WILPINJONG COAL PROJECT

APPENDIX HE

Eight Part Tests of Significance

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EIGHT PART TESTS OF SIGNIFICANCE

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HE1 INTRODUCTION

This document assesses the Wilpinjong Coal Project (the Project) for significant effects on threatened species, populations, ecological communities, and their habitats in accordance with Section 5A of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act). The effects of the Project which have been considered include direct (eg. habitat removal) and indirect effects (eg. pests).

The Project is located approximately 40 kilometres (km) north-east of Mudgee near the village of Wollar, in central New South Wales (NSW) (Figure HE-1). The Project is being developed by Wilpinjong Coal Pty Ltd (WCPL).

The Project includes the development of an open cut mining operation, together with the construction and operation of associated rail and coal handling/train loading infrastructure. More specifically, the Project would include (Figure HE-2):

- development and operation of an open cut mine within the Mining Lease Application (MLA 1) area to produce coal for domestic electricity generation and export markets;
- selective highwall mining of the Ulan Seam within the MLA 1 area;
- a Coal Handling and Preparation Plant (CHPP) and mine facilities area;
- water management infrastructure including the relocation of Cumbo Creek;
- water supply bores and associated pump and pipeline system;
- placement of mine waste rock (i.e. overburden, interburden/partings and coarse rejects) predominantly within mined-out voids;
- placement of tailings within a combination of out-of-pit and in-pit tailings storages;
- development and rehabilitation of final mine landforms and establishment of woodland vegetation in areas adjacent to the Project;
- a mine access road, temporary construction camp access road, internal access roads and haul roads;
- closure of Wilpinjong Road and Bungulla Road;
- realignment of two sections of Ulan-Wollar Road (including the relocation of two road-rail crossings);
- relocation of the existing 11 kilovolt (kV) electricity transmission line;
- an on-site temporary construction camp to accommodate up to 100 people during the construction phase;
- a rail spur and rail loop;
- coal handling and train loading infrastructure;
- transportation of product coal to market via train; and
- Enhancement and Conservation Areas (ECAs).

A detailed description of the Project is provided in Section 2, Volume 1, of the Project Environmental Impact Statement (EIS).

A list of threatened species, populations and endangered ecological communities which are known or considered possible occurrences in the Project area and surrounds which are assessed by Eight Part Tests of Significance is presented in Table HE-1.

Table HE-1
Threatened Species, Populations, Ecological Communities or their Habitats
Assessed by Eight Part Tests of Significance

Threatened Species, Populations, Ecological Communities or their Habitats		Conservation Status	
		TSC Act[1]	EPBC Act[2]
Flora Species			
Ozothamnus tesselatus	A Rice Bush	V	V
Swainsona recta	Small Purple Pea	E	E
Kennedia retrorsa	A Kennedy Pea	V	V
Goodenia macbarronii	Narrow-leaved Goodenia	V	V
Prostanthera discolor	A Mint-bush	V	V
Prostanthera cryptandroides subsp. *cryptandroides*	A Mint-bush	V	V
Prostanthera stricta	A Mint-bush	V	V
Eucalyptus cannonii	Cannon's Stringybark	V	V
Homoranthus darwinioides	-	V	V
Persoonia marginata	Clandulla Geebung	V	V
Pomaderris queenslandica	A Pomaderris	E	-
Philotheca ericifolia	A Waxflower	V	V
Lasiopetalum longistamineum	A Rusty-petals	V	V
Diuris sheaffiana	Tricolor Diuris	V	V
Thesium australe	Austral Toadflax	V	V
Fauna Species			
Mixophyes iteratus	Giant Barred Frog	E	E
Hoplocephalus bungaroides	Broad-headed Snake	E	V
Aprasia parapulchella	Pink-tailed Legless Lizard	V	V
Suta flagellum	Little Whip Snake	V	-
Varanus rosenbergi	Rosenberg's Goanna	V	-
Burhinus grallarius	Bush Stone-curlew	E	-
Lophoictinia isura	Square-tailed Kite	V	-
Calyptorhynchus banksii	Red-tailed Black-cockatoo	V	E
Calyptorhynchus lathami	Glossy Black-cockatoo	V	-
Lathamus discolor	Swift Parrot	E	E
Neophema pulchella	Turquoise Parrot	V	-
Ninox connivens	Barking Owl	V	-
Ninox strenua	Powerful Owl	V	-
Tyto novaehollandiae	Masked Owl	V	-
Climacteris picumnus victoriae	Brown Treecreeper	V	-
Pyrrholaemus sagittata	Speckled Warbler	V	-
Grantiella picta	Painted Honeyeater	V	-
Melithreptus gularis gularis	Black-chinned Honeyeater	V	-
Xanthomyza phrygia	Regent Honeyeater	E	E
Melanodryas cucullata cucullata	Hooded Robin	V	-
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V	-
Stagonopleura guttata	Diamond Firetail	V	-
Dasyurus maculatus	Spotted-tailed Quoll	V	E
Phascolarctos cinereus	Koala	V	-
Petaurus norfolcensis	Squirrel Glider	V	-
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V
Pteropus poliocephalus	Grey-headed Flying Fox	V	V

Table HE-1 (Continued)
Threatened Species, Populations, Ecological Communities or their Habitats
Assessed by Eight Part Tests of Significance

Threatened Species, Populations, Ecological Communities or their Habitats		Conservation Status	
		TSC Act[1]	EPBC Act[2]
Myotis macropus	Large-footed Myotis	V	-
Chalinolobus dwyeri	Large-eared Pied Bat	V	V
Mormopterus norfolkensis	East-coast Freetail Bat	V	-
Falsistrellus tasmaniensis	Eastern Falsistrelle	V	-
Miniopterus schreibersii oceanensis	Large Bentwing Bat	V	CD
Miniopterus australis	Little Bentwing Bat	V	-
Nyctophilus timoriensis	Greater Long-eared Bat	V	V
Saccolaimus flaviventris	Yellow-bellied Sheathtail Bat	V	-
Vespadelus troughtoni	Eastern Cave Bat	V	-
Endangered Ecological Communities			
White Box, Yellow Box, Blakely's Red Gum Woodland		E	E

[1] NSW *Threatened Species Conservation Act, 1995*
[2] Commonwealth *Environment Protection and Biodiversity Conservation Act, 1999*
V (Vulnerable), E (Endangered), CD (Conservation Dependent)

HE2 BACKGROUND AND APPLICATION OF THE EIGHT PART TEST OF SIGNIFICANCE

HE2.1 BACKGROUND

The Eight Part Test of Significance is a systematic list of factors that must be taken into account under the EP&A Act in assessing the impact of a proposed development on threatened species, populations, ecological communities, and/or their habitats. The eight factors are:

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at the risk of extinction

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

(e) Whether critical habitat will be affected

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

These factors are considered for the fifteen threatened flora species (Section HE3.1), thirty-six threatened fauna species (Section HE3.2) and one endangered ecological community (Section HE3.3) identified in Table HE-1. The assessment is made in accordance with National Parks and Wildlife Service (NPWS) (1996) *Information Circular No. 2: Threatened Species Assessment under the EP&A Act: The '8 Part Test of Significance'*. The application of parts (a) to (h) of the Eight Part Test is discussed further in Section HE2.2.

HE2.2 APPLICATION OF THE EIGHT PART TEST

The following sections (a) to (h) provide an overview of the factors considered for the threatened species and endangered ecological communities addressed in Section HE3 of this report.

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at the risk of extinction

This question requires the understanding of the lifecycle components of the threatened species. Important lifecycle components for plants include seed banks, recruitment (germination and establishment of plants) and reproduction (including pollination and fecundity). For animals important lifecycle components include breeding, mortality, dormancy, roosting, feeding, migration and dispersal. Habitat resources such as trees with hollows, caves, water bodies and foraging resources may be essential to the lifecycle of a species (NPWS, 1996).

A local population of the species is determined by the species' home range and important lifecycle components such as breeding, dormancy, roosting, feeding, migration and dispersal (NPWS, 1996). NPWS (1996) and Department of Environment and Conservation (DEC) (2004d) define a local population as one that occurs within a study area, except in the case where the existence of contiguous or proximal occupied habitat and the movement of individuals or exchange of genetic material across the study area boundary, can be demonstrated.

A local population should be considered to be viable (ie. a population that has the capacity to live, develop and reproduce under normal conditions), unless the contrary can be conclusively demonstrated through analysis of records and references (NPWS, 1996).

Part (a) of the Eight Part Test is only applicable to the threatened species addressed in Sections HE3.1 and HE3.2 of this report. It is not applicable to Section HE3.3 which addresses endangered ecological communities.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Part (b) of the Eight Part Test assesses endangered populations and the impacts of development on them. The following endangered populations are currently (January 2005) listed in Schedule 1 of the NSW *Threatened Species Conservation Act, 1995* (TSC Act, 1995):

- Tusked Frog (*Adelotus brevis*) population in the Nandewar and New England Tablelands Bioregions;
- Gang-gang Cockatoo (*Callocephalon fimbriatum*) populations in the Hornsby and Ku-ring-gai Local Government areas;
- Riverina population of the Glossy Black-cockatoo (*Calyptorhynchus lathami*);
- White-browed Treecreeper (*Climacteris affinis*) population in the Carrathool Local Government area south of the Lachlan River and Griffith Local Government area;
- Emu (*Dromaius novaehollandiae*) population in the NSW North Coast Bioregion and Port Stephens Local Government area;
- Manly Point population of the Little Penguin (*Eudyptula minor*);
- Barrington Tops population of the Broad-toothed Rat (*Mastacomys fuscus*) in the Local Government areas of Gloucester, Scone and Dungog;
- North Head population of the Long-nosed Bandicoot (*Perameles nasuta*);
- Wagga Wagga Local Government area population of the Squirrel Glider (*Petaurus norfolcensis*);
- population of the Squirrel Glider (*Petaurus norfolcensis*) on the Barrenjoey Peninsula, north of Bushrangers Hill;
- Hawks Nest and Tea Gardens population of the Koala (*Phascolarctos cinereus*);
- Pittwater Local Government area population of the Koala (*Phascolarctos cinereus*);
- *Menippus fugitivus* population in the Sutherland Shire;
- Gosford Wattle (*Acacia prominens*) in the Hurstville and Kogarah Local Government areas;
- *Chorizema parviflorum* in the Wollongong and Shellharbour Local Government areas;
- *Darwinia fascicularis* subsp*. oligantha* populations in the Baulkham Hills and Hornsby Local Government areas;
- Kemps Creek population of *Dillwynia tenuifolia*;
- *Eucalyptus seeana* population in the Greater Taree Local Government area;
- *Glycine clandestina* (broad leaf form) in the Nambucca Local Government area;
- *Keraudrenia corrolata* var. *denticulata* in the Hawkesbury Local Government area;
- *Lespedeza juncea* subsp. *sericea* population in the Wollongong Local Government area;
- *Marsdenia viridiflora* R. Br subsp. *viridiflora* in Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith Local Government areas;
- *Pomaderris prunifolia* in the Parramatta, Auburn, Strathfield and Bankstown Local Government areas;

- *Pultenaea villifera* in the Blue Mountains Local Government area;
- Tadgell's Bluebell (*Wahlenbergia multicaulis*) in the Local Government areas of Auburn, Bankstown, Strathfield, Baulkham Hills, Hornsby, Parramatta and Canterbury;
- low-growing form of *Zieria smithii*, Diggers Head;
- *Dillwynia tenuifolia* in the Baulkham Hills Local Government area;
- *Eucalyptus parramattensis* subsp. *parramattensis* in the Wyong and Lake Macquarie Local Government areas;
- Woronora Plateau population of *Callitris endlicheri* (a tree);
- Long-nosed Potoroo population, Cobaki Lakes and Tweed Heads West; and
- *Eucalyptus oblonga* (a tree) population, Bateau Bay.

None of the above endangered populations occur in the Project area and surrounds. Therefore Part (b) of the Eight Part Test is not applicable to the Project area and is indicated as such in the following Eight Part Tests of Significance.

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

In accordance with regional mapping contained within *An Interim Biogeographic Regionalisation of Australia (IBRA): A Framework for Setting Priorities in the National Reserves System Co-operative Program* (Thackway and Cresswell, 1995; Environment Australia, 2000), the Project area is located within the NSW Sydney Basin Bioregion.

The TSC Act, 1995 defines habitat as, "*an area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community and includes any biotic or abiotic component*". For the purpose of this assessment, known habitat is considered to be habitat in which the species has been recorded. Further, potential habitat is considered to be habitat in which the species has not been recorded but may potentially utilise.

The following broad habitat types occur within the NSW Sydney Basin Bioregion (DEC, 2004a):

- Rainforest.
- Forest in dry lowland environments.
- Coastal Forest.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Rocky hills and escarpment.
- Riparian Vegetation along watercourses.
- Shrubland.
- Heathland.
- Native grassland.
- Cleared land with or without scattered trees.
- Lakes, wetlands and swamps.
- Mangroves and salt marshes in estuaries.
- Frontal dunes along the coastal area.
- Caves.

The determination of whether a significant area of known habitat is to be removed or modified from within the region as a result of the development has taken the following factors into account: the amount of habitat of the threatened species, population or ecological community that occurs within the NSW Sydney Basin Bioregion, within the Project area, as well as, the amount of habitat that would be removed or modified by the proposed development and the ecological integrity of the habitat to be removed.

Part (c) of the Eight Part Test is applicable to the threatened species and endangered ecological communities presented in Sections HE3.1 to HE3.3.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

Part (d) of the Eight Part Test requires definition and discussion of known habitat areas, connectivity between habitat and mechanisms that act to isolate known habitats.

In relation to the movement of fauna, species possess a variety of dispersal mechanisms by which they are able to colonise new habitats or maintain genetic health by interacting with different populations in a locality. For example, amphibians are typically restricted to water bodies such as rivers, creeks or lagoons, however they may undertake forays across elevated terrain in damp conditions. By comparison, birds are generally highly mobile and are able to cover relatively large areas of land.

Factors such as habitat clearance, fire, damming, road / freeway construction, fences, mining/quarrying, etc. can create a barrier to the dispersal of some species. The type of barrier and the species involved will determine the level of impact on dispersal capability or the degree of isolation.

Part (d) of the Eight Part Test is applicable to the threatened species and endangered ecological communities presented in Sections HE3.1 to HE3.3.

(e) Whether critical habitat will be affected

Part (e) of the Eight Part Test considers whether a proposed development or activity is likely to affect land that is, or is part of, critical habitat.

In accordance with Division 1 of Part 3 of the TSC Act, 1995 habitat that is eligible to be declared to be critical habitat is:

> "*the whole or any part or parts of the area or areas of land comprising the habitat of an endangered species, population or ecological community that is critical to the survival of the species, population or ecological community*."

There is no critical habitat within the vicinity of the Project area and surrounds as designated by the Register of Critical Habitat held by the Director-General of the NSW NPWS.

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figures HE-3a and HE-3b.

Information on the representation of threatened species and endangered ecological communities in conservation reserves has been principally sourced from various NPWS management plans for parks and reserves (NPWS, 1992; NPWS, 1993; NPWS, 1995; NPWS, 1997a, b, c; NPWS, 1998a, b ,c ,d, e and f, NPWS, 1999a, b, c and d; NPWS, 2000a, b and c; NPWS, 2001a, b, c, d, e, f and g; NPWS, 2002a, b, c, d and e; NPWS, 2003a, b and c; NPWS, 2004 a, b, c, d, e, f and g). Table HE-2 provides a summary of the habitat in conservation reserves within the NSW Sydney Basin Bioregion (for which habitat information was available).

Table HE-2
Habitat in Conservation Reserves of the NSW Sydney Basin Bioregion

Conservation Reserve	Area (ha)	Description of Habitat Present
National Parks		
Blue Mountains National Park	264,848	Dominated by dry forest and Eucalypt woodland, smaller areas of rocky complex and plateau complex heaths, low woodlands, moist forest and rainforest (NPWS, 2001c).
Botany Bay National Park	458	Wet and dry heath communities, open scrubland, low closed forest in sheltered sand dune valleys, swamps, freshwater wetlands, sclerophyll woodland, and remnant wet forest in the swamps and wet gullies (NPWS, 2002b).
Bouddi National Park	1,216	Heathland, palm forest, Eucalypt forest and woodland including low open woodland, closed forest, tall open forest, grassland, swamp and remnant sand dune successional communities (NPWS, 1999c).
Brisbane Water National Park	11,455	Mainly low open forest, low open woodland and open woodland with either a dry or moist understorey on exposed ridges and slopes, and closed forest (rainforest) (NPWS, 1992).
Budderoo National Park	7,120	Cool/warm temperate and subtropical rainforests, open forests, woodlands, heaths and sedgelands of the plateau, tall open forests, warm temperate rainforests and subtropical rainforest of the slopes, gullies and ridges below the escarpment (NPWS, 2004a).
Robertson Nature Reserve	5	
Macquarie Pass National Park	1,064	
Barren Grounds Nature Reserve	2,024	
Cattai National Park	424	Dry sclerophyll woodland on slopes, tall and low open forest on lowlands, wetlands and gallery rainforest along the creek (NPWS, 1997c).
Dharug National Park	14,850	Vegetation consists of low open forest, open forest and low woodland with dry or moist understorey on exposed sandstone ridges and slopes, smaller areas of shrubland on valley slopes and closed forest along sheltered shale valleys, heathland and swamp forest (NPWS, 1997a).
Gardens of Stone National Park	15,010	Eucalypt dominated open-forest and woodlands on sandstone-shale flats and slopes occur interspersed with minor areas of moist forest type vegetation (NPWS, 2004f).
Garigal National Park	2,203	Vegetation includes heath, hanging swamps, shrubland, woodland and open forest on sandstone slopes, mallee woodland, tall open forest and rainforest in moist sheltered gullies (NPWS, 1998e).
Goulburn River National Park	70,323	Vegetation dominated by Eucalypt woodland on ridges, slopes, valleys and gullies, and open forest and Eucalypt shrubland on more shallow soils (NPWS, 2003a).
Heathcote National Park	2,250	A mosaic of subtropical, warm temperate and littoral rainforest, Eucalypt forest and woodland including tall moist forest, shale forest, sandstone gully forest and sandstone plateau woodland, heathlands and open scrub and wetlands including estuarine wetlands, freshwater lagoons and upland swamps (NPWS, 2000a).
Royal National Park	15,080	
Kanangra-Boyd National Park	68,661	Predominantly composed of moist montane forests on higher plateaus and sheltered slopes and dry sclerophyll forests on lower siltstone and shale, vegetation also consists of rainforest, and relict sub-alpine swamp and snow gum communities in escarpment and plateau valleys (NPWS, 2001g).
Ku-ring-gai Chase National Park	14,894	Vegetation consists of wet and dry heathland on rock platforms and shallow sandy soils, low Eucalypt woodland, low open forest and taller open forest on slopes and ridges, warm temperate rainforest in deeper protected gullies and mudflats on creeks and bays (NPWS, 2002c).
Lane Cove National Park	601	Closed forest communities, tall forests of Blackbutt and Sydney Bluegum, open woodland and heath on upper slopes and mangrove along the river occur (NPWS, 1998b).
Marramarra National Park	11,759	Closed forest diatreme vegetation on volcanic soils and in sandstone gullies, open forest and shale woodlands, hanging swamp communities and estuarine communities on alluvial deposits and estuarine mudflats occur (NPWS, 1998f).
Muogamarra Nature Reserve	2,274	

Table HE-2 (Continued)
Habitat in Conservation Reserves of the NSW Sydney Basin Bioregion

Conservation Reserve	Area (ha)	Description of Habitat Present
National Parks (Continued)		
Morton National Park	189,668	Extensive areas of tall open forest on slopes, in gullies and gorges often with rainforest understorey, heathy woodland on rocky slopes and exposed ridges, mallee woodlands, wet and dry heathlands and sedgelands, gallery forest along watercourses and rainforest in sheltered locations (NPWS, 2001f).
Murramarang National Park	11,977	Vegetation consists of open Eucalypt forest and tall open Eucalypt forest with either shrubby or rainforest understorey, smaller areas of scrub and heath communities, patches of warm temperate, subtropical and littoral rainforest also occur in gullies on steep slopes (NPWS, 2002a).
Nattai National Park	48,944	Dominated by dry sclerophyll Eucalypt forest/woodland communities on sandstone slopes and ridges and in river valleys, mixed moist forest and warm temperate rainforest also occurs in eastern gullies (NPWS, 2001b).
Popran National Park	3,970	Open forest and woodland on exposed sandstone ridges and hillslopes, smaller areas of shrub and heath on poorly-drained sandstone, sedges, rainforest and remnant woodland on lower shale slopes and sheltered valleys (NPWS, 2000b).
Scheyville National Park	920	Eucalypt woodland on hilly shale and sandy ridges, transitional forest, seasonal and permanent freshwater wetlands, and extensive grasslands (NPWS, 2000c).
Seven Mile Beach National Park	898	Vegetation consists of large areas of natural coastal dune vegetation including teatree scrub and open forest, closed littoral rainforest and estuarine mangrove woodland, salt marsh, swamp oak forest and Eucalypt low open forest communities (NPWS, 1998a).
Comerong Island Nature Reserve	660	
Sydney Harbour National Park	393	Extensive coastal heath confined to poorly-drained shallow soils, woodland on exposed ridges and slopes and forests in gullies (NPWS, 1998d).
Thirlmere Lakes National Park	630	Vegetation consists of numerous species of hydrophyte, littoral and riparian species on lake margins, colluvial and alluvial flats, and Eucalypt woodland characterised by sclerophylous understorey on slopes and ridges (NPWS, 1997b).
Tomaree National Park	2,318	Vegetation dominated by open forest, scrub and heathland, with smaller areas of swamp forest, swampland, sedgeland and rainforest (NPWS, 2004g).
Towarri National Park	4,787	Vegetation communities include snow grass open forests on basalt, grass tree low woodlands, box spinifex open forests on basalt, warm temperate rainforests, river oak riparian forests, grey gum-apple alluvial open forests, box open forests on basalt, and a diversity of Eucalypt communities (NPWS, 2004e).
Wingen Maid Nature Reserve	1,077	
Wollemi National Park	492,976	Vegetation consists of Eucalypt open forest on steep sandstone-shale, dry closed forest and woodland with occasional distinctive rainforest, heath and grassy knoll communities (NPWS, 2001a).
Wyrrabalong National Park	621	Swamp forest, exposed coastal heath and scrub, open Eucalypt forest and woodland, littoral rainforest and mangroves (NPWS, 1995).
Yengo National Park	152,229	Dry open forest and woodland, tall Eucalypt forest and warm temperate rainforest occur in sheltered valleys and swamp forest (NPWS, 2001d).
Nature Reserves		
Agnes Banks Nature Reserve	107	Widespread mixed woodland vegetation, open Eucalypt forest/woodland on clay soils and low Eucalypt woodland on sandy soils (NPWS, 1999b).
Castlereagh Nature Reserve	490	
Windsor Downs Nature Reserve	363	

Table HE-2 (Continued)
Habitat in Conservation Reserves of the NSW Sydney Basin Bioregion

Conservation Reserve	Area (ha)	Description of Habitat Present
Nature Reserves (Continued)		
Berkeley Nature Reserve	8	Remnant moist and dry subtropical rainforest surrounded by Casuarina dominated open forest and woodland (NPWS, 2004b).
Cecil Hoskins Nature Reserve	47	Significant areas of lagoon aquatic-riparian vegetation, open Eucalypt riparian forest with dense shrubby understorey, mixed floodplain forest/woodland extending to woodland on lower slopes (NPWS, 1999d).
Dalrymple-Hay Nature Reserve	11	Vegetation consists of Blackbutt and Blue Gum dominated tall open forest, moist forest and rainforest species in gullies and along creeklines and mixed forest exposed ridgetops and upper northern slopes (NPWS, 2004c).
Dharawal Nature Reserve	347	Dominated by sandstone woodland and eastern gully forest, vegetation also includes dry sclerophyll forest, dry sclerophyll woodland and heathlands, shale forest and shrub/sedge dominated upland swamp communities (NPWS, 2002d).
Hexham Swamp Nature Reserve	900	Variety of vegetation communities from mangrove forest, saltmarsh, saline and freshwater pasture, rainforest, and diverse range of swamp vegetation types (NPWS, 1998c).
Munghorn Gap Nature Reserve	5,934	Generally, the vegetation of the area is woodland dominated by Eucalypt woodland and forest. Dominant species include *Eucalyptus fibrosa*, *E. oblonga*, *E. sideroxylon*, *E. dwyeri*, *E. punctata*, *E. agglomerate* and *E. caleyi*. Where skeletal soils occur or drainage is poor, a shrubland formation dominates. The influence of basalt leads to the presence of *Callitris* species and the river valley contains *Casuarina cunninghamiana* in association with more moisture-dependent species such as *E. crebra, E. dawsonii, E. blakelyi* and *Angophora floribunda* (NPWS, 2003a).
Newington Nature Reserve	48	Comprised of distinct wetland and woodland areas vegetation consists of mangroves, saltmarsh, closed forest, tall forest with moist understorey, woodland with grassy understorey.
Pambalong Nature Reserve	35	Vegetation is dominated by wetland dependant communities including rushes, sedges and Melaleuca swamp woodland (NPWS, 2004d).
Pulbah Island Nature Reserve	69	Vegetation consists of mixed forest with grassy understorey, dry rainforest, scrub forest, sheltered dry forest on sandstone and estuarine swamp forest (NPWS, 2003b).
Towra Point Nature Reserve	386	Mosaic of vegetated sand dunes, coastal Banksia woodlands, small stands of swamp forest, littoral rainforest and saltmarsh (NPWS, 2001e).
Wallumatta Nature Reserve	6	Dominated by open forest associations with scrubby understorey or grassy understorey where disturbance has occurred, vegetation is interspersed with transitional forest (NPWS, 1999a).
Wamberal Lagoon Nature Reserve	132	Vegetation consists of littoral rainforest, Banksia scrub, heath, Melaleuca woodland and heath, sedgeland and saltmarsh (NPWS, 1993).
Wambina Nature Reserve	54	Vegetation includes open Eucalypt dominated forest on slopes and valleys, mixed open forest on steeper slopes and ridge tops forest and warm temperate rainforest with subtropical elements in gullies (NPWS, 2003c).
Yatteyattah Nature Reserve	19	Dry rainforest on exposed stony slopes, subtropical rainforest on lower slopes, along the creek and tributary gullies, and Eucalypt forest on the plateau (NPWS, 2002e).

In addition to the conservation reserves listed in Table HE-2, the following National Parks and reserves also occur within the NSW Sydney Basin Bioregion: Bangadilly, Booderee, Bugong, Conjola, Cudmirrah, Jerrawangala, Georges River, Meroo, New South Wales Jervis Bay, Watagans and Werakata National Parks, as well as Awabakal, Bamarang, Barrengarry, Black Ash, Brundee Swamp, Burning Mountain, Cambewarra Range, Cockle Bay, Devils Glen, Gulguer, Joadja, Kangaroo River, Kooragang, Manobalai, Moffats Swamp, Mulgoa, Narrawallee Creek, Parma Creek, Pelican Island, Pitt Town, Red Rocks, Rileys Island, Rodway, Saltwater Swamp, Tapitallee, Tilligerry, Tingira Heights, Triplarina, Wogamia, Woollamia, Worrigee and Wollondilly River Nature Reserves.

Further, the following protected areas also occur within the NSW Sydney Basin Bioregion: Appletree, Finchley, Howe, Mooney Mooney, Mount Ku-ring-gai, Murramarang Aboriginal Areas, Bargo, Barnunj, Bents Basin, Burragorang, Colymea, Corramy, Dharawal, Garawarra, Georges River, Glenrock, Illawarra Escarpment, Lake Macquarie, Munmorah, Nattai, Parr, Yarranderie State Conservation Areas, Cadmans Cottage, Maroota, Throsby, Wisemans Ferry Historic Sites and Berowra Valley, Leacock, Parramatta River, Penrith Lakes, Rouse Hill, Western Sydney, William Howe, Wolli Creek, Yellomundee Regional Parks. Seven landholders have also entered into voluntary conservation agreements (NPWS, 2005c).

As shown in Figure HE-3a, the Project area is situated in the far north-west of the Sydney Basin Bioregion (Thackway and Cresswell, 1995; Environment Australia, 2000), and is close to other IBRA Regions, namely, the NSW South Western Slopes and Brigalow Belt South bioregions. Consequently, the Project area is influenced by environmental characteristics of these nearby IBRA Regions.

The protected areas which are most relevant to the Project are located in approximately a 60 km radius of the Project area including: Goulburn National Park; Munghorn Gap Nature Reserve; Wollemi National Park; Gardens of Stone National Park; Yengo National Park and Manobalai Nature Reserve.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

Schedule 3 of the TSC Act, 1995 makes provision for listing threatening processes as recognised by the NSW Scientific Committee. There are currently (January 2005) 25 key threatening processes listed within the Schedule:

- alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- anthropogenic climate change;
- bushrock removal;
- clearing of native vegetation;
- competition and grazing by the feral European Rabbit (*Oryctolagus cuniculus*);
- competition from feral honeybees (*Apis mellifera*);
- introduction of the Large Earth Bumblebee (*Bombus terrestris*);
- high frequency fire resulting in the disruption of lifecycle processes in plants and animals, and loss of vegetation structure and composition;
- importation of Red Imported Fire Ants (*Solenopsis invicta*);
- infection of native plants by *Phytophthora cinnamomi*;
- invasion of native plant communities by exotic perennial grasses;
- invasion of native plant communities by *Chrysanthemoides monilifera*;
- loss and/or degradation of sites used for hill-topping by butterflies;
- predation by the Mosquito Fish (*Gambusia holbrooki*);
- predation by the European Red Fox (*Vulpes vulpes*);
- predation by the Feral Cat (*Felis catus*);
- predation by the Ship Rat (*Rattus rattus*) on Lord Howe Island;
- Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations;
- infection of frogs by amphibian chytrid causing the disease Chytridiomycosis;
- death or injury to marine species following capture in shark control programs on ocean beaches;
- removal of dead wood and dead trees;
- entanglement in or ingestion of anthropogenic debris in marine and estuarine environments;
- feral pigs;
- competition and habitat degradation by feral goats; and
- herbivory and environmental degradation caused by feral deer.

The above threatening processes have been considered in the following Eight Part Tests of Significance.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

In assessing species' distribution boundaries under Part (h) of the Eight Part Test, a number of databases and reference materials have been examined including the Atlas of NSW Wildlife (NPWS, 2005a, b and c), field guides and seminal texts (eg. Schodde and Tidemann, 1997; Cogger, 2000; Garnett and Crowley, 2000; Strahan, 1998). Various scientific publications and recovery plans have also been reviewed.

HE3 EIGHT PART TESTS OF SIGNIFICANCE

HE3.1 THREATENED FLORA SPECIES

HE3.1.1 A Rice Bush (*Ozothamnus tesselatus*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Rice Bush (*Ozothamnus tesselatus*) is a dense shrub that grows in Eucalypt woodland to a height of approximately 1 m (Harden, 1992). The plant's leaves have a green and shining upper surface and a white and woolly lower surface (*ibid.*). *O. tesselatus* produces golden, bisexual flowers in spring (Harden, 1992; Everett, 1992 in Hill, 2000).

Threats to *O. tesselatus* include grazing, logging and agricultural activities (Hill, 2000). The habitat of *O. tesselatus* is woodlands of Slaty Gum, *Eucalyptus dawsonii* or Grey Gum, *E. punctata* on talus of Narrabeen sandstone or Permian siltstone (McRae and Cooper, 1985). While no potential habitat resources for this species occur in the Project area, they do occur in the ranges surrounding the Project area.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *O. tesselatus* has been recorded at four locations in the region (ie. Merriwa 1:100,000 map sheet), the closest of which is located approximately 23 km east of the Project area[1]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is unlikely that a local population of *O. tesselatus* occurs in the Project area given the lack of potential habitat resources.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

O. tesselatus grows in woodland dominated by Slaty Gum or Grey Gum on talus slopes derived from Narrabeen sandstone or Permian siltstone (McRae and Cooper, 1985). In the Sydney Basin Bioregion, this species has been recorded in the Goulburn River and Wollemi National Parks (Briggs and Leigh, 1996).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *O. tesselatus*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes of the sandstone ranges outside of proposed disturbance areas (*ibid.*) (Figure HE-4).

[1] This record has an accuracy of 0.1 km (NPWS, 2005a)

No known (or potential) habitat for this species will be modified or removed for the Project since potential habitat only occurs on the sandstone ranges surrounding the Project area.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *O. tesselatus* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *O. tesselatus* occurs in the areas surrounding the Project area, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

O. tesselatus occurs in the area north of Rylstone (Harden, 1992). In the Sydney Basin Bioregion, this species has been recorded in the Goulburn River and Wollemi National Parks (Briggs and Leigh, 1996). This species is distributed in the north-western corner of the NSW Sydney Basin Bioregion (NPWS, 2005c) and potential habitat (as described above) seems to occur in select protected areas in the bioregion.

While Briggs and Leigh (1996) states this species occurs in Goulburn River and Wollemi National Parks, the Atlas of NSW Wildlife (NPWS, 2005b) indicates that *O. tesselatus* has been recorded at five locations in the bioregion, of which four are located in one protected area, namely the Goulburn River National Park. An overview of the records in the protected areas is provided in Table HE-3.

Table HE-3
Records of a Rice Bush (*Ozothamnus tesselatus*) in Protected Areas in the Sydney Basin Bioregion

Protected Area	Range of Recorded Numbers	Number of Locations	Date of Records
Goulburn River National Park	Approx. 5 to 100	4	1893-1996

Source: NPWS, 2005b

The information provided suggests that habitat for *O. tesselatus* may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

O. tesselatus occurs in the area north of Rylstone (Harden, 1992). In the Sydney Basin Bioregion, this species has been recorded in the Goulburn River and Wollemi National Parks (Briggs and Leigh, 1996). All records are to the east of the Project area.

Considering the above, it can be concluded that the Project area is located west of the known distribution of *O. tesselatus* and therefore if this species were to occur in the Project area it may represent the western distributional limit for this species.

HE3.1.2 Small Purple Pea (*Swainsona recta*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at the risk of extinction

The Small Purple Pea (*Swainsona recta*) is an erect perennial herb which grows between 12-35 centimetres (cm) high (Ayers *et al*., 1996). Leaves are 3 to 6 cm long with five to 13 pairs of linear 10 to 20 millimetres (mm) long leaflets (*ibid.*). This species resprouts from a woody root stock during autumn and winter (Australian Capital Territory (ACT) Government, 1997).

Flowering usually occurs between September and December (Thompson and James, 1991 in Ayers *et al*., 1996). Ten to 20 purple flowers are arranged in the upper half of an erect raceme 10 to 25 cm long. The seed ripens in late December to early January and the shoot dies leaving only the root stock (ACT Government, 1997). Fire benefits the species by breaking the hard seed coat (Ayers *et al*., 1996). Individual plants are thought to live up to 20 years or more (*ibid.*).

The threats which are relevant to *S. recta* include habitat loss, degradation and fragmentation (after ACT Government, 1997). However, plants are usually not killed by light trampling and are sometimes able to resprout (Briggs and Mueller, in prep in ACT Government, 1997). Flowering and seed germination can be suppressed by competition with dense ground covers (eg. grasses and weed species) (ACT Government, 1997; Ayers *et al*., 1996). Two main centres of distribution are known for extant populations of this species, namely the Wellington to Mudgee area, and the ACT and nearby parts of NSW. The Wellington-Mudgee occurrences are closest to the Project area.

Some potential habitat resources for this species occur in the Project area and surrounds. In the Wellington-Mudgee area *S. recta* occurs in grassy open woodland on undulating terrain with dominant tree species including White Box, *Eucalyptus albens*, White Cypress Pine, *Callitris glaucophylla*, Yellow Box, *E. melliodora*, Blakely's Red Gum, *E. blakelyi* and Long-leaved Box, *E. goniocalyx* (Ayers *et al.,* 1996). These tree species constitute the White Box, Yellow Box, Blakely's Red Gum Endangered Ecological Community, remnants of which occur on the Project area where they have been designated as Communities 1 and 5a (FloraSearch 2005). The Project will involve the removal/modification of a portion of potential habitat resources for *S. recta* and may disrupt reproduction including pollination, germination and establishment of this species (were it to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates that *S. recta* have been recorded at four locations in the region (ie. Mudgee 1:100,000 map sheet), the closest of which is located approximately 30 km south-west of the Project area[2]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is possible that a local population of *S. recta* could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the lack of records near the Project area (despite targeted surveys).

[2] This record has an accuracy of 1 km (NPWS, 2005a)

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Habitat for *S. recta* occurs in grassy open woodland on grey sandy or stony loams always on undulating terrain (ACT Government, 1997; Ayers *et al*., 1996). Dominant associated species include: White Box (*E. albens*), White Cypress (*Callitris glaucophylla*), Blakely's Red Gum (*E. blakelyi*), Yellow Box (*E. mellidora*), *E. goniocalyx*, Kangaroo Grass (*Themeda australis*), *Helichrysum apiculatum, Bulbine bulbosa, Leptohynchos squamatus*, *Pseudognaphalium luteoalbum* and *Dichopogon fimbriatus* (*ibid.*). The ACT Action Plan for *S. recta* also lists Black Cypress (*Callitris endlicheri*), *E. bridgesiana*, *E. dives*, Grey Box (*E. microcarpa*), *E. nortonii* and *E. polyanthemos* as associated species (ACT Government, 1997). This species has also been recorded in secondary grassland in NSW (ACT Government, 1997).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *S. recta*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Some potential habitat for this species occurs within the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for *S. recta*. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *S. recta* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *S. recta* occurs within the Project area and surrounds, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

(e) *Whether critical habitat will be affected*

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

S. recta was formerly distributed on the Western Plains, Central Western Slopes and Southern Tablelands of NSW and inland north-eastern Victoria (Leigh *et al.,* 1984 in Ayers *et al*., 1996). This species' present distribution is known from Mt Arthur and the Burrendong Arboretum near Wellington, Mudgee, and several localities in the ACT (*ibid.*). This species is mainly distributed in the NSW South Western Slopes Bioregion however has been recorded in the north-western corner of the NSW Sydney Basin Bioregion (NPWS, 2005c). It is not known if potential habitat (as described above) occurs in any protected areas in the bioregion.

S. recta has not been recorded in any conservation reserve in the NSW Sydney Basin Bioregion. The Atlas of NSW Wildlife (NPWS, 2005b) indicates this species has been recorded at one location in the bioregion and this was not in a conservation reserve.

The information provided above suggests habitat for *S. recta* is not adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

S. recta was formerly distributed on the Western Plains, Central Western Slopes and Southern Tablelands of NSW and inland north-eastern Victoria (Leigh *et al.,* 1984 in Ayers *et al*., 1996). This species' present distribution is known from Mt Arthur and the Burrendong Arboretum near Wellington, Mudgee, and several localities in the ACT (*ibid.*). It appears to be confined to the upper areas of the western slopes in NSW and the ACT.

Considering the above, it can be concluded that if *S. recta* were to occur within the Project area it would be at the north-eastern limit of its range.

HE3.1.3 A Kennedy Pea (*Kennedia retrorsa*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Kennedy Pea (*Kennedia retrorsa*) is a climbing perennial herb that appears prostrate when unsupported and may form a multi-stemmed bush when subject to grazing or slashing (NPWS, 2000d). However, if supported, *K. retrorsa* forms dense mounds to 4 m high (*ibid.*). Flowers are pea-shaped (12-15 mm long) and coloured pink/purple or scarlet (*ibid.*). Flowers are arranged in groups of 4 to 20 and each flower consists of four petals (NPWS, 2000d).

