Revised Flora and Fauna Assessment

Warriewood STP Buffer Area 3
Proposed Residential Development

Total Earth Care Pty Ltd
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1 INTRODUCTION

Meriton Apartments is proposing the development of a site within Warriewood STP Buffer Area 3, located at the corner of Boondah Rd and MacPherson St, Warriewood Valley. This project has been declared a Part 3A Major Project under the Environmental Planning & Assessment Act 1979, and Meriton has previously submitted a Concept Application to the Department of Planning (DoP). The submitted Environmental Assessment has been reviewed by the DoP and comments on the application have been received by Meriton. This Flora and Fauna assessment is an update of the previously submitted report, and considers the impacts of the revised development proposal on the local environment, and addresses the comments received from DoP, as well as issues contained in the responses from the NSW Department of Environment, Climate Change and Water (DECCW) and the NSW Office of Water (NOW).

Based on comments received, Meriton has revised the design of the development, which now includes the construction of 16 residential buildings, providing 559 apartments. The Stage 1 Project option is for 264 units with Stage 2 for the remaining 295 units. The development also includes internal roadways, landscaped areas, asset protection zones, core riparian zone, vegetation buffer zones and the retention of significant native vegetation where possible.

Total Earth Care has been engaged previously by Meriton Apartments to conduct Flora and Fauna Survey and Assessments associated with Development Applications lodged with Pittwater Council in the past for the same site. In August 2003 Meriton Pty Ltd engaged Total Earth Care Pty Ltd (TEC) to carry out a flora and fauna survey and assessment on several land parcels at the corner of MacPherson St and Boondah Road, Warriewood Valley. Field survey for the assessment was carried out in August 2003 and the subsequent *Flora and Fauna Assessment Warriewood STP Buffer Sector 3, Proposed Residential Subdivision Master Plan* report was issued in January 2004 (TEC, 2004). This 2004 flora and fauna report assessed the potential impacts of the rezoning of the subject site in consideration of the flora and fauna recorded from the site during the field survey and potential habitat available for threatened biodiversity previously recorded from the locality.

An additional aspect of the 2004 report was survey and mapping in conjunction with Pittwater Council to better define the edge of the Warriewood Wetland at or adjoining the southern boundary of the subject site. This agreed wetland edge defines the extent of the high conservation habitat mapped on-site by Pittwater Council. The wetland buffer widths, developed to reduce the potential impacts of a future development upon the wetland, as described in the 2004 report have been maintained through the various proposals for the site, and the current plans include the same setbacks and buffers as established at that time, and subsequently approved by Council. These zones are further discussed in sections of this report below.

The 2004 report was updated in May 2006 to include additional targeted field survey and the amended report was submitted as part of a rezoning application to Pittwater Council for the site. Development Consent (NO615/04) was granted by Pittwater Council for the consolidation of several existing lots into one larger lot. The subject site is now referred to collectively as Lot 20 DP 1080979.

Meriton Apartments had previously investigated a proposal under the *State Environmental Planning Policy (SEPP) Housing for Seniors or People with a Disability*, for the construction of between 14 and 15 buildings on the site. TEC was approached in April 2008 by Flower and Samios Architects, acting as an agent for Meriton Apartments, to revise the flora and fauna assessment. The SEPP Seniors Living proposal however did not proceed.

1.1 Proposed Development Description

The current proposal comprises a multi-storey residential development as described above, and the subject site located in the suburb of Warriewood on Sydney's northern beaches (Figure 1, Appendix

B). The boundary of the subject site and the existing land use is shown in Figure 2, Appendix B. The general arrangement of the development proposal, including proposed building footprints, roads and stormwater/drainage works can be seen in Figure 3 (Appendix B). The current development plan includes the following key design measures (Figure 4, Appendix B) related to the retention, protection, restoration and enhancement of environmental features. These zones and associated zone widths have been retained as part of the current proposal as they were approved by Pittwater Council as part of a previous Part 4 Development Application (DA 526/08).

The current design proposal retains and protects additional areas of remnant native vegetation than the Part 3A application previously submitted, and revegetation works are proposed within sections of the Core Riparian Zone, along the Fern Creek Corridor and within the proposed Flood Storage Area in order to offset the vegetation clearing that is proposed. In addition, all infrastructure has now been relocated out of the 20m Core Riparian Zone, and the majority out of the Vegetated Buffer as far as possible, with the exception of Bio-retention Basin B.

The zones that were previously approved, and have been retained in the current proposal are:

- **Core Riparian Zone (CRZ):** retention of a 20 metre-wide core riparian zone (referred to as the CRZ) along the southern boundary of the site measured from the agreed wetland edge (as requested by Pittwater Council in the pre Development Application meeting for the previous proposal held on the 17th March 2008);
- **Public Riparian Zone:** Creation of a 50 metre-wide Public Riparian Zone associated with Fern Creek along the western boundary. This buffer is consistent with the Pittwater Council P21 Development Control Plan Section C6.7.
- **10m Vegetated Buffer (VB):** Where available, retention and/or creation of a 10 metre-wide vegetation buffer to directly adjoin the CRZ. This buffer is to protect the boundary of Warriewood Wetland and is required under the Pittwater 21 Development Control Plan (P21 DCP) Section B4.14. This buffer was negotiated between Council and the former DIPNR (now DECCW) in 2003 and is maintained in the current proposal (as requested by Pittwater Council in the pre Development Application meeting for the previous proposal held on the 17th March 2008);
- **25m Buffer Strip:** Were available, creation of a 25 metre-wide Buffer Strip to directly adjoin the Public Riparian Zone to the east. This buffer strip is required under the P21 DCP Section C6.7.
- **Asset Protection Zone (APZ):** Creation of a 25 metre-wide APZ along the southern boundary of the site located outside of the Core Riparian Zone. The APZ will consist of a 15m Inner Protection Area (IPA) and 10m Outer Protection Area (OPA), with the OPA located within the VB. This APZ is a requirement of State legislation and the Rural Fire Service (RFS) as the site has been identified as bushfire prone land.

The current proposal also includes the retention of larger areas of Endangered Ecological Communities. Areas of remnant native vegetation which are representative of components of the endangered ecological communities Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion (SSF) and Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion (SFW) will be retained and regenerated where located outside the development zone. These areas are mainly contiguous with Warriewood Wetland and located within the proposed CRZ and VB areas, although an area located between the wetland and Boondah Rd between Buildings O and roadway 01 adjoining building N will also be retained. This zone will form a vegetated link through the site, maintaining a connection to habitat located across Boondah Road within the Sydney Water site and Warriewood Wetlands. The proposal will also require clearing of a section of SSF, and the impacts of this and proposed remediation and offset measures are discussed further within the report.

The design of the Flood Storage Area has also been modified in order to limit earthworks within this zone, and the zone will be revegetated using species that are characteristic of the adjoining remnant native vegetation communities.

2 AIMS

The aims of the current report are to update the previous flora and fauna assessment (TEC 2010), in accordance with the Director General's Requirements dated 23/12/09 and comments received from DoP, DECCW and NOW. The aims are to:

- Confirm the presence or likely occurrence of threatened species, populations and ecological communities (or their habitats), as listed under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act* 1999 and *NSW Threatened Species Conservation (TSC) Act* 1995;
- Address the significance of potential direct and indirect impacts on flora and fauna, including threatened species, populations or endangered ecological communities or their habitats, including off site impacts to Warriewood Wetlands;
- Make recommendations to avoid-mitigate-compensate (offset) the identified impacts; and;
- Clearly set out environmental management measures that are to be implemented before, during and after construction. This includes the implementation of measures to protect and rehabilitate Fern Creek, Warriewood Wetlands area and the CRZ and VB within the riparian corridor.

3 METHODS

3.1 Desktop Research

Prior to field surveys, records of all threatened species, populations and endangered ecological communities previously recorded within 5 kilometres of the subject site (10km locality search) were obtained from the Department of Environment, Climate Change and Water (DECCW) Wildlife Atlas database, and the Federal Environment Department Protected Matters search tool. All previous reports and plans relating to the site were reviewed including the Flora and Fauna Assessment Reports (TEC 2004, 2006, and April 2008). Additionally, a review of all updated plans and reports relating to the site, relevant legislation, recent vegetation mapping and other documentation were reviewed, including:

- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (Draft) (DECCW 2009a); and
- Broad-scale mapping of the Sydney 1:100,000 map sheet by Benson and Howell (1994).
- *Arboricultural Assessment/Vegetation Management Report* (TALC 2008);
- Landscape Master Plans (Landscape Direct 2009);
- *Guidelines for Controlled Activities: Riparian Corridors* (DWE 2008);
- *NSW State Rivers and Estuaries Policy (*NSW WRC 1993);
- *NSW Wetlands Management Policy (DL & WC 2000);* and
- *Groundwater Dependent Ecosystems.*

3.2 Previous Survey and Assessments

The submitted flora and fauna assessment was based on the results of previous survey effort conducted within the study area. Following comments received from DECCW, an additional flora survey was conducted on site on the 6th August 2010, focussing on the type and extent of vegetation communities currently occurring within the study area. The previous survey included the use of nocturnal and diurnal survey methods and the survey effort, including the most recent flora survey, has been summarised in Table 1below. Floristic surveys for the subject site have been conducted as per the general outline below;

- the identification of native and exotic plant species according to *Field Guide to the Native Plants of Sydney* (Robinson 2003) and the *Flora of NSW* (Harden 1992, 1993, 2000, 2002), with reference to recent taxonomic changes;
- the identification and mapping of plant communities (where present) according to the structural definitions of Specht & Specht (1999), and reference to previous broad-scale mapping of the Sydney 1:100,000 map sheet by Benson & Howell (1994) and the *Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (Draft) (DECCW 2009a) vegetation mapping;
- identification of vegetation communities using three 400m^2 quadrats using a modified Braun-Blanquet to record percentage cover score, with reference to the *Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (Draft) (DECCW 2009a) vegetation community profiles: and
- targeted searches for plant species of conservation significance according to the "random meander" method (Cropper 1993).

The conservation significance of plant species and plant communities was determined according to:

- TSC Act for significance within NSW; and
- EPBC Act for significance within Australia.

Previous fauna survey included both nocturnal and diurnal survey techniques (Table 1). Nocturnal surveys involved call playback, spotlighting throughout the site and specifically targeting of potential habitat of threatened fauna previously recorded in the locality. An AnaBat Detector was placed in potential micro-bat flyways and left out for the duration of the survey. Targeted fauna species during nocturnal survey included (but were not limited to) Powerful Owl, Barking Owl, Masked Owl, Southern Brown Bandicoot, and Squirrel Glider.

The diurnal surveys involved observations of animal activity, habitat identification and searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings). Surveys for avifauna and amphibians involved visual detection and aural recognition of bird and frog calls.

The conservation significance of fauna species and populations was determined at a State level according to the TSC Act and at a national level according to the EPBC Act.

All flora and fauna species, as well as fauna habitat types and evidence of fauna activity, were recorded and an inventory of species was compiled (Appendix A).

Table 1 14-18 Boondah Rd, Warriewood Flora & Fauna Survey Effort

Survey Dates	Survey Effort	Survey Methods	Weather
21st August 2003	Diurnal Survey Throughout Subject Site	*Floristic survey* – 'random meander' & target search for threatened species *Avifauna* – visual and aural recognition *Reptiles/ Amphibians* – active search in habitats; logs, rocks, litter & base of trees *Amphibians* - frog aural detection *Diurnal mammals* – active search for; tree hollows, nests, scats, tracks and scratches *Habitat Assessment* – potential habitats for identified threatened species	<u>Day</u> Mild daily temperatures 18-20^{o}C, light breeze and light cloud cover.

Table 1 cont' 14-18 Boondah Rd, Warriewood Flora & Fauna Survey Effort

	Nocturnal Survey	*Arboreal Species* - spotlighting for 2hrs. Stag/hollow watch at dawn 0.5hr *Owl Species* – Playback calls for threatened Powerful & Barking Owls – 5 min repeats *Microchiroptera* - AnaBat Detector in southern boundary adjacent to water body left over night total of 13hrs. Harp trap in potential micro-bat flyway overnight and checked during the night and removed at dawn.	Night Cool to mild, Temperature 14 – 16^{o}C
22nd August 2003	Diurnal Survey	*Avifauna – visual and aural recognition*	Morning Cool to mild Morning temperatures
3rd May 2006	Diurnal Survey	*Floristic survey – 'random meander' & target search for threatened species* *Avifauna – visual and aural recognition* *Amphibians - frog aural detection* *Diurnal mammals – active search for tree hollows, nests, scats, burrows, diggings, tracks and scratches* *Habitat Assessment – potential habitats for identified threatened species*	Day Mild, dry 20oC
	Nocturnal Survey	*Ground Species – target spotlighting for Southern Brown Bandicoot but limited to.* *Arboreal Species - spotlighting for 2hrs. Stag/hollow watch at dawn 0.5hr. Target search for Squirrel Glider.* *Owl Species – Playback calls for threatened Powerful & Barking Owls – 5 min repeats* *Microchiroptera - AnaBat Detector in southern boundary adjacent to water body left over night total of 13hrs. Harp trap in potential micro-bat flyway overnight and checked during the night and removed at dawn.*	Night Light breeze and low night light
4th May 2006	Diurnal Survey	*Avifauna – visual and aural recognition*	Morning Fine mild conditions, 17oC.

Table 1 cont' 14-18 Boondah Rd, Warriewood Flora & Fauna Survey Effort

Survey Dates	Survey Effort	*Survey Methods*	Weather
17th March 2008	Diurnal Survey	*Floristic survey* – 'random meander' & target search for threatened species *Avifauna* – visual and aural recognition *Reptiles/ Amphibians* – active search in habitats - logs, rocks, litter & base of trees *Amphibians* - frog aural detection *Diurnal mammals* – active search for tree hollows, nests, scats, tracks and scratches *Habitat Assessment* – potential habitats for identified threatened species	Day Mild temperature 25°C High night light
	Nocturnal Survey	*Ground Species* – target spotlighting for Southern Brown Bandicoot *Arboreal Species* - spotlighting for 2hrs. Stag/hollow watch at dawn 0.5hr. Target search for Squirrel Glider *Owl Species* – Playback calls for threatened Powerful & Barking Owls – 5 min repeats *Microchiroptera* - AnaBat Detector within possible Micro-bat flypath	Night Light breeze
	Diurnal Survey	Floristic survey – 'random meander' & target search for threatened species. Three 20m X 20m quadrats, recording % cover using a modified Braun-Blanquet score. Mapping the extent of vegetation communities.	*Day* *Mild, dry 17oC*

3.3 Limitations

Previous field surveys at the subject site have been conducted over one day and evening during autumn 2008, one day and one evening in autumn 2006 and two days and one evening in winter 2003 (TEC 2008; TEC, 2006; and TEC, 2004). It was considered that additional survey was not required for the previous report, however additional flora survey has been recently conducted to clarify vegetation communities within the site in response to agency comments.

However, the length of surveys and their timing mean that the full spectrum of flora and fauna species and ecological processes likely to occur on the site cannot be fully quantified or described in the reports. These limitations have been addressed by identifying potential habitats for such species and assessing the potential for these species to occur on the site based on previous records, the type and condition of habitats present, the land use of the site and its landscape context.

