Wet 'n' Wild Sydney

Part 3A – Biodiversity Impact Assessment

Prepared for
JBA Urban Planning Consultants

13th January 2010

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Abbreviations

ABBREVIATION	DESCRIPTION
BIA	Biodiversity Impact Assessment
CPW	Cumberland Plain Woodland and Derived Native Grasslands
CEEC	Critically Endangered Ecological Community
DECC	NSW Department of Environment & Climate Change (now DECCW)
DECCW	NSW Department of Environment, Climate Change and Water (formerly DECC)
DEWHA	Commonwealth Department of Environment, Water, Heritage and the Arts
DGEARs	Director Generals Environmental Assessment Requirements
DNG	Derived Native Grassland
EEC	Endangered Ecological Community, listed under the TSC Act and/or EPBC Act
ELA	Eco Logical Australia
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
NES	Matters of National Environmental Significance under the EPBC Act
NPWS	NSW National Parks and Wildlife Service (now part of the DECCW)
SHW	Shale Hills Woodland
SPW	Shale Plains Woodland
Subject Site	Wet 'n' Wild Project Site, as depicted in Figure 2.
Study Area	Within 10km of the Subject Site, as depicted in Figure 1.
TEC	Threatened Ecological Community, i.e. an ecological community listed under the TSC Act and/or EPBC Act, as Critically Endangered, Endangered, or Vulnerable.
TSC Act	NSW Threatened Species Conservation Act 1995
DSEWPAC	Department of Sustainability, Environment, Water, Population and Communities (formerly DEWHA)

1 Introduction

1.1 BACKGROUND

Prospect Aquatic Investments Pty Ltd (The Proponent) is submitting a Part 3A Concept Plan Application for a 'Wet 'n' Wild Sydney' water theme park (The Project) on the site at Reservoir Road, Prospect, and is seeking approval from the Minister for Planning under Part 3A the *Environmental Planning and Assessment Act 1979* (EP&A Act). (**Figure 1** and **Figure 2**).

The Part 3A Concept Plan Application seeks approval for the following aspects of the 'Wet 'n' Wild Sydney' water theme park:

- Stages 1 and 2 – Design, Construction and Operation; and
- Complying Development Code for the site including future development of Stage 3.

Stages 1 and 2 of 'Wet 'n' Wild Sydney' comprise the following:

- Water theme park rides and attractions that include a surf wave pool and extreme river ride as the fixed centre pieces, and a series of different rides for families, children and teenage thrills;
- Ancillary park support facilities including car park, entry building, food & beverage facilities, restrooms/lockers, outdoor sporting facilities, events area, merchandise facilities, back-of-house loading dock and administration office facilities, and safety and security measures including life guards, first aid, access controls and information services;
- Landscaping of the water theme park with various landscape zones and spaces to integrate with native woodland around the site perimeter and reinforce the character of different precincts within the water theme park including a park entry celebrated with iconic avenue trees, surf wave pool with landscape material normally found around beaches on the eastern seaboard, a sub tropical rainforest for shade and an intimate experience around the children's water play area as well as the river rides and bungalows, supplementing existing woodland areas with plantings of Cumberland Plain Woodland species, and planting of native wetland and sedge species around the water detention pond;
- Access and parking;
- Water cycle management;
- Utility services infrastructure;
- Signage;
- Site preparation works including earthworks, demolition and tree removal; and an
- Environmental management plan.

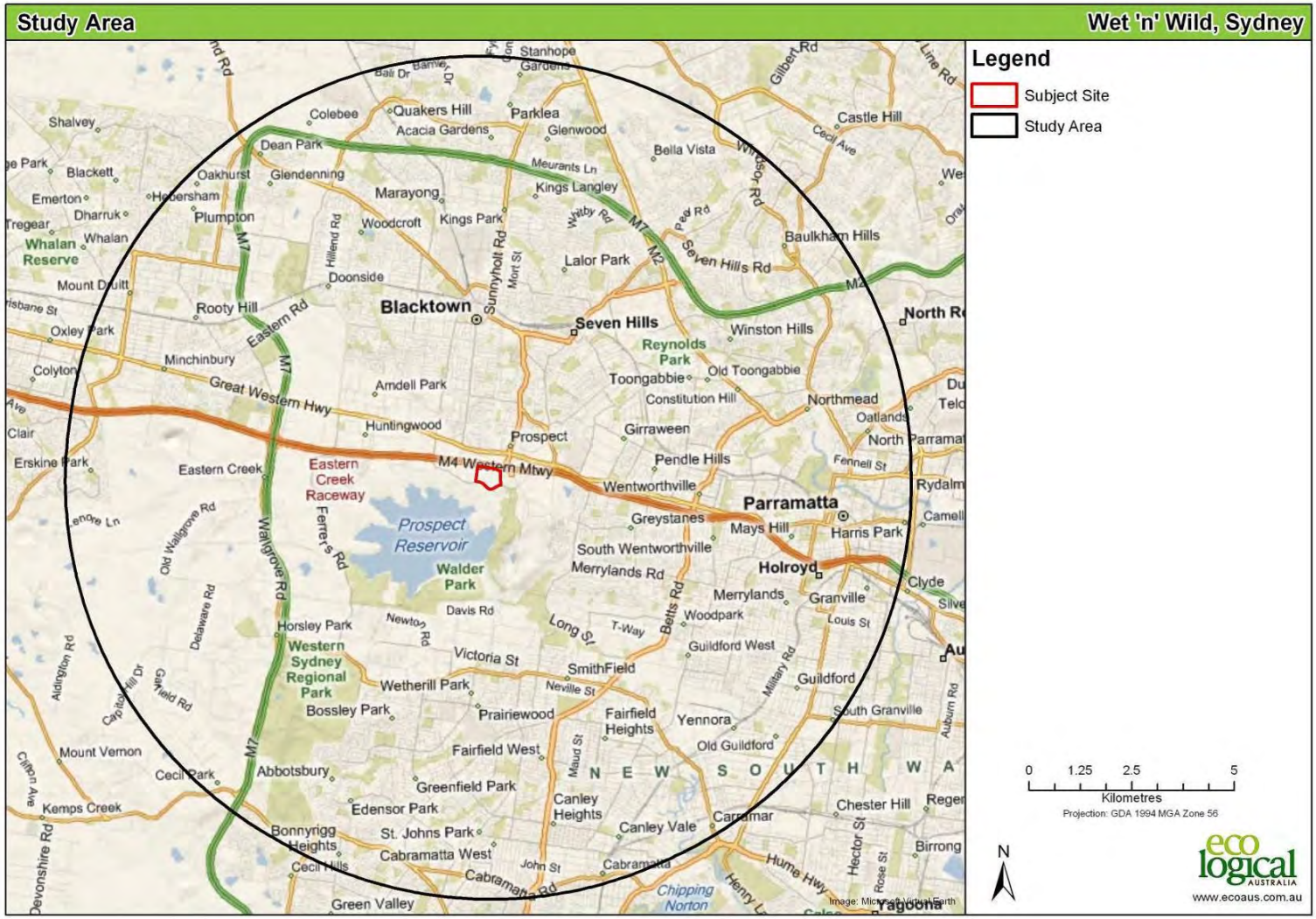

Figure 1: Study area.

Figure 2: Subject Site.

1.2 COMPLIANCE WITH THE DIRECTOR – GENERALS REQUIREMENTS

The final DGRs issues on December 3rd 2010 require the proponent to:

> *Address impacts on flora and fauna, including threatened species, populations and endangered ecological communities and their habitats and steps taken to mitigate any identified impacts to protect the environment.*

It is understood that biodiversity ecological assessment reports are required to be submitted as part of a Part 3A Concept Plan and Environmental Assessment Report (EAR).

1.3 REPORT OBJECTIVES

The aims of this report are to:

- Provide a review of existing reports, plans, databases, and relevant government/statutory requirements and standards;
- Report on the results of a site survey performed for threatened ecological communities, populations and species within the study area including a targeted survey for Cumberland Land Snail (*Meridolum corneovirens*) and microchiropteran bats;
- Identify potential ecological constraints to the proposed development;
- Identify land use constraints for any significant ecological values identified
- Provide recommendations on any stands of native vegetation to be retained and advice on mitigating impacts, buffer, and management requirements; and
- Assess the impact of the proposed works on threatened ecological communities, populations and species in accordance with the 'Draft Guidelines for Threatened Species Assessment (Part 3A)' (DEC and DPI 2005) and under the Commonwealth Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act).

2 Study Area

2.1 SUBJECT SITE AND STUDY AREA

The ***Subject Site*** is located between the M4 Motorway to the north and Reservoir Road to the south, at Eastern Creek, within the Blacktown Local Government Area, in Western Sydney (**Figure 2**). The site consists of small remnants of native and exotic vegetation, a riparian strip towards the middle of the site, four rural-residential housing lots, four small farm dams and large expanses of exotic grass/pasturelands. It is surrounded by the M4 Motorway to the north, rural- residential and associated urban infrastructure to the east and west, the Prospect Reservoir to the south, and is currently found in a degraded state with weed infestation common to the urban interface.

The Subject Site encompasses an area of approximately 25.5 hectares (ha) and it falls within the following Longitude and Latitude points (Table 1: Location of Subject Site in longitude and latitude **Table 1**).

Table 1: Location of Subject Site in longitude and latitude

LOCATION POINT	LATITUDE			LONGITUDE		
	degrees	minutes	seconds	degrees	minutes	seconds
Southwest	-33	48	28.8	150	54	25.2
Southeast	-33	48	32.4	150	54	50.4
Northeast	-33	48	21.6	150	54	50.4
Northwest	-33	48	18.0	150	54	28.8

The ***Study Area*** is defined by a 10 km radius from the Subject Site to account for any additional areas which are likely to be affected by the proposal, either directly or indirectly (**Figure 2**). The Study Area maintains a large cross-section of habitats moving from the intact remnant vegetation of the Prospect Reservoir in the south, proceeding north through rural farmlands, peri-urban and urban landscapes.

The Study Area is located on the Cumberland Plain, within the Sydney Basin Bioregion (Thackway and Creswell 1995), and vegetation across this area includes intact forest and woodland, exotic and intact riparian vegetation, cleared grazing lands, and pockets of small to medium remnants of extant vegetation native of the Cumberland Plain.

2.2 SOILS AND GEOLOGY

Mitchell Landscapes are a system of ecosystem classification mapped at 1:25 000 scale, based on a combination of soils, topography and vegetation (Mitchell 2002). The study area falls wholly within the Werris Creek Basalt Hills and Valleys Mitchell landscape, this landscape is described as undulating plain with low hills on gently folded lower Permian basalt, tuff and tuffaceous sandstone, general elevation 500 to 550 m, local relief 30 to 50 m. Brown and red brown gradational structured loam and clay loam merging with black sticky clay along streamlines. Profiles thicken down slope and are of moderate fertility (Mitchell 2002).

Soil landscapes at the Subject Site comprise residual landscapes predominantly of shale origin (Bannerman and Hazelton 1990). One soil landscape has been mapped at the Subject Site, the Blacktown landscape. The Blacktown landscape is found on gently undulating rises of the Wianamatta Group shales, with local relief up to 30 m, and slopes usually <5%. Soils are shallow to moderately deep (<100 cm) hardsetting mottled texture contrast soils, *red and brown podzolics* on crest grading to *yellow podzolics* on lower slopes and drainage lines (Bannerman and Hazelton 1990; McDonald et al. 1990). The soils are of low fertility and display poor drainage (Bannerman and Hazelton 1990).

2.3 VEGETATION COMMUNITIES

A regional vegetation map for the Cumberland Plain has been produced by NPWS (2003), with the following vegetation types mapped onsite:

- Shale Plains Woodland
- Shale Hills Woodland

Most recently the vegetation survey of the Subject Site validated this vegetation mapping in accordance with Biometric Vegetation types (DECC 2008), which can be easily correlated with threatened ecological communities listed under the EPBC and TSC Acts (**Section 5**). This mapping identified two Biometric vegetation types at the site:

- Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin
- Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin'

These two Biometric vegetation types correlate with a TEC listed under State and Commonwealth legislation, known as:

- Cumberland Plain Woodland of the Sydney Basin Bioregion (TSC Act); and
- Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (EPBC Act)

Accordingly, remnant vegetation at the site has been mapped using the name Cumberland Plain Woodland. Other vegetation onsite includes exotic/disturbed grass/pastureland and shrublands. Vegetation types at the Subject Site are hereafter referred to as:

- ***(1) Cumberland Plain Woodland***
- ***(2) Exotic/disturbed grass/pastureland***
- ***(3) Exotic/disturbed shrubland***

The correlation between these vegetation types is outlined in **Table 4** and discussed further in **Sections 4** and **5** of this report.

2.4 RIVERS, CREEKS AND WATERCOURSES

There is one naturally occurring drainage line occurring within the boundaries of the Subject Site, which drains into Blacktown Creek (Penrith 1:25,000 topographic map, DITM 2001), with Girraween Creek to the east (~1 km), Bungarribee Creek to the north-west (~2 km) and Prospect Reservoir immediately to the south of the site. There are also four artificial farm dams at the site

Blacktown and Girraween Creeks drain east to the Parramatta River. Bungarribee Creek drains north into Eastern Creek and then into the Hawkesbury River.

2.5 SURROUNDING RESERVES

The nearest reserve to the Subject Site is Prospect Nature Reserve, immediately to the south. The nearest significant water body occurs within this nature reserve, Prospect Reservoir.

There are no significant wetlands of national significance within the study area (i.e. within 10 km).

2.6 CLIMATE

West of Parramatta, the majority of the Cumberland Plain receives <800 mm of rain annually. Annual rainfall increases with elevation to approximately 900 mm on the margins of the Plain, and reaches a maximum of 1444 mm at Pymble on the Hornsby Plateau (Tozer 2003).

The mean maximum temperature in the hottest month (January) is 40.1^{o}C, and the mean minimum temperature in the coldest month (June) is 1.8^{o}C (BOM 2010).

Frosts occur more frequently away from the coast and at higher elevations, although the incidence and severity vary considerably over a small scale as a function of topographic, vegetation and soil related factors (Tozer 2003).

3 Legislative Context

3.1 COMMONWEALTH LEGISLATION

Environment Protection and Biodiversity Conservation Act 1999

The primary objective of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is to 'provide for the protection of the environment, especially those aspects of the environment that are matters of National Environmental Significance.'

Environmental approvals under the EPBC Act are required for an 'action' that is likely to have a significant impact on the following.

- Matters of National Environmental Significance (known as 'NES matters') including:
    - World Heritage Areas;
    - National Heritage Places;
    - Ramsar wetlands of international importance;
    - Nationally listed threatened species and ecological communities;
    - Listed migratory species;
    - Nuclear actions.

- Commonwealth marine areas; and
    - Commonwealth heritage places.

- Actions taken on Commonwealth land that are likely to have a significant impact on the environment,
- Actions that are likely to have a significant impact on the environment of Commonwealth land, even if the action is taken outside Commonwealth land.
- Any action taken by a Commonwealth agency that is likely to have a significant impact on the environment.

An 'action' is considered to include a project, development, undertaking, activity or series of activities.

Of potential relevance to the Wet 'n' Wild Project are matters of NES which include nationally listed threatened species and ecological communities and listed migratory species. Three migratory species and one threatened ecological community have been recorded or have the potential to occur at the Subject Site. An impact assessment for the threatened ecological community has been undertaken at **Appendix D**.

