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SKM

NSW GOVERNMENT
Department of Planning

Erskine Park Link Road Concept Plan

FLORA AND FAUNA IMPACT ASSESSMENT

- FINAL
- November 2008

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Contents

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1. Introduction

Sinclair Knight Merz (SKM) has been commissioned by the NSW Department of Planning (DoP) to prepare a flora and fauna impact assessment for the Erskine Park Link Road Concept Plan. An Environmental Assessment (EA) for the Proposal was conducted by National Environmental Consulting Services Pty Ltd in February 2008 (NECS 2008). Comments on the EA were received from the Department of Environment and Climate Change (DECC) in April 2008 who considered the desktop based EA insufficient for assessing the impact of the Proposal on threatened species, populations and endangered ecological communities. This report provides a detailed flora and fauna impact assessment of the Erskine Park Link Road Network and includes thorough consideration of the concerns raised by the DECC.

1.1. Project Description

Throughout this report, the term 'the Subject Site' is used to describe the area directly affected by the proposed Erskine Park Link Road (defined as a 40 m wide road easement plus 5 m disturbance buffer on either side of the easement), while the term 'the Study Area' refers to the the area within 2 km of the Subject Site.

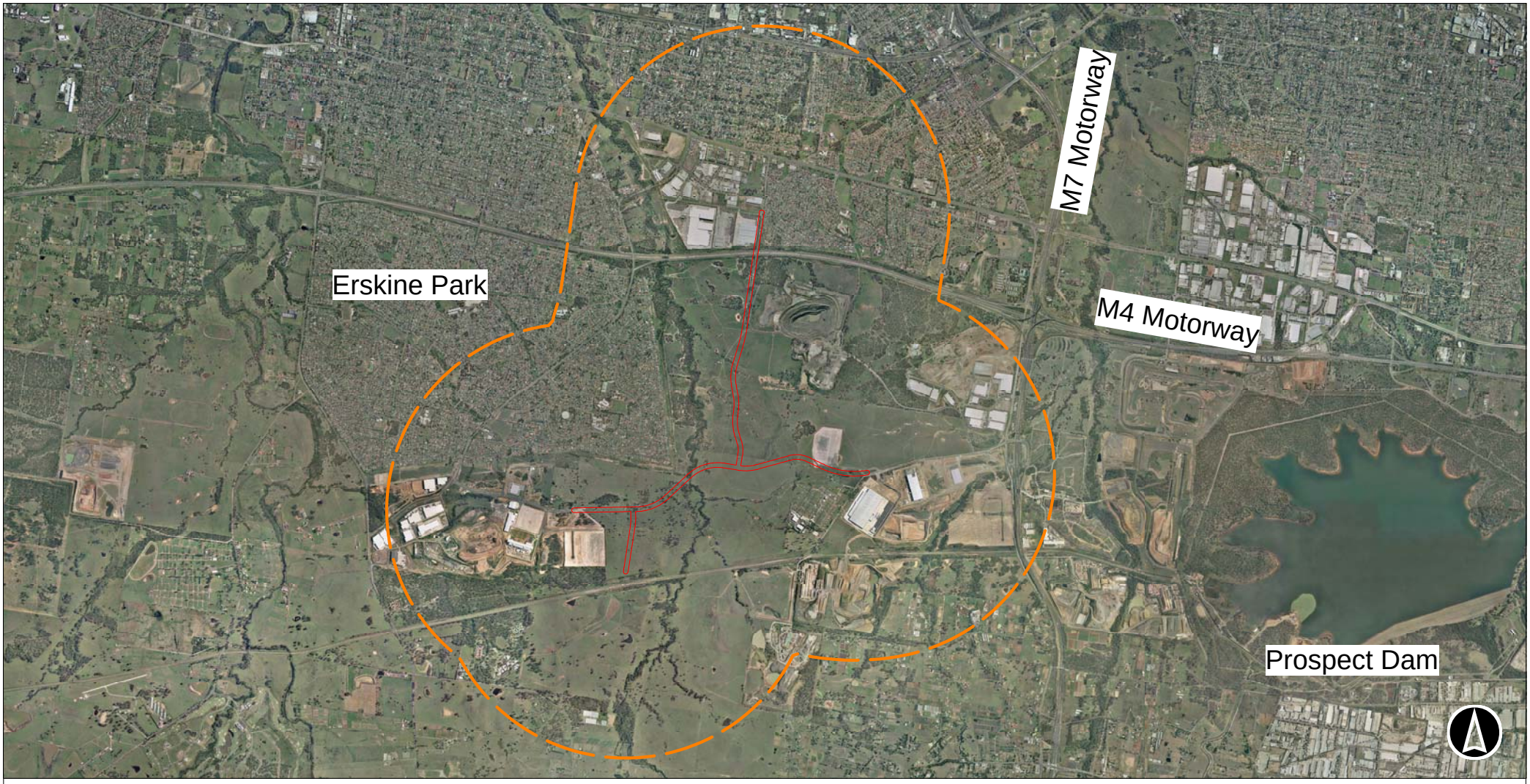
The proposed Erskine Park Link Road Network (the 'Proposal') is comprised of a four lane carriageway, generally within a 40 m wide road reserve with the following elements:

- An approximately 3.4 km east-west route (Erskine Park Link Road) which connects Old Walgrove Road to Lenore Lane providing connection between Mamre Road and the M7;
- An approximately 2.7 km north-south route which connects Archbold Road to the Erskine Park Link Road and the M4 via a new interchange; and
- An approximately 0.7 km southern extension from the end of the existing Lenore Lane across the Sydney Water Supply Pipeline.

Erskine Park is located approximately 40 km west of the Sydney CBD. The Proposal crosses Ropes Creek which forms the north-south boundary between the Penrith and Blacktown Local Government Areas (LGA). The location of the Study Area and the Subject Site is shown in Figure 1.

1.2. Assessment Objectives

This report documents the results of a flora and fauna assessment conducted by SKM to investigate the potential impacts associated with the Proposal. The information presented in this report is based on a review of available data and site investigations to assess the potential impacts of the Proposal in relation to relevant State and Commonwealth environmental and threatened species legislation,



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The Study Area

The Subject Site

Data Sources:
Aerial by AUSIMAGE 2007

0 1.2 2.4
kilometers

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Figure 1.
The Study Area and proposed Erskine Park Link Road Network

namely the *Threatened Species Conservation Act 1995* (TSC Act) and the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The specific objectives of this report are to:

- Identify species, ecological communities and populations of local, regional, state and national conservation significance, and their habitats, which are known or considered likely to occur within lands affected by the Proposal;
- Describe the biological environment of the Study Area in relation to flora and fauna; and
- Assess the potential impacts of the Proposal on the ecological values of the Study Area.

1.3. Limitations

The list of flora and fauna species recorded from this study is not comprehensive. Rather it is an indication of the species present at the time of the survey. A period of several seasons or years is often needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year (e.g. migratory birds, orchids), and/or may require specific weather and seasonal conditions for optimum detection (e.g. frogs). Therefore a precautionary approach has been implemented to satisfactorily address the potential presence of threatened species. This approach combined with the level of survey effort is considered adequate to identify the conservation value of the site and ensure that the limitations of the survey have been taken into account when drawing conclusions from the study.

2. Local Environment

The types of organisms (flora and fauna) in terrestrial ecosystems are determined by the local and regional climate, the topography (slope, elevation and aspect which affects the local climate and the soil), the geology and soil, the other organisms in the area, and the history of disturbance events (El-Shaarawi & Piegorsch 2002). Similarly, the soil is determined by the climate, vegetation, topography/geology, animals/microbes, and time since disturbance. The presence of animals and microbes are determined by plants, climate, soil and vegetation. Microclimates, and some aspects of regional climate, are determined by vegetation and topography (El-Shaarawi & Piegorsch 2002).

2.1. Climate

The nearest meteorological station to the Study Area is Prospect Reservoir (Station No. 067019, elevation 61 m), located approximately 6 km to the east of the Study Area. Climate data for Prospect Reservoir is summarised in Table 2-1 (Bureau of Meteorology website www.bom.gov.au, accessed 9 October 2008).

Table 2-1 Climate data for Prospect Reservoir Meteorological Station

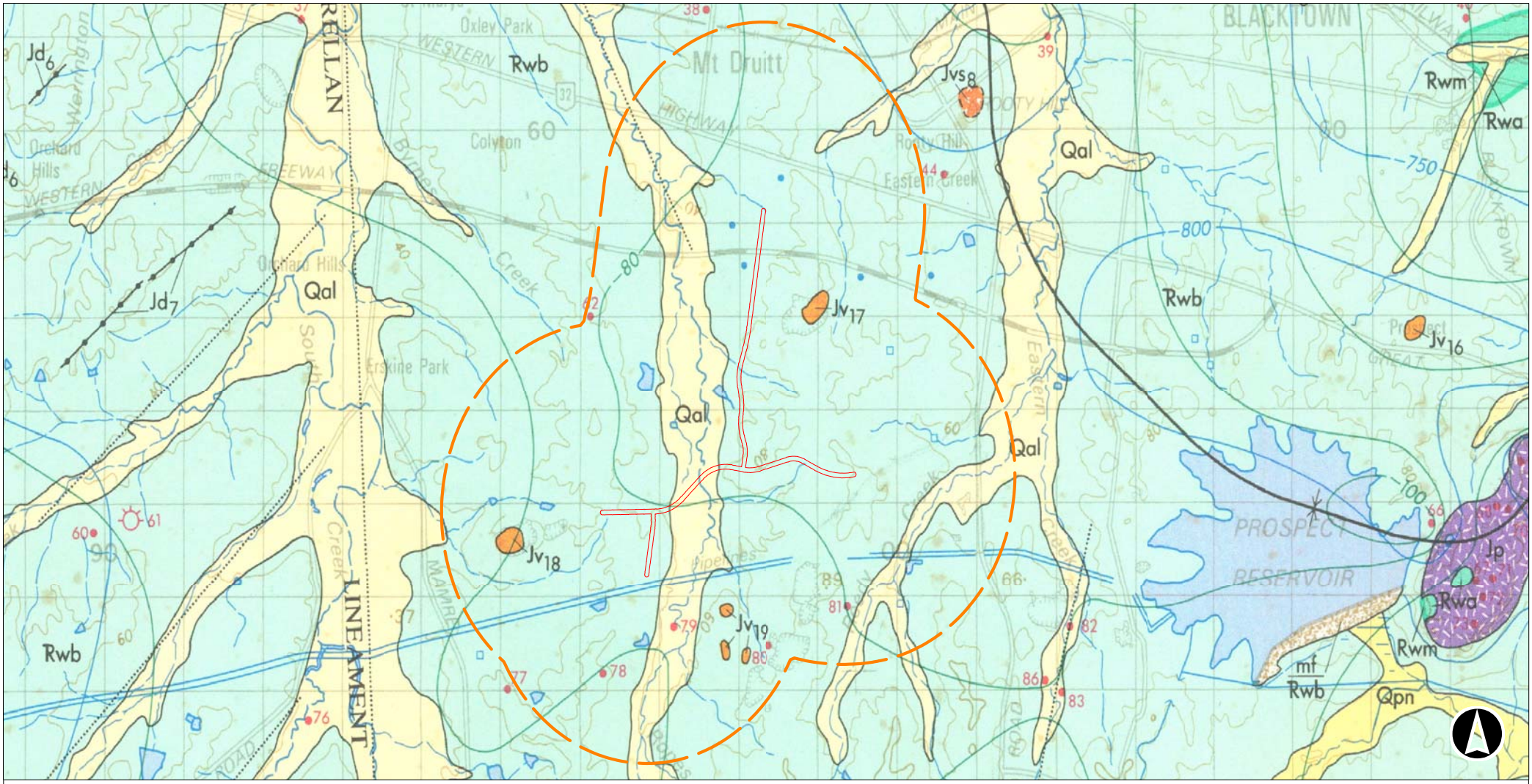
Category	Temperature / Rainfall
Annual rainfall	871.3 mm
Highest monthly rainfall	96.1 mm (March)
Lowest monthly rainfall	47.8mm (September)
Annual average minimum / maximum temperatures	12.2° C / 23° C
Highest mean monthly maximum temperature	28.2° C (January)
Lowest mean monthly minimum temperature	6.1° C (July)

The average rainfall in Sydney ranges from over 1200 mm near the coast to less than 800 mm on the undulating country of the Cumberland Plain in western Sydney (Division of National Mapping 1986). Rainfall increases progressively across the Blue Mountains with up to 1400 mm average annual rainfall at Katoomba due to the orographic effect of the Great Dividing Range (Division of National Mapping 1986).

2.2. Soils and Geology

2.2.1. Geology

The geology of the Study Area has been mapped at a scale of 1:100,000 as Wianamatta Group Bringelly Shale (map unit 'Rwb') with Quaternary Alluvium (map unit 'Qal') mapped along Ropes Creek (Geological Survey of NSW 1981, Figure 2). Small areas of Jurassic Volcanics (map unit 'Jv') occur in the Study Area, typically associated with operational quarries.



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The Study Area

The Subject Site

Geological Units

Quaternary Alluvium (map unit 'Qal')
Bringelly Shale (map unit 'Rwb')
Jurassic Volcanics (map unit 'Jv')

Data Sources:
Geological Survey of NSW 1981

0 1.4 2.8
kilometers

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Figure 2.
Geology of the Study Area

Bringelly Shale is comprised of shale, carbonaceous claystone, claystone, laminite, fine to medium grained lithic sandstone, rare coal and tuff. The depositional environment of this unit is described as alluvial and estuarine.

Quaternary Alluvium is described as fine grained sand, silt and clay. The depositional environment is fluvial.

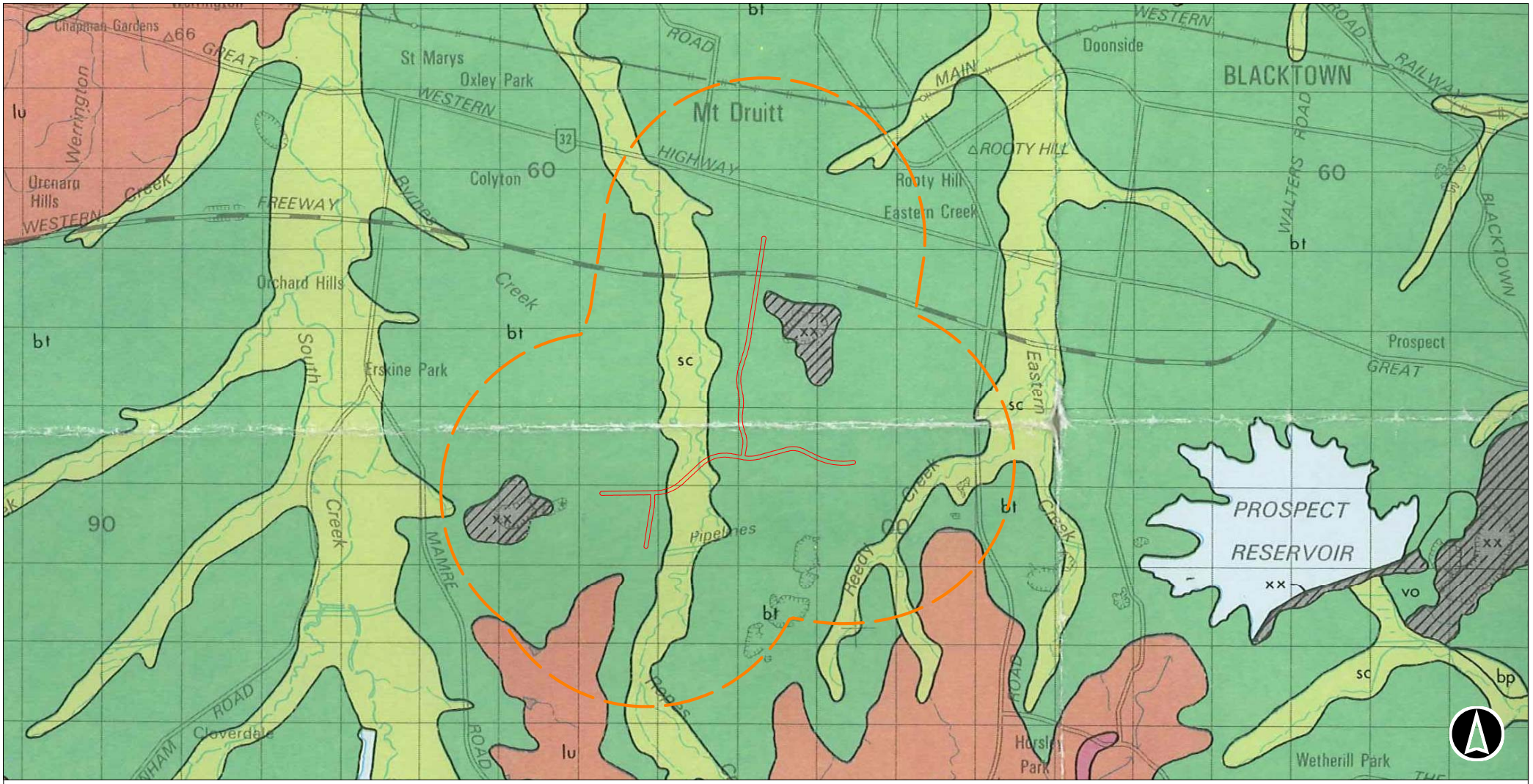
2.2.2. Soil Landscapes

The soil landscapes of the Study Area have been mapped at a scale of 1:100,000 as Blacktown soil landscape (map unit 'bt') over the majority of the Study Area, with South Creek (map unit 'sc') soil landscape mapped along Ropes Creek (Bannerman and Hazelton 1990, Figure 3). Luddenham soil landscape (map unit 'lu') has been mapped adjoining the southern boundary of the Study Area.

Descriptions of the soil landscapes of the Study Area are provided in Table 2-2.

Table 2-2 Soil Landscapes of the Study Area

Name	Map unit	Description
Blacktown	Bt	Landscape – gently undulating rises on Wianamatta Group shales. Local relief to 30 m, slopes usually < 5%. Broad rounded crests and ridges with gently inclined slopes. Cleared eucalypt woodland and tall open-forest (dry sclerophyll forest). Soils – shallow to moderately deep (<100 cm) hardsetting mottled texture contrast soils, red and brown podzolic soils on crest grading to yellow podzolic soils on lower slopes and in drainage lines. Limitations – moderately reactive highly plastic subsoil, low soil fertility, poor soil drainage.
South Creek	Sc	Landscape – floodplains, valley flats and drainage depressions of the channels on the Cumberland Plain. Usually flat with incised channesl; mainly cleared. Soils – often very deep layered sediments over bedrock or relict soils. Where pedogensesis has occurred there are structured plastic clays or structured loams in and immediately adjacent to drainage lines; red and yellow podzolic soils are most common on terraces with small areas of minimal krasnozems, leached clays and yellow solodic soils Limitations – erosion hazard, frequent flooding.
Luddenham	Lu	Landscape – undulating to rolling low hills on Wianamatta Group Shales, often associated with Minchinbury Sandstone. Local relief 50-80 m, slopes 5-20%. Narrow ridges, hillcrests and valleys. Soils – shallow (<100cm) dark podzolic soils or massive earthy clays on crests; moderately deep (70-150cm) red podzolic soils on upper slopes; moderately deep (<150cm) yellow podzolic soils and prairie soils on lower slopes and drainage lines. Limitations – high soil erosion hazard, localised impermeable highly plastic subsoil, moderately reactive.