K. retrorsa is likely to reproduce by self-pollination and outbreeding assisted by bees (NPWS, 2000d). The peak flowering period for this species is September to December while seeds are produced from October to December and are released at maturity (*ibid.*). Seeds are mostly locally dispersed, accumulate in the surrounding soil, and have a period of dormancy.

Threats to *K. retrorsa* include wildfire and fire management activities because the majority of presently known populations are reproductively immature and are therefore susceptible to fire (NPWS, 2000d). Grazing may also threaten *K. retrorsa.*

Some potential habitat resources for this species occur in the Project area surrounds. It occurs in a variety of situations on soils derived from Narrabeen Group sediments including mountain sides, rocky ridgelines, sheltered forest and riparian zones (NPWS, 2000d). The dominant tree species are those associated with sandstone ranges in the north-western parts of the Sydney Basin including Rough-barked apple, *Angophora floribunda*; Grey Gum, *Eucalyptus punctata*; Slaty Gum, *Eucalyptus dawsonii*; Narrow-leaved Ironbark, *E. crebra*; Broad-leaved Ironbark, *E. fibrosa* and Narrow-leaved Stringybark, *E. sparsifolia* (*ibid.*), all of which occur on the sandstone ranges surrounding the Project area. These species are components of Community 6 as defined by FloraSearch (2005). While no potential habitat resources for this species occur in the Project area, they do occur in the rocky gullies of the sandstone ranges surrounding the Project area.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *K. retrorsa* has been recorded at 11 locations in the region (ie. Merriwa 1:100,000 map sheet), the closest of which is located approximately 47 km east of the Project area[3]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is unlikely that a local population of *K. retrorsa* occurs in the Project area given the lack of potential habitat resources.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

K. retrorsa is found in a broad range of habitats including mountain sides, riparian zones, sheltered forest, including on a range of substrates such as exposed rocky ridgelines and in sandy soils (NPWS, 2000d).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *K. retrorsa*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. No known (or potential) habitat for this species will be modified or removed for the Project since potential habitat only occurs on the sandstone ranges surrounding the Project area.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *K. retrorsa* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *K. retrorsa* occurs only in areas surrounding the Project area, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

[3] This record has an accuracy of 1 km (NPWS, 2005a)

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

K. retrorsa has a very restricted distribution, and is known from the Mt. Dangar area and the Goulburn River catchment area (NPWS, 2000d) and between the Goulburn River and the village of Putty. This species is distributed in the north-west of the NSW Sydney Basin Bioregion (NPWS, 2005c) however potential habitat (as described above) occurs in many protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates *K. retrorsa* has been recorded at 13 locations in the bioregion, of which 11 are located in two protected areas, namely Goulburn River and Wollemi National Parks. An overview of the records in the protected areas is provided in Table HE-4.

Table HE-4
Records of a Kennedy Pea (*Kennedia retrorsa*) in Protected Areas in the Sydney Basin Bioregion

Protected Area	Range of Recorded Numbers	Number of Records	Date of Records
Goulburn River National Park	Unknown	6	1966-1999
Wollemi National Park	5-59	5	1984-1999

Source: NPWS, 2005b

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Yengo National Park (NPWS, 2001d); Munghorn Gap Nature Reserve (NPWS, 2003a) and Parr State Recreational Area (NPWS, 2001d).

The information provided suggests that habitat for *K. retrorsa* is likely to be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

K. retrorsa has a very restricted distribution, and is known from the Mt. Dangar area and the Goulburn River catchment area (NPWS, 2000d) and between the Goulburn River and the village of Putty.

Considering the above, it can be concluded that the Project area is located outside the known distribution of *K. retrorsa* and if it occurred on the Project area may represent the western distributional limit for this species.

HE3.1.4 Narrow-leaved Goodenia (*Goodenia macbarronii*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Narrow-leaved Goodenia (*Goodenia macbarronii*) is an annual herb that grows to 30 cm high (Harden, 1992). Flowers are in racemes on almost leafless scapes and flowering occurs mainly between October and March followed by ovoid fruit with yellow-brown seeds (*ibid.*).

Threats to *G. macbarronii* are not specifically known. However, the removal of habitat is a threat relevant to this species. Some potential habitat resources for this species occur in the Project area and surrounds (moist sites such as soaks, discharge areas or roadside drains). Vegetation communities in which *G. macbarronii* occurs include the White Box, Yellow Box, Blakely's Red Gum Endangered Ecological Community (Porteners, 1997), which is found on the Project area. The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt reproduction including pollination, germination and establishment of this species (were it to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *G. macbarronii* has been recorded at three locations in the region (ie. Gulgong 1:100,000 map sheet), the closest of which is located approximately 8 km north-north-west of the Project area[4]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is possible that a local population of *G. macbarronii* could occur in the Project area given the occurrence of potential habitat resources and records near the Project area. However, it is considered that a local viable population of this species (were one to exist) would not be placed at risk of extinction given the localised nature of the Project.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

G. macbarronii grows in damp, sandy soils, south from Guyra and Inverell districts (Harden, 1992). This species requires permanently moist sites such as soaks or discharge areas below rocky hills (Berwick, 1996).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *G. macbarronii*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for *G. macbarronii*. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

[4] This record has an accuracy of 1 km (NPWS, 2005a)

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *G. macbarronii* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *G. macbarronii* occurs within the Project area and surrounds, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

G. macbarronii is quite widespread with many recent records in NSW where it occurs south from the Guyra and Inverell districts to the Victorian border (Harden, 1992). This species is mainly distributed in the NSW South Western Slopes Bioregion and Brigalow Belt South Bioregion however has been recorded in the north and north-west of the NSW Sydney Basin Bioregion (NPWS, 2005c). It is not known if potential habitat (as described above) occurs in any protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates this species has been recorded at four locations in the bioregion and none of these records occur in conservation reserves. However, this species was recorded in Munghorn Gap Nature Reserve recently by TransGrid (2004).

The information provided above suggests habitat for *G. macbarronii* may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

G. macbarronii is quite widespread with many recent records in NSW and Victoria. In NSW, this species occurs south from the Guyra and Inverell districts to the Victorian border (Harden, 1992).

Considering the above, it can be concluded that the Project area is located within the known distribution of *G. macbarronii* and therefore does not represent a distributional limit for this species.

HE3.1.5 A Mint-bush (*Prostanthera discolor*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Mint Bush (*Prostanthera discolor*) is a perennial, open, erect shrub which grows 0.6-3 m high and 1-2 m wide (NPWS, 2000e). This species produces flowers between September and October that are likely to be pollinated by insects (Conn, 1992; Keighery, 1980; NPWS, 2000e). *P. discolor* is likely to be reproductively mature at three to five years old (NPWS, 2000e). The seed has low viability, complex dormancy mechanisms and short duration of seed viability (*ibid.*).

Threats to *P. discolor* include low population numbers, fire, and catchment changes leading to nutrification or introduction of pathogens. However, the effect of vegetation clearance on the lifecycle of pollinators is currently unknown because the pollination vectors for *Prostanthera* are poorly known (NPWS, 2000e).

The habitat of *P. discolor* is rocky soils derived from Narrabeen sandstone in the side gullies of creeklines (NPWS, 2000e). Dominant overstorey trees include Grey Gum, *Eucalyptus punctata*; Broad-leaved Ironbark, *E. fibrosa* and Caley's Ironbark, *E. caleyi* (*ibid.*). While no potential habitat resources for this species occur in the Project area, they do occur in the rocky gullies of the sandstone ranges surrounding the Project area.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *P. discolor* has been recorded at six locations in the region (ie. Mt. Pomany and Merriwa 1:100,000 map sheets), located approximately 29 km east of the Project area[5]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is unlikely that a local population of *P. discolor* occurs in the Project area given the lack of potential habitat resources.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

P. discolor often grows in open forest in rocky substrate of the side gullies of main creeklines (Conn, 1992, NPWS, 2000e). This species has been recorded within the Goulburn River National Park (Briggs & Leigh, 1996).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *P. discolor*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known or potential habitat for this species will be modified or removed for the Project since potential habitat only occurs on the rocky gullies in the sandstone ranges surrounding the Project area.

[5] This record has an accuracy of 10 km (NPWS, 2005a)

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *P. discolor* is described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *P. discolor* occurs in areas surrounding the Project area, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

P. discolor is restricted to a few known localities from Bylong to the Baerami Valley in the Central Western Slopes Botanical Division of NSW. Potential habitat occurs within the Rylstone (Mid-Western Regional Council) and Muswellbrook Shires (NPWS, 2000e). This species is distributed in the north-western corner of the NSW Sydney Basin Bioregion (NPWS, 2005c), however, potential habitat (as described above) occurs in two protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *P. discolor* has been recorded at six locations in the bioregion, of which five are located in one protected area, namely Wollemi National Park. An overview of the records in the protected areas is provided in Table HE-5.

Table HE-5
Records of a Mint-bush (*Prostanthera discolor*) in Protected Areas in the Sydney Basin Bioregion

Protected Area	Range of Recorded Numbers	Number of Records	Date of Records
Wollemi National Park	Up to 100	5	1969-1999

Source: NPWS, 2005b

Further, it is recognised that this species occurs in Goulburn River National Park (Briggs and Leigh, 1996).

The information provided suggests that habitat for *P. discolor* may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion, given the size of Wollemi National Park and Goulburn River National Parks and the large area of potential habitat they contain.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

P. discolor is restricted to a few known localities from Bylong to the Baerami Valley in the Central Western Slopes Botanical Division of NSW. Potential habitat occurs within the Rylstone (Mid-Western Regional Council) and Muswellbrook Shires (NPWS, 2000e).

Considering the above, it can be concluded that the Project area is located close to the western distribution of *P. discolor* and if it occurred in the Project area, may represent a distributional limit for this species.

HE3.1.6 A Mint-bush (*Prostanthera cryptandroides*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Mint Bush (*Prostanthera cryptandroides* subsp. *cryptandroides*) is a low divaricate perennial shrub which grows to approximately 0.5 to 2 m in height and chiefly produces mauve insect-pollinated flowers from September to April (Harden, 1990; NPWS, 2000f). This species is likely to reach reproductive maturity at three to five years with recruitment occurring from the soil seed bank after fire (NPWS, 2000f).

A recent morphological re-evaluation of the *P. cryptandroides, P. euphrasioides* and *P. odoratissima* complex by Conn (1999) concluded that it comprised a single species (*P. cryptandroides*) and two sub-species (subsp. *cryptandroides* and subsp. *euphrasioides*). The listing of *P. cryptandroides* as Vulnerable under the TSC Act is considered to refer to subsp. *cryptandroides* (Bell, 2001).

Threats to *P. cryptandroides* subsp. *cryptandroides* include habitat loss through land degradation, grazing, weed invasion, inappropriate fire regimes, nutrification of the soil, and other factors that affect this species include contact with waterborne and soil pathogens, runoff, erosion and sedimentation (*ibid.*).

The habitat of *P. cryptandroides* is open forest on soils derived from Narrabeen Group sediments on talus slopes, amongst sandstone pagodas or on rocky ridgelines (NPWS, 2000f). At Glen Davis, *P. cryptandroides* occurs in a community dominated by Broad-leaved Ironbark, *Eucalyptus fibrosa* on talus slopes with White Box, *E. albens*; Narrow-leaved Ironbark, *E. crebra*; Slaty Gum, *E. dawsonii*; Grey Gum, *E. punctata* and Black Cypress Pine, *Callitris endlicheri*. A very similar community occurs on the lower to mid slopes of the sandstone ranges surrounding the Project area and represents potential habitat for this species. *P. cryptandroides* also occurs in open forest and heath associations on sandstone ridge and plateaux in the Denman area and the north of Wollemi National Park (NPWS, 2000f). While no potential habitat resources for this species occur in the Project area, potential resources do occur in sclerophyll forests on the rocky ridges and slopes of the sandstone ranges surrounding the Project area.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *P. cryptandroides* subsp. *cryptandroides* has been recorded at one location in the region (ie. Mt. Pomany 1:100,000 map sheet), located approximately 60 km south-east of the Project area[6]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is unlikely that a local population of *P. cryptandroides* subsp. *cryptandroides* occurs in the Project area given the lack of potential habitat resources.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

[6] This record has an accuracy of 0.1 km (NPWS, 2005a)

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

P. cryptandroides subsp. *cryptandroides* grows in dry sclerophyll forest (Harden, 1990), often on rocky sites, and has been identified growing at the base of sandstone boulders (Muswellbrook, Scone and Singleton Bush Fire Management Committees, undated). *P. cryptandroides* subsp. *cryptandroides* is also found on dry shelving sandstone hills on the north-west branch of Hunter's River and on a Pine or *Callitris* range on the southern approaches to Mt. Dangar (Cunningham, 1825 in Conn, 1999).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *P. cryptandroides* subsp. *cryptandroides*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known or potential habitat for this species will be modified or removed for the Project since potential habitat only occurs on the hillslopes and ridgetops of the sandstone ranges surrounding the Project area.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *P. cryptandroides* subsp. *cryptandroides* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *P. cryptandroides* subsp. *cryptandroides* occurs in areas surrounding the Project area, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

P. cryptandroides subsp. *cryptandroides* is primarily restricted to the Central Tablelands and Central Western Slopes Botanical Divisions in the Lithgow and Sandy Hollow districts (Harden, 1990; Conn, 1999). *P. cryptandroides* subsp. *cryptandroides* is found on dry shelving sandstone hills on the north branch of Hunter's River and on a Pine or *Callitris* range on the southern approaches to Mt. Dangar (Cunningham, 1825 in Conn, 1999). Conn (1999) also refers to a collection from Bumberry in the Harvey Range near Parkes, where it is now presumed to be extinct. This species is distributed in the north of the NSW Sydney Basin Bioregion (NPWS, 2005c), however potential habitat (as described above) occurs in a number of protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *P. cryptandroides* subsp. *cryptandroides* has been recorded at 13 locations in the bioregion, of which 6 are located in two protected areas, namely Wollemi and Gardens of Stone National Parks. An overview of the records in the protected areas is provided in Table HE-6.

Table HE-6
Records of a Mint-bush (*Prostanthera cryptandroides* subsp. *cryptandroides*) in Protected Areas in the Sydney Basin Bioregion

Protected Area	Range of Recorded Numbers	Number of Records	Date of Records
Wollemi National Park	60-1000	6	1964-1999
Gardens of Stone National Park	Records occur outside Sydney Basin Bioregion		

Source: NPWS, 2005b

This sub-species is also known to occur in the Blue Mountains National Park (Briggs and Leigh, 1996).

The information provided suggests that habitat for *P. cryptandroides* subsp. *cryptandroides* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

P. cryptandroides subsp. *cryptandroides* is primarily restricted to the Central Tablelands and Central Western Slopes Botanical Divisions in the Lithgow and Sandy Hollow districts and the Central Western Slopes Botanical Division in the upper Hunter Valley (Harden, 1990; Conn, 1999). *P. cryptandroides* subsp. *cryptandroides* is found on dry shelving sandstone hills on the north branch of Hunter's River and on a Pine or *Callitris* range on the southern approaches to Mt. Dangar (Cunningham, 1825 in Conn, 1999). Conn (1999) also refers to a collection from Bumberry in the Harvey Range near Parkes, where it is now presumed to be extinct.

Considering the above, it can be concluded that the Project area is located outside the known distribution of *P. cryptandroides* subsp. *cryptandroides* and if it occurred on the Project area may represent the north-western distributional limit of this species.

HE3.1.7 A Mint-bush (*Prostanthera stricta*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Mint Bush (*Prostanthera stricta*) is a perennial bushy shrub which grows to approximately 2 m in height and 3 m in diameter, and produces mauve/violet flowers from winter to spring (Harden, 1990; Ollerenshaw, 1988). The plant has densely hairy branches, 8-13 mm long ovate lamina leaves and terminal flowers (*ibid.*). Populations are often clonal (Harden, 1990) and the species is considered easy to grow from cuttings (Ollerenshaw, 1988).

There are two forms of *P. stricta* because *P.* aff. *stricta* which is found in the northern Wollemi area differs from the type form (*P. stricta sensu stricto*) by having leaves which are broad ovate to ovate with broadly rounded leaf bases, as well as having a slightly longer and greater density of indumentum of the plant (NPWS, 2000g).

Threats to *P. stricta* include habitat clearance for mining, agriculture, residential and road development and inappropriate fire regimes, as well as grazing/trampling by feral and domesticated animals (NPWS, 2000g). In particular, potential pathogen infection points such as septic systems and access roads may result from increased density of dwellings and may pose a threat to *P. stricta* (*ibid.*).

The recorded habitats for *P. stricta sensu stricto* are the interfaces between basalt caps and the underlying Narrabeen sandstone in skeletal or deeper soils on rock platforms, or steep or gentle slopes (NPWS 2000g). The vegetation types are open forests and heathy scrubs, often on cliff edges (*ibid*.). *P.* aff. *stricta* is associated with Narrabeen Group geology and colluvial and alluvial deposits derived from it. It is locally common on cliff ledges, at the base of cliffs and in sandy deposits along watercourses (*ibid*.). While no potential habitat resources for this species occur in the Project area, they do occur in the rocky gullies of the sandstone ranges surrounding the Project area.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *P. stricta* has been recorded at 11 locations in the region (ie. Mudgee, Mt. Pomany and Merriwa 1:100,000 map sheets), the closest of which is located approximately 47 km east of the Project area[7]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is unlikely that a local population of *P. stricta* occurs in the Project area given the lack of potential habitat resources.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

P. stricta grows in sclerophyll forest, in sandy well-drained alluvium soil, near watercourses (Ollerenshaw, 1998; Harden, 1990). However, since 1999 this species has been recorded relatively frequently in sandstone environments between Putty and Ilford (after NPWS, 2005c).

P. stricta occurs in areas receiving between 600-700 mm annual rainfall, particularly on steep rocky side slopes, cliff-lines, sandstone platforms and gentle slopes with exposed sandstone outcroppings (NPWS, 2000g).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *P. stricta*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known (or potential) habitat for this species will be modified or removed for the Project since potential habitat only occurs on the sandstone ranges surrounding the Project area.

[7] This record has an accuracy of 0.1 km (NPWS, 2005a)

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *P. stricta* are described above. As previously established, no known habitat for this species occurs in the Project area or surrounds. While some potential habitat for *P. stricta* occurs in areas surrounding the Project area, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

P. stricta s. str. is found in Mt. Vincent and Genowlan Mountain, in the Central Tablelands Botanical Division of NSW whereas *P.* aff. *stricta* is found in Dingo Creek and the Widden and Baerami Valleys in the Central Western Slopes Botanical Division of NSW (Harden, 1990; NPWS, 2000g). This species is distributed in the north west of the NSW Sydney Basin Bioregion (NPWS, 2005c), however, potential habitat (as described above) occurs in a number of protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates that *P. stricta* has been recorded at 11 locations in the bioregion, of which four are located in one protected area, namely Wollemi National Park. An overview of the records in the protected areas is provided in Table HE-7.

Table HE-7
Records of a Mint-bush (*Prostanthera stricta*) in Protected Areas in the Sydney Basin Bioregion

Protected Area	Range of Recorded Numbers	Number of Records	Date of Records
Wollemi National Park	150-2200	4	1999

Source: NPWS, 2005b

The information provided suggests that habitat for *P. stricta* may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

P. stricta s. str. is found in Mt. Vincent and Genowlan Mountain, in the Central Tablelands Botanical Division of NSW whereas *P.* aff. *stricta* is found in Dingo Creek and the Widden and Baerami Valleys in the Central Western Slopes Botanical Division of NSW (Harden, 1990; NPWS, 2000g).

Considering the above, it can be concluded that the Project area is located outside the known distribution of *P. stricta* and if it occurred in the Project area may represent the western edge of the distribution of this species.

HE3.1.8 Cannon's Stringybark (*Eucalyptus cannonii*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Cannon's Stringybark (*Eucalyptus cannonii*) is a perennial which usually occurs as a tree 10-15m high with persistent stringy bark and produces white flowers from January to April (Benson and McDougall, 1998; NPWS, 2000h). The seed viability of *E. cannonii* is high, and is spread by wind and gravity to within close proximity to the parent tree (<30 m) (NPWS, 2000h). *E. cannonii* seems to produce hybrids with the closely related *E. macrorhyncha.*

Threats to *E. cannonii* include loss of habitat due to land clearing, open-cut coal mining, inappropriate fire regimes, road construction, grazing, logging, and firewood collection (NPWS, 2000h).

E. cannonii is found in Tablelands grassy forests at altitudes above 800m and in woodlands on talus slopes, which range in altitude from 200 to 900m (NPWS 2000h). Only the talus slope woodlands are found in or near the Project area. Typical tree species in talus slope woodlands in the core areas of the *E. cannonii* distribution include Red Stringybark, *E. macrorhyncha*; Broad-leaved Ironbark, *E. fibrosa* and Grey Gum, *E. punctata*, all of which occur on the slopes of the sandstone ranges surrounding the Project area. The Project will not involve the removal/modification of any known or potential habitat resources for this species.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *E. cannonii* has been recorded at 23 locations in the region (ie. Mudgee and Mt. Pomany 1:100,000 map sheets), the closest of which is located approximately 24 km south-east of the Project area[8]. During targeted surveys of the Project area and surrounds, *E. cannonii* was identified in Sandstone Range Shrubby Woodland (*E. punctata* ± *E. sparsifolia* ± *E. agglomerata* ± *C. endlicheri*) adjacent to Pit 5 (FloraSearch, 2005) (Figures HE-2 and HE-4).

Although a known population of Cannon's Stringybark occurs within the Project area surrounds, the Project is unlikely to disrupt the lifecycle of this species such that a viable local population is likely to be placed at risk of extinction since the Project will avoid any contact with the known Cannon's Stringybark population (Figure HE-4).

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Cannon's Stringybark is locally frequent, but restricted, to sclerophyll woodland on shallow soil on rises (Hill, 2002). *E. cannonii* most usually occurs on footslopes in grassy woodland, dominated by Red Stringybark and Long-leaved Box (NPWS, 2000h). Populations may be found in paddocks, along roadsides and in reserves (*ibid.*).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for Cannon's Stringybark. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

[8] This record has an accuracy of 1 km (NPWS, 2005a)

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Although a known population of Cannon's Stringybark occurs within the Project area surrounds, the Project will avoid any contact with this population (Figure HE-4). No known habitat for Cannon's Stringybark will be cleared or modified during this Project.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Cannon's Stringybark within the Project area including:

- *Enhancement and conservation of remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the Wilpinjong Enhancement and Conservation Areas (ECAs).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Appropriate exclusion fencing – to* reduce grazing by stock and encourage natural regeneration by fencing the perimeter of the ECAs. This is expected to benefit Cannon's Stringybark because grazing by stock prevents regeneration of native Eucalypt woodland.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation.

Further detail of these measures will be provided in a Flora and Fauna Management Plan as discussed in Section 5, Volume 1 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *E. cannonii* are described above. As previously established, known and potential habitat for *E. cannonii* occurs within the immediate surrounds of the Project area. Although a known population of Cannon's Stringybark occurs close to the margins of the Project disturbance area, the Project will avoid any contact with the Cannon's Stringybark known population (Figure HE-4).

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the disturbance and the connectivity of the surrounding potential habitat.

A number of measures have been developed to aid dispersion of *E. cannonii*, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs (Figure HE-5).
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland for *E. cannonii* in the long-term. A key objective of Project rehabilitation initiatives would be to establish corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

This species is restricted to the western side of the Blue Mountains from Mt. Piper to Mudgee area, as well as populations to the west in Winburndale Nature Reserve and adjacent State Forests (NPWS, 2000h). This species is distributed in the north-west of the NSW Sydney Basin Bioregion (NPWS, 2005c), however, potential habitat (as described above) occurs in a number of protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates that *E. cannonii* has been recorded at 25 locations in the bioregion, of which nine are located in two protected areas, namely Wollemi and Gardens of Stone National Parks. An overview of the records in the protected areas is provided in Table HE-8.

Table HE-8
Records of Cannon's Stringybark (*Eucalyptus cannonii*) in Protected Areas in the Sydney Basin Bioregion

Protected Area	Range of Recorded Numbers	Number of Records	Date of Records
Wollemi National Park	1-20	6	1969-1999
Gardens of Stone National Park	unknown	3	2001

Source: NPWS, 2005b

The information provided suggests that habitat for *E. cannonii* is not adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

This species is restricted to the western side of the Blue Mountains from Mt. Piper to Mudgee area, as well as populations to the west in Winburndale Nature Reserve and adjacent State Forests (NPWS, 2000h).

Considering the above, it can be concluded that the Project area is at the northern limits of the distribution of *E. cannonii*.

HE3.1.9 *Homoranthus darwinioides*

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

H. darwinioides is a spreading shrub, usually 1-1.5 m high which flowers between March to December but mainly during spring (Weston and Harden, 2002).

Threats to *H. darwinioides* include inappropriate fire regimes (Ayers *et al*., 1996). The removal of habitat is a threat also relevant to this species.

H. darwinioides occurs in heaths and open forests on the upper slopes and ridges of the Narrabeen sandstone ranges in Goulburn River National Park (Hill, 2000). The dominant trees include Broad-leaved Ironbark, *Eucalyptus fibrosa*; Black Cypress Pine, *Callitris endlicheri*; Narrow-leaved Ironbark*, E. crebra*; Narrow-leaved Stringybark, *E. sparsifolia*; Blue-leaved Stringybark, *E. agglomerate* and Grey Gum, *E. punctata* (*ibid.*), all of which occur on the sandstone ranges surrounding the Project area, but not in the proposed Project disturbance areas. While no potential habitat resources for this species occur in the Project area, they do occur in woodland and heath on the rocky ridges of the sandstone ranges surrounding the Project area.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *H. darwinioides* has been recorded at three locations in the region (ie. Merriwa 1:100,000 map sheet), located approximately 10 km east of the Project area[9]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is unlikely that a local population of *H. darwinioides* occurs in the Project area given the lack of potential habitat resources.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

H. darwinioides grows in dry sclerophyll forest or woodland, usually on sandstone ridges or outcrops (Weston and Harden, 2002).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *H. darwinioides*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known (or potential) habitat for this species will be modified or removed for the Project since potential habitat only occurs on the sandstone ranges surrounding the Project area.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *H. darwinioides* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *H. darwinioides* occurs in areas surrounding the Project, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

[9] This record has an accuracy of 0.1 km (NPWS, 2005a)

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

H. darwinioides is rare, occurring from the Dubbo district to Merriwa, primarily recorded from Goonoo Forest and Lee's Pinch (Weston and Harden, 2002). This species is mainly distributed in the Brigalow Belt South Bioregion however has been recorded in the north-western corner of the NSW Sydney Basin Bioregion (NPWS, 2005c). Potential habitat (as described above) occurs in a number of protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *H. darwinioides* has been recorded at three locations in the bioregion, of which all are located in one protected area, namely Goulburn River National Park. An overview of the records in the protected areas is provided in Table HE-9.

Table HE-9
Records of *Homoranthus darwinioides* in Protected Areas in the Sydney Basin Bioregion

Protected Area	Range of Recorded Numbers	Number of Records	Date of Records
Goulburn River National Park	unknown	3	1951-1989

Source: NPWS, 2005b

Additional findings of *H. darwinioides* have recently been made in Goulburn River National Park by Hill (2000). The information provided suggests that habitat for *H. darwinioides* may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

H. darwinioides is rare, occurring from the Dubbo district to Merriwa, primarily recorded from Goonoo Forest and Lee's Pinch (Weston and Harden, 2002).

Considering the above, it can be concluded that the Project area is located within the known distribution of *H. darwinioides* and does not represent a distributional limit for this species.

HE3.1.10 Clandulla Geebung (*Persoonia marginata*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Clandulla Geebung (*Persoonia marginata*) is a spreading shrub that grows to 50 cm high and 1 m across and produces yellow flowers in winter (NPWS, 2000i) or spring (Blombery & Maloney, 1992) or January-February (Weston, 1995). Long fleshy fruit with a stone are likely to be dispersed by birds and mammals and germination is likely to be triggered by fire and/or high light levels (*ibid.*). Fire therefore assists the lifecycle of *P. marginata* by creating niches for the establishment of young (*ibid.*). Substantial numbers of fruit do not survive to maturity, possibly indicating a pollen incompatibility problem.

Threats to *P. marginata* include disease (including fungal pathogens), intense fire, drought, weed invasion due to dumping of garden waste, introduced honey bees, and road construction (NPWS, 2000i). Nevertheless, this species appears to respond well to disturbance which is evidenced by the greater densities found along the edges of tracks and in areas disturbed by forestry (NPWS, 2000i).

The habitat of *P. marginata* is dry woodlands on Shoalhaven Group sediments. The dominant tree species include Grey Gum, *Eucalyptus punctata*; Narrow-leaved Stringybark, *E. sparsifolia*; Broad-leaved Ironbark, *E. fibrosa* and Narrow-leaved Ironbark, *E. crebra*, which all occur on the sandstone ranges surrounding the Project area, but not on the proposed disturbance areas for the Project.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *P. marginata* has been recorded at 17 locations in the region (ie. Mudgee and Merriwa 1:100,000 map sheet), the closest of which is located approximately 50 km east of the Project area[10]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is unlikely that a local population of *P. marginata* occurs in the Project area given the lack of potential habitat resources.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

P. marginata is found in dry woodland communities on flat land with sandy soils associated with Shoalhaven Group sediments (NPWS, 2000i). Note that Shoalhaven Group sediments do not occur on the Project area or surrounds. However, there are records of *P. marginata* at the eastern end of Goulburn River National Park (NPWS, 2005) and these are probably on Narrabeen Group sediments.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *P. marginata*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

[10] This record has an accuracy of 0.1 km (NPWS, 2005a)

No known (or potential) habitat for this species will be modified or removed for the Project since potential habitat only occurs on the sandstone ranges surrounding the Project area.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *P. marginata* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *P. marginata* occurs in areas surrounding the Project area, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

P. marginata occurs mainly in the area between Kandos and Portland in the Capertee district of central-eastern NSW (Harden, 1991; DEH, 2004a). This species is distributed sparsely in the centre of the NSW Sydney Basin Bioregion, (NPWS, 2005c), however, potential habitat (as described above) occurs in a number of protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *P. marginata* has been recorded at 21 locations in the bioregion, of which six are located in three protected areas, namely Goulburn River, Wollemi and Gardens of Stone National Parks. An overview of the records in the protected areas is provided in Table HE-10.

Table HE-10
Records of Clandulla Geebung (*Persoonia marginata*) in Protected Areas in the Sydney Basin Bioregion

Protected Area	Range of Recorded Numbers	Number of Records	Date of Records
Goulburn River National Park	5-50	4	1999
Wollemi National Park	5-59	2	1999
Gardens of Stone National Park	Records are outside the Sydney Basin Bioregion		

Source: NPWS, 2005b

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Yengo National Park (NPWS, 2001d) and Parr State Recreational Area (NPWS, 2001d).

The information provided suggests that habitat for *P. marginata* may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

P. marginata occurs mainly in the area between Kandos and Portland in the Capertee district of central-eastern NSW (Harden, 1991; DEH, 2004a), however this species is also known to occur 50 km east of the Project area (NPWS, 2005b).

Considering the above, it can be concluded that the Project area is located outside the known distribution of *P. marginata* and if it occurred on the Project area may represent the north western edge of the distribution of this species.

HE3.1.11 A Pomaderris (*Pomaderris queenslandica*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Pomaderris (*Pomaderris queenslandica*) is a shrub which grows to 2 to 3 m high and produces cream flowers without petals (Weston and Harden, 2000).

Threats to *P. queenslandica* are not specifically known. However, the removal of habitat is a threat relevant to this species. The existing literature provides no specific information on the habitat of *P. queenslandica* except that it occurs in 'sheltered dry sclerophyll forest' near Denman (Hill, 2000) and 'moist eucalypt forests with a shrubby understorey and occasionally along creeks' (NPWS, 2000j). To be conservative, it is considered that some potential habitat resources for this species may occur in the Project area and surrounds. The Project will involve the removal/modification of a portion of these potential habitat resources and may disrupt germination and establishment of this species (were it to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *P. queenslandica* has not been recorded in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets). Historically, *P. queenslandica* has been recorded near Mt. Dangar in Goulburn River National Park (Harden, 2000). However, recent collections have been made in the upper Hunter Valley at two locations near Denman, including Manobalai Nature Reserve, and in Towarri National Park, near Scone (Bell, 2001). This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is possible that a local population of *P. queenslandica* could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the absence of records near the Project area (despite targeted surveys).

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

P. queenslandica grows in dry or moist eucalypt forest with a shrubby understorey, occasionally along creeks (Hill, 2000; NPWS, 2000j). This species also occurs in open forest, primarily on the slopes north of the Peak Hill district, also in the Gloucester district (Weston and Harden, 2000) and several other locations on the north coast (NPWS, 2000j).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *P. queenslandica*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for *P. queenslandica*. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *P. queenslandica* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *P. queenslandica* may occur within the Project area and surrounds, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

P. queenslandica occurs primarily north of the Peak Hill district, and also on the NSW north coast and upper Hunter Valley (Weston and Harden, 2000; NPWS, 2000j; Bell, 2001). This species is distributed in the north of the NSW Sydney Basin Bioregion (NPWS, 2005c), however, potential habitat (as described above) occurs in a number of protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *P. queenslandica* has been recorded at five locations in the bioregion, of which four are located in two protected areas, namely Towarri National Park and Manobalai Nature Reserve. An overview of the records in the protected areas is provided in Table HE-11.

Table HE-11
Records of a Pomaderris (*Pomaderris queenslandica*) in Protected Areas in the Sydney Basin Bioregion

Protected Area	Range of Recorded Numbers	Number of Records	Date of Records
Towarri National Park	4-10	3	2000
Manobalai Nature Reserve	20	1	1999

Source: NPWS, 2005b

The populations within this National Park and Nature Reserve do appear small (well less than 1000 plants) (Bell, 2001).

The information provided suggests that habitat for *P. queenslandica* is not adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

P. queenslandica occurs primarily north of the Peak Hill district, and on the north coast (Weston and Harden, 2000; NPWS, 2000j). This species has recently been identified in Manobalai Nature Reserve and Towarri National Park in the upper Hunter Valley (NPWS, 2005b; Bell, 2001).

Considering the above, it can be concluded that the Project area is located outside the known distribution of *P. queenslandica* and if it occurred on the Project area may represent the western edge of the distribution of this species.

HE3.1.12 A Waxflower (*Philotheca ericifolia*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Waxflower (*Philotheca ericifolia*) is a shrub that grows to approximately 1-2 m high in dry sclerophyll forest and heath (Weston and Harden, 2002). During spring, this species produces purple to pink flowers in clusters (*ibid.*).

P. ericifolia was previously called *Eriostemon ericifolius* before a taxonomic review of the *Eriostemon* and *Philotheca* genera in 1998 (Wilson, 1998).

The threats to *P. ericifolia* are not specifically known. However, the removal of habitat is a threat relevant to this species. There is very little precise habitat information for *P. ericifolia* in the literature. Hill (2000) notes that it was recorded near Denman in 1908 in a 'dry sandstone habitat' and that potential habitat occurs in the heathy open forests of the sandstone ranges in Goulburn River National Park and Munghorn Gap Nature Reserve. Weston and Harden (2002) note the habitat as 'dry sclerophyll forest and heath'. Potentially suitable habitats for *P. ericifolia* may occur on dry hills with shallow soil in the Project area (Community 3 of FloraSearch, 2005) and surrounds (Communities 5b and 6 of FloraSearch, 2005). Potential habitat resources for this species occur in the Project area and on the sandstone ranges surrounding the Project area.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *P. ericifolia* has been recorded at one location in the region (ie. Mt. Pomany 1:100,000 map sheet), located approximately 64 km south-south-east of the Project area[11]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is possible that a local population of *P. ericifolia* could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the lack of records near the Project area (despite targeted surveys).

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

P. ericifolia grows mainly in dry sclerophyll forest and heath (Weston and Harden, 2002).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *P. ericifolia*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for *P. ericifolia*. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *P. ericifolia* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *P. ericifolia* occurs within the Project area and surrounds, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

[11] This record has an accuracy of 1 km (NPWS, 2005a)

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The main distribution of *P. ericifolia* is in the Brigalow Belt South bioregion from the northern Pilliga Scrub to the Peak Hill and Upper Hunter Valley districts (Weston and Harden, 2002). This species is distributed in the north-western part of the NSW Sydney Basin Bioregion (NPWS, 2005c), however, potential habitat (as described above) occurs in a number of protected areas in the bioregion.

It is not known whether *P. ericifolia* has been recorded in any conservation reserve in the NSW Sydney Basin Bioregion. The Atlas of NSW Wildlife (NPWS, 2005b) indicates this species has been recorded at two locations in the bioregion and neither of these records occur in conservation reserves.

The information provided above suggests habitat for *P. ericifolia* may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The main distribution of *P. ericifolia* is in the Brigalow Belt South bioregion from the northern Pilliga Scrub to the Peak Hill and Upper Hunter Valley districts (Weston and Harden, 2002).

Considering the above, it can be concluded that the Project area is located within the known distribution of *P. ericifolia* and does not represent a distributional limit for this species.

HE3.1.13 A Rusty-petals (*Lasiopetalum longistamineum*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Rusty-petals (*Lasiopetalum longistamineum*) is a spreading shrub which grows to 1.5 m high with dense branches and produces flowers clustered in spike-like branches during spring (Weston and Harden, 2000).

Threats to *L. longistamineum* are not specifically known. However, the removal of habitat is a threat relevant to this species. Detailed information on the habitat of this species is lacking. Harden (2002) indicates it grows 'in rich alluvial deposits in the Gungal-Mt. Dangar area' while Hill (2000) speculates it may occur in dry rainforest in sandstone gorges below Mt. Dangar or in Box woodland on basalt soils. To be conservative it is considered that some potential habitat resources for this species may occur in the Project area and surrounds. The Project will involve the removal/modification of a portion of these potential habitat resources and may disrupt germination and establishment of this species.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *L. longistamineum* has been recorded at three locations in the region (ie. Merriwa 1:100,000 map sheet), the closest of which is located approximately 52 km east of the Project area in Goulburn River National Park[12]. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is possible that a local population of *L. longistamineum* could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the lack of records near the Project area (despite targeted surveys).

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

L. longistamineum grows in rich alluvial deposits in the Gungal-Mt. Dangar area (Weston and Harden, 2000).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *L. longistamineum*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for *L. longistamineum*. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *L. longistamineum* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *L. longistamineum* may occur within the Project area and surrounds, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

[12] This record has an accuracy of 1 km (NPWS, 2005a)

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

L. longistamineum occurs in the Gungal-Mt. Dangar area (Weston and Harden, 2000). This species is distributed in the north of the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *L. longistamineum* has been recorded at four locations in the bioregion, of which three are located in one protected area, namely Goulburn River National Park. An overview of the records in the protected areas is provided in Table HE-12.

Table HE-12
Records of a Rusty-petals (*Lasiopetalum longistamineum*) in Protected Areas in the Sydney Basin Bioregion

Protected Area	Range of Recorded Numbers	Number of Records	Date of Records
Goulburn River National Park	unknown	3	1966-1999

Source: NPWS, 2005b

The information provided suggests that habitat for *L. longistamineum* may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

L. longistamineum occurs in the Gungal-Mt. Dangar area (Weston and Harden, 2000).

Considering the above, it can be concluded that the Project area is located outside the known distribution of *L. longistamineum* and if it occurred on the Project area may represent the western distribution of this species.

