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Transport Infrastructure Development Corporation

North West Rail Link Environmental Assessment

Ecological Assessment

November 2006

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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1. Introduction

1.1 Purpose

This report has been prepared as part of the environmental assessment of the proposed North West Rail Link (NWRL) (the proposal). The Transport Infrastructure Development Corporation (TIDC) is the proponent of the proposal, and the environmental assessment is being prepared by GHD in accordance with the requirements of Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

This report assesses the key environmental issues and potential impacts on those species, populations and communities that are currently listed as threatened under the *NSW Threatened Species Conservation Act 1995* (TSC Act) or *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The report has been prepared to meet the Department of Planning Director General's Requirements for this environmental assessment.

The Assessment of Environmental Issues Report (SKM 2003) identified key issues and investigated potential impacts along the 2002 NWRL alignment. The alignment has since been slightly modified, and additional investigations were required to account for these changes to the alignment as well as to provide an updated investigation of the available threatened species records. The findings contained within the SKM report were used for the portions of the route that remain the same and only an assessment to verify the current condition of these areas was undertaken. A more thorough investigation of the areas unassessed in the SKM report was undertaken.

Issues that were addressed include:

- Whether the route alignment contains, or is likely to contain flora or fauna or ecological communities listed under the TSC Act or potential habitat for threatened species;
- The presence, or likely presence, of any Matters of National Environmental Significance (NES) listed under the EPBC Act;
- The likely impact of the rail link on biodiversity and in particular threatened species and endangered ecological communities;
- Assessment of the likely requirements for provisions under *Rivers and Foreshores Improvement Act (1948)*;
- An assessment under State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44); and
- An assessment under State Environmental Planning Policy 19 – Bushland in Urban Areas (SEPP 19).

1.2 Project Outline

The proposed North West Rail Link would be the principal trunk public transport line in Sydney's North West. It would connect with the Northern Line between Beecroft and Cheltenham Stations and terminate at Rouse Hill Town Centre. The rail link would be twin track, approximately 23 kilometres in length and would include:

- A 2.5 km surface quadruplication of the Northern Line between north of Epping Station and Beecroft Station (including works at Cheltenham Station);
- A 16 km section in tunnel from the Northern Line to north of Norwest Business Park, including four underground stations (Franklin Road Station, Castle Hill Station, Hills Centre Station and Norwest Station);
- A 4 km surface section from north of Norwest Business Park to Rouse Hill, including two underground stations (Burns Road Station and Rouse Hill Station)
- An interim train stabling facility at Rouse Hill;
- Ancillary tunnel support facilities such as tunnel ventilation, transformers and a water treatment plant(s); and
- Construction work sites, including a large site within the Balmoral Road Release Area.

1.2.1 Stations

The four stations located between Beecroft and Norwest Business Park would require varying levels of surface disturbance for the purpose of construction zones and access to the stations. These four stations are outlined briefly below:

- Franklin Road Station site is proposed within a residential area with surrounding vegetation and forest;
- Castle Hill Station site is proposed within a commercial area under a community parkland;
- Hills Centre Station site is proposed within ovals situated within an urban area with current land use as a community showground; and
- Norwest Station site is proposed within a heavily commercialised area.

The surface section of the rail line from north of Norwest Business Park to Rouse Hill would be a 40 / 60 m wide corridor and exist as a combination of a cut and cover sub-surface structure, cut or fill surface structure and a viaduct structure. A further two stations would be developed within this portion, requiring large surface area disturbance. These two stations are outlined briefly below:

- Burns Road Station site is proposed within a current development zone; and
- Rouse Hill Station site is proposed within a current development zone.

The end of the NWRL would open into a stabling facility with a number of additional supporting facilities surrounding the yard.

1.2.2 Limitations

The impact assessment required under Part 3A of the EP&A Act has been undertaken at a concept level and therefore may be used only as a guide for further assessments and it should be noted that additional factors, such as offset requirements may be identified to progress design and development of the project.

1.3 Site Location

The proposed alignment is located within the Local Government Areas (LGA) of Blacktown, Hornsby and Baulkham Hills (Figure 1.1). The alignment (Figure 1.2) of the NWRL would deviate from the Main North Line between Cheltenham and Beecroft, connecting this area with stations along Castle Hill Road, Castle Hill and continuing to the North West sector of Sydney, terminating in Rouse Hill.

1.4 Climate

The study area has a warm temperate climate with warm wet summers and mild dry winters. The average annual rainfall in the area is 1000 to 1,200 mm. During summer the temperatures range from between an average maximum of 24 - 27^{o}C and an average minimum of 17 - 20^{o}C. In winter the average maximum drops to 16 - 19^{o}C and the average minimum to 6 - 10^{o}C (Bureau of Meteorology 2006).

1.5 Soils and Geology

The 1:100 000 Soil Landscape Sheet indicates that the NWRL travels through various soil landscape groupings including shallow to moderately deep podzolic soils with low fertility and poor drainage and floodplains with deep-layered sediments over bedrock or relict soils with erosion hazard (Chapman & Murphy 1989; Bannerman & Hazelton 1990).

1.6 Land Use

The majority of the proposed alignment (Figure 1.2) traverses urban and commercial areas, with smaller areas of rural land. The selected route is largely developed.

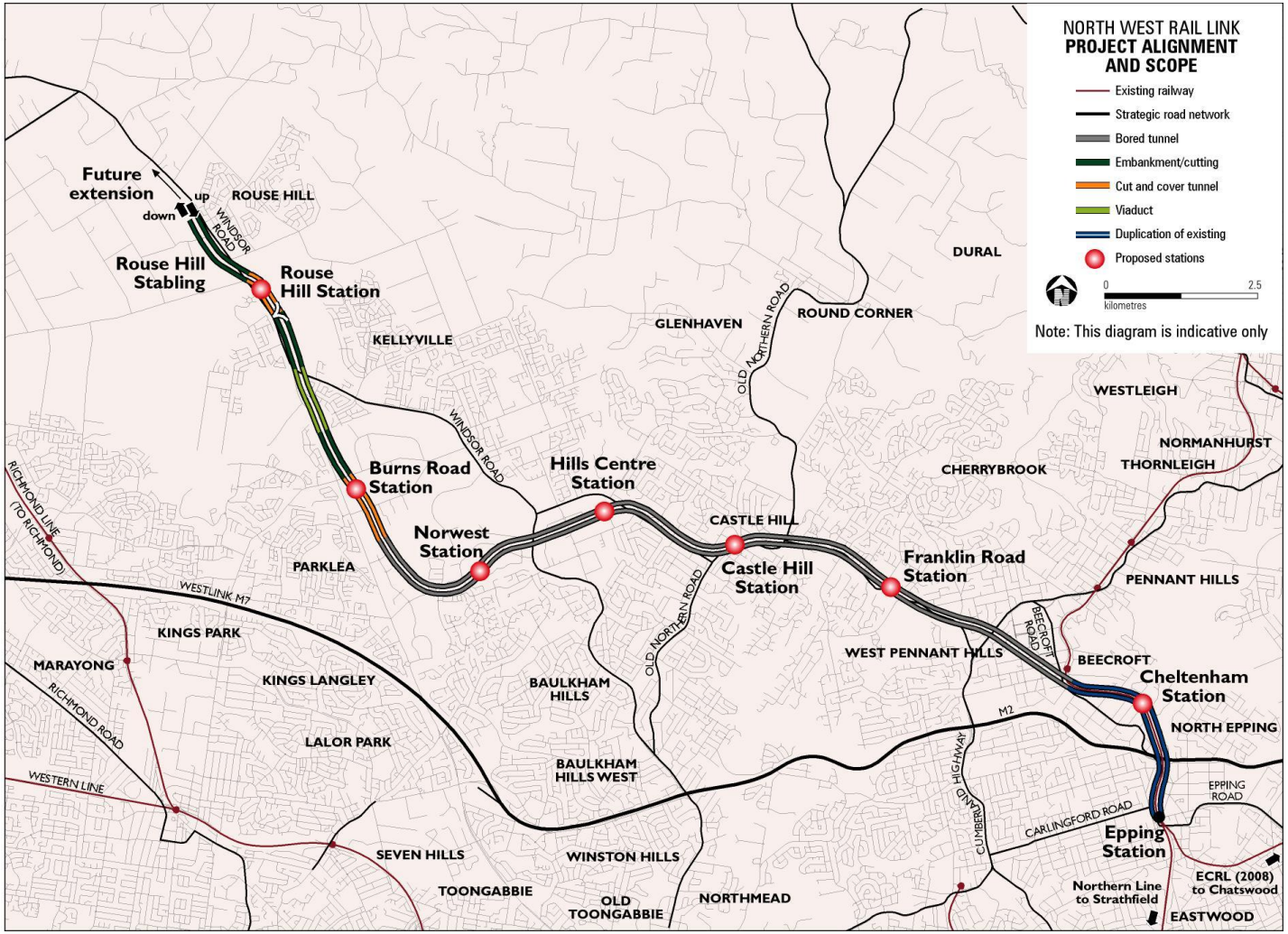
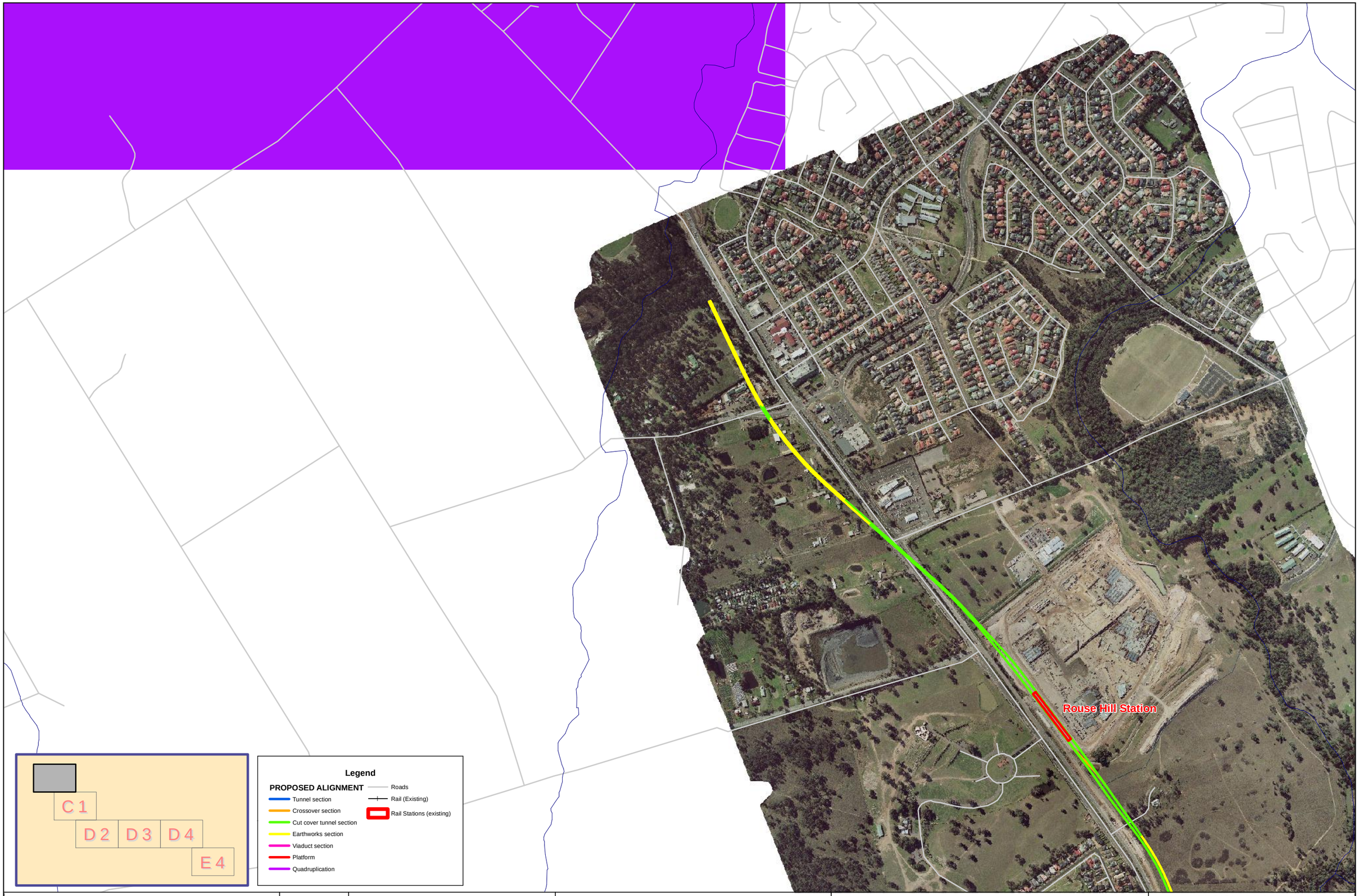