3.2 INTERNATIONAL AGREEMENTS

International Migratory Bird Agreements

- Japan - Australia Migratory Bird Agreement (JAMBA)
- China - Australia Migratory Bird Agreement (CAMBA)

The JAMBA and CAMBA agreements list terrestrial, water and shorebird species which migrate between Australia and the respective countries. In both cases, the majority of listed species are shorebirds.

Both agreements require the parties to protect migratory birds by:

- limiting the circumstances under which migratory birds are taken or traded;
- protecting and conserving important habitats;
- exchanging information; and
- building cooperative relationships.

The JAMBA agreement also includes provisions for cooperation on the conservation of threatened birds.

Australian government and non-government representatives meet every two years with Japanese and Chinese counterparts to review progress in implementing the agreements and to explore new initiatives to conserve migratory birds (DSEWPAC 2011).

- Republic of Korea – Australia Migratory Bird Agreement (ROKAMBA)

In April 2002, Australia and the Republic of Korea agreed to develop a bilateral migratory bird agreement similar to the JAMBA and CAMBA.

The ROKAMBA formalises Australia's relationship with the Republic of Korea in respect to migratory bird conservation and provides a basis for collaboration on the protection of migratory shorebirds and their habitat (DSEWPAC 2011).

Any actions that have the potential to impact upon these agreements are formally addressed under the EPBC Act.

3.3 NEW SOUTH WALES LEGISLATION

Environmental Planning and Assessment Act 1979

The NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) is the principal planning legislation for NSW. It provides a framework for land use control and assessment, determination and management of development. Part 3A of the EP&A Act facilitates major project and infrastructure delivery of development which is of significance to the State and encourages economic development, while strengthening environmental safeguards and community participation.

For the initial application under Part 3A, a Preliminary Environmental Assessment (PEA) was prepared and submitted to the NSW Department of Planning (DoP) in September 2010. Of relevance to this Biodiversity Impact Assessment (BIA), the PEA included information on the following matters:

- Visual landscape
- Integrated water management
- Waste management
- Heritage conservation
- Biodiversity conservation
- Bushfire hazard
- Soils and Geotechnical issues
- Acoustic impact
- Ecologically sustainable development

Following a review of the PEA, and after consultation with other relevant government agencies, the Department of Planning issued Director-General's Requirements (DGRs) for the Wet 'n' Wild Project. The DGRs require the following to be addressed:

> *Impacts on flora and fauna, including threatened species, populations and endangered ecological communities and their habitats and steps taken to mitigate any identified impacts to protect the environment.*

Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) aims to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The Act is integrated with the NSW EP&A Act and requires consideration of whether a major infrastructure or other project (Part 3A of the EP&A Act), a development (Part 4 of the EP&A Act) or an activity (Part 5 of the *EP&A Act*) is likely to significantly affect threatened species, populations and ecological communities or their habitat.

Fisheries Management Act 1994

The *Fisheries Management Act 1994* (FM Act) aims to conserve, develop and share the fishery resources of NSW for the benefit of present and future generations. The FM Act defines 'fish' as any marine, estuarine or freshwater fish or other aquatic animal life at any stage of their life history, exclude whales, mammals, reptiles, birds, amphibians or species specifically excluded. No threatened fish species, or endangered populations are known to occur within the study area.

In accordance with section 75U of the EP&A Act, applications for separate permits under section 201, 205 or 219 of the FM Act are not required as these matters are addressed and approved as part of the EP&A Part 3A process.

Noxious Weeds Act 1993

The Noxious Weeds Act 1993 (NW Act) defines the roles of government, councils, private landholders and public authorities in the management of noxious weeds. The Act sets up categorisation and control actions for the various noxious weeds, according to their potential to cause harm to our local environment.

The objectives of the NW Act include:

- to identify noxious weeds in respect of which particular control measures need to be taken;
- to specify those control measures;
- to specify the duties of public and private landholders as to the control of those noxious weeds; and
- to provide a framework for the State-wide control of those noxious weeds by the Minister and local control authorities.

Under this Act, noxious weeds have been identified for Local Government Areas and assigned Control Categories (eg. 1, 2, 3, 4 and 5). Part 3 of the NW Act provides that occupiers of land (this includes owners of land) have responsibility for controlling noxious weeds on the land they occupy.

State Environmental Planning Policy 44 (Koala Habitat)

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

SEPP 44 applies to the Liverpool Plains Shire LGA (formerly, Quirindi Shire), however, SEPP 44 does not apply to Part 3A Projects. An assessment under SEPP 44 is therefore not required.

4 Methodologies

4.1 DATA AUDIT AND LITERATURE REVIEW

A review of relevant data and background literature was undertaken as an initial stage of the Wet 'n' Wild Project, prior to field surveys. Relevant datasets and information included:

- existing vegetation, soil and landscape mapping, as well as other available GIS data;
- Atlas of NSW Wildlife;
- EPBC Protected Matters Search Tool;

An assessment of the 'likelihood of occurrence' was made for threatened ecological communities, populations and species, and migratory species identified from a search of a 10 km radius from the centre of the Subject Site (co-ordinates -S 33.8083˚, E 154.9069˚). This assessment included database and other records (as outlined above), presence or absence of suitable habitat, features of the Subject Site, results of the field survey and professional judgement.

A full summary of the results of this data audit along with a 'likelihood of occurrence' ranking using the following terminology can be found at **Appendix B**.

- "Known" = the species was or has been observed on the Subject Site
- "Likely" = a medium to high probability that a species uses the Subject Site
- "Potential" = suitable habitat for a species occurs on the Subject Site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "Unlikely" = a very low to low probability that a species uses the Subject Site
- "No" = habitat on Subject Site and in the vicinity is unsuitable for the species.

4.2 FIELD ASSESSMENT OVERVIEW

The following sections outline the survey and assessment methodologies undertaken for this report, which were designed to meet the requirements of the Project Brief and the DGRs (DoP 2010). Reference was also made to the Commonwealth 'Survey Guidelines for Threatened Species' (DEWHA 2010a and b), for birds and microchiropteran bats (microbats) where applicable.

4.2.1 Preliminary Field Assessment

A preliminary site assessment was conducted by two Eco Logical Australia ecologists, Jennie Powell and Bruce Mullins, on the 3rd November 2010. The purpose of the preliminary assessment was to identify access constraints and on ground location of the proposed Wet 'n' Wild Project footprint. Observations on habitat were also undertaken.

Detailed flora lists were compiled within two quadrats at the northern remnant of the site during preliminary assessment, dominant species, structure, and composition of vegetation communities were noted to validate vegetation communities within the study area.

4.2.2 Field Survey Overview

Field survey was designed to target threatened flora and fauna regarded as having the potential to occur in the study area. Information on the methods and effort employed for surveying vegetation

communities, flora and fauna are outlined in detail in **Sections 4.3**, **4.4** and **4.5**, but generally, the following methods were implemented:

- Flora: quadrat surveys, transects, traverses, and opportunistic observations;
- Diurnal birds: habitat assessments and opportunistic observations;
- Nocturnal birds: habitat assessments;
- Microbat species: ultrasonic sound detection (Anabat) and habitat assessments;
- Mammals (not including bats): habitat assessments and opportunistic observations; and
- Reptiles: opportunistic observations.
- Cumberland Land Snail: searches within leaf litter and at the base of trees

Field surveys were conducted within the Subject Site, although observations on habitat were also made for areas directly adjacent to the study area in order to determine the fauna and flora potentially occurring near the study area. Field survey was carried out over 2 days (3rd and 10th November 2010) and 2 nights (24th November and 6th December 2010).

A summary of field survey effort within the Subject Site is shown in (**Figure 3**).

Figure 3: Flora and fauna survey effort at the Subject Site, November 2010.

4.2.3 Weather

Weather conditions during the survey were considered to be good. Bureau of Meteorology data from the nearest weather station at Penrith (~30km west) showed daytime temperatures ranged from 9.9℃ to 30.6℃. A small amount of rainfall was recorded during the survey week and cloud cover was minimal for both day and night time surveys (**Table 2**).

Table 2: Weather conditions during field survey recorded at Penrith, NSW (~30km west of Subject Site)

Date	Day	Temps		Rain	9:00 AM				3:00 PM			
		Min	Max		Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
		℃	℃	mm	℃	%	km/h		℃	%	km/h	
3	We	9.9	25.6	0.2	16.7	78	NNE	6	25	37	SE	7
10	We	18	29.5	0.2	21.1	90	N	7	28	51	E	13
24	We	14	30.6	0	20.7	72	S	7	30	32	NE	11

Source: http://www.bom.gov.au/climate/dwo/201011/html/IDCJDW2111.201011.shtml

4.3 VEGETATION COMMUNITIES

The vegetation classification system employed in this report follows the Biometric Vegetation Type Database (DECCW 2009). Listed threatened ecological communities (TECs) may consist of a single biometric vegetation type or be made up of various biometric vegetation types.

4.4 FLORA

Flora were surveyed by four ecologists over two days across the Subject Site using quadrat and transect survey techniques. These surveys were supplemented by random meander traverses throughout the survey period.

Quadrats included 0.04ha (20m x 20m) surveys to record presence of all vascular flora species, along with cover and abundance for each species using a modified Braun-Blanquet scale (measures of cover and abundance were taken to determine species dominating each stratum). Habitat features were determined over 0.1 ha survey (50m x 20m quadrats); measures included number of hollow bearing trees and length of fallen dead timber greater than 10 cm diameter. Within the 0.1 ha quadrats, projected foliage cover of each strata level and exotic flora was assessed along a 50m transect.

Vegetation quadrats and transect habitat assessments followed the NSW Biobanking Methodology (DECC 2008).

Quadrats and transects were conducted in native remnant woodlands to the north and south-east of the site. Random meander traverses focussed on 'grass/pastureland' communities to identify any derived native grasslands that may conform with the NSW TSC Act threatened ecological community listings.

The physical characteristics (such as aspect, slope and disturbance) of each location were noted and photos were taken of the quadrats along the 50 m transect line as well at points along the random meander traverses. Species were identified to the lowest taxonomic level possible. Nomenclature followed the Flora of New South Wales (Harden 1992; 1993; 2000; 2002) except where more recent taxonomic changes have taken place.

The locations of all flora survey undertaken are shown in **Figure 3**.

4.5 FAUNA

4.5.1 Avifauna

Diurnal Birds

Diurnal birds were surveyed continuously during daytime hours over the 2 day survey period (3rd and 10th November 2010) while traversing suitable habitat within the study area.

Nocturnal Birds

Habitat assessments of remnant bushland were undertaken for large hollow bearing trees, stags, roosting and nesting sites.

No stag watching was conducted as no owl wash was observed at the base of any large trees supporting tree hollows.

4.5.2 Mammals

Ground dwelling and arboreal mammals

Faunal habitat assessments were initially undertaken remotely using aerial photography, with waterbodies, woodland remnants, grasslands and manmade structures delineated in order to target survey accordingly. Additional habitat assessments were undertaken continuously during daytime hours over the survey period, whilst traversing suitable habitat within the study area. Resources recorded include: shelter, basking, roosting, nesting and foraging sites for amphibians, birds, bats, arboreal mammals, ground-dwelling mammals and reptiles.

Any indirect evidence of fauna present were recorded including, feathers, fur, tracks, dens, nests, scratches, chew marks and owl wash.

Microchiropteran bat species

Survey for Microchiropteran (microbats) bat species involved the use of ultrasonic Anabat detectors equipped with ZCAIM recording devices over two nights (November 24th and December 6th). On each night of survey the Anabats were turned on between 1630 hours and 1800 hours and then turned off the following morning between 0730 hours and 0900 hours. Anabat calls were downloaded in the office and analysed by Alicia Lyon (Ecologist, Eco Logical Australia, Coffs Harbour).

Bat calls were analysed using the program AnalookW (Version 3.3q 03 October 2006, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay *et al*. 2004); and south-east Queensland and north-east New South Wales (Reinhold et al. 2001) and the accompanying reference library of over 200 calls from north-eastern NSW (http://www.forest.nsw.gov.au/research/bats/default.asp).

Bat calls are analysed using species-specific parameters of the call profile such as call shape, characteristic frequency, initial slope and time between calls (Reinhold *et al*. 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd *et. al*. 2006) were followed:

- Recordings containing less than three pulses were not analysed (Law et al. 1999).
- Only search phase calls were analysed (McKenzie et al. 2002).
- Four categories of confidence in species identification were used (Mills et al. 1996):
    - definite – identity not in doubt;

  - probable – low probability of confusion with species of similar calls;
  - possible – medium to high probability of confusion with species with similar calls; and
  - unidentifiable – calls made by bats which cannot be identified to even a species group.
- Nyctophilus spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay et al. 2004).

4.5.3 Reptiles and Amphibians

Opportunistic observations of amphibians occurred throughout the survey period.

4.5.4 Cumberland Land Snail (*Meridolum corneovirens*)

A targeted search was undertaken for Cumberland Land Snail at the base of trees and within leaf-litter in the wooded areas of the site.

4.6 SURVEY LIMITATIONS

4.6.1 Flora

Flora survey is always limited by seasonality, with best practice for survey generally being within the spring and summer months (except for when surveying for specific flora species that may be flowering at other times of year; DEC 2004). Survey work for this report occurred at the end of Spring (November) and is thus within the optimal survey period.

4.6.2 Fauna

Best practice for fauna survey is generally within the spring and summer months (except for when surveying for specific fauna species that may be active at other times of year; DEC 2004). Survey work for this report occurred during Spring (November) and is thus within the optimal survey period. Targeted threatened species survey occurred for Cumberland Land Snail (*Meridolum corneovirens*) and microchiropteran bats, though it was not considered to be necessary for other threatened fauna species given the low quality of the habitat present, the low likelihood of occurrence (as per **Appendix A**) and minimal removal of quality habitat proposed.

5 Results

5.1 DATABASE REVIEW

5.1.1 Threatened species, populations and migratory species

A list of threatened species that have been recorded from database searches within the Study Area is provided at **Appendix A**. In **Appendix A**, the habitat requirements of these species have been evaluated to determine their likelihood to occur at the Subject Site.

The results of this search identified one threatened ecological community, 15 threatened flora species, 29 threatened fauna and 12 migratory species. Of these it was determined that one threatened ecological communities and two threatened species were 'known' to occur at the Subject Site (**Figure 4**), one threatened species and three migratory species had the 'potential" to occur on the Subject Site (**Table 2**).

Table 3: Threatened species 'known ' or with the 'potential' to occur at the Subject Site

SCIENTIFIC NAME	COMMON NAME	CONSERVATION STATUS		LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT	
ECOLOGICAL COMMUNITIES				
Cumberland Plain Woodland of the Sydney Basin Bioregion (TSC Act); and Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (EPBC Act)		CE	CE	Known
AVES				
Ardea alba	Great Egret, White Egret	-	M	Potential
Ardea ibis	Cattle Egret	-	M	Potential
Merops ornatus	Rainbow Bee-eater	-	M	Potential
Stagonopleura guttata	Diamond Firetail	V	-	Potential
MAMMALIA				
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Known
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	Known

CE: critically endangered M: migratory species V: vulnerable species.

