



Appendix E

Flora and Fauna Impact Assessment

FLORA AND FAUNA IMPACT ASSESSMENT
PROPOSED THIRD RAIL TRACK FOR THE MINIMBAH
BANK NEAR BELFORD



Prepared for
GHD Pty Ltd & ARTC



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EXECUTIVE SUMMARY

An assessment of the impacts on flora and fauna in relation to the preferred route for the proposed Minimbah Bank third rail track, including road overpasses and drainage works, has been made based on a combination of literature review and field survey. The resulting information has been used to address Part 3A of the *Environmental Planning and Assessment Act 1979*, which includes a requirement for assessment of impact of the proposal on threatened species pursuant to section 5A of the *Environmental Planning and Assessment Act 1979* and other relevant legislation.

One threatened flora species listed under legislation was recorded within the study area. Slaty red gum (*Eucalyptus glaucina*), listed as vulnerable under both the TSC and EPBC Acts, was confirmed to occur in several private properties mainly outside, but occasionally within the existing rail track easement. The species was generally restricted to the part of the study area east of the Golden Highway overpass, but occurred relatively frequently in this section, occupying several areas. Habitat for this species would be impacted by the proposal, but the impact assessment using the seven-part test concluded that this would not occur to the extent of placing the local population of the species at risk of extinction. Assessment using the criteria in the EPBC Act guidelines indicated that the proposal would not constitute a significant impact on the local population of *Eucalyptus glaucina*.

Two endangered ecological communities listed under the TSC Act were confirmed as occurring within the study area. These are *Hunter lowland redgum forest* and *River-flat eucalypt forest on coastal floodplains*. The possible presence of a third EEC, *Lower Hunter spotted gum-ironbark forest*, was ruled out as occurring within the study area as a result of further investigation. Additionally, the tentative identification of *Swamp oak floodplain forest* from the route options survey was found to more accurately constitute *River-flat eucalypt forest on coastal floodplains*, although it does have characteristics of the former EEC. Both the confirmed EECs were in a highly modified condition within the study area, mostly with simplified or slashed understories that are subject to grazing or other disturbances and have been invaded by weeds. Both EECs would be impacted by the proposal, but not to the extent that the local occurrences of each community would be placed at risk of extinction. The greatest area of removal would be on *Hunter lowland redgum forest*.

One flora species that forms an Endangered Population in the Hunter catchment, the river red gum *Eucalyptus camaldulensis*, was tentatively recorded in three locations south of the existing railway easement during the survey for the route options investigations. However, closer inspection of the relevant trees during the current field surveys confirmed them to be mature *Eucalyptus glaucina* trees. It was therefore concluded that the endangered population of *Eucalyptus camaldulensis* does not occur in the study area and would not be impacted by the proposal.

One rare plant not listed by legislation but listed as a rare plant by ROTAP (Briggs and Leigh 1996) was recorded in the study area. Mountain grevillea (*Grevillea montana*) occurred in several areas at high abundance within the study area, and sporadically or as isolated plants. It was restricted to the section of the study area east of the Golden Highway. Some habitat for the species would be removed by the proposal, but given the abundance of the species in habitat beyond the impact footprint, it is not expected to be affected to the extent that the local population of the species is placed at risk of extinction.

The main potential impacts on fauna within the study area are considered to be the loss of roosting/nesting sites (particularly the loss of hollow-bearing trees) and the loss of foraging habitat.

Three threatened fauna species, the brown treecreeper, grey-crowned babbler and grey-headed flying-fox, were recorded within the study area. Three species, the eastern bentwing-bat, speckled warbler and squirrel glider, have been recorded nearby and are considered to have a high probability of occurring within the study area. A number of additional threatened species have potential to occur and have been included for consideration in the assessment section of this report. The results of the assessment indicate that while the proposal would result in the loss of some known and potential habitat, it is unlikely to result in a significant impact on any threatened fauna species. Although the likelihood that a threatened species using one of the hollow-bearing trees as a nest or roost tree during construction of the Proposal is remote, mitigation measures have nonetheless been incorporated into the Proposal to minimise the risk of individuals being killed or injured during clearing operations.

A series of Mitigation Measures are provided that are designed to minimise the expected impacts. These include management practices during the construction period, ongoing weed management and the setting aside of areas of land as offsets for the loss of habitat for threatened species and endangered ecological communities.

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1.0 INTRODUCTION

1.1 Background and Scope

This Flora and Fauna Part 3A Assessment Report has been prepared at the request of Mr Shaun Taylor of GHD Pty Ltd on behalf of the Australian Rail Track Corporation Ltd (ARTC). The chosen preferred alignment for the proposed Minimbah Bank third rail track near Belford is the subject of this assessment. This report will investigate the potential ecological impacts resulting from the construction of the third rail line, and associated road deviations.

These activities are hereafter referred to as *the Proposal*.

The general aims of this assessment are to:

- describe the existing biological environment of the study area in relation to flora and fauna;
- discuss the potential impacts of the proposal for any threatened species that occur or could be likely to occur in the subject site;
- provide discussion on measures to mitigate impacts.

The environmental studies have been conducted in three stages:

- (a) the first stage being a review of available literature pertaining to the site and surrounding locality and preliminary habitat assessment of the study area;
- (b) the second stage being the completion field surveys and habitat assessment for threatened species regarded as potential subject species, and surveys to investigate the inherent biological attributes of the study area; and
- (c) the third stage being the assessment of impact of the proposal on flora and fauna in accordance with the relevant NSW and Commonwealth legislation and planning instruments.

Within this report, reference is given to the relevant sections of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); NSW *Threatened Species Conservation Act 1995* (TSC Act); *National Parks and Wildlife Act 1974* (NP&W Act); *Environmental Planning and Assessment Act 1979* (EP&A Act); and subsequent amendments to these. Specific consideration is given to Part 3A of the *EP&A Act* and the guidelines provided for threatened species assessment (former NSW Department of Environment and Conservation (DEC) (now Department of Environment and Climate Change (DECC)) and Department of Primary Industries (DPI), 2005).

For this report,

- the *subject site* is defined as the land area potentially directly affected by the chosen alignment for the Minimbah Bank third rail track route. This alignment is approximately 10km in length and runs adjacent to the existing rail corridor;
- the *study area* consists of the subject site plus the immediately surrounding land and watercourses that could be potentially affected directly or indirectly by the proposal; and
- the *study locality* is the area of land within a ten (10) kilometre radius of the centre of the subject site.

1.2 General Description of the Study Area and Study Locality

A broad description of the prominent natural and developed features of the study area and study locality is provided in **Table 1** below. The location of the study area within the study locality is shown in **Figure 1**.

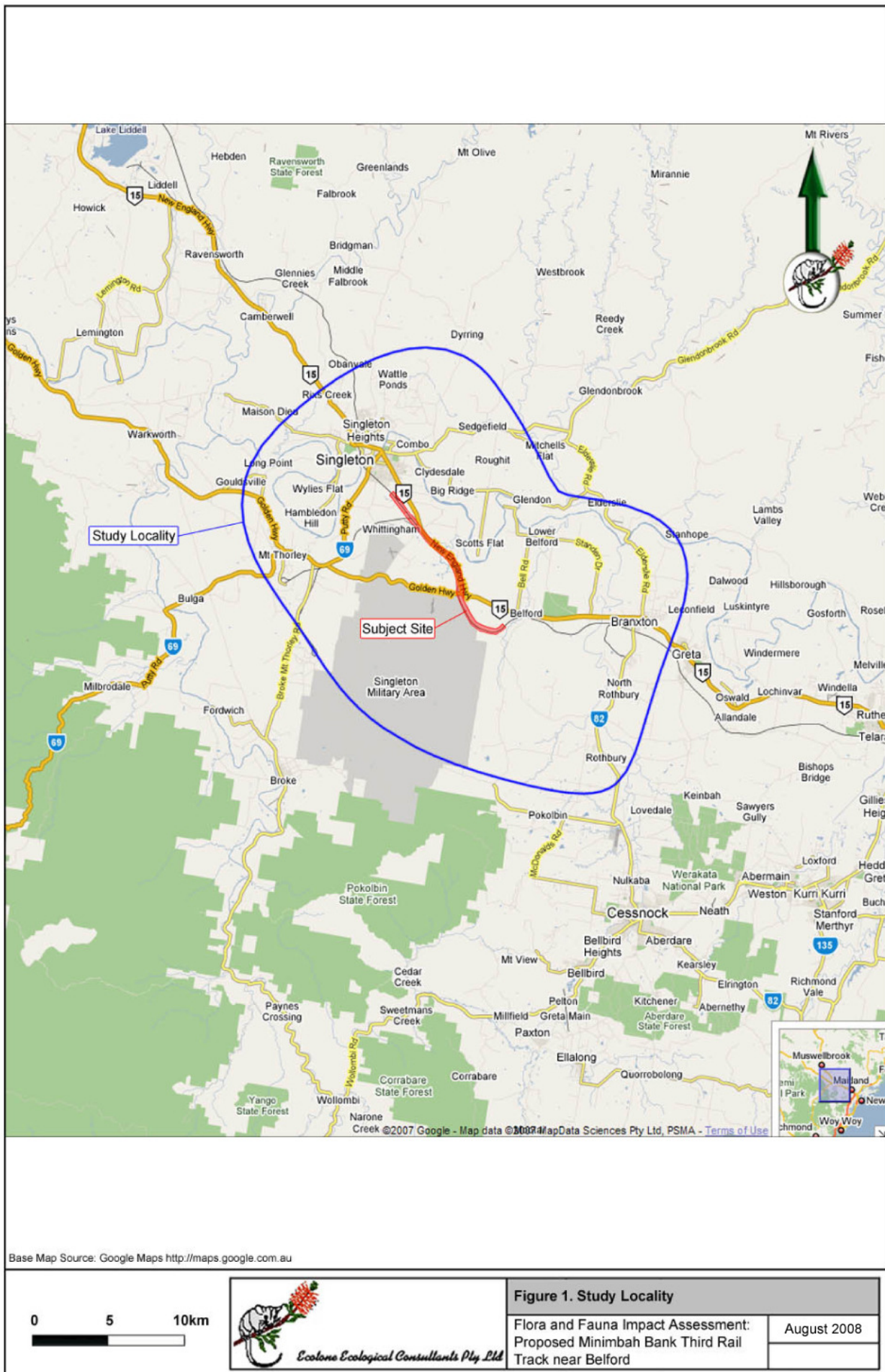
Table 1. Description of the Study Area and Locality

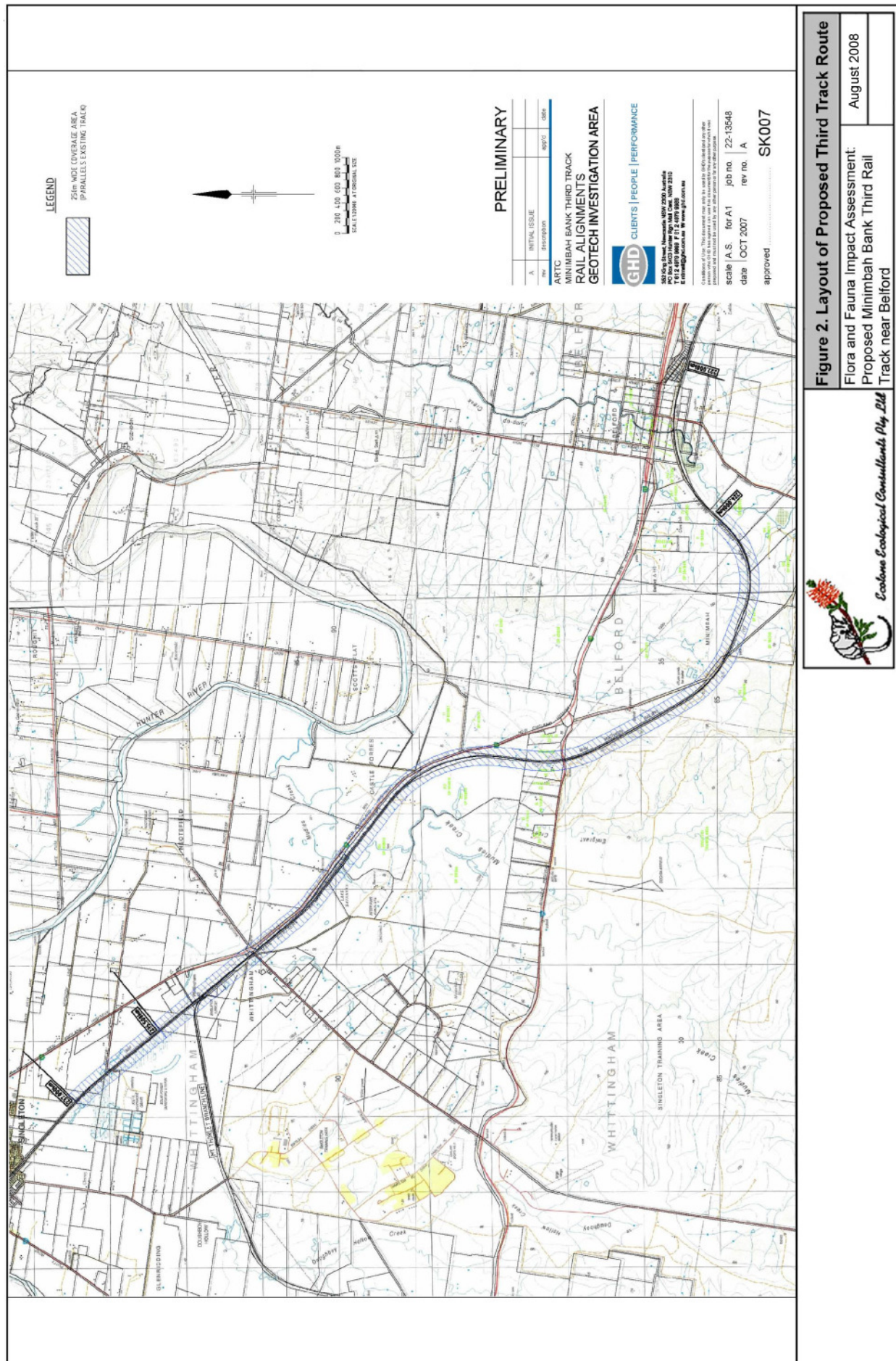
Client	Australian Rail Track Corporation Ltd (ARTC)
Location	Between Whittingham Junction and Belford along the Main Northern Railway Line and New England Highway (approximately 10km south of Singleton). Map sheet: 9132 Cessnock 1:100000 Zone 56 329800E 6392100N to 338800E 6385200N (GDA94)
LGA	Singleton
Bioregion	Sydney Basin
Botanical Subregion	North Coast
Study Locality Description	The study locality consists predominantly of agricultural and grazing lands, though some areas of native vegetation remain. It includes the urban centres of Singleton, Branxton and Rothbury as well as a number of smaller localities. Native vegetation within the study locality occurs in Belford National Park, Singleton Military Area and on private lands. The Hunter River flows through the study locality to the north of the subject site.
Geology	Mixed – gravel, sand, silt and clay alluvial of the Hunter River floodplain and Maitland Group siltstone, sandstone, conglomerate and mudstone.
Elevation	Approximately 40m to 100m asl
Subject Site Description	Generally flat floodplain of the Hunter River and its tributaries at the western end, more undulating at the eastern end. The site is almost completely cleared and treeless at the western end, with remnant disturbed and partially cleared vegetation (often reduced to the tree layer) and some plantations (olives and vineyards) at the eastern end.
Current landuse and general condition	Transport - major 2-track railway and two major highways (New England Highway and Golden Highway) within or near the study area. Farming, grazing, olive plantations and vineyard beyond transport easements.
Significant features	A number of creeks/drainage lines run through the subject site and drain into the Hunter River to the north, including Jump-Up Creek and Mudies Creek.
Surrounding landuse	Surrounding landuse is predominantly rural, with much of the surrounding land cleared for grazing. Some areas of native vegetation occur, in particular within Singleton Military Area and Belford National Park. The subject site includes the localities of Belford and Whittingham.

1.3 Description of the Proposal

On behalf of ARTC, GHD Pty Ltd are preparing a design for a third rail track at Minimbah Bank between Whittingham Junction and Belford on the Main Northern Railway Line. Three possible alignments for the third rail track were originally under investigation for the constraints report. Two of the potential alignments run either side of and parallel to the existing track (Option 6 – the ‘Up’ Option and Option 7 – the ‘Down’ Option) and the third option (Option 1) deviated along the New England Highway from Belford to rejoin the existing track just north of the Golden Highway.

The chosen route, the subject of this Part 3A Assessment, is a combination of the two options parallel to the existing track as work is intended to occur on both sides of the rail easement. Intended works occur within a 50m strip along the existing railway corridor, except for new overhead crossings and road realignments at Range Road and the Golden Highway. Other works involve earthworks for batters and cuttings, the construction of a retaining wall and drainage works. The proposal layout is shown in **Figure 2**.





2.0 FIRST STAGE ECOLOGICAL INVESTIGATION – PRELIMINARY ASSESSMENT

2.1 Review of Local Threatened Species and Other Records

A review of the documented records of the locations of threatened flora and fauna species within the study locality has been undertaken. Threatened species records were accessed from the Department of Environment and Climate Change (DECC) Atlas of NSW Wildlife Database for the Cessnock (9132) 1: 100 000 map sheet (updated to 29th April 2008).

2.1.1 Flora

Rare or Threatened Flora

From the review, a total of eight rare or threatened flora species are known to occur within the study locality. These are listed in **Table 2** below. Two of these, *Eucalyptus glaucina* and *Persoonia pauciflora*, are listed as threatened species by the NSW TSC Act (as Vulnerable and Critically Endangered respectively), with *Eucalyptus camaldulensis* listed as an Endangered Population in the Act. Three species are listed in the Commonwealth EPBC Act, *Bothriochloa biloba* and *Eucalyptus glaucina* as Vulnerable and *Persoonia pauciflora* as Critically Endangered. Four additional species are not protected under State or Commonwealth legislation but are listed under the national database known as ROTAP *Rare or Threatened Australian Plants* (Briggs & Leigh 1996).

Table 2. Rare or Threatened Flora previously recorded within the Study Locality

Scientific Name	Status (TSC)	Status (EPBC)	ROTAP Risk Code	Earliest/ latest record	No. of records within 10km of site	No. of records within 2km of site
<i>Bothriochloa biloba</i>	U	V	3V	1968	1	0
<i>Eucalyptus camaldulensis</i>	E2	~	~	2006	5	0
<i>Eucalyptus glaucina</i>	V	V	3VCa	1904-2005	10	2
<i>Persoonia pauciflora</i>	E4A	CE	~	1997-2005	48	0
ROTAP Only						
<i>Acacia bulgaensis</i>	U	~	2RC-	2002	1	0
<i>Eucalyptus fergusonii</i> subsp. <i>fergusonii</i>	U	~	3KC-	1999-2005	6	0
<i>Grevillea montana</i>	U	~	2KC-	1997-2005	40	0
<i>Macrozamia flexuosa</i>	U	~	2K	1999-2006	31	0

Notes:

329800E/6392100N and 338800E/6385200N are the approximate end coordinates of the subject site (Cessnock 9132 1:100000 mapsheet AGD66).

Nomenclature follows Harden (1990-1993) and Harden & Murray (2000).

Status (TSC): refers to the NSW *Threatened Species Conservation Act* 1995 (TSC)

E2 Schedule 1, Part 2: Endangered Populations

E4A Schedule 1, Part 1A: Critically Endangered Species

V Schedule 2: Vulnerable Species

U Unprotected (not listed in Schedule 13 of the NPW Act 1974 or in the TSC Act 1995)

Status (EPBC): refers to the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC)

CE Critically Endangered Species

V Vulnerable Species

ROTAP Risk Code (Briggs and Leigh 1996)

2 Geographic range in Australia less than 100km

-
- 3 Geographic range in Australia greater than 100km
 - V Vulnerable Species: not presently endangered, but possibly at risk in future due to continuing depletion or land-use change
 - R Rare Species: rare in Australia, but currently without any identifiable threat
 - K Poorly Known: taxon that is suspected, but not definitely known, to belong to one of the above categories. At present, accurate field information is inadequate
 - C Reserved: indicates taxon has at least one population within a national park, or other proclaimed conservation reserve or in an area otherwise dedicated for the protection of flora
 - a 1000 plants or more are known to occur within a conservation reserve(s)
 - reserved population size is not accurately known

Please note: These records are based on information supplied by the Department of Environment and Climate Change and other sources, and may contain errors or omissions.

Endangered Populations of Plants

The following endangered populations of flora as listed by the *TSC Act 1995* could occur somewhere within the study locality:

- *Acacia pendula* in the Hunter catchment
- *Eucalyptus camaldulensis* in the Hunter catchment
- *Cymbidium canaliculatum* in the Hunter catchment
- *Leionema lamprophyllum* (F. Muell.) Paul G. Wilson subsp. *obovatum* F.M. Anderson in the Hunter catchment

Endangered Ecological Communities and Critical Habitat

The following endangered ecological communities as listed by the *TSC Act 1995* could occur within the study locality, and possibly in the study area if suitable habitat is available:

- Hunter lowland redgum forest in the Sydney basin and NSW north coast bioregions
- Swamp oak floodplain forest of the NSW north coast, Sydney basin and south east corner bioregions
- Swamp sclerophyll forest on coastal floodplains of the NSW north coast, Sydney basin and south east corner bioregions
- River-flat eucalypt forest on coastal floodplains of the NSW north coast, Sydney basin and south east corner bioregions
- Freshwater wetlands on coastal floodplains of the NSW north coast, Sydney basin and south east corner bioregions
- Quorrobolong scribbly gum woodland in the Sydney basin bioregion
- Warkworth sands woodland of the Sydney Basin Bioregion
- Lower Hunter spotted gum - ironbark forest in the Sydney basin bioregion
- Kurri sand swamp woodland in the Sydney basin bioregion
- White box yellow box Blakely's red gum woodland

An assessment of the likely presence of any of these ecological communities in the study area will be undertaken later in the report.

No critical habitat declared to date occurs within the study locality.

2.1.2 Fauna

Threatened Species

A total of 28 threatened terrestrial fauna species have previously been recorded within the study locality, comprising 15 bird and 13 mammal species. Of these, three species (black-necked stork, swift parrot and regent honeyeater) are currently listed as endangered on Schedule 1, Part 1 of the *TSC Act 1995* and the remainder as vulnerable on Schedule 2 of the Act. Five species are also listed in the Commonwealth EPBC Act (1999), three (swift parrot, regent honeyeater and spotted-tailed quoll) as endangered and two (large-eared pied bat and grey-headed flying-fox) as vulnerable. The regent honeyeater is also listed as a migratory species in the EPBC Act. The local threatened fauna species previously recorded in the locality are listed below in **Table 3**.

Table 3. Threatened Fauna previously recorded within the Study Locality

Scientific Name	Common Name	Status (TSC)	Status (EPBC)	Earliest/latest record	Number of records within 10km of site	Number of records within 2km of site
Birds						
<i>Callocephalon fimbriatum</i>	Gang-gang cockatoo	V	~	2004	1	0
<i>Calyptorhynchus lathami</i>	Glossy black-cockatoo	V	~	1977-2001	2	0
<i>Climacteris picumnus</i>	Brown treecreeper	V	~	2003-2005	6	3
<i>Ephippiorhynchus asiaticus</i>	Black-necked stork	E1	~	1999-2003	9	0
<i>Grantiella picta</i>	Painted honeyeater	V	~	1977	1	0
<i>Lathamus discolor</i>	Swift parrot	E1	E	2000-2005	6	0
<i>Lophoictinia isura</i>	Square-tailed kite	V	~	2006	1	0
<i>Melithreptus gularis gularis</i>	Black-chinned honeyeater (eastern subsp.)	V	~	2005	2	0
<i>Ninox connivens</i>	Barking owl	V	~	1977	1	0
<i>Ninox strenua</i>	Powerful owl	V	~	1977-2004	3	0
<i>Pomatostomus temporalis temporalis</i>	Grey-crowned babbler (eastern subsp.)	V	~	1993-2006	42	4
<i>Pyrrholaemus sagittatus</i>	Speckled warbler	V	~	1992-2005	13	3
<i>Stagonopleura guttata</i>	Diamond firetail	V	~	2005	1	0
<i>Tyto novaehollandiae</i>	Masked owl	V	~	2005	1	0
<i>Xanthomyza phrygia</i>	Regent honeyeater	E1	E,Mi	1977-2000	3	0
Flying Mammals						
<i>Chalinolobus dwyeri</i>	Large-eared pied bat	V	V	2005	1	0
<i>Falsistrellus tasmaniensis</i>	Eastern false pipistrelle	V	~	2002-2006	2	0
<i>Miniopterus australis</i>	Little bent-wing bat	V	~	2001-2006	2	0
<i>Miniopterus schreibersii oceanensis</i>	Eastern bent-wing bat	V	~	1994-2006	17	2
<i>Mormopterus norfolkensis</i>	East-coast freetail-bat	V	~	1994-2006	11	2
<i>Myotis macropus</i>	Southern myotis	V	~	1994-2006	3	0
<i>Pteropus poliocephalus</i>	Grey-headed flying-fox	V	V	2000-2005	13	4
<i>Scoteanax rueppellii</i>	Greater broad-nosed bat	V	~	2002	1	0
Non-flying Mammals						
<i>Dasyurus maculatus maculatus</i> (southeastern mainland population)	Spotted-tailed quoll	V	E	1980-2006	16	1
<i>Petaurus australis</i>	Yellow-bellied glider	V	~	2005	1	0
<i>Petaurus norfolcensis</i>	Squirrel glider	V	~	2000-2008	12	2
<i>Phascogale tapoatafa</i>	Brush-tailed phascogale	V	~	1995-2006	9	0
<i>Phascolarctos cinereus</i>	Koala	V	~	1980-2006	6	0

Notes:

329800E/6392100N and 338800E/6385200N are the approximate end coordinates of the subject site (Cessnock 9132 1:100000 mapsheet AGD66).

Status (TSC): refers to the NSW *Threatened Species Conservation Act 1995* (TSC)

- E1 Schedule 1, Part 1: Endangered Species
- V Schedule 2: Vulnerable Species

Status (EPBC): refers to the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC)

- E Endangered Species
- V Vulnerable Species
- Mi Migratory Species

Please note: These records are based on information supplied by the Department of Environment and Conservation and other sources, and may contain errors or omissions.

Endangered Fauna Populations

No listed endangered populations of fauna occur within the study locality.

2.1.3 EPBC Act Protected Matters Report

The EPBC Act Protected Matters Search Tool was accessed on 30th April 2008 to identify the Protected Matters under the Commonwealth EPBC Act that occur or may occur within the study locality. This review yielded a report listing the matters that could potentially be relevant under the EPBC Act for activities within the study area. The report below identifies matters that could potentially be relevant in any part of the study locality of 10 km radius around the subject site. The species or matters listed below may not necessarily be relevant to the study area or subject site itself.

Table 4. Summary of Potentially Relevant Matters under the Commonwealth EPBC Act 1999

Protected Matter	Potentially Relevant?	Details
Matters of National Environmental Significance		
Biodiversity		
Threatened Species - Flora	Yes	Four species: Species or species habitat likely to occur within area according to EPBC modeling. <i>Eucalyptus glaucina</i> Slaty red gum (V) <i>Eucalyptus pumila</i> Pokolbin mallee (V) <i>Prostanthera cineolifera</i> (V) Species or species habitat known to occur within area according to EPBC modeling. <i>Persoonia pauciflora</i> North Rothbury persoonia (CE) The likelihood of these species occurring in the study area, on the basis of available habitat, is assessed in Table 5 (Section 2.3.1).

Protected Matter	Potentially Relevant?	Details
Threatened Species – Fauna (Terrestrial Species only)	Yes	Eleven species: Species or species habitat may occur within area according to EPBC modeling. Australian painted snipe <i>Rostratula australis</i> (V) Brush-tailed rock-wallaby <i>Petrogale penicillata</i> (V) Eastern long-eared bat <i>Nyctophilus timoriensis</i> (V) Large-eared pied bat <i>Chalinolobus dwyeri</i> (V) Spotted-tail quoll <i>Dasyurus maculatus maculatus</i> (SE mainland population) (E) Swift parrot <i>Lathamus discolor</i> (E) Green and golden bell frog <i>Litoria aurea</i> (V) Species or species habitat likely to occur within area according to EPBC modeling. Hastings river mouse <i>Pseudomys oralis</i> (E) Regent honeyeater <i>Xanthomyza Phrygia</i> (E) Southern barred frog <i>Mixophyes iteratus</i> (E) Roosting known to occur within area according to EPBC modeling. Grey-headed flying-fox <i>Pteropus poliocephalus</i> (V) The likelihood of any of these species occurring in the study area, on the basis of available habitat, is assessed in Table 6 (Section 2.3.2).
Migratory Species (Terrestrial Species Only)	Yes	Eleven species : Species or species habitat likely to occur within area according to EPBC modeling. White-bellied sea eagle <i>Haliaeetus leucogaster</i> (Mi) Regent honeyeater <i>Xanthomyza Phrygia</i> (Mi, E) Species or species habitat may occur within area according to EPBC modeling. White-throated needletail <i>Hirundapus caudacutus</i> (Mi) Rainbow bee-eater <i>Merops ornatus</i> (Mi) Breeding may occur within area according to EPBC modeling. Black-faced monarch <i>Monarcha melanopsis</i> (Mi) Rufous fantail <i>Rhipidura rufifrons</i> (Mi) Breeding likely to occur within area according to EPBC modeling. Satin flycatcher <i>Myiagra cyanoleuca</i> (Mi) Wetlands Species Species or species habitat may occur within are according to EPBC modeling. Latham's snipe <i>Gallinago hardwickii</i> (Mi) Painted snipe <i>Rostratula benghalensis s. lat.</i> (Mi) Cattle egret <i>Ardea ibis</i> (Mi) Great egret <i>Ardea alba</i> (Mi) These species are addressed in Section 4.4.
Listed Marine Species	No	-

Protected Matter	Potentially Relevant?	Details
Invasive Species	Yes	Feral animals Species or species habitat may occur within area according to EPBC modeling. Water Buffalo <i>Bubalus bubalis</i> Goat <i>Capra hircus</i> Pig <i>Sus scrofa</i> Species or species habitat likely to occur within area according to EPBC modeling. Cane Toad <i>Bufo marinus</i> Cat <i>Felis catus</i> Rabbit <i>Oryctolagus cuniculus</i> Red fox <i>Vulpes vulpes</i> Weeds of national significance Species or species habitat may occur within area according to EPBC modeling. Alligator Weed <i>Alternanthera philoxeroides</i> Bridal Creeper <i>Asparagus asparagoides</i> Cabomba <i>Cabomba caroliniana</i> Serrated Tussock <i>Nassella trichotoma</i> Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow <i>Salix spp. except S.babylonica, S.x calodendron & S.x reichardtiji</i> Gorse <i>Ulex europaeus</i> Species or species habitat likely to occur within area according to EPBC modeling. Lantana <i>Lantana camara</i> Blackberry <i>Rubus fruticosus agg.</i> Bitou Bush, Boneseed <i>Chrysanthemoides monilifera</i> Salvinia <i>Salvinia molesta</i> Invasive Weeds Species or species habitat may occur within area according to EPBC modeling. Broom <i>Genista sp. X Genista monspessulana</i> African Boxthorn, Boxthorn <i>Lycium ferocissimum</i> Monterey Pine, Radiata Pine <i>Pinus radiata</i>
Whales and Other Cetaceans	No	-
Threatened Ecological Communities	Yes	One: Community likely to occur within area according to EPBC modeling. White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland (CE)
Heritage		
World Heritage Properties	Yes	None
Australian Heritage Places	Yes (natural places only)	One: Glendon Area NSW (glendonite rock outcrop, 44ha, 9km east of Singleton)

Protected Matter	Potentially Relevant?	Details
Wetlands (catchment areas for these wetlands occur within the study locality)		
Wetlands of International Significance (Ramsar sites)	Yes	One: Hunter Estuary Wetlands
Nationally Important Wetlands	Yes	None
National Pollutant Inventory		
Reporting Facilities	No	None are relevant to this site
Airsheds	-	None
Catchments	Yes	Hunter River, NSW
Protected Areas		
Reserves and Conservation Areas	Yes	None
Regional Forest Agreements	Yes	Lower North East NSW RFA, New South Wales

Notes:**V** Species listed as **Vulnerable** under the Commonwealth *EPBC Act*.**E** Species listed as **Endangered** under the Commonwealth *EPBC Act*.**CE** Species listed as **Critically Endangered** under the Commonwealth *EPBC Act*.**Mi** Species listed as **Migratory** under the Commonwealth *EPBC Act*.

The information compiled in relation to the floral and faunal habitats of the study site has been used in the determination of a list of threatened flora and fauna species that may be regarded as potential inhabitants of the site (i.e. potential subject species). This has been undertaken in Section 2.3 below.

2.2 Determination of Local Threatened Flora and Fauna as Potential Subject Species

A list of potential subject species has been compiled. Subject species are defined as those threatened species considered likely to occur in the habitats present within the study area according to the criteria for determining the list of such species given by DECC (2007). Therefore, such species could be potentially impacted by the proposal and would require formal assessment of impact unless their presence can be conclusively ruled out by appropriate field surveys.

2.2.1 Threatened Flora

An assessment of the relative likelihood of the threatened flora species previously recorded in the study locality occurring within the study area is provided below in **Table 5**. Species not recorded, but predicted to occur within the locality in the EPBC Act Protected Matters Report (Section 2.1.3), have also been included for consideration.

In this report, potential subject flora species are regarded as locally-occurring species listed on the TSC Act and/or EPBC Act that are rated as having at least a moderate likelihood of occurring in the study area in Table 5 below. On this basis, one of the locally occurring threatened flora species (*Eucalyptus glaucina*) and one species that forms an endangered population locally (*Eucalyptus camaldulensis* in the Hunter catchment) could be considered potential subject species based on the available habitat and presence of previous records in the locality. Regarding species not listed by legislation, none are considered to have greater than a low to moderate likelihood of occurring in the study area.

Table 5. Assessment of the Potential for Local Rare or Threatened Flora Species to occur within the Study Area

Scientific Name	Latest Record	Records Within	Preferred Habitat and Comments*	Habitat available	Potential to	ect Spec
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		10 km	2 km				
Threatened Species							
<i>Bothriochloa biloba</i>	1968	1	0	Woodland on poorer soils.	Possibly	Low, due to presence of only one record	-
<i>Eucalyptus camaldulensis</i> (river red gum)	2006	5	0	Grassy woodland or forest on deep alluvial soils near large bodies of permanent water.	Possibly	Moderate	√
<i>Eucalyptus glaucina</i> (slaty red gum)	2005	10	2	Locally frequent but very sporadic. Grassy woodland on deep, moderately fertile and well-watered soil.	Possibly	Moderate	√
<i>Eucalyptus pumila</i> (Pokolbin mallee)	No records – DEWHA habitat modelling only			Currently only known from a single population west of Pokolbin where it grows on north-west facing slopes on sandstone derived soils.	Very marginal	Low	-
<i>Persoonia pauciflora</i> (North Rothbury persoonia)	2005	48	0	Dry open spotted gum/ironbark forest or woodland with a sparse shrub layer and grassy understorey. Only known from a 2.5km radius around North Rothbury.	Possibly	Low, due to limited distribution of species	-
<i>Prostanthera cineolifera</i> (Singleton mint bush)	No records – DEWHA habitat modelling only			Open woodland on exposed sandstone ridges. Usually associated with shallow or skeletal sands. Restricted to a few localities near Walcha, Scone and St Albans.	Possibly	Low, due to lack of records	-
ROTAP Only Species							
<i>Acacia bulgaensis</i>	2002	1	0	Restricted to the Bulga-Milbrodale-Broke area where it grows on sandstone or shale in sclerophyll forest/woodland. May become locally dominant in some exposed rocky situations and form monotypic stands.	Unlikely	Low, due to presence of only one record	
<i>Eucalyptus fergusonii</i> subsp. <i>fergusonii</i>	2005	6	0	Scattered and sporadic, in wet sclerophyll forest or woodland on sandy soils.	Possibly	Low, due to low numbers of records	
<i>Grevillea montana</i>	2005	40	0	Open forest in sandy soils over mixed sedimentary substrates.	Possibly	Low to Moderate	
<i>Macrozamia flexuosa</i>	2006	31	0	Scattered in sclerophyll forests on siliceous soils.	Possibly	Low to Moderate	

Notes for Table 5

*compiled primarily from Harden (1990-2002), Harden & Murray (2000) and DECC threatened species information.

^a**Note** – Species rated as having a moderate or better likelihood of occurring are regarded as potential subject species if listed by legislation. Species listed by ROTAP only are not eligible to be subject species.

2.2.2 Threatened Fauna

An assessment of the likelihood of the threatened fauna species previously recorded in the study locality occurring within the subject site is provided below in **Table 6**. Species not recorded, but

predicted to occur within the locality in the EPBC Act Protected Matters Report (Section 2.1.3), have also been included for consideration.