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The Study Area

The Subject Site

Soil Landscapes

Blacktown (map unit 'bt')
South Creek (map unit 'sc')
Luddenham (map unit 'lu')
Disturbed Terrain (map unit 'xx')

Data Sources:
Bannerman and Hazelton 1990

0 1.4 2.8
kilometers

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Figure 3.
Soil Landscapes of the Study Area

3. Preliminary Review

3.1. Previous Studies

3.1.1. Erskine Park Line Road Environmental Assessment

An Environmental Assessment (EA) for the Erskine Park Link Road Concept Plan was conducted by National Environmental Consulting Services Pty Ltd in February 2008 (NECS 2008). The EA identified two Endangered Ecological Communities (EECs) as occurring in the Study Area, namely:

- Cumberland Plain Woodland (TSC Act and EPBC Act); and
- River-flat Eucalypt Forest (TSC Act).

The EA also identified three threatened flora and fauna species as occurring in the Study Area, namely:

- *Hypsela sessiliflora* (now *Isotoma sessiliflora*)
- *Grevillea juniperina subsp. juniperina* (Juniper-leaved Grevillea)
- *Meridolum corneovirens* (Cumberland Land Snail)

Key flora and fauna impacts identified in the EA include clearing of EECs (Cumberland Plain Woodland and River Flat Eucalypt Forest), clearing of threatened species and their habitat (in particular the Cumberland Land Snail and several species of threatened flora), the proposed crossing of Ropes Creek and the Erskine Park Biodiversity Corridor.

The following mitigation measures were recommended in the EA for each road in the network:

- *Targeted surveys for threatened flora and fauna species likely to occur within the road easement;*
- *Conduct of vegetation surveys in accordance with the requirements of the Erskine Park Biodiversity Management Strategy;*
- *Review the requirement for a Referral under the EPBC Act;*
- *Retention where possible of patches of remnant vegetation;*
- *Protection of identified populations located in close proximity to the proposed alignment through the construction and operational phases through the implementation of an EMP. This would include the Grevillea juniperina subsp. juniperina population identified adjacent to the proposed Erskine Park Link Road.*

- *Maintenance of the habitat corridor created by the riparian vegetation of Ropes Creek and associated tributaries. The design should provide for movement of ground-dwelling and arboreal fauna;*
- *Evaluation of the need for a Compensatory Habitat Package and development and implementation of that package; and*
- *Monitoring of the impact on the terrestrial ecosystems.*

3.1.2. Erskine Park Employment Area Biodiversity Strategy and Management Plan

The Erskine Park Biodiversity Strategy (the Strategy) and the Biodiversity Management Plan (the Plan) were developed by HLA-Envirosciences Pty Ltd in consultation with the Erskine Park Employment Area (EPEA) land owners, Penrith City Council, the DoP and the DECC (HLA 2005 and 2006). The Strategy was developed to provide a strategic framework for the conservation of biodiversity within the EPEA. The strategy provides for an east-west biodiversity corridor which links the South Creek and Ropes Creek riparian corridors. Approximately 25% of the EPEA is to be included in this corridor, 113.4 hectares of which is under private ownership.

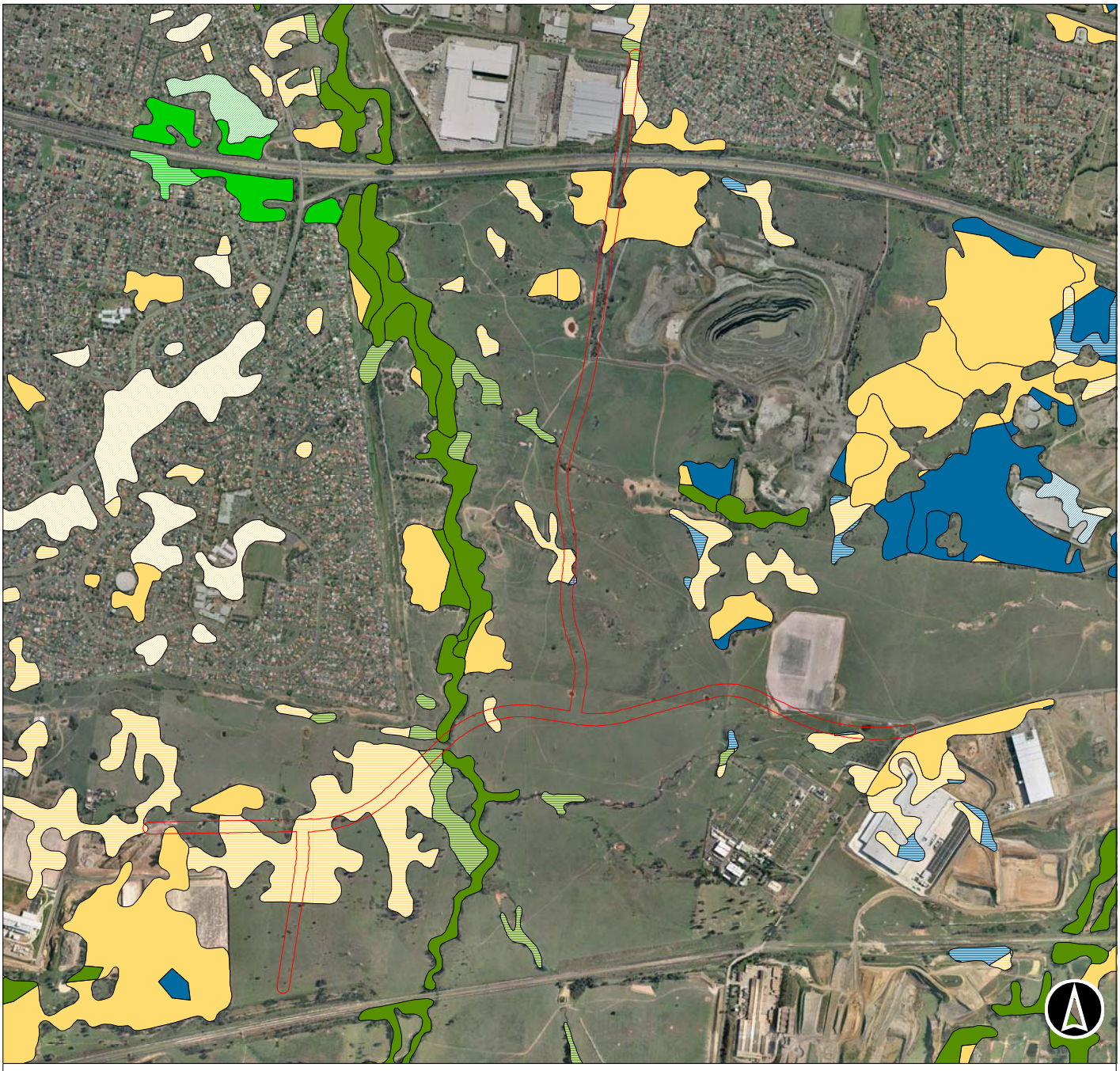
The Strategy provides two main phases. Phase one is to occur over a six-year period from the subdivision of the biodiversity corridor or when a restriction to user is placed on the title of the lots containing dedicated biodiversity areas. The Strategy nominates six years as a sufficient period of time for the biodiversity area to become self sustaining. Phase two is the maintenance period for the biodiversity area and is to continue in perpetuity.

The Plan follows on from the Strategy to provide further detail about the boundary of the Erskine Park Biodiversity Area, the revegetation and conservation offset ratios and the ownership, funding and management arrangements. A total of $4 M in land owner contributions has been agreed for the establishment and perpetual management of the Biodiversity Area.

3.1.3. The Native Vegetation of the Cumberland Plain

The NSW National Parks and Wildlife Service (NPWS) conducted a vegetation mapping project for the Cumberland Plain in western Sydney from 1997 – 2002 (NPWS 2002a, Figure 4). The project aimed to:

- Map all remnant native vegetation within the Study Area greater than 0.5 ha using repeatable, scientifically robust methods;
- Provide large scale (1:25,000) maps of all vegetation mapped during the project;
- Contribute to greater certainty and rigour in the environmental impact assessment process through consistent, region-wide mapping; and
- Provide sufficient information to assist with an assessment of bushland conservation significance.



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The Subject Site

Data Sources:
Aerial by AUSIMAGE 2007
NPWS 2002

0 0.5 1
kilometers

NPWS Vegetation Communities

>10% Canopy Cover
- 9 - Shale Hills Woodland
- 10 - Shale Plains Woodland
- 11 - Alluvial Woodland
- 103 - Shale/Gravel Transition Forest

<10% Canopy Cover
- 9 - Shale Hills Woodland
- 10 - Shale Plains Woodland
- 11 - Alluvial Woodland
- 103 - Shale/Gravel Transition Forest

<10% Canopy Cover (urban areas)
- 9 - Shale Hills Woodland
- 10 - Shale Plains Woodland
- 11 - Alluvial Woodland
- 103 - Shale/Gravel TF

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Figure 4.
NPWS Vegetation Mapping

The NPWS mapped four vegetation communities within the Study Area (Figure 4). Each of the four mapped communities corresponds to EECs under the TSC Act, with two corresponding to an EEC scheduled on the EBPC Act. These communities and their status are presented in Table 3-1.

Table 3-1 NPWS Vegetation Communities

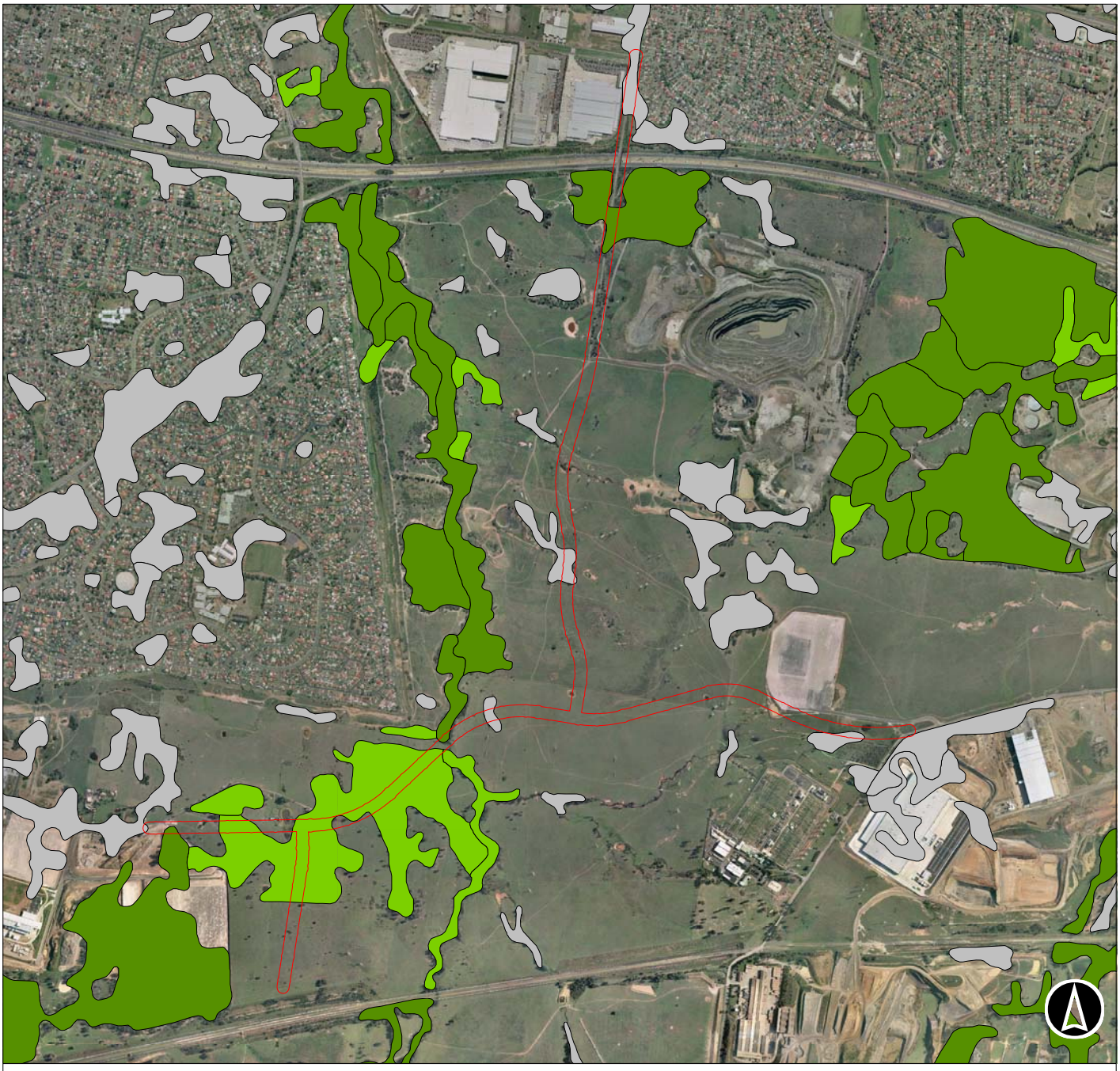
NPWS (2002) vegetation community	Map Unit	Corresponding EEC	TSC Act	EPBC Act	Approximate Area within the Study Area	Approximate Area within the proposed Erskine Park Link Road footprint
Shale Hills Woodland	9	Cumberland Plain Woodland	E	E	108 ha	0.14 ha
Shale Plains Woodland	10	Cumberland Plain Woodland	E	E	516 ha	8.264 ha
Alluvial Woodland	11	River-flat Eucalypt Forest	E	-	184 ha	0.63 ha
Shale/Gravel Transition Forest	103	Shale/Gravel Transition Forest	E	-	5.6 ha	0 ha

E = Endangered

3.1.4. Conservation Significance Assessment

In conjunction with the vegetation mapping project for the Cumberland Plain, NPWS conducted a conservation significance assessment. The assessment assigns one of four categories to each parcel of remnant vegetation on the Cumberland Plain (Figure 5). These categories are defined (NPWS 2002b) as:

> ***Core Habitat*** *- Areas that constitute the backbone of a viable conservation network across the landscape (core areas), or areas where the endangered ecological communities are at imminent risk of extinction.*
>
> ***Support for Core*** *- Areas that provide a range of support values to the critically endangered and/or core habitat, including increasing the size and buffering of these areas, and providing corridor connections. The focus is to identify priority areas for restoration work in order to enhance the biodiversity values in the region.*
>
> ***Urban Remnant Trees (Critically Endangered Communities)*** *- Areas of critically endangered ecological communities which remain as remnant trees in an urban landscape.*
>
> ***Other Remnant Vegetation*** *- Other native vegetation communities that do not fall within the above significance categories but which retain conservation significance.*



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The Subject Site

NPWS Significance Assessment

Core Habitat

Support to Core Habitat

Other Remnant Vegetation

Data Sources:
Aerial by AUSIMAGE 2007
NPWS 2002

0 0.5 1
kilometers

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Figure 5.
NPWS Conservation Assessment

NPWS (2002b) mapped three categories of conservation significance within the Study Area (Figure 5). These categories are presented in Table 3-2.

Table 3-2 NPWS Conservation Significance

NPWS (2002b) Conservation Significance Category	CSA map unit	Approximate Area within the Study Area	Approximate Area within the proposed Erskine Park Link Road footprint
Core Habitat	1	354 ha	1.16 ha
Support to Core Habitat	2	93.72 ha	5.47 ha
Other Remnant Vegetation	4	378.5 ha	3.57 ha

3.2. Biodiversity Databases

Data sources used in this review included the:

- Department of Environment and Climate Change (DECC) Atlas of NSW Wildlife, searched within the Gunning and Goulburn 1:100,000 mapsheets (DECC 2008a);
- Database of the Royal Botanic Gardens PlantNET (Botanic Gardens Trust 2008); and
- Department of the Environment, Water, Heritage and the Arts (DEWHA) Protected Matters Search Tool for nationally threatened species and ecological communities listed on the EPBC Act (DEWHA 2008).

Listed species and ecological communities habitat requirements have been sourced from DECC Species Profiles (DECC 2008b) unless otherwise stated.

3.3. Threatened Flora Species

A search of existing New South Wales threatened species databases (DECC 2008a) revealed that six threatened flora have been recorded or are predicted to occur in the Study Area (Table 3-3, Figure 6). Five of these are also listed under the Commonwealth EPBC Act.

Table 3-3 Threatened Flora Species Recorded in the Study Area

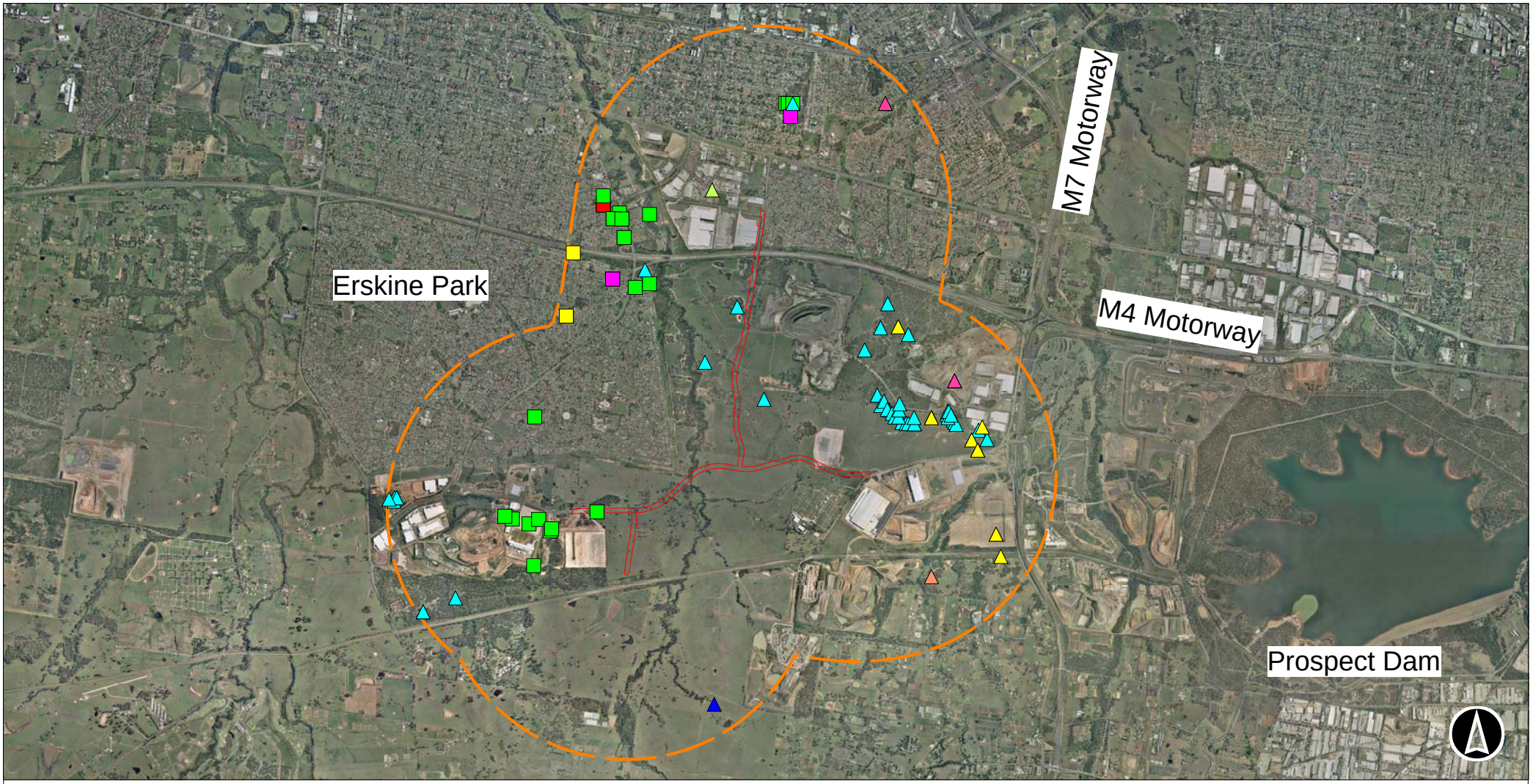
Common Name	Species	TSC Act	EPBC Act	Habitat
White-flowered Wax Plant	*Cynanchum elegans*	E	E	The White-flowered Wax Plant usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; Coastal Tea-tree (*Leptospermum laevigatum*) – Coastal Banksia (*Banksia integrifolia* subsp. *integrifolia*) coastal scrub; Forest Red Gum (*Eucalyptus tereticornis*) aligned open forest and woodland; Spotted Gum (*E. maculata*) [now *Corymbia* maculata] aligned open forest

Common Name	Species	TSC Act	EPBC Act	Habitat
				and woodland; and Bracelet Honeymyrtle (*Melaleuca armillaris*) scrub to open scrub (DECC 2008b).
Dillwynia tenuifolia	*Dillwynia tenuifolia*	V	V	In western Sydney, may be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland (DECC 2008b)
Juniper-leaved Grevillea	*Grevillea juniperina* subsp. *juniperina*	V	-	Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels (DECC 2008b). Recorded from Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest (DECC 2008b).
Spiked Rice-flower	*Pimelea spicata*	E	E	In both the Cumberland Plain and Illawarra environments this species is found on well-structured clay soils (DECC 2008b). On the inland Cumberland Plain sites it is associated with Grey Box and Ironbark (DECC 2008b).
Brown Pomaderris	*Pomaderris brunnea*	V	V	Brown Pomaderris grows in moist woodland or forest on clay and alluvial soils of flood plains and creek lines (DECC 2008b).
Pultenaea parviflora	*Pultenaea parviflora*	E	V	May be locally abundant; particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays (DECC 2008b). May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland (DECC 2008b).