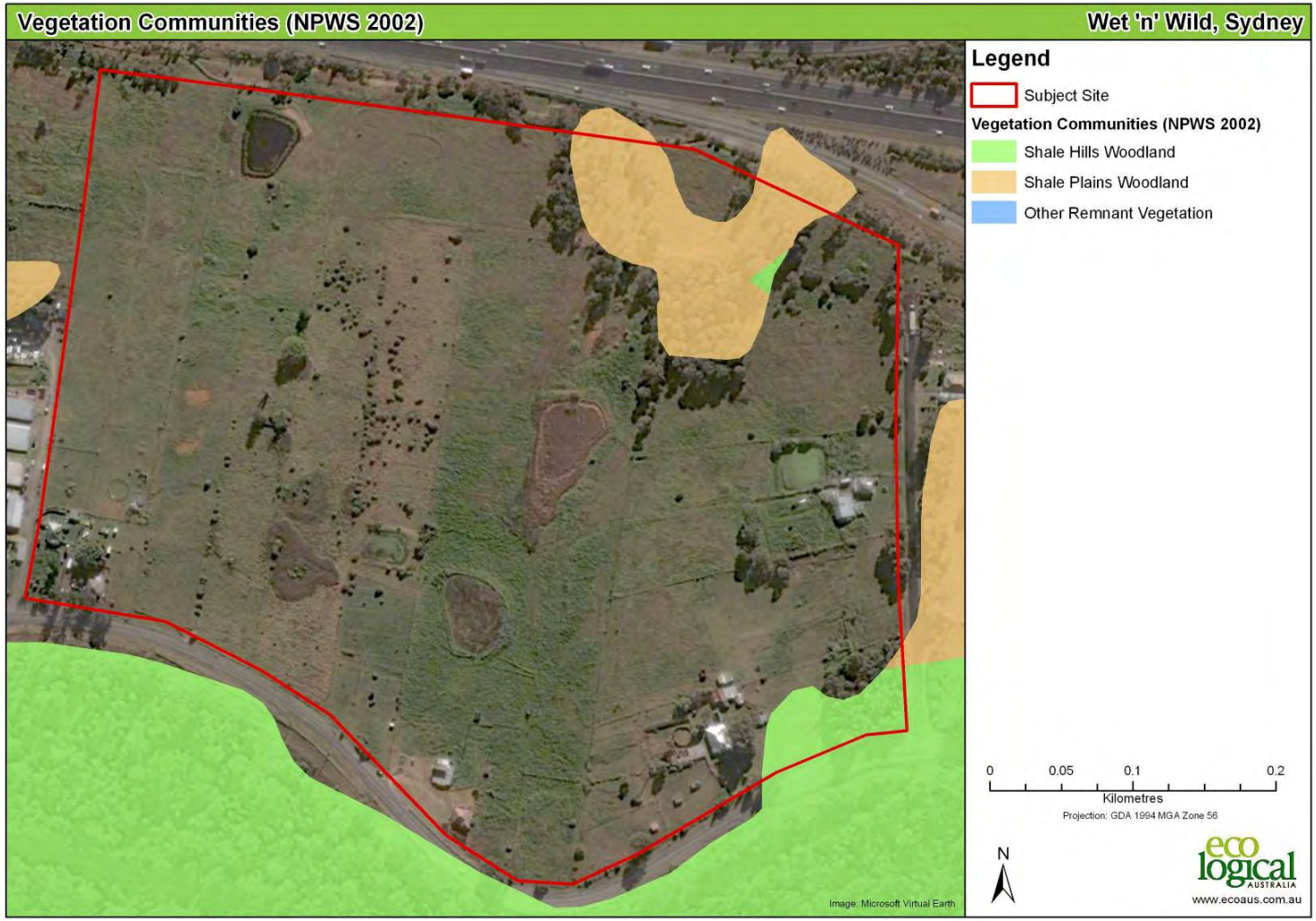

Figure 4: Vegetation at the Subject Site as mapped by NPWS (2002).

Only those species 'known' or 'considered' likely to occur require further assessment in accordance with 'Part 3A Draft Threatened Species Assessment Guidelines' (DEC and DPI 2005) and Significance Impact Guidelines 1,1 (CoA 2009) (**Appendix B**).

5.1.2 Threatened ecological communities

One threatened ecological community (TEC) listed under State (TSC Act) and Commonwealth legislation (EPBC Act), known as '*Cumberland Plain Woodland of the Sydney Basin Bioregion* (TSC Act)' and '*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* (EPBC Act)' is mapped onsite.

5.2 FLORA SURVEYS

5.2.1 Flora

A total of 96 flora species were identified, including 50 native species. For a full floristic species list see **Appendix C**.

5.2.2 Vegetation Communities

The remnant woodland vegetation on site was mapped as by NPWS (2002) as, '*Shale Hills Woodland*' and '*Shale Plains Woodland*'. These vegetation units are equivalent of Biometric Vegetation Types (DECC 2008), '*Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin*' and '*Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin*'.

These two Biometric vegetation types correlate with threatened ecological communities (TEC) listed under State and Commonwealth legislation, known as '*Cumberland Plain Woodland of the Sydney Basin Bioregion* (TSC Act)' and '*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* (EPBC Act)'.

Accordingly, remnant vegetation at the site has been mapped using the name Cumberland Plain Woodland. Other vegetation onsite includes exotic/disturbed grass/pastureland and shrublands. Vegetation types at the Subject Site are hereafter referred to as:

- *(1) Cumberland Plain Woodland*
- *(2) Exotic/disturbed grass/pastureland*
- *(3) Exotic/disturbed shrubland*

A vegetation map is found at **Figure 5**. The relationship between these communities is presented in **Table 4**.

Figure 5: Vegetation map of the Subject Site, as mapped by ELA (2010).

Table 4: Relationship between vegetation units and threatened ecological communities at the Subject Site

ELA (2010)	NPWS (2002)	DECC (2008)	Threatened Ecological Communities
Cumberland Plain Woodland	Shale Hills Woodland	Grey Box - Forest Red Gum grassy woodland on shale of the southern Cumberland Plain, Sydney Basin	Cumberland Plain Woodland of the Sydney Basin Bioregion (TSC Act); Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (EPBC Act)
	Shale Plains Woodland	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin	
Exotic/disturbed grass/pastureland	Un-mapped	Un-classified	Not listed
Exotic/disturbed shrubland	Un-mapped	Un-classified	Not listed

5.2.3 Cumberland Plain Woodland

Two small patches of modified Cumberland Plain Woodland (Tozer 2003) are located to the north and south-east of the subject Site, and occupy collectively approximately 2.2 ha (**Table 5**). These remnants are found in different condition states and are described below.

Northern Remnant (1.74 ha)

Two flora survey quadrats were undertaken within the northern remnant of the site. This remnant is dominated by *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus moluccana* (Grey Box), with *Eucalyptus crebra* (Narrow-leaved Ironbark) also present (**Figure 6** and **Figure 7**). The canopy of this remnant is relatively intact with ~20-30% projected foliage cover (See **Appendix C** for full floristic data).

The understorey consisted of a sparse coverage of shrubs including the *Bursaria spinosa* subsp. *spinosa* (Native Box-thorn) and *Dodonaea viscosa* subsp. *cuneata*; and the exotic species *Lantana camara** (Lantana), *Olea europaea* subsp. *cuspidata** (African Olive) and *Sida rhombifolia** (Paddy's Lucerne).

The groundcover consisted primarily of the native grasses *Cynodon dactylon* (Couch) and *Microlaena stipoides* (Weeping Grass), with a mixture native and exotic herbs and grasses. Native groundcovers included 22 species common to Cumberland Plain Woodland (CPW) such as the grasses: *Austrodanthonia racemosa* var. *racemosa*. (Wallaby Grass), *Bothriochloa* sp., *Dichelachne* sp., *Sporobolus creber*, and *Themeda australis* (Kangaroo Grass); the sedge *Carex inversa*; the herbs, *Centella asiatica* (Indian Pennywort), *Desmodium* sp., *Euchiton sphaericus*, *Phyllanthus virgatus* and *Zornia dyctiocarpa*; along with the vine species *Glycine clandestina*.

The groundcover also included a large number of exotic species including: the grasses, *Briza* sp.*, *Bromus catharticus** (Prairie Grass), *Lolium rigidum** (Wimmera Ryegrass), *Paspalum dilatatum** (Paspalum), *Pennisetum clandestinum** (Kikuyu) and *Phalaris* sp.*; the sedge *Cyperus* sp.*; the vine species *Araujia sericifera** (Moth Vine) and *Asparagus asparagoides** (Bridal Creeper) and the herbs *Anagallis arvensis** (Scarlet Pimpernel), *Bidens pilosa** (Cobblers Pegs), *Cirsium* sp.* (Thistle), *Hypochaeris radicata** (Flatweed), *Nothoscordum borbonicum** (Onion Weed), *Plantago lanceolata**

Figure 6: Northern remnant of Cumberland Plain Woodland, *Eucalyptus moluccana* (Coastal Grey Box).

Figure 7: Northern remnant of Cumberland Plain Woodland, with Eucalyptus crebra (Narrow-leaved Ironbark) and E. tereticornis (Forest Red Gum).

(Lambs Tongue), *Senecio madagascariensis** (Fireweed), *Sonchus oleraceus** (Common Sowthistle), *Trifolium* sp.* (Clover), *Verbena bonariensis** (Purple-top) and *Vicia* sp.* (A Vetch).

South-eastern Remnant (0.46ha)

The south eastern remnant of the site is dominated by *Eucalyptus moluccana* (Grey Box), with *Eucalyptus tereticornis* (Forest Red Gum) also present in low abundance. The canopy of this remnant is also intact with ~20-30% projected foliage cover (PFC) (**Figure 8**).

Only one native shrub species was found in the patch, *Bursaria spinosa* subsp. *spinosa* (Native Box-thorn), and it was in low abundance) (only 1 specimen). Other native understorey species common to the CPW included the grasses: *Aristida sp.* (Three Awn Grass), *Sporobolus* elongatus (Slender Rats-tail Grass) and *Microlaena stipoides* subsp. *stipoides*; the herbs *Brunoniella australis (Blue Trumpet), Commelina cyanea* (Native Wandering Jew), *Daucus glochidiatus* (Native Carrot) and *Einadia* sp.; the vine *Glycine* sp.; and the sedge *Cyperus gracilis* (Slender Flat Sedge).

Exotic shrub species dominated the mid-storey with *Lantana camara* (Lantana) and *Olea europaea* var. *cuspidata* providing almost 50% PFC. Other exotic shrubs included: *Asparagus aethiopicus* (Asparagus Fern), *Asparagus officinalis* (Asparagus), *Bidens pilosa, Rubus fruticosus (Blackberry) and Sida rhombifolia.*

The groundcover consisted of a mixture native and exotic species but was again dominated by exotic noxious weed species *Bryophyllum delagoense** (Mother of Millions) and the exotic grass *Pennisetum clandestinum** (Kikuyu). Other exotics found in the understorey included grasses *Briza** sp. and *Bromus catharticus*; the herbs *Anagallis arvensis** *Bidens pilosa** *Oxalis* sp., *Plantago lanceolata* (Lambs Tongue), *Tradescantia fluminensis** (Wandering Jew) and *Verbena bonariensis**; and t*he vines: Araujia sericifera* and *Asparagus asparagoides.*

Table 5: Area and condition class of extant Cumberland Plain Woodland at the Subject Site.

CUMBERLAND PLAIN WOODLAND		
PATCH	**CONDITION**	**AREA (HA)**
Northern Remnant	Woodland with native dominated understorey	1.74
South-eastern remnant	Woodland with heavily exotic dominated understorey	0.46
Total		2.2

Figure 8: South-eastern remnant of Cumberland Plain Woodland, with *E. moluccana* and a heavy *Olea europaea* var. *cuspidata* (African Olive) infestation.

Figure 9: Exotic/disturbed grasslands and shrublands across the Subject Site.

Exotic/disturbed Grass/pastureland (exotic) – 20.95 hectares

Disturbed grass/pastureland across the majority of the site, dominated by exotic grasses with little prevalence of native flora (**Figure 9**). Currently, the site is segregated into a number of paddocks, with horses grazing throughout most of the paddocks.

The vegetation was dominated by exotic grasses and herbs, with species recorded including *Anagallis arvensis**, *Avena sativa** (Oats)*, Bidens pilosa**, *Briza* spp.*, *Bromus* spp.*, *Lolium perenne** (Rye Grass), *Paspalum dilatatum**, *Plantago lanceolata**, *Rubus fruticosus**, *Senecio madagascariensis**, *Sida rhombifolia*, Verbena* spp.*, *Vicia* sp.* and Vulpia sp.*. A small amount of natives were noted across the grass/pastureland including, *Juncus* sp., *Rumex* sp. and *Persicaria* sp..

Exotic/disturbed exotic shrubland

Towards the middle of the site a large shrubland of the noxious weed, *Olea europaea* var. *cuspidata*, occurred, with other isolated remnants of horticultural plantings occurring in close proximity to the houses onsite (**Figure 9**. A lone large mature *Ficus macrophylla* and two *Grevillea robusta* (Silky Oak) were also found onsite. *Grevillea robusta* is not native to the Cumberland Plain and grows naturally in rainforest north from Sydney. Whilst the *Ficus macrophylla* is found within its native range, given its proximity to the two planted *Grevillea robusta*, it is likely that this was also a planted specimen.

5.2.4 Threatened Flora

It was considered that *Acacia pubescens* and *Pimelea spicata* had the 'potential' to occur onsite, though these species were not recorded during survey.

5.2.5 Threatened ecological communities

One threatened ecological community (TEC) listed under State (TSC Act) and Commonwealth legislation (EPBC Act), known as '*Cumberland Plain Woodland of the Sydney Basin Bioregion* (TSC Act)' and '*Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest* (EPBC Act)' is found onsite.

5.3 FAUNA SURVEYS

5.3.1 Opportunistic fauna observations

Opportunistic fauna records included a total of six native species, including four native birds, Australian Raven (*Corvus coronoides*), Australian Magpie (*Gymnorhina tibicen*), Sulphur-crested Cockatoo (*Cacatua galerita*), Noisy Miner (*Manorina melanocephala*), two exotic birds, Common Myna (*Acridotheres tristis**), Crested Pigeon *(Ocyphaps lophotes**), two introduced mammals, European Cow (*Bos taurus*) and the Horse (*Equus ferus caballus*), and two native amphibians Common Eastern Froglet (*Crinia signifera*) and Eastern Dwarf Tree Frog (*Litoria fallax*).

5.3.2 Microchiropteran bats

A total of 199 Anabat sequences were submitted for analysis from recordings made during the nights of 24 November. Due to mechanical errors, recordings for the night of 6 December 2010 were not able to analysed. There were 100 (50%) sequences that did not contain any microbat calls. Forty calls (20%) were unable to be positively identified to species or genus level due to the low quality or short length of the sequences. Fifty-nine (30%) of the sequences could be identified confidently to species or genus level (**Table 6** and **Table 7**). The calls of four species, including two threatened species, were identified. Example call profiles for these species are shown at Appendix **B**.

The most commonly recorded species was *Chalinolobus gouldii*, followed by fewer than 10 calls each of *C. morio, M. s. oceanensis*, and *F .tasmaniensis*. Call sequences indicative of foraging activity (feeding buzzes) were occasionally recorded. There were no calls recorded during dusk which suggests that microbats were not roosting nearby. Relative microbat activity levels, as estimated by number of Anabat call sequences recorded, were low to moderate.

Table 6: Results from Anabat 1, with threatened species highlighted in blue.