Table 6. Assessment of the Potential for Local Threatened Fauna Species to occur within the Study Area

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2 km		Breeding	Roosting	Foraging		
Birds									
Gang-gang cockatoo	2004	1	0	Tall montane forests and woodlands in summer, moving to lower altitudes in winter, preferring more open eucalypt forest and woodland, including coastal areas. Nest during the summer in trunk and limb hollows in large mature trees, often in live trees close to water.	N?	-	N?	Unlikely	-
Glossy black-cockatoo	2001	2	0	Coastal woodlands and dry eucalypt forests to open inland woodlands and forested watercourses. Requires particular food trees (She-oaks, particularly <i>Allocasuarina torulosa</i>) and large tree hollows for nesting.	N?	-	Y?	Limited potential	√
Brown treecreeper	2005	6	3	Eucalypt forests, woodlands and scrubs of the drier areas, river-edge trees, timbered paddocks. Occasionally coastal plains and ranges, though predominantly found on inland plains and inland slopes of the Great Dividing Range.	N?	-	Y?	Moderate	√
Black-necked stork	2003	9	0	Inhabits permanent freshwater wetlands including margins of billabongs, swamps, shallow floodwaters, and adjacent grasslands and savannah woodlands; can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water on a variety of prey including fish, frogs, eels, turtles, crabs and snakes. Breeds in late summer in the north, and early summer further south. A large nest, up to 2 m in diameter, is made in a live or dead tree, in or near a freshwater swamp.	N	-	N	No	-
Painted honeyeater	1977	1	0	Dry forest and woodland. Primarily feeds on fruit of Mistletoe <i>Amyema</i> spp., also nectar and insects. Most common on the western slopes and plains. The habitat on site is marginal for this species.	N	-	Y?	Potential seasonal visitor	√
Swift parrot	2005	6	0	The migratory nature of these species makes them difficult to assess. Known to frequent sclerophyll forest and woodlands with winter flowering trees (eg. spotted gum, red ironbark, <i>Eucalyptus crebra</i> and <i>E. siderophloia</i> , forest red gum and swamp mahogany) on an opportunistic basis along the coast and ranges of NSW. The habitat on site is marginal for this species.	N	-	Y?	Potential seasonal visitor	√

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2 km		Breeding	Roosting	Foraging		
Square-tailed kite	2006	1	0	Specialised canopy predator, feeding on small birds, eggs and insects. Primarily hunts over open forest, woodlands and mallee communities that are rich in passerines, as well as over adjacent heaths and other low scrubby habitats and in wooded towns. Appears to prefer a structurally diverse landscape.	?	?	Y	Potential foraging	✓
Black-chinned honeyeater	2005	2	0	Dry eucalypt savannah woodland and forest with an annual rainfall range of 400-700mm, particularly with box-ironbark associations and River Red Gums. Considered to be locally nomadic requiring remnants of greater than 200ha in area. Forages within foliage and bark of eucalypt trees on spiders, insects, lerp and nectar.	Y?	-	Y	Moderate	✓
Barking owl	1977	1	0	Open forests, woodlands, dense scrubs, foothills and paperbark swamps. Favours dense creeklines with river red gums and other large trees in open country. Feeds on a variety of vertebrate and invertebrate fauna. Requires large hollows for nesting.	N?	N?	Y	Limited potential (foraging only)	✓
Powerful owl	2004	3	0	Occurs in open forest and woodland, roosting in dense tree foliage, often in riparian situations. Prefers well developed tall forest with large tree hollows for nesting. Feeds on possums, gliders, birds and fruit-bats.	N?	N?	Y	Moderate	✓
Grey-crowned babbler	2006	42	4	Open eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. May also be observed along streams in cleared areas and grassy road verges. Conspicuous large communal nests/roosts are constructed out of twigs. Raucous groups of 2-13 individuals foraging for insects in all substrates.	Y?	-	Y	High	✓
Speckled warbler	2005	13	3	Open timbered eucalypt woodlands, preferably where ground cover consists of grass, fallen leaves and bark. This species forages on insects and small seeds.	Y?	-	Y	High	✓
Diamond firetail	2005	1	0	Open forest with a grassy groundcover, woodland, mallee, acacia scrub lands and timber belts along watercourses and roadsides.	Y?	-	Y	Moderate	✓
Masked owl	2005	1	0	Predominantly forages for terrestrial prey, such as rats and small rabbits within a mosaic of open woodland/forest habitats and on the edge of cleared land. Roosts and nest in large tree hollows although will also roost in dense vegetation and caves.	Y?	Y?	Y	Moderate	✓
Regent honeyeater	2000	3	0	Box-ironbark eucalypt associations, though uses other woodland types and wet lowland coastal forest in times of food shortage. The wandering nature of this species makes it difficult to assess. Known to frequent areas with densely blossoming winter-flowering trees (eg. Spotted Gum, Red Iron bark, Forest Red Gum and Swamp Mahogany) on an opportunistic basis along the coast and ranges of NSW.	N	-	Y?	Potential seasonal visitor	✓

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2 km		Breeding	Roosting	Foraging		
Australian painted snipe	No records – DEW habitat modelling only			Permanent and temporary shallow inland and coastal wetlands (can be freshwater or brackish), particularly where there is a cover of vegetation. Individuals have been known to use artificial wetlands (such as sewage ponds, dams and water-logged grasslands).	N	-	N	No	-
Turquoise parrot	No records – potentially suitable habitat occurs within the locality			Open eucalypt woodland or forest with a grassy or sparsely shrubby understorey. Favours grasslands on the edge of these habitat types, particularly timbered grassland on mountain slopes and ridges. Feeds on seeds of native and introduced grasses and other herbs. Requires suitable hollows in tree limbs, logs or fence posts for breeding.	Y?	-	Y	Moderate	✓
Hooded robin	No records – potentially suitable habitat occurs within the locality			Prefers open areas adjacent to large blocks of woodland, particularly with areas of dead timber and sparse shrub cover. Also recorded in open forests and acacia shrublands.	Y?	-	Y	Moderate	✓
Grass owl	No records – potentially suitable habitat occurs within the locality			Found in areas of tall grass, including swampy areas, grassy plains and heath. Also found in areas of tall sedges on floodplains. Roost and nest on trampled down platforms of grass.	Y?	-	Y	Moderate	✓
Flying Mammals									
Large-eared pied bat	2005	1	0	Range of well-wooded habitats, including dry sclerophyll forests and woodlands of coastal and semi-arid areas. Occasionally in sub-alpine woodlands and at the edge of rainforest and semi-arid areas. Reliant on suitable roosting habitat including caves and mine tunnels (though may use other structures, eg. abandoned Fairy Martin nests).	N	N	N?	Unlikely	-
Eastern false pipistrelle	2006	2	0	Tall forest, woodland or heath/ grassland edges. Observed to roost in the hollow trunks of the largest trees and sometimes buildings.	Y?	Y	Y	Moderate	✓
Little bentwing-bat	2006	2	0	Forages in a range of habitats, including forest, woodland, heath, coastal swamps and rainforest. A nightly foraging range of 20km from roost sites has been reported. Reliant on suitable roosting habitat in caves and mine tunnels, though has been recorded roosting in hollowed out tree bases and dense foliage.	N	Y	Y	Moderate	✓
Eastern bentwing-bat	2006	17	2	Forages within a variety of habitat types including moist and dry eucalypt forest, woodland, rainforest, heath and open environments, including urban areas. Reliant on suitable roosting/breeding habitat in caves and mine tunnels, though will also roost in stormwater channels, road culverts and other comparable structures (including buildings). Estimated nightly foraging range of 20+ km.	N	Y	Y	High	✓

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2 km		Breeding	Roosting	Foraging		
East-coast freetail-bat	2006	11	2	The habitat preference of this species is unclear. It has been predominantly recorded in dry eucalypt forest and woodland, but has been recorded in moist and edge environments. The wing morphology indicates that this species is adapted to more open habitats or above the tree canopy. This species primarily roosts in tree hollows, although the roofs of buildings are also used.	Y?	Y	Y	Moderate	✓
Southern myotis	2006	3	0	Habitats adjacent to large bodies of water for hunting aquatic insects. Usually forages over or adjacent to water-bodies and associated terrestrial habitats. Roosts in caves, mines, tunnels, bridges, culverts and tree hollows.	N	Y	Y	Moderate	✓
Grey-headed flying-fox	2005	13	4	Regularly occurs along the eastern coastal plain through NSW. Roosts in camps, usually in dense riparian habitats. At dusk disperses in search of the preferred food source, mainly Eucalypt blossom and rainforest fruits. Long distances are covered (30+km) in search of food.	N	N	Y	High (foraging only)	✓
Greater broad-nosed bat	2002	1	0	Forages for insects over a range of natural and altered habitats, including tall forest, woodland or heath/grassland edges, often along the tree line boundary. Prefers tree hollows in large, often isolated, mature trees for roosting. Usually associated with tall moist open forest.	Y?	Y	Y	Moderate	✓
Eastern long-eared bat	No records – DEW habitat modelling only			Eastern long-eared bat roost in tree hollows and fissures. On the mainland, this species is known from tall eucalypt forest as well as mallee, open savanna and black box woodland. Appear to have a preference for semi-arid areas.	Y?	Y?	Y?	Unlikely	-
Yellow-bellied sheathtail-bat	No records – potentially suitable habitat occurs within the locality			Wide range of habitats, including open forest. Forages above the canopy in wooded areas and lower down in more open areas or along creeklines. Reliant on suitable trees with hollows for roosting.	Y?	Y	Y	Moderate	✓
Non-flying Mammals									
Spotted-tailed quoll	2006	16	1	Inhabits a variety of habitat types from moist and wet sclerophyll through to dry forests and woodlands on the edge of open grasslands. Requires large hollowed logs on the ground for den sites. Use a large home range within extensive areas of bushland.	N	-	Y?	Limited potential	✓
Yellow-bellied glider	2005	1	0	Occurs in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Den, often in family groups, in hollows of large trees. Very mobile and occupy large home ranges between 20 to 85 ha to encompass dispersed and seasonally variable food resources. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein.	N	N	N	Unlikely	-

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2 km		Breeding	Roosting	Foraging		
Squirrel glider	2008	12	2	Usually inhabits dry open sclerophyll forest and woodlands, but has also been observed in moist regenerating forest and moist gullies. Forages on Acacia gum, Eucalypt sap, nectar, honeydew, manna invertebrates and pollen, utilising areas with an abundance of flowering eucalypts and tall shrubs (eg. Banksias). Acacia species are the preferred sap feeding trees. This species requires an abundance of suitably sized hollow-bearing trees.	Y?	Y?	Y	High	√
Brush-tailed phascogale	2006	9	0	Found in dry sclerophyll open forests and woodlands, with a preference for sparse ground cover. Also inhabits heath, swamps, rainforest and wet sclerophyll forest. Requires large areas of intact habitat. Nests and shelters in tree hollow.	Y?	Y?	Y?	Moderate	√
Koala	2006	6	0	Forest and woodland habitats that contain suitable regional eucalypt feed trees. In the locality, the forest red gum is a listed food trees in SEPP 44.	?	-	Y	Limited potential	√
Brush-tailed rock-wallaby	No records – DEW habitat modelling only		Rock-wallabies are restricted to rock outcrops containing suitable caves and tunnels within rock boulders for daytime shelter. Forage on grasses and herbs in adjacent forests/woodlands and farmland. Limited foraging areas occur on site and 2km from known cliff habitat		N	N	N	No	-
Hastings River mouse	No records – DEW habitat modelling only		Known from habitat near creeklines within open eucalypt forest with dense ground cover of sedges, grasses and/ or ferns.		N	N	N	No	-
Frogs									
Green and golden bell frog	No records – DEW habitat modelling only		Inhabits marshes, dams and stream-sides, particularly those containing bullrushes (<i>Typha</i> spp.) or spikerushes (<i>Eleocharis</i> spp.). Optimum habitat includes water-bodies that are unshaded, free of predatory fish such as plague minnow (<i>Gambusia holbrooki</i>), have a grassy area nearby and diurnal sheltering sites available. Some sites, particularly in the Greater Sydney region occur in highly disturbed areas. The species is active by day and usually breeds in summer when conditions are warm and wet. Males call while floating in water and females produce a raft of eggs that initially float before settling to the bottom, often amongst vegetation. Tadpoles feed on algae and other plant-matter; adults eat mainly insects, but also other frogs. Preyed upon by various wading birds and snakes.		N?	-	N?	Limited potential	√

Common Name	Most Recent Record	Closest Records		Preferred Habitat and Comments*	Habitat available on site			Potential to utilise study area	Subject Species
		10 km	2 km		Breeding	Roosting	Foraging		
Giant (southern) barred frog	No records – DEW habitat modelling only			Giant barred frogs forage and live amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams from late spring to summer. Females lay eggs onto moist creek banks or rocks above water level, from where tadpoles drop into the water when hatched. Tadpoles grow to a length of 80 mm and take up to 14 months before changing into frogs. When not breeding the frogs disperse hundreds of metres away from streams. They feed primarily on large insects and spiders.	N	N	N	No	-

*Compiled from: Australian Museum Fact Sheets; Barrett et al. 2003; Churchill, 1998; Cogger, 1995; Garnett & Crowley, 2000; DECC threatened species information; Strahan, 2002.

√ most potential to occur and therefore a potential subject species.

? it is uncertain, though considered unlikely that suitable habitat may be available.

Of the 38 threatened fauna species assessed in the above table, 29 are considered to be potential or likely subject species and these are listed in **Section 2.3.3** below.

2.2.3 Potential Threatened Species, Endangered Populations and Endangered Ecological Communities to be assessed

The following statutory-listed species and ecological communities that were considered to have at least a moderate likelihood of occurrence in **Section 2.3.1** and **2.3.2** above are considered to have potential to occur within the study area and are considered to be potential subject species in this assessment. Species that were rated as having a “low to moderate” or lower likelihood of occurring are not included. Migratory species are discussed under the EPBC Act in **Section 4.1.2**.

Flora

Eucalyptus glaucina – slaty red gum (Vulnerable – TSC and EPBC Acts)

Eucalyptus camaldulensis – river red gum (Endangered Population in the Hunter Catchment)

Fauna

The following threatened fauna species have potential to at least forage within the study area;

- Glossy black cockatoo
- Black-chinned honeyeater
- Barking owl
- Masked owl
- Square-tailed kite
- Speckled warbler
- Turquoise parrot
- Hooded robin
- Brown treecreeper
- Painted honeyeater
- Powerful owl
- Swift parrot
- Grey-crowned babbler
- Regent honeyeater
- Diamond firetail
- Grass owl

-
- | | |
|------------------------------|----------------------------------|
| - Eastern bentwing-bat | - Little bentwing-bat |
| - Greater broad-nosed bat | - East-coast freetail-bat |
| - Southern myotis | - Yellow-bellied sheath-tail-bat |
| - Grey-headed flying-fox | - Eastern false pipistrelle |
| - Spotted-tailed quoll | - Brush-tailed phascogale |
| - Squirrel glider | - Koala |
| - Green and golden bell frog | |

Endangered Ecological Communities

- Hunter lowland redgum forest
- River-flat eucalypt forest on coastal floodplain
- Swamp-oak floodplain forest
- Swamp sclerophyll forest on coastal floodplain
- Freshwater wetlands on coastal floodplains
- Lower Hunter spotted gum - ironbark forest
- White box yellow box Blakely's red gum woodland

Field survey techniques were designed to adequately target these subject species, populations and ecological communities and are discussed in **Section 3**. The potential impacts on these subject species and communities as a result of the proposal are formally assessed in **Section 4** of this report.

3.0 SECOND STAGE ECOLOGICAL INVESTIGATION – FIELD SURVEYS

3.1 Floral Investigations

3.1.1 Methodology

Field surveys were undertaken on 22nd and 30th April 2008 to document the flora and vegetation communities within the private properties or lands alongside and outside of the existing railway easement on both sides. The area of land surveyed generally consisted of a strip of land along the railway easement boundary encompassing the outermost limit of potential disturbance due to the proposal, which for most of its length was no greater than 50 m from the railway easement boundary. Major additional areas within the project area which were surveyed included the deviation areas for the realigned Golden Highway and Range Road overpasses. Additional widened areas or minor projections from the project area for the purposes of drainage shaping etc. were also surveyed.

The surveys were undertaken on foot and took the form of a random meander or irregular transect within the study area, along the existing railway easement. Grid references were taken with a hand-held GPS (5-10m accuracy) of points where changes in vegetation types occurred or any threatened or significant flora species or other flora features were detected.

Greater survey effort was expended in areas where natural vegetation occurred and/or areas where threatened or significant flora species were detected or possible due to the presence of suitable habitat. A targeted search was carried out in areas of suitable habitat for each of the subject flora species. The possible presence of any rare or significant flora species was also considered during the survey.

At least one 400m² quadrat was examined within a representative part of each natural vegetation community type. Information recorded from the quadrats included all vascular flora species, the structure and condition of the community and relevant environmental data.

Small samples of any plant species that could not be identified in the field were obtained for further examination and identification, particularly any species that may be threatened or significant (if such specimens could be obtained).

The results from these surveys supplemented the results from surveys undertaken on 30th October 2007 within the railway easement itself for the route options investigations phase of the project (full details of these surveys are given in Ecotone Ecological Consultants, 2007).

The flora survey methods were considered to be compliant with current best practice Flora Survey Guidelines for a full impact assessment, such as those endorsed by local councils in the Lower Hunter area (LHCCREMS 2002).

3.1.2 Survey Limitations

The areas that were entirely cleared of natural vegetation including all but scattered trees and consisted of open pasture (as determined from the route options investigations and aerial photographs) were not surveyed during the current field work. Most of the study area west of the Golden Highway overpass fell into this category. It is considered very unlikely that threatened flora species, endangered flora populations or EECs occur in these areas, apart from those previously identified during the field work for the route options assessment.

3.1.3 Results

Vegetation Communities

Three broad natural vegetation community types and three artificial, derived or cultivated vegetation community types were found to occupy the study area:

Natural Communities

1. Ironbark - Spotted Gum – Grey Box Woodland / Open Forest
2. Red Gum – Grey Box Woodland / Open Forest
3. Red Gum – Swamp Oak Riparian Forest

Artificial Communities

4. Plantations
5. Derived Open Pasture – Grassland / Weedy areas
6. Wet Soak Areas

Distributions of the vegetation communities are shown in **Figure 3** and descriptions of the structure and floristics of the natural communities within the site are given in **Table 7**.

Comparison with Regional Vegetation Mapping

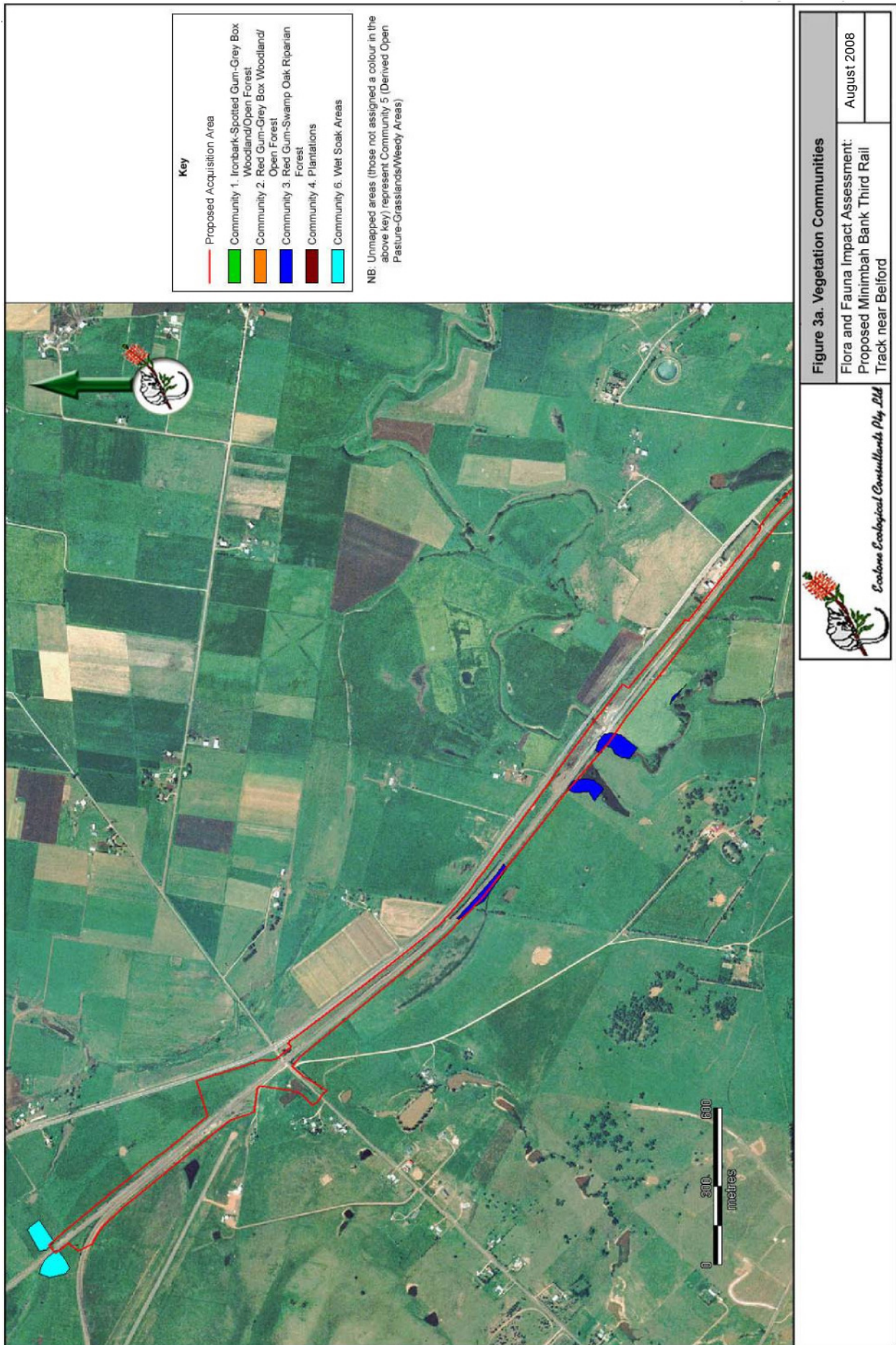
The regional mapping of vegetation in the Central Hunter Valley for the Hunter Remnant Vegetation Project (HRVP) (Peake 2006) shows the remnant vegetation occurring within the study area as comprising three Map Units:

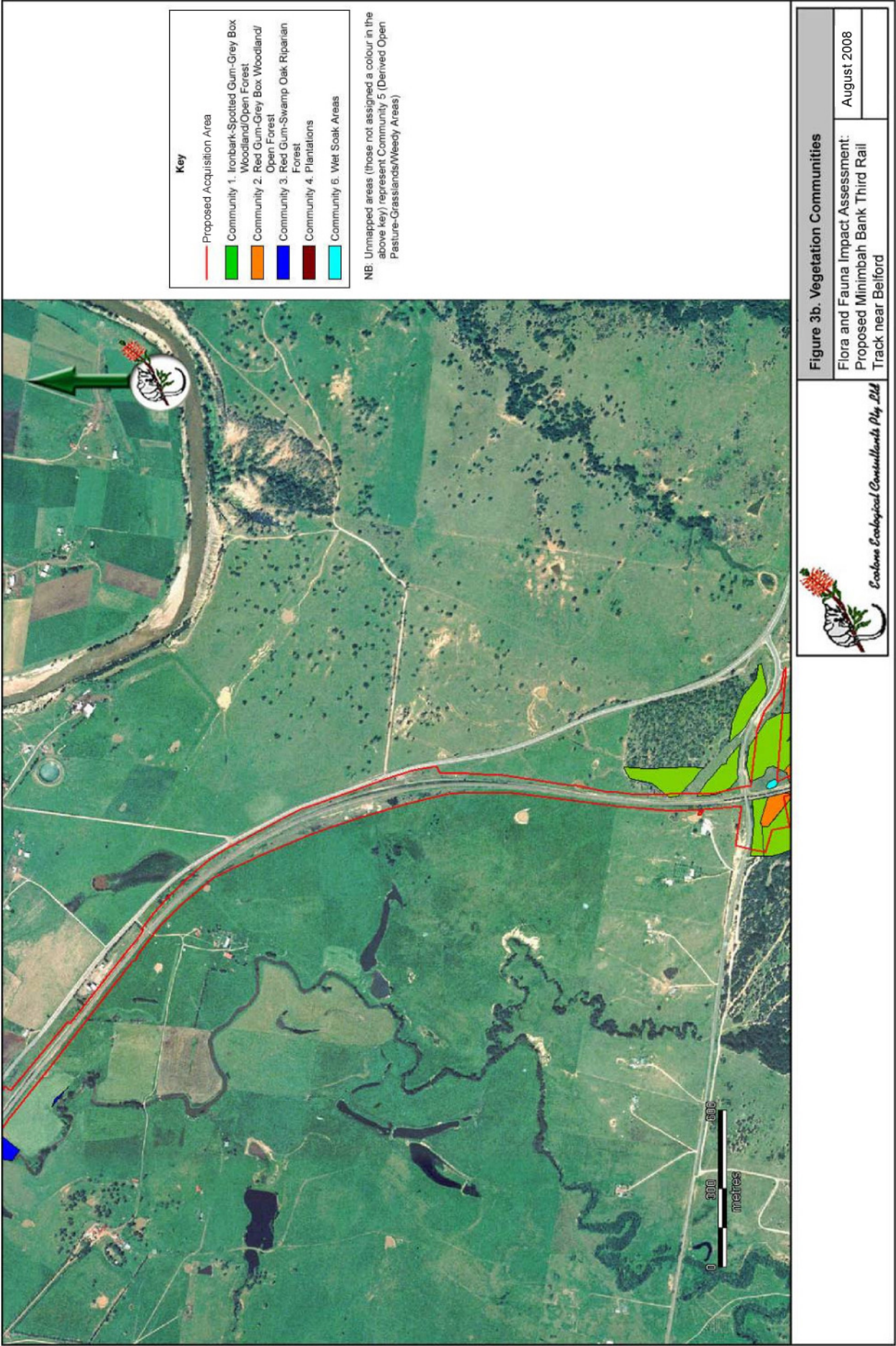
- MU 24: Hunter Lowlands Redgum Forest
- MU 27: Central Hunter Ironbark – Spotted Gum – Grey Box Forest
- MU 28: Central Hunter Swamp Oak Forest

The regional mapping appears to be broadly correct for the study area at the scale at which it was done, but individual patches from this study may be classified slightly differently due to the finer scale at which this study was undertaken. One notable difference is that some areas mapped by the regional mapping as MU 27 (Central Hunter Ironbark – Spotted Gum – Grey Box Forest) would be more appropriately classified as MU 24 (Hunter Lowlands Redgum Forest), but at the scale of the regional mapping these areas are relatively small.

The HRVP Map Units that are considered to most closely correspond to the vegetation units from this study are as follows:

- Community 1 – MU 27
- Community 2 – MU 24
- Community 3 – MU 28 with elements of MU 24
- Communities 4, 5 and 6 – Shown as blank





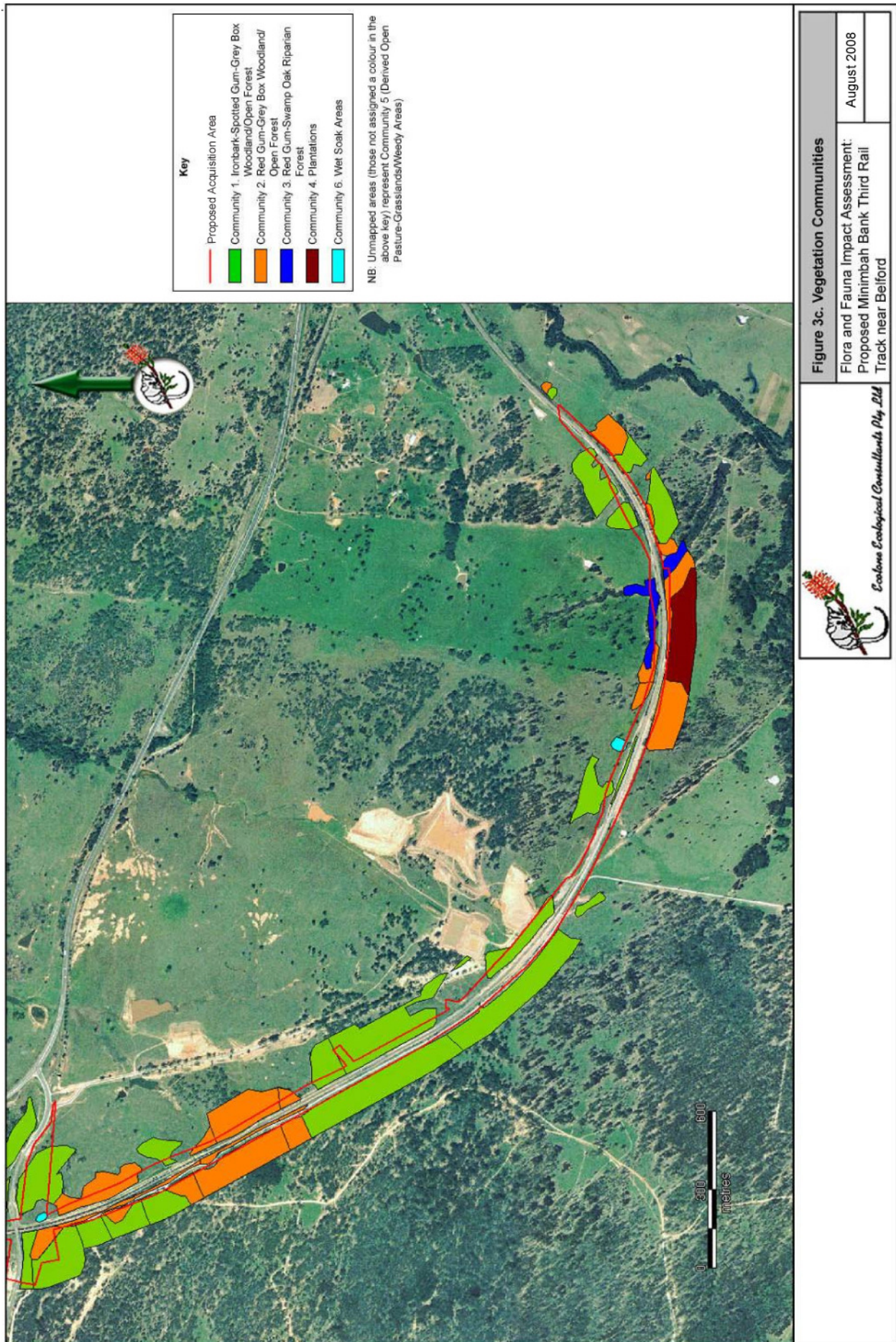


Table 7. Descriptions of the vegetation communities within the study area

Stratum	Height	% cover*	Dominant species	Comments
Community 1: WOODLAND / OPEN FOREST: Ironbark - Spotted Gum - Grey Box				
Tree layer	20 – 25 m	15 – 30	<i>Corymbia maculata</i> <i>Eucalyptus crebra</i> <i>E. moluccana</i>	<u>Habitat</u>: Well-drained slopes and the more elevated areas, including ridgetops. <u>Structure/Characteristics</u>: Woodland to open forest dominated by species adapted to or tolerant of drier or well-drained conditions. <u>Distribution within Study Area</u>: Occurs as a number of large, discontinuous remnants collectively accounting for the largest area of natural vegetation within the study area, from just west of the Golden Highway overpass to the eastern limit of the study area. <u>Condition & Presence of Weeds</u>: Most patches of the community are generally in a modified condition, with varying degrees of clearing and/or underscrubbing. The level of weed invasion is generally low, apart from edge areas. In many patches the tree layer only remains. <u>Conservation Status</u>: Although some elements characteristic of the EEC 'Lower Hunter spotted gum -ironbark forest', occur within the community, the relative abundance of particular tree layer and understorey species indicate that the community within the study area is not the EEC. This is discussed in detail in the text. Some patches of the community contain the ROTAP species <i>Grevillea montana</i>.
Shrub layer	1 – 3 m	0 – 30	<i>Acacia falcata</i> <i>Cassinia aculeata</i> <i>Ozothamnus diosmifolius</i> <i>Pultenaea spinosa</i>	
Ground layer	To 1 m	20 – 50	<i>Austrodanthonia</i> sp. <i>Brunoniella australis</i> <i>Cheilanthes sieberi</i> <i>Calotis lappulacea</i> <i>Chrysocephalum apiculatum</i> <i>Dichondra repens</i> <i>Enchylaena tomentosa</i> <i>Eremophia debilis</i> <i>Grevillea montana</i> <i>Lachnagrostis filiformis</i> <i>Lomandra filiformis</i> <i>L. multiflora</i> <i>Themeda australis</i> <i>Tricoryne elatior</i> <i>Vernonia cinerea</i> <i>Wahlenbergia communis</i>	
Climbers/ Twiners	-	-	<i>Glycine tabacina</i> <i>Hardenbergia violacea</i> <i>Desmodium varians</i>	



*projective foliage canopy cover

Table 7, continued . . .

Stratum	Height	% cover*	Dominant species	Comments
Community 2: WOODLAND / OPEN FOREST: Red Gum – Grey Box				
Tree layer	20 – 25 m	15 – 30	<i>Eucalyptus tereticornis</i> <i>E. glaucina</i> <i>E. moluccana</i> <i>E. crebra</i>	Habitat: Lower slopes, drainage lines, shallow gully and upper floodplain areas with restricted drainage adjoining riparian areas. Structure/Characteristics: Woodland to open forest dominated by species adapted to or tolerant of moister or less well-drained conditions. Distribution within Study Area: Occurs as a set of discontinuous patches tending to alternate with Community 1 depending on topography, east from the Golden Highway overpass to the eastern end of the study area. Condition & Presence of Weeds: Most patches of the community are generally in a modified condition, with varying degrees of clearing and/or underscrubbing. The level of weed invasion is generally low, apart from edge areas. Conservation Status: The habitat of the community together with the particular assemblage of species according to the Final Determination (NSW Scientific Committee 2002a) indicates that the community qualifies as the EEC 'Hunter lowland redgum forest' under the NSW TSC Act. The vulnerable <i>Eucalyptus glaucina</i> occurs within the community.
Sub-canopy layer	6 – 12 m	0 – 20	<i>Allocasuarina leuhmanii</i> <i>A. littoralis</i>	
Shrub layer	2 – 5 m	5 – 30	<i>Exocarpus cupressiformis</i> <i>Jacksonia scoparia</i> <i>Acacia falcata</i> <i>A. irrorata</i>	
Ground layer	To 1 m	30 – 60	<i>Austroanthonia</i> sp. <i>Cheilanthes sieberi</i> <i>Daviesia ulicifolia</i> <i>Desmodium varians</i> <i>Dichondra repens</i> <i>Lachnagrostis filiformis</i> <i>Lagenophora stipitata</i> <i>Lomandra</i> spp. <i>Panicum simile</i> <i>Poa labillardierei</i> <i>Pratia purpurascens</i> <i>Solanum prinophyllum</i> <i>Themeda australis</i> <i>Vernonia cinerea</i> <i>Wahlenbergia communis</i>	
Climbers / Twiners	-	-	<i>Polymeria calycina</i> <i>Glycine tabacina</i> <i>Marsdenia rostrata</i>	



*projective foliage canopy cover

Table 7, continued . . .

Stratum	Height	% cover*	Dominant species	Comments
Community 3: RIPARIAN FOREST: Red Gum – Swamp Oak				
Tree layer	0 – 25 m	0 – 40	<i>Eucalyptus tereticornis</i> <i>Angophora floribunda</i>	Habitat: Floodplains, banks and fringe areas of creeks, major drainage lines and watercourses. <u>Structure/Characteristics</u>: Forest to open forest associated with streams and watercourses. Dominated by trees and/or shrubs adapted to or tolerant of wet or waterlogged conditions. Swamp oaks, sedges, reeds, rushes and aquatic plants common. <u>Distribution within Study Area</u>: Occupies narrow linear areas directly associated with creeks and watercourses, mainly in the eastern part of the study area, with remnant occurrences in the western part. <u>Condition & Presence of Weeds</u>: The community has been modified to varying degrees by clearing and underscrubbing in parts, and is partially invaded by weeds <u>Conservation Status</u>: The habitat of the community together with the particular assemblage of species according to the Final Determination indicates that the community qualifies as a marginal form of the EEC 'River-flat eucalypt forest on coastal floodplains' (NSW Scientific Committee 2004a).
Sub-canopy layer	5 – 15 m	0 – 75	<i>Casuarina glauca</i> <i>Acacia irrorata</i> <i>Melaleuca linariifolia</i>	
Shrub layer	1 – 2 m	10 - 90	<i>Bolboschoenus caldwellii</i> <i>Dianella caerulea</i> <i>Eleocharis cylindrostachys</i> <i>Persicaria hydropiper</i> <i>Phragmites australis</i> <i>Typha orientalis</i>	
Ground layer	To 1 m	30 – 80	<i>Commelina cyanea</i> <i>Cheilanthes sieberi</i> <i>Cymbopogon refractus</i> <i>Cynodon dactylon</i> <i>Desmodium varians</i> <i>Dichondra repens</i> <i>Geranium solanderi</i> <i>Hydrocotyle peduncularis</i> <i>Microlaeana stipoides</i> <i>Oplismenus aemulus</i> <i>Pratia purpurascens</i>	
Aquatic plants	Water surface	-	<i>Azolla filiculoides</i> <i>Marsilea hirsuta</i> <i>Spirodela punctata</i> <i>Triglochin procerum</i>	
Vines / twiners	-	-	<i>Cayratia clematidea</i> <i>Clematis aristata</i> <i>Glycine tabacina</i>	



*projective foliage canopy cover

Table 7, continued . . .