Figure 1.1 Location of the proposal



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PROJECT: North West Rail Link

Figure 1.2 (B1) Proposed NWRL Alignment

VERSION: DRAFT

PROJECT NO: 21-14856

MAP NO: 21-14856-Z004R1

VERSION: DRAFT

Document (MXD): G:\Projects\21\14856\CADD\GIS\MapDocuments\Z004R1.mxd

B 1

D 2 D 3 D 4

E 4

Legend

PROPOSED ALIGNMENT

- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Platform
- Quadruplication

- Roads
- Rail (Existing)
- Rail Stations (existing)

Kilometers

0.25 0.125 0 0.25

N

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Figure 1.2 (C1) Proposed NWRL Alignment

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MAP NO: 21-14856-Z004R1

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Burns Road Station

Norwest Station

B 1
C 1
D 3
D 4
E 4

Legend

PROPOSED ALIGNMENT
- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Platform
- Quadruplication

- Roads
- Rail (Existing)
- Rail Stations (existing)

Kilometers
0.25 0.125 0 0.25

N

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Figure 1.2 (D2) Proposed NWRL Alignment

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Hills Centre Station

Castle Hill Station

B 1
C 1
D 2
D 4
E 4

Legend

PROPOSED ALIGNMENT
- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Platform
- Quadruplication

- Roads
- Rail (Existing)
- Rail Stations (existing)

Kilometers
0.25 0.125 0 0.25

N

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Figure 1.2 (D3) Proposed NWRL Alignment

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MAP NO: 21-14856-Z004R1

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Document (MXD): G:\Projects\21\14856\CADD\GIS\MapDocuments\Z004R1.mxd

Franklin Road Station

B 1
C 1
D 2
D 3
E 4

Legend

PROPOSED ALIGNMENT
- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Platform
- Quadruplication

- Roads
- Rail (Existing)
- Rail Stations (existing)

Kilometers
0.25 0.125 0 0.25

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Figure 1.2 (D4) Proposed NWRL Alignment

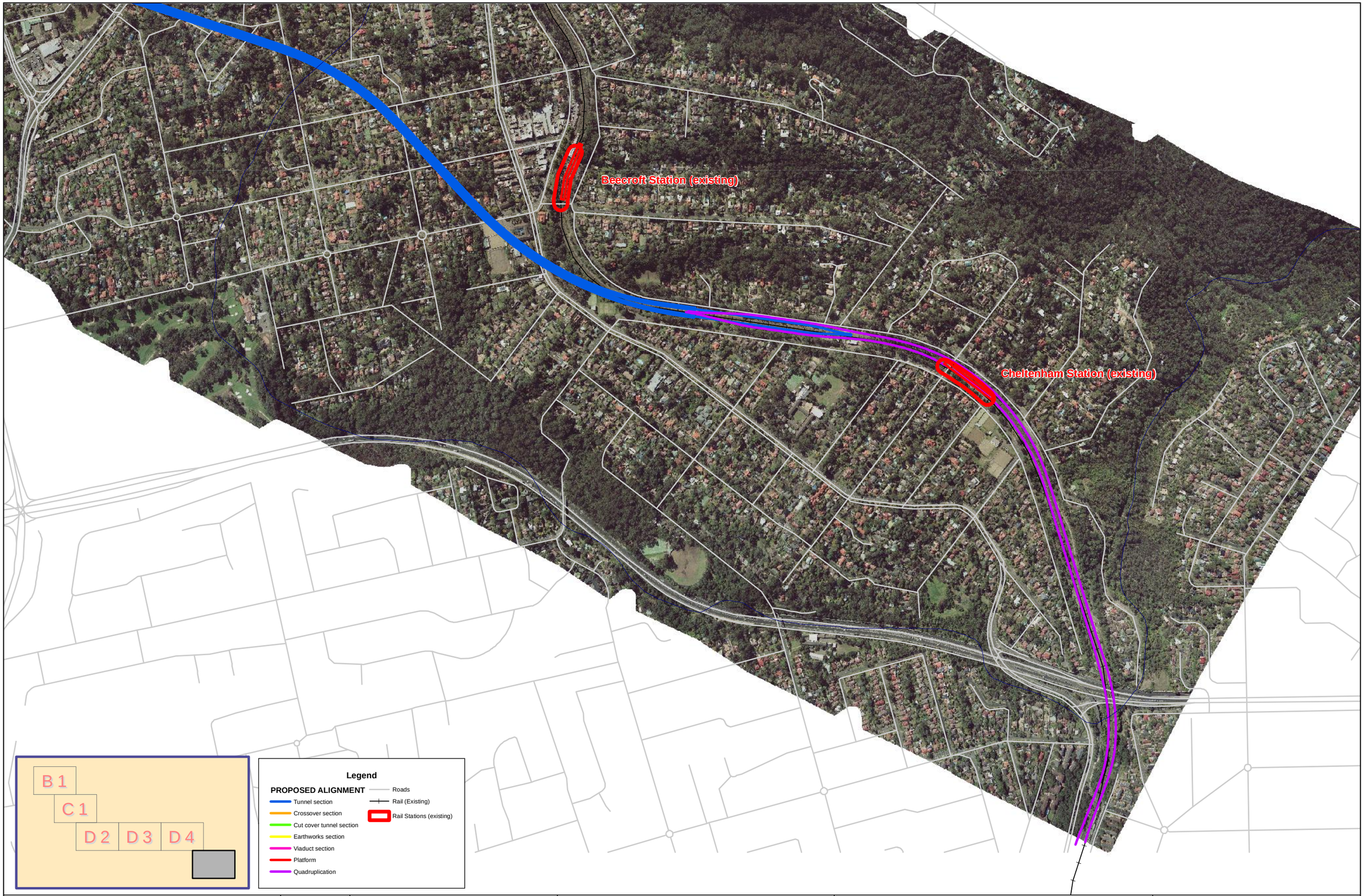
VERSION: DRAFT

PROJECT NO: 21-14856

MAP NO: 21-14856-Z004R1

VERSION: DRAFT

Document (MXD): G:\Projects\21\14856\CADD\GIS\MapDocuments\Z004R1.mxd



Legend

PROPOSED ALIGNMENT
- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Platform
- Quadruplication

- Roads
- Rail (Existing)
- Rail Stations (existing)

Kilometers
0.25 0.125 0 0.25

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Figure 1.2 (E4) Proposed NWRL Alignment

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MAP NO: 21-14856-Z004R1

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2. Methods

2.1 Literature Review

Available literature and database records regarding the environmental features of the study area and locality (i.e. 10 km radius) were reviewed and those of particular relevance are listed below, whilst a complete reference list is detailed in Section 7:

- Department of Environment and Conservation (DEC) Threatened Species Database Search for threatened species recorded within the locality;
- Department of Environment and Heritage (DEH) Protected Matters Search Tool for Matters of National Environmental Significance likely to occur in the locality;
- National Parks and Wildlife Service Native Vegetation of the Cumberland Plain CD Rom;
- SKM 2003 *North West Rail Link: Assessment of Environmental Issues, Flora and Fauna Assessment*; and
- SKM 2006 *North West Rail Link: Project Application and Preliminary Environmental Assessment.*

2.2 Field Surveys

Where applicable, the methodology was designed to meet the requirements of the DEC *Draft Threatened Biodiversity Survey and Assessment* Guidelines (DEC 2004). Two ecologists undertook surveys for threatened species over three days: 17, 18 and 20 July 2006. The information contained within SKM 2003 was relied upon where the proposed alignment remained the same and verification of these areas was carried out in conjunction with an assessment of the new portions of the alignment.