Key: E = Endangered, V = Vulnerable

3.4. Endangered Populations

A search of the *Atlas of NSW Wildlife* (DECC 2008a, Figure 6) revealed one endangered plant population listed under the TSC Act that has been previously recorded within the Study Area, namely *Marsdenia viridiflora* subsp. *viridiflora* in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs.



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The Study Area

The Subject Site

Threatened Fauna

- Eastern False Pipistrelle
- Green and Golden Bell Frog
- Cumberland Plain Land Snail
- Eastern Bentwing-bat
- Eastern Freetail-bat
- Large-footed Myotis

Threatened Flora

- Dillwynia tenuifolia
- Grevillea juniperina subsp. juniperina
- Marsdenia viridiflora subsp. viridiflora
- Pultenaea parviflora

Data Sources:
Aerial by AUSIMAGE 2007

0 1.2 2.4
kilometers

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Figure 6.
Threatened Flora and Fauna

3.5. Threatened Fauna Species

A search of existing New South Wales threatened species databases (DECC 2008a) revealed that 36 threatened fauna species have been recorded within a 10 km radius of the Subject Site (Table 3-4). Twenty-six of these are also listed under the Commonwealth EPBC Act.

Table 3-4 provides an assessment of the likelihood of these threatened fauna species occurring at the Subject Site (obligate marine species recorded within the ten kilometre radius have been excluded from the assessment.) Several of the threatened species listed in Table 3-4 may utilise habitats present at the Subject Site, but are considered unlikely to occur there because the areas of remnant vegetation at the Subject Site are considered too small, isolated and/or disturbed for these species. For example, Green and Golden Bell Frogs previously occurred in the region, but have not been detected in the Study Area for several years. It is suspected the combined impacts of habitat fragmentation and decline, and urbanisation have rendered the area inhospitable to the species.

A total of 24 threatened species, comprising one invertebrate, one frog, seven mammals and 15 birds were assessed as potentially occurring in the Study Area.

- **Table 3-4 Threatened Fauna Species known or considered likely to occur in the Study Area**

Common Name	Species	EPBC	TSC	Likelihood of Being Found in the Study Area	7-Part Test Applied
Invertebrates					
Adams Emerald Dragonfly	*Archaeophya adamsi*	-	V	Unlikely – unsuitable habitat	No
Sydney Hawk Dragonfly	*Austrocrodulia leonardi*	-	E	Unlikely – unsuitable habitat	No
Cumberland Land Snail	*Meridolum corneovirens*	-	E	Likely – suitable habitat	Yes
Ray-finned Fishes					
Macquarie Perch	*Macquaria australasica*	E	V	Unlikely – unsuitable habitat	No
Australian Grayling	*Prototroctes maraena*	V	-	Unlikely – unsuitable habitat	No
Amphibians					
Giant Burrowing Frog	*Heleioporus australiacus*	V	V	Unlikely – unsuitable habitat	No
Green and Golden Bell Frog	*Litoria aurea*	V	E	Unlikely – unsuitable habitat	No

Common Name	Species	EPBC	TSC	Likelihood of Being Found in the Study Area	7-Part Test Applied
Reptiles					
Broad-headed Snake	*Hoplocephalus bungaroides*	V	E	Unlikely – unsuitable habitat.	No
Mammals					
Large-eared Pied Bat, Large Pied Bat	*Chalinolobus dwyeri*	V	V	Unlikely – unsuitable habitat	No
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population)	*Dasyurus maculatus maculatus* (SE mainland population)	E	V	Unlikely – unsuitable habitat	No
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	-	V	Possible – suitable habitat.	Yes
Eastern Freetail-bat	*Mormopterus norfolkensis*	-	V	Possible – suitable habitat.	Yes
Southern Myotis	*Myotis macropus*	-	V	Possible – suitable habitat.	Yes
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	-	V	Possible – suitable habitat.	Yes
Brush-tailed Rock-wallaby	*Petrogale penicillata*	V	E	Unlikely – unsuitable habitat	No
Long-nosed Potoroo (SE mainland)	*Potorous tridactylus tridactylus*	V	V	Unlikely – unsuitable habitat	No
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Possible – suitable habitat.	Yes
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V	V	Possible – suitable habitat.	Yes
Birds					
Great Egret, White Egret	*Ardea alba*	M / L	-	Possible – suitable habitat.	Yes
Cattle Egret	*Ardea ibis*	M / L	-	Possible – suitable habitat.	Yes
Fork-tailed Swift	*Apus pacificus*	M / L	-	Possible – suitable habitat.	Yes
Bush Stone-curlew	*Burhinus grallarius*	-	E	Possible – suitable habitat.	Yes
Latham's Snipe, Japanese Snipe	*Gallinago hardwickii*	M / L	-	Possible – suitable habitat.	Yes
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	M / L	-	Unlikely – unsuitable habitat	No
White-throated Needletail	*Hirundapus caudacutus*	M / L	-	Possible – suitable habitat.	Yes
Swift Parrot	*Lathamus discolor*	E / M	E	Possible – suitable habitat.	Yes
Black-tailed Godwit	*Limosa limosa*	-	V	Unlikely – unsuitable habitat	No
Hooded Robin	*Melanodryas*	-	V	Possible – suitable habitat.	Yes

Common Name	Species	EPBC	TSC	Likelihood of Being Found in the Study Area	7-Part Test Applied
	cucullata cucullata				
Black-chinned Honeyeater	*Melithreptus gularis gularis*	-	V	Possible – suitable habitat.	Yes
Rainbow Bee-eater	*Merops ornatus*	M	-	Possible – suitable habitat.	Yes
Black-faced Monarch	*Monarcha melanopsis*	M	-	Unlikely – unsuitable habitat	No
Satin Flycatcher	*Myiagra cyanoleuca*	M	-	Unlikely – unsuitable habitat	No
Speckled Warbler	*Pyrrholaemus saggitatus*	-	V	Unlikely – unsuitable habitat	No
Rufous Fantail	*Rhipidura rufifrons*	M	-	Unlikely – unsuitable habitat	No
Australian Painted Snipe	*Rostratula australis*	V	E	Unlikely – unsuitable habitat	No
Painted Snipe	*Rostratula benghalensis*	M / L	-	Possible – suitable habitat.	Yes
Diamond Firetail	*Stagonopleura guttata*	V	V	Possible – suitable habitat.	Yes
Regent Honeyeater	*Xanthomyza phrygia*	E / M	E	Possible – suitable habitat.	Yes

E = Endangered; V = Vulnerable; M = Migratory, L = Listed overfly marine area

4. Flora Assessment

A detailed flora survey of the proposed Erskine Park Link Road was conducted on the 8th October 2008. The survey included assessing approximately 8 km of the Erskine Park Link Road Network. The areas surveyed are detailed in Figure 7.

All vegetation within a 50 m wide corridor (40 m wide road easement and 5 m buffer) was surveyed with particular emphasis on vegetation communities likely to be impacted upon by the Proposal.

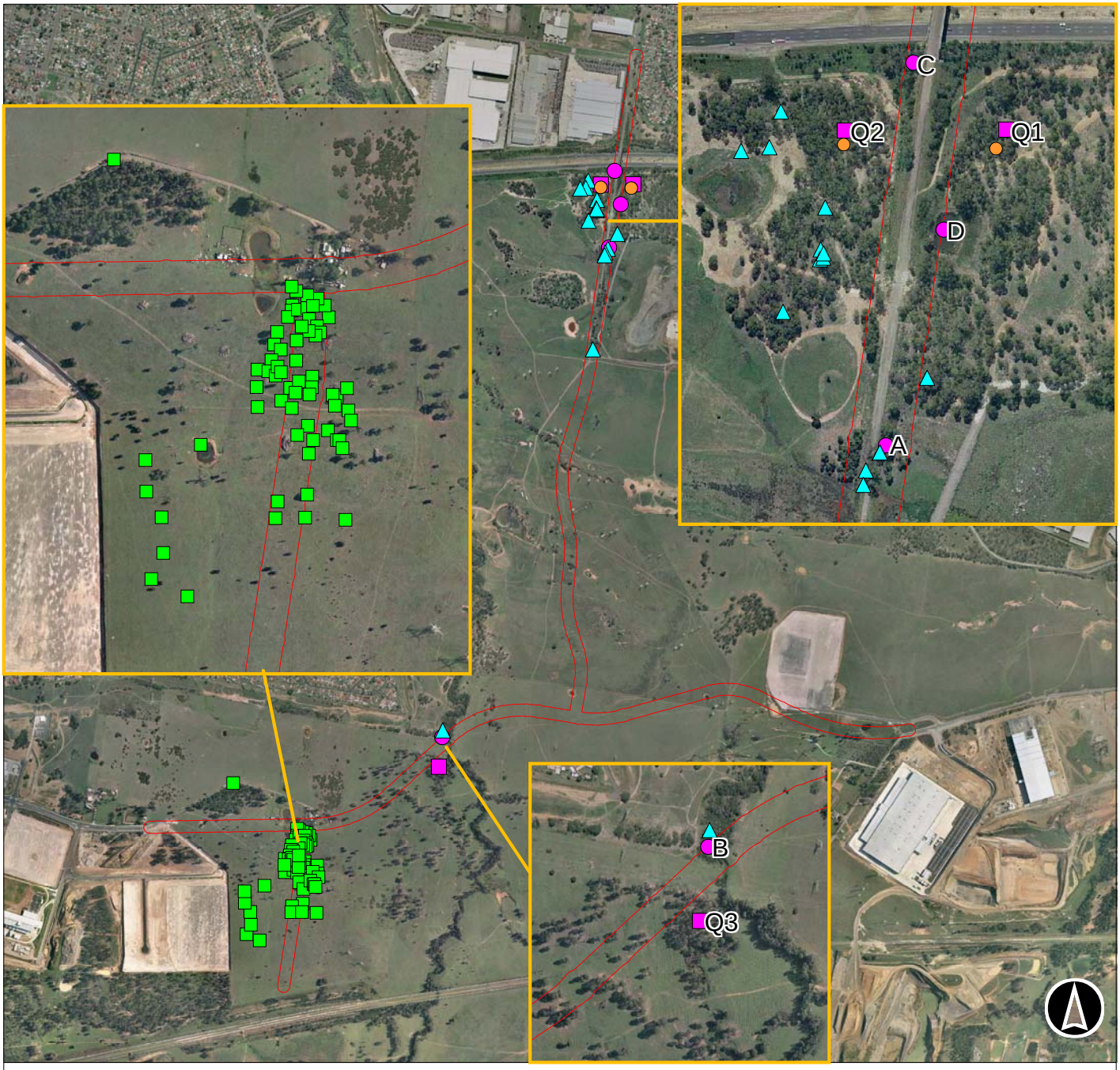
4.1. Methods

The flora survey aimed to identify the floristics, structure of the vegetation, and the type and distribution of plant communities present. The vegetation communities along the proposed Erskine Park Link Road were recorded using standard vegetation sampling methods comprising a total of 3 quadrats (Q1-Q3) and 4 supplementary spot locations. Each quadrat was 20 m long by 20 m wide (0.04 ha). For the spot locations, all species within a 20 m radius were recorded.

Site data for each quadrat was recorded (Appendix A). The overall condition of the site vegetation was noted, including the extent of disturbance and weed invasion. Vegetation condition was rated through a combination of weed abundance, native cover, size of patch and past disturbance and scored as either low, low-moderate, moderate, moderate-high and high (Table 4-1).

Table 4-1 Vegetation Condition

Vegetation Condition	Description
Low	This condition class includes all exotic vegetation, heavily disturbed areas, cleared areas and areas with more than 50% weed cover. This class typically has a disturbed structure (groundcovers, shrubs or trees missing).
Low-Moderate	This condition class typically included areas of regrowth that had some structural diversity (groundcovers, shrubs and canopy) but were still impacted by disturbance.
Moderate	This condition class includes vegetation containing older regrowth with limited hollows. Medium patch sizes with some connectivity typify this class.
Moderate-High	This condition class includes moderately dense vegetation with all structural layers intact, large patch size and connectivity with adjoining remnants, but is likely to have suffered from clearing/logging in the past. This vegetation typically has a large abundance of hollow bearing trees.
High	This condition class includes dense remnant (intact) vegetation with all structural layers intact, large patch size and connectivity with adjoining remnants. This condition class typically has a large abundance of hollow bearing trees.



Legend

The Subject Site

Quadrats

Spot Locations

Grevillea juniperina subsp. juniperina

Habitat Tree

Cumberland Land Snail

Data Sources:
Aerial by AUSIMAGE 2007

0 0.5 1
kilometers

EN02516
Erskine Park Link Road Concept Plan
Flora and Fauna Impact Assessment
GDA 1994 MGA 56

Figure 7.
Sampling Locations and Threatened Species

The location of flora survey quadrats are presented in Figure 7. Digital photographs of each site have been included in Appendix B.

Vegetation communities were mapped *in situ* using a hand-held geographic mapping unit loaded with ArcPad® software. Each area of vegetation along the proposed transmission line was tagged with dominant canopy species and vegetation condition. This mapping was subsequently revised and refined as part of this report. A map detailing vegetation communities and condition is presented in Figure 8.

Identification of plant communities was undertaken including an assessment of the presence of Endangered Ecological Communities (EECs) as listed under the TSC and EPBC Acts.

Targeted searches were undertaken for threatened flora species listed under the TSC Act and the EPBC Act, particularly Spiked Rice-flower (*Pimelea spicata*), and included consideration of potential subject species and any additional rare or significant plant species. Cropper (1993) suggested that a general traverse is a suitable method for detecting the presence of rare species during flora surveys. As such, a general traverse was undertaken across the entire pipeline corridor as part of the field surveys, focussing on areas of remnant vegetation.

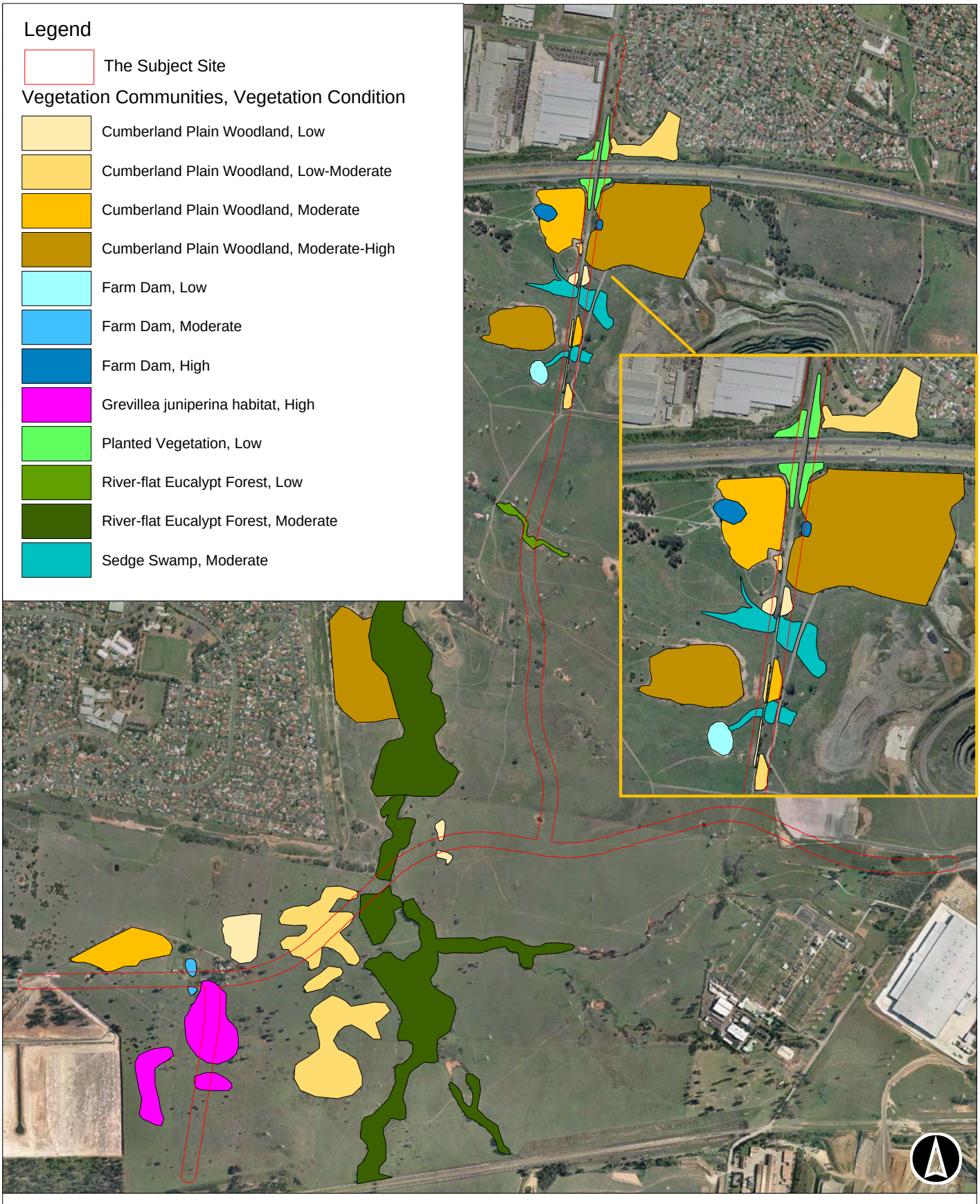
Botanical nomenclature follows Harden (1990-1993, 2002), with updates from PlantNET, The Plant Information Network System of the Botanic Gardens Trust (Botanic Gardens Trust 2008).