HE3.1.14 Tricolor Diuris (*Diuris sheaffiana*)

Diuris sheaffiana is listed as Vulnerable under the schedules of the TSC Act. In 1989, Mark Clements synonymised *D. sheaffiana* and *D. colemaniae* with *D. tricolor* in an Australian Orchid Research publication (Clements, 1989). By synonymising *D. sheaffiana* with *D. tricolor,* Clements (1989) identified that *D. sheaffiana* does not occur as a separate species and cannot be distinguished from *D. tricolor.* Subsequently, the Flora of New South Wales recognised *D. sheaffiana* as a synonym of *D. tricolor* (Harden, 1993). Records of *D. sheaffiana* in the Atlas of NSW Wildlife (NPWS, 2005b), which were entered prior to the taxonomic review, have been renamed to *D. tricolor* (NPWS, pers. comm., 29 October 2004).

D. tricolor is considered to be a widespread and common species in NSW (D. Jones, pers. comm., 5 October 2004), known on the NSW western slopes and plains from Gillenbah near Narrandera in the south to the far north (Bishop, 2000). Other localities include Girilambone, Tottenham (Cunningham *et al*., 1981), Wattamondara south of Cowra (Bower, personal observation) and Dubbo (Bishop, 2000). There is one record from Lake Rowan in north-east Victoria (Jeanes and Backhouse, 2000) and it extends to the Moreton and Darling Downs districts in Queensland, where it is said to also be common (Stanley and Ross, 1989). Regardless of the taxonomic review, *D. sheaffiana* is still listed under the TSC Act.

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

D. sheaffiana is a terrestrial orchid that grows in an interdependent relationship with a mycorrhizal fungus (Australian National Botanic Gardens, pers. comm., 29 October 2004) and flowers from September to November (Harden, 1993). Flowers of this species are bright yellow to orange and speckled with red to purple and white markings on the labellum and dorsal sepal (*ibid.*). This species grows from underground tubers which occur in the top 5 to 10 cm of soil. This species like most orchids, is dispersed via wind-blown seed.

Threats to *D. sheaffiana* are not specifically known. While clearing of habitat is a threat relevant to *D. sheaffiana*, this species is also known to colonise previously disturbed areas (Bower, personal observation). Habitats for *D. sheaffiana* are mainly box woodlands on well-drained soils, often with White Cypress Pine, *Callitris endlicheri* (Harden, 1993; Bishop, 2000). Some potential habitat resources for this species occur in the Project area and surrounds (eg. Communities 1, 2 and 5a, FloraSearch, 2005). The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt germination and establishment of this species.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *D. sheaffiana* has not been recorded in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets). However, records for this species occur in the Sydney Royal Botanical Gardens database (2004) for a search area of approximately 600 km^2 surrounding the Project area. This species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is possible that a local population of *D. sheaffiana* could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the lack of records near the Project area (despite targeted surveys).

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

D. sheaffiana grows in sclerophyll forest among grass and often with *Callitris* sp. (Harden, 1993) and in Box/Pine woodlands (DLWC, 2002). During recent surveys this species was found in Eucalypt woodland often with Bimble Box (*E. populnea*), White Cypress (*C. glaucophylla*) and Dwyers Red Gum (*E. dwyeri*). Further, each population of this species was found on well drained sloping to hilly sites (FloraSearch, 2004b), a trait also noted by Bishop (2000). *D. sheaffiana* was absent from flat areas prone to waterlogging and heavily weed infested sites (FloraSearch, 2004b).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *D. sheaffiana*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for *D. sheaffiana*. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *D. sheaffiana* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *D. sheaffiana* occurs within the Project area and surrounds, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

A widespread and formerly abundant species, *D. sheaffiana* is known on the NSW western slopes and plains from Gillenbah near Narrandera in the south to the far north (Bishop, 2000). Other localities include Girilambone, Tottenham (Cunningham *et al*., 1981), Wattamondara south of Cowra (Bower, personal observation) and Dubbo (Bishop, 2000). This species is distributed in the north of the NSW Sydney Basin Bioregion (NPWS, 2005c), however, it is not known if potential habitat (as described above) occurs in any protected areas in the bioregion.

It is not known whether *D. sheaffiana* has been recorded in any conservation reserve in the NSW Sydney Basin Bioregion. The Atlas of NSW Wildlife (NPWS, 2005b) indicates this species has been recorded at three locations in the bioregion and none of these records occur in conservation reserves.

The information provided above suggests habitat for *D. sheaffiana* is not adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

A widespread and formerly abundant species, *D. sheaffiana* is known on the NSW western slopes and plains from Gillenbah near Narrandera in the south to the far north (Bishop, 2000). Other localities include Girilambone, Tottenham (Cunningham *et al*., 1981), Wattamondara south of Cowra (Bower, personal observation) and Dubbo (Bishop, 2000). There is one record from Lake Rowan in north-east Victoria (Jeanes and Backhouse, 2000) and it extends to the Moreton and Darling Downs districts in Queensland, where it is said to be common (Stanley and Ross, 1989).

Considering the above, it can be concluded that the Project area is located within the known distribution of *D. sheaffiana* and does not represent a distributional limit for this species.

HE3.1.15 Austral Toadflax (*Thesium australe*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Austral Toadflax (*Thesium australe*) is an erect perennial herb that grows up to 40 cm high and produces solitary green/yellow flowers during spring to summer (Wiecek, 1992). *T. australe* is hemiparasitic on the roots of other plants, especially Kangaroo Grass, *Themeda triandra*.

Threats to *T. australe* include trampling and grazing by feral deer as recorded in Oxley Wild Rivers National Park, east of Armidale (NSW Scientific Committee, 2004c). In addition, grazing by feral rabbits reduces survival and recruitment of *T. australe* (*ibid*.).

The main habitats for *T. australe* are grasslands, grassy woodlands and sub-alpine grassy heathlands, usually with Kangaroo Grass or *Poa* spp. Potential habitat resources for this species occur in the Project area and surrounds, particularly the grassy woodlands comprising communities 1, 2, and 5a (FloraSearch, 2005). These habitats formerly supported Kangaroo Grass and *Poa* spp., although grazing in the farming areas has severely reduced the abundance of these grasses and therefore has diminished resources for *T. australe*. Some good stands of Kangaroo Grass persist along roadsides, but these are relatively few and scattered (*ibid*.). The Project will involve the removal/modification of a portion of potential habitat resources for *T. australe* and may disrupt germination and establishment of this species.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *T. australe* has not been recorded in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets). Further, this species has not been recorded during targeted surveys within the Project area and surrounds (FloraSearch, 2005).

Considering the above, it is possible that a local population of *T. australe* could occur in the Project area given the very wide former distribution of this species and the occurrence of potential habitat resources, however it is unlikely given the lack of records near the Project area (despite targeted surveys).

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

T. australe grows in grassland and woodland, frequently in damp sites and although this species is widespread it is rare and possibly endangered (Wiecek, 1992).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *T. australe*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for *T. australe*. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *T. australe* are described above. As previously established, no known habitat for this species occurs within the Project area or surrounds. While some potential habitat for *T. australe* occurs within the Project area and surrounds, areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

T. australe has a widespread distribution across Queensland and Tasmania and the NSW Botanical Divisions of North Coast, Central Coast, South Coast, Northern Tablelands, Southern Tablelands, North Western Slopes and Central Western Slopes (Wiecek, 1992 in PlantNET, 2005). This species is distributed towards the coast in the NSW Sydney Basin Bioregion (NPWS, 2005c). However, it is not known if potential habitat (as described above) occurs in any protected areas in the bioregion.

It is not known whether *T. australe* has been recorded in any conservation reserve in the NSW Sydney Basin Bioregion. The Atlas of NSW Wildlife (NPWS, 2005b) indicates this species has been recorded at four locations in the bioregion and none of these records occur in conservation reserves.

The information provided above suggests habitat for *T. australe* is not adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

T. australe has a widespread distribution across Queensland and Tasmania and the NSW Botanical Divisions of North Coast, Central Coast, South Coast, Northern Tablelands, Southern Tablelands, North Western Slopes and Central Western Slopes (Wiecek, 1992 in PlantNET, 2005).

Considering the above, it can be concluded that the Project area is located within the known distribution of *T. australe* and does not represent a distributional limit for this species.

HE3.2 THREATENED FAUNA SPECIES

HE3.2.1 Giant Barred Frog (*Mixophyes iteratus*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Giant Barred Frog (*Mixophyes iteratus*) is frequently found half-buried under leaf litter (Meyer *et al*., 2001) and usually near permanently running water (Turner, 2004) of high quality (Mahony *et al*., 1997). Large streams are required for this species to breed (Lemckert, 1999). The Giant Barred Frog produces approximately 1300-4200 eggs (Morrison & Hero, 2002; Fickling, 1996 in DEH, 2005) and deposits them out of water under overhanging stream banks or on steep banks of large pools (Knowles *et al*., 1998 in DEH, 2005).

The Giant Barred Frog appears to be a generalist feeder evidenced by crickets, spiders, beetles, earwigs, snails and frogs found in gut contents (Department of Environment and Heritage, 2005). Steatfield (1999) found that this species uses an average area of 622 m^2 and 403 m^2 for females and males respectively and that the maximum distance moved by an individual was 268 m along the stream and 50 m away from the stream. The Giant Barred Frog also tends to favour the previous day's diural shelter after a night of activity (Streatfeild, 1999).

Threats to the Giant Barred Frog include selective logging and disturbance of habitat (eg. forest) (Lemckert, 1999) and deterioration in water quality caused from fertilisers, sewage, erosion and herbicides/pesticides (Mahony *et al*., 1997). In addition, introduced predatory fish (eg. *Gambusia holbrooki* and *Cyprinus carpio*) may pose a threat to the Giant Barred Frog by preying on tadpoles (*ibid.*). Remnant vegetation which occurs within the Project area and surrounds, offers marginal potential foraging, roosting and breeding habitat resources for *M. iteratus* (eg. along Cumbo and Wilpinjong Creek). The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, roosting and breeding (were it to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *M. iteratus* has been recorded at one location in the region (ie. Gulgong 1:100,000 map sheet), located near the northern boundary of the Project area[13]. The record for the Giant Barred Frog by Kerrie Donachy of Badgers Bend, Wollar Road, Ulan is the only record for this species in the area. The Giant Barred Frog was once found from near Narooma on the south coast of NSW northwards along the eastern escarpment to south-eastern Queensland, but there are no present-day records from the Hunter region southwards (Mahony *et al*., 1997). This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005). It has not been recorded form the adjacent park and reserve areas, despite systematic fauna surveys (NPWS, 2005c; NPWS, 2003a; NPWS, 2002f; NPWS, 2001h).

[13] This record has an accuracy of 1 km (NPWS, 2005a)

Considering the above, it is unlikely that a local population of the Giant Barred Frog could occur in the Project area given the occurrence of only marginal potential habitat resources. Since it is unlikely that a viable local population of the Giant Barred Frog exists in the Project area, it is also unlikely that the lifecycle of the species will be disrupted such that one would be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Giant Barred Frog is a habitat specialist (Lemckert, 1999) which occurs in uplands and lowlands in wet sclerophyll forest and rainforest including in disturbed areas containing vegetated riparian strips (Ingram & McDonald, 1993; Department of Environment and Heritage, 2005). Deep leaf litter provided by canopy vegetation and/or thick cover (including introduced vegetation such as Lantana) is necessary for the Giant Barred Frog (Mahony *et al*., 1997). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Giant Barred Frog. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Giant Barred Frog. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *M. iteratus* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for *M. iteratus* occurs within the Project area and surrounds.

The Giant Barred Frog moves around to feed at night but tends to favour the previous day's diural shelter after a night of activity (Streatfeild, 1999). Steatfield (1999) found that this species uses an average area of 622 m^2 and 403 m^2 for females and males respectively and that the maximum distance moved by an individual was 268 m along the stream and 50 m away from the stream. Due to the species' mobility, only interconnecting potential habitat for this species within the Project area and surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4). The riparian vegetation along all of the watercourses in the Project area has been extensively cleared in the past (*ibid.*).

Vegetation clearance associated with the Project area is unlikely to cause fragmentation of potential habitat for the Giant Barred Frog given the degraded nature of the potential habitat. Further, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Giant Barred Frog given the localised nature of the disturbance and the connectivity of the surrounding potential habitat.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Giant Barred Frog is distributed from Queensland to northern NSW and south to Narooma (Turner, 2004). This species is distributed in the north of the NSW Sydney Basin Bioregion and potential habitat (described above) occurs in select protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *M. iteratus* has been recorded at approximately 15 locations in the bioregion, of which four are located in one protected areas, namely Watagans National Parks. Further, it is recognised that potential habitat for this species may occur in Budderoo National Park (NPWS, 2004a) and Dharawal Nature Reserve (NPWS, 2002d).

The information provided suggests that habitat for *M. iteratus* may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Giant Barred Frog is distributed from the coast and ranges of south-east Queensland and in northern NSW south to Narooma (Turner, 2004) although there have been no specimens/records to substantiate claims that this species is found south towards Narooma (Hines & SEQTFRT, 2002).

Considering the above, the Project area is located at the western limit of the known distribution of *M. iteratus* and therefore could represent a distributional limit for this species were it to occur in the Project area.

HE3.2.2 Broad-headed Snake (*Hoplocephalus bungaroides*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Broad-headed Snake (*Hoplocephalus bungaroides*) utilises tree hollows during summer and rock crevices and exfoliating sheets of weathered sandstone during the cooler months (Webb and Shine, 1998a). The rock crevice refuges commonly have a west to north-westerly aspect in order to maximise temperatures (Webb and Shine, 1998b). This species is ovoviviparous giving birth to eight to 20 young (Cogger, 2000). Juveniles take four to six years to reach maturity (NPWS, 1999f).

The Broad-headed Snake is nocturnal to crepuscular (active at dusk) and ambushes its prey (NPWS, 1999f). This species forages predominately on lizards (particularly Lesuers Velvet Gecko) and frogs during winter, while the feeding preference shifts to mammals during the warmer months (Cogger, 2000; Webb and Shine, 1998a). Young are almost totally dependant on geckos as a source of food (Webb and Shine, 1998a). Individual Broad-headed Snakes have been recorded moving distances of up to 600 m (Ayers *et al*., 1996).

The Broad-headed Snake may be particularly vulnerable to anthropogenic disturbances (Reed & Shine, 2002) such as removal of bushrocks because this equates to loss of shelter for this species and for its prey (Green, 1997; Wilson & Swan, 2003). Other threats listed by NPWS (1999) are loss of habitat due to urbanisation, bushfire, forestry activities, impacts of feral animals, as well as collectors illegally taking this species (Wilson & Swan, 2003).

Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources for *H. bungaroides*. The Project will involve the removal/modification of a portion of potential habitat resources (eg. woodland) for this species and may disrupt foraging, roosting and breeding (were it to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *H. bungaroides* has been recorded at two locations in the region (ie. Mt. Pomany 1:100,000 map sheet), located approximately 31 km south-east of the Project area[14]. This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005). It has not been recorded form the adjacent park and reserve areas, despite systematic fauna surveys (NPWS, 2005c; NPWS, 2003a; NPWS, 2002f; NPWS, 2001h).

Considering the above, it is possible that a local population of *H. bungaroides* could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the lack of records proximal to the Project area (despite targeted surveys). Since it is unlikely that a viable local population of the Broad-headed Snake exists in the Project area, it is also unlikely that the lifecycle of the species will be disrupted such that one would be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

H. bungaroides favours habitat centred on the communities occurring on the Triassic sandstone of the Sydney Basin Bioregion including exposed sandstone outcrops and benching in woodland, open woodland and/or heath (NPWS, 1999f). This species uses rock crevices and exfoliating sheets of sandstone during the cooler months and tree hollows during the warmer months (Webb and Shine, 1998a in NPWS, 1999f). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Woodland on undulating and level land.
- Woodland on slopes and steep hills.

[14] This record has an accuracy of 1 km (NPWS, 2005a)

- Rocky hills and escarpment.
- Heathland.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Broad-headed Snake. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Broad-headed Snake. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *H. bungaroides* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for *H. bungaroides* occurs within the Project area and surrounds. Individual Broad-headed Snakes have been recorded moving distances of up to 600 m (Ayers *et al*., 1996).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area is unlikely to cause fragmentation of potential habitat for the Broad-headed Snake given the degraded nature of the potential habitat. Further, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Broad-headed Snake.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Broad-headed Snake is restricted to within a 200 km radius of Sydney, from Wollemi National Park in the north, south to the Clyde River Catchment, south-west of Nowra, west to the upper Blue Mountains and east to the Royal National Park (NPWS, 1999f). The current distribution of this species is focused in four key locations: the Blue Mountains, southern Sydney, an area north-west of the Cumberland Plains and the Nowra hinterland (*ibid.*). This species is distributed in the lower two thirds of the NSW Sydney Basin Bioregion and potential habitat (described above) occurs in a number of protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *H. bungaroides* has been recorded at approximately 53 locations in the bioregion, of which a portion are located in nine protected areas, namely Bugong, Dharug, Heathcote, Royal, Wollemi, Yengo, Morton, Blue Mountains and Gardens of Stone National Parks.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Brisbane Water National Park (NPWS, 1992); Garigal National Park (NPWS, 1998e); Popran National Park (NPWS, 2000b); Dharawal Nature Reserve (NPWS, 2002d); and Parr State Recreational Area (NPWS, 2001d). Further, this species is thought to occur in Goulburn River National Park (NPWS, 2003a) and Munghorn Gap Nature Reserve (NPWS, 2003a).

The information provided suggests that habitat for *H. bungaroides* may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of bushrocks. Removal of bushrocks is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

As discussed above, the Broad-headed Snake is restricted to within a 200 km radius of Sydney, from Wollemi National Park in the north, south to the Clyde River Catchment, south-west of Nowra, west to the upper Blue Mountains and east to the Royal National Park (NPWS, 1999f). The current distribution of this species is focused in four key locations: the Blue Mountains, southern Sydney, an area north-west of the Cumberland Plains and the Nowra hinterland (*ibid.*).

Considering the above, the Project area is located at the northern edge of the known distribution of *H. bungaroides* and could represent a distributional limit for this species if it were to occur in the Project area.

HE3.2.3 Pink-tailed Legless Lizard (*Aprasia parapulchella*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Pink-tailed Legless Lizard (*Aprasia parapulchella*) is a nocturnal species which lives beneath rocks in burrows formed by ant colonies (Ayers *et al.,* 1996). This species has also been found in occupied ant nests (Osborne *et al*., 1991 in Ayers *et al*., 1996). The Pink-tailed Legless Lizard is oviparous and has a clutch size of two (Osborne and Jones, 1995 in DEH, 2004b). The species has a specialised diet of small black ants of the genus *Iridiomyrex*, as well as their eggs and larvae (Swan, 1990; Osborne *et al*., 1991 in Ayers *et al*., 1996).

The Pink-tailed Legless Lizard is a morphologically degenerate lizard which lacks external limbs, has eyes reduced to small black dots under scales and no visible ear openings (Ayers *et al*., 1996). The dispersal and movement patterns of the Pink-tailed Legless Lizard are unknown, however Osborne *et al.,* (1991 in Ayers *et al*., 1996) notes that this species occurs in small populations.

The primary threats to the Pink-tailed Legless Lizard include habitat loss through degradation as well as removal of bushrocks (Ayers *et al.,* 1996). Some potential foraging and breeding habitat resources (eg. rocks in open areas) for the Pink-tailed Legless Lizard occur within the Project area and surrounds. The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging and breeding (were this species to occur).

This species has been recorded at one location in the region (ie. Gulgong 1:100,000 map sheet) located approximately 8 km east of the Project area[15]. This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005). It has not been recorded form the adjoining Munghorn Gap Nature Reserve, despite systematic fauna surveys (NPWS, 2005c; NPWS, 2003a; NPWS, 2002f; NPWS, 2001h).

Considering the above, it is possible that a local population of the Pink-tailed Legless Lizard could occur in the Project area given the occurrence of potential habitat resources and records proximal to the Project area, however unlikely given that this species was not recorded during recent targeted surveys. Since it is unlikely that a viable local population of the Pink-tailed Legless Lizard exists in the Project area, it is also unlikely that the lifecycle of the species will be disrupted such that one would be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Pink-tailed Legless Lizard inhabits small rocky clearings in tall shrubland, woodland or native grassland (Osborne, 1994 in Ayers *et al*., 1996). The lizard resides under rocks in open areas with little or no woody vegetation, a predominantly native grass understorey, well-drained soil with little or no leaf litter (Swan, 1990; Osborne *et al*., 1991 in Ayers *et al*., 1996). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Rocky hills and escarpment.
- Shrubland.
- Native grassland.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Pink-tailed Legless Lizard. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

As stated above, habitat loss through degradation is a primary threat to the Pink-tailed Legless Lizard (Ayers *et al.,* 1996). While, some potential habitat for this species occurs within the Project area in rocky clearings, native grasslands have been replaced by non-endemic pasture species to the extent that would likely preclude the Pink-tailed Legless Lizard from occurring. Despite this, some specimens have been collected from grassland sites devoid of native grassland (DEH, 2004b).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Pink-tailed Legless Lizard. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

[15] This record has an accuracy of 0.1 km (NPWS, 2005a)

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Pink-tailed Legless Lizard and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for the Pink-tailed Legless Lizard occurs within the Project area and surrounds.

As stated above, habitat loss and bushrock removal are primary threats to the Pink-tailed Legless Lizard (Ayers *et al.,* 1996). Fragmentation of habitat appears to be a secondary issue which threatens the lizard. Although the dispersal and movement patterns of the Pink-tailed Legless Lizard are unknown, it is considered that the range of this species is poor due to the lack of external limbs and therefore proximate habitat areas within the Project area would be habitat which is interconnecting.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4). Areas of potential habitat that are separated by agricultural land are not considered to be proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the disturbance and the connectivity of the surrounding potential habitat.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Pink-tailed Legless Lizard is known to occur in NSW in areas near Tarcutta, Cootamundra, Bathurst and West Wyalong (Ayers *et al.,* 1996). This species is mainly distributed outside the NSW Sydney Basin Bioregion, however potential habitat (described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates that *A. parapulchella* has been recorded at approximately one location in the bioregion, which is located in a protected area, namely Goulburn River National Park.

The information provided suggests potential habitat for the Pink-tailed Legless Lizard may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of bushrocks. Removal of bushrocks is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Pink-tailed Legless Lizard is known to occur in NSW in areas near Tarcutta, Cootamundra, Bathurst and West Wyalong (Ayers *et al.,* 1996). This species is also distributed in disjunct populations near Coppins Crossing on the Molonglo River in the ACT and Bendigo in Victoria (Ayers *et al.,* 1996; Cogger, 2000).

Considering the above, the Project area is located at the northern distribution of the Pink-tailed Legless Lizard and therefore could represent a distributional limit for this species were this species to occur in the Project area.

HE3.2.4 Little Whip Snake (*Suta flagellum*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Little Whip Snake (*Suta flagellum*) shelters under rocks and logs (Cogger, 1994 in Ayers *et al*., 1996). Little information regarding the breeding requirements and biology of this species is available although this species does exhibit male combat (Turner, 1992 in Ayers *et al*., 1996). The Little Whip Snake is nocturnal and feeds on skinks (Shine, 1988 in Ayers *et al*., 1996) and frogs (Cogger, 1994). Little is known about the movement of this species, however, the Little Whip Snake is entirely terrestrial and is frequently found in groups (Swan, 1990 in Ayers *et al*., 1996).

Threats to the Little Whip Snake include clearing and fire resulting in understorey removal, firewood collection and bushrock removal because these processes reduce available habitat and shelter sites not only for the species but also for its prey (Ayers *et al*., 1996).

Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources (eg. woodlands and associated grasslands) for *S. flagellum*. The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, roosting and breeding (were it to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *S. flagellum* has been recorded at one location in the region (ie. Gulgong 1:100,000 map sheet), located approximately 13 km west of the Project area[16]. This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005). It has not been recorded form the adjacent park and reserve areas, despite systematic fauna surveys (NPWS, 2005c; NPWS, 2003a; NPWS, 2002f; NPWS, 2001h).

Considering the above, it is possible that a local population of *S. flagellum* could occur in the Project area given the occurrence of potential habitat resources and records proximal to the Project area, however unlikely given that this species was not recorded during recent targeted surveys. Since it is unlikely that a viable local population of the Little Whip Snake exists in the Project area, it is also unlikely that the lifecycle of the species will be disrupted such that one would be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

[16] This record has an accuracy of 0.1 km (NPWS, 2005a)

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Little Whip Snake is found mostly in Eucalypt woodlands and associated grasslands, especially on rocky hills where it can shelter under logs and rocks (Cogger, 1994). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Rocky hills and escarpment.
- Native grassland.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *S. flagellum*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for *S. flagellum*. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *S. flagellum* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for *S. flagellum* occurs within the Project area and surrounds.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

All occurrences of potential habitat for this species within the Project area and surrounds are considered proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the disturbance and the connectivity of the surrounding potential habitat.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Little Whip Snake is distributed in the cool and mesic south-western and eastern parts of Australia from Victoria to south-eastern NSW and south-eastern South Australia (Shine, 1988, Swan, 1990 in Ayers *et al*., 1996) as well as near Bathurst (Beukers, 1995 in Ayers *et al*., 1996). This species is mainly distributed to the south of the NSW Sydney Basin Bioregion and potential habitat (eg. described above) occurs in a number of protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates this species has been recorded at no locations in the bioregion. However, management plans available for the protected areas in the bioregion indicate the species has been recorded near Munghorn Gap Nature Reserve (NPWS, 2000d).

The information provided suggests potential habitat for the Little Whip Snake may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of bushrocks. Removal of bushrocks is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Little Whip Snake is distributed in the cool and mesic south-western and eastern parts of Australia from Victoria to south-eastern NSW and south-eastern South Australia (Shine, 1988, Swan, 1990 in Ayers *et al*., 1996) as well as near Bathurst (Beukers 1995 in Ayers *et al*., 1996).

Considering the above, the Project area is located at the northern edge of the known distribution of *S. flagellum* and therefore could represent a distributional limit for this species were this species to occur in the Project area.

HE3.2.5 Rosenberg's Goanna (*Varanus rosenbergi*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Rosenberg's Goanna (*Varanus rosenbergi*) is mostly terrestrial and shelters in burrows (which it digs for itself), hollow logs and rock crevices (Wilson and Swan, 2003; Cogger, 2000). This species lays clutches of eggs in termite mounds (Wilson and Swan, 2003). Rosenberg's Goanna forages on insects, small mammals, birds and other reptiles.

Threats to Rosenberg's Goanna include habitat clearance, eg. flat sandstone ridge tops, and it is thought that this species may consume baits used during Fox and Dog eradication programs (DEC, 2004d). Road mortality may also be a threat to this species (NPWS 2002 in DEC, 2004d).

Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources for *V. rosenbergi*. The Project will involve the removal/modification of a portion of potential habitat resources (eg. open woodlands) for this species and may disrupt foraging, roosting and breeding (were this species to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *V. rosenbergi* has been recorded at one location in the region (ie. Mt. Pomany 1:100,000 map sheet), located approximately 44 km south-east of the Project area[17]. This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005). It has not been recorded form the adjacent park and reserve areas, despite systematic fauna surveys (NPWS, 2005c; NPWS, 2003a; NPWS, 2002f; NPWS, 2001h).

Considering the above, it is possible that a local population of the Rosenberg's Goanna could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the lack of records proximal to the Project area (despite targeted surveys). Since it is unlikely that a viable local population of the Rosenberg's Goanna exists in the Project area, it is also unlikely that the lifecycle of the species will be disrupted such that one would be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Rosenberg's Goanna (*Varanus rosenbergi*) is found in open woodlands, heaths on sandy soil (Wilson and Swan, 2003) and in both wet and dry sclerophyll forests. In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Heathland.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Rosenberg's Goanna. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Rosenberg's Goanna. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

[17] This record has an accuracy of 0.1 km (NPWS, 2005a)

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *V. rosenbergi* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for *V. rosenbergi* occurs within the Project area and surrounds.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

All occurrences of potential habitat for this species within the Project area and surrounds are considered proximate habitat areas for this species.

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the disturbance and the connectivity of the surrounding potential habitat.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

V. rosenbergi is distributed from WA to western Victoria with isolated populations in the ACT and the mid-coast of NSW (Wilson and Swan, 2003). This species is distributed throughout the NSW Sydney Basin Bioregion and potential habitat (described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *V. rosenbergi* has been recorded at approximately 82 locations in the bioregion, of which some are located in six protected areas, namely Dharug, Ku-ring-gai Chase, Heathcote, Royal, Wollemi, Morton and Blue Mountains National Parks.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Popran National Park (NPWS, 2000b); Yengo National Park (NPWS, 2001d); Dharawal Nature Reserve (NPWS, 2002d) and Parr State Recreational Area (NPWS, 2001d).

The information provided suggests it is unknown if potential habitat for *V. rosenbergi* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

V. rosenbergi is distributed from WA to western Victoria with isolated populations in the ACT and the mid-coast of NSW (Wilson and Swan, 2003).

Considering the above, the Project area is located towards the north-eastern limit of the known distribution of *V. rosenbergi* and therefore may represent a distributional limit were this species to occur in the Project area.

HE3.2.6 Bush Stone-curlew (*Burhinus grallarius*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Bush Stone-curlew (*Burhinus grallarius*) nests consist of a slight depression in the ground usually near dead timber where they roost during the day relying on camouflage to hide them from predators (NPWS, 1999g; Pizzey and Knight, 1999). Breeding occurs in spring with both parents caring for and actively defending their young (Marchant and Higgins, 1993 in NPWS, 1999g).

Foraging by night, the Bush Stone-curlew feeds on invertebrates (molluscs, centipedes, crustaceans, spiders, grasshoppers, moths, etc.), small vertebrates (frogs, lizards, snakes, small rodents) and some vegetation (Marchant and Higgins, 1993 in NPWS, 1999g). This species is mainly sedentary although is known to be locally dispersive outside breeding periods, occurring singly or in pairs (NPWS, 1999g).

The Bush Stone-curlew is particularly sensitive to the removal/modification of habitat. Primary threats relevant to the Bush Stone-curlew include removal of dead timber, cultivation, grazing, predation by foxes, pigs, dogs, cats, and disturbance by human activities (especially during nesting) (NPWS, 2003e; NPWS, 1999g). Remnant vegetation which occurs within the Project area offers known and potential foraging, roosting and breeding habitat resources (eg. woodlands) for the Bush Stone-curlew. The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, roosting and breeding (were this species to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates the Bush Stone-curlew has not been recorded in the region (ie. Mudgee, Gulgong, Mt. Pomany, Merriwa 1:100,000 map sheets). This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005). It has not been recorded form the adjacent park and reserve areas, despite systematic fauna surveys (NPWS, 2005c; NPWS, 2003a; NPWS, 2002f; NPWS, 2001h).

Considering the above, it is possible that a local population of the Bush Stone-curlew could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the absence of records proximal to the Project area (despite targeted surveys).

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

In inland NSW, the Bush Stone-curlew favours habitat associated with riverine woodlands of Casuarina, Eucalypt, Acacia or Epolycarpa with a cover of litter, fallen branches and short grasses (NPWS, 2003e; NPWS, 1999g; Pizzey and Knight, 1999). Further, dry open grassland or cropland with nearby cover may also provide habitat for this species (*ibid.*). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.

- Riparian vegetation along watercourses.
- Native grassland.
- Cleared land with or without scattered trees.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Bush Stone-curlew. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Bush Stone-curlew. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Bush Stone-curlew and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for the Bush Stone-curlew occurs within the Project area and surrounds.

This species is mainly sedentary although it is known to be locally dispersive outside breeding periods, occurring singly or in pairs (NPWS, 2003d). In western NSW the Bush Stone-curlew has been recorded using corridors of vegetation (*ibid.*). Due to the species' mobility, only interconnecting potential habitat for this species within the Project area and surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4). The riparian vegetation along all of the watercourses in the Project area has been extensively cleared in the past (*ibid.*).

In consideration of the above, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this species given the localised nature of the disturbance and the connectivity of the surrounding potential habitat.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Bush Stone-curlew is distributed throughout mainland Australia, except in the most arid areas and offshore islands (Garnett and Crowley, 2000). However, this species has suffered severe declines in abundance throughout its distribution in southern, eastern and western Australia (NPWS, 2003e). The range of this species is also thought to have contracted due to extensive clearing of woodland habitat (NPWS, 1999g). Once widespread along the east coast of NSW, recent records indicate that *B. grallarius'* distribution is now limited to areas of the NSW central and north coast (*ibid.*). West of the Great Dividing Range *B. grallarius* has been recorded widely from the Western Slopes and Plains and the Riverina District (*ibid.*). This species is distributed throughout the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *B. grallarius* has been recorded at approximately 67 locations in the bioregion, of which some are located in four protected areas, namely Royal National Parks, and Pelican Island, Rileys Island and Towra Point Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Blue Mountains National Park (NPWS, 2001c).

The information provided suggests potential habitat for *B. grallarius* may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

There is also the potential for an increase in the numbers of Red Fox (*Vulpes vulpes*) as a result of activity in the Project area. Predation by the Red Fox is also recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Bush Stone-curlew is distributed throughout mainland Australia, except in the most arid areas and offshore islands (Garnett and Crowley, 2000). However, this species has suffered severe declines in abundance throughout its distribution in southern, eastern and western Australia (NPWS, 2003e). The range of this species is also thought to have contracted due to extensive clearing of woodland habitat (NPWS, 1999g). Once widespread along the east coast of NSW, recent records indicate that *B. grallarius'* distribution is now limited to areas of the NSW central and north coast (*ibid.*). West of the Great Dividing Range *B. grallarius* has been recorded widely from the Western Slopes and Plains and the Riverina District (*ibid.*).

Considering the above, the Project area is located within the known distribution of the Bush Stone-curlew and therefore does not represent a distributional limit for this species.

HE3.2.7 Square-tailed Kite (*Lophoictinia isura*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Square-tailed Kite (*Lophoictinia isura*) breeds from July to December (Lindsey, 1992; Pizzey and Knight, 1999) and while little is known of its requirements for breeding in terms of habitat, it appears to need a large wooded area in the order of hundreds of hectares (Marchant and Higgins, 1993 in Ayers *et al*., 1996). Nests are constructed in a mature tree near an assured food supply and often within 100 m of a watercourse (Marchant and Higgins, 1993 in Ayers *et al*., 1996; Schodde and Tidemann, 1997). The nests of this species consist of large platforms made from sticks, which are lined with Eucalypt leaves. Square-tailed Kites may re-use nests in successive years (Lindsey, 1992; Schodde and Tidemann, 1997).

The Square-tailed Kite specialises in taking small prey from the tree canopy, such as birds (including nestlings), reptiles and insects (Schodde and Tidemann, 1997; Ayers *et al.,* 1996), and rarely, if ever, visits the ground (NPWS, 2000j). It hunts primarily over open forest, woodlands and mallee communities that are rich in passerines, as well as over adjacent heaths and other low scrubby habitats and in wooded towns (Storr, 1980; Debus and Czechura, 1989 in Garnett and Crowley, 2000).

Resident pairs have a large hunting range of at least 100 km^2 (NPWS, 2000j). Records suggest that this species moves north to tropical areas in winter (Blakers *et al*., 1984; Brouwer and Garnett, 1990), and Marchant and Higgins (1993 in Ayers *et al*., 1996) describe the species as migratory across much of its distribution.

The Square-tailed Kite is threatened by the removal, degradation and fragmentation of habitat, particularly of mature Eucalypts along watercourses (Ayers *et al*., 1996; NPWS, 1999h; NPWS, 2000j). Other threats relevant to this species include inappropriate fire regimes, illegal shooting and collection of eggs (Ayers *et al*., 1996; NPWS, 1999h; NPWS, 2000j). Remnant vegetation which occurs within the Project area and surrounds, offers known and potential foraging, roosting and breeding habitat resources (eg. woodland) for the Square-tailed Kite. The Project will involve the removal/modification of marginal known and potential habitat resources for this species and may disrupt foraging, roosting and breeding.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates this species has been recorded at nine locations in the region (ie. Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets) the closest of which is located within the Project area[18]. In addition the Square-tailed Kite has been recorded by Birds Australia (2004) in a search area of approximately 600 km^2 surrounding the Project area.

During targeted surveys within the Project area and surrounds, the Square-tailed Kite was observed flying over the edges of wooded habitat at several sites (Figure HE-6) (Mount King Ecological Surveys, 2005). It appeared to be foraging on insects within the grassland (*ibid.*).

Considering the above, it is possible that a local population of the Square-tailed Kite could occur in the Project area given the occurrence of potential habitat resources and records of this species within the Project area. However, the removal/modification of a portion of habitat for the Square-tailed Kite is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Square-tailed Kite has previously been identified within Goulburn River National Park and Munghorn Gap Nature Reserve (NPWS, 2005b); and
- the progressive nature of Project disturbance and early rehabilitation.

[18] This record has an accuracy of 1 km (NPWS, 2005a)

Further, a number of measures have been developed for the Project to minimise potential impacts on the Square-tailed Kite within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Square-tailed Kite. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Square-tailed Kite in the long-term.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Square-tailed Kite inhabits dry woodland and open forest, while vegetation along major rivers and belts of trees in urban or semi-urban areas are favoured for hunting (NPWS, 2000j). In NSW, *L. isura* is often associated with ridge and gully forests dominated by Woollybutt (*E. longiflora*), Spotted Gum (*Corymbia maculata*) or Peppermint Gum (*E. elata, E. smithii*), however has also been sighted in forests containing other Eucalypts, (eg. *Angophora* sp. and *Callitris* sp.) with a shrubby understorey and Box-Ironbark woodland (Debus and Czechura, 1989 in NPWS, 1999h). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Forest in dry lowland environments.
- Coastal forest.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Square-tailed Kite. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

As stated above, the Square-tailed Kite is threatened by the removal and degradation of habitat, particularly of mature Eucalypts along watercourses (Ayers *et al*., 1996; NPWS, 1999h; NPWS, 2000j).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is known or potential habitat for the Square-tailed Kite. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Square-tailed Kite in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Square-tailed Kite and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Square-tailed Kite occurs within the Project area and surrounds.

As stated above, resident pairs of the Square-tailed Kite have a large hunting range of at least 100 km^2 (NPWS, 2000j). Records suggest that this species moves north to tropical areas in winter (Blakers *et al*., 1984; Brouwer and Garnett, 1990), and Marchant and Higgins (1993 in Ayers *et al*., 1996) describe the species as migratory across much of its distribution. Due to the species' mobility and large hunting range, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

Fragmentation of habitat is a recognised threat to the Square-tailed Kite, as it reduces the density of prey species and also reduces the opportunities for breeding given that this species breeds in large wooded areas (of the order of hundreds of hectares) (Marchant and Higgins, 1993 in Ayers *et al*., 1996). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4). The riparian vegetation along all of the watercourses in the Project area has been extensively cleared in the past (*ibid.*).

Vegetation clearance associated with the Project area is unlikely to cause fragmentation of current interconnecting habitat for the Square-tailed Kite given this species is highly mobile. Therefore, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Square-tailed Kite.

A number of measures have been developed to improve movement of the Square-tailed Kite, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.

- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Square-tailed Kite in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Square-tailed Kite. This would include rehabilitation of the riparian vegetation along the Cumbo Creek.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Square-tailed Kite is uncommon, yet widespread, occurring across most parts of NSW (Marchant and Higgins, 1993 in Ayers *et al*., 1996; NPWS, 2000j). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates that *L. isura* has been recorded at approximately 73 locations in the bioregion, of which many are located in nine protected areas, namely Goulburn River, New South Wales Jervis Bay, Royal, Wollemi, Morton and Blue Mountains National Parks, and Munghorn Gap, Barren Grounds and Kooragang Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Tomaree National Park (NPWS, 2004g).