2.2.1 Flora

Vegetation Mapping

Mapping of the communities within the study area was undertaken along the proposed alignment. Vegetation mapping of the 2002 alignment had been previously undertaken (SKM 2003) and was relied upon for this report. Therefore ground-verification of this mapping and broad scale mapping of vegetation communities within previously unassessed areas was undertaken, especially in relation to those areas which have the potential to be an Endangered Ecological Community (EEC) listed under the TSC Act and / or the EPBC Act. Vegetation communities were identified based on the dominant canopy species and the boundaries marked using a Global Positioning System (GPS).

During previous surveys (SKM 2003) no threatened or significant flora species were identified as being present in the area whilst GHD's assessment identified the presence of potential habitat for a number of species of plants listed under the TSC Act. Notes were taken on the dominant species, soil type and condition, the level of weed invasion and any other signs of disturbance. Opportunistic flora records were also taken throughout the proposed route. Those species that could not be verified in the field were sampled and identified later in accordance with Harden (1990, 1991, 1992, 1993) or sent to the Sydney Royal Botanic Gardens for identification.

2.2.2 Fauna

The study route has the potential to provide habitat for a range of fauna in certain areas and the assessment conducted aimed to ascertain the potential importance of these areas for native fauna, and in particular threatened species.

Habitat Assessment

A general fauna habitat assessment was undertaken to identify areas of potential habitat within the study area. Specific resources such as shelter, basking, roosting, nesting and foraging sites for amphibians, birds, bats, arboreal mammals, ground-dwelling mammals and reptiles were noted.

Threatened Fauna

Targeted surveys for the Cumberland Land Snail were carried out in the area north of Norwest Business Park within habitat deemed suitable for this species. Empty snail shells were collected and sent to the Australian Museum for verification.

Opportunistic Records

Incidental records of bird, amphibian and mammal species were collected during the entire survey period.

2.2.3 State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44)

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) applies within the Hornsby LGA. Therefore an assessment was carried out to determine the presence of habitat considered likely to support a Koala population. Assessments were conducted for the Koala using a three-stage technique in accordance with *Hornsby Shire Council Flora and Fauna Assessment Guidelines for Development Applications* (Hornsby Shire Council 2006).

Step 1: – Is the land potential Koala habitat?

Step 1 involved the identification of potential Koala Feed Trees listed on Schedule 2 of *State Environmental Planning Policy 44 – Koala Habitat Protection* and determination that these trees constituted greater than 15% of the total number of trees. If this is found to be the case then Step 2 must be carried out.

Step 2: - Is the land core Koala habitat?

After identification of potential Koala habitat evidence must be obtained, such as breeding females or recent sightings or historical records of a Koala population, in order to determine the presence of a resident population of Koalas and therefore the presence of core Koala habitat. If this is found to be the case a plan of management must be prepared.

As no potential Koala habitat was located along the proposed alignment, consideration as to the presence of core Koala habitat was not given.

2.2.4 State Environmental Planning Policy 19 – Bushland in Urban Areas (SEPP 19)

State Environmental Planning Policy 19 – Bushland in Urban Areas (SEPP 19) applies within the Blacktown, Hornsby and Baulkham Hills LGAs to land zoned for public open space purposes. Therefore an assessment was carried out to determine the presence of bushland, defined as "land on which there is vegetation which is either a remainder of the natural vegetation of the land or, if altered, is still or may be representative of the structure and floristics of the natural vegetation" along the proposed alignment. These assessments were carried out during the broad scale vegetation mapping.

2.2.5 Weather Conditions

Weather conditions during the survey period were mostly fine and cool. Monday 17 July 2006 was fine and sunny, overcast conditions and light rain was experienced on Tuesday 18 July 2006 and Thursday 20 July was fine and sunny in the morning with afternoon showers.

2.2.6 Limitations

Surveys were undertaken outside the optimal survey period for some species and therefore it is possible that some species use the study area but were not detected during the survey period. These species are likely to include cryptic species and threatened flora, which are not in flower during winter. Some fauna species are also mobile and transient in their use of resources. Consequently, it is likely that not all species either resident or transitory to the site would have been recorded during the site inspection. Mammal activity is also known to decrease during the colder months and therefore the detection potential for these species may have been somewhat reduced.

This survey was not designed to detect all species, either resident or transitory to the study area. Instead it was aimed at providing an overall assessment of the ecological values of the site and study area with particular emphasis on threatened species to allow an assessment of the likely impacts of the proposal.

3. Results

3.1 Literature Review

Results of the literature review indicated that a number of threatened flora and fauna have been recorded within the locality or have the potential to occur within the locality. The results of the DEC search are shown in Figure 3.1. Not all species listed are likely to occur within the study area. Species that have the potential to exist within the study area and their likelihood of occurring are listed in Table 3.2 and Table 3.3.

3.2 Flora

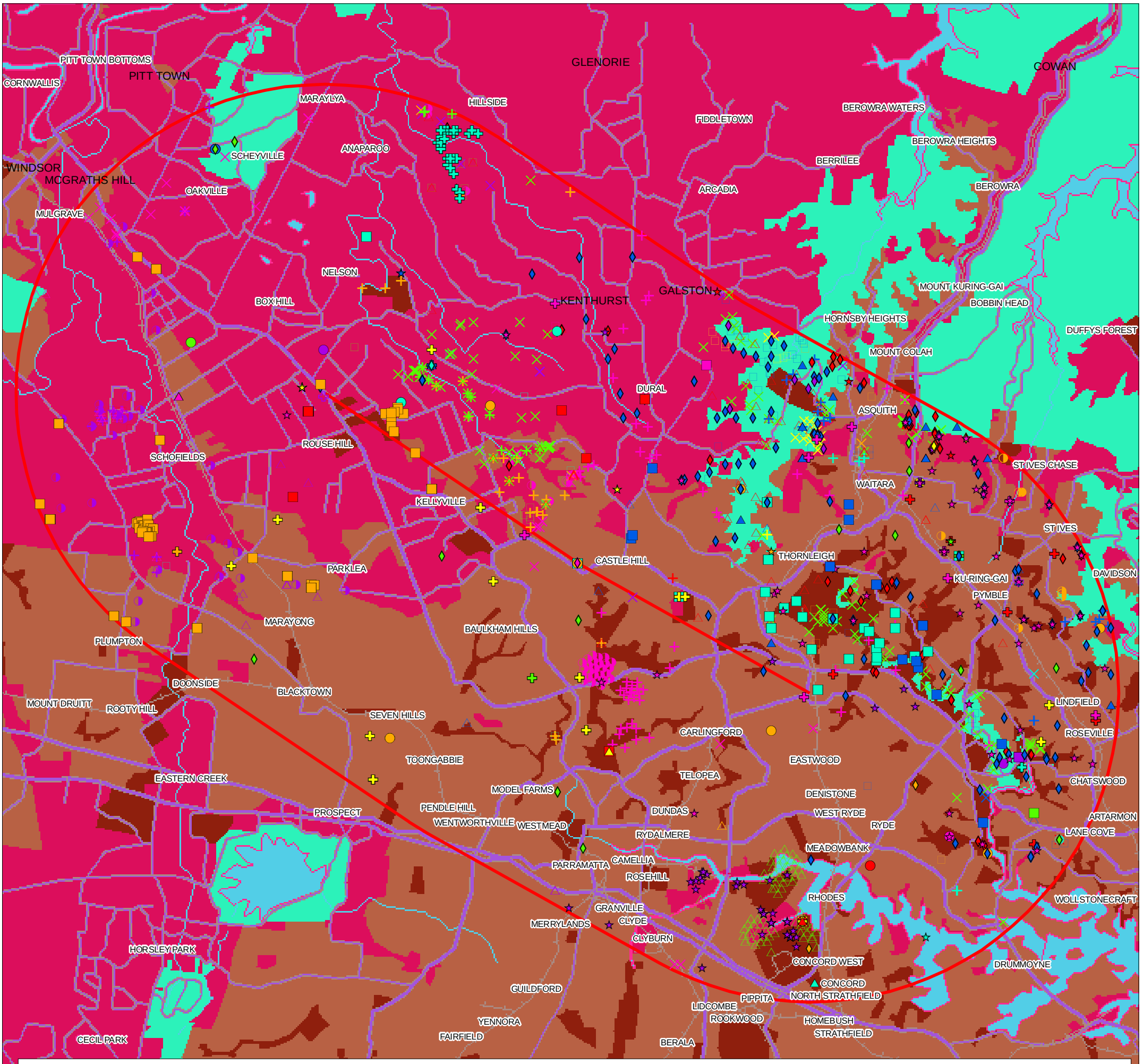
Vegetation along the proposed alignment was variable with the majority of the route passing through urban areas or highly commercial / industrial areas. These areas supported predominantly planted trees and urban gardens.

The proposed quadruplication area within the rail corridor from Epping to Beecroft varied in vegetation type from regions with a high proportion of invasion by exotic species as well as some areas of remnant native communities with intact native understorey likely to represent remnant stands of the endangered ecological community Sydney Turpentine - Ironbark Forest.