4.2. Results

4.2.1. Site Characterisation and Context

The Study Area is characterised by remnant patches of Cumberland Plains Woodland embedded in a landscape of improved pasture and isolated paddock trees. There are numerous dams of varying sizes throughout the Study Area, along with creek and riparian habitats at Ropes Creek (Figure 8). Disturbances to the site include numerous dirt roads, high voltage powerlines, rubbish dumping in woodlands adjacent to the M4 at the north of the Study Area, and dirt bike riding. The Subject Site has previously been used for agricultural purposes, with several farm sheds, abandoned farmhouses, and fence lines in various conditions.

Adjacent land uses include suburban subdivisions (the urban areas of St Clair, Erskine Park, and Minchinbury lie to the west and north respectively), quarries, and the redeveloped Sydney Wonderland site. The remaining adjacent land is rural or semi-rural, and supports light industrial activities and small rural holdings.



Data Sources:
Aerial by AUSIMAGE 2007

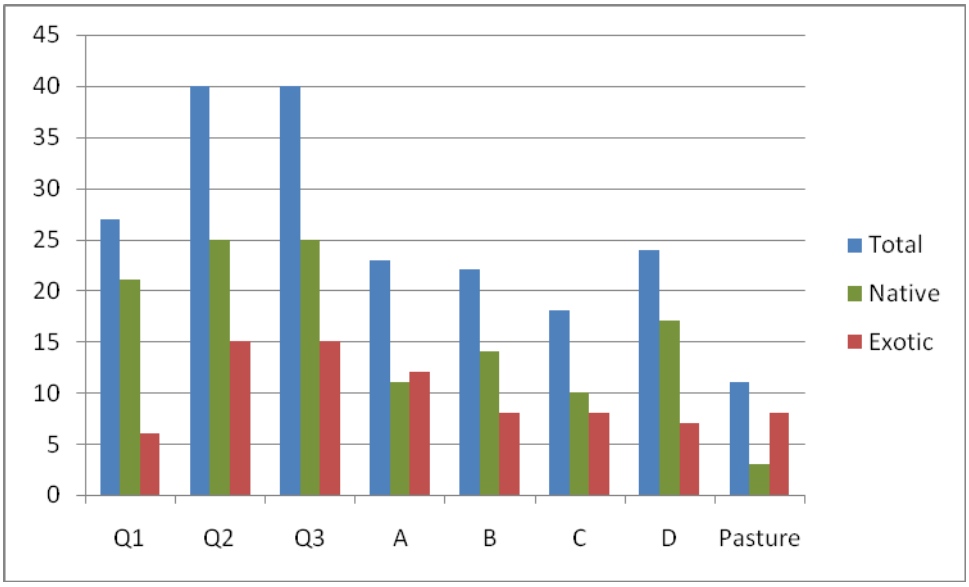
0 360 720
meters

EN02516
Erskine Park Link Road Concept Plan
Flora and Fauna Impact Assessment
GDA 1994 MGA 56

Figure 8.
Vegetation Mapping

4.2.2. Species richness

A total of 127 species (86 native, 40 exotic and one non-local native) from 18 plant families were recorded in the Study Area (Appendix A). Species richness is presented in Graph 4-1 below.



- **Graph 4-1 Species richness**

4.2.3. Juniper Leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*)

The Juniper Leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*), a vulnerable species listed on the TSC Act was recorded in the Study Area (Plate 4-1 and Plate 4-2). Approximately 500 individuals of Juniper Leaved Grevillea were recorded in the south-western corner of the Study Area near Lenore Lane (Figure 7). This large population of Juniper Leaved Grevillea consisted of mature plants with a significant juvenile recruitment. It is likely that there are a significantly larger number of seedlings. The population was recorded in an area mapped by NPWS (2002) as Cumberland Plain Woodland (EEC); however this vegetation appears to have been cleared as evidenced by a large number of timber stockpiles in the vicinity (Plate 4-1).

The Juniper Leaved Grevillea is a *broadly spreading to erect shrub to 2.5 m high. The leaves are prickly, narrow, often bright green, to 22 mm long and clustered along short lateral branches. Flowers are "spider-like", 2.5 - 3.5 cm long and may be red to pinkish, yellow, pale orange or greenish* (DECC 2008b).

The Juniper Leaved Grevillea grows *on clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels* (2008b). It is typically associated with canopy species of Cumberland Plain Woodland. Physical disturbance of

the soil appears to increase the establishment of this Grevillea with a tendency to colonize disturbed areas.

- **Plate 4-1 Juniper Leaved Grevillea growing amongst exotic pasture with timber stockpiles in the background**

- **Plate 4-2 Juniper Leaved Grevillea with scattered Broad-leaved Red Ironbark (*Eucalyptus fibrosa*) and soil disturbance in the foreground.**

While a local population of Juniper Leaved Grevillea has been previously identified in the EA (NECS 2008) and subsequently included in the Erskine Park Biodiversity Strategy and Biodiversity Management Plan (HLA 2005 and 2006), this large viable population has not been included nor afforded protection from subsequent development.

4.2.4. Targeted Searches for Spiked Rice-flower (*Pimelea spicata*)

Spiked Rice-flower *is a shrub to 50 cm tall that may be erect or somewhat prostrate in habit. The leaves are opposite and elliptical, to 20 mm long by 8 mm wide. The white, pink-tinged flowers are tubular, to 10 mm long, with four spreading petals. They may appear at any time of the year, but are mostly seen in summer* (DECC 2008b).

Targeted searches for Spiked Rice-flower were conducted during the flora and fauna survey in areas of suitable habitat in accordance with the Environmental Impact Assessment Guidelines for *Pimelea spicata* (NPWS 2004). Suitable habitat for Spiked Rice-flower includes Cumberland Plain Woodland vegetation and derived native grasslands. These habitats were limited to the northern end of the Subject Site, with the majority of the Subject Site being dominated by exotic pasture. A random meander search was conducted for approximately 2 hours in all areas of suitable habitat likely to be disturbed by the Proposal.

No Spiked Rice-flower were observed during the targeted survey.

4.2.5. Vegetation communities

Four vegetation communities are represented in the Study Area, namely:

- Cumberland Plain Woodland (EEC listed under the TSC Act and EPBC Act);
- River-flat Eucalypt Forest (EEC listed under the TSC Act);
- Farm dams and sedge swamps; and
- Exotic pasture.

A description of the biophysical and floristic characteristics of vegetation types associated with these communities is described below.

4.2.5.1. Cumberland Plain Woodland

This vegetation community would have once been the most widespread across the Study Area occurring on soils derived from Wianamatta Shale. Cumberland Plain Woodland was once widespread across western Sydney, with only 9 % of the original extent remaining intact (DECC 2008b). Historical clearing has reduced this vegetation community to isolated fragments in the north and south-west of the Study Area (Figure 8). Cumberland Plain Woodland typically grades into River-flat Eucalypt Forest (section 4.2.5.2) on the more fertile alluvial soils in the Study Area along Ropes Creek and its tributaries.

The canopy of this vegetation community is generally dominated by Grey Box (*Eucalyptus moluccana*) up to 15 m in height with foliage projected cover typically in the order of 10% or more, giving the vegetation its' characteristic woodland structure (Specht and Specht 2002). While some old-growth Grey Box were observed as isolated paddock trees, the majority were regrowth of approximately 20 years in age. The midstorey is typically open in structure and dominated by regenerating Grey Box.

Scattered individuals of Australian Boxthorn (*Bursaria spinosa*) were recorded in the shrub layer in the north of the Study Area.

A moderate diversity of native groundcover species were recorded overall across this vegetation community. Native herbs only accounted for up to 10 % cover, while the abundance of native grass appeared to be related to past soil disturbance with some areas having up to 40 % cover. Native herbs and grass groundcovers frequently recorded included Purple Wiregrass (*Aristida ramosa*), Common Woodruff (*Asperula conferta*), Wallaby Grass (*Austrodanthonia* spp.), Blue Trumpet (*Brunoniella australis*), Tall Windmill Grass (*Chloris ventricosa*), Kidney-weed (*Dichondra repens*), Star Cudweed (*Euchiton involucratus*), Wattle Mat-rush (*Lomandra filiformis* subsp. *filiformis*), Weeping Grass (*Microlaena stipoides*), Oxalis (*Oxalis perennans*) and Spreading Panicgrass (*Paspalidium distans*).

Exotic species typically accounted for up to 10 % of the foliage projected cover based on the level of disturbance such as clearing and rubbish dumping. Commonly recorded exotic species included Rhodes Grass (*Chloris gayana*), Couch (*Cynodon dactylon*), Paspalum (*Paspalum dilatatum*), Plantain (*Plantago lanceolata*) and Fireweed (*Senecio madagascariensis*).

This vegetation community generally conforms to Cumberland Plain Woodland as listed under the TSC Act and EPBC Act with up to 51% of the listed characteristic species (Dickman 1997). Cumberland Plain Woodland was recorded in a range of condition states in the Study Area, ranging from canopy species only (Low condition) with a highly modified understorey to relatively large patches of regrowth with moderate species diversity (Moderate-High condition) (Figure 8).

4.2.5.2. River-flat Eucalypt Forest

This vegetation community occurs on the fertile alluvial soils of the Study Area associated with Ropes Creek and its tributaries. Once widespread across the central and southern coasts of NSW, this vegetation community has been reduced to 30% of its original range (DECC 2008b). Historical clearing and grazing has reduced this vegetation community to relictual, structurally modified stands along Ropes Creek and its tributaries in the Study Area (Figure 8). River-flat Eucalypt Forest typically grades into Cumberland Plain Woodland (section 4.2.5.1) on the more undulating country on soils derived from Wianamatta Shale. River-flat Eucalypt Forest was sampled in Quadrat 4 and spot location B.

The canopy is generally dominated by Cabbage Gum (*Eucalyptus amplifolia*) up to 12 m in height, with Swamp-Oak (*Casuarina glauca*) and Rough-barked Apple (*Angophora floribunda*) being recorded along the banks of Ropes Creek. Foliage projected cover is typically in the order of 15% or more. The majority of the canopy in the River-flat forest consisted of regrowth eucalypts within several distinct age classes.

The midstorey consisted of Cabbage Gum, Flax-leaved Paperbark (*Melaleuca linariifolia*) and Prickly Paperbark (*Melaleuca styphelioides*) up to 6 m in height. Scattered individuals of Australian Boxthorn were recorded in the shrub layer.

A moderate diversity of native groundcover species were recorded given the current level of grazing disturbance in the riparian zones. Native herbs only accounted for up to 1 % cover, while the abundance of native grass was reduced apparently by grazing with up to 15 % cover. Native herbs and grass groundcovers recorded included Purple Wiregrass, Common Woodruff, Headache Vine (*Clematis glycinoides*), Giant Sedge (*Cyperus exaltatus*), Shorthair Plumegrass (*Dichelachne micrantha*), Forest Hedgehog Grass (*Echinopogon ovatus*), Honey Reed (*Lomandra longifolia*),Weeping Grass, Water Pepper (*Persicaria hydropiper*), Whiteroot (*Pratia purpurascens*), Native Raspberry (*Rubus parvifolius*) and Water Ribbons (*Triglochin procerum*).

Exotic species typically accounted for up to 25 % of the foliage projected cover most likely due to t urban effects in riparian areas (such as increased nutrients in runoff) and on other disturbances such as clearing and grazing. Commonly recorded exotic species included Spiny Rush (*Juncus acutus*), Small-Leaved Privet (*Ligustrum sinense*), Slender Birdsfoot Trefoil (*Lotus angustissimus*), Curled Dock (Rumex crispus), African Daisy (*Senecio pterophorus*) and Blackberry Nightshade (Solanum nigrum).

This vegetation community generally conforms to River-flat Eucalypt Forest as listed under the TSC Act with up to 38% of the listed characteristic species (Adam 2004). River-flat Eucalypt forest was recorded in a range of condition states in the Study Area, ranging from canopy species only (Low condition) with a highly modified understorey to relatively large connected patches of regrowth with moderate species diversity (Moderate condition) (Figure 8)

4.2.5.3. Farm Dams and Sedge Swamps

Numerous farm dams were observed across the Study Area, some in excellent condition (Figure 8). The farm dams in the north of the Study Area mapped in 'High' condition had high floristic diversity with abundant emergent, submerged and floating macrophyte (aquatic) vegetation being recorded.

Macrophytes fringing the banks of the dams included Club-rush (*Bolboschoenus fluviatilis*), Juncus (*Juncus usitatus*), Stalked Brooklime (*Gratiola pedunculata*), Water Pepper and River Buttercup

(*Ranunculus inundatus*). Floating macrophytes included Water Primrose (*Ludwigia peploides* subsp. *montevidensis*) and Floating Pondweed (*Potamogeton tricarinatus*)with Tall Spike-rush (*Eleocharis sphacelata*), Water Ribbons and Broad-leaf Cumbungi (*Typha orientalis*) frequenting deeper water.

A number of swampy depressions were observed in the north of the Study Area (Figure 8) with drainage being directed away from the large quarry in the east. These sedge swamps were observed to be poorer condition than that of the farm dams with a number of invasive species such as Spiny Rush and Pampas Grass (*Cortaderia selloana*).

4.2.5.4. Exotic Pasture

Exotic pasture is the most abundant vegetation community across the Study Area. Exotic pasture was not mapped as part of this project but occurs predominantly in all grazed open areas which have been cleared of vegetation. This community was dominated by the exotic pasture grasses Quaking Grass (*Briza subaristata*), Prairie Grass (*Bromus catharticus*), Paspalum and Phalaris (*Phalaris aquatica*). Other exotic species recorded in the pasture include Fireweed and African Daisy. A number of hardy and opportunistic native species were recorded growing amongst the pasture including Common Woodruff, Native Geranium (*Geranium solanderi*) and Weeping Grass. This vegetation community is considered to be in low condition.

4.2.6. Noxious Weeds

Of the 40 exotic species recorded on the Subject Site, five have been declared noxious within the Hawkesbury River County Council which includes the Penrith and Blacktown LGAs (NSW DPI 2008). These species, their class and legal requirements are listed in Table 4-2.

Table 4-2 Noxious weeds recorded on the Subject Site.

Common Name	Species	Control Category	Sampling Location	Legal Requirements
Bridal Creeper	*Asparagus asparagoides*	5	Q2, Q3, A	The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with
Mother-of-Millions	*Bryophyllum delagoense*	3	A	The plant must be fully and continuously suppressed and destroyed and the plant may not be sold, propagated or knowingly distributed
Pampas Grass	*Cortaderia selloana*	3	A	The plant must be fully and continuously suppressed and destroyed
St Johns-wort	*Hypericum perforatum*	4	C	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority

Common Name	Species	Control Category	Sampling Location	Legal Requirements
Small-Leaved Privet	*Ligustrum sinense*	4	B	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority and the plant may not be sold, propagated or knowingly distributed

5. Fauna Assessment

5.1. Methods

A site survey and assessment of the Proposal was conducted on the 8th of October 2008. The survey focussed on assessing the habitat value of areas potentially impacted by the Proposal, and included consideration of the extent and quality of native vegetation, the number and type of hollows and habitat trees, disturbance history, and the type and condition of waterbodies. A particular focus of the survey was to assess the potential usefulness of the site to fauna species listed on Schedules 1 and 2 of the TSC Act, and the federal EPBC Act, that were considered likely to occur in the type of vegetative habitat present at the Subject Site, as identified in Section 3.5. The likelihood of any 'key threatening processes' occurring at the Subject Site was also assessed.

A standardised proforma was used to record habitat attributes at the sites for fauna. Seven discrete assessments were undertaken, covering all accessible sections of the proposed road route. The presence of all fauna species encountered (either heard or seen) was noted, as were any signs of fauna (such as scratches in trees, diggings, scats, footprints, etc).

Weather conditions during the survey were warm and mild, with part cloud cover and no rainfall.

5.2. Results

5.2.1. Habitat Assessment

Several different habitat types occur at the site including Cumberland Plain Woodland (EEC), pasture with isolated paddock trees, Ropes Creek and associated riparian zone (River-flat Eucalypt Forest), several farm dams and sedge swamps in drainage lines.

5.2.1.1. Woodland

Woodland habitats throughout the Study Area are in good condition, despite being disturbed by agriculture and recreational use (Plate 5-1). Specific patches in the path of the proposed link road offer foraging, refuge and breeding habitat for a range of fauna, including the endangered Cumberland Land Snail (*Meridolum corniovirens*) (Appendix B). Habitat features present include:

- *Abundant hollows* - which provide breeding and refuge habitat for birds, arboreal mammals, insectivorous bats, reptiles and amphibians;
- *Fallen logs, leaf litter and large rubbish items* - which provide foraging and refuge habitat for small mammals, reptiles, amphibians and invertebrates, and
- *Flowering trees and shrubs* - which provide foraging, refuge and breeding habitat for birds, mammals and invertebrates.

Several bird species were observed nesting in hollows and constructed nests in woodland (Table 5-1). Cumberland Land Snails were also detected in woodland immediately adjacent to the M4 Motorway in the north of the Subject Site (Figure 7). Other signs of fauna occupation and use were also common, such as possum scratches in tree bark, and small mammal 'tunnels' in long grass.

Table 5-1 Bird species observed nesting in woodland trees at the Subject Site.

Common Name	Scientific Name
Galah	*Cacatua roseicapilla*
Magpie Lark	*Grallina cyanoleuca*
Rainbow Lorikeet	*Trichoglossus haematodus*
Magpie	*Ghymnorhina tibicen*
Indian Mynah	*Acridotheres tristis*

Plate 5-1 Woodland habitat adjacent to the M4 Motorway in the north of the Study Area.

The presence of abundant and high quality farm dams and swampy drainage lines either in woodland patches or adjacent to them further enhances the habitat value of woodland at the Subject Site. The presence of water provides a foraging resource for many fauna, breeding habitat for frogs, and permanent habitat for freshwater invertebrates. The complement of woodland and waterbody

habitats is especially valuable to frogs, which use fallen logs, leaf litter and trees in the woodland for refuge and foraging, and the waterbody for breeding.

Disturbances to the Subject Site include grazing, illegal rubbish dumping and trail bike riding. There are no signs of recent high intensity fires in the woodland habitats at the Subject Site. Several well-used dirt roads traverse the Study Area, and although the area is fenced, this has been compromised affording easy access for both two and four-wheel drive vehicles.

5.2.1.2. Pasture and Isolated Paddock Trees

Much of the Study Area is cleared and grazed exotic pasture, with isolated paddock trees (Plate 5-2). Although these areas have limited conservation value they do provide some habitat resources to native fauna. Isolated paddock trees are known to provide foraging, breeding and refuge habitat for insectivorous bats and birds, and may support a high diversity of invertebrates (Gibbons & Boak 2000). These trees also contribute to the viability of wildlife populations in agricultural and peri-urban landscapes by maintaining connectivity between larger patches of woodland and forest.