The information provided suggests potential habitat for the Square-tailed Kite may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Square-tailed Kite is uncommon, yet widespread, occurring across most parts of NSW (Marchant and Higgins, 1993 in Ayers *et al*., 1996; NPWS, 2000j).

The Project area is located within the known distribution of the Square-tailed Kite and does not represent a distributional limit for this species.

HE3.2.8 Red-tailed Black-cockatoo (*Calyptorhynchus banksii*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Red-tailed Black-cockatoo (*Calyptorhynchus banksii*) has been found to roost in patches of *Eucalyptus leucoxylon/ E. camaldulensis* woodland (Joseph *et al*., 1991). This species is likely to breed mainly in spring/summer (Joseph *et al*., 1991) and nests in large hollows of mature, but more often dead trees (Joseph *et* al., 1991; Ayres *et al.*, 1996). The diet of this species consists of seeds and fruit (Ayres *et al.*, 1996), with *E. baxteri* seed as a staple and *Allocasurina luehmannii* seed taken opportunistically (Joseph *et al*., 1991; Maron & Lill, 2004). This species is considered to be sedentary, nomadic or part-migratory (*ibid.*).

Threats to the Red-tailed Black-cockatoo include inappropriate fuel reduction burning of *E. baxteri*, harvesting of large live *E. camaldulensis* and felling of dead trees for firewood (Joseph *et al*., 1991).

Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources (eg. woodlands) for the Red-tailed Black-cockatoo. The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, roosting and breeding (were this species to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates the Red-tailed Black-cockatoo has not been recorded in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets). This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005).

Considering the above, it is possible that a local population of Red-tailed Black-cockatoo could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the lack of records proximal to the Project area (despite targeted surveys). Since it is unlikely that a viable local population of the Red-tailed Black-cockatoo exists in the Project area, it is also unlikely that the lifecycle of the species will be disrupted such that one would be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

Red-tailed Black-cockatoo is mainly found in Eucalypt woodland along watercourses, but also found in open forests and woodlands (Ayres *et al.*, 1996). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Red-tailed Black-cockatoo. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Red-tailed Black-cockatoo. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Red-tailed Black-cockatoo and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for the Red-tailed Black-cockatoo occurs within the Project area and surrounds.

This species is considered to be sedentary, nomadic or part-migratory (Joseph *et al*., 1991; Maron & Lill, 2004). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4). The riparian vegetation along all of the watercourses in the Project area has been extensively cleared in the past (*ibid.*).

Vegetation clearance associated with the Project area is unlikely to cause fragmentation of current interconnecting habitat for the Red-tailed Black-cockatoo given this species is highly mobile. Therefore, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Red-tailed Black-cockatoo.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

In NSW, this species is closely associated with the Darling River and its tributaries (Ayres *et al.*, 1996). This species is mainly distributed outside the NSW Sydney Basin Bioregion, however potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the Red-tailed Black-cockatoo has not been recorded in the bioregion. The information provided suggests potential habitat for the Red-tailed Black-cockatoo may not be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

In NSW, this species is closely associated with the Darling River and its tributaries. They are less common downstream of Wilcannia, although they are found in association with Belah woodlands between Menindee and Ivanhoe (Ayres *et al.*, 1996).

The Project area is located outside the known distribution of the Red-tailed Black-cockatoo. If this species was to occur in the Project area it would be outside the limit of its known distribution.

HE3.2.9 Glossy Black-cockatoo (*Calyptorhynchus lathami*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Glossy Black-cockatoo (*Calyptorhynchus lathami*) roosts communally in groves of trees in close proximity to stands of She-oaks (Pizzey and Knight, 1999). The species breeds from March to August and nests in hollow limbs or trunks of old or dead trees, usually 15-30 m off the ground. The nest is lined with woodchips (Pizzey and Knight, 1999). The birds lay one egg per season (Garnett *et al*., 1999 in Garnett and Crowley, 2000).

C. lathami forages for long hours each day to gain sufficient food, particularly during the breeding season. The Glossy Black-cockatoo's diet is primarily restricted to the seeds of She-oaks (*Allocasuarina* sp. and *Casuarina* sp.), although Acacia, angophora and Eucalypt seeds, angophora fruit, sunflower seeds and grubs found in some *Allocasuarina* and *Acacia* species have occasionally been recorded (Higgins, 1999; Schodde and Tidemann, 1997; Barker and Vestjens, undated in Ayers *et al.,* 1996; Blakers *et al.*, 1984). The birds rely heavily on *Allocasuarina* species with large cones such as *A. stricta*, *A. littoralis* and *A. torulosa* (Schodde and Tidemann, 1997). *A. luehmannii, A. diminuta, A. gymnanthera* and *A. verticillata* have also been recorded as food plants (Ayers *et al.*, 1996).

Populations of *C. lathami* are often sedentary so long as the requirement of an adequate supply of seed exists, however they are nomadic when supplies fail for any reason (eg. due to the removal of foraging habitat) (Schodde and Tidemann, 1997).

The Glossy Black-cockatoo is particularly sensitive to the removal of foraging habitat (NSW Scientific Committee, 1999; NPWS, 1999i; Garnett and Crowley, 2000). Other threats relevant to this species include habitat loss and fragmentation, logging of nesting trees within the proximity of food resources, competition for hollows and grazing of the She-oak seedlings by rabbits, sheep and goats (NPWS, 1999j; Garnett and Crowley, 2000).

Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources (eg. open woodland) for the Glossy Black-cockatoo. The Project will involve the removal/modification of a portion of known and potential habitat resources for this species and may disrupt foraging, roosting and breeding.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *C. lathami* has been recorded at 47 locations in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets), including inside the Project area[19]. In addition the Glossy Black-cockatoo has been recorded by Birds Australia (2004) and Hunter Bird Observers Club (2004) in a search area of approximately 600 km^2 surrounding the Project area.

During recent targeted surveys within the Project area and surrounds, a pair of Glossy Black-cockatoos were recorded at two locations in the Project area during autumn, although it was possible that these were the same pair (Figure HE-6) (Mount King Ecological Surveys, 2005). Both sightings were within woodland habitat (*ibid.*).

[19] This record has an accuracy of 1 km (NPWS, 2005a)

It is possible that a local population of the Glossy Black-cockatoo exists within the Project area given that the species was recorded during recent surveys, other records of this species proximal to the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Glossy Black-cockatoo is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance; and
- occurrence of proximal known and potential habitat to the Project area. The Glossy Black-cockatoo has previously been identified within Goulburn River National Park (NPWS, 2005b) and Munghorn Gap Nature Reserve (NPWS, 2003a; NPWS, 2000d).

Further, a number of measures have been developed for the Project to minimise potential impacts on the Glossy Black-cockatoo within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Glossy Black-cockatoo. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Selective planting of key forage species, eg. *Casuarina* spp.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Glossy Black-cockatoo in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Glossy Black-cockatoo inhabits coastal forests, open woodland, timbered watercourses or wherever Casuarinas are common (Schodde and Tidemann, 1997; Pizzey and Knight, 1999). But not all apparently suitable habitat provides adequate food value to support the cockatoos (Crowley and Garnett, in press, in Garnett and Crowley, 2000; Crowley *et al*., 1999; Clout, 1989). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Coastal forest.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Glossy Black-cockatoo. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is known or potential habitat for the Glossy Black-cockatoo. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Glossy Black-cockatoo in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion with *Casuarina* spp. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Glossy Black-cockatoo and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Glossy Black-cockatoo occurs within the Project area and surrounds.

The Glossy Black-cockatoo is often sedentary, however can be nomadic when searching for food (Schodde and Tidemann, 1997). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and surrounds are considered proximate habitat areas for this species.

Fragmentation of habitat is a recognised threat to the Glossy Black-cockatoo, especially when associated with agriculture, as it can lead to penetration of competitors from surrounding open habitats (eg. Galahs [*Eolophus roseicapillus*]) (NSW Scientific Committee, 1999; NPWS, 1999i; Garnett and Crowley, 2000).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4). The riparian vegetation along all of the watercourses in the Project area has been extensively cleared in the past (*ibid.*).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Glossy Black-cockatoo. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Glossy Black-cockatoo given the mobility of the species, the localised nature of the Project.

A number of measures have been developed to improve movement of the Glossy Black-cockatoo, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Glossy Black-cockatoo in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Glossy Black-cockatoo. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

In NSW, the Glossy Black-cockatoo is distributed along the coast and as far west as Cobar and Griffith in isolated mountain ranges (NPWS, 1999i). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *C. lathami* has been recorded at numerous locations in the bioregion, of which many are located in 34 protected areas, namely Goulburn River, Towarri, Bouddi, Brisbane Water, Bugong, Cattai, Conjola, Dharug, Garigal, Ku-ring-gai Chase, Macquarie Pass, Meroo, New South Wales Jervis Bay, Popran, Scheyville, Watagans, Werakata, Yengo, Murramarang, Morton, Blue Mountains , Gardens of Stone, Kanangra-Boyd and Nattai National Parks, and Manobalai, Wingen Maid, Bamarang, Barren Grounds, Cockle Bay, Gulguer, Joadja, Kangaroo River, Triplarina and Wollondilly River Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Marramarra National Park (NPWS, 1998f); Tomaree National Park (NPWS, 2004g); Wollemi National Park (NPWS, 2001a); Dharawal Nature Reserve (NPWS, 2002d); Muogamarra Nature Reserve (NPWS, 1998f); Wambina Nature Reserve (NPWS, 2003d); Munghorn Nature Reserve (NPWS, 2003a; 2000d), Maroota Historic Site (NPWS, 1998f) and Parr State Recreational Area (NPWS, 2001d).

The information provided suggests that habitat for the Glossy Black-cockatoo is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Glossy Black-cockatoo is sparsely distributed along the east coast and immediate inland districts from western Victoria to Rockhampton in Queensland (Crome and Shields, 1992 in NPWS, 1999i). Isolated populations of the species inhabit King Island in Bass Strait and Kangaroo Island off the coast of South Australia (Schodde *et al*., 1993 in NPWS, 1999i). In NSW, the Glossy Black-cockatoo is found as far west as Cobar and Griffith in isolated mountain ranges (NPWS, 1999i).

Considering the above, the Project area is located within the known distribution of the Glossy Black-cockatoo and does not represent a distributional limit for this species.

HE3.2.10 Swift Parrot (*Lathamus discolor*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Swift Parrot (*Lathamus discolor*) only breeds in Tasmania, always within 8 km of the coast (Brereton, 1998 in Garnett and Crowley, 2000). *L. discolor* nests in tree cavities or hollows, usually high in a Eucalypt (Lindsey, 1992; Pizzey and Knight, 1999).

Generally a canopy feeder, this species congregates where there is profuse flowering of Eucalypts (Blakers *et al.*, 1984; Brouwer and Garnett, 1990). On the western slopes of NSW, winter flowering Eucalypts are particularly important, including Grey Box (*Eucalyptus microcarpa*), Mugga Ironbark (*E. sideroxylon*) and White Box (*E. albens*). *E. robusta*, *Corymbia maculata* and Red Bloodwood (*C. gummifera*) are utilised by this species on the coast of NSW (Swift Parrot Recovery Team, 2001).

The Swift Parrot breeds in Tasmania and migrates to mainland Australia from May to August (Swift Parrot Recovery Team, 2001; NSW Scientific Committee, 2004d). Non-breeding birds are highly mobile and their movements vary between years (Hindwood and Sharland, 1964; Brown, 1989; in Garnett and Crowley, 2000). However, if sufficient food is available this species will remain in an area and return to the same tree to roost (Pizzey and Doyle, 1980).

The Swift Parrot is particularly sensitive to the removal of foraging habitat (NSW Scientific Committee, 2004d; Ayers *et al*., 1996). Another threat includes firewood collection (Brown, 1989 in Garnett and Crowley, 2000). Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging and roosting habitat resources (eg. Box forests and woodlands) for the Swift Parrot. The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging and roosting (were this species to occur).

This species has been recorded at three locations in the region (ie. Gulgong and Mt. Pomany 1:100,000 map sheets), the closest of which is located approximately 5 km south-west of the Project area[20]. In addition the Swift Parrot has been recorded by Hunter Bird Observers Club (2004) in a search area of approximately 600 km^2 surrounding the Project area. This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005).

[20] This record has an accuracy of 1 km (NPWS, 2005a)

It is possible that a local migratory population of the Swift Parrot exists within the Project area given records of this species exist in the region and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Swift Parrot is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Swift Parrot has previously been identified within Goulburn River National Park (NPWS, 2003a) and Munghorn Gap Nature Reserve (NPWS, 2005b); and
- the progressive nature of Project disturbance and early rehabilitation.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Swift Parrot within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Swift Parrot. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland for the Swift Parrot in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

In NSW the Swift Parrot inhabits Box-Ironbark forests and woodlands (Swift Parrot Recovery Team, 2001). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Swift Parrot. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Swift Parrot. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants*– to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland for the Swift Parrot in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Swift Parrot and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for the Swift Parrot occurs within the Project area and surrounds.

Non-breeding Swift Parrots are highly mobile and their movements vary between years (Hindwood and Sharland, 1964; Brown, 1989 in Garnett and Crowley, 2000). However, if sufficient food is available this species will remain in an area and return to the same tree to roost (Pizzey and Doyle, 1980). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4). The riparian vegetation along all of the watercourses in the Project area has been extensively cleared in the past (*ibid.*).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Swift Parrot. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Swift Parrot given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Swift Parrot, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland for the Swift Parrot in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Swift Parrot breeds in Tasmania and typically migrates to mainland Australia to over-winter on the inland slopes of central and eastern NSW (Swift Parrot Recovery Team, 2001; Garnett and Crowley, 2000). This species migratory distribution is widespread in the NSW Sydney Basin Bioregion and potential habitat (as discussed above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *L. discolor* has been recorded at approximately 147 locations in the bioregion, of which many are located in 11 protected areas, namely Botany Bay, Scheyville, Sydney Harbour, Werakata, Wollemi, Wyrrabalong, Murramarang and Nattai National Parks, and Munghorn Gap, Barren Grounds and Castlereagh Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Goulburn River National Park (NPWS, 2003a), Ku-ring-gai Chase National Park (NPWS, 2002c), Seven Mile Beach National Park (NPWS, 1998a) and Blue Mountains National Park (NPWS, 2001c). Further, it is recognised that potential habitat for this species may occur in Pitt Town Nature Reserve (2000c).

The information provided suggests that habitat for the *L. discolor* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Swift Parrot breeds in Tasmania and typically migrates to mainland Australia to over-winter on the inland slopes of the Great Dividing Range in Victoria and central and eastern NSW, with smaller numbers reaching south-east Queensland and south-east South Australia (Swift Parrot Recovery Team, 2001; Garnett and Crowley, 2000).

Considering the above, the Project area is located within the migratory distribution of the Swift Parrot and therefore does not represent a distributional limit for this species.

HE3.2.11 Turquoise Parrot (*Neophema pulchella*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Turquoise Parrot (*Neophema pulchella*) breeds between August and December, often producing two broods (Schodde and Tidemann, 1997). Nests are in hollows and cavities in stumps, fence posts and live trees close (usually <2 m) to the ground (Forshaw, 1981; Lindsey, 1992; Ayers *et al.*, 1996). Logs on the ground are also used for nesting (Quinn and Baker-Gabb, 1993 in NPWS, 1999j). Females are responsible for incubation, which lasts approximately 18 days. Birds fledge at four weeks, after which young birds are dependent on the parents for a few months (Schodde and Tidemann, 1997).

Foraging is almost entirely on the ground (Higgins, 1998 in NPWS, 1999j) on introduced and native grasses and herbs (Ayers *et al.*, 1996) such as the Parrot Pea (*Dillwynia* sp.), Barley Grass (*Hordeum murinum*), Mustard (*Sisymbrium* sp.), Wallaby Grass (*Danthonia* sp.), Stinging Nettle (*Urtica urens*) and Saffron Thistle (*Carthamus lanatus*) (Crome and Shields, 1992 in NPWS, 1999j). In addition, a reliable water source is an essential component of the habitat requirements of this species (Higgins, 1998 in NPWS, 1999j). The Turquoise Parrot is partly nomadic (Ayers *et al.*, 1996).

The Turquoise Parrot is sensitive to the removal of foraging and breeding habitat resources (NPWS, 1999j). Other threats relevant to this species include livestock grazing of this species' foraging resources, timber cutting and predation (by cats and foxes) (Ayers *et al.*, 1996). Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources for the Turquoise Parrot. The Project will involve the removal/modification of a portion of known and potential habitat resources for this species and may disrupt foraging, roosting and breeding.

This species has been recorded at 33 locations in the region (ie. Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets) (NPWS, 2005a), the closest of which is located 1 km south of the Project area[21]. In addition the Turquoise Parrot has been recorded by Birds Australia (2004) and Hunter Bird Observers Club in a search area of approximately 600 km^2 surrounding the Project area.

During targeted surveys within the Project area and surrounds, the Turquoise Parrot was recorded at one location at the edge of the woodland habitat outside the proposed disturbance area (Figure HE-6) (Mount King Ecological Surveys, 2005).

It is possible that a local population of the Turquoise Parrot exists within the Project area given that the species was recorded during past surveys, the presence of other records of this species proximal to the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Turquoise Parrot is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Turquoise Parrot has previously been identified within Goulburn River National Park and Munghorn Gap Nature Reserve (NPWS, 2005b); and

[21] This record has an accuracy of 0.1 km (NPWS, 2005a)

- the progressive nature of Project disturbance and early rehabilitation.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Turquoise Parrot within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Turquoise Parrot. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - 1:1 long-term re-establishment plus greater than 1:1 conservation of White Box, Yellow Box, Blakely's Red Gum Woodland Endangered Ecological Community which offers habitat resources for this species.
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Turquoise Parrot in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion .

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Turquoise Parrot favours open grassy woodland with dead trees and forested hills with Yellow Box (*Eucalyptus melliodora*), Blakely's Red Gum (*E. blakelyi*) and White Box (*E. albens*) with an accessible water source (Morris, 1980; Pizzey and Knight, 1999). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Turquoise Parrot. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is known or potential habitat for the Turquoise Parrot. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants*– to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include:
  - 1:1 long-term re-establishment plus greater than 1:1 conservation of White Box, Yellow Box, Blakely's Red Gum Woodland Endangered Ecological Community which offers habitat for this species, ie. greater than 80 ha of the endangered community is conserved in the ECAs, and an additional 50 ha will be re-established in the long-term.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
  - *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Turquoise Parrot in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Turquoise Parrot and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Turquoise Parrot occurs within the Project area and surrounds.

The Turquoise Parrot is partly nomadic (Ayers *et al.*, 1996) and known to prefer open and fragmented vegetation (NPWS, 2001h). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4). The riparian vegetation along all of the watercourses in the Project area has been extensively cleared in the past (*ibid.*).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Turquoise Parrot. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Turquoise Parrot given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Turquoise Parrot, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Turquoise Parrot in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Turquoise Parrot. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

N. pulchella occurs along the eastern and western scarps of the Great Dividing Range, south to Nowra and Benella (NSW), north to Maryborough and Taroom (QLD), and west to Griffith (Schodde and Tidemann, 1997). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as discussed above) occur in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *N. pulchella* has been recorded at over 100 locations in the bioregion, of which a portion are located in 12 protected areas, namely Goulburn River, Conjola, Ku-ring-gai Chase, New South Wales Jervis Bay, Wollemi, Yengo, Morton, Blue Mountains, Gardens of Stone and Nattai National Parks, and Munghorn Gap and Barren Grounds Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Scheyville National Park (NPWS, 2000c); Tomaree National Park (NPWS, 2004g); and Parr State Recreational Area (NPWS, 2001d). Further, potential habitat for this species may also occur in Towarri National Park (2004e) and Dharawal Nature Reserve (2002e).

The information provided suggests that habitat for *N. pulchella* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

There is also the potential for an increase in the numbers of Red Fox (*Vulpes vulpes*) as a result of activity in the Project area. Predation by the Red Fox is also recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

N. pulchella occurs along the eastern and western scarps of the Great Dividing Range, south to Nowra and Benella (NSW), north to Maryborough and Taroom (QLD), and west to Griffith (Schodde and Tidemann, 1997).

Considering the above, the Project area is located within the known distribution of the Turquoise Parrot and does not represent a distributional limit for this species.

HE3.2.12 Barking Owl (*Ninox connivens*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Barking Owl (*Ninox connivens*) roosts by day in dense streamside galleries and thickets of Acacia, Casuarina and Eucalypts, and forages in adjacent woodland (Ayers *et al.,* 1996). The Barking Owl typically breeds from July to November with one brood per season (Schodde and Tidemann, 1997). Breeding takes place in traditional territories, in large hollows in old Eucalypts (Ayers *et al.,* 1996), which may be used year after year. Nest entrances are typically 2-35 m above the ground (Higgins, 1998). *N. connivens* is also known to nest in rabbit burrows (Hollands, 1991 in Pizzey and Knight, 1999).

The Barking Owl hunts nocturnally for a variety of small to medium-sized mammals, birds and large insects within woodland and forest habitats (Higgins, 1998). The Barking Owl is assumed to be sedentary, living singly, in pairs, or in family groups of 3-5 in permanent territories containing several roost sites (Ayers *et al.,* 1996).

The Barking Owl is particularly sensitive to the removal of nesting habitat in hollows of old trees (Ayers *et al*., 1996; NPWS, 2003f). Other threats relevant to this species include reduction in the availability of prey items, timber harvesting, overgrazing of habitat by livestock, and predation by foxes (Ayers *et al*., 1996; NPWS, 2003f). Remnant vegetation within the Project area and surrounds offers potential foraging, roosting and breeding habitat resources for the Barking Owl. The Project will involve the removal/modification of a portion of potential habitat resources (eg. open forests and woodland) for this species and may disrupt foraging, roosting and breeding (were this species to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates that the Barking Owl has been recorded at six locations in the region (Mudgee, Gulgong and Merriwa 1:100,000 map sheets), the closest of which is located approximately 4 km north of the Project area[22]. This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005).

It is possible that a local population of the Barking Owl exists within the Project area given that records of this species occur proximal to the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Barking Owl is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Barking Owl has previously been identified within Goulburn River National Park (NPWS, 2005b) and Munghorn Gap Nature Reserve (NPWS, 2000d); and
- the progressive nature of Project disturbance and early rehabilitation.

[22] This record has an accuracy of 0.1 km (NPWS, 2005a)

Further, a number of measures have been developed for the Project to minimise potential impacts on the Barking Owl within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Barking Owl. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Selective planting of habitat species, eg. White Box (*E. albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*).
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Barking Owl in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Barking Owl primarily inhabits open forest and woodland in warm lowland areas on gentle terrain (Ayers *et al.,* 1996), avoiding high altitudes and dense, wet escarpment forests (Debus, 1997). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Barking Owl. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Barking Owl. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Barking Owl in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Barking Owl and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for the Barking Owl occurs within the Project area and surrounds.

The Barking Owl is assumed to be sedentary in permanent territories containing several roost sites (Ayers *et al.,* 1996). All occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4). The riparian vegetation along all of the watercourses in the Project area has been extensively cleared in the past (*ibid.*).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Barking Owl. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Barking Owl given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Barking Owl, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Barking Owl in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Barking Owl. This would include rehabilitation of the riparian vegetation along the Cumbo Creek).

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Barking Owl is found throughout most of NSW, with the main part of the distribution being west of the Great Dividing Range (Debus, 1997). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *N. connivens* has been recorded at approximately 96 locations in the bioregion, of which many are located in 17 protected areas, namely Goulburn River, Bouddi, Budderoo, Dharug, Garigal, New South Wales Jervis Bay, Royal, Scheyville, Watagans, Wollemi, Yengo, Murramarang, Blue Mountains, Kanangra-Boyd and Nattai National Parks, and Barren Grounds and Wambina Nature Reserves. The Barking Owl has also been recorded in Lane Cove National Park (NPWS, 2003f).

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Popran National Park (NPWS, 2000b); Seven Mile Beach National Park (NPWS, 1998a); Munghorn Gap Nature Reserve (NPWS, 2000d); Dharawal Nature Reserve (NPWS, 2002d) and Parr State Recreational Area (NPWS, 2001d).

The information provided suggests that habitat for *N. connivens* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

There is also the potential for an increase in the numbers of Red Fox (*Vulpes vulpes*) as a result of activity in the Project area. Predation by the Red Fox is also recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Barking Owl is found throughout most of NSW, with the main part of the distribution being west of the Great Dividing Range (Debus, 1997).

Considering the above, the Project area is located within the known distribution of the Barking Owl and does not represent a distributional limit for this species.

HE3.2.13 Powerful Owl (*Ninox strenua*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Powerful Owl (*Ninox strenua*) breeds from May to October and has one brood a year (Schodde and Tidemann, 1997). Nests are located in large hollow tree limbs or trunks (*ibid.*). The Powerful Owl roosts by day on the branches of relatively open trees, usually within dense foliage along streams amid Eucalypt forest (Ayers *et al.,* 1999). Each pair has a number of roosting trees (Schodde and Tidemann, 1997).

The Powerful Owl is a sedentary species that lives singly or in pairs within permanent territories (300 to 1,000 ha, depending on habitat productivity) (Schodde and Tidemann, 1997; Ayers *et al.,* 1999). *N. strenua* hunts nocturnally for primary prey items such as arboreal and semi-arboreal mammals, birds, insects and terrestrial mammals (*ibid.*).

Threats to the Powerful Owl include clearing of forests and consequently foraging and breeding habitat (Debus and Chafer, 1994 in Ayers *et al*., 1996), as well as timber harvesting, inappropriate fire regimes and predation by foxes on fledgling owls (McNabb, 1996, Debus and Chafer, 1994 in Ayers *et al*., 1996).

Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources (eg. woodland) for the Powerful Owl. The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, roosting and breeding (were this species to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates Powerful Owl has been recorded at 27 locations in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets), including within the Project area[23]. In addition the Powerful Owl has been recorded by Birds Australia (2004) and Hunter Bird Observers Club (2004) in a search area of approximately 600 km^2 surrounding the Project area. This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005).

It is possible that a local population of the Powerful Owl exists within the Project area given records of this species within the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Powerful Owl is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Powerful Owl has previously been identified within Goulburn River National Park and Munghorn Gap Nature Reserve (NPWS, 2005b); and
- the progressive nature of Project disturbance and early rehabilitation.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Powerful Owl within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Powerful Owl. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control.

[23] This record has an accuracy of 1 km (NPWS, 2005a)

- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Powerful Owl in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Powerful Owl occurs in open forest and tall open forest, particularly in wet and dry sclerophyll forest, as well as in gully rainforest and in woodland (NPWS, undated-a). This species' habitat includes forested coastal and tablelands areas in NSW (*ibid.*). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Forest in dry lowland environments.
- Coastal forest.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Powerful Owl. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Powerful Owl. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.

- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Powerful Owl in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Powerful Owl and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for the Powerful Owl occurs within the Project area and surrounds.

The Powerful Owl is a sedentary species that lives singly or in pairs within permanent territories (300 to 1,000 ha, depending on habitat productivity) (Schodde and Tidemann, 1997; Ayers *et al.,* 1999). All occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Powerful Owl. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Powerful Owl given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Powerful Owl, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Powerful Owl in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Powerful Owl. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

N. strenua is primarily distributed from the Clarke Range in Queensland to the Mount Burr region of south-eastern South Australia, primarily on the coastal side of the Great Dividing Range (Ayers *et al.,* 1999). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occur in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *N. strenua* has been recorded at over 400 locations in the bioregion, of which many are located in 38 protected areas, namely Goulburn River, Botany Bay, Bouddi, Brisbane Water, Cattai, Dharug, Garigal, Heathcote, Ku-ring-gai Chase, Lane Cove, Macquarie Pass, Meroo, New South Wales Jervis Bay, Popran, Royal, Seven Mile Beach, Sydney Harbour, Tomaree, Werakata, Wollemi, Yengo, Murramarang, Morton, Blue Mountains, Gardens of Stone, Kanangra-Boyd and Nattai National Parks, and Manobalai, Moffats Swamp, Munghorn Gap, Barren Grounds, Dalrymple-Hay, Kooragang, Muogamarra, Tapitallee, Tilligerry, Wambina and Awabakal Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Towarri National Park (NPWS, 2004e); Marramarra National Park (NPWS, 1998f); Dharawal Nature Reserve (NPWS, 2002d); Maroota Historic Site (NPWS, 1998f) and Parr State Recreational Area (NPWS, 2001d). Further, it is recognised that potential habitat for this species may occur in Budderoo National Park (2004a) and Pulbah Nature Reserve (2003b).

The information provided suggests that habitat for *N. strenua* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

There is also the potential for an increase in the numbers of Red Fox (*Vulpes vulpes*) as a result of activity in the Project area. Predation by the Red Fox is also recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

N. strenua is primarily distributed from the Clarke Range in Queensland to the Mount Burr region of south-eastern South Australia, primarily on the coastal side of the Great Dividing Range (Ayers *et al.,* 1999).

Considering the above, the Project area is located within the known distribution of the Powerful Owl and does not represent a distributional limit for this species.

HE3.2.14 Masked Owl (*Tyto novaehollandiae*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Masked Owl (*Tyto novaehollandiae*) roosts communally within a diverse range of wooded habitats that provide large hollow-bearing trees, often in riparian forests (Garnett and Crowley, 2000). The species breeds any month, mostly from Autumn to Winter and nests on decayed debris in hollow Eucalypts 12-20 m high, bare sand or earth of cave (Pizzey and Knight, 1999).

The Masked Owl forages in nearby open areas (Kavanagh and Murray, 1996; Higgins, 1999 in Garnett and Crowley, 2000). The Masked Owl's diet mainly consists of possums, rabbits, currawongs, gliders, bats, birds and lizards (Pizzey and Knight, 1999; Garnett and Crowley, 2000). This species keeps to the same territory all year round (Schodde and Tidemann, 1997). The mobility and ranging behaviour of *T. novaehollandiae* enable it to utilise large areas as a forage resource including cleared, open land characteristic of the region.

Critical habitat components for this species include roomy cavities in large mature trees for nesting (and sometimes roosting) and open forest and woodland (as well as adjacent farmland and open country) for foraging (Debus, 1993; Debus and Rose, 1994). Clearance for agriculture has affected the abundance of this species in many parts of its distribution (Garnett and Crowley, 2000). The reason for the low density however, is unknown. Although food does not appear to be limiting on the east coast (Kavanagh, 1996 in Garnett and Crowley, 2000), the apparent decline in arid Australia may be linked to that of mammals of between 50 and 200 grams (Burbridge and McKenzie, 1989). Other threats to this species include predation by foxes (Debus, 1997).

The Project area will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, roosting and breeding (were this species to occur).

The Masked Owl was recorded in two locations in the region according to the Atlas of NSW Wildlife (ie. Merriwa 1:100,000 map sheet) (NPWS, 2005a), the closest of which was 45 km east of the Project area[24]. During targeted surveys within the Project area and surrounds, an individual Masked Owl responded to call broadcasting (Mount King Ecological Surveys, 2005). The call came from a densely vegetated gully to the north-west of the broadcast site outside the proposed disturbance area (Figure HE-6) (*ibid.*).

Considering the above, it is possible that a local population of the Masked Owl could occur in the Project area given the occurrence of potential habitat resources and records of this species within the Project area. However, the removal/modification of a portion of habitat for the Masked Owl is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Masked Owl has previously been identified within Goulburn River National Park (NPWS, 2005b); and
- the progressive nature of Project disturbance and early rehabilitation.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Masked Owl within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Masked Owl. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Masked Owl in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

[24] This record has an accuracy of 0.1 km (NPWS, 2005a)

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Masked Owl inhabits forests, woodlands and nearby clearings (Flegg, 2002). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Coastal forest.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.
- Shrubland.
- Cleared land with or without scattered trees.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Masked Owl. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is known or potential habitat for the Masked Owl. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Masked Owl in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Masked Owl and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Masked Owl occurs within the Project area and surrounds.

The mobility and ranging behaviour of *T. novaehollandiae* enable it to utilise large areas as a forage resource including cleared, open land characteristic of the region. All occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Masked Owl. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Masked Owl given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Masked Owl, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs.
- Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Masked Owl in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Masked Owl. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The main distribution of the Masked Owl in NSW is located along the coast (NPWS, undated-b). This species is distributed in the eastern half of the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *T. novaehollandiae* has been recorded at over 200 locations in the bioregion, of which many are located in 22 protected areas, namely Goulburn River, Bouddi, Brisbane Water, Cattai, Conjola, Dharug, Ku-ring-gai Chase, Meroo, New South Wales Jervis Bay, Royal, Seven Mile Beach, Tomaree, Watagans, Wollemi, Yengo, Murramarang, Morton, Blue Mountains and Nattai National Parks, and Mulgoa, Muogamarra and Awabakal Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Lane Cove National Park (NPWS, 1998b); Popran National Park (NPWS, 2000b); Dharawal Nature Reserve (NPWS, 2002d); and Parr State Recreational Area (NPWS, 2001d).

The information provided suggests that habitat for *T. novaehollandiae* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

There is also the potential for an increase in the numbers of Red Fox (*Vulpes vulpes*) as a result of activity in the Project area. Predation by the Red Fox is also recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The main distribution of the Masked Owl is located along the coast (NPWS, undated-b). However this species is sparsely distributed through sub-coastal mainland Australia from Fraser Island to Carnarvon (Western Australia) including the Nullarbor Plain and inland of the Great Dividing Range (Schodde and Mason, 1980; Smith *et al.,* 1995; Higgins, 1999 in Garnett and Crowley, 2000).

Considering the above, the Project area is located within the distribution of the Masked Owl and does not represent a distributional limit for this species.

HE3.2.15 Brown Treecreeper (*Climacteris picumnus* sub-species *victoriae*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Brown Treecreeper (eastern sub-species) (*Climacteris picumnus victoriae*) breeds between June and December, earlier in inland areas and later towards the coast (Schodde and Tidemann, 1997). The Brown Treecreeper builds cup nests, which are made from dried grass, bark and dung; usually lined with fur, feathers or plant down (*ibid.*). Nests are often built in the hollows of trees, on branches or fence posts, 1-3 m above the ground (NSW Scientific Committee, 2001a). Approximately 2-3 eggs are laid, and incubated for 16-17 days (Schodde and Tidemann, 1997).

This species is insectivorous, and forages on tree trunks and the ground for ants, beetles and larvae (Garnett and Crowley, 2000) and is sedentary, often occurring in pairs or small groups (NSW Scientific Committee, 2001a).

Populations of the Brown Treecreeper are communal and sedentary (Schodde and Tidemann, 1997). Pairs or groups of three to six hold to the same large territory of about 5-10 ha year round (*ibid.*).

The Brown Treecreeper (eastern sub-species) is particularly sensitive to the clearance and fragmentation of woodland habitat. The abundance of this species decreases with decreasing remnant size, to the point where this species is thought to be unable to maintain a viable population in remnant vegetation less than 200 ha (Barrrett *et al.*, 1994 in NSW Scientific Committee, 2001a). Other threats relevant to this species include removal of dead timber and loss of hollow bearing trees and grazing by stock in woodland areas (NSW Scientific Committee, 2001a). Remnant vegetation which occurs within the Project area offers potential foraging, roosting and breeding habitat resources (eg. open Eucalypt woodlands) for the Brown Treecreeper (eastern sub-species). The Project will involve the removal/modification of a portion of known and potential habitat for this species and may disrupt foraging, roosting and breeding.

This species has been recorded at 68 locations in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets), the closest of which is located 1 km south of the Project area[25]. In addition the Brown Treecreeper has been recorded by Birds Australia (2004) and Hunter Bird Observers Club (2004) in a search area of approximately 600 km^2 surrounding the Project area.

During targeted surveys within the Project area and surrounds, the Brown Treecreeper (eastern sub-species) was sighted 23 times with all except one recorded within wooded areas (Figure HE-6) (Mount King Ecological Surveys, 2005). The exception was an individual sighted in trees at a cliff line (*ibid.*).

It is possible that a local population of the Brown Treecreeper (eastern sub-species) exists within the Project area given that the species was recorded during past surveys, other records of this species proximal to the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Brown Treecreeper (eastern subsp.) is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Brown Treecreeper (eastern subsp.) has previously been identified within Goulburn River National Park and Munghorn Gap Nature Reserve (NPWS, 2005b); and
- the progressive nature of Project disturbance and early rehabilitation.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Brown Treecreeper (eastern subsp.) within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Brown Treecreeper (eastern subsp.). The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Brown Treecreeper (eastern subsp.) in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

[25] This record has an accuracy of 0.1 km (NPWS, 2005a)

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Brown Treecreeper (eastern sub-species) favours open Eucalypt woodlands and drier open forests, including Mallee and River Gum (Schodde and Tidemann, 1997; NSW Scientific Committee, 2001a). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Brown Treecreeper (eastern sub-species). This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

As previously stated, the Brown Treecreeper (eastern sub-species) appears unable to maintain a viable population in remnants less than 200 ha and its abundance decreases as remnant size decreases (Barrett *et al.,* 1994 in NSW Scientific Committee, 2001a).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is known or potential habitat for the Brown Treecreeper (eastern sub-species). In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants*– to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Brown Treecreeper (eastern subsp.) in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Brown Treecreeper (eastern sub-species), and the occurrence of such habitat in the NSW Sydney Basin Bioregion, are described above. As previously established, known and potential habitat for the Brown Treecreeper (eastern sub-species) occurs within the Project area and surrounds.

Fragmentation of habitat is a recognised threat of the Brown Treecreeper (eastern sub-species) (NSW Scientific Committee, 2001a). Populations of the Brown Treecreeper are communal and sedentary (Schodde and Tidemann, 1997). As previously stated, the Brown Treecreeper (eastern sub-species) appears unable to maintain a viable population in remnants less than 200 ha and its abundance decreases as remnant size decreases (Barrett *et al*., 1994 in NSW Scientific Committee, 2001a).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the study area and these are mainly associated with stony outcrops (*ibid.*). The vegetation along all the watercourses in the study area has been cleared in the past.

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Brown Treecreeper (eastern sub-species). However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Brown Treecreeper given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Brown Treecreeper, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Brown Treecreeper (eastern subsp.) in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Brown Treecreeper. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The eastern sub-species of the Brown Treecreeper (eastern sub-species) is distributed throughout central NSW on the western side of the Great Dividing Range (NSW Scientific Committee, 2001a). Scattered populations also exist on the east of the Divide in drier areas such as the Cumberland Plain of Western Sydney and in parts of the Hunter, Clarence, Richmond and Snowy River valleys (NSW Scientific Committee, 2001a). This species is distributed in scattered locations in the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the Brown Treecreeper has been recorded at numerous locations in the bioregion, of which a portion are located in 15 protected areas, namely Goulburn River, Scheyville, Thirlmere Lakes, Werakata, Wollemi, Yengo, Murramarang, Blue Mountains, Gardens of Stone, Kanangra-Boyd and Nattai National Parks, and Manobalai, Wingen Maid, Munghorn Gap and Wollondilly River Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Towarri National Park (NPWS, 2004e). Further, potential habitat for this species may occur in Pitt Town Nature Reserve (2000c).

