occurs along the east coast of Australia inhabiting moist gullies and river systems from the Atherton Tableland in QLD to southern NSW. The distributional stronghold of the Greater Broad-nosed Bat is in the gullies and river systems draining the Great Dividing Range (Hoye and Richards, 1995).

The Greater Broad-nosed Bat is found in a variety of habitats from dry woodland to tall, wet forests and does not occur at altitudes above 500 m (Hoye and Richards, 1995), except in the very north of its range where it has been recorded at 780 m (Churchill, 1998). This species roosts in tree-hollows, tree branches and in the roofs of old buildings. Its flight pattern is suited to open eucalypt woodlands and forests particularly because it has limited manoeuvrability and is a noticeably slow flier. It feeds on slow flying prey (such as large moths), but will also feed on ground beetles. These are 'hawked' within 20 m of the ground along rows of trees which line creeks and small rivers, and the edges of patches of woodland in otherwise cleared paddocks (Churchill, 1998). The Greater Broad-nosed Bat is also known to eat other small bats, including the threatened Little Bent-wing Bat, especially when captured together in harp traps or mist nets.

. The main threats to the Greater Broad-nosed Bat include:

- land clearing (resulting in the loss of foraging habitat
- loss of hollow-bearing trees
- disturbance to roosting and summer breeding sites
- pesticide and herbicide use (reducing the availability of insects and / or resulting in the accumulation of toxic residues in individuals' fat stores)
- changes to water regimes impacting on food resources.

The Greater Broad-nosed Bat was not recorded during the surveys. The desktop survey revealed seven previous records from within 5 km of the project site. Potential foraging and breeding habitats were recorded in timbered areas of the study area. It could potentially occur within the study area due to the presence of suitable foraging habitat and potential roost sites (e.g. hollow-bearing trees).

(a) The proposed development would possibly require the removal of a small number of large hollowbearing trees, which could provide potential roosting and foraging habitat for the Greater Broad-nosed Bat. It is also possible that some of the younger trees in the study area contain small hollows of suitable size for this species. Consequently, the proposed development has the potential to adversely impact this species through habitat loss and the loss of potential roosting hollows.

When considering the large areas of more suitable habitat in the surrounding forest and ranges, this species is unlikely to be reliant on the vegetation to be removed. Surrounding habitat that is less disturbed would contain higher densities of hollow-bearing trees. Consequently, the proposed development is unlikely to disrupt the lifecycle of the Greater Broad-nosed Bat such that a viable local population of the species is likely to be placed at risk of extinction.

(b) Not applicable.

(c) Not applicable.



(*d*) (i) The proposed development would require the removal of a relatively small area of potential habitat (approximately 15 to 35 ha). (ii) The stands of vegetation within the study area that provide potential habitat for the Greater Broad-nosed Bat exist within an already fragmented landscape and highly modified; Consequently, the proposed development is unlikely to result in an area of known habitat becoming isolated from other areas of habitat for the Greater Broad-nosed Bat. (iii) The proposed development would require the removal of a relatively small area of potential foraging habitat. This area could not be regarded as important habitat for the Greater Broad-nosed Bat on a local or regional basis, given the large areas of suitable habitat that exist in the surrounding forests and ranges.

(e) No critical habitat of relevance to the Greater Broad-nosed Bat has been declared by the Director-General of the NPWS.

(*f*) There is currently no recovery plan or threat abatement plan for the Greater Broad-nosed Bat. Nineteen priority action statements have been prepared to help recover this species (DECC, 2005). One of these states that attempts should be made to ensure the largest hollow-bearing trees, including dead trees and paddock trees are given highest priority for retention during land assessments. Provided the mitigation measures are followed, as identified below, then the proposed action would not be inconsistent with all 19 priority action statements.

(g) Key threatening processes of relevance to the Greater Broad-nosed Bat include the clearing of native vegetation, and the loss of hollow-bearing trees (DECC, 2005).

The proposed development would result in the clearing of approximately 15 to 35 ha of native vegetation, and possibly the loss of a small number of hollow-bearing trees. This is likely to only result in a small reduction in the available foraging and roosting resources for the Greater Broad-nosed Bat in the study area, locality and region. This species would not rely on this vegetation, particularly when considering the large areas of available habitat in the surrounding forests and ranges.

Mitigation measures

To minimise potential impacts to the Greater Broad-nosed Bat from the proposed development, the following mitigation measures are recommended:

- Minimise the amount of vegetation to be cleared by reducing the width of the footprint in timbered habitats.
- Protect and retain the largest hollow-bearing trees, including dead trees and paddock trees, wherever possible.

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