- **Plate 5-2 Pasture and isolated paddock tree habitat at the site.**

5.2.1.3. Ropes Creek and Associated Riparian Zone

Ropes Creek is a first order stream that joins South Creek in Llandilo, and eventually the Nepean River at Windsor. The Proposal crosses Ropes Creek in the south-east of the Subject Site, in an area already cleared of riparian vegetation for a high voltage powerline easement (Plate 5-3). The Proposal would require further clearing of the riparian zone on both sides of the creek.

The creek is approximately 0-5 m wide in the vicinity of the proposed crossing, with steep banks and a riparian zone width of approximately 10 m. The creek was shallow, but flowing at the time of the survey (October 2008). However, upstream of the proposed crossing site flow had ceased, forming isolated pools within the creek channel. It was apparent from the depth of the banks, and presence of debris well above the watermark, that Ropes Creek experiences variability in flow depending on rainfall in the catchment. Littoral and fringing vegetation included native species such as Honey Reed (*Lomandra longifolia*), Juncus (*Juncus* sp.), Swamp Oak and Rough-barked Apple (Plate 5-4).

- **Plate 5-3 Ropes Creek and associated riparian zone at the proposed crossing point for the link road.**

The riparian zone and instream habitats were disturbed as evidenced by the presence of invasive species such as Small-leaved Privet and the Plague Minnow (*Gambusia holbrooki*), rubbish items instream, and the narrowness of the riparian zone. However, the riparian zone supported the most structurally diverse, dense and connected vegetation in the Study Area.

The Proposal will also affect a tributary of Ropes Creek at the north-south extension of Archbold Road below the M4 Motorway. The condition of the stream and riparian zone here is largely synonymous with that at Ropes Creek. The main exceptions are that the riparian zone is narrower, and the stream size smaller.

- **Plate 5-4 Fringing vegetation in Ropes Creek at the proposed link road crossing site.**

5.2.1.4. Other Aquatic Habitats – Farm Dams and Sedge swamps

Aquatic habitats at the Subject Site consist of both constructed dams and sedge swamps. The farm dams are generally in excellent condition, with species rich and abundant emergent, submerged and floating macrophyte vegetation, and an apparent absence of Plague Minnows (Plate 5-5 & Plate 5-6). These areas provide permanent habitat for macroinvertebrates, breeding habitat for frogs, and foraging habitat for several different fauna. The sedge swamps are characterised by dense growth of reeds, sedges and rushes. These areas provide an ephemeral water resource that would fill during rain events and gradually dry in-between rainfall events. Frogs in particular rely on high quality ephemeral habitats for breeding and as refuge year round.

Although there are several farms dams scattered throughout the Study Area, those considered likely to be directly damaged or removed as a consequence of the Proposal occur adjacent to the north-south aligned section of the proposed link road (Figure 8). The proposed link road will also directly

impact on two sedge swamp habitats in the same vicinity (Figure 8, Plate 5-7). Each constitutes an important resource which contributes to the viability of fauna in the locality.

- **Plate 5-5 Dam habitat in woodland adjacent to the M4 Motorway on the western side of the proposed link road.**

- **Plate 5-6 Dam habitat woodland adjacent to the M4 Motorway on the eastern side of the proposed link road.**

- **Plate 5-7 Ephemeral sedge swamp habitat adjoining the proposed link road.**

5.2.2. Habitat Trees

Habitat trees contain hollows used by forest fauna. Vertebrate and invertebrate species use hollows as diurnal or nocturnal shelter sites, for rearing young, feeding, thermoregulation and to facilitate ranging behaviour and dispersal (Gibbons & Lindenmayer 2002). Approximately 400 Australian species potentially use hollows either on a permanent or opportunistic basis. Many threatened species are obligate users, requiring the presence of hollows to survive in the landscape (Gibbons & Lindenmayer 2002).

A hollow survey was conducted at the Subject Site to provide an assessment of the number of habitat trees present (Figure 7). A total of fifteen habitat trees were detected. Most of the hollows were small to medium sized occurring in branches, however there were several trunk hollows at the Subject Site. Hollows were most prevalent in stags, and mature trees at the site. Bird nests were also present in several of the trees.

Given approximately 8-12 habitat trees per hectare are required to maintain fauna at natural densities there is a paucity of habitat trees at the Subject Site (ARCS 1999).

5.2.3. SEPP 44 Koala Habitat

State Environment Planning Policy (SEPP) 44 – Koala Habitat Protection (SEPP 44) requires that any development proposal affecting one hectare or more of a property must be evaluated for potential and core Koala habitat. Potential Koala habitat is defined as *'areas of native vegetation where the trees listed in Schedule 2 (of SEPP 44) constitute at least 15% of the total number of trees in the upper and lower strata of the tree component'*. Should potential Koala habitat be found, further investigation for the existence of core Koala habitat should be undertaken. Core Koala habitat is defined as *'an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population'*. If such habitat is found, then a detailed Plan of Management should be prepared for the Koala colony in the area.

Koalas may use several different tree species as feed trees within their home ranges (Hindell & Lee 1991). Those eucalypt species frequently used by Koalas as feed trees are listed in Schedule 2 and provided in Table 5-2.

None of the listed Schedule 2 Koala feed tree species were found at the Subject Site, therefore no further investigation was undertaken.

Table 5-2 SEPP 44 Koala feed tree species.

Scientific Name	Common Name
Eucalyptus tereticornis	Forest Red Gum

Scientific Name	Common Name
Eucalyptus microcorys	Tallowwood
Eucalyptus punctata	Grey Gum
Eucalyptus viminalis	Ribbon or Manna Gum
Eucalyptus camaldulensis	River Red Gum
Eucalyptus haemastoma	Broad-leaved Scribbly Gum
Eucalyptus signata	Scribbly Gum
Eucalyptus albens	White Box
Eucalyptus populnea	Bimble Box or Poplar Box
Eucalyptus robusta	Swamp Mahogany

6. Assessment of Impacts

6.1. Impacts to Flora

The Proposal traverses four ecological communities. The estimated maximum clearing required in each vegetation community separated by vegetation condition (Table 4-1) have been calculated from GIS analysis and are presented in Table 6-1. The clearing required has been calculated from a 50 m wide easement (40 m road corridor plus 5 m disturbance on either side).

Table 6-1 Estimated clearing required in each ecological community by condition

Ecological Community	Vegetation Condition					Total Clearing by Vegetation Community
	Low	Low-Mod	Mod	Mod-High	High	
Cumberland Plain Woodland (EEC)	0.28 ha	1.5 ha	0.23 ha	0.36 ha	-	**2.37 ha**
River-flat Eucalypt Forest (EEC)	0.19 ha	-	0.41 ha	-	-	**0.6 ha**
Sedge Swamps	-	-	0.41 ha	-	-	**0.41 ha**
Farm Dams	-	-	0.03 ha	-	0.02 ha	**0.05 ha**
Juniper Leaved Grevillea habitat	-	-	-	-	1.7 ha	**1.7 ha**
Planted Vegetation	0.7 ha	-	-	-	-	**0.7 ha**

The calculations for clearing of Farm Dams and Sedge Swamps specified in Table 6-1 are not likely to adequately represent the true impact as these areas will be extensively damaged by road construction.

Assessments of Significance under s. 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) have been conducted for the TSC Act listed Cumberland Plain Woodland, River-flat Eucalypt Forest and Juniper Leaved Grevillea (Appendix C) and an Assessment of Impact using the *EPBC Act Policy Statement – Significant Impact Guidelines 1.1* (DEH 2006) has been undertaken for the EPBC Act listed EEC Cumberland Plain Woodland (Appendix D).

The clearing of Cumberland Plain Woodland and River-flat Eucalypt Forest required for the Proposal is not considered likely to constitute a significant flora impact given the current level of disturbance in these areas.

6.1.1. Impacts to the Juniper Leaved Grevillea

The Juniper Leaved Grevillea is endemic to Western Sydney with its population centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor with outlier populations at Kemps

Creek and Pitt Town (DECC 2008b). The Juniper Leaved Grevillea occurs entirely within the Hawkesbury/Nepean Catchment Management Authority region.

Only one small population (11 individuals) is adequately conserved in a known conservation area, namely Castlereagh Nature Reserve (NPWS 2002c). Most population of Juniper Leaved Grevillea are found in disturbed sites, responding to soil disturbance and fire (NPWS 2002c). Large populations (of between 500 and 1000 individuals) have been previously recorded from Erskine Park and Mt Druitt (NPWS 2002c).

According to the BioBanking Threatened Species Profile Database which has been recently developed by the DECC (DECC 2008c), the number of Juniper Leaved Grevillea which may be cleared from a development site and still considered a negligible loss is only 5 individuals. While this database has only been recently developed, the negligible loss criteria for each species have been determined by threatened species experts.

The large population identified in the current study is in the centre of the Juniper Leaved Grevillea distribution, consists of a large number of mature and immature individuals as well as seedlings and is likely to be significant to the survival of the Juniper Leaved Grevillea in both the local and regional context.

The clearing of 1.7 ha of habitat for the Juniper Leaved Grevillea which includes the direct removal of approximately 286 individuals and a cumulative loss of the entire identified population through subdivision development is likely to constitute a significant impact. Recommendations to reduce the impact on this threatened species are provided in Section 7.1.7.

6.2. Fauna impacts

Much of the Study Area directly affected by the Proposal consists of exotic pasture with isolated paddock trees. However some removal of Cumberland Plain Woodland is required, with Ropes Creek and farm dam habitats also affected. The proposed link road will therefore reduce the size and condition of the remaining woodland patches and further fragment these areas, as well as reducing the number and quality of waterbodies available to fauna. Construction of a four lane road through agricultural land will contribute to urbanisation of the Study Area resulting in permanent, direct and indirect impacts on the quality of habitats available to native fauna. Direct impacts of the Proposal on fauna will include:

- *Habitat loss* – the consumption of land, and the consequent loss of natural habitat is inherent in road development. Where new roads intersect habitat, the areas occupied by the road itself, borrow pits and quarries is subtracted from the total habitat area available to flora and fauna (Tsunokawa & Hoban 1997).

- *Habitat fragmentation* – when a road cuts through an ecosystem, the sum of the two parts created by the cut is less than the initial whole, even when the habitat loss is ignored. By slicing through habitat, roads compromise ecosystem stability and health, thus making the whole more vulnerable to invasions and degradation (Tsunokawa & Hoban 1997).
- *Movement restrictions* – when a road intersects or blocks habitat, the result is either cessation of use of the area because animals are reluctant to cross the road, an increase in mortality because of collisions with vehicles, or a delay in migration. Some fauna may also be attracted to the road which often leads to accidental death (Tsunokawa & Hoban 1997).
- *Aquatic habitat loss and damage* – the effects of roads on aquatic habitats includes erosion from poorly constructed and rehabilitated sites leading to siltation, constriction of flows at water crossings, changed hydrological regimes and channelization (Tsunokawa & Hoban 1997).
- *Interruption of biogeochemical cycle* – Road development disrupts the flow of nutrients and materials in the ecosystem via alteration of flows of surface and groundwater, removal of biomass and relocation of topsoil (Tsunokawa & Hoban 1997). Also human activity can be a major source of nutrients which in aquatic habitats can raise turbidity and biological oxygen demand of the water to a point where some aquatic species cannot survive. In terrestrial habitats these changes can increase weed invasion (Hill *et al*. 2005).

Indirect impacts on fauna will include:

- *Altered remnant conditions* – may provide conditions more favourable to competitors or predators of native species. Native species will then suffer increased predation during breeding, juvenile and adult stages, or be out-competed for food, and breeding resources. Species often respond to this by changing their behaviour in an attempt to optimise their fitness in the new conditions (Hill *et al*. 2005).
- *Accessibility* – the presence of a road in the Study Area will increase accessibility for humans and thereby contribute to further ecosystem modification. The road will facilitate an increase in the number of people having access to the site for illegal rubbish dumping and unauthorised dirt bike riding, and fires (Tsunokawa & Hoban 1997).
- *Pollution and contamination* – the presence of motor vehicles introduces the potential for contamination of the soil, air and water adjacent to the road. Chronic contamination via bioaccumulation can become a serious problem for some animal species, especially those at the top of the food chain (Tsunokawa & Hoban 1997).
- *Transmission of disease* – roads are effective vectors for the spread of diseases, which can have marked impacts on animal populations. Carriers of disease can gain easy access to new areas along road corridors (Tsunokawa & Hoban 1997).

Although much of the Subject Site is cleared pasture and isolated paddock trees, the site supports several remnant patches of woodland in good condition with opportunities for regeneration if managed for conservation. Taken individually, these habitats have varying utility to native fauna from high value in the woodland to limited value in the open pasture. However, the overall value of the Subject Site to native fauna is enhanced by the complement of habitats present at the site. For example, many of the farm dams are in good condition and occur adjacent to woodland, thereby enhancing the habitat value of both the dam and the woodland.

The proposed link road will contribute to urbanisation of Cumberland Plain Woodland; the loss of important aquatic habitats for woodland fauna and the loss of habitat for threatened fauna species such as the Cumberland Land Snail.

Approximately four of the fifteen (27%) mature hollow bearing trees identified during the site survey will be removed as part of the Proposal.

Assessments of Significance under s. 5A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) have been conducted for the TSC Act listed fauna predicted to occur in the Study Are (Appendix C) and an Assessment of Impact using the *EPBC Act Policy Statement – Significant Impact Guidelines 1.1* (DEH 2006) has been undertaken for the EPBC Act listed fauna predicted to occur in the Study Area (Appendix D).

7. Conclusions and Recommendations

From the Flora and Fauna Impact Assessment it has been identified that the majority of the proposed Erskine Park Link Road Network occurs within predominantly cleared and grazed exotic pasture. There are however several areas of ecological significance that were identified, namely:

- Relatively diverse regrowth Cumberland Plain Woodland (state and nationally listed EEC) in the north of the Subject Site (Figure 8);
- River-flat Eucalypt Forest (state listed EEC) along Ropes Creek and its tributaries (Figure 8);
- A large population of Juniper Leaved Grevillea in the south-west near Lenore Lane (Figure 7);
- Populations of Cumberland Land Snail (listed as endangered on the TSC Act) identified in the Cumberland Plain Woodland in the north of the Subject Site (Figure 7); and
- Farm dams in high condition in the north of the Study Area (Figure 8).

Application of the TSC and EPBC Acts assessments of significance revealed that for all the threatened fauna species which may potentially occur on the Subject Site, the Proposal represented an acceptable level of threat to the viability of the local populations. In view of this, no further investigation would be required for fauna under the provisions of the EP&A Act, TSC Act and EPBC Act.

The clearing of 2.37 ha of Cumberland Plain Woodland and 0.6 ha of River-flat Eucalypt Forest required for the Proposal is not considered likely to constitute a significant flora impact given the current level of disturbance in these areas and the amount of remnant vegetation existing elsewhere in the Study Area. The large regrowth areas of Cumberland Plain Woodland and farm dams in the north of the Study Area outside of the Subject Site (Figure 8) should be retained and incorporated into any future development.

The clearing of 1.7 ha of habitat for the Juniper Leaved Grevillea which includes the direct removal of approximately 286 individuals and a cumulative loss of the entire identified population through subdivision development is likely to constitute a significant impact. Recommendations to reduce the impact on this threatened species are provided in Section 7.1.7.

7.1. Mitigation Measures

Management and mitigation measures to ensure direct and indirect impacts of the proposed link road are minimised include actions to avoid, ameliorate and compensate any affects on habitat for fauna at the subject site. Further recommendations include a translocation program for the Cumberland Land Snail to avoid unnecessary losses of individuals at the site.

7.1.1. Avoid Impacts

Wherever possible, construction should avoid important habitats at the Subject Site. This includes avoiding Cumberland Plain Woodland, habitat trees, and farm dams and sedgelands. It is accepted that the removal of some woodland and dams is inevitable, but the area removed should be as parsimonious as possible and unnecessary clearing and damage should be absolutely avoided. This includes removing only those trees directly in the path of the road and associated easement, and avoiding impacting on the root zone of trees marked for retention. Additionally stockpile, storage and depot sites should be on the approved work corridor and avoid tree and riparian cover.

Any tree-clearing activities should be conducted according to a Tree-clearing protocol and under the direction of a suitably qualified and experienced wildlife ecologist. Actions incorporated in the tree-clearing protocol should include conducting a pre-clearing survey just prior to tree-felling activities commencing to determine the occupancy of habitat trees by fauna. Hollows and nests occupied by fauna in the area will need to be either 'soft-felled' or retained until fauna abandon the tree.

The clearing area should also be clearly delineated via fencing to ensure no incremental and accidental incursions into the remaining habitats by equipment. Lastly, and likely most importantly, construction staff should be inducted and made aware of their environmental responsibilities, including the preservation of tree cover and riparian habitats.

7.1.2. Vegetation clearing protocols

Vegetation clearing protocols should be developed as part of the detailed design for the Erskine Park Link Road Network. These protocols should include the following objectives:

- Minimise clearing;
- Clearly fence all vegetation to be retained to prevent accidental incursions;
- Avoid impacts on waterways;
- Minimise impacts on Cumberland Plain Woodland (EEC) and River-flat Eucalypt Forest (EEC);
- Minimise impacts on the Juniper Leaved Grevillea;
- Minimise impacts on the Cumberland Land Snail;
- Minimise impacts on important fauna habitat;
- Retain mature trees as part of road landscaping wherever possible through the use of technology such as wire rope barriers; and
- Prevent weed spread.

7.1.3. Ameliorate Impacts

Ameliorating the impacts of habitat loss and clearing includes:

- The retention of important habitat features such as:
  - Fallen logs - Fallen logs encountered within the works corridor should be retained and scattered throughout the remaining woodland habitats at the site. This should be conducted using the most sensitive manner possible (i.e. not piled up in a heap at the edge of the road or shoved into the woodland with a bulldozer).
  - Timber felled for clearing should be retained on the ground as cover for terrestrial fauna.
- Using smaller, more manoeuvrable equipment to minimise the width of the disturbance corridor and protect trees and shrubs.
- Implementing a weed control program that safeguards against the establishment movement of invasive weeds at the subject site.

Enduring sediment control fencing is correctly installed and maintained to safeguard against the movement of sediment into adjacent aquatic and terrestrial habitats.

7.1.4. Compensate for Impacts

Compensating for the loss of habitat involves:

- Installing nestboxes in a 1:1 ratio for hollows lost during tree-clearing for the proposed link road. These should be a diversity of sizes and positioned at a variety of heights and aspects to ensure a diversity refuge and breeding opportunities are retained at the site. These can be installed as soon as the construction area is clearly defined and doesn't require further tree-clearing.
- Creating dams and sedgelands of a similar size in adjacent habitats to compensate for those lost during construction.
- Enhancing or rehabilitating existing habitats at the site to improve the overall habitat condition of the subject site. This could include extending the area of woodland using planting, reinstating boundary fencing such that people cannot enter the site, and controlling weeds.

7.1.5. Post-construction Rehabilitation

Prior to clearing vegetation, qualified native seed collectors should conduct a collection in the Study Area (particularly in areas to be cleared) to ensure an adequate supply of native shrub and grass seed is available to rehabilitate any areas disturbed during the construction phase of the Proposal. Native seed collection should be undertaken during the spring/summer period to maximise collection success for a larger range of native species.