4 LANDSCAPE

4.1 Site Description

4.1.1 General

Warriewood STP Buffer Sector 3 is zoned 2 (f) Urban Purposes – Mixed Residential under the *Pittwater Local Environmental Plan 1997*. The site is located at the junction of Macpherson Street and Boondah Road, Warriewood, and is bounded by Boondah Road to the east, Warriewood Wetlands to the south, Warriewood Valley Sector 11 to the west and Macpherson Street to the north. The current land use is rural residential, with horse paddocks located at the rear of residential properties fronting Macpherson Street, as well as disused agricultural land, plantation, and light industrial premises on Boondah Road.

Surrounding land uses include low density residential to the north and current construction of an aged care facility, medium density housing to the west (Sector 11), and conservation to the south (Warriewood Wetlands). Warriewood Sewage Treatment Plant and a Sydney Water Maintenance Depot lie to the east, opposite the site across Boondah Road.

4.1.2 Soils

The site lies within land mapped on the Sydney 1:100,000 soil landscape sheet as “disturbed terrain” (Chapman *et al*., 1989), which is described as “level to plain hummocky terrain, extensively disturbed by human activity” (Chapman & Murphy 1989). The original soils are likely to have been subject to complete burial or removal from previous agricultural and silvicultural land use. This description is consistent with the surface conditions observed during field surveys, which indicate that major levelling and filling has occurring over the majority of the site, with near complete removal of vegetation in some areas, and changes to surface and subsurface drainage, through the construction of irrigation channels and the surrounding road and drainage systems.

The surrounding land throughout the Warriewood Valley is mapped as the Warriewood Soil Landscape Group (Chapman *et al*., 1989) which occurs on “level to gently undulating swales, depressions and infilled lagoons on Quaternary sands”. The Warriewood landscape group contains soils described as “deep, well sorted, sandy humus podzols and dark, mottled siliceous sands, overlying acid peats in depressions, and deep podzols and pale siliceous sands on sandy rises”. Soils within the Warriewood landscape are highly permeable and subject to localised flooding, waterlogging, and high water tables. These soils are possibly still present at the surface on some parts of the site, and most likely occur at subsoil levels beneath fill and exotic vegetation.

4.1.3 Topography and Aspect

The site is located within the Warriewood Valley, and on the margins of the Fern Creek floodplain. The site is characterised by gently sloping topography, bordered by moderately inclined slopes to the north and the flat low-lying terrain of the Warriewood Wetlands to the south. The site has low relief, with a south-westerly aspect.

The water table is located close to the surface across most of the site and some areas, particularly in the south, are subject to waterlogging and periodic inundation. Surface runoff drains mainly into low-lying areas in the southern and western parts of the site, as well into artificial drainage channels constructed in various locations (apparently as irrigation channels for previous agricultural activities). The site drains into Fern Creek, which at this location, forms a direct link in the Warriewood Wetlands close to the southern boundary of the site.

4.1.4 Vegetation

The site contains a mixture of exotic pasture grasses, planted trees, some horticultural garden plantings associated within the area of the adjoining residences and areas of remnant and regrowth native vegetation.

Most of the original vegetation of the site has been removed, and the majority of native bushland still present appears to have regenerated following previous clearing events, based on the relatively young age of most of the trees, except for vegetation close to the southern boundary of the site. Localised infestations of common herbaceous and woody weeds are present in disturbed parts of the site, with Lantana common throughout the understorey of the native vegetation and exotic grasses dominant within the Poplar Forest and margins of the native communities. Overall, the natural resilience of most of the site would be very low, with the exception of sections of native vegetation along the Warriewood Wetland boundary and within the remnant Swamp Sclerophyll Forest.

4.1.5 Habitat Corridors

Portions of the site are mapped as being part of a wildlife corridor as per the Pittwater Council mapping. The site is adjacent to Warriewood Wetlands which is mapped as a 'major habitat area', and this classification crosses into the boundary of the site along the central southern boundary. This classification extends into the existing Poplar Forest community area and in this area is not an accurate classification of the wetland area or significant habitat resources currently present. A Category 2 area has been mapped in the western corner of the subject site, along Fern Creek. Category 2 is defined as 'mostly cleared non-residential areas with good potential for improvement of habitat'. This classification is accurate and is reflected in the management proposed for this area under the current proposal.

The remainder of the subject site is classified as 'developed area' in the habitat corridor mapping, which is correct given the disturbed nature of the site. The riparian zones described briefly in Section 1.1 once established will provide for the protection of flora and fauna habitat and habitat corridor values, as required under the Pittwater 21 Development Control Plan (P21DCP) Section B4.4. In addition, it is recommended that the remnant vegetation located outside of the development footprint between the wetland and Boondah Rd is retained, regenerated and rehabilitated to contribute to fauna movement. The retained vegetation and restoration works within the riparian zones will help to protect the wetland from potential indirect impacts and maintain the value of the habitat as a wildlife corridor.

5 FLORA

5.1 Plant Species

As part of the current revision of the Flora and Fauna Report, more extensive floristic sampling was carried out in the form of three 20m x 20m quadrats (0.04 hectares in size) within those parts of the study area that have previously been mapped as containing native vegetation. Plant species cover abundance scores were collected using a modified Braun-Blanquet scale transformation scale as used by DECCW (2009b). This transformed score equates a series of Braun-Blanquet scales to a standardised scale of the whole numbers 1-6. A flora inventory for the site is provided in Appendix A that includes this most recent data, along with the 2004 random meander survey methodology data (TEC 2004). Characteristic species for the EECs Swamp Oak Forest (SOF), Swamp Sclerophyll Forest (SSF), Bangalay Sand Forest (BSF) and Freshwater Wetlands (FW) are also marked in this inventory.

A total of 145 plant species have been recorded on the site during the flora field surveys, including 69 native species and 76 exotic species. The quadrats assessed in August 2010 noted 48 species within the three 0.04 hectare quadrats, of which 29 were native species and 19 were exotic species. Many species found within the Cleared and Disturbed and Poplar Forest vegetation communities were horticultural introductions (i.e. planted) included exotic species. Noxious weeds were noted on the site, and those listed under the *NSW Noxious Weeds Act 1993* for the Pittwater LGA are listed below (Table 2).

Table 2 Plant species recorded within the study site listed under the *NSW Noxious Weeds Act 1993* for the Pittwater LGA (Order No.21).

Control Class[1]	Scientific Name	Common Name
4	*Acetosa sagittata*	Turkey Rhubarb
4	*Asparagus aethiopicus*	Asparagus Fern
3	*Cestrum parqui*	Green Cestrum
3	*Cortaderia selloana*	Pampas Grass
4	*Ipomoea indica*	Morning Glory
5	*Lantana camara*	Lantana
4	*Ligustrum lucidum*	Large-leaf Privet
4	*Ligustrum sinense*	Small-Leaf Privet
3	*Ludwigia peruviana*	Ludwigia, Water Primrose
4	*Parietaria judaica*	Pellitory of the Wall
4	*Rubus fruticosus* sp. agg.	Blackberry

5.2 Vegetation Communities

Previous broad-scale mapping of the Sydney 1:100,000 map sheet (Benson & Howell, 1994) has identified the subject site as not supporting a native plant community, with the Coastal Swamp Forest Complex occurring nearby to the north and south. Mapping of the native vegetation of Pittwater has identified the subject site as supporting the 'Lowland' plant community Pittwater Council (2008).

The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area, a vegetation community mapping project conducted by Department of Environment, Climate Change & Water (DECCW 2009a) has been released as a draft since the previous site survey. This project has mapped Coastal Sand Bangalay Forest and Coastal Sand Swamp Mahogany Forest occurring on the subject site. The remainder of the site is either unmapped, or considered to be weeds and exotic vegetation. Coastal Freshwater Reedland has been mapped to the south of the subject site within Warriewood Wetlands, while Coastal Flats Swamp Mahogany Forest is mapped to the east across Boondah Rd within the Sydney Water depot. The draft DECCW vegetation community mapping within the locality is provided in Figure 5, Appendix B).

These vegetation communities are considered to be components of endangered ecological communities, and four EECs that are listed in Part 3 of Schedule 1 of the TSC Act have been mapped on the south-eastern section of the subject site and in the surrounding area within Warriewood Wetlands and the Sydney Water depot to the east (DECCW 2009a). These EECs as mapped in the draft DECCW vegetation community are shown on Figure 6, Appendix B and are listed below;

- Bangalay Sand Forest of the Sydney Basin and South East Corner Bioregions;
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions; and
- Sydney Freshwater Wetlands in the Sydney Basin Bioregion.

[1] Class 1 State Prohibited Weeds. The plant must be eradicated from the land and the land must be kept free of the plant.
Class 2 Regionally Prohibited Weeds. The plant must be eradicated from the land and the land must be kept free of the plant.
Class 3 Regionally Controlled Weeds. The plant must be fully and continuously suppressed and destroyed.
Class 4 Locally Controlled Weeds. The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
Class 5 Restricted Plants. The requirements in the Noxious Weeds Act 1993 for a notifiable weed must be complied with.

Four plant communities were identified within the study site during the current survey, and they are as follows:

- Coastal Sand Swamp Mahogany Forest;
- Coastal Freshwater Reedland;
- Poplar Forest; and
- Cleared and Disturbed.

The distribution of plant communities identified in the current survey within the study site is shown in Figure 7 (Appendix B) and are described below. The 2009 DECCW mapping includes Coastal Sand Bangalay Forest within the study area, although it is not thought to occur within the subject site as discussed below within Section 5.4 Endangered ecological Communities.

Coastal Sand Swamp Mahogany Forest

Coastal Sand Swamp Mahogany Forest is located in the south east corner of the subject site. The canopy of this native plant community is dominated by Swamp Oak *Casuarina glauca* with Swamp Mahogany *Eucalyptus robusta* being secondarily dominant. The canopy is commonly to a height of between 15 and 20 metres, with Foliage Projective Cover (FPC) of approximately 60–70%. Regrowth Swamp Oak dominates the mid canopy with the understorey to 3 metres dominated by woody weeds including Lantana, Senna *Senna pendula* var. *glabrata* and Small Leaved Privet *Ligustrum sinense,* with native species such as Bleeding Heart *Homalanthus populifolius* and Cheese Tree *Glochidion ferdinandi* var. *ferdinandi* occurring occasionally or uncommonly, FPC is 60%. The groundcover stratum is also dominated by exotic species throughout this community with Asparagus Fern *Asparagus aethiopicus* and Whisky Grass *Andropogon virginicus* common. Native species present in the groundcover stratum include Mat Rush *Lomandra longifolia*, Bracken *Pteridium esculentum and* Batswing Fern *Histriopteris muelleri.*

Resilience of the Coastal Sand Swamp Mahogany Forest of the subject site varies from moderate to low. This community contains diagnostic species of a coastal floodplain endangered ecological community (EEC), Swamp Sclerophyll Floodplain Forest, which is listed under the TSC Act 1995.

Coastal Freshwater Reedland

Coastal Freshwater Reedland is a component of the EEC Freshwater Wetlands on Coastal Floodplain where it occurs on muds, sands, silts and loams associated with coastal floodplains (DECCW 2009a). Vegetation composition is typically sedges and reeds subject to periodically or semi-permanently inundated by freshwater. Some exposure to saline conditions is expected near the coast. The dense semi-aquatic vegetation acts as a natural buffer against erosion and surface water flow. Common species include; *Typha sp, Phragmites australis, Pseudoraphis spinescens* Spiny Mud Grass and *Carex appressa* Tall Sedge. The tree canopy is scare with some species from neighbouring communities co-existing such as Casuarina and Melaleuca species (DECCb 2008).

A small area of this community corresponding to the EEC is mapped in the current survey as occurring in the south-western part of the subject site. It is dominated by the characteristic species *Phragmites australis* which are growing under planted *Populus alba.* A simple groundlayer is dominated by the native grass *Entolasia marginata*, the native fern *Hypolepis muelleri,* and the exotic grass *Pennisetum clandestinum*. This community extends south across the site boundary and adjoins a grove of *Melalueca ericifolia* which has been mapped in the current report as Coastal Sand Swamp Mahogany Forest.

Poplar Forest

Planted White Poplars *Populus alba* form a large stand in on the southern and south-western boundary and north-east portion of the subject site (Figure 7, Appendix B). Canopy heights in the

Poplar Forest are approximately 20 metres and FPC is 10%. There is a very sparse understorey from 2 to 4 metres with FPC approximately 5%. Thickets of Lantana occur commonly in the understorey and other species include Senna *Senna pendula* var. *glabrata,* Blackberry *Rubus fruticosus complex* and Small Leaved Privet *Ligustrum sinense*. Native species in the understorey include Cheese Tree *Glochidion ferdinandi* var. *ferdinandi* and Cabbage Palm *Livistona australis* (uncommon). The groundcover stratum is to 1 metre and dominated by Kikuyu *Pennisetum clandestinum* and Whisky Grass *Andropogon virginicus.* Other exotic plant species include *Hydrocotyle bonariensis* and Montbretia *Crocosmia x crocosmiiflora*. The most commonly occurring native groundcover species was Bracken *Pteridium esculentum*.

Appendix 4 of the Pittwater 21 DCP states that there "is little historical or cultural value of introduced vegetation (in Warriewood Valley), with exception of two Poplar plantations between Garden Street and Boondah Road. The Valley was previously used for market gardening which involved clearing much of the existing native vegetation. The Poplar plantations provide a contrasting visual resource due to their height (20 metres) and contrasting rectilinear textural pattern (Pittwater Council, 2008)."

Resilience of the Poplar Forest of the subject site is generally low grading to moderate along the boundary with vegetation communities at the Warriewood Wetlands interface.

Cleared and Disturbed

This plant community corresponds to the Landscaped/Horticultural plant community described in the previous survey (TEC, 2004). The majority of the Cleared and Disturbed plant community comprises paddocks dominated by grazing pastures such as Kikuyu, Paspalum and Common Couch *Cynodon dactylon*. There are thickets of weeds such as Lantana and Privets *Ligustrum* spp and exotic and native species have been planted in landscaped areas and around dwellings of the subject site. Other shrubs and trees include Cocos Palm *Arecastrum romanzoffianum*, Irish Strawberry Tree *Arbutus unedo*, Crepe Myrtle *Lagerstroemia indica* and Crimson Bottlebrush *Callistemon citrinus*. Resilience of the Cleared and Disturbed plant community is very low.

Coastal Sand Bangalay Forest

According to the draft Sydney Metro CMA mapping (DECCW 2009b) Coastal Sand Bangalay Forest vegetation community is located within the south-east boundary of the subject site (Figure 5, Appendix B). Recent site assessment confirmed the presence of *Eucalyptus botryoides* Bangalay and *Banksia integrifolia* subsp. *integrifolia* Coast Banksia as indicator species for this vegetation community, although *E. botryoides* is also a characteristic species for SSF and there was only one individual noted of Banksia integrifolia. Coastal Sand Bangalay Forest is a component of the EEC Bangalay Sand Forest (BSF), and floristic comparisons of the EECs SSF and SBF, and their presence on the subject site, is provided below in section 5.4 and within the Flora inventory in Appendix A.

Previous vegetation mapping of BSF community has not located BSF north of the Sydney region, including Pittwater LGA (Keith, 2004; NSW Scientific Committee, 2008). The Hydrogeological Report prepared as part of the investigations for the subject site confirmed that the soils type was a composition of clay soils and bedrock of sandstone (Jeffery and Katauskas, 2010). Bangalay Sand Forest are known to occur closer to the coastal areas on deep sandy foredune and hind dunes area, often adjacent to the Swamp Sclerophyll Forest (DECC 2008).

5.3 Threatened Plant Species

No threatened plant species listed under the TSC Act or EBPC Act were recorded on the subject site in the current or previous investigations.

A search of the DECCW Wildlife Atlas identified 11 threatened plant species occurring within 10 kilometres of the site (Table 3).

Table 3 Threatened flora species previously recorded within the locality (5km of the site) on the DECCW and EPBC databases.

Scientific Name	TSC Act Status[2]	EPBC Act Status[3]
Chamaesyce psammogeton	E1	
Epacris purpurascens var. purpurascens	V	
Eucalyptus camfieldii	V	V
Eucalyptus nicholii	V	V
Genoplesium baueri	V	
Grevillea caleyi	E1	E
Microtis angusii	E1	E
Persoonia hirsuta	E1	E
Pimelea curviflora var. *curviflora*	V	V
Syzygium paniculatum	V	V
Tetratheca glandulosa	V	V

5.4 Endangered Ecological Communities

Vegetation communities that are components of two threatened ecological communities are recorded on the subject site, these being Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions and Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.

The endangered ecological communities Bangaly Sand Forest and Sydney Freshwater Wetlands are also mapped within the locality, with Swamp Oak Floodplain Forest mapped further to the south in areas with increased estuarine influences. Bangalay Sand Forest is previously mapped on the subject site (DECCW 2009), and additional floristic survey (20m X 20m quadrats) has been conducted to assess which communities the vegetation on the site is most representative of, and therefore whether Swamp Sclerophyll Forest or Bangalay Sand Forest EEC is present. Several characteristic species of both of these communities are present within the remnant vegetation community, and a discussion below provides reasoning regarding the assessed community types. The location of the survey quadrats is provided on Figure 5, Appendix B.

The area in question is approximately 1270m^2 of native vegetation adjacent to Boondah Road which has a floristic composition that reflects edaphic conditions of better drainage. This stand was noted in the previous surveys (TEC, 2004 and TEC, 2006) and is characterised by a canopy of Smooth-barked Apple *Angophora costata* and Bangalay *Eucalyptus botryoides*, from 12 to 15 metres. There is an understorey dominated by Lantana *Lantana camara* and Sweet Pittosporum *Pittosporum undulatum* with uncommon specimens of Tick Bush *Kunzea ambigua* and Black She-oak *Allocasuarina littoralis*. Occasional specimens of Dogwood *Jacksonia scoparia* occur along the Boondah Road boundary. This species is listed by Pittwater and Warrringah Councils as a locally significant species. It is usually associated with gravelly or clayey soils in areas with very good drainage. There is an isolated

[2] CE - critically endangered (Schedule 1A of the TSC Act); E1 – endangered (Schedule 1 of the TSC Act); V – vulnerable (Schedule 2 of the TSC Act).

[3] CE – critically endangered, E – endangered, V – vulnerable

large specimen of this plant growing approximately 150 metres to the west of Boondah Road in the Poplar Forest Vegetation Community.

Other species not considered characteristic species of Swamp Sclerophyll Forest that occur within this area include one specimen of Coast Banksia, *Banksia integrifolia* and commonly Narrow Wattle *Acacia stricta*. Occassionally Native Sarsparilla *Hardenbergia violacea* and uncommonly Dusky Coral Pea *Kennedia rubicunda* also occur here. The groundcover stratum is a mix of natives and exotic species such as Kikuyu Grass *Pennisetum clandestinum*, Blady Grass *Imperata cylindrica,* Saw Sedge *Gahnia clarkei* and Spiny-headed Mat-rush *Lomandra longifolia*.

Quadrats 1 and 2 were found to contain floristics closest to Swamp Sclerophyll Forest with occurrences of seven (7) and eight (8) characteristic species from this EEC found in these quadrats. Quadrat 1 had twelve (12) occurrences of characteristic species for another EEC Sand Bangalay Forest (SBF). Although this quadrat had a higher number of species characteristic of SBF, and it is encompassing an area of vegetation that is distinctively floristically different from contiguous native vegetation, it is difficult to determine that this quadrat (quadrat 1) or the floristically distinctive area that it is part of, is representative of SBF as much as it is to determine that it is not SSF. The dominant tree species in this area adjacent to Boondah Road is Sydney Red Gum *Angophora costata*, which is not a characteristic species of either SSF or SBF according to the Scientific Committee final determinations. It is noted by DECCW (2009a) as being a positive species with a very high group frequency (83%) for the equivalent community of Coastal Sand Bangalay Forest, but this area does not contain a high correlation of species representative of this community as per the attendant methodology compared to the same source's (DECCW 2009a) methodology for determining the component communities of the EEC SSF.

The draft mapping of DECCW (2009a) uses the same methodology to assess community types, and maps an area as Coastal Sand Bangalay Forest, which is the component community of the EEC BSF, although floristically, this mapping does not correspond entirely to the area of *Angophora costata* dominated vegetation mentioned above. The current report has mapped this floristically aberrant area dominated by *Angophora costata* as SSF and not SBF due to the strong species count of characteristic species in quadrat 1 as well as the floristically distinct area that the quadrat occurs in. Additionally, although there is a higher score for characteristic species in quadrat 1 and the particular area for BSF, the cover abundance and specimen numbers for those species is generally poorer than it is for those species present that are characteristic for SSF. The two description methodologies, the NSW Scientific Committee's Final Determinations and the SMCMA Community Descriptions, are both quite differing in what species they encompass as component species, and the current report preferentially applies the Final Determination of the Scientific Committee as the determining factor.

The Final Determinations for SSF and SBF allow for the occurrence of other species in a stand of these EECs, but where these species are not characteristic species of one, nor of the other EEC, giving speculative reasoning for the assessment of a community as an EEC because they are not precluded from being a *potential* characteristic species of that or any other EEC, a conservative approach has been taken in the current report and the number of species of characteristic species, measured along with those species cover and abundance, has been the overriding factor to determine the community type. The precautionary principle has thus been applied here to guard against refuting the existence of one particular EEC due to a depauperate condition, over guarding against the potential existence of another EEC due to the potential that species within it may be allowed to be encompassed in its determination.

6 FAUNA

6.1 Fauna Species

A total of 22 vertebrate fauna species were recorded during the field survey in March 2008, including 18 bird species and four mammals. Ad hoc observations during the August 2010 flora survey recorded several bird species that were previously recorded, continued evidence of long-nosed bandicoot diggings as well as one Swamp Wallaby and a Red-bellied Black Snake, neither of which had been recorded on site previously. A full list of species recorded during the surveys can be found in Appendix A.

The majority of species recorded on the site are generally typical of urban fringe or semi-rural areas within the Sydney Basin region and are widespread in distribution and common to abundant within their ranges.

One species listed as Vulnerable under the *Threatened Species Conservation Act* 1995 was observed during the survey in March 2008, Powerful Owl *Ninox strenua.*

6.2 Fauna Habitats

Warriewood Wetlands is a regionally significant vegetation community for local and international fauna species. The wetlands are considered the largest remaining sandplain wetlands in Northern Sydney, at 26 hectares, (Pittwater Council 2004) and are utilised by several threatened species. Migratory birds from China and Japan have been known to visit the wetlands, and are protected under the China-Australia Migratory Bird Agreement (CAMBA) and Japan-Australia Migratory Bird Agreement (JAMBA).

The main habitat types occurring within the study area are:

- Coastal Sand Swamp Mahogany Forest;
- Poplar Forest;
- Cleared and Disturbed; and
- Wetlands/Pond.

Coastal Sand Swamp Mahogany Forest

The canopy and understorey vegetation of the Coastal Sand Swamp Mahogany Forest provides shelter, nectar, blossom and seed for birds and arboreal mammals. The main habitats include well developed and intact native canopy, shrubs and woody weed thickets in the understorey and a well developed native/exotic groundcover stratum in the section near Boondah Road. Very few hollows were observed in the canopy suitable for roosting and nesting. Habitat features such as fallen branches, leaf litter, logs and rotting stumps are present and provide additional foraging and sheltering habitat for native ground dwelling mammals, invertebrates and reptiles. Lantana thickets smothered in exotic vine species along the margins are likely to provide good nesting and sheltering habitat for arboreal mammals such as Common Brushtail Possums *Trichosurus vulpecular* and small birds such as Superb Fairy-wren *Malurus cyaneus* and Silver-eye *Zosterops lateralis*, as were recorded on site during the surveys.

As noted in previous assessment of this major habitat of the subject site, common native ground-dwelling mammals such as Long-nosed Bandicoot *Perameles nasuta* utilise this habitat. Other species may include Water Rat *Hydromys chrysogaster* and Brown Antechinus *Antechinus stuartii*. Canopy cover and connectivity to Warriewood Wetlands by vegetation and periodic inundation would also provide shelter, foraging opportunities and corridors for common reptile and amphibian species including Eastern Water Dragon *Physignathus lesueurii*, Diamond Python *Morelia spilota*, and the Striped Marsh Frog *Limnodynastes peronii*.

The threatened Powerful Owl *Ninox strenua* was observed roosting in this habitat (See Section 6.3 below).

Poplar Forest

Due to the spaced distribution and deciduous nature of the dominant tree species, canopy of the Poplar Forest provides limited and seasonal shelter, nectar, blossom and seed for birds and arboreal mammals. Hollows were observed in some larger trees and these would provide nesting and sheltering resources throughout the year. The sparse and patchy understorey has some habitat value

and provides sheltering, nesting and foraging habitat for birds, arboreal mammals (eg. Common Brushtail Possum *Trichosurus vulpecular* and Willie Wagtail *Rhipidura leucophrys*).

A dense groundcover stratum, mainly exotic grasses, in the southern stand of Poplar Forest provides good habitat for terrestrial native and exotic mammals such as Bush Rat *Rattus fuscipes* or Black Rat *Rattus rattus*. Connectivity through continuous groundcover into the semi aquatic and aquatic habitats of Warriewood Wetlands is likely to provide foraging and sheltering opportunities for reptiles and amphibians such as Eastern Water-skink *Eulamprus quoyii*, Red-bellied Black Snake *Pseudechis porphyriacus* and Eastern Dwarf Tree Frog *Litoria fallax*.

Cleared and Disturbed

The cleared and disturbed habitat is composed of pasture grasses with scattered trees, shrubs, occasional buildings, sheds, disused agricultural equipment and piles of building debris. It represents a highly modified landscape that lacks many of the natural habitat features and resources that are important in the maintenance of native fauna diversity and life cycles, including fully structured vegetation, a diverse shrub layer for food sources and protection, leaf litter and rocks and logs.

The cleared and disturbed habitat type favours ecological generalist species that are capable of utilising a wide range of habitats for foraging, as well as disturbance-tolerant species that are ubiquitous in modified urban and rural habitats throughout the region. An example of a generalist bird species that were recorded within this habitat are the Australian Magpie *Gynorhina tibicen* and the Spotted Turtle Dove *Streptopelia chinensis*. These species and common introduced and native mammal or reptile species such as Rabbit *Oryctolagus cuniculus*, Long-nosed Bandicoot and Bluetongue Lizard *Tiliqua scincoides* are likely to forage over the cleared parts of the site and throughout the locality in general.

Wetlands/Dams

The constructed pond and channel in the western portion of the subject site provides aquatic and semi-aquatic habitats that are likely to be used by water fowl and other birds, reptiles, amphibians and mammals for foraging, sheltering. Dusky Moorhen *Gallinula tenebrosa* and Australian Wood Duck *Chenonetta jubata*, were observed utilising adjacent ponds in Warriewood Wetlands and these and other native fauna such as Eastern Snake-necked Turtle *Chelodina longicollis*, Longfinned Eel *Anguilla reinhardtii*, Common Eastern Froglet *Crinia signifera* and Green-tree Snake *Dendrelaphis punctulatus* potentially may use this habitat type of the subject site.

Warriewood wetlands are an important habitat for many bird and animal species, and the wetland and surrounding natural areas comprise an important wildlife corridor in the catchment. Over 80 bird species have been recorded including threatened bird species as well as several migratory birds protected under international migratory bird treaties (JAMBA, CAMBA), reptile, frog and mammal species (Pittwater Council 2004).

6.3 Threatened Fauna Species

One threatened fauna species listed under the TSC Act was recorded on the subject site during the investigation in March 2008. A Powerful Owl *Ninox strenua*, listed as Vulnerable under this Act, was observed roosting in the eastern section of the Swamp Forest', and appeared to be a large male (Figure 10, Appendix B). In the current proposal, this area will be altered by the construction of an entrance way into the development and a local street which will require selective removal of vegetation that composes part of the fauna habitat on site.

The Powerful Owl is found in coastal areas and adjacent ranges of eastern Australia from South Australia to around Rockhampton in Queensland, generally within 200 kilometres from the coast. Within NSW, Powerful Owls are distributed throughout the length of the Great Dividing Range, which is their stronghold, and extend from the coast to the western slopes where they occur in much lower numbers. The Powerful Owl inhabits a wide range of vegetation types from wet Eucalypt forests with a Rainforest understorey to Dry Open Forests and Woodlands (DECC 2006). The species has been recorded utilising disturbed habitats such as exotic pine plantations and large trees in parks and gardens. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes. The species breeds and hunts in open or closed sclerophyll forest or woodlands (DECC 2006).

The Powerful Owl is the largest predator of nocturnal forest-dwelling animals in Australian forests. Major prey species in NSW forests are the Greater Glider, Common Ringtail Possum, Sugar Glider, Grey-headed Flying Fox, and several species of diurnal birds, including the Pied Currawong, Magpie and Lorikeets. As most prey species require hollows and a shrub layer, these are important habitat components for the owl (DECC 2006).

It rests during the day amongst thick foliage, often grasping food-remains. The male of the species employs a slow, far-carrying 'whoo-hoo' call, more deliberate than the females call, which is higher pitched with the second note slightly higher than the first. Powerful Owls nest in a slight depression in the wood-mould on the base of a cavity in a large old tree, sometimes in excess of 25 metres above the ground. The breeding season of the Powerful Owl is highly synchronised, being strictly winter breeders. One or two young are produced, although some pairs do not breed in every year. Pairs appear to mate for life and occupy exclusive territories which range from 400-1450 hectares (DECC 2006). During the breeding season, the male Powerful Owl roosts in a "grove" of up to 20-30 trees, situated within 100-200 metres of the nest tree where the female shelters. As one individual was observed, it is highly likely that a family unit occurs in, or close to the locality.

A search of the DECC Wildlife Atlas identified 34 threatened fauna species, with potential relevance to the subject site, occurring within 10 kilometres of the site (Table 4). The list below excludes marine species.

The development proposal at 14-18 Boondah Rd, Warrriewood is connected to Fern Creek riparian corridor at the south eastern boundary of the site and adjacent to a significantly regional area at Warriewood Wetlands. Warriewood Wetlands is a natural detention basin for the surrounding creeks; it provides potential habitat for species such as the *Botaurus poiciloptilus* Australiasian Bittern.

6.4 Endangered Populations

No endangered fauna populations listed under the TSC Act were recorded on the subject site in the current investigation.

Table 4 Threatened fauna species previously recorded within the locality (10km search) on the DECCW and EPBC databases.

Scientific Name	Common Name	TSC Act Status[4]	EPBC Act Status[5]
Botaurus poiciloptilus	Australasian Bittern	V	
Ninox connivens	Barking Owl	V	
Ixobrychus flavicollis	Black Bittern	V	
Hoplocephalus bungaroides	Broad-headed Snake	E1	V
Burhinus grallarius	Bush Stone-curlew	E1	
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V	
Mormopterus norfolkensis	Eastern Freetail-bat	V	
Cercartetus nanus	Eastern Pygmy-possum	V	
Puffinus carneipes	Flesh-footed Shearwater	V	M
Callocephalon fimbriatum	Gang-gang Cockatoo	V	
Heleioporus australiacus	Giant Burrowing Frog	V	V
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	
Scoteanax rueppellii	Greater Broad-nosed Bat	V	
Pteropus poliocephalus	Grey-headed Flying-fox	V	V
Phascolarctos cinereus	Koala population	E2	
Phascolarctos cinereus	Koala	V	
Myotis macropus	Large-footed Myotis	V	
Charadrius mongolus	Lesser Sand Plover	V	M
Miniopterus australis	Little Bentwing Bat	V	
Glossopsitta pusilla	Little Lorikeet	V	
Pandion haliaetus	Osprey	V	M
Ninox strenua	Powerful Owl	V	
Pseudophryne australis	Red-crowned Toadlet	V	
Xanthomyza Phrygia	Regent Honeyeater	E1	E, M
Varanus rosenbergi	Rosenberg's Goanna	V	
Haematopus fuliginosus	Sooty Oystercatcher	V	
Isoodon obesulus obesulus	Southern Brown Bandicoot (eastern)	E1	E
Dasyurus maculatus	Spotted-tailed Quoll	V	E
Ptilinopus superbus	Superb Fruit-Dove	V	
Lathamus discolour	Swift Parrot	E1	E
Ptilinopus magnificus	Wompoo Fruit-Dove	V	

[4] CE critically endangered (Schedule 1A of the TSC Act); E1 & E2 – endangered (Schedule 1 of the TSC Act); V – vulnerable (Schedule 2 of the TSC Act).

[5] CE - critically endangered, E – endangered, V – vulnerable, M - Migratory

7 HABITAT POTENTIAL FOR THREATENED SPECIES

7.1 Flora

Table 5 summarises the habitat potential of the subject site for the threatened flora species previously recorded as occurring within 10 km search on the DECCW Wildlife Atlas.

Table 5 Habitat potential for threatened flora species previously recorded within the locality (10km of the site) on the DECCW Wildlife Atlas

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Chamaesyce psammogeton	Sand Spurge is a herb that forms mats to 1 m across and is found sparsely along the coast from south of Jervis Bay (at Currarong, Culburra and Seven Mile Beach National Park) to Queensland (and Lord Howe Island). Grows on fore-dunes and exposed headlands, often with Spinifex.	Low. Subject site habitat is not foredune or exposed headland.
Epacris purpurascens var. *purpurascens*	An erect shrub, 50 - 180 cm high with white or sometimes pinkish flowers. Recorded from Gosford in the north, to Narrabeen in the east and other districts. Found in a range of habitat types, most of which have a strong shale soil influence.	Nil to low. Subject site soil type not consistent with soil type of preferred habitat.
Eucalyptus camfieldii	Mostly a mallee to 4 m tall though can grow to a straggly tree to 9 m high. Bark is rough, fibrous and stringy, red or dark grey-brown and flowers creamy-white. Distribution restricted to a narrow band with the most northerly records in the Raymond Terrace Area south to Waterfall. Localised and scattered distribution includes sites at Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai, Wattamolla and a few other sites in Royal National Park. Occurs in coastal areas in shallow sandy soils overlying Hawkesbury sandstone. Coastal heath mostly on exposed sandy ridges in small scattered stands near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas.	Nil to low. Subject site soil type not consistent with soil type of preferred habitat.
Eucalyptus nicholii	This species is widely planted as an urban street tree and in gardens but is quite rare in the wild. It is confined to the New England Tablelands of NSW, where it occurs from Nundle to north of Tenterfield, largely on private property. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.	Low. The subject site is outside the known range of this species.
Genoplesium baueri	A terrestrial orchid with yellowish-green or reddish inflorescence 6-15 cm high, recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. Grows in sparse sclerophyll forest and moss gardens over sandstone.	Nil to low. Subject site soil type not consistent with soil type or vegetation type of preferred habitat.

Table 5 cont' Habitat potential for threatened flora species previously recorded within the locality (10km search) on the DECC Wildlife Atlas

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Grevillea caleyi	A medium to tall shrub, with long spreading branches, growing to a height of up to 4 m. Restricted to an 8km square area around Terry Hills. All natural remnant sites occur within a habitat that is both characteristic and consistent between sites. All sites occur on the ridgetop between elevations of 170 to 240m asl, in association with laterite soils and a vegetation community of open forest, generally dominated by *Eucalyptus sieberi* and *Corymbia. Gummifera* and commonly found in the endangered Duffys Forest ecological community.	Nil to low. Subject site soil type not consistent with soil type or topography of preferred habitat.
Microtis angusii	A terrestrial "onion orchid" grows to 25 to 60 cm tall with green, linear cylindrical and tapering leaves. Currently only known from one site at Ingleside in the north of Sydney with habitat preference poorly defined due to the disturbed nature (modified soils and degree of weed infestation) of the only know site of occurrence.	Nil to low. Subject site soil type not consistent with soil type or vegetation type of the known location at Ingleside.
Persoonia hirsuta	The Hairy Geebung is best distinguished by its hairiness - long coarse hairs on flowers and branchlets and short stiff ones on the leaves. The Hairy Geebung has been recorded in the Sydney coastal area (subsp. hirsuta - Gosford to Berowra to Manly to Royal National Park), the Blue Mountains area (subsp. evoluta - Springwood, Lithgow, Putty) and the Southern Highlands (subsp. evoluta - Balmoral, Buxton, Yanderra and Hill Top areas). The Hairy Geebung is found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone. It is usually present as isolated individuals or very small populations. It is probably killed by fire (as other Persoonia species are) but will regenerate from seed.	Low - Medium. Subject site supports preferred soils for this species however most native vegetation has been highly modified and was not recorded on site.
Pimelea curviflora var. *curviflora*	A much-branched shrub 20 to 120cm high with hairy stems and flowers are red to yellow. Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-west. Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes in woodlands amongst dense grasses and sedges. It may not always be visible at a site as it appears to survive for some time without any foliage after fire or grazing.	Nil to low. Subject site soil type not consistent with soil type, vegetation type or topography of preferred habitat.
Syzygium paniculatum	The Magenta Lilly Pilly is a small to medium sized rainforest tree that grows to 8 m tall. The bark is flaky and the leaves are shiny, dark-green above and paler underneath. Plants produce white flower-clusters at the end of each branch fruits develop to a deep magenta and may be spherical or egg-shaped. The Magenta Lilly Pilly is found only in NSW, in a narrow, linear coastal strip from Bulahdelah south to Conjola State Forest. Occurs on grey soils over sandstone, restricted mainly to remnant stands of littoral (coastal) rainforest. On the central coast Magenta Lilly Pilly occurs on gravels, sands, silts and clays in riverside gallery rainforests and remnant littoral rainforest communities.	Low to medium. Subject site provides suitable soil and habitat nearby.

Table 5 cont' Habitat potential for threatened flora species previously recorded within the locality (10km of the site) on the DECC Wildlife Atlas

Scientific Name	Species Habitat Preference	Likelihood of Species to Occur on Subject Site
Tetratheca glandulosa	A small spreading shrub which grows 20 - 50cm in height. Stems often become entwined among other small shrubs, sedges and grasses. Flowers are pink with the flower stalk and sepals covered with dark-red gland-tipped hairs, which distinguishes T. glandulosa from other Tetratheca species. Restricted to the Baulkham Hills, Gosford, Hawkesbury, Hornsby, Ku-ring-gai, Pittwater, Ryde, Warringah and Wyong LGA's the eastern limit is at Ingleside and the western limit is at East Kurrajong. Occurs in shale-sandstone transition habitat where shale-cappings occur over sandstone, and the plant occupies ridgetops, upper-slopes and to a lesser extent mid-slope sandstone benches. Soils are generally shallow, consisting of a yellow, clayey/sandy loam. Stony lateritic fragments are also common in the soil profile on many of these ridgetops. Vegetation structure varies from heaths and scrub to woodlands/open woodlands, and open forest. Vegetation communities correspond broadly to Sydney Sandstone Ridgetop Woodland.	Nil to low. Subject site soil type not consistent with soil type or vegetation type of preferred habitat.

7.2 Fauna

Table 6 summarises the habitat potential of the subject site for the threatened fauna species previously recorded as occurring within 10 km search the DECCW Wildlife Atlas.

Table 6 Habitat potential for threatened fauna species previously recorded within the locality (10km of the site) on the DECCW Wildlife Atlas.

Scientific name	Species distribution and Habitat Preference	Likelihood of Species to Occur on Subject Site
Botaurus poiciloptilus	The Australasian Bittern occurs from southern Queensland through south-eastern Australia to Tasmania and is recorded in south western, Western Australia. In NSW the species has been observed along the east coast and in wetlands of the Murrumbidgee and Lachlan Rivers and the Murray Darling Basin. Generally sedentary, inhabiting terrestrial and estuarine wetlands with permanent water, preferring dense fringing emergent vegetation of sedges and reeds. Nests are created from trampled reeds and rushes over shallow water with a clutch consisting of 4 – 5 eggs. Feeds at dusk foraging over shallow water for frogs, fish, invertebrates and vegetation or fruit (NPWS 1999).	Medium. Suitable foraging and nesting habitat nearby in Warriewood Wetlands.

Table 6 cont' Habitat potential for threatened fauna species previously recorded within the locality (10km of the site) on the DECC Wildlife Atlas.

Scientific name	Species distribution and Habitat Preference	Likelihood of Species to Occur on Subject Site
Callocephalon fimbriatum	The Gang Gang Cockatoo is a relatively small, dark grey cockatoo. Feathers are distinctively squarish on the ends. Males have a bright red head and crest. Females have a grey head and crest and the females breast feathers are reddish – pink. The species is listed as Vulnerable in NSW and the population found in the Ku-ring-gai and Hornsby LGA's is listed as Endangered. This population is believed to be largely confined to an area bounded by Thornleigh and Wahroonga in the north, Epping and North Epping in the south, Beecroft and Cheltenham in the west and Turramurra/South Turramurra to the east. It is known to inhabit areas of Lane Cove National Park, Pennant Hills Park and other forested gullies in the area. It occurs within a variety of forest and woodland types and usually frequents forested areas with old growth attributes required for nesting and roosting purposes. Also utilises less heavily timbered woodlands and urban fringe areas to forage, but appears to favour well timbered country through which it habitually flies as it moves about. Individuals of this population are likely to move outside the 'defined' population boundary in the general area and should still be considered of this population.	Low. Minimal suitable foraging and nesting habitat on site or nearby in Warriewood Wetlands.
Calyptorhynchus lathami	The Glossy Black-cockatoo is a dusky brown to black cockatoo with a massive, bulbous bill and a broad, red band through the tail and are usually seen in pairs or small groups feeding in she-oaks. The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW. Inhabits open forest and woodlands of the coast and the Great Dividing Range. Feeds almost exclusively on the seeds of several species of she-oak particularly Black She-oak, Forest She-oak and Drooping She-oak. Is dependent on large hollow-bearing eucalypts for nest sites.	Medium. Suitable foraging habitat on site and nearby in Warriewood Wetlands. Minimal nesting habitat.
Cercartetus nanus	Adult Eastern Pygmy-possums have a head and body length of between 70 - 110 mm and are active climbers with prehensile tails. The Eastern Pygmy-possum is found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extents from the coast inland as far as the Pillaga and to Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes and insects. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum dreys or thickets of vegetation, (eg. grass-tree skirts) and are generally nocturnal.	Low. Minimal suitable foraging and nesting habitat on site or nearby in Warriewood Wetlands.

Table 6 cont' Habitat potential for threatened fauna species previously recorded within the locality (10km of the site) on the DECC Wildlife Atlas.

Scientific name	Species distribution and Habitat Preference	Likelihood of Species to Occur on Subject Site
Charadrius mongolus	The Lesser Sand Plover is a migratory species utilizing the eastern Australian coastline during the summer months. It stores fat supplies of 70% of its bodyweight to travel back to south east Asia for breeding in March-April. Foraging occurs along sheltered bays, mud and sand flats and estuaries. Roosting occurs within coral reefs, rock platforms and sandy shores. Diet consists of aquatic invertebrates.	Low. Minimal suitable foraging on subject site, minor areas nearby in sections of Warriewood Wetlands.
Dasyurus maculatus	The Spotted-tailed Quoll is about the size of a domestic cat with rust to dark-brown fur above, with irregular white spots on the back and tail, and a pale belly. The range has contracted and is now found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Mostly nocturnal, it spends most of the time on the ground, but may also climb to raid possum and glider dens and prey on roosting birds. Prey includes gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects and also eats carrion and takes domestic fowl. Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. Females occupy home ranges up to about 750 hectares and males up to 3500 hectares and usually traverse their ranges along densely vegetated creek lines.	Low. Minimal suitable foraging and potential den site habitat on subject site or nearby in Warriewood Wetlands.
Glossopsitta pusilla	The Little Lorikeet is the smallest of the Australian Lorikeets. The species is distributed from Cairns in QLD to Adelaide in SA. In New South Wales Little Lorikeets are occur in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending west to Albury, Parkes, Dubbo and Narrabri. The species predominately forages for nectar and pollen in the tree canopy as well as melaleucas and mistletoes.	Nil-low. Subject site does not support preferred foraging habitat.
Haematopus fuliginosus	The Sooty Oystercatcher is a large wader, reaching 50 cm in length with a bright orange-red bill, eye-ring and iris, and coral pink legs and feet and entirely black plumage. Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Small numbers of the species are evenly distributed along the NSW coast. The availability of suitable nesting sites may limit populations. Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rock or coral at low tide for foods such as limpets and mussels. Breeds in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories. The nest is a shallow scrape on the ground, or small mounds of pebbles, shells or seaweed when nesting among rocks.	Low. Nil to minimal suitable foraging and nesting habitat on site or nearby in Warriewood Wetlands.

Table 6 cont' Habitat potential for threatened fauna species previously recorded within the locality (10km of the site) on the DECC Wildlife Atlas.

Scientific name	Species distribution and Habitat Preference	Likelihood of Species to Occur on Subject Site
Heleioporus australiacus	The Giant Burrowing Frog is a large, slow-moving frog that grows to about 10 cm long. It occurs from the NSW Central Coast to eastern Victoria, but is most common on the Sydney sandstone geology from the coast to the Great Dividing Range. Found in heath, woodland and open forest with sandy soils the species generally lives in heath or forest and will travel several hundred metres to creeks to breed. Burrows into deep litter or loose soil, emerging to feed or breed after rain. Diet includes ground-dwelling invertebrates such as ants, beetles and spiders.	Low. Minimal suitable vegetation or soil type on site. However marginal habitat provided in Warriewood Wetlands, and species previously recorded nearby.
Hoplocephalus bungaroides	The Broad-headed Snake is generally black above with yellow spots forming narrow, irregular cross-bands and the average length is about 60 cm, with a maximum of around 150 cm. Largely confined to Triassic sandstones, including the Hawkesbury, Narellan and Shoalhaven formations, within the coast and ranges in an area within approximately 250 km of Sydney. A nocturnal species it shelters in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter and spring. Moves from the sandstone rocks to shelters in hollows in large trees within 200 m of escarpments in summer. Feeds mostly on geckos and small skinks and will also eat frogs and small mammals occasionally.	Nil to low. Minimal suitable foraging or sheltering habitat on site or in Warriewood Wetlands.
Isoodon obesulus obesulus	Southern Brown Bandicoots have a relatively short nose and ears, dark grey or yellowish brown fur on its upper body, tail and feet and a creamy white belly. The species has a patchy distribution. It is found in south-eastern NSW, east of the Great Dividing Range south from the Hawkesbury River, to coastal Victoria, south-eastern South Australia, south-west Western Australia and the northern tip of Queensland. Southern Brown Bandicoots are largely crepuscular and are generally only found in heath or open forest with a heathy understorey on sandy or friable soils. They feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogenous (underground-fruiting) fungi. Their searches for food often create distinctive conical holes in the soil. Nesting during the day in a shallow depression in the ground covered by leaf litter, grass or other plant material. Nests may be located under Grass trees Xanthorrhoea sp. and other shrubs, or in rabbit burrows. The upper surface of the nest may be mixed with earth to waterproof the inside of the nest.	Low to medium. Subject site supports some potential foraging or nesting habitat on site and in Warriewood Wetlands.

Table 6 cont' Habitat potential for threatened fauna species previously recorded within the locality (10km of the site) on the DECC Wildlife Atlas.

Scientific name	**Species distribution and Habitat Preference**	**Likelihood of Species to Occur on Subject Site**
Ixobrychus flavicollis	The Black Bittern is a species of heron, dark grey to black in colour, with buff streaks on the throat and a characteristic yellow streak on the sides of the head and down the neck. The Black Bittern has a wide distribution, from southern NSW north to Cape York and along the north coast to the Kimberley region and in the south-west of Western Australia. In NSW, records of the species are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland. Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves. Feeds on frogs, reptiles, fish and invertebrates, including snails, dragonflies, shrimps and crayfish, with most feeding done at dusk and at night. During the day, roosts in trees or on the ground amongst dense reeds. Nests, built in spring are located on a branch overhanging water and consist of a bed of sticks and reeds on a base of larger sticks.	Medium. Some suitable foraging and nesting within riparian zones on site and nearby in Warriewood Wetlands.
Lathamus discolor	Migrating from breeding grounds in Tasmania to the Australian mainland in winter Swift Parrot ranges from south-eastern South Australia across inland and coastal areas to southeast Queensland. The preferred habitat on mainland Australia is woodlands and riparian vegetation where there are winter flowering eucalypts such as the Swamp Mahogany, *Eucalyptus robusta* in coastal areas (NPWS 2002a). Breeding in Tasmania between September and February sometimes in small colonies the nest is an unlined tree hollow with three to five eggs laid. The species feeds mainly on nectar but also pollen and insects (NPWS 2003).	Medium. Suitable foraging habitat, including preferred tree species on site and nearby in Warriewood Wetlands.
Miniopterus schreibersii oceanensis	The Eastern Bent-wing Bat has chocolate to reddish-brown fur on its back and slightly lighter coloured fur on its belly. The species occur along the east and north-west coasts of Australia. Caves are the primary roosting habitat but also use man-made structures. Form discrete populations centered on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes and cold caves are used for hibernation in southern Australia. At other times of the year, populations disperse within about 300 km range of maternity caves. Forage in forested areas, catching moths and other flying insects above the tree tops.	Low to medium. Some potential foraging habitat on site and over Warriewood Wetlands. Low roosting and maternity cave habitat potential.
Mormopterus norfolkensis	The Eastern Freetail-bat has dark brown to reddish brown fur on the back and is slightly paler below and is found along the east coast from south Queensland to southern NSW. Occur in dry sclerophyll forest and woodland east of the Great Dividing Range and roost mainly in tree hollows but will also roost under bark or in man-made structures. Solitary and probably insectivorous.	Medium. Potential foraging and roosting habitat on site and in Warriewood Wetlands.

Table 6 cont' Habitat potential for threatened fauna species previously recorded within the locality (10km of the site) on the DECC Wildlife Atlas.

Scientific name	**Species distribution and Habitat Preference**	**Likelihood of Species to Occur on Subject Site**
Myotis macropus (formally *Myotis adversus*)	The Large-footed Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. Generally roost in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface. In NSW females have one young each year usually in November or December.	Low to medium. Potential foraging and roosting habitat on site and in Warriewood Wetlands.
Ninox connivens	The Barking Owl is a typical hawk-owl with no facial-disc and males may be up to 45 cm. The Barking Owl is found throughout Australia except for the central arid regions and Tasmania. It is quite common in parts of northern Australia, but is generally considered uncommon in southern Australia. It has declined across much of its distribution across NSW and now occurs only sparsely. It is most frequently recorded on the western slopes and plains. It is rarely recorded in the far west or in coastal and escarpment forests. Inhabits eucalypt woodland, open forest, swamp woodlands and timber along watercourses. Denser vegetation is used occasionally for roosting. Roost during the day they roost along creek lines, usually in tall understorey trees with dense foliage. Feeds on a variety of prey including insects, birds and mammals such as smaller gliders, possums, rodents and rabbits becoming important during breeding. Territories range from 30 to 200 hectares and birds are present all year. Nests are made in hollows of large, old eucalypts.	Medium. Potential foraging and roosting habitat on site and over Warriewood Wetlands. Some prey species recorded in survey.
Ninox strenua	The Powerful Owl is the largest owl in Australasia. It is a typical hawk-owl with no facial-disc. Adults reach 60 cm in length. The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands. Now uncommon throughout its range where it occurs at low densities. Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest and requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally in open habitats. It roosts by day in dense. Preys on medium-sized arboreal mammals particularly the Greater Glider, Common Ringtail Possum, Sugar Glider and flying foxes. Have high fidelity to a small number of hollow-bearing nest trees.	High. Species occupies a large home range, potential foraging and roosting habitat on site and over Warriewood Wetlands. Some prey species recorded in survey. Species located on-site roosting.

Table 6 cont' Habitat potential for threatened fauna species previously recorded within the locality (10km of the site) on the DECC Wildlife Atlas.

Scientific name	Species distribution and Habitat Preference	Likelihood of Species to Occur on Subject Site
Pandion haliaetus	The Osprey is a large, water-dependent bird of prey, distinctive in flight and when perched. Ospreys are found around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. Nests are made high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea.	Low. Minimal suitable foraging or nesting habitat on site or in Warriewood Wetlands.
Phascolarctos cinereus	The Koala is an arboreal marsupial with fur ranging from grey to brown above, and is white below. The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the western region and in sparse and possibly disjunct populations along the south coast. Inhabit eucalypt woodlands and forests and feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. Spend most of their time in trees, but will descend and traverse open ground to move between trees.	Nil to low. Although previously recorded nearby to the subject site the last sighting for the LGA was in 1997.
Pseudophryne australis	The Red-crowned Toadlet is an unmistakable small frog, usually measuring less than 30 mm long with distinctive reddish-orange patches, one between the eyes and one along the rump. The species has a restricted distribution and it is confined to the Sydney Basin, from Pokolbin in the north, the Nowra area to the south, and west to Mt Victoria in the Blue Mountains. Occurs in open forests, mostly on Hawkesbury and Narrabeen Sandstones inhabiting periodically wet drainage lines below sandstone ridges that often have shale lenses or cappings. Shelters under rocks and amongst masses of dense vegetation or thick piles of leaf litter. Disperses outside the breeding period, when they are found under rocks and logs on sandstone ridges and forage amongst leaf-litter.	Low. Minimal suitable vegetation or other habitat on site or in Warriewood Wetlands.
Pteropus poliocephalus	The Grey-headed Flying-fox is the largest Australian bat. Grey-headed Flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Travel up to 50 km to forage and feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksias, and fruits of rainforest trees and vines.	Medium. Species occupies a large home range, potential foraging habitat on site and over Warriewood Wetlands.

Table 6 cont' Habitat potential for threatened fauna species previously recorded within the locality (10km of the site) on the DECC Wildlife Atlas.

Scientific name	Species distribution and Habitat Preference	Likelihood of Species to Occur on Subject Site
Ptilinopus magnificus	The Wompoo Fruit-dove is a large rainforest pigeon, up to 56 cm long, with a pale grey head shading into rich green back and wings. There is a broken yellow band across each wing. The breast and belly are plum-purple and the underparts are yellow. Occurs along the coast and coastal ranges from the Hunter River in NSW to Cape York Peninsula. It is rare south of Coffs Harbour. Three subspecies are recognised, with the most southerly in NSW and south-eastern Queensland. It used to occur in the Illawarra, though there are no recent records. Occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests. Feeds on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit. The nest is a typical pigeon nest - a flimsy platform of sticks on a thin branch or a palm frond, often over water, usually 3 - 10 m above the ground.	Low. Minimal suitable vegetation or other habitat on site or in Warriewood Wetlands.
Puffinus carneipes	Flesh-footed Shearwater are large blackish-brown shearwater with flesh-coloured feet. The large bill is straw coloured with a dark tip and the eyes are brown. Ranges throughout the Pacific and Indian Oceans. There are two main breeding areas in the world: one in the South West Pacific includes Lord Howe Island and New Zealand; the other along the coast of Western Australia. A marine species.	Nil to low. No suitable foraging or nesting habitat on site or in Warriewood Wetlands is absent.
Scoteanax rueppellii	The Greater Broad-nosed Bat is a large powerful micro bat. The Greater Broad-nosed Bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands. Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. The species usually roosts in tree hollows, but it has also been found in buildings. Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species. Females congregate at maternity sites located in suitable trees.	Medium. Potential foraging habitat on site and over Warriewood Wetlands. Medium roosting habitat potential and low maternity camp habitat.

Table 6 cont' Habitat potential for threatened fauna species previously recorded within the locality (10km of the site) on the DECC Wildlife Atlas.

Scientific name	Species distribution and Habitat Preference	Likelihood of Species to Occur on Subject Site
Varanus rosenbergi	Rosenberg's Goanna reaches up to 1.5 metres in length. Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south and also occurs in South Australia and Western Australia. Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component and individuals require large areas of habitat. Feeds on carrion, birds, eggs, reptiles and small mammals. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens. Lays up to 14 eggs in a termite mound; the hatchlings dig themselves out of the mounds.	Nil to low. Minimal suitable foraging, sheltering or nesting habitat on site or in Warriewood Wetlands
Xanthomyza phrygia	The Regent Honeyeater is a medium-sized, black and yellow honeyeater with a curved bill and mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Birds are also found in drier coastal woodlands and forests in some years. Its range has contracted to between north-eastern Victoria and south-eastern Queensland and in NSW the distribution is very patchy and mainly confined to the two main breeding areas although in some years non-breeding flocks converge on flowering coastal woodlands and forests. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak with large numbers of mature trees, high canopy cover and abundance of mistletoes. Non-breeding flocks are known to forage in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast. The species is a generalist forager and mainly feeds on the nectar from a wide range of eucalypts and mistletoes.	Low to medium. Potential foraging habitat and preferred feed trees on site and in Warriewood Wetlands.

8 LEGISLATION

8.1 *Environment Protection and Biodiversity Conservation Act* 1999

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) would only become relevant if it was considered that an impact on a 'matter of National Environmental Significance (NES)' were likely, thus providing a trigger for referral of the proposal to the Department of Environment and Heritage.

Matters of national environmental significance identified in the Act are:

- world heritage properties;
- national heritage places;
- Ramsar wetlands;

- nationally threatened species and communities;
- migratory species protected under international agreements;
- the Commonwealth marine environment; and
- nuclear actions.

The Commonwealth Government has published *Administrative Guidelines* (Environment Australia 2000) to assist in the determination of whether an action is likely to have a significant impact on a matter of NES.

No nationally threatened species, populations or ecological communities were observed in the study area. The matters of NES of potential relevance to the site include several "threatened species" and "migratory species" that have been recorded within 5 kilometres of the study area. These species include:

- Grey-headed Flying Fox, Swift Parrot, Spotted-tailed Quoll, Broad-headed Snake, Giant Burrowing frog, Regent Honeyeater, Southern Brown bandicoot and Swift Parrot.

Several significant migratory species are also identified within this area include;

- Lesser Sand Plover, Flesh-footed Shearwater, Osprey and Regent Honeyeater. These species are nomadic to migratory andwhilst individuals of these species could occur on or over the site on occasion, they are not likely to nest on the site or permanently inhabit the site, owing to a lack of suitable quality nesting sites and their nomadic habit.

The consideration of the proposed activities on the threatened species identified within the 5km of the subject site is detailed within the fauna habitat table and the *Test of Significant* (Appendix C). A list of Key threatening processes relevant to the subject site is as follows;

- Land clearance;
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants;
- Predation by European red fox; and
- Predation by feral cats.

8.2 *Environmental Planning and Assessment Act* 1979 (EP&A Act) and *Threatened Species Conservation Act* 1995 (TSC Act)

Any proposal for the site should be assessed in accordance with the *Environmental Planning and Assessment Act 1979* and the *Environmental Planning and Assessment Regulation 2000*. The Act institutes a system for environmental planning and assessment, including approvals and environmental impact assessment. This project has been declared a major project, and will be assessed and approved under Part 3A provisions, rather than under Part 4 or Part 5 of the EPA Act. The Planning Minister is the consent authority. The site is located within the Pittwater local government area and the relevant local government control is the Pittwater Local Environmental Plan 1993, although as stated Council does not have a consent role. The need for further approvals related to the environmental planning instruments considered below is at the discretion of the Minister.

The *Threatened Species Conservation Act 1995* provides for the protection of all threatened plants and animals native to NSW and their habitats (including endangered populations and ecological communities, and their habitats). The TSC Act provides for the listing of species, populations and ecological communities considered to be threatened in NSW. Schedule 1 of the TSC Act contains listings of endangered species, populations and ecological communities, and Schedule 2 of the TSC Act contains listings of vulnerable species.

Section 5A (s.5A) of the *Environmental Planning & Assessment Act 1979* (the so called '7-part test') lists seven factors that "must be taken into account" by a determining authority in the administration of Sections 79C of the Act when considering a development. The aim of s.5A is to determine "whether

there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats", as listed under Schedules 1 and 2 of the TSC Act, and hence whether a *Species Impact Statement* (SIS) is required for the action. As seven species and two EEC's listed under the TSC Act, the Swamp Sclerophyll Forest and Freshwater Wetlands, s.5A assessments have been completed for the current proposal and are attached in Appendix C. Four of the species were also listed as nationally threatened species under the *Environmental Protection and Biodiversity Conservation Act* and the Significant Impact Assessment was required. These are available within Appendix D.

A list of key threatening processes under the TSC Act relevant to the subject site;

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands;
- Clearing of native vegetation;
- Competition from feral honey bees (*Apis mellifera*);
- Invasion and establishment of exotic vines and scramblers;
- Invasion and establishment and spread of *Lantana camara;*
- Loss of hollow-bearing trees;
- Predation by the European red fox (*Vulpes vulpes*) & feral cat (*Felis catus*);
- Competition and grazing by the feral European rabbit (*Oryctolagus cuniculus*); and
- Removal of dead wood and dead trees.

8.3 Water Management Act 2000

The former *River and Foreshore Improvements Act* 1948 has been repealed and replaced by the *Water Management Act* 2000 (The WMA) in NSW. The WMA aims to provide for sustainable and integrated management of water sources within NSW for the benefit of present and future generations.

To carry out works in, on or under waterfront land a 'controlled activity' approval is required from the NSW Dept of Water and Energy (formerly DIPNR) under Part 3 Section 91 of the WMA. The definition for a 'controlled activity' includes the "erection of a building or the carrying out of work" in, on or under waterfront land. However, no approval is required as the project is to be assessed under Part 3A of the EP&A Act. Guidelines for the riparian zone, developed in relation to this Act will be considered where relevant.

8.4 SEPP 19 – Bushland in Urban Areas

State Environmental Planning Policy No.19 - Bushland in Urban Areas (SEPP 19) aims to, amongst other things, "protect and preserve bushland" within the urban areas of Sydney (Department of Planning 1986). The policy applies where natural vegetation remains or vegetation representative of the structure and floristics of natural vegetation exists.

As the proposed development within the subject site adjoins bushland zoned or reserved for public open space purposes, the clearing of vegetation must consider the objectives of SEPP 19.

Any future proposed development should be designed to be sensitive to the urban bushland values of the subject site and adjoining land. This includes limiting the extent of clearing of vegetation, and considering the erosion of soils and the spread of weeds and exotic plants into surrounding areas.

8.5 SEPP 44 – Koala Habitat Protection

State Environmental Planning Policy No.44 - Koala Habitat Protection (SEPP 44) aims to protect the Koala and its habitat by incorporating prescriptions for consent authorities to consider during the assessment of development applications. SEPP 44 contains prescriptions for the consideration of "potential koala habitat" and "core koala habitat" for developments within Local Government Areas listed on Schedule 1 of the Policy. Pittwater LGA is listed on Schedule 1 as an area to which SEPP 44 applies.

"Potential koala habitat" is defined by SEPP 44 as "areas of native vegetation where the trees of types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component". One tree species listed under Schedule 2 of the Policy as Koala "feed tree species", Swamp Mahogany *Eucalyptus robusta*, was recorded on the subject site during previous field surveys. This species occurred occasionally on the site, and did not constitute a major component of the canopy within the Cleared and Disturbed plant community. As such, 15% or more of the total number of trees in the canopy stratum of the Cleared and Disturbed plant community or the subject site are "feed tree species" and hence the site does contain "potential koala habitat", as defined under SEPP 44.

In further consideration of the SEPP 44, "Core koala habitat" is defined as areas of land that contain "a resident population of koalas, evidenced by attributes such as breeding females and recent sightings of and historical records of a population". There is no evidence (such as sightings, calls, scats and fur) that the study area supports a resident population of the Koala and there is no evidence in general of koala activity. Hence, the site does not constitute "core koala habitat", within the meaning of SEPP 44.

On this basis, the provisions of Clause 9 of SEPP 44 do not apply to the proposed activity. A *Koala Plan of Management* is not required to be prepared as part of the proposal.

8.6 Pittwater LEP 1993

The Pittwater LEP aims to incorporate the relevant provisions of the Warringah LEP 1985 into an LEP for the area of Pittwater. It sets out development control within specified zones within the area. The subject site is zoned 2 (f) Urban Purposes – Mixed Residential under this LEP.

8.6.1 Pittwater 21 DCP

The Pittwater 21 Development Control Plan (P21 DCP) describes development controls for land within the Pittwater LGA. Part B4 describes various controls which apply to land which has been classified as Category 1, 2 or 3 and/or wildlife corridor. The land within the subject site is classified as containing a Flora and Fauna Enhancement Area (Category 2) and a Wildlife Corridor as part of the Warriewood Wetlands. As such, section B4.4 controls apply to this land. Controls include buffering wildlife corridors, retaining and enhancing habitat for threatened species, populations and communities, and ensuring that 60% of the open areas are to maintain native vegetation. Section B4.14 also applies to this land as the development is in the vicinity of wetlands. Controls include appropriate disposal of stormwater and wastewater, provision of an adequate buffer to wetlands, maintenance of wildlife corridors and ensuring that 80% of landscaping species are locally native.

Part C of the DCP describes controls for specific aspects of the land release areas in the Warriewood Valley. The land within the subject site contains a Core Riparian Zone and creekline buffer strip areas and as such sections *C6.7 Water Management and Creekline Corridors* and C6.13 *Landscaped Amenity Buffer Strips* controls apply to this land. These controls are further described below in Section 10.1.

9 IMPACT ASSESSMENT

The potential direct and indirect impact of the proposal on any threatened species, populations, endangered ecological communities is provided below. This includes consideration of any critical habitat and any relevant recovery plan related to threatened biodiversity. In order to assess the potential impacts the extent, nature and timing of the construction works is considered as well as any maintenance activities and the ongoing occupation of the site. Activities that need to be considered include the construction of buildings, provision of utilities, site access, drainage and stormwater management structures. The proposed landscaping works and asset protection zone treatments will also be considered.

Potential impacts to threatened biodiversity may occur due to clearing, modification and long term degradation of habitat, from impacts associated with future residential areas adjacent to habitat (trampling, pollution, rubbish dumping, spread of weeds, increased predation by domestic animals) overshadowing, and from increased susceptibility associated with edge effects and urbanisation (weeds, pests, competition, disease, insect attack).

As previously described the majority of the remnant rural/semi-rural site displays a history of anthropogenic disturbance, with large areas previously cleared and disturbed. Evidence of this is visible on site in the form of previous plantation forestry and associated drainage channels and current horse paddocks and residential developments. The vegetation and habitats present have been substantially altered by human occupation and land use over a number of decades. As a consequence, the majority of the site contains very limited natural resources and supports a low diversity of native flora, fauna and their habitats.

However, the remnant native vegetation located along the southern boundary and near Boondah Rd consists of endangered ecological communities of high conservation value, and the site also adjoins Warriewood Wetland which is a refuge habitat for numerous flora and fauna species, including threatened and migratory species. The wetland contains vegetation communities that are part of endangered ecological communities as well and is of regional significance.

Other potential direct and indirect impacts from the proposal include habitat fragmentation, weed infestation, alteration of surface and ground water flows, overshadowing, creation of asset protection zones and edge effects. These issues are further discussed below, and impact mitigation measures have been proposed where there is a potential risk to the flora and fauna, and their habitats, occurring within the study area.

Impacts of Construction

The proposed residential development requires the clearance of vegetation predominately contained within Cleared and Disturbed areas and areas of Poplar Forest (Figure 8, Appendix B) which contain exotic species of little or no conservation value. The vegetation to be removed comprises mainly paddocks of exotic grassland, stands of planted White Poplar and exotic horticultural plantings associated with residential development. These areas generally have a low to moderate habitat value as they provide limited shelter and foraging resources for native fauna that may occur within the study area. The soil profile in these areas is likely to have been greatly disturbed in the past, with little potential for natural regeneration of native plant species.

The *Arboricultural Assessment/Vegetation Management Report* (TALC 2008) determined that the majority of the 749 trees located within the site to be affected (i.e. removed) occur within the Poplar Forest. The majority of trees proposed to be removed from the site comprise exotic species, including Populus *deltoids* Poplar*, Pinus radiata* Radiata Pine and *Erythrina x skyesii* Coral Tree.

No threatened flora species or populations listed under the TSC Act were recorded on the site during field investigations. Given the highly altered state of the site, no threatened plant species are likely to be adversely affected by the proposal. Native tree species located within the development footprint requiring removal include *Casuarina glauca* Swamp Oaks, *Angophora costata* Sydney Red Gum, *Eucalyptus botryoides* Bangalay and five *Callistemon viminalis* Weeping Bottlebrush (TALC 2008). These trees predominately occur within the area mapped as a Swamp Sclerophyll Forest.

The preferred development proposal requires the clearance of approximately 2003m^2 of the existing 6023m^2 Swamp Sclerophyll Forest (SSF), which is listed as an EEC under the TSC Act. This area is located in the south east section of the site near Boondah Road, where construction for the entranceway and Road 01 from Boondah Road, widening of Boondah Rd, footpath construction and Building N will occur. Additional clearing of the remnant vegetation is required for construction of a pedestrian/cycle path through the Swamp Sclerophyll Forest remnant, for the construction of stormwater pipes from Road 01 to Bio-retention Basin B, and to a lesser extent for a overflow pipe from Bio-retention Basin A into Warriewood Wetlands. Pipelines will be constructed via open trenching, requiring clearing of a corridor of vegetation prior to excavation. The width of clearing required for construction of Road 01 or for the pipelines is not available at this stage, although the additional impact is estimated at an additional 150m^2 that will be followed by rehabilitation.

The proposal will also modify approximately 590m^2 and 647m^2 of existing SSF within the VB and OPA zones respectively, where canopy cover will be reduced in order to satisfy bush fire management requirements. The proposal will retain approximately 1762m^2 of existing SSF within the CRZ and 1017m^2 will be undisturbed in the area close to Boondah Rd which is outside of the development footprint, riparian and asset protection zones. The report recommendations below include a consideration of the design of the APZ in this area to maximise biodiversity outcomes by reducing the amount of SSF clearing and/or modification required.

The clearing of native vegetation is listed as a key threatening process for the decline in many fauna and flora species. This vegetation also forms a corridor between Warriewood Wetlands and vegetation to the east within the Sydney Water site, providing valuable substrata for the dispersal of fauna species between habitat areas. The significance of the impact of the development on the Swamp Sclerophyll Forest has been assessed via a 7-part test (Appendix C) which has concluded that the removal of 2003m^2 of vegetation and the modification of 1237m^2 is unlikely to result in a significant effect on the Swamp Sclerophyll Forest EEC.

The vegetation retained off Boondah Road is at risk of degradation subsequent to the reduction in the size of the stand. Greater exposure to fragmentation, weed infestation and edge effect conditions is expected. Edge effects currently operate across the site to some extent at the interface between the horse paddocks, existing roads and poplar plantation and the Swamp Sclerophyll forest. Edge effects tend to occur within a transitional zone between two opposing habitats, and impacts may include increase in sun, rain and wind exposure on core vegetation, influx of weeds, pests and disease. The creation of a new ‘edge effect’ that will impact on the retained SSF is likely following the clearing of the remnant vegetation for the construction of roads, paths and residential dwellings.

The proposed residential buildings also have the potential to alter the vegetation retained within the riparian zones due to overshadowing. Overshadowing reduces the likelihood of plants establishing and the suppression of plant growth through the obstruction of the sunlight by buildings. This risk has been considered by review of the shadow diagrams, although these have only been prepared to date for the Stage 1 proposal, and shadow diagrams of the revised design were not sighted.

For Stage 2 the risk is predicted to be higher during the morning daylight hours, and a section of the wetland and core riparian zone is a greater risk of overshadowing from Buildings O and P. Some minor impacts may occur to the riparian buffer zones or within the Asset Protection Zone. The APZ is a combination of sparse vegetation, paths and road structures where overshadowing will have less impact, however following construction the impacts of overshadowing upon the remnant native vegetation and riparian zones should be monitored and the revegetation strategy altered if required.

The proposed development of the site will reduce the availability of fauna lifecycle resources and habitats that are commonly associated with rural and semi-rural landscapes. This will have minor adverse effects on some of the locally occurring fauna that utilise the rural-urban land interface. The majority of these species are unlikely to be significantly affected by the proposal, as they are considered common within their range, widespread in distribution and tolerant of urban development and disturbance. Currently available habitats within the locality such as Warriewood Wetlands and native vegetation of the escarpment, the Sydney water site to the east and national parks further away will not be significantly impacted by the proposal

Impacts to the Swamp Sclerophyll Forest adjacent to Boondah Road cannot be avoided due to the footprint of the current proposal. This will reduce the extent of habitat available for fauna species, and this is an area of the site where the Powerful Owl *Ninox strenua* species was located during the March 2008 survey.

Forty trees were identified from the Poplar Forest and Cleared and Disturbed Areas as supporting potential fauna habitat features such as hollows, cavities and cracks (TALC 2008). The removal of Poplar trees from the central parts of the site may affect the life cycles of the arboreal fauna recorded in some of these trees, including Possums and Rainbow Lorikeets, and the tree removal will reduce the availability of nesting sites for birds and microbat species at this location, as well as prey items for predators such as the Powerful Owl..

The species recorded using the hollows and the majority of other fauna species identified from the subject site are considered common to abundant within urban areas in the locality and the habitats found on the site are not unique or restricted in the area. Consequently, potential adverse effects on these species as a result of development of the site are not expected to be significant, and these species should recolonise parts of the site once native vegetation has established within planted areas.

The proposed development of the site may indirectly impact the adjacent Warriewood Wetland. The boundary of the wetland was assessed in detail during the 2004 assessment (TEC 2004) and it was concluded that the distance of the wetland boundary from the subject site varies from approximately 6.8 metres to 29.8 metres to the south and west of the site boundaries respectively. This wetland boundary line is included on the design plans for the proposal, and has been used as the basis of locating the CRZ and subsequent riparian and asset protection zones. Increased stormwater volumes will enter the wetland due to the increased hard surface catchment area as a result of the development. Stormwater will enter the wetland from the two overland flow paths, the flood storage area, overflow from the Bio-retention Basins and the stormwater pipe adjacent to Road 04.

The movement of ground water is from the north east across the site and drains towards Fern Creek and the wetlands at the southern boundary. The subject site slopes down towards the wetland at an average of 1^0 with groundwater depth decreasing in proximity to the wetland boundary (Jeffery and Katauskas Pty Ltd 2009). The proposed construction for the underground car parks and building foundations involves cutting through the bedrock, therefore intercepting groundwater flows. The proposed design includes a groundwater collection and diversion system that will act to intercept flows on the high side of the development, diverting the groundwater through a series of subsoil drains under the construction, and then disperse it below ground towards the wetlands. The Hydrogeological Report confirms the drainage structures are capable of transporting intercepted groundwater around the development and discharging it back into the water table at a similar volume and depth as the existing situation. Obstruction of groundwater from the construction, according to the report should be negligible and the impact or changes to the hydrological regime into Warriewood Wetlands, and the associated vegetation communities not considered to be significant. Water quality and flow is expected to remain consistent with current flows. Regular monitoring will assist in the management of the ground water and wetlands, and should assess the degree of impact to the water quality within the wetlands and the wetland vegetation.

Asset Protection and Landscaping

The modification of the endangered ecological community will also result from the establishment of the Asset Protection Zone in the area of the site between the CRZ and Boondah Road. The APZ is currently 25m wide, and this width and the location of the APZ within and adjoining the proposed Vegetated Buffer is based on the previous design approved by Pittwater Council. The 15m IPA and the 10m OPA (Vegetated Buffer) will be modified to contain 15% and 30% tree canopy cover respectively, along with a modified understorey of grasses. Canopy vegetation assists in the dispersal and foraging of fauna arboreal species. The reduction on the canopy cover will impact the fauna opportunities, however, optimal habitat within the riparian zone is still available. Again, redesign of the APZ in this area may result in improved biodiversity outcomes and improve fauna habitat links, while maintaining acceptable risks to life and property assets.

The submitted proposal includes a Landscape Plan prepared by Site Image. The Plan has been revised to ensure that infrastructure is located away from the riparian zones as much as possible, with only a section of Bio-retention Basin B and a pedestrian/cycle path crossing Fern Creek through the PRZ. Tree retentions are highlighted, and tree species selection will exclude invasive species that could impact the riparian zone and adjoining habitats. The Plan should complement the VMP prepared for the project in order to carry out suitable restoration activities that result in improved biodiversity values for the site above those currently occurring.

Site Maintenance and Occupation

As surface water runoff may potentially contain large quantities of sediment and chemicals, two bio-retention ponds and an overland flowpath has been included within the design of the site. An overland flowpath at the western boundary of the site is designed to assist in reducing the flow of water and sediments. The volumes of water entering the wetland from the overland flow paths will be higher than currently exists, however the exact amount and therefore the significance of impacts has not been quantified. Water stored within the Bio-retention basins is leeched out of the system through porous soils and vegetation, thereby reducing the impacts to the adjoining wetlands via the controlled release.

The proposed development includes the rehabilitation of remnant vegetation within the CRZ, VB, Fern Creek corridor and Flood Storage Area through regeneration, revegetation and weed control measures, and these activities should be continued within these zones initially by the developer and then transferred to Council/and or a Trust, with works set out in a site specific Management Plan. The risk of weed infestation from increased urbanisation, while high, is not considered to be significantly different to the current situation.

The long-term impact on Warriewood Wetlands is difficult to assess, however, the vegetated riparian zones proposed will assist to reduce ongoing impacts such as edge effects, weed infestation, reduced water quality, pollution and trampling. The creation of these zones and management of the movement of people close to the wetlands is unlikely to significantly increase the impact on the wetland habitat, and if fact may reduce them in relation to the existing situation. By creating and maintaining the riparian zones the potential spread of weed into the wetland is reduced and will assist in connectivity within and between the adjoining sites.

In summary, the impacts of the proposal to the remnant native vegetation via clearing or modification of SSF, proposed regeneration of SSF within the CRZ, and rehabilitation of other riparian, asset protection and flood management zones is as follows.

Table 7 Summary of vegetation clearing, retention and restoration.

Vegetation Community Treatment	Area m^2
Existing Swamp Sclerophyll Forest	6023
Existing Freshwater Wetland	905
Swamp Sclerophyll Forest Removed	2003
Swamp Sclerophyll Forest Retained Outside Development Footprint	1017
Swamp Sclerophyll Forest Retained Within Core Riparian Zone	1762
Freshwater Wetland Retained within CRZ	543
Swamp Sclerophyll Forest Retained within VB (Modified)	590
Swamp Sclerophyll Forest Retained within IPA (Modified)	647
Freshwater Wetland Retained within VB (Modified)	353
Swamp Sclerophyll Forest Regeneration within CRZ	890
Forest Rehabilitation within VB (Modified)	1541

Forest Rehabilitation Fern Creek PRZ	5700
Forest Rehabilitation IPA and FSA (Modified)	6425

Additional areas of revegetation within the Flood Storage Area and the Fern Creek Buffer Strip, Bio-retention Basins and landscape works using native plant species will also contribute to the values of the site, however these areas have not been quantified as part of this assessment.

10 ENVIRONMENTAL MANAGEMENT AND RECOMMENDATIONS

The current proposal should aim to retain and rehabilitate as much of the remnant vegetation as possible to form a vegetated link through the site between Warriewood Wetlands and Boondah Road and further into the Sydney Water Sewage Treatment Plant site. The current plans will retain approximately 2779m^2 of remnant native vegetation between the Warriewood Wetlands junction and the proposed entrance at Boondah Road, with approximately an additional 820m^2 retained in a modified format within the VB and IPA of the APZ. This is an increase from the previous design, and will reduce the impacts to the community than previously would have occurred. By avoiding impacts to a larger area of the EEC, the potential fragmentation and isolation of Warriewood Wetlands with possible habitat in the adjacent Sydney Water site will be reduced.

The vegetation will be retained in order to maintain fauna movement between sites and as a precaution against fauna isolation. The corridor, while not considered to be critical to the survival of fauna species, has been highlighted for retention, and supplementary planting of native species in this area will help to restore the quality of the corridor subsequent to the initial impacts of clearing.

To avoid impacts to hollow dependent fauna, appropriate precautions adopted prior to and during construction should include a pre-clearing surveys of those trees with hollows that require removal. The retention of as many Poplar trees as possible will provide habitat for hollow dependent species. This retention of the Poplars should include all areas within the riparian zones and any other Poplar trees where vegetation clearing and earthworks will not occur.

Some migratory and regionally significant avian species are known to utilise the wetlands on periodic occasions. Consideration of the timing of construction activities and the potential impacts to arrival of significant birds to the wetlands needs to be considered as part of the works in proximity to the wetland habitats and when conducting the riparian zone restoration. Monitoring of the Swamp Sclerophyll Forest for the presence of nesting by threatened birds during the breeding season is recommended, particularly for the threatened Black Bittern that may occur within the adjoining wetlands (December – March).

Additional scope exists to potentially avoid impacts to the retained SSF EEC by the redesign of the APZ within the section of the site where the remnant is located. Incorporating the APZ into the proposed road corridor (Road 01) and associated landscape works adjoining Building N may reduce the need to modify tree canopy cover to create the required densities within the IPA and OPA (VB). Alternatively, the level of Bushfire Construction requirements could be increased in order to reduce the width of the required APZ.

The affects of urbanisation may potentially impact the regionally significant Warriewood Wetlands in the adjacent site, and for those impacts that cannot be avoided safeguards have been developed to reduce the potential impacts to flora and fauna of the locality, and the adjoining wetland habitat. The development will include the creation and maintenance of creekline and wetland buffer zones and the predominant use of native plant species within landscape zones that will improve the fauna habitat values of the site over time. A Core Riparian Zone, Vegetated Buffer and Riparian zones associated with the re-alignment of Fern Creek are required to reduce potential impacts to significant biodiversity values of the site (Fern Creek, Warriewood Wetland and the SSF and FW EECs), as well as reduce water quality impacts and filter sediments. The creation and maintenance of the riparian zones will also provide an ongoing buffer between the development and the higher quality habitats of the wetland.

Fern Creek and the Warriewood Wetland CRZ is a high priority bushland regeneration and restoration area. Activities include reconstructing the Fern Creek into a more natural system than is currently the case, installation of erosion control measures such as rock armouring, and revegetation of the Fern Creek corridor following weed control works with species that are characteristic of the local vegetation communities. Short-term impacts of possible sedimentation into the riparian corridor and Warriewood Wetlands can be minimised through the installation of mitigation controls outlined within this report and the proposed stormwater management system designs. The CRZ works should focus on weed removal and the use of bushland regeneration techniques to re-establish the Swamp Sclerophyll and Freshwater Wetland communities, with revegetation only occurring within areas where resilience is low.

Clearing corridors for construction of roads and pipes should be kept to an absolute minimum within remnant vegetation areas, and the use of non-trenching technologies explored for the pipelines where feasible. Construction fencing to delineate the corridors and prevent machinery impacting a wider zone is essential, as well as rehabilitation of the areas impacted.

Connectivity of vegetation is preserved through the protection of the riparian corridor adjacent to Fern Creek. Core Riparian and Vegetated Buffer Zones for proposed works within the riparian zone are proposed in accordance with the Pittwater Council approval. A 20m Core Riparian Zone and additional 10m Vegetated Buffer Zone is essential for the protection of the Warriewood Wetland, and plans to rehabilitate the Fern Creek corridor will assist in the connectivity of the site and adjoining wetlands with adjacent vegetation strata and fauna habitats. The current level of edge effects, especially weed invasion will be reduced from levels currently occurring on the site as the proposed riparian zones includes buffer areas that will function to mitigate edge effects to the core riparian zones and Warriewood Wetland beyond.

Swamp Sclerophyll Forest to be retained, regeneration of the community within the CRZ and restoration within the VB will preserve the level of connectivity and establish a vegetated buffer zone against surface water runoff directly into Warriewood Wetlands. The impact from the removal of vegetation to endangered fauna species has been assessed via the 7-part test (Appendix C), which concluded that the current proposal is unlikely to result in a significant effect on threatened fauna recorded from the study area. Habitat for these species including the Powerful Owl are found within areas adjoining the site, and the restoration activities as part of the proposal will provide additional habitat for this species in the future once revegetation has established. The proposal also includes substantial landscapes areas that will support a variety of native tree and shrub species that will offer improved foraging, nesting, sheltering and roosting habitat for some fauna species in the future.

In order to mitigate potential impacts on native trees to be retained, the *Arboricultural Assessment/Vegetation Management Report* (TALC 2008) describes in detail the protection measures that should be implemented prior to and during construction works. Briefly, these measures include;

- establishment of Tree Protection Zone (TPZ) fencing encompassing several trees where possible;
- installation of siltation fencing to the extremities of TPZ fencing;
- boardwalk piers in or near a TPZ to be dug by hand or light machinery;
- any excavation for construction within a TPZ is to be monitored by the consulting Arborist; and
- no material storage or stockpiling within TPZs.

Provided these protection measures are implemented, potential adverse effects on trees to be retained as a result of development of the site are not expected to be significant.

The Sediment and Erosion Plan will detail appropriate measures to be taken during the proposed construction to reduce off site impact on water quality within Fern Creek and Warriewood Wetlands. Precautionary measures during the initial construction stage include the installation of the temporary rock check dams, sediment fences and the bio-retention basins. Sheet water runoff is diverted into sediment basins through sediment fences, while concentrated surface water runoff is reduced by the rock check dams. Surface water is filtered through a series of controls including the sediment and barrier fences prior to entering the wetlands.

Bio-retention Basin B at the south of the site have been re-located outside of the Core Riparian Zone, however the edge is still within the Vegetated Buffer Zone. The Basins act as a filtering system discharging cleaner water than the inflow, and provide potential habitat capacities. A combination of planted sedges, rushes and grasses and sand filtering will reduce the velocity of storm water runoff and remove heavy sediment particles.

The establishment of the 20 metre-wide Core Riparian Zone, as well as the 10 metre-wide Vegetated Buffer zone for the majority of the wetland interface, results in an effective wetland buffer width. This is considered ample in order to effectively buffer direct impacts from the proposal. With the implementation of sufficient water and wastewater strategies and the installation of effective erosion and sediment controls during the construction phase, this buffer should also be ample in providing an effective buffer to indirect impacts as well. The removal of noxious and environmental weeds from the riparian zones, and ongoing maintenance will improve the condition of the endangered ecological vegetation communities on and adjoining the site, while providing improved fauna habitats.

To off set the clearing of habitat within the Poplar plantation large canopy species are incorporated in the landscape design. *Eucalyptus robusta* Swamp Mahogany and *Angophora costata* Sydney Red Gum are included along the Macpherson St interface. *E. robusta* is a significant feed tree for two endangered species the Swift Parrots and the Regent Honeyeater. DECCW within their comments has requested that Poplar tree removals should be staged and only occur after installation of nest boxes. The installation of nest boxes for hollow dependent birds, microbats and arboreal mammals is recommended to compensate for the loss of hollows from tree removals, thereby providing alternative nesting and sheltering habitat to these species. The nest boxes should be suitable for the target species, and installed and monitored by an ecologist with appropriate knowledge and experience as per the DECCW comments.

Prior to construction, the numbers, sizes and locations of nest boxes should be determined, and documented as part of an installation plan or similar. The nest boxes should be installed according to the Plan prior to construction commencing. Current literature into nest box design should be researched and recommendations made regarding materials, volumes, opening size, height etc. A recent paper by Goldingay and Stevens *Use of artificial tree hollows by Australian birds and bats* (Wildlife Research, 2009, 36, 81–97), should be used as an initial reference as part of the nest box design investigations. The paper also discusses monitoring, which is also required and recommended.

A Vegetation Management Plan was prepared for the previous design, and this should be reviewed to ensure that the appropriate selection of plant species that will provide future habitat resources for fauna species, including threatened fauna species within the locality are incorporated into the project. The VMP should also outline the required weed control works, bush regeneration activities, revegetation within the riparian zones, ongoing maintenance, monitoring and responsibilities.

10.1 Buffer Zones and Landscaping

The Warriewood Valley Urban Release Area: Landscape Masterplan and Design Guidelines (Pittwater Council, 2007) has been created in order to assist in the planning and design of the streetscape, open space and creeklines through the development of the release areas within the Warriewood Valley. This Masterplan builds upon previous planning controls for the area including DCP No 9 and No 29, Pittwater 21 DCP, Section 94 Plan and the Roads Masterplan. The concept Masterplan includes Lot 20, Boondah Rd where landscaping has been designed to include buffer zones that will protect Fern Creek, that passes along the western boundary of Buffer Sector 3, and Warriewood Wetlands that are located in proximity to the southern boundary of the site.

A proposed shared bicycle/pedestrian path meanders through the western, southern and south-western boundaries of the subject site. The re-designed proposal has moved this path out of the CRZ and outside the VB where possible. This path will link within similar paths on adjoining land in Sector 11 and within the Warriewood Wetlands and will comprise a raised boardwalk. The path does cross the Fern Creek riparian zone in the south-west corner of the site, and the NoW Guidelines for

controlled activities – Riparian corridors and Watercourse Crossings should be adhered to as part of detailed designs.

The *Arboricultural Assessment/Vegetation Management Report* (TALC 2008) recommends that boardwalk piers required to be installed within or near TPZs in any zones to be dug by hand or light machinery and that any excavation for construction within a TPZ is to be monitored by the consulting Arborist. This will minimise potential damage to the root zones of trees to be retained. Due to the raised nature of the boardwalk, it is highly unlikely that this shared bicycle/pedestrian path will impede current surface flows, restrict fauna movement or contribute to sedimentation or erosion to the creek.

Core Riparian Zone (CRZ)

The CRZ comprises a 20 metre-wide vegetated buffer along the southern boundary of the site, as requested by Pittwater Council (from the pre Development Application meeting for the previous proposal held on the 17th March 2008). Riparian zones support many important ecosystem functions, including stabilising stream banks, minimising sedimentation and nitrification of the stream, providing flora and fauna habitat and connectivity between areas of fauna habitat (DWE 2008). The re-designed proposal has excluded all infrastructure from the CRZ. Ultimately, a CRZ should comprise "fully structure native vegetation (including groundcovers, shrubs and trees)", necessary components in the maintenance of these many functions.

All native trees will be retained within this Zone, predominately *Casuarina glauca* Swamp Oak (TALC 2009, Landscape Direst 2008) and other species associated with the Coastal Sand Swamp Mahogany Forest and Coastal Freshwater Reedland communities. Regeneration of this zone will largely comprise removal of environmental and noxious weeds currently occurring in high densities in places, especially Lantana, Senna, Small-leaved Privet, Kikuyu and Honey suckle. The removal of weeds will allow for the regeneration of native species from the soil seedbank, only supplemented by revegetation where necessary in areas of low resilience.

10m Vegetated Buffer Zone

The 10 metre-wide vegetated buffer (VB) zone will be established along the southern boundary of the site, to directly adjoin the CRZ to the north. This buffer is to protect the boundary of Warriewood Wetland and is referred to under the Pittwater 21 Development Control Plan (P21 DCP) Section B4.14. This buffer was negotiated between Council and the former DIPNR (now DECCW) in 2003 and is to be maintained in the current proposal (as requested by Pittwater Council in the pre Development Application meeting for the previous proposal held on the 17th March 2008).

Where possible all infrastructure has been removed from the VB as part of the re-designed proposal, however this zone does includes part of Bio-retention Basin B and the Flood Storage Area. Existing remnant native vegetation is to be retained within the 10m VB zone, with other areas revegetated using local endemic vegetation characteristic of the local communities. The type of species, provenance and densities should be established in accordance with the VMP.

The current design of the VB is as per the previously approved project, which has the Outer Protection Zone of the APZ to coincide with this zone, and additional revegetation works on the site outside of the VB such as the Fern Creek corridor will aim to compensate for this fact.

Asset Protection Zone (APZ)

The APZ will provide setbacks from infrastructure to reduce the potential impacts of bush fire. Ideally the APZ will encompass landscaped gardens and roads in order to allow increased areas of revegetation between the APZ and the Riparian Zones whilst not increasing the risk to life or property assets. The APZ must be located outside of the Riparian Zones, and modification of the SSF EEC limited in the southern-eastern section of the site. Bush fire protection measures must ensure planting in this zone does not create a fire path to infrastructure or dwellings, therefore vegetation will

predominately consist of managed grasses with a tree canopy of no greater than 15% cover within the IPA, with 30% cover proposed within the OPA, which coincides with the VB as stated.

Public Riparian Zone

The Public Riparian Zone is 50m and consists of two inner 25 metre-wide (measured from the top of the creek bank) "multi-function corridor" located on either side of Fern Creek. This buffer is required under the P21 DCP Section C6.7 and will be protected and managed in accordance with the specifications of P21 DCP. This 50 metre-wide multi-function corridor is to be dedicated to public ownership under Council control. Rehabilitation works within this area will be carried out by Council and will involve substantial reconstruction of the creek profile, the construction of new creek banks, and possibly re-alignment of the creek into a more natural channel than currently exists. Weed infestations and exotic trees will be removed and erosion controls installed. The retention of native trees within this Zone, predominately *Casuarina glauca* Swamp Oak (TALC 2009, Landscape Direct 2008) will be supplemented by the introduction of indigenous plant stock along the riparian zone of the creek, which will create a dense narrow band of native vegetation linking other areas of bushland to the Warriewood Wetlands.

Buffer Strip

The Buffer Strip, up to 25 metres where possible, will directly adjoin the Public Riparian Zone (Figure 4, Appendix B), and will remain in private ownership. This buffer strip will be rehabilitated and will contain open space areas, landscaped gardens and a shared bicycle/pedestrian path. Native species to be planted within this buffer strip may include *Acmena smithii, Backhousia myrtifolia, Casuarina glauca, Eucalyptus robusta, Ficus rubignosa* and *Livistonia australis.* Once established, many of these species will offer foraging, nesting and roosting habitat to common, protected and threatened fauna species.

10.2 Mitigation Measures

10.2.1 Environmental Management Measures to be implemented before Construction

- Inspection (by a qualified biologist) of hollow-bearing trees and dense shrub thickets for fauna habitation, prior to their felling and removal. Where animals are located, they would be carefully released at the time, or captured for later release. Captured animals would generally be released into the edges of the Warriewood Wetlands at dusk, and injured fauna would be transferred to the care of WIRES;
- The retention of hollow-bearing trees and all native trees within the CRZ and VB zones is required. This includes Poplars located in the south-western and southern parts of the site. Trees identified for retention will be inspected by a qualified arborist to assess their safety, longevity and suitability for retention within the riparian zones. The Poplars will be removed in stages to ensure hollow dependent fauna habitat is retained. Under Section B4.4 of P21 DCP there is to be no net loss of native canopy trees as a result of the development;
- Installation of nest boxes for hollow dependent species such as birds and microbats prior to tree removals within retained vegetation in close proximity to previous Poplar plantations. A Nest Box Plan should be prepared and approved prior to construction which utilises the latest research and that sets out the numbers of nest boxes required, target species, nest box designs, installation and monitoring requirements;
- Seed collection and establishment of SSF and FW provenance species suitable for use in the revegetation works within the riparian zones;
- Installation of temporary exclusion fencing along the outer boundaries of the buffer zones, including the 10m Buffer Strip, Public Riparian Zone and remnant native vegetation areas, prior to construction. Appendix 4 of P21 DCP addresses the protection of existing vegetation, and states that "The existing vegetation, to be retained, should be protected from root

compaction, root, trunk and limb damage, soil contamination and changes in surface level that may affect the health of each specimen. Protection measures are to be installed prior to the commencement of any earthworks. It is suggested that a chain wire fence be erected 1 metre beyond the dripline of each specimen for the full circumference of all vegetation to be protected". All stands of Swamp Sclerophyll Forest adjacent to the development footprint that will be retained will be protected by erecting temporary exclusion fencing during construction in accordance with the Arborists recommendations;

- Review of the Vegetation Management Plan (VMP) in accordance with the revised proposal, that demonstrates the "the protection of the adjoining Fern Creek, Warriewood Wetland and riparian corridor in respect of the Stage 1 proposal and the Concept Plan", in accordance with the Director General's requirements. The VMP should include a description of proposed regeneration, rehabilitation and restoration methodologies, planting layout and densities, including a list of appropriate species for use in revegetation in any rehabilitation areas and provide a maintenance program for a minimum period of 2 years after the completions of works, including monitoring and reporting responsibilities;
- The retention of all mapped Swamp Sclerophyll Forest (except for the area proposed for removal) should occur, and all construction activities should be excluded from this area. The retention of the Swamp Sclerophyll Forest vegetation adjacent to the proposed buildings close to Boondah Rd may require additional bushfire protection measures are incorporated into the building design in addition to APZ to achieve a satisfactory level of protection to residents, emergency workers and buildings in the event of a fire. Native canopy species in this area should be retained in particular; and
- Removal of all noxious weeds and conduct primary weeding using bush regeneration techniques of all areas of retained vegetation on the site, and within the entire Core Riparian Zone both on and off site.

10.2.1 Environmental Management Measures to be implemented during Construction

- Monitoring of retained stands of Swamp Sclerophyll Forest, the riparian zones and adjacent wetlands for the presence of threatened birds species during their breeding season that may nest within this type of habitat. This would include *Ixobrychus flavicollis* Black Bittern.
- A program of weed control and bush regeneration should be implemented for all Swamp Sclerophyll Forest and riparian zones, in accordance with the approved VMP. Regular follow-up or secondary weeding within the SSF and CRZ is required as per the VMP;
- Revegetation of the CRZ and VB with locally indigenous plant species. Species selection will be based on achieving a target community similar in structure and diversity to the Swamp Sclerophyll Forest community within the CRZ, and canopy cover within the VB as per the bush fire recommendations. Appropriate and inappropriate species for the revegetation works are listed in the Appendices of P21 DCP, and contained with the VMP;
- Revegetation within the 25 metre Asset Protection Zone must be designed so that the function of the APZ is not compromised by the landscaping works. This will require careful selection of species, creation of gaps in the canopy and separation of the ground and canopy fuel layers as per the Bush Fire Report;
- Landscaping around the entrance way at Boondah Road, and in the other areas of the development that required removal of Swamp Sclerophyll Forest, (the south eastern section of the site) should consist of species characteristic of this community, and that only genetically integral plantings of species diagnostic of the community be used in landscaping in the area beside the roads and dwellings;
- The location of material stockpiles and vehicle parking areas must be on already cleared and disturbed land, well away from vegetation to be retained on the site and the boundary close to the wetlands;
- Chipping of felled trees and other vegetation (excluding noxious or invasive weeds) from the site for use as mulch in rehabilitation works is recommended;

- Maintenance and installation of appropriate erosion control measures during the construction phase of the development (e.g. silt fences, sediment ponds etc), to protect terrestrial habitats on-site and wetland habitats downslope of the site. These will conform to *Managing Urban Stormwater - Soils and Construction* (NSW Department of Housing 1998), and will be maintained throughout the construction period.
- Management of stormwater, wastewater and runoff as per the P21 DCP and design plans in relation to the sites proximity to a significant wetland; and
- Management of construction materials, fuels and wastes should be controlled to minimise the potential for any discharge of chemicals or contaminants (such as concrete or other building materials) impacting upon adjacent areas of native vegetation or waterways.

10.2.2 Environmental Management Measures to be implemented after Construction

- The program of weed control and bush regeneration in all conservation areas retained on-site is to continue, with preference to areas of Swamp Sclerophyll Forest and the riparian zones, in accordance with the approved VMP to enhance the quality of the remaining vegetation. Conduct monitoring in accordance with the approved VMP;
- Implement a fauna monitoring program as set out in the Nest Box Plan;
- Material stockpiles and vehicle parking areas that have been created on site are to be removed and made good upon completion of the construction works;
- Non-permanent erosion control measures (e.g. silt fencing, sediment ponds) implemented during the construction phase of the development are to be carefully removed following completion and stabilisation of the works; and
- Management of stormwater, wastewater and runoff will continue as per the project design and P21 DCP in relation to the sites proximity to a significant wetland.

11 CONCLUSION

As previously reported, no threatened species, populations, or ecological communities or their habitats were identified on the site during the 2003 study. This previous report noted that despite this absence it was 'theoretically possible that mobile, nomadic or migratory threatened species could occur on the site on a temporary or occasional basis, including several threatened birds (*e.g.* the Swift Parrot, Regent Honeyeater, or Powerful Owl), microchiropteran bats (*e.g.* the Eastern Bent-wing Bat) and megachiropteran bats (e.g. the Grey-headed Flying Fox). As a result the author of the previous report conducted a collective 'assessment of significance' addressing the superseded 'eight factors of s.5A of the EP&A Act' with respect to threatened fauna previously recorded in the locality. The author concluded that the proposed development of Buffer Sector 3 was not "likely" to impose "a significant effect" on any "threatened species, populations or ecological communities, or their habitats". Therefore there was no requirement for the preparation of a Species Impact Statement to accompany the previous development application (TEC, 2004).

Recent amendments to the TSC Act and Section 5A (s.5A) of the *Environmental Planning & Assessment Act 1979* have modified the so called 8-part test to a 7-part test. The 7-part test lists seven factors that "must be taken into account" by a consent or determining authority in the administration of Sections 78A, 79C and 112 of the Act when considering a development proposal or DA. The aim of s.5A is to determine "whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats", as listed under Schedules 1 and 2 of the TSC Act, and hence whether a *Species Impact Statement* (SIS) is required. Whilst there has been modification to the nature of the assessment of significance since the previous flora and fauna survey and assessment in 2003/04, the aims, intent and general content of the 7-part test remain consistent with the previous 8-part test.

As described previously in this report, two endangered ecological communities are recorded on site. These are Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions and a small area (905m^2) of Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions. Both communities are contiguous with Warriewood Wetlands adjoining the southern site boundary. No direct clearing impacts to the Freshwater Wetland community will occur, and this community is largely contained within the proposed Core Riparian Zone. The direct and indirect impacts to the Swamp Sclerophyll Forest community are discussed with the report. The level of impact from the proposed actions has been assessed under the *TSC Act* s5A Assessment (7-part test).

According to the Department of Environment, Climate Change and Water *Recommended Environmental Assessment* (EA) requirements the following threatened or endangered species have

been recently recorded within 500m of the subject site, and have therefore been assessed as part of the s5A Assessment (7-part test) (Appendix C);

- Barking Owl *Ninox connivens*
- Powerful Owl *Ninox strenua*
- Swift parrot *Lathamus discolor**
- Grey-headed Flying-fox *Pteropus poliocephalus*
- Regent Honeyeater *Xanthomyza Phrygia**
- Black Bittern *Ixobrychus flavicollis**
- Lesser Sand Plover *Charadrius mongolus**

* *Denotes species listed as threatened under the EP&BC Act and assessed at a National level for the Assessment of Significant.*

The assessments have concluded that the current proposal is unlikely to result in a significant effect on the threatened biodiversity recorded on site, or their habitats. The subject site is predominately a highly modified semi-rural landscape with very limited natural resources; no critical habitat was assessed within the site. The proposed actions to supplement the removal of exotic Poplar trees with native species characteristic of the local vegetation communities that will provide future fauna habitat, provision of suitable nest boxes as compensation for removals, the removal of exotic weeds, the rehabilitation of Fern Creek and the regeneration of the CRZ and wetland buffer are significant ecological improvements on the current biodiversity within the subject site. The low native floristic assemblage represented within the subject site is the result of anthropogenic practices and extensive weed infestation. The proposed improvements will provide food and foraging substrata for local and migrating threatened species, and increase the plant diversity within the retained remnants.

The site could potentially provide habitat for a limited number of threatened or migratory fauna species, most of which are highly mobile with large home ranges. No viable threatened population utilises the subject site and as such the proposed actions will not directly increase the risk of extinction to local threatened populations or species. Public reserves either adjoin the subject site or are located nearby within the locality, and currently provide far better habitat for threatened species than that of the subject site. Retention of native vegetation on the subject site where possible, creation of riparian buffer zones, habitat, and linkages with adjacent natural areas has been recommended in this report. The risks associated with changes to overshadowing, stormwater and groundwater flows and habitat connectivity are considered to be low, and the threats to the biodiversity located on the site, and to the adjoining Warriewood Wetland are not significant.

The areas of highest biodiversity value include the southern and south-western corners as these areas contain native riparian vegetation and are in close proximity to the Warriewood Wetlands. While the proposal includes clearing 2003m^2 of the endangered ecological community near Boondah Rd the retention and enhancement of the vegetation in this area will be maximised to provide for the preservation of habitat for threatened species in the locality. A total of approximately 2779 m^2 of SSF will be retained and an additional 890m^2 will be regenerated and rehabilitated within the CRZ. A total of 1237m^2 of existing SSF will be modified within the APZ (IPA and VB) in accordance with canopy cover percentages as per bush fire requirements. To offset these impacts restoration of approximately 5700m^2 of fully structured native forest community using species characteristic of SSF will occur with the Fern Creek PRZ, with a further 1541m^2 of modified vegetation within the VB and further revegetation opportunities within the IPA and Flood Storage Zone which totals approximately 6425m^2.

Compensation for the proposed impacts to the SSF community will occur on site, with regeneration and restoration of this community within the CRZ and Fern Creek corridor, with additional habitat creation within the VB, IPA and the Flood Storage area as set out above. These actions will result in the maintenance of the biodiversity values of the site, and these will improve over time as the riparian zones are established. These zones will also protect the significant habitat within Warriewood Wetlands, creating riparian zones that are wider than currently exists. The proposed vegetation management measures will also improve the quality of the retained vegetation and the CRZ.

This report concludes that the impacts of the proposed development of the site are not likely to be significant at a local, regional or national level. This is based on the biodiversity significance of the site as assessed previously in 2003/04, 2006, March 2008 , September 2008 and currently in January and August 2010. The long-term viability of the threatened biodiversity occurring within the site and the wider locality will not be reduced as a result of the proposal, and no increased risk of extinction is considered likely. No Critical Habitat for threatened biodiversity has been declared for the subject species or the locality that would impact the current proposal. Therefore, in light of this assessment, a Species Impact Statement or a Referral to the Federal Environment Minister is not required.

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