DATE	SPECIES NAME	COMMON NAME	NUMBER OF CALLS	DEFINITE	PROBABLE	POSSIBLE
24/11/10	*Chalinolobus gouldii*	Gould's Wattled Bat	42	42		
24/11/10	*Chalinolobus morio*	Chocolate Wattled Bat	2	1	1	
24/11/10	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	1		1	
24/11/10	*Miniopterus schreibersii oceanensis*	Eastern Bent-wing Bat	4	4		
24/11/10	Junk		52			
24/11/10	Low quality calls		13			
24/11/10	Calls too short to identify		18			
		Total Anabat sequences	132			

Table 7: Results from Anabat 2, with threatened species highlighted in blue.

DATE	SPECIES NAME	COMMON NAME	NUMBER OF CALLS	DEFINITE	PROBABLE	POSSIBLE
24/11/10	*Chalinolobus gouldii*	Goulds Wattled Bat	1	1		
24/11/10	*Chalinolobus morio*	Chocloate Wattled Bat	8	8		
24/11/10	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	1			1
24/11/10	Junk		27			
24/11/10	Low quality calls		5			
24/11/10	Calls too short to identify		4			
		Total Anabat sequences	46			

5.3.3 Cumberland Land Snail (*Meridolum corneovirens*)

Targeted searches for Cumberland Land Snail within the Cumberland Plain Woodland patches on the Subject Site did not record this species.

5.3.4 Threatened Fauna

Two threatened microbats were recorded at the Subject Site, *Falsistrellus tasmaniensis* and *Miniopterus schreibersii oceanensis*. All observations were of common species, and no species listed as threatened or migratory under the TSC Act or the EPBC Act were recorded onsite. A full list of fauna species detected onsite is available in **Appendix C**.

5.4 HABITAT SURVEYS

The vegetation within the study area is routinely disturbed as it is managed through the use of horse grazing. Despite this, the study area contains a number of habitat elements suitable for a range of native fauna, as summarised in **Table 8**.

Table 8: Summary of fauna habitat features at the site

HABITAT FEATURE	SPECIES
Woodland vegetation	Birds, microchiropteran bats (microbats), megachiropteran bats (fruit bats), arboreal mammals, reptiles
Leaf litter	Reptiles, amphibians, invertebrates
Trees with defoliating bark	Microbats, reptiles, some amphibians
Coarse woody debris	Terrestrial mammals, reptiles, invertebrates
Drainage lines and dams	Amphibians
Anthropogenic structures	Refugia for reptiles and amphibians; perching habitat for birds

Birds

The woodland vegetation, particularly native trees, provides foraging and nesting opportunities for woodland birds. There were no hollow-bearing recorded within the Subject Site, though not of sufficient size to provide potential nesting habitat for hollow-dependant species.

Mammals (not including bats)

The ground layer contains a mix of grasses, fallen litter and woody debris suitable for small terrestrial mammals.

Bats

Microchiropteran bats (microbats) were found to be present within the Subject Site, thought it is not thought that they are roosting onsite as they were not recorded onsite until well after dusk. Defoliating bark of mature Eucalypt species provides potential overnight roosting habitat for microbats. Residences adjacent to the study area may also provide roosting habitat for microbat species known to inhabit man-made structures, and urban plantings may provide a reliable and varied source of nectar and fruit for megachiropteran bats (fruitbats).

Amphibians

Potential amphibian habitat was provided within the Cumberland Plain Woodland within the leaf litter and in the defoliating bark detected on the mature Eucalypts. Drainage lines and farm dams throughout the Subject Site also provide moist habitat for amphibians.

Reptiles

Potential habitat for reptiles was provided within the leaf litter and in the defoliating bark on the mature Eucalypt species within the Cumberland Plain Woodland, as well as the fallen limbs.

Threatened and Migratory Fauna Species

Based on the database search, field results and the habitat encountered on site, the following species are considered 'known' to occur or to 'potentially' occur at the Subject Site. A precautionary approach has been applied in developing this list to mitigate the limitations of the survey intensity.

- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*) – Vulnerable (TSC Act)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Grey-headed Flying-Fox (*Pteropus poliocephalus*) – Vulnerable (TSC Act & EPBC Act)
- Rainbow Bee-eater (*Merops ornatus*) – Migratory (EPBC Act)
- Cattle Egret (Ardea alba) – Migratory (EPBC Act)

6 Impact Assessment

6.1 SUMMARY OF IMPACTS

The proposed subdivision will require the removal of ~0.78 ha of Cumberland Plain Woodland vegetation to provide a sufficient building footprint for the Wet 'n' Wild proposal. The direct impacts of this work will be final and include:

- Clearing of regrowth vegetation and of derived exotic grasslands;
- The removal of 0.78 ha of Cumberland Plain Woodland;
- Excavation works and removal of soils

Each of these impacts produce a risk of further indirect impacts including:

- Incremental clearing of an EEC; and
- Fragmentation of an EEC.

Table 9 presents threatened species and ecological communities that are 'known' or considered 'likely' to utilise the Subject Site (as per **Appendix A**). The potential impact of the proposal on these species has been assessed under the EPBC Act and the EP&A Act (**Appendix A**).

Table 9: Species and EECs requiring an assessment of significance

SCIENTIFIC NAME	COMMON NAME	CONSERVATION STATUS		LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT	
ECOLOGICAL COMMUNITIES				
Cumberland Plain Woodland of the Sydney Basin Bioregion (TSC Act); and Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (EPBC Act)		CE	CE	Known
MAMMALIA				
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Known
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	Known

(Critically Endangered; E = Endangered, M = Migratory, V = Vulnerable)

These impacts are discussed below with reference to Key Threatening Processes (KTP; listed under the TSC Act) where appropriate, in relation to the remnant vegetation found at the subject site and any potential habitat for threatened species. Recommendations to manage these impacts are included in **Section 6**.

6.2 DIRECT IMPACTS

To necessitate the proposed works required for the Wet 'n' Wild proposal at the Subject Site, it will be necessary to clear ~0.78 ha of Cumberland Plain Woodland, and clear and excavate an area >20 ha of degraded exotic grassland.

Clearing

A large proportion of the site is exotic/disturbed vegetation and exotic/disturbed grass/pasturelands (**Figure 5** and **Figure 9**), and will be cleared to facilitate the proposed works (22.69 ha). This vegetation has been cleared and or managed for a number of years through slashing (grassland) and grazing (horses).

Clearing of native vegetation' is listed as a Key Threatening Process (KTP), under the TSC Act.

Habitat removal

The key habitat features proposed for removal at the Subject Site includes woodland vegetation, coarse woody debris, farm dams and disturbed grasslands. This will result in the reduction of 33% in woodland habitat, the loss of three farm dams and ~22 ha of disturbed grassland.

'*Removal of dead wood and dead trees*' are listed KTPs.

Excavation

The excavation of the soil below the retained trees will result in the removal of any native seed bank in the area.

6.3 INDIRECT IMPACTS

Reduction in extant of a Threatened Ecological Community

The direct impact of partial clearing, underscrubbing and excavating of soils at the subject site will remove 0.78 ha of remnant Cumberland Plain Woodland, a Critically Endangered Ecological Community (CEEC). The most recent mapping available for this ecological community within the Study Area (NPWS 2002) calculates ~3426 ha extant of this CEEC (**Figure 10**; **Table 10**). This will indirectly impact on the total extant of this CEEC by <0.03%.

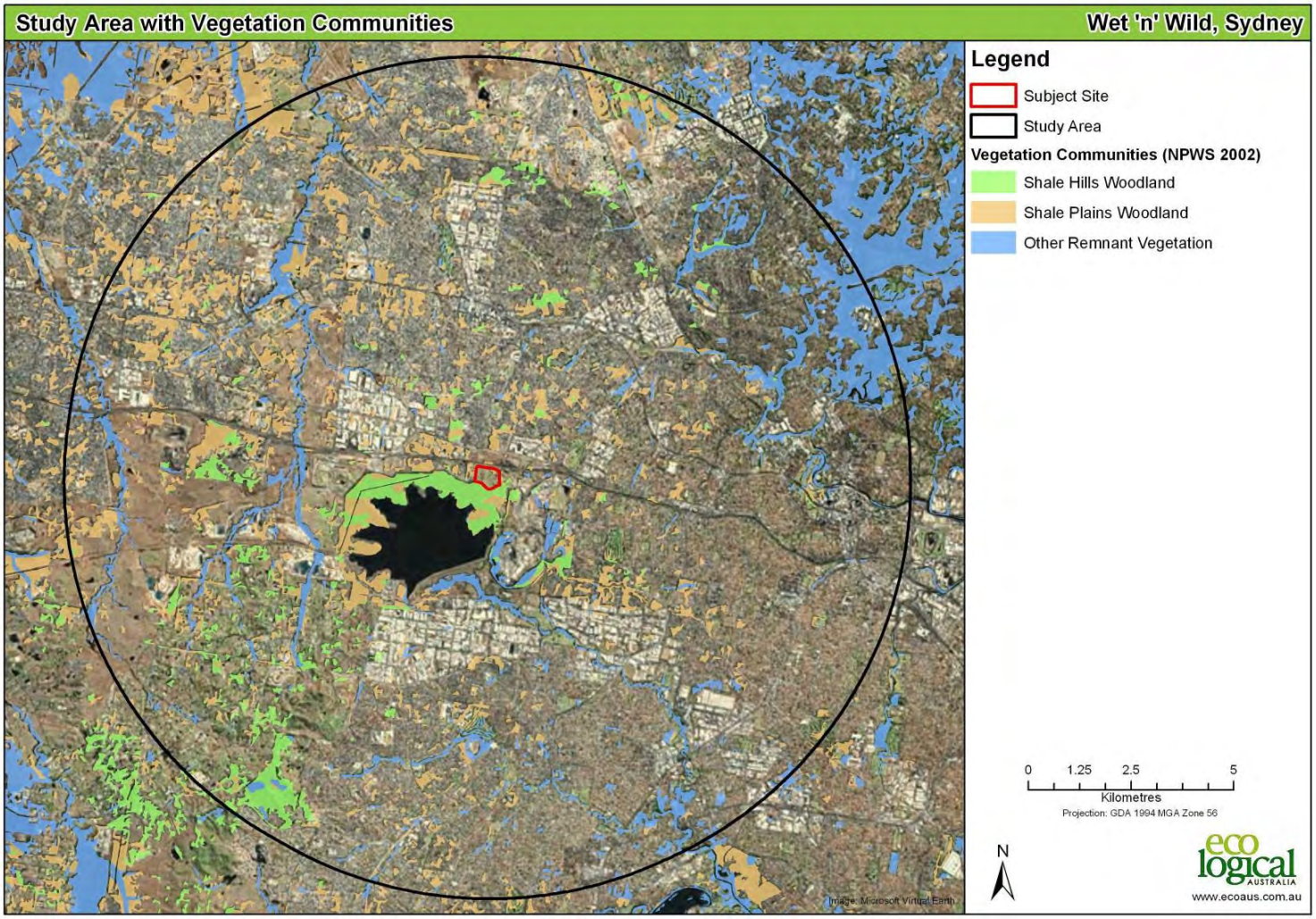

Figure 10: Extant vegetation in the Study Area.

Table 10: Extant Cumberland Plain Woodlands in the Study Area (taken from NPWS 2002).

CUMBERLAND PLAIN WOODLAND			
SHALE HILLS WOODLAND		**SHALE PLAINS WOODLAND**	
Condition Class	**Area (ha)**	**Condition Class**	**Area (ha)**
A	471.57	A	571.5
B	55.53	B	200.57
Cmi	29.1	Cmi	21.08
TX	159.15	TX	649.32
TXR	32.24	TXR	133.71
TXU	116	TXU	986.33
Total	**863.59**	**Total**	**2562.51**

* For a discussion on Condition Classes (CC), see NPWS (2002). Generally speaking, CC-A is good condition, progressively getting lower to CC-TX.

Considering this mapping was undertaken >8 years ago, there is likely to have been some reduction in this extent due clearing approvals over this time. As a precautionary measure, if 10% reduction of extant is assumed, approximately 3083 ha would still remain in the Study Area of this CEEC, including >300 ha within the Prospect Reservoir Nature Reserve immediately to the south of the Subject Site. This would still equate to ~0.03 % reduction in actual extent of this CEEC in the Study Area.

Fragmentation

There is minimal risk of fragmentation to native remnant vegetation due to the proposed works, as currently the remnant is removed from other extant native vegetation through the reduction of native understorey species, the prevalence of exotic shrubs and the presence of the M4 Motorway immediately north of the site which is curtailed by residential housing and associated infrastructure to the north of the Motorway (**Figure 10**). Potential impacts to habitat for mobile species (e.g. bats, birds) through the removal of canopy species (i.e. Eucalypts) has been reduced through the proposed retention of almost 70% of the trees on site (**Figure 5**).

6.4 CONSIDERATION OF SITE CONDITION

Notwithstanding the above impacts, it must be considered that whilst this vegetation is identified as a remnant of a CEEC, judging by the site condition it has remained in a degraded state for a many years with a high prevalence of exotic species, and has maintained little management other than horse grazing.

It is currently subject to a variety of KTPs due to it landscape position amongst the peri-urban environment and current management, including:

- Invasion and establishment of exotic vines and scramblers (*Araujia sericifera, Tradescantia fluminensis, Asparagus asparagoides. A. aethiopicus*);
- Invasion, establishment and spread of *Lantana camara*; and
- Invasion of native plant communities by exotic perennial grasses (*Eragrostis curvula, Phalaris aquatica*).

6.5 AVOIDANCE AND MINIMISATION MEASURES

The Wet 'n' Wild Project involves the clearing of ~33% of the extant native remnant vegetation at the Subject Site, in order to provide sufficient space a water retention basin. The size and placement of this water retention basin has been designed to take into account the geography of the site and has been placed in cleared land where possible. The extent of this basin has been reduced to the minimum extent necessary to still meet the engineering requirements of this structure.

6.6 MITIGATION MEASURES

Whilst vegetation clearing must be undertaken due to the geographical placement required for the water retention basin, the Proponent would mitigate the impacts of this disturbance by adopting risk minimising practices for pre-start and clearing activities onsite.

To ameliorate the potential impacts on site and ensure the best possible environmental outcomes, the following recommendations for impact mitigation should be required as modifications to the proposal and/or imposed as conditions of consent.

- All trees or other vegetation to be retained should be identified, clearly marked and fenced off prior to any vegetation removal;
- Vegetation clearing should be undertaken during seasons that minimise the risk of impacting on hibernating microbats or breeding woodland birds;
- A Pre-start Clearing Inspection should be completed by an ecologist of the proposed disturbance area to identify the presence of fauna (including threatened species such as microbats);
- Pre Start Clearing Inspections also identify biological resources within the disturbance area including habitat resources (hollows, stag trees and coarse woody debris) and the availability of endemic seed.
- The following active clearing practices are to be implemented:
    - Environmental and noxious weeds are controlled within the disturbance area prior to clearing;
    - Seed collection is undertaken;
    - The identified habitat trees are inspected prior to felling;
    - If no fauna is observed, a bulldozer is used to rip the root zone around the base of the tree;
    - The dozer slowly pushes the tree to allow it to fall under its own weight, thereby minimising damage during felling;
    - A trained wildlife handler is onsite to inspect the tree and to attend to any animals which may be injured or require assistance; and
    - The toppled trees are left on the ground overnight to allow any other unidentified animals to relocate.
- Sediment fences or equivalent should be erected prior to the removal of any vegetation and kept in place until all areas of bare soil have been stabilised;
- Stripping soil in disturbance areas and immediately re-spreading over rehabilitation areas;
- Weed management particularly focused on noxious weeds which includes routine inspection and identification;
- A Soil and Water Management Plan should be designed and implemented for the proposed works in accordance with appropriate guidelines for managing urban stormwater, for example, Soils and Construction: Managing Urban Stormwater 4th Edition (Landcom 2004);

- Stormwater runoff will be controlled within the development planning so as to minimise nutrient and contaminant escape to surrounding lands; and
- Pest management activities as required.