Where required for rehabilitation purposes, seed should be sent to a reputable local nursery with expertise in the propagation of native plants. Critical areas which may be disturbed by construction such as drainage lines, creek lines and endangered ecological communities must be rehabilitated using plants of local provenance (collected within the region). Most critical areas will require rehabilitation using both propagated tube-stock and direct seeding. Rehabilitation should be part of any pre-planning works as there is considerable lead-up time (up to 6 months for growing native plants and 2 years for collecting native seed).

Other less critical areas disturbed by construction should be direct seeded or hand seeded with native trees, shrubs and groundcovers as part of the rehabilitation process.

7.1.6. Translocation of Cumberland Land Snails

Given the Cumberland Land Snail is small and relatively easy to find and collect, it may be possible to move them to a more secure site to avoid killing them during construction and operation of the link road. This would involve a conducting a thorough search of the impact area to collect as many individuals as possible prior to construction commencing, and moving them to a site supporting similar or better habitat for the species that is protected from development.

7.1.7. Specific Mitigation Measures for the Juniper Leaved Grevillea

Avoidance of the population should be the primary objective given the significance of the population in the local and regional context. Alternatives such as mitigation and offsetting should only be considered if there are no other feasible options.

To avoid impact on Juniper Leaved Grevillea, the approximately 0.7 km long southern road extension from the end of the existing Lenore Lane across the Sydney Water Supply Pipeline should be relocated to a less ecologically constrained location to the east. By replacing this section of the link road with an extension of the Erskine Park Biodiversity Corridor, the majority of the population (286 individuals) would be retained. Other individuals outside of the proposed link road in the approved subdivision area should be translocated into this area to enhance connectivity with the east-west corridor in the south. This area should then be conserved in line with the objectives of the Erskine Park Biodiversity Strategy. If the population cannot be avoided, then the following mitigation measures should be considered.

As the Juniper Leaved Grevillea is a shrub with a relatively shallow root system, translocation using a tree-spade (typically mounted on a truck or bobcat) into a designated conservation area may be undertaken as a mitigation measure, but success will depend on a number of factors such as planning, season (temperature stress), watering and maintenance.

If translocation is to be considered, a translocation program should be developed in accordance with the ANPC guidelines (ANPC 1997) and be supplemented with a plant propagation program. Translocation programs should not be considered lightly as they require detailed planning, commitment and long term monitoring.

Given the proximity of this population to the Erskine Park Biodiversity Corridor, translocated Juniper Leaved Grevillea should be relocated into the corridor to enhance its value.

Any impact on the Juniper Leaved Grevillea that cannot be mitigated through translocation should be considered in the development of a biodiversity offset strategy.

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Appendix A Flora Survey Data

Flora survey data - Erskine Park Link Road Network

Note:

1. Families are group under the headings 1. Pteridophytes, 2. Gymnosperms, 3. Dicotyledons, 4. Monocotyledons

2. An '*' before species indicates exotic species, # indicates non-local native

3. A sample flora assemblage obtained from a short term survey, such as the present one, cannot be considered to be comprehensive, but rather indicative of the actual flora assemblage. It can take many years of flora surveys to record all of the plant species occurring within any area, especially species that are only apparent in some seasons (for example orchids).

4. Not all species can be accurately identified in a 'snapshot' survey due to absence of flowering or fruiting material.

Family	Species	Common name	Q1	Q2	Q3	A	B	C	D	Pasture	Traverse
1. Pteridophytes											
Sinopteridaceae	*Cheilanthes sieberi* subsp. *sieberi*	Rock Fern		X							
3. Dicotyledons											
Acanthaceae	*Brunoniella australis*	Blue Trumpet, Blue Yam	X			X					
Amaranthaceae	*Alternanthera denticulata*	Common Joyweed							X		
Apiaceae	*Daucus glochidiatus*	Native Carrot		X	X	X					
	Centella asiatica	Pennywort		X							
Asclepiadaceae	*Araujia sericifera*	Moth Vine, Cruel Plant					X	X			
	Gomphocarpus fruticosus	Narrow-leaved Cotton Bush		X		X		X			
Asteraceae	*Sonchus oleraceus*	Common Sow-thistle, Milk-thistle		X							
	Taraxacum officinale	Dandelion		X	X						
	Cirsium vulgare	Black Thistle, Spear Thistle		X	X				X	X	
	Vernonia cinerea			X							
	Senecio madagascariensis	Fireweed, Madagascar Ragwort	X		X	X				X	
	Bidens pilosa	Farmer's Friend, Cobblers Pegs	X								
	Hypochaeris radicata	Catsear, False Dandelion			X						
	Senecio pterophorus	African Daisy		X	X				X	X	
	Euchiton involucratus	Star Cudweed	X	X	X	X					
	Vittadinia pustulata			X					X		
	Senecio quadridentatus	Cotton Fireweed				X			X		
	Conyza sumatrensis	Tall Fleabane				X			X		
	Lactuca serriola	Prickly Lettuce, Compass Plant		X		X					
	Lagenophora gracilis			X							
Brassicaceae	*Lepidium bonariense*	Cut-leaf Peppercress			X						
Campanulaceae	*Wahlenbergia gracilis*	Sprawling Bluebell		X	X				X		
Casuarinaceae	*Casuarina glauca*	Swamp Oak, Swamp She-oak					X	X			
	Allocasuarina littoralis	Black She-Oak						X			
Chenopodiaceae	*Einadia nutans*	Climbing Saltbush			X				X		
	Einadia hastata	Berry Saltbush			X						
Clusiaceae	*Hypericum perforatum*	St Johns-wort						X			
Convolvulaceae	*Dichondra repens*	Kidney-weed, Mercury Bay Weed	X	X	X						
Crassulaceae	*Bryophyllum delagoense*	Mother-of-Millions				X					

Family	Species	Common name	Q1	Q2	Q3	A	B	C	D	Pasture	Traverse
Fabaceae Faboideae	*Dillwynia sieberi*										X
	Lotus angustissimus	Slender Birdsfoot Trefoil			X	X			X		
	Glycine clandestina	Twining Glycine	X								
	Vicia sativa					X					
	Hardenbergia violacea	False Sarsaparilla						X			
	Trifolium repens	White Clover						X			
	Glycine tabacina			X	X						
	Bossiaea prostrata			X							
Fabaceae Mimosoideae	*Acacia rubida*	Red-stemmed Wattle						X			
	Acacia fimbriata	Fringed Wattle						X			
	Acacia elongata	Swamp Wattle				X					
	Acacia implexa	Hickory Wattle						X			
	Acacia parramattensis	Parramatta Wattle					X				
Geraniaceae	*Geranium solanderi*	Native Geranium								X	
Lobeliaceae	*Pratia purpurascens*	Whiteroot					X				
Malvaceae	*Sida rhombifolia*	Paddy's Lucerne		X	X						
Myrtaceae	*Eucalyptus* sp.	Unidentified Eucalypt						X			
	Corymbia maculata	Spotted Gum				X					
	Melaleuca styphelioides	Prickly Paperbark			X		X	X			
	Corymbia citriodora	Lemon-scented Gum									X
	Angophora floribunda	Rough-barked Apple					X				
	Melaleuca nodosa	Ball Honey-myrtle									X
	Eucalyptus fibrosa	Broad-leaved Red Ironbark									X
	Callistemon pinifolius	Pine-leaved Bottlebrush									X
	Eucalyptus tereticornis	Forest Red Gum									X
	Eucalyptus moluccana	Grey Box	X	X		X					X
	Melaleuca linariifolia	Flax-leaved Paperbark			X						
	Eucalyptus amplifolia	Cabbage Gum			X						X
Oleaceae	*Olea europaea* subsp. *cuspidata*	African Olive								X	X
	Ligustrum sinense	Small-Leaved Privet, Chinese Privet					X				
Onagraceae	*Ludwigia peploides* subsp. *montevidensis*	Water Primrose							X		
Oxalidaceae	*Oxalis perennans*	Oxalis	X	X	X						
Pittosporaceae	*Bursaria spinosa*	Australian Boxthorn	X		X		X				
Plantaginaceae	*Plantago gaudichaudii*		X								
	Plantago lanceolata	Plantain, Ribwort		X	X		X	X		X	
	Plantago debilis			X							
Polygonaceae	*Persicaria hydropiper*	Water Pepper					X		X		
	Rumex crispus	Curled Dock					X				
Primulaceae	*Anagallis arvensis*	Pimpernel				X					
Proteaceae	*Grevillea rosmarinifolia*	Rosemary Grevillea						X			
	Grevillea juniperina subsp. *juniperina*										X

Family	Species	Common name	Q1	Q2	Q3	A	B	C	D	Pasture	Traverse
Ranunculaceae	*Clematis glycinoides*	Headache Vine, Traveller's Joy					X				
	Ranunculus inundatus	River Buttercup							X		
Rosaceae	*Rubus parvifolius*	Native Raspberry					X				
	Rosa sp.	Unidentified		X			X				
	Rubus sp.	Blackberry						X			
Rubiaceae	*Asperula conferta*	Common Woodruff	X	X			X			X	
	Richardia stellaris	Field Madder		X							
Scrophulariaceae	*Veronica plebeia*	Creeping Speedwell			X						
	Gratiola pedunculata	Stalked Brooklime							X		
Solanaceae	*Solanum nigrum*	Blackberry Nightshade		X	X		X				
	Solanum prinophyllum	Forest Nightshade			X						
Thymelaeaceae	*Pimelea curviflora* var. *subglabrata*		X								
Verbenaceae	*Verbena bonariensis*	Purpletop			X			X		X	
4. Monocotyledons											
Anthericaceae	*Tricoryne elatior*	Yellow Rush Lily		X							
	Arthropodium milleflorum	Vanilla Lily	X								
Asparagaceae	*Asparagus asparagoides*	Bridal Creeper		X	X	X					
Cyperaceae	*Cyperus exaltatus*	Giant Sedge, Tall Flat-sedge					X				
	Bolboschoenus fluviatilis	Club-rush							X		
	Carex appressa	Tall Sedge			X						
	Fimbristylis dichotoma			X							
	Eleocharis sphacelata	Tall Spike-rush							X		
	Cyperus gracilis	Slender Sedge	X		X						
	Cyperus sp.		X								
Juncaceae	*Juncus acutus*	Spiny Rush					X				
	Juncus usitatus								X		
Juncaginaceae	*Triglochin procerum*	Water Ribbons					X		X		
Lemnaceae	*Spirodela* sp.	Duckweed					X				
Lomandraceae	*Lomandra longifolia*	Honey Reed, Spike Mat-rush					X	X			
	Lomandra filiformis subsp. *filiformis*	Wattle Mat-rush	X	X	X						
	Lomandra multiflora	Many-flowered Mat-rush				X					
Phormiaceae	*Dianella revoluta*	Blue Flax-lily, Spreading Flax-lily							X		
Poaceae	*Themeda australis*	Kangaroo Grass	X			X					
	Microlaena stipoides	Meadow Rice-grass, Weeping Grass	X	X	X	X				X	
	Echinopogon ovatus	Forest Hedgehog Grass			X						
	Paspalidium distans	Spreading Panicgrass	X	X	X						
	Paspalum dilatatum	Paspalum	X	X						X	
	Cynodon dactylon	Couch, Bermuda Grass	X	X	X	X			X		
	Chloris ventricosa	Tall Windmill Grass	X	X	X						
	Setaria gracilis	Slender Pigeon Grass	X		X						
	Ehrharta erecta	Panic Veldgrass	X								

Family	Species	Common name	Q1	Q2	Q3	A	B	C	D	Pasture	Traverse
	Aristida ramosa	Purple Wiregrass	X	X	X						
	Eragrostis leptostachya	Paddock Lovegrass			X						
	Eragrostis curvula	African Lovegrass			X	X					
	Bromus catharticus	Prairie Grass					X			X	
	Lolium perenne	Perennial Ryegrass							X		
	Phalaris aquatica	Phalaris								X	
	Briza subaristata	Quaking Grass				X				X	
	Aristida vagans	Threeawn Speargrass	X								
	Cortaderia selloana	Pampas Grass				X					
	Chloris gayana	Rhodes Grass		X		X		X	X		
	Austrodanthonia racemosa	Wallaby Grass		X	X						
	Dichelachne micrantha	Shorthair Plumegrass		X	X						
	Paspalidium criniforme			X							
	Austrodanthonia monticola	Wallaby Grass	X						X		
Potamogetonaceae	*Potamogeton tricarinatus*	Floating Pondweed							X		
Typhaceae	*Typha orientalis*	Broad-leaf Cumbungi, Bulrush							X		

Appendix B Photographic Record

	
Q1	Q2
	
Q3	A
	
B	D

	
Cumberland Land Snail shells	Cumberland Land Snail under sheet metal
	
Juniper Leaved Grevillea – green flowered form	Juniper Leaved Grevillea – red flowered form

Appendix C Assessment of Significance (Part 5a EP&A Act)

The EP&A Act aims to control development in the context of environmental protection and is of the highest priority in New South Wales planning legislation. It ensures that consent authorities duly consider environmental concerns in the decision-making process. The Act aims to encourage:

- The proper management, development and conservation natural and human-made resources, including natural areas, for the purpose of promoting the social and economic welfare of the community and a better environment;
- The promotion and coordination of the orderly and economic use and development of land;
- The protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities and their habitats.

The EP&A Act was amended by the TSC Act. The aim of the TSC Act is to conserve threatened species, endangered populations and communities through consideration of the potential impacts on these through the development assessment process. Determining authorities have an obligation under the EP&A Act to consider whether a proposal is likely to significantly affect threatened species, population or ecological communities, or their habitats. In this regard, the determining authority must take into account the 'seven-part test' or assessment of significance.

A review of the threatened species detected within the Study Area revealed several could occur in or could be found in similar habitat in the immediate region. An assessment of significance was applied to threatened flora and fauna species and endangered ecological communities listed in Table 8-1.

- **Table 8-1 Assessment of Significance**

Common Name	Species
Threatened Flora	
Juniper Leaved Grevillea	*Grevillea juniperina* subsp. *juniperina*
Endangered Ecological Communities	
Cumberland Plain Woodland	
River-flat Eucalypt Forest	
Threatened Fauna	
Cumberland Land Snail	*Meridolum corneovirens*
Green and Golden Bell Frog	*Litoria aurea*
Grey-headed Flying-fox	*Pteropus poliocephalus*

Common Name	Species
Bush Stone-curlew	*Burhinus grallarius*
Hooded Robin	*Melanodryas cucullata cucullata*
Black-chinned Honeyeater	*Melithreptus gularis gularis*
Speckled Warbler	*Pyrrholaemus saggitatus*
Diamond Firetail	*Stagonopleura guttata*
Australian Painted Snipe	*Rostratula australis*
Hollow-Roosting Microchiropteran Bats	
Greater Broad-nosed Bat	*Scoteanax rueppellii*
Eastern Freetail-bat	*Mormopterus norfolkensis*
Yellow-bellied Sheath-tailed Bat	*Saccolaimus flaviventris*
Cave-Roosting Microchiropteran Bats	
Eastern Bentwing-bat	*Miniopterus schriebersii oceanensis*
Southern Myotis	*Myotis macropus*
Migratory Birds	
Great Egret	*Ardea alba*
Cattle Egret	*Ardea ibis*
Fork-tailed Swift	*Apus pacificus*
Latham's Snipe	*Gallinago hardwicki*
White-throated Needletail	*Hirundapus caudacutus*
Swift Parrot	*Lathamus discolor*
Rainbow Bee-eater	*Merops ornatus*
Painted Snipe	*Rostratula benghalensis*
Regent Honeyeater	*Xanthomyza phrygia*

C.1 Threatened Flora

The following questions (from the seven-part test) relate only to ecological communities and endangered populations, so they have been removed from this assessment.

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

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

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

Juniper Leaved Grevillea (*Grevillea juniperina* subsp. *juniperina*)

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

The Juniper Leaved Grevillea is reported to be pollinated by birds, however bees have also been observed pollinating flowers (DECC 2008b). The large abundance of Juniper Leaved Grevillea's on the Subject Site is likely to provide valuable foraging habitat for a number of native birds. The life cycle of the Juniper Leaved Grevillea appears to be influenced by fire with mature plants dying and a sudden increase in the recruitment of seedlings post fire (DECC 2008b). Fire frequency is likely to be a significant factor in the long term survival of populations with recruitment of individuals only occurring from the soil seed bank post fire (DECC 2008b).

The proposed action is likely to affect the life cycle of the Juniper Leaved Grevillea by greatly reducing the size of the population and available habitat.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposed action is likely to remove approximately 1.7 ha of Juniper Leaved Grevillea habitat which includes the direct removal of approximately 286 individuals.

This equates to direct removal of 27 % of the mapped habitat of Juniper Leaved Grevillea (Figure 8) and direct removal of over 57 % of the total population (out of 500 individuals recorded).

The remainder of the population is likely to be further modified or removed as a result of surrounding industrial development which is not subject of this assessment.

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

The proposed action will directly fragment and isolate Juniper Leaved Grevillea habitats through the construction of the link road through the middle of this important population.

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

The Juniper Leaved Grevillea is endemic to Western Sydney, centred on an area bounded by Blacktown, Erskine Park, Londonderry and Windsor (DECC 2008b). The population of Juniper Leaved Grevillea at the Subject Site is a large (500 individuals), healthy population as evidenced by mature and juvenile individuals which is likely to have established after soil disturbance in the area (clearing of woodland).

The loss of habitat resulting from the proposed action will contribute to further isolating, fragmenting and removing habitat important to the survival of the species in the locality.

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

No critical habitat for the Juniper Leaved Grevillea has been declared by the Scientific Committee, however the Juniper Leaved Grevillea is endemic to Western Sydney and only occurs in four vegetation communities, namely Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forest (DECC 2008b).

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

No specific recovery plans or threat abatement plans are relevant to this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation leading to weed invasion (including exotic perennial grasses), and a reduction in native ground cover;
- Increased disturbance leading to an increase in exotic vines and scramblers; and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

Conclusion:

The proposed action will result in the direct removal and modification of a 1.7 ha of Juniper Leaved Grevillea habitat which includes the direct removal of approximately 286 individuals. The potential impacts to this species as a result of the Proposal are considered likely to constitute a 'significant impact' in terms of Part 5a Assessment of Significance.

C.2 Endangered Ecological Communities

The following Assessment of Significance for Cumberland Plain Woodland and River-flat Eucalypt Forest describes the nature and severity of any potential impacts arising during construction and operation of the proposed Gunning Wind Farm Transmission Line.

The following questions (from the seven-part test) relate only to species and endangered populations, so they have been removed from this assessment.

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

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

Cumberland Plain Woodland

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

The proposed action requires the direct removal of 2.37 ha of Cumberland Plain Woodland. This constitutes a removal of 0.4% of the total Cumberland Plain Woodland within the Study Area. The majority of the Cumberland Plain Woodland to be removed is in low-moderate condition (Table 6-1). The proposed action is not likely to place the local occurrence of Cumberland Plain Woodland at risk of extinction.

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

The proposed action is not likely to substantially and adversely modify the composition of the Cumberland Plain Woodland such that its local occurrence is likely to be placed at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposed action requires the direct removal of 2.37 ha of Cumberland Plain Woodland. This constitutes a removal of 0.4 % of the total Cumberland Plain Woodland within the Study Area. The majority of the Cumberland Plain Woodland to be removed is in low-moderate condition (Table 6-1).

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

Minimal clearing is required through the areas of higher quality Cumberland Plain Woodland vegetation in the north of the Subject Site due to an existing road (Archbold Road), however widening will be required to accommodate the four lane carriageway which may exacerbate the fragmentation of existing remnants.