Some remnant vegetation occurred within parklands and urban environments along the route, including the presence of a forest area with structure and canopy species composition characteristic of the endangered Blue Gum High Forest.

North of Norwest Business Park the route passes through a more rural area with open areas of remnant trees characteristic of the endangered Cumberland Plain Woodland, terminating at an uncleared area of Cumberland Plain Woodland with a greater diversity of characteristic species. The majority of this portion of the route passed through existing development areas, residential properties and grazed pastures with scattered trees. Much of this area is affected by the European Wild Rabbit (*Oryctolagus cuniculus*), considered a pest species in NSW and nationally.

The endangered ecological community River-flat Eucalypt Forest on Coastal Floodplains was present along watercourses that ran along the proposed alignment at varying distances from the proposed corridor. These riparian areas varied in the level of invasion by exotic species from high to low.



Note* Points may have been spread locally for improved interpretation at map scale.

Threatened Fauna

- Australasian Bittern
- Barking Owl
- Black Bittern
- Black-chinned Honeyeater (eastern subspecies)
- Black-tailed Godwit
- Blue-billed Duck
- Broad-billed Sandpiper
- Brown Treecreeper
- Cotton Pygmy-Goose
- Cumberland Plain Land Snail
- Diamond Firetail
- Eastern Bentwing-bat
- Eastern Freetail-bat
- Eastern Pygmy-possum
- Freckled Duck
- Gang Gang Cockatoo
- Giant Burrowing Frog
- Glossy Black-Cockatoo
- Grass Owl
- Great Knot
- Greater Broad-nosed Bat
- Greater Sand-plover
- Green and Golden Bell Frog
- Grey Falcon
- Grey-headed Flying-fox
- Hooded Robin
- Koala
- Large-eared Pied Bat
- Large-footed Myotis
- Little Tern
- Masked Owl
- Osprey
- Pink Robin
- Powerful Owl
- Red-crowned Toadlet
- Regent Honeyeater
- Rosenberg's Goanna
- Sooty Owl
- Sooty Oystercatcher
- Speckled Warbler
- Spotted-tailed Quoll
- Square-tailed Kite
- Superb Fruit-Dove
- Superb Parrot
- Swift Parrot
- Yellow-bellied Glider
- Yellow-bellied Sheathtail-bat

Threatened Flora

- Acacia bynoeana
- Acacia gordonii
- Acacia pubescens
- Callistemon linearifolius
- Camarophyllopsis kearneyi
- Darwinia biflora
- Darwinia peduncularis
- Deyeuxia appressa
- Dillwynia tenuifolia
- Epacris purpurascens var. purpurasc
- Epacris purpurascens var. purpurascen
- Eucalyptus camfieldii
- Eucalyptus scoparia
- Eucalyptus sp. Cattai
- Galium australe
- Genoplesium baueri
- Grevillea juniperina subsp. juniper
- Haloragodendron lucasii
- Hibbertia superans
- Hygrocybe anomala var. ianthinomargin
- Hygrocybe aurantipes
- Hygrocybe austropratensis
- Hygrocybe lanecovensis
- Hygrocybe reesiae
- Hygrocybe rubronivea
- Leptospermum deanei
- Leucopogon fletcheri subsp. fletche
- Melaleuca deanei
- Micromyrtus minutiflora
- Persoonia hirsuta
- Persoonia mollis subsp. maxima
- Pimelea curviflora var. curviflora
- Pimelea spicata
- Pomaderris prunifolia
- Pultenaea parviflora
- Syzygium paniculatum
- Tetratheca glandulosa
- Wilsonia backhousei

N

Kilometres
0 1 2 4

Legend

- Approximate Corridor Location
- DEC 10km radius
- Rail
- Major Road
- Road
- Drainage
- Mangrove
- Wetland
- Water
- Restricted Area
- Reserve
- Built Area
- Park

VERSION: DRAFT	
PROJECT NO: 21-14856	
MAP NO: YY-14856-Z001	
DRAWN: CWilson	DATE: 23/06/2006
SOURCE: Geoscience Australia, DEC	
DATUM/PROJECTION: MGA Zone 56	

Client Name

NW Rail

Figure 3.1:

DEC Threatened Species Records (2006)

Document (MXD): G:\Projects\21\14586\CADD\GIS\Map Documents\Z001.mxd

3.2.1 General Vegetation Communities

Seven vegetation communities were recorded along the proposed alignment as well as areas of high disturbance due to current development. The vegetation communities recorded along the proposed alignment and a brief description of each is provided below. The distribution of vegetation communities across the study area is shown in Figure 3.2 and their location along the proposed alignment is shown in Table 3.1.

Community 1 – Blue Gum High Forest (BGH)

A community of Blue Gum High Forest was previously mapped by SKM (2003) adjacent to the proposed Franklin Road Station site. This community was reported by SKM as a high quality remnant community with a high diversity of characteristic species and low weed invasion. Access into this community was not possible during the current survey due to property access restrictions. This area does not fall into the proposed impact zone. The vegetation present within the proposed impact zone adjacent to the previously mapped intact stand of Blue Gum High Forest appeared highly modified and disturbed consisting primarily of canopy trees, possibly planted, dominated by Spotted Gum (*Corymbia maculata*). The understorey was primarily residential gardens and paddocks as well as vacant blocks of land with a high level of weed infestation. Understorey species included Sweet Pittosporum (*Pittosporum undulatum*), *Oxalis* sp., Kidney Weed (*Dichondra repens*), as well as exotic species such as Small Leaved Privet (*Ligustrum sinense*) and Wandering Jew (*Tradescantia albiflora*).

Another consideration is the transition between Wianamatta Shale and Hawkesbury Sandstone. Blue Gum High Forest is confined to soils derived from Wianamatta Shale and is distinct from a similar open forest that occurs within sandstone gullies. The growth of Spotted Gums in the area may be indicative of a sandstone platform and hence further consideration must be given to the structure of this community. Characteristic canopy species were not identified as dominant in the adjacent vegetation.

Sydney Blue Gum was identified within the rail corridor between Epping in Cheltenham on the western side of the corridor amongst a stand of Spotted Gums. The understorey in this area was disturbed with a high level of weed invasion. This area is considered unlikely to represent a stand of Blue Gum High Forest.

Community 2 – Cumberland Plain Woodland (CPW)

This community was present north of Norwest Business Park, adjacent to Old Windsor Road within rural properties in this area. This community was patchy in its stands with varying levels of remnant species and transitions in canopy species. The majority of this area has been used for various purposes by different landholders and therefore quality varies from areas containing predominantly Forest Red Gum (*Eucalyptus tereticornis*) and Narrow-leaved Ironbark (*E. crebra)* over grazed pasture land or residential properties, to denser patches of canopy trees with more native grassy understorey. Two stands existed in the area with a greater diversity of understorey, midstorey and canopy species. A small stand on an uncleared block of land just north of Norwest Business Park consisted of Forest Red Gum and Narrow-leaved Ironbark over a native understorey including Wattle Mat-rush (*Lomandra filiformis*), Weeping Grass (*Microlaena stipoides*), Kidney Weed, Threeawn Speargrass (*Aristida vagans*), *Eragrostis* sp. and Kangaroo Grass (*Themeda australis*). The midstorey was dominated by *Acacia* spp. and *Melaleuca nodosa*. The groundcover appeared grazed in some places by the European Wild Rabbit but weed invasion in this stand was minimal.

At the northern end of the alignment an uninhabited parcel of land contained uncleared woodland and provided connectivity with woodland into the west and north. Dominant canopy species included Forest Red Gum, Cabbage Gum (*E. amplifolia*) and Rough-barked Apple (*Angophora floribunda*). The midstorey was dominated by the exotic Common Olive (*Olea europaea*). Native species present included Prickly Beard-heath (*Leucopogon juniperinus*), Sydney Green Wattle (*Acacia parramattensis*), Shorthair Plumegrass (*Dichelachne micrantha*), *Dianella* sp., Brown's Lovegrass (*Eragrostis brownii*), Threeawn Speargrass and *Aristida ramosa*. This area adjoined vegetation along Second Ponds Creek and appeared to contain species characteristic of both River-flat Eucalyptus Forest and Cumberland Plain Woodland. This area is likely to contain species characteristic of both communities as a transition zone between the two. Evidence of extensive grazing by the European Wild Rabbit was also present.

Community 3 – Sydney Turpentine - Ironbark Forest (STIF)

This community was located within the rail corridor between Cheltenham and Beecroft Stations on the east and west side of the railway track. On the western side, closer to Beecroft Station, dominant canopy species included Turpentine (*Syncarpia glomulifera*), Smooth-barked Apple (*Angophora costata*), Blackbutt, Red Bloodwood (*Corymbia gummifera*) and *Allocasuarina* sp. The midstorey included *Acacia* spp., Tick Bush (*Kunzea ambigua*), Needlebush (*Hakea sericea*), Black Wattle (*Callicoma serratifolia*) and Sweet Pittosporum. The groundcover included native species such as *Cheilanthes sieberi*, Kangaroo Grass and Threeawn Speargrass. This stand was a narrow strip along the edge of the rail corridor and was a disturbed area with access paths and a small amount of weed invasion by species such as Lantana (*Lantana camara*), Common Olive and *Asparagus* sp. On the eastern side of the corridor, Red Bloodwood and Blackbutt were the dominant canopy species with numerous *Allocasuarina* sp. Other characteristic species included Sweet Pittosporum, Tick Bush, Threeawn Speargrass, *Entolasia* sp., Prickly Beard-heath, *Acacia falcata*, Spiny-headed Mat-rush (*Lomandra longifolia*) and Kangaroo Grass. This community was situated on the edge of a steep embankment into the rail corridor edged by a cleared access path along the fence line. There was little weed invasion within this stand.