The information provided suggests that habitat for *C. picumnus victoriae* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Brown Treecreeper (eastern sub-species) is distributed throughout central NSW on the western side of the Great Dividing Range (NSW Scientific Committee, 2001a). Scattered populations also exist on the east of the Divide in drier areas such as the Cumberland Plains of Western Sydney and in parts of the Hunter, Clarence, Richmond and Snowy River valleys (NSW Scientific Committee, 2001a). On the western boundary of the distribution of *C. picumnus victoriae,* which runs through Wagga Wagga, Temora, Forbes, Dubbo and Inverell, this sub-species integrates with the western sub-species *C. picumnus picumnus* (Schodde and Mason, 1999 in NSW Scientific Committee, 2001a).

Considering the above, the Project area is located within the known distribution of the Brown Treecreeper (eastern sub-species) and does not represent a distributional limit for this sub-species.

HE3.2.16 Speckled Warbler (*Pyrrholaemus sagittatus*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Speckled Warbler (*Pyrrholaemus sagittatus*) typically breeds between August and January (Pizzey and Knight, 1998) and approximately three to four eggs are laid (Schodde and Tidemann, 1997). Domed nests are made from grass and bark shreds and are lined with fur and feathers. The nest is usually hidden in a slight hollow predominantly on the ground (Gardner, 2002), however it can also be placed in a low shrub or tree trunk (Schodde and Tidemann, 1997; Pizzey and Knight, 1998).

P. sagittatus forages on the ground for arthropods and seeds (Blakers *et al*., 1984 in Garnett and Crowley, 2000; Ford *et al*., 1986 in NSW Scientific Committee, 2001b). Preferred foraging habitat of the Speckled Warbler includes areas with a combination of open grassy patches, leaf litter and shrub cover (NSW Scientific Committee, 2001b). The Speckled Warbler is sedentary, living in pairs or trios and the home range of this species can vary from 6 to 12 ha (NSW Scientific Committee, 2001b).

Threats relevant to the Speckled Warbler include habitat clearance and fragmentation, as well as the removal of dead timber (NSW Scientific Committee, 2001b). The Speckled Warbler appears to be extinct in districts where no fragments larger than 100 ha remain (NSW Scientific Committee, 2001b). Nesting on the ground also makes this species particularly susceptible to predation from cats and foxes (Gardner, 2002). Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources (eg. Eucalypt dominated vegetation) for the Speckled Warbler. The Project will involve the removal/modification of a portion of known and potential habitat resources for this species and may disrupt foraging, roosting and breeding.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates the Speckled Warbler has been recorded at 33 locations in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets), the closest of which is located 1 km west of the Project area[26]. During targeted surveys within the Project area and surrounds, the Speckled Warbler was recorded at two locations (Figure HE-6), in scattered trees on the side of a hill, and in shrubby regrowth vegetation (Mount King Ecological Surveys, 2005).

It is possible that a local population of the Speckled Warbler exists within the Project area given that the species was recorded during past surveys, other records of this species proximal to the Project area and the occurrence of habitat resources. However, the removal/modification of a portion of habitat for the Speckled Warbler is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Speckled Warbler has previously been identified within Goulburn River National Park and Munghorn Gap Nature Reserve (NPWS, 2005b); and
- the progressive nature of Project disturbance and early rehabilitation.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Speckled Warbler within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Speckled Warbler. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* –- to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Speckled Warbler in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

[26] This record has an accuracy of 0.1 km (NPWS, 2005a)

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Speckled Warbler inhabits a wide range of Eucalypt and Cypress dominated vegetation which have a grassy understorey, often on ridges or in gullies (Garnett and Crowley, 2000; NSW Scientific Committee, 2001b). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Speckled Warbler. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

As previously stated, the Speckled Warbler appears to be extinct in districts where no fragments larger than 100 ha remain (NSW Scientific Committee, 2001b). Species abundance has been found to decrease with decreasing area of woodland (Barrett *et al*., 1994 in NSW Scientific Committee, 2001b).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Speckled Warbler. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants*– to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Speckled Warbler in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Speckled Warbler and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Speckled Warbler occurs within the Project area and surrounds.

The home range of this species can vary from 6 to 12 ha (NSW Scientific Committee, 2001b). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Speckled Warbler. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Speckled Warbler given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Speckled Warbler, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Speckled Warbler in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Speckled Warbler. This would include rehabilitation of the riparian vegetation along the Cumbo Creek.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

P. sagittatus is distributed from south-eastern Queensland, through central and eastern NSW to Victoria (NSW Scientific Committee, 2001b). In NSW, this species occurs predominantly on the western slopes and tablelands of the Great Dividing Range, and on the driest sections of the coast (Blakers *et al*., 1984; Schodde and Mason, 1999 in NSW Scientific Committee, 2001b). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates that *P. sagittatus* has been recorded at over 100 locations in the bioregion, of which a portion are located in 14 protected areas, namely Goulburn River, Dharug, Royal, Scheyville, Wollemi, Yengo, Blue Mountains, and Nattai National Parks, and Manobalai, Wingen Maid, Munghorn Gap, Burning Mountain, Castlereagh and Windsor Downs Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Towarri National Park (NPWS, 2004e). Further, potential habitat for this species may occur in Pitt Town Nature Reserve (NPWS, 2000c).

The information provided suggests that habitat for *P. sagittatus* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

P. sagittatus is distributed from south-eastern Queensland, through central and eastern NSW to Victoria (NSW Scientific Committee, 2001b). In NSW, this species occurs predominantly on the western slopes and tablelands of the Great Dividing Range, and on the driest sections of the coast (Blakers *et al*., 1984; Schodde and Mason, 1999 in NSW Scientific Committee, 2001b).

Considering the above, the Project area is located within the distribution of *P. sagittatus* and does not represent a distributional limit for this species.

HE3.2.17 Painted Honeyeater (*Grantiella picta*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Painted Honeyeater (*Grantiella picta*) breeds between October and March, and its breeding distribution is often dictated by the fruiting of mistletoes (Pizzey and Knight, 1999; Garnett and Crowley, 2000). Approximately 1-3 eggs are laid in a frail cup nest which is constructed from fibrous rootlets, Casuarina needles or grass bound with spider web (Ayers *et al.,* 1996). This nest is constructed 3-20 m above the ground (Ayers *et al.,* 1996; Pizzey and Knight, 1999). After 14-15 days of incubation by both sexes, the juvenile young spend 12-14 days in the nest before fledging (Schodde and Tidemann, 1997).

The diet of mature Painted Honeyeaters is primarily mistletoe berries (genus *Amyema*), however, it can also include mistletoe nectar, insects and Eucalypt flowers (Ayers *et al.,* 1996). Juveniles of this species feed mainly on insects (*ibid.*). The Painted Honeyeater is nomadic and migrates to the north during winter months (Schodde and Tidemann, 1997).

The Painted Honeyeater is particularly sensitive to the removal of foraging habitat (Garnett and Crowley, 2000). This is largely attributable to the removal of parasitic mistletoe on which this species feeds (Ayers *et al.,* 1996). Other threats relevant to this species include habitat loss and fragmentation and competition for limiting resources with other Honeyeaters (P. Ewin, pers. comm. in Ayers *et al.*, 1996). Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources (eg. woodlands) for the Painted Honeyeater. The Project will involve the removal/modification of a portion of known and potential habitat resources for this species and may disrupt foraging, roosting and breeding.

This species has been recorded at eight locations in the region (ie. Gulgong and Merriwa 1:100,000 map sheets) (NPWS, 2005a), the closest of which is located 2 km south of the Project area[27]. In addition the Painted Honeyeater has been recorded by Birds Australia (2004) and Hunter Bird Observers Club (2004) in a search area of approximately 600 km^2 surrounding the Project area.

During targeted surveys within the Project area and surrounds, an individual Painted Honeyeater was sighted in spring, foraging within the upper canopy of Ironbark trees (Figure HE-6) (Mount King Ecological Surveys, 2005).

[27] This record has an accuracy of 0.1 km (NPWS, 2005a)

It is possible that a local population of the Painted Honeyeater exists within the Project area given that the species was recorded during recent surveys, other records of this species proximal to the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Painted Honeyeater is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Painted Honeyeater has previously been identified within Goulburn River National Park (NPWS, 2003a) and Munghorn Gap Nature Reserve (NPWS, 2005b); and
- the progressive nature of Project disturbance and early rehabilitation. .

Further, a number of measures have been developed for the Project to minimise potential impacts on the Painted Honeyeater within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Painted Honeyeater. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* - to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Painted Honeyeater in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Painted Honeyeater inhabits open Eucalypt forests and woodlands (Schodde and Tidemann, 1997). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.

- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.
- Shrubland.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Painted Honeyeater. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Painted Honeyeater. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Painted Honeyeater in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Painted Honeyeater and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Painted Honeyeater occurs within the Project area and surrounds.

The Painted Honeyeater is nomadic and migrates to the north during winter months (Schodde and Tidemann, 1997). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Painted Honeyeater. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Painted Honeyeater given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Painted Honeyeater, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Painted Honeyeater in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Painted Honeyeater. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Painted Honeyeater is sparsely distributed over much of inland eastern Australia, from south-eastern Australia, to north-western Queensland and eastern Northern Territory (Schodde and Tidemann, 1997; Garnett and Crowley, 2000). This species is more common in the north during winter months. The Painted Honeyeater can be found virtually anywhere with mistletoe (P. Ewin, pers. comm. in Ayers *et al.,* 1996). This species is sparsely distributed in the northern half of the NSW Sydney Basin Bioregion and potential habitat (as described above) occur in a number of protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates that *G. picta* has been recorded at approximately 22 locations in the bioregion, of which some are located in three protected areas, namely Wollemi National Park, and Munghorn Gap and Castlereagh Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Goulburn River National Park (NPWS, 2003a); Heathcote National Park (NPWS, 2000a) and Blue Mountains National Park (NPWS, 2001c). Potential habitat for this species may occur in Towarri National Park (NPWS, 2004e).

The information provided suggests that habitat for *G. picta* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Painted Honeyeater is sparsely distributed over much of inland eastern Australia, from south-eastern Australia, to north-western Queensland and eastern Northern Territory (Schodde and Tidemann, 1997; Garnett and Crowley, 2000). This species is more common in the north during winter months. The Painted Honeyeater can be found virtually anywhere with mistletoe (P. Ewin, pers. comm. in Ayers *et al.,* 1996).

Considering the above, the Project area is located within the distribution of the Painted Honeyeater and does not represent a distributional limit for this species.

HE3.2.18 Black-chinned Honeyeater (*Melithreptus gularis gularis*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Black-chinned Honeyeater (eastern sub-species) (*Melithreptus gularis gularis*) typically breeds between July and December (Pizzey and Knight, 1997). Approximately 1-2 eggs are laid, and incubated for 14-15 days (Schodde and Tidemann, 1997). Breeding can be communal, with additional members of the colony helping the senior parental pair feed their young (*ibid.*). Nests of the Black-chinned Honeyeater are a fragile cup made of bark-shreds, grass, wool and/or spiders web (Pizzey and Knight, 1997). This species typically nests high (approximately 3-15 m) in outer foliage (Schodde and Tidemann, 1997).

The Black-chinned Honeyeater feeds on insects, nectar and lerp (Blakers *et al*., 1984 in Garnett and Crowley, 2000). The Black-chinned Honeyeater has a large feeding territory and as a result, often appears locally and is seasonally nomadic (Pizzey and Knight, 1997; Schodde and Tidemann, 1997). Populations of the Black-chinned Honeyeater (eastern subsp.) appear to be unable to persist in areas which lack remnants of native vegetation larger than 200 ha (NSW Scientific Committee, 2001c). Threats relevant to the Black-chinned Honeyeater (eastern subsp.) include clearance and fragmentation of woodland habitat, increased competition (eg. Noisy Miner) and nest predation (eg. Pied Currawongs) (NSW Scientific Committee, 2001c).

Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources for the Black-chinned Honeyeater (eastern sub-species). The Project will involve the removal/modification of a portion of potential habitat resources (eg. Box woodlands) for this species and may disrupt foraging, roosting and breeding.

The Black-chinned Honeyeater (eastern sub-species) has been recorded at 18 locations in the region (ie. Mt. Pomany and Merriwa 1:100,000 map sheets) the closest of which is located approximately 2 km south of the Project area (NPWS, 2005a) [28]. In addition the Black-chinned Honeyeater (eastern subsp.) has been recorded by Birds Australia (2004), Hunter Bird Observers Club (2004) and Australian Museum (2004) in a search area of approximately 600 km^2 surrounding the Project area.

During targeted surveys within the Project area and surrounds, the Black-chinned Honeyeater (eastern subsp.) was recorded in two locations outside the proposed disturbance area (Figure HE-6) (Mount King Ecological Surveys, 2005). One individual was heard calling in an area where a portion of the Ironbark trees retained some blossom. Another two individuals were sighted foraging in the upper tree canopy (*ibid.*).

It is possible that a local population of the Black-chinned Honeyeater (eastern subsp.) exists within the Project area given this species was recorded during recent targeted surveys, other records of this species proximal to the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Black-chinned Honeyeater (eastern subsp.) is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;

[28] This record has an accuracy of 1 km (NPWS, 2005a)

- occurrence of proximal known and potential habitat to the Project area. The Black-chinned Honeyeater has previously been identified within Goulburn River National Park and Munghorn Gap Nature Reserve (NPWS, 2005b); and
- the progressive nature of Project disturbance and early rehabilitation.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Black-chinned Honeyeater (eastern subsp.) within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Black-chinned Honeyeater (eastern subsp.). The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* –- to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Black-chinned Honeyeater (eastern subsp.) in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

In NSW, the Black-chinned Honeyeater (eastern subsp.) is mainly found in woodlands containing Box-Ironbark woodland associations and River Red Gum (Garnett and Crowley, 2000; NSW Scientific Committee, 2001c). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Black-chinned Honeyeater (eastern subsp.). This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

As previously stated, populations of the Black-chinned Honeyeater (eastern subsp.) appear to be unable to persist in areas which lack remnants of native vegetation larger than 200 ha (NSW Scientific Committee, 2001c).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Black-chinned Honeyeater (eastern subsp.). In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Black-chinned Honeyeater (eastern subsp.) in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Black-chinned Honeyeater (eastern subsp.) and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Black-chinned Honeyeater (eastern subsp.) occurs within the Project area and surrounds.

The Black-chinned Honeyeater (eastern subsp.) has a large feeding territory and as a result, often appears locally and seasonally nomadic (Pizzey and Knight, 1997; Schodde and Tidemann, 1997). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Black-chinned Honeyeater (eastern subsp.). However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Black-chinned Honeyeater (eastern subsp.) given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Black-chinned Honeyeater (eastern subsp.), including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Black-chinned Honeyeater (eastern subsp.) in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Black-chinned Honeyeater. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Black-chinned Honeyeater (eastern subsp.) is found predominately west of the Great Dividing Range in a narrow belt through NSW, extending north into southern Queensland, and south into Victoria and South Australia, where it occupies Eucalypt woodlands within an approximate annual rainfall range of 400-700 mm (Blakers *et al.*, 1984). This species is distributed across most of the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in a number of protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates that *M. gularis gularis* has been recorded at approximately 97 locations in the bioregion, of which a portion are located in 11 protected areas, namely Goulburn River, Georges River, Ku-ring-gai Chase, Scheyville, Werakata, Wollemi, Blue Mountains, and Nattai National Parks, and Munghorn Gap, Castlereagh and Windsor Downs Nature Reserves. Further, it is recognised that potential habitat for this species may occur in Pitt Town Nature Reserve (2000c).

The information provided suggests that habitat for *M. gularis gularis* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

M. gularis gularis is found predominately west of the Great Dividing Range in a narrow belt through NSW, extending north into southern Queensland, and south into Victoria and South Australia, where it occupies Eucalypt woodlands within an approximate annual rainfall range of 400-700 mm (Blakers *et al.*, 1984).

Considering the above, the Project area is located within the distribution of the Black-chinned Honeyeater (eastern subsp.) in NSW and does not represent a distributional limit for this species.

HE3.2.19 Regent Honeyeater (*Xanthomyza phrygia*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Regent Honeyeater (*Xanthomyza phrygia*) usually nests in isolated pairs, although they sometimes breed in loose colonies (NPWS, 1999k). The nest is a thick walled cup of bark strips bound with cobwebs and lined with dry grass and bark shreds (Geering and French, 1998). There are only a small number of known breeding sites in NSW, the most important being in the Capertee Valley (DEC, 2004c) although other important breeding areas are situated in Warrumbungle National Park, Pilliga Nature Reserve, Barraba district, the central coast around Gosford, and the Hunter Valley (Ayers *et al.,* 1996; NPWS, 1999k). This species has been recorded breeding from June to February, but mainly breeding from August to November (DEC, 2004c; Geering and French, 1998).

Although nectar is their main food source, Regent Honeyeaters also eat insects, lerps and fruit (Ayers *et al.,* 1996). The most frequent nectar sources are three species of Eucalypt, namely, Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*) and Yellow Box (*E. melliodora*) (NPWS, 1999k; DEC, 2004c). Other 'key' foraging species include Yellow Gum (*E. leucoxylon*), Red Box (*E. polyanthemos*), Spotted Gum (*Corymbia maculata*), Swamp Mahogany (*E. robusta*), Blakely's Red Gum (*E. blakelyi*), Grey Gum (*E. punctata*), Box Mistletoe (*Amyema cambadgei*) and Needle-leaf Mistletoe (*A. cambadgei*) on *C. cunninghamiana* along watercourses (DEC, 2004c). The Regent Honeyeater has demonstrated a preference for larger trees to forage and the preference for particular species may be related to the timing of flowering (*ibid.*).

The Regent Honeyeater is regarded as a single population (DEC, 2004c). The birds are partly migratory, shifting generally northwards in autumn and winter and returning south to breed in spring (Schodde and Tidemann, 1997). Individuals have been found to travel over 350 km between the Capertee Valley and Canberra (David Geering pers comm., 2004). The movements of the Regent Honeyeater are related to the regional patterns of flowering of the 'key' forage species (DEC, 2004c).

Threats which are relevant to the Regent Honeyeater are clearing and fragmentation of woodland and forest that contain the Eucalypt species preferred by this species because this not only reduces the amount of habitat available, but also makes any remnants unusable if they become too small or isolated (Garnett and Crowley, 2000; DEC, 2004c). Other threats include competition for resources with Noisy Miners (*Manorina melanocephala*) (Ford *et al*., 1993 in DEC, 2004c), loss of habitat resources through illegal firewood collection (Garnett and Crowley, 2000) and grazing of key food species by rabbits, sheep and cattle, as well as lack of water and degradation of riparian habitat through over-utilised or diverted stream flows (DEC, 2004c).

Remnant vegetation which occurs within the Project area and surrounds, offers known and potential foraging, roosting and breeding habitat resources for the Regent Honeyeater. The Project area will involve the removal/modification of a portion of known and potential habitat resources (eg. Box woodlands) for this species and may disrupt foraging, roosting and breeding. The closest core breeding area is located approximately 70 km south of the Project area in the Capertee Valley (after DEC, 2004c). However, it is recognised that the Mudgee-Wollar area (in which the Project is located) is a currently regularly used breeding area (DEC, 2004c).

This species has been recorded at 73 locations in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets), the closest of which is located within the Project area (NPWS, 2005a) [29]. In addition the Regent Honeyeater has been recorded by Birds Australia (2004) and Hunter Bird Observers Club (2004) in a search area of approximately 600 km^2 surrounding the Project area.

[29] This record has an accuracy of 1 km (NPWS, 2005a)

David Geering from the Regent Honeyeater Recovery Team verbally provided information about the distribution of records in and near the Project area. There are records for the Regent Honeyeater along the southern end of Wilpinjong Road, as well as along Wollar Road and Cumbo Road outside the disturbance area (David Geering pers comm., 2004) (Figure HE-6). An inspection of part of the Project area by David Geering indicated habitat for the Regent Honeyeater is present within the Project area. The distribution of potential habitat for the Regent Honeyeater within the Project area closely follows vegetation communities containing Box tree species (particularly White Box). The Regent Honeyeater was not recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005).

Based on the above, the Regent Honeyeater would be expected to periodically utilise habitat within the Project area given records of this species within the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Regent Honeyeater is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Regent Honeyeater has previously been identified within Goulburn River National Park and Munghorn Gap Nature Reserve (NPWS, 2005b; NPWS, 2003a; NPWS, 2002f; NPWS, 2001h); and
- the progressive nature of Project disturbance and early rehabilitation. Rehabilitation would not provide suitable habitat for the species in the short-term. However, suitable habitat would be developed in the long-term through the use of suitable endemic vegetation species [eg. White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*)] and creation of areas of woodland.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Regent Honeyeater within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Regent Honeyeater. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) is a recognised threat to the survival of Regent Honeyeater as grazing prevents regeneration of shrubs and Eucalypts (DEC, 2004c).
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - 1:1 long-term re-establishment plus greater than 1:1 conservation of White Box, Yellow Box, Blakely's Red Gum Woodland Endangered Ecological Community which offers preferred habitat and foraging resources for this species.
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration. This is expected to benefit the Regent Honeyeater because grazing by stock prevents regeneration of native Eucalypt woodland and riverine Casuarinas (DEC, 2004c). It is recognised that the most effective solution to this threat is to fence remnant areas to reduce/exclude grazing (DEC, 2004c).
  - Selective planting of key forage species, eg. White Box (*E. albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*).
  - Revegetation of Wilpinjong Creek in ECA-B with species such as *C. cunninghamiana*. Degradation of riparian habitat is a recognised threat to the Regent Honeyeater (DEC, 2004c).

- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Regent Honeyeater in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion with species such as *C. cunninghamiana*.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Regent Honeyeater occurs in a wide variety of habitats including Swamp Mahogany forest, Spotted Gum, riverine She-oak woodlands, remnant stands of timber, roadside reserves and travelling stock routes (DEC, 2004c). However, it is most commonly found in Box-Ironbark woodlands (DEC, 2004c; NPWS, 1999k). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Coastal forest.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Regent Honeyeater. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999).

Most habitat for the Regent Honeyeater is now highly fragmented and occurs as scattered trees in farmland or as reserved forests (Franklin, *et al*., 1989 in Geering and French, 1998). In NSW, some mapping of significant habitat has been undertaken (eg. vegetation of the Capertee Valley) and further mapping of Regent Honeyeater habitat is recognised as a future action in the Regent Honeyeater Recovery Plan (DEC, 2004c). Regent Honeyeater habitat is also mapped in Goulburn River National Park (NPWS, 2001h).

Less than 290 ha of remnant vegetation containing either known or potential habitat for the Regent Honeyeater (including approximately 50 ha of White Box, Yellow Box, Blakely's Red Gum Woodland Endangered Ecological Community) will be cleared or modified for the Project (mature vegetation in intact remnants). In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include:

  - 1:1 long-term re-establishment plus greater than 1:1 conservation of White Box, Yellow Box, Blakely's Red Gum Woodland Endangered Ecological Community which offers preferred habitat for this species, ie. greater than 80 ha of the endangered community is conserved in the ECAs, and an additional 50 ha will be re-established in the long-term.
  - Revegetation of Wilpinjong Creek in ECA-B with species such as *C. cunninghamiana*.

- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Regent Honeyeater in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion with species such as *C. cunninghamiana*. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Regent Honeyeater and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Regent Honeyeater occurs within the Project area and surrounds.

Regent Honeyeaters are partly migratory, shifting generally northwards in autumn and winter and returning south to breed in spring (Schodde and Tidemann, 1997). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

Fragmentation of habitat is a recognised threat to the Regent Honeyeater. Fragmentation advantages more aggressive honeyeaters, particularly the Noisy Miner which may be displacing the Regent Honeyeater (Franklin *et al*., 1989, Grey *et al*., 1998 in Garnett and Crowley, 2000). Corridors of remnant vegetation are important for the Regent Honeyeater to travel distances (eg. for birds to disperse from the Capetree Valley to as far as Canberra, located approximately 350 km west) (David Geering pers comm., 2004).

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of (mostly small) areas of remnant vegetation scattered throughout the Project area (*ibid.*) (Figure HE-4). Pit 3 contains the largest intact vegetation remnant (approximately 145 ha).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Regent Honeyeater. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Regent Honeyeater given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Regent Honeyeater, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Wilpinjong Creek in ECA-B with species such as *C. cunninghamiana*.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Regent Honeyeater in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Regent Honeyeater. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion with species such as *C. cunninghamiana*.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Regent Honeyeater is distributed from the Great Dividing Range, north to Brisbane in Queensland and south to Bendigo in Victoria, with outliers in the Mount Lofty Ranges and Kangaroo Island in South Australia (Schodde and Tidemann, 1997). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in a number of protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *X. phrygia* has been recorded at over 300 locations in the bioregion, of which a portion are located in 20 protected areas, namely Goulburn River, Brisbane Water, Cattai, Dharug, Ku-ring-gai Chase, New South Wales Jervis Bay, Royal, Scheyville, Seven Mile Beach, Sydney Harbour, Wollemi, Yengo, Murramarang, Morton, Blue Mountains, Gardens of Stone and Nattai National Parks, and Munghorn Gap, Cockle Bay and Muogamarra Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Tomaree National Park (NPWS, 2004g); Agnes Banks Nature Reserve (NPWS, 1999b); Windsor Downs Nature Reserve (NPWS, 1999b) and Parr State Recreational Area (NPWS, 2001d). Further, it is recognised that potential habitat for this species may occur in Bouddi National Park (NPWS, 1999c).

The information provided suggests that habitat for *X. phrygia* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Regent Honeyeater is distributed from the Great Dividing Range, north to Brisbane in Queensland and south to Bendigo in Victoria, with outliers in the Mount Lofty Ranges and Kangaroo Island in South Australia (Schodde and Tidemann, 1997). On the western-edge of its range in NSW, this species occurs as far inland as Narrabri, Warrumbungle National Park, Dubbo, Parkes and Finley (DEC, 2004c).

There are only a small number of known breeding sites in NSW, the most important being in the Capertee Valley (DEC, 2004c) although other important breeding areas are situated in Warrumbungle National Park, Pilliga Nature Reserve, Barraba district, the central coast around Gosford, and the Hunter Valley (Ayers *et al.,* 1996; NPWS, 1999k).

The closest core breeding area is located approximately 70 km south of the Project area in the Capertee Valley (after DEC, 2004c). However, it is recognised that the Mudgee-Wollar area (in which the Project is located) is a currently regularly used breeding area (DEC, 2004c).

Considering the above, the Project area is located within the distribution for the Regent Honeyeater and does not represent a distributional limit for this species.

HE3.2.20 Hooded Robin (*Melanodryas cucullata cucullata*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Hooded Robin (south-eastern form) (*Melanodryas cucullata cucullata*) feeds on the ground on insects and small lizards in areas with a mix of bare ground, ground cover and leaf litter (Garnett and Crowley, 2000; NSW Scientific Committee, 2001d).

The Hooded Robin breeds from July to December communally in groups of three or more individuals (Pizzey and Knight, 1999). The nest is an open cup made from bark-strips, rootlets, grass and / or spiders' web. The nest is built in a tree fork, crevice or hollow on or near dead wood, approximately 1-6 m above the ground (Pizzey and Knight, 1999; Schodde and Tidemann, 1997). Within these nests, two eggs are laid and incubated for approximately 14 days (Schodde and Tidemann, 1997).

This species is often observed in small family groups and sometimes in isolated pairs (NSW Scientific Committee, 2001d). The species is typically territorial and has a home range of approximately 10-20 ha (Schodde and Tidemann, 1997). Juveniles of this species are dispersive (Pizzey and Knight, 1999).

Threatening processes relevant to the Hooded Robin (south-eastern form) include vegetation clearance and fragmentation, the removal of dead timber, isolation of populations in small remnants, low population densities, habitat degradation by stock grazing, weed invasion and increased populations of nest predators (such as Pied Currawongs and Australian Ravens) (NSW Scientific Committee, 2001d). This species appears to be unable to survive in remnants smaller than 100-200 ha (NSW Scientific Committee, 2001d). Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources for the Hooded Robin (south-eastern form). The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, roosting and breeding (were this species to occur).

This species has been recorded at 22 locations in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets) the closest of which is located within the Project area (NPWS, 2005a) [30]. In addition the Hooded Robin has been recorded by Birds Australia (2004) and Hunter Bird Observers Club (2004) in a search area of approximately 600 km^2 surrounding the Project area.

During targeted surveys within the Project area and surrounds, the Hooded Robin (south-eastern form) was recorded in low numbers in multiple locations within the Project area, but always outside the proposed disturbance area (Figure HE-6) (Mount King Ecological Surveys, 2005). Most sightings of the Hooded Robin (south-eastern form) were at the interface between woodland and grassland (cleared) habitat and a few in regrowth shrubby vegetation at the edge of Grey Box woodland.

It is possible that a local population of the Hooded Robin (south-eastern form) exists within the Project area given records of this species within the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Hooded Robin (south-eastern form) is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Hooded Robin (south-eastern form) has previously been identified within Goulburn River National Park and Munghorn Gap Nature Reserve (NPWS, 2005b); and

[30] This record has an accuracy of 0.1 km (NPWS, 2005a)

- the progressive nature of Project disturbance and early rehabilitation.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Hooded Robin (south-eastern form) within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Hooded Robin (south-eastern form). The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Hooded Robin (south-eastern form) in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Hooded Robin (south-eastern form) inhabits a wide range of Eucalypt woodlands, mallee, Acacia scrubland and open forests (Garnett and Crowley, 2000). In temperate woodlands, this species favours open areas which adjoin large areas of woodland, with areas of dead timber and sparse shrub cover (Fitri and Ford, 1997 in NSW Scientific Committee, 2001d). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Shrubland.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Hooded Robin. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

As previously stated, this species appears to be unable to survive in remnants smaller than 100-200 ha (NSW Scientific Committee, 2001d).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Hooded Robin (south-eastern form). In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Hooded Robin (south-eastern form) in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Hooded Robin (south-eastern form) and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Hooded Robin (south-eastern form) occurs within the Project area and surrounds.

The species is typically territorial and has a home range of approximately 10-20 ha (Schodde and Tidemann, 1997). Juveniles of this species are dispersive (Pizzey and Knight, 1999). During recent targeted surveys, most sightings of the Hooded Robin (south-eastern form) in the Project area were at the interface between woodland and grassland (cleared) habitat. Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Hooded Robin (south-eastern form). However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Hooded Robin given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Hooded Robin (south-eastern form), including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs.

- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Hooded Robin (south-eastern form) in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Hooded Robin. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Hooded Robin is distributed throughout south-eastern Australia, from Central Queensland to the Spencer Gulf in South Australia (NSW Scientific Committee, 2001d). This species is distributed across most the NSW Sydney Basin Bioregion and potential habitat (as discussed above) occurs in a number of protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *M. cucullata* has been recorded at a number of locations in the bioregion, of which a portion are located in seven protected areas, namely Goulburn River, Werakata, Wollemi, and Nattai National Parks, and Munghorn Gap, Gulguer and Wollondilly River Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Towarri National Park (NPWS, 2004e). Further, it is recognised that potential habitat for this species may occur in Scheyville National Park and Pitt Town Nature Reserve (NPWS, 2000c).

The information provided suggests that habitat for *M. cucullata cucullata* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

M. cucullata cucullata is distributed throughout south-eastern Australia, from central Queensland to the Spencer Gulf in South Australia (NSW Scientific Committee, 2001d).

Considering the above, the Project area is located within the distribution of the Hooded Robin and does not represent a distributional limit for this species.

HE3.2.21 Grey-crowned Babbler (*Pomatostomus temporalis temporalis*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Grey-crowned Babbler (eastern subsp.) (*Pomatostomus temporalis temporalis*) lives and breeds in a co-ordinated communal group which may include up to 12 individuals (Schodde and Tidemann, 1997). These extended family parties are essential for both the co-operative feeding of young and predator avoidance (King, 1980 in Garnett and Crowley, 2000).

The Grey-crowned Babbler typically breeds between July and February (Schodde and Tidemann, 1997). Pairs mate for life and are usually the only breeding birds within the group (Schodde and Tidemann, 1997). A domed nest, up to 500 mm wide (with a roomy cavity reached by a small tunnel) is made of strong twigs and lined with grass, fur or cow dung (*ibid.*). The nest is built in the fork of small branches usually about 4 m above the ground. Approximately 2-3 eggs are laid, and incubated for 18-23 days by the female (Schodde and Tidemann, 1997). Nests used for breeding have been found to be used afterwards as roosts, while some nests have been found to be used for roosting only (Dow and King, 1984).

P. temporalis temporalis feeds on invertebrates (spiders and insects) and lizards, foraging on the ground, in leaf litter, on the bark of trees and in shrubs and foliage (Schodde and Tidemann, 1997; NSW Scientific Committee, 2001e; Garnett and Crowley, 2000). Populations of the Grey-crowned Babbler are nomadic ground foragers (Flegg, 2002).

Threatening processes relevant to the Grey-crowned Babbler (eastern subsp.) include clearance and fragmentation of habitat, habitat degradation as a result of weed invasion and grazing, and increased abundance of competitors (eg. Noisy Miners) and nest predators (eg. Pied Currawong and Australian Raven) (Garnett and Crowley, 2000; NSW Scientific Committee, 2001e). Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources for the Grey-crowned Babbler (eastern subsp.). The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, roosting and breeding (were this species to occur).

The Atlas of NSW Wildlife indicates the Grey-crowned Babbler has been recorded at three locations in the region (ie. Gulgong and Merriwa 1:100,000 map sheets) (NPWS, 2005a), the closest of which is located 2 km south of the Project area[31]. In addition the Grey-crowned Babbler has been recorded by Hunter Bird Observers Club (2004) in a search area of approximately 600 km^2 surrounding the Project area. However, this species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005).

It is possible that a local population of the Grey-crowned Babbler (eastern subsp.) exists within the Project area given records of this species proximal to the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Grey-crowned Babbler is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Grey-crowned Babbler has previously been identified within Goulburn River National Park and Munghorn Gap Nature Reserve (NPWS, 2005b); and
- the progressive nature of Project disturbance and early rehabilitation.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Grey-crowned Babbler (eastern subsp.) within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.

[31] This record has an accuracy of 1 km (NPWS, 2005a)

- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Grey-crowned Babbler (eastern subsp.). The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Selective planting of key forage species, eg. White Box (*E. albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*).
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Grey-crowned Babbler (eastern subsp.) in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Grey-crowned Babbler (eastern subsp.) inhabits open forests, Acacia shrubland, open woodlands (dominated by mature Eucalypts with regenerating trees, tall shrubs and an intact ground cover of grass and forbs) and adjoining farmland (Garnett and Crowley, 2000; Schodde and Tidemann, 1997). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Shrubland.
- Cleared land with or without scattered trees.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Grey-crowned Babbler (eastern subsp.). This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Grey-crowned Babbler (eastern subsp.). In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Grey-crowned Babbler (eastern subsp.) in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Grey-crowned Babbler and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for the Grey-crowned Babbler occurs within the Project area and surrounds.

Populations of the Grey-crowned Babbler (eastern subsp.) are nomadic ground foragers (Flegg, 2002). However, these birds are reluctant to traverse tracts of cleared land (NSW Scientific Committee, 2001e). Accordingly, proximate habitat areas within the Project area and close surrounds are considered to be occurrences of potential habitat when not separated by tracts of cleared land.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Grey-crowned Babbler (eastern subsp.). However, an area of potential habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for Grey-crowned Babbler given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Grey-crowned Babbler (eastern subsp.), including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Grey-crowned Babbler (eastern subsp.) in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Grey-crowned Babbler (eastern subsp.). This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

In NSW, *P. temporalis temporalis* occurs on the western slopes and plains but is less common at higher altitudes of the tablelands (*ibid.*). Isolated populations exist in coastal woodlands on the North Coast, in the Hunter Valley, and from the South Coast near Nowra (Blakers *et al*., 1984; Schodde and Mason, 1999 in NSW Scientific Committee, 2001e). This species is distributed in the northern half of the NSW Sydney Basin Bioregion (after NPWS, 2005c) and potential habitat (as described above) occurs in many protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *P. temporalis* has been recorded at over 100 locations in the bioregion, of which a portion are located in five protected areas, namely Goulburn River, Werakata, Wollemi, and Yengo National Parks, and Munghorn Gap Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Towarri National Park (NPWS, 2004e).

The information provided suggests that habitat for *P. temporalis temporalis* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

P. temporalis temporalis formally ranged throughout eastern Australia, from South Australia through NSW and central Queensland, and north to southern New Guinea (NSW Scientific Committee, 2001e). The species is now considered to be extinct in South Australia, coastal Victoria and the ACT. In NSW, *P. temporalis temporalis* occurs on the western slopes and plains but is less common at higher altitudes of the tablelands (*ibid.*). Isolated populations exist in coastal woodlands on the North Coast, in the Hunter Valley, and from the South Coast near Nowra (Blakers *et al*., 1984; Schodde and Mason, 1999 in NSW Scientific Committee, 2001e).

Considering the above, the Project area is located within the known distribution of the Grey-crowned Babbler and does not represent a distributional limit for this species.

HE3.2.22 Diamond Firetail (*Stagonopleura guttata*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Diamond Firetail (*Stagonopleura guttata*) typically breeds between August and January (Pizzey and Knight, 1998). Approximately four to seven eggs are laid, and incubated for 12-15 days (Schodde and Tidemann, 1997). Nests are placed in the thick foliage of mistletoe clumps, Eucalypt tree or shrub, up to 10 m above the ground (Schodde and Tidemann, 1997). The nests are bulky and bottle-shaped and are made from grass (Pizzey and Knight, 1998). After fledging, young birds spend about a week in the breeding area before joining a larger flock to forage wherever food sources are abundant (Schodde and Tidemann, 1997). Many young are nomadic during winter, moving to new areas as food sources become depleted (*ibid.*).

Diamond Firetails drink frequently throughout the day. The main food source of this species is seed, mostly from grasses (Read, 1994 in Garnett and Crowley, 2000), however their diet can also include insects (Blakers *et al*., 1984, Read, 1994 in NSW Scientific Committee, 2001f). At dusk, feeding flocks disperse to dense shrubbery or to specifically build nests to roost (Schodde and Tidemann, 1997). Roosting nests are made of coarse green and dry grasses and are smaller and built lower to the ground than breeding nests (*ibid.*).

Populations of the Diamond Firetail are sedentary (Pizzey and Knight, 1997), however many young exist as nomads during the winter months, not constructing roost nests and moving on as the food source becomes depleted (Schodde and Tidemann, 1997).

Threatening processes relevant to the Diamond Firetail include habitat removal, fragmentation and degradation (particularly overgrazing of the grass understorey) and increased abundance of predators (eg. Pied Currawong and Australian Ravens) (Garnett and Crowley, 2000; NSW Scientific Committee, 2001f). Further, populations of the Diamond Firetail appear to be unable to persist in areas which lack remnants of native vegetation larger than 200 ha (NSW Scientific Committee, 2001f). Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources for the Diamond Firetail (eg. woodland). The Project will involve the removal/modification of a portion of known and potential habitat resources for this species and may disrupt foraging, roosting and breeding.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates the Diamond Firetail has been recorded at 22 locations in the region (ie. Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets), including within the Project area[32]. In addition the Diamond Firetail has been recorded by Birds Australia (2004), Hunter Bird Observers Club (2004) and Australian Museum (2004) in a search area of approximately 600 km^2 surrounding the Project area.

During targeted surveys within the Project area and surrounds, the Diamond Firetail was the most common finch found in the study area during the autumn survey and was classed as locally abundant during this survey period (Mount King Ecological Surveys, 2005). Flocks of 20 or more Diamond Firetail were observed in wooded areas close to cleared land (ie. mainly on the edge of patches of woodland habitat) (Figure HE-6).