Community 4: Plantations	
This community occurs in a single location within the study area, south of the existing railway line. One olive plantation occurs at the eastern end of the study area, close to the railway easement boundary. The community consists of rows of artificially planted olive trees and has no natural floristic conservation value.	
Community 5: Derived Open Pasture – Grassland / Weedy areas	
In total, this community occupies the largest portion of the study area. It is the predominant community in the western half of the study area and consists of either grazed pasture composed of exotic or native pasture grasses and minor herbs; or derelict weedy areas from which trees and shrubs have generally been cleared. Most of the area within the railway easement is characterised by the latter form, whilst private grazing land characterises the derived open pasture form. The community has no floristic conservation value, but could provide habitat for certain native fauna groups, particularly birds.	
Community 6: Wet Soaks	
This is a minor community which occurs in two distinct patches in the study area, both to the north of the existing railway easement and east of the Golden Highway overpass. Additional areas of poor drainage that are too small to map also have the characteristics of this community. The community is artificially derived since it has been formed as a result of impeded drainage due to earthworks and consequent blocking of natural drainage lines. It is permanently waterlogged and dominated by rushes such as <i>Juncus</i> and sedges. The community has no specific floristic value according to legislation, but could provide habitat for certain native fauna groups, particularly frogs.	

Floral Diversity

Flora species diversity was found to be moderate within the study area, with 191 flora species from 69 families being identified. This total included four ferns, 132 dicotyledons and 55 monocotyledons. A high proportion of the flora was exotic. Of the total species recorded, 82 species of introduced flora were identified, representing approximately 43% of the total species.

A list of all flora species recorded and identified from within the study area is included as **Appendix 1**.

Condition of the Vegetation and Presence of Weeds

The vegetation within the railway easement part of the study area in particular is highly cleared, in poor condition and very weedy. Very little natural vegetation remains in this area. Vegetation condition is generally much better in the private properties, apart from particular highly cleared and disturbed areas. Native vegetation in all areas is modified and limited to trees, swamp or riparian species and robust native shrub and ground layer species. In particular, the western section of the study area (generally west of the Golden Highway crossing) is the most highly cleared and disturbed with very little if any native vegetation remaining in this section.

Native vegetation in the eastern section is mainly restricted to partially cleared and/or under-scrubbed remnants subject to grazing and other disturbances. Due to the absence of grazing, the most intact areas of native vegetation occur within the Singleton Army Training Area, although this property also contained the greatest abundance of weeds, including noxious species. Some patches of vegetation within private property which were not heavily grazed and had not been subject to recent clearing or under-scrubbing were found to be in relatively good condition.

All vegetation within the railway easement is subject to frequent modification in the form of easement maintenance, and is subject to constant edge effects, including nutrient-rich runoff and dispersal of weed seeds by transport activities.

Eleven of the species recorded in the study area are declared Noxious Weeds in the Upper Hunter County Council control area, pursuant to the *Noxious Weeds Act 1993*. These, together with their relevant control classes, are:

- Annual ragweed (*Ambrosia artemisiifolia*) – Class 5
- Bathurst burr (*Xanthium spinosum*) – Class 4
- Blackberry (*Rubus fruticosus* sp. aggr.) – Class 4
- Mexican poppy – (*Argemone ochroleuca*) – Class 5
- Mother of millions – (*Bryophyllum delagoense*) – Class 3
- Paterson's curse – (*Echium plantagineum*) – Class 4
- Common prickly pear (*Opuntia stricta* var. *stricta*) – Class 4
- Tiger pear (*Opuntia aurantica*) – Class 4
- Shamrock oxalis (*Oxalis articulata*) – Class 5
- Sweet briar (*Rosa rubiginosa*) – Class 4
- Weeping willow (*Salix babylonica*) – Class 5

Explanations of the relevant control categories are as follows:

- Class 3: Regionally Controlled Weeds: The plant must be fully and continuously suppressed and destroyed.
- Class 4: Locally Controlled Weeds: 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. Management plans for most of the above weeds and general advice about control of all Class 4 noxious weeds in the Upper Hunter County Council control area is available from the website for the Upper Hunter Weeds Authority at <http://www.muswellbrook.nsw.gov.au/Weeds/index.html>
- Class 5: Restricted Plants: The requirements in the *Noxious Weeds Act 1993* for a notifiable weed must be complied with. See **Appendix 2** for further details.

Most of the noxious weeds identified had a trace presence within the subject site only or were present in very restricted areas within the site. Because of the lack of grazing, prickly pear and tiger pear were relatively abundant in the Singleton Military Training Area and the parts of the property opposite.

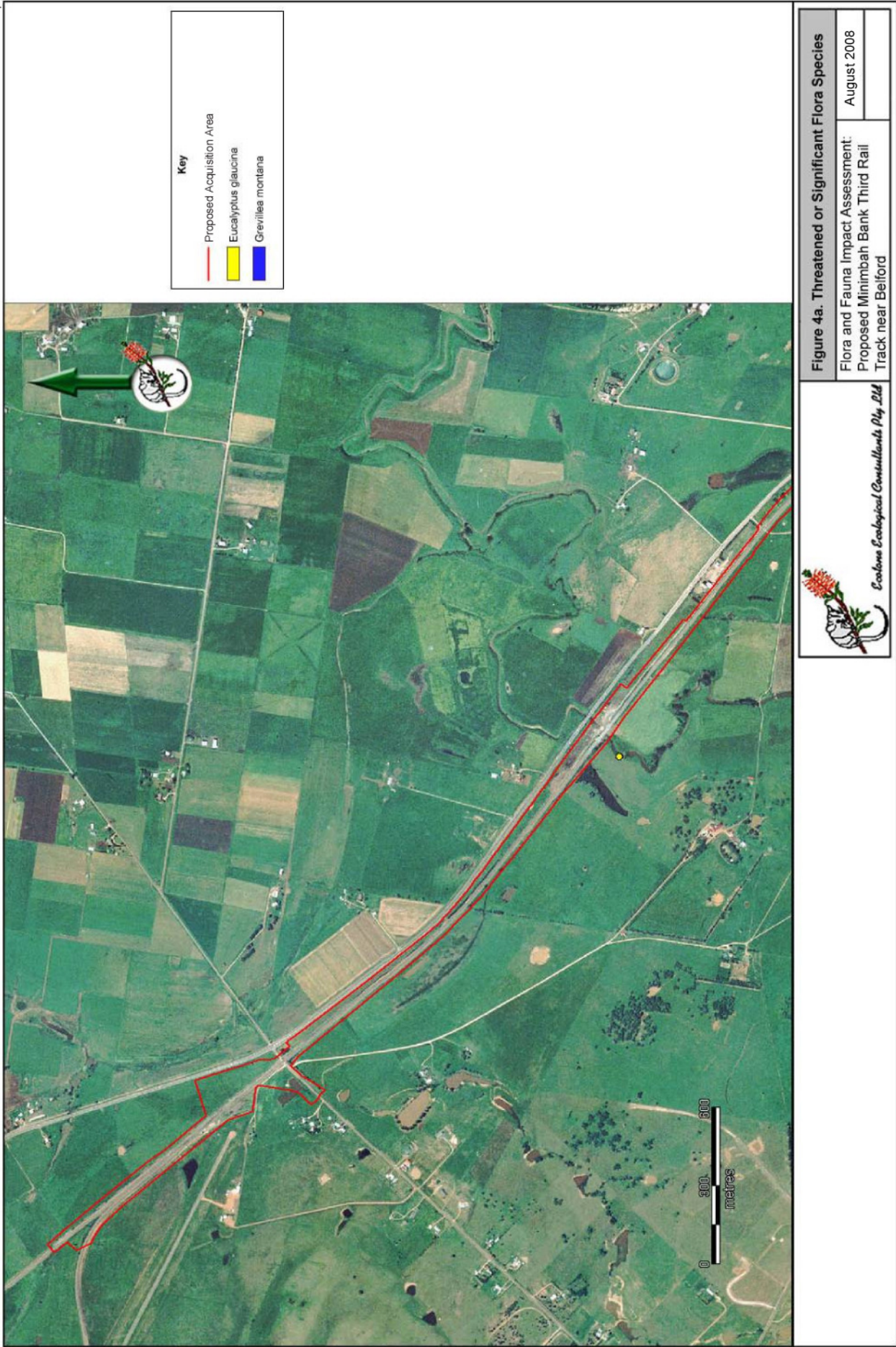
Apart from declared noxious species, common or established environmental weed species within the subject site include galenia, fennel, narrow-leaf cotton bush, cobblers pegs, skeleton weed, spear thistle, variegated thistle, fire weed, hairy brassica, common peppergrass, honeysuckle, castor oil plant, common melilot, wall fumitory, redflower mallow, paddy's lucerne, large-leaved privet, purpletop, onion weed, trad, paspalum, kikuyu and coolatai grass. Some of these weed species occurred at locally high densities, but most were generally restricted in their distribution throughout the site or occurred at low density. Control or management of any of these species is desirable.

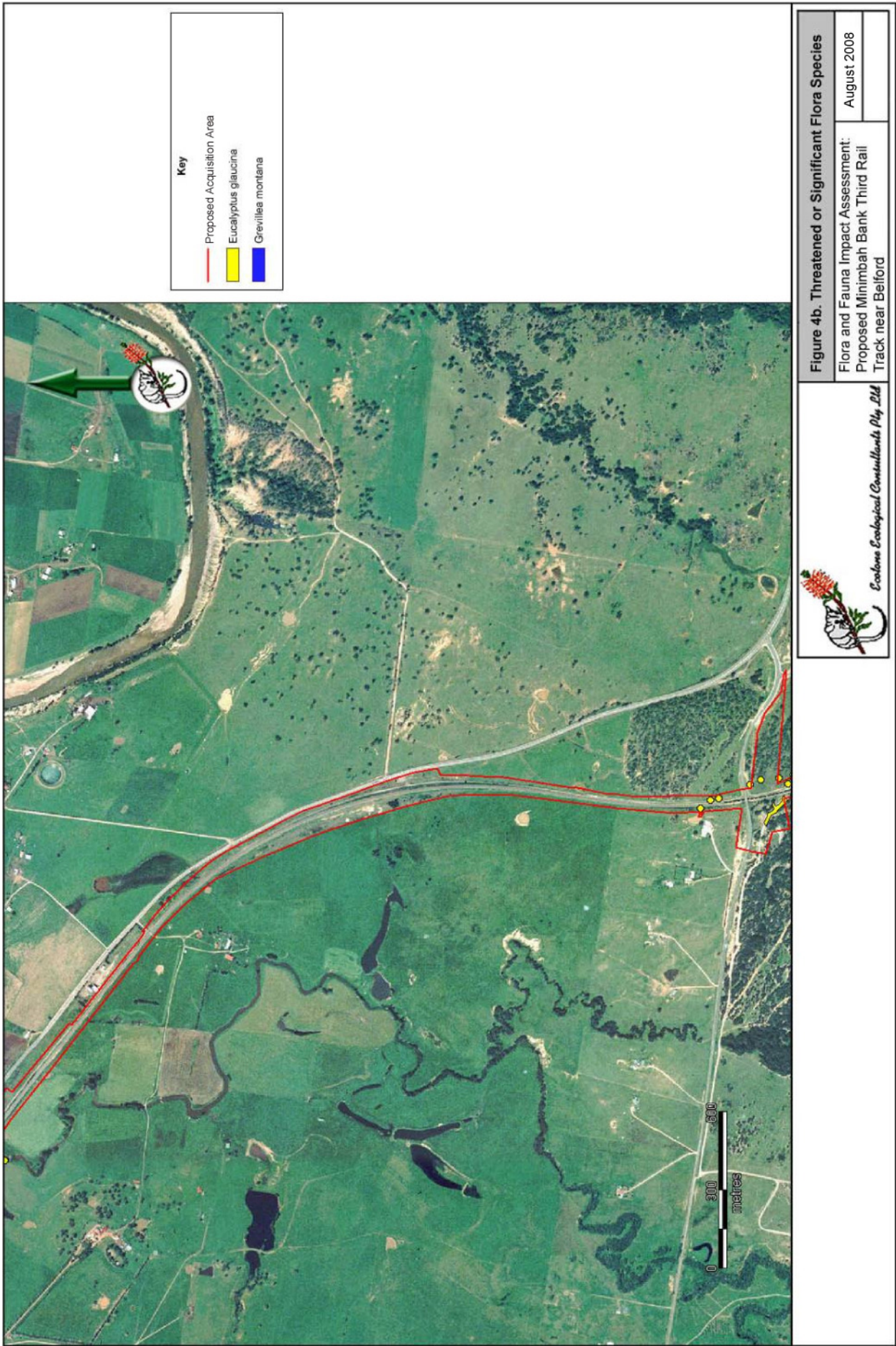
Threatened or Significant Flora Species

One threatened flora species listed under both the NSW TSC Act 1995 and the Commonwealth EPBC Act 1999 was definitively recorded within the study area. Slaty red gum (*Eucalyptus glaucina* – TSC and EPBC Acts: Vulnerable) was found to occur in areas of locally high abundance in the private property along the railway easement boundary on both sides (and sometimes in the railway easement near the tops of cuttings or on embankments) mainly from the Golden Highway overpass east to the eastern limit of works (**Figure 4**). Specimens of the trees were taken and one sent to the Royal Botanic Gardens was confirmed as *Eucalyptus glaucina*. The species is known to intergrade with the closely-related forest red gum (*Eucalyptus tereticornis*). It appeared that some forms of red gum within the study area possessed intermediate characteristics between the two species, these being likely to represent intergrade forms.

The presence of *E. glaucina* within the private property is not unexpected, since it was predicted during the route options assessment (Ecotone Ecological Consultants 2007) that some trees observed from a distance and interpreted as the superficially similar forest red gum (*Eucalyptus tereticornis*) could be this species. Additionally, Peake (2006) considers that slaty red gum may be sub-dominant in the Belford district through to the Singleton Military Area.

The species generally occurred in or on the slopes above shallow gullies and watercourses and was generally restricted to the red gum community (Community 2). It was generally absent from ridgetops.





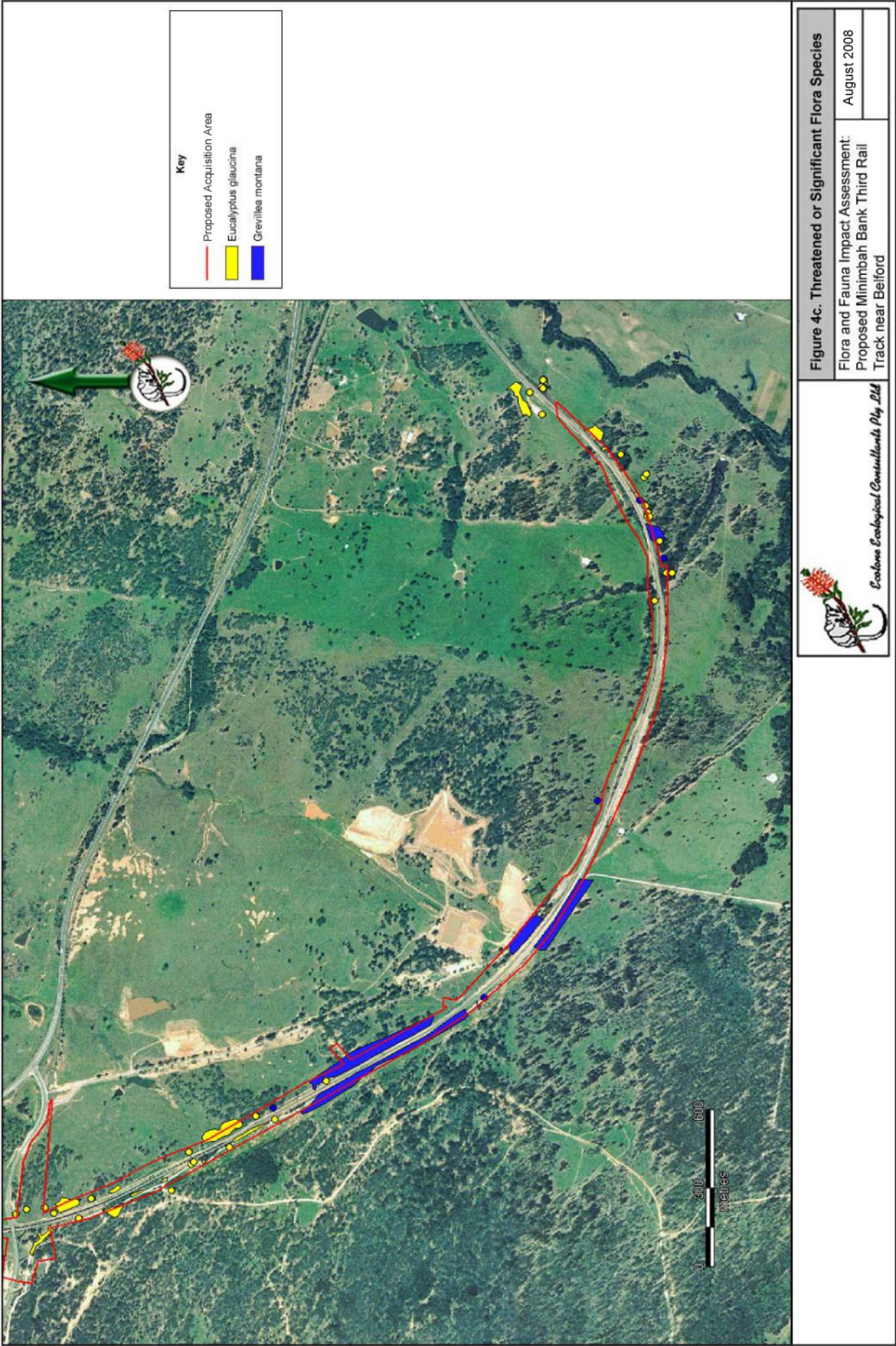


Figure 4 shows the locations of both individual large trees of *E. glaucina*, and patches within which numerous trees of *E. glaucina* occurred, often in the form of immature trees or regenerating saplings. The presence of regenerating saplings around isolated adult trees in many cleared pasture areas, or on existing railway embankments, indicates the potential for the species to expand its area of occupancy, and possibly re-occupy areas from which it has mostly been removed in the past.

One flora species not listed under legislation, but listed exclusively on the national ROTAP database of rare or threatened plants (Briggs and Leigh 1996), *Grevillea montana* (mountain grevillea) was recorded and found to be locally abundant in parts of the study area. The species was restricted to east of the Golden Highway crossing, but was relatively common in many patches on both sides of the existing railway easement (Figure 4), and sometimes in the easement itself near the boundary fence. It was almost invariably restricted to drier, more elevated topographic positions in the ironbark / spotted gum / grey box Community (Community 1). Occasionally, it overlapped with areas containing *Eucalyptus glaucina* in transition areas between Communities 1 and 2.

Endangered Populations of Flora

One species that forms an Endangered Population in the Hunter catchment, river red gum (*Eucalyptus camaldulensis*), had been tentatively recorded in three locations in private land near the easement boundary during the route options assessment, by viewing remotely from within the railway easement. However, closer inspection of the relevant trees from within the private property revealed that these trees were in fact very large, mature specimens of the vulnerable slaty red gum (*Eucalyptus glaucina*) referred to above. *Eucalyptus camaldulensis* was not recorded elsewhere in the study area during the current surveys, therefore, it is now concluded that the endangered population of river red gum does not occur in the study area.

According to the DECC Wildlife Atlas, *Eucalyptus camaldulensis* has previously been recorded south of the western end of the study area near the Singleton landing ground, between Mt Thorley branch line and Range Road.

Endangered Ecological Communities

The following Endangered Ecological Communities listed under the NSW TSC Act are considered to occur within the study area on the basis of the more detailed flora survey work undertaken within the parts of the study area in private property:

1. Hunter lowland redgum forest (HLRF). Vegetation Community 2 appears to broadly correspond to the listed EEC according to the Final Determination (NSW Scientific Committee 2002a). Of the assemblage of 55 species that are listed in the Final Determination as characterising the EEC, 23 species (55%) are present in the study area. Small patches of Map Unit 24 (Hunter Lowlands Redgum Forest) are shown by the regional mapping of the Central Hunter (Peake 2006) as occurring at the eastern end of the study area, usually associated with creeks and floodplains. This community is mainly restricted to the eastern end of the study area. It also contains the bulk of occurrences of the vulnerable species *Eucalyptus glaucina* in the study area.
2. River-flat eucalypt forest on coastal floodplains (RFEFCF). Vegetation Community 3 would constitute a transitional form or local variant of this EEC. The community within the study area is an outlying extension along minor tributaries of the more extensive and characteristic occurrences of the community along Jump-Up Creek and other larger watercourses that occur outside the study area. As such, it does not occur on a true coastal floodplain within the study area, since the watercourses along which it occurs are in deeper

channels with little flat floodplain. This EEC is not listed as occurring within the study area for the Hunter Remnant Vegetation Project (Peake 2006); however the Final Determination for the EEC (NSW Scientific Committee 2004a) states that this EEC is known from parts of Singleton LGA. Most parts of this community in the study area are dominated by swamp oaks (*Casuarina glauca*) suggesting that at least parts of this community may be the EEC swamp oak floodplain forest. However, for the reasons given below, this EEC is not considered to occur in the study area, although the abundance of swamp oaks in Community 3 suggests that the EEC in the study area intergrades with swamp oak floodplain forest. The two minor patches of riparian vegetation in the study area (Community 3) are considered to constitute the EEC River-flat eucalypt forest on coastal floodplains.

The following Endangered Ecological Communities listed under the NSW TSC Act were considered to have potential to occur within the study area following the fieldwork for the route options assessment phase on the project. However, they have since been rejected as occurring within the study area on the basis of the more detailed flora survey work undertaken within the parts of the study area in private property including comparisons of the characteristic species composition of the EECs according to the Final Determinations for the EECs with the on-ground species compositions of two communities from this study:

1. Swamp oak floodplain forest (SOFF). Although Community 3 contains some species characteristic of this EEC and is dominated by swamp oaks (*Casuarina glauca*) in some patches, the proportion of additional characteristic species for this EEC is low and there is probably insufficient saline influence for this EEC to occur. Additionally, the EEC is stated as being restricted to elevations below 50 m ASL (NSW Scientific Committee 2004b) but the elevation of the community within the study area is slightly greater than this. Patches of Map Unit 28 (Central Hunter Swamp Oak Forest) of Peake (2006) are shown as occurring in and near the study area. However, this EEC is not listed as occurring within the investigation area for the Hunter Remnant Vegetation Project (Peake 2006); nor is it stated as being known from the Singleton LGA in the Final Determination for the EEC (NSW Scientific Committee 2004b). The community is considered to be a variant of RFEFCF as discussed above with locally high densities of swamp oak, but could intergrade with SOFF where saline influence increases.
2. Lower Hunter spotted gum – ironbark forest (LHSGIF). Vegetation Community 1 from this study is dominated by various combinations of spotted gum, ironbarks and grey box. The regional vegetation study of Peake (2006) shows Map Unit 26 (Lower Hunter Spotted Gum – Ironbark Forest), which is included in this EEC, as occurring to the east of the study area. Locally, this community is replaced by Map Unit 27 (Central Hunter Ironbark – Spotted Gum – Grey Box Forest), which is not part of the EEC (NSW Scientific Committee 2005). The characteristics that distinguish this community from LHSGIF are the higher frequencies of *Eucalyptus crebra* and *E. moluccana*, low abundance of *Eucalyptus fibrosa*, absence of *Acacia parvipinnula*, more open understorey dominated by grassy rather than prickly shrub species and a ground layer distinguished by herbs such as *Desmodium varians*, *Glycine tabacina*, *Dichondra repens*, *Brunoniella australis* and *Calotis lappulacea* (NSW Scientific Committee 2005). (Peake 2006) also notes that narrow-leaved ironbark (*Eucalyptus crebra*) and grey box (*E. moluccana*) become more abundant in MU 27, and red ironbark (*E. fibrosa*) generally becomes less dominant. These characteristics all apply to Community 1 from this study, as confirmed by the current field investigations within the private properties. Therefore, it concluded that the EEC does not occur within the study area.

Therefore, from this assessment, two EECs listed under the NSW TSC Act 1995 are considered to occur within the study area – *Hunter lowland redgum forest* and *River-flat eucalypt forest on coastal floodplains*. The distribution of the EECs is shown in Figure 5.

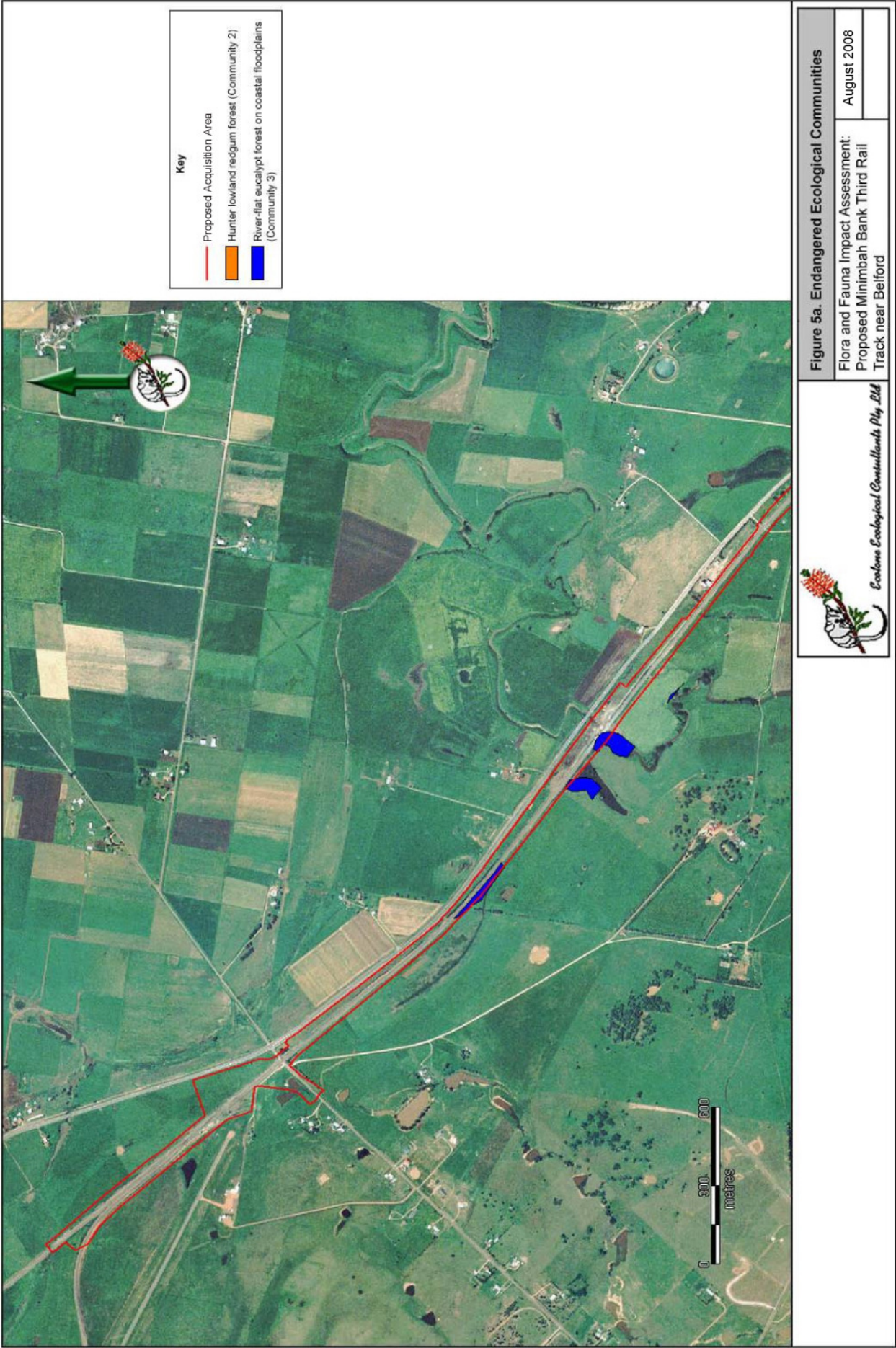
The potential presence of the EECs *Lower Hunter spotted gum-ironbark forest*, and *Swamp oak floodplain forest* have been ruled out by the surveys within private property.

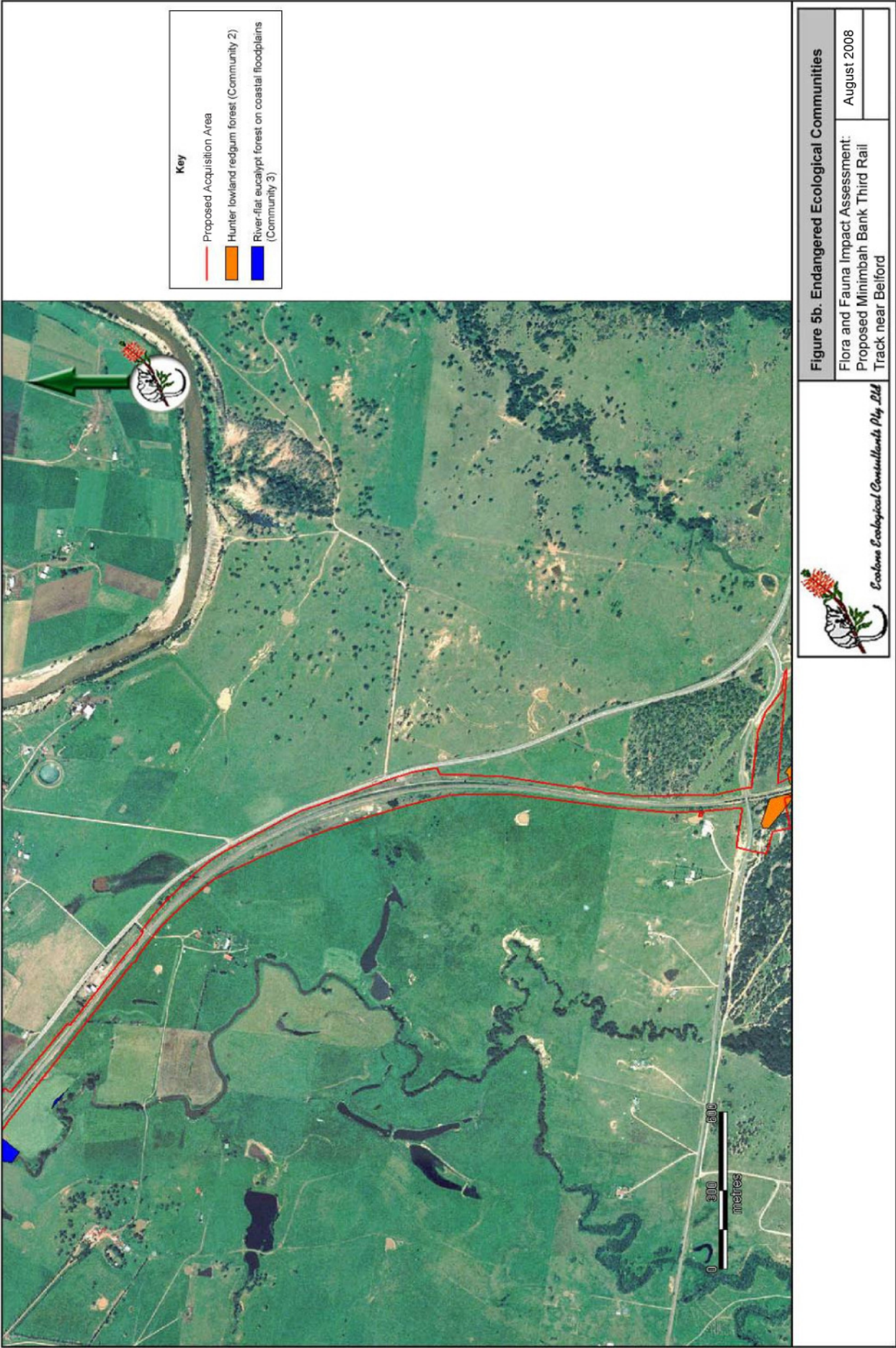
No endangered ecological communities listed under the Commonwealth EPBC Act 1999 are considered to occur in the study area.

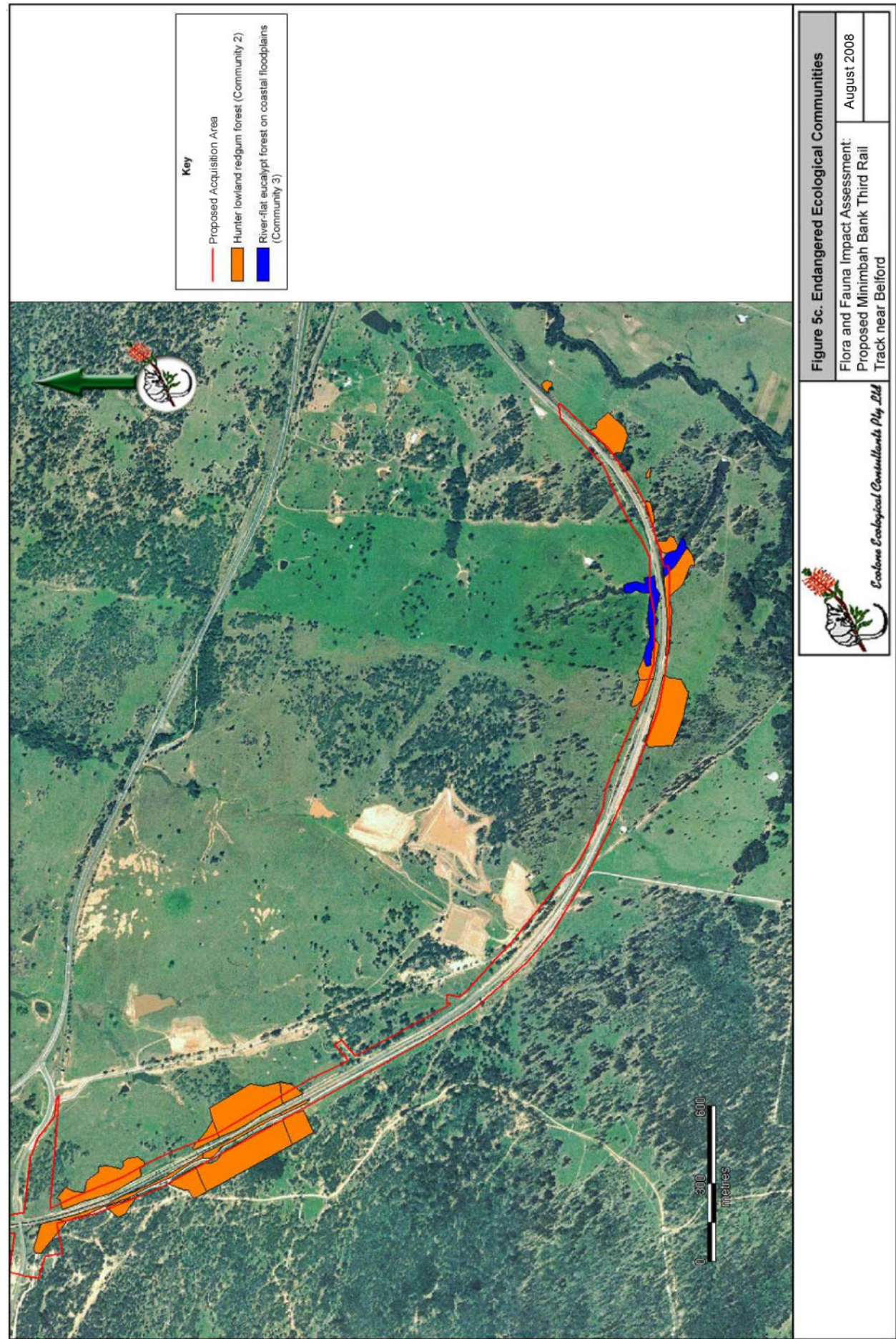
Overall Significance of the Vegetation

The vegetation within the study area is significant primarily because it contains occupied habitat for one threatened flora species, *Eucalyptus glaucina*, and one ROTAP species, *Grevillea montana*. Additionally, two vegetation communities qualify as EECs.