6.7 REHABILITATION / REVEGETATION

- A Vegetation Management Plan (VMP) should be developed for the areas of retained remnant woodland and the proposed water retention basin. The VMP should set out a 5 year implementation period from the completion of development and include the creation of management zones, vegetation monitoring and weed control measures;
- A seed collection strategy and program to harvest endemic seed from local vegetation to either directly sow or propagate for tube stock planting in rehabilitation areas; and
- Revegetation of the water retention basin with native wetland flora is undertaken to provide a resource for amphibians to colonise / take refuge during migration across the landscape.

6.8 CONCLUSION OF ASSESSMENTS OF SIGNIFICANCE (EP&A ACT)

Assessments of significance in accordance with the 'Draft Part 3A Guidelines for Threatened Species Assessment' (DEC and DPI 2005) under Part 3A of the EP&A Act were undertaken for those species and TEC's observed (i.e. 'known') on the site or considered 'likely' to occur on the site (**Appendix B**).

The extent of habitat to be removed is considered a negligible impact in the context of the available resources in the study area and those to be retained at the Subject Site. The removal of the vegetation at the Subject Site will not affect habitat connectivity nor increase fragmentation as the vegetation to be cleared / modified is currently in a degraded state with a high prevalence of exotic flora species and horse grazing.

The outcome of these assessments were that it is unlikely the development would significantly impact on those threatened species and ecological community assessed (**Table 9**). Recommendations have been provided in **Section 6.6** and **6.7** to ameliorate any potential impacts from the proposed works.

6.9 CONCLUSION OF EPBC ACT ASSESSMENT

An assessment of significance under the EPBC Act was undertaken for Cumberland Plain Woodland, as it was the only listed species observed (i.e. known) or considered 'likely' to occur on the site (**Appendix B**). The outcome of this assessment was that it is unlikely that the development would significantly impact on this community those threatened or migratory species assessed (**Table 9**).

The removal of the vegetation at the Subject Site will not affect habitat connectivity nor increase fragmentation as the vegetation to be cleared / modified is currently in a degraded state with a high prevalence of exotic flora species and horse grazing. Referral to the Commonwealth under the EPBC Act would not be recommended.

Recommendations have been provided in **Sections 6.6** and **6.7** to ameliorate any potential impacts of the proposed works.

7 Conclusion

This report describes the ecological environment of the proposed site of the Wet 'n' Wild Project, at Reservoir Rd, Prospect, and assesses the potential impacts of the proposed works on threatened and migratory species, threatened populations and ecological communities.

Two threatened microbat species listed under the TSC Act were recorded at the Subject Site. No threatened or migratory species listed under the EPBC Act were recorded or considered 'likely' to occur at the Subject Site. The Critically Endangered Ecological Community, *Cumberland Plain Woodlands* (TSC Act and EPBC Act), was recorded in the study area.

Through the application of the 'Draft Guidelines for threatened Species Assessment' under Part 3A of the EP&A Act, it is concluded that the proposal is unlikely to have a significant effect on threatened species, populations, ecological communities, or their habitats, and accordingly a Species Impact Statement is not required for the proposal.

Following consideration of the administrative guidelines for determining significance under the EPBC Act, it is concluded that the proposal is unlikely to have a significant impact on matters of National Environmental Significance or Commonwealth land, and accordingly a referral to the Commonwealth Environment Minister is not necessary.

A number of impact mitigation and amelioration strategies have been recommended for the proposal and these are set out in the **Section 6.6** and **6.7**. These strategies mitigate the effects of the proposal on threatened species, populations, ecological communities, or their habitats and minimise the impacts of the proposal on the flora and fauna values of the study area in general.

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Appendix A: Threatened Species Likelihood

An assessment of likelihood of occurrence was made for threatened and migratory species identified from the database search. Five terms for the likelihood of occurrence of species are used in this report. This assessment was based on database or other records, presence or absence of suitable habitat, features of the proposal site, results of the field survey and professional judgement. The terms for likelihood of occurrence are defined below:

- "yes" = the species was or has been observed on the site
- "likely" = a medium to high probability that a species uses the site
- "potential" = suitable habitat for a species occurs on the site, but there is insufficient information to categorise the species as likely to occur, or unlikely to occur
- "unlikely" = a very low to low probability that a species uses the site
- "no" = habitat on site and in the vicinity is unsuitable for the species.

FAUNA

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
FISH					
Macquarie australasica	Macquarie Perch	-	E	Habitat for the Macquarie perch is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland–upland areas through the drier summer periods.	No
Prototroctes maraena	Australian Grayling	-	V	Historically, this species occurred in coastal streams from the Grose River southwards through NSW, VIC and TAS. On mainland Australia, this species has been recorded from rivers flowing east and south of the main dividing ranges. This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops but has also been found in muddy-bottomed, heavily silted habitat. Grayling migrate between freshwater streams and the ocean and as such it is generally accepted to be a diadromous (migratory between fresh and salt waters) species.	No
FROGS					
Heleioporus australiacus	Giant Burrowing Frog	-	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Litoria aurea	Green and Golden Bell Frog	E1	V	This species has been observed utilising a variety of natural and man-made waterbodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DECC 2007). Fast flowing streams are not utilised for breeding purposes by this species (Mahony 1999). Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DECC 2007). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes–Typha sp. and spikerushes–Eleocharis sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (Gambusia holbrooki) (DECC 2007).	Unlikely – Not recorded
Litoria raniformis	Southern Bell Frog	-	V	Relatively still or slow-flowing sites such as billabongs, ponds, lakes or farm dams, especially where bulrushes (*Typha* sp., *Eleocharis* sp. and *Phragmites* sp.) are present (DECC 2007; Ehmann 1997). This species is common in lignum shrublands, black box and River Red Gum woodlands, irrigation channels and at the periphery of rivers in the southern parts of NSW (DECC 2007). This species occurs in vegetation types such as open grassland, open forest and ephemeral and permanent non-saline marshes and swamps (DECC 2007). Open grassland and ephemeral permanent non-saline marshes and swamps have also been associated with this species (Ehmann 1997).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Mixophyes balbus	Stuttering Frog	-	V	A variety of forest habitats from rainforest through wet and moist sclerophyll forest to riparian habitat in dry sclerophyll forest (DECC 2007) that are generally characterised by deep leaf litter or thick cover from understorey vegetation (Ehmann 1997). Breeding habitats are streams and occasionally springs. Not known from streams disturbed by humans (Ehmann 1997) or still water environments (NSW Scientific Committee 2002).	No
Mixophyes iteratus	Giant Barred Frog	-	E	Found on forested slopes of the escarpment and adjacent ranges in riparian vegetation, subtropical and dry rainforest, wet sclerophyll forests and swamp sclerophyll forest (DECC 2007; Ehmann 1997). This species is associated with flowing streams with high water quality, though habitats may contain weed species (Ehmann 1997). This species is not known from riparian vegetation disturbed by humans (NSW Scientific Committee 1999). During breeding eggs are kicked up onto an overhanging bank or the streams edge (DECC 2007).	No
REPTILES					
Hoplocephalus bungaroides	Broad-headed Snake	E1	V	Typical sites consist of exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin (DECC 2007). They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998b). S ome of the canopy tree species found to regularly co-occur at known sites include *Corymbia eximia, C. gummifera, Eucalyptus sieberi, E. punctata* and *E.piperita* (DECC 2007).	No
DIURNAL BIRDS					

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Anthochaera Phrygia (aka Xanthomyza phrygia)	Regent Honeyeater	E1	E	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak (*Casuarina cunninghamiana*) (Garnett 1993). Areas containing Swamp Mahogany (*Eucalyptus robusta*) in coastal areas have been observed to be utilised (NPWS 1997). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000).	Unlikely – Not recorded
Anseranas semipalmata	Magpie Goose	V	-	Activities centred on terrestrial sedge-dominated wetlands; mainly those on floodplains of rivers (Marchant & Higgins 1993 Simpson & Day 1999).	No
Lathamus discolor	Swift Parrot	E1	E	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers et al. 1984; Schodde and Tidemann 1986; Forshaw and Cooper 1981). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*) (DECC 2007).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Polytelis swainsonii	Superb Parrot	-	V	The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round. Inhabit box-gum woodland and Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest foraging at or near the ground. Nest in hollows.	No
Rostratula australis (a.k.a. R. benghalensis)	Painted Snipe (Australian subspecies)	-	V	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (ibid.). Breeding is often in response to local conditions; generally occurs from September to December (DECC 2007). Roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (DECC 2007). Feeds on worms, molluscs, insects and some plant-matter (ibid.).	No
Stagonopleura guttata	Diamond Firetail	V	-	Typically found in grassy eucalypt woodlands, but also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities (DECC 2007). It is often found in riparian areas and sometimes in lightly wooded farmland (DECC 2007). Appears to be sedentary, though some populations move locally, especially those in the south (DECC 2007).	Potential – Not recorded

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Xanthomyza phrygia (see Anthochaera Phrygia)	Regent Honeyeater	E1	E	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak (*Casuarina cunninghamiana*) (Garnett 1993). Areas containing Swamp Mahogany (*Eucalyptus robusta*) in coastal areas have been observed to be utilised (NPWS 1997). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000).	No
NOCTURNAL BIRDS					
Ninox connivens	Barking Owl	V	-	Associated with a variety of habitats such as savanna woodland, open eucalypt forests, wetland and riverine forest. The habitat is typically dominated by Eucalypts (often Redgum species), however often dominated by Melaleuca species in the tropics (DECC 2007). It usually roosts in dense foliage in large trees such as River She-oak (*Allocasuarina cunninghamiana*), other Casuarina and Allocasuarina, eucalypts, Angophora, Acacia and rainforest species from streamside gallery forests (NPWS 2003). It usually nests near watercourses or wetlands (NPWS 2003) in large tree hollows with entrances averaging 2-29 metres above ground, depending on the forest or woodland structure and the canopy height (Debus 1997).	Unlikely – Not recorded
MAMMALS (EXCLUDING BATS)					

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Cercartetus nanus	Eastern Pygmy-possum	V	-	Found in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath (Menkhorst & Knight 2004). Pygmy-Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit (Turner & Ward 1995). The presence of Banksia sp. and Leptospermum sp. are an important habitat feature (DECC 2007). Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old birds nests and in the branch forks of tea-trees (Turner & Ward 1995).	No
Dasyurus maculatus *Dasyurus maculatus maculatus*	Spotted-tailed Quoll Spotted-tailed Quoll (SE Mainland Population)	V -	- E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECC 2007j), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECC 2007). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000).	No
Petrogale penicillata	Brush-tailed Rock-wallaby	-	V	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (Strahan 1995).	No
Potorous tridactylus tridactylus	Long-nosed Potoroo (SE Mainland Population)	-	V	Associated with dry coastal heath and dry and wet sclerophyll forests (Strahan 1998) with dense cover for shelter and adjacent more open areas for foraging (Menkhorst & Knight 2004).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pseudomys novaehollandiae	New Holland Mouse	-	V	The New Holland Mouse has a fragmented distribution across Tasmania, Victoria, New South Wales and Queensland. In 2006 there were known to be 6 - 8 metapopulations of the species Across the species' range the New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand dunes. The New Holland Mouse is a social animal, living predominantly in burrows shared with other individuals. The home range of the New Holland Mouse ranges from 0.44 ha to 1.4 ha (DEWHA 2010).	No
MAMMALS (BATS)					
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998; DECC 2007). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998; DECC 2007).	No
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Prefers moist habitats with trees taller than 20m (DECC 2007). Roosts in tree hollows but has also been found roosting in buildings or under loose bark (DECC 2007).	Known – Recorded onsite

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 1998). It forages above and below the tree canopy on small insects (AMBS 1995, Dwyer 1995, Dwyer 1981). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Environment Australia 2000, Dwyer 1995).	Known – Recorded onsite
Mormopterus norfolkensis	East Coast Free-tail Bat	V	-	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 1998). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Environment Australia 2000; Allison & Hoye 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Environment Australia 2000; Allison & Hoye 1998).	Potential – Not recorded
Myotis adversus	Large-footed Myotis	V	-	Will occupy most habitat types such as mangroves, paperbark swamps, riverine monsoon forest, rainforest, wet and dry sclerophyll forest, open woodland and River Red Gum woodland, as long as they are close to water (Churchill 1998). While roosting is most commonly associated with caves, this species has been observed to roost in tree hollows, amongst vegetation, in clumps of Pandanus, under bridges, in mines, tunnels and stormwater drains (Churchill 1998). However the species apparently has specific roost requirements, and only a small percentage of available caves, mines, tunnels and culverts are used (Richards 1998).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pteropus poliocephalus	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).	Potential – Not recorded
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Associated with moist gullies in mature coastal forest, or rainforest, east of the Great Dividing Range (Churchill, 1998), tending to be more frequently located in more productive forests (Hoye & Richards 1998). Within denser vegetation types use is made of natural and man made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 1998).	No
INVERTEBRATES					
Meridolum corneovirens	Cumberland (Large) Land Snail	E1	-	Associated with open eucalypt forests, particularly Cumberland Plain Woodland described in Benson (1992). Found under fallen logs, debris and in bark and leaf litter around the trunk of gum trees or burrowing in loose soil around clumps of grass (NPWS 1997; Rudman 1998). Urban waste may also form suitable habitat (NSW NPWS 1997; Rudman 1998).	Potential – No recorded onsite
MIGRATORY TERRESTRIAL SPECIES LISTED UNDER EPBC ACT					
Apus pacificus	Fork-tailed Swift	-	M	Sometimes travels with Needletails. Varied habitat with a possible tendency to more arid areas but also over coasts and urban areas (Simpson & Day 1999).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	No
Hirundapus caudacutus	White-throated Needletail	-	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	No
Merops ornatus	Rainbow Bee-eater	-	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May (Pizzey and Doyle 1988). Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (ibid). Nest is a chamber a the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting (*ibid*).	Potential – Not recorded
Monarcha melanopsis	Black-faced Monarch	-	M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	No
Myiagra cyanoleuca	Satin Flycatcher	-	M	Wetter, denser forest, often at high elevations (Simpson & Day 2004).	No

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Rhipidura rufifrons	Rufous Fantail	-	M	The Rufous Fantail is a summer breeding migrant to southeastern Australia (Morcombe, 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe, 2004). Open country may be used by the Rufous Fantail during migration (Morcombe, 2004).	No
Xanthomyza phrygia	Regent Honeyeater	E	E, M	SEE DIURNAL BIRDS ABOVE	SEE DIURNAL BIRDS ABOVE
MIGRATORY WETLAND SPECIES LISTED UNDER EPBC ACT					
Ardea alba	Great Egret	-	M	The Great Egret is common and widespread in Australia (McKilligan, 2005). It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (McKilligan, 2005).	Potential – Not recorded
Ardea ibis	Cattle Egret	-	M	Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments (McKilligan, 2005). Some individuals stay close to the natal heronry from one nesting season to the next, but the majority leave the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing Range (McKilligan, 2005).	Potential – Not recorded