It is possible that a local population of the Diamond Firetail exists within the Project area given that the species was recorded within the Project area during recent surveys and the occurrence of potential habitat resources. However, the removal/modification of a portion of habitat for the Diamond Firetail is unlikely to disrupt the lifecycle such that a local viable population of this species would be placed at risk of extinction given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The Diamond Firetail has previously been identified within Goulburn River National Park and Munghorn Gap Nature Reserve (NPWS, 2005b); and
- the progressive nature of Project disturbance and early rehabilitation. Rehabilitation would not provide suitable habitat for the species in the short-term. However, suitable habitat would be developed in the long-term through the use of suitable endemic vegetation species [eg. White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*)] and creation of areas of woodland.

[32] This record has an accuracy of 1 km (NPWS, 2005a)

Further, a number of measures have been developed for the Project to minimise potential impacts on the Diamond Firetail within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential nesting/breeding habitat for the Diamond Firetail. The surveys would include observations to determine completion of nesting activities (ie. young have left the nest and the nest is no longer used for nesting).
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Diamond Firetail in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Diamond Firetail inhabits a wide range of Eucalypt dominated vegetation communities that have a grassy understorey including woodland, forest and mallee (Garnett and Crowley, 2000). Water and trees are always near, to provide drinking and shelter respectively (Schodde and Tidemann, 1997). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Coastal forest.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Diamond Firetail. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Bensen, 1999).

Populations of the Diamond Firetail appear to be unable to persist in areas which lack remnants of native vegetation larger than 200 ha (NSW Scientific Committee, 2001f).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Diamond Firetail. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including (Figure HE-5):

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Diamond Firetail in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Diamond Firetail and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Diamond Firetail occurs within the Project area and surrounds.

Populations of the Diamond Firetail are sedentary (Pizzey and Knight, 1997), however many young exist as nomads during the winter months, not constructing roost nests and moving on as the food source becomes depleted (Schodde and Tidemann, 1997). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Diamond Firetail. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Diamond Firetail given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Diamond Firetail, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.

- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Diamond Firetail in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Diamond Firetail. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

In NSW, populations of *S. guttata* occur primarily west of the Great Dividing Range, although some occur in drier coastal areas such as the Cumberland Plains of western Sydney and the Hunter, Clarence, Richmond and Snowy River Valleys (Blakers *et al.,* 1984; Schodde and Mason, 1999 in NSW Scientific Committee, 2001f). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in a number of protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates *S. guttata* has been recorded at over 100 locations in the bioregion, of which a portion are located in six protected areas, namely Goulburn River, Wollemi, Blue Mountains and Nattai National Parks, and Munghorn Gap and Wollondilly River Nature Reserves. Further, it is recognised that potential habitat for this species may occur in Scheyville National Park and Pitt Town Nature Reserve (NPWS, 2000c).

The information provided suggests that habitat for *S. guttata* is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

S. guttata is distributed through central and eastern NSW, extending north into southern and central Queensland and south through Victoria to the Eyre Peninsula, South Australia (NSW Scientific Committee, 2001f). In NSW, populations of *S. guttata* occur primarily west of the Great Dividing Range, although some occur in drier coastal areas such as the Cumberland Plains of western Sydney and the Hunter, Clarence, Richmond and Snowy River Valleys (Blakers *et al.,* 1984; Schodde and Mason, 1999 in NSW Scientific Committee, 2001f).

Considering the above, the Project area is located within the distribution of the Diamond Firetail and does not represent a distributional limit for this species.

HE3.2.23 Spotted-tailed Quoll (*Dasyurus maculatus*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Spotted-tailed Quoll (*Dasyurus maculatus*) requires suitable den sites (such as hollow logs, tree hollows, rock outcrops or caves) and utilises numerous dens within its home range (NPWS, 1999l). Both sexes of the Spotted-tailed Quoll become sexually mature when they reach about one year old and mating takes place from April to July (Edgar and Belcher, 1998). This species has an average litter size of five (*ibid.*).

The Spotted-tailed Quoll requires an abundance of food (such as birds and small mammals) and large areas of relatively intact vegetation through which to forage (Ayers *et al*., 1996; NPWS, 1999l). This species is primarily solitary and nocturnal, although it may forage during the day (NPWS, 1999l). Prey items of this carnivore include birds, reptiles, small mammals (eg. gliders, possums, rats and small macropods), arthropods and carrion (Edgar and Belcher, 1998; Ayers *et al.,* 1996; NPWS, 1999l). This species is thought to occupy large home ranges (between 800 ha and 2,000 ha) and has been known to move several kilometres overnight (NPWS, 1999l).

Threats to the Spotted-tailed Quoll include loss of habitat through clearing, logging and frequent fire (Edgar & Belcher, 1995 and Dickman & Read, 1992 in NPWS, 1999l), loss of potential den sites including hollow logs (Scotts, 1992 in NPWS, 1999l), as well as competition for food and predation by foxes and cats, and shooting as agricultural pests (Edgar & Belcher, 1995 and Dickman & Read, 1992 in NPWS, 1999l). In addition, spread of disease by cats to the Spotted-tailed Quoll, and poisoning from Dingo baits may also prove to be a threat (*ibid.*).

Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, denning and breeding habitat resources (eg. woodland) for *D. maculatus*. The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, denning and breeding (if this species were to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *D. maculatus* has been recorded at five locations in the region (ie. Mudgee and Mt. Pomany 1:100,000 map sheets), located approximately 32 km south-west of the Project area[33]. This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005).

Considering the above, it is possible that a local population of the Spotted-tailed Quoll could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the lack of records proximal to the Project area (despite targeted surveys). Since it is unlikely that a viable local population of the Spotted-tailed Quoll exists in the Project area, it is also unlikely that the lifecycle of the species will be disrupted such that one would be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Spotted-tailed Quoll occurs in a range of habitats that include sclerophyll forests and woodlands, rainforests and coastal heathlands (after NPWS, 1999l). This species has also been observed in treeless areas including grazing lands, open country and rocky outcrops but they do require large areas of relatively intact vegetation for foraging as well as hollow logs, tree hollows, rock outcrops and caves to use as den sites (*ibid.*). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Forest in dry lowland environments.

[33] This record has an accuracy of 1 km (NPWS, 2005a)

- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Rocky hills and escarpment.
- Heathland.
- Native grassland.
- Cleared land with or without scattered trees.
- Caves.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Spotted-tailed Quoll. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves.

No known habitat for this species will be modified or removed for the Project since this species has not been identified in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Spotted-tailed Quoll. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *D. maculatus* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for *D. maculatus* occurs within the Project area and surrounds.

D. maculatus is thought to occupy large home ranges (between 800 ha and 2,000 ha) and has been known to move several kilometres overnight (NPWS, 1999l). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area is unlikely to cause fragmentation of current interconnecting habitat for the Spotted-tailed Quoll given that this species is highly mobile. Therefore, an area of potential habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Spotted-tailed Quoll.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

In NSW, the Spotted-tailed Quoll occurs on both sides of the Great Dividing Range (NPWS, 1999l). The north-east of NSW represents a stronghold for this species as numbers in the south-east have dramatically declined (*ibid.*). This species is mainly distributed towards the coast in the NSW Sydney Basin Bioregion (after NPWS, 2005c) and potential habitat (as described above) occurs in a number of protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *D. maculatus* has been recorded at approximately 404 locations in the bioregion, of which many are located in 16 protected areas, namely Bouddi, Brisbane Water, Budderoo, Cattai, Dharug, Ku-ring-gai Chase, Popran, Seven Mile Beach, Wollemi, Murramarang, Morton, Blue Mountains, Kanangra-Boyd and Nattai National Parks, and Barren Grounds and Cambewarra Range Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Marramarra National Park (NPWS, 1998f); Tomaree National Park (NPWS, 2004g); Wyrrabalong National Park (NPWS, 1995); Yengo National Park (NPWS, 2001d); Gardens of Stone National Park (NPWS, 2004f); Muogamarra Nature Reserve (NPWS, 1998f); Maroota Historic Site (NPWS, 1998f) and Parr State Recreational Area (NPWS, 2001d). Further, it is recognised that potential habitat for this species may occur in Dharawal Nature Reserve (2002e) and Pulbah Island Nature Reserve (NPWS, 2003c).

The information provided suggests that habitat for the Spotted-tailed Quoll is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

There is also the potential for an increase in the numbers of Red Fox (*Vulpes vulpes*) as a result of activity in the Project area. Predation by the Red Fox is also recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

In NSW, the Spotted-tailed Quoll occurs on both sides of the Great Dividing Range (NPWS, 1999l). The north-east of NSW represents a stronghold for this species as numbers in the south-east have dramatically declined (*ibid.*).

Considering the above, the Project area is located within the known distribution of *D. maculatus* and does not represent a distributional limit for this species.

HE3.2.24 Koala (*Phascolarctos cinereus*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

A nocturnal species, the Koala (*Phascolarctos cinereus*) rests in tree forks during the day (Martin and Handasyde, 1998). Although it is not known if the abundance of rest sites has an influence on Koala presence, it has been suggested that mature trees may not be essential for resting (AMBS, 1995). Koalas breed in summer and generally females produce a single offspring each year (Martin and Handasyde, 1998).

The tree species preferred by Koalas in NSW as their principal food source are presented in Table HE-13. Koalas have however been observed to feed on the leaves of approximately 70 species of Eucalypt and 30 non-Eucalypt species (Phillips, 1990 in NPWS, 1999m).

Table HE-13
Preferred Food Trees of Koalas in NSW

Scientific Name	Common Name
Eucalyptus punctata	Grey Gum
E. tereticornis	Forest Red Gum
E. robusta	Swamp Mahogany
E. microcorys	Tallowwood
E. viminalis	Ribbon or Manna Gum
E. camaldulensis	River Red Gum
E. haemastoma	Broad-leaved Scribbly Gum
E. signata	Scribbly Gum
E. albens	White Box
E. populnea	Bimble Box or Poplar Box

Source: State Environmental Planning Policy (SEPP) No. 44 - Koala Habitat Protection (1995)

The Koala is regarded as a solitary species that spends most of its time in defined home ranges (Martin and Handasyde, 1998; Ayers *et al.,* 1996). Koalas live in complex groups and individuals have overlapping home range areas (Martin and Handasyde, 1998). Dispersal distances generally range from 1–11 km, although movements in excess of 50 km have been recorded (NPWS, 1999m).

Threats to the Koala include fragmentation and destruction of habitat for urban development, agriculture and mining as well as other degradation of habitat (eg. fire, weed invasion, climate change), road mortalities, dog attacks, fire, and disease (NPWS, 1999m; DEC, 2003g).

Remnant vegetation which occurs within the Project area and surrounds, offers very limited potential foraging, shelter and breeding habitat resources for the Koala. Potential Koala food trees in accordance with Schedule 2 of SEPP 44, present within the study area include Grey Gum (*Eucalyptus punctata*) and White Box (*E. albens*) (FloraSearch, 2005). However, these species represent less than 15% of the upper or lower strata tree component in the Project area (Mount King Ecological Surveys, 2005). Based on this, the Project area and surrounds is not potential Koala habitat.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates the Koala has been recorded at 28 locations in the region (ie. Mudgee, Gulgong and Merriwa 1:100,000 map sheets), the closest of which is located approximately 3 km south east of the Project area from 1957[34]. This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005). Further, there was no evidence of the presence of Koalas within the study area. No characteristic scratches or faecal pellets were observed, despite searching smooth-barked trees and the base of trees at each survey site during each survey. Discussions with local residents revealed that Koalas were known in the district in the past, but have not been seen locally for many years. It is unlikely that any Koalas currently use the Project area.

It is unlikely that a local population of the Koala exists within the Project area due to the lack of recent records and absence of potential habitat resources. Since it is unlikely that a viable local population of the Koala exists in the Project area, it is also unlikely that the lifecycle of the species will be disrupted such that one would be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

[34] This record has an accuracy of 0.1 km (NPWS, 2005a)

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Koala occurs in certain Eucalypt forest and woodland depending on a number of factors including the size and species of trees, soil nutrients, climate, rainfall and amount of past disturbance (Reed *et al*., 1990 in NPWS, 1999m). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Coastal forest.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Koala. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves.

Most primary habitat for the Koala in the Sydney Basin Bioregion has been cleared (NPWS, 2003f). The populations which remain are small, highly fragmented and disjunct in areas of secondary habitat (*ibid.*).

Potential Koala food trees in accordance with Schedule 2 of SEPP 44 present within the study area represent less than 15% of the upper or lower strata tree component in the Project area. Based on this, the land is not potential Koala habitat so no known habitat for this species will be modified or removed for the Project.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Koala and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential Koala food trees in accordance with Schedule 2 of SEPP 44 present within the study area represent less than 15% of the upper or lower strata tree component in the Project area. Based on this, no potential habitat for the Koala occurs within the Project area.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Koala has a fragmented distribution throughout eastern Australia, from north-east Queensland to the Eyre Peninsula in South Australia (Martin and Handasyde, 1998). In NSW, *P. cinereus* mainly occurs on the central and north coasts (NPWS, 1999m). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *P. cinereus* has been recorded at numerous locations in the bioregion, of which many are located in 21 protected areas, namely Goulburn River, Brisbane Water, Cattai, Dharug, Garigal, Heathcote, Ku-ring-gai Chase, Royal, Tomaree, Watagans, Wollemi, Yengo, Morton, Blue Mountains and Nattai National Parks, and Moffats Swamp, Munghorn Gap, Muogamarra, Pulbah Island, Tilligerry and Wollondilly River Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Marramarra National Park (NPWS, 1998f); Scheyville National Park (NPWS, 2000c); Dharawal Nature Reserve (NPWS, 2002d); Pitt Town Nature Reserve (NPWS, 2000c); Maroota Historic Site (NPWS, 1998f); Parr State Recreational Area (NPWS, 2001d); Lake Macquarie State Recreation Area (NPWS, 2003c) and Burragorang State Recreation Area (NPWS, 2001b).

The information provided suggests that habitat for the Koala is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

There is also the potential for an increase in the numbers of Red Fox (*Vulpes vulpes*) as a result of activity in the Project area. Predation by the Red Fox is also recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Koala has a fragmented distribution throughout eastern Australia, from north-east Queensland to the Eyre Peninsula in South Australia (Martin and Handasyde, 1998). In NSW, *P. cinereus* mainly occurs on the central and north coasts (NPWS, 1999m).

Considering the above, the Project area is located within the known distribution of the Koala and does not represent a distributional limit for this species.

HE3.2.25 Squirrel Glider (*Petaurus norfolcensis*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Squirrel Glider (*Petaurus norfolcensis*) is dependent on trees with hollows as den and nest sites. A number of studies have found strong relationships between the prevalence of trees with hollows in an area of forest or woodland, and the presence and abundance of gliders (Lindenmayer, 2002). The Squirrel Glider utilises tree hollows for sheltering and breeding where it lives in family groups of up to ten animals (Suckling, 1998).

The diet of the Squirrel Glider consists of insects, Acacia gum, Eucalypt sap, nectar and pollen (*ibid.*). Squirrel Gliders appear to be restricted to stands of mixed forest that contain at least one species of winter-flowering Eucalypt or banksia that can contribute to a reliable, year-round food supply (NPWS, 2000b). The estimated home range size for this species varies from 2 to 13 ha, with densities from 0.4 to 3 individuals per hectare (Quin, 1993; Traill and Coates, 1993; Suckling, 1998).

Primary threats to populations of the Squirrel Glider include clearing of woodlands, firewood collection, land clearing, inappropriate forms of timber harvesting, and habitat fragmentation.

Remnant vegetation which occurs within the Project area offers potential foraging, shelter and breeding habitat resources (eg. woodland) for the Squirrel Glider. The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, shelter and breeding.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates the Squirrel Glider has been recorded at two locations in the region (ie. Gulgong and Mt. Pomany 1:100,000 map sheets), the closest of which is located approximately 1 km north of the Project area in Goulburn River National Park[35]. During targeted surveys within the Project area and surrounds, the Squirrel Gilder was recorded at one location outside the disturbance area, in response to a call broadcast (Figure HE-6). In addition, hair belonging to the *Petaurus* genus was located in the disturbance area during the autumn survey. Further survey of this location was planned for the spring survey, however potential habitat for the Squirrel Glider (eg. mature trees) had been removed by logging in the intervening period.

It is possible that a local population of the Squirrel Glider may occur within the Project area given the occurrence of potential habitat resources and records of this species within the Project area and surrounds. However, the removal/modification of a portion of habitat for the Squirrel Glider is unlikely to place a local viable population of this species (were one to exist) at risk of extinction. This conclusion is based on the:

- occurrence of proximal known and potential habitat (this species has previously been identified within Goulburn River National Park to the north of the Project area and Munghorn Gap Nature Reserve to the south (NPWS, 2005c; NPWS, 2003a; NPWS, 2001h); and
- the high level of past disturbance to vegetation within the proposed disturbance area resulting from past vegetation clearance for agricultural purposes.

A number of measures have been developed for the Project to minimise potential impacts on the Squirrel Glider within the Project area and adjacent park and reserve areas including:

- *Pre-clearance Surveys* – to identify and survey potential nesting/breeding habitat for the Squirrel Glider. The surveys would include the capture and release of any Squirrel Gliders into alternative suitable habitat located outside of the proposed disturbance areas.
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals within the Project area and on surrounding habitat, including Protected areas. Measures will include active weed and feral animal control.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include the fencing of ECAs to exclude stock.
- *Progressive Rehabilitation* – to result in the establishment of wildlife corridors for the Squirrel Glider. This would include rehabilitation of the riparian vegetation of Wilpinjong Creek and the Cumbo Creek diversion. The species of vegetation used to rehabilitate the area will include suitable habitat species for the Squirrel Glider including *Eucalyptus crebra* (Narrow-leaved Ironbark) and *E. moluccana* (Coast Grey Box) which are both known to exist in the study area. This will benefit the Squirrel Glider in the long-term.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Squirrel Glider inhabits dry sclerophyll forests and woodland (NPWS, 1999n). Within these broad vegetation categories, this species requires hollow bearing trees and a mix of Eucalypts, Acacias and Banksias (*ibid.*). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.

[35] This record has an accuracy of 0.1 km (NPWS, 2005a)

- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Squirrel Glider. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves.

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Squirrel Glider. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

Further, approximately 480 ha of remnant woodland habitat and adjacent farmland will be enhanced and conserved as part of the Wilpinjong Enhancement and Conservation Areas (ECAs), which will improve habitat opportunities for the Squirrel Glider. Management measures would include fencing of woodland remnants to exclude stock and allow natural regeneration and the implementation of weed and feral animal control programmes. Project rehabilitation initiatives would also increase potential habitat for this species in the long-term through the establishment of significant areas of woodland. A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Squirrel Glider and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for the Squirrel Glider occurs within the Project area.

The estimated home range size for this species varies from 2 to 13 ha, with densities from 0.4 to 3 individuals per ha (Quin, 1993; Traill and Coates, 1993; Suckling, 1998). However, proximate habitat areas within the Project area and close surrounds are considered to be occurrences of potential habitat when not separated by tracts of cleared land.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting potential habitat for the Squirrel Glider. However, an area of potential habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Squirrel Glider given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

Further, as discussed above, approximately 480 ha of remnant woodland habitat and adjacent farmland will be enhanced as part of the ECAs and as part of Progressive Rehabilitation. A key objective of the Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Squirrel Glider as this species has been recorded near ECA-C (Mount King Ecological Surveys, 2005) (Figures HE-5 and HE-6). A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Squirrel Glider is widespread throughout central Victoria (on the Riverine Plains, Northern Uplands and northern slopes of the Western Highlands), central eastern NSW and central eastern Queensland, excluding the dense coastal ranges (Ayers *et al*., 1996). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occur in a number of protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *P. norfolcensis* has been recorded at approximately 295 locations in the bioregion, of which many are located in 15 protected areas, namely Goulburn River, Bouddi, Brisbane Water, Dharug, Popran, Tomaree, Wollemi, Wyrrabalong, Yengo, Murramarang, Blue Mountains and Kanangra-Boyd National Parks, and Cockle Bay, Wambina and Wollondilly River Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Towarri National Park (NPWS, 2004e); Nattai National Park (NPWS, 2001b); Pulbah Island Nature Reserve (NPWS, 2003c); Munghorn Gap Nature Reserve (NPWS, 2000d); Parr State Recreational Area (NPWS, 2001d); and Lake Macquarie State Recreation Area (NPWS, 2003c). Further, it is recognised that potential habitat for this species may occur in Dharawal Nature Reserve (NPWS, 2002d).

The information provided suggests that habitat for the Squirrel Gilder is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

The Project area may also involve the removal of dead wood and dead trees. Removal of dead wood and dead trees is recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Squirrel Glider is widespread throughout central Victoria (on the Riverine Plains, Northern Uplands and northern slopes of the Western Highlands), central eastern NSW and central eastern Queensland, excluding the dense coastal ranges (Ayers *et al*., 1996).

Considering the above, the Project area is located within the known distribution of the Squirrel Gilder and does not represent a distributional limit for this species.

HE3.2.26 Brush-tailed Rock Wallaby (*Petrogale penicillata*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Brush-tailed Rock Wallaby favours sites with numerous ledges, caves and crevices in which they shelter during the day (Eldridge and Close, 1998; NPWS, undated). The refuges are generally situated among large boulders, however dense vegetation (such as large Figs) are also used for shelter (NPWS, undated). Highly territorial, colonies of *P. penicillata* are very loyal to their sites (NPWS, 2000k).

Adult male Brush-tailed Rock Wallabies aggressively defend an area including the refuge sites of up to three females (Jarman and Bayne, 1997 in NPWS, 2003g). Whereas juvenile males leave the colony or disperse to vacant areas within the colony, juvenile females may disperse or will otherwise remain and breed in their natal colony (NPWS, 2003h).

In the evening, *P. penicillata* emerges from shelter to feed in grassy areas above or below the cliffs, usually within 200 m of the refuge site (NPWS, 2000k; NPWS, undated). The Brush-tailed Rock Wallaby feeds predominantly on grasses, herbs and forbs (Ayers *et al.*, 1999). Seeds, fruit and flowers are eaten opportunistically (Eldridge and Close, 1998).

P. penicillata occurs in small groups or colonies, with individuals having non-exclusive home ranges of up to 15 ha (Ayers *et al.*, 1999; NPWS, undated).

Threats to the Brush-tailed Rock Wallaby includes predation by feral animals, competition for shelter and food resources with introduced herbivores, as well as degradation of habitat due to inappropriate fire regimes and weed invasion (Miller and Moss, 1997 and Lunney *et al*., 1997 in NPWS, 2003g). In addition, clearing of habitat for agriculture and hunting for fur trade and persecution by farmers have also proven to be threats.

Remnant vegetation which occurs within the Project area and surrounds, offers potential foraging habitat resources (eg. open woodland) for *P. penicillata*. The Project will involve the removal/modification of a portion of potential habitat for this species and may disrupt foraging if this species were to occur in the Project area.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *P. penicillata* has been recorded at 17 locations in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets), the closest of which is located approximately 31 km south-east of the Project area[36]. This species has not been recorded during recent targeted surveys within the Project area and surrounds (Mount King Ecological Surveys, 2005).

Considering the above, it is possible that a local population of *P. penicillata* could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the lack of records proximal to the Project area (despite targeted surveys). Since it is unlikely that a viable local population of the Brush-tailed Rock Wallaby exists in the Project area, it is also unlikely that the lifecycle of the species will be disrupted such that one would be placed at risk of extinction.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

[36] This record has an accuracy of 1 km (NPWS, 2005a)

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Brush-tailed Rock Wallaby occurs in a variety of habitats, ranging from rainforest to sclerophyll forest and open woodland (Eldridge and Close, 1998). The sites occupied by *P. penicillata* typically have north-facing cliffs, allowing the wallabies to sun themselves in the morning and evening (Eldridge and Close, 1998; NPWS, 2000k). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Rocky hills and escarpment.
- Native grassland.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Brush-tailed Rock Wallaby. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves.

No known habitat for this species will be modified or removed for the Project. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Brush-tailed Rock Wallaby. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *P. penicillata* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for *P. penicillata* occurs within the Project area and surrounds.

The Brush-tailed Rock Wallaby occurs in small groups or colonies, with individuals having non-exclusive home ranges of up to 15 ha (Ayers *et al.*, 1999; NPWS, undated). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Brush-tailed Rock Wallaby. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Brush-tailed Rock Wallaby given the localised nature of the Project and the connectivity of the surrounding potential habitat.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Brush-tailed Rock Wallaby is distributed along the Great Dividing Range from southern Victoria into central Queensland and extends west into central NSW (Ayers *et al.*, 1999). In NSW, an endangered population of the Brush-tailed Rock Wallaby occurs within and outside of the Warrumbungle National Park (NPWS, undated). Elsewhere in NSW, it has a fragmented distribution on the coast and ranges from the Queensland border to the south coast (*ibid.*). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in a number of protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *P. penicillata* has been recorded at approximately 154 locations in the bioregion, of which many are located in 12 protected areas, namely Goulburn River, Bugong, Watagans, Wollemi, Yengo, Morton, Blue Mountains, Gardens of Stone, Kanangra-Boyd and Nattai National Parks, and Manobalai and Wingen Maid Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Towarri National Park (NPWS, 2004e); Munghorn Gap Nature Reserve (NPWS, 2003a) and Parr State Recreational Area (NPWS, 2001d). Further, it is recognised that potential habitat for this species may occur in Dharawal Nature Reserve (NPWS, 2002d).

The information provided suggests that habitat for the Brush-tailed Rock Wallaby is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

There is also the potential for an increase in the numbers of Red Fox (*Vulpes vulpes*) as a result of activity in the Project area. Predation by the Red Fox is also recognised as a threatening process in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Brush-tailed Rock Wallaby is distributed along the Great Dividing Range from southern Victoria into central Queensland and extends west into central NSW (Ayers *et al.*, 1999). In NSW, an endangered population of the Brush-tailed Rock Wallaby occurs within and outside of the Warrumbungle National Park (NPWS, undated). Elsewhere in NSW, it has a fragmented distribution on the coast and ranges from the Queensland border to the south coast (*ibid.*).

Considering the above, the Project area is located within the known distribution of *P. penicillata* and does not represent a distributional limit for this species.

HE3.2.27 Grey-headed Flying Fox (*Pteropus poliocephalus*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Roost sites, also known as camps, of the Grey-headed Flying Fox (*Pteropus poliocephalus*) are commonly formed in gullies, typically not far from water and usually in vegetation with a dense canopy (Tidemann, 1998). *P. poliocephalus* is an obligate nectarivore and frugivore (Eby, 2000). This species feeds on a wide variety of flowering and fruiting plants and is responsible for the seed dispersal of many rainforest trees, such as native figs and palms (Tidemann, 1998). The Grey-headed Flying Fox also feeds extensively on the blossoms of Eucalypts, Angophoras, Tea-trees and Banksias, as well as in introduced tree species in urban areas and in commercial fruit crops (Tidemann, 1998; Duncan *et al.,* 1999). Native plant species known to be consumed by *P. poliocephalus* include *Angophora floribunda, Banksia integrifolia, Corymbia maculata*, *Eucalyptus blakelyi, E. crebra, E. melliodora, E. punctata, E. moluccana* and *E. tereticornis* (Hall and Richards, 2000).

Mating, birth and the rearing of young occur at the roost sites (*ibid.*). Mating occurs at any time of the year, however most conceptions occur in March or April (Hall and Richards, 2000; Tidemann, 1998). The majority of reproductively mature females give birth to a single young each October/November (NPWS, 2001b).

The Grey-headed Flying Fox commutes daily to foraging areas, usually within 15 km of the day roost, while a few individuals may travel up to 50 km (Tidemann, 1998). *P. poliocephalus* responds to changes in the amount and location of available food by migrating in irregular patterns (Eby, 2000; Hall and Richards, 2000). Migration patterns vary between years in association with the changing location of flowering trees (*ibid.*).

Threats to the Grey-headed Flying Fox include the destruction of habitat, particularly habitat used for foraging, by clearing for urban development and agriculture, electrocution on powerlines, competition and hybridisation with the Black Flying-fox (*Pteropus alecto*) and unregulated shooting (NPWS, 2001j). In addition, disturbance at roosting sites can cause pregnant females to abort (*ibid.*).

Waterbodies and remnant vegetation which occur within the Project area and surrounds, offer potential foraging, roosting and breeding habitat resources (eg. woodlands) for *P. poliocephalus*. The Project will involve the removal/modification of a portion of potential habitat for this species and may disrupt foraging, roosting and breeding if this species were to occur in the Project area.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *P. poliocephalus* has not been recorded in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets). This species has not been recorded during targeted surveys within the Project area and surrounds (Greg Richards and Associates, 2005).

Considering the above, it is possible that a local population of the Grey-headed Flying Fox could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the absence of records proximal to the Project area (despite targeted surveys). It is considered that a local viable population of this species (were one to exist) would not be placed at risk of extinction given the occurrence of habitat outside the proposed disturbance area including better quality habitat in Goulburn River National Park and Munghorn Gap Nature Reserve. This species is unlikely to be dependant upon the habitat in the proposed disturbance area.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Grey-headed Flying Fox inhabits subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as cultivated fruit crops and residential gardens (Eby, 1995; NPWS, 2001j). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Heathland.
- Lakes, wetlands and swamps.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Grey-headed Flying Fox. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been recorded in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Grey-headed Flying Fox. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion. Especially considering the extensive habitat conserved in the adjacent Goulburn River National Park (70,323 ha, Table HE-2) to the north and Munghorn Gap Nature Reserve (5,934 ha, Table HE-2) to the south. The 290 ha of remnant vegetation to be cleared or modified equates to approximately 0.4% of the habitat in the 'local' area.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *P. poliocephalus* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for *P. poliocephalus* occurs within the Project area and surrounds.

The Grey-headed Flying Fox commutes daily to foraging areas, usually within 15 km of the day roost, while a few individuals may travel up to 50 km (Tidemann, 1998; Hall and Richards, 2000). *P. poliocephalus* responds to changes in the amount and location of available food by migrating in irregular patterns (Eby, 2000). Migration patterns vary between years in association with the changing location of flowering trees (*ibid.*). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Grey-headed Flying Fox. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Grey-headed Flying Fox given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat. Furthermore the Grey-headed Flying Fox does not appear to be restricted by fragmentation per se, providing that commuting distances for foraging are approximately less than 20-30 km from roost sites (Hall and Richards, 2000).

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Grey-headed Flying Fox is distributed in coastal south-eastern Australia, from Victoria to Miriam Vale in Queensland and inland to the western slopes (Hall and Richards, 2000). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *P. poliocephalus* has been recorded at over 100 locations in the bioregion, of which many are located in 25 protected areas, namely Brisbane Water, Bugong, Dharug, Garigal, Heathcote, Ku-ring-gai Chase, Lane Cove, Meroo, Popran, Royal, Seven Mile Beach, Sydney Harbour, Wollemi, Wyrrabalong, Murramarang, Morton, Blue Mountains and Kanangra-Boyd National Parks, and Cockle Bay, Comerong Island, Kooragang, Narrawallee Creek, Wallumatta, Wambina and Yatteyattah Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Botany Bay National Park (NPWS, 2002b); Bouddi National Park (NPWS, 1999c); Budderoo National Park (NPWS, 2004a); Tomaree National Park (NPWS, 2004g); Dalrymple-Hay Nature Reserve (NPWS, 2004c); Dharawal Nature Reserve (NPWS, 2002d); Pulbah Island Nature Reserve (NPWS, 2003c) and Lake Macquarie State Recreation Area (NPWS, 2003c).

The information provided suggests that habitat for the Grey-headed Flying Fox is adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Grey-headed Flying Fox is distributed in coastal south-eastern Australia, from Victoria to Miriam Vale in Queensland and inland to the western slopes (Hall and Richards, 2000).

Considering the above, the Project area is located within the known distribution of *P. poliocephalus* and does not represent a distributional limit for this species.

HE3.2.28 Large-footed Myotis (*Myotis macropus*)

The Large-footed Myotis (*Myotis adversus*) is listed as Vulnerable under the Schedules TSC Act. However, *M. adversus* is the taxonomic name given to the species of Large-footed Myotis which is distributed in Asia. The Australian species of Large-footed Myotis is referred to as *Myotis macropus* and therefore has been referenced in the following Eight Part Test of Significance.

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Colonies of the Large-footed Myotis (*M. macropus*) roost during the day, predominantly in caves or their substitutes (such as mines and tunnels), however there has also been an odd record in tree hollows and disused bird nests (NPWS, 2000k). In cooler regions this species hibernates in winter, remaining in roosts which are separate from the maternity sites (Richards, 1998b).

Within breeding colonies, males establish a territory, excluding other males and form a harem of females during the breeding periods (Richards, 1998b). When not breeding, males roost alone (*ibid.*). In NSW, females of this species give birth to one young each year, usually in November or December (Richards, 1998b).

The Large-footed Myotis forage most commonly over water, raking its surface with the sharp claws of their large feet to catch aquatic insects and small fish, which make up most of their diet (Richards, 1998b; Churchill, 1998; NPWS, 2000k). The Large-footed Myotis may also forage aerially and may forage individually or hunt together (*ibid.*).

Threats to the Large-footed Myotis are currently poorly known but possible threats are suggested to include sensitivity to changes in water quality caused by sedimentation, eutrophication, alteration of flow regimes and other pollution (Duncan *et al*., 1999 in DEC, 2004b) as well as disturbance to roosting sites by activities such as recreational caving and/or roadworks, particularly during the colder months when the species is hibernating (Ayers *et* al., 1996; Duncan *et al*., 1999; Gilmore & Parnaby, 1994 in DEC, 2004b).

No potential foraging, roosting and breeding habitat resources (eg. caves near fresh water) for the Large-footed Myotis occur within the Project area. While some roosting and breeding habitat resources for this species (ie. caves) occur in the surrounding area, no caves or abandoned mines occur within the proposed disturbance area. Further, foraging habitat with water present that could be considered suitable for this species includes only Wilpinjong and Cumbo Creeks, but neither appear to have permanent large pools of water; both are ephemeral and water levels/ponding appears to be influenced by the local rainfall regime. During recent targeted surveys (Greg Richards and Associates, 2005) neither watercourse provided potential foraging habitat for the Large-footed Myotis. Considering the above, the Project will not involve the removal/modification of potential habitat for this species.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates the Large-footed Myotis has not been recorded in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets). This species has not been recorded during targeted surveys within the Project area and surrounds (Greg Richards and Associates, 2005).

Considering the above, it is possible that a local population of the Large-footed Myotis could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the absence of records proximal to the Project area (despite targeted surveys). It is considered that a local viable population of this species would not be placed at risk of extinction given the Project will not involve the removal/modification of a portion of potential habitat for this species.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Large-footed Myotis inhabits areas close to fresh water including rainforest streams, lakes and reservoirs (Richards, 1995 in Ayers *et al*., 1996) and uses roost sites located in caves, mines, tunnels, dense foliage etc. (Ayers *et al*., 1996). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Riparian vegetation along watercourses.
- Lakes, wetlands and swamps.
- Caves.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Large-footed Myotis. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999).

No known or potential habitat for this species occurs within the Project area. Therefore a significant area of known (or potential) habitat will not be modified or removed for the Project.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Large-footed Myotis and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, no known or potential habitat for the the Large-footed Myotis occurs within the Project area and surrounds.

Due to the species' mobility, all occurrences of potential habitat for this species within the surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas.

No known or potential habitat for this species occurs within the Project area therefore, an area of known (or potential) habitat is unlikely to become isolated from currently interconnecting areas of habitat for this species. Further, an area of known (or potential) habitat is unlikely to become isolated from proximate areas of habitat for this species due to the species' mobility.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Large-footed Myotis was previously considered to only occur disjunctly along the coast of Australia from Victoria to south-east Queensland and inland along waterways (Duncan *et al*., 1999). However a recent taxanomic assessment of the Australian *Myotis* group (*M. adversus, M. macropus* and *M. moluccarum*) showed that these taxa form a monophyletic group that was given the name *M. macropus* (Cooper *et al.*, 2004). Hence, the general distributional range is now considered to be across northern Australia, coastally to Victoria. In NSW, this species is distributed along the coast of the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in a number of protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *M. macropus* has been recorded at over 100 locations in the bioregion, of which many are located in nine protected areas, namely Dharug, Meroo, New South Wales Jervis Bay, Popran, Royal, Wollemi, Wyrrabalong, Murramarang and Blue Mountains National Parks.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Ku-ring-gai Chase National Park (NPWS, 2002c) and Morton National Park (NPWS, 2001f).

The information provided suggests that habitat for the Large-footed Myotis may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Large-footed Myotis occurs disjunctly along the coast of Australia across the north from the Kimberley, coastally to Victoria and including inland waterways (Duncan *et al*., 1999).

Considering the above, the Project area is located outside the known distribution of the Large-footed Myotis. If this species was to occur, it would be outside the limit of its known distribution.

HE3.2.29 Large-eared Pied Bat (*Chalinolobus dwyeri*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Large-eared Pied Bat (*Chalinolobus dwyeri*) roosts in caves, mine tunnels and the abandoned mud nests of Fairy Martins (Hoye and Dwyer, 1998). In contrast to most other cave dwelling bat species, *C. dwyeri* has been found to roost close to the entrance of shallow limestone caves in the 'twilight' zone (*ibid.*).

Little is known of the reproduction of this species. However, females give birth (commonly to twins) in November and young are independent by late February (Hoye and Dwyer, 1998). Young leave the cave soon after, while the females remain another month before abandoning the roost in late March for winter (Churchill, 1998). This species is thought to spend the coldest months in hibernation (Hoye and Dwyer, 1998).

This species forages for small flying insects below the forest canopy (Hoye and Dwyer, 1998; Churchill, 1998). The Large-eared Pied Bat is thought to disperse from colonies during winter (Hoye and Dwyer, 1995 in Ayers *et al.*, 1996).

The only confirmed threat to *C. dwyeri* is the destruction/interference of roost sites (DEC, 2004b). However, mining induced subsidence that destroys roost sites, habitat (eg. foraging) destruction for urban and agricultural development, and predation by feral animals are all potential threats (Ayers *et* al., 1996; Duncan *et al*., 1999 in DEC, 2004b).

Waterbodies and remnant vegetation which occurs within the Project area and surrounds, offers potential foraging habitat resources (eg. woodland near caves) for *C. dwyeri*. No roosting or breeding habitat for this species (eg. caves or abandoned mines) occurs within the proposed disturbance area. The Project will involve the removal/modification of a portion of known and potential habitat for this species and may disrupt foraging, roosting and breeding.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *C. dwyeri* has been recorded at 21 locations in the region (ie. Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets), the closest of which is located approximately 3 km north of the Project area[37]. During targeted surveys within the Project area and surrounds, the Large-eared Pied Bat was recorded (Greg Richards and Associates, 2005). All records of this species were from extensive tracts of vegetation in the south-east corner of the Project area, on the fringe of the Munghorn Gap Nature Reserve (Figure HE-7) (*ibid.*).

It is possible that a small local population of the Large-eared Pied Bat may use habitat within the Project area given this species was recorded in the Project area during both targeted surveys, the presence of other records of this species proximal to the Project area and the occurrence of potential habitat resources. However, the lifecycle of the Large-eared Pied Bat is unlikely to be disrupted such that a local viable population of this species would be placed at risk of extinction given the presence of extensive habitat resources in the surrounding area and wider region (eg. Goulburn River National Park and Munghorn Gap Nature Reserve).