The main ecological function of the remnant vegetation in the study area is as part of a system of corridors that provide connectivity both for movement of fauna and for exchange of genetic material between native flora species locally. This would tend to reduce the risk of local flora populations becoming isolated.







3.2 Faunal Investigations

3.2.1 Methodology

A comprehensive fauna field habitat assessment was undertaken on the 22nd, 23rd and 30th of April 2008. This supplemented the previous habitat assessment undertaken as part of the route options investigations on the 30th October 2007. The area of land surveyed generally consisted of a strip of land along the railway easement boundary encompassing the outermost limit of potential disturbance due to the proposal, which for most of its length was no greater than 50 m from the railway easement boundary. Major additional areas within the project area which were surveyed included the deviation areas for the realigned Golden Highway and Range Road overpasses. Additional widened areas or minor projections from the project area for the purposes of drainage shaping etc. were also surveyed.

Water features, areas of remnant vegetation and other potential fauna habitat features were investigated more thoroughly. The locations of all threatened fauna species, hollow-bearing trees and other important habitat features were recorded, with grid references taken using a hand-held GPS (5-10m accuracy). All opportunistic observations of fauna or faunal activity were recorded during the survey, including visual and auditory recognition of fauna species and recognition of evidence of faunal activity (eg. nests, diggings, scratch marks, droppings).

The survey methods were not complaint with current best practice Fauna Survey Guidelines for a full impact assessment, such as those endorsed by local councils in the Lower Hunter area (LHCCREMS 2002). However the fauna habitat assessment undertaken is considered sufficient to flag any potential impacts on threatened fauna and general faunal diversity within the study area and in combination with the literature review provides a good basis for assessing the potential impacts of the proposed third rail track.

3.2.2 Survey Limitations

The fauna field surveys were limited to daytime field habitat assessment and targeted searches for evidence of threatened fauna species or their habitat within the study area, so nocturnal species are unlikely to have been encountered. A full fauna survey would reveal a greater diversity of species and would include nocturnal fauna.

As a precautionary measure, all threatened species with potential to occur within the study area (subject species), have been addressed using the seven-part test in Section 4.

3.2.3 Fauna Survey Results

A total of 80 fauna species were recorded within the study area during the field habitat assessment, including 63 birds, six reptiles, six mammals and five frogs. Of these, four are introduced species and the remainder native. Three threatened fauna species were recorded, the brown tree creeper, grey-crowned babbler and grey-headed flying-fox.

The western section of the study area is comprised mostly of highly modified agricultural land, while the eastern section contains larger areas of remnant native vegetation. With regard to fauna, the eastern section of the study area was found to contain a wider variety of fauna habitat types and contained a greater diversity of fauna species.

Most of the bird species identified within the study area are commonly found in agricultural areas, including the Australian magpie, Australian raven, brown falcon, galah and rufous songlark. Some of the observed bird species, including the threatened brown treecreeper and grey-crowned babbler, are reliant upon remnant patches of vegetation or solitary trees for breeding, roosting and foraging purposes. Wet areas within the study area provide habitat for a number of bird species, including the clamorous reed-warbler, pacific black duck and white-faced heron. Built structures (eg. bridges, culverts) provide nesting habitat for the fairy martin and welcome swallow.

All six reptile species were recorded south and east of the Golden Highway, possibly reflecting the greater diversity of natural habitats in the eastern section of the study area. The bearded dragon, robust ctenotus, eastern blue-tongued lizard and tree-base litter skink could be found anywhere in the study area, though are more likely to occur in areas where some remnant vegetation occurs. The eastern snake-necked turtle and eastern water dragon are likely to occur in creeklines and suitable wet areas throughout the study area.

Four mammal species, the eastern grey kangaroo, grey-headed flying-fox, rabbit and yellow-footed antechinus, were observed within the study area. Eastern grey-kangaroo and rabbit scats were regularly observed during the survey and both species are expected to occur throughout the study area. One yellow-footed antechinus was found under bark during the field survey and this species is likely to occur in vegetated areas within the study area where suitable shelter is available. An individual grey-headed flying-fox was observed flying over the study area and this species is expected to forage within the study area, particularly during peak winter flowering of the spotted gum. Common brushtail possum scratches were observed on the trunks of trees in a number of locations and evidence of echidna diggings was also observed.

Given further survey work, it is expected that a greater number of fauna species would be recorded within the study area. This would include groups that require specific survey techniques for detection, including insectivorous bats, nocturnal birds and arboreal mammals. A list of all species recorded in the study area during this survey is presented in **Appendix 3**.

Fauna Habitat Features

During the field survey, the locations of important habitat features were recorded using a hand-held GPS (accuracy 5-10m). The following fauna habitat features were recorded within the study area:

- Drainage pipes/culverts – these are used as nest sites by the fairy martin and welcome swallow and also provide potential roosting habitat for insectivorous bats, including threatened species.
- Grey-crowned babbler nests – these large nests are used by the threatened grey-crowned babbler for communal roosting at night and for breeding
- Hollow-bearing trees – these provide important nesting and roosting habitat for a wide variety of fauna, including threatened species
- Large trees (with a DBH of greater than 50cm) – these provide important foraging and shelter habitat for a wide range of fauna and represent the next generation of hollow-bearing trees
- Water features – wet soaks, dams and creeklines within the study area provide habitat for a range of different fauna species.

The locations of all fauna habitat features recorded within the study area are shown in **Figure 6**. Details of all habitat trees (i.e. large trees, hollow-bearing trees and trees containing grey-crowned babbler nests) recorded within the study area are included in **Appendix 4**.

Threatened Species

Three threatened fauna species, the brown treecreeper, grey-crowned babbler and grey-headed flying-fox, were recorded within the study area. All three species were recorded in the eastern section of the study area (**Figure 7**).

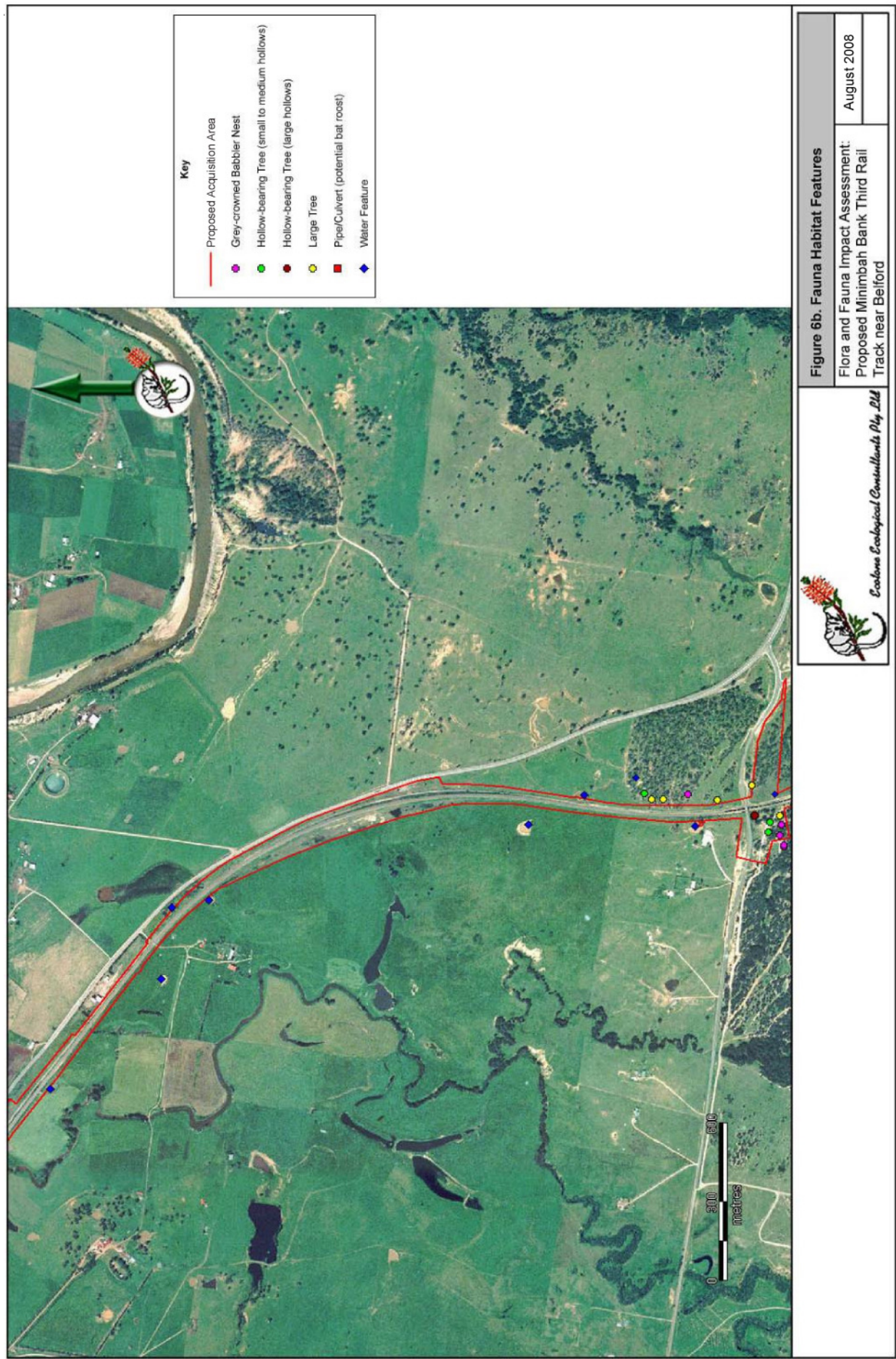
The grey-crowned babbler was the most frequently recorded threatened species, with approximately 30 individuals encountered during field survey work. Eleven grey-crowned babbler nests were recorded, all in woodland or open forest vegetation in the eastern section of the study area

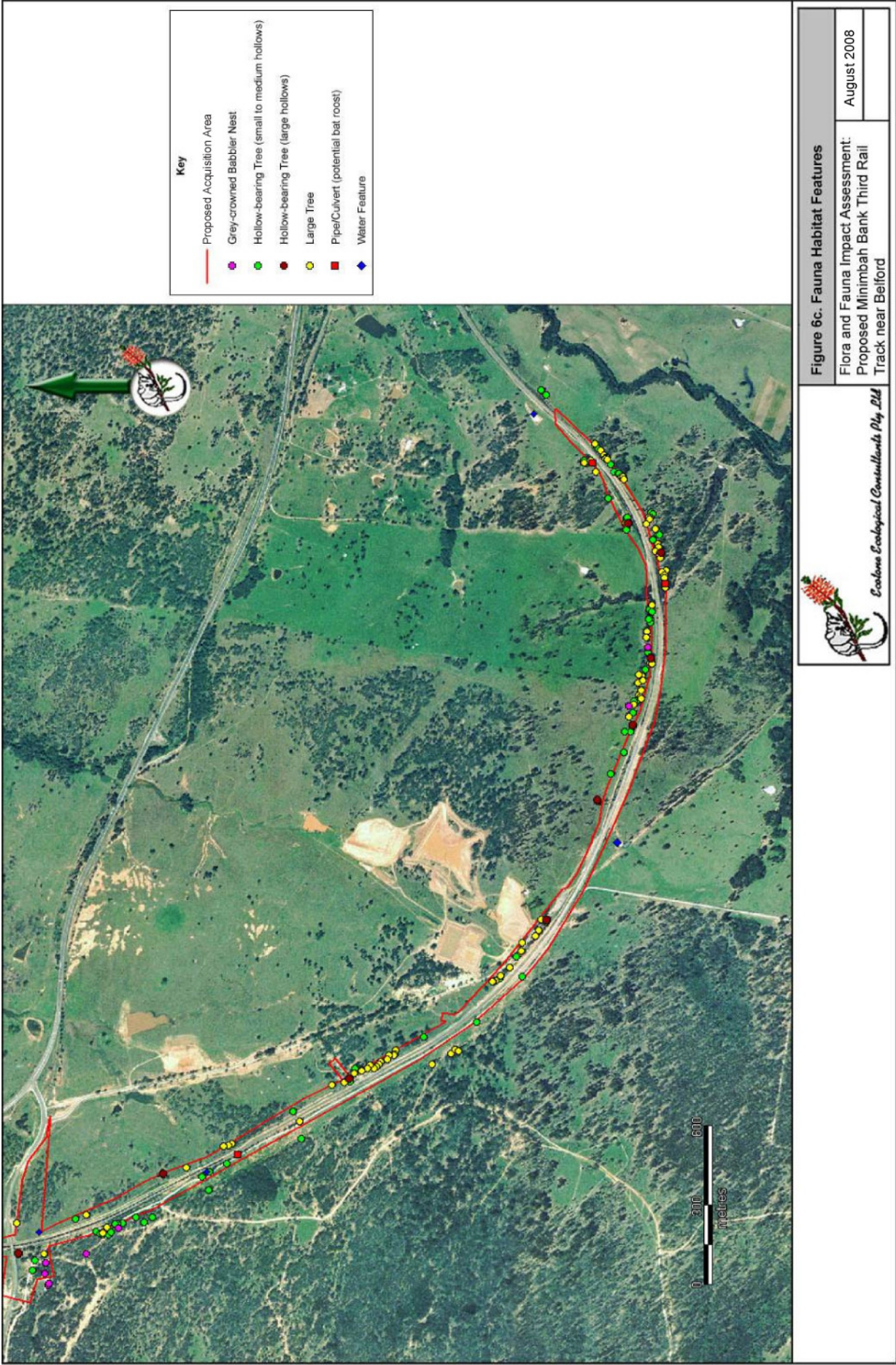
Only one brown treecreeper was recorded during the survey. This individual was heard in woodland vegetation at the far eastern end of the study area. The brown treecreeper and other threatened woodland bird species have potential to occur throughout woodland and open forest vegetation within the study area.

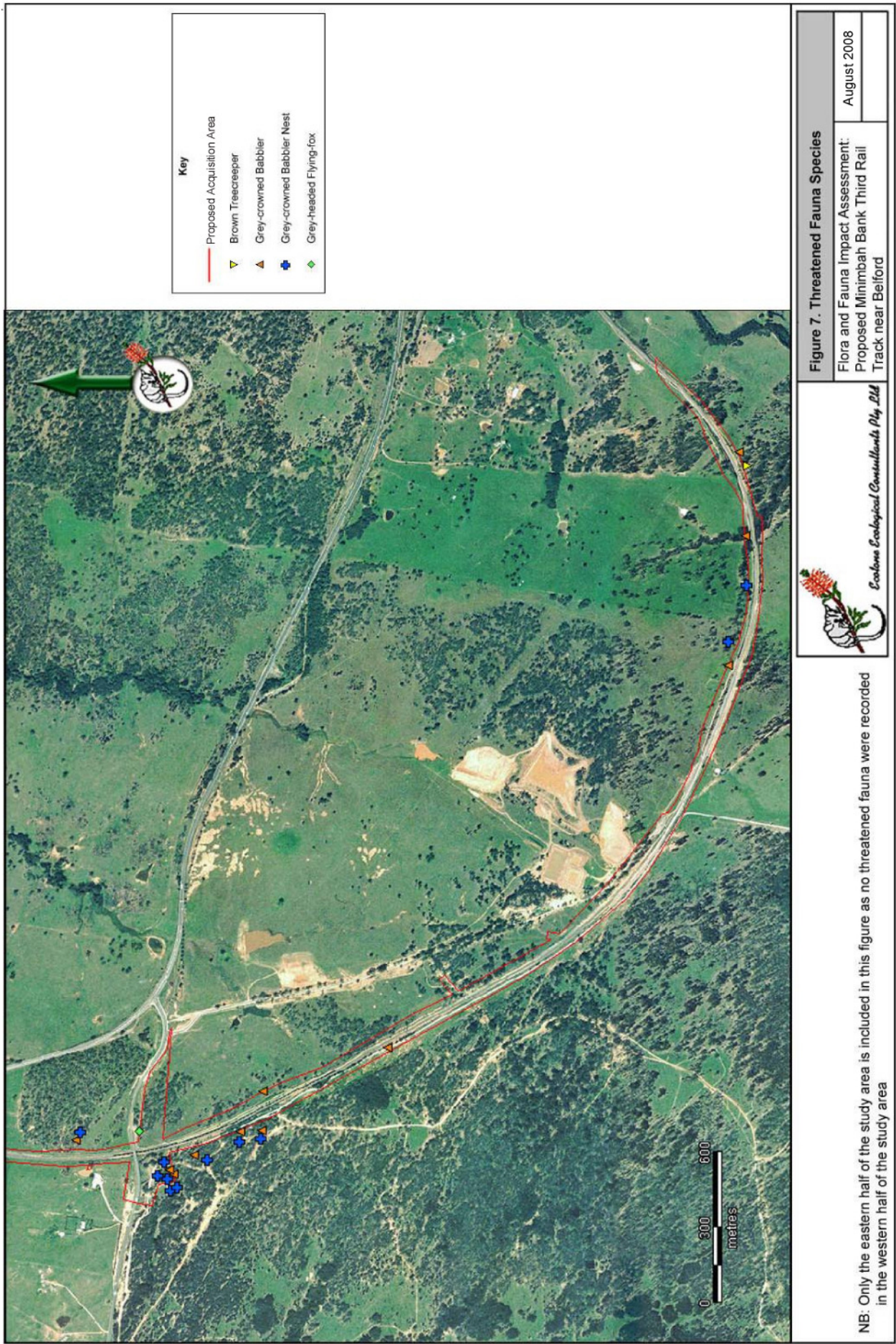
One grey-headed flying-fox was observed flying over the study area during the field survey. It is expected that this species would forage throughout treed areas within the study area, particularly during peak winter flowering of the spotted gum.

A number of additional threatened fauna species have potential to occur, in particular the speckled warbler, eastern bentwing-bat, east-coast freetail-bat and squirrel glider. Some species have potential to visit the study area on an irregular, opportunistic or seasonal basis, including the swift parrot and regent honeyeater.









Threatened Fauna Habitat

Based on the results of the literature review and field survey work, a total of 29 threatened fauna species are known or have potential to occur within the study area. For each vegetation community and specific habitat feature a list of potential threatened fauna species has been prepared as follows:

Community 1: Ironbark-Spotted Gum-Grey Box Woodland/Open Forest

Most of the identified subject species have some potential to occur within this community, particularly in the larger tracts of remnant vegetation in the eastern section of the study area south of the existing rail track and north of the New England Highway.

Glossy black-cockatoo	-some potential foraging as limited <i>Allocasuarina littoralis</i> occurs; a number of suitable nest hollows were observed
Brown treecreeper	-foraging habitat occurs and potential nest sites observed
Black-chinned honeyeater	-potential foraging and nesting (though more likely to be an occasional opportunistic visitor than to breed within the area)
Painted honeyeater	-potential foraging and nesting (though more likely to be an occasional opportunistic visitor than to breed within the area)
Turquoise parrot	-potential foraging, limited potential nesting
Diamond firetail	-potential foraging and nesting
Hooded robin	-potential foraging and nesting
Barking owl	-potential foraging, few large hollows suitable for nesting observed
Powerful owl	-potential foraging, few large hollows suitable for nesting observed
Masked owl	-potential foraging, few large hollows suitable for nesting observed
Swift parrot	-occasional, opportunistic visitor (foraging only)
Regent honeyeater	-occasional opportunistic visitor (foraging only)
Square-tailed kite	-potential foraging, few trees suitable for nesting observed
Grey-crowned babbler	-foraging habitat occurs and a number of nests were observed
Speckled warbler	-potential foraging and nesting
Little bentwing-bat	-potential foraging
Eastern bentwing-bat	-potential foraging
Eastern false pipistrelle	-potential foraging, roosting and breeding
East-coast freetail-bat	-potential foraging, roosting and breeding
Greater broad-nosed bat	-potential foraging, roosting and breeding
Yellow-bellied sheath-tail-bat	-potential foraging, limited potential roosting and breeding
Grey-headed flying-fox	-foraging habitat occurs
Spotted-tailed quoll	-potential foraging, no potential den hollows observed – may occur in or visit larger remnants but is unlikely to visit isolated patches
Brush-tailed phascogale	-potential foraging and potential nest hollows observed – may occur in or visit larger remnants but is unlikely to visit isolated patches
Squirrel glider	-potential foraging and possible nest hollows observed – more likely to occur in larger remnants but is unlikely to visit isolated patches
Koala	-potential shelter and movement corridor only

Community 2: Red Gum-Grey Box Woodland/Open Forest

As for Community 1, with the addition that potential foraging habitat for the koala occurs within this community.

Community 3: Riparian forest/shrubland

As for Community 2, with the addition that potential foraging habitat is available for the southern myotis where open water occurs.

Communities 4 & 5: Plantations/vineyards and cleared pasture

Given the disturbance history within these areas, less potential threatened fauna habitat is available within these two communities. However a number of species still have potential to occur, particularly grassland specialists.

Barking owl	-potential foraging
Grass owl	-potential foraging and nesting in areas of tall grass; heavily grazed areas are unsuitable for this species
Masked owl	-potential foraging along vegetated edges
Turquoise parrot	-potential foraging, particularly near remnant woodland
Greater broad-nosed bat	-potential foraging along remnant woodland edges
Yellow-bellied sheath-tail-bat	-potential foraging

Hollows

Hollows occurring in living trees, dead stags and fallen timber provide potential breeding and roosting habitat for a range of threatened species, including the glossy black-cockatoo, brown treecreeper, turquoise parrot, spotted-tailed quoll, brush-tailed phascogale, squirrel glider, forest owls and insectivorous bats.

Occasional large fallen logs were observed during the field habitat assessment and these may provide potential nesting habitat for the brown treecreeper and brush-tailed phascogale. While some of these fallen logs may contain large hollows, given the fragmented nature of habitat in the proposed impact area, it is unlikely that these would be utilised by the spotted-tailed quoll.

A total of 79 hollow-bearing trees were recorded within the study area. These provide potential roost/nest sites for a number of threatened fauna species, including the brown treecreeper, squirrel glider and insectivorous bats.

Culverts/bridges

A number of bridges, culverts and drains occur within the proposed impact area. During the field habitat survey, some of these were observed to contain potential roost sites for the little bentwing-bat, eastern bentwing-bat and southern myotis. These could potentially be utilised by small groups or individual bats, however these species are unlikely to breed within the study area as no suitable maternity roost sites were observed.

Watercourses, dams, etc.

Dams and other open water bodies within the study area provide potential foraging and breeding habitat for the green and golden bell frog, though there are no records within the locality and most known extant populations of this species tend to be located closer to the coast. The southern myotis has potential to forage over open water bodies within the study area and other insectivorous bats are likely to utilise flyways provided by vegetated watercourses within the study area.

Fauna Habitat Ranking

Treed areas within the study area have been ranked according to their relative habitat value for fauna. Each treed area has been ranked as having high, medium or low fauna habitat value according to the following criteria:

<u>High Fauna Habitat Value</u>	- threatened fauna species either recorded or having a high potential to occur - high percentage of trees containing hollows - high percentage of trees with dbh >50m
<u>Medium Fauna Habitat Value</u>	- threatened fauna species either recorded or having a high potential to occur - moderate percentage of trees containing hollows - moderate percentage of trees with dbh >50cm
<u>Low Fauna Habitat Value</u>	- lower frequency of visitation by threatened fauna species - absence or very low percentage of trees containing hollows - absence or very low percentage of trees with dbh >50cm

As can be seen in **Figure 8**, only small patches vegetation with a low fauna habitat value occur in the western section of the study area. Some areas of high value would be lost at the very eastern end of the study area, though the bulk of the high value fauna habitat would be lost near the intersection with the Golden Highway.

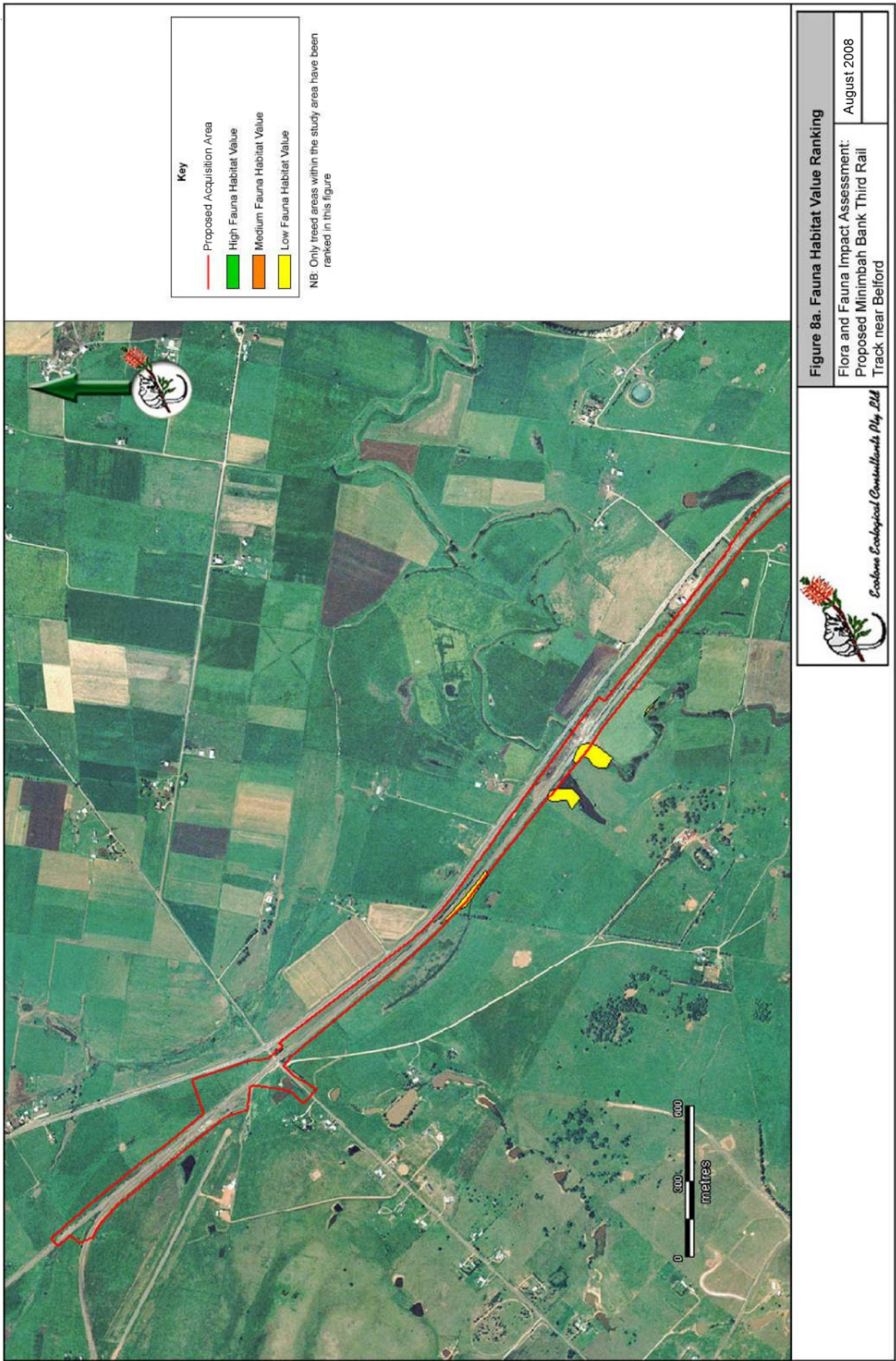
Corridor Links

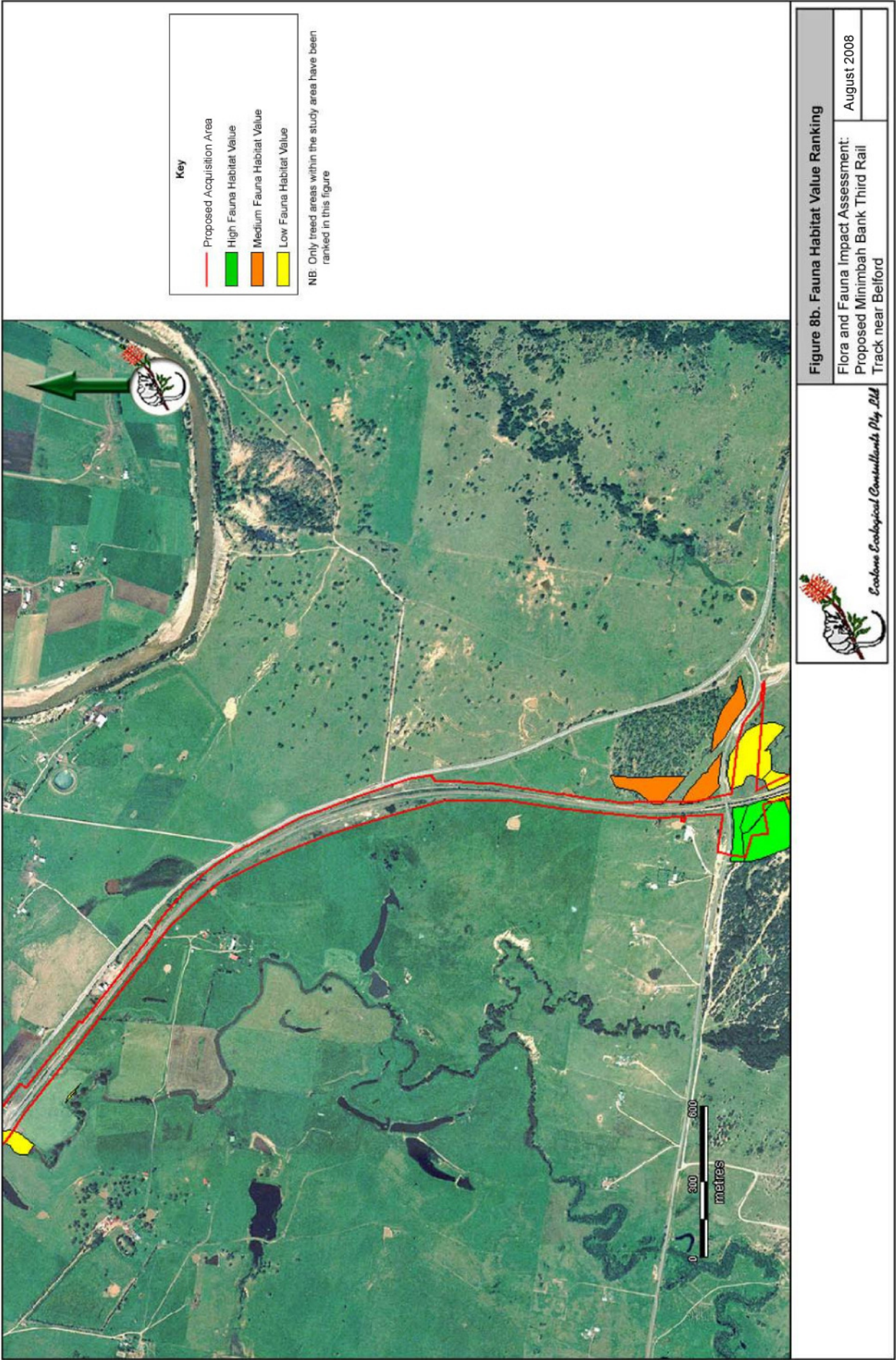
The western section consists of predominantly cleared land, though vegetation along Mudies Creek may provide a movement corridor for more mobile species (particularly birds and bats). The main potential fauna movement corridors occur in the eastern section of the study area and are shown in **Figure 9**.

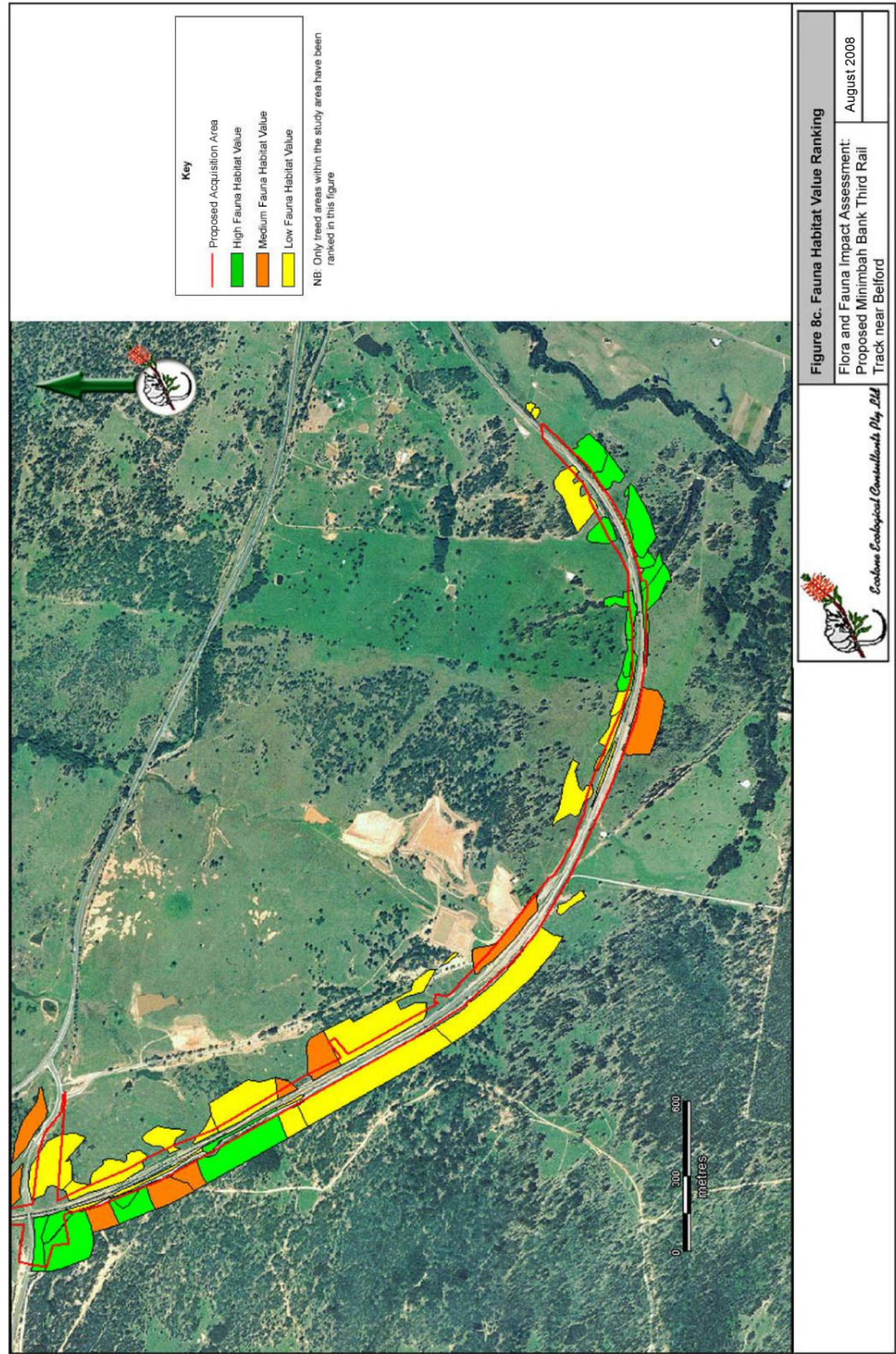
Vegetation within the eastern section of the study area forms part of a regional vegetation linkage identified in the Hunter-Central Rivers Catchment Management Authority report "The Vegetation of the Central Hunter Valley" (Peake, 2006).