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Gallinago hardwickii	Latham's Snipe	-	M	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Marchant and Higgins 1999). Occupies a variety of vegetation around wetlands (Marchant and Higgins 1999) including wetland grasses and open wooded swamps (Simpson and Day 1999).	No
Rostratula benghalensis (a.k.a. R. australis)	Painted Snipe	-	M	See: *Rostratula australis*	No

Disclaimer: Data extracted from the Atlas of NSW Wildlife and DEW Protected Matters Report are only indicative and cannot be considered a comprehensive inventory. 'Migratory marine species' and 'listed marine species' listed on the EPBC Act (and listed on the DEW protected matters report) have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine habitat. (E = Endangered; E2 = Endangered Population; V = Vulnerable; M = Migratory)

FLORA

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Acacia pubescens		V	V	Associated with on Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest. Clay soils, often with ironstone gravel (NPWS 1997, Benson and McDougall 1996).	Not recorded

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Cynanchum elegans		E1	E	Climber or twiner with a variable form (DECC 2007). It occurs in dry rainforest gullies, scrub and scree slopes (NPWS 1997). It prefers the ecotone between dry subtropical rainforest and sclerophyll woodland/forest. However has been found in littoral rainforest; *Leptospermum laevigatum – Banksia integrifolia* subsp *integrifolia* coastal scrub; *Eucalyptus tereticornis* aligned open forest/ woodland; *E. maculata* aligned open forest/woodland; and *Melaleuca armillaris* scrub to open scrub (DECC 2007). Flowers between August and May, peaking in November (DECC 2007). Seeds are unlikely to persist in the seedbank (DECC 2007).	Not recorded
Dillwynia tenuifolia		V	-	It has a core distribution within the Cumberland Plain, where it may be locally abundant within scrubby, dry heath areas within Castlereagh Ironbark Forest and Shale/Gravel Transition Forest on tertiary alluvium or laterised clays (DECC 2007). May also be common in the ecotone between these areas and Castlereagh Scribbly Gum Woodland (*ibid.*). Flowers sporadically from August to March.	Unlikely – Not recorded
Epacris purpurascens var *purpurascens*		V	-	Sydney Sandstone Gully Forest and wet heath with strong clay influences (NPWS 1997). Recorded between Gosford in the north to Avon Dam in the south. Found in a range of habitats, but most have a strong shale soil influence. Killed by fire and re-establishes from soil stored seed (DECC 2007).	Unlikely – Not recorded
Grevillea juniperina subsp. *juniperina*		V	-	Restricted to red sandy to clay soils – often lateritic on Wianamatta Shale and Tertiary alluvium in Cumberland Plain Woodland and Castlereagh Woodland (NSW Scientific Committee 2000).	Unlikely – Not recorded

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Grevillea parviflora subsp. *parviflora*	Small Flower Grevillea	-	V	Occurs on sandy clay loam soils, often with lateritic ironstone gravels (DECC 2007). Soils are mostly derived from Tertiary sands or alluvium and from the Mittagong Formation with alternating bands of shale and fine-grained sandstones. Soil landscapes include Lucas Heights and Berkshire Park (DECC 2007). Often occurs in open, slightly disturbed sites such as along tracks. Flowering has been recorded between July to December as well as April-May (DECC 2007).	Unlikely – Not recorded
Hibbertia superens		E1	-	Occurs in both open woodland and heathland, and appears to prefer open disturbed areas, such as tracksides. Occurs from Baulkham Hills to South Maroota in the northern outskirts of Sydney, where there are currently 16 known sites, and at one locality at Mount Boss, inland from Kempsey. Flowering time is July to December. The species occurs on sandstone ridgetops often near the shale/sandstone boundary.	No – Not recorded
Persoonia nutans		E1	E	Associated with dry woodland, Castlereagh Scribbly Gum Woodland, Agnes Banks Woodland and sandy soils associated with tertiary alluvium, occasionally poorly drained (Benson and McDougall 2000). Endemic to the Western Sydney (Benson and McDougall 2000).	No – Not recorded
Pimelea curviflora var curviflora		V	V	Associated with the Duffys Forest Community, shale lenses on ridges in Hawkesbury sandstone geology (Pittwater Council 2000).	No – Not recorded

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pimelea spicata		E1	E	In western Sydney, it occurs on an undulating topography of well structured clay soils, derived from Wianamatta shale (DEC 2004). It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines (*Ibid.*). Has been located in disturbed areas that would have previously supported CPW (*Ibid.*).	Potential – Not recorded
Pomaderris brunnea	Rufous Pomaderris	-	V	Associated with open forests (Harden, 1990) in association with *Eucalyptus amplifolia, Angophora floribunda, Acacia parramattensis, Bursaria spinosa* and *Kunzea ambigua* (Maryott-Brown & Wilks 1993). It is found on the Colo River, the Nepean R. floodplain at Menangle, in creeklines at Wirrumbirra Sanctuary (Bargo) and on the Hawkesbury R. (Harden 1990; Peacock 1996; Fairley & Moore 2000). The distribution may extend into the southern section of Yengo NP along major creeklines and floodplains (Maryott-Brown & Wilks 1993).	Potential – Not recorded

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pterostylis gibbosa	Illawarra Greenhood	E	-	Associated with seasonally hard setting clay soils with approximately 1000mm of rainfall (NPWS 1997). All known populations grow in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum *Eucalyptus tereticornis*, Wollybutt *E. longifolia* and White Feather Honey-myrtle *Melaleuca decora*. Near Nowra, the species grows in an open forest of Spotted Gum *Corymbia maculata*, Forest Red Gum and Grey Ironbark *E. paniculata*. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark *E. crebra*, Forest Red Gum and Black Cypress Pine *Callitris endlicheri.* The Illawarra Greenhood is a deciduous orchid that is only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. The leaf rosette grows from an underground tuber in late summer, followed by the flower stem in winter and flowers in spring.	No – Not recorded
Pterostylis saxicola		E	-	Terrestrial orchid predominantly found in Hawkesbury Sandstone Gully Forest growing in small pockets of soil that have formed in depressions in sandstone rock shelves (NPWS 1997). Known from Georges River National Park, Ingleburn, Holsworthy, Peter Meadows Creek, St Marys Tower (NSW Scientific Committee 1999).	No – Not recorded

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
Pultenaea parviflora		E1	V	May be locally abundant, particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays (DECC 2007). May also be common in ecotone between these communities and Castlereagh Scribbly Gum Woodland (*ibid.*). *Eucalyptus fibrosa* is usually the dominant canopy species (*ibid.*). *E. globoidea, E. longifolia, E. parramattensis, E. sclerophylla and E. sideroxylon* may also be present or co-dominant, with *Melaleuca decora* frequently forming a secondary canopy layer (*ibid.*). Associated species may include *Allocasuarina littoralis, Angophora bakeri, Aristida spp. Banksia spinulosa, Cryptandra spp., Daviesia ulicifolia, Entolasia stricta, Hakea sericea, Lissanthe strigosa, M. nodosa, Ozothamnus diosmifolius* and *Themeda australis* (*ibid.*). Often found in association with other threatened species such as *Dillwynia tenuifolia, Dodonaea falcata, Grevillea juniperina, Micromyrtus minutiflora, Persoonia nutans* and *Styphelia laeta* (*ibid.*). Flowering may occur between August and November (*ibid.*).	Potential – Not recorded
Pultenaea pedunculata		E1	-	Shale Gravel Transition Forest in the Wianamatta Shale - Tertiary alluvium intergrade areas (NPWS 1997).	Potential – Not recorded

Disclaimer: Data extracted from the Atlas of NSW Wildlife and EPBC Act Protected Matters Report are only indicative and cannot be considered a comprehensive inventory. (E = Endangered; E2 = Endangered Population; V = Vulnerable)

Appendix B: Flora and Fauna Inventory

FLORA

FAMILY	GENUS	SPECIES	COMMON NAME	CPW SPECIES	NATIVE/EXOTIC	TYPE	PLOT 1	PLOT 2	PLOT 3
							P/Ab.	C/Ab.	C/A
Acanthaceae	***Brunoniella***	***australis***	**Blue Trumpet**	**Yes**	**native**	**Herb**			**1**
Alliaceae	*Nothoscordum*	*borbonicum*	Onion Weed		exotic	Herb	P		
Anthericaceae	***Arthropodium***	***sp.***	**Vanilla Lily**	**Yes**	**native**	**Herb**		**P**	
Apiaceae	***Centella***	***asiatica***	**Indian Pennywort**	**Yes**	**native**	**Herb**	**P**		
	Daucus	***glochidiatus***	**Native Carrot**	**Yes**	**native**	**Herb**		**P**	**1**
Apocynaceae	*Araujia*	*sericifera*	Moth Vine		exotic	Vine		P	1
Asparagaceae	*Asparagus*	*asparagoides*	Bridal Creeper		exotic	Vine	P	P	3
	Asparagus	*officinalis*	Asparagus		exotic	Herb			P
	Asparagus	*plumosus*	Climbing Asparagus Fern		exotic	Vine	P		
Asteraceae	*Bidens*	*pilosa*	Cobblers Pegs		exotic	Herb	P	P	3
	Cirsium	*sp.*	Thistle		exotic	Herb	P	P	
	Cotula	*australis*	Carrot Weed		native	Herb		P	
	Euchiton	***sphaericus***		**Yes**	**native**	**Herb**	**P**		
	Hypochaeris	*radicata*	Flatweed		exotic	Herb	P		
	Hypochaeris	*sp.*			exotic	Herb		P	
	Senecio	*madagascariensis*	Fireweed		exotic	Herb	P	P	

FAMILY	GENUS	SPECIES	COMMON NAME	CPW SPECIES	NATIVE/EXOTIC	TYPE	PLOT 1	PLOT 2	PLOT 3
	Sonchus	*oleraceus*	Common Sowthistle		exotic	Herb	P	P	
	Taraxacum	*officinale*	Dandelion		exotic	Herb		P	
Brassicaceae	*Lepidium*	*africanum*			exotic	Herb		P	
	Lepidium	*bonariense*			exotic	Herb		P	
Campanulaceae	***Wahlenbergia***	***sp.***		**Yes**	**native**	**Herb**		**P**	
Caryophyllaceae	*Stellaria*	*media*	Common Chckweed		exotic	Herb		P	
Chenopodiaceae	***Einadia***	***nutans***	**Climbing Saltbush**	**Yes**	**native**	**Herb**		**P**	
	Einadia	***sp.***		**Yes**	**native**	**Herb**			**1**
	Einadia	***trigonos***	**Fishweed**	**Yes**	**native**	**Herb**		**P**	
Commelinaceae	***Commelina***	***cyanea***	**Wandering Jew**	**Yes**	**native**	**Herb**			**1**
	Tradescantia	*fluminensis*	Wandering Jew		exotic	Herb			3
Convolvulaceae	*Dichondra*	*repens*	Kidney Weed		native	Herb	P	P	6
Crassulaceae	*Bryophyllum*	*delagoense*	Mother-of-millions		exotic	Herb			5
Cyperaceae	*Carex*	*appressa*	Tall Sedge		native	Sedge			2
	Carex	***inversa***		**Yes**	**native**	**Sedge**	**P**	**P**	
	Cyperus	***gracilis***	**Slender Flat-sedge**	**Yes**	**native**	**Sedge**			**P**
	Cyperus	*sp.*			exotic	Sedge	P		
Fabaceae - Faboideae	***Desmodium***	***sp.?***		**Yes**	**native**	**Herb**	**P**		
	Desmodium	***varians***	**Slender Tick-trefoil**	**Yes**	**native**	**Herb**		**P**	
	Glycine	***clandestina***		**Yes**	**native**	**Vine**	**P**	**P**	
	Glycine	***sp.***		**Yes**	**native**	**Vine**			**1**
	Trifolium	*sp.*	Clover		exotic	Herb	P		

FAMILY	GENUS	SPECIES	COMMON NAME	CPW SPECIES	NATIVE/EXOTIC	TYPE	PLOT 1	PLOT 2	PLOT 3
	Vicia	*sativa*	Common Vetch		exotic	Herb			
	Vicia	*sp.*			exotic	Herb	P		
	Zornia	***dyctiocarpa***	**Zornia**	**Yes**	**native**	**Herb**	**P**		
Fabaceae - Mimosoideae	*Acacia*	*parramattensis*	Parramatta Wattle		native	Shrub			
Gentianaceae	*Centaurium*	*sp.*			exotic	Herb	P		
	Juncus	*sp.*			native	Sedge	P	P	
Juncaceae	***Juncus***	***usitatus***	**Common rush**	**Yes**	**native**	**Sedge**			
Lamiaceae	*Stachys*	*arvensis*	Stagger Weed		exotic	Herb		P	
	Malva	*parviflora*	Small-flowered Mallow		exotic	Herb		P	
	Modiola	*caroliniana*	Red-flowered Mallow		exotic	Herb		P	
Malvaceae	*Sida*	*rhombifolia*	Paddy's Lucerne		exotic	Shrub	P	P	2
	Ficus	*rubiginosa*	Port Jackson Fig		native	Tree			
Moraceae	*Ficus sp.?*				native	Tree		P	
Myrsinaceae	*Anagallis*	*arvensis*	Scarlet Pimpernel		exotic	Herb	P		P
	Eucalyptus	***crebra***	**Narrow-leaved Ironbark**	**Yes**	**native**	**Tree**		**P**	
	Eucalyptus	***moluccana***	**Grey Box**	**Yes**	**native**	**Tree**	**1**	**4b**	**4b**
	Eucalyptus	***tereticornis***	**Forest Red Gum**	**Yes**	**native**	**Tree**	**4b**		**1**
Myrtaceae	***Eucalyptus***	***tereticornis (young)***	**Forest Red Gum**	**Yes**	**native**	**Tree**	**4b**		
Oleaceae	*Olea*	*europaea subsp. cuspidata*	African Olive		exotic	Shrub	1	4b	4b
Oxalidaceae	***Oxalis***	***perennans***		**Yes**	**native**	**Herb**		**P**	
Oxalidaceae	*Oxalis*	*sp.*			native	Herb	P		

FAMILY	GENUS	SPECIES	COMMON NAME	CPW SPECIES	NATIVE/EXOTIC	TYPE	PLOT 1	PLOT 2	PLOT 3
	Oxalis	*sp.*			exotic	Herb			1
Phormiaceae	*Dianella*	*caerulea*	Blue Flax-lily		native	Herb			1
Phyllanthaceae	***Phyllanthus***	***virgatus***		**Yes**	**native**	**Herb**	**P**		
Pittosporaceae	***Bursaria***	***spinosa***	**Boxthorn**	**Yes**	**native**	**Shrub**	**P**	**P**	**1**
Plantaginaceae	*Plantago*	*lanceolata*	Lamb's Tongue		exotic	Herb	P	P	2
	Aristida	***sp.***	**Threeawn Speargrass**	**Yes**	**native**	**Grass**			**2**
	Austrodanthonia	***racemosa var. racemosa***	**Wallaby Grass**	**Yes**	**native**	**Grass**	**P**		
	Austrodanthonia	***sp.***	**Wallaby Grass**	**Yes**	**native**	**Grass**			
	Bothriochloa	***sp.***		**Yes**	**native**	**Grass**	**P**		
	Briza	*minor*	Quaking Grass		exotic	Grass	P		1
	Briza	*subaristata*			exotic	Grass	P		P
	Bromus	*catharticus*	Prairie Grass		exotic	Grass	P	P	1
	Cynodon	*dactylon*	Couch		native	Grass	4b		
	Dichelachne	*micrantha*	Plumegrass		native	Grass			
	Dichelachne	***sp.***		**Yes**	**native**	**Grass**	**P**	**P**	
	Ehrharta	*erecta*	Panic Veldtgrass		exotic	Grass		4b	
	Entolasia	*marginata*	Bordered Panic		native	Grass		P	
	Eragrostis sp.			**Yes**	**Exotic**	**Grass**		**P**	
	Lolium	*perenne*	Perennial Ryegrass		exotic	Grass		P	
	Lolium	*rigidum*	Wimmera Ryegrass		exotic	Grass	P	P	
	Microlaena	***stipoides***	**Weeping Grass**	**Yes**	**native**	**Grass**	**5**	**5**	**3**
Poaceae	*Oplismenus*	*aemulus*			native	Grass			1