Further, a number of measures have been developed for the Project to minimise potential impacts on the Large-eared Pied Bat within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential roosting/breeding habitat for the Large-eared Pied Bat.
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Large-eared Pied Bat in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

[37] This record has an accuracy of 0.1 km (NPWS, 2005a)

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Large-eared Pied Bat occurs in moderately-well wooded habitats (Ayers *et al*., 1996). This species roosts in caves, mine tunnels and the abandoned mud nests of Fairy Martins (Hoye and Dwyer, 1998). In contrast to most other cave dwelling bat species, *C. dwyeri* has been found to roost close to the entrance of shallow limestone caves in the 'twilight' zone (*ibid.*). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Caves.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for *C. dwyeri*. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves.

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for *C. dwyeri*. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including:

- *Enhancement and Conservation of Remnants*– to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Large-eared Pied Bat in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *C. dwyeri* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for *C. dwyeri* occurs within the Project area and surrounds.

The Large-eared Pied Bat is thought to disperse from colonies during winter (Hoye and Dwyer, 1995 in Ayers *et al.*, 1996). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for *C. dwyeri*. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for *C. dwyeri* given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Large-eared Pied Bat, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Large-eared Pied Bat in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Large-eared Pied Bat. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Large-eared Pied Bat is distributed from south-eastern Queensland to NSW, from the coast to the western slopes of the Great Dividing Range (Churchill, 1998). This species is distributed throughout the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *C. dwyeri* has been recorded at over 100 locations in the bioregion, of which many are located in 13 protected areas, namely Goulburn River, Bouddi, Royal, Watagans, Wollemi, Yengo, Morton, Blue Mountains, Kanangra-Boyd and Nattai National Parks, and Munghorn Gap, Barren Grounds and Joadja Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Tomaree National Park (NPWS, 2004g); Gardens of Stone National Park (NPWS, 2004f); Dharawal Nature Reserve (NPWS, 2002d); Parr State Recreational Area (NPWS, 2001d). Further, it is recognised that potential habitat for this species may occur in Towarri National Park (NPWS, 2004e).

The information provided suggests that habitat for the Large-eared Pied Bat may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Large-eared Pied Bat is distributed from south-eastern Queensland to NSW, from the coast to the western slopes of the Great Dividing Range (Churchill, 1998).

Considering the above, the Project area is located within the known distribution of *C. dwyeri* and does not represent a distributional limit for this species.

HE3.2.30 East-coast Freetail Bat (*Mormopterus norfolkensis*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The East-coast Freetail Bat (*Mormopterus norfolkensis*) roosts in tree hollows, although records from man-made structures may indicate a certain degree of flexibility in roost site selection (Greg Richards and Associates, 2001). Little is known about the reproduction and diet of the Eastern Freetail Bat. However, some data suggests the males and females of this species separate at certain times of the year possibly for birth and raising of young (Allison and Hoye, 1998).

Threats to *M. norfolkensis* are poorly known but may include development for agriculture and logging (DEC, 2004b).

Waterbodies and remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources (eg. woodland) for *M. norfolkensis*. The Project will involve the removal/modification of a portion of potential habitat for this species and may disrupt foraging, roosting and breeding if this species were to occur in the Project area.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *M. norfolkensis* has not been recorded in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets). During targeted surveys within the Project area and surrounds, the East-coast Freetail Bat was recorded in small portions in the east and south-west of the Project area (Figure HE-7) (Greg Richards and Associates, 2005).

It is possible that a local population of the East-coast Freetail Bat exists within the Project area given this species was recorded in the Project area, the presence of other records of this species proximal to the Project area and the occurrence of potential habitat resources. However, it is considered that a local viable population of this species (were one to exist) would not be placed at risk of extinction given the occurrence of habitat outside the proposed disturbance area including better quality habitat in Goulburn River National Park and Munghorn Gap Nature Reserve this species is unlikely to be dependant upon the habitat in the proposed disturbance area.

Further, a number of measures have been developed for the Project to minimise potential impacts on the East-coast Freetail Bat within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential roosting/breeding habitat for the East-coast Freetail Bat.

- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the East-coast Freetail Bat in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

M. norfolkensis inhabits dry sclerophyll forest, woodland and coastal dune vegetation and has been found roosting in tree hollows in the Hunter Valley (NPWS, undated). The east-coast Freetail Bat is thought to prefer large and mature canopy trees in forest that also has a dense subcanopy and shrubby understorey (Richards, 2002; Greg Richards and Associates, 2003). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Frontal dunes along the coastal area.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the East-coast Freetail Bat. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves.

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the East-coast Freetail Bat. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including:

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the East-coast Freetail Bat in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *M. norfolkensis* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for *M. norfolkensis* occurs within the Project area and surrounds.

Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for East-coast Freetail Bat. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for East-coast Freetail Bat given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the East-coast Freetail Bat, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the East-coast Freetail Bat in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the East-coast Freetail Bat. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The East-coast Freetail Bat is distributed from southern NSW to south-east Queensland, east of the Great Dividing Range (Allison and Hoye, 1998) as well as isolated records west of the Great Dividing Range (NPWS, 2005c). This species is distributed towards the coast of the NSW Sydney Basin Bioregion and potential habitat (as described above) occur in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *M. norfolkensis* has been recorded at over 100 locations in the bioregion, of which a portion are located in nine protected areas, namely Bugong, Dharug, Tomaree, Wollemi, Yengo, Morton, Blue Mountains and Nattai National Parks and Manobalai Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Munghorn Gap Nature Reserve (NPWS, 2000d); and Parr State Recreational Area (NPWS, 2001d).

The information provided suggests that habitat for the East-coast Freetail Bat may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The East-coast Freetail Bat is distributed from southern NSW to south-east Queensland, east of the Great Dividing Range (Allison and Hoye, 1998) as well as isolated records west of the Great Dividing Range (NPWS, 2005c).

Considering the above, the Project area is located within the known distribution of *M. norfolkensis* and does not represent a distributional limit for this species.

HE3.2.31 Eastern Falsistrelle (*Falsistrellus tasmaniensis*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Eastern Falsistrelle (*Falsistrellus tasmaniensis*) predominantly roosts in tree hollows, as well as abandoned buildings (Parnaby, 1983 in Ayers *et al*., 1996), and there is also one record from the Jenolan Caves. This species has been recorded roosting in hollow trunks of Eucalypt trees in colonies of three to 36 (Churchill, 1998). Breeding occurs in late spring and early summer, with a single young being born in December (Churchill, 1998).

This species forages within or just below the tree canopy (Churchill, 1998). The diet of mainland bats consists of moths, beetles, weevils, bugs, flies and ants (Menkhorst and Lumsden, 1995 in Ayers *et al.*, 1996).

F. tasmaniensis has been recorded travelling 12 km from foraging areas to roosting sites (Churchill, 1998). During winter, some populations of the Eastern Falsistrelle may migrate from highland to coastal areas, while others may hibernate (Parnaby, 1983 in Ayers *et al.*, 1996).

Threats to *F. tasmaniensis* include effects of forestry such as harvesting of native hardwoods that result in the loss of roosting trees (Parnaby, 1983 in Ayers *et al*., 1996).

Waterbodies and remnant vegetation which occurs within the Project area and surrounds, offers potential foraging, roosting and breeding habitat resources for *F. tasmaniensis*. No subterranean roosting or breeding habitat for this species (eg. caves or abandoned mines) occurs within the proposed disturbance area. The Project will involve the removal/modification of a portion of potential habitat for this species and which may disrupt foraging, tree hollow roosting and breeding habitat resources.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *F. tasmaniensis* has been recorded at nine locations in the region (ie. Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets), the closest of which is located approximately 5 km east of the Project area[38]. During targeted surveys within the Project area and surrounds, the Eastern Falsistrelle was recorded in small portions in the south-east of the Project area (Figure HE-7) (Greg Richards and Associates, 2005).

Considering the above, it is possible that a local population of the Eastern Falsistrelle could occur in the Project area given this species was recorded during recent targeted surveys and the occurrence of potential habitat resources. However, it is considered that a local viable population of this species (were one to exist) would not be placed at risk of extinction given the occurrence of habitat outside the proposed disturbance area including better quality habitat in Goulburn River National Park and Munghorn Gap Nature Reserve, and therefore this species is unlikely to be totally dependant upon the foraging habitat in the proposed disturbance area.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

F. tasmaniensis inhabits high rainfall forests with a canopy height exceeding 20 m, where it roosts in tree hollows (Churchill, 1998; Parnaby, 1983 in Ayers *et al.*, 1996). This species also roosts in caves and abandoned buildings and occasionally caves, and forages in open woodland and over water (Menkhorst and Lumsden, 1995; Phillips, 1995 in Ayers *et al.*, 1996). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.
- Lakes, wetlands and swamps.
- Caves.

[38] This record has an accuracy of 0.1 km (NPWS, 2005a)

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Eastern False Pipistrelle. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Eastern Falsistrelle. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *F. tasmaniensis* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for *F. tasmaniensis* occurs within the Project area and surrounds.

F. tasmaniensis has been recorded travelling 12 km from foraging areas to roosting sites (Churchill, 1998). During winter, some populations of the Eastern Falsistrelle may migrate from highland to coastal areas, while others may hibernate (Parnaby, 1983 in Ayers *et al.*, 1996). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Eastern Falsistrelle. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Eastern Falsistrelle given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Eastern Falsistrelle is distributed in Tasmania and along the eastern coast of Australia from south-eastern Queensland to south-west Victoria (Phillips, 1998). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occur in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *F. tasmaniensis* has been recorded at over 100 locations in the bioregion, of which many are located in 13 protected areas, namely Goulburn River, Brisbane Water, Heathcote, New South Wales Jervis Bay, Popran, Royal, Werakata, Wollemi, Yengo, Blue Mountains, Gardens of Stone, Kanangra-Boyd National Parks and Joadja Nature Reserve.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Morton National Park (NPWS, 2001f); Munghorn Gap Nature Reserve (NPWS, 2000d); Dharawal Nature Reserve (NPWS, 2002d); Parr State Recreational Area (NPWS, 2001d). Further, it is recognised that potential habitat for this species may occur in Towarri National Park (2004e).

The information provided suggests that habitat for the Eastern Falsistrelle may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Eastern Falsistrelle is distributed in Tasmania and along the eastern coast of Australia from south-eastern Queensland to south-west Victoria (Phillips, 1998).

Considering the above, the Project area is located within the known distribution of the Eastern Falsistrelle and does not represent a distributional limit for this species.

HE3.2.32 Large Bentwing-Bat (*Miniopterus schreibersii*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Large Bentwing Bat (*Miniopterus schreibersii*) is an obligate cave-dweller, and also uses cave substitutes such as mine adits and road culverts (*ibid.*). Females congregate in maternity colonies that act as regional population centroids, with males being resident elsewhere at this time (Greg Richards and Associates, 2000). The maternity cave is used annually for the birth and development of young (Churchill, 1998). Each population disperses to other caves during the year but only within its specific territorial range of approximately 300 km (*ibid.*).

In temperate regions mating takes place during May to June. In October, adult females congregate in maternity colonies and give birth to their single young in December to mid January (Churchill, 1998). Once the young have been weaned, the mothers disperse to their winter roosts. There is a mass exodus of juveniles a few weeks thereafter and the maternity colony is deserted by April (*ibid.*).

This species forages on insects that are hunted by aerial pursuit (Greg Richards and Associates, 2000). The Large Bentwing Bat is seasonally nomadic and distribution is dictated by local climatic conditions and suitability of breeding sites (Ayers *et al.,* 1996).

Threats to *M. schreibersii* include disturbance/damage to roosting sites (DEC, 2004b) and this can be especially detrimental to hibernating colonies because this can lead to starvation (Gilmore and Parnaby, 1994 in DEC, 2004b). Other threats may include disturbance by recreational caving, agricultural and urban development and predation by feral animals (Dwyer 1995, Gilmore and Parnably, 1994 in DEC, 2004b).

Waterbodies and remnant vegetation which occur within the Project area and surrounds offer potential foraging habitat resources for *M. schreibersii*. No roosting or breeding habitat for this species (eg. caves or abandoned mines) occurs within the proposed disturbance area. The Project will involve the removal/modification of a portion of known and potential foraging habitat for this species and may disrupt foraging.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *M. schreibersii* has been recorded at four locations in the region (ie. Gulgong and Mt. Pomany 1:100,000 map sheets), the closest of which is located approximately 5 km south of the Project area[39]. During targeted surveys within the Project area and surrounds, the Large Bentwing Bat was recorded on the fringe of Munghorn Gap and Goulburn National Parks (Figure HE-7) (Greg Richards and Associates, 2005).

It is possible that a local population of the Large Bentwing Bat exists within the Project area, given that this species was recorded in the Project area during two surveys, the presence of other records of this species proximal to the Project area and the occurrence of potential habitat resources. However, it is considered that a local viable population of this species (were one to exist) would not be placed at risk of extinction. Given the occurrence of habitat outside the proposed disturbance area including better quality habitat in Goulburn River National Park and Munghorn Gap Nature Reserve this species is unlikely to be dependant upon the habitat in the proposed disturbance area.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Large Bentwing Bat within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential roosting/breeding habitat for the Large Bentwing Bat.
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Large Bentwing Bat in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

[39] This record has an accuracy of 0.1 km (NPWS, 2005a)

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

M. schreibersii inhabits a variety of habitats including grasslands, subtropical rainforest and well-timbered valleys, and uses caves for breeding and roosting (Dwyer, 1968 in Ayers *et al*., 1996). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Native grassland.
- Caves.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Large Bentwing Bat. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Large Bentwing Bat. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including:

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Large Bentwing Bat in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *M. schreibersii* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for *M. schreibersii* occurs within the Project area and surrounds.

Large Bentwing Bat is seasonally nomadic and distribution is dictated by local climatic conditions and suitability of breeding sites (Ayers *et al.,* 1996). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Large Bentwing Bat. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Large Bentwing Bat given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Large Bentwing Bat, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Large Bentwing Bat in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Large Bentwing Bat. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Large Bentwing Bat is distributed in Northern Australia from the Kimberley through the Top End to the western Gulf of Carpentaria (Churchill, 1998; Dwyer, 1998b). In eastern Australia, *M. schreibersii* is distributed from north Queensland to far south-east South Australia (*ibid.*). In NSW, the Large Bentwing Bat is found along the coast and western slopes, including high altitude elevations of the Great Dividing Range (NPWS, 2000b). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occur in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *M. schreibersii* has been recorded at over 100 locations in the bioregion, of which many are located in 25 protected areas, namely Goulburn, Botany Bay, Bouddi, Brisbane Water, Dharug, Heathcote, Ku-ring-gai Chase, Lane Cove, New South Wales Jervis Bay, Royal, Sydney Harbour, Wollemi, Wyrrabalong, Yengo, Murramarang, Blue Mountains, Kanangra-Boyd and Nattai National Parks, and Munghorn Gap, Barren Grounds, Cockle Bay, Gulguer, Joadja, Narrawallee Creek and Wamberal Lagoon Nature Reserves.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Budderoo National Park (NPWS, 2004a); Garigal National Park (NPWS, 1998e); Popran National Park (NPWS, 2000b); Tomaree National Park (NPWS, 2004g); Morton National Park (NPWS, 2001f); Dharawal Nature Reserve (NPWS, 2002d); Newington Nature Reserve (NPWS, 2003b); Pulbah Island Nature Reserve (NPWS, 2003c); Wambina Nature Reserve (NPWS, 2003d); Parr State Recreational Area (NPWS, 2001d); Lake Macquarie State Recreation Area (NPWS, 2003c). Further, it is recognised that potential habitat for this species may occur in Towarri National Park (NPWS, 2004e).

The information provided suggests that habitat for the Large Bentwing Bat may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Large Bentwing Bat is distributed in Northern Australia from the Kimberley through the Top End to the western Gulf of Carpentaria (Churchill, 1998; Dwyer, 1998b). In eastern Australia, *M. schreibersii* is distributed from north Queensland to far south-east South Australia (*ibid.*). In NSW, the Large Bentwing Bat is found along the coast and western slopes, including high altitude elevations of the Great Dividing Range (NPWS, 2000b).

Considering the above, the Project area is located within the known distribution of *M. schreibersii* and does not represent a distributional limit for this species.

HE3.2.33 Little Bentwing Bat (*Miniopterus australis*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Little Bentwing Bat (*Miniopterus australis*) roosts in caves and tunnels, and occasionally houses, usually near extensive areas of relatively dense, well timbered vegetation (Dwyer, 1968; Dwyer, 1995 in Ayers *et al*., 1996). This species is known to share roost sites with the Large Bentwing Bat (*M. schreibersii*) and in winter, the two species may form mixed clusters (Dwyer, 1998a).

M. australis breeds in July and August, and births occur in December (Churchill, 1998; Dwyer, 1998a). *M. australis* is insectivorous and forages beneath the canopy of its well-timbered habitats (Dwyer, 1998a).

The main threat to *M. australis* is disturbance to nursery and hibernating sites but predation by feral and native animals may also potentially be a threat (Dwyer, 1995 in Ayers *et al*., 1996).

Waterbodies and remnant vegetation which occur within the Project area and surrounds, offer potential foraging habitat resources for *M. australis*. No roosting or breeding habitat for this species (eg. caves or abandoned mines) occurs within the proposed disturbance area. The Project will involve the removal/modification of a portion of known and potential habitat for this species and may disrupt foraging.

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *M. australis* has not been recorded in the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets). During targeted surveys within the Project area and surrounds, the Little Bentwing Bat was recorded (Figure HE-7) (Greg Richards and Associates, 2005).

It is possible that a local population of the Little Bentwing Bat exists within the Project area given this species was recorded in the Project area during two targeted surveys, the presence of other records of this species proximal to the Project area and the occurrence of potential habitat resources. However, it is considered that a local viable population of this species (were one to exist) would not be placed at risk of extinction given the occurrence of habitat outside the proposed disturbance area including better quality habitat in Goulburn River National Park and Munghorn Gap Nature Reserve, therefore this species is unlikely to be dependant upon the habitat in the proposed disturbance area.

Further, a number of measures have been developed for the Project to minimise potential impacts on the Little Bentwing Bat within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential roosting/breeding habitat for the Little Bentwing Bat.
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Little Bentwing Bat in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

M. australis inhabits well-timbered areas and roosts in caves etc, usually near extensive areas of relatively dense, well-timbered forest, *Melaleuca* swamp or scrub (Dwyer, 1968; Dwyer, 1995 in Ayers *et al*., 1996). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Rainforest.
- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Shrubland.
- Lakes, wetlands and swamps.
- Caves.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Little Bentwing Bat. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Little Bentwing Bat. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including:

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Little Bentwing Bat in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *M. australis* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for *M. australis* occurs within the Project area and surrounds.

Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Little Bentwing Bat. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Little Bentwing Bat given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Little Bentwing Bat, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Little Bentwing Bat in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Little Bentwing Bat. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

M. australis is distributed from Cape York Peninsula, south to mid NSW, becoming increasingly coastal towards the southern limit of its range (Ayers *et al.,* 1996). This species is distributed in the north-eastern corner of the NSW Sydney Basin Bioregion with outlying records of this species further inland (NPWS, 2005c). Potential habitat (as described above) occurs in a number of protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *M. australis* has been recorded at 94 locations in the bioregion, of which many are located in four protected areas, namely Bouddi, Wollemi, Gardens of Stone National Parks and Cockle Bay Nature Reserve.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Popran National Park (NPWS, 2000b); Tomaree National Park (NPWS, 2004g); Kanangra-Boyd National Park (NPWS, 2001g); Pulbah Island Nature Reserve (NPWS, 2003c); Wambina Nature Reserve (NPWS, 2003d) and Lake Macquarie State Recreation Area (NPWS, 2003c).

The information provided suggests that habitat for the Little Bentwing Bat may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

M. australis is distributed from the Cape York Peninsula, south to mid NSW, becoming increasingly coastal towards the southern limit of its range (Ayers *et al.,* 1996).

Considering the above, the Project area is located within the known distribution of *M. australis* and does not represent a distributional limit for this species.

HE3.2.34 Greater Long-eared Bat (*Nyctophilus timoriensis*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Greater Long-eared Bat (*Nyctophilus timoriensis*) appears to be quite flexible in their roost selection, but has a predilection for tree hollows, exfoliating bark or dense foliage (Lunney *et al.,* 1988 in North Limited, 1998).

The Greater Long-eared Bat forages for large moths and beetles over water or in arid habitats; hovers around the foliage of trees and may glean insects from leaves and branches as do other long-eared bats; and also hovers low to the ground (Hall and Richards, 1979; Richards, 1983).

The Greater Long-eared Bat is under threat from loss of habitat (Duncan *et al*., 1999). Other threats include timber harvesting, grazing and altered fire regimes (*ibid.*).

Waterbodies and remnant vegetation which occur within the Project area and surrounds offer potential foraging, roosting and breeding habitat resources for the Greater Long-eared Bat. The Project will involve the removal/modification of a portion of potential habitat resources for this species and may disrupt foraging, roosting and breeding resources (were this species to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates the Greater Long-eared Bat has been recorded at 10 locations in the region (ie. Gulgong and Merriwa 1:100,000 map sheets), the closest of which is located approximately 1 km north of the Project area[40]. This species has not been recorded during targeted surveys within the Project area and surrounds (Greg Richards and Associates, 2005).

It is possible that a local population of the Greater Long-eared Bat may exist within the Project area given that records of this species occur proximal to the Project area and the occurrence of potential habitat resources. However, the removal/modification of a portion of potential habitat for the Greater Long-eared Bat is unlikely to disrupt the lifecycle such that a local viable population of this species (were one to occur) would be placed at risk of extinction given the occurrence of habitat outside the proposed disturbance area including better quality habitat in Goulburn River National Park and Munghorn Gap Nature Reserve, therefore this species is unlikely to be dependant upon the habitat in the proposed disturbance area.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The Greater Long-eared Bat inhabits dry open woodlands and around River Red Gums that line watercourses and lakes on the inland plains of the semi-arid zone (Parnaby, 1995 in Ayers *et al.,* 1996). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.

[40] This record has an accuracy of 0.1 km (NPWS, 2005a)

- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Greater Long-eared Bat. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been recorded in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Greater Long-eared Bat. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Greater Long-eared Bat and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for the Greater Long-eared Bat occurs within the Project area and surrounds.

Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Greater Long-eared Bat. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for Greater Long-eared Bat given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Greater Long-eared Bat is distributed across southern mainland Australia in three regions, one of which includes NSW, Victoria and eastern South Australia (Churchill, 1998). This species is only distributed in the north of the NSW Sydney Basin Bioregion however potential habitat (as described above) occurs in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *N. timoriensis* has been recorded at 10 locations in the bioregion, of which some are located in two protected areas, namely Goulburn River National Park and Manobalai Nature Reserve.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Munghorn Gap Nature Reserve (NPWS, 2000d).

The information provided suggests that habitat for the Greater Long-eared Bat may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Greater Long-eared Bat is distributed across southern mainland Australia in three regions, one of which includes NSW, Victoria and eastern South Australia (Churchill, 1998).

Considering the above, the Project area is located within the known distribution of the Greater Long-eared Bat and does not represent a distributional limit for this species.

HE3.2.35 Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

The Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*) roosts in tree hollows in a wide range of habitats (NPWS, 2000k). Roosts are predicted to be large and situated such that there is enough clear space at the exit to allow an unencumbered drop until the bat attains normal flight speed (Greg Richards and Associates, 2000). *S. flaviventris* has been found to utilise multiple roost sites (*ibid.*).

The Yellow-bellied Sheathtail Bat is insectivorous and forages above the tree canopy. A variety of prey items are eaten including long-horned grasshoppers, shield bugs and flying ants, while beetles comprise up to 90% of this species' diet (Churchill, 1998).

The threats relevant to the Yellow-bellied Sheathtail Bat include loss of roost sites (eg. old trees with hollows) and predation by feral cats (Ayers *et al*., 1996).

Waterbodies and remnant vegetation which occurs within the Project area and surrounds, offers known and potential foraging, roosting and breeding habitat resources for the Yellow-bellied Sheathtail Bat. The Project will involve the removal/modification of a portion of known and potential habitat resources for this species and may disrupt foraging, roosting and breeding resources.

Records for the Yellow-bellied Sheathtail Bat do not exist in the Atlas of NSW Wildlife for the region (ie. Mudgee, Gulgong, Mt. Pomany and Merriwa 1:100,000 map sheets) (NPWS, 2005a). During targeted surveys within the Project area and surrounds, the Yellow-bellied Sheathtail Bat was recorded throughout the Project area (Figure HE-7) (Greg Richards and Associates, 2005).

It is possible that a local population of the Yellow-bellied Sheathtail Bat exists within the Project area given this species was recorded in the Project area, the presence of other records of this species proximal to the Project area and the occurrence of potential habitat resources. However, the lifecycle of the Yellow-bellied Sheathtail Bat is unlikely to be disrupted such that a local viable population of this species would be placed at risk of extinction given:

- ecology of this species (eg. to use multiple roost sites and extensive foraging habitat); and
- the presence of extensive habitat resources in the surrounding area and wider region (eg. Goulburn River National Park and Munghorn Gap Nature Reserve).

Further, a number of measures have been developed for the Project to minimise potential impacts on the Yellow-bellied Sheathtail Bat within the Project area and adjacent park and reserve areas including:

- *Vegetation Clearance Protocol* – A Vegetation Clearance Protocol would be developed for the Project and would include details of the delineation of areas to be cleared of vegetation, pre-clearance surveys, identification of fauna management strategies and specific procedures relating to vegetation clearance.
- *Pre-clearance Surveys* – Vegetation Pre-clearance Surveys would be undertaken to identify and survey potential roosting/breeding habitat for the Yellow-bellied Sheathtail Bat.
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control.
- *Enhancement and Conservation of Remnants* – to enhance and conserve woodland habitat resources through the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – to establish significant areas of woodland and result in the establishment of wildlife corridors for the Yellow-bellied Sheathtail Bat in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

S. flaviventris roosts in tree hollows in a wide range of habitats (NPWS, 2000k), including wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert (Churchill, 1998). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Forest in dry lowland environments.
- Woodland on undulating and level land.
- Woodland on slopes and steep hills.
- Riparian vegetation along watercourses.
- Shrubland.
- Native grassland.
- Cleared land with or without scattered trees.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Yellow-bellied Sheathtail Bat. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Yellow-bellied Sheathtail Bat. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

A number of measures have been developed so the Project will not result in a long-term net loss of habitat, including:

- *Enhancement and Conservation of Remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the ECAs. Management measures would include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - Revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Yellow-bellied Sheathtail Bat in the long-term. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion. In the order of approximately 1200 ha of woodland would be created by regeneration of vegetation outside the disturbance area (additional to the ECAs) and progressive rehabilitation. This area is greater than four times the amount of remnant vegetation removed.

A detailed description of the Project rehabilitation initiatives and ECAs is provided in Section 4 and 5 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for the Yellow-bellied Sheathtail Bat and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, known and potential habitat for the Yellow-bellied Sheathtail Bat occurs within the Project area and surrounds.

S. flaviventris has been found to utilise multiple roost sites (Greg Richards and Associates, 2000). Due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Yellow-bellied Sheathtail Bat. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Yellow-bellied Sheathtail Bat given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

A number of measures have been developed to improve movement of the Yellow-bellied Sheathtail Bat, including:

- *Enhancement and Conservation of Remnants Adjoining Protected Areas* – to enhance and conserve remnant woodland habitat and adjacent farmland (that adjoin Munghorn Gap Nature Reserve and Goulburn River National Park) in the ECAs as well as revegetation of Cumbo Creek in ECA-A and Wilpinjong Creek in ECA-B.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of wildlife corridors for the Yellow-bellied Sheathtail Bat in the long-term. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the movement of the Yellow-bellied Sheathtail Bat. This would include rehabilitation of the riparian vegetation along the Cumbo Creek diversion.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

The Yellow-bellied Sheathtail Bat has a widespread distribution across eastern and northern Australia (Churchill, 1998; Richards, 1998 in Strahan, 1998). This species is distributed across the NSW Sydney Basin Bioregion and potential habitat (as described above) occur in many protected areas in the bioregion (NPWS, 2005c).

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *S. flaviventris* has been recorded at 24 locations in the bioregion, of which some are located in three protected areas, namely Botany Bay, Seven Mile Beach and Blue Mountains National Parks.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Bouddi National Park (NPWS, 1999c); Tomaree National Park (NPWS, 2004g); Dharawal Nature Reserve (NPWS, 2002d); Wambina Nature Reserve (NPWS, 2003d). Further, it is recognised that potential habitat for this species may occur in Lane Cove National Park (NPWS, 1998b) and Pulbah Island Nature Reserve (NPWS, 2003c).

The information provided suggests that habitat for the Yellow-bellied Sheathtail Bat may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

The Yellow-bellied Sheathtail Bat has a widespread distribution across eastern and northern Australia (Churchill, 1998; Richards, 1998 in Strahan, 1998).

Considering the above, the Project area is located within the known distribution of the Yellow-bellied Sheathtail Bat and therefore does not represent a distributional limit for this species.

HE3.2.36 Eastern Cave Bat (*Vespadelus troughtoni*)

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction

Compared with most other Australian bat species, the biology of the Eastern Cave Bat (*Vespadelus troughtoni*) is not well known (Parnaby, 1995). This species has been reviewed by Parnaby (1995) and appears to be an obligate cave-dweller.

Females of this species are likely to give birth during December each year. There is apparently some sexual segregation in the breeding season (Churchill 1998) but nothing else is known of this species' breeding biology. *V. troughtoni* can be assumed to forage primarily upon insects that are hunted by aerial pursuit, which is indicated by morphological characters that reflect this type of hunting, such as its wing aspect ratio and wing loading, and also via personal observations on Cape York (Greg Richards and Associates, 1997).

Although this species is regarded as an obligate cave dweller, these sites are rarely completely dark, and sandstone overhangs, boulder piles and mines are selected (Richards 2000). As well as dark caves, buildings are also occupied in the tropical Queensland part of its Australian range (Parnaby 1995), but records of such roosts are unknown in NSW. Colonies range in size from less than 10 to 50 in NSW, and up to 500 in Queensland. Nothing is known about movement or migration patterns of this species.

Threats to *V. troughtoni* include disturbance to cave roosting sites, destruction of caves, as well as loss of feeding habitat resulting from agricultural practises.

Waterbodies and remnant vegetation which occurs within the Project area and surrounds, offers potential foraging habitat resources for *V. troughtoni*. No roosting or breeding habitat for this species (eg. caves or abandoned mines) occurs within the proposed disturbance area. The Project will involve the removal/modification of a portion of potential foraging habitat for this species and may disrupt foraging resources (were this species to occur).

The Atlas of NSW Wildlife (NPWS, 2005a) indicates *V. troughtoni* has been recorded at four locations in the region (ie. Mt. Pomany and Merriwa 1:100,000 map sheets), the closest of which is located approximately 17 km east of the Project area[41]. This species has not been recorded during targeted surveys within the Project area and surrounds (Greg Richards and Associates, 2005).

Considering the above, it is possible that a local population of the Eastern Cave Bat could occur in the Project area given the occurrence of potential habitat resources, however it is unlikely given the absence of records proximal to the Project area (despite targeted surveys). It is considered that a local viable population of this species (were one to exist) would not be placed at risk of extinction given the occurrence of habitat outside the proposed disturbance area including better quality habitat in Goulburn River National Park and Munghorn Gap Nature Reserve, therefore this species is unlikely to be dependant upon the habitat in the proposed disturbance area.

[41] This record has an accuracy of 0.1 km (NPWS, 2005a)

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

V. troughtoni inhabits dry tropical areas in Northern Queensland but tends to inhabit coastal forests in NSW (Greg Richards and Associates, 1997). Although this species is regarded as an obligate cave dweller, these sites are rarely completely dark, and sandstone overhangs, boulder piles and mines are selected (Richards 2000). *V. troughtoni* is also known to inhabit disused Fairy Martin (*Hirundo ariel*) nests in road culverts (Schulz, 1998). In the NSW Sydney Basin Bioregion, potential habitat for this species occurs within the following habitat types:

- Coastal forest.
- Forest in dry lowland environments.
- Riparian vegetation along watercourses.
- Caves.

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the Eastern Cave Bat. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2004; Tame, 2003; Keith, 2002). Thirty percent of the Sydney Basin Bioregion has been cleared with most of the clearance occurring on the Illawarra and Cumberland Plains (NPWS, 1998g in Benson, 1999). Despite this, 39% of the bioregion is protected in conservation reserves (Benson, 1999).

No known habitat for this species will be modified or removed for the Project since this species has not been recorded in the Project area. Less than 290 ha of remnant vegetation will be cleared or modified for the Project, of which only a portion is potential habitat for the Eastern Cave Bat. In relation to the regional distribution of known or potential habitat for this species, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given the small scale of the habitat removal/modification required for the Project and the greater quantity and quality of such habitat in the bioregion.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population or ecological community

The habitat requirements for *V. troughtoni* and the occurrence of such habitat in the NSW Sydney Basin Bioregion are described above. As previously established, potential habitat for *V. troughtoni* occurs within the Project area and surrounds.

Nothing is known about movement or migration patterns of this species. However, due to the species' mobility, all occurrences of potential habitat for this species within the Project area and close surrounds are considered proximate habitat areas for this species.

The flat valley lands in the Project area and surrounds have been extensively cleared and are currently grazed by cattle and sheep with minor areas of cropping (Mount King Ecological Surveys, 2005; FloraSearch, 2005). Most natural vegetation is restricted to the steep hills and slopes outside of proposed disturbance areas with the exception of small areas of remnant vegetation scattered throughout the Project area, which are mainly associated with stony outcrops (*ibid.*) (Figure HE-4).

Vegetation clearance associated with the Project area may cause some fragmentation of current interconnecting habitat for the Eastern Cave Bat. However, an area of known (or potential) habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for the Eastern Cave Bat given the mobility of the species, the localised nature of the Project and the connectivity of the surrounding potential habitat.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or other similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 National Parks, 54 Nature Reserves, 16 State Conservation Areas, nine Regional Parks, six Aboriginal Areas and six Historic Sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

V. troughtoni is found in the forests of the coast and ranges of NSW, ranging inland to the western slopes in the northern portion of the NSW distribution, but is very patchily distributed south of (approximately) Kempsey. This species is distributed in the north-west of the NSW Sydney Basin Bioregion (NPWS, 2005c) and potential habitat (as described above) occurs in many protected areas in the bioregion.

The Atlas of NSW Wildlife (NPWS, 2005b) indicates the *V. troughtoni* has been recorded at 4 locations in the bioregion, of which many are located in three protected areas, namely Goulburn River, Wollemi National Parks and Manobalai Nature Reserve.

In addition, management plans available for the protected areas in the bioregion indicate the species has been recorded in Munghorn Gap Nature Reserve (NPWS, 2000d). Further, it is recognised that potential habitat for this species may occur in Lane Cove National Park (NPWS, 1998b).

The information provided suggests that habitat for the Eastern Cave Bat may be adequately represented in conservation reserves (or other similar protected areas) in the bioregion.

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population or ecological community is at the limit of its known distribution

V. troughtoni is found in the forests of the coast and ranges of NSW, ranging inland to the western slopes in the northern portion of the NSW distribution, but is very patchily distributed south of (approximately) Kempsey.

Considering the above, the Project area is located within the known distribution of *V. troughtoni* and does not represent a distributional limit for this species.

HE3.3 ENDANGERED ECOLOGICAL COMMUNITIES

HE3.3.1 White Box, Yellow Box, Blakely's Red Gum Woodland

The White Box, Yellow Box, Blakely's Red Gum (WBYBBRG) Endangered Ecological Community (EEC) listed under the TSC Act can be considered equivalent to the Grassy White Box Woodland community (defined under the EPBC Act) together with the Yellow Box/Red Gum Grassy Woodland [which is currently nominated for listing as an EEC under the EPBC Act (DEH, 2004c)] (FloraSearch, 2005).

(a) In the case of a threatened species, whether the lifecycle of the species is likely to be disrupted such that a viable population of the species is likely to be placed at the risk of extinction

Not applicable. Refer to Section HE2.2(a).

(b) In the case of an endangered population, whether the lifecycle of the species that constitutes the endangered population is likely to be disrupted such that the viability of the population is likely to be significantly compromised

Not applicable. Refer to Section HE2.2(b).

(c) In relation to the regional distribution of the habitat of a threatened species, population or ecological community, whether a significant area of known habitat is to be modified or removed

The WBYBBRG EEC includes woodlands where the characteristic tree species include one or more of the following species in varying proportions and combinations – White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) or Blakely's Red Gum (*E. blakelyi*) (NSW Scientific Committee, 2004e; NPWS, 2002g). In addition to the dominant tree species present, understorey species are a key to whether or not particular remnants belong to the WBYBBRG EEC. Grass and herbaceous species generally characterise the ground layer, and shrubs are generally sparse or absent, though they may be locally common (NSW Scientific Committee, 2004e; NPWS, 2002g).

The vegetation of the Sydney Basin Bioregion has not yet been fully mapped to a standard that is suitable for quantitative bioregional assessment of the habitat for the WBYBBRG EEC. This is because the level of available information is patchy and uneven, though major vegetation mapping available includes 1:100,000 map sheets (eg. McRae and Cooper, 1985 in Benson, 1999), protected areas (eg. Hill, 2000; NPWS, 2004h) and other miscellaneous sources (eg. Keith, 2002, 2004; Tame, 2003; Keith, 2002).

The WBYBBRG community was formerly a dominant and very widespread community in the western half of the NSW Sydney Basin Bioregion (NSW Scientific Committee, 2004e; NPWS, undated-d). This woodland community typically occurs on soils that are moderately to highly fertile and as a result has been extensively cleared and modified in the past by thinning, clearing, grazing, pasture improvement and cultivation (NPWS, 2002g). There are many thousands of hectares of fragmented and disturbed remnants on farmland, roadsides, travelling stock routes and other lands.

The occurrence of the WBYBBRG EEC in the Project area was recently assessed by FloraSearch (2005) in Appendix HA of the EIS. FloraSearch (2005) mapped approximately 180 ha of WBYBBRG EEC (Figure HE-4). The WBYBBRG community within the Project area is considered to be represented by Community 1 (Yellow Box and Blakely's Red Gum woodlands) and Community 5a (Grassy White Box woodlands) (FloraSearch, 2005). A summary of Community 1 and Community 5a is provided below.

Community 1 occurs within the Project area on the deep, moist soils of the drainage lines and creek banks, as well as on sheltered south facing slopes north of Wilpinjong Creek (FloraSearch, 2005). Community 1 has a predominantly grassy understorey but also comprises herbs and grasses typical of WBYBBRG community (*ibid.*). All remnants of Community 1 in the Project area have been highly modified by clearing for agriculture and roads (*ibid*.). They have been heavily grazed, and as a consequence have relatively fewer shrubs and juvenile trees (*ibid.*). There are three main remnants of Community 1 in the Project area. The first is found against the sandstone ranges to the north of Wilpinjong Creek, the second is found in the large patch of vegetation in the south-east of the Project area and the third is found in a strip of Crown land in the west of the Project area (*ibid.*).

Community 5a is dominated by White Box and has a grassy understorey which is almost devoid of shrubs and is located on the lower slopes of the sandstone ranges in the south of the Project area (FloraSearch, 2005). Community 5a is considered here to represent the WBYBBRG community to avoid underestimating its occurrence in the Project area (*ibid*.). However, it is unclear whether the grassy understorey is instead a consequence of grazing stock, and if it is, this community may be better described as White Box shrubby woodland (*ibid.*).