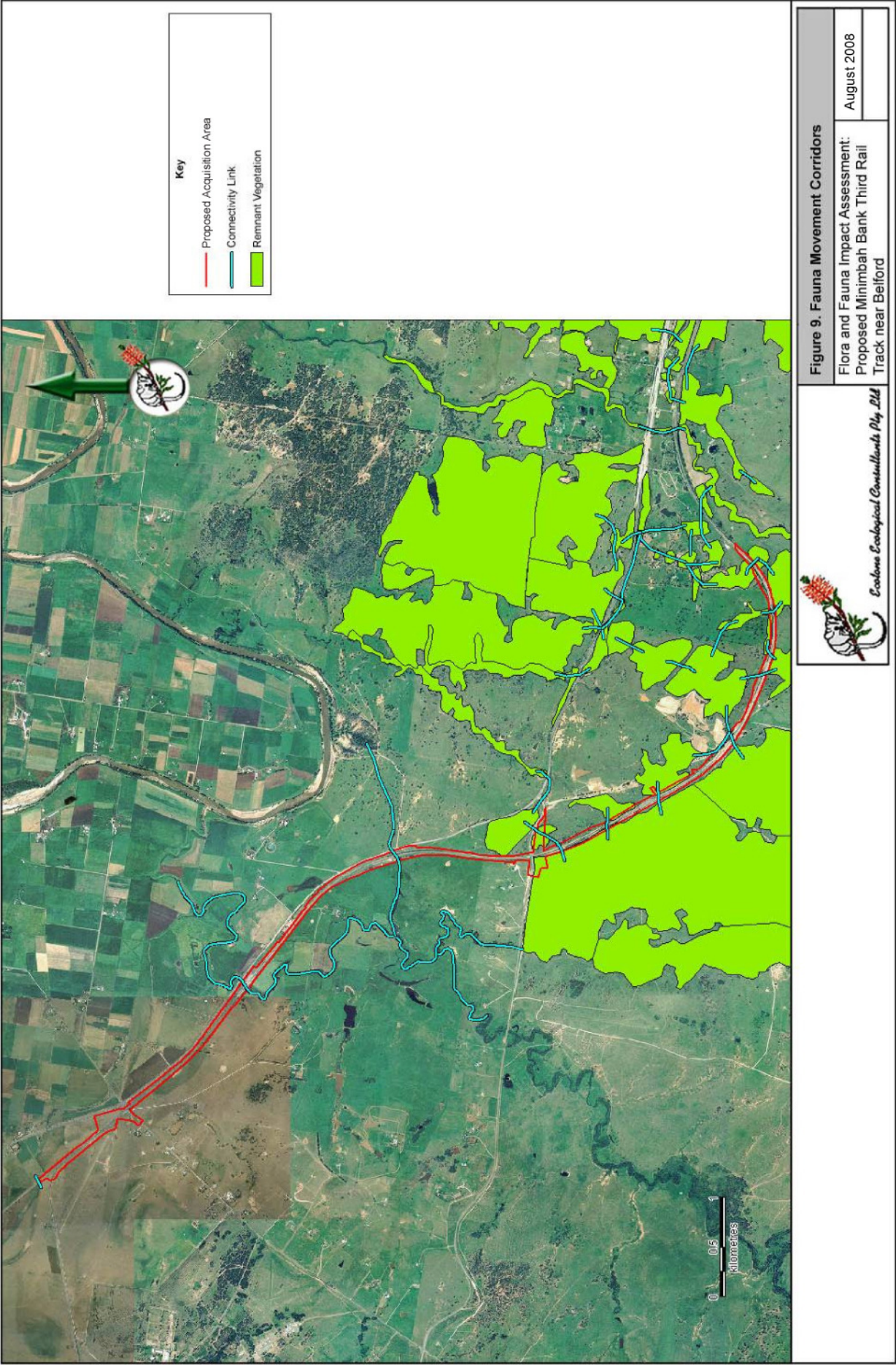
3.2.4 Additional Fauna Survey by GHD

Supplementary fauna survey work was undertaken by GHD on the 29th of July, 2008, as part of investigations for Enabling Works for signalling work for the overall Minimbah project. This involved a stagwatch of a large hollow-bearing tree on the south-eastern side of the Golden Highway overpass for a period of 1.5 hours at dusk, followed by a short spotlight in the immediate vicinity. No fauna were observed or heard during the stagwatch, though one brushtail possum was recorded within adjoining habitat during the spotlight survey.









4.0 ASSESSMENT OF THE PROPOSAL

4.1 Overview of Potential Impacts Associated with the Proposal

The proposal would remove or modify narrow strips or patches of mostly cleared pasture, plus some areas of disturbed native vegetation. The areas of vegetation to be impacted from each vegetation community, including the proportion of the total impact area are presented in **Table 8**. Note that the total impact area includes a 5 metre buffer around the total earthworks area.

Table 8. Extent of potential habitat loss for each Vegetation Community associated with the Proposal

Vegetation Community	Area affected (ha)	Proportion of total impact area (%)
1 – Ironbark-spotted gum-grey box woodland /open forest	2.81	5.20
2 – Red gum-grey box woodland / open forest	2.76	5.11
3 – Red gum-swamp oak riparian forest	0.66	1.22
4 – Plantations	0	0.00
5 – Wet soak areas	0.06	0.11
Total	6.29	11.65

The total area of natural vegetation to be removed or modified amounts to approximately 6.3 hectares (or just under 12% of the total impact area of 54 hectares) for the construction of a third rail track, deviations for the Golden Highway and Range Road at the railway crossing points and associated works such as service tracks and drainage installations. Occupied habitat for one threatened flora species, *Eucalyptus glaucina* and one ROTAP species, *Grevillea montana* will be impacted. Occupied habitat for two endangered ecological communities, *Hunter lowland redgum forest* and *River-flat eucalypt forest on coastal floodplains*, will also be directly affected.

A narrow strip of foraging habitat for a number of threatened fauna species would be removed by the proposal. No grey-crowned babbler nests would be lost but 16 hollow-bearing trees that provide potential roosting and nesting sites for a number of threatened fauna species (including the brown tree creeper, squirrel glider and insectivorous bats) would be removed. A number of large trees would also be lost.

The potential for impact on threatened species and ecological communities as a result of the proposal has been formally addressed below under the provisions of Part 3A of the *Environmental Planning and Assessment Act 1979* (including a DECC requirement for a Section 5A assessment pursuant to the *Environmental Planning and Assessment Act 1979*) and the *Environment Protection and Biodiversity Conservation Act 1999*.

4.2 NSW State Legislative Requirements

4.2.1 Part 3A of the Environmental Planning & Assessment Act 1979 (EP&A Act)

This proposal will be assessed under Part 3A of the Environmental Planning & Assessment Act 1979. Part 3A was introduced by the NSW government in July, 2005. This allows the Minister for Planning to call in ‘major projects’ or anything deemed as ‘critical infrastructure’. A new *State Environmental Planning Policy (Major Projects) 2005* defines what projects are subject to Part 3A and require ministerial approval. The proposed Minimbah Bank third rail track has been declared by the government as ‘critical infrastructure’. Such a declaration can only be made where the Minister is of the opinion the project is ‘essential to the State for economic, environmental or social reasons’.

Under Part 3A, The Department of Planning prepares the matters that the proponent must address in the environmental assessment for the Proposal, known as the Director-General's requirements for environmental assessment. The requirements are developed in consultation with State agencies such as the Department of Environment and Climate Change and other relevant authorities including local councils. Under Part 3A, the proponent would be required to include a written impact assessment including a statement of commitments to demonstrate how the project's likely environmental impacts will be minimised or managed. If the project is approved, the proponent will be required to honour these commitments as part of the conditions of approval. Following preparation of the impact assessment, the Director-General prepares a statement to the Minister as to whether the assessment is considered to have met the Director-General's requirements. The Minister must take this statement into account when deciding whether to approve the proposed development, but is not obliged to be bound by it.

The Director-General's requirements for environmental assessment of the proposal (Section 75F of the EP&A Act) includes the preparation of a comprehensive ecological impact assessment for both terrestrial and aquatic ecosystems.

In terms of Director-General's requirements relevant to assessment of the impact on flora and fauna by the proposal, the Department of Environment and Climate Change (DECC) has provided a set of specifications outlining the nature of the information and type of assessment that is required. A summary of these requirements is as follows:

Flora

- A field survey and assessment to determine the presence or absence and condition of threatened flora.
- Targeted surveys of threatened flora and EECs likely to be impacted by the proposal, in accordance with the Draft Guidelines for Threatened Species Assessment (DECC and Department of Primary Industries, July 2005).
- A comprehensive description of the vegetation of the subject site including condition, size, conservation significance of plant communities present at the local, regional and State level; and the occurrence of any threatened species, populations and / or ecological communities listed by the TSC Act and any ROTAP species.
- A plan showing the distribution of any threatened or ROTAP species and the vegetation communities on the subject site, and the extent of vegetation proposed to be cleared.
- The effect of the proposed development on threatened species, populations, EECs or their habitats by an assessment pursuant to section 5A of the *Environmental Planning and Assessment Act 1979*.
- An assessment of the impact of the development on the plant communities and ROTAP species.
- A description of the measures proposed to mitigate and / or ameliorate the impact of the development on the plant communities, threatened and ROTAP species.
- Any appropriate biodiversity offsets required in accordance with the *Principles for the use of biodiversity offsets in NSW* which forms part of DECC's *Guidelines for Biodiversity Certification of Environmental Planning Instruments* – Working Draft (April 2007).

Fauna

- A fauna survey to identify the distribution and abundance of fauna species known or likely to use the subject site. This should include a description of available fauna habitats and an assessment of the conservation status of each of the faunal components at a local, regional and State level.
- Targeted surveys of threatened fauna and endangered populations that are likely to be impacted by the proposal in accordance with the Draft Guidelines for Threatened Species Assessment (DECC and Department of Primary Industries, July 2005).
- A plan showing the results of the above surveys. The plan should be at the same scale as (or as an overlay to) the plan of the development footprint and overall site, to assist in the assessment of potential impacts of the proposal on fauna.
- An assessment of the potential impact of the development on fauna.
- An assessment of the occurrence or likely occurrence of threatened species or populations, or their habitats, on the subject land. Where the assessment concludes that threatened species or populations, or their habitats, exist on or in close proximity to the subject site, the effect of the proposal should be determined in accordance with an assessment pursuant to Section 5A of the *Environmental Planning and Assessment Act 1979*.
- A description of the measures proposed to mitigate and/or ameliorate the impact of the development on fauna.
- Where necessary the proponent should develop in consultation with DECC, appropriate biodiversity offsets in accordance with the *Principles for the use of biodiversity offsets in NSW* which forms part of DECC's *Guidelines for Biodiversity Certification of Environmental Planning Instruments* – Working Draft (April 2007) where necessary.

Since DECC specifies that the assessment of impact for the proposal is to be undertaken according to the provisions of section 5A of the *EP&A Act 1979* (the seven-part test), this assessment is presented in the next section.

4.2.1.1 Assessment of Impact on Threatened Flora and Endangered Ecological Communities

One threatened flora species, slaty red gum (*Eucalyptus glaucina*: vulnerable) and two Endangered Ecological Communities (*Hunter Lowland Redgum Forest* and *River-flat eucalypt forest on coastal floodplains*) were confirmed as occurring within the study area.

A species suspected as being part of an endangered population of flora during field investigations for the route options assessment, *Eucalyptus camaldulensis*, was found to not in fact occur in the study area as a result of targeted field investigations. The relevant trees were found to be *Eucalyptus glaucina* when closer inspection was possible.

It was also concluded that the Endangered Ecological Community (EEC) *Swamp oak floodplain forest* (which was flagged as possibly occurring during the route options investigations assessment) was unlikely to occur in the study area, the relevant riparian community more appropriately being classified as a variant of *River-flat eucalypt forest on coastal floodplains*.

Given the presence of the one threatened flora species and two EECs within the study area, and the removal of a portion of their habitat as a result of the proposal, a seven-part test will be carried out for the entities confirmed to occur in the study area under Section 5A of the *EP&A Act 1979*, as presented below.

- (a) ***in the case of a threatened species, whether the action proposed is likely to have an adverse affect 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.***

Eucalyptus glaucina

An estimated 0.68 ha of occupied habitat including approximately 25 adult trees of *Eucalyptus glaucina* are likely to be removed or modified by the proposed action (bearing in mind the inaccuracy of up to 10 m inherent in locations determined by hand-held GPS).

The occupied habitat for *E. glaucina* extends beyond the impact area of the proposal and well beyond the study area. Many areas of occupied habitat for *E. glaucina* outside the impact area for the proposal were observed to be regenerating from past clearing and numerous saplings were observed to be establishing within a 30 m radius of many adult trees. Whilst some habitat would be removed, there is also potential for individuals and clumps of the species to regenerate on land disturbed by the proposal once construction is complete, such as batters and areas of bare soil. Overall natural and assisted regeneration and protection of the retained portion of the population from further clearing and damage should ensure that the viability of the local population.

It is therefore considered unlikely that the current proposal would have an adverse affect on the life cycle of the species such that it would place the local population 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 likely to be placed at risk of extinction.***

No endangered populations of flora occur in the vicinity of the study area. No assessment under this part is required.

- (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.***

Hunter Lowland Redgum Forest

(i) The proposal would affect a minor proportion of the occupied area of habitat for the EEC (Figure 5) locally. The extent of the EEC would not be reduced to the extent that its local occurrence would be placed at risk of extinction.

(ii) Apart from direct removal of a minor portion of the EEC, the composition of the retained EEC would not be substantially and adversely modified such that its local occurrence is likely to be placed at risk of extinction. Potential impacts on the retained portion of the EEC locally such as runoff, edge effects and weed invasion can be managed by the standard protection and rehabilitation protocols generally adopted for such projects (see Mitigation Measures [Section 6]).

River-flat Eucalypt Forest on Coastal Floodplains

(i) The proposal would affect a very minor proportion of the occupied area of habitat for the EEC (Figure 5) locally. The extent of the EEC would not be reduced to the extent that its local occurrence would be placed at risk of extinction.

(ii) Apart from direct removal of a minor portion of the EEC, the composition of the retained EEC would not be substantially and adversely modified such that its local occurrence is likely to be placed at risk of extinction. Potential impacts on the retained portion of the EEC locally such as runoff, edge

effects and weed invasion can be managed by the standard protection and rehabilitation protocols generally adopted for such projects (see Mitigation Measures [Section 6]).

(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, and**
- (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**
- (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.**

Eucalyptus glaucina

- (i) The proposal would remove or modify up to 0.68 ha of occupied habitat for this species. Within the survey area (defined as the corridor of land 100 m from the outer edge of the impact area as shown in Figure 4), 2.55 ha of occupied habitat for *Eucalyptus glaucina* was recorded. Therefore, the proposal would remove or modify up to 26.7% of occupied habitat for *E. glaucina* from the survey area. The area of occupied habitat for the species that occurs beyond the survey area is not known, but the species was observed to occur within several properties some distance from the survey area, and it is expected that the percentage loss or modification of habitat for the species from the entire local population would be much lower than this. In NSW, the species is known from two major geographic regions; the far north coast between Grafton and Casino where it is locally common and the mid-north coast / Hunter region from Taree to Broke and inland to west of Singleton.
- (ii) The population of *E. glaucina* has already been fragmented into two halves by the existing railway line. Given that disturbances due the proposal would only occur at the edges of occupied habitat areas, the distance of separation between the two halves of the population would be increased slightly, but the population would not be further fragmented nor would any areas become isolated from other areas of habitat as a result of the proposal.
- (iii) The areas of habitat to be removed or modified due to the proposal, whilst currently contributing to the viability of the population, would not be crucial to the long-term survival of the species in the locality. Many areas of regenerating habitat for *E. glaucina* occurred within the survey area outside the impact area for the proposal, and if protected from future clearing or damage, would ensure the long-term survival of the species in the locality.

EECs: Hunter Lowland Redgum Forest and River-flat Eucalypt Forest

- (i) Habitat areas for two endangered ecological communities (EECs) would be directly removed or modified by the proposal. **Table 9** shows the maximum areas of each EEC that are at risk of being lost or affected due to the proposal, based on the boundary of the impact area.

Table 9. Extent of potential habitat loss for each EEC associated with the Proposal

Vegetation Community	Corresponding EEC	Predicted Impact Area (hectares)
2 – Red Gum-Grey Box Woodland/Open Forest	Hunter Lowland Redgum Forest	2.76
3 – Red Gum-Swamp Oak Riparian Forest	River-flat Eucalypt Forest on Coastal Floodplains	0.66

As the table shows, the largest area of loss would be of the Hunter Lowland Redgum Forest (HLRF). A much smaller area of River-flat Eucalypt Forest on Coastal Floodplains (RFEFCF) would be affected by the proposal.

In order to place the extent of each EEC that would be impacted by the proposal into a local and regional context, data from two regional mapping studies was consulted. The subject site is located within the investigation area for the Hunter Remnant Vegetation Project (HRVP) (Peake 2006) which covers the Central Hunter Region. However, the subject site is near the eastern boundary of this area where it adjoins the investigation area for the regional mapping of vegetation in the Lower Hunter and Central Coast (LHCCREMS 2002). The study locality of 10 km beyond the impact area overlaps into the LHCCREMS area. Therefore, data on the areas of vegetation communities from both studies were used to assess the areas of each EEC within both the study locality and the region (defined as the combination of both the HRVP and LHCCREMS areas).

The relevant map units from both regional studies that are included within or best match each EEC according to the relevant Final Determinations, together with their remaining areas at the date of each study are given in **Table 10**.

Table 10. Vegetation Communities from Peake (2006) and LHCCREMS (2002) that correspond to the Endangered Ecological Communities in the Subject Site

EEC	Corresponding Vegetation Communities from Regional Studies		Current Regional Extent (ha)	Current Local Extent (in Study Locality – 10 km beyond impact area) (ha)
	Map Unit No.	Community Name		
Hunter Lowland Redgum Forest	Peake (2006)			
	24	Hunter Lowlands Red Gum Forest	147	41
	LHCCREMS (2002)			
	19	Hunter Lowland Red Gum Forest	7 052	31
	Total		7 199	72
River-flat Eucalypt Forest on Coastal Floodplain	Peake (2006)			
	13	Hunter Floodplain Woodland Complex	437	10
	22	Wollombi Alluvial Red Gum - Apple Forest	198	-
	LHCCREMS (2002)			
	13	Central Hunter Riparian Forest	937	179
	14	Wollombi Redgum – River Oak Forest	1 575	-
	38	Redgum Rough Barked Apple Forest	367	-
	Total		3 514	189

Some qualifications need to be made in the interpretation of Table 10. Firstly, the map units from LHCCREMS (2002) that correspond to each EEC have been stated by the Final Determinations for the EECs (NSW Scientific Committee 2002a, 2004a) as either comprising or being included within the appropriate EEC. Since the study by Peake (2006) was conducted subsequent to the writing of the Final Determinations, the corresponding map units for each EEC have been determined by comparing the characteristics of the map units with the Final Determinations for each EEC.

Secondly, owing to the size of their respective investigation areas, both the LHCCREMS (2002) and Peake (2006) studies contain inaccuracies and are based on many assumptions where particular areas were not ground-truthed. For example, the Singleton Military Area is shown by Peake (2006) as comprising almost entirely Map Unit 27 Central Hunter Ironbark – Spotted Gum – Grey Box Forest. This appears to be an oversimplification on the basis of the field surveys at the edge of this land undertaken for this assessment. It is likely that this has resulted in an underestimate of the areas of some of the map units and hence some of the EECs listed in Table 10 above within the local area, particularly Hunter Lowland Redgum Forest.

The proportions of the remaining area of each EEC within 10 km of the subject site and within the entire region (area covered by LHCCREMS and HRVP studies) that would be affected by the proposal is given in **Table 11**.

Table 11. Proportion of the Total Area of Endangered Ecological Communities in the Region and Locally that would be affected by the Proposal

EEC	Total Regional Extent of EEC (LHCCREMS 2002 & Peake 2006)	Total local extent of EEC (within 10 km of subject site)	Area of EEC Impacted by Proposal (ha)	Percentage of EEC Impacted	
				within 10 km of subject site	in entire Region
Hunter Lowland Redgum Forest	7 199	72	2.8	3.8%	0.04%
River-flat Eucalypt Forest	3 514	189	0.7	0.3%	0.02%

As the table shows, only a small proportion of RFEFCF would be affected at either the local (10 km from subject site) or regional levels. Whilst a greater proportion of HLRF would be removed at the local level, as discussed above, the percentage of this EEC that would actually be impacted is probably lower because of the likely underestimation by the regional studies of the area of this community that occurs locally. The proportion of both EECs that would be impacted at a regional level is very minor.

The Final Determination for HLRF estimates that less than 500 ha or about 27% of the community remains in NSW (NSW Scientific Committee 2002a). However, this figure is clearly in error since the studies of LHCCREMS (2002) and Peake (2006) have mapped over 7,000 hectares in the lower and central Hunter regions alone.

The remaining area of RFEFCF in NSW is likely to represent less than 30% of its original range. In the entire state, it is estimated that at least 13,000 ha of the EEC remains, of which about 2,000 ha occurs in the lower Hunter region (NSW Scientific Committee 2004a). This is consistent with the figures obtained from both regional mapping studies.

- (ii) Both EECs have already been fragmented by the existing railway line, particularly HLRF, which has been divided into two separate habitat areas by the line. Given that disturbances due to the proposal would only occur at the edges of occupied habitat areas, the distance of separation between the fragmented parts of each EEC would be increased slightly, but the EECs would not be further fragmented nor would any areas become isolated from other areas of habitat as a result of the proposal.
 - (iii) The areas of habitat for each EEC to be removed or modified due to the proposal, whilst currently contributing to the viability of each community, would not be crucial to the long-term survival of the EECs in the locality. The current condition of both EECs is highly modified, mainly by farming activities, and no core areas of either community occur in the study area. Many areas of modified habitat for both communities occur within the survey area but outside the impact area for the proposal, and if protected from future clearing or damage, the long-term survival of the EECs in the locality would be assured.
- (e) *whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).*

No areas of designated critical habitat so far identified under the provisions of the *Threatened Species Conservation Act 1995* apply to the study area.

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

No draft or final recovery plans for *Eucalyptus glaucina*, Hunter lowland redgum forest or River-flat eucalypt forest on coastal floodplains have been prepared to date. However, DECC has developed sets of priority actions to help recover *E. glaucina* and the two EECs in NSW. The key priority actions include:

Eucalyptus glaucina

- Fence areas of known habitat to protect from grazing stock and to promote regeneration.
- Protect areas of habitat from timber harvesting activities.
- Protect known populations and areas of potential habitat from clearing and development.

Hunter lowland redgum forest

- Reinstatement of an appropriate fire regime (either prevent frequent fire or undertake ecological burns as appropriate).
- Control access to remnants by installing fencing and signage and rationalising informal tracks through the community.
- Fence off areas supporting the community to preclude stock from remnants.
- Undertake weed control as required using removal methods that will not damage the community.
- Protect and actively manage HLRF remnants through conservation mechanisms such as covenanting and the preparation/implementation of site-specific vegetation management plans.
- Improve vegetative connectivity between and within remnants through revegetation/regeneration programs.

River-flat eucalypt forest on coastal floodplains

- Instigate feral animal control programs.
- Ensure that the fire sensitivity of the community is considered when planning hazard reduction and asset management burning.
- Protect habitat by minimising further clearing of the community. This requires recognition of the values of all remnants in the land use planning process, particularly development consents, rezonings and regional planning.
- Promote regeneration by avoiding prolonged or heavy grazing.
- Undertake restoration including bush regeneration, revegetation and weed control, and promote public involvement in this restoration.

Most of the priority actions for recovery specified above relate to regulation of grazing and farmland activities. In terms of the proposed action, the important consideration to ensure consistency with the priority actions is to minimise the extent of clearing of habitat for *Eucalyptus glaucina* and the EECs as far as possible. Protection and management of remaining habitat patches for the species and EECs within ARTC land, particularly where they are contiguous with habitat on adjoining land, would also support the priority actions.

Few draft or final threat abatement plans for key threatening processes have been prepared to date – none apply to those discussed in (g) below.

(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.***

To date, thirty-two (32) key threatening processes have been finally determined under the provisions of the *TSC Act*. Those that are potentially most relevant to the current proposal are discussed below.

1. Clearing of native vegetation

The majority of the area of potential impact due to the proposal will occur on land that is already cleared of native vegetation. Of the balance of the area where native vegetation clearing will be necessary, most of this vegetation is in a modified condition, often with only the tree layer and little or no natural understory remaining. Appendix 2 of the Final Determination for the threatening process (NSW Scientific Committee 2001) lists grassy woodland and riparian communities as "...ecological communities that could become threatened by this threatening process". Communities 1, 2 and 3 from this study would fall into this category. However, in the context of the remaining area of all these communities locally and regionally, the degree of vegetation loss would be minor.

2. Invasion of native plant communities by exotic perennial grasses

Numerous species of exotic perennial grasses were recorded in the study area, including coolatai grass, paspalum, vasey grass (tall paspalum), slender pigeon grass, kikuyu, Rhodes Grass, African love grass, elastic grass, perennial rye grass, red natal grass, narrow-leaved carpet grass, quaking grass, shivery grass and others. Many of these species are listed in the Final Determination for the threatening process (NSW Scientific Committee 2003). These grasses occur at greatest density and abundance within the railway easement section of the study area, but most species also occur in the pasture areas. The potential threat to the native species and communities of the study area can be ameliorated as a part of appropriate weed control measures during the rehabilitation of natural vegetation on areas of newly created bare soil such as batter areas. Further details are given in the Mitigation Measures section.

3. Invasion and establishment of exotic vines and scramblers

The only species of exotic vine and scrambler recorded in the study area that are listed by the Final Determination for the threatening process (NSW Scientific Committee 2006) are honeysuckle and trad (wandering jew). These species occur in very specific habitats (usually damp and shady areas such as near watercourses) in limited parts of the study area and were not present at high abundance. The proposal would remove occurrences of these species in some areas, but has the potential to initiate invasion of the species into new areas. The risk of this occurring can be reduced by implementation of simple protocols as part of a weed management strategy. Further details are given in the Mitigation Measures section.

4. High Frequency Fire

'High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is an identified key threatening process to a number of ecological communities and native species. It is unlikely that the proposal would result in an increase in the frequency of fire in or adjoining the study area.

5. Infection of native plants by *Phytophthora cinnamomi*

None of the species or vegetation communities in the study area are specifically listed by the Final Determination for the threatening process (NSW Scientific Committee 2002b) as being particularly susceptible to this pathogen. However, any native plants could potentially be infected by the disease. Spores of the root-rot fungus *Phytophthora cinnamomi* could be introduced to the site on machinery or equipment that has been in a contaminated area, or in soil or fill imported to the site. Protocols should be established to ensure that machinery or fill brought in from off-site is certified to be free from the disease, or decontaminated before being allowed into the site.

6. Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands

The proposal has the potential to alter the natural flow regimes of streams where these cross the project area. However, it is expected that adequate provision for culverts or pipes will be made where streams cross the railway easement that will provide sufficient capacity for maximum flow during flood events. Therefore, it is not expected that the natural flow regimes of streams in the study area will be altered significantly.

7. Human-caused climate change

Vehicle and machinery use and vegetation removal associated with the proposal would incrementally add to the cumulative effects of greenhouse gas emissions contributing to human-caused climate change. If operation of the proposal results in additional quantities of coal being exported, this would also contribute to climate change. However, on a global scale, the degree to which this proposal would contribute to this key-threatening process is negligible.

In conclusion, the proposed development is not expected to significantly increase the incidence of designated key threatening processes listed on Schedule 3 of the TSC Act, or any other threatening processes, if they are appropriately managed. Such management would mainly include protection and management of key areas of vegetation for threatened species and EECs outside the development footprint as offset areas and rehabilitation of these areas where required, rehabilitation and replanting of bare areas, management of runoff, weed control and containment and protocols for the prevention of the spread of plant pathogens. Further details are given in the Mitigation Measures section.

Conclusions from the seven-part test for the threatened flora species and endangered ecological communities: One threatened flora species (*Eucalyptus glaucina*) and two endangered ecological communities (Hunter Lowland Redgum Forest and River-flat Eucalypt Forest on Coastal Floodplains) lie within the proposed impact area and would be affected by the proposal. However the potential impacts associated with the proposal are unlikely to be so great as to result in either endangered ecological community or *Eucalyptus glaucina* being placed at risk of local extinction.

4.2.1.2 Assessment of Impact on Threatened Fauna

Three threatened fauna species, the brown treecreeper, grey-crowned babbler and grey-headed flying-fox, were positively identified within the study area. All three species are listed as vulnerable in the TSC Act and the grey-headed flying-fox is also listed as vulnerable in the EPBC Act. In addition to these species, a further 25 species are considered subject species and may visit or occur within the study area. Of these, the speckled warbler, eastern bent-wing bat, east-coast freetail-bat and squirrel glider are considered to have the greatest potential to occur. Potential impacts on all 28 fauna subject species identified in section 2.3.2 are assessed below using the seven-part test.

- (a) *in the case of a threatened species, whether the action proposed is likely to have an adverse affect 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.*

BIRDS

Forest Owls – powerful owl *Ninox strenua*, masked owl *Tyto novaehollandiae* and barking owl *Ninox connivens* (all vulnerable – TSC Act)

Three species of threatened forest owl, the powerful owl, masked owl and barking owl have been recorded in the study locality and have some potential to utilise habitat within the study area, though none have been recorded near the study area. All three species are sedentary, occupy large home ranges and are reliant upon trees containing large hollows for nesting. Nine trees containing hollows large enough to be used as nest sites were recorded during the field survey (shown as “Hollow-bearing Tree (large hollows)” in **Figure 6**). No evidence of nesting/roosting owls was observed at any of these trees, although only daytime surveys were carried out. Three of these trees lie within the proposed earthworks area and would be removed as a result of the proposal.

Given the expected large foraging range of these species, it is unlikely that the proposal would disrupt the life cycle of any of these three owl species to such an extent that a viable population would be placed at risk of extinction. Although the likelihood of a threatened forest owl species using one of the hollow-bearing trees as a nest or roost tree during construction of the proposal is remote, mitigation

measures have nonetheless been incorporated into the proposal to minimise the risk of individuals being killed or injured during clearing operations. See the Mitigation Measures in Section 6 for further information regarding hollow-bearing tree removal.

Glossy black-cockatoo *Calyptorhynchus lathami* (vulnerable – TSC Act)

The glossy black-cockatoo occupies forests of south-eastern Australia, from Shoalwater Bay in central Queensland to the Victorian border region. Habitat for this species generally consists of moist and dry eucalypt forest types with a she-oak understorey. Glossy black-cockatoos require hollows for nesting and she-oak fruit, on which it usually feeds in small groups. This species roosts communally at night, travelling at dawn to groves of seeding she-oaks to spend the day feeding. In areas where she-oaks are abundant, this species is sedentary, though in other areas glossy black-cockatoos can be nomadic, moving from one food source to another.

One preferred food tree species, the black she-oak *Allocasuarina littoralis*, occurs within the subject site. Some of these may be removed as a result of the proposal, however the bulk are expected to remain within surrounding bushland areas. A number of hollow-bearing trees are likely to be removed as a result of the proposal including four trees containing hollows of a suitable size for nesting by the glossy-black-cockatoo. However the glossy black-cockatoo was not recorded during the survey period and only two records of this species exist for the study locality. While the removal of vegetation and potential habitat trees associated with the proposal contributes to the incremental loss of habitat affecting this species, it is unlikely to have an adverse affect on the life cycle of the glossy black-cockatoo such that a viable local population of the species is likely placed at risk of extinction.

Grass owl *Tyto capensis* (vulnerable – TSC Act)

The grass owl is found in areas of tall grass, including swampy areas, grassy plains and heath. It is also known to occupy areas of tall sedges on floodplains. This species roosts and nests on the ground on trampled down platforms of grass. No records of the grass owl exist for the study locality however some suitable habitat occurs in open grassland areas that have not been heavily grazed.

While a narrow strip containing some potential habitat for the grass owl is expected to be removed as a result of the proposal, it is unlikely to have an adverse affect on the lifecycle of this species such that a viable local population of the species is likely to be placed at risk of extinction.

Square-tailed kite *Lophoictinia isura* (vulnerable – TSC Act)

In Southern Australia, eucalypt woodland, open forest and heath-woodland are preferred habitat for the square-tailed kite. Large stick nests are created in tall eucalypt trees often near permanent creeks and rivers. This species forages above and in the upper canopy on passerines (particularly honeyeaters), insects and reptiles. The square-tailed kite was not recorded during field survey work and only one record exists for the locality.

While the proposal would result in the loss of a small extent of potential foraging habitat for the square-tailed kite, an ample food supply should remain in surrounding bushland areas. It is therefore considered that the life cycle of this species is unlikely to be disrupted such that a viable local population of the species is likely to be placed at risk of extinction.

Swift parrot *Lathamus discolor* (endangered – TSC Act; endangered & migratory – EPBC Act) and regent honeyeater *Xanthomyza phrygia* (endangered – TSC & EPBC Acts)

Both the regent honeyeater and swift parrot have potential to occasionally visit the study area, particularly during peak winter flowering periods. While potential foraging habitat is available, neither of these species are expected to breed within the study area.

In terms of impacts, only a small amount of potential foraging habitat is expected to be removed as a result of the proposal. This is highly unlikely to impact the ability of either of these species to utilise the study area. Therefore the proposed action is considered highly unlikely to have an adverse affect on the life cycle of the swift parrot or regent honeyeater to such an extent that a local population is likely to be placed at risk of extinction.

Woodland Birds – brown treecreeper *Climacteris picumnus*, painted honeyeater *Grantiella picta*, black-chinned honeyeater *Melithreptus gularis gularis*, turquoise parrot *Neophema pulchella*, hooded robin *Melanodryas cucullata*, diamond firetail *Stagonopleura guttata*, grey-crowned babbler *Pomatostomus temporalis*, speckled warbler *Pyrholaemus sagittatus* – all Vulnerable (TSC Act)

The eastern form of the brown treecreeper prefers dry open woodland habitats, mainly on the western slopes of the Great Dividing Range, with a patchy distribution to the east of the Divide. It is an insectivorous species, mainly feeding on ants, beetles and larvae, and forages on tree trunks or on the ground. The brown treecreeper nests in tree hollows, with a pair or small family group frequenting a permanent territory. Viable populations of this species are thought to require a minimum patch size of 200ha of suitable habitat. The brown treecreeper was recorded during the field survey, with one individual heard at the far eastern end of the study area. It is likely that this species also occurs in other areas of remnant woodland and open forest elsewhere within the eastern section of the subject site.

The painted honeyeater inhabits dry forests and woodlands, generally in larger areas of intact habitat. It feeds primarily on the fruit of *Amyema* mistletoes, though it also forages on insects and nectar. While some mistletoe-bearing trees may be removed as a result of the proposal, the vast majority would remain within surrounding bushland areas. The painted honeyeater was not recorded during field survey work and only one old record exists for the locality, though it could potentially visit the area on occasion.

In NSW, the black-chinned honeyeater prefers woodlands with box-ironbark associations and does not persist in remnants less than 200ha in area (DECC threatened species information). While this species was not recorded during field survey work and only two records exist for the locality, given the presence of suitable habitat, the black-chinned honeyeater has potential to occur within the study area.

The turquoise parrot inhabits eucalypt woodlands and open forests with a low shrubby understorey and grassy groundcover layer and usually nests in hollows less than two metres from the ground. It feeds primarily on native and introduced grass seeds and requires habitat with a nearby water source. The turquoise parrot was not recorded during field survey work and no records exist for the locality, though potential breeding and foraging habitat occurs within the study area.

Hooded robins prefer drier habitats throughout their range and the adults are generally sedentary in pairs or small family groups. This species builds its small cup nest in a tree fork or crevice 0.5-5m above the ground (Morcombe, 2000). The hooded robin was not recorded during field survey work and no records exist within the locality, though potentially suitable habitat occurs.

The grey-crowned babbler predominantly inhabits open eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. These sedentary birds live in groups of 5-12 and defend a territory of approximately 12 hectares. This species create large domed nests (up to 50cm wide) in trees at a height of 4 to 7metres (Morcombe, 2000; DECC threatened species profiles). Eleven of these conspicuous nests were observed within the study area and approximately 30 grey-crowned babblers were recorded. All of the nests and birds were observed in the eastern section of the study area. No trees containing grey-crowned babbler nests occur within the proposed impact area boundary and therefore none would be removed as a result of the proposal. However, a narrow strip of foraging habitat would be removed from within the study area.

The speckled warbler is a sedentary species with a home range that varies from 6-12 hectares. This species appears to prefer woodland areas where ground cover consists of grass, fallen leaves and bark.

The speckled warbler congregates in small family groups and constructs dome shaped nests, camouflaged under a tuft of grass beneath fallen branches or base of a small shrub (Readers Digest, 1979; DEC threatened species profiles). While this species was not recorded during field survey work, nearby records exist and suitable habitat occurs. There is a high potential for the speckled warbler to occur in remnant woodland and open forest vegetation in the eastern section of the study area.

The diamond firetail usually gathers in small flocks of 20-30. This species inhabits open forests with a grassy groundcover, woodlands, mallee, acacia scrublands and timber belts along watercourses and roadsides. Diamond firetails build a horizontal nest in dense foliage of a tree, shrub or mistletoe clump (Morcombe, 2000). The diamond firetail was not recorded within the study area and only one record exists for the locality, however suitable habitat exists and this species may occasionally visit the subject site.

The main potential impact on threatened woodland birds resulting from the proposal is expected to be the loss of foraging habitat. Although no nest trees for the babbler would be lost, the proposal could result in the loss of nest sites for other threatened woodland bird species that may nest within the proposed impact area.

In summary, foraging and breeding habitat for at least two threatened woodland bird species is expected to be lost as a result of the proposal. However, as the proposed impact area is a narrow strip of vegetation alongside the existing rail easement, it is considered highly unlikely that the proposal would impact the lifecycle of any of these species to such an extent that a local population would be placed at risk of extinction.

MAMMALS

Brush-tailed phascogale (vulnerable – TSC Act)

The brush-tailed phascogale is a nocturnal, semi-arboreal, carnivorous dasyurid and preys on invertebrates and small vertebrates. The eastern distribution of the brush-tailed phascogale is along the coast and adjacent ranges from southern Queensland to south-eastern South Australia. This species appears to prefer dry open forest types with sparse ground cover though it has also been recorded in moist forest and cool temperate rainforest (Soderquist, 1995).