STIF was previously mapped by SKM (2003) along Cattai Creek near the proposed Hills Centre Station. This current study found this community to be greatly disturbed with an extremely high level of weed invasion and weed diversity along the creek line. Further up the embankment there was an area of native vegetation with species characteristic of this endangered community including the Blue Flax-lily (*Dianella caerulea*), Forest Clematis (*Clematis glycinoides*), Bordered Panic (*Entolasia marginata*), Spiny-headed Mat-rush, Daviesia sp., Sweet Pittosporum, *Acacia longifolia* and *Allocasuarina* sp. While the understorey is characteristic of this community the canopy species were difficult to identify due to a high scale of dieback of the larger trees. This may be indicative of an infection by *Phytopthora cinnamomi* or changes to drainage patterns in the vicinity of the trees.

Community 4 – River-flat Eucalypt Forest on Coastal Floodplains (RFEF)

This community was present along Elizabeth Macarthur Creek and Caddies Creek. Dominant canopy species included Forest Red Gum, Cabbage Gum and Rough-barked Apple. Swamp Oak (*Casuarina glauca*) was present along the creek lines and weed invasion varied along the watercourse with level of disturbance and human accessibility. The understorey is likely to contain native grasses, however grazing by the European Wild Rabbit was evident, therefore characteristic groundcover was limited. This community exists in the area with varying degrees of disturbance and weed invasion. More intact areas were present further removed from the impacts of human access and activities.

Community 5 – Native Grassland

This community was restricted to a small piece of land at the rear of a property off Balmoral Road. Native grasses in this community included Threeawn Speargrass, Kangaroo Grass, *Eragrostis* sp. and Two-colour Panic (*Panicum simile*). A number of exotic species were also present including *Verbena* sp. and Fireweed (*Senecio madagascariensis*). There were scattered Narrow-leaved Ironbarks throughout this grassland which were more densely present adjacent to this area.

Community 6 – Pasture / Open Grass

Areas of pasture within private properties were scattered regularly throughout the study area along the proposed route. These areas were either used as grazing pastures or left as open pastures with varying levels of maintenance. These areas contained predominantly introduced species including Rhodes Grass (*Chloris gayana*), *Verbena* sp., Buffalo Grass (*Stenotaphrum secundatum*) and Couch (*Cynodon dactylon*) with occasional native species such as Threeawn Speargrass and Kangaroo Grass. These areas also contained scattered trees including Narrow-leaved Ironbark, Forest Red Gum and Grey Box (*Eucalyptus punctata*).

Community 7 – Planted and Garden Areas

Planted and landscaped gardens were common throughout the proposed route as the route passes through urban residential areas and landscaped business areas. These areas are residential lawns and planted gardens consisting of various planted shrubs and trees with some properties maintaining remnant trees including Forest Red Gum, Rough-barked Apple, Spotted Gum and Grey Box.

Community 8 – Development Sites

Development sites where land clearance has occurred were present along Windsor Road. Land clearance has removed all vegetation with the exception of occasional roadside strips of trees such as Grey Box.

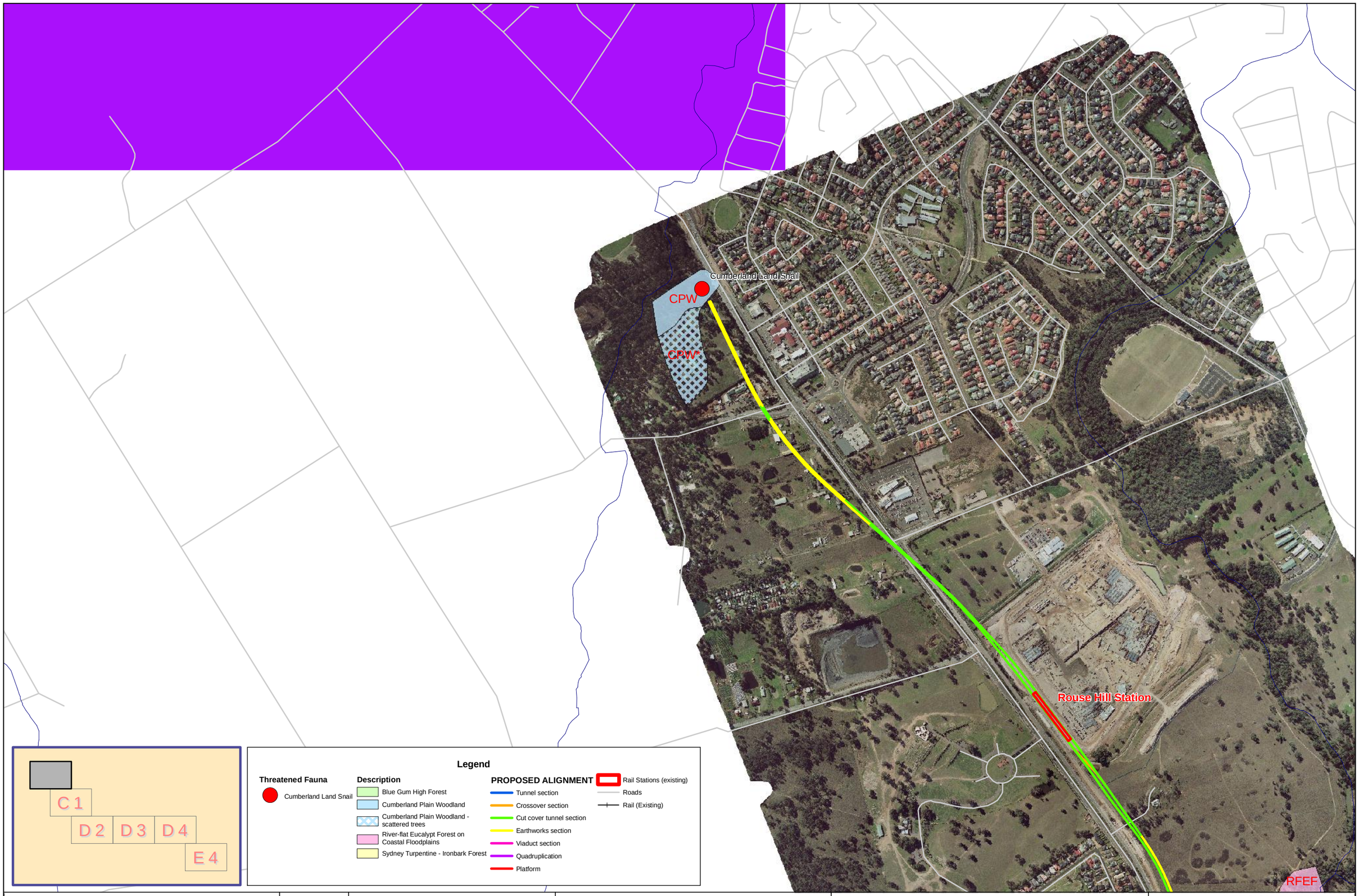
Table 3.1 Vegetation communities and study area status and the location along the proposed alignment

No.	Vegetation Community	Location / Condition	Endangered Ecological Community
1	Blue Gum High Forest	» Franklin Road Station proposed construction site: diverse community located adjacent to proposed construction zone (SKM 2003).	Blue Gum High Forest (TSC Act & EPBC Act)
2	Cumberland Plain Woodland	» North of Norwest Business park: private property that has retained the understorey, low level weed invasion with evidence of grazing by Rabbits; » Along Windsor Road at the northern extreme of the route: medium weed invasion with evidence of Rabbit grazing, and » Remnant canopy trees characteristic of this community remain scattered throughout properties over modified lands along the route north of Norwest Business Park.	Cumberland Plain Woodland (TSC Act & EPBC Act)
3	Sydney Turpentine - Ironbark Forest	» Within the rail corridor on the western and eastern side between Cheltenham and Beecroft Stations: small stands with high disturbance; and » Along Cattai Creek near the proposed Hills centre Station: intact understorey with low weed invasion upslope of a weed dominated riverbed and edge.	Sydney Turpentine - Ironbark Forest (TSC Act*)

No.	Vegetation Community	Location / Condition	Endangered Ecological Community
4	River-flat Eucalypt Forest on Coastal Floodplains	» Within the alignment along Windsor Road this community meets Windsor Road and consists of remnant canopy species over modified lands along a drainage line. » Along Caddies Creek along the viaduct structure consisting of high weed invasion in places with representative canopy trees; and » Along Caddies Creek at the viaduct construction site with varying levels of weed invasion and loss of understorey with remnant canopy trees.	River-flat Eucalypt Forest on Coastal Floodplains (TSC Act)
5	Native Grassland	» On a maintained property on the south side of Burns Road	None
6	Pasture / Open Grass	» Franklin Road Station site: maintained pasture area; » Scattered between Norwest Business Park and Balmoral Road on private property: varying levels of weed invasion, some grazing areas with remnant trees; » Scattered in properties from Balmoral Road to just south of Burns Road before construction site: mostly grazed pasture with remnant trees; » Scattered throughout properties north of Burns Road until Samantha Riley Drive and large car park area: varying levels of weed invasion and maintenance with scattered remnant trees; » Immediately north of Samantha Riley Drive on private land: open grassland with high level of weed invasion; » Along Old Windsor Road, south of Windsor Road adjacent to Caddies Creek: open grass with high level of weed invasion;	None

No.	Vegetation Community	Location / Condition	Endangered Ecological Community
		» North of Windsor Road until construction area: large open pasture areas with few remnant trees; » Scattered within properties north of Commercial Road: high level of weed invasion with few remnant trees; and » Scattered within properties north of Rouse Road: open pastures with remnant trees.	
7	Planted and Garden Areas	» Throughout the proposed alignment	None
8	Development Sites	» Parallel to Old Windsor Road; » Along Old Windsor road just south of Burns Road; » Along Windsor Road just south of Samantha Riley Drive; and » Along Windsor Road, south of Commercial Road.	None