FAMILY	GENUS	SPECIES	COMMON NAME	CPW SPECIES	NATIVE/EXOTIC	TYPE	PLOT 1	PLOT 2	PLOT 3
	Paspalum	*dilatatum*	Paspalum		exotic	Grass	P		
	Pennisetum	*clandestinum*	Kikuyu		exotic	Grass	P	P	4b
	Phalaris	*sp.*			exotic	Grass	P		
	Sporobolus	***creber***	**Western Rat-tail Grass**	**Yes**	**native**	**Grass**	**P**		
	Sporobolus	***elongatus***	**Slender Rat-tail Grass**	**Yes**	**native**	**Grass**			**1**
	Sporobolus	*sp.*			native	Grass	P		
	Themeda	***australis***	**Kangaroo Grass**	**Yes**	**native**	**Grass**	**P**		
Polygonaceae	*Rumex*	*crispus*	Dock		exotic	Herb	P		
Rosaceae	*Rubus*	*fruticosus*	Blackberry		exotic	Shrub			2
Sapindaceae	***Dodonaea***	***viscosa subsp. cuneata***	**Wedge-leaf Hop-bush**	**Yes**	**native**	**Shrub**		**2**	
	Solanum	*nigrum*	Blackberry Nightshade		exotic	Shrub			
Solanaceae	***Solanum***	***prinophyllum***	**Forest Nightshade**	**Yes**	**native**	**Herb**		**P**	
	Lantana	*camara*	Lantana		exotic	Shrub		P	4b
	Verbena	*bonariensis*	Purpletop		exotic	Herb	P		
Verbenaceae	*Verbena*	*sp.*			exotic	Herb			2
						Total sp.	**48**	**45**	**35**
						Total CPW sp.	**18**	**18**	**12**

P = present; Ab. = Absent; C = Cover A = Abundance;; 1: <5% (rare); 2 = <5% (uncommon); 3 = <5% (common); 4a = <5% (Abundant); 4b = 5-25%; 5 = 25-50%; 6 = 50-75%; 7 = 75-100%)

FAUNA

CLASS	FAMILY	GENUS	SPECIES	COMMON NAME	NATIVE/EXOTIC
Amphibia	Hylidae	*Litoria*	*fallax*	Eastern Dwarf Tree Frog	Native
	Myobatrachidae	*Crinia*	*signifera*	Common Eastern Froglet	Native
Aves	Artamidae	*Gymnorhina*	*tibicen*	Australian Magpie	Native
	Cacatuidae	*Cacatua*	*galerita*	Sulphur-crested Cockatoo	Native
	Columbidae	*Ocyphaps*	*lophotes*	Crested Pigeon	Exotic
	Corvidae	*Corvus*	*coronoides*	Australian Raven	Native
	Meliphagidae	*Manorina*	*melanocephala*	Noisy Miner	Native
	Sturnidae	*Acridotheres*	*tristis*	Common Myna	Exotic
Mammalia	Bovidae	*Bos*	*taurus*	European Cow	Exotic
	Equidae	*Equus*	*ferus subsp. caballus*	Horse	Exotic

Appendix C: Anabat Analysis – Blacktown, NSW.

Bat calls were analysed using the program AnalookW (Version 3.3q 03 October 2006, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al. 2004); and south-east Queensland and north-east New South Wales (Reinhold et al. 2001) and the accompanying reference library of over 200 calls from north-eastern NSW (http://www.forest.nsw.gov.au/research/bats/default.asp).

Bat calls are analysed using species-specific parameters of the call profile such as call shape, characteristic frequency, initial slope and time between calls (Rienhold et al. 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd et. al. 2006) were followed:

1. Recordings containing less than three pulses were not analysed (Law et al. 1999).

2. Only search phase calls were analysed (McKenzie et al. 2002).

3. Four categories of confidence in species identification were used (Mills et al. 1996):

    a. definite – identity not in doubt

    b. probable – low probability of confusion with species of similar calls

    c. possible – medium to high probability of confusion with species with similar calls; and

    d. unknown – calls made by bats which cannot be identified to even a species group.

4. Nyctophilus spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay et al. 2004).

A total of 199 Anabat sequences were submitted for analysis from recordings made during the nights of 24 November and 6 December 2010 at Blacktown, NSW. Due to mechanical issues the recording from December 6th were not able to be analysed. There were 100 (50%) sequences that did not contain any microbat calls. Forty calls (20%) were unable to be positively identified to species or genus level due to the low quality or short length of the sequences. Fifty-nine (30%) of the sequences could be identified confidently to species or genus level (**Tables C1** and **C2**). The calls of four species, including two threatened species, were identified in the Blacktown recordings. Example call profiles for these species are shown below.

The calls of *Falsistrellus tasmaniensis* often display very similar characteristics to other species such as *Scotorepens orion*, *S. greyii* and *S. sp* as well as *Scoteanax rueppellii*. Calls of *F. tasmaniensis* were distinguished by the characteristic frequency, frequency of the knee, lack of an up-sweeping tail and length of pre-characteristic section.

The calls of *Miniopterus schreibersii oceanensis* can often display very similar characteristics to other species such as *Vespadelus darlingtonii* and *Vespadelus regulus*. Calls of *M. s. oceanensis* were distinguished by the irregular pulse shape and time between calls, lack of an up-sweeping tail and drop in frequency of the pre-characteristic section of more than 2 kHz.

The most commonly recorded species was *Chalinolobus gouldii*, followed by fewer than 10 calls each of *C. morio, M. s. oceanensis*, and *F.tasmaniensis*. Call sequences indicative of foraging activity (feeding buzzes) were occasionally recorded. There were no calls recorded during dusk which suggests that microbats were not roosting nearby. Relative microbat activity levels, as estimated by number of Anabat call sequences recorded, were low to moderate.

Table C1: Results from Anabat 1, with threatened species highlighted in grey.

Date	Species Name	Common Name	Number of calls	Definite	Probable	Possible
24/11/2010	*Chalinolobus gouldii*	Goulds Wattled Bat	42	42		
24/11/2010	*Chalinolobus morio*	Chocloate Wattled Bat	2	1	1	
24/11/2010	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	1		1	
24/11/2010	*Miniopterus schreibersii oceanensis*	Eastern Bent-wing Bat	4			
24/11/2010	Junk		52			
24/11/2010	Low quality calls		13			
24/11/2010	Calls too short to identify		18			
		Total Anabat sequences	132			

Table C2: Results from Anabat 2, with threatened species highlighted in grey.

Date	Species Name	Common Name	Number of calls	Definite	Probable	Possible
24/11/2010	*Chalinolobus gouldii*	Goulds Wattled Bat	1			
24/11/2010	*Chalinolobus morio*	Chocloate Wattled Bat	8			
24/11/2010	*Falsistrellus tasmaniensis*	Eastern False Pipistrelle	1			1
24/11/2010	Junk		27			
24/11/2010	Low quality calls		5			
24/11/2010	Calls too short to identify		4			
		Total Anabat sequences	46			

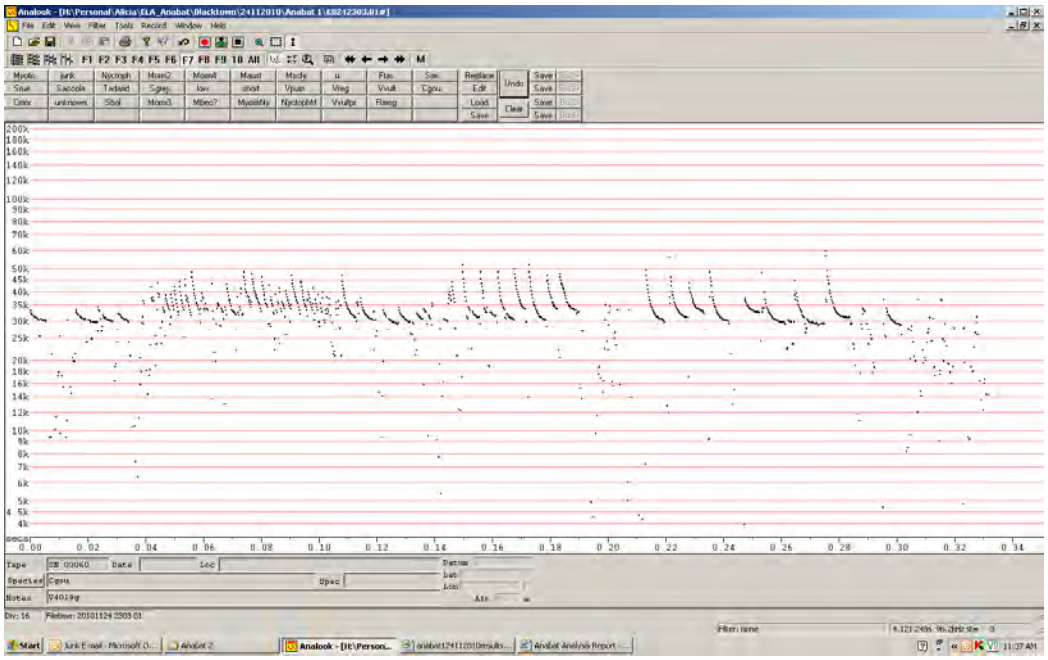

Figure C1: Call profile of *Chalinolobus gouldii* recorded at 23:03h on 24 November 2010, Blacktown, NSW.

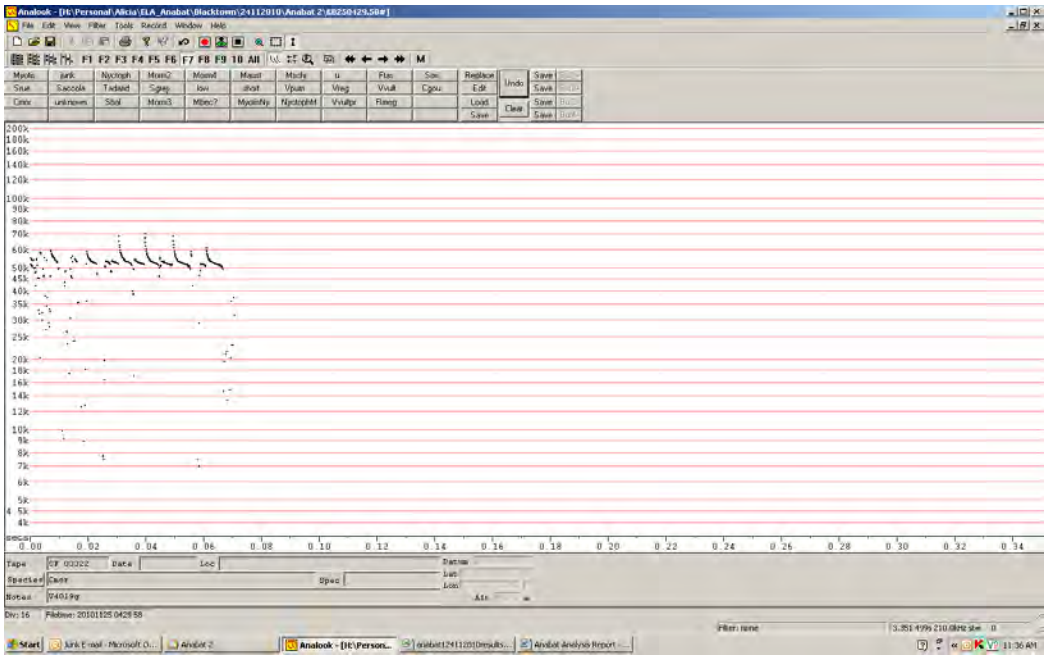

Figure C2: Call profile of *Chalinolobus morio* recorded at 04:29h on 25 November 2010, Blacktown, NSW.

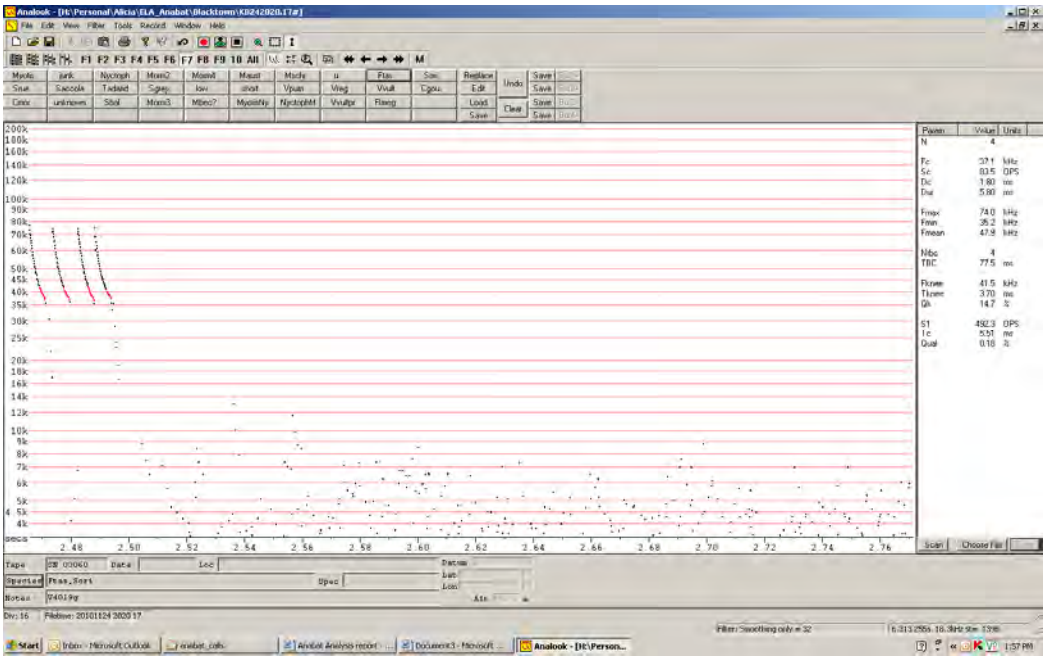

Figure C3: Probable call profile of the threatened *Falsistrellus tasmaniensis* (Vulnerable, TSC Act) recorded at 20:20h on 24 November 2010, Blacktown, NSW.