Considered to be the most arboreal of the dasyurids, individuals have been reported using up to 20 nests in a single year, which include hollow tree limbs, rotted stumps and globular bird nests, although breeding nests are usually situated in tree hollows. Studies have reported a home range of 37.05 ha for females and 86.53 ha for males outside the breeding season (Traill & Coates, 1993; Soderquist, 1995). Female home ranges do not overlap with other unrelated females however male home ranges can overlap with those of other males and females. The brush-tailed phascogale has a very restricted breeding season, which occurs in the winter with annual male die-off occurring after mating. Births tend to occur during July and August, with the female having up to eight young. Females can live beyond their second year though tend not to breed after this time.

No nearby records of the brush-tailed phascogale exist, however suitable habitat occurs in larger areas of intact habitat, particularly south of the existing rail easement in the eastern section of the study area. While some potential foraging habitat for the brush-tailed phascogale would be removed as a result of the proposal, the main impact would be the loss of potential nesting and shelter hollows. Given the linear nature of the impact area, the proposal is not expected to have an adverse affect on the lifecycle of the brush-tailed phascogale such that a viable local population of the species is likely to be placed at risk of extinction.

Cave-roosting bats – little bentwing-bat *Miniopterus australis* and eastern bentwing-bat *Miniopterus schreibersii oceanensis* (both vulnerable – TSC Act)

Two species of threatened microbat known to primarily roost in caves and similar structures, the little bentwing-bat and eastern bentwing-bat, have been recorded within the study locality. Foraging habitat for both species occurs within the study area however no breeding habitat is available. Limited roost sites occur in drains and culverts within the study area and these may be used on an occasional basis by groups or individual bats.

If drains and culverts within the proposed impact area are to be removed or modified as a result of the proposal, then there is a small possibility that individual bats may be affected. However given the extent of foraging habitat available in the study locality, the large foraging range of these species and the fact that no breeding habitat would be affected, it is considered highly unlikely that any local population of the little bentwing-bat or eastern bentwing-bat would be placed at risk of extinction as a result of the proposal.

Grey-headed flying-fox *Pteropus poliocephalus* (vulnerable – TSC & EPBC Acts)

The grey-headed flying-fox was recorded within the study area during the field survey and numerous records occur within the study locality. In NSW, the grey-headed flying-fox occurs in coastal areas, roosting in communal camps during the day and flying out in search of food (eucalypt blossom, rainforest fruits, banksias etc.) at night (DECC threatened species information). The subject site is well within foraging range of the nearest known camp at Singleton and likely to be regularly visited when food resources are available (particularly during peak winter flowering periods).

As the study area provides known foraging habitat for the grey-headed flying-fox, the removal of vegetation associated with the proposal does contribute to the long-term cumulative loss of habitat affecting this threatened species. However, given the large foraging range of this species, the extent of foraging habitat that would remain within the locality and the fact that roosting habitat would not be affected, it is considered highly unlikely that any local population of the grey-headed flying-fox would be placed at risk of extinction as a result of the proposal.

Hollow-roosting bats – east-coast freetail-bat *Mormopterus norfolkensis*, eastern false pipistrelle *Falsistrellus tasmaniensis*, greater broad-nosed bat *Scoteanax ruepellii* and yellow-bellied sheath-tail-bat *Saccolaimus flaviventris* (all vulnerable – TSC Act)

Three species of threatened microbat known to roost primarily in tree hollows, the east-coast freetail-bat, eastern false pipistrelle and greater broad-nosed bat, have been recorded within the study locality. One additional species, the yellow-bellied sheath-tail-bat, has not been recorded within the locality but could potentially occur as suitable habitat exists. Potential roosting and foraging habitat for all four species occurs within the study area.

The proposal is likely to result in the loss of potential foraging habitat for these species and the loss of potential roosting and breeding habitat as 16 hollow-bearing trees lie within the proposed earthworks area and would require removal. Given the expected large foraging range of these species, it is unlikely that the proposal would disrupt the life cycle of any of these four species to such an extent that a viable population would be placed at risk of extinction. Although the likelihood of a threatened bat species using one of the hollow-bearing trees as a maternity roost during construction of the proposal is remote, mitigation measures have nonetheless been incorporated into the proposal to minimise the risk of individuals being killed or injured during clearing operations. See the Mitigation Measures in Section 7 for further information regarding hollow-bearing tree removal.

Koala *Phascolarctos cinereus* (vulnerable – TSC Act)

Distributed from about Townsville, Queensland to the Victorian / South Australian border, from the coast to the western slopes and plains in New South Wales, this species is rare in the north and south of its range and nowhere can it be considered abundant. The koala is a foliovore, feeding on a number of

preferred eucalypt species. The koala is found in a variety of habitats where suitable food trees occur and is often sighted in younger trees, which may have leaves of a higher palatability and nutrient value.

No evidence of koala activity was recorded during the field survey and no nearby records exist. One preferred food tree listed under SEPP44 (the forest red gum *Eucalyptus tereticornis*) occurs within the study area and one secondary food tree, the grey box *Eucalyptus moluccana* was also recorded. A narrow stretch of potential koala habitat would be removed as a result of the proposal. However given the extent of suitable habitat that would remain in surrounding bushland, the proposal is considered highly unlikely to have an adverse affect on the life cycle of the koala such that a viable local population would be placed at risk of extinction. Potential impacts on koala habitat are addressed further in a discussion of SEPP44 requirements in **Section 4.2.4**.

Southern myotis *Myotis macropus* (vulnerable – TSC Act)

The southern myotis is known to occur in a wide coastal band from southern Queensland, New South Wales, Victoria, and into far south-eastern South Australia. While this species is generally infrequently recorded during surveys within the region, the southern myotis can be relatively common in suitable habitats surrounding roost sites. This species forages over water and is usually found near large bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to the roost site. The species has specific roost requirements, and only a small percentage of available caves, mines, tunnels and culverts are used.

Potentially suitable foraging habitat for the southern myotis exists in the form of the dams and watercourses within the study area. No suitable roosting or breeding habitat for the southern myotis was observed within the study area. Given the large foraging range of this species and the existence of numerous other open waterbodies in the area, it is considered highly unlikely that any local population of the southern myotis would be placed at risk of extinction as a result of the proposal.

Spotted-tailed quoll *Dasyurus maculatus* (vulnerable – TSC Act; endangered – EPBC Act)

The current distribution of the spotted-tailed quoll is the coast and ranges of eastern Australia from southern Queensland to the Victorian/South Australian border and Tasmania. The mainland range of this species has been much fragmented and significantly reduced and is now disjunct over much of its former range. The spotted-tailed quoll utilises a wide range of habitat types including rainforest, wet and dry sclerophyll forest, woodland, coastal heathland and inland riparian forest (Edgar & Belcher 1995). A solitary, nocturnal and semi-arboreal species, spotted-tailed quolls prey on a variety of species, ranging in size from small wallabies to insects, as well as plants. Spotted-tailed quolls, as opportunistic predators, utilise extensive home ranges, estimated to be between 500 - 1000 hectares (Australian Museum Business Services 1995). Den and nest sites have been recorded in caves, rock crevices, tree hollows and hollow logs (Edgar & Belcher 1995).

A number of spotted-tailed quoll records exist for the study locality, including one nearby record. Potential foraging habitat does occur within the study area for this species though hollow logs were generally scarce indicating that few potential den sites are available. Some potential foraging habitat for the spotted-tailed quoll would be removed as a result of the proposal, though it is unlikely that any den sites would be affected. Given the extent of suitable foraging habitat that would remain in surrounding bushland, the proposal is considered unlikely to affect the life cycle of the spotted-tailed quoll to such an extent that a local population would be placed at risk of extinction.

Squirrel glider *Petaurus norfolcensis* (vulnerable – TSC Act)

The squirrel glider is distributed along the coast and ranges of eastern Australia from Cairns in north Queensland to the Victorian/South Australian border, extending to the western slopes and plains. This species usually inhabits dry open sclerophyll forest and woodland but there have been recent observations in moist regenerating forest and moist gullies. Absent from dense coastal ranges in the

south of its distribution, it does occur in coastal forest and wet areas bordering rainforest in New South Wales and Queensland (Strahan 2002). Although requiring nesting hollows, this species is not dependent on mature forest as sightings have been made in Eucalyptus plantations and forest remnants (Ray Williams, Ecotone Ecological Consultants, pers. obs.). It is possible that disused Ringtail Possum dreys and birds nests are used in the absence of an abundance of suitable hollows.

A number of squirrel glider records exist for the locality, with two records occurring within two kilometres of the study area. There is a good possibility that this species occurs within the study area as potential foraging habitat occurs in areas of remnant vegetation and a reasonable number of trees containing suitable roost hollows were recorded.

A narrow strip of potential foraging habitat for the squirrel glider would be removed as a result of the proposal. Fourteen trees containing potentially suitable roost hollows lie within the proposed earthworks area and would require removal. If a population of squirrel gliders does occur, given that a number of hollow-bearing trees containing potential roost sites would be removed, there is a small possibility that individual animals could be killed during clearing operations. However given the linear nature of the proposed impact area and the presence of suitable habitat in adjoining bushland areas, the proposal is considered unlikely to affect the life cycle of the squirrel glider to such an extent that a local population would be placed at risk of extinction.

FROGS

Green and golden bell frog *Litoria aurea* (endangered – TSC Act; vulnerable – EPBC Act)

The green and golden bell frog is reliant upon suitable waterbodies for breeding. It appears to prefer waterbodies that are adjacent to unshaded grassland/sedgeland for foraging and free from predatory fish (in particular the introduced mosquito fish *Gambusia holbrooki*). A number of dams providing potentially suitable habitat for the green and golden bell frog occur within the study area. However given the pattern of decline for this species and the fact that most of the recent records are from coastal areas, the likelihood of this species occurring within the study area is considered minimal.

While some potential habitat may be affected by the proposal, it is considered highly unlikely that the life cycle of the green and golden bell frog would be disrupted to such an extent 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 likely to be placed at risk of extinction.*

Not applicable

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

Not Applicable

- (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, and*
 - (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*
 - (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.*

BIRDS

Forest Owls – powerful owl *Ninox strenua*, masked owl *Tyto novaehollandiae* and barking owl *Ninox connivens* (all vulnerable – TSC Act)

- (i) Approximately 14 hectares of remnant vegetation would be removed as a result of the proposal. In addition, three trees containing hollows large enough to be used for nesting by these species would require removal. Those trees containing potentially suitable owl nest hollows are shown as “Hollow-bearing Tree (large hollows)” in **Figure 6**.
- (ii) No habitat for these species is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Given the linear nature of the proposed impact area and the extent of foraging habitat available in surrounding areas, the ability of these forest owl species to forage within the local area is unlikely to be greatly affected. Although the likelihood of a threatened forest owl species using one of the hollow-bearing trees as a nest or roost tree during construction of the proposal is remote, mitigation measures have nonetheless been incorporated into the proposal to minimise the risk of individuals being killed or injured during clearing operations. See the Mitigation Measures in Section 6 for further information regarding hollow-bearing tree removal.

Glossy black-cockatoo *Calyptorhynchus lathami* (vulnerable – TSC Act)

- (i) A small amount of potential foraging habitat for the glossy black-cockatoo is likely to be removed. Four trees containing potentially suitable nest hollows would require removal as they lie within the proposed impact area boundary.
- (ii) No habitat for this species is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) The loss of a small extent of potential foraging habitat is unlikely to significantly impact a local population of the glossy black-cockatoo. While a number of trees containing potentially suitable nest hollows would be removed, no evidence of the glossy black-cockatoo was recorded during the field surveys and only two records exist for the locality. It is therefore considered unlikely that a nest tree exists within the study area and the extent of potential glossy black-cockatoo habitat to be removed as a result of the proposal is considered unlikely to be important to the survival of the species within the locality.

Grass owl *Tyto capensis* (vulnerable – TSC Act)

- (i) A long narrow strip of grassland is likely to be removed as a result of the proposal, some of which may contain suitable habitat for the grass owl.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Given the linear nature of the proposed impact area, the loss of potential habitat from within this area is unlikely to be important to the survival of the grass owl in the locality.

Square-tailed kite *Lophoictinia isura* (vulnerable – TSC Act)

- (i) Approximately 14 hectares of potential foraging habitat for the square-tailed kite would be removed as a result of the proposal. No breeding habitat was recorded within the study area and none is expected to be affected.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Given the linear nature of the proposed impact area and the presence of suitable potential habitat in surrounding bushland, the loss of habitat associated with the proposal is unlikely to be important to the long-term survival of the square-tailed kite in the locality.

Swift parrot *Lathamus discolor* (endangered – TSC Act; endangered & migratory – EPBC Act) and regent honeyeater *Xanthomyza phrygia* (endangered – TSC & EPBC Acts)

- (i) The proposal is likely to result in the loss of approximately 14 hectares of potential foraging habitat that may be used on an occasional or seasonal basis by the swift parrot and regent honeyeater.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Both species are highly mobile and only likely to occasionally visit the study area during peak flowering periods. As such, the amount of habitat that would be removed or modified as a result of the proposal is considered highly unlikely to impact the long-term survival of the swift parrot and regent honeyeater in the locality.

Woodland Birds – brown treecreeper *Climacteris picumnus*, painted honeyeater *Grantiella picta*, black-chinned honeyeater *Melithreptus gularis gularis*, turquoise parrot *Neophema pulchella*, hooded robin *Melanodryas cucullata*, diamond firetail *Stagonopleura guttata*, grey-crowned babbler *Pomatostomus temporalis*, speckled warbler *Pyrholaemus sagittatus* – all Vulnerable (TSC Act)

- (i) Fourteen hectares of foraging habitat for the brown treecreeper and grey-crowned babbler would be removed as a result of the proposal. These areas also provide potential habitat for the painted honeyeater, black-chinned honeyeater, turquoise parrot, hooded robin, diamond firetail and speckled warbler. Twelve trees containing hollows suitable for nesting by the brown treecreeper lie within the proposed earthworks area and would be removed as a result of the proposal.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Given the linear nature of the proposed impact area, the loss of habitat associated with the proposal is unlikely to significantly impact threatened woodland birds in the area. The loss of nest sites for the brown treecreeper would contribute to increasing pressures on these threatened species though is considered unlikely to be important to the long-term survival of these species in the locality.

MAMMALS

Brush-tailed phascogale (vulnerable – TSC Act)

- (i) Approximately 14 hectares of potential foraging habitat and 14 trees containing potentially suitable nest hollows for the brush-tailed phascogale would be removed as a result of the proposal.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Given the linear nature of the proposed impact area, the loss of potential foraging habitat associated with the proposal is unlikely to significantly impact a local population of the brush-tailed phascogale. If a population of the brush-tailed phascogale does occur within the area, the loss of hollow-bearing trees associated with the proposal would contribute to increasing

pressures on this threatened species, but is unlikely to have a significant impact on the long-term survival of the brush-tailed phascogale within the locality.

Cave-roosting bats – little bentwing-bat *Miniopterus australis* and eastern bentwing-bat *Miniopterus schreibersii oceanensis* (both vulnerable – TSC Act)

- (i) No significant roosting habitat is likely to be removed or modified as a result of the proposal, though drains and culverts within the proposed impact area may provide temporary roost sites for individual or small groups of bats. The area of potential foraging habitat to be removed represents only a small amount of the available habitat in the area.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Given the large foraging range of these species, the small amount of potential habitat to be modified/removed as a result of the proposal is considered highly unlikely to impact the long-term survival of threatened cave-roosting microbat species in the locality.

Grey-headed flying-fox *Pteropus poliocephalus* (vulnerable – TSC & EPBC Acts)

- (i) Approximately 14 hectares of foraging habitat for the grey-headed flying-fox would be removed as a result of the proposal. No roost sites would be affected.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) The removal of vegetation associated with the proposal contributes to the cumulative effect of habitat loss for the grey-headed flying-fox in the area. However, given the large home range of this species, the amount of potential foraging habitat to be removed as a result of the proposal is considered unlikely to impact the long-term survival of the grey-headed flying-fox in the locality.

Hollow-roosting bats – east-coast freetail-bat *Mormopterus norfolkensis*, eastern false pipistrelle *Falsistrellus tasmaniensis*, greater broad-nosed bat *Scoteanax ruepellii* and yellow-bellied sheath-tail-bat *Saccolaimus flaviventris* (all vulnerable – TSC Act)

- (i) Approximately 14 hectares of potential foraging habitat would be removed or modified as a result of the proposal. Sixteen habitat trees containing potentially suitable roost hollows would also require removal as they lie within the proposed earthworks area.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Given the large foraging range of these species, the amount of potential habitat to be removed as a result of the proposal is considered unlikely to impact the long-term survival of threatened tree-roosting microbat species in the locality. Although the likelihood of a threatened bat species using one of the hollow-bearing trees as a maternity roost during construction of the proposal is remote, mitigation measures have nonetheless been incorporated into the proposal to minimise the risk of individuals being killed or injured during clearing operations.

Koala *Phascolarctos cinereus* (vulnerable – TSC Act)

- (i) Approximately 14 hectares of potential shelter or foraging habitat for the koala is expected to be removed as a result of the proposal. However no evidence of koala activity was recorded during the field survey and it is unlikely that this would constitute important habitat for the koala.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Given the linear nature of the proposed impact area, the extent of potential shelter or foraging habitat expected to be removed as a result of the proposal is considered unlikely to be important to the long-term survival of the koala in the locality.

Southern myotis *Myotis macropus* (vulnerable – TSC Act)

- (i) A few dams, watercourses and other wet areas lie within the proposed impact area, however these represent only a very small extent of the potential foraging habitat available for the southern myotis within the locality.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Given the large home range of this species and the presence of numerous open waterbodies within the area, the proposal is highly unlikely to affect the long-term survival of the southern myotis in the locality.

Spotted-tailed quoll *Dasyurus maculatus* (vulnerable – TSC Act; endangered – TSC Act)

- (i) Approximately 14 hectares of potential foraging habitat for the spotted-tailed quoll would be removed as a result of the proposal. No suitable den hollows were observed within the subject site and none are expected to be affected.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) Given the linear nature of the proposed impact area, the large home range of the spotted-tailed quoll and the extent of habitat available within the study locality, the loss of potential foraging habitat associated with the proposal is unlikely to be important to the long-term survival of the spotted-tailed quoll in the locality.

Squirrel glider *Petaurus norfolcensis* (vulnerable – TSC Act)

- (i) Approximately 14 hectares of potential foraging habitat and 14 trees containing potentially suitable roost hollows would be removed as a result of the proposal.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) The loss of potential foraging habitat and hollow-bearing trees would contribute to the cumulative loss of habitat affecting the squirrel glider. However given the linear nature of the proposed impact area and the presence of suitable potential habitat in adjacent bushland, the extent of habitat loss associated with the proposal is considered unlikely to be significant to the long-term survival of the squirrel glider in the locality.

FROGS**Green and golden bell frog *Litoria aurea* (endangered – TSC Act; vulnerable – EPBC Act)**

- (i) It is unlikely that any green and golden bell frog habitat would be affected by the proposal, though a few dams and other wet areas lie within the proposed impact area.
- (ii) No habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposal.
- (iii) While a small extent of potential green and golden bell frog (i.e. dams and other wet areas) may be lost as a result of the proposal, it is unlikely that this species occurs within the study area. The proposal is therefore considered unlikely to be important to the long-term survival of the green and golden bell frog in the locality.

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

No areas of designated critical habitat so far identified under the provisions of the *Threatened Species Conservation Act 1995* apply to the study area.

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

Recovery Plans

Two subject species, the powerful owl and masked owl, are the subject of a final recovery plan prepared by the NSW Department of Environment and Conservation (now Department of Environment and Climate Change [DECC]). Two subject species, the regent honeyeater and swift parrot, are the subject of recovery plans prepared by their respective specific recovery teams. Three subject species, the green and golden bell frog, barking owl and koala, are the subject of draft recovery plans prepared by the NSW Department of Environment and Conservation (now DECC). No recovery plans have been prepared for the remaining subject species.

Recovery Plan for the Large Forest Owls: Powerful Owl *Ninox strenua* Sooty Owl *Tyto tenebricosa* Masked Owl *Tyto novaehollandiae* (DEC 2006)

The main objective of the plan is to ensure that these threatened owl species persist in the wild in NSW in each region where they currently occur. Two specific objectives within the recovery plan have potential relevance to the current proposal. Objective 1 deals with minimising the loss and fragmentation of habitat and Objective 2 deals with minimising the impacts of development on large forest owl habitat. Given the large home range of these species and the small amount of potential habitat likely to be affected, the action proposed is considered not inconsistent with the objectives of this draft recovery plan. Although the likelihood of a threatened forest owl species using one of the hollow-bearing trees as a nest or roost tree during construction of the proposal is remote, mitigation measures have nonetheless been incorporated into the proposal to minimise the risk of individuals being killed or injured during clearing operations. See the Mitigation Measures in Section 6 for further information regarding hollow-bearing tree removal.

Swift Parrot Recovery Plan (Swift Parrot Recovery Team, 2001)

The main objectives of the plan are to change the status of the swift parrot from endangered to vulnerable within 10 years and to improve the quality of swift parrot habitat to increase the carrying capacity. This is mainly centred on the restricted breeding areas within the Tasmanian blue gum forest along the south-east coast of Tasmania; however foraging habitat in Victoria and NSW also requires protection. While there are a number of records for this species within the locality, it is likely that the swift parrot would only visit the study area on occasion and therefore the loss of potential habitat from within the proposed impact area would not be inconsistent with the aims of the recovery plan.

Regent Honeyeater Recovery Plan (Regent Honeyeater Recovery Team, 1999)

The main objectives of the plan are to:

- (i) ensure that the regent honeyeater persists in the wild;
- (ii) achieve a down-listing in the status of the regent honeyeater from endangered to vulnerable by stabilising the population decline and securing habitat extent and quality in the main areas of occupancy; and
- (iii) achieve increased reporting rates from areas known to have previously been used regularly by this species.

As for the swift parrot, it is likely that the regent honeyeater would only visit the study area on occasion and therefore the loss of potential habitat associated with the proposal would not be inconsistent with the aims of the recovery plan.

Draft Recovery Plan for the Green and Golden Bell Frog (*Litoria aurea*) (DEC 2005)

The two overall objectives of this recovery plan are to stabilise and prevent further decline of the green and golden bell frog within five years by managing threats impacting on current known populations and to return the species to its former distribution wherever possible within the next 10-20 years. The specific objectives of the plan are to:

- (i) prevent the further loss of, and where possible increase or improve, green and golden bell frog habitat at key populations in order to stabilise the security of those key populations
- (ii) eliminate or mitigate threats to known green and golden bell frog populations
- (iii) implement habitat management initiatives guided by further research into and monitoring of the green and golden bell frog
- (iv) establish self-sustaining and representative captive populations for re-establishment purposes
- (v) increase awareness of the green and golden bell frog through community education and involvement

The proposal does not appear to be inconsistent with the aims and objectives of this recovery plan.

Draft Recovery Plan for the Barking Owl (NPWS 2003a)

The main aim of this recovery plan is to recover the barking owl to a position of viability in nature in NSW. Action 3.2 is considered potentially relevant to the current proposal and addresses the issue of protecting barking owl habitat from disturbance due to developments and activities. Given the linear nature of the proposed impact area and the presence of additional potential foraging habitat in adjacent bushland, the proposal is not considered inconsistent with the aims and objectives of the recovery plan.

Draft Recovery Plan for the Koala (NPWS 2003b)

The overall objectives of this recovery plan are to reverse the decline of the koala in NSW, to ensure adequate protection, management and restoration of koala habitat and to maintain healthy breeding populations of koalas throughout their current range. Specific objective number two is considered potentially relevant to the proposal and addresses the issue of rehabilitation and restoration of koala habitat and populations. Given the linear nature of marginal potential koala habitat that would be removed as a result of the proposal, it is not considered inconsistent with the aims and objectives of this recovery plan.

Threat Abatement Plans

One threat abatement plan approved by DECC is considered potentially relevant to the proposal, this addresses the key threatening process 'Predation by the Red Fox' (NPWS 2001). Four potentially relevant national threat abatement plans are current for "Competition and Land Degradation by Feral Rabbits", 'Infection of amphibians with chytrid fungus resulting in chytridiomycosis', 'Predation by European Red Fox' and 'Predation by Feral Cats'. The current proposal is not considered inconsistent with the aims and objectives of these threat abatement plans. However if works are undertaken within the creekline or other wet areas within the site, there is a small chance that the chytrid fungus could be spread to or from the site via footwear, tools, machinery and vehicles if appropriate cleaning/disinfecting protocols are not implemented.

- (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.*

To date, 32 key threatening processes have been finally determined under the provisions of the *TSC Act*. Those that are considered potentially relevant to the current proposal and the fauna present are discussed below.

Key Threatening Processes – final

1. Competition and grazing by the feral European rabbit

Evidence of feral rabbit activity was recorded throughout the study area during field survey work. It is highly unlikely that the proposal would contribute to an increase in feral rabbit activity in the area.

2. Competition from feral honeybees

Feral honeybees were recorded during the field survey, including a hive observed in one of the hollow-bearing trees. It is highly unlikely that the proposal would contribute to an increase in this key threatening process within the area.

3. Predation by feral cats

While not recorded during the field survey, it is expected that feral cats would occur within the study area. It is highly unlikely that the proposal would lead to an increase in feral cat activity in the area.

4. Predation by the European Red Fox

While not recorded during the field survey, it is expected that the European red fox would occur within the study area. It is highly unlikely that the proposal would lead to an increase in feral cat activity in the area.

5. Clearing of native vegetation

The proposal is expected to result in the clearing of approximately 6.3 hectares of remnant bushland within the study area and would contribute to the incremental cumulative loss of native vegetation within the local region.

6. Human-caused climate change

Vehicle and machinery use and vegetation removal associated with the proposal are likely to add to the cumulative effects of greenhouse gas emissions contributing to human-caused climate change. However, on a global scale, the degree to which this proposal contributes to this key-threatening process is negligible.

7. Infection of frogs by the amphibian chytrid causing the disease chytridiomycosis

While unlikely, if works are undertaken within the creekline or other wet areas there is a small possibility that the chytrid fungus could be imported into or exported out of the study area on boots, tools, machinery or vehicles.

8. Loss of hollow-bearing trees

A number of threatened fauna species known or with potential to occur within the study area are reliant on hollow-bearing trees for roosting and breeding purposes, including the brown treecreeper, squirrel glider, brush-tailed phascogale, threatened owls and hollow-roosting insectivorous bats. Sixteen hollow-bearing trees were recorded within the proposed earthworks area and are expected to be removed as a result of the proposal. Therefore the proposal is expected to increase the incidence of this key threatening process.

9. Removal of dead wood and dead trees

A number of dead standing trees and occasional fallen timber occurs across the study area. Thirteen dead trees with hollows are likely to be removed as a result of the proposal, though little fallen timber is expected to be affected. Therefore the proposal is expected to increase the incidence of this key threatening process.

Conclusions from the seven-part test for the threatened fauna species:

For many of the subject species the proposed impact area represents only a small proportion of the potential foraging area within the study locality. The removal of 6.3 hectares of potential foraging habitat associated with the proposal is unlikely to have a significant impact on these wide-ranging species (e.g. the swift parrot, regent honeyeater, cave-roosting bats, grey-headed flying-fox and spotted-tailed quoll). For a number of other species (e.g. the grass owl, green and golden bell frog and square-tailed kite), impacts are expected to be minimal or non-existent.

Known and potential habitat for woodland bird species would be removed as a result of the proposal. However given the linear nature of the proposed impact area and availability of suitable habitat in adjacent bushland, the loss of this habitat is unlikely to have a significant impact on the local populations of these species. Although no trees containing grey-crowned babbler nests would be removed as a result of the proposal, there is the possibility that individual birds could be killed if an appropriate tree-clearing strategy is not implemented.

Those species most likely to be impacted by the proposal are those reliant upon hollow-bearing trees for roosting or breeding purposes, as 16 hollow-bearing trees would be lost as a result of the proposal. These include the brown treecreeper, forest owls, hollow-roosting bats, brush-tailed phascogale and squirrel glider. While it is uncertain whether any of these species are currently utilising hollows within the proposed impact area, the loss of those trees would reduce the availability of nesting/roosting hollows in the general area. It is considered unlikely that the removal of these trees will result in a significant impact on a local population of any of these species. Although the likelihood of a threatened species using one of the hollow-bearing trees as a nest or roost tree during construction of the proposal is remote, mitigation measures have nonetheless been incorporated into the proposal to minimise the risk of individuals being killed or injured during clearing operations. .

In summary, while some potential impacts on threatened fauna have been identified, the likelihood of any of these potential impacts having a significant impact on any threatened fauna species is considered remote. A number of measures may assist in mitigating impacts on threatened fauna species and have been included in the Mitigation Measures (**Section 6**).

4.2.1.3 Provision of Biodiversity Offsets

The Director-General's requirements specify that "the proponent should develop, in consultation with DECC, appropriate biodiversity offsets in accordance with the *Principles for the use of biodiversity offsets in NSW* which forms part of DECC's *Guidelines for Biodiversity Certification of Environmental Planning Instruments* – Working Draft (April 2007)."

Flora – to compensate for the habitat lost, offsets could be provided by the protection and enhancement of identified habitat (both occupied and adjoining potential habitat) for *Eucalyptus glaucina*, *Grevillea montana* and the EECs in both ARTC land and adjoining properties, in consultation with the property owners, or by acquisition of the relevant habitat areas from property owners. Management could include exclusion of stock by fencing, weed control and possible replanting although assisted natural regeneration should be the preferred method.

Fauna – to compensate for the habitat lost, offsets could be provided by the protection and enhancement of habitat for those fauna species known or likely to occur within the study area, including the brown treecreeper, grey-crowned babbler, speckled warbler, east-coast freetail-bat, spotted-tailed quoll and squirrel glider. Offset areas could be located in both ARTC land and

adjoining properties, in consultation with the property owners. Management could include exclusion of stock by fencing, weed control and possible replanting although assisted natural regeneration should be the preferred method.

4.2.2 Koala Habitat Assessment

An assessment under SEPP 44 has not been requested in the Director General's Requirements. However given that suitable potential habitat for this species occurs consideration of potential impacts on koalas has been undertaken pursuant to the principles of SEPP 44.

One preferred food species listed in SEPP 44, the forest red gum (*Eucalyptus tereticornis*), was recorded within the study area during the field survey. The grey box (*Eucalyptus moluccana*) also occurs within the study area and is known to be a secondary food species, though it is not listed in SEPP 44.

Some areas of remnant vegetation within the study area would represent potential koala habitat as defined in SEPP 44 as the forest red gum makes up 15% or more of the total canopy cover. These areas of potential koala habitat are restricted to Communities 2 and 3 (refer to **Figure 3**).

An inspection of leaf litter at the base of forest red gums within the study area was made during the field habitat assessment though no koala scats or other evidence of koala activity was observed. Given that there are no koala records within two kilometres of the subject site, it is highly unlikely that a resident population of koalas occurs within or near the study area. Native vegetation within the study area therefore would not constitute core koala habitat according to SEPP 44.

4.3 Commonwealth Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act was gazetted in 2000 and replaced several earlier Commonwealth statutes. This Act focuses Commonwealth interests on matters of national environmental significance (NES) including integrated biodiversity conservation and the management of important protected areas. The Act also establishes a streamlined environmental assessment and approvals process.

The matters of NES as identified in the Act which require assessment and approval to be addressed by the Commonwealth include:

- World Heritage properties
- National Heritage places
- RAMSAR wetlands
- Nationally threatened species and ecological communities (Part 13, Division 1, Subdivision A of the EPBC Act)
- Migratory species
- Commonwealth Marine areas
- Nuclear actions (including uranium mining)

The assessment and approval process applies to any action that has, will have or is likely to have a significant impact on a matter of NES. An 'action' is defined as a project, development, undertaking or an activity or series of activities. As of 18 January 2007, a bilateral agreement has been signed between the Commonwealth and the state of NSW which essentially accredits the NSW assessment process of environmental impact for the purposes of the EPBC Act, provided that the

assessment has been done in accordance with the bilateral agreement. This has effectively removed the need for duplication of assessment effort by both the Commonwealth and state.

With regard to flora and fauna, the only matters of NES relevant to the study area are nationally listed threatened species and migratory species. The relevant criteria given in the administrative guidelines for the Act to determine whether the action will or is likely to have a significant impact on a nationally threatened species are as follows:

Significant Impact Criteria and Assessment	
Critically Endangered and Endangered Ecological Communities None	
Critically endangered and endangered species Flora – None Fauna – swift parrot, regent honeyeater, spotted-tailed quoll	
An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	<i>a) lead to a long-term decrease in the size of a population;</i> The swift parrot and regent honeyeater are only likely to visit the study area on an opportunistic, occasional basis and are unlikely to be greatly affected by the proposal. Given the linear nature of the proposed impact area, if a population of the spotted-tailed quoll does occur, the loss of habitat associated with the proposal is unlikely to lead to a long-term decrease in the size of that population.
	<i>b) reduce the area of occupancy of the species;</i> While some potential foraging habitat for the swift parrot, regent honeyeater and spotted-tailed quoll would be lost as a result of the proposal, this is unlikely to have a significant impact on any of these three species.
	<i>c) fragment an existing population into two or more populations;</i> The proposal would not fragment an existing population of the swift parrot, regent honeyeater or spotted-tailed quoll into two or more populations.
	<i>d) adversely affect habitat critical to the survival of a species;</i> The proposal would not adversely affect habitat critical to the survival of the swift parrot, regent honeyeater or spotted-tailed quoll.
	<i>e) disrupt the breeding cycle of a population;</i> No breeding habitat for the swift parrot, regent honeyeater or spotted-tailed quoll has been recorded within the study area and none is likely to be affected. The proposal would not disrupt the breeding cycle of a population of any of these three species.
	<i>f) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;</i> The proposal would not affect the habitat of the swift parrot, regent honeyeater or spotted-tailed quoll to such an extent that one or more of these species would be likely to decline.
	<i>g) result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*;</i> The proposal is highly unlikely to result in an invasive species harmful to the swift parrot, regent honeyeater or spotted-tailed quoll from becoming established within the study area.
	<i>h) introduce disease that may cause the species to decline; or</i> The proposal is highly unlikely to result in the introduction of a disease that would cause the swift parrot, regent honeyeater or spotted-tailed quoll to decline.
	<i>i) interfere with the recovery of the species.</i> While the proposal would result in the loss of some potential foraging habitat for the swift parrot, regent honeyeater and spotted-tailed quoll, this would not interfere significantly with the recovery of these species.