» TSC Act = *Threatened Species Conservation Act 1995* (DEC 2006); EPBC Act = *Environment Protection and Conservation Act 1999* (DEH 2006); * = This community is also listed under the EPBC Act however area limitations under this Act exclude the stands existing in the study area from consideration under this Act



C 1
D 2
D 3
D 4
E 4

Legend

Threatened Fauna
- Cumberland Land Snail

Description
- Blue Gum High Forest
- Cumberland Plain Woodland
- Cumberland Plain Woodland - scattered trees
- River-flat Eucalypt Forest on Coastal Floodplains
- Sydney Turpentine - Ironbark Forest

PROPOSED ALIGNMENT
- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Quadruplication
- Platform

- Rail Stations (existing)
- Roads
- Rail (Existing)

Kilometers
0.25 0.125 0 0.25

N

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PROJECT: North West Rail Link

Figure 3.2 (B1) Endangered Vegetation Communities and Cumberland Land Snail

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PROJECT NO: 21-14856

MAP NO: 21-14856-Z003

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RFEF

RFEF

CPW

B 1

D 2 D 3 D 4

E 4

Legend

Threatened Fauna

- Cumberland Land Snail

Description

- Blue Gum High Forest
- Cumberland Plain Woodland
- Cumberland Plain Woodland - scattered trees
- River-flat Eucalypt Forest on Coastal Floodplains
- Sydney Turpentine - Ironbark Forest

PROPOSED ALIGNMENT

- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Quadruplication
- Platform

- Rail Stations (existing)
- Roads
- Rail (Existing)

Kilometers

0.25 0.125 0 0.25

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Figure 3.2 (C1) Endangered Vegetation Communities and Cumberland Land Snail

VERSION: DRAFT

PROJECT NO: 21-14856

MAP NO: 21-14856-Z003

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Burns Road Station

RFEF

CPW*

CPW

Norwest Station

B 1
C 1
D 3
D 4
E 4

Legend

Threatened Fauna
- Cumberland Land Snail

Description
- Blue Gum High Forest
- Cumberland Plain Woodland
- Cumberland Plain Woodland - scattered trees
- River-flat Eucalypt Forest on Coastal Floodplains
- Sydney Turpentine - Ironbark Forest

PROPOSED ALIGNMENT
- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Quadruplication
- Platform

- Rail Stations (existing)
- Roads
- Rail (Existing)

Kilometers
0.25 0.125 0 0.25

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Figure 3.2 (D2) Endangered Vegetation Communities and Cumberland Land Snail

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MAP NO: 21-14856-Z003

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Hills Centre Station

STIF

Castle Hill Station

B 1
C 1
D 2
D 4
E 4

Legend

Threatened Fauna
- Cumberland Land Snail

Description
- Blue Gum High Forest
- Cumberland Plain Woodland
- Cumberland Plain Woodland - scattered trees
- River-flat Eucalypt Forest on Coastal Floodplains
- Sydney Turpentine - Ironbark Forest

PROPOSED ALIGNMENT
- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Quadruplication
- Platform

- Rail Stations (existing)
- Roads
- Rail (Existing)

Kilometers
0.25 0.125 0 0.25

N

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Figure 3.2 (D3) Endangered Vegetation Communities and Cumberland Land Snail

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MAP NO: 21-14856-Z003

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BGH

Franklin Road Station

B 1
C 1
D 2
D 3
E 4

Legend

Threatened Fauna
- Cumberland Land Snail

Description
- Blue Gum High Forest
- Cumberland Plain Woodland
- Cumberland Plain Woodland - scattered trees
- River-flat Eucalypt Forest on Coastal Floodplains
- Sydney Turpentine - Ironbark Forest

PROPOSED ALIGNMENT
- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Quadruplication
- Platform

- Rail Stations (existing)
- Roads
- Rail (Existing)

Kilometers
0.25 0.125 0 0.25

N

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Figure 3.2 (D4) Endangered Vegetation Communities and Cumberland Land Snail

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MAP NO: 21-14856-Z003

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B1
C1
D2
D3
D4

Beecroft Station (existing)

STIF
STIF

Cheltenham Station (existing)

STIF
STIF

Legend

Threatened Fauna
- Cumberland Land Snail

Description
- Blue Gum High Forest
- Cumberland Plain Woodland
- Cumberland Plain Woodland - scattered trees
- River-flat Eucalypt Forest on Coastal Floodplains
- Sydney Turpentine - Ironbark Forest

PROPOSED ALIGNMENT
- Tunnel section
- Crossover section
- Cut cover tunnel section
- Earthworks section
- Viaduct section
- Quadruplication
- Platform

- Rail Stations (existing)
- Roads
- Rail (Existing)

Kilometers
0.25 0.125 0 0.25

N

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Figure 3.2 (E4) Endangered Vegetation Communities and Cumberland Land Snail

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3.2.2 Endangered Ecological Communities

Four endangered ecological communities listed under the TSC Act were recorded within the study area during the surveys. These included:

- Blue Gum High Forest; (Critically Endangered under the EPBC Act)
- Cumberland Plain Woodland (Endangered under the EPBC Act)
- Sydney Turpentine – Ironbark Forest; and
- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

These communities were distributed throughout the study area (Figure 3.2) and were of varying quality. They are discussed individually in Section 3.2.1 and 4.2.3.

3.2.3 Threatened Flora

Table 3.2 list those threatened flora that have been recorded in the locality, or are likely to occur within the locality, together with their conservation status and likelihood of occurring at the site (DEC and DEH). Suitable habitat is present within the study area for a number of species. However, these surveys were undertaken outside the flowering period of some species making detection difficult as some are cryptic and can only be detected during their flowering period. Therefore the assessment of the likelihood of cryptic species occurring at the site has been based on the presence of potential habitat within the study area.

Table 3.2 Threatened Flora that have been recorded in the locality or have the potential to occur within the locality (DEC 2006; DEH 2006)

Species name	Common name	TSC Act Status	EPBC Act Status	Potential to Occur Within Study Area
Acacia bynoeana	Bynoe's Wattle	E	V	This species occurs mainly in heath and dry sclerophyll forest, seeming to prefer open, sometimes slightly disturbed sites such as trail margins, road edges and in recently burnt open patches. Suitable habitat may therefore exist for this species.
Acacia gordonii		E	E	This species is unlikely to occur as it occurs in dry sclerophyll forest and heaths amongst or within rock platforms on sandstone outcrops. Suitable habitat is not present.
Acacia pubescens	Downy Wattle	V	V	This species occurs in open woodland and forest, in a variety of plant communities, including Cumberland Plain Woodland. Suitable habitat may therefore exist for this species.
Caladenia tessellata	Thick-lipped Spider-orchid	E	V	This species inhabits grassy sclerophyll woodland on clay loam or sandy soils. Suitable habitat may exist for this species.
Callistemon linearifolius	Netted Bottle Brush	V		This species grows in dry sclerophyll forest therefore suitable habitat may exist for this species.
Camarophyllopsis kearneyi		E		Appears to be limited to the Lane Cove Bushland Park and is unlikely to occur within the study area.
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V	Potential habitat for this species is poorly understood and it is thought to typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*E. gummifera*) and Black She-oak (*Allocasuarina littoralis*). This species is unlikely to occur along the proposed route.
Cynanchum elegans	White-flowered Wax Plant	E	E	Unlikely to occur as it usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, Open Forest and Woodland, and Melaleuca scrub, habitat not present within the study area.

Species name	Common name	TSC Act Status	EPBC Act Status	Potential to Occur Within Study Area
Darwinia biflora		V	V	Occurs in Sydney only on the edges of weathered shale-capped ridges, where these intergrade with Hawkesbury Sandstone. Associated overstorey species include *Eucalyptus haemastoma, Corymbia gummifera* and/or *E. squamosa*. The vegetation structure is usually woodland, open forest or scrub-heath. Habitat for this species may occur.
Darwinia peduncularis		V		This species is unlikely to occur as it usually grows on or near rocky outcrops on sandy, well drained, low nutrient soil over sandstone, habitat not present within the study area.
Deyeuxia appressa		E	E	This species is a highly restricted NSW endemic known only from two pre-1942 records in the Sydney area. Consequently, almost nothing is known of this species' habitat and ecology other than it grows in moist conditions. It is unlikely to occur in the highly disturbed habitat present in the study area.
Dillwynia tenuifolia		V	V	This species is known from nearby areas and therefore may occur. However suitable scrubby / dry heath habitat is limited in the study area although suitable clay soil type and shale geology is present.
Epacris purpurascens var. *purpurascens*		V		This species occurs in sclerophyll forest, scrubs and swamps and is unlikely to occur as suitable habitat is not present.
Eucalyptus camfieldii	Heart-leaved Stringybark	V	V	This species occurs on poor coastal country in shallow sandy soils overlying Hawkesbury sandstone often in coastal heath mostly on exposed sandy ridges. Stands usually occur near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. This species is unlikely to occur as suitable habitat is not present.
Eucalyptus scoparia	Wallangarra White Gum	E	V	In NSW this species is found on well-drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland. Suitable habitat is not present in the study area for this species.
Eucalyptus spp. cattai		E		This species is known from the area within the proposed route and may occur in suitable habitat within the study area.