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

Cumberland Plain Woodland was once widespread across western Sydney, with only 9 % of the original extent remaining intact (DECC 2008b) with an additional 13% present as degraded patches of varying sizes within the landscape (Hill *et al*. 2005). All remaining remnants of Cumberland Plain Woodland are of conservation significance in the regional context given this vast reduction in original extent.

The proposal requires the direct removal of 0.4 % of Cumberland Plain Woodland from the Study Area which is of reasonable importance to the long-term survival of Cumberland Plain Woodland in the locality.

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

No critical habitat for Cumberland Plain Woodland has been declared by the Scientific Committee, however Cumberland Plain Woodland is endemic to Western Sydney and only occurs on soils derived from Wianamatta shale.

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

No specific recovery plans or threat abatement plans have been prepared for Cumberland Plain Woodland.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation leading to weed invasion (including exotic perennial grasses), and a reduction in native ground cover;
- Increased disturbance leading to an increase in exotic vines and scramblers; and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

Conclusion:

The proposed action requires the direct removal of approximately 2.37 ha of Cumberland Plain Woodland from the Subject Site which equates to the removal of 0.4 % of the Cumberland Plain Woodland within the Study Area.

Provided the large remnant areas of Cumberland Plain Woodland adjoining the Subject Site in the north of the Study Area (Figure 8) are retained, the Proposal is not considered likely to constitute a significant impact.

River-flat Eucalypt Forest

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

The proposed action requires the direct removal of 0.6 ha of River-flat Eucalypt Forest. This constitutes the removal of 0.3% of the total River-flat Eucalypt Forest within the Study Area. The River-flat Eucalypt Forest to be removed is in low-moderate condition (Table 6-1). As the Proposal has been designed to cross Ropes Creek in an existing transmission line easement to minimise clearing, the proposed action is not likely to place the local occurrence of River-flat Eucalypt Forest at risk of extinction.

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

The proposed action is not likely to substantially and adversely modify the composition of the River-flat Eucalypt Forest such that its local occurrence is likely to be placed at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposed action requires the direct removal of 0.6 ha of River-flat Eucalypt Forest. This constitutes the removal of 0.3% of the total River-flat Eucalypt Forest within the Study Area. The River-flat Eucalypt Forest to be removed is in low-moderate condition (Table 6-1).

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

The proposed action is likely to further fragment areas of River-flat Eucalypt Forest, particularly as the proposal requires the construction of a road network across Ropes Creek which will prevent the re-establishment of woody vegetation in this area. Construction of a bridge across Ropes Creek will nevertheless allow low-growing vegetation (such as herbs, grasses, sedges and shrubs) to establish and maintain fauna connectivity.

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

Once widespread across the central and southern coasts of NSW, this vegetation community has been reduced to 30% of its original range (DECC 2008b). Given the effects that clearing and grazing have had on this community and the ecosystem services riparian vegetation provides (such as nutrient filtering and soil stabilisation); all River-flat Eucalypt Forest is of conservation significance.

The proposal requires the direct removal of 0.3 % of River-flat Eucalypt Forest from the Study Area which is of moderate importance to the long-term survival of River-flat Eucalypt Forest in the locality.

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

No critical habitat for River-flat Eucalypt Forest has been declared by the Scientific Committee, however River-flat Eucalypt Forest only occurs on the coastal floodplains of NSW which have been extensively cleared for agriculture, farming and urban development.

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

No specific recovery plans or threat abatement plans have been prepared for River-flat Eucalypt Forest.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation leading to weed invasion (including exotic perennial grasses), and a reduction in native ground cover;
- Increased disturbance leading to an increase in exotic vines and scramblers; and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

Conclusion:

The proposed action requires the direct removal of approximately 0.6 ha of Cumberland River-flat Eucalypt Forest from the Subject Site which equates to the removal of 0.3 % of the River-flat Eucalypt Forest within the Study Area.

Provided Ropes Creek is adequately revegetated using local native species post construction, the Proposal is not considered likely to constitute a significant impact.

C.3 Threatened Fauna

The following seven-part tests describe the nature and severity of any potential impacts arising during construction and operation of the proposed development on those threatened fauna species considered likely to occur in the type of habitat represented both at and in the locality of the Subject Site.

Groups of species with similar ecological and habitat requirements or life-cycle patterns can be assessed within a single seven-part test. Hence a combined assessment has been prepared for migratory birds, threatened microbats that roost largely in caves and those that roost largely in trees.

The following questions (from the seven-part test) relate only to ecological communities and endangered populations, so they have been removed.

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

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

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

Cumberland Land Snail (*Meridolum corneovirens*)

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

Very little of the biology and ecology of the Cumberland Land Snail is understood. The species is a fungus specialist that primarily occupies Cumberland Plain Woodland in western Sydney, living under bark, leaf litter, leaves and logs, and occasionally rubbish items (DECC 2008a). No further details regarding its biology, including breeding biology, is known. It is therefore very difficult to determine whether the proposed action is likely to have an adverse effect on the life cycle of the species. If it is assumed the Snails don't move very far daily, seasonally or annually (and therefore

cannot escape), the removal of woodland for the proposed link road will constitute habitat loss for the species and cause the loss of individuals from the local population. Both the capacity of the woodland to support Cumberland Land Snails and the genetic diversity of the local population will be reduced.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposed action will result in the removal of 2.7 ha of Cumberland Plain Woodland, and modification of the remaining areas (owing to edge effects, reduced patch size and an increase in disturbance).

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

The proposed action will further fragment and isolate Cumberland Land Snail habitats.

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

Given the Cumberland Land Snail only occurs in a small area on the Cumberland Plain in western Sydney, and its primary habitat is Cumberland Plain Woodland, and clearing and degradation of Cumberland Plain Woodland remnants is a recognised threat to this species, it is critically important that all habitats are protected. The loss of habitat resulting from the proposed action will contribute to further isolating, fragmenting and removing habitat important to the survival of the species in the locality.

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

No critical habitat for the Cumberland Land Snail has been declared by the Scientific Committee.

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

No specific recovery plans or threat abatement plans are relevant to this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation leading to weed invasion, and a reduction in native ground cover, and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

Hollow-Roosting Microchiropteran Bats

- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*)

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

Although the three species listed above are quite different in their size, breeding biology and foraging habits, all occur in woodland habitats and roost primarily in tree hollows and under loose bark on trees (Churchill 1998). Hence their forest habitats provide for their daily and seasonal foraging, roosting and breeding requirements. Consequently each of these threatened species is reliant on a sufficient area of their preferred forest habitats to persist in the landscape.

The proposed action will cause the removal of potential foraging and roosting habitats for these species, and cause the area to become further disturbed, but it is unlikely to have an adverse effect on the life cycle of these species such that the viability of their local populations is compromised.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will result in the removal of approximately 3 ha of vegetation from the edges of two patches of woodland and riparian zone at the Subject Site. However, although the vegetation to be removed is mostly within vegetation described as 'edge-affected', such clearing will likely result in

the modification of vegetation in these patches, which will become the forest edge. Edge-affected areas are more susceptible to disturbance such as weed invasion and therefore vegetation removal on the Subject Site will result in a slightly larger area of habitat being modified in the longer term. Some tree hollows (roosting habitat) will also be removed.

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

Clearing of edge areas of the Subject Site will further fragment and isolate woodland and riparian habitats at the Subject Site.

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

Woodland and aquatic habitats at the Subject Site likely provide foraging and potential roosting habitat for these species, as part of a much larger home range. It is likely that these species also utilise other remnants present in the landscape. Although all habitats remaining in western Sydney are important for the long-term survival of these species, it is considered unlikely that the survival of a local population of these species is entirely dependent on habitats at the Subject Site.

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

No critical habitat for these species has been declared by the Scientific Committee.

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

No specific recovery plans or threat abatement plans are relevant to these species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation leading to weed invasion, and a reduction in native ground cover;
- Loss of hollow-bearing trees, and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

The following threats are species-specific, relate directly to the persistence of these bats in the landscape in western Sydney, and are likely to occur as a result of the proposed action:

- Clearing of foraging habitat for residential and other developments, including clearing by resident within rural subdivisions;
- Application of pesticides and herbicides in or adjacent to foraging areas;
- Changes to water regimes, and
- Reduction in stream water quality affecting food resources.

Cave-Roosting Microchiropteran Bats

- Eastern Bentwing-bat (*Miniopterus schriebersii oceanensis*)
- Southern Myotis (*Myotis macropus*)

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

Both species use caves for roosting, but Eastern Bentwing-bats will occasionally use trees hollows and Southern Myotis regularly use tree hollows for roosting (pers. comm. G. Hoye). Both species forage in forested habitat but their niches differ. The Eastern Bentwing-bat uses the canopy for foraging, while Southern Myotis skim the surface of streams and ponds catching insects and small fish (Richards 2000, Dwyer 2001a, 2001b). Research on the home ranges of these species is limited but suggests Eastern Bentwing-bats exhibit a high fidelity to a particular foraging area that may change seasonally and that Southern Myotis are capable of travelling long linear distances along riparian zones to exploit hunting areas (pers. comm. G. Hoye).

The proposed action will cause the removal of potential foraging and roosting habitats for these species, and cause the area to become further disturbed, but it is unlikely to have an adverse effect on the life cycle of these species such that the viability of their local populations is compromised.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will result in the removal of approximately 3 ha of vegetation from the edges of two patches of woodland and riparian zone at the Subject Site. However, although the vegetation to be removed is mostly within vegetation described as 'edge-affected', such clearing will likely result in the modification of vegetation in these patches, which will become the forest edge. Edge-affected

areas are more susceptible to disturbance such as weed invasion and therefore vegetation removal on the Subject Site will result in a slightly larger area of habitat being modified in the longer term. Some tree hollows (roosting habitat) will also be removed.

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

Clearing of edge areas of the Subject Site will further fragment and isolate woodland and riparian habitats at the Subject Site.

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

Woodland and aquatic habitats at the Subject Site likely provide foraging and potential roosting habitat for these species, as part of a much larger home range. It is likely that these species also utilise other remnants present in the landscape. Although all habitats remaining in western Sydney are important for the long-term survival of these species, it is considered unlikely that the survival of a local population of these species is entirely dependent on habitats at the Subject Site.

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

No critical habitat for these species has been declared by the Scientific Committee.

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

No specific recovery plans or threat abatement plans are relevant to these species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation leading to weed invasion, and a reduction in native ground cover; and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

The following threats are species-specific, relate directly to the persistence of these bats in the landscape in western Sydney, and are likely to occur as a result of the proposed action:

- Reduction in stream water quality affecting food resources;
- Loss or disturbance of roosting sites;
- Clearing adjacent to foraging areas;
- Application of pesticides in or adjacent to foraging areas;
- Loss of forest foraging habitat, and
- Predation by cats or foxes.

Grey-headed Flying-fox (*Pteropus poliocephalus*)

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

Grey-headed Flying-foxes exhibit a high site fidelity to their roosting locations and will travel up to 50 km from their roosting camp to forage. Roosting camps may be occupied by tens of thousands of individuals and generally occur within 20 km of a regular food source, in densely vegetation gullies close to permanent water (DECC 2008b). They feed on the nectar and pollen of native trees, especially Eucalyptus, Melaleuca and Banksia, and fruits or rainforest trees and vines (DECC 2008b). They will also forage in cultivated gardens and fruit crops.

There was no indication a roosting camp occurs at the Subject Site, but Grey-headed Flying-foxes may utilise the Subject Site for foraging when the trees are flowering. Given their ability to traverse unsuitable habitat to reach foraging grounds is considerably greater than the size of the area to be removed under the proposed action, it is unlikely that the development would affect the life cycle of the Grey-headed Flying-fox such that a local viable population would be put at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will result in the removal of approximately 3 ha of vegetation from the edges of two patches of woodland and riparian zone at the Subject Site, and isolated paddock trees. This will reduce the amount and variety of potential foraging habitat available to the Grey-headed Flying-fox.

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

Clearing of edge areas of the Subject Site will further fragment this site from adjacent areas of forest.

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

Woodland and aquatic habitats at the Subject Site are likely to provide foraging habitat for this species, as part of a much larger home range. Thus the proposed action will reduce the amount of foraging habitat available to the species. If considered in isolation the proposed link road will affect only a small proportion of the foraging habitat available to the species. However, the proposed link road is the first part of a local development which may result in the loss of all habitat for the species at the site. Also, there are numerous other developments in the region justifying the loss of small portions of habitat for the species because it has a large foraging range. The cumulative effect is the species will continue to lose substantial portions of its foraging habitat until there is very little left in western Sydney.

However, for the purposes of the proposed link road, Grey-headed Flying-foxes would also utilise other remnants present in the landscape. Although all habitats remaining in western Sydney are important for the long-term survival of these species, it is considered unlikely that the survival of a local population of these species is entirely dependent on habitats at the Subject Site.

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

No critical habitat for this species has been declared by the Scientific Committee.

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

No specific recovery plans or threat abatement plans are relevant to this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation, and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

The following threats relate directly to the persistence of Grey-headed Flying-fox in the landscape in western Sydney, and are likely to occur as a result of the proposed action:

- Loss of foraging habitat, and
- Clearing adjacent to foraging areas.

Bush Stone-curlew (*Burhinus grallarius*)

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

The Bush Stone-curlew occupies open forests and woodlands with sparse grassy groundlayer and fallen timber. It is nocturnal and nests on the ground on a scrape or small bare patch. The species occupies a home range of approximately 250-600 ha for foraging with a core breeding habitat of 10-25 ha (DECC 2006). Bush Stone-curlews have suffered significant declines in their range throughout south-eastern Australia such that it is now sparsely distributed and continues to decline in this region. This decline is attributed to extensive clearing of its woodland habitat, and predation by introduced species such as foxes, dogs and cats (NPWS 1999).

The proposed action would reduce the area of habitat available to the Bush Stone-curlew; however it is unlikely to adversely affect the species such that a viable local population is likely to be placed at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will result in the removal of approximately 3 ha of vegetation from the edges of two patches of woodland and riparian zone at the Subject Site, and isolated paddock trees.

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

Clearing of edge areas of the Subject Site will further fragment this site from adjacent areas of forest.

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

Given Bush Stone-curlew populations are declining owing to clearing of their woodland habitats, it is critically important that all habitats are protected. Thus the loss of habitat resulting from the proposed action will contribute to further isolating, fragmenting and removing habitat important to the survival of the species in the locality because it permanently reduces the amount and distribution of habitat available to a species already under pressure from land clearing and development. The creation of easy road access for predators into the area also further compromises the species ability to persist in the locality.

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

No critical habitat for these species has been declared by the Scientific Committee.

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

The Recovery Plan for the Bush Stone-curlew (2006) cites eleven recovery objectives relating to raising awareness of the species conservation status and habitats, supplementing wild populations with a captive-breeding program, and undertaking research to further understanding of the species biology and ecology. The proposed action does not compromise the objectives of the recovery plan for this species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation, and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

The following threats relate directly to the persistence of Bush Stone-curlew in the landscape in western Sydney, and are likely to occur as a result of the proposed action:

- Predation by foxes and cats;
- Trampling by eggs and cattle;
- Clearance of woodland habitat for development;
- Modification and destruction of ground habitat through removal of litter and fallen timber, introduction of exotic pasture grasses, grazing and infrequent fires;
- Disturbance from humans and domestic animals, and

- Application of pesticides and herbicides.

Hooded Robin (*Melanodryas cucullata cucullata*)

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

Hooded Robins prefer open Eucalypt woodland, acacia scrub and mallee habitats often in or near clearings or open areas (DECC 2008b). It occupies home ranges of up to 30 ha during the non-breeding season. Whilst breeding this contracts to around 10 ha. The proposed action will reduce the amount and diversity of woodland habitat available to the species in the locality and region, but is unlikely to adversely affect it such that a viable local population is placed at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will result in the removal of approximately 3 ha of vegetation from the edges of two patches of woodland and riparian zone at the Subject Site, and isolated paddock trees.

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

Clearing of edge areas of the Subject Site will further fragment this site from adjacent areas of forest.

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

Given Hooded Robin populations are declining owing to clearing of their woodland habitats, it is critically important that all habitats are protected. Thus the loss of habitat resulting from the proposed action will contribute to further isolating, fragmenting and removing habitat important to the survival of the species in the locality because it permanently reduces the amount and distribution of habitat available to a species already under pressure from land clearing and development. The creation of easy road access for predators into the area also further compromises the species ability to persist in the locality.

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

No critical habitat for these species has been declared by the Scientific Committee.

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

No specific recovery plans or threat abatement plans are relevant to these species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation, and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

The following threats relate directly to the persistence of Hooded Robins in the landscape in western Sydney, and are likely to occur as a result of the proposed action:

- Clearing of woodlands, resulting in loss and fragmentation of habitat;
- Modification and destruction of ground habitat through heavy grazing and compaction by stock;
- Removal of litter and fallen timber;
- Introduction of exotic pasture, and
- Frequent fires.

Black-chinned Honeyeater (*Melithreptus gularis gularis*)

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

The Black-chinned Honeyeater occupies a home range of at least 5 ha in woodland or drier open forests dominated by box and ironbark eucalypts. Hence, although the proposed action will reduce the amount of foraging habitat available to the species it is unlikely to adversely affect it such that a viable local population would be placed at risk extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will result in the removal of approximately 3 ha of vegetation from the edges of two patches of woodland and riparian zone at the Subject Site, and isolated paddock trees.

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

Clearing of edge areas of the Subject Site will further fragment this site from adjacent areas of forest.

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

Given Black-chinned Honeyeater populations are declining owing to clearing of their woodland habitats, it is critically important that all habitats are protected. Thus the loss of habitat resulting from the proposed action will contribute to further isolating, fragmenting and removing habitat important to the survival of the species in the locality because it permanently reduces the amount and distribution of habitat available to a species already under pressure from land clearing and development. The creation of easy road access for predators into the area also further compromises the species ability to persist in the locality.

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

No critical habitat for these species has been declared by the Scientific Committee.

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

No specific recovery plans or threat abatement plans are relevant to these species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation, and

- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

The following threats relate directly to the persistence of Black-chinned Honeyeater in the landscape in western Sydney, and are likely to occur as a result of the proposed action:

- Clearing of remnant open forest and woodland habitat;
- Poor regeneration of open forest and woodland habitat due to instance grazing; and
- May be excluded from smaller remnant by aggressive species such as the Noisy Miner (*Manorina melanocephala*).

Diamond Firetail (*Stagonopleura guttata*)

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

Diamond Firetails appear to be relatively sedentary, occupying the same area of grassy eucalypt woodland throughout their lives (DECC 2008b). They feed exclusively on the ground on ripe and partly-ripe grass and herb seeds and green leaves, and on insects. They are usually encountered in flocks of between 5-40 birds, but during the breeding season they separate into smaller colonies (DECC 2008b). Diamond Firetails are known to have experienced declines in the Cumberland Plain of western Sydney and the Hunter, Clarence, Richmond and Snowy River Valleys (Blakers *et al*. 1984, Schodde & Mason 1999).

Given the area of habitat potentially affected by the proposed action its removal is unlikely to adversely affect the Diamond Firetail such that a viable local population would be placed at risk extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will result in the removal of approximately 3 ha of vegetation from the edges of two patches of woodland and riparian zone at the Subject Site, and isolated paddock trees.

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

Clearing of edge areas of the Subject Site will further fragment this site from adjacent areas of forest.

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

Given Diamond Firetail populations have declined in the locality it is critically important that all habitats are protected. Thus the loss of habitat resulting from the proposed action will contribute to further isolating, fragmenting and removing habitat important to the survival of the species in the locality because it permanently reduces the amount and distribution of habitat available to a species already under pressure from land clearing and development. The creation of easy road access for predators into the area also further compromises the species ability to persist in the locality.

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

No critical habitat for these species has been declared by the Scientific Committee.

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

No specific recovery plans or threat abatement plans are relevant to these species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation, and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

The following threats relate directly to the persistence of the species in the landscape in western Sydney, and are likely to occur as a result of the proposed action:

- Clearing and fragmentation of woodland, open forest, grassland and mallee habitat for development and firewood collection;
- Poor regeneration of open forest and woodland habitats;
- Invasion of weeds, resulting in loss of important food pants;

- Modification and destruction of ground and shrub layers within habitat through removal of native plants, litter and fallen timber; introduction of exotic pasture grasses, and frequent fire; and
- Risk of local extinction due to small, isolated populations.

Swift Parrot (*Lathamus discolor*)

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

The Swift Parrot breeds in Tasmania and migrate to mainland Australia in autumn to overwinter. The principal over-wintering habitat on the mainland is the box-ironbark forests and woodlands inland of the Great Dividing Range in Victoria and New South Wales (Kennedy & Overs 2001). Swift Parrot preferred feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculatai)*, Mugga Ironbark (*E. sideroxylon*), Red Bloodwood (*C. gummifera*), Blackbutt (*E. piluaris*i) and White Box (*E. albens*).

Woodland vegetation at the Subject Site may provide an opportunistic food source for Swift Parrots at certain times of the year. However, the proposed action requires the loss of a small portion of habitat, so the action is considered unlikely to adversely affect the species such that a viable local population could be placed at risk of extinction.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will result in the removal of approximately 3 ha of vegetation from the edges of two patches of woodland and riparian zone at the Subject Site, and isolated paddock trees.

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

Clearing of edge areas of the Subject Site will further fragment this site from adjacent areas of forest.

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

Woodland and aquatic habitats at the Subject Site likely provide foraging habitat for this species, as part of a much larger migratory range. Thus the proposed action will reduce the amount of foraging habitat available to the species. If considered in isolation the proposed link road will affect only a small proportion of the foraging habitat available to the species. However, the proposed link road is the first part of a local development which will result in the likely loss of all habitat for the species at the site. Also, there are numerous other developments in the region justifying the loss of small portions of habitat for the species because it has a large foraging range. The cumulative effect is the species will continue to lose substantial portions of its foraging habitat until there is very little left in western Sydney.

However, for the purposes of the proposed link road, Swift Parrots would also utilise other remnants present in the landscape. Although all habitats remaining in western Sydney are important for the long-term survival of these species, it is considered unlikely that the survival of a local population of these species is entirely dependent on habitats at the Subject Site.

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

No critical habitat for these species has been declared by the Scientific Committee.

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

The recovery plan for Swift Parrots (Swift Parrot Recovery Plan 2001) identifies the protection of potential and known foraging habitat as a priority action for this species. Clearing for development of the proposed link road would reduce the extent of potential foraging habitat for the species, and is therefore inconsistent with this recovery plan objective.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation, and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

The following threats relate directly to the persistence of the species in the landscape in western Sydney, and are likely to occur as a result of the proposed action:

- Clearing and fragmentation of woodland and open forest habitat for development and firewood collection;
- Firewood collection, and
- Collisions with chain link fences, windows and cars.

Regent Honeyeater (*Xanthomyza phrygia*)

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

The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. There are three key breeding regions remaining: north-east Victoria (Chiltern-Albury), Capertee Valley and the Bundarra-Barraba region (DECC 2008b). In NSW the distribution is patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. It is most likely to be encountered on the Cumberland Plain when non-breeding flocks converge on flowering woodlands and forests (DECC 2008b). Hence the Regent Honeyeater could use tree species at the Subject Site as a foraging resource. However, no local population would be placed at risk of extinction as a result of the proposed action.

(d) in relation to the habitat of a threatened species, population or ecological community:

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

The proposal will result in the removal of approximately 3 ha of vegetation from the edges of two patches of woodland and riparian zone at the Subject Site, and isolated paddock trees.

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

Clearing of edge areas of the Subject Site will further fragment this site from adjacent areas of forest.

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

Woodland and aquatic habitats at the Subject Site potentially provide foraging habitat for this species, as part of a much larger migratory range. Thus the proposed action may reduce the amount

of foraging habitat available to the species. If considered in isolation the proposed link road will affect only a small proportion of the foraging habitat available to the species. However, the proposed link road is the first part of a local development which will result in the likely loss of all habitat for the species at the site. Also, there are numerous other developments in the region justifying the loss of small portions of habitat for the species because it has a large foraging range. The cumulative effect is the species will continue to lose substantial portions of its foraging habitat until there is very little left in western Sydney.

However, for the purposes of the proposed link road, Regent Honeyeaters would also utilise other remnants present in the landscape. Although all habitats remaining in western Sydney are important for the long-term survival of these species, it is considered unlikely that the survival of a local population of these species is entirely dependent on habitats at the Subject Site.

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

No critical habitat for these species has been declared by the Scientific Committee.

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

No specific recovery plans or threat abatement plans are relevant to these species.

(g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed development has potential to exacerbate the following key threatening processes:

- Clearing and modification of native vegetation, and
- High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

The following threats relate directly to the persistence of the species in the landscape in western Sydney, and are likely to occur as a result of the proposed action:

- Historical loss, fragmentation and degradation of habitat from clearing for agricultural and residential development;
- Continuing loss of key habitat tree species and woodlands from strategic agricultural developments, timber gathering and residential developments;
- Firewood harvesting;

- Competition from larger aggressive honeyeaters, particularly noisy Miner, Noisy Friarbirds and Red Wattlebirds, and
- Egg and nest predation by native birds.

Appendix D Assessment of Impact (Commonwealth EPBC Act)

D.1 Endangered Ecological Communities

Cumberland Plain Woodland

Cumberland Plain Woodland is listed as an EEC under EPBC Act. This community was identified in the north and south-west of the Subject Site (Figure 8)

This assessment has been prepared in accordance with the *Department of Environment and Heritage EPBC Act Policy Statement – Significant Impact Guidelines 1.1* (2006)

When making a decision as to whether or not to refer an action to the Minister, the following points must be considered (DEH 2006):

1) ***Are there any matters of national environmental significance located in the area of the proposed action?***

Yes. Cumberland Plain Woodland is located in the area of the proposed action.

2) ***Considering the proposed action at its broadest scope, is there potential for impacts on matters of national environmental significance?***

Yes, the proposed action requires the direct removal of 2.37 ha of Cumberland Plain Woodland which constitutes a removal of 0.4% of the total Cumberland Plain Woodland within the Study Area.

3) ***Are there any proposed measures to avoid or reduce impacts on matters of national environmental significance?***

Yes. The proposed Erskine Park Link Road has been positioned as extensions of existing roads which minimises the clearing of Cumberland Plain Woodland by not bisecting existing remnants.

4) ***Are any impacts of the proposed action on matters of national environmental significance likely to be significant impacts?***

No. Provided the large remnant areas of Cumberland Plain Woodland adjoining the Subject Site in the north of the Study Area (Figure 8) are retained, the Proposal is not considered likely to constitute a significant impact.

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- ***reduce the extent of an ecological community;***

The proposed action requires the direct removal of 2.37 ha of Cumberland Plain Woodland. This constitutes a removal of 0.4% of the total Cumberland Plain Woodland within the Study Area. The majority of the Cumberland Plain Woodland to be removed is in low-moderate condition (Table 6-1).

- ***fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;***

Minimal clearing is required through the areas of higher quality Cumberland Plain Woodland vegetation in the north of the Subject Site due to an existing road (Archbold Road); however widening will be required to accommodate the four lane carriageway which may exacerbate the fragmentation of existing remnants.

- ***adversely affect habitat critical to the survival of an ecological community;***

No critical habitat has been identified for Cumberland Plain Woodland.

- ***modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;***

The construction of the proposed Erskine Park Link Road is unlikely to modify abiotic factors necessary for the survival of Cumberland Plain Woodland. Widening to the junction between the M4 Motorway and Archbold Road will require significant batters to be formed which may slightly alter surface water drainage patterns in the vicinity.

- ***cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;***

The Proposal is unlikely to cause a substantial change in the species composition of Cumberland Plain Woodland in the Study Area given the relatively low level of disturbance required.

- ***cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:***
  - ***assisting invasive species, that are harmful to the listed ecological community, to become established; or***

Five noxious weeds were recorded across the Study Area (section 4.2.6). These species were not observed in large abundance but may be assisted by the proposed road construction or operation due to soil disturbance, clearing and increased nutrients from road surfaces.

  - ***causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or***

The proposed action is not likely to cause regular mobilisation of fertilizer, herbicides or chemicals into Cumberland Plain Woodland. While clearing has been proposed to be undertaken no fertilisers, herbicides or other chemical pollutants are to be used for this process.

- ***interfere with the recovery of an ecological community.***

The construction of the proposed link road network is not likely to interfere with the recovery of Cumberland Plain Woodland given that the road network is to be located primarily on an existing road (Archbold Road) in the north of the Subject Site. The areas traversed by the road network are not considered likely to be important for the recovery of Cumberland Plain Woodland.

Conclusion

The proposed action requires the direct removal of approximately 2.37 ha of Cumberland Plain Woodland from the Subject Site which equates to the removal of 0.4 % of the Cumberland Plain Woodland within the Study Area.

Provided the large remnant areas of Cumberland Plain Woodland adjoining the Subject Site in the north of the Study Area (Figure 8) are retained, the Proposal is not considered likely to constitute a significant impact and the preparation of a Referral under the EPBC Act is not required.

D.2 Nationally Threatened and Migratory Fauna

D.2.1 Endangered Species

Swift Parrot and Regent Honeyeater

The two endangered bird species previously known or considered likely to occur in the Study Area are the Swift Parrot and Regent Honeyeater. These birds are both migratory species considered to potentially use the Subject Site for foraging and/or refuge.

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

Both species are occasional visitors to the region during peak flowering events of the dominant trees. here are no breeding records in the Study Area and the extent of habitat remaining in the Study Area would provide sufficient resources to sustain future visitation.

Woodland and aquatic habitats at the Subject Site likely provide foraging habitat for this species, as part of a much larger home range. Thus the proposed action will reduce the amount of foraging habitat available to the species. If considered in isolation the proposed link road will affect only a small proportion of the foraging habitat available to the species. However, the proposed link road is the first part of a local development which will result in the likely loss of almost all habitat for the species at the site. Also, there are numerous other developments in the region justifying the loss of small portions of habitat for the species because it has a large foraging range. The cumulative effect is the species will continue to lose substantial portions of its foraging habitat until there is very little left in western Sydney.

However, for the purposes of the proposed link road, Swift Parrots and Regent Honeyeaters would also utilise other remnants present in the landscape. Although all habitats remaining in western Sydney are important for the long-term survival of these species, it is considered unlikely that the long-term survival of a local population of these species is entirely dependent on habitats at the Subject Site.

- ***Reduce the area of occupancy of the species;***

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

- ***Fragment an existing population into two or more populations;***

Both species are occasional visitors to the region and there are no known permanent populations, hence the proposed link road will not fragment a resident population.

- ***Adversely affect habitat critical to the survival of a species;***

Any use of the site habitats by these migratory and nomadic birds is likely to be sporadic and during peak flowering events of the dominant mature trees. It is considered likely the site habitats to be disturbed are too small to sustain an ecologically significant proportion of the population.

- ***Disrupt the breeding cycle of a population;***

There are no breeding records of Swift Parrot and Regent Honeyeater in the Study Area.

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

The proposed action will remove and isolate habitat available to the species, and contribute to the degradation of remaining habitat. However, it is likely the site habitats to be disturbed are too small to affect the species such that it is likely to decline.

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

Roads are known to provide access for exotic predatory species and invasive or pest species. Some native generalist native species that are robust to the changes enacted by development may also become established in the area, to the detriment of Regent Honeyeaters and Swift Parrots. For example:

- Foxes and cats may take advantage of the easy ingress provided by the proposed link road to increase their activity at the site, or traverse areas previously inaccessible to them. This may increase the risk of predation to the Swift Parrot and Regent Honeyeater at the Subject Site.
- Noisy Miners are adept at colonising disturbed remnant patches and urban habitats, and are aggressively territorial, harassing other birds until they leave the area. Competition from larger aggressive honeyeaters is known to threaten the survival of Regent Honeyeaters.
- Pest plant species are transported and dispersed along roads, and may contribute to modifying the condition of remnant woodland at the Subject Site, and therefore changing its composition and structure such that the Swift Parrot and Regent Honeyeater no longer find the site suitable habitat.
- Humans already use the Subject Site for illegal rubbish dumping, trail bike riding and harvesting firewood. Currently the rubbish dumping and firewood harvesting is conducted largely adjacent to establish dirt roads in woodland areas in the north of the Subject Site. Provision of easy access further into the site will enable people to affect a larger proportion of the site. This will increase the general disturbance to remaining habitats at the site for these species.

- ***Introduce disease that may cause the species to decline; or***

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

- ***Interfere with the recovery of the species.***

Provided management measures are implemented to protect potential habitat (as identified within the report), it unlikely that the proposal would interfere with the recovery of these species.

Summary

In line with the findings of the assessment guidelines under the EPBC Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct impact on a matter of national environmental significance (threatened species) or potential habitat if the mitigation measures outlined in Section 7.1 are implemented. Therefore, preparation of a Referral under the EPBC Act is not required.

D.2.2 Threatened Species

Grey-headed Flying-fox, Greater Broad-nosed Bat, and Diamond Firetail

Three vulnerable species previously known or considered likely to occur in the Study Area are the Grey-headed Flying-fox, Greater Broad-nosed Bat, and Diamond Firetail.

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

The proposed action will cause the removal of potential foraging and roosting habitats for these species, and cause the area to become further disturbed, but it is unlikely to have an adverse effect that will precipitate a long-term decrease in the size of an important population.

- ***Reduce the area of occupancy of an important population;***

The proposed link road would reduce the area of habitat currently available to these species by approximately 3 ha.

- ***Fragment an existing important population into two or more populations;***

The proposed link road will not fragment the distribution of these populations. Each species is considered highly agile, and therefore capable of crossing the expanse of road proposed for development.

- ***Adversely affect habitat critical to the survival of a species;***

Critical habitat includes breeding, refuge and movement habitats. At minimum the Subject Site is potential refuge and movement habitat for all three species considered. Although the proposed development will cause the loss and modification of existing habitats for these species, its magnitude is small, and therefore considered unlikely to substantially adversely affect critical habitat for the Diamond Firetail, Grey-headed Flying-fox and Greater Broad-nosed Bat.

However, the proposed link road is the first part of a local development which will result in the likely loss of or disturbance to almost all habitat for these species at the site. Also, there are numerous other developments in the region justifying the loss of small portions of habitat for the species because it has a large foraging range. The cumulative effect is the species will continue to lose substantial portions of its foraging habitat until there is very little left in western Sydney.

- ***Disrupt the breeding cycle of an important population;***

Disruptions to breeding cycles include loss of breeding habitat, disturbance to habitats such that breeding is interrupted or compromised and therefore unsuccessful, and disturbance to habitats such that predation or competition renders breeding attempts unsuccessful. The loss of habitat and modification to remaining habitats at the site as a result of the proposed link road may contribute to disrupting the breeding cycle of all three species via a decrease in the availability of foraging and breeding resources. This forces individuals to travel further or compete harder and thereby compromises their fitness and ability to raise young, as well as feed young. Likely consequences include reduced clutch sizes, reduced fitness of young, increased periods of time away from young allowing great predation and misadventure opportunities, and increased opportunities for adults to suffer misadventure.

In this manner the proposed development will contribute to pressures on these species in the locality, but it will not strictly disrupt the breeding cycle of an important population.

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

Approximately 3 ha of habitat will likely be impacted by the proposed link road. Removal of this area, and consequent modification of the remaining areas (e.g. decreased core habitats and increased edge or perimeter habitat) is unlikely to cause the species to decline.

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

Roads are known to provide access for exotic predatory species and invasive or pest species. Some native generalist native species that are robust to the changes enacted by development may also become established in the area, to the detriment of Diamond Firetails, Greater Broad-nosed Bats and Grey-headed Flying-foxes. For example:

- Foxes and cats may take advantage of the easy ingress provided by the proposed link road to increase their activity at the site, or traverse areas previously inaccessible to them. This may increase the risk of predation to the species (particularly the Diamond Firetail) at the Subject Site.
- Noisy Miners and Indian Mynas are adept at colonising disturbed remnant patches and urban habitats, and are aggressively territorial, harassing other birds until they leave the area.

Competition from larger aggressive honeyeaters for foraging and nesting resources may threaten the survival of Diamond Firetails and Greater Broad-nosed Bats at the Subject Site.

- Pest plant species are transported and dispersed along roads, and may contribute to modifying the condition of remnant woodland at the Subject Site, and therefore changing its composition and structure such that the species no longer find the site suitable habitat.
- Humans already use the Subject Site for illegal rubbish dumping, trail bike riding and harvesting firewood. Currently the rubbish dumping and firewood harvesting is conducted largely adjacent to establish dirt roads in woodland areas in the north of the Subject Site. Provision of easy access further into the site will enable people to affect a larger proportion of the site. This will increase the general disturbance to remaining habitats at the site for these species.
- ***Introduce disease that may cause the species to decline; or***

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

- ***Interfere with the recovery of the species.***

Provided management measures are implemented to protect potential habitat as identified within, it unlikely that the proposal would interfere with the recovery of these species.

Summary

In line with the findings of the assessment guidelines under the EPBC Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct impact on a matter of national environmental significance (threatened species) or potential habitat if the mitigation measures outlined in Section 7.1 are implemented. Therefore, preparation of a Referral under the EPBC Act is not required.

D.2.3 Migratory Species

The species considered likely to be impacted by the proposal due to the removal and/or potential disturbance of suitable habitat include the:

- White-throated Needletail;
- Rainbow Bee-eater;
- Great Egret;
- Fork-tailed Swift;
- Cattle Egret;
- Latham's Snipe, and
- Painted Snipe.

- ***Substantially modify (including fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;***

The habitats in the Study Area are unlikely to constitute an 'important' area of habitat on the basis that significant population densities are not known from the region, the habitat is widespread throughout the south west slopes, and there are no critical or unique habitats or features present that are required by these species for particular life-cycle events.

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

Invasive species may become established in the Study Area as a result of the proposed action, but as the area is not 'important habitat' for migratory species their affect likely would be negligible.

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

The Study Area is expected to provide some resources for a small proportion of the entire populations of these migratory species. Such resources are very widespread and there is nothing that distinguishes the habitat from the remainder of the bioregion or indeed the habitat throughout the distributional range of these species.

Summary

In line with the findings of the assessment guidelines under the EPBC Act and based on the aforementioned assessment criteria, it is considered that the proposal would be unlikely to have a significant direct impact on a matter of national environmental significance (threatened species) or potential habitat if the mitigation measures outlined in Section 7.1 are implemented. Therefore, preparation of a Referral under the EPBC Act is not required.