Vulnerable species Flora – <i>Eucalyptus glaucina</i> Fauna – grey-headed flying-fox, green and golden bell frog	
An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	a) lead to a long-term decrease in the size of an important population** of a species; <u><i>Eucalyptus glaucina</i></u> – is not regarded as an important population at this site. The presence of slaty red gum within the study area is one of at least eight occurrences in the local area (from Bransxton to Whittingham) and is therefore is not considered a key source population for dispersal and maintaining genetic diversity in the local area. Additionally the species occurs as far west as Ravensworth State Forest and the Bulga / Warkworth area (approx 15 km west of the study area), consequently the species is not near the limit of its known range. Considering the proportion of the population that extends beyond the study area, the fact that only narrow areas of occupied habitat would be removed by the proposal and the likelihood that with appropriate management, the population would expand into new areas; it is concluded that the proposal is unlikely to lead to a long-term decrease in the size of the local population of <i>Eucalyptus glaucina</i>. <u>Grey-headed flying-fox</u> – while some foraging habitat would be removed as a result of the proposal, this is unlikely to lead to a long-term decrease in the size of the local population. <u>Green and golden bell frog</u> – no known population of this species occurs within the study area and given the pattern of decline for the green and golden bell frog, none is likely to occur. Some potential green and golden bell frog habitat may be affected if dams within the proposed impact area are closed as a result of the proposal. However this is highly unlikely to lead to a long-term decrease in the size of an important population of the species.
	b) reduce the area of occupancy of an important population; <u><i>Eucalyptus glaucina</i></u> – the area of occupancy would be reduced by 1.2 ha or 47.1% of the occupied habitat within the survey area, but as mentioned above, the local population is not deemed to be an important one. In the long term, the area of occupancy of the population is likely to increase with appropriate protection and management. <u>Grey-headed flying-fox</u> – while some foraging habitat would be removed, this is unlikely to reduce the area of occupancy of the local population. <u>Green and golden bell frog</u> – while some potential habitat would be lost, it is unlikely that a population of the green and golden bell frog occurs within the study area. The proposal is highly unlikely to reduce the area of occupancy of an important population of this species.
	c) fragment an existing important population into two or more populations; <u><i>Eucalyptus glaucina</i></u> – is already fragmented into two parts by the existing railway. The proposal would remove incremental areas from the edges of each part which would slightly increase the distance of separation of the two parts, but not to the extent that exchange of genetic material would cease to occur. <u>Grey-headed flying-fox & green and golden bell frog</u> – the proposal would not fragment an existing important population of either species into two or more populations.
	d) adversely affect habitat critical to the survival of a species; <u><i>Eucalyptus glaucina</i></u> – no habitat critical to the survival of the species has been declared in the study area. <u>Grey-headed flying-fox & green and golden bell frog</u> – the proposal would not adversely affect habitat critical to the survival of either species.
	e) disrupt the breeding cycle of an important population; <u><i>Eucalyptus glaucina</i></u> – exchange of genetic material by cross-pollination between individuals of the species would not be significantly disrupted by the proposed action. <u>Grey-headed flying-fox & green and golden bell frog</u> – neither species is known or likely to breed within the study area. The proposal would not disrupt the breeding cycle of an important population of either species.
	f) modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

	<u>Eucalyptus glaucina</u> – whilst narrow areas of occupied habitat would be removed by the proposal, a viable and healthy population of the species would continue to exist and thrive, and with appropriate management, is likely to expand into new areas. <u>Grey-headed flying-fox</u> – some foraging habitat is likely to be lost as a result of the proposal but this would not affect the grey-headed flying-fox to the extent that the species is likely to decline. <u>Green and golden bell frog</u> – a small amount of potential habitat is likely to be lost or altered as a result of the proposal but this would not affect the green and golden bell frog to the extent that the species is likely to decline. <i>g) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat***;</i> <u>Eucalyptus glaucina</u> – with implementation of an appropriate weed control and management strategy, the proposal would not result in harmful invasive species becoming established in the species' habitat. <u>Grey-headed flying-fox</u> – the proposal is highly unlikely to result in an invasive species harmful to the grey-headed flying-fox becoming established within the study area. <u>Green and golden bell frog</u> – it is highly unlikely that the proposal would result in an invasive species harmful to the green and golden bell frog becoming established within the study area. <i>h) introduce disease that may cause the species to decline; or</i> <u>Eucalyptus glaucina</u> – there is a risk that the action could introduce plant diseases or pathogens such as <i>Phytophthora cinnamomi</i> into the species' habitat, but this risk can be substantially reduced by implementation of protocols to prevent the introduction and spread of pathogens, as outlined in the Mitigation Measures. <u>Grey-headed flying-fox</u> – it is highly unlikely that the proposal would result in the introduction of a disease that may cause the grey-headed flying-fox to decline. <u>Green and golden bell frog</u> – there is a risk that the proposal could introduce chytrid fungus into the study area, but this risk can be substantially reduced by implementation of appropriate protocols to prevent the introduction or spread of chytrid fungus, as outlined in the Mitigation Measures. <i>i) interfere substantially with the recovery of the species.</i> <u>Eucalyptus glaucina</u> – with protection and enhancement of occupied and adjoining potential habitat that would be retained on ARTC land and adjoining private property, the proposal would not substantially interfere with the recovery of the species. <u>Grey-headed flying-fox & green and golden bell frog</u> – the proposal would not interfere substantially with the recovery of either species.
Migratory Species white-bellied sea-eagle, regent honeyeater, white-throated needletail, rainbow bee-eater, black-faced monarch, rufous fantail, satin flycatcher, Latham's snipe, cattle egret, great egret	
An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:	<i>a) substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat[#] for a migratory species;</i> No important habitat for migratory species would be substantially modified as a result of the proposal. <i>b) 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</i> It is highly unlikely that an invasive species that is harmful to any of the above listed migratory species would become established within the study area as a result of the proposal. <i>c) seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion^{##} of the population^{###} of a migratory species.</i> The proposal would not seriously disrupt the lifecycle of any of the above listed migratory species.
Wetlands of International Importance Hunter Estuary Wetlands	
An action is likely to have a significance	<i>a) areas of the wetland being destroyed or substantially modified;</i> No part of the Hunter Estuary Wetlands would be destroyed or substantially modified as a result of the proposal.

impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:	<i>b) a substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland;</i> The proposal is highly unlikely to affect the hydrological regime of the Hunter Estuary Wetlands.
	<i>c) the habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected;</i> While the study area lies within the catchment for the Hunter Estuary Wetlands, it is highly unlikely that the proposal would affect the habitat or lifecycle of any native species dependent upon the wetland.
	<i>d) a substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health; or</i> It is highly unlikely that the proposal would cause a substantial and measurable change in the water quality of the wetland. However as the study area lies within the catchment for the Hunter Estuary Wetlands, a best practice pollution and sediment management system should be implemented and maintained for the life of the project.
	<i>e) an invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland</i> It is highly unlikely that the proposal would result in an invasive species harmful to the ecological character of the Hunter Estuary Wetlands being established in the wetland.

[^] 'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

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

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

A 'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of local populations or
- a population, or collection of local populations, that occurs within a particular bioregion.

* Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a critically endangered or endangered species by direct competition, modification of habitat, or predation.

** An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal,
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

*** Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.

An area of 'important habitat' for a migratory species is:

- habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- habitat that is of critical importance to the species at particular life-cycle stages; and/or
- habitat utilised by a migratory species which is at the limit of the species range; and/or
- habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be

evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.

Key Threatening Processes

Seventeen key threatening processes have been finally determined under the EPBC Act. Those that could be potentially relevant to the proposal are discussed below:

1) Competition and land degradation by feral Rabbits

The proposal is unlikely to increase the incidence of this key threatening process within the study locality.

- 2) Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*); and
3) Infection of amphibians with chytrid fungus resulting in chytridiomycosis

The proposal could potentially result in *Phytophthora cinnamomi* or chytrid fungus being transported into or out of the study area on boots, machinery, tools and vehicles.

4) Land clearance

The proposal is expected to result in the clearing of approximately 14 hectares of native vegetation and the loss of a number of scattered paddock trees within study area.

5) Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases

The proposal is expected to result in the emission of greenhouse gases through vegetation clearing and the use of vehicles and other machinery, though this would represent a tiny proportion of total global emissions.

- 6) Predation by feral Cats; and
7) Predation by the European Red Fox (*Vulpes vulpes*)

The proposal is unlikely to increase the incidence of these key threatening processes within the study locality.

Summary of impacts on EPBC Act matters of NES

According to the criteria given in the administrative guidelines for the EPBC Act, the proposal is unlikely to have a significant impact on any nationally listed threatened or migratory flora or fauna species.

4.4 Impacts on non-listed species and communities

One rare species not listed by legislation, but listed by the national ROTAP database (Briggs and Leigh 1996), mountain grevillea (*Grevillea montana*), will be impacted by the proposal. Approximately 2.74 ha of occupied habitat for the species will be directly removed or modified by the proposal. A total of 6.39 ha of occupied habitat was identified as occurring within the area

surveyed, but occupied habitat for the species was observed as occurring and continuing well beyond the limits of the formal investigation area.

The species has been classified with the risk code 2KC-, which means that its geographic range is currently less than 100 km, it is poorly known (the taxon is suspected, but not definitely known, to belong to one of the conservation categories rare, vulnerable or endangered), at least one population occurs in a national park or other proclaimed conservation reserve but the reserved population size is not accurately known.

The species is known to thrive as a result of disturbance, and often readily establishes on newly-disturbed areas, particularly areas where the understorey has been removed or modified and the canopy opened up. During the flora surveys, the species was observed to have established on mounds of stockpiled soil in one property. It was often observed to be common and abundant in weedy grassland in and adjacent to the railway easement, where the tree layer was sparse or had been cleared.

Whilst the proposal would remove portions of the population, significant areas of occupied habitat would remain unaffected in adjoining land. The species could be used as a target species for rehabilitation of bare or disturbed areas as part of a revegetation and rehabilitation plan. Such a strategy should assure the continuing viability of the local population.

With regard to fauna, 73 non-listed native species were recorded during the field survey. The loss of habitat associated with the proposal would decrease the extent of fauna habitat available. However given the linear nature of the proposed impact area, it is not expected that the proposal would greatly impact any of these fauna species. Those non-listed species most likely to be affected are those reliant on hollow-bearing trees (including the brush-tailed possum, parrots, cockatoos and insectivorous bats). Nest and roost hollows for at least some of these species are likely to be lost as a result of the proposal and there is potential for individual animals to be killed during clearing operations.

4.5 Aquatic Ecology Impact Assessment

Aquatic habitat was very limited within the study area, being restricted to:

- Two ephemeral creeks that cross the existing railway line (Mudies Creek at the western end and a tributary of Jump-Up Creek at the eastern end of the study area); and
- Three artificial wet soak areas created as a result of impeded drainage. One is possibly tenuously linked to Mudies Creek, one possibly tenuously linked to Jump Up Creek and one with no apparent link to a named watercourse.

These areas correspond to Vegetation Communities 3 (Riparian forest) and 6 (Wet soaks) as shown on **Figure 3**. Most of the aquatic habitat was in a degraded condition, due to the extensive levels of clearing for agricultural purposes in and surrounding the study area.

An assessment was undertaken in consideration of relevant NSW Fisheries Guidelines (1998 and 1999) for aquatic habitat and fish assessment. The results of the aquatic and fish habitat assessment are as follows:

Geomorphology – The study area occurs in the catchment area for the Hunter River. The flatter part at the western end of the study area occurs directly on the floodplain of Mudies Creek, a tributary of the Hunter River. The land east of the Golden Highway occurs on gently undulating

land drained by tributaries of Jump-Up Creek that eventually flow into the Hunter River. Soils of the area are composed of gravel, sand, silt and clay alluvial of the Hunter River floodplain and Maitland Group siltstone, sandstone, conglomerate and mudstone.

Flow Regime – At the time of survey, little or no flow was evident in the creeks, the drainage lines or wet soaks within the study area due to the ephemeral nature of these watercourses. Water within Mudies Creek and Jump-Up Creek in the study area occurred in the form of small pools of still water or very slow-flowing streams. The watercourses within the study area are associated with degraded riparian vegetation and exhibited minor erosion possibly caused by previous riparian vegetation removal.

Water Quality – No water quality testing was undertaken as part of this assessment. From observations at the time of the survey, it was noted that the water quality appeared to vary between different waterbodies from relatively clear to highly discoloured. Following heavy rain, high turbidity was noted in the tributary of Jump-Up Creek at the eastern end of the study area.

Water Depth – At the time of the survey, the water depth in all observed pools within the study area was no more than one (1) metre and mostly much less than this. The average depth was 30-40 cms.

Land Use – Land use within the immediate catchment of the study area is predominantly devoted to transport infrastructure (the existing railway), cattle grazing or reserved military land, with an olive plantation at the eastern end.

Riparian Vegetation – Due to grazing pressure and erosion, riparian vegetation throughout the subject site is moderately degraded, with some areas infested with weeds and exotic pasture grasses. A partial to full complement of canopy trees remains along the riparian zone of the two creeks, dominant species being swamp oak (*Casuarina glauca*), rough-barked apple (*Angophora floribunda*), forest red gum (*Eucalyptus tereticornis*) and slaty red gum (*Eucalyptus glaucina*).

In less degraded riparian areas, robust native shrubs and herbs such as *Persicaria hydropiper* and *Hydrocotyle peduncularis* occur.

In-stream Vegetation – Very little instream vegetation occurs in any of the creeks or drainage lines in the study area. The larger, permanent pools of Mudies Creek and the tributary of Jump-Up Creek contain Pacific azolla (*Azolla filiculoides*), nardoo (*Marsilea hirsuta*), duck weed (*Spirodela punctata*) and water ribbons (*Triglochin procerum*). *Typha orientalis*, thatch-reed (*Phragmites australis*) and spike-rush (*Eleocharis cylindrostachys*).

Some sedges and rushes (such as *Juncus usitatus*) form a major component of aquatic vegetation in the wet soak areas and along some streams.

Presence of Wetlands – No true wetlands occur in the study area, but the wet soak areas, which are artificially created due to the impedance of natural water flow in drainage lines, assume some of the characteristics of small wetlands, such as standing shallow water, presence of rushes etc. However despite these characteristics, these wet soaks are dominated by Kikuyu and other exotic vegetation.

Substrate Type – Predominantly soil with some rocky areas.

Fish Refuge Areas – No potential fish refuge areas such as overhangs, snags or large woody debris, were considered to occur within the study area. This is due to the fact that they are minor watercourses with degraded riparian zones.

Potential Spawning Areas – None apparent at the time of survey.

Natural and Artificial Barriers to Fish – The ephemeral nature of both the creeks and the drainage lines within the study area results in a natural barrier to passage between the more permanent pools outside periods of high water flow. Under high flow conditions there would be some connectivity with the Hunter River, a few kilometres to the north. In addition, the length and catchments of these creeks and drainage lines upstream of the rail line are small and also degraded. Any artificial barriers to fish in the form of culverts etc. are currently in place due to the existing railway infrastructure. The current proposal would not significantly increase existing artificial barriers to fish.

Likely Presence of Threatened or Migratory Fish Species – No threatened or migratory fish species listed under the *Fisheries Management Act 1994* are expected to occur, given the nature and condition of the aquatic habitats available. A search of Bionet web site revealed that no threatened fish, mollusc or crustacean species have previously been recorded within the Cessnock LGA. Those aquatic fauna previously recorded within the entire Hunter/Central Rivers Catchment Management Area are listed in **Appendix 5**.

It is not expected that the proposed rail upgrade or associated construction works would negatively impact any species of threatened or migratory fish.

Aquatic Fauna Present – In compliance with the Guidelines for Assessment of Aquatic Ecology (DUAP, 1998), and in response to the low level of disturbance to aquatic habitats expected as a result of the construction of the project, no survey for aquatic fauna was undertaken as part of this assessment. Based on the available aquatic habitat, it is expected that relatively common aquatic fauna such as freshwater crayfish and aquatic macro-invertebrates, are likely to occur in wet soak areas and in some of the larger pools in creeklines within the study area (particularly Mudies Creek and the tributary of Jump-Up Creek).

Conclusion from Aquatic Ecology Assessment

Given the limited, ephemeral and degraded nature of creeklines and wet areas within the subject site and the fact that no threatened aquatic species are expected to occur, the undertaking of a full aquatic survey is not considered warranted under the survey guidelines.

4.6 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems are ecosystems that can depend on groundwater and that may support threatened or endangered species, communities and populations.

They include:

- Terrestrial vegetation communities that show seasonal or episodic reliance on groundwater;
- River base flow systems which are aquatic and riparian ecosystems in or adjacent to streams/rivers dependent on the input of groundwater to base flows;
- Aquifers;
- Wetlands;
- Estuarine and near-shore marine discharge ecosystems; and

- Fauna which directly depend on groundwater as a source of drinking water or that live within water which provides a source.

Vegetation communities 3 (Riparian forest) and 6 (Wet soaks) from this study broadly correspond to one or more of the above ecosystem types. These communities have been identified as being significant communities in the discussion above.

Therefore, it can be concluded that any potential impacts on Groundwater Dependent Ecosystems have already been identified in the impacts on EECs and wet soak areas elsewhere in this report. If the proposal were to result in the complete loss of one or more of the wet soak areas, it is recommended that compensatory habitat be created elsewhere within or near the study area.

However, the groundwater assessment included in the Environmental Assessment (GHD, 2008) concluded that minimal impacts on groundwater flow regimes would occur as a result of the proposal. Therefore there are unlikely to be any significant impacts on groundwater dependent ecosystems as a result of the proposal.

5.0 CONCLUSIONS

An assessment of the impacts on flora and fauna in relation to the preferred route for the proposed Minimbah Bank third rail track, including road overpasses and drainage works, has been made based on a combination of literature review and field survey. The resulting information has been used to address Part 3A of the *Environmental Planning and Assessment Act 1979*, which includes a requirement for assessment of impact of the proposal on threatened species pursuant to section 5A of the *Environmental Planning and Assessment Act 1979* and other relevant legislation.

One threatened flora species listed under legislation was recorded within the study area. Slaty red gum (*Eucalyptus glaucina*), listed as vulnerable under both the TSC and EPBC Acts, was confirmed to occur in several private properties mainly outside, but occasionally within the existing rail track easement. The species was generally restricted to the part of the study area east of the Golden Highway overpass, but occurred relatively frequently in this section, occupying several areas. Habitat for this species would be impacted by the proposal, but the impact assessment using the seven-part test concluded that this would not occur to the extent of placing the local population of the species at risk of extinction. Assessment using the criteria in the EPBC Act guidelines indicated that the proposal would not constitute a significant impact on the local population of *Eucalyptus glaucina*.

Two endangered ecological communities listed under the TSC Act were confirmed as occurring within the study area. These are *Hunter lowland redgum forest* and *River-flat eucalypt forest on coastal floodplains*. The possible presence of a third EEC, *Lower Hunter spotted gum-ironbark forest*, was ruled out as occurring within the study area as a result of further investigation. Additionally, the tentative identification of *Swamp oak floodplain forest* from the route options survey was found to more accurately constitute *River-flat eucalypt forest on coastal floodplains*, although it does have characteristics of the former EEC. Both the confirmed EECs were in a highly modified condition within the study area, mostly with simplified or slashed understories that are subject to grazing or other disturbances and have been invaded by weeds. Both EECs would be impacted by the proposal, but not to the extent that the local occurrences of each community would be placed at risk of extinction. The greatest area of removal would be on *Hunter lowland redgum forest*.

One flora species that forms an Endangered Population in the Hunter catchment, the river red gum *Eucalyptus camaldulensis*, was tentatively recorded in three locations south of the existing railway easement during the survey for the route options investigations. However, closer inspection of the relevant trees during the current field surveys confirmed them to be mature *Eucalyptus glaucina* trees. It was therefore concluded that the endangered population of *Eucalyptus camaldulensis* does not occur in the study area and would not be impacted by the proposal.

One rare plant not listed by legislation but listed as a rare plant by ROTAP (Briggs and Leigh 1996) was recorded in the study area. Mountain grevillea (*Grevillea montana*) occurred in several areas at high abundance within the study area, and sporadically or as isolated plants. It was restricted to the section of the study area east of the Golden Highway. Some habitat for the species would be removed by the proposal, but given the abundance of the species in habitat beyond the impact footprint, it is not expected to be affected to the extent that the local population of the species is placed at risk of extinction.

The main potential impacts on fauna within the study area are considered to be the loss of roosting/nesting sites (particularly the loss of hollow-bearing trees) and the loss of foraging habitat. Three threatened fauna species, the brown treecreeper, grey-crowned babbler and grey-headed flying-fox, were recorded within the study area. Three species, the eastern bentwing-bat, speckled warbler and squirrel glider, have been recorded nearby and are considered to have a high probability of occurring within the study area. A number of additional threatened species have potential to occur and have been included for consideration in the assessment section of this report. The results of the assessment indicate that while the proposal would result in the loss of some known and potential habitat, it is unlikely to result in a significant impact on any threatened fauna species. Although the likelihood of a threatened species using one of the hollow-bearing trees as a nest or roost tree during construction of the proposal is remote, mitigation measures have nonetheless been incorporated into the proposal to minimise the risk of individuals being killed or injured during clearing operations.

6.0 MITIGATION MEASURES

The project will involve some clearing of native vegetation and disturbance to flora and fauna habitat, including threatened species and EECs, within the subject site.

ARTC have agreed to undertake the following series of measures designed to minimise the potential impacts of the proposed Minimbah Bank Third Rail project. These include management practices during the construction period, ongoing weed management and the setting aside of areas of land as offsets for the loss of habitat for threatened species and endangered ecological communities.

- Locating works and machinery compounds and soil stockpiles in cleared areas and not in any areas of natural vegetation;
- Rehabilitation and replanting of native vegetation on areas of newly created bare soil, such as batters, following construction. A rehabilitation plan should be prepared, including particularly strategies for protection and rehabilitation of occupied or potential habitat for Slaty Red Gum (*Eucalyptus glaucina*), *Grevillea montana* and the Hunter Lowland Redgum Forest and River-flat Eucalypt Forest on Coastal Floodplains EECs;
- A weed control strategy for newly created areas of bare soil, such as batters. All weeds from areas cleared during construction should be completely removed from the site and not allowed to enter watercourses or moist areas such as drainage lines;
- Replanting locally-occurring species characteristic of the EECs in appropriate areas, particularly on areas of newly-created bare soil such as batters.
- Facilitating the expansion of *Eucalyptus glaucina* into additional areas, particularly where saplings were observed to be regenerating around adult trees;
- Hydro-seeding and hydro-mulching batters with sterile cover crops and native species;
- Engaging with local Landcare groups and adjoining landowners to identify opportunities for assisting with revegetation works e.g. seed-collection;
- In order to provide offset areas for the loss of *Eucalyptus glaucina* and EEC habitat, agreements could be entered into with adjoining property owners to fence and protect occupied areas of habitat. By fencing off land containing and adjacent to *Eucalyptus glaucina* plants, the population could potentially expand, particularly where saplings were observed to be regenerating around adult trees;
- Land set aside to ameliorate the loss of *Eucalyptus glaucina* and EEC habitat would also compensate for the loss of threatened fauna habitat;
- Installation of nest boxes outside of the construction zone, prior to the removal of hollow-bearing trees, to provide temporary shelter habitat for animals displaced by clearing activities;
- Pre-clearing surveys of all habitat trees (including any grey-crowned babbler nests and hollow-bearing trees) within the construction zone to determine which trees are occupied by fauna. Any habitat trees are to be clearly marked;
- Inspection of culverts and drains for roosting bats, by an ecologist, immediately prior to any works;
- During removal of habitat trees (including hollow-bearing trees) and clearing of native vegetation, an experienced and fully equipped wildlife handler should be present to retrieve and manage any displaced wildlife;

- Prior to vegetation clearance, seed is to be collected from fruiting *Eucalyptus glaucina* for subsequent redistribution within habitat adjoining the construction zone. The species flowers during Spring, with fruit borne on the plant all year;
- *Eucalyptus glaucina* to be cleared from the construction zone is to be mulched and redistributed in habitat in the vicinity of the location from which it is removed. This will serve to retain seed stock as well as maintain the species within appropriate locations along the rail corridor;
- Hollow logs, leaf litter and woody debris removed from within the construction areas should be redistributed during re-vegetation works along the route so as to provide ground habitat;
- Tree hollows should be salvaged from felled hollow-bearing trees and re-attached to mature trees within adjoining habitat;
- Measures should be incorporated into the Project design to adequately manage runoff, including management of siltation and sedimentation during construction. This is particularly important near watercourses and soaks;
- Protocols to prevent introduction or spread of *Phytophthora cinnamomi* should be implemented following DECC guidelines;
- No barbed wire is to be used in any fencing installed as part of the Project due to the known risk to fauna (particularly gliders and bats) of becoming entangled;
- Fencing should funnel (direct) animals towards culverts and bridges to reduce the barrier effect imposed by the fencing;
- Opportunities for incorporating 'kangaroo-friendly' fencing which allows animals (such as kangaroos, wallabies and wombats) to traverse the fence (either over or under) should be examined so that animals are not forced to use road overpasses as a means of moving between habitats on either side of the rail corridor. This would not only assist with reducing the potential risk of creating roadkill 'hotspots' at road overpasses, but would also reduce the risk of creating a traffic safety issue through animal / vehicle collisions;
- Incorporate fauna movement considerations into the fencing configuration at the Golden Highway overpass so that larger animals, such as kangaroos, are not directed onto the highway;
- Underpasses could also assist in maintaining habitat connectivity for fauna. Various studies (e.g. AMBS 1997, 2002 and Finegan 1997) have demonstrated that Australian fauna (such as kangaroos, wallabies and wombats) will use appropriately designed culverts and bridges as crossing structures. A number of potential underpasses already exist at culvert and bridge crossings within the study area. It is recommended that consideration of fauna movement (e.g. providing dry passage and incorporating directional fencing) be incorporated into the design of such structures to maintain / improve their use by fauna, particularly larger species such as kangaroos, wallabies and wombats; and
- It is recommended that existing fauna movement corridor, as seen in Figure 9 of this Assessment, links be retained and that gaps between patches of vegetation are not extended to greater than 30-40m in width. This would assist in maintaining a continuous link for squirrel gliders, as this species is known to be able to negotiate a glide distance of 30-40m (depending on the height of the launch tree).

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8.0 APPENDICES

Appendix 1. Flora Species Recorded in the Study Area

The following is a combined list of all flora species recorded within the study area during both the route options investigations phase and the current impact assessment phase of the project. Please note that this list may be not fully comprehensive, and should be regarded as an indication of the flora present. A period of some years is often needed to identify all species present in an area, particularly for cryptic or seasonally detectable species (such as orchids and small grass-like herbs).

Notes:

* indicates an exotic or introduced native species

R indicates locally indigenous species that are potentially suitable for revegetation or replanting works

Nomenclature follows Harden (1990, 1992, 1993, 2002), Harden & Murray (2000) and subsequent recent revisions from PlantNET <http://plantnet.rbgsyd.nsw.gov.au/>

CLASS FILICOPSIDA (Ferns)

ADIANTACEAE

<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	R	Mulga fern
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AZOLLACEAE

<i>Azolla filiculoides</i> var. <i>rubra</i>	R	Pacific azolla
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DENNSTAEDTIACEAE

<i>Pteridium esculentum</i>		Bracken
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MARSILEACEAE

<i>Marsilea hirsuta</i>	R	A nardoo
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CLASS MAGNOLIOPSIDA (Flowering Plants)

Subclass Magnoliidae (Dicotyledons)

ACANTHACEAE

<i>Brunoniella australis</i>	R	Blue trumpet
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AIZOACEAE

<i>Carpobrotus glaucescens</i>	R	Pigface
<i>Galenia pubescens</i> *		Galenia

ANACARDIACEAE

<i>Schinus ariera</i> *		Pepper tree
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APIACEAE

<i>Foeniculum vulgare</i> *		Fennel
<i>Hydrocotyle peduncularis</i>	R	-

APOCYNACEAE

<i>Nerium oleander</i> *		Oleander
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ASCLEPIADACEAE

<i>Gomphocarpus fruticosus</i> *		Narrow leaf cotton bush
<i>Marsdenia rostrata</i>	R	Common milk vine

ASTERACEAE

<i>Ambrosia artemisiifolia</i> *		Annual ragweed
<i>Bidens pilosa</i> *		Cobblers pegs

<i>Bidens subalternans</i> *		Greater beggar's ticks
<i>Calotis lappulacea</i>		Yellow burr-daisy
<i>Chondrilla juncea</i> *		Skeleton weed
<i>Chrysocephalum apiculatum</i>	R	Yellow buttons
<i>Cirsium vulgare</i> *		Spear thistle / black thistle
<i>Conyza sp.</i> *		Fleabane
<i>Gamochaeta spicata</i> *		Cudweed
<i>Hypochaeris radicata</i> *		Flatweed/catsear
<i>Lactuca serriola</i> *		Compass plant/prickly lettuce
<i>Lagenophora stipitata</i>		Blue bottle-daisy / lagenophora
<i>Ozothamnus diosmifolius</i>	R	Ball everlasting/pill flower/ rice flower
<i>Senecio madagascariensis</i> *		Fire weed
<i>Silybum marianum</i> *		Variegated thistle
<i>Sonchus oleraceus</i> *		Common sowthistle
<i>Tagetes minuta</i> *		Stinking Roger
<i>Vernonia cinerea</i>		-
<i>Vittadinia cuneata</i> var. <i>cuneata</i>		A fuzzweed
<i>Xanthium spinosum</i> *		Bathurst burr
BIGNONIACEAE		
<i>Jacaranda mimosifolia</i> *		Jacaranda
BORAGINACEAE		
<i>Echium plantagineum</i> *		Paterson's curse
BRASSICACEAE		
<i>Hirschfeldia incana</i> *		Hairy brassica/buchan weed
<i>Lepidium africanum</i> *		Common peppergrass
CACTACEAE		
<i>Opuntia aurantiaca</i> *		Tiger pear
<i>Opuntia stricta</i> var. <i>stricta</i> *		Common prickly pear/smooth pest pear
CAMPANULACEAE		
<i>Wahlenbergia communis</i>	R	Tufted bluebell
CAPRIFOLIACEAE		
<i>Lonicera japonica</i> *		Honeysuckle
CASUARINACEAE		
<i>Allocasuarina leuhmanii</i>	R	Bulloak
<i>Allocasuarina littoralis</i>	R	Black she-oak
<i>Casuarina glauca</i>	R	Swamp oak
CHENOPODIACEAE		
<i>Chenopodium album</i> *		Fat hen / white goosefoot
<i>Einadia nutans</i> subsp. <i>linifolia</i>		-
<i>Einadia trigonos</i> subsp. <i>trigonos</i>		Fishweed
<i>Enchylaena tomentosa</i>		Ruby saltbush
CONVOLVULACEAE		
<i>Convolvulus erubescens</i>		Blushing bindweed
<i>Dichondra repens</i>	R	Kidney weed
<i>Polymeria calycina</i>		Swamp bindweed
CRASSULACEAE		
<i>Bryophyllum delagoense</i> *		Mother of millions
<i>Crassula sieberiana</i> subsp. <i>sieberiana</i>		Austral stonecrop
EUPHORBIACEAE		
<i>Chamaesyce dallachyana</i> *		Caustic weed
<i>Ricinus communis</i> *		Castor oil plant

FABACEAE - Subfamily Faboideae

<i>Daviesia ulicifolia</i> subsp. <i>ulicifolia</i>	R	Gorse bitter pea
<i>Desmodium varians</i>	R	Slender tick-trefoil
<i>Glycine tabacina</i> sens. lat.	R	A love creeper
<i>Hardenbergia violacea</i>	R	False sarsaparilla
<i>Indigofera australis</i>	R	Native indigo
<i>Jacksonia scoparia</i>	R	Dogwood
<i>Medicago polymorpha</i> *		Burr medic
<i>Melilotus officinalis</i> *		Common melilot
<i>Pultenaea spinosa</i>	R	A bush pea
<i>Robinia pseudoacacia</i> *	R	Black locust / false acacia
<i>Trifolium arvense</i> *		Haresfoot clover
<i>Trifolium repens</i> *		White clover
<i>Vicia sativa</i> subsp. <i>nigra</i> *		Narrow-leaved vetch

FABACEAE - Subfamily Mimosoideae

<i>Acacia falcata</i>	R	Falcate wattle
<i>Acacia filicifolia</i>	R	Fern-leaved wattle
<i>Acacia irrorata</i> subsp. <i>irrorata</i>	R	Green wattle
<i>Vachellia farnesiana</i>		Mimosa bush / thorny acacia

FUMARIACEAE

<i>Fumaria muralis</i> subsp. <i>muralis</i> *		Wall fumitory
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GERANIACEAE

<i>Geranium homeanum</i>		Northern cranesbill
<i>Geranium solanderi</i> var. <i>solanderi</i>		Cutleaf cranesbill

GOODENIACEAE

<i>Goodenia hederacea</i> var. <i>hederacea</i>	R	Ivy goodenia/forest goodenia
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LAMIACEAE

<i>Spartothamnella juncea</i>		Bead bush
<i>Stachys arvensis</i> *		Stagger weed

LAURACEAE

<i>Endiandra sieberi</i> ?	R	Hard corkwood
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LOBELIACEAE

<i>Pratia concolor</i>		Poison pratia
<i>Pratia purpurascens</i>	R	White root

LORANTHACEAE

<i>Amyema pendulum</i> subsp. <i>pendulum</i>		A mistletoe
<i>Muellerina eucalyptoides</i>		A mistletoe

LYTHRACEAE

<i>Lythrum hyssopifolia</i>		Hessop loosestrife
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MALACEAE

<i>Pyracantha crenulata</i> *		A firethorn
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MALVACEAE

<i>Malva parviflora</i> *		Small-flowered mallow
<i>Modiola caroliniana</i> *		Redflower mallow
<i>Pavonia hastata</i> *		Pink pavonia
<i>Sida rhombifolia</i> *		Paddy's lucerne

MENYANTHACEAE

<i>Villarsia exaltata</i>		Yellow marsh flower
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MYOPORACEAE

<i>Eremophila debilis</i>	R	Amulla/winter apple
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MYRTACEAE

<i>Angophora floribunda</i>	R	Rough-barked apple
<i>Corymbia maculata</i>	R	Spotted gum
<i>Eucalyptus crebra</i>	R	Narrow-leaved ironbark
<i>Eucalyptus fibrosa</i>	R	Broad-leaved red ironbark
<i>Eucalyptus glaucina</i> V – TSC & EPBC Act	R	Slaty red gum
<i>Eucalyptus melliodora</i> (planted)		Yellow box
<i>Eucalyptus moluccana</i>	R	Grey box
<i>Eucalyptus paniculata</i> subsp. <i>paniculata</i>	R	Grey ironbark
<i>Eucalyptus sideroxylon</i>	R	Red ironbark / mugga
<i>Eucalyptus tereticornis</i>	R	Forest red gum
<i>Melaleuca armillaris</i> subsp. <i>armillaris</i>	R	Giant honeymyrtle
<i>Melaleuca linariifolia</i>	R	Snow-in-summer
<i>Melaleuca styphelioides</i>		Prickly-leaved paperbark

OLEACEAE

<i>Ligustrum lucidum</i> *		Large-leaved privet
<i>Olea europaea</i> subsp. <i>europaea</i> *		Common olive

ONAGRACEAE

<i>Ludwigia peploides</i> subsp. <i>montevidensis</i> *		Water primrose
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OXALIDACEAE

<i>Oxalis articulata</i> *		Shamrock oxalis
<i>Oxalis perennans</i>		A wood sorrell

PAPAVERACEAE

<i>Argemone ochroleuca</i> subsp. <i>ochroleuca</i> *		Mexican poppy
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PLANTAGINACEAE

<i>Plantago lanceolata</i> *		Common plantain
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POLYGONACEAE

<i>Persicaria hydropiper</i>	R	Knotweed
<i>Polygonum arenastrum</i> *		Wire weed
<i>Rumex crispus</i> *		Curly dock

PRIMULACEAE

<i>Anagallis arvensis</i> *		Pimpernel
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PROTEACEAE

<i>Grevillea montana</i> Poorly Known 2KC-	R	Mountain grevillea
<i>Grevillea robusta</i>	R	Silky oak

RANUNCULACEAE

<i>Clematis aristata</i>	R	Old man's beard / traveller's joy
<i>Ranunculus repens</i> *		Creeping buttercup
<i>Ranunculus sceleratus</i> *		Celery buttercup

ROSACEAE

<i>Rosa rubiginosa</i> *		Sweet briar
<i>Rubus fruticosus</i> species aggregate*		Blackberry
<i>Rubus parvifolius</i>		Native raspberry

RUBIACEAE

<i>Asperula conferta</i>		Common woodruff
<i>Galium aparine</i> *		Goosegrass/cleavers

SALICACEAE

<i>Salix babylonica</i> *		Weeping willow
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SANTALACEAE

<i>Exocarpus cupressiformis</i>	R	Cherry ballart
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SCROPHULARIACEAE*Verbascum virgatum***Veronica plebeia*R Twiggy mullein
Trailing speedwell**SOLANACEAE***Solanum nigrum***Solanum prinophyllum*Blackberry nightshade
Southern forest nightshade**STERCULIACEAE***Brachychiton populneus* subsp. *populneus*

Kurrajong

ULMACEAE*Celtis occidentalis**

Hackberry

VERBENACEAE*Verbena bonariensis***Verbena rigida* var. *rigida**Purpletop
Veined verbena**VITACEAE***Cayratia clematidea*

Slender grape

Subclass Liliidae (Monocotyledons)**ALLIACEAE***Nothoscordum borbonicum**

Onion weed

ANTHERICACEAE*Tricoryne elatior*

R Yellow rush-lily

ARECACEAE*Phoenix canariensis**

Palm

COMMELINACEAE*Commelina cyanea**Tradescantia fluminensis**Scurvy weed
Trad/wandering jew**CYPERACEAE***Bolboschoenus caldwellii*

R -

Eleocharis cylindrostachys

R A spike-rush

Fimbristylis dichotoma

R -

Schoenoplectus mucronatus

R A club-rush

HYDROCHARITACEAE*Ottelia ovalifolia*

Swamp lily

JUNCACEAE*Juncus usitatus*

R Common rush

Juncus planifolius

R Broad-leaf rush

JUNCAGINACEAE*Triglochin procerum* sens. lat.