Species name	Common name	TSC Act Status	EPBC Act Status	Potential to Occur Within Study Area
Galium australe	Tangled Bedstraw	E		This species is unlikely to occur as it occurs in moist forested gullies.
Genoplesium baueri	Bauer's Midge Orchid	V		This species is found growing in sparse sclerophyll forest and moss gardens over sandstone, habitat not present within the study area.
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	V		This species grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium (often with shale influence), typically containing lateritic gravels. Suitable habitat may exist within Cumberland Plain Woodland.
Grevillea parviflora subsp. parviflora		V	V	This species is known to occur in areas supporting heath, shrubby woodland and forests and often in disturbed areas such as on the fringes of tracks. Habitat may exist for this species.
Haloragodendron lucasii		E	E	This species generally occurs in low open woodland upon Hawkesbury sandstone in moist sandy loam soil of sheltered aspects and gentle slopes below cliff lines near creeks, habitat not present within the study area.
Hibbertia superans		E		This species occurs on sandstone ridge tops often near the shale/sandstone boundary. It occurs both in open woodland and heathland, and appears to prefer open disturbed areas, such as track sides. Habitat for this species may exist.
Hygrocybe anomala var. ianthinomargin		V		These fungi occur within open gallery warm temperate forests. Habitat is unlikely to exist for these species along the proposed alignment.
Hygrocybe aurantipes		V		
Hygrocybe austropratensis		E		
Hygrocybe lanecovensis		E		
Hygrocybe reesiae		V		
Hygrocybe rubronivea		V		

Species name	Common name	TSC Act Status	EPBC Act Status	Potential to Occur Within Study Area
Lasiopetalum joyceae		V	V	This species grows in heath on sandstone. It has a restricted range occurring on lateritic to shaley ridgetops on the Hornsby Plateau south of the Hawkesbury River. This species may occur within the area however suitable habitat is not present within the study area.
Leptospermum deanei		V	V	This species is found only in the Sydney area and occurs in woodland on lower hill slopes or near creeks in riparian scrub or woodland on sandy alluvial soil or sand over sandstone. Habitat for this species may exist within River Flat Eucalypt Forest.
Leucopogon fletcheri subsp. *fletcheri*		E		Occurs in dry eucalypt woodland or in shrubland on clayey lateritic soils, generally on flat to gently sloping terrain along ridges and spurs. Suitable habitat for this species may be present.
Melaleuca deanei	Deane's Paperbark	V	V	Deane's Paperbark occurs in two distinct areas, in the Ku-ring-gai / Berowra and Holsworthy / Wedderburn areas respectively and it grows on sandstone. Suitable habitat is not present along the proposed route.
Micromyrtus minutiflora		E	V	Grows in Castlereagh Scribbly Gum Woodland, Ironbark Forest, Shale/Gravel Transition Forest, open forest on tertiary alluvium and consolidated river sediments. Suitable habitat may be present in woodland and forest areas.
Persoonia hirsuta	Hairy Geebung		E	This species is found on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. Suitable growing habitat is not present for this species along the proposed alignment.
Persoonia mollis subsp. *maxima*		E	E	This species is unlikely to be present as it occurs in sheltered aspects of deep gullies or on the steep upper hillsides of narrow gullies on Hawkesbury Sandstone.
Pimelea curviflora var. *curviflora*		V	V	This species is confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the northwest and is unlikely to occur.
Pimelea spicata	Spiked Rice-flower	E	E	This species may occur as it grows on undulating topography of substrates derived from Wianamatta Shale, within Cumberland Plain Woodland.

Species name	Common name	TSC Act Status	EPBC Act Status	Potential to Occur Within Study Area
Pomaderris prunifolia		EP		This is an endangered population occurring in three known sites. These areas do not fall into the study area of the proposed route.
Pultenaea parviflora		E	V	This species is endemic to the Cumberland Plain, occurring mostly from Windsor to Penrith and east to Dean Park and may be present in the area.
Syzygium paniculatum	Magenta Lilly Pilly	V	V	This species is unlikely to occur as it is a rainforest tree.
Tetratheca glandulosa		V	V	This species is known to inhabit heaths and scrubs, woodlands, open woodlands and forests associated with shale-sandstone transition habitat where shale-cappings occur over sandstone. Habitat for this species may be present.
Wilsonia backhousei	Narrow-leafed Wilsonia	V		This is a species of the margins of salt marshes and lakes, both coastal and inland and is unlikely to occur within the study area.

E = Endangered; V = Vulnerable; EP = Endangered Population; TSC Act = *Threatened Species Conservation Act 1995* (DEC 2006); EPBC Act = *Environment Protection and Conservation Act 1999* (DEH 2006)

3.3 Fauna

3.3.1 Fauna Habitat

The majority of the proposed alignment for the proposal passes through highly modified urban and commercial environments and therefore provides limited potential fauna habitat. There were a number of vegetated areas within the urban environment that provided limited fauna habitat. These areas provide potential habitat for woodland birds, some bat species and arboreal mammals.

Remnant vegetated areas were also isolated from large areas of bushland, with the exception of the northern end of the proposed alignment where the vegetation was linked with a larger intact area of vegetation. This isolation into small remnant areas also limits the suitability and likelihood of an area supporting substantial populations of fauna, threatened or otherwise.

The urbanised and modified nature of much of the area provided habitat for a number of introduced and feral species such as European Red Fox (*Vulpes vulpes*), European Wild Rabbit and Domestic Dog (*Canis familiaris*), all of which were recorded from scats, direct observation or resident's observations (of the Red Fox) during the current field assessments.

Non-flying Mammals

The small amount of remnant forested and woodland areas provided limited habitat for mammals. Small ground-dwelling mammals require dense groundcover or shrub layer for foraging and shelter. Due to previous clearing of land on rural properties there was very little groundcover or fallen debris within the woodland areas and therefore insufficient suitable habitat to support a significant population of ground-dwelling mammals. This area is currently suffering from high numbers of the European Wild Rabbit. This species is considered a pest within NSW as well as nationally as it competes with native mammals and degrades the available habitat.

Tree hollows were not observed with regularity and only a small number of stags were observed during the current surveys. The trees within the communities were of varying ages with much young growth, therefore not providing possible hollow habitat. As many arboreal mammals require suitable tree hollows within old growth trees for nesting and considering the high level of disturbance throughout the vegetated areas, habitat along the proposed alignment may be limited and restricted to species accustomed to urban environments such as the Common Ring-tailed Possum (*Pseudocheirus peregrinus*) and Common Brushtail Possum (*Trichosurus vulpecula*). As mentioned, scratchings on trees were observed within these communities providing evidence of the presence of arboreal mammals, along with the direct observation of a Common Ring-tailed Possum during daylight hours along the rail corridor.

Bats

Potential foraging habitat for insectivorous bat species was present along the proposed alignment at different locations, notably along creeks and other intermittent water bodies for insectivorous microchiropteran bat species. Tree hollows and decorticating bark provided possible roosting habitat for many species and the stags existing within the area may provide habitat otherwise limited in the area. The decorticating bark of the many eucalypts throughout the study area may also be a valuable resource. A number of bat species, such as the Large-footed Myotis (*Myotis adversus*) and the Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), use man made structures such as bridges, drainage

tunnels and old buildings as roosting sites. This route provided potential roosting sites such as these in locations such as in drainage channels for the creek passing into Norwest Business Park.

Avifauna

The site provided habitat for a large number of species. Due to the predominantly modified nature of the environment along the proposed alignment the majority of these species were common species and well adapted to the disturbed nature of urban areas such as, the Rainbow Lorikeet (*Trichoglossus haematodus*), Magpie-lark (*Grallina cyanoleuca*) and Noisy Miner (*Manorina melanocephala*).

The woodland areas in the northern portion of the proposed route provided habitat suitable to woodland species such as the White-winged Chough (*Corcorax melanorhamphos*) that was recorded along the proposed alignment. The lack of any substantial midstorey in these woodland areas precludes suitability for many birds.

The Blue Gum High Forest would provide potential habitat for avifauna with denser vegetation in the mid and upper levels. The substantial midstorey in this area would provide nesting, sheltering and foraging habitat for smaller birds while the larger trees and canopy cover would provide habitat for larger birds. Similarly the River-Flat Eucalypt Forest provided a greater range of habitat for small and large birds.

Open grass areas may provide foraging habitat for larger birds of prey, especially considering the large population of European Wild Rabbits in the area.

Owls require large areas of habitat and tree hollows for roosting and nesting. Tree hollows were not observed within the remnant vegetation areas and therefore habitat for owls within the area would be limited. These areas were also quite isolated and therefore limiting in their potential provision of home range areas.

Amphibians and Reptiles

The lack of fallen debris within the woodland areas and any substantial form of groundcover indicates limited potential habitat for larger reptile species. However leaf litter and decorticating bark would provide suitable habitat for a variety of small skinks and other reptiles. Areas supporting suitable habitat for frogs would also potentially support snake species that consider frogs as an important prey item therefore creek side areas within the study area would not only provide habitat for frogs but also, potentially for a range of snakes.

Invertebrates

Suitable habitat for many invertebrates existed throughout the study area, both within the urban environment and urban gardens as well as in remnant vegetation areas. Of particular note is the presence of Cumberland Plain Woodland in the northern portion of the route that provides suitable habitat for the endangered (TSC Act) Cumberland Land Snail (*Meridolum corneovirens*), notably open woodland with leaf litter and other debris. A specimen collected during the current surveys was identified by the Australian Museum as a Cumberland Land Snail, confirming the presence of this species within the study area (Figure 3.2). Suitable habitat for this species also occurs in Cumberland Plain Woodland just north of Norwest Business Park.

A complete list of the fauna recorded within the survey area is provided in Appendix B.

3.3.2 Threatened Fauna

A number of threatened fauna have been recorded within the locality (DEC 2006) and potential habitat is present within the study area for a number of these species. Table 3.3 lists those terrestrial fauna species that have been recorded in the locality, or are likely to occur within the locality, together with their conservation status and likelihood of occurring at the site (DEC and DEH).