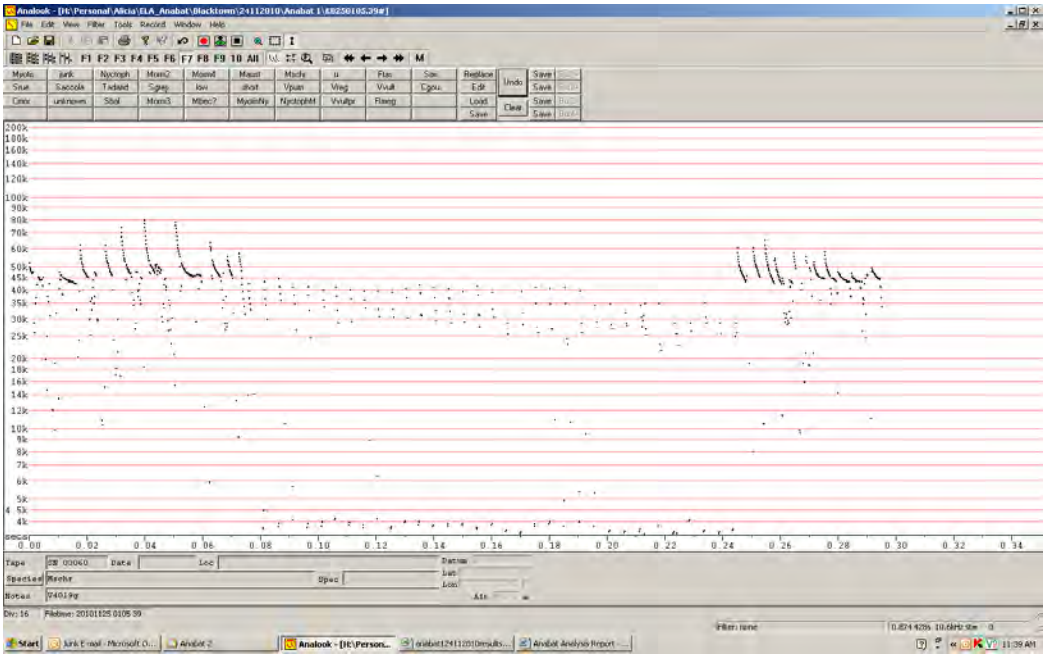

Figure C4: Call profile of the threatened *Miniopterus schreibersii oceanensis* (Vulnerable, TSC Act), showing distinctive lower frequency post-feeding buzz recorded at 01:05h on 25 November 2010, Blacktown, NSW.

Appendix D: Assessments of Significance

The following assessments of significance have been made to determine if the proposed development will significantly impact on threatened species, populations or ecological communities, in accordance with NSW 'Draft Guidelines for the Threatened Species Assessment' (DEC and DPI 2005), for developments under Part 3A, *Environmental Planning and Assessment Act 1979*, and the Commonwealth 'Significant impact guidelines 1.1' (DEWHA 2008), under the *Environment Protection and Biodiversity Conservation Act 1999*.

State Significance Criteria (DEC and DPI 2005)

Cumberland Plain Woodland

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

N/A

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

a) disturbs any permanent, semi-permanent or ephemeral water bodies;

The proposed works will involve the removal of four small farm dams, and the replacement of this resource with a large retention basin which is to vegetated with wetland flora species.

b) degrades soil quality;

N/A

c) clears or modifies native vegetation;

The proposed action will clear and modify native vegetation that forms part of the Cumberland Plain Woodland (CPW) ecological community. The proposal will result in the loss of 0.78 ha of CPW from a total 2.33 ha at the Subject Site. The implementation of a Vegetation Management Plan for the Subject Site will however include the clearing of weeds (including noxious weeds, Asparagus asparagoides, Bryophyllum delagoense, Lantana camara and Olea europaea var cuspidata) and the revegetation of currently degraded areas with species native to the CPW.

d) introduces weeds, vermin or feral species or provides conditions for them to increase and/or spread;

The area of CPW is already heavily infested with weeds as outlined in this report, The proposed action is not likely introduce further weeds or feral animals, on the contrary it will involve the removal of all weeds within the CPW remnants and revegetation where necessary with CPW flora through the implementation of a VMP.

Given the future proposed land use of the site, it likely there will be a reduction in the numbers of any feral animals at the site (e.g. European rabbits and foxes).

e) removes or disturbs key habitat features such as trees with hollows, caves and rock crevices, foraging habitat;

The remnant trees of the CPW will mostly remain intact, subject to health and vigour assessments of a qualified Arborist. The remaining trees in the remnant CPW do not contain hollows. Other habitat features of the area include fallen timber and grassy foraging areas, though they are not considered to provide a significant habitat resource for native fauna.

f) affects natural revegetation and recolonisation of existing species following disturbance;

The proposal will affect the recolonisation of CPW native flora species, as the area will be managed as a theme park.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution? N/A

How is the proposal likely to affect current disturbance regimes?

a) *modifies the intensity and frequency of fires;* N/A. It is likely that this area hasn't been burnt for 75+ years, as such there will be no change to disturbance regime.

b) *modifies flooding flows.* N/A. The northern remnant is subject to intermittent localised flooding, though the vegetation is not reliant on flooding as a matter of survival.

How is the proposal likely to affect habitat connectivity?

a) creates a barrier to fauna movement;

The fauna assemblage recorded at the site consists of species common to the urban environment, and whilst the proposal will alter the habitat by removing grasslands and removing ~33% of the existing woodland, the proposed alterations are not likely to create a barrier to the movement of this fauna.

b) removes remnant vegetation or wildlife corridors;

The proposal will remove remnant CPW, though the retained remnants will be incorporated into the final landuse. The area is not a wildlife corridor.

c) modifies remnant vegetation or wildlife corridors.

The proposal will modify the remnant vegetation by removing exotic flora species and revegetating with native CPW flora. A Vegetation Management Plan (to be produced) will recommended that plantings are sympathetic to the indigenous vegetation of the area, with planting palettes suggested.

How is the proposal likely to affect critical habitat? N/A. The area is not identified as Critical Habitat.

Conclusions:

With the above factors considered, impacts to the Cumberland Plain Woodland Critically Endangered Ecological Community, are not judged to be significant to the community as a whole. This judgement takes into account the isolated nature of the remnant, the degraded state of the remnant, the current landuses surrounding the remnant and its viability in the near to medium term.

Common, Eastern or Large Bent-wing Bat – *Miniopterus orianae* (sensu lat. *M. schreibersii oceanensis*)

The Eastern Bent-wing Bat is a wide ranging species and is essentially an obligate cave rooster (although it sometimes roosts in disused mines) that utilises a wide variety of habitats for foraging (Churchill 1998). The Eastern Bent-wing Bat hunts above forested areas, feeding upon moths and other flying insects above the tree tops (DECCW 2010).

This species was recorded flying over the site in 2010 (ELA 2010). No roosting caves are recorded on or near the site (DECCW 2010b).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

a) *displaces or disturbs threatened species and/or populations:* N/A. This species was recored at the site, but is most likely a flyover as there is no cave habitat at the sie.

b) *disrupts the breeding cycle:* N/A. There are no breeding populations recorded at the Subject Site.

c) *disturbs the dormancy period:* N/A

d) *disrupts roosting behaviour:* N/A

e) *changes foraging behaviour:* N/A

f) *affects migration and dispersal ability:* N/A

g) *disrupts pollination cycle:* N/A

h) *disturbs seedbanks and i) disrupts recruitment (ie. germination and establishment of plants);* N/A

j) *affects the interaction between threatened species and other species in the community (eg. pollinators, host species, mychorrizal associations):* N/A

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

As discussed above, it is likely that this species uses the site for foraging, but given there is no roosting habitat onsite the proposal is considered unlikely to affect the habitat of Eastern Bent-wing Bat.

a) *disturbs any permanent, semi-permanent or ephemeral water bodies:* N/A

b) *degrades soil quality:* N/A

c) *clears or modifies native vegetation:* N/A. The amount of vegetation proposed for removal is <0.03% within the Study Area (i.e. within 10 kms).

d) *introduces weeds, vermin or feral species or provides conditions for them to increase and/or spread:*

The area of CPW is already heavily infested with weeds as outlined in this report, The proposed action is not likely introduce further weeds or feral animals, on the contrary it will involve the removal of all

weeds within the CPW remnants and revegetation where necessary with CPW flora through the implementation of a VMP.

Given the future proposed land use of the site, it likely there will be a reduction in the numbers of any feral animals at the site (e.g. European rabbits and foxes).

e) *removes or disturbs key habitat features such as trees with hollows, caves and rock crevices, foraging habitat:* N/A

f) *affects natural revegetation and recolonisation of existing species following disturbance:* N/A. See above.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

No.

How is the proposal likely to affect current disturbance regimes?

The current disturbance regime of horse grazing will cease as the Subject Site is developed. There is no disturbance regime in the Wooded Remnants of CPW, though the area will be modified through positive management actions to be outlined in a VMP.

a) *modifies the intensity and frequency of fires:* N/A

b) *modifies flooding flows:* N/A

How is the proposal likely to affect habitat connectivity?

a) *creates a barrier to fauna movement;* N/A

b) *removes remnant vegetation or wildlife corridors; and c) modifies remnant vegetation or wildlife corridors.*

As discussed above, the removal of ~33% (0.78 ha) of the woodland onsite is not considered likely to affect habitat connectivity as the site is already fragmented and remnants to be retained will see an improvement in the vegetation condition over time as a VMP is implemented.

How is the proposal likely to affect critical habitat?

N/A. The area is not identified as critical habitat.

Conclusions:

As discussed above, it is considered unlikely that Eastern Bent-wing Bat uses the Project Site or is likely to colonise the existing remnant vegetation, and as such there can be significant impact to this threatened species by the proposed works.

Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) – Vulnerable (TSC Act)

The Eastern False Pipistrelle is listed as vulnerable under Schedule 2 of the NSW *Threatened Species Conservation Act 1995*. The species is wide-ranging, occurring along the southeast coast of Australia with records from South East Queensland, New South Wales, Victoria and Tasmania.

The species occurs in sclerophyll forests from the Great Dividing Range to the coast, and generally prefers wet habitats where trees are more than 20 m high. Roosting occurs in hollow trunks of eucalypt trees, usually in single sex colonies, but the species has been recorded roosting in caves under loose bark and occasionally in old wooden buildings (Churchill 1998). Their flight pattern is high and fast and they forage within or just below the tree canopy. They feed on a variety of prey including moths, rove beetles, weevils, plant bugs, flies and ants.

This species is threatened by a number of processes including loss of trees for foraging and hollow-bearing trees for roosting, disturbance to winter roosting and breeding sites, and application of pesticides in or adjacent to foraging areas (DECC 2005).

The Eastern False Pipistrelle was recorded during the field surveys but this species was only recorded twice, once as a 'probable' and once as a 'possible'. Suitable foraging habitat and was observed at the site though potential roost sites (hollow-bearing trees) were not.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Factors likely to have an adverse effect on the life cycle of the Eastern False Pipistrelle would include a substantial loss and/or fragmentation of foraging habitat and a loss of suitable roosting or breeding habitat.

i) displaces or disturbs threatened species and/or populations: N/A. This species was not common at the site, though there is ample habitat in the neighbouring Prospect Nature Reserve for it to forage/roost. and is most likely a flyover as there is no cave habitat at the sie.

j) *disrupts the breeding cycle:* N/A. There are no breeding populations recorded at the Subject Site.

k) disturbs the dormancy period: N/A

l) disrupts roosting behaviour: N/A

m) changes foraging behaviour: N/A

n) affects migration and dispersal ability: N/A

o) disrupts pollination cycle: N/A

p) disturbs seedbanks and i) disrupts recruitment (ie. germination and establishment of plants); N/A

k) affects the interaction between threatened species and other species in the community (eg. pollinators, host species, mychorrizal associations): N/A

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

As discussed above, it is likely that this species uses the site in any great abundance, as it was only recorded twice during the survey period and only as 'possible' or 'probably' recordings, and given there is no roosting habitat onsite the proposal is considered unlikely this species.

g) disturbs any permanent, semi-permanent or ephemeral water bodies:

The proposal will require the removal of four farm dams at the Subject Site, though these will be replaced by a large water retention basin at the centre of the site, providing for a watering site and potential small insects for feeding.

h) degrades soil quality: N/A

i) clears or modifies native vegetation: N/A. The amount of vegetation proposed for removal is <0.03% within the Study Area (i.e. within 10 kms).

j) introduces weeds, vermin or feral species or provides conditions for them to increase and/or spread:

The area of CPW is already heavily infested with weeds as outlined in this report, The proposed action is not likely introduce further weeds or feral animals, on the contrary it will involve the removal of all weeds within the CPW remnants and revegetation where necessary with CPW flora through the implementation of a VMP.

Given the future proposed land use of the site, it likely there will be a reduction in the numbers of any feral animals at the site (e.g. European rabbits and foxes).

k) removes or disturbs key habitat features such as trees with hollows, caves and rock crevices, foraging habitat: N/A

l) *affects natural revegetation and recolonisation of existing species following disturbance:* N/A. See above.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

No.

How is the proposal likely to affect current disturbance regimes?

The current disturbance regime of horse grazing will cease as the Subject Site is developed. There is no disturbance regime in the Wooded Remnants of CPW, though the area will be modified through positive management actions to be outlined in a VMP.

c) modifies the intensity and frequency of fires: N/A

d) *modifies flooding flows:* N/A

How is the proposal likely to affect habitat connectivity?

c) creates a barrier to fauna movement; N/A

d) removes remnant vegetation or wildlife corridors; and c) modifies remnant vegetation or wildlife corridors.

As discussed above, the removal of ~33% (0.78 ha) of the woodland onsite is not considered likely to affect habitat connectivity as the site is already fragmented and remnants to be retained will see an improvement in the vegetation condition over time as a VMP is implemented.

How is the proposal likely to affect critical habitat?

N/A. The area is not identified as critical habitat.

Conclusions:

The proposal is unlikely to impose a significant effect on Eastern False Pipistrelle given that:

- the proposed works would only disturb a small area of foraging habitat within the study area;
- the proposed works would not disturb any hollow bearing trees ; and
- larger areas of more suitable foraging habitat are present within the surrounding landscape.

On the basis of the above considerations, it is not likely that the proposal will result in a significant effect on the survival of Eastern False Pipistrelle.

EPBC ACT ASSESSMENT OF SIGNIFICANCE

Cumberland Plain Woodland

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

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

The current proposal will reduce the extent of the CEEC by approximately <0.03%, within the Study Area (i.e. within 10 km).

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

N/A. No significant fragmentation will take place due to the current proposal.

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

N/A. The area of proposed clearing is not critical to the survival of this ecological community.

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

There will no substantial change to the groundwater or abiotic factors at the Subject Site.

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

There will be a positive change in the species composition as a result of the proposal due to the implementation of Vegetation Management Plan, which reduce exotics flora species and revegetate with native CPW flora.

- **cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:**
    - **assisting invasive species, that are harmful to the listed ecological community, to become established, or**
    - **causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community, or**
    - **interfere with the recovery of an ecological community.**

No. The proposal will not result in any of the above.

Conclusion

the current proposal is unlikely to have a significant impact on the CEEC, as:

- it involves the removal of only 0.78 ha of CPW
- the retained CPW at the site will be managed through the implementation of a VMP
- the VMP will reduce the prevalence of exotic and noxious weeds in the immediate area and supplement this with the revegetation of these areas with local provenance CPW flora.

Given the above conclusions, it will not be necessary to make a Referral to the Commonwealth DSEWPAC, as it unlikely the proposal will be deemed a 'controlled action'.

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