



# Ecological Inventory Report

## North Tuncurry

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# Executive Summary

RPS was commissioned by Landcom to undertake an *Ecological Inventory Report* (EIR) over Crown Land located at North Tuncurry. The aim of the survey and subsequent report was to identify the flora, fauna and habitat characteristics of the site, to inform due diligence on ecological issues, assist in conceptual planning phases, and ultimately inform the production of an ecological impact assessment documentation as a component of any future development proposal.

A variety of field survey techniques were employed over the course of desktop and fieldwork to document flora, fauna and habitat characteristics of the site. A gap analysis was conducted, between the ecological survey effort of previous studies undertaken on site (ERM 2005; 2010a) and the requirements or relevant government agencies. Ecological survey effort for this study was concentrated in areas that were identified as deficient to relevant guidelines to ensure compliance.

## Vegetation Communities

The following four vegetation communities have been identified within the site based on ERM and RPS surveys:

- *Eucalyptus pilularis* Dry Sclerophyll Forest (dunal);
- *Banksia aemula* Dry Heathland;
- *Leptospermum laevigatum* Dry Sclerophyll Shrubland; and
- Fore-dune Complex.

The site is comprised predominantly of *Banksia aemula* Dry Heathland and *Leptospermum laevigatum* Dry Sclerophyll Shrubland with *Eucalyptus pilularis* Dry Sclerophyll Forest (dunal) occurring in the northern and western sectors of the site. Some stands of Slash Pine (*Pinus elliotii*) were also scattered throughout the site, in some instances with predominately exotic or highly disturbed lower strata. Floristic analyses has identified that at some locations emergent trees (*E. pilularis* and/or *P. elliotii*) occur over layers that are consistent with the surrounding heath or shrubland communities and have been mapped and described as part of these communities.

## Endangered Ecological Communities (EEC)

No EEC's, as listed within the *Threatened Species Conservation Act 1995* (TSC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) occur on site.

## Threatened Flora

One threatened flora species, *Genoplesium littorale* syn. *Corunastylis littoralis* (Tuncurry Midge Orchid), which is listed as Critically Endangered under the TSC Act and under the EPBC Act, was recorded within the site. Given the limited known distribution of this species, any development proposal that is likely to involve the removal of individuals or habitat of this species, will require specific consideration against relevant significance criteria.

## Threatened Fauna

A total of twelve (12) threatened species as listed under the TSC Act and/or EPBC Act have been recorded on site, namely:

- *Pandion cristatus* Eastern Osprey
- *Haematopus longirostris* Pied Oystercatcher

▪	<i>Glossopsitta pusilla</i>	Little Lorikeet
▪	<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale
▪	<i>Cercartetus nanus</i>	Eastern Pygmy Possum
▪	<i>Petaurus norfolcensis</i>	Squirrel Glider
▪	<i>Miniopterus australis</i>	Little Bentwing-bat
▪	<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat
▪	<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat
▪	<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat
▪	<i>Pteropus poliocephalus</i>	Grey-headed Flying-Fox
▪	<i>Syconycteris australis</i>	Eastern Blossom Bat

Any development proposal that is likely to affect individuals or habitat of these species will require specific consideration against relevant significance criteria.

#### **SEPP 44 – Koala Habitat Protection**

One SEPP - 44 Schedule 2 Koala preferred feed tree species was identified as occurring on site, being *Eucalyptus robusta* (Swamp Mahogany). This tree species did not constitute 15% of the total number of trees in the canopy and as such the site does not constitute “Potential Koala Habitat”. Whilst Koala sightings have been recorded directly south and east of the site, no evidence of resident populations of Koalas was found on site. As such the site does not constitute “Core Koala Habitat”.

#### **Habitat**

Floristic diversity on site provides seasonal foraging resources for several guilds of birds and arboreal mammal species. Sufficient foraging and sheltering opportunities for terrestrial mammals and reptiles occur where understorey densities are highest and sufficient forest debris is present. The shrubby understorey and heathland also provides suitable foraging and nesting habitat for a number of common woodland bird species apparent on site. Open areas of forest and heath communities offer grazing and browsing opportunities for herbivorous fauna, such as Macropods.

A low frequency of hollow bearing trees containing small to medium class hollows were observed within the Blackbutt Forest onsite and provide roosting, breeding and den habitat for micro-chiropteran bats and other hollow-dependent bird and mammal species. There were no tree hollows or dead stags identified during the survey period with entrances sufficient to accommodate larger birds such as forests owls.

There are no rocky outcrops, overhangs or other cave like structures that occur on site, therefore the site would represent only potential foraging habitat for cave roosting bat species. No potential locations for roosting camps of flying-foxes and/or blossom bats were observed within the site during ecological surveys.

Habitat opportunities for amphibious species are limited, given the paucity of permanent water (one permanent dam occurs within the golf course). Wooded habitats, ephemeral ponds and damp areas provide foraging and shelter opportunities for some tree-dwelling and terrestrial frog species or intermittent habitat for resident or dispersing frog species.

Coastal habitats adjacent to the site potentially provide foraging and / or nesting opportunities for a number of threatened or migratory pelagic species. Increased human activity related to any future

development, and in particular beach & dune access, will need to be managed accordingly to avoid deleterious impacts on such species.

### **Combined Habitat Value Mapping**

The combined habitat value map showed that the northern parts of the site had the highest combined habitat values. The highest habitat values were generally in areas containing Blackbutt Forest (due to high habitat complexity for a number of recorded threatened species) and areas containing moderate – high numbers of Tuncurry Midge Orchid, a Critically Endangered species. These areas also provide the most important areas for regional and local wildlife connectivity within the site.

### **Connectivity**

Parts of the site provide connectivity between Darawank Nature Reserve, coastal habitats and forested areas between The Lakes Way and Wallamba River and Millers Mistake Creek beyond the western boundary of the site. As such, the site is recognised as a key fauna habitat and is mapped as part of a regional fauna corridor (DEC 2004, Scott 2003).

### **Conclusion**

Through desktop analysis of previous ecological works undertaken on site (ERM 2005, 2010a; 2010b; Paget 2008) and work undertaken by RPS the following significant ecological features have been identified within the site:

- The presence of *Genoplesium littorale* syn. *Corunastylis littoralis* (Tuncurry Midge Orchid) on site, listed as critically endangered under the TSC Act and the EPBC Act;
- The recorded presence of *Pandion cristatus* (Eastern Osprey), *Glossopsitta pusilla* (Little Lorikeet), *Petaurus norfolcensis* (Squirrel Glider), *Phascogale tapoatafa* (Brush-tailed Phascogale), *Cercartetus nanus* (Eastern Pygmy Possum), *Pteropus poliocephalus* (Grey-headed Flying-Fox) and a number of threatened micro-bat species.

## Terms and Abbreviations

Abbreviation	Meaning
API	Aerial Photograph Interpretation
DEC	Department of Environment and Conservation – now known as DECCW
DECCW	Department of Environment, Climate Change and Water (now OEH)
DEWHA	Department of Environment, Water, Heritage and Arts (now SEWPAC)
EIR	Ecological Inventory Report
EEC	Endangered Ecological Communities
EP&A Act	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
GIS	Geographic Information System
GLCVS 2005	Great Lakes Council Vegetation Strategy 2005
GPS	Global Positioning System
LGA	Local Government Act
LHCCREMS	Lower Hunter and Central Coast Regional Environment Management Strategy
MU	Map Unit
NES	National Environmental Significance
OEH	Office of Environment and Heritage (previously DECCW)
PFC	Projected Foliage Cover
ROTAP	Rare or Threatened Australian Plants
RPS	RPS Australia East Pty Ltd
SEPP	State Environmental Planning Policy
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities
TSC ACT	<i>Threatened Species Conservation Act 1995</i>

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***Corunastylis littoralis* Tuncurry Midge Orchid Combined Survey Results 2010/2011**

# I Introduction

RPS Newcastle has been commissioned by Landcom to undertake an Ecological Inventory Report (EIR) over Crown Land, Lot 331 DP 1104340 and the Golf Course located therein known as Lots 294 – 295 DP 43110, located at North Tuncurry, refer to **Figure 1-1** for the site location, hereafter referred to as the 'site'.

This report specifically provides an inventory of field investigation results undertaken during this study (2010 to 2012) as well as considering previous ecological studies (ERM 2010a; 2010b; 2005; Paget 2008) conducted on site. The report aims to document flora, fauna and habitat attributes of the site to: provide baseline data on ecological characteristics of the site and to assess conservation status of recorded flora and fauna for their potential as threatened species, populations or endangered ecological communities as listed under the Threatened Species Conservation Act 1995 (TSC Act) and the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).

The report is required to inform due diligence on ecological issues, assist in conceptual planning phases and will ultimately inform the production of detailed ecological assessment documentation as a component of any future development proposal.

## 1.1 Site Particulars

<b>Locality</b>	The site is located to the north of the town of Tuncurry. The site is bound by Nine Mile Beach to the east, the Lakes Way to the west, educational facilities to the south, vacant land and the Tuncurry Waste Management facility to the north.
<b>LGA</b>	Great Lakes
<b>Title(s)</b>	Crown Land Lot 331 DP 1104340. Golf Course Lot 294 DP 43110 and Lot 295 DP 43110
<b>Area</b>	The site area covers approximately 628 ha of which the Golf Course comprises approximately 60.2 ha.
<b>Current Land Use</b>	The site is currently vacant native vegetation, with several easements established over the land.
<b>Topography</b>	The site has a relatively level topography with some undulations increasing toward the eastern sector due to coastal dunes.
<b>Vegetation</b>	The site is largely vegetated with an operating Golf Course situated in the sites central southern portion. A power easement runs north/ south generally parallel with the Lakes Way adjacent to the western boundary. The site is dissected into large patches by numerous tracks.

**Soils and Geology** Soils are predominately within the Hawks Nest soil landscape with a small area within the Frogalla Swamp soil landscape unit. Hawks Nest soils are characterised by well drained aeric podsols on older dunes with deep rudosols on younger seaward dunes. Frogalla Swamp soils comprise of poorly drained acid peats/siliceous sands or acid/peat/humic gley intergrades (ERM 2010a).

## 1.2 Background

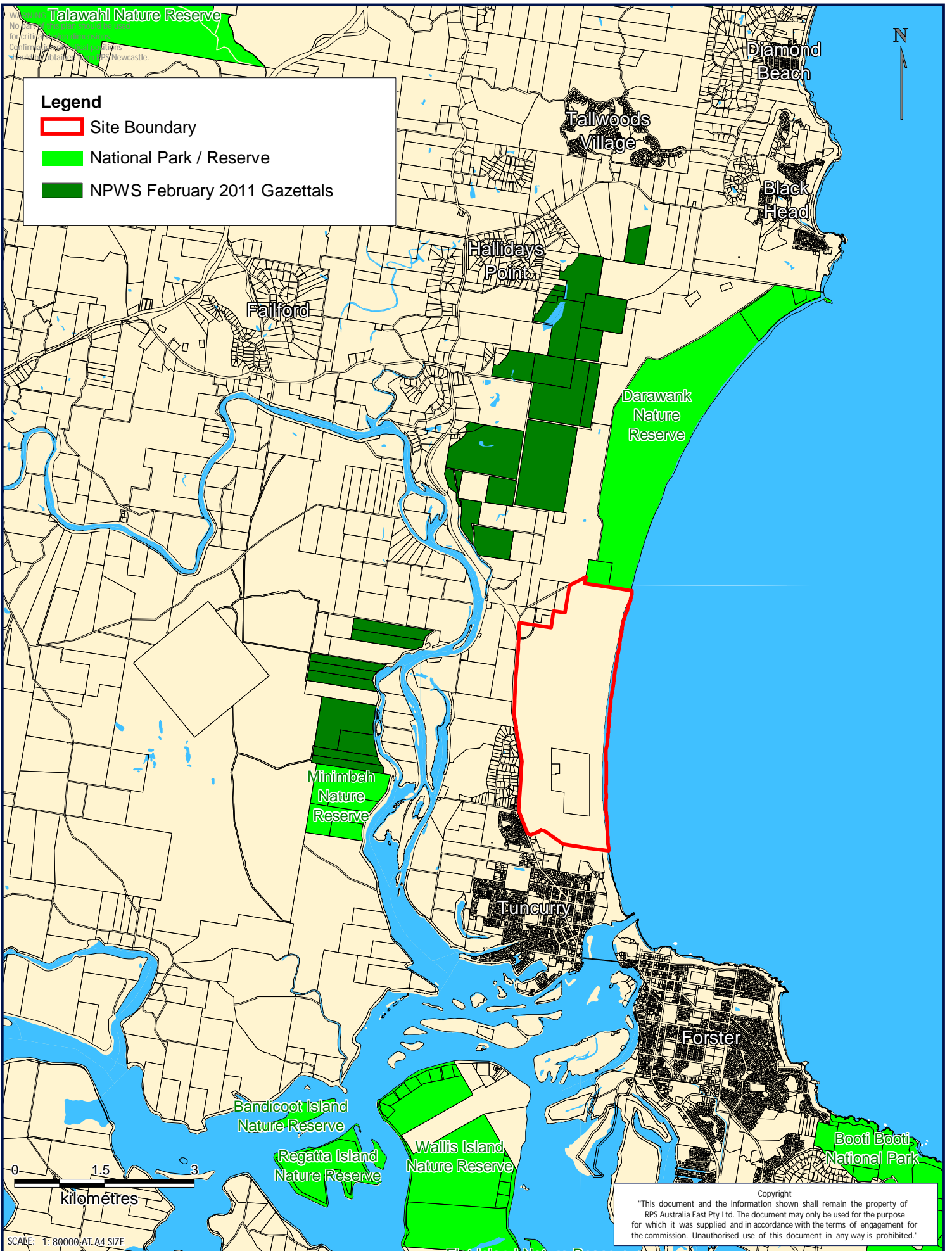
The site has been subjected to numerous historical land uses including attempts at forestry and related activities, mineral extraction and recreational uses.

It has been subject to a number of ecological surveys since 2005 and each survey has built upon the preceding works, resulting in a detailed baseline ecological inventory of the site, of which this report summarises the results of the original and additional surveys.

The most important ecological issue for the site is the known occurrence of the Tuncurry Midge Orchid (*Genoplesium littorale* syn. *Corunastylis littoralis*). This species is listed as Critically Endangered and is only known to occur in the Forster-Tuncurry and Nabiac localities. Surveys by Andrew Paget and subsequent surveys by ERM and RPS have expanded the local known distribution of the species, although the distribution still remains limited. It is considered that this species is the main historically known constraint to future land use on the site. Records of the species tend to indicate a preference for disturbed areas such as power easements and sandy tracks, where it has been observed most frequently.

Since the historical land uses have ceased (apart from illegal recreational activities), the site condition has improved via natural regeneration and the site is now largely covered by heath, forest and sand dunes.

The planning process has been ongoing for the site for a number of years with a view to developing an environmentally sympathetic master plan for the site. It is expected that this EIR will be used to inform further refinement of a master plan for the site.



TITLE: FIGURE 1-1: SITE LOCATION

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 22/03/2012  
 PURPOSE: ECO INVENTORY

LAYOUT REF: J:\JOBS\26K\26414 -  
 North Tuncurry\10-Drafting\Inventory  
 Report Figures  
 VERSION (PLAN BY): P. HILLIER

CLIENT: LANDCOM  
 JOB REF: 26414

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RPS

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## 1.3 Qualifications and Licensing

### 1.3.1 Qualifications

The principal author of this report is Matt Doherty BLMC, with additional input from Toby Lambert BEnvSc, Lauren Vanderwyk BSc, Paul Hillier BEnvSc, Rob Sansom BSc (Hons), David Tierney BSc (Masters Natural Resource Management, PhD, Dip.Ed) and Isaac Mamott BSc. (Botany).

### 1.3.2 Licensing

Research was conducted under the following licences:

- NSW National Parks and Wildlife Service Scientific Investigation Licence S100536 (Valid 31 December 2012);
- Animal Research Authority (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2013);
- Animal Care and Ethics Committee Certificate of Approval (Trim File No: 01/1142) issued by NSW Agriculture (Valid 12 March 2013); and
- Certificate of Accreditation of a Corporation as an Animal Research Establishment (Trim File No: 01/1522 & Ref No: AW2001/014) issued by NSW Agriculture (Valid 22 May 2014).

## 1.4 Sub-consultants, Personal Communications and Observations

### 1.4.1 Sub-consultants

Thanks to Barbara Triggs who undertook hair analysis and Anna McConville who undertook ultrasonic bat call analysis.

### 1.4.2 Personal Observations

Relevant observations made by the authors or other RPS ecologists outside of the project or other published studies have been included within this report as 'personal observations' (pers. obs.).

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## 1.5 Certification

As the principal author, I, Matt Doherty, make the following certification:

- The results presented in the report are, in the opinion of the principal author and certifier, a true and accurate account of the species recorded, or considered likely to occur within the site;
- All research workers have complied with relevant laws and codes relating to the conduct of flora and fauna research, including the *Animal Research Act 1995*, *National Parks and Wildlife Act 1974* and the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes*.

**Matt Doherty**  
**Manager – Ecology and GIS | Technical Director (Ecology)**  
**RPS**

## 2 Methods

A variety of field survey techniques were employed over the course of desktop appraisal and fieldwork for this report to document flora, fauna and habitat characteristics of the site. A gap analysis was conducted, between the ecological survey effort of previous studies on the site (ERM 2005; 2010a, RPS 2010; 2011) and the requirements listed in DEC (2004) *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*. Ecological survey effort for this study was concentrated in areas that were identified as deficient to DEC guidelines to ensure compliance. These guidelines underpin the field surveys conducted across the site.

### 2.1 Preliminary (Desktop) Assessments

Preliminary assessments drew on a number of information sources, including previous ecological works undertaken on the site (ERM 2005, 2010a; 2010b; Paget 2008) and information held on government databases and archives.

Data gathered during preliminary assessments was used to assist in identifying distributions, suitable habitats and known records of threatened species so that field investigations could more efficiently focus survey effort. Assessment information sources included:

- Aerial Photography Interpretation (API);
- 'Birddata': Bird Atlas of Australian Birds Database, Birds Australia;
- OEH database of Threatened Species, Populations and Ecological Communities: Species Profiles site;
- Threatened fauna and flora records obtained from OEH and NSW Wildlife Atlas within the local area (10km search), received 20<sup>th</sup> March 2012;
- EPBC Act 1999 Protected Matters Search (10km search), received 7<sup>th</sup> March 2012;
- ERM (2005) North Tuncurry – Ecological Constraints & Opportunities, Report to Landcom, dated 20<sup>th</sup> Oct 2005;
- ERM (2010a) Crown Land off the Lakes Way, North Tuncurry – Ecological Assessment, Report to Landcom, dated 12<sup>th</sup> Jan 2010;
- ERM (2010b) *Tuncurry Midge Orchid Survey*, Letter & Map to Landcom, dated 12<sup>th</sup> Jan 2010;
- GIS Data including aerial photography, topographic maps, SEPP 14 Wetland Mapping, Soil landscapes, Acid Sulphate Soil Potential;
- Great Lakes Council (2003) *Draft Great Lakes Council Vegetation Strategy*, Great Lakes Council, Forster NSW;
- Paget, A (2008) Results of Searches for the Tuncurry Midge-Orchid (*Genoplesium littorale*, syn *Corunastylis littoralis*), CMA, Autumn 2008;
- ROTAP records of the North Tuncurry area obtained from Plantnet assessed March 2010 (10km search);



- Relevant policies and documents concerning biodiversity objectives for the region;
- Scotts, D. (2003) Key Habitats and Corridors for Forest Fauna: Occasional Paper 32, NSW NPWS; and
- RPS (2011) *Ecological Inventory Report North Tuncurry*, RPS, Broadmeadow, NSW, Australia.

## 2.2 Survey Site Positioning & Delineation of Stratification Units

Stratification of the site was undertaken based on the vegetation mapping undertaken by RPS in 2011. RPS has performed a gap analysis between the survey effort from the previous studies and the survey requirements listed in the current *DEC Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*. The surveys undertaken in 2012 have sought to meet the DEC Biodiversity Survey Guidelines based on the stratification units detailed below.

### Flora Stratification Units

The DEC Biodiversity Survey Guidelines were consulted to determine survey requirements for the site. These guidelines suggest that areas should be initially stratified on biophysical attributes (e.g. soil, geology) followed by vegetation structure (e.g. Woodland, Forest, Shrubland) and then floristics. Within the site, three vegetation structures of Heath, Dry Blackbutt Forest and Beach Complex exist. The Beach Complex is a combination of the dunal vegetation and beach. In addition to the above, the heavily fragmented and often modified golf course vegetation has been analysed as a separate stratification unit.

### Fauna Stratification Units

The DEC Biodiversity Survey Guidelines were consulted to determine survey requirements for the site. Stratification units designated for each trapping transect were defined by encompassing each vegetation community identified in 2011, namely Heath, Dry Blackbutt Forest and Beach Complex exist. The Beach Complex is a combination of the dunal vegetation and beach. In addition to the above, the heavily fragmented and often modified golf course vegetation has been analysed as a separate stratification unit. Due to its known positive responses to certain forms of disturbance, including fire, the Pit Fall Trapping method used to target the New Holland mouse was afforded an additional stratification unit, namely Burnt Heath. The Burnt Heath stratification unit occurs in the north of the site.

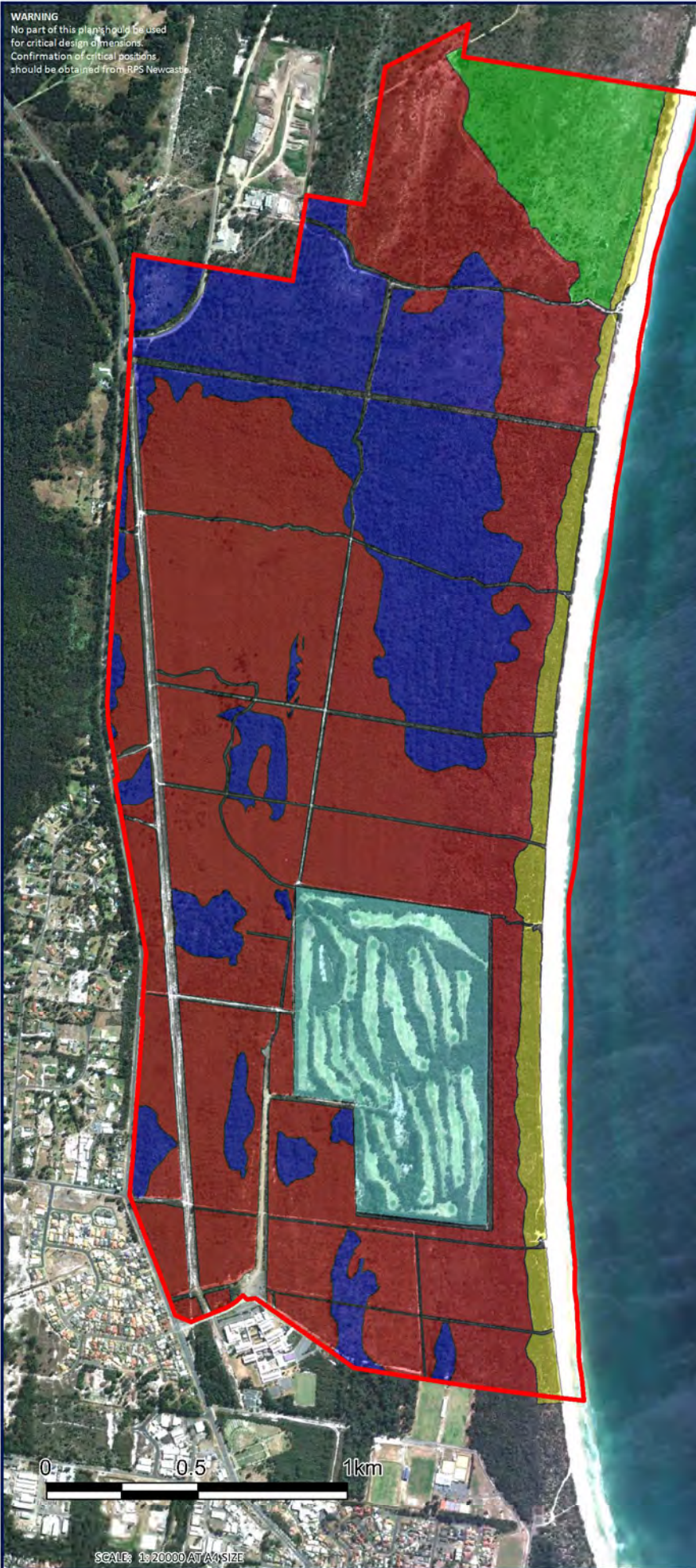
**WARNING**  
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

**Legend**

 Site Boundary

Stratification Units based on RPS (2011)

-  Heath (304.78ha)
-  Dry Blackbutt Forest (132.7ha)
-  Burnt Heath (33.57ha)
-  Beach Complex (30ha)
-  Golf Course (30ha)



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TITLE: FIGURE 2-1 STRATIFICATION UNITS

LOCATION: TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 22/3/2012  
 PURPOSE: ECO INVENTORY

LAYOUT REF: J:\JOBS\26K\26414 -  
 North Tuncurry\10-Drafting\Inventory  
 Report Figures  
 VERSION (PLAN BY): PH (A-A4)

CLIENT: LANDCOM  
 JOB REF: 26414

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)  
 241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303  
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RPS

## 2.3 Flora Survey and Assessment

Baseline and targeted flora surveys have been carried out on the site by RPS in 2010, 2011 and 2012. Survey methods for each of the 3 years work was undertaken on the site by RPS are detailed below.

### 2.3.1 Vegetation Mapping

Initial RPS vegetation surveys were undertaken on May 2010. These surveys were used to verify the vegetation mapping previously undertaken by ERM (2010a). Vegetation surveys used a combination of ground-truthing of the vegetation and aerial photograph interpretation to delineate the vegetation on site. The 2010 vegetation mapping was used to calculate stratification units to define the survey effort for the 2012 survey period, required to meet the DEC (2004) survey guidelines (refer to **Section 2.2**).

A plot based flora survey was undertaken to inventory vascular plants across the site in February 2012 by RPS Senior Botanist Dr David Tierney. A total of 23 full floristic plots were sampled across the site. Replicate plots were sampled within each of the 4 mapped vegetation communities to account for structural and floristic variances and to comply with the Draft DEC Biodiversity Survey and Assessment Guidelines (DEC 2004) (refer **Table 2-7** for survey effort compliance).

All vascular taxa within and overhanging the plots were recorded on field proformas and assigned to one of 6 foliage cover classes (modified Braun Blanquet; after Braun-Blanquet 1982) along with other bio-physiographic attributes such as vegetative structure, geology and soils, slope, aspect, topographic position, location, time since last fire event and forms of disturbance, other than fire.

The structural classification used for the vegetation community description generally follows Walker and Hopkins (1990). Subformation names for vegetation types follows the classification proposed by Beadle and Costin (1952). The vegetation communities are named after dominant indicator species of the tallest stratum and could be considered as 'associations' as defined by Beadle (1981). Botanical nomenclature follows Harden (1990-1993, 2000, 2002) and the Royal Botanic Gardens PlantNet website.

The plot based survey was supplemented with a total of 48 flora Rapid Data Points (RDPs) undertaken in conjunction with the full floristic plots in all 4 vegetation communities across the site. RDPs are essentially summaries of floristic information recorded at specific points in the field and are a cost effective ground truthing approach to quickly and accurately refine and/or verify vegetation mapping for a site. Information recorded at each RPD (on RDP field proformas) comprised dominant flora for each strata, vegetation structure (strata heights, projected foliage cover), Threatened flora species, vegetation community description and notes on geology and soils, topography, aspect and weeds.

Assessment of the conservation significance of the vegetation communities recorded on the subject site was made with reference to the TSC and EPBC Acts, Griffith et al (2000,

2003), Griffith and Wilson (2011), Hager and Benson (1994), Great Lakes Council Vegetation Strategy (Great Lakes Council 2003), Biometric Vegetation Database (DEC (2008) and North Coast Vegetation Community Audit Dataset (Griffith unpublished data).

The location of the 23 full floristic plots and 48 RDPs is provided in **Figure 2-2**.

### 2.3.2 Plant Identification

During this survey when a plant could not be identified accurately within the field, a voucher sample was collected, together with notes on habitat, form and height, labelled and identified according to nomenclature in Harden (1990, 1991, 1992, 1993, 2000, and 2002). Opportunistic sightings of taxa were also collected if they were not found in any of the sampled sites. At a minimum, all dominant species were identified in all strata to ensure that an informed delineation resulted. All flora species recorded are documented in **Appendix 3**.

### 2.3.3 Significant Flora Surveys

A list of potentially occurring significant flora species from the locality (10km radius) was compiled, which included threatened species (Endangered or Vulnerable) and EEC's listed under the TSC Act and ROTAP listed flora species (Briggs and Leigh 1996) as well as any other species deemed to be of local importance.

Based on the environmental units and vegetation communities present, targeted searches were conducted for those species deemed as having the potential habitat on the site. Targeted searches were undertaken throughout the site for these species and flora species which were recorded within a 10 km radius of the site during the survey period. Refer to **Table 4-1**.

Targeted surveys were undertaken across the site for the following Threatened flora species previously recorded or considered as having a high likelihood of occurrence on the site based on site habitats (and those for the species):

- *Genoplesium littorale* (syn. *Corunastylis littoralis*);
- *Cryptostylis hunteriana*;
- *Allocasuarina simulans*;
- *Allocasuarina defungens*; and
- *Chamaesyce psammogeton*.

Targeted searches for Tuncurry Midge Orchid (TMO) (*Genoplesium littorale* syn. *Corunastylis littoralis*) were undertaken on site in March 2010 on 23rd, 24th, 29th, 30th and 31st; in April 2010 on 19th, 20th, 21st, 22nd and 23rd; in May 2010 on 14th, 17th, 18th, 19th and 20th. These surveys included walking transects and random meanders within potential habitats within the site. These habitats included areas of disturbance such as power easements and tracks. Vegetation communities and habitats where the orchid has been previously recorded were also targeted. Where positive records were made, searches within adjacent vegetation were also undertaken in attempt to record additional

individuals and improve the understanding of habitat associations. Above ground stems were counted and mapped using a Trimble Differential GPS with sub-metre accuracy following post processing.