The Cumberland Land Snail, listed as endangered under the TSC Act, was collected and identified from Cumberland Plain Woodland at the northern end of the proposed alignment (Figure 3.2). Habitat for this species also exists within the intact stand that falls within the Balmoral Road construction zone

Table 3.3 Threatened fauna recorded within the locality or have the potential to occur within the locality (DEC 2006; DEH 2006)

Common name	Species name	TSC Act Status	EPBC Act Status	Potential to Occur Within Study Area
Amphibians				
Giant Burrowing Frog	*Heleioporus australiacus*	V	V	May occur in suitable woodland and forest habitat. However soil type may not be suitable, as this species prefers loose sandy soils.
Giant Barred Frog	*Mixophyes iteratus*	E	E	This species has not been recorded in the locality. May occur within suitable forest habitat. This species requires deep moist leaf litter and rocky streams for breeding.
Green and Golden Bell Frog	*Litoria aurea*	E	V	May occur within suitable stream or dam habitat present along the route. This species often occurs within highly disturbed habitats.
Red-crowned Toadlet	*Pseudophryne australis*	V		Unlikely to occur as no suitable sandstone outcrops are present along the proposed alignment.
Birds				
Australasian Bittern	*Botaurus poiciloptilus*	V		These species have been recorded in the locality but are unlikely to occur within the study area as the alignment does not pass through permanent wetlands or swamps.
Black Bittern	*Ixobrychus flavicollis*	V		
Blue-billed Duck	*Oxyura australis*	V		
Cotton Pygmy-Goose	*Nettapus coromandelianus*	E	Marine	
Freckled Duck	*Stictonetta naevosa*	V		
Barking Owl	*Ninox connivens*	V		May occur. Suitable woodland and forest habitat exists. Hollows are required by this species for roosting and nesting.
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	V		May occur. Suitable eucalypt woodland and forest foraging habitat may be present.

Common name	Species name	TSC Act Status	EPBC Act Status	Potential to Occur Within Study Area
Brown Treecreeper	*Climacteris picumnus*	V		May occur. Suitable eucalypt woodland and forest habitat may be present.
Diamond Firetail	*Stagonopleura guttata*	V		May occur. Suitable grassy eucalypt woodland habitat may be present.
Gang Gang Cockatoo Population, Hornsby & Ku-ring-gai LGA	*Callocephalon fimbriatum*	EP		This population may extend into the study area. Potential habitat for this population exists within the woodland areas along the proposed rail alignment.
Gang-gang Cockatoo	*Callocephalon fimbriatum*	V		Potential habitat for this species exists within the woodland areas along the proposed rail alignment.
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	V		Unlikely to occur as this species requires stands of Allocasuarina for foraging.
Grass Owl	*Tyto capensis*	V		Prefers swampy areas and grassy plains that are not present within the proposed alignment.
Grey Falcon	*Falco hypoleucos*	V		This species occurs mostly along watercourses and occasionally coastal in open woodland. Habitat for this species is not present within the study area.
Hooded Robin	*Melanodryas cucullata*	V		May occur. Suitable woodland and forest habitat exists. Although the absence of a substantial groundcover and shrub layer may be limiting.
Masked Owl	*Tyto novaehollandiae*	V		May occur. Suitable woodland and forest foraging habitat exists. This species mostly breeds in moist eucalypt gullies in hollows or caves.
Pink Robin	*Petroica rodinogaster*	V	M	Suitable forested habitat occurs within the route although this species occurs mostly in densely vegetated gullies.
Powerful Owl	*Ninox strenua*	V		May occur. Suitable woodland and forest habitat exists. Hollows are required by this species for roosting and nesting as well as habitat components for prey species. This species can occur in fragmented landscapes.

Common name	Species name	TSC Act Status	EPBC Act Status	Potential to Occur Within Study Area
Regent Honeyeater	*Xanthomyza phrygia*	E	E	May occur. Suitable eucalypt woodland and forest habitat may be present.
Sooty Owl	*Tyto tenebricosa*	V		Prefers rainforest areas that are not present along the proposed alignment.
Speckled Warbler	*Pyrrholaemus sagittatus*	V		May occur. Suitable eucalypt communities with grassy understorey are present along the proposed alignment. Although large undisturbed remnants are required.
Square-tailed Kite	*Lophoictinia isura*	V		Habitat may exist for this species within woodland and forested areas however this species prefers habitat along watercourses, not present along the proposed alignment.
Superb Fruit-Dove	*Ptilinopus superbus*	V	M	Unlikely to occur as this species inhabits rainforests and similar closed forests containing fruit-bearing trees, not present along the proposed route.
Superb Parrot	*Polytelis swainsonii*	V	V	Habitat for this species may occur within the woodland areas along the route. This species requires hollows for nesting.
Swift Parrot	*Lathamus discolor*	E	E	This species inhabits areas with abundent winter flowering eucalpyts or lerp infestations. Habitat may exist along the proposed alignment.
Bats				
Eastern Bentwing-bat	*Miniopterus schreibersii oceanis*	V		Foraging habitat for this species may occur in forested areas. This species roosts primarily within caves but also in storm-water tunnels, buildings and other man-made structures.
Eastern Freetail-bat	*Mormopterus norfolkensis*	V		Foraging and roosting habitat may be present as this species occurs in woodland areas and roosts in tree hollows, under bark or in man-made structures.
Greater Broad-nosed Bat	*Scoteanax rueppellii*	V		Foraging habitat for this species may be present in woodland areas although it mostly flies along creek and river corridors. Roost sites include tree hollows and roofs of buildings.

Common name	Species name	TSC Act Status	EPBC Act Status	Potential to Occur Within Study Area
Large-eared Pied Bat	*Chalinolobus dwyeri*	V	V	This species is unlikely to roost within the proposed alignment as it requires caves or mines and mostly occurs in well-wooded areas with gullies.
Large-footed Myotis	*Myotis adversus*	V		This species forages over streams and pools and roosts in a variety of locations including tree hollows, storm water channels, under bridges and in dense foliage. Sutaible habitat for this species may occur in the study area.
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	V		Foraging habitat for this species be present as it forages widely. Roost sites include tree hollows, mammal burrows and buildings.
Other Mammals				
Eastern Pygmy-possum	*Cercartetus nanus*	V		This species occurs in a range of habitats including woodland which occurs in the study area. This species feeds largely on nectar from flowering plants such as banksias, bottlebrushes and eucalypts as well as insects. Potential marginal habitat for this species may occur.
Grey-headed Flying-fox	*Pteropus poliocephalus*	V	V	Foraging habitat, including flowing trees scuh as banksias, melaleucas and eucalypts, may be present within the study area.
Koala	*Phascolarctos cinereus*	V		This species inhabits eucalypt woodlands and feeds on the foliage of specific feed trees. Koala habitat was not identified within the study area and therefore this species is unlikely to occur.
Spotted-tailed Quoll	*Dasyurus maculatus*	V	E	Unlikely to occur as it prefers large stands of woodland, swamp forest and heath that are not present along the proposed alignment.
Yellow-bellied Glider	*Petaurus australis*	V		This species occupies mature eucalypt forests and den in hollows of large trees. It is unlikely to occur as this habitat is highly disturbed and provides limited den sites.

Common name	Species name	TSC Act Status	EPBC Act Status	Potential to Occur Within Study Area
Reptiles				
Rosenberg's Goanna	*Varanus rosenbergi*	V		This species occurs in woodland areas which are present within the study area. It nests in termite mounds that are therefore a critical habitat component. Termite mounds were not observed within suitable woodland habitat along the route and therefore this species is unlikely to nest within the area.
Invertebrates				
Cumberland Land Snail	*Meridolum corneovirens*	E		This species occupies Cumberland Plain Woodland which is present within the study area. This species was located at the northern end of the proposed alignment.

E = Endangered; V = Vulnerable; M = Migratory; EP = Endangered Population; TSC Act = *Threatened Species Conservation Act 1995* (DEC 2006); EPBC Act = *Environment Protection and Conservation Ac 1999t* (DEH 2006)

3.4 *Rivers and Foreshores Improvement Act (1948)*

Encroachment into a riparian zone within 40 m of a creek requires consideration under the provisions of *Rivers and Foreshores Improvement Act (1948*;RFI Act). However, as specified under Part 3A, Division 4, section 75U of the EP&A Act, a separate approval process under the RFI Act is not required for projects that are being assessed under Part 3A of the EP&A Act (see below).

75U Approvals etc legislation that does not apply

(1) The following authorisations are not required for an approved project (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):

(a) the concurrence under Part 3 of the *Coastal Protection Act 1979* of the Minister administering that Part of the Act,

(b) a permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*,

(c) an approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977*,

(d) a permit under section 87 or a consent under section 90 of the *National Parks and Wildlife Act 1974*,

(e) an authorisation referred to in section 12 of the *Native Vegetation Act 2003* (or under any Act to be repealed by that Act) to clear native vegetation,

(f) a permit under Part 3A of the *Rivers and Foreshores Improvement Act 1948*,

(g) a bush fire safety authority under section 100B of the *Rural Fires Act 1997*,

(h) a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the *Water Management Act 2000*.

3.5 State Environmental Planning Policy 44 – Koala Habitat Protection

State Environmental Planning Policy 44 – Koala Habitat Protection (SEPP 44) aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas in order to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline.

SEPP 44 applies within the Hornsby LGA. Feed trees listed on Schedule 2 of *State Environmental Planning Policy 44 – Koala Habitat Protection* identified along the route include *Eucalyptus. tereticornis* and *E. punctata*. For an area to be considered potential Koala habitat, appropriate tree species must represent at least 15 % of the total number of trees in the upper or lower strata of the tree component. This was not the case in any of the areas assessed. Therefore no further consideration was given to SEPP 44.

3.6 State Environmental Planning Policy 19 – Bushland in Urban Areas

State Environmental Planning Policy 19 – Bushland in Urban Areas (SEPP 19) aims to protect and preserve bushland within urban areas. While the proposed alignment is in the vicinity of lands zoned for public open space the proposed rail corridor itself does not pass through or disturb such land and therefore SEPP 19 is not likely to apply. However, associated structures such as air shafts and discharge/runoff outlets have not been considered in this current report as locations of these structures had not been finalised at the time of writing. An additional consideration will be the work site associated with the quadruplication between Epping and Beecroft that may encroach into Beecroft Village Green. The extent of possible encroachment would be clarified during future design work.