Of the approximately 180 ha of the WBYBBRG EEC mapped by FloraSearch in the Project area and surrounds, approximately 50 ha (of which approximately 8 ha is Community 5a) occurs in the proposed disturbance area and will be cleared or modified by the Project. In relation to the regional distribution of known or potential habitat for this EEC, it is considered that the area to be removed or modified for the Project area does not constitute a significant area given:

- the localised nature of the Project area disturbance;
- occurrence of proximal known and potential habitat to the Project area. The WBYBBRG EEC has previously been identified within Goulburn River National Park (Hill, 2000; NSW Scientific Committee, 2004e); and
- the progressive nature of Project disturbance and early rehabilitation with species characteristic of the WBYBBRG community in some areas [eg. White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*)].

Further, a number of measures have been developed for the Project to minimise potential impacts on the WBYBBRG EEC within the Project area including:

- *Enhancement and conservation of remnants* – to enhance and conserve approximately 480 ha of remnant woodland habitat and adjacent farmland in the Wilpinjong Enhancement and Conservation Areas (ECAs). Management measures would include:
  - 1:1 long-term re-establishment plus greater than 1:1 conservation of the WBYBBRG community, ie. greater than 80 ha of the endangered community is conserved in the ECAs, and an additional 50 ha will be re-established in the long-term.
  - Appropriate exclusion fencing where required to reduce grazing by stock and encourage natural regeneration. This is expected to benefit the WBYBBRG EEC because grazing by stock prevents regeneration of native Eucalypt woodland.
- *Weed and Pest Management* – to control the potential adverse impacts of weeds and feral animals on surrounding habitat. Measures will include active weed and feral animal control. Grazing by feral animals (eg. rabbits) prevents regeneration of shrubs and Eucalypts.
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland. In the order of approximately 1200 ha of woodland will be established which will include areas containing species characteristic of the WBYBBRG community [eg. White Box (*Eucalyptus albens*), Yellow Box (*E. melliodora*) and Blakely's Red Gum (*E. blakelyi*)].

Further detail of these measures will be provided in the integrated environment management plans as discussed in Section 5, Volume 1 of the EIS.

(d) Whether an area of known habitat is likely to become isolated from currently interconnecting or proximate areas of habitat for a threatened species, population, or ecological community

The habitat requirements for the WBYBBRG EEC are described above. As previously established, known habitat for the WBYBBRG EEC occurs within the Project area and surrounds.

The WBYBBRG EEC is heavily fragmented in NSW due to clearance for cropping, pasture improvement and grazing (NSW Scientific Committee, 2004e). In the Project area, the remaining WBYBBRG EEC occurs in (mostly small) patches that have been heavily grazed and highly modified by clearing (eg. for agriculture) (Figure HE-4).

Vegetation clearance associated with the Project would result in some fragmentation of WBYBBRG EEC (eg. in Pit 3), however an area of known habitat is unlikely to become isolated from current interconnecting or proximate areas of habitat for this community given the localised nature of the disturbance and the connectivity of the surrounding habitat.

Further, a number of measures have been developed to improve connectivity of the WBYBBRG EEC, including:

- Enhancement and conservation of remnants adjoining protected areas – to enhance and conserve remnant woodland habitat and adjacent farmland (including approximately 80 ha of the WBYBBRG community to be conserved in the ECAs, and an additional 50 ha will be re-established).
- *Progressive Rehabilitation* – will result in the establishment of significant areas of woodland and result in the establishment of corridors for the WBYBBRG EEC in the long-term. A key objective of Project rehabilitation initiatives would be to establish corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. In the long-term this would be expected to improve the expansion of the WBYBBRG EEC through aiding dispersal, recruitment and survival.

A detailed description of the ECAs and Project rehabilitation initiatives is provided in Sections 4 and 5 of the EIS. Progressive Rehabilitation is shown on Figures 2.4 to 2.11, Section 2 of the EIS.

(e) Whether critical habitat will be affected

Not applicable. Refer to Section HE2.2(e).

(f) Whether a threatened species, population or ecological community, or their habitats, are adequately represented in conservation reserves (or similar protected areas) in the region

A total of 132 protected areas are in whole or in part contained within the NSW Sydney Basin Bioregion, including 42 national parks, 54 nature reserves, 16 state conservation areas, nine regional parks, six aboriginal areas and six historic sites (NPWS, 2005c; Environment Australia, 2002). The locations of the National Parks and Nature Reserves in the bioregion are shown in Figure HE-3a and b.

In NSW, the WBYBBRG EEC is confined to the New England Tableland, Nandewar, Brigalow Belt South, NSW North Coast, Sydney Basin, NSW South Western Slopes and South Eastern Highlands Bioregions. This community is distributed from north to south of the NSW Sydney Basin Bioregion and potential habitat (as described above) occurs in a number of protected areas in the bioregion (NPWS, 2005c).

Within the Sydney Basin Bioregion, the WBYBBRG community has been recorded in the Goulburn River, Towarri and Wollemi National Parks, as well as the Manobalai and Wingen Maid Nature Reserves (NSW Scientific Committee, 2004e). In addition, management plans available for the protected areas in the bioregion indicate the EEC has been recorded in Gardens of Stone National Park (NPWS, 2004f).

However, these occurrences are generally small and the community is not regarded as adequately represented in conservation reserves (NSW Scientific Committee, 2004e).

(g) Whether the development or activity proposed is of a class of development or activity that is recognised as a threatening process

The Project will involve the removal of vegetation. Vegetation clearance is recognised as a threatening process in the National Strategy for the Conservation of Australia's Biological Diversity (Department of the Environment, Sport and Territories, 1996), the NSW Biodiversity Strategy (NPWS, 1999e) and in Schedule 3 of the TSC Act, 1995.

(h) Whether any threatened species, population, or ecological community is at the limit of its known distribution

The WBYBBRG EEC occurs predominantly on the Tablelands and upper Western Slopes of NSW between about the 400 and 800 mm rainfall isohyets (NSW Scientific Committee, 2004e). In NSW, the EEC is confined to the bioregions shown in Figure HE-8, *viz*.: New England Tableland, Nandewar, Brigalow Belt South, NSW North Coast, Sydney Basin, NSW South Western Slopes and South Eastern Highlands.

Figure HE-8
Extent of the White Box, Yellow Box, Blakely's Red Gum Woodland Endangered Ecological Community in NSW

Considering the Project area is located in the NSW Sydney Basin Bioregion, it can be concluded that the Project area is located within the middle of the distribution of the WBYBBRG EEC and therefore does not represent a distributional limit for this community.

HE3.4 CONCLUSION

This document has assessed the Project for significant effects on threatened species, populations, ecological communities, and their habitats in accordance with Section 5A of the EP&A Act and it has been determined that:

- No local populations of threatened species would be placed at risk of extinction.
- In relation to the regional distribution of habitat of a threatened species, it is considered that a significant area of known habitat would not be modified or removed by the Project.
- An area of known habitat is unlikely to become isolated from currently interconnecting or proximate areas of habitat for each threatened species or ecological community.

These determinations were supported by the following factors:

- The existing disturbed nature of the majority of the Project area due to past landuse.
- The occurrence of higher quality habitat proximal to the Project area.
- The enhancement and conservation of remnants in the Wilpinjong Enhancement and Conservation Areas (ECAs) which will include:
  - Appropriate fencing of the ECAs to reduce grazing by stock and encourage natural regeneration.
  - 1:1 long-term re-establishment plus greater than 1:1 conservation of White Box, Yellow Box, Blakely's Red Gum Woodland Endangered Ecological Community.
  - Selective planting of riparian vegetation along Wilpinjong Creek in ECA-B.
- The progressive nature of Project disturbance and early rehabilitation to establish significant areas of woodland. A key objective of Project rehabilitation initiatives would be to establish wildlife corridors between the ECAs, existing remnant vegetation, Goulburn River National Park and Munghorn Gap Nature Reserve. Measures would also include rehabilitation of the Cumbo Creek diversion.

Therefore, it is considered that the proposed development is unlikely to have a significant effect on any threatened species, populations, ecological communities or their habitats.

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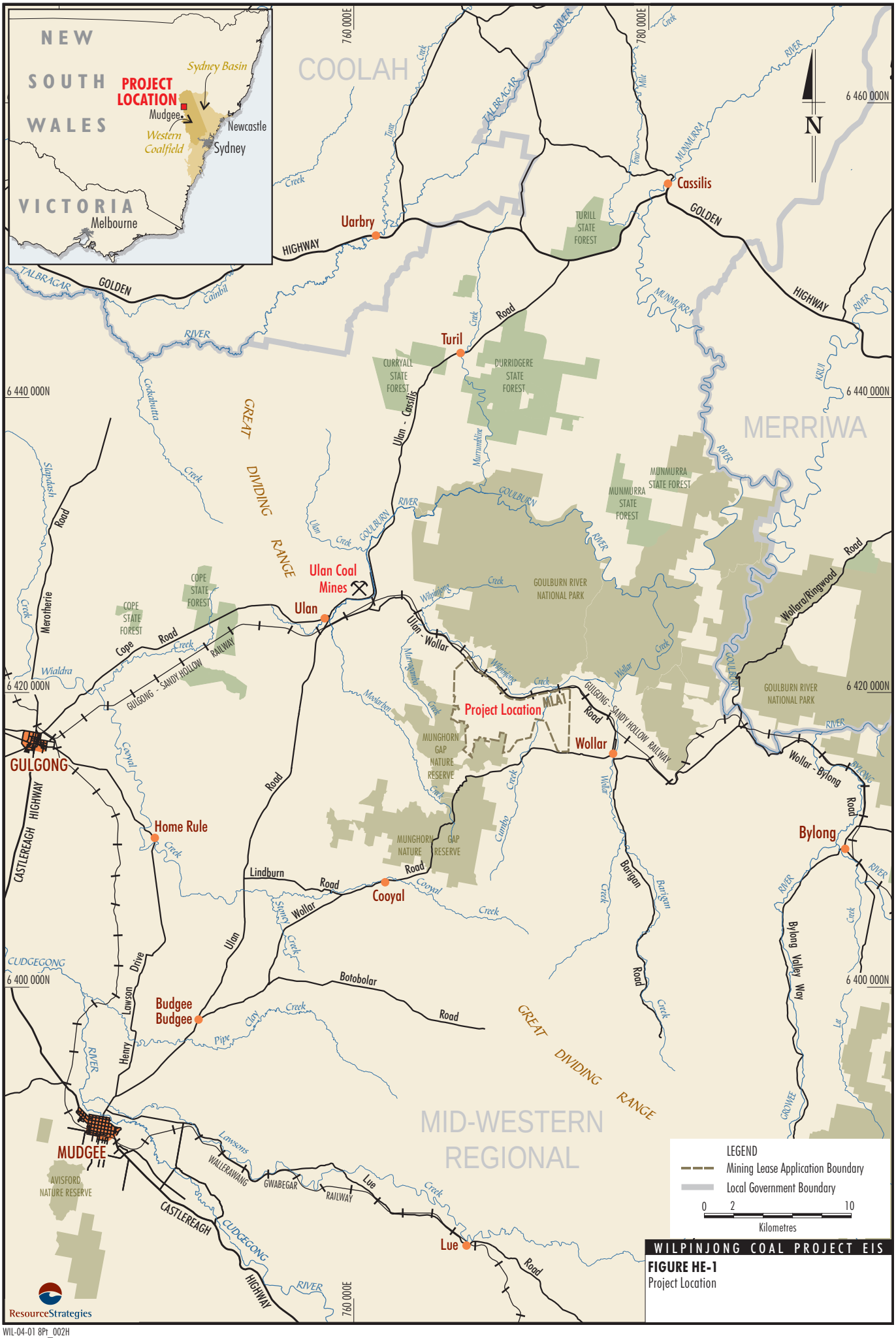
FIGURES


NEW SOUTH WALES
VICTORIA
Sydney Basin
PROJECT LOCATION
Mudgee
Newcastle
Western Coalfield
Sydney
Melbourne
COOLAH
MERRIWA
MID-WESTERN REGIONAL
760 000E
780 000E
6 460 000N
6 440 000N
6 420 000N
6 400 000N
N
Uarbry
Cassilis
Turil
Ulan Coal Mines
Ulan
Project Location
MLA1
Wollar
Bylong
Cooyal
Home Rule
GULGONG
Budgee Budgee
MUDGEE
Lue
TURILL STATE FOREST
CURRYALL STATE FOREST
DURRIDGERE STATE FOREST
MUNMURRA STATE FOREST
COPE STATE FOREST
GOULBURN RIVER NATIONAL PARK
MUNGHORN GAP NATURE RESERVE
AVISFORD NATURE RESERVE
GREAT DIVIDING RANGE
TALBRAGAR HIGHWAY
GOLDEN HIGHWAY
Ulan - Cassilis Road
Ulan - Wollar Road
Wollara/Ringwood Road
Cope Road
Lindburn Road
Botobolar Road
Wollar - Bylong Road
GULGONG - SANDY HOLLOW RAILWAY
CASTLEREAGH HIGHWAY
CUDGEGONG RIVER
GOULBURN RIVER
MUNMURRA RIVER
Bylong Valley Way
LEGEND
Mining Lease Application Boundary
Local Government Boundary
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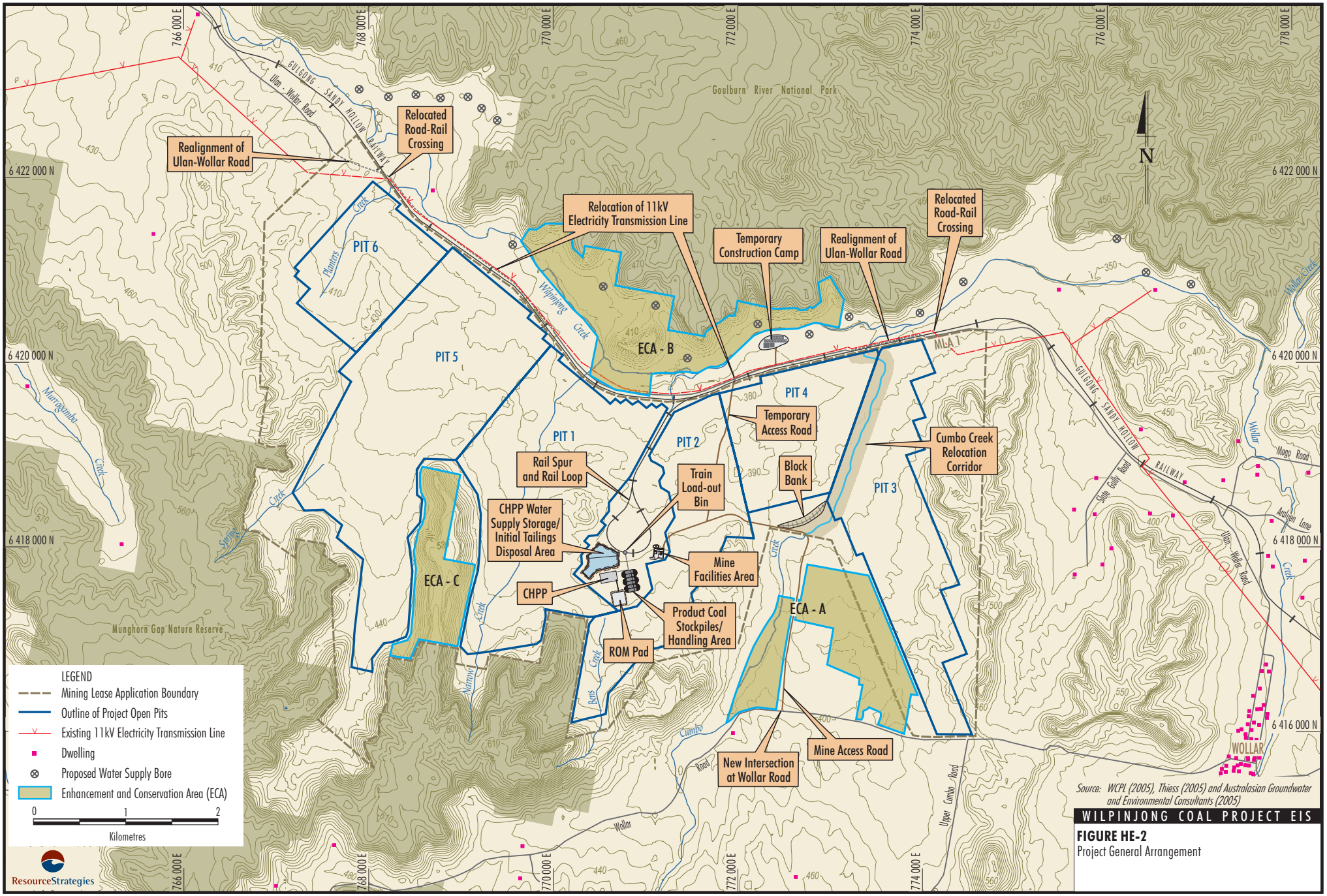
WILPINJONG COAL PROJECT EIS
FIGURE HE-1
Project Location
ResourceStrategies
WIL-04-01 8Pt_002H

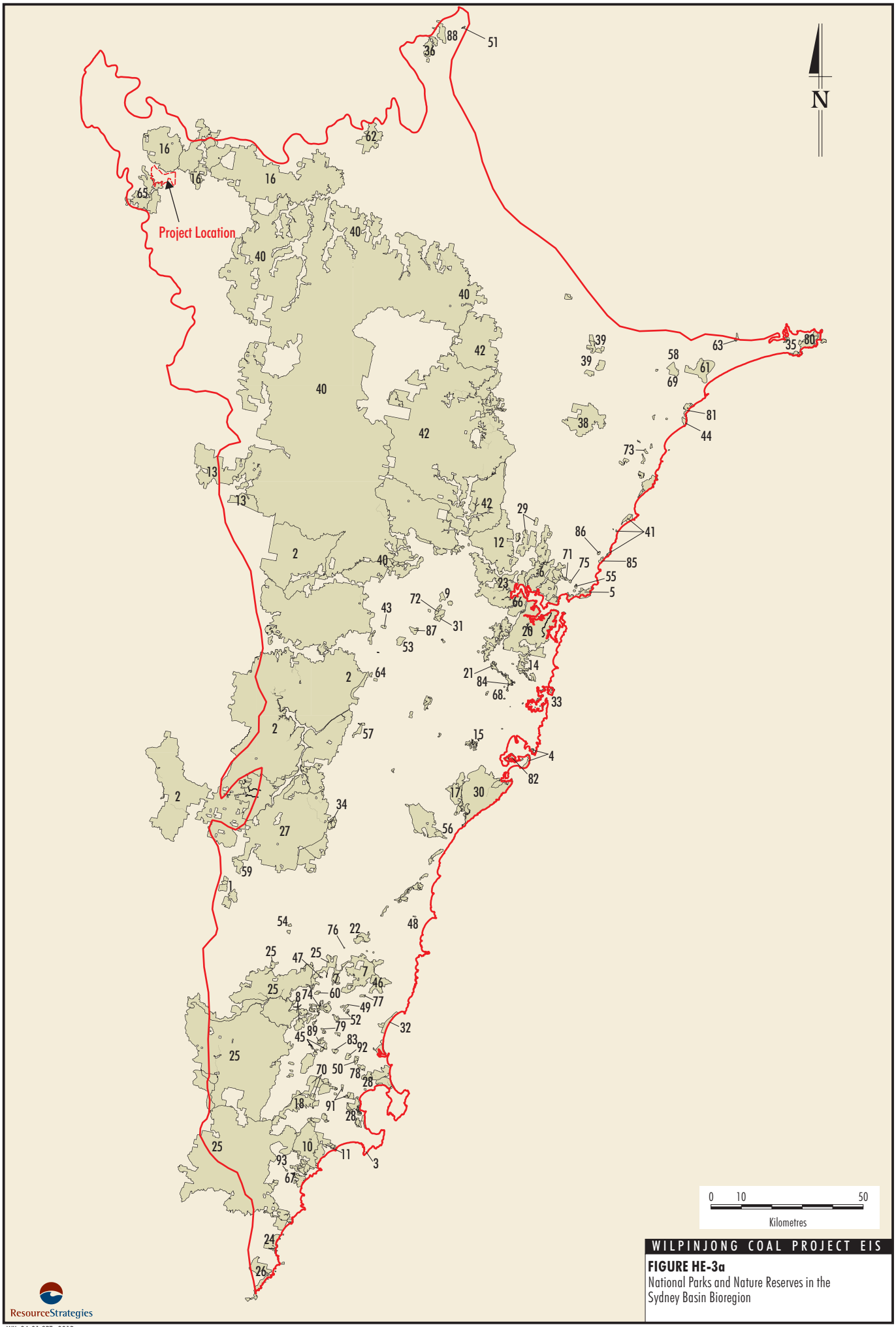


Source: WCPL (2005), Thiess (2005) and Australasian Groundwater and Environmental Consultants (2005)

WILPINJONG COAL PROJECT EIS

FIGURE HE-2
Project General Arrangement

WIL-04-01 8Pt_003K



WILPINJONG COAL PROJECT EIS

FIGURE HE-3a
National Parks and Nature Reserves in the Sydney Basin Bioregion

ResourceStrategies

WIL-04-01 8PT_001D

1 Bangadilly National Park
2 Blue Mountains National Park
3 Booderee National Park
4 Botany Bay National Park
5 Bouddi National Park
6 Brisbane Water National Park
7 Budderoo National Park
8 Bugong National Park
9 Cattai National Park
10 Conjola National Park
11 Cudmirrah National Park
12 Dharug National Park
13 Gardens of Stone National Park
14 Garigal National Park
15 Georges River National Park
16 Goulburn River National Park
17 Heathcote National Park
18 Jerrawangala National Park
20 Ku-ring-gai Chase National Park
21 Lane Cove National Park
22 Macquarie Pass National Park
23 Marramarra National Park
24 Meroo National Park
25 Morton National Park
26 Murramarang National Park
27 Nattai National Park
28 New South Wales Jervis Bay National Park
29 Popran National Park
30 Royal National Park
31 Scheyville National Park
32 Seven Mile Beach National Park
33 Sydney Harbour National Park
34 Thirlmere Lakes National Park
35 Tomaree National Park
36 Towarri National Park
38 Watagans National Park
39 Werakata National Park
40 Wollemi National Park
41 Wyrrabalong National Park
42 Yengo National Park
43 Agnes Banks Nature Reserve
44 Awabakal Nature Reserve
45 Bamarang Nature Reserve
46 Barren Grounds Nature Reserve
47 Barrengarry Nature Reserve
48 Berkeley Nature Reserve
49 Black Ash Nature Reserve
50 Brundee Swamp Nature Reserve
51 Burning Mountain Nature Reserve
52 Cambewarra Range Nature Reserve
53 Castlereagh Nature Reserve
54 Cecil Hoskins Nature Reserve
55 Cockle Bay Nature Reserve
56 Dharawal Nature Reserve
57 Gulguer Nature Reserve
58 Hexham Swamp Nature Reserve
59 Joadja Nature Reserve
60 Kangaroo River Nature Reserve
61 Kooragang Nature Reserve
62 Manobalai Nature Reserve
63 Moffats Swamp Nature Reserve
64 Mulgoa Nature Reserve
65 Munghorn Gap Nature Reserve
66 Muogamarra Nature Reserve
67 Narrawallee Creek Nature Reserve
68 Newington Nature Reserve
69 Pambalong Nature Reserve
70 Parma Creek Nature Reserve
71 Pelican Island Nature Reserve
72 Pitt Town Nature Reserve
73 Pulbah Island Nature Reserve
74 Red Rocks Nature Reserve
75 Rileys Island Nature Reserve
76 Robertson Nature Reserve
77 Rodway Nature Reserve
78 Saltwater Swamp Nature Reserve
79 Tapitallee Nature Reserve
80 Tilligerry Nature Reserve
81 Tingira Heights Nature Reserve
82 Towra Point Nature Reserve
83 Triplarina Nature Reserve
84 Wallumatta Nature Reserve
85 Wamberal Lagoon Nature Reserve
86 Wambina Nature Reserve
87 Windsor Downs Nature Reserve
88 Wingen Maid Nature Reserve
89 Wogamia Nature Reserve
90 Wollondilly River Nature Reserve
91 Woollamia Nature Reserve
92 Worrigee Nature Reserve
93 Yatteyattah Nature Reserve

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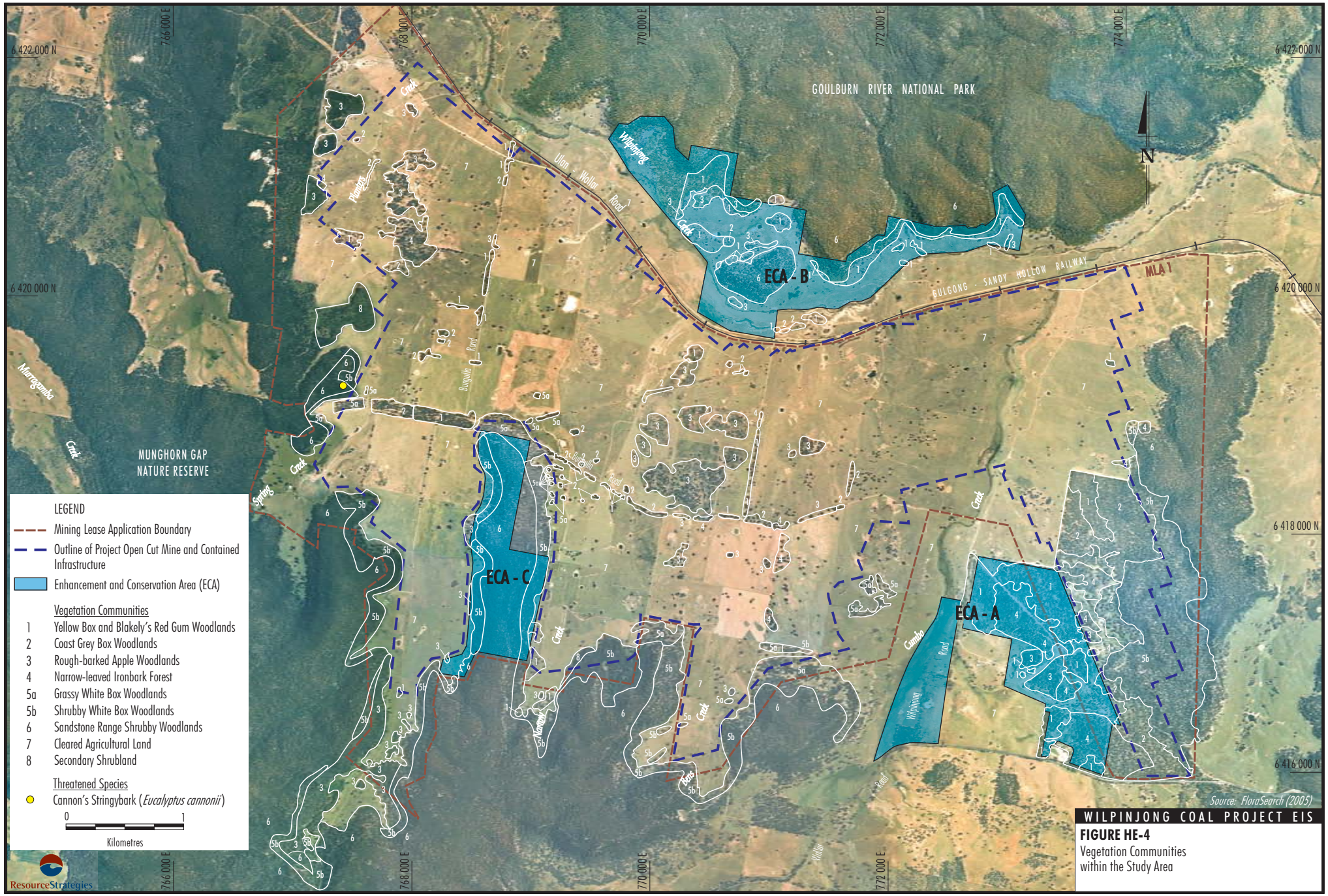
FIGURE HE-3b
National Parks and Nature Reserves in the Sydney Basin Bioregion

ResourceStrategies

WIL-04-01 8PT_007C



WIL-04-01 8PT_006G

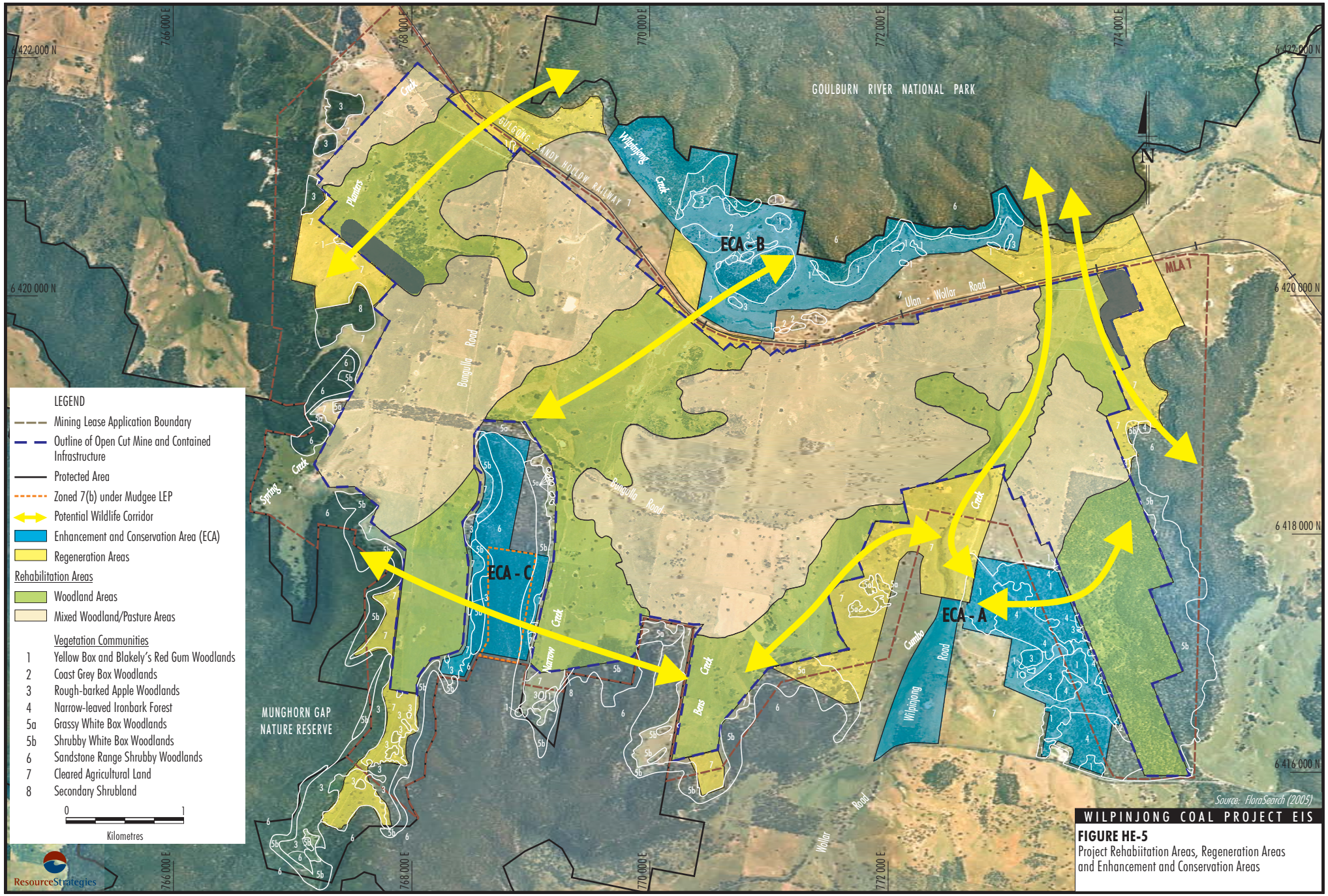


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FIGURE HE-5
Project Rehabiitation Areas, Regeneration Areas and Enhancement and Conservation Areas

WIL-04-01 8PT_004L

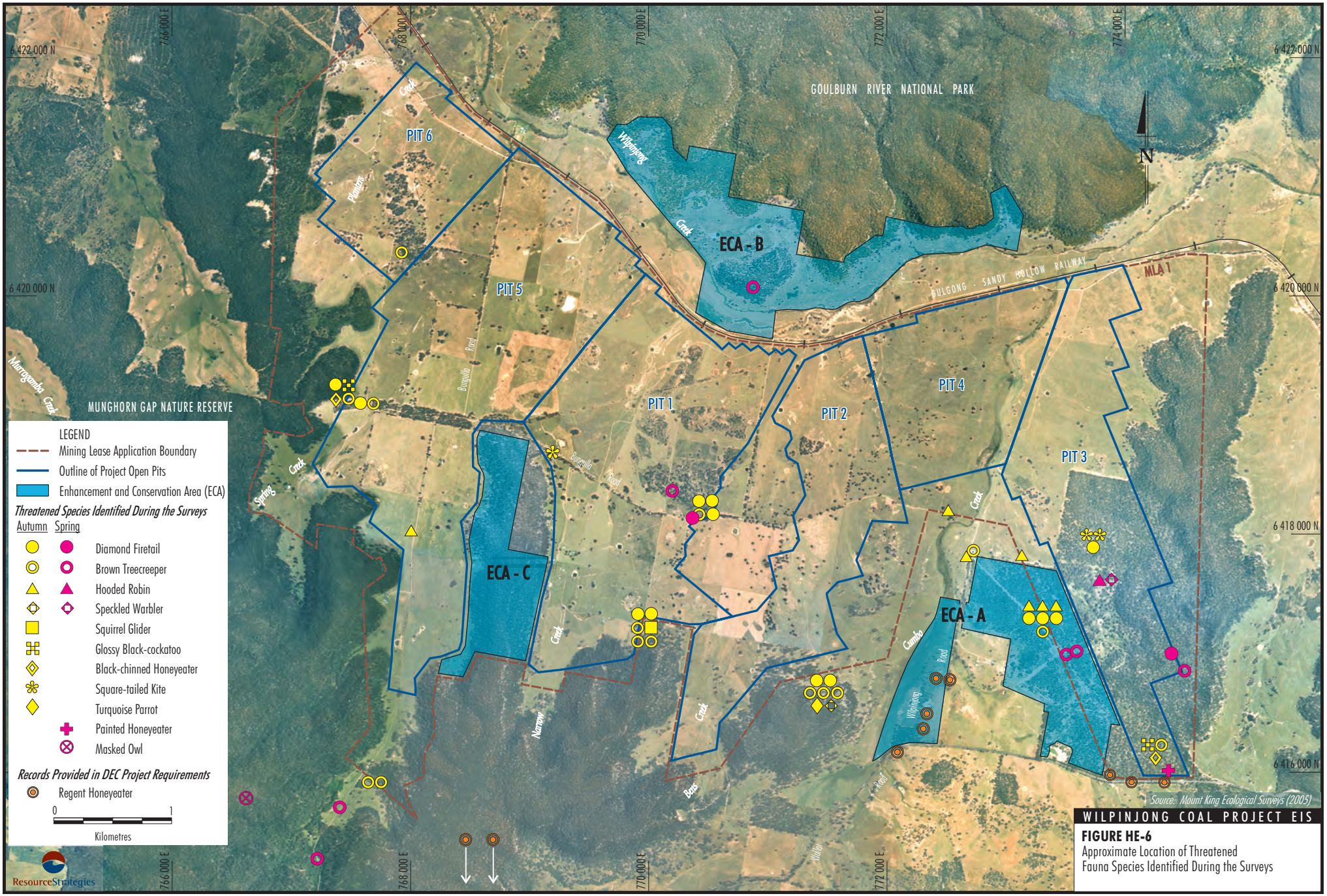

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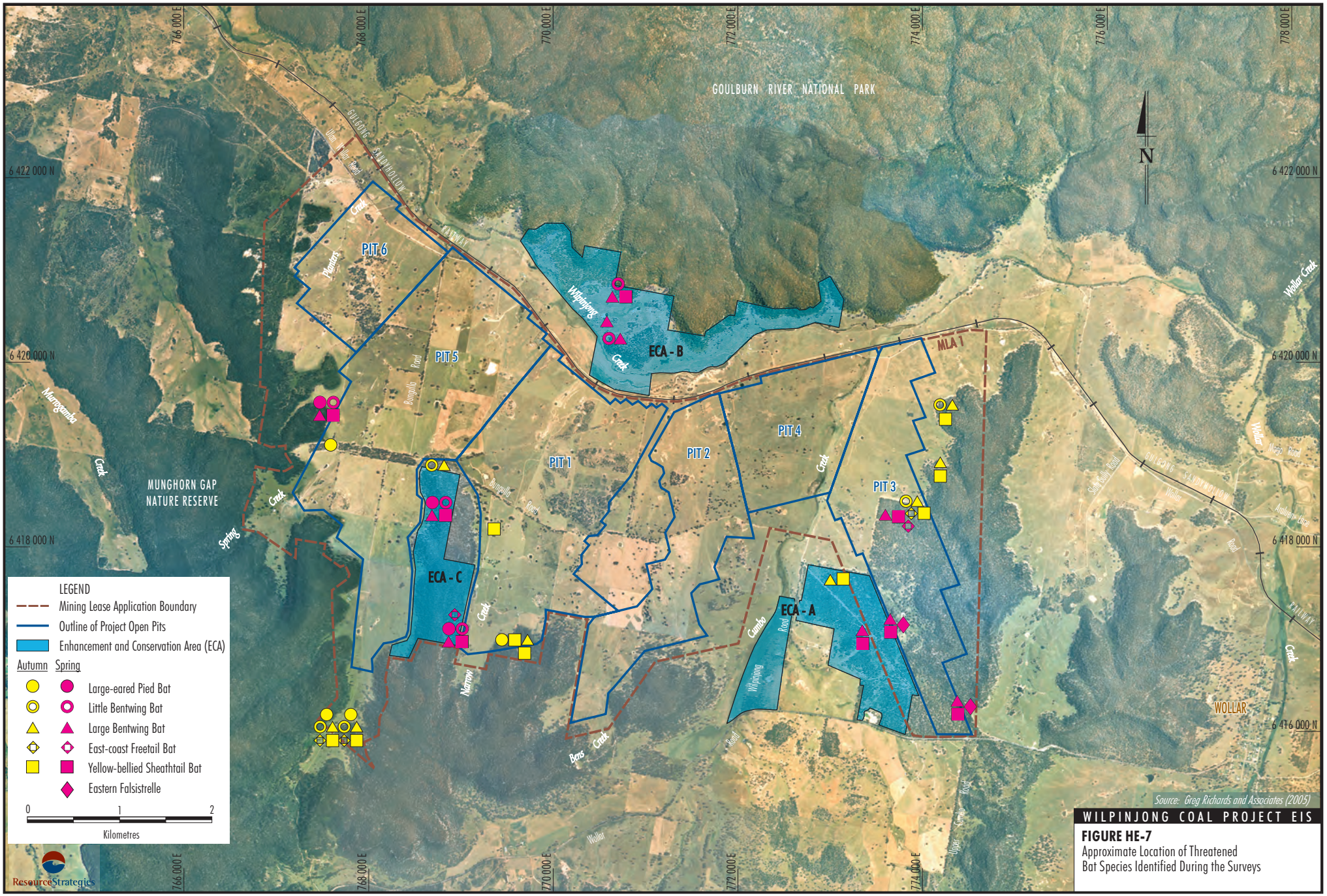
FIGURE HE-6
Approximate Location of Threatened Fauna Species Identified During the Surveys

WIL-04-01 8Pt_008D



Source: Greg Richards and Associates (2005)

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FIGURE HE-7
Approximate Location of Threatened Bat Species Identified During the Surveys

WIL-04-01 8Pt_005F