The 2011 TMO survey work within the site focussed on stratified sampling of the under-surveyed heath habitats to ultimately estimate the potential population within this habitat on site. This habitat type had previously been under-surveyed due to the physical difficulty of accessing the dense heath environs. In a similar fashion to the transect surveys across suitable habitat areas over the site, TMO surveys in the heath consisted of nine random plots being set up within the heath vegetation across the site, each being 40 x 40m (0.16ha) in size. Within each of these plots, two RPS ecologists walked parallel transects approximately 2 metres apart. The random plots were surveyed on 11th and 13th April 2011. The locations of the quadrats are provided in **Figure 2-2**.

Given the variability of heath vegetation within the site, which may have potential implications towards TMO habitat suitability, several parameters were recorded within each quadrat. These included:

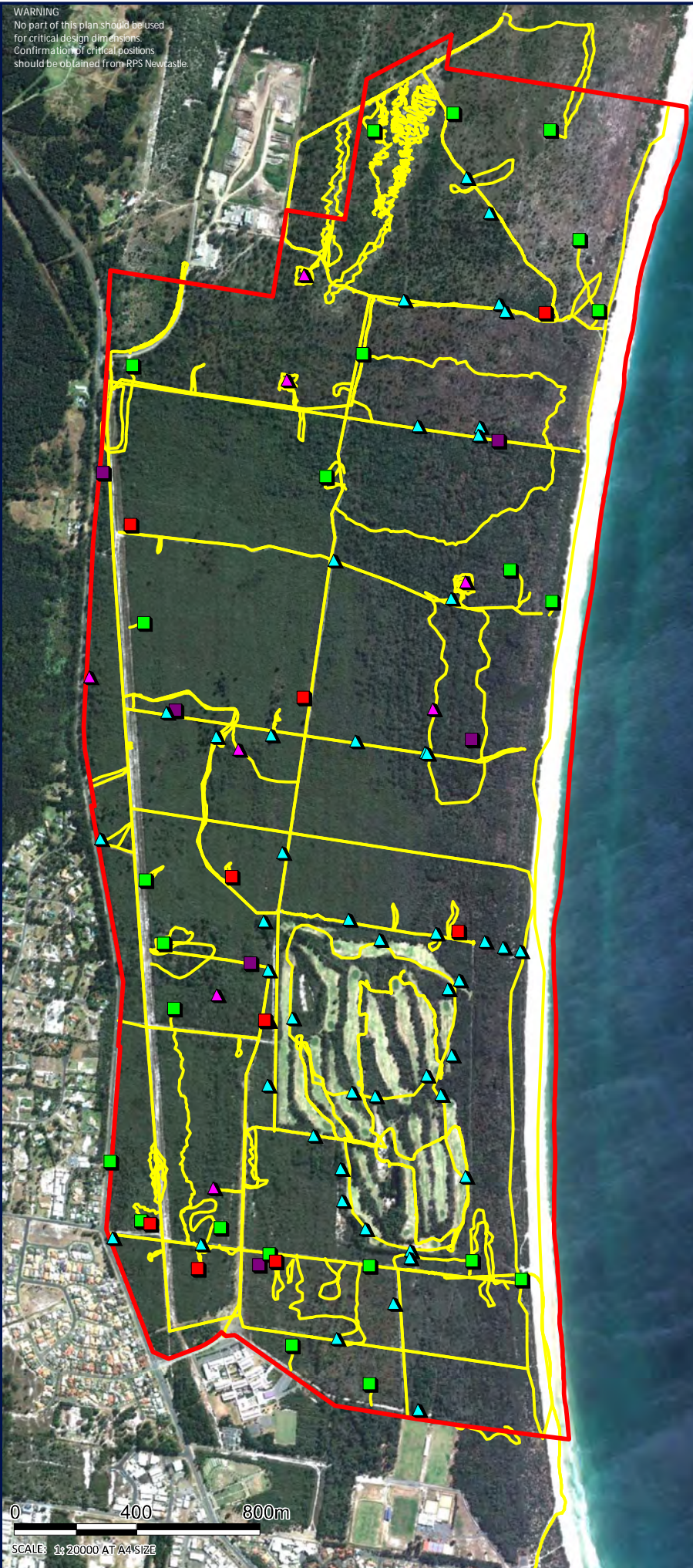
- species and percentage foliage cover (PFC) of each strata;
- height of vegetation;
- thickness of ground debris;
- percentage cover of ground debris; and
- disturbance levels.

Full methods and results of TMO surveys undertaken by RPS are provided in **Appendix C**.

*Cryptostylis hunteriana* (Leafless Tongue Orchid) is currently listed as vulnerable under both the TSC Act and EPBC Act. The Leafless Tongue Orchid is a cryptic species known to occur within a range of habitats, remaining underground for the majority of its lifecycle, flowering periodically when conditions are optimal to reproduce. Flowering period for this species is December – February. Targeted searches for this species were undertaken on 20th and 21st December 2010 and included two ecologists searching potential habitats across the site.

*Allocasuarina simulans*, *Allocasuarina defungens* and *Chamaesyce psammogeton* are species which can be detected throughout the year and were considered during all phases of field work undertaken on site.

WARNING  
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.



Legend

- Site Boundary
- Tuncurry Midge Orchid Survey Quadrats
- ▲ Hollow Bearing Tree Quadrats
- Biometric Plots with Nested Floristic Quadrat
- ▲ Rapid Data Point
- Floristic Quadrat (ERM)
- Random Meander / Targeted Flora Surveys



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TITLE: FIGURE 2-2: FLORA SURVEY EFFORT	LOCATION: NORTH TUNCURRY	DATUM: DATUM PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 22/3/2012 PURPOSE: ECO INVENTORY	LAYOUT REF: "J:\JOBS\26k\26414 - North Tuncurry\10-Drafting VERSION (PLAN BY): PAUL HILLIER
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## 2.4 Fauna Assessment

RPS undertook formal field fauna investigations within the study area in March 2010 and again from February to March 2012. The fauna survey methodology initially consisted of the production of an Expected Fauna Species List for the area and an assessment of the potential use of the site by threatened fauna species (as listed under the TSC Act and EPBC Act) identified from the vicinity of the site. Assessment was achieved through undertaking literature and database reviews followed by confirmation through habitat assessment against the known movements, distribution and habitat requirements of threatened fauna species recorded from the wider locality. Those species not occurring within fauna record databases, but for which potential habitat exists within the site, have been assessed to ensure completeness. Additional species observed were also noted on the list.

### 2.4.1 Diurnal Birds

Incidental bird observations were made and bird habitat assessments were undertaken across the entire site during all phases of flora and fauna surveys. Particular note was taken of habitat quality based on structural complexity, vegetation community age cohort and evidence of successional growth patterns. Habitat quality attributes were used to inform assessment of site suitability for those potential avifauna species that were not detected due to seasonal movements, cryptic or secretive habits or general scarcity.

Habitat assessment included targeted searches for habitat attributes used by threatened species listed as having some potential to occur within the site, including the seasonally occurring Swift Parrot and Regent Honeyeater.

For diurnal surveys, emphasis was placed on peak activity periods, i.e. dawn and dusk, to maximise the chances of species encountered. Birds were identified by direct observation, by recognition of calls or distinctive features such as nests, feathers etc. Opportunistic observations of bird species encountered during other fieldwork were also recorded.

Diurnal bird surveys were specifically undertaken across the golf course during 2012 surveys to further encompass this particular area of the site that may not have been thoroughly surveyed in previous years.

Beach sweeps, which involved driving, walking and searching into the sand dune along the beach from one end of the site to the other were conducted on nine occasions in 2012 to target bird species or secondary indications thereof. Beach sweeps were undertaken at dawn and dusk targeting roosting birds. These targeted bird surveys provided a valuable opportunity to gather a list of bird species that would otherwise not be attainable through other ecological survey methods.

## 2.4.2 Nocturnal Birds

Dates of owl call playback is provided in **Table 2-1** below. Their locations are shown on **Figure 2-3**. The calls were broadcast through an amplification system design to project the sound for at least 1km under still night conditions, in order to elicit vocal responses from owls or to attract an owl to the playback site. The call of each species was broadcast for at least five minutes, followed by five minutes of listening, and stationary spotlighting, as described by Kavanagh and Peake (1993). Following the final broadcast and listening, the area was spotlighted on foot. Owl species targeted were Powerful Owl, Grass Owl, Barking Owl, Masked Owl and Sooty Owl.

The presence of breeding habitat attributes, namely mature trees containing large hollows, was given consideration, if or where present, during vegetation surveys. Habitats were also assessed for their potential to support terrestrial and arboreal prey species for forest owls.

**Table 2-1: Owl Call Playback Survey Effort**

Site	Date	Surveyor
1	23/03/2010	RPS
2	23/03/2010	RPS
3	24/03/2010	RPS
4	24/03/2010	RPS
5	29/03/2010	RPS
6	29/03/2010	RPS
7	30/03/2010	RPS
8	07/02/2012	RPS
9	13/02/2012	RPS
10	14/02/2012	RPS
11	14/02/2012	RPS
12	15/02/2012	RPS
13	15/02/2012	RPS
15	21/02/2012	RPS
16	Nov 2008	ERM
17	Nov 2008	ERM
Location unknown	2005	ERM

The DEC (2004) guidelines requires a minimum survey effort of at least 5 visits per site, on different nights for the Powerful Owl, Grass Owl and Barking Owl, 6 visits per site for Sooty Owl and 8 visits per sites for Masked Owl. Sites are required to be separated by 800m to 1km. As shown by **Figure 2-1**, separate playback sites were chosen each time, providing a uniform spread across the site. The 18 call playback sessions are considered adequate to satisfy the DEC (2004) guidelines.



### 2.4.3 Spotlighting

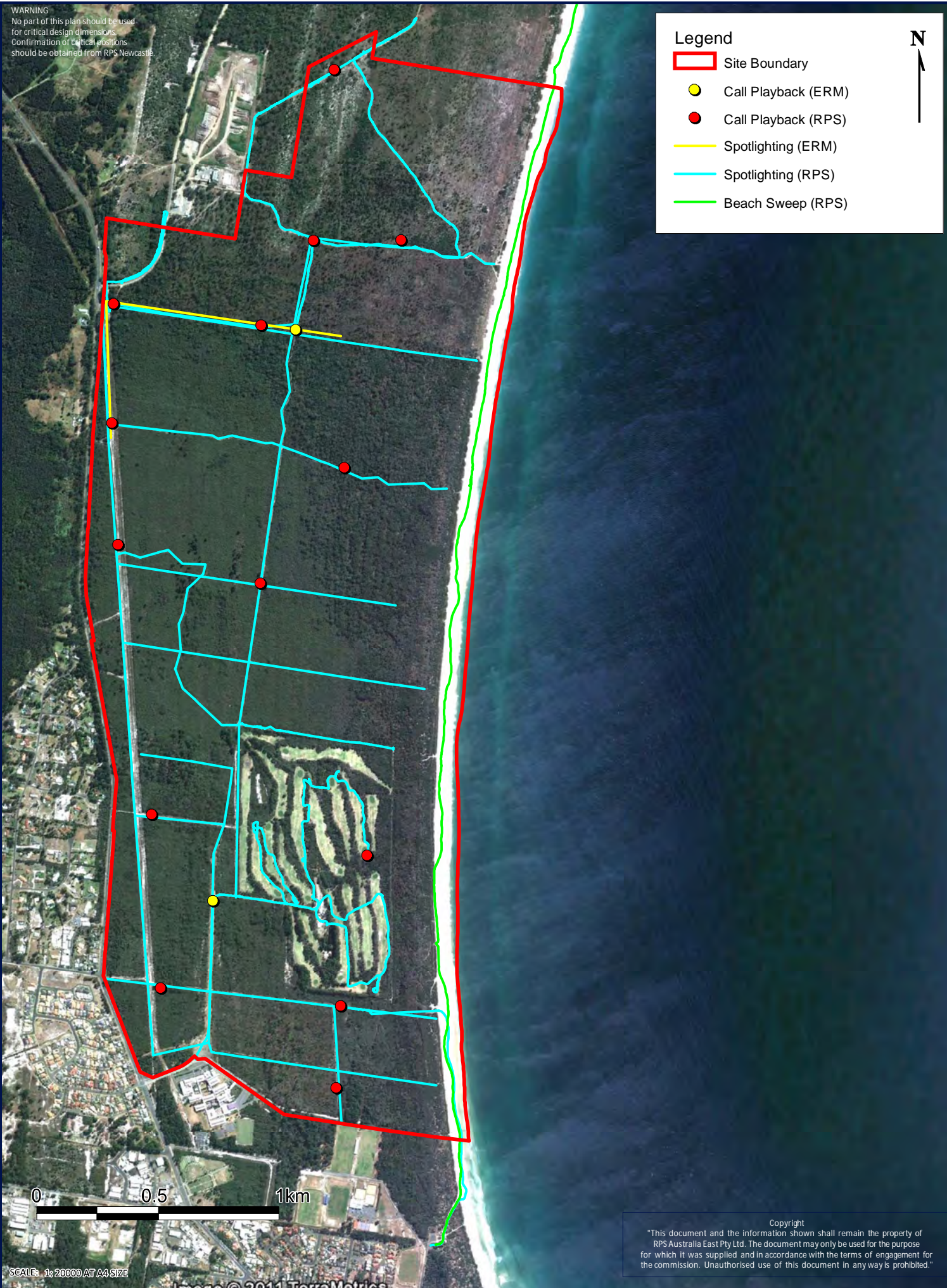
Spotlighting in car and on foot was undertaken on three nights by RPS in 2010 and on four nights in 2012, equating to 42 person hours of survey effort (2 people x 7 nights for 3hrs per night). In addition, ERM undertook walking spotlighting transects with a total survey effort of six person hours undertaken.

Two ecologists, each with 35/75 Watt hand-held spotlights and head torches traversed the site, illuminating vegetation canopies, understorey and ground cover searching for fauna. Spotlighting sweeps of the beach environs were also carried out during the 2012 survey. Priority was given to those areas that were deemed most likely to contain nocturnal species, particularly arboreal and terrestrial mammals. **Figure 2-3** shows the locations of spotlighting transects across the site.

WARNING  
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

Legend

- Site Boundary
- Call Playback (ERM)
- Call Playback (RPS)
- Spotlighting (ERM)
- Spotlighting (RPS)
- Beach Sweep (RPS)



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Title: <b>FIGURE 2-3: SPOTLIGHTING AND BIRD SURVEY LOCATIONS</b>	LOCATION: NORTH TUNCURRY	DATUM: DATUM PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 22/3/2012 PURPOSE: ECO INVENTORY	LAYOUT REF: "J:\JOBS\26k\26414 - North Tuncurry\10-Drafting VERSION (PLAN BY): PAUL HILLIER
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#### 2.4.4 Arboreal and Terrestrial Mammal Trapping

Trapping was performed over the site to aid in determining the suite of Arboreal and Terrestrial Mammals utilising the site. Trap lines were set out across the site targeting the different vegetation communities present (See **Figure 2-5**. **Table 2-2** shows the total numbers and nights of Elliot and cage trapping effort over the site.

**Table 2-2: Arboreal and Terrestrial Mammal Trapping Effort**

Trap Line	Date	Nights	Terrestrial Elliot A's	Terrestrial Elliot B's	Arboreal Elliot B's	Cages
<b>Dry Blackbutt Forest</b>						
1 (RPS)	22/03/2010	6	25	25		2
2 (RPS)	22/03/2010	6			14	
3 (RPS)	20/02/2012	4	25	22		5
4 (ERM)	Nov-08	3	8			
5 (ERM)	Nov-08	3			5	
6 (ERM)	Nov-08	3			5	
7 (ERM)	Nov-08	3			5	
8 (ERM)	Nov-08	3	8			
9 (ERM)	Nov-08	3	8			
<b>Total</b>		<b>34</b>	<b>74</b>	<b>47</b>	<b>29</b>	<b>7</b>
<b>Heath</b>						
10 (RPS)	22/03/2010	6	25	25		2
11 (RPS)	29/03/2010	6	25	25	14	2
12 (RPS)	29/03/2010	6	25	25		2
13 (RPS)	20/02/2012	4	25	29	7	10
14 (ERM)	Nov-08	3	8			
15 (ERM)	Nov-08	3	8			
16 (ERM)	Nov-08	3			5	
<b>Total</b>		<b>31</b>	<b>116</b>	<b>104</b>	<b>26</b>	<b>16</b>
<b>Foredune Vegetation</b>						
17 (RPS)	25/02/2012	4	25	25		5
<b>Golf Course</b>						
18 (RPS)	20/02/2012	4	25	25	6	5

Based on the trapping effort depicted in **Table 2-2** above, the overall trap nights per survey technique undertaken have been calculated and provided in **Table 2-3** below.

**Table 2-3: Elliot and Cage trap night survey effort**

Stratification Unit	Area	Terrestrial B	Terrestrial A	Arboreal B	Cage
Dry Blackbutt Forest	130	322	238	129	32
Heath	338	598	566	127	76
Foredune Vegetation	66	100	100	0	20
Golf Course	30	100	100	24	20

All Elliott traps were covered to prevent inundation and contained leaves and other organic matter to provide warmth and reduce stress to the animal. Elliott traps were baited using a mixture of peanut butter, rolled oats and honey. The entrances of the arboreal traps and the trunk of the tree immediately above and below the trap were also sprayed with a mixture of vanilla essence, honey and water to further attract potential animals. Of the two cage traps placed on each terrestrial trap line, one was baited with the peanut butter mixture and the other was baited with chicken legs. All Elliott and cage traps were checked every morning at first light and any fauna trapped was recorded and released.

Incidental observations and habitat assessments for arboreal and terrestrial mammal species were also undertaken across the entire site during ecological surveys. Key habitat attributes noted during ecological surveys included structural complexity of vegetation communities, incidence of hollow-bearing trees, presence of blossom-producing trees and shrubs and levels of understorey forest debris.

The potential presence of Koala was assessed through the identification of potential Koala food trees, followed by inspection for signs of Koala usage. Trees were inspected for the presence of Koalas, characteristic scratch and claw marks on the trunk, and scats around the base of each tree.

#### **2.4.5 Pit Fall Trapping**

Pit fall trap lines targeting the New Holland Mouse (*Pseudomys noveahollandiae*) and herpetofauna were undertaken in February 2012 across all stratification types over the site. Based on the stratification units, to satisfy the DEC Guidelines 9 x 60m pit fall trap lines with 6 pits in each were required. To ensure greatest site coverage each pit fall trap line was split into two 30m lengths with 3 pits inserted along the fence line. Sturdy mesh material 30cm high was run along the ground the entire length of the trap line. This was held up with wooden stakes. At 0m, 15m and 30m intervals a 400mm deep bucket was dug into the ground. Leaf litter and a piece of Styrofoam were placed in each bucket to create shade and in the event of rain prevent any animals in the buckets from drowning.

A total of 18 pit fall trap lines, each containing three pits were spread throughout the site, resulting in 216 trap nights. Based on the required survey effort per stratification unit (see **Table 2-7**) the spread of pit fall trap lines across the site is as follows:

- 2 pit fall trap lines in Burnt Heath (24 trap nights);
- 8 pit fall trap lines in Heath (96 trap nights);
- 6 pit fall trap lines in Dry Blackbutt Forest (72 trap nights); and
- 2 pit fall trap lines in Foredune Vegetation (24 trap nights).

## 2.4.6 Hair Tube Survey

Arboreal and terrestrial mammals were also sampled by the use of 'Faunatech' hair tubes. Hair tubes, baited with peanut butter, honey and rolled oats, were placed on the trunk or lower branches of trees to target arboreal and terrestrial mammals. **Table 2-4** shows the total numbers and nights of hair tube sampling over the site. Hair samples were forwarded to a recognised expert in hair identification, Barbara Triggs, for analysis.

**Table 2-4: Arboreal and Terrestrial Hair Tube Trapping Effort**

Trap Line	Date	Nights	Arboreal	Terrestrial
<b>Dry Blackbutt Forest</b>				
1 (RPS)	22/03/2010	10	19	
2 (RPS)	22/03/2010	10	20	
3 (RPS)	29/03/2010	10	20	
4 (RPS)	29/03/2010	10	20	
5 (ERM)	Nov-08	10		5
6 (ERM)	Nov-08	10		5
7 (ERM)	Nov-08	10		5
8 (ERM)	Nov-08	10		5
<b>Total</b>		<b>80</b>	<b>79</b>	<b>20</b>
<b>Heath</b>				
9 (RPS)	20/02/2012	11	17	17
10 (ERM)	Nov-08	10		10
11 (ERM)	Nov-08	10		10
12 (ERM)	Nov-08	10		10
<b>Total</b>		<b>41</b>	<b>17</b>	<b>47</b>
<b>Golf Course</b>				
13 (RPS)	20/02/2012	11	15	15

Based on the trapping effort depicted in **Table 2-4** above, the overall trap nights per survey technique undertaken have been calculated and provided in **Table 2-5** below.

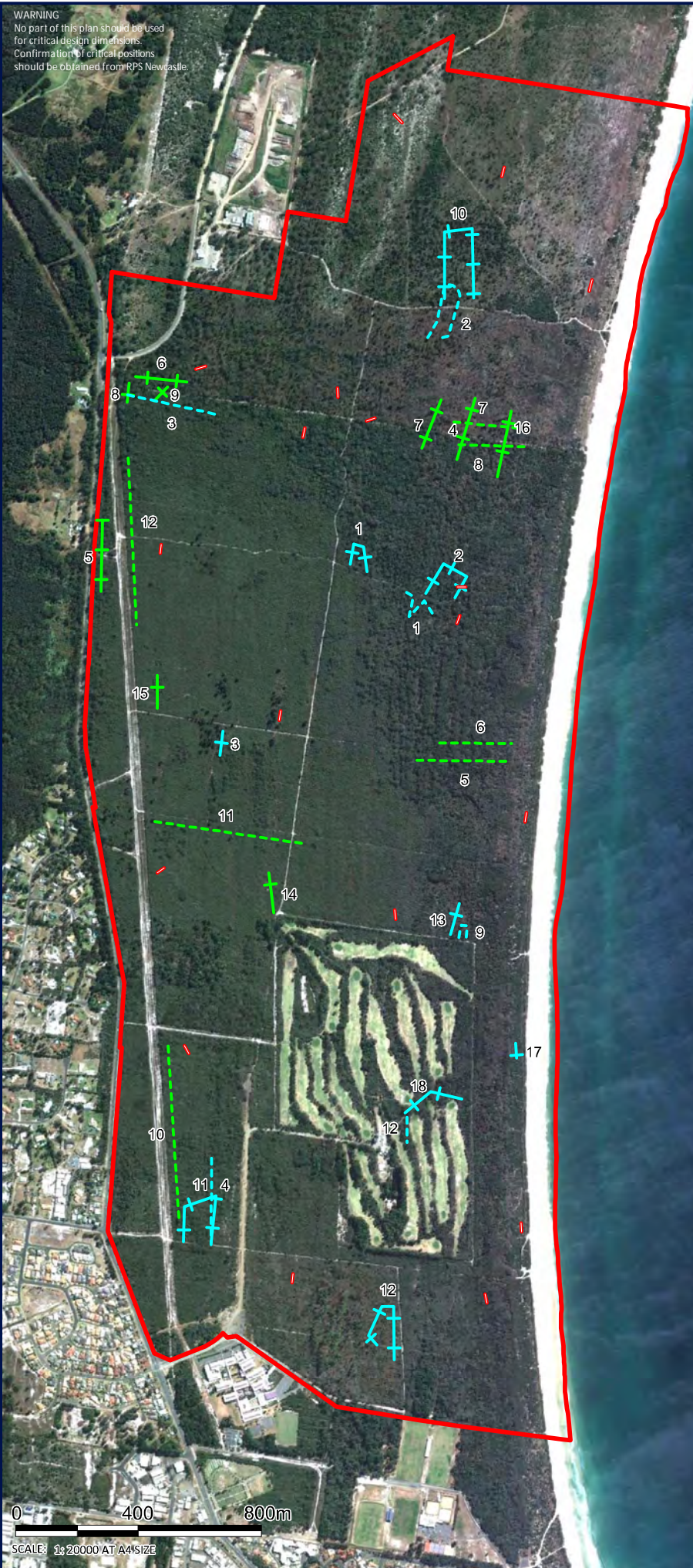
**Table 2-5: Hair Tubes Trap Nights Survey Effort**

Stratification Unit	Area	Arboreal	Terrestrial
Dry Blackbutt Forest	130	790	200
Heath	338	187	487
Foredune Vegetation	66		
Golf Course	30	165	165

WARNING  
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

Legend

- Site Boundary
- Hair Tubes (RPS)
- Hair Tubes (ERM)
- + Elliot and Cage Trapping (RPS)
- + Elliot and Cage Trapping (ERM)
- Pitfall Tapping (RPS)



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FIGURE 2-4: TRAP LINE SURVEY LOCATIONS

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 22/3/2012  
 PURPOSE: ECO INVENTORY

LAYOUT REF: "J:\JOBS\26k\26414 - North Tuncurry\10-Drafting  
 VERSION (PLAN BY): PAUL HILLIER

CLIENT: LANDCOM  
 JOB: 26414


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#### 2.4.7 Microchiropteran Bats

Anabat ultrasonic call detectors were used to record bat echolocation calls over ten nights, equating to a survey effort of 228 hours [2 Anabats x 9 nights for 12hrs per night + 1 Anabat x 1 night for 12 hrs per night]. Anabats were strategically located within areas of prime habitat and possible flyways. Calls were analysed by Anna McConville using AnalookW (Version 3.5g) software. The identification of calls was undertaken with reference to *Bat Calls of NSW: region guide to the echolocation calls of microchiropteran bats* (Penny et al 2004) and through the comparison of recorded reference calls from north-eastern NSW and the Sydney Basin.

Harp trapping was performed over six, four night periods equating to a survey effort of 20 trap nights (1 Harp trap x 4 nights + 2 Harp traps x 3 nights + 4 Harp traps x 2 nights + 1 Harp trap x 2 nights). Harp traps were set within prime habitat and possible flyways, see **Figure 2-5**. All Harp traps were checked every morning just prior to first light and any bats captured were identified, recorded and then released.

#### 2.4.8 Megachiropteran Bats

Megachiropteran bat surveys were conducted during nocturnal spotlighting surveys. Habitat for these species, specifically the Grey-headed Flying Fox and Common Blossom-bat, was assessed by targeting blossom-producing and fruit-bearing tree species. Such areas were spotlighted for signs of activity. Targeted searches were also conducted for roosting camps within the site.

#### 2.4.9 Herpetofauna

Opportunistic herpetofauna (frog and reptile) searches were carried out and habitat assessments were conducted during vegetation surveys across the site. Attributes targeted during habitat assessment for amphibian species included: dams and damper habitats. Understorey forest debris levels, as well as understorey complexity and densities, were noted with regard to potential reptile habitat.

#### 2.4.10 Secondary Indications and Incidental Observations

Opportunistic sightings of secondary indications (scratches, scats, diggings, tracks etc.) of resident fauna were noted. Such indicators included:

- Distinctive scats left by mammals;
- Scratch marks made by various types of arboreal animals;
- Nests made by various guilds of birds;
- Feeding scars on Eucalyptus trees made by Gliders;
- Whitewash, regurgitation pellets and prey remains from Owls;
- Various fauna calls;
- Skeletal material of vertebrate fauna; and
- Various fauna tracks.

WARNING  
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- Legend**
- Site Boundary
  - Harp Trap (RPS)
  - Bat Detector (RPS)



0 400 800m  
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FIGURE 2-5: MICROCHIROPTERAN  
 BAT AND MEGACHIROPTERAN  
 BAT SURVEY LOCATIONS

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 22/3/2012  
 PURPOSE: ECO INVENTORY

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## 2.5 Habitat Assessment

An assessment of the relative habitat value present on site was undertaken. This assessment focused primarily on the identification of specific habitat types and resources on the site favoured by known threatened species from the region. The assessment also considered the potential value of the site (and surrounds) for all major guilds of native flora and fauna. Habitat assessment included:

- Presence, size and types of tree hollows;
- Presence of rocks, logs, caves, rock outcrops, leaf litter, overhangs and crevices;
- Vegetation complexity, structure and quality;
- Presence of freshwater or estuarine aquatic habitats, noting permanency;
- Connectivity to adjacent areas of habitat;
- Extent and types of disturbance;
- Presence of foraging opportunities such as flowering eucalypts, fruits, seeds or other nectar bearing native plants; and
- Presence and abundance of various potential prey species.

Habitat assessment was based on the specific habitat requirements of each threatened fauna species in regards to home range, feeding, roosting, breeding, movement patterns and corridor requirements. Consideration was given to contributing factors including topography, soil, light and hydrology for threatened flora and assemblages.

### 2.5.1 Hollow Bearing Tree Assessment

Targeted quadrats were undertaken across the various vegetation stratifications to assess the abundance of hollows available for arboreal fauna. A total of 31 quadrats (eight [50x50m] and 23 [20x50m]) were completed across the site. Areas of potential hollow bearing trees were also targeted during nocturnal surveys to increase the probability of recording nocturnal arboreal fauna. The location of the eight 50x50m hollow bearing tree survey plots and the 23 biometric plots are provided in **Figure 2-2**.

### 2.5.2 Fauna Survey Dates, Type and Prevailing Conditions

**Table 2-6** below depicts the dates, survey type and prevailing weather during the faunal investigations conducted during the survey period.

**Table 2-6: Fauna Survey Dates, Types & Prevailing Weather**

Survey Type	Date	WEATHER						
		Min Temp °C	Max Temp °C	Daily Rainfall (mm)	Sun		Moon	
					Rise	Set	Rise	Set
<b>2012</b>								
Pitfall Traps	12/02/2012	17	25.5	1.8	05:30	18:46	21:17	09:47
	13/02/2012	20	26	0	05:30	18:45	22:01	10:54
	14/02/2012	19	27	18	05:31	18:44	22:48	12:00
	15/02/2012	19	25	18.2	05:32	18:44	23:41	13:04
	16/02/2012	21.5	25.5	0	05:33	18:43	n/a	14:06
	27/02/2012	21	25	0	05:42	18:31	10:14	21:11
	28/02/2012	23	26.5	0	05:42	18:30	11:08	21:50
	29/02/2012	20	29	0	05:43	18:29	12:01	22:33
	01/03/2012	19	28	0	05:44	18:28	12:53	23:21
	02/03/2012	20	20	0.8	05:45	18:27	13:44	n/a
Terrestrial A	20/02/2012	21	27	1.4	05:36	18:39	03:41	17:17
	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54
	22/02/2012	19	26	3	05:38	18:37	05:40	18:27
	23/02/2012	17.5	25	2.5	05:39	18:36	06:37	18:59
	27/02/2012	21	25	0	05:42	18:31	10:14	21:11
	28/02/2012	23	26.5	0	05:42	18:30	11:08	21:50
	29/02/2012	20	29	0	05:43	18:29	12:01	22:33
	01/03/2012	19	28	0	05:44	18:28	12:53	23:21
	27/02/2012	21	25	0	05:42	18:31	10:14	21:11
	28/02/2012	23	26.5	0	05:42	18:30	11:08	21:50
	29/02/2012	20	29	0	05:43	18:29	12:01	22:33
	01/03/2012	19	28	0	05:44	18:28	12:53	23:21
Terrestrial B	20/02/2012	21	27	1.4	05:36	18:39	03:41	17:17
	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54
	22/02/2012	19	26	3	05:38	18:37	05:40	18:27
	23/02/2012	17.5	25	2.5	05:39	18:36	06:37	18:59
	27/02/2012	21	25	0	05:42	18:31	10:14	21:11
	28/02/2012	23	26.5	0	05:42	18:30	11:08	21:50
	29/02/2012	20	29	0	05:43	18:29	12:01	22:33
	01/03/2012	19	28	0	05:44	18:28	12:53	23:21
Cage	20/02/2012	21	27	1.4	05:36	18:39	03:41	17:17
	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54
	22/02/2012	19	26	3	05:38	18:37	05:40	18:27

Survey Type	Date	WEATHER						
		Min Temp °C	Max Temp °C	Daily Rainfall (mm)	Sun		Moon	
					Rise	Set	Rise	Set
	23/02/2012	17.5	25	2.5	05:39	18:36	06:37	18:59
	27/02/2012	21	25	0	05:42	18:31	10:14	21:11
	28/02/2012	23	26.5	0	05:42	18:30	11:08	21:50
	29/02/2012	20	29	0	05:43	18:29	12:01	22:33
	01/03/2012	19	28	0	05:44	18:28	12:53	23:21
	20/02/2012	21	27	1.4	05:36	18:39	03:41	17:17
Arboreal B	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54
	22/02/2012	19	26	3	05:38	18:37	05:40	18:27
	23/02/2012	17.5	25	2.5	05:39	18:36	06:37	18:59
	12/02/2012	17	25.5	1.8	05:30	18:46	21:17	09:47
	13/02/2012	20	26	0	05:30	18:45	22:01	10:54
	14/02/2012	19	27	18	05:31	18:44	22:48	12:00
	15/02/2012	19	25	18.2	05:32	18:44	23:41	13:04
	20/02/2012	21	27	1.4	05:36	18:39	03:41	17:17
Harp trap	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54
	22/02/2012	19	26	3	05:38	18:37	05:40	18:27
	23/02/2012	17.5	25	2.5	05:39	18:36	06:37	18:59
	27/02/2012	21	25	0	05:42	18:31	10:14	21:11
	28/02/2012	23	26.5	0	05:42	18:30	11:08	21:50
	29/02/2012	20	29	0	05:43	18:29	12:01	22:33
	01/03/2012	19	28	0	05:44	18:28	12:53	23:21
	20/02/2012	21	27	1.4	05:36	18:39	03:41	17:17
	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54
	22/02/2012	19	26	3	05:38	18:37	05:40	18:27
	23/02/2012	17.5	25	2.5	05:39	18:36	06:37	18:59
	24/02/2012	20	26	0.3	05:39	18:35	07:32	19:30
Hair Tube Arboreal	25/02/2012	16	27	0	05:40	18:34	08:26	20:02
	26/02/2012	21	26.5	0	05:41	18:32	09:21	20:36
	27/02/2012	21	25	0	05:42	18:31	10:14	21:11
	28/02/2012	23	26.5	0	05:42	18:30	11:08	21:50
	29/02/2012	20	29	0	05:43	18:29	12:01	22:33
	01/03/2012	19	28	0	05:44	18:28	12:53	23:21
	20/02/2012	21	27	1.4	05:36	18:39	03:41	17:17
Hair Tube Terrestrial	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54

Survey Type	Date	WEATHER						
		Min Temp °C	Max Temp °C	Daily Rainfall (mm)	Sun		Moon	
					Rise	Set	Rise	Set
	22/02/2012	19	26	3	05:38	18:37	05:40	18:27
	23/02/2012	17.5	25	2.5	05:39	18:36	06:37	18:59
	24/02/2012	20	26	0.3	05:39	18:35	07:32	19:30
	25/02/2012	16	27	0	05:40	18:34	08:26	20:02
	26/02/2012	21	26.5	0	05:41	18:32	09:21	20:36
	27/02/2012	21	25	0	05:42	18:31	10:14	21:11
	28/02/2012	23	26.5	0	05:42	18:30	11:08	21:50
	29/02/2012	20	29	0	05:43	18:29	12:01	22:33
	01/03/2012	19	28	0	05:44	18:28	12:53	23:21
	12/02/2012	17	25.5	1.8	05:30	18:46	21:17	09:47
	13/02/2012	20	26	0	05:30	18:45	22:01	10:54
	14/02/2012	19	27	18	05:31	18:44	22:48	12:00
Ultrasonic detection	15/02/2012	19	25	18.2	05:32	18:44	23:41	13:04
	20/02/2012	21	27	1.4	05:36	18:39	03:41	17:17
	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54
	22/02/2012	19	26	3	05:38	18:37	05:40	18:27
	23/02/2012	17.5	25	2.5	05:39	18:36	06:37	18:59
	13/02/2012	20	26	0	05:30	18:45	22:01	10:54
Spotlighting	14/02/2012	19	27	18	05:31	18:44	22:48	12:00
	15/02/2012	19	25	18.2	05:32	18:44	23:41	13:04
	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54
Stag Watching	No visible stags in surveyed area							
	13/02/2012	20	26	0	05:30	18:45	22:01	10:54
Call Playback (mammals)	14/02/2012	19	27	18	05:31	18:44	22:48	12:00
	15/02/2012	19	25	18.2	05:32	18:44	23:41	13:04
	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54
	13/02/2012	20	26	0	05:30	18:45	22:01	10:54
Owl Call Playback	14/02/2012	19	27	18	05:31	18:44	22:48	12:00
	15/02/2012	19	25	18.2	05:32	18:44	23:41	13:04
	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54

Survey Type	Date	WEATHER						
		Min Temp °C	Max Temp °C	Daily Rainfall (mm)	Sun		Moon	
					Rise	Set	Rise	Set
Beach Sweeps	13/02/2012	20	26	0	05:30	18:45	22:01	10:54
	14/02/2012	19	27	18	05:31	18:44	22:48	12:00
	15/02/2012	19	25	18.2	05:32	18:44	23:41	13:04
	16/02/2012	21.5	25.5	0	05:33	18:43	n/a	14:06
	21/02/2012	21	24.5	7	05:37	18:38	04:41	17:54
	22/02/2012	19	26	3	05:38	18:37	05:40	18:27
<b>2010</b>								
Terrestrial A	22/03/10	18	26.8	0	06:53	18:58	12:50	22:53
	23/03/10	17.5	26.5	0mm	06:54	18:57	13:48	23:54
	24/03/10	15	26	0mm	06:54	18:56	14:40	-
	25/03/10	18.8	27	0mm	06:55	18:54	15:27	01:00
	29/03/10	20.6	24.8	0mm	06:58	18:49	17:58	05:38
	30/03/10	20	25.8	0mm	06:59	18:48	18:33	06:47
Terrestrial B	22/03/10	18	26.8	0	06:53	18:58	12:50	22:53
	23/03/10	17.5	26.5	0mm	06:54	18:57	13:48	23:54
	24/03/10	15	26	0mm	06:54	18:56	14:40	-
	25/03/10	18.8	27	0mm	06:55	18:54	15:27	01:00
	29/03/10	20.6	24.8	0mm	06:58	18:49	17:58	05:38
	30/03/10	20	25.8	0mm	06:59	18:48	18:33	06:47
Cage	22/03/10	18	26.8	0	06:53	18:58	12:50	22:53
	23/03/10	17.5	26.5	0mm	06:54	18:57	13:48	23:54
	24/03/10	15	26	0mm	06:54	18:56	14:40	-
	25/03/10	18.8	27	0mm	06:55	18:54	15:27	01:00
	29/03/10	20.6	24.8	0mm	06:58	18:49	17:58	05:38
	30/03/10	20	25.8	0mm	06:59	18:48	18:33	06:47
Arboreal B	22/03/10	18	26.8	0	06:53	18:58	12:50	22:53
	23/03/10	17.5	26.5	0mm	06:54	18:57	13:48	23:54
	24/03/10	15	26	0mm	06:54	18:56	14:40	-
	25/03/10	18.8	27	0mm	06:55	18:54	15:27	01:00
	29/03/10	20.6	24.8	0mm	06:58	18:49	17:58	05:38
	30/03/10	20	25.8	0mm	06:59	18:48	18:33	06:47
Hair Tube Arboreal	22/03/10	18	26.8	0	06:53	18:58	12:50	22:53
	23/03/10	17.5	26.5	0mm	06:54	18:57	13:48	23:54
	24/03/10	15	26	0mm	06:54	18:56	14:40	-

Survey Type	Date	WEATHER						
		Min Temp °C	Max Temp °C	Daily Rainfall (mm)	Sun		Moon	
					Rise	Set	Rise	Set
	25/03/10	18.8	27	0mm	06:55	18:54	15:27	01:00
	29/03/10	20.6	24.8	0mm	06:58	18:49	17:58	05:38
	30/03/10	20	25.8	0mm	06:59	18:48	18:33	06:47
	31/03/10	18.4	23	28.4mm	06:59	18:47	19:10	07:56
	01/04/10	16.8	25.2	1.2mm	07:00	18:45	19:51	09:05

Australian Government – Geoscience Australia [<http://www.ga.gov.au/geodesy/astro/.jsp>]  
 Australian Bureau of Meteorology Daily Weather Observations Forster [<http://www.bom.gov.au>]

## 2.6 Survey Effort Considerations

Stratification of the site was undertaken based on the vegetation mapping undertaken by RPS in 2011. RPS has performed a gap analysis between the survey effort from the previous studies and the survey requirements listed in the current *DEC Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities*. The results of the complete survey effort over the site, in relation to DEC (2004) is shown in **Table 2-7**.

It is noted herewith, in a number of instances trapping lines undertaken by ERM (2010a) and RPS (2010) cross stratification unit boundaries. Where this occurs, survey effort has been attributed to the stratification unit with the greatest overlap.

**Table 2-7: Total Survey Effort by 2011 Stratification Units**

Target Species	Method	Heath 304.78ha	Burnt Heath 33.57ha	Dry Blackbutt Forest 132.7ha	Beach Complex (inc Fore-dune Vegetation) 65.90ha	Golf Course 30ha	Site Total	Comment	
Small mammals and reptiles	Pitfall Traps	RPS	96	24	72	24	0	216 trap nights	Pit fall trapping in the golf course is not considered desirable. Additionally, habitat is considered marginal in the golf course for the target species (New Holland Mouse).
		ERM	0	0		0	0	0 trap nights	
		<b>Total Undertaken</b>	<b>96</b>	<b>24</b>	<b>72</b>	<b>24</b>	<b>0</b>	<b>216 trap nights</b>	
		<b>Total Required</b>	<b>96 trap nights</b>	<b>24 trap nights</b>	<b>72 trap nights</b>	<b>24 trap nights</b>	<b>24 trap nights</b>	<b>240 trap nights</b>	
Small mammals	Terrestrial A	RPS		550	250	100	100	1000 trap nights	
		ERM		48	72	0	0	120 trap nights	
		<b>Total Undertaken</b>		<b>598</b>	<b>322</b>	<b>100</b>	<b>100</b>	<b>1120 trap nights</b>	
		<b>Total Required</b>		<b>400 trap nights</b>	<b>200 trap nights</b>	<b>100 trap nights</b>	<b>100 trap nights</b>	<b>800 trap nights</b>	
Medium sized mammals	Terrestrial B	RPS		566	238	100	100	1004 trap nights	
		ERM		0	0	0	0	0 trap nights	
		<b>Total Undertaken</b>		<b>566</b>	<b>238</b>	<b>100</b>	<b>100</b>	<b>1004 trap nights</b>	
		<b>Total Required</b>		<b>400 trap nights</b>	<b>200 trap nights</b>	<b>100 trap nights</b>	<b>100 trap nights</b>	<b>800 trap nights</b>	
Large mammals	Cage	RPS		76	32	20	20	148 trap nights	Target species (Eastern Quoll) is considered too readily traverse all stratification units and is highly mobile. Consideration of the site as a full stratification unit would require 168 trap nights, which is slightly under the DEC (2004) guidelines.
		ERM		0	0	0	0	0 trap nights	
		<b>Total Undertaken</b>		<b>76</b>	<b>32</b>	<b>20</b>	<b>20</b>	<b>148 trap nights</b>	
		<b>Total Required</b>		<b>96 trap nights</b>	<b>48 trap nights</b>	<b>24 trap nights</b>	<b>24 trap nights</b>	<b>192 trap nights</b>	
Arboreal mammals	Arboreal B	RPS		112	84	0	24	220 trap nights	
		ERM		15	45	0	0	60 trap nights	
		<b>Total Undertaken</b>		<b>127</b>	<b>129</b>	<b>0</b>	<b>24</b>	<b>280 trap nights</b>	
		<b>Total Required</b>		<b>96 trap nights</b>	<b>48 trap nights</b>	<b>24 trap nights</b>	<b>24 trap nights</b>	<b>192 trap nights</b>	
Various sized mammals	Hair Tube Terrestrial	RPS		187	0	0	165	352 trap nights	
		ERM		300	200	0	0	500 trap nights	
		<b>Total Undertaken</b>		<b>487</b>	<b>200</b>	<b>0</b>	<b>165</b>	<b>852 trap nights</b>	
		<b>Total Required</b>		<b>320 trap nights</b>	<b>160 trap nights</b>	<b>80 trap nights</b>	<b>80 trap nights</b>	<b>640 trap nights</b>	
	Hair Tube Arboreal	RPS		187	474	0	165	826 trap nights	
		ERM		0	0	0	0	0 trap nights	
		<b>Total Undertaken</b>		<b>187</b>	<b>790</b>	<b>0</b>	<b>165</b>	<b>826 trap nights</b>	
		<b>Total Required</b>		<b>480 trap nights</b>	<b>240 trap nights</b>	<b>120 trap nights</b>	<b>120 trap nights</b>	<b>960 trap nights</b>	
Bats	Harp trap	RPS		10	6	4	0	20 trap nights	Target species (microchiropteran bats and blossom bats) is considered too readily traverse all stratification units and is highly mobile. Consideration of the site as a full stratification unit would require 28 trap nights, which is slightly under the DEC (2004) guidelines.
		ERM		0	0	0	0	0 trap nights	
		<b>Total Undertaken</b>		<b>10</b>	<b>6</b>	<b>4</b>	<b>0</b>	<b>20 trap nights</b>	
		<b>Total Required</b>		<b>16 trap nights</b>	<b>8 trap nights</b>	<b>4 trap nights</b>	<b>4 trap nights</b>	<b>32 trap nights</b>	
Bats	Ultrasonic detection	RPS		132	84	12	0	228 hours	
		ERM			11.5 hours across the site			11.5 hours	
		<b>Total Undertaken</b>		<b>132</b>	<b>84</b>	<b>12</b>	<b>0</b>	<b>239.5 hours</b>	
		<b>Total Required</b>		<b>32 hours</b>	<b>16 hours</b>	<b>8 hours</b>	<b>8 hours</b>	<b>64 hours</b>	

Target Species	Method	Heath 304.78ha	Burnt Heath 33.57ha	Dry Blackbutt Forest 132.7ha	Beach Complex (inc Foredune Vegetation) 65.90ha	Golf Course 30ha	Site Total	Comment
	Spotlighting on foot	RPS		30 hours across the site			30 hours	RPS survey undertaken by two ecologists therefore the survey effort in man hours is doubled.
		ERM		12 hours across the site			12 hours	
		<b>Total Undertaken</b>		<b>42 hours across the site</b>			<b>42 hours</b>	
		<b>Total Required</b>	<b>8 hours</b>	<b>4 hours</b>	<b>4 hours</b>	<b>4 hours</b>	<b>20 hours</b>	
Various nocturnal mammals and birds	Spotlighting in car	RPS	11	6		2	19 hours	In terms of kilometres of the site traversed while driving spotlighting, the total distance travelled by RPS during this survey activity was 40.1km.
		ERM	0	0	Driving not recommended	0	0 hours	
		<b>Total Undertaken</b>	<b>11</b>	<b>6</b>		<b>2</b>	<b>19 hours</b>	
		<b>Total Required</b>	<b>10 hours</b>	<b>5 hours</b>		<b>5 hours</b>	<b>20 hours</b>	
Call Playback (birds) Using the minimum for Masked Owl	RPS						15 events	<i>Note: Owl call Playback survey effort is calculated by site size and not by stratification unit.</i>
		ERM					3 events	
		<b>Total Undertaken</b>					<b>18 events</b>	
		<b>Total Required</b>					<b>16 events</b>	
	Random Meander	RPS	10	6	4	0	20 hours	
		ERM	0	0	0	0	0 hours	
		<b>Total Undertaken</b>	<b>10</b>	<b>6</b>	<b>4</b>	<b>0</b>	<b>20 hours</b>	
		<b>Total Required</b>	<b>5 hours</b>	<b>1.5 hours</b>	<b>1.5 hours</b>	<b>1 hour</b>	<b>9 hours</b>	
Flora Surveys	Tuncurry Midge Orchid 40m x 40m plot surveys	RPS	9	0	0	0	9 quadrats	
		ERM	0	0	0	0	0	
		<b>Total Undertaken</b>	<b>9</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>9 quadrats</b>	
		<b>Total Required</b>		<b>Not required in DEC (2004)</b>				
	Quadrats	RPS	15	6	2	0	23 quadrats	The 23 RPS quadrats were biometric plots per BioBanking with additional nested floristic quadrats contained within each.
		ERM	4	2	0	0	6 quadrats	
		<b>Total Undertaken</b>	<b>19</b>	<b>8</b>	<b>2</b>	<b>0</b>	<b>29 quadrats</b>	
		<b>Total Required</b>	<b>5 quadrats</b>	<b>3 quadrats</b>	<b>3 quadrats</b>	<b>2 quadrats</b>	<b>13 quadrats</b>	



## 2.7 Limitations

Limitations associated with this EIR are presented herewith. Where limitations are identified and as relevant to the context of this EIR (non-impact assessment) a precautionary approach has been adopted; whereby 'assumed presence' of relevant threatened species, populations and ecological communities have been made where appropriate.

### **Seasonality**

Timing limitations are often encountered during ecological surveys due to the seasonal variations across the broad spectrum of flora and fauna species to be studied.

The flowering and fruiting plants that attract some nomadic or migratory species, often fruit or flower in cycles spanning a number of years. Furthermore, these resources might only be accessed in years when resources more accessible to nomadic or migratory species fail. As a consequence certain species may be absent from some areas where potential habitat exists for extended periods.

The seasonality of the surveys places limits on the number of flora species identified in the site. Some species that have flowering periods outside survey times are often difficult to detect. Whilst seasonal coverage has been a key consideration, prioritisation has been afforded to cryptic species. To this end, floristic surveys outside the spring and summer seasons have been undertaken with a focus on cryptic orchids and a priority focus on the Critically Endangered Tuncurry Midge Orchid.

### **Data Availability & Accuracy**

The collated threatened flora and fauna species records provided by NSW Atlas of Wildlife Database for the region are known to vary in accuracy and reliability. Traditionally this is due to the reliability of information provided to the NSW Atlas of Wildlife Database for collation and/or the need to protect specific threatened species locations. For the purposes of this report this information has been considered to have an accuracy of  $\pm$  1km.

Threatened flora and fauna records within the region were predominantly sourced from the NSW Atlas of Wildlife Database and a SEWPAC Protected Matters Search. Similar limitations are known to exist with regards to these data sources and their accuracy.

Data recorded by RPS during the survey period, has been gathered with a Trimble Differential GPS unit, which is capable of sub-metre accuracy following post processing.

## **Fauna**

Fauna survey effort varying from the standards set within the DEC Biodiversity Survey Guidelines (2004) was due to the following reasons:

- Seasonal constraints as outlined above.
- Diurnal Birds - Habitat assessment and previous records and reporting were used to determine the probability of site use. Bird census surveys outlined in the aforementioned methods in combination with opportunistic surveys conducted during other fieldwork were considered as representing a wider and more thorough coverage of the site than short periods over limited transects. Survey coverage was determined by stratification units designed to represent other fauna guilds and flora surveys.
- Deficiencies in survey effort using wire cage traps, targeting Spotted-tailed Quoll and Long-nosed Potoroo, were considered to be supplemented through increases in spotlighting and hair tube surveys, which have been consistently shown by RPS to be more effective at recording these species than cage trapping.

Despite some minor deficiencies against guidelines criteria, suitable survey effort of the site is considered to have been accomplished as discussed and scientifically justified above. Potential occurrences of likely species has been assumed (precautionary approach) in light of habitat assessment, previous local records, seasonality deficiencies, the known movements of locally occurring threatened species and the combined authors local knowledge and experience.

## 3 Results

### 3.1 Flora

A total of 154 flora species were identified during field investigations, of which 18 (12%) were exotic. A complete list of the flora species identified is provided in **Appendix A** of this report.

#### 3.1.1 Description of Vegetation Communities

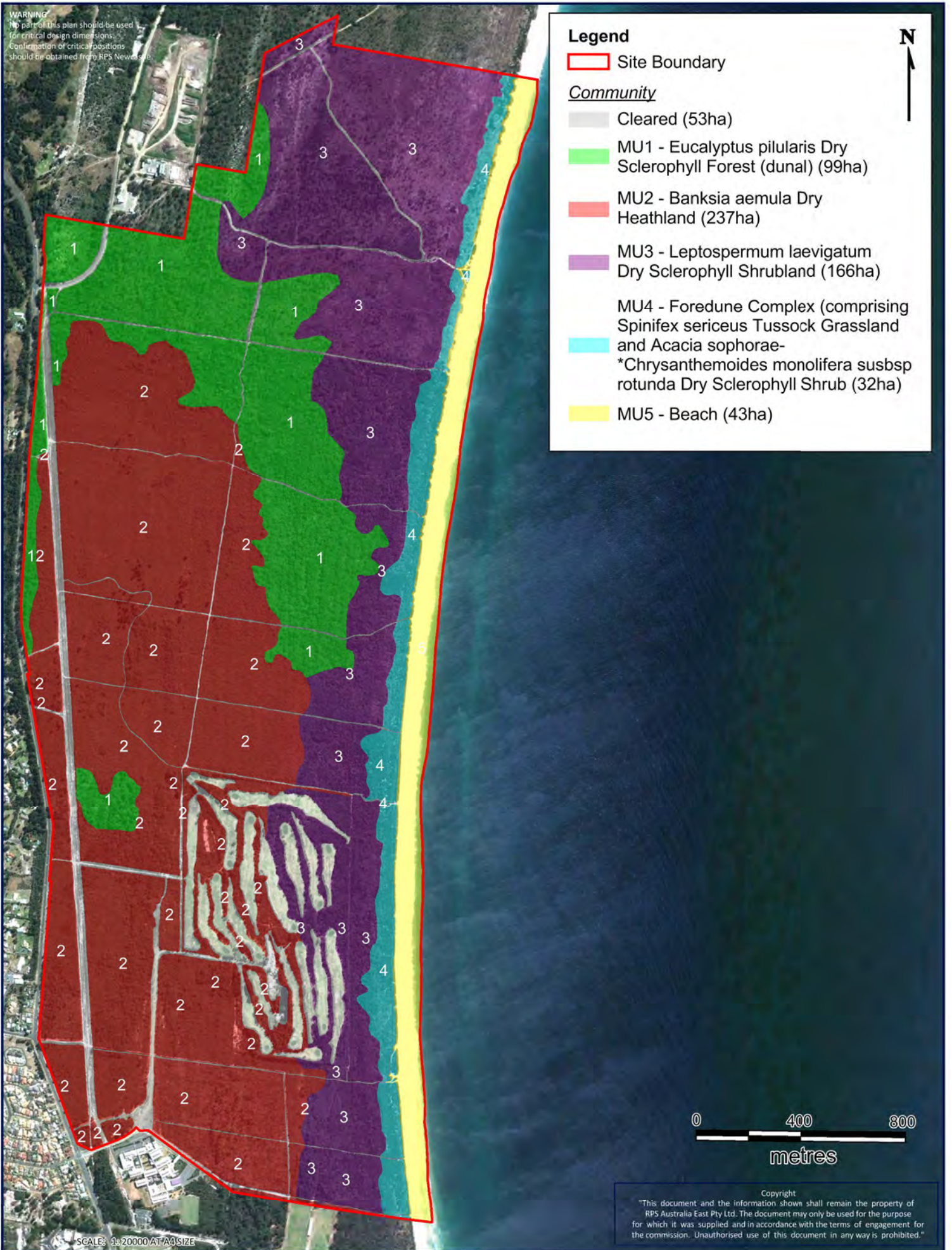
The following four vegetation communities have been identified within the site based on RPS surveys:

- *Eucalyptus pilularis* Dry Sclerophyll Forest (dunal);
- *Banksia aemula* Dry Heathland;
- *Leptospermum laevigatum* Dry Sclerophyll Shrubland; and
- Fore dune Complex.

The site is comprised predominantly of *Banksia aemula* Dry Heathland and *Leptospermum laevigatum* Dry Sclerophyll Shrubland with *Eucalyptus pilularis* Dry Sclerophyll Forest (dunal) occurring in the northern and western sectors of the site. Some stands of Slash Pine (*Pinus elliotii*) were also scattered throughout the site, in some instances with predominately exotic or highly disturbed lower strata. Floristic analyses has identified that at some locations emergent trees (*E. pilularis* and/or *P. elliotii*) occur over layers that are consistent with the surrounding heath or shrubland communities and have been mapped and described as part of these communities. The east of the site is bounded by the Fore dune Complex. The locations of the vegetation communities occurring on site are mapped in **Figure 3-1**.

The site has been subjected to various disturbances as a result of past and present land use, however vegetation communities are generally in relatively good condition, given it's been regenerating since the 1950's, with few weed species identified during surveys. Evidence of household rubbish dumping is also apparent throughout the site and a number of tracks that traverse the site appear to be frequently utilised.

**WARNING**  
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.



**Legend**

- Site Boundary

Community

- Cleared (53ha)
- MU1 - Eucalyptus pilularis Dry Sclerophyll Forest (dunal) (99ha)
- MU2 - Banksia aemula Dry Heathland (237ha)
- MU3 - Leptospermum laevigatum Dry Sclerophyll Shrubland (166ha)
- MU4 - Foredune Complex (comprising Spinifex sericeus Tussock Grassland and Acacia sophorae-  
\*Chrysanthemoides monolifera subsp rotunda Dry Sclerophyll Shrub (32ha)
- MU5 - Beach (43ha)



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The vegetation community descriptions below generally follows Walker and Hopkins (1990).

### 1 *Eucalyptus pilularis* Dry Sclerophyll Forest (dunal)



Plate 3-1: *Eucalyptus pilularis* Dry Sclerophyll Forest (dunal)

#### **General description**

This community was recorded on freely draining podzolised sands on the Tuncurry Holocene dunefield in the northern and central portions of the study area. *Eucalyptus pilularis* accounted for more than 50% of total crown cover. The occasional presence of *E. robusta* is indicative of localised drainage variations across this community. The presence of *Corymbia gummifera* in some locations may also correspond with within community variations in soil type, drainage or disturbance history. A mid stratum of *Banksia* and *Leptospermum* species was present throughout with a ground cover dominated by ferns, grasses and graminoids.

#### **Known floristic / structural variations**

The presence of *Corymbia intermedia* (Pink Bloodwood) and *Corymbia gummifera* (Red Bloodwood) in particular sections of the Blackbutt community represent a variation commensurate with MU 37 Dry Blackbutt with elements of MU 41 Blackbutt – Bloodwood/Apple as described by Great Lakes Council (2003).

#### **Distribution**

This community occurs in a number of conservation reserves on the NSW North Coast on the large coastal sand masses (Griffith and Wilson 2007 unpublished data).

### **Extent**

This vegetation covers a moderate amount of the site, encompassing approximately 99ha.

### **Relationship to other communities**

This community grades into *Banksia aemula* Dry Heathland and *Leptospermum laevigatum* Dry Sclerophyll Shrubland with increasing exposure to the sea and a decrease in soil fertility.

### **Equivalent vegetation types**

*Eucalyptus pilularis*-*Angophora costata* Dry Sclerophyll Forest and Woodland (Griffith et al. 2000); 'Blackbutt-Swamp Mahogany Low Woodland on Coastal Sands of the North Coast' or 'Blackbutt – Smooth-barked Apple Shrubby Open Forest on Coastal Sands of the Southern North Coast' (Biometric veg database).

### **Significant species**

The TSC/EPBC-listed critically endangered Tuncurry Midge Orchid (*Genoplesium littoralis* syn. *Corunastylis littorale*) was recorded on site within this community mostly in the northern section of the site in areas where disturbance has occurred. No other threatened flora species that have been recorded as having potential to occur in the area were recorded on site.

### **Community conservation status**

Not analogous to any TSC/EPBC listed EECs, VECs.

### **Vegetation structure**

Upper Stratum – 15m to 20m with a projected foliage cover (PFC) of 30 to 50%, the dominant species being *Eucalyptus pilularis* (Blackbutt), with associated species including *Eucalyptus robusta* (Swamp Mahogany), *Angophora costata* (Smooth-barked Apple), *Corymbia gummifera* (Red Bloodwood) and *Corymbia intermedia* (Pink Bloodwood).

Mid Stratum – 0.5m to 8m with a PFC of 30 to 40%, the dominant species being *Leucopogon lanceolatus*, *Banksia aemula*, *Leptospermum polygalifolium* and *Leucopogon leptospermoides*.

Lower Stratum – Ground to 1m with a PFC of 50% to 75%, dominated by *Pteridium esculentum* (Bracken), *Xanthorrhoea macronema* and *Lomandra longifolia* (Spiny-headed Mat-rush). Other species commonly encountered within this community included *Bossiaea heterophylla* (Variable Bossiaea), *Acacia suaveolens* (Sweet Wattle), *Dianella caerulea* (Blue Flax-lily), *Imperata cylindrica* (Blady Grass), *Themeda australis* (Kangaroo Grass), *Pomax umbellata*, *Billardiera scandens* (Appleberry) and *Pandorea pandorana* (Wonga Wonga Vine).

## 2 *Banksia aemula* Dry Heathland



Plate 3-2: *Banksia aemula* Dry Heathland

### General description

This community was recorded on deep, freely draining podzolised sands on the Tuncurry Holocene dunefield over much of the site in areas exposed to the prevailing onshore winds. The community was characterised by a diverse suite of heathy shrubs to 2 metres in height dominated with a groundcover of subshrubs, sedges and graminoids. Parts of the southern section of this community supported scattered emergents or small clumps of *Eucalyptus pilularis* and the introduced *Pinus elliotii*.

### Known floristic / structural variations

The composition of this community was consistent over the majority of the site; however there were slight variations depending on soil characteristics and disturbance levels. In particular, the north-eastern extent of the site is an area where fire has removed the existing shrub layers leaving the area dominated by *Banksia serrata* (Old-man Banksia) and *Pteridium esculentum* (Bracken) with some small areas of regenerating shrubby heath species. In the south a wet heath variant occurs (predominately as a large patch) within the south of the site however it may also occur in other parts within linear depressions. This variant differs by having a lower, more open mid-storey stratum and denser lower stratum comprised of predominately of *Caustis recurvata* and Rushes.

### **Distribution**

This community occurs in a number of conservation reserves on the NSW North Coast on large coastal sand masses (Griffith and Wilson 2011 unpublished data).

### **Extent**

This vegetation community dominates the majority of the site. It encompasses approximately 237ha.

### **Relationship to other communities**

This community grades into *Eucalyptus pilularis* Dry Sclerophyll Forest with reduced exposure to the prevailing sea winds and an increase in soil fertility.

### **Equivalent vegetation types**

*Banksia aemula* Dry Heathland Community no. 31 (Griffith et al 2003); *Banksia* Dry Shrubland on Coastal Sands of the North Coast (DECCW 2008).

### **Significant species**

The TSC/EPBC-listed critically endangered Tuncurry Midge Orchid (*Genoplesium littoralis* syn. *Corunastylis littorale*) was recorded along 4WD tracks and within the main powerline easement that runs parallel to The Lakesway as well as within previously sand mined (regenerating) areas east of the Tuncurry Tip within this community. The community represents habitat for the regionally rare shrubs *Persoonia katerae* and *Acacia quadrilateralis* (previously on the Nabiak sandbeds to the west of the Wallamba River and in Darawank Nature Reserve). The community also represents potential habitat for the locally occurring Threatened shrubs/small trees *Allocasuarina simulans* and *Allocasuarina defungens* previously recorded by on the Nabiak sandbeds and by Griffith et al (2000) in Booti Booti NP. However, these species were not detected on site by the survey.

### **Community conservation status**

Not analogous to any TSC/EPBC listed EECs, VECs.

### **Vegetation structure**

Upper Stratum – 3m to - 5m with a PFC of 20% to 40%, the dominant species being *Banksia aemula* (Wallum Banksia) and *Leptospermum juniperinum* (Prickly tea-tree).

Mid Stratum – 1m to 3m with a PFC of 50% to 90%, the dominant species being *Leptospermum polygalifolium* (Tantoon), *Leptospermum laevigatum* (Coastal Tea-tree), *Leucopogon ericoides* (Bearded Heath) and *Leptospermum polyanthum* (Slender Tea-tree). Other commonly occurring species include *Ricinocarpos pinifolius* (Wedding Bush), *Dillwynia retorta*, *Boronia pinnata*, *Persoonia lanceolata* (Lance Leaf Geebung), *Leucopogon lanceolatus*, *Bossiaea rhombifolia*, *Bossiaea heterophylla* (Variable Bossiaea), *Astroloma pinifolium* (Pine Heath), *Conospermum taxifolium*, *Acacia longifolia* var. *longifolia* (Sydney Golden Wattle) and *Actinotus helianthi* (Flannel Flower).

Lower Stratum – 0.4m to 0.7m with a PFC of 20% to 60%, the dominant species being *Caustis recurvata*, *Pteridium esculentum* (Bracken) with *Imperata cylindrica* (Blady



Grass), *Themeda australis* (Kangaroo Grass), *Lomandra longifolia* (Spiny-headed Mat-rush), *Ficinia nodosa* (Knobby Club-rush) and *Gonocarpus tetragynus*.

### 3 *Leptospermum laevigatum* Dry Sclerophyll Shrubland



Plate 3-3: *Leptospermum laevigatum* Dry Sclerophyll Shrubland

#### General description

This community was recorded in well drained siliceous sand of the Holocene foredune close to the sea, with the tallest stratum dominated being 4-6 metre high with a small shrub stratum also present. The Groundcover was comprised of herbs, graminoids, grasses and ferns. Portions of this community supported scattered emergents of the introduced *Pinus elliottii*.

#### Known floristic / structural variations

In some locations thickets of *Leptospermum laevigatum* occur (particularly close to the Foredune Complex) to the east occur with a low diversity of other species.

#### Distribution

This community occurs in a number of conservation reserves on the NSW North Coast on the large coastal sand masses (Griffith and Wilson 2011 unpublished data).

#### Extent

This community covers a large portion of the site encompassing approximately 166ha.

### **Relationship to other communities**

This community grades landward into *Eucalyptus pilularis* Dry Sclerophyll Forest and *Banksia aemula* Dry Heathland with reduced exposure to the prevailing sea winds and seaward into the Foredune Complex with increased exposure to the sea.

### **Equivalent vegetation types**

*Banksia aemula* Dry Heathland Community no. 31 (Griffith et al 2003); Banksia Dry Shrubland on Coastal Sands of the North Coast (DECCW 2008).

### **Significant species**

The listed critically endangered Tuncurry Midge Orchid (*Genoplesium littoralis* syn. *Corunastylis littorale*) was recorded occasionally within this community in areas where leaf litter was not dense with some sunlight filtering through the shrub foliage.

### **Community conservation status**

Not analogous to any TSC/EPBC listed EECs, VECs.

### **Vegetation structure**

Mid Stratum – 4m to 6m with a PFC of 2% to 10%, the dominant species being *Leptospermum laevigatum* (Coastal Tea-tree), *Persoonia levis*, *Banksias serrata* and *Monotoca elliptica*.

Lower Stratum – 1.0m to 4m with a PFC of 2% to 10% with *Leucopogon parviflorus*, *Dillwynia retorta*, *Ricinocarpos pinifolius*, *Acacia suaveolens* and *Bossiaea rhombifolia* subsp *rhombifolia* frequently dominant.

Ground cover – Ground to 1.0m with a PFC of 20% to 90%, *Gonocarpus tetragynus*, *Lomandra longifolia* and *Dianella caerulea* var *caerulea*.

## 4 Foredune Complex



Plate 3-4: Foredune Complex

### General description

The Foredune Complex map unit is used to delineate the following two vegetation communities which are too small or intermixed to map separately at the scale employed for the project:

- A. *Acacia longifolia* subsp *sophorae* (syn. *Acacia sophorae*) *Chrysanthemoides monilifera* subsp *rotunda* Dry Sclerophyll Shrubland; and
- B. *Spinifex sericeus* Tussock Grassland.

### **A. *Acacia longifolia* subsp *sophorae* – \**Chrysanthemoides monilifera* subsp *rotunda* Dry Sclerophyll Shrubland**

This community is a narrow linear band on well drained siliceous sands of the Tuncurry Holocene dunes just landward of the spring high tide zone. In addition to the shrub co-dominants listed in the community name, *Rhagodia candolleana* subsp *candolleana* was recorded as a subsidiary to minor shrub species. The introduced *Chrysanthemoides monilifera* subsp *rotunda* may displace *Acacia longifolia* subsp *sophorae* over time without active intervention. The community typically supported a bare to sparse ground cover due to shading effects from the canopy dominants.

**Known floristic / structural variations**

None recorded on site.

**Distribution**

This community occurs in a number of conservation reserves on the NSW North Coast on the large coastal sand masses (Griffith and Wilson 2011 unpublished data).

**Relationship to other communities**

This community grades landward into the *Leptospermum laevigatum* Dry Sclerophyll Shrubland with reduced exposure to the sea and grades seaward (at slightly lower elevation) into the *Spinifex sericeus* Tussock Grassland.

**Equivalent vegetation types**

*Acacia longifolia* subsp *sophorae* – \**Chrysanthemoides monilifera* subsp *rotunda* Dry Sclerophyll Shrubland (Griffith et al 2000); no equivalent Biometric Vegetation database type in DECCW (2008).

**Significant Species**

No threatened flora species were recorded within this vegetation community.

**Community conservation status**

Not analogous to any TSC/EPBC listed EECs, VECs.

**Vegetation Structure**

Mid Stratum – 5m to 1.5m with a PFC of 2% to 10%, the dominant species being *Chrysanthemoides monilifera* subsp *rotunda*, *Acacia longifolia* subsp. *sophorae* (Coastal Wattle) and *Rhagodia candolleana* subsp *candolleana*

Lower Stratum – Ground to 1.0m with a PFC of 10% to 90%, dominated by introduced and native herbs, prostrate shrubs, grasses and climbers including *Hibbertia scandens*, *Oxalis rubens*, *Hydrocotyle bonariensis*\*, *Cakile edentula*\*, *Scaevola calendulacea*, *Dianella crinoides*, *Zoysia macrantha* and *Tetragonia tetragonioides*.

**B. *Spinifex sericeus* Tussock Grassland**

This community was recorded as a narrow linear band on well drained siliceous sands on the Tuncurry Holocene dune just landward of the spring high tide zone at slightly lower elevations relative to the *Acacia longifolia* subsp *sophorae* – \**Chrysanthemoides monilifera* subsp *rotunda* Dry Sclerophyll Shrubland community. *Spinifex sericeus* dominates this community with a number minor associate species including *Carpobrotus glaucescens*.

**Known floristic / structural variations**

None recorded on site.

### **Distribution**

This community occurs in a number of conservation reserves on the NSW North Coast on the large coastal sand masses (Griffith and Wilson 2011 unpublished data).

### **Relationship to other communities**

This community exists on the exposed beach sand to the east of the *Leptospermum laevigatum* Dry Sclerophyll Shrubland.

### **Equivalent vegetation types**

*Spinifex sericeus* Tussock Grassland (Griffith et al 2000); Kangaroo Grass Sod Tussock Grassland of Coastal Areas of the North Coast (DECCW 2008).

### **Significant flora species**

No threatened flora species were recorded within this vegetation community.

### **Community conservation status**

Not analogous to any TSC/EPBC listed EECs, VECs.

### **Vegetation structure**

This vegetation community occurs along the eastern edge of the site, between the beach and the hinddune vegetation. It encompasses approximately 26.96ha and is commensurate with MU SAND as described by Great Lakes Council (2003). Floristic composition within this community is relatively uniform across the site.

Mid Stratum – 1.5m to 5m with a PFC of 2% to 10%, the dominant species being *Leptospermum laevigatum* (Coastal Tea-tree), *Acacia longifolia* subsp. *sophorae* (Coastal Wattle) and *Monotoca scoparia* (Prickly Broom-heath).

Lower Stratum – Ground to 1.0m with a PFC of 10% to 90%, the dominant species being *Lomandra longifolia* (Spiny-headed Mat-rush), *Spinifex hirsutus* (Hairy Spinifex), *Sporobolus virginicus* (Sand Couch), *Carpobrotus* sp. (Pigface) and *Dianella revoluta* (Blue Flax-Lily).

### **Extent**

The Foredune complex comprising both the abovementioned communities covers approximately 32ha of the site.

#### **3.1.2 Endangered Ecological Communities**

No EEC listed under the TSC Act and/or EPBC Act was found to occur on site.

#### **3.1.3 Regionally Significant Vegetation Communities/Species**

No regionally significant flora species were recorded on site.

Some regionally significant vegetation communities do occur on site (**Table 3-1**). The *Eucalyptus pilularis* Dry Sclerophyll Forest (dunal) community is recorded as of conservation significance by the Great Lakes Vegetation Strategy (Great Lakes Council 2003) at this local (LGA) level, but not in the other referenced documents. The *Banksia*

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*aemula* Dry Heathland has been described as moderate to high conservation value locally (Great Lakes Council 2003) and is recorded as 70% cleared in the Hunter Central Rivers CMA. Overall it is considered to be of moderate to high conservation significance. The *Leptospermum laevigatum* Dry Sclerophyll Shrubland and the Foredune Complex have both been subject to high levels of clearing regionally and both have been considered to be of high local conservation significance (Great Lakes Council 2003).

Whilst these documents provide context for the communities, each differs in the age since it was completed and the specific methodologies used and some documents were specifically focused on forest conservation assessments and may be of lower accuracy in the assessment applied to other communities (e.g. coastal heath and scrub communities).

Table 3-1: Regional Conservation Value of Extant Vegetation

	Griffith <i>et al</i> (2000; 2003); Griffith and Wilson (2011)	Hager and Benson 1994	Great Lakes Vegetation Strategy (2003)	Biometric Vegetation Database	TSC Act	EPBC Act	Coastal Vegetation Community Audit (Griffith, unpublished)	HCCREMS (2012 updated veg mapping)
<b>Vegetation Community</b>								
<i>Eucalyptus pilularis</i> Dry Sclerophyll Forest (dunal)	Occurs in a number of the north coast reserves on the large coastal sand masses (Griffith and Wilson 2011).  68.5 ha reserved locally in Booti Booti NP with additional habitat reserved in Darawank NR.	Adequately conserved in the North East of NSW	Moderate-High Conservation Value (MU 41)  Extant area in eastern portion of LGA = 683 ha (approx.) (MU 41)	Equivalent Biometric Vegetation Type = Blackbutt-Smooth barked Apple shrubby Open Forest on coastal sands of the southern North Coast (estimated 25% cleared in HCR CMA)	Not listed as a CEEC, EEC or VEC.	Not listed as a CEEC, EEC or VEC.	Extant area = 2700 ha (approx) conserved in north coast reserves (NPWS Map Code 3505, 3506).	Not yet available
<i>Banksia aemula</i> Dry Heathland	Occurs in many of the north coast reserves on the large coastal sand masses (Griffith and Wilson 2011).  89 ha reserved locally in Booti Booti NP (co-dominant with <i>Allocasuarina simulans</i> ).	-	'Heaths' in general classified as Moderate to High Conservation Value (MU 223).  Extant area in eastern portion of LGA = 2660 ha (approx.) for 'Heaths' (includes wet and dry heathlands).	Equivalent Biometric Vegetation Type = Banksia dry shrubland on coastal sands of the North Coast (estimated 70% cleared in HCR CMA)	Not listed as a CEEC, EEC or VEC.	Not listed as a CEEC, EEC or VEC.	Extant area = 2400 ha (approx) in north coast reserves.	Not yet available
<i>Leptospermum laevigatum</i> Dry Sclerophyll Shrubland	Occurs in most lower/mid north coast conservation reserves (e.g. Booti Booti, Crowdy Bay, Hat Head NPs, Limeburners Creek, Kattang NRs) as foredune vegetation.  26 ha reserved locally in Booti Booti NP.	N/A	'Scrub' in general classified as having a High Conservation Value (MU 224).  Extant area in eastern portion of LGA = 122 ha.	Coast Banksia-Coast Wattle dune scrub, Sydney Basin and South East Corner (estimate 45% cleared in HCR CMA).	Not listed as a CEEC, EEC or VEC.	Not listed as a CEEC, EEC or VEC.	Extant area = no data	Not yet available
Foredune Complex	The <i>Acacia longifolia</i> subsp <i>sophorae</i> -* <i>Chrysanthemoides monilifera</i> community is reserved locally in Booti Booti NP as well as in the far north coast in Bundjalung NP and Richmond River Nature Reserve (Griffith and Wilson 2011).  <i>Spinifex sericeus</i> tussock grassland represented in most of the North Coast reserves on the large coastal sand masses (Griffith and Wilson 2011)	N/A	The <i>Acacia sophorae</i> – Bitou Bush community is considered to form part of the GLC 'Scrub' community , classified as having a High Conservation Value (MU 224) with an extant area in eastern portion of LGA = 122 ha.  The <i>Spinifex sericeus</i> community is considered to form part of the GLC 'Sand' community, having a High conservation value with an extant area in the eastern portion of the LGA = 318 ha.	Coast Banksia-Coast Wattle dune scrub, Sydney Basin and South East Corner (estimate 45% cleared in HCR CMA).	Not listed as a CEEC, EEC or VEC.	Not listed as a CEEC, EEC or VEC.	Extant area = 74 ha within North Coast reserves for <i>Acacia longifolia</i> subsp <i>sophorae</i> - <i>Chrysanthemoides monilifera</i> subsp <i>rotunda</i> community, excluding 65.5 ha reserved in Booti Booti NP, Darawank NR) for the <i>Spinifex sericeus</i> tussock grassland community.	Not yet available

### 3.1.4 Desktop Assessment - Threatened Flora Search Results

A search of potentially occurring significant flora species from the locality (10km radius) was undertaken in March 2012. This search examined species listed under the TSC Act, EPBC Act and Rare or Threatened Australian Plants (ROTAP) listed flora species (Briggs and Leigh 1996), as well as any other species deemed to be of local importance, refer **Table 4-1**.

The following 12 threatened flora species were identified from the desktop survey:

- *Allocasuarina defungens* (Dwarf Heath Casuarina);
- *Allocasuarina simulans* (Nabiac Casuarina);
- *Cryptostylis hunteriana* (Leafless Tongue Orchid);
- *Asperula asthenes* (Trailing Woodruff);
- *Genoplesium littorale* syn. *Corunastylis littoralis* (Tuncurry Midge-Orchid);
- *Cryptostylis hunteriana* (Leaf-tongue Orchid)
- *Cynanchum elegans* (White-flowered Wax Plant);
- *Eucalyptus fergusonii*
- *Euphrasia ramulosa*
- *Lindernia alsinoides* (Noah's False Chickweed)
- *Maundia triglochinos*; and
- *Syzygium paniculatum* (Magenta Lilly Pilly).

### 3.1.5 Threatened Flora Species Survey Results

One threatened flora species, *Genoplesium littorale* syn. *Corunastylis littoralis* (Tuncurry Midge-Orchid), listed as Critically Endangered under the TSC Act and Critically Endangered under the EPBC Act was recorded within the site.

#### **Tuncurry Midge Orchid (*Corunastylis littoralis* syn *Genoplesium littorale*)**

A total of 1738 individuals of this species (Plate 3-4) have been located within the site (Refer to **Figure 3-2** for locations). An additional 667 individuals have been recorded to the immediate northwest of the site.

Targeted surveys detected the orchid within the Blackbutt Dry Sclerophyll Forest (Dunal Blackbutt Forest, *Banksia aemula* Dry Heathland and *Leptospermum laevigatum* Dry Sclerophyll Shrubland, particularly within but not exclusive to areas of previous disturbance. A section, of the main power line clearing, approximately 0.5ha in size, which runs north-south of the site, was intensively surveyed. A total of 51 stems were recorded within this area. Many additional individuals were also recorded within dense scrub dominated by *Leptospermum polygalifolium*. An additional 12 x 0.05ha quadrats were intensively surveyed, spread along the remaining extent of this easement. This recorded 17 individuals.



A large number of orchids were detected to the north of the site, generally associated with the extent of historic mining, potentially extending areas of the 'core population' as described by Paget (2008). Additional observations of orchid were made within other areas of the site.

In the locality, surveys were undertaken in 2010 and 2011 to gain information on the range of occurrence for this species. To date a total of 90 individuals have been recorded south of Forster in the Booti Booti National Park area. Similarly, 62 individuals have been recorded within Crown lands and Mid Coast Water Lands to the west of Tuncurry, closer to Nahiab (Refer to **Figure 3-3**).

Tuncurry Midge Orchid surveys should not be considered a complete census and individuals recorded on site should be viewed only as a sample of population extent.

Additional studies on TMO distribution and ecology undertaken by RPS in 2011, combined with the 2010 results (RPS 2011) can be summarised as:

- The total number of TMO individuals recorded within the site by RPS, during the 2010 and 2011 surveys, is 1286 stems;
- The total number of TMO individuals recorded outside of the site by RPS, during the 2010 and 2011 surveys, is 689;
- The total number of TMO individuals recorded by Paget (2008), within the site is 452; and
- The total number of TMO individuals recorded by Paget (2008), outside the site is 130.

Full methods and results of TMO surveys undertaken by RPS are provided in **Appendix C**.

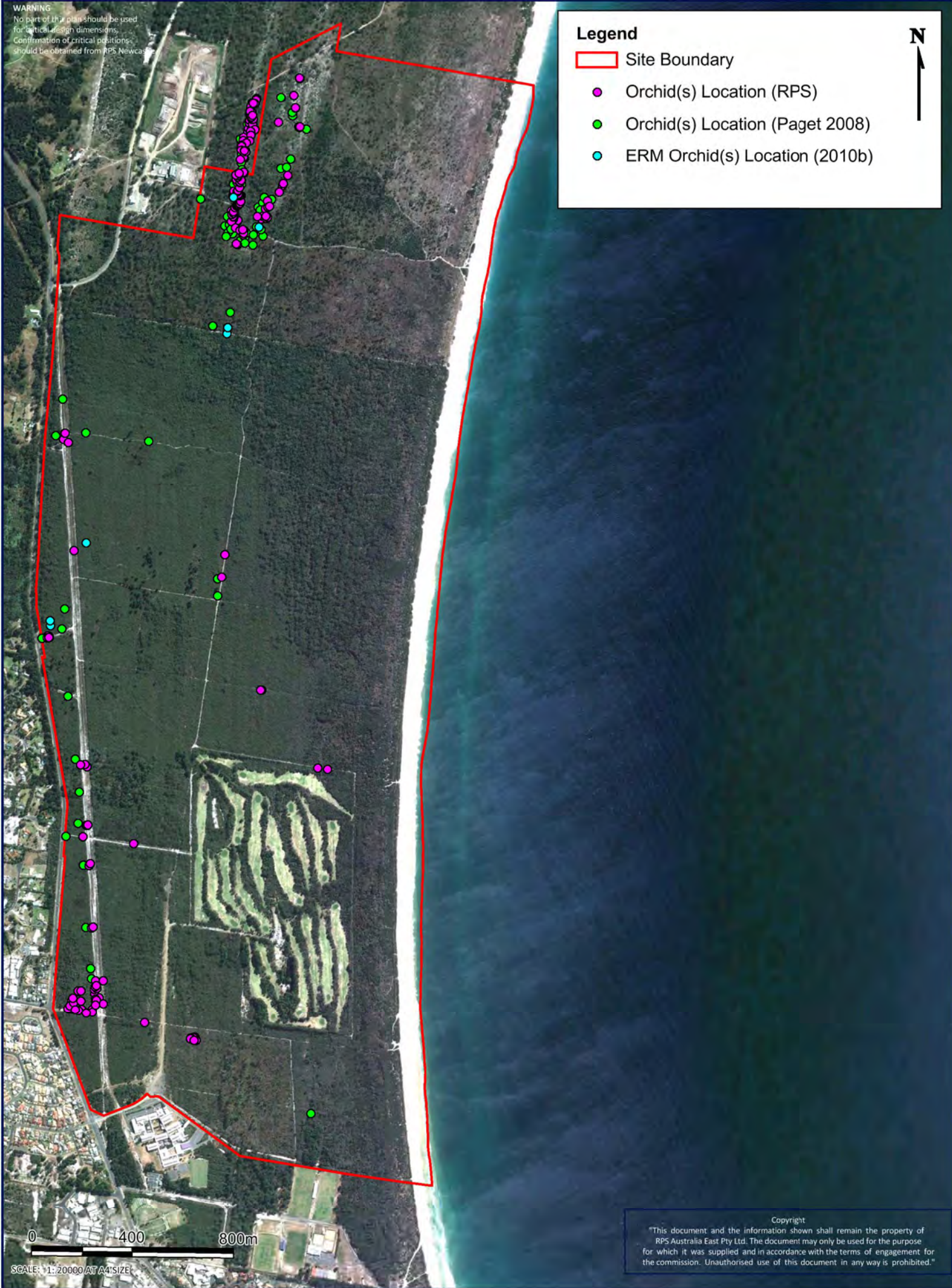


**Plate 3-5: Tuncurry Midge Orchid (*Corunastylis littoralis* syn *Genoplesium littorale*)**

**WARNING**  
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

**Legend**

- Site Boundary
- Orchid(s) Location (RPS)
- Orchid(s) Location (Paget 2008)
- ERM Orchid(s) Location (2010b)



0 400 800m

SCALE: 1:20000 AT A4 SIZE

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TITLE: FIGURE 3-2 TMO RECORDS ON SITE

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 22/3/2012  
 PURPOSE: ECO INVENTORY

LAYOUT REF: "J:\JOBS\26k\26414 - North Tuncurry\10-Drafting  
 VERSION (PLAN BY): PAUL HILLIER

CLIENT: LANDCOM  
 JOB: 26414

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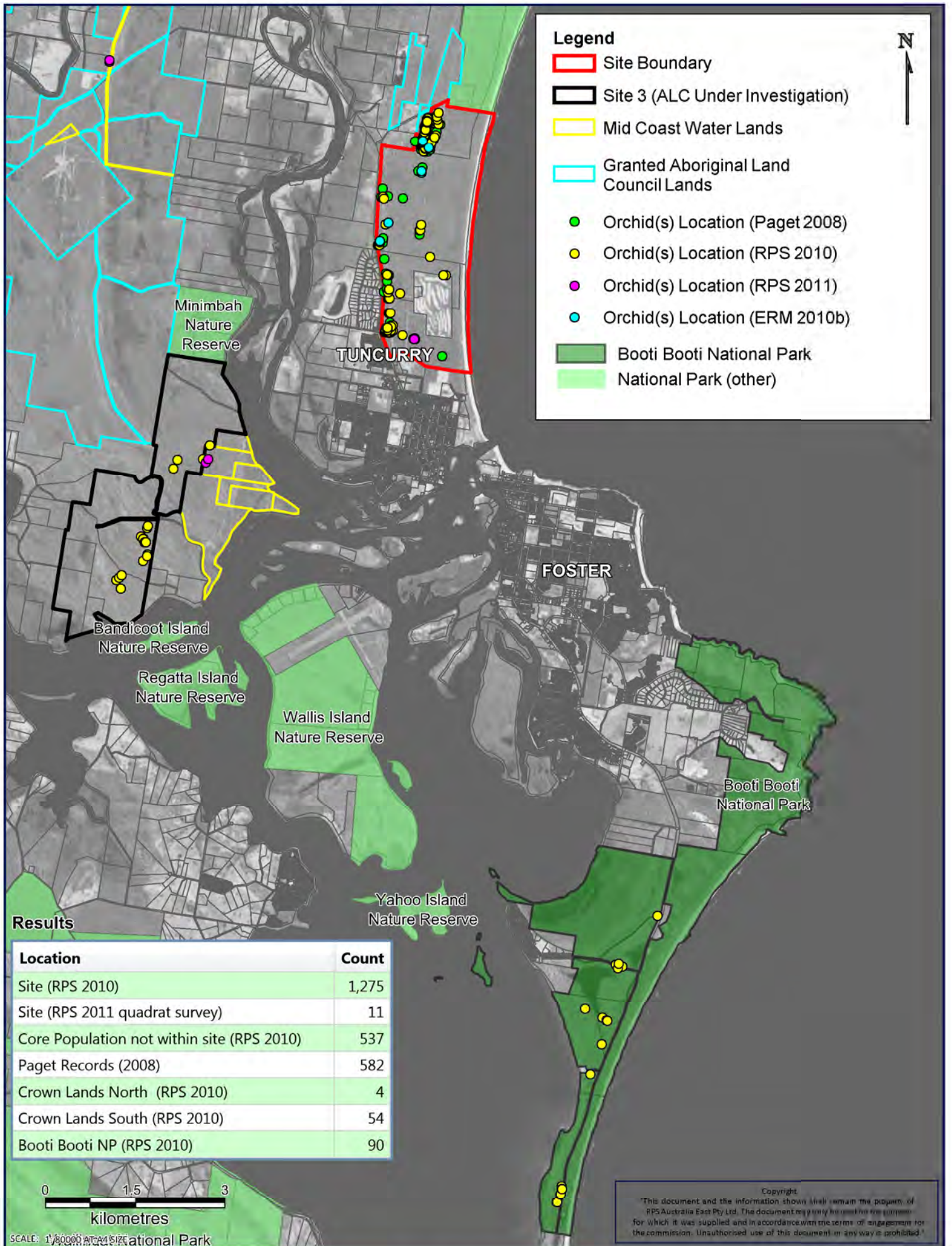


FIGURE 3-3: TMO WIDER RECORDS

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 22/3/2012  
PURPOSE: ECO INVENTORY

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## 3.2 Fauna

### 3.2.1 Desktop Assessment - Threatened Fauna Search Results

The results of a threatened species search indicated that 47 threatened fauna species have been previously recorded within 10km of the site and/or have potential habitat within the site (NSW Atlas of Wildlife Database 2012; DEWHA 2011 and Briggs and Leigh 1996). These species are:

#### Frogs:

- *Crinia tinnula* (Wallum Froglet)
- *Litoria aurea* (Green and Golden Bell Frog)
- *Mixophyes balbus* (Stuttering Frog)
- *Mixophyes iteratus* (Southern Barred Frog)

#### Birds:

- *Anthochaera phrygia* (Regent Honeyeater)
- *Botaurus poiciloptilus* (Australian Bittern)
- *Calidris tenuirostris* (Great Knot)
- *Calyptorhynchus lathami* (Glossy Black-Cockatoo)
- *Charadrius mongolus* (Lesser Sand-plover)
- *Daphoenositta chrysoptera* (Varied Sittella)
- *Ephippiorhynchus asiaticus* (Black-necked Stork)
- *Esacus magnirostris* (Beach Stone-curlew)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Haematopus fuliginosus* (Sooty Oystercatcher)
- *Haematopus longirostris* (Pied Oystercatcher)
- *Heiraaetus morphonoides* (Little Eagle)
- *Ixobrychus flavicollis* (Black Bittern)
- *Lathamus discolor* (Swift Parrot)
- *Limosa limosa* (Black-tailed Godwit)
- *Lophoictinia isura* (Square-tailed Kite)
- *Ninox connivens* (Barking Owl)
- *Ninox strenua* (Powerful Owl)
- *Pandion cristatus* (Eastern Osprey)
- *Pomatostomus temporalis temporalis* (Grey-crowned Babbler)

- *Rostratula australis* (Australian Painted Snipe)
- *Sterna albifrons* (Little Tern)
- *Tyto capensis* (Grass Owl)
- *Tyto novaehollandiae* (Masked Owl)
- *Xenus cinereus* (Terek Sandpiper)

**Mammals:**

- *Cercartetus nanus* (Eastern Pygmy Possum)
- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Dasyurus maculatus maculatus* (Spotted-tailed Quoll)
- *Falsistrellus tasmaniensis* (Eastern False Pipistrelle)
- *Miniopterus australis* (Little Bentwing-bat)
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)
- *Myotis macropus* (Southern Myotis)
- *Mormopterus norfolkensis* (Eastern Freetail-bat)
- *Phascogale tapoatafa* (Brush-tailed Phascogale)
- *Phascolarctos cinereus* (Koala)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Potorous tridactylus tridactylus* (Long-nosed Potoroo)
- *Pseudomys novaehollandiae* (New Holland Mouse)
- *Pteropus poliocephalus* (Grey-headed Flying-Fox)
- *Saccolaimus flaviventris* (Yellow-bellied Sheath-tail-bat)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat)
- *Syconycteris australis* (Common Blossom Bat)
- *Vespadelus troungtoni* (Eastern Cave Bat)

### 3.2.2 Threatened Fauna Species

A total of 13 threatened species as listed under the TSC Act or EPBC Act have been recorded on site during the 2010, 2011 and 2012 surveys by RPS, namely:

- *Pandion cristatus* (Eastern Osprey)
- *Haematopus longirostris* (Pied Oystercatcher)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Phascogale tapoatafa* (Brush-tailed Phascogale)
- *Cercartetus nanus* (Eastern Pygmy Possum)
- *Petaurus norfolcensis* (Squirrel Glider)
- *Falsistrellus tasmaniensis* (Eastern Falsistrelle)

- *Syconycteris australis* (Eastern Blossom Bat)
- *Miniopterus australis* (Little Bentwing-bat)
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)
- *Mormopterus norfolkensis* (Eastern Freetail-bat)
- *Scoteanax rueppellii* (Greater Broad-nosed Bat)
- *Pteropus poliocephalus* (Grey-headed Flying-Fox)

The locations of all threatened fauna recorded on site is shown in **Figure 3-4**.

### 3.2.3 Mammals

Several species of terrestrial and arboreal mammals were identified as occurring within the site, including three arboreal mammals which are listed as threatened under the TSC Act and/or EPBC Act. A full list of fauna recorded on site is provided in **Appendix B**.

Mammals recorded during terrestrial surveys included endemics such as *Antechinus stuartii* (Brown Antechinus); *Antechinus flavipes* (Yellow-footed Antechinus); *Rattus fuscipes* (Bush Rat) and *Rattus lutreolus* (Swamp Rat). Feral species including European Rabbits, Foxes, Wild Dogs; Black Rats and a House Mouse were also trapped and/or observed on occasions during the field survey on site. *Macropod* sp tracks were also observed, with previous surveys (ERM 2010a) recording *Wallabia bicolor* (Swamp Wallaby) as occurring on site. *Tachyglossus aculeatus* (Short-beaked Echidna) was recorded through observation as well as secondary indications such as diggings and scats.

Secondary indications of small conical diggings were observed throughout the site, made when species forage for invertebrates, tubers and/or other plant material.

*Petaurus norfolcensis* (Squirrel Glider) and *Petaurus breviceps* (Sugar Glider) were identified during arboreal fauna surveys, through captures in arboreal traps within the Blackbutt Open Forest Community. A large number of *Pseudocheirus peregrinus* (Common Ringtail Possums) were observed during both nocturnal and incidental diurnal surveys throughout the site. Several dreys associated with this species were also observed within *Leptospermum* sp. on site. *Phascogale tapoatafa* (Brush-tailed Phascogale) and *Trichosurus vulpecula* (Common Brushtail Possum) were also identified during nocturnal spotlighting surveys on site. The presence of the Brush-tailed Phascogale within the Golf Course was also reported by managers of the site and are highly suspected to use parts of the club house as den sites (RPS Ecologist *pers. comm.*).

The combined results of hair-tube analysis confirmed the presence on site of the Eastern Pygmy Possum and Brush-tailed Phascogale with hair tubes containing hair attributable to these species. Hair-tube analysis also identified several occurrences of native Brown Antechinus and *Petaurus* sp (probable Sugar Glider) as well as the introduced Black Rat.

One House Mouse (*Mus musculus*) was caught in a pit along a pit fall trap line in the heath vegetation.

#### 3.2.4 Bats

A total of 16 species of bats have been recorded and identified within the site, including two megabats and 14 microchiropteran bats. Of these, there were seven threatened species being *Miniopterus australis* (Little Bentwing-bat), *Scoteanax rueppellii* (Greater Broad-nosed Bat), *Miniopterus schreibersii oceanensis* (Eastern Bentwing-Bat), *Mormopterus norfolkensis* (Eastern free-tail Bat), *Falsistrellus tasmaniensis* (Eastern Falsistrelle), *Syconycteris australis* (Common Blossom Bat) and *Pteropus poliocephalus* (Grey-headed Flying Fox). Other species recorded included *Chalinolobus gouldii* (Gould's Wattle Bat), *Chalinolobus morio* (Chocolate Wattle Bat), *Vespadelus darlingtoni* (Large Forest Bat) and *Vespadelus pumilus* (Eastern Forest Bat). All recorded species are listed in **Appendix B**.

Bat call analysis recorded a high number of 'excited and social' bat calls during the middle of one survey night, most likely from *Tadarida australis* (White-striped Freetail Bat).

#### 3.2.5 Avifauna

A total of 79 species of birds were systematically recorded during combined survey periods and methods. A full list of birds recorded is provided in **Appendix B**.

Avian species groups encountered, included but were not limited to, Whistlers and Thrushes, Robins, Fairy-wrens, Thornbills, Honeyeaters, Whipbirds, Parrots, Cuckoos, Butcherbirds, Quails, Cockatoos and birds of prey amongst others.

While it is not common to find avifauna in Elliot and/or cage traps, during 2012 surveys one Australian Raven was captured in a cage trap set along the dune system community.

Beach sweeps during 2012 surveys produced a number of species not previously recorded including one threatened species, namely the *Haematopus longirostris* (Pied Oystercatcher).

Whilst Glossy Black-Cockatoos, listed as vulnerable under the TSC Act, were not observed on site, *Allocasuarina* tree species, suited to the foraging requirements of this species, are present on site.

Although no forest owl species were observed during targeted surveys, the site has the potential to represent a portion of the local foraging range of both *Tyto novaehollandiae* (Masked Owl) and *Ninox strenua* (Powerful Owl), due to the presence of terrestrial and arboreal mammals, which are the respective prey of these owl species. A limiting factor on the presence of forest owl species may be the absence of large hollows that these species require for breeding observed during field surveys, and in the case of the Masked Owl, roosting purposes. Potential habitat also exists for *Tyto longimembris* (Eastern Grass Owl) within the grassy heath areas on site. Coastal populations of the Eastern



Grass Owl are considered fairly sedentary however local colonisations are known after irruptions of terrestrial prey species populations.

### 3.2.6 Herpetofauna

A total of seven species of frogs were identified within the site. Several common species of frog including *Limnodynastes peronii* (Striped Marsh Frog), *Crinia signifera* (Common Froglet), *Litoria fallax* (Eastern Dwarf Tree Frog), *Litoria peronii* (Peron's Tree Frog), *Litoria revelata* (Revealed Frog) and *Litoria tyleri* (Tyler's Tree Frog) occurred on site. Although threatened frog species are known to occur within the region, in particular that belonging to the Genus *Crinia* and *Mixophyes*, habitat within the site is not suited to these threatened species. Minimal habitat potential exists for *Litoria aurea* (Green and Golden Bell Frog), being limited to the vicinity of the dam located within the golf course adjacent to site.

The most commonly encountered reptiles within the site were common skink species occurring within ground debris, particularly *Lampropholis delicata* (Grass Skink), which was observed across all habitats within the site. *Varanus varius* (Lace Monitor) was also observed in open forest habitat within the site. Reptiles identified and recorded included a total of six individual species.

Most recorded reptiles were caught through pit fall traps which are particularly effective target herpetofauna. By far the most commonly caught species was the amphibian *Limnodynastes peronii* (Striped Marsh Frog) which was recorded a total of 46 times followed by the Jacky dragon (*Amphibolurus muricatus*) recorded 10 times.

### 3.2.7 State Environmental Planning Policy No.44 – Koala Habitat Protection

Ecological surveys identified one SEPP - 44 Schedule 2 Koala preferred feed tree species on site, being *Eucalyptus robusta* (Swamp Mahogany). This tree species did not constitute 15% of the total number of trees in the canopy, and as such the site does not constitute "Potential Koala Habitat".

Whilst Koala sightings have been recorded directly south and east of the site no attribute evidence of resident populations of Koalas was found on site. As such the site does not constitute "Core Koala Habitat".

However it should be noted that the Blackbutt, Smooth-barked Apple and Red Bloodwood trees, that are present on site, are known as secondary browse trees for this species and may provide potential foraging habitat for dispersing Koala populations linking areas of preferred habitat (Phillips et al 2000; DECCW 2010).

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 for critical design dimensions.  
 Confirmation of critical positions  
 should be obtained from RPS Newcastle



**Legend**

- Site Boundary
- ▲ Osprey (RPS)
- ▲ Osprey (ERM)
- ▲ Pied Oystercatcher (RPS)
- ▲ Little Lorikeet (RPS)
- Eastern Pygmy Possum (RPS)
- Squirrel Glider (RPS)
- Squirrel Glider (ERM)
- Brush-tailed Phascogale (RPS)
- Brush-tailed Phascogale (ERM)
- Common Blossom Bat (RPS)
- ◆ Grey-headed Flying-fox (RPS)
- ◆ Grey-headed Flying-fox (ERM)
- Hollow Dependent Microbats*
- Eastern Freetail-bat (RPS)
- Eastern False Pipistrelle (RPS)
- Cave Dwelling Microbats*
- ▲ Eastern Bentwing-bat (RPS)
- ▲ Little Bentwing-bat (RPS)



0 400 800m

SCALE: 1:20000 AT A4 SIZE

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FIGURE 3-4: THREATENED FAUNA RECORDS

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 22/3/2012  
 PURPOSE: ECO INVENTORY

LAYOUT REF: "J:\JOBS\26k\26414 - North Tuncurry\10-Drafting VERSION (PLAN BY): PAUL HILLIER

CLIENT: LANDCOM  
 JOB: 26414

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### 3.3 Habitat Assessment

Habitats within the site were assessed for their potential to support native fauna species including threatened fauna for which records occur within the wider locality. The habitat present throughout the site may be classified as two broad habitat types, being Open Forest and Heath. The below sections provides an overview of the habitat attributes encountered on site. Habitat value assessments for those threatened species recorded within the site is considered in further detail in **Section 4**.

#### 3.3.1 Terrestrial Habitats

The open forest communities within the site provides suitable habitat for a number of common terrestrial mammals, including small marsupials, rodents and Echidna. Within dry forest communities understorey complexity is variable, ranging from simplistic to moderately high. The floristic complexity within heath communities are generally high however varied slightly within areas of past and present disturbances. The most suitable foraging and sheltering opportunities for terrestrial mammals occur where understorey densities are highest and sufficient forest debris is present. Trends observed from the trapping surveys indicate that small mammals such as *Antechinus* and Native Rats were in moderate abundances throughout the site. The shrubby understorey and heathland also provides suitable foraging and nesting habitat for a number of common insectivorous/nectivorous bird species apparent on site.

Open areas of forest and heath communities offer grazing and browsing opportunities for herbivorous fauna, such as Macropods. The grassy understorey of these areas provides additional seed and stem resources for these species as well as granivorous species such as birds. Open areas also provide habitat for pest species such as *Oryctolagus cuniculus* (Rabbit) and *Vulpes vulpes* (Fox) that were observed on site.

Reptile species have sheltering and foraging opportunities within community areas of increased understorey complexity, leaf litter and forest debris. Habitat opportunities for amphibious species are limited with only one permanent water body, a dam, occurring within the Golf Course. However wooded habitats provide foraging and shelter opportunities for some tree-dwelling and terrestrial frog species. Ephemeral ponds and damp areas may also provide intermittent habitat for resident or dispersing frog species.

Coastal habitats adjacent to the site provide nesting opportunities for pelagic bird and reptile species along the sandy beach and dunes.

#### 3.3.2 Arboreal Habitats

Canopy tree species and myrtaceous/proteaceous understorey shrubs provide abundant foraging resources such as foliage, seeds, pollen, nectar and invertebrates for nectivorous and insectivorous birds as well as mammals such as possums, gliders, bats. Some foraging potential for migratory nectar seeking species such as *Lathamus discolor* (Swift Parrot) and *Anthochaera phrygia* (Regent Honeyeater) exists within winter flowering Eucalypts and Banksia trees. Understorey structure is generally characterised

with sufficient structural diversity and debris to provide foraging opportunities for a range of common woodland bird species. Cleared, open and disturbed areas with a low diversity and density of Eucalypt species hold limited habitat for arboreal mammal species. Canopy trees within the site offer blossom foraging opportunities for Grey-headed Flying-foxes and the Common Blossom Bat. These bat species are highly mobile and travel widely to access foraging resources. No potential locations for roosting camps of flying-foxes and/or blossom bats were observed within the site during ecological surveys.

Hollow bearing trees, albeit at a low frequency, within the site provide roosting, breeding and den habitat for micro-chiropteran bats and other hollow-dependent bird and mammals species including the threatened *Petaurus norfolcensis* (Squirrel Glider), *Phascogale tapoatafa* (Brush-tailed Phascogale) and *Cercartetus nanus* (Eastern Pygmy Possum).

Few tree hollows or dead stags were identified with entrances sufficient to accommodate larger forest owls or other species with larger hollow requirements however the abundance of potential prey items available on site suggests that the site would potentially represent a portion of the local foraging range of these species. Deep fissures that occur within the bark of *Eucalypt* and *Banksia* sp may also provide further roosting opportunities for some micro-chiropteran bats. There are no rocky outcrops, overhangs or other cave like structures that occur on site and therefore the site would represent only potential foraging habitat for cave roosting bat species.

### 3.3.3 Hollow Bearing Tree Assessment

Targeted hollow bearing tree assessments suggest that hollows are more abundant in the Blackbutt Forest than the remaining vegetation types (see **Figure 3-5**). Quadrats were undertaken as follows:

- *Eucalyptus pilularis* Dry Sclerophyll Forest (dunal): 4 (50x50m) quadrats and 4 (20x50m) quadrats;
- *Banksia aemula* Dry Heathland: 3 (50x50m) quadrats and 10 (20x50m) quadrats;
- *Leptospermum laevigatum* Dry Sclerophyll Shrubland: 1 (50x50m) quadrat and 6 (20x50m) quadrats; and
- Foredune Complex: 3 (20x50m) quadrats

Five hollow bearing trees yielding 7 hollows were recorded within three of the eight quadrats undertaken within the Blackbutt Forest. No hollows were found in the remaining vegetation types. The five hollow bearing trees showed signs of use in the form of scratches and/or fresh sap. In total 6 of the hollows were of a small hollow class and the remaining hollow of a medium hollow class.

Based on a simple extrapolation of hollow density encountered with the eight plots against the total area of Blackbutt Forest (99ha), this resulted in a calculation of up to 495 hollows with potential to exist. Despite finding no actual hollows in the remaining vegetation types it must be conveyed that there is still potential for hollows to be present. Cracks and decorticating bark on Banksia species prevalent throughout the heath community can develop into small hollows and potentially utilised by Pygmy Possums and microchiropteran bats. Hollows can also be positioned in parts of the tree not visible to observers, making it difficult to assess every true hollow.

Hollow formation in Eucalypts, suitable for supporting vertebrate fauna is estimated to not appear until trees are at least 120 years old (Gibbons, P. and Lindenmayer, D.B. 2002). Hollows formation is dependent on a number of factors, including species, tree stress or injury, fungal activity and climatic conditions. However, the site was used for Pine plantations up to approximately 70 years ago, thus indicating the age cohort of extant Eucalypts on site. On this basis the low frequency of hollow bearing trees recorded during the survey period and size class of hollows therein appears to be consistent with the abovementioned literature.

#### **3.3.4 Corridors and Habitat Linkages**

The site is situated to north of the Tuncurry business district in the Great Lakes LGA and is bordered to the south and west by industrial and residential development. To the north, the site borders Darawank Nature Reserve and forms the southern extent of a large parcel of vegetated land that borders the coast to Hallidays Point and Black Head. Some of the site also forms part of a vegetated corridor between coastal habitat and forested areas between The Lakes Way and the Wallamba River and Millers Mistake Creek beyond the western boundary of the site.

The site is recognised as a key fauna habitat and is mapped as part of a regional fauna corridor (DEC 2004, Scott 2003). Regional fauna corridors are vegetated connections between larger important areas of habitat that are generally substantial in width and provide for fauna habitat and dispersal of species (DEC 2004). The likely regional habitat corridors are predicted in **Figure 3-6**.



SCALE: 1:20000 AT A4 SIZE

**Legend**

- Site Boundary
- Hollow Bearing Tree Sample Plot
- Hollow Bearing Tree Sample Plot (Hollow Bearing Trees Recorded)



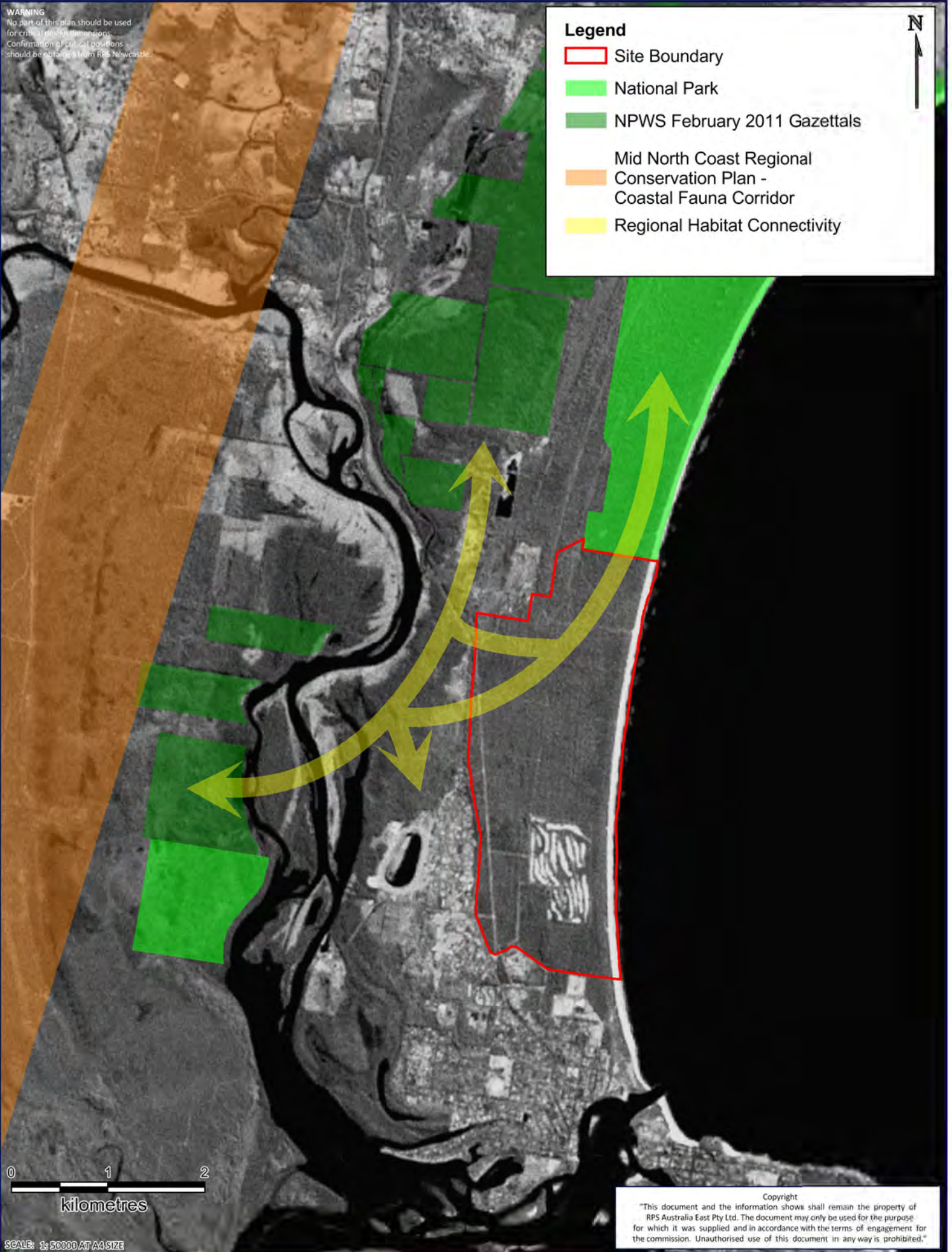
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TITLE: FIGURE 3-5: HOLLOW BEARING TREE QUADRAT SURVEY RESULTS	LOCATION: NORTH TUNCURRY	DATUM: DATUM PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 22/03/2012 PURPOSE: ECO INVENTORY	LAYOUT REF: J:\JOBS\26K\26414 - North Tuncurry\10-Drafting\Habitat Mapping VERSION (PLAN BY): P. HILLIER (B-A4)
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**Legend**

- Site Boundary
- National Park
- NPWS February 2011 Gazettals
- Mid North Coast Regional Conservation Plan - Coastal Fauna Corridor
- Regional Habitat Connectivity



0 1 2  
 kilometres

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TITLE: FIGURE 3-6: REGIONAL HABITAT CONNECTIVITY	LOCATION: NORTH TUNCURRY	DATUM: DATUM PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 21/03/2012 PURPOSE: ECO INVENTORY	LAYOUT REF: J:\JOBS\26K\26414 - North Tuncurry\10-Drafting\Habitat Mapping VERSION (PLAN BY): P. HILLIER
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 JOB REF: 26414

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### 3.4 Survey Effort Considerations of Revised Stratification Units

The DEC Biodiversity Survey Guidelines (2004) suggest that areas to be surveyed should be initially stratified on biophysical attributes (e.g. soil, geology) followed by vegetation structure (e.g. Woodland, Forest, Shrubland) and then floristics. The undertaking additional detailed floristic survey work in 2012, has resulted in a refinement of the vegetation delineated on site as outlined above. On this basis, a revision of stratification units against the DEC (2004) survey guidelines has been undertaken to update the overall survey effort against stratification unit presented previously in the methods section (Refer to **Table 2-7**).

The revised stratification units are based on the refined vegetation delineation over the site which now includes the Golf Course, previously not surveyed, as part of the entire site. That is, the Golf Course is no longer defined as an independent stratifications unit (Refer to **Table 3-2** below). It is noted herewith, in a number of instances trapping lines undertaken by ERM (2010a) and RPS (2010) cross stratification unit boundaries. Where this occurs, survey effort has been attributed to the stratification unit with the greatest overlap.

Whilst it is noted that the re-delineation of stratification units has resulted in variance in required survey effort for certain survey methods within specific stratification units, it is important when assessing the consequence of these deficiencies, that consideration must also be afforded to the specific habitat requirements of those species being targeted and the methods being employed. For instance, within the *Eucalyptus pilularis* Dry Sclerophyll Forest (dunal) a variance exists in survey effort for trapping small, medium and large terrestrial mammals, however those terrestrial fauna species being targeted are likely to readily utilise many of these stratification units, particularly given the often large ecotonal areas that have now been delineated as either the *Leptospermum laevigatum* Dry Sclerophyll Shrubland or *Banksia aemula* Dry Heathland, based on more detailed floristic analysis. Conversely the survey effort undertaken for targeting medium size arboreal mammals exceed that required by DEC (2004). Medium size arboreal mammals are considered to have a higher likelihood within this area due to the specific habitat attributes present. An appreciation of the likely habitat characteristics and utilisations of the target species should therefore also be taken into consideration when assessing survey effort required to satisfactorily assess the species diversity occurring on site. In this instance, it is considered that the survey intensity and spread across the site [provides adequate coverage given the habitat attributes present and the diversity of the flora and fauna recorded therein.



**Table 3-2: Total Survey Effort by 2012 Stratification Units**

Target Species	Method	Leptospermum laevigatum Dry Sclerophyll Shrubland 166ha		Banksia aemula Dry Heathland 237ha	Eucalyptus pilularis Dry Sclerophyll Forest (dunal) 99ha	Foredune Complex 32ha	Site Total	Comment	
		Unburnt 132.43	Burnt 33.57ha						
Small mammals and reptiles	Pitfall Traps	RPS	36	24	72	60	24	216 trap nights	Pit fall trapping in the golf course is not considered desirable. Additionally, habitat is considered marginal in the golf course for the target species (New Holland Mouse).
		ERM	0	0	0	0	0	0 trap nights	
		<b>Total Undertaken</b>	<b>36</b>	<b>24</b>	<b>72</b>	<b>60</b>	<b>24</b>	<b>216 trap nights</b>	
		<b>Total Required</b>	<b>48 trap nights</b>	<b>24 trap nights</b>	<b>72 trap nights</b>	<b>48 trap nights</b>	<b>24 trap nights</b>	<b>216 trap nights</b>	
Small mammals	Terrestrial A	RPS	350		400	150	100	1000 trap nights	
		ERM	24		48	48	0	120 trap nights	
		<b>Total Undertaken</b>	<b>374</b>		<b>448</b>	<b>198</b>	<b>100</b>	<b>1120 trap nights</b>	
		<b>Total Required</b>	<b>200 trap nights</b>		<b>300 trap nights</b>	<b>200 trap nights</b>	<b>100 trap nights</b>	<b>800 trap nights</b>	
Medium sized mammals	Terrestrial B	RPS	366		388	150	100	1004 trap nights	
		ERM	0		0	0	0	0 trap nights	
		<b>Total Undertaken</b>	<b>366</b>		<b>388</b>	<b>150</b>	<b>100</b>	<b>1004 trap nights</b>	
		<b>Total Required</b>	<b>200 trap nights</b>		<b>300 trap nights</b>	<b>200 trap nights</b>	<b>100 trap nights</b>	<b>800 trap nights</b>	
Large mammals	Cage	RPS	72		44	12	20	148 trap nights	Target species (Eastern Quoll) is considered too readily traverse all stratification units and is highly mobile. Consideration of the site as a full stratification unit would require 168 trap nights, which is slightly under the DEC (2004) guidelines.
		ERM	0		0	0	0	0 trap nights	
		<b>Total Undertaken</b>	<b>72</b>		<b>44</b>	<b>12</b>	<b>20</b>	<b>148 trap nights</b>	
		<b>Total Required</b>	<b>48 trap nights</b>		<b>72 trap nights</b>	<b>48 trap nights</b>	<b>24 trap nights</b>	<b>192 trap nights</b>	
Arboreal mammals	Arboreal B	RPS	52		84	84	0	220 trap nights	
		ERM	15		0	45	0	60 trap nights	
		<b>Total Undertaken</b>	<b>67</b>		<b>84</b>	<b>129</b>	<b>0</b>	<b>280 trap nights</b>	
		<b>Total Required</b>	<b>48 trap nights</b>		<b>72 trap nights</b>	<b>48 trap nights</b>	<b>24 trap nights</b>	<b>192 trap nights</b>	
Various sized mammals	Hair Tube Terrestrial	RPS	187		165	0	0	352 trap nights	
		ERM	150		300	50	0	500 trap nights	
		<b>Total Undertaken</b>	<b>337</b>		<b>465</b>	<b>50</b>	<b>0</b>	<b>852 trap nights</b>	
		<b>Total Required</b>	<b>160 trap nights</b>		<b>240 trap nights</b>	<b>160 trap nights</b>	<b>80 trap nights</b>	<b>640 trap nights</b>	
Various sized mammals	Hair Tube Arboreal	RPS	307		405	114	0	826 trap nights	
		ERM	0		0	0	0	0 trap nights	
		<b>Total Undertaken</b>	<b>307</b>		<b>405</b>	<b>114</b>	<b>0</b>	<b>826 trap nights</b>	
		<b>Total Required</b>	<b>240 trap nights</b>		<b>360 trap nights</b>	<b>120 trap nights</b>	<b>120 trap nights</b>	<b>840 trap nights</b>	
Bats	Harp trap	RPS	5		9	2	4	20 trap nights	Target species (microchiropteran bats and blossom bats) is considered too readily traverse all stratification units and is highly mobile. Consideration of the site as a full stratification unit would require 28 trap nights, which is slightly under the DEC (2004) guidelines.
		ERM	0		0	0	0	0 trap nights	
		<b>Total Undertaken</b>	<b>5</b>		<b>9</b>	<b>2</b>	<b>4</b>	<b>20 trap nights</b>	
		<b>Total Required</b>	<b>8 trap nights</b>		<b>16 trap nights</b>	<b>4 trap nights</b>	<b>4 trap nights</b>	<b>32 trap nights</b>	
Bats	Ultrasonic detection	RPS	24		132	60	12	228 hours	
		ERM			11.5 hours across the site			11.5 hours	
		<b>Total Undertaken</b>	<b>24</b>		<b>123</b>	<b>60</b>	<b>12</b>	<b>239.5 hours</b>	
		<b>Total Required</b>	<b>16 hours</b>		<b>24 hours</b>	<b>8 hours</b>	<b>8 hours</b>	<b>56 hours</b>	

Target Species	Method	Leptospermum laevigatum Dry Sclerophyll Shrubland 166ha		Banksia aemula Dry Heathland 237ha	Eucalyptus pilularis Dry Sclerophyll Forest (dunal) 99ha	Foredune Complex 32ha	Site Total	Comment
		Unburnt 132.43	Burnt 33.57ha					
	Spotlighting on foot	RPS	30 hours across the site				30 hours	RPS survey undertaken by two ecologists therefore the survey effort in man hours is doubled.
		ERM	12 hours across the site				12 hours	
		<b>Total Undertaken</b>	<b>42 hours across the site</b>				<b>42 hours</b>	
		<b>Total Required</b>	<b>4 hours</b>	<b>8 hours</b>	<b>4 hours</b>	<b>4 hours</b>	<b>20 hours</b>	
Various nocturnal mammals and birds	Spotlighting in car	RPS	10	3	6		19 hours	In terms of kilometres of the site traversed while driving spotlighting, the total distance travelled by RPS during this survey activity was 40.1km.
		ERM	0	0	0	Driving not recommended	0 hours	
		<b>Total Undertaken</b>	<b>10</b>	<b>3</b>	<b>6</b>		<b>19 hours</b>	
		<b>Total Required</b>	<b>5 hours</b>	<b>10 hours</b>	<b>5 hours</b>		<b>20 hours</b>	
Call Playback (birds) Using the minimum for Masked Owl	RPS						15 events	<i>Note: Owl call Playback survey effort is calculated by site size and not by stratification unit.</i>
							3 events	
							<b>18 events</b>	
							<b>16 events</b>	
Flora Surveys	Random Meander	RPS	22.6	23	11.6	7.7	64.9 hours	Random meander undertaken by RPS is calculated on distance covered within each stratification unit with an estimated average speed being 1km per hour. It is believed that this is a conservative estimate and the actual time spend undertaking random meanders is likely to be greater than what is displayed.
		ERM	-	-	-	-	-	
		<b>Total Undertaken</b>	<b>22.6</b>	<b>23</b>	<b>11.6</b>	<b>7.7</b>	<b>64.9 hours</b>	
		<b>Total Required</b>	<b>1.5 hours</b>	<b>2.5 hours</b>	<b>1.5 hours</b>	<b>1 hour</b>	<b>6.5 hours</b>	
Tuncurry Midge Orchid 40m x 40m plot surveys	RPS	2	7	0	0	9 quadrats		
		ERM	0	0	0	0 quadrats		
		<b>Total Undertaken</b>	<b>2</b>	<b>7</b>	<b>0</b>	<b>0</b>		<b>9 quadrats</b>
		<b>Total Required</b>	<b>Not Required in DEC (2004)</b>					
Quadrats	RPS	6	10	4	3	23 quadrats	The 23 RPS quadrats were biometric plots per BioBanking with additional nested floristic quadrats contained within each.	
		ERM	1	3	2	0		6 quadrats
		<b>Total Undertaken</b>	<b>7</b>	<b>13</b>	<b>6</b>	<b>3</b>		<b>29 quadrats</b>
		<b>Total Required</b>	<b>3 quadrats</b>	<b>3 quadrats</b>	<b>3 quadrats</b>	<b>2 quadrats</b>		<b>11 quadrats</b>

## 4 Discussion

This section provides an analysis of the results achieved from the extensive field surveys undertaken. Aspects covered in this section include:

- Site disturbances and mapping;
- Threatened species and community analysis;
- Habitat value mapping;
- Hollow-bearing tree analysis; and
- Combined site habitat value analysis.

Consideration of the above factors provides a picture of the overall ecological values of the site.

### 4.1 Disturbance Factors

#### 4.1.1 Forestry disturbance

Historic land use of the site shown in **Figure 4-1** outlines the planting allotments depicted in “Tuncurry State Forest No 283, Plantation Area Southern Section” (Bailey 1931). It is possible that this mapping was not drawn to scale, as supported by the misalignment of the past and existing tracks. The figure however demonstrates the extent to which plantation disturbance has occurred across the site.

Historic planting of *Pinus radiata* could have occurred across the site from as early as 1890 however the earliest documented planting was in 1911 (Bailey 1931:18). Native vegetation growing on targeted compartment lots was either “cleared and burnt”, “felled and burnt” or “brushed, matted and planted” (Bailey 1931:2) to make way for Pine plantations. The high disturbance levels of these methods arguably caused the loss and degradation of the native soil seed bank throughout the site. The overall flora species diversity across the site has likely been reduced as a result. The oldest vegetation on site is likely to be around 70 yrs (following cessation of pine plantation).

Areas dominated or co-dominated by Pines are still present on site (see **Figure 4-1**). These areas have altered both the canopy structure, through direct competition, as well as the understorey, through producing, in places, a thick litter of pine needles, potentially limiting the opportunities of plant recruitment within these areas, though these areas are limited in extent. Areas affected by pine needles have the potential to inhibit the requirement of Tuncurry Midge Orchid into those areas, through limiting the potential for the seed bank to reach the soil and if seeding is successful, the leaves of dormant tubers may struggle to penetrate the litter in order to photosynthesize.

Whilst the areas of Pine may potentially induce competitive stresses on surrounding vegetation, these areas may still have habitat value to those threatened fauna recorded on site, as most areas still retain a native understorey. Older individual Pine trees may

provide supplementary foraging habitat for insectivorous mammal and bird species. Furthermore the large Pine Trees may aid in Squirrel Glider movement pathways throughout the site.

#### 4.1.2 Bushfire Disturbance

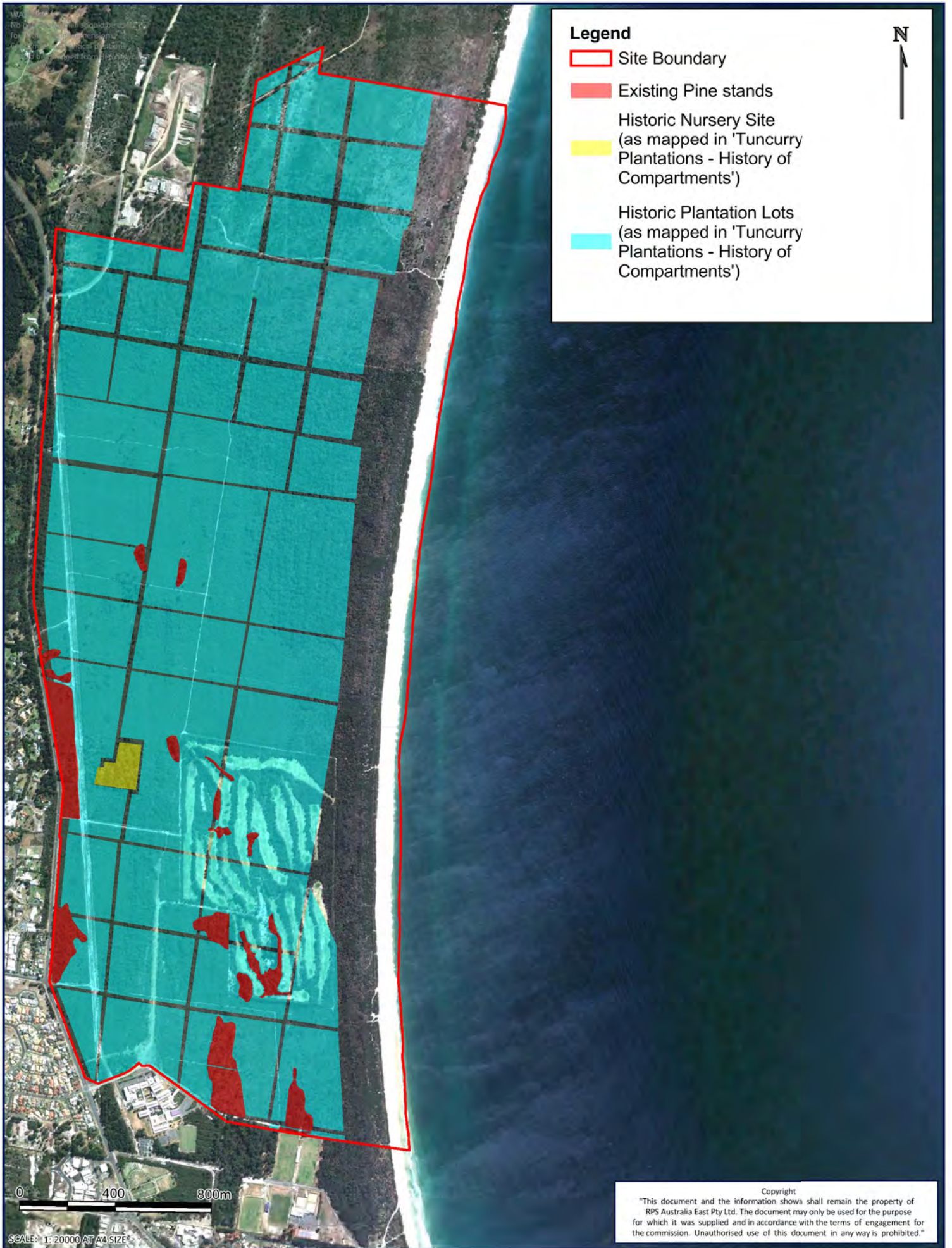
The northern section of the site highlighted in **Figure 4-2** was disturbed by an accidentally lit bushfire in 2007 (*pers comm*; NPWS 2005). The fire started in the Tuncurry Waste Management facility and proceeded to burn northwards into Darawank National Park but also crept into the north-eastern portion of the site. It was considered a high intensity fire, burning the area so severely that native vegetation took years to recover.

The vegetation community affected by the fire was Banksia heath in which fire plays a significant role for specific flora and fauna species associated with this community type. For example infrequent fires are beneficial to Banksia species as the heat stimulates the opening of seed-bearing follicles and allows the seed to regenerate (Fisher et al. 2009). However too frequent a fire can reduce soil seed bank diversity and alter the vegetation community composition (Fisher et al. 2009). For the threatened *Pseudomys novaehollandiae* (New Holland Mouse), which was targeted during 2012 RPS field surveys, fire frequency is considered one of the most important determinants for this species (Lazenby et al. 2008:145). It has been described as an early successional species, preferring habitats that are actively regenerating after disturbances (Seebeck et al. 1996). Peaks in abundance on mainland Australia have been known to occur 2-3 years post-fire (Lazenby et al. 2008) which is essential to know when targeting this species as with the Tuncurry site. Nevertheless targeted surveys did not reveal the presence of the New Holland Mouse within the Burnt Heath area or over any of the site.

Part of the Tuncurry Midge Orchid (TMO) (*Genoplesium littorale* syn. *Corunastylis littoralis*) population recorded on site occurs in the northern burnt areas. Whilst this species may respond to fire, the occurrence of this species within this area is suspected more likely attributed to past mining activities (see **Section 4.1.3**).

#### 4.1.3 Mineral Extraction Disturbance

The extent of the mineral extraction area, depicted on **Figure 4-3**, was matched with that shown in the Land Use History Report (Whelans. 2007). It is possible that this mapping is indicative of the areas previously mined and the actual footprint is potentially larger. This assumption is supported by aerial photography interpretation. The mineral extraction involved the dredging of heavy minerals and extended further north into Darawank Nature Reserve (Whelans 2007). Mineral extraction activities involved the clearing of native vegetation and disturbance to the soil which has had repercussions on regenerating vegetation post-mineral extraction. Nutrient levels in the soil biota may have been affected by mineral extraction activities which directly affects the type of flora species that re-establish (Frouz et al. 2008). *Corunastylis littoralis* has been found to persist in an area of disturbance and the recorded northern population of this species (**Figure 3-2**) correlates with the mineral extraction extent in **Figure 4-3**. It has also been recorded growing along tracks throughout the site, showing a clear relationship with disturbance.



TITLE: FIGURE 4-1: FORESTRY DISTURBANCE

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 22/03/2012  
 PURPOSE: ECO INVENTORY

LAYOUT REF: J:\JOBS\26K\26414 - North Tuncurry\10-Drafting\Inventory Report Figures\RPS 2012  
 VERSION (PLAN BY): P. HILLIER

CLIENT: LANDCOM  
 JOB REF: 26414

RPS AUSTRALIA EAST PTY LTD (ABN 44 140 292 762)  
 241 DENISON STREET BROADMEADOW PO BOX 428 HAMILTON NSW 2303  
 T: 02 4940 4200 F: 02 4961 6794 www.rpsgroup.com.au

RPS



**Legend**

- Site Boundary
- 2007 Bushfire Extent



1991 Bushfire (RFS)

1991 Bushfire (RFS)

1991 Bushfire (RFS)

0 400 800m

SCALE: 1: 20000 AT A4 SIZE

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TITLE: FIGURE 4-2: BUSHFIRE DISTURBANCE

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

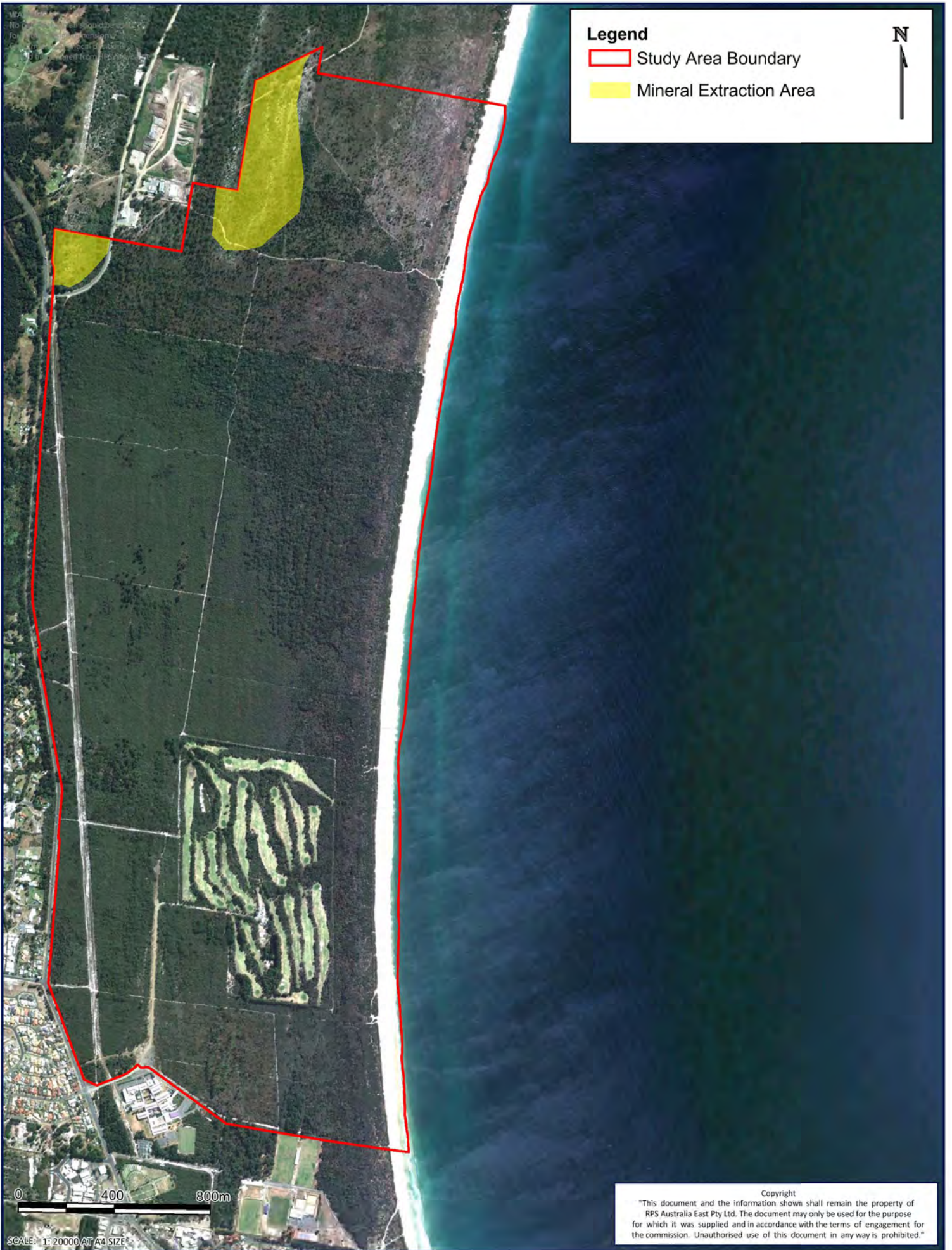
DATE: 15/03/2012  
 PURPOSE: ECO INVENTORY

LAYOUT REF: J:\JOBS\26K\26414 - North Tuncurry\10-Drafting\Inventory Report Figures\RPS 2012  
 VERSION (PLAN BY): P. HILLIER

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TITLE: FIGURE 4-3: MINERAL EXTRACTION DISTURBANCE

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 15/03/2012  
 PURPOSE: ECO INVENTORY

LAYOUT REF: J:\JOBS\26K\26414 - North Tuncurry\10-Drafting\Inventory Report Figures\RPS 2012  
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## 4.2 Likelihood of occurrence for Threatened Species, Populations & Ecological Communities

Those threatened flora and fauna species (listed *under the TSC Act and the EPBC Act*) that have been recorded from within the locality based on the database searches have been considered in this ecological inventory. EEC's and Endangered Populations known from the broader area have also been addressed. Each species / community / population is considered for its potential to occur within the site.

**'Species' or 'EEC / Population'** – Lists each threatened species / EEC / population known from the locality of the site. The status of each threatened species under the TSC Act and EPBC Act is also provided.

**'Habitat'** – Provides a brief account of the species / community / population and the preferred habitat attributes required for the existence / survival of each species / community / population.

**'Likelihood of Occurrence'**– Assesses the likelihood of each species / community / population to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.



**Table 4-14-1: Likelihood of Occurrence**

Species / Community	Habitat Description	Likelihood of Occurrence
<b>Plants</b>		
<i>Allocasuarina defungens</i> Dwarf Heath Casuarina (E, E*)	A small member of the <i>Casuarinaceae</i> (She-oak) family growing up to 2m in height. Dwarf Heath Casuarina is found only in NSW from the Nahiic area, north-west of Forster, to Byron Bay on the NSW north coast. This species grows mainly in tall heath and on sand but can also occur on clay soils and sandstone. Habitat also extends to exposed nearby-coastal hills or headlands adjacent to sand plains.	This species was not observed during field surveys, however potential habitat exists for this species within the sandy heath communities and therefore could <b>potentially</b> occur on site.
<i>Allocasuarina simulans</i> Nahiic Casuarina (V, V*)	A small member of the <i>Casuarinaceae</i> family growing from 1m to 3m in height. Branchlets are approximately 20cm long, with six teeth at the internodes and cones are oblong with a pointed top. It occurs within heathy habitats on sand between Nahiic and Forster on the Mid-north coast of NSW. This species has specific habitat requirements and is only found within a small range.	This species was not observed during field surveys, however potential habitat exists for this species within the sandy heath communities and therefore could <b>potentially</b> occur on site.
<i>Asperula asthenes</i> Trailing Woodruff (V, V*)	This species is a low, trailing perennial herb with leaves and stipules in whorls of four around the stem. It occurs only in NSW, having been found at damp sites, often along riverbanks at scattered locations from Bulahdelah to Kempsey, as well as Port Stephens and Wallis Lakes.	This species was not observed during field surveys and preferred habitat was generally absent due to the lack of wetland areas on site, therefore it is considered <b>unlikely</b> to occur on site.
<i>Corunastylis littoralis</i> syn <i>Genoplesium littorale</i> Tuncurry Midge-Orchid (CE, CE*)	A small terrestrial, single stemmed orchid that grow to 30-40 cm tall. Small flowers, moderately crowded, are green with purple-brown labellum. Occurs in well drained, open sandy areas in low dense heath. Known to occur in disturbed areas such as power easements, within this habitat. <i>Corunastylis littoralis</i> is currently only known from coastal heathland and Blackbutt ( <i>Eucalyptus pilularis</i> ) forest to the north of Tuncurry.	This species was <b>recorded</b> on site during field investigations.
<i>Cryptostylis hunteriana</i> Leafless-tongue Orchid (V, V*)	A very rare leafless, saprophytic orchid, which has a symbiotic relationship with a mycorrhizal fungi which provides the plant with all its nutrient requirements. This orchid remains underground for the majority of its lifecycle, flowering periodically, when conditions are optimal to reproduce. This species is extremely cryptic as it does not flower every year. This species is known to occur within a range of habitats including woodlands to swamp heaths. The species typically prefers moist sandy soils in sparse to dense heath and sedgeland, or moist to dry clay loams in coastal forests.	This species was not observed during targeted field surveys during the known flowering time. Due to the cryptic nature of this orchid its occurrence on site cannot be discounted and therefore could still <b>potentially</b> occur on site.
<i>Cynanchum elegans</i> White-flowered Wax Plant (E, E*)	Occurs scattered along the NSW Northern Coast to Wollongong usually in dry, littoral or subtropical rainforest and occasional scrub or woodland, can occur across a wide range of habitats. Flowers between August and May peaking early summer, flowers numbers can vary from plant to plant from sparse to abundant. The species response to fire is unknown.	This species was not recorded within the site during fieldwork and is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Eucalyptus fergusonii</i> ssp <i>fergusonii</i> (ROTAP 3KC-)	Dark grey ironbark up to 25 m high. Distribution is scattered and sporadic, in wet sclerophyll forest or woodland on sandy soils.	This species was not observed during field surveys, however potential habitat exists within the forest/heath communities on site therefore could <b>potentially</b> occur on site.
<i>Euphrasia ramulosa</i> (ROTAP 3RC-)	Erect perennial herb or subshrub 25–50 cm high, much-branched from base, densely hairy with short non-glandular or sometimes glandular hairs. Grows in moist to boggy areas in wet and dry sclerophyll forest; Point Lookout-Ebor area	This species was not recorded within the site during fieldwork and is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Lindernia alsinoides</i> Noah's False Chickweed (E)	Occurs in swampy habitats within sclerophyll forest, coastal heath and at Shannon Creek (near Grafton) within paperbark swampland with species such as <i>Melaleuca alternifolia</i> (Tea Tree) and <i>M. quinquenervia</i> (Broad-leaved Paperbark). Historic records exist from Bulahdelah and Coopernook.	This species was not observed during field surveys, however potential habitat exists within the forest/heath communities on site. Due to the cryptic nature of this orchid its occurrence on site cannot be discounted and therefore could still <b>potentially</b> occur on site.
<i>Maundia triglochoides</i> (V)	Perennial rush with rhizomes about 5mm thick and emergent tufts of spongy leaves, triangular in cross section, arising along their length. Grows in fresh water swamps, creeks and shallow freshwater 30 - 60 cm deep on heavy clay.	This species was not observed during field surveys and preferred habitat was generally absent due to the lack of wetland areas on site, therefore it is considered <b>unlikely</b> to occur on site.
<i>Senna acclinis</i> Rainforest Cassia (E)	A compound leaved shrub growing to 3m in height, it occurs on the edges of Sub-tropical and Dry Rainforest from the tablelands to coastal districts. Without care it can easily be mistaken for the introduced Senna.	This species was not recorded within the site and preferred habitat is generally absent and therefore it is considered <b>unlikely</b> to occur on site.
<i>Syzygium paniculatum</i> Magenta Lilly Pilly (E, V*)	A shrub to small tree, found in sub-tropical and littoral rainforest on sandy soils or sheltered gullies mostly near water courses. Distribution between Bulahdelah and Jervis Bay.	This species was not recorded within the site and preferred habitat is generally absent and therefore it is considered <b>unlikely</b> to occur on site.

Species / Community	Habitat Description	Likelihood of Occurrence
<b>Herpetofauna</b>		
<i>Crinia tinnula</i> Wallum Froglet (V)	Occurs in coastal, low-lying acid Paperbark forest, within the 'wallum country' (often on sandy soils). Its distribution ranges from Maryborough in Queensland south to Kurnell near Sydney. A very small and cryptic frog that breeds in late winter to spring when males are heard calling and females lay approximately 120 eggs. It has a white or light brown belly with a little mottling or flecking and a mid line of white dots along the throat. Due to the species preference for coastal swamps and associated areas along the east coast, <i>C. tinnula</i> is exposed to large habitat loss as this area has the highest growth rate in human population in Australia.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Litoria aurea</i> Green and Golden Bell Frog (E, V*)	<i>Litoria aurea</i> was formerly known to inhabit the eastern seaboard of New South Wales and Victoria from Byron Bay to the Gippsland Lake Region as well as highland sites (New England District, south-western slopes of NSW and Monaro District). Recent literature indicates that it is no longer found on sites above an altitude of 300m above sea level. <i>L. aurea</i> species inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. <i>L. aurea</i> is thought to be displaced from more established sites by other frog species thus explaining its existence on disturbed sites.  Inhabits swamps, lagoons, streams and ponds as well as dams, drains and storm water basins. Thought to be displaced from more established sites by other frog species, thus explaining its existence on disturbed sites.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Mixophyes balbus</i> Stuttering Frog (E, E*)	Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Breeds in streams during summer after heavy rain, outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. Eggs are laid on rock shelves or shallow riffles in small, flowing streams.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Mixophyes iteratus</i> Giant Barred Frog (V, E*)	Mostly restricted to wet sclerophyll forest and rainforest, including Antarctic Beech ( <i>Notafagus moorei</i> ) forest. Usually found within close proximity to permanent running water (Robinson, M, 1996). Occur within damp leaf litter.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<b>Avifauna</b>		
<i>Anthochaera phrygia</i> Regent Honeyeater (CE, E*)	After breeding <i>Anthochaera phrygia</i> disperses to non-breeding areas, including the coast, in winter, where flowering trees are sought. Two main breeding areas occur in NSW, that being the Barraba District and Capertee Valley. Within its range it is mostly recorded in Box-Ironbark Eucalypt associations along creek flats, river valleys and foothills. Common western feed trees include <i>Eucalyptus alba</i> (White Box), <i>E. melliodora</i> (Yellow Box) and <i>E. sideroxylon</i> (Mugga Ironbark). Movements eastward sees the food sources change to include <i>Corymbia maculata</i> (Spotted Gum), <i>E. fibrosa</i> (Broad-leaved Ironbark), <i>E. crebra</i> (Narrow-leaved Ironbark) and various Stringybark sp. Coastal swamp forests are used when more western or near coastal resources fail and may be critical refuges during these times, the sought after tree species in this habitat is <i>E. robusta</i> (Swamp Mahogany). <i>A. phrygia</i> has been recorded in a variety of flowering sp. not normally associated with normal feed patterns, probably a result of a lack of their preferred food source.	This species was not recorded during field survey. Some winter foraging resources are available on site, therefore has <b>potential</b> to occur on site.
<i>Botaurus poiciloptilus</i> Australian Bittern (V)	The Australasian Bittern is confined to Australia and New Zealand. Within Australia this species occurs in the southeast and southwest with the occasional vagrant in the northwest of Australia. It favours permanent fresh-waters dominated by sedges, rushes, reeds or cutting grasses (e.g. <i>Phragmites</i> , <i>Scirpus</i> , <i>Eleocharis</i> , <i>Juncus</i> , <i>Typha</i> , <i>Baumea</i> and <i>Gahnia</i> ). Feeds on insects, small fish, eels, frogs and other aquatic life, sometimes in rice fields. It is partly nocturnal in habits, and, keeping as it does to the depths of reedy swamps, is seldom seen during the day.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Calidris tenuirostris</i> Great Knot (V, M*)	Large sandpiper visiting Australian coasts during the austral summer. <i>Calidris tenuirostris</i> habitats include coastal inlets, estuaries, bays, intertidal mudflats and sandbanks and lagoons. On occasion they can be found on inland fresh and salt water lakes. Also occasionally seen on rocky platforms on the coast.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Calyptorhynchus lathamii</i> Glossy Black-Cockatoo (V)	Occurs in forests and woodlands where it forages predominantly on <i>Allocasuarina</i> cones. Favoured species include <i>Allocasuarina littoralis</i> (Black She-oak), <i>A. torulosa</i> (Forest She-oak) and <i>A. verticillata</i> (Drooping She-oak). In the Riverina area inhabits <i>Casuarina cristata</i> stands. Requires large Eucalypt tree hollows for nesting.	This species was not recorded within the site during fieldwork and only limited preferred foraging resources, such as <i>Allocasuarina</i> sp. are available on site. Some nesting habitat occurs within the Open Forest Communities and therefore this species has some <b>potential</b> to occur within the site.
<i>Charadrius mongolus</i> Lesser Sand Plover (V, M*)	When in Australia, this migratory species inhabits sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats. Also known to frequent coral reefs and rocky shores and headlands. Roosts at high tide on sandy beaches and rocky shores. Becoming less common to rare heading south down the NSW coast from northern parts. Prey includes molluscs, worms, crustaceans and insects.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Daphoenositta chrysoptera</i> Varied Sittella (V)	<i>Daphoenositta chrysoptera</i> is a sedentary species. Its range covers most of Australia except for the treeless deserts and open grasslands. <i>D. chrysoptera</i> inhabits eucalypt forests and woodlands, especially rough-barked sp. mature smooth-barked sp. with dead branches, mallee and <i>acacia</i> woodland.	This species was not detected during targeted field surveys on site at the time of survey. Habitat exists within the site and therefore this species has the <b>potential</b> to occur within the site.

Species / Community	Habitat Description	Likelihood of Occurrence
<i>Ephippiorhynchus asiaticus</i> Black-necked Stork (E)	Inhabits swamps associated with river systems and large permanent pools but sometimes appears on the coast or in estuaries. It has also been recorded on farm dams and sewage treatment ponds.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Esacus magnirostris</i> Beach-Stone-curlew (CE)	Typical habitat of this species is undisturbed sandy beaches, especially where a mangrove backed sandflats occur. Also occur c mudflats and occasionally reefs. They have also been recorded on grassy verges alongside ck. and near sand flats.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Glossopsitta pusilla</i> Little Lorikeet (V)	<i>Glossopsitta pusilla</i> extends from Cairns to Adelaide coastally and to inland locations. Commonly found in dry, open eucalypt forests and woodlands. Can be found in roadside vegetation to woodland remnants. <i>G. pusilla</i> feeds on abundant flowering Eucalypts, but will also take nectar from, <i>Melaleuca</i> sp and <i>Mistletoe</i> sp. <i>Eucalyptus albens</i> (White Box) and <i>E. melliodora</i> (Yellow Box) are favoured food sources on the western slopes in NSW. On the eastern slopes and coastal areas favoured food sources are <i>Corymbia maculata</i> (Spotted Gum), <i>E. fibrosa</i> (Broad-leaved Ironbark), <i>E. robusta</i> (Swamp Mahogany) and <i>E. pilularis</i> (Blackbutt). Nesting takes place in hollow bearing trees.	This species was <b>recorded</b> on site during previous field investigations. Potential habitat exists within the site with some foraging opportunities occurring on the blossom of Eucalypt sp. Nesting and refuge habitat also exist within the hollow bearing trees on site.
<i>Haematopus fuliginosus</i> Sooty Oystercatcher (V)	Marine, usually rock shoreline, high rocky islets, boulders below cliffs, wave-cut platforms and reefs. Also inhabits sandy beaches and coves between rocky headlands (Morecombe, 2000). Also occurs within closed estuarine habitats where rocky substrates are present.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Haematopus longirostris</i> Pied Oystercatcher (E)	This species prefers undisturbed sandy shell-grit or pebble beaches, sandspits and sandbars, tidal mudflats and estuaries, coastal islands. Occasionally rocky reefs, shores rock-stacks, brackish or saline wetlands. Also grassy paddocks, golf-courses or parks near coast. Forages for molluscs, crustaceans, polychaetes, ascidians, echinoderms and small fish, probes for worms in short wet grass.	This species was <b>recorded</b> on the beach directly adjacent to the site.
<i>Heiraaetus morphonoides</i> Little Eagle (V)	Inhabits open eucalypt forest, woodland and open woodland. Birds of inland NSW can occur across riparian woodland and acacia woodland. Can be found across the mainland except the most densely forested areas of the great divide. It requires a tall living tree within a forested area for nesting.	This species was not detected during targeted field surveys on site at the time of survey. Some potential habitat and foraging opportunities exists within remnant forest communities and therefore this species has the <b>potential</b> to occur within the site.
<i>Ixobrychus flavicollis</i> Black Bittern (V)	Solitary species, living near water (estuarine to brackish) in mangroves and other trees which need to form only a narrow fringe of cover. A riparian species that occasionally ventures into the open within estuarine habitats. Sedentary resident along Dora and Stockton Creeks in western Lake Macquarie, but is likely to occur in any brackish to estuarine forested coastal creeks in the lower NSW coast.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Lathamus discolor</i> Swift Parrot (E, E*)	On the mainland this species frequents Eucalypt forests and woodlands with large trees having high nectar production during winter. Mainland winter foraging sites often vary from year to year as a consequence of varying eucalypt blossoming cycles. Preferred winter flowering species in NSW include <i>Corymbia maculata</i> (Spotted Gum), <i>Eucalyptus fibrosa</i> (Broad-leaved Ironbark), <i>E. crebra</i> (Narrow-Leaved Ironbark), <i>E. sideroxylon</i> (Mugga Ironbark), <i>E. albens</i> (White Box) and <i>E. tereticornis</i> (Forest Red Gum). <i>Lathamus discolor</i> also uses these species for lerp. Such species include <i>E. fibrosa</i> (Broad-leaved Ironbark), <i>E. moluccana</i> (Grey Box), and <i>E. tereticornis</i> (Forest Red Gum). Nests only in Tasmania during spring/summer. <i>L. discolor</i> uses some of these tree species for roosting purposes as well.	This species was not recorded during field survey, however some winter foraging resources are available on site, therefore has the <b>potential</b> to occur on site.
<i>Limosa limosa</i> Black-tailed Godwit (V, M*)	A medium sized wading bird species that breeds in the northern hemisphere during the austral winter. During the northern winter it migrates to Australian salt and freshwater wetlands where it feeds on invertebrate species within muddy sediments. It is easily confused with the more common <i>Limosa lapponica</i> (Bar-tailed Godwit), but can be distinguished by a slighter build and more powdery plumage colouration lacking the striations of the Bar-tail. A white rump and black and white under-wing colouration are also distinguishing features. May turn up in any suitable habitat on the NSW coast often associated with Bar-tailed Godwits and/or other waders.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Lophoictinia isura</i> Square-tailed Kite (V)	Inhabits open forests and woodlands, particularly those on fertile soils with abundant passerines. They may also range in nearby open habitats but not into extensive treeless regions. This species is notably absent from alpine regions and small isolated remnant woodlands in large open areas. Has been recorded in suburbia hawking over yards looking for prey.	Due to the generalist habitat requirements of this species, it could <b>potentially</b> occur within the site on a seasonal basis.
<i>Ninox connivens</i> Barking Owl (V)	Inhabits eucalypt woodland, open forest, swamp woodlands and timber along watercourses with denser vegetation occasionally used for roosting. During the day this species roost along creek lines, usually in tall understorey trees. The Barking Owl is widespread within New South Wales, with records from coastal areas along with the slopes, plains, tablelands, and far western plains. Hollands (1991) regards the habitat of this species as open country with a choice of large trees for roosting and nesting. Prey species taken includes arrange of mammals and birds, as well as invertebrates (Readers Digest 1982). Usually occupies permanent territories, generally greater than 100 ha.	This species was not recorded during owl call back and nocturnal spotlighting surveys. Some potential foraging and roosting opportunities exists on site however this species has a propensity to prefer timbered areas along creeklines which do not occur on site, therefore limiting the possibility of occurrence. Therefore it is considered <b>unlikely</b> to occur on site.

Species / Community	Habitat Description	Likelihood of Occurrence
<i>Ninox strenua</i> Powerful Owl (V)	Occurs in sclerophyll forests and woodlands where suitable prey species occur (being predominantly arboreal mammals). Requires large hollows, usually in Eucalypt trees, for nesting. Roosts in dense vegetation within such areas.	This species was not recorded during owl call back and nocturnal spotlighting surveys. <b>Potential</b> foraging habitat exists within the site; however previous field surveys identified no suitable nesting hollows.
<i>Pandion cristatus</i> Eastern Osprey (V, M*)	Requires water bodies for fishing in close proximity (usually <1km) to suitably tall nesting site such as dead tree, power pole etc. Essentially an estuarine species, but an accidental species to inland / freshwater wetland habitats. They occur over habitats such as heath, woodland and forest when travelling to and from foraging sites.	This species was <b>recorded</b> on site during previous field investigations.
<i>Pomatostomus temporalis temporalis</i> Grey-crowned Babbler (V)	Occupies open forests and woodlands, <i>Acacia</i> shrubland and adjoining farmland. Also Box-Gum Woodlands on the divide slopes and Box-Cypress Pine and open Box Woodlands on the plains. They feed on terrestrial invertebrates and insects on lower trunks and branches. Generally they prefer wooded areas with an intact ground cover, although in such areas as the Hunter Valley they occur in sparsely vegetated areas such as properties and golf courses. Appears unable to persist in cleared and highly fragmented habitats. Nest comprise of a dome shape stick nest which is often only a couple of metres from the ground in shrubs or Eucalypt saplings.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Rostratula australis</i> Australian Painted Snipe (E, V*)	A small freshwater and estuarine wader, which prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Sterna albifrons</i> Little Tern (E, M*)	Migratory bird from eastern Asia, which most commonly occurs in sheltered coastal environments. Has been recorded several kilometres from the sea in bays, harbours and estuaries. Occasionally recorded from offshore Islands and coral cays. <i>Sterna albifrons</i> nest in loose colonies in shelly beaches just above the high tide line. Feeding habitat consists of shallow channels and estuaries and the in the surf on the beach.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<i>Tyto longimembris</i> Eastern Grass Owl (V)	Prefers tall grass, swampy, sometimes tidal areas, mangrove fringes, grassy plains, coastal heath, grassy woodland, cane-grass, lignum, sedges, cumbungi, cultivated sorghum, sugar cane and grain stubble. Roosts and nests low to or on the ground. Roosting by day on a large trampled area of <i>Poa</i> sp. (Tussock Grass) or similar heavy growth, known as a 'form'. Feed by flying low over vegetation.	This species was not detected during field surveys on site. Habitat exists within the site and therefore this species has the <b>potential</b> to occur within the site.
<i>Tyto novaehollandiae</i> Masked Owl (V)	Found in a range of habitats, more commonly found in dry eucalypt forests and woodlands. A forest owl which often hunts on forest edges and also roadsides. Requires large Eucalypt hollows for nesting and these hollows are also preferred for roosting sites. Breeding has also been recorded in caves.	Potential foraging habitat exists as part of a larger home range and therefore this species has the <b>potential</b> to occur within the site.
<i>Xenus cinereus</i> Terek Sandpiper (V, M*)	Recorded on coastal mudflats, lagoons, creeks and estuaries. It favours muddy beaches near mangroves but may also be observed on rocky pools and coral reefs occasionally up to 10km inland around brackish pools (NSW NPWS, 1999). Generally roosts communally amongst mangroves of dead trees, often roosts with related wader species.	This species was not recorded within the site during fieldwork. This species is <b>unlikely</b> to occur within the site due to the lack of appropriate habitat.
<b>Mammals</b>		
<i>Cercartetus nanus</i> Eastern Pygmy Possum (V)	Occurs from rainforest through sclerophyll forest to tea-tree heath. In north-eastern NSW they are more frequently encountered in rainforest, most areas though there seems to be a preference for woodlands and heath. Favoured food being nectar of banksias, myrtaceous shrubs and trees and insects. Soft fruits are also eaten when nectar isn't available. Insects become a major source of food in wetter forest where nectar isn't readily available. Sheltering sites include <i>Pseudocheirus peregrinus</i> (Ringtail Possum) dreys, hollow, vegetation thickets, rotten stumps, abandoned bird nest and holes in the ground. Nesting sites are generally in drier habitats (Strahan, 1995a). Nest are most often in hollows with spherical bark nests also being recorded.	This species was <b>recorded</b> on site during field investigations.
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat (V, V*)	This species forages in tall open forests and the edges of rainforest. It roosts in mine shafts and similar structures. Roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of <i>Hirundo ariel</i> (Fairy Martin), frequenting low to mid-elevation dry open forest and woodland close to these features. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years. Found in well-timbered areas containing gullies. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.	This species was not recorded during field surveys on site. No roosting habitat and limited potential foraging habitat exists, therefore this species is <b>unlikely</b> to occur within the site.
<i>Dasyurus maculatus maculatus</i> Spotted-tailed Quoll (V, E*)	Found in a variety of forested habitats. These habitats include sclerophyll forest and woodlands, coastal heaths and rainforest. Occasional venture into open areas, treeless plains and rocky outcrops. Has been known to steal poultry. This species creates a den in fallen hollow logs or among rocky outcrops. Generally does not occur in otherwise suitable habitats that are in close proximity to urban development.	This species was not detected during field surveys on site. Nesting habitat is limited however foraging habitat exists and therefore this species has the <b>potential</b> to occur within the site. The sites connectivity to Darawank Nature Reserve may further increase the potential of occurrence.

Species / Community	Habitat Description	Likelihood of Occurrence
<i>Falsistrellus tasmaniensis</i> Eastern False Pipistrelle (V)	This species is found in a variety of forest types such as open forests, woodlands and wetter sclerophyll forests (usually with trees >20m). This species roosts in tree hollows. Hunts beetles, moths, weevils and other flying insects below or just above the canopy.	This species was identified from bat call sequences <b>recorded</b> on site during field surveys.
<i>Miniopterus australis</i> Little Bentwing-bat (V)	Prefers to forage in well-vegetated areas, such as within wet and dry sclerophyll forests and rainforests and also dense coastal Banksia scrub. Requires caves or similar structures for roosting habitat. Occasionally roost in tree hollows. Largely confined to more coastal areas. Often found roosting with <i>Miniopterus schreibersii</i> (Eastern Bentwing-bat).	This species was identified from bat call sequences <b>recorded</b> on site during field surveys.
<i>Miniopterus schreibersii</i> subsp. <i>oceanensis</i> Eastern Bentwing-Bat (V)	This species utilises a range of habitats for foraging, including rainforest, wet and dry sclerophyll forests, woodlands and open grasslands. Feed above the canopy catching moths and other flying insects. Requires caves or similar structures for roosting habitat such as derelict mines, disused buildings and storm-water tunnels	This species was identified from bat call sequences <b>recorded</b> on site during field surveys.
<i>Myotis macropus</i> Southern Myotis (V)	Usually found near bodies of water, including estuaries, lakes, reservoirs, rivers and large streams, often in close proximity to their roost site. Although usually recorded foraging over wet areas, it also utilises a variety of wooded habitats adjacent to such areas including rainforest, wet and dry sclerophyll forest, woodland, and swamp forest. Roosts in small colonies of between 15 and several hundred individuals in caves, mines and disused railway tunnels.	Habitat exists on site that occurs in close proximity to Forster/Tuncurry's rivers, lakes and estuaries systems (preferred foraging habitat) therefore this species has the <b>potential</b> to occur within the site.
<i>Mormopterus norfolkensis</i> Eastern Freetail-bat (V)	This species forages predominantly in dry forests and woodlands east of the divide. Individuals have been recorded in riparian zones in rainforest and wet sclerophyll forest. Forages above the canopy or forest edges. It roosts in tree hollows, under bark and within man-made structures.	This species was identified from bat call sequences <b>recorded</b> on site during field surveys
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale (V)	Inhabits dry open forest and woodlands, often in areas with sparse groundcover of grasses, herbs or leaf litter. They have also been recorded in heathland, swamps, rainforest and wet sclerophyll forest. It is one of the most arboreal Dasyurids and mainly hunts invertebrates, although some vertebrate prey is taken on occasion. Utilises small tree hollows for nesting and refuge sites.	This species was <b>recorded</b> on site during field investigations.
<i>Phascolarctos cinereus</i> Koala (V)	Occurs in forests and woodlands where it requires suitable feed trees (particular <i>Eucalyptus</i> spp.) and habitat linkages. It feeds on the foliage of more than 70 <i>eucalypt</i> sp. and more than 30 non- <i>eucalypt</i> sp., but will select preferred feed within its home range. Home range varies according to available habitat. Will occasionally cross open areas, although it becomes more vulnerable to predator attack and road mortality during these excursions.	This species was not detected during field surveys on site. Minimal occurrences of SEPP- 44 feed trees were identified on site however Blackbutt trees, that are present on site, are known as secondary browse trees and may provide <b>potential</b> for foraging habitat for dispersing Koala populations.
<i>Petaurus norfolcensis</i> Squirrel Glider (V)	Occurs in eucalypt forests and woodlands where it feeds on sap exudates and blossoms. This species is generally absent from rainforest and closed forest. A wide range of forest types have been recorded as habitat for <i>Petaurus norfolcensis</i> , these include, <i>Eucalyptus camaldulensis</i> (River Red Gum) Forest, Box-Ironbark Forests in the west, <i>E. pilularis</i> (Blackbutt), <i>E. tereticornis</i> (Forest Red Gum) and <i>Corymbia gummifera</i> (Red Bloodwood) Forest, <i>Banksia integrifolia</i> (Coastal Banksia) Heathland and <i>E. punctata</i> (Grey Gum)/ <i>C. maculata</i> (Spotted Gum)/ <i>E. paniculata</i> ssp. <i>paniculata</i> (Grey Ironbark) Forests. In these areas tree hollows are utilised for nesting sites. Also requires winter foraging resources when the availability of normal food resources may be limited, such as winter-flowering shrub and small tree species. As such <i>P. norfolcensis</i> requires habitat with a mix of <i>eucalypt</i> , <i>acacia</i> and <i>Banksia</i> sp. with winter and summer flowering species and smooth/rough barked Eucalypts.	This species was <b>recorded</b> on site during field investigations.
<i>Potorous tridactylus</i> Long-nosed Potoroo (V, V*)	Prefers cool rainforest, wet sclerophyll forest and heathland. Essentially, requires dense understorey with occasional open areas. These open areas most likely consist of sedges, ferns, heath or grass-trees. Sleeps by day in a nest on the ground, and digs for succulent roots, tubers, fungi and subterranean insects. Some diggings seemingly attributable to this species may belong to <i>Isodon macrourus</i> (Northern Brown Bandicoot). Generally east of the divide, hides by day in dense vegetation, sometimes feeds during winter during daylight hours during overcast or low light conditions.	This species was not detected during targeted field surveys on site. Some potential habitat exists within heath communities on site and therefore this species has the <b>potential</b> to occur within the site.
<i>Pseudomys novaehollandiae</i> New Holland Mouse (V*)	Known to inhabit open heathlands, open woodlands with a heathland understorey and vegetated sand dunes.	This species was not detected during targeted field surveys on site and no records exist within a 10km radius of the site (DECCW 2011). Some potential habitat exists within heath communities on site and therefore this species has the <b>potential</b> to occur within the site.
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox (V, V*)	Forages over a large area for nectar / fruits etc. Occurs across subtropical and temperate forest, sclerophyll forest and woodlands, heaths, swamps, urban gardens and cultivated crops. Frequently observed to forage in flowering Eucalypts. Seasonally roosts in communal base camps situated within wet sclerophyll forests or rainforest. These camps are usually located within 20kms of their food source. Frequently observed to forage in flowering Eucalypts.	This species was <b>recorded</b> on site during field surveys.

Species / Community	Habitat Description	Likelihood of Occurrence
<i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat (V)	Range of habitats from rainforest to arid shrubland, roosts in tree-hollows, sometimes roosts in mammal burrows when no hollows available. Seasonal movements are unknown, may migrate to southern Australia in summer. Feeds by foraging for insects over the canopy, but flies low in arid shrubland.	Due to the high mobility of this species the presence of potential foraging and roosting habitat within the site, it is <b>likely</b> that this species occurs within the site on at least an intermittent basis
<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat (V)	Forages in moister gullies and wet sclerophyll forests as well as in lightly wooded areas and open spaces/ ecotones, most commonly found in tall wet forest. Open woodland and habitat and dry open forest suits the direct flight of this species as it searches for beetles and other larvae. This species roosts in tree hollows, although has been recorded in buildings.	This species was identified from bat call sequences <b>recorded</b> on site during field surveys.
<i>Syconycteris australis</i> Common Blossom-bat (V)	Throughout its range this species often roosts in littoral rainforest where they roost individually changing their roosts on a daily basis. They feed on the fruit and the nectar of blossoms on heathland, woodland land forest plant species.	This species was <b>recorded</b> on site.
<i>Vespadelus troughtoni</i> Eastern Cave Bat (V)	A cave dweller, known from wet sclerophyll forest and tropical woodlands from the coast and Dividing Range to the drier forests of the semi-arid zone. It has been found roosting in small groups in sandstone overhangs, in mine tunnels and occasionally in buildings. In all situations, the roost sites are frequently in reasonably well-lit areas	This species was not detected during targeted field surveys on site. Primarily cave-roosting, no roosting habitat recorded within the site. The site may be utilised by this species for foraging within forest vegetation and therefore has the <b>potential</b> to occur on site.
<b>Endangered Ecological Communities</b>		
Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions (EEC)	Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner occurs in the intertidal zone on the shores of estuaries and lagoons, including when they are intermittently closed along the NSW coast.	Floristic composition commensurate to this EEC was not identified on site during flora assessments. Therefore it is considered <b>unlikely</b> to occur on site.
Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions (EEC)	Associated with periodic or semi-permanent inundation by freshwater, although there may be minor saline influence in some wetlands. They typically occur on silts, mud or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Wetlands or parts of wetlands that lack standing water most of the time are usually dominated by dense grassland or sedgeland vegetation, often forming a turf less than 0.5 metre tall and dominated by amphibious plants including <i>Paspalum distichum</i> (Water Couch), <i>Leersia hexandra</i> (Swamp Ricegrass) and <i>Carex appressa</i> (Tall Sedge). Wetlands or parts of wetlands subject to regular inundation and drying may include large emergent sedges over 1 metre tall, such as <i>Baumea articulate</i> (Jointed Twig-rush), <i>Eleocharis equisetina</i> and <i>Lepironia articulata</i> .	Floristic composition commensurate to this EEC was not identified on site during flora assessments. Therefore it is considered <b>unlikely</b> to occur on site.
Littoral Rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions. (EEC)  EPBC Equivalent Littoral Rainforest and Coastal Vine Thickets of Eastern Australia (CE*)	Littoral rainforest occurs on both sand dunes and on soils derived from underlying rocks. Littoral Rainforest is a closed forest in structure, and the species composition is strongly influenced by the close proximity to the ocean. The floristic composition consists of predominantly rainforest species with evergreen mesic or coriaceous leaves. Several species have compound leaves, and vines may be a major component of the canopy. Littoral Rainforest comprises the <i>Cupaniopsis anacardioides</i> (Tuckeroo) – <i>Acmena</i> spp. alliance of Floyd (1990). This alliance as described by Floyd includes five sub-alliances – <i>Syzygium luehmannii</i> (Small-leaved Lillypilly) – <i>Acmena hemilampra</i> (Broad-leaved Lillypilly), <i>Cupaniopsis anacardioides</i> (Tuckeroo), <i>Lophostemon confertus</i> (Brush Box), <i>Drypetes</i> sp. – <i>Sarcomelicope</i> sp. – <i>Cassine</i> sp. – <i>Podocarpus</i> sp. and <i>Acmena smithii</i> (Lillypilly) – <i>Ficus</i> sp. – <i>Livistona</i> sp. – <i>Podocarpus</i> sp.. While the canopy is dominated by rainforest species, scattered emergent individuals of sclerophyll species, such as <i>Angophora costata</i> (Smooth-barked Apple), <i>Banksia integrifolia</i> (Coast Banksia), <i>Eucalyptus botryoides</i> (Southern Mahogany) and <i>E. tereticornis</i> (Forest Red Gum) occur in many stands.	Floristic composition commensurate to this EEC was not identified on site during flora assessments. Therefore it is considered <b>unlikely</b> to occur on site.
Lowland Rainforest on Floodplain in the NSW North Coast Bioregion (EEC)	Lowland Rainforest, in a relatively undisturbed state, has a closed canopy, characterised by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. Typically, the trees form three major strata: Emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes results in an irregular canopy appearance. The trees are taxonomically diverse at the genus and family levels, and some may have buttressed roots. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. In disturbed stands of this community the canopy cover may be broken, or the canopy may be smothered by exotic vines. The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions.	Floristic composition commensurate to this EEC was not identified on site during flora assessments. Therefore it is considered <b>unlikely</b> to occur on site.
River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast Sydney Basin and South East Corner Bioregions (EEC)	This community occurs on silts, clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees. Typically these forests and woodlands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water. Composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>E. amplifolia</i> (Cabbage Gum), <i>Angophora floribunda</i> (Rough-barked Apple) and <i>A. subvelutina</i> (Broad-leaved Apple). Correlates with LHCCREMS communities - 'Central Hunter Riparian Forest' Map Unit (MU) 13, 'Wollombi Redgum-River Oak Woodland' MU14 and 'Redgum Roughbarked Apple Swamp Forest' MU38.	Floristic composition commensurate to this EEC was not identified on site during flora assessments. Therefore it is considered <b>unlikely</b> to occur on site.

Species / Community	Habitat Description	Likelihood of Occurrence
Sub-tropical Coastal Floodplain Forest of NSW North Coast Bioregions (EEC)	<p>Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion is the name given to the ecological community associated with clay-loams and sandy loams, on periodically inundated alluvial flats, drainage lines and river terraces associated with coastal floodplains. Subtropical Coastal Floodplain Forest generally occurs below 50 m, but may occur on localised river flats up to 250 m elevation in the NSW North Coast bioregion. The structure of the community may vary from tall open forests to woodlands, although partial clearing may have reduced the canopy to scattered trees.</p> <p>Subtropical Coastal Floodplain Forest of the NSW North Coast bioregion has a tall open tree layer of eucalypts, which may exceed 40 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. While the composition of the tree stratum varies considerably, the most widespread and abundant dominant trees include <i>Eucalyptus tereticornis</i> (Forest Red Gum), <i>E. siderophloia</i> (Grey Ironbark), <i>Corymbia intermedia</i> (Pink Bloodwood) and, north of the Macleay floodplain, <i>Lophostemon suaveolens</i> (Swamp Turpentine). Other trees may be scattered throughout at low abundance or locally common at few sites, particularly where there is an influence from lithic substrates upslope. These include <i>Eucalyptus moluccana</i> (Grey Box), <i>E. propinqua</i> (Grey Gum), <i>E. seeana</i> (Narrow-leaved Red Gum), <i>Angophora subvelutina</i> (Broad-leaved Apple), <i>E. robusta</i> (Swamp Mahogany), <i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i> (Red Mahogany), <i>E. acmenoides</i> (White Mahogany), <i>Angophora woodsiana</i>, <i>A. paludosa</i> and rainforest trees such as <i>Ficus</i> spp. (Figs) and <i>Cupaniopsis</i> spp (Tuckeroo).</p>	Floristic composition commensurate to this EEC was not identified on site during flora assessments. Therefore it is considered <b>unlikely</b> to occur on site.
Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bio-regions (EEC)	This community is associated with periodically inundated flats, drainage lines, lake margins and estuarine fringes associated with coastal floodplains, typically occurring on grey-black clay-loams and sandy loams. Usually occurring below 20m altitude.	Floristic composition commensurate to this EEC was not identified on site during flora assessments. Therefore it is considered <b>unlikely</b> to occur on site.
Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bio-regions (EEC)	<p>The community is associated with humic clay or sandy loams on waterlogged or episodically flooded alluvial flats and drainage lines within coastal floodplains. It is generally characterised by an open to dense canopy of eucalypts and / or paperbarks. Canopy heights generally vary from 8m to 25m depending on species composition. The most widespread and abundant dominant trees include <i>Eucalyptus robusta</i> (swamp mahogany), <i>Melaleuca quinquenervia</i> (paperbark) and, south from Sydney, <i>Eucalyptus botryoides</i> (bangalay) and <i>Eucalyptus longifolia</i> (Woollybutt). Other trees may be scattered throughout at low abundance or may be locally common at few sites, including <i>Callistemon salignus</i> (sweet willow bottlebrush), <i>Casuarina glauca</i> (swamp oak) and <i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i> (red mahogany), <i>Livistona australis</i> (cabbage palm) and <i>Lophostemon suaveolens</i> (swamp turpentine). Small trees and shrubs, including <i>Melaleuca</i> sp., <i>Glochidion ferdinandi</i>, <i>Acacia</i> sp. <i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i> and <i>Dodonaea triquetra</i>, are often present in the lower strata. Correlates with LHCCREMS Map Unit (MU) 42 'Riparian Melaleuca Swamp Woodland', MU42a – 'Melaleuca Scrub', MU43 – 'Wyong Paperbark Swamp Forest' and MU43a – 'Melaleuca Scrub'.</p>	Floristic composition commensurate to this EEC was not identified on site during flora assessments. Therefore it is considered <b>unlikely</b> to occur on site.

- Notes: (V) = Vulnerable Species listed under the *Threatened Species Conservation Act 1995*.  
(E) = Endangered Species listed under the *Threatened Species Conservation Act 1995*  
(CE) = Critically Endangered Species listed under the *Threatened Species Conservation Act 1995*.  
(V\*) = Vulnerable Species listed under the *Commonwealth EPBC Act 1999*.  
(E\*) = Endangered Species listed under the *Commonwealth EPBC Act 1999*.  
(CE\*) = Critically Endangered Species listed under the *Commonwealth EPBC Act 1999*  
(M\*) = Migratory Species listed under the *Commonwealth EPBC Act 1999*  
ROTAP = Rare and Threatened Plants of Australia;  
ROTAP CODES: 3 = Geographic range in Australia greater than 100km  
K = Poorly Known  
R = Rare  
C = Reserved  
- = Reserve population size is not accurately known.

#### 4.2.1 Pelagic Species Considerations

The following additional primarily pelagic species were identified during a 10km radius search as a species that could potentially occur within the locality.

- *Diomedea exulans* (Wandering Albatross) (E, V\*, M\*)
- *Diomedea exulans amsterdamensis* (Amsterdam Albatross) (E\*, M\*)
- *Diomedea exulans antipodensis* (Antipodean Albatross) (V, V\*, M\*)
- *Diomedea exulans exulans* (Tristan Albatross) (E\*, M\*)
- *Diomedea exulans gibsoni* (Gibson's Albatross) ( V, V\*, M\*)
- *Macronectes giganteus* (Southern Giant Petrel) (E, E\*,M\* )
- *Macronectes halli* (Northern Giant Petrel) (V, V\*,M\*)
- *Pterodroma leucoptera leucoptera* (Gould's Petrel) (V, E\*, M\*)
- *Pterodroma neglecta neglecta* (Kermadec Petrel) (V, V\* )
- *Puffinus carneipes* (Flesh-footed Shearwater) (V, M\*)
- *Thalassarche bulleri* (Buller's Albatross) (V\*, M\*)
- *Thalassarche cauta cauta* (Shy Albatross) (V, V\*, M\*)
- *Thalassarche cauta salvini* (Salvin's Albatross) (V\*, M\*)
- *Thalassarche cauta steadi* (White-capped Albatross) (V\*, M\*)
- *Thalassarche melanophris* (Black-browed Albatross) (V, V\*,M\*)
- *Thalassarche melanophris impavida* (Campbell Albatross) (V\*, M\*)
- *Caretta caretta* (Loggerhead Turtle) (E,E, M\*)
- *Chelonia mydas* (Green Turtle) (V,V\*,M\*)
- *Dermochelys coriacea* (Leatherback Turtle) (V,E\*, M\*)
- *Natator depressus* (Flatback Turtle) (V\*,M\*)

These species were considered unlikely to occur on site due to their habitat preferences, however it is still possible that one or more may forage, roost or nest along the shoreline and dunes on the periphery and adjacent to the site. Notably the Green Turtle has been previously recorded on the beach adjacent to the site. Any development would likely lead to an increase in human shoreline activity, which may potentially impact breeding opportunities of some of these species unless appropriately managed. This should be covered under any future impact assessment.



### 4.3 Habitat Value of Recorded Species

The following section provides commentary on the likely habitat utilisations and value of those habitats present within the site.

#### 4.3.1 Tuncurry Midge Orchid (*Genoplesium littorale* syn. *Corunastylis littoralis*)

Tuncurry Midge Orchid (TMO) is a deciduous, terrestrial orchid considered endemic to the Forster-Tuncurry and Nabiac localities. The *Genoplesium* genus is characteristically known for having upside-down flowers and has been taxonomically separated from the Prasophyllum genus. The *Genoplesium* spilt into *Corunastylis* has not been widely accepted and the species is still referred to by the NSW National Herbarium as *Genoplesium littorale*, although its synonym *Corunastylis littoralis*, is acknowledged by the Royal Botanic Gardens 'PlantNet' website. Debate over the *Genoplesium/Corunastylis* taxonomy continues to date, with the species being listed as *Corunastylis littoralis* under the EPBC Act (critically endangered) and *Genoplesium littorale* (critically endangered) under the TSC Act. For the purposes of this inventory report, botanical nomenclature follows Harden and the 'PlantNet' website and thus TMO is herein referred to as *Genoplesium littorale* (syn. *Corunastylis littoralis*).

TMO occurs on the Holocene and Pleistocene aged dunes on freely draining podsolised sands and is thought to be, at least in part (as with many *Genoplesium* species), a post disturbance coloniser favouring sites with sparse groundcover and leaf litter, typically along tracks, easements or in Dune Scrub, Dry Heathland or Dune Forest areas recently subject to fire or slashing. Much of the original type population recorded by Paget (2008) was situated east of the Tuncurry Tip on the site in an area that was subject to historical mineral sands mining and bushfire. Additional (sub)populations of TMO were subsequently recorded by RPS in 2010 and 2011 in Booti Booti NP, Crown Lands at Minimbah and along Aerodrome Road at Nabiac on Pleistocene sands.

On site, TMO is considered to have its highest habitat value within those areas that have undergone recent or continued disturbance, particularly the various tracks and power easement, or where past disturbance (mineral extraction) is still evident. Additionally there is potential habitat within the heath for non-flowering plants that may be induced to flower following a disturbance event. Refer to **Figure 4-4**.

#### 4.3.2 Eastern Osprey (*Pandion haliaetus*)

This medium sized raptor is a fish specialist that patrols stretches of water in search of prey. Eastern Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. It frequents the shores of beaches, reefs, bays, swamps, estuaries and islands and often perches quite distinctly in trees or on poles. They require extensive areas of open fresh, brackish or saline water for foraging. They prefer larger bodies of water (>100ha) as opposed to smaller water bodies for foraging. They may occur over atypical habitats such as heath, woodland or forest when travelling to and from foraging sites. They breed from April-September and makes

large stick nests on cliff faces, rocky shores, dead trees or manmade structures. Nests are usually 5-10km away from foraging grounds.

This species is most likely to utilise the foredune complex where it will perch between foraging bouts. The beach may also provide an irregular source of food in the form of carrion washed up on to the beach. Refer to **Figure 4-5**.

#### **4.3.3 Pied Oystercatcher (*Haematopus longirostris*)**

A medium sized shorebird that frequents the shores of beaches and inlets. It occupies muddy, sandy, inlets and beaches, particularly intertidal mudflats and sandbanks in large marine bays and is less common in stony and rocky estuaries (Evans 2010). The habitat of this species is frequently disturbed by human activities on beaches. It is distributed along the entire NSW coast. The Pied Oystercatcher's nest is typically a scrape in sand, soil, shingle or shellgrit above the tideline, on a beach, lagoon shore, sandbank or sand island in an estuary, between high-water mark and dunes, amongst vegetation or wrack (e.g. seaweed, driftwood) or under a shrub, and lined with plant fibres or shells (NSW Scientific Committee 2008). Pairs have a traditional, small nesting territory which they occupy for many years, and in which they will repeatedly attempt to nest during a breeding season (NSW Scientific Committee 2008). The home range of a pair of Pied Oystercatchers is approximately 400m along a stretch of shore (NSW Scientific committee 2008).

Due to the habitat preferences and requirements of the Pied Oystercatcher, the most valuable habitat is considered to be along the beach and foredune areas. Refer to **Figure 4-6**.

#### **4.3.4 Common Blossom Bat (*Syconycteris australis*)**

The Common Blossom Bat is a small species of megachiropteran bat that forages on flowering blossoms, including Coastal Banksia (*Banksia integrifolia*; Law 1993) and is known to roost within Littoral Rainforest (Law 1993). Radio tracking of this species in Papua New Guinea suggests a home range of between 2.6-13.5 ha (Winkelmann et al 2000) while Law (1993) suggests a home range of approximately 13 hectares in Coastal Heathland and Rainforest in north-eastern New South Wales.

This site does not provide suitable roosting habitat for species. This species feeds predominantly on Banksia blossom however is also known to feed on Eucalypt blossom and as such the vegetation of the site when in flower provides habitat for this species. Refer to **Figure 4-7**.

#### **4.3.5 Grey-headed flying-fox (*Pteropus poliocephalus*)**

The Grey-headed flying-fox (*Pteropus poliocephalus*) is a large species of macrobat that roosts in large colonies, 'camps' of up to 80,000 individuals that disperse each night to forage (Parry Jones and Augee 1992). These bats have a nightly feeding range of 20 to 50km from their camp and can fly for extended periods (Chruchill 1998). The diet of Grey-headed flying-fox predominantly includes flowering trees from the Myrtaceae family

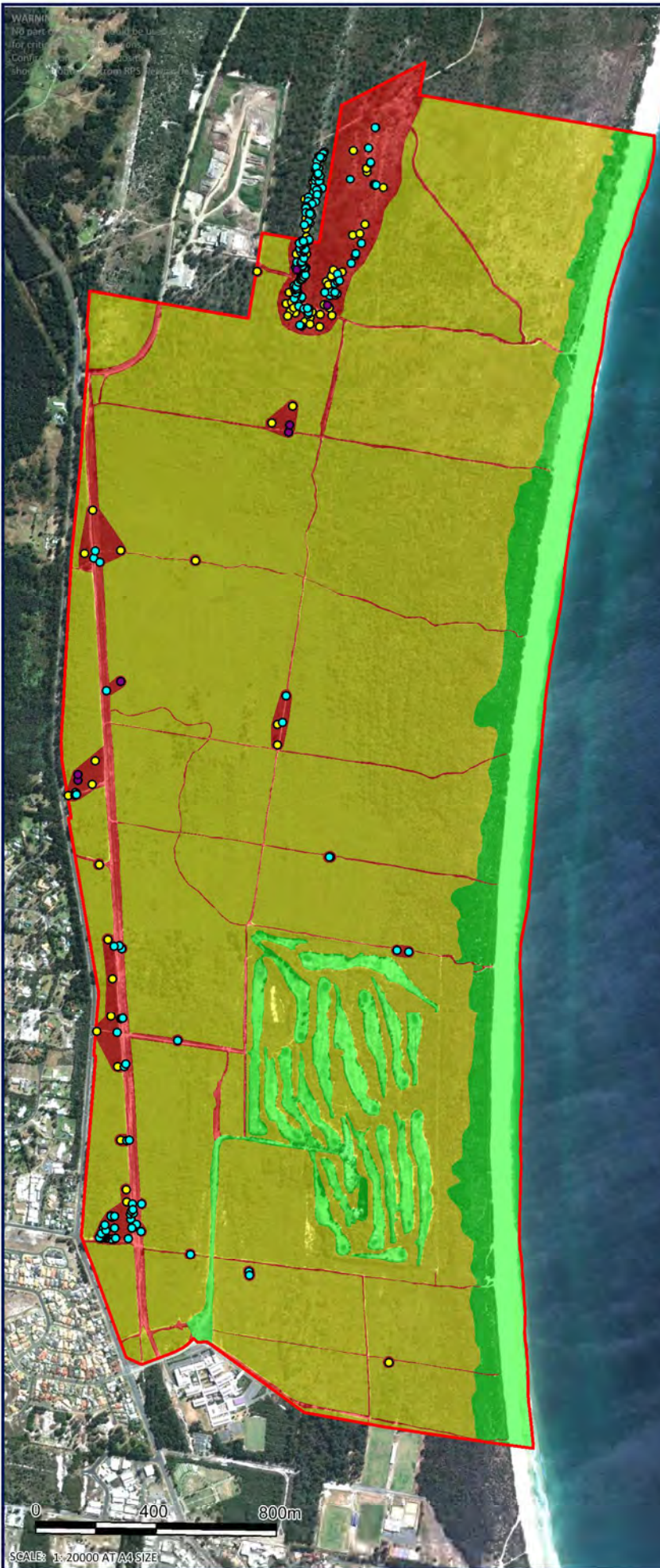
(including Eucalyptus sp.; but will also target exotic garden plants (Parry Jones and Augee 1991).

No camps were recorded or known on the site. The vegetated environs of the site offer suitable foraging resources for this species and during seasonal flowering it is expected the flying-fox would utilise the site as part of a wider home range. Refer to **Figure 4-8**.

#### **4.3.6 Cave dwelling bat species**

Cave dwelling microbat species utilise caves, disused mines, tunnels and road culverts as roost sites. On the site the Common Bentwing Bat (*Miniopterus schreibersii*) was recorded. This species has been known to utilise caves, mines, tunnels and road culverts as roost sites in north-eastern New South Wales (Dwyer 1966) and are able to travel up to 60km each night to forage (Dwyer 1969).

Due to the sandy nature of the soil on the site, no caves, mines or tunnels are known to occur, however small culverts under nearby roads may provide for local roost sites for known cave dwelling bat species. The open tracks and other suitable flyways provide potential foraging habitat for these bat species. Refer to **Figure 4-9**.



**Legend**

- Site Boundary
- Tuncurry Midge Orchid (RPS)
- Tuncurry Midge Orchid (Paget 2008)
- Tuncurry Midge Orchid (ERM 2010b)

Habitat Value

- Low  
- low potential habitat value
- Moderate  
- potential habitat for non-flowering plants that may be induced to flower following a disturbance event
- High  
- known records;  
- 'high' potential habitat areas  
- 20 metre buffer around known records



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TITLE: FIGURE 4-4: TUNCURRY MIDGE ORCHID HABITAT VALUE | LOCATION: NORTH TUNCURRY

DATUM: DATUM | PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 19/03/2012 | PURPOSE: ECO INVENTORY

LAYOUT REF: J:\JOBS\26K\26414 - North Tuncurry\10-Drafting\Inventory Report Figures\RPS 2012  
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CLIENT: LANDCOM  
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**Legend**

- Site Boundary
- Hollow Bearing Tree Sample Plot
- Hollow Bearing Tree Sample Plot (Hollow Bearing Trees Recorded)

*Habitat Value*

- Low**
  - unvegetated; or
  - areas with no visible hollow recruitment
- Moderate**
  - scattered Blackbutt Stands with some hollow recruitment
- High**
  - Blackbutt Forest containing known hollow locations



3 HBTs

1 HBT

1 HBT

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TITLE: FIGURE 4-10: HOLLOW BEARING TREE (HBT) DENSITY	LOCATION: NORTH TUNCURRY	DATUM: DATUM PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 22/03/2012 PURPOSE: ECO INVENTORY
		LAYOUT REF: J:\JOBS\26K\26414 - North Tuncurry\10-Drafting\Inventory Report Figures\RPS 2012 VERSION (PLAN BY): P. HILLIER	

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**Legend**

Site Boundary

● Pied Oystercatcher (RPS)

Habitat Value

Low  
- non-preferred habitat

High  
- foraging, roosting and breeding



0 400 800m

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TITLE: FIGURE 4-6 PIED OYSTERCATCHER HABITAT VALUE

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 15/03/2012  
PURPOSE: ECO INVENTORY

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**Legend**

Site Boundary

Common Blossom Bat (RPS)

Habitat Value

Low  
 - unvegetated

High  
 - foraging habitat



0 400 800m

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TITLE: FIGURE 4 7: COMMON BLOSSOM BAT HABITAT

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 08/03/2012  
 PURPOSE: ECO INVENTORY

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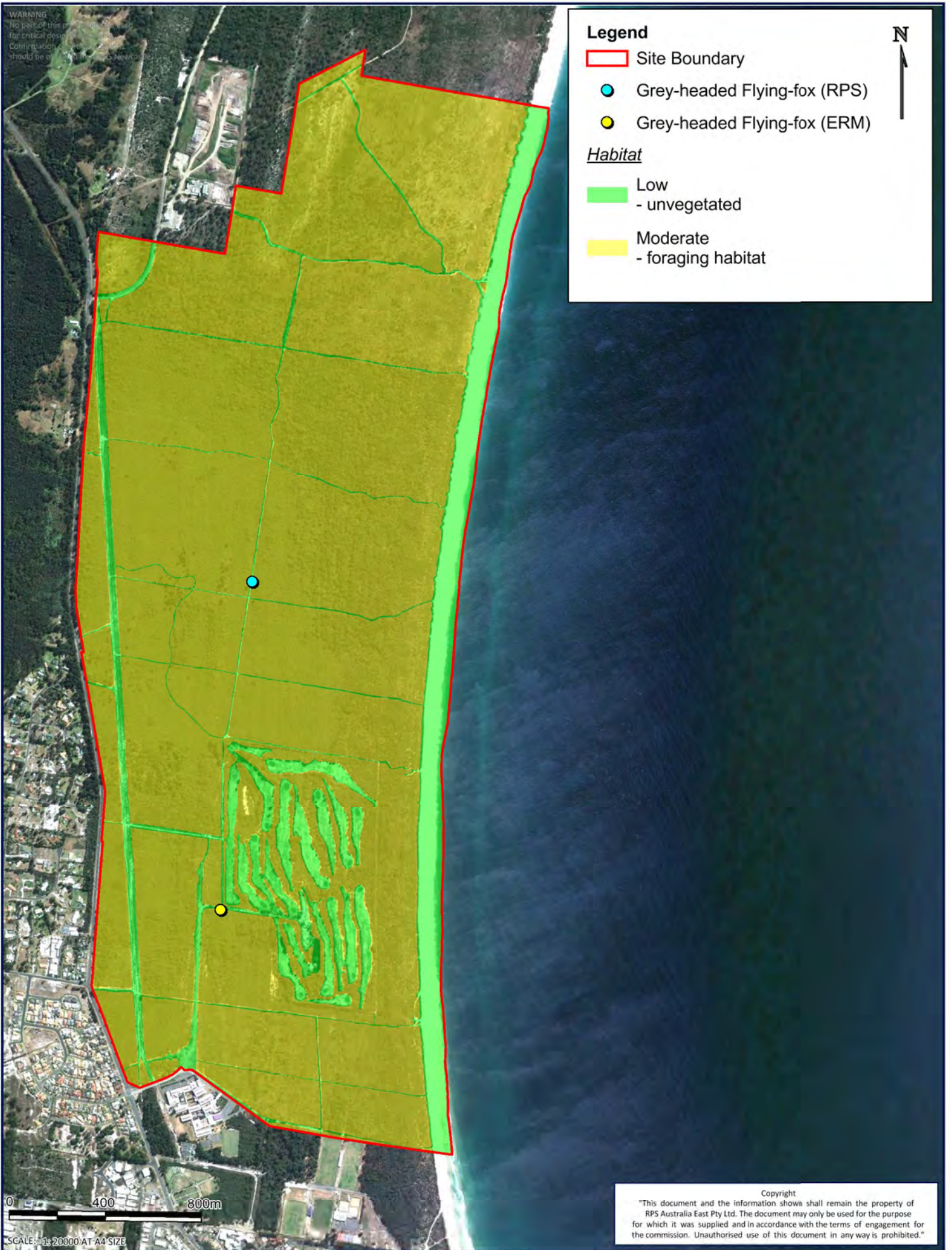
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**Legend**

- Site Boundary
- Grey-headed Flying-fox (RPS)
- Grey-headed Flying-fox (ERM)

Habitat

- Low  
- unvegetated
- Moderate  
- foraging habitat



0 400 800m

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TITLE: FIGURE 4-8: GREY-HEADED FLYING-FOX HABITAT VALUE

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 15/03/2012  
 PURPOSE: ECO INVENTORY

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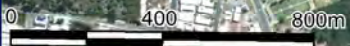


**Legend**

- Site Boundary
- Eastern Bentwing-bat
- Little Bentwing-bat

Habitat Value

- Moderate  
- foraging habitat



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TITLE: FIGURE 4-9:  
CAVE DWELLING  
MICRO-BAT HABITAT

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 15/03/2012  
PURPOSE: ECO INVENTORY

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#### 4.3.7 Hollow Dependent Fauna

A number of hollow-dependent fauna species are present on the site, as recorded during the surveys. A random sampling methodology was used to ascertain the density of hollow-bearing trees across the site and within distinct habitat types. Refer to **Figure 4-10** for the hollow-bearing tree density map.

The results generally showed that, as would be expected, the areas containing Blackbutt trees were most important in terms of hollow-provision. The most important area from a hollow-bearing tree perspective is the extensive area of Blackbutt Forest in the northern part of the site. A small isolated area exists in the south-west of the site with Blackbutt stands that contains low numbers of hollows, while the remainder of the site is heath or other vegetation not likely to contain hollows.

Whilst the Blackbutt Forest areas provide the highest frequency of hollows within the site, as discussed in **Section 3.2.3**, given that the site was used for Pine plantations up to approximately 70 years ago tree hollow frequency relative to older stands of this is expected to be low.

The following information provides more detailed individual assessment of hollow-use by recorded threatened species.

##### **Little Lorikeet (*Glossopsitta pusilla*)**

The Little Lorikeet is a small parrot species found throughout Eastern Australia. It is an obligate hollow user, with nesting occurring in hollows (NSW DEC 2008). The species disperses readily, following flowering Eucalypts (NSW DEC 2008). The species may also feed on other blossom (NSW DEC 2008).

On the site this species is likely to occur in a foraging capacity predominantly within the Blackbutt Forest where flowering Eucalypts occur. Hollows of a suitable size were not observed during the field survey and therefore on this basis breeding activities are unlikely to take place. Refer to **Figure 4-11**.

##### **Eastern Pygmy Possum (*Cercartetus nanus*)**

The Eastern Pygmy Possum (*Cercartetus nanus*) is one of the world's smallest possum species and weighs an average of 24 grams (Turner and Ward 1995). Its diet is largely based on nectar and pollen, obtained from flowering plants, which is supplemented by invertebrates (Ward 1990). It is an opportunistic hollow user and is also known to roost within tree stumps (Duncan and Taylor 2001) and within dense vegetation (Turner and Ward 1995). It occurs in a range of habitat types including rainforest (Bladon et al. 2002), dry and wet sclerophyll forest (Duncan and Taylor 2001) and heathland (Ward 1990). The home range size is small, being less than one hectare (Turner and Ward 1995, Bladon et al 2002), however an individual has been known to move at least 125m in one night (Turner and Ward 1995).

Due to the broad range of habitats utilised by this species across its range for foraging and roosting, it is considered the unfragmented environs on site area likely to provide habitat. Refer to **Figure 4-12**.

**Squirrel Glider (*Petaurus norfolcensis*)**

The Squirrel Glider (*Petaurus norfolcensis*) is a small hollow dependent arboreal marsupial found throughout eastern Australia (Suckling 1995). It weighs up to 230g and can glide up to 90m (Sucking 1995, van der Ree 2000).

The diet of the Squirrel Glider includes nectar from flowering plants (*Corymbia*, *Eucalyptus*, *Melaleuca*, *Banksia*), tree kino (from incised trees; Sharpe and Goldingay 1998, Ball et al. 2009) and invertebrates (Sharpe and Goldingay 1998, Ball et al. 2009). The home range size of the Squirrel Glider has been studied extensively throughout its range with estimates ranging from 1.4-7.07ha (van der Ree and Bennett 2003, Sharp and Goldingay 2007, Brearley et al. 2011), varying as a function of the suitability of the habitat. The home range of the species can also be linear, with van der Ree and Bennett (2003) recording home ranges up to 800m in length.

The Squirrel Glider being a hollow dependent will reach its highest density on the site within the Blackbutt Forest, the largest stand of which generally occurring within the northern half of the site. While this species will forage widely on nectar offered by species such as *Banksia* within the heathlands during on site, it's occurrence is likely to be concentrated in areas closest to stands of Blackbutt Forest. In order to access suitable foraging resources, opportunities for dispersal throughout the site during foraging may be substituted by emergent species such as pine, large *Banksia* as well as the Blackbutt Forest where this species will most readily achieve the greatest glide paths. Most notably the low frequency of hollow-bearing trees recorded during plots surveys coupled with the capture rate during targeted ecological surveys may be an indicator of an overall decreased population size to that encountered in similar coastal environs where the age cohort of vegetation is capable of recruiting a higher frequency of hollows. Refer to **Figure 4-13**.

**Brush Tailed Phascogale (*Phascogale tapoatafa*)**

The Brush Tailed Phascogale (*Phascogale tapoatafa*) is a small marsupial carnivore, weighing up to 300 grams (Soderquist 1995). The preferred diet of the Phascogale is primarily invertebrates, obtained through foraging under the bark of rough barked species (Scarff et al. 1998) but has been known to also eat small vertebrates (Soderquist 1995). The species exhibits the typical Dasyurid 'male die off' where all males die at one year of age during the breeding season, however females can live for up to three years in the wild (Soderquist 1995).

Brush Tailed Phascogale's are opportunistic hollow users with the species also having being recorded as utilising rotten stumps and globular bird nests as den sites, with individuals being known to extensively den swap across their home range (Soderquist 1995). Previous radio tracking studies of the species has shown a high degree of variation in home range size, however this is possibly a response due to differences in resource availability and site productivity (van der Ree et al. 2001). The recorded home range size

varies from 2.3 ha in high productivity linear roadside remnant forest to over 40 hectares in drier, heavily logged woodland (Traill and Coates 1993). Preferred habitat has also found to be related to understory density, with a sparse groundcover preferred.

The species has the potential to utilise all areas of native vegetation on the site but it is predicted that they would reach their highest density within the Blackbutt Forest on the site, which recorded the only hollows, during hollow bearing tree plot surveys. This species may also have a preference for areas with a sparse ground cover, such as around the Golf Course and within the more recently fire affected areas to the north of the site and generally within areas of Blackbutt Forest across the site. A population has been reportedly persisting in the Golf Course for many years and anecdotally is known to utilise areas of the club house as a den site. Refer to **Figure 4-14**.

#### **Hollow dependent microchiropteran bats**

Hollow dependent microbats typically have a smaller home range than cave dwelling species (Law and Anderson 2000). These species forage on insects in a variety of habitats, including dry forests and woodlands. Individuals have been recorded in riparian zones in rainforest and wet sclerophyll forest. These species will roost in tree hollows, under bark and within man-made structures.

These species have the potential to utilise all areas of native vegetation on the site for roosting but in relation to potential breeding habitat, it is predicted that they would reach their highest density within the Blackbutt forest on the site, which recorded the only hollows during hollow bearing tree surveys. Refer to **Figure 4-15**.

#### **4.3.8 Vegetation Community Conservation Significance**

The vegetation recorded on site has been considered for its conservation significance based on regional extent and supporting documents. Whilst none of the recorded vegetation communities are listed under the TSC Act or EPBC Act, they have been afforded a significance value by various reports. The key resource that has informed this conservation significance assessment is the Biometric Vegetation Database which utilises the Hunter-Central Rivers Catchment Management Authority (HCR CMA) vegetation mapping. The database has been checked against the vegetation types present on site.

The conservation values assigned to each of the communities present has been derived from the percentage cleared categories associated with the Biometric Vegetation Database, specifically:

- Low = < 30% cleared;
- Medium = 30% to 70% cleared; and
- High = > 70% cleared.

The results of the modelling are presented in **Figure 4-16**.

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**Legend**

- Site Boundary
- Hollow Bearing Tree Sample Plot
- Hollow Bearing Tree Sample Plot (Hollow Bearing Trees Recorded)

*Habitat Value*

- Low**
  - unvegetated; or
  - areas with no visible hollow recruitment
- Moderate**
  - scattered Blackbutt Stands with some hollow recruitment
- High**
  - Blackbutt Forest containing known hollow locations



3 HBTs

1 HBT

1 HBT

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TITLE: FIGURE 4-10: HOLLOW BEARING TREE (HBT) DENSITY

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 22/03/2012  
PURPOSE: ECO INVENTORY

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VERSION (PLAN BY): P. HILLIER

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**Legend**

- Site Boundary
- Little Lorikeet (RPS)

Habitat Value

- Low
- unvegetated, non-preferred foraging habitat
  - High - preferred foraging habitat



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TITLE: FIGURE 4-11: LITTLE LORIKEET HABITAT VALUE

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 15/03/2012  
PURPOSE: ECO INVENTORY

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**Legend**

Site Boundary

Eastern Pygmy Possum (RPS)

Habitat Value

Low  
- unvegetated

Moderate  
- fragmented and disturbed

High  
- foraging and breeding habitat



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TITLE: FIGURE 4-12: EASTERN PYGMY POSSUM HABITAT VALUE

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 15/03/2012  
PURPOSE: ECO INVENTORY

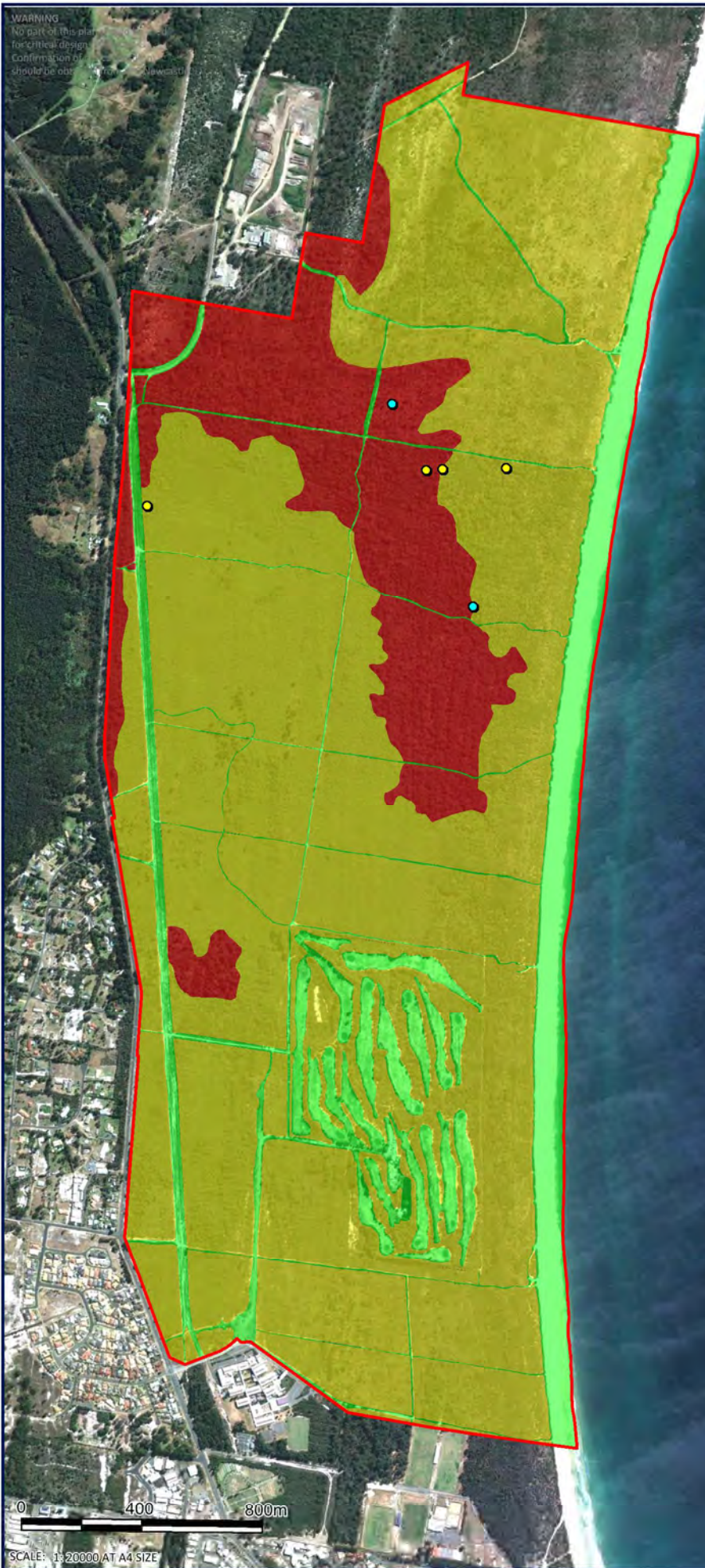
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**Legend**

- Site Boundary
  - Squirrel Glider (RPS)
  - Squirrel Glider (ERM)
- Habitat Value
- Low  
- unvegetated
  - Moderate  
- foraging habitat
  - High  
- breeding and foraging habitat



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TITLE: FIGURE 4-13: SQUIRREL GLIDER HABITAT VALUE

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 15/03/2012  
PURPOSE: ECO INVENTORY

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**Legend**

- Site Boundary
- Brush-tailed Phascogale (RPS)
- Brush-tailed Phascogale (ERM)

Habitat Value

- Low**
- unvegetated; or
  - dense unfavourable vegetation
- Moderate**
- foraging habitat determined by areas containing a sparse ground layer.
- High**
- suitable breeding and foraging habitat; or
  - known occupied habitat



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TITLE: FIGURE 4-14: BRUSH-TAILED PHASCOGALE HABITAT VALUE	LOCATION: NORTH TUNCURRY	DATUM: DATUM PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 08/03/2012 PURPOSE: ECO INVENTORY	LAYOUT REF: J:\JOBS\26K\26414 - North Tuncurry\10-Drafting\Inventory Report Figures\RPS 2012 VERSION (PLAN BY): P. HILLIER
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making  
Consultation  
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**Legend**

- Site Boundary
- Eastern Freetail-bat
- Eastern falsistrelle

Habitat Value

- Moderate  
- foraging habitat
- High  
- foraging and roosting habitat



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TITLE: FIGURE 4-15: HOLLOW DEPENDENT MICRO-BAT HABITAT VALUE	LOCATION: NORTH TUNCURRY	DATUM: DATUM PROJECTION: MGA ZONE 56 (GDA 94)	DATE: 15/03/2012 PURPOSE: ECO INVENTORY	LAYOUT REF: J:\JOBS\26K\26414 - North Tuncurry\10-Drafting\Inventory Report Figures\RPS 2012 VERSION (PLAN BY): P. HILLIER
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**Legend**

 Site Boundary

Conservation Significance

Low

Community = *Eucalyptus pilularis*  
 Dry Sclerophyll Forest (dunal)  
 - < 30% cleared in HCR CMA  
 - not an EEC; and  
 - not considered regionally rare.



Moderate

Community = *Banksia aemula* Dry  
 Heathland / *Leptospermum* /  
*laevigatum* Dry Sclerophyll  
 Shrubland / Fore-dune Complex  
 - 30-70% cleared in HCR CMA; and  
 - not an EEC.



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TITLE: FIGURE 4-16:  
 VEGETATION COMMUNITY  
 CONSERVATION SIGNIFICANCE

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 08/03/2012  
 PURPOSE: ECO INVENTORY

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## 4.4 Combined Habitat Values

### Introduction

The previous individual species maps provide species-specific indications of the habitat quality distribution throughout the site.

In order to provide an overall indication of the most important habitat areas within the site, a combined habitat map has been produced. This enables habitats to be ranked in order to inform development area design in the future.

The habitat was ranked for each known threatened species and for vegetation type as follows:

- Low (1)
- Medium (2)
- High (3)

Disturbance and habitat connectivity maps were also prepared, as these partly influence overall habitat value, although such considerations are difficult to incorporate into the actual combined habitat value mapping process (but nevertheless are referred