R Water ribbons

LEMNACEAE*Spirodela punctata*

Duck weed

LOMANDRACEAE*Lomandra filiformis* subsp. *filiformis*

R Iron grass

Lomandra multiflora subsp. *multiflora*

R Many-flowered mat-rush

PHORMIACEAE*Dianella caerulea* var. *caerulea*

R Blue flax lily

Dianella revoluta var. *revoluta*

R Spreading flax lily

POACEAE

<i>Aristida vagans</i>	R	A three-awn speargrass
<i>Austrodanthonia</i> sp.	R	Wallaby grass
<i>Austrostipa pubescens</i>	R	A speargrass
<i>Austrostipa verticillata</i>	R	Slender bamboo grass
<i>Avena fatua</i> *		Wild oats
<i>Axonopus fissifolius</i> *		Narrow-leaved carpet grass
<i>Bothriochloa macra</i>		Red-leg grass
<i>Briza maxima</i> *		Quaking grass
<i>Briza minor</i> *		Shivery grass
<i>Bromus cartharticus</i> *		Prairie grass
<i>Chloris gayana</i> *		Rhodes grass
<i>Cymbopogon refractus</i>		Barbed-wire grass
<i>Cynodon dactylon</i>		Couch
<i>Dichelachne micrantha</i>	R	Shorthair plume grass
<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	R	Bushy hedgehog grass
<i>Eragrostis curvula</i> *		African love grass
<i>Eragrostis tenuifolia</i> *		Elastic grass
<i>Hyparrhenia hirta</i> *		Coolatai grass
<i>Lachnagrostis filiformis</i>	R	Blown grass
<i>Lolium perenne</i> *		Perennial rye grass
<i>Melinis repens</i> *		Red natal grass
<i>Microlaena stipoides</i> var. <i>stipoides</i>	R	Weeping grass
<i>Oplismenus aemulus</i>	R	Basket grass
<i>Panicum simile</i>		Two colour panic
<i>Paspalum dilatatum</i> *		Paspalum
<i>Paspalum distichum</i>		Water couch
<i>Paspalum urvillei</i> *		Tall paspalum / vasey grass
<i>Pennisetum clandestinum</i> *		Kikuyu
<i>Phragmites australis</i>	R	Native reed/thatch reed
<i>Poa labillardierei</i> var. <i>labillardierei</i>		Tussock grass
<i>Setaria gracilis</i> *		Slender pigeon grass
<i>Themeda australis</i>	R	Kangaroo grass
<i>Triticum aestivum</i> *		Common wheat/bread wheat
<i>Zea mays</i> *		Corn/sweet corn/maize

TYPHACEAE

<i>Typha domingensis</i>	R	Narrow-leaved cumbungi
<i>Typha orientalis</i>	R	Bullrush/cumbungi

XANTHORRHOEACEAE

<i>Xanthorrhoea</i> sp.	R	A grass-tree
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Appendix 2. Actions required in relation to Notifiable Weeds pursuant to the Noxious Weeds Act 2003

Section 8 of the amended Noxious Weeds Act 1993 classifies noxious weeds into 5 weed control classes as follows:

- (a) Class 1 - State Prohibited Weeds,
- (b) Class 2 - Regionally Prohibited Weeds,
- (c) Class 3 - Regionally Controlled Weeds,
- (d) Class 4 - Locally Controlled Weeds,
- (e) Class 5 - Restricted Plants.

The characteristics of each class are as follows:

- (a) Class 1 noxious weeds are plants that pose a potentially serious threat to primary production or the environment and are not present in the State or are present only to a limited extent.
- (b) Class 2 noxious weeds are plants that pose a potentially serious threat to primary production or the environment of a region to which the order applies and are not present in the region or are present only to a limited extent.
- (c) Class 3 noxious weeds are plants that pose a serious threat to primary production or the environment of an area to which the order applies, are not widely distributed in the area and are likely to spread in the area or to another area.
- (d) Class 4 noxious weeds are plants that pose a threat to primary production, the environment or human health, are widely distributed in an area to which the order applies and are likely to spread in the area or to another area.
- (e) Class 5 noxious weeds are plants that are likely, by their sale or the sale of their seeds or movement within the State or an area of the State, to spread in the State or outside the State.

A noxious weed that is classified as a Class 1, 2 or 5 noxious weed is referred to in the Act as a "**notifiable weed**".

The relevant sections of the Act that define the actions required in relation to **notifiable weeds** are reproduced below:

Section 15: An occupier of land (other than a local control authority) on which there is a **notifiable weed** must notify the local control authority for the land of that fact within 3 days after becoming aware that the **notifiable weed** is on the land. *Maximum penalty (for an occupier other than a public authority): 20 penalty units*

Section 16: For the purpose of proving in any prosecution under section 15 (1) that an occupier of land was aware that a **notifiable weed** was located on the land, if it is proved that the occupier or an employee of the occupier or other person using the land ought reasonably to have known that a **notifiable weed** was located on the land, that is evidence that the occupier was aware that it was on the land.

Section 28:

- (1) A person (including a public authority) must not sell or purchase:
 - (a) any **notifiable weed** material or other noxious weed material prescribed by the regulations, or
 - (b) any animal or thing which has on it, or contains, **notifiable weed** material or other noxious weed material prescribed by the regulations, knowing it to be, or to have on it or to contain, any such weed material.
- (2) An occupier of land (including a public authority) must not knowingly remove or cause to be removed from the land any animal or thing which has on it, or contains, **notifiable weed material** or other noxious weed material prescribed by the regulations. *Maximum penalty: 50 penalty units.*
- (3) Notifiable weed material:
 - (a) in subsection (1) extends to the weed material of a weed that is a **notifiable weed** in any part of the State, and
 - (b) in subsection (2) is limited to the weed material of a weed that is a **notifiable weed** in that part of the State that includes the land that is relevant for the purposes of that subsection.

Section 29: An occupier of land (including a public authority) must not use or permit the land to be used for the purpose of disposing of, transporting or selling soil, turf or fodder, if the occupier knows, or ought reasonably to know, that there is a weed on the land that is a **notifiable weed** in any part of the State. *Maximum penalty: 50 penalty units.*

Section 40: An inspector who has reasonable cause to suspect that **notifiable weed** material of a weed that is a **notifiable weed** in any part of the State is or may be present in an agricultural machine may require the person apparently in charge of the machine to treat the machine immediately, in the manner specified by the inspector, to remove any such weed material.

For further information about notifiable noxious weeds, contact: Weeds Hotline 1800 680 244 or email: weeds@dpi.nsw.gov.au (NSW Department of Primary Industries).

Appendix 3. Fauna recorded within the Study Area**Notes:**

AMG references for site

Map Grid 56

Southeast end of subject site: Easting 336870 Northing 6384950 Accuracy 100m

Northwest end of subject site: Easting 330425 Northing 6391965 Accuracy 100m

* indicates introduced species (not native to the area)

Bold indicates a threatened species

V - Vulnerable, E – Endangered, M- Migratory

Observation types:

O	observed	W	Heard	H	Hair, feathers or skin
F	tracks/scratchings	P	scat	E	Nest/roost
T	Trapped or netted	Y	Bone or teeth	Z	In raptor/owl pellet
K	Dead	X	In scat	R	Road kill
M	Miscellaneous	U	Ultrasonic call	d	Definite identification
p	Probable identification				

Mammals

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Number of individuals	Observation type	NPWS code
Family: <i>TACHYGLOSSIDAE</i> <i>Tachyglossus aculeatus</i>	Short-beaked echidna			1	F	1003
Family: <i>DASYURIDAE</i> <i>Antechinus flavipes</i>	Yellow-footed antechinus			1	O	1027
Family: <i>PHALANGERIDAE</i> <i>Trichosurus vulpecula</i>	Common brushtail possum			1+	F	1113
Family: <i>MACROPODIDAE</i> <i>Macropus giganteus</i>	Eastern grey kangaroo			5	O/P	1265
Family: <i>PTEROPODIDAE</i> <i>Pteropus poliocephalus</i>	Grey-headed flying-fox	V	V	1	O	1280
Family: <i>LEPORIDAE</i> <i>Oryctolagus cuniculus</i> *	Rabbit			4+	O/E/F/P	1510

Reptiles

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Number of individuals	Observation type	NPWS code
Family: <i>CHELIDAE</i> <i>Chelodina longicollis</i>	Eastern snake-necked turtle			1	O	2017
Family: <i>AGAMIDAE</i> <i>Physignathus lesueurii</i>	Eastern water dragon			1	O	2252
<i>Pogona barbata</i>	Bearded dragon			1	O	2177

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Number of individuals	Observation type	NPWS code
Family: <i>SCINCIDAE</i>						
<i>Carlia foliorum</i>	Tree-base litter-skink			1	O	2307
<i>Ctenotus robustus</i>	Robust ctenotus			1	O	2375
<i>Tiliqua scincoides</i>	Eastern blue-tongued lizard			1	O	2580

Frogs

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Number of individuals	Observation type	NPWS code
Family: <i>MYOBATRACHIDAE</i>						
<i>Crinia signifera</i>	Common eastern froglet			13	W	3134
<i>Limnodynastes peronii</i>	Striped marsh frog			1	W	3061
<i>Limnodynastes tasmaniensis</i>	Spotted grass frog			5	W	3063
Family: <i>HYLIDAE</i>						
<i>Litoria fallax</i>	Eastern dwarf tree frog			2	O/W	3183
<i>Litoria verreauxii</i>	Verreaux's tree frog			1	W	3215

Birds

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Number of individuals	Observation type	NPWS code
Family: <i>ANATIDAE</i>						
<i>Chenonetta jubata</i>	Australian wood duck			1	O	0202
<i>Anas superciliosa</i>	Pacific black duck			1	O	0208
Family: <i>ARDEIDAE</i>						
<i>Egretta novaehollandiae</i>	White-faced heron			2	O	0188
Family: <i>THRESKIORNITHIDAE</i>						
<i>Threskiornis spinicollis</i>	Straw-necked ibis			1	O	0180
Family: <i>ACCIPITRIDAE</i>						
<i>Aquila audax</i>	Wedge-tailed eagle			2	O	0224
Family: <i>FALCONIDAE</i>						
<i>Falco berigora</i>	Brown falcon			1	O	0239
<i>Falco peregrinus</i>	Peregrine falcon			1	O	0237
<i>Falco cenchroides</i>	Nankeen kestrel			1	O	0240
Family: <i>CHARADRIIDAE</i>						
<i>Vanellus miles</i>	Masked lapwing			3	O/W	0133
Family: <i>COLUMBIDAE</i>						
<i>Ocyphaps lophotes</i>	Crested pigeon			2	O	0043
<i>Geopelia humeralis</i>	Bar-shouldered dove			1	W	0032

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Number of individuals	Observation type	NPWS code
Family: <i>CACATUIDAE</i> <i>Eolophus roseicapillus</i>	Galah			3	O	0273
Family: <i>PSITTACIDAE</i> <i>Trichoglossus chlorolepidotus</i>	Scaly-breasted lorikeet			3	W	0256
<i>Platycercus elegans</i>	Crimson rosella			1	W	0282
<i>Platycercus eximius</i>	Eastern rosella			6	O/W	0288
Family: <i>CUCULIDAE</i> <i>Cuculus pallidus</i>	Pallid cuckoo			1	O	0337
Family: <i>ALCEDINIDAE</i> <i>Dacelo novaeguineae</i>	Laughing kookaburra			3	W	0322
<i>Todiramphus sanctus</i>	Sacred kingfisher			1	W	0326
Family: <i>CORACIIDAE</i> <i>Eurystomus orientalis</i>	Dollarbird			1	O	0318
Family: <i>CLIMACTERIDAE</i> <i>Cormobates leucophaeus</i>	White-throated treecreeper			1	W	0558
<i>Climacteris picumnus</i>	Brown treecreeper	V		1	W	0555
Family: <i>MALURIDAE</i> <i>Malurus cyaneus</i>	Superb fairy-wren			6	O/W	0529
<i>Malurus lamberti</i>	Variegated fairy-wren			2	O/W	0536
Family: <i>PARDALOTIDAE</i> <i>Pardalotus punctatus</i>	Spotted pardalote			8	W	0565
<i>Pardalotus striatus</i>	Striated pardalote			6	W	0976
<i>Smicrornis brevirostris</i>	Weebill			2	W	0465
<i>Acanthiza nana</i>	Yellow thornbill			1	O	0471
Family: <i>MELIPHAGIDAE</i> <i>Plectorhyncha lanceolata</i>	Striped honeyeater			6	W	0585
<i>Philemon corniculatus</i>	Noisy friarbird			2	O/W	0645
<i>Manorina melanocephala</i>	Noisy miner			17	O/W	0634
<i>Lichenostomus chrysops</i>	Yellow-faced honeyeater			25+	W	0614
<i>Lichenostomus penicillatus</i>	White-plumed honeyeater			2	W	0625
<i>Melithreptus brevirostris</i>	Brown-headed honeyeater			1	W	0583
<i>Melithreptus lunatus</i>	White-naped honeyeater			2	O	0578
Family: <i>PETROICIDAE</i> <i>Microeca fascians</i>	Jacky winter			1	O	0377
<i>Eopsaltria australis</i>	Eastern yellow robin			1	W	0392
Family: <i>POMATOSTOMIDAE</i> <i>Pomatostomus temporalis</i>	Grey-crowned babbler	V		30	O/W/E	0443
Family: <i>PACHYCEPHALIDAE</i> <i>Pachycephala pectoralis</i>	Golden whistler			1	W	0398
<i>Pachycephala rufiventris</i>	Rufous whistler			3	W	0401
<i>Colluricincla harmonica</i>	Grey shrike-thrush			1	W	0408
Family: <i>DICRURIDAE</i> <i>Grallina cyanoleuca</i>	Magpie-lark			6	O/W	0415
<i>Rhipidura fuliginosa</i>	Grey fantail			1	W	0361

Family / Scientific Name	Common Name	TSC Act	EPBC Act	Number of individuals	Observation type	NPWS code
<i>Rhipidura leucophrys</i>	Willie wagtail			5	O/W	0364
Family: <i>CAMPEPHAGIDAE</i>						
<i>Coracina novaehollandiae</i>	Black-faced cuckoo-shrike			6	O/W	0424
Family: <i>ORIOLIDAE</i>						
<i>Oriolus sagittatus</i>	Olive-backed oriole			3	W	0671
Family: <i>ARTAMIDAE</i>						
<i>Artamus cyanopterus</i>	Dusky woodswallow			3	W	0547
<i>Cracticus torquatus</i>	Grey butcherbird			5	W	0702
<i>Cracticus nigrogularis</i>	Pied butcherbird			6	O/W	0700
<i>Gymnorhina tibicen</i>	Australian magpie			7	O/W/E	0705
<i>Strepera graculina</i>	Pied currawong			2	O/W	0694
Family: <i>CORVIDAE</i>						
<i>Corvus coronoides</i>	Australian raven			14	O/W	0930
Family: <i>CORCORACIDAE</i>						
<i>Corcorax melanorhamphos</i>	White-winged chough			3+	O/W	0693
Family: <i>PASSERIDAE</i>						
<i>Passer domesticus</i> *	House sparrow			1+	O	0995
<i>Taeniopygia bichenovii</i>	Double-barred finch			1+	O/W	0655
<i>Neochmia temporalis</i>	Red-browed firetail			1	W	0662
Family: <i>DICAEIDAE</i>						
<i>Dicaeum hirundinaceum</i>	Mistletoebird			4	W	0564
Family: <i>HIRUNDINIDAE</i>						
<i>Hirundo neoxena</i>	Welcome swallow			6	O/W	0357
<i>Hirundo ariel</i>	Fairy martin			1+	O/E	0360
Family: <i>SYLVIIDAE</i>						
<i>Arcocephalus stentoreus</i>	Clamorous reed-warbler			1	O	0524
<i>Cincloramphus mathewsi</i>	Rufous songlark			1	W	0509
Family: <i>ZOSTEROPIDAE</i>						
<i>Zosterops lateralis</i>	Silvereye			10+	O/W	0574
Family: <i>STURNIDAE</i>						
<i>Sturnus vulgaris</i> *	Common starling			1+	O	0999
<i>Acridotheres tristis</i> *	Common myna			2	O/W	0998

Appendix 4. Habitat Trees recorded within the Study Area

ID	Tree Species	DBH (cm)	Hollow-bearing?	Number of Hollows						Easting GDA94	Northing GDA94	Within Impact Area*?	Notes
				<5cm	5-10cm	10-15cm	15-20cm	20-40cm	>40cm				
1	Eucalyptus glaucina	50	No							334006	6386356	Yes	Large tree
2	Dead stag	50	Yes			1	1	2		333984	6386443	No	
3	Eucalyptus crebra	60	No							333831	6386734	Yes	Large tree
4	Bulloak	60	Yes	1?						333815	6386775	Yes	
5	Grey box	60	No							333798	6386998	No	Large tree
6	Grey box	90	Yes		3	3	1?			333619	6386937	No	
7	Grey box	90	Yes		4	2	1t			333658	6386930	No	
8	Forest red gum	60	No							333649	6386888	No	Grey-crowned babbler nest
9	Grey box	85	Yes	1				1t		333683	6386989	No	
10	Eucalyptus glaucina	20	No							333609	6386892	No	Grey-crowned babbler nest
11	Bulloak	10/12	No							333564	6386879	No	Grey-crowned babbler nest
12	Bulloak	25/20	No							333570	6386877	No	Grey-crowned babbler nest
13	Grey box	70	No							333682	6386894	No	Large tree
14	Eucalyptus glaucina	15	No							333684	6386736	No	Grey-crowned babbler nest
15	Eucalyptus glaucina	35	Yes		1	1?	1			333767	6386697	No	Possum scratches + nesting material
16	Eucalyptus glaucina	50	Yes	2	2					333759	6386682	No	Mistletoe
17	Grey box	75	No							333760	6386673	No	Large tree
18	Eucalyptus glaucina	28	Yes	2						333755	6386672	No	
19	Grey box	75	Yes		2	1				333756	6386652	No	
20	Eucalyptus glaucina	55	No							333783	6386656	No	Bird nest; Large tree
21	Forest red gum	40	Yes				1t			333765	6386640	No	
22	Forest red gum	12	No							333779	6386612	No	Grey-crowned babbler nest
23	Eucalyptus glaucina	45	Yes		1t					333796	6386617	No	
24	Eucalyptus glaucina	70	Yes		1	1t				333796	6386627	No	
25	Dead stag	45	Yes		1t					333819	6386546	No	Split trunk
26	Ironbark	75	Yes	2	1	1t				333802	6386516	No	Introduced bees in largest hollow
27	Ironbark	50	Yes	3	1		1t			333820	6386486	No	Exfoliating bark
28	Eucalyptus glaucina	90	Yes		1?					333922	6386271	No	Bird nest
29	Grey box	50-60	Yes	2+	2+	1?				333972	6386296	No	

ID	Tree Species	DBH (cm)	Hollow-bearing?	Number of Hollows						Easting GDA94	Northing GDA94	Within Impact Area*?	Notes
				<5cm	5-10cm	10-15cm	15-20cm	20-40cm	>40cm				
30	Grey box	70-80	Yes	1+?						333972	6386296	No	
31	Eucalyptus glaucina	70-80	Yes	2+						333972	6386296	No	
32	Dead stag	35	Yes	2+	2	1				333972	6386296	No	
33	Dead stag	33	Yes	1	2					333991	6386270	No	
34	Eucalyptus glaucina	135	Yes	2+	2?					334024	6386203	No	
35	Dead stag	90	Yes	2+	2+	2+	1			334118	6385924	No	Dead ironbark; introduced bees in largest hollow
36	Spotted gum	65	No							334181	6385930	Yes	Large tree
37	Spotted gum	75	No							334399	6385429	No	Large tree
38	Ironbark	60	No							334440	6385358	No	Large tree
39	Spotted gum	60	No							334453	6385340	No	Large tree
40	Spotted gum	60	No							334448	6385330	No	Large tree
41	Ironbark	85	Yes	1?						334556	6385259	No	Probably Eucalyptus crebra
42	Dead stag	48	Yes	2+	1					334729	6385088	No	
43	Eucalyptus crebra	50	No							333742	6387130	No	Large tree
44	Eucalyptus crebra	50	No							333765	6387244	No	Grey-crowned babbler nest x 3; 10 birds seen
45	Eucalyptus crebra	35/35	No							333765	6387244	No	Grey-crowned babbler nest x 3; 10 birds seen
46	Eucalyptus crebra	75	No							333744	6387337	No	Large tree
47	Eucalyptus crebra	50	No							333744	6387380	No	Large tree
48	Eucalyptus crebra	95	Yes	2+?						333768	6387410	No	
49	Grey box	70	No							336133	6384596	Yes	Large tree
50	Eucalyptus crebra	52	Yes	1+	1					336122	6384607	No	
51	Grey box	65	No							336117	6384607	No	Large tree
52	Red gum	65	No							336108	6384597	Yes	Large tree; either forest red gum or Eucalyptus glaucina
53	Allocasuarina glauca	25	Yes		1t					336087	6384606	No	
54	Allocasuarina glauca	25	Yes		1t					336083	6384606	No	
55	Dead stag	35	Yes			1t				336079	6384604	No	Stump
56	Allocasuarina glauca	33	Yes		1t					336067	6384604	No	Hollow at base of trunk
57	Allocasuarina glauca	25	Yes		1t					336079	6384609	No	

ID	Tree Species	DBH (cm)	Hollow-bearing?	Number of Hollows						Easting GDA94	Northing GDA94	Within Impact Area*?	Notes
				<5cm	5-10cm	10-15cm	15-20cm	20-40cm	>40cm				
58	Spotted gum	65	No							336032	6384615	No	Large tree
59	Spotted gum	60	No							336011	6384619	No	Large tree
60	Angophora floribunda	18	No							335973	6384613	No	Grey-crowned babbler nest
61	Allocasuarina glauca	20	Yes	1						335954	6384612	No	
62	Angophora floribunda	88	No							335935	6384603	No	Large tree
63	Dead stag	55	Yes	1?		1?		1t;1br		335929	6384602	No	
64	Forest red gum	57	No							335916	6384600	No	Large tree
65	Forest red gum	58	No							335913	6384603	No	Large tree
66	Angophora floribunda	60	No							335912	6384597	No	Large tree
67	Dead stag	28	Yes	3+	1					335910	6384596	No	
68	Eucalyptus crebra	80	Yes	2+	1?					335889	6384621	No	
69	Dead stag	50	No							335864	6384636	No	Bird nest; Large tree
70	Forest red gum	60	No							335870	6384646	No	Large tree
71	Forest red gum	55	No							335840	6384652	No	Large tree
72	Spotted gum	65	No							335847	6384631	No	Large tree
73	Forest red gum	65	No							335812	6384638	No	Large tree
74	Forest red gum	63	No							335793	6384647	No	Large tree
75	Forest red gum	50	No							335786	6384642	No	Large tree
76	Grey box	68	No							335779	6384637	No	Large tree
77	Dead stag	40	Yes	1?						335771	6384657	No	
78	Spotted gum	50	Yes	1+?	1?					335771	6384665	No	Large scratches on trunk
79	Spotted gum	65	No							335759	6384666	No	Large tree; Possum scratches
80	Spotted gum	17	No							335751	6384685	No	Grey-crowned babbler nest
81	Dead stag	40/30/30	Yes	1t	2?	1	2			335727	6384668	No	
82	Forest red gum	95	No							335711	6384685	No	Large tree; Possum scratches
83	Dead stag	70	Yes	2+	5	1	3	2		335675	6384669	No	
84	Dead stag	57	Yes				1			335655	6384679	No	
85	Forest red gum	55	Yes	2+	4	1				335654	6384700	No	Possum scratches and large scratches
86	Spotted gum	57	No							335577	6384703	No	Large tree; Possum scratches

ID	Tree Species	DBH (cm)	Hollow-bearing?	Number of Hollows						Easting GDA94	Northing GDA94	Within Impact Area*?	Notes
				<5cm	5-10cm	10-15cm	15-20cm	20-40cm	>40cm				
87	Spotted gum	75	Yes		1?					335495	6384753	No	Probable lace monitor scratches
88	Dead stag	70	Yes					1t		335391	6384803	No	
89	Grey box	53	Yes		1					336417	6384695	No	
90	Grey box	60	Yes					1t		336439	6384686	Yes	
91	Grey box	60	No							336440	6384690	Yes	Large tree
92	Grey box	40	Yes	2	2					336442	6384689	Yes	
93	Spotted gum	55	No							336442	6384696	Yes	Large tree
94	Grey box	40	Yes	2	1					336458	6384692	Yes	
95	Grey box	45	Yes	2	1					336459	6384691	Yes	
96	Grey box	35	Yes		2		1t			336461	6384691	Yes	
97	Grey box	50	Yes	1?	2	1				336460	6384693	Yes	
98	Grey box	30	Yes		1t	1t				336463	6384691	Yes	
99	Grey box	70	Yes	2t						336680	6384855	No	
100	Grey box	60	No							336669	6384855	No	Large tree
101	Grey box	55	No							336678	6384829	No	Large tree
102	Eucalyptus fibrosa	68	No							336635	6384811	No	Large tree
103	Dead stag	65	Yes	3?	2?					336535	6384764	No	Probable solid spouts with no hollows
104	Eucalyptus glaucina	100	Yes	1		1t	1			336944	6385017	No	
105	Eucalyptus crebra	70	Yes			1t				336925	6384996	No	Possible nest
106	Eucalyptus glaucina	55	No							336742	6384814	No	Large tree
107	Eucalyptus glaucina	55/50	Yes	2?		1t				336724	6384801	No	Possum scratches
108	Eucalyptus glaucina	50/50	No							336716	6384792	No	Large tree
109	Grey box	50/45	No							336693	6384769	No	Large tree
110	Eucalyptus crebra	50	No							336697	6384778	No	Large tree
111	Dead stag	35	Yes							336689	6384773	No	Exfoliating bark
112	Ironbark	60	No							336684	6384772	No	Large tree; Probably E. crebra or E. fibrosa
113	Ironbark	60	No							336682	6384766	No	Large tree; Probably E. crebra or E. fibrosa
114	Dead stag	38	Yes							336663	6384753	No	Exfoliating bark; Dead E. crebra
115	Dead stag	20/28	Yes	2?	1+1?					336637	6384742	Yes	
116	Dead stag	40	Yes	2?						336629	6384725	No	

ID	Tree Species	DBH (cm)	Hollow-bearing?	Number of Hollows						Easting GDA94	Northing GDA94	Within Impact Area*?	Notes
				<5cm	5-10cm	10-15cm	15-20cm	20-40cm	>40cm				
117	Dead stag	35	Yes	2+?	2	2				336628	6384723	No	
118	Spotted gum	60	No							336618	6384712	No	Large tree
119	Ironbark	60	No							336617	6384708	No	Large tree; Probably E. fibrosa
120	Spotted gum	70	No							336609	6384705	No	Large tree
121	Dead stag	65	Yes	2	3					336482	6384600	No	
122	Grey box	65	Yes				1t			336476	6384595	No	
123	Grey box	60	No							336465	6384603	No	Large tree
124	Dead stag	22	Yes	1						336465	6384609	No	
125	Grey box	60	No							336465	6384610	No	Large tree
126	Grey box	55	No							336458	6384607	No	Large tree
127	Grey box	60	No							336440	6384619	No	Large tree
128	Spotted gum	60	No							336420	6384586	No	Large tree
129	Grey box	60	Yes	2?						336406	6384577	No	
130	Grey box	50	Yes		1?					336397	6384576	No	
131	Dead stag	35	Yes	1						336397	6384569	No	
132	Spotted gum	65	Yes	1	1					336380	6384594	No	
133	Spotted gum	50	No							336363	6384576	No	Large tree
134	Grey box	50	No							336350	6384572	No	Large tree
135	Grey box	50	Yes	1+2?						336347	6384575	No	
136	Grey box	53	No							336335	6384584	No	Large tree
137	Dead stag	35	Yes					1t		336328	6384562	No	
138	Grey box	50	No							336323	6384568	No	Large tree
139	Grey box	55	No							336322	6384569	No	Large tree
140	Grey box	53	No							336319	6384569	No	Large tree
141	Grey box	57	No							336311	6384566	No	Large tree
142	Grey box	65	No							336263	6384544	No	Large tree
143	Grey box	55	No							336257	6384561	No	Large tree
144	Grey box	50	No							336245	6384551	No	Large tree
145	Spotted gum	60	No							336235	6384550	No	Large tree; Possum scratches
146	Grey box	63	No							336197	6384547	No	Large tree
147	Spotted gum	80	Yes	1?	1?		2	1t		334941	6384995	Yes	

ID	Tree Species	DBH (cm)	Hollow-bearing?	Number of Hollows						Easting GDA94	Northing GDA94	Within Impact Area*?	Notes
				<5cm	5-10cm	10-15cm	15-20cm	20-40cm	>40cm				
148	Eucalyptus fibrosa	80	Yes			1				334936	6384996	Yes	Introduced bees in hollow
149	Eucalyptus fibrosa	58	No							334904	6385025	Yes	Large tree
150	Grey box	50	No							334881	6385037	Yes	Large tree
151	Spotted gum	50	No							334946	6385016	No	Large tree
152	Spotted gum	70	No							334858	6385089	No	Large tree
153	Spotted gum	50/45	No							334826	6385091	Yes	Large tree
154	Eucalyptus fibrosa	65	No							334811	6385103	Yes	Large tree
155	Eucalyptus fibrosa	65	Yes	4	2		1			334803	6385109	Yes	
156	Spotted gum	70	No							334764	6385136	Yes	Large tree
157	Spotted gum	60	No							334731	6385170	Yes	Large tree
158	Grey box	50/50	Yes		1					334724	6385171	Yes	
159	Spotted gum	65	No							334715	6385187	Yes	Large tree
160	Spotted gum	57	No							334711	6385198	Yes	Large tree
161	Eucalyptus fibrosa	60	No							334710	6385202	Yes	Large tree
162	Dead stag	60	Yes	1						334500	6385461	Yes	Not much good as shelter
163	Eucalyptus fibrosa	60	No							334452	6385565	No	Large tree
164	Eucalyptus fibrosa	65/50	No							334437	6385570	Yes	Large tree
165	Eucalyptus fibrosa	55	No							334432	6385571	Yes	Large tree
166	Eucalyptus fibrosa	55	No							334432	6385590	Yes	Large tree
167	Eucalyptus fibrosa	52	No							334418	6385597	Yes	Large tree
168	Eucalyptus fibrosa	60	No							334408	6385624	Yes	Large tree
169	Eucalyptus fibrosa	55	No							334397	6385628	Yes	Large tree
170	Eucalyptus fibrosa	75	No							334388	6385639	Yes	Large tree
171	Eucalyptus fibrosa	70	No							334382	6385647	Yes	Large tree
172	Eucalyptus fibrosa	60	No							334396	6385664	No	Large tree
173	Eucalyptus crebra	55	No							334384	6385674	No	Large tree
174	Spotted gum	65	No							334377	6385695	No	Large tree
175	Eucalyptus fibrosa	50	No							334374	6385695	No	Large tree
176	Eucalyptus fibrosa	60	No							334364	6385721	No	Large tree
177	Spotted gum	70	Yes	2?	2?	2?				334381	6385720	No	
178	Dead stag	63	Yes	1?	2				1t	334342	6385739	Yes	Mid-sized hollows very open and not great for shelter

ID	Tree Species	DBH (cm)	Hollow-bearing?	Number of Hollows						Easting GDA94	Northing GDA94	Within Impact Area*?	Notes
				<5cm	5-10cm	10-15cm	15-20cm	20-40cm	>40cm				
179	Spotted gum	60	No							334334	6385739	Yes	
180	Eucalyptus crebra	45/47/25	No							334328	6385760	Yes	Large tree
181	Eucalyptus crebra	50	No							334320	6385807	No	Large tree
182	Eucalyptus crebra	33/35	Yes	1						334221	6385954	Yes	
183	Eucalyptus glaucina	60	No							334098	6386184	No	Large tree
184	Eucalyptus glaucina	65	No							334093	6386198	No	Large tree
185	Eucalyptus glaucina	50	No							334090	6386216	No	Large tree

Notes:

* Impact Area constitutes a five metre buffer of the proposed earthworks area

DBH = diameter at breast height

br = branch hollow

t = trunk hollow

? = appears hollow, though could be solid

Appendix 5. Aquatic fauna recorded within the Hunter/Central Rivers CMA

Scientific Name	Common Name	Status (FM Act 1994)
<i>Anguilla australis</i>	Short-finned Eel	
<i>Anguilla reinhardtii</i>	Long-finned Eel	
<i>Pseudomugil signifer</i>	Southern Blue-eye	
<i>Herklotsichthys castelnaui</i>	Sprat	
<i>Potamalosa richmondia</i>	Freshwater Herring	
<i>Carassius auratus</i>	Goldfish	
<i>Cyprinus carpio</i>	Common Carp	
<i>Gambusia holbrooki</i>	Gambusia (mosquito fish)	
<i>Caracharias taurus</i>	Grey Nurse Shark	Endangered
<i>Liza argentea</i>	Brown-back Mullet	
<i>Mugil cephalus</i>	Bully Mullet	
<i>Myxus petardi</i>	Freshwater Mullet	
<i>Galaxias maculatus</i>	Common Jollytail	
<i>Retropinna semoni</i>	Australian Smelt	
<i>Ostrea edulis</i>	European Flat Oyster	
<i>Ambassis jacksoniensis</i>	Port Jackson Glassfish	
<i>Ambassis marianus</i>	Silver Perchlet	
<i>Heniochus monoceros</i>	Masked Bannerfish	
<i>Gobiomorphus australis</i>	Striped Gudgeon	
<i>Gobiomorphus coxii</i>	Cox's Gudgeon	
<i>Hypseleotris compressa</i>	Carp Gudgeon	
<i>Hypseleotris galii</i>	Firetail Gudgeon	
<i>Philypnodon grandiceps</i>	Big-headed Gudgeon	
<i>Gerres subfasciatus</i>	Common Silver Belly	
<i>Afurcagobius tamarensis</i>	Tamar Goby	
<i>Gobiopterus semivestitus</i>	Glass Goby	
<i>Pseudogobius olorum</i>	Blue-spot Goby	
<i>Girella tricuspidata</i>	Black Bream	
<i>Macquaria ambigua</i>	Golden Perch	
<i>Macquaria novemaculeata</i>	Australian Bass	
<i>Paraplesiops bleekeri</i>	Bleekers Devil Fish	Protected
<i>Pomacentrus coelestris</i>	Neon Damsel	
<i>Argyrosomus hololepidotus</i>	Mulloway	
<i>Pseudanthias huchtii</i>	Threadfin Anthias	
<i>Sillago ciliata</i>	Sand Whiting	
<i>Acanthopagrus australis</i>	Australian Seabream	
<i>Pagrus auratus</i>	Cockney Bream	
<i>Rhabdosargus sarba</i>	Goldlined Seabream	
<i>Bidyanus bidyanus</i>	Silver Perch	Vulnerable
<i>Zanclus cornutus</i>	Moorish Idol	
<i>Pseudorhombus jenynsii</i>	Flounder	
<i>Oncorhynchus mykiss</i>	Rainbow trout	
<i>Salmo trutta</i>	Brown Trout	
<i>Salvelinus fontinalis</i>	Brook Trout	
<i>Platycephalus fuscus</i>	Dusky Flathead	
<i>Notesthes robusta</i>	Bullrout	
<i>Cnidoglanis macrocephalus</i>	Estuary Catfish	
<i>Plotosus lineatus</i>	Striped Catfish	
<i>Tandanus tandanus</i>	Freshwater Catfish	
<i>Tetractenos glaber</i>	Smooth Toadfish	
<i>Tetractenos hamiltoni</i>	Common Toadfish	
<i>Crassostrea gigas</i>	Pacific Oyster	
<i>Tanichthys albonubes</i>	White Cloud Mountain Minnow	

source: BioNet www.bionet.nsw.gov.au

Appendix 6. Project Personnel and Relevant Licences

REPORT COMPONENT	STUDY TEAM MEMBERS	QUALIFICATIONS
Overall Project Management, Flora Field Surveys, Flora Descriptions, Report Writing	Stefan Rose	B.Sc (Biol. Sci), M.Env.Stud., MAIBiol, MECA
Literature Review	Amy Rowles	B. Sc. (Hons) Biology/Ecology
Report Writing, Figure Preparation	Jenny Lewis	B.Sc (Res. & Env. Mgt.), TAFE Cert II (Conserv. & Land Mgt. Nat. Area Rest.), MECA
Fauna Field Surveys	Narawan Williams	TAFE Cert II (Conserv. & Land Mgt. Nat. Area Rest.)
Report Review	Brian Wilson	B. Appl. Sc. (Env. Biol.) Adv. Dip. Bus. Mgmt MAIBiol, MEIANZ, MECA

Relevant licences held by Ecotone Ecological Consultants

TYPE	FOR	LICENCE NO	NAME	DATE VALID TO	ORGANISATION	LOCATION
Animal Research Authority	Vertebrate Fauna Surveys	AW94/082	Brian Wilson	15-Nov-08	Animal care and ethics committee of the Director-General of NSW Agriculture	NSW
Certificate of Approval	Vertebrate Fauna Surveys	DG's ACEC 94/082	Brian Wilson	15-Nov-08		
Licence to	Access NPWS Wildlife Atlas Data Base	CON93002	Brian Wilson	31-Jan-09	NSW Department of Environment and Conservation	
Scientific Licence	Harm/ trap/ release: protected fauna; pick/ hold: native flora	S10555	Brian Wilson Stefan Rose Jenny Lewis Amy Williams Narawan Williams Anne Williams	30-Nov-08		
	As above plus bat banding	S10556	Ray Williams	31-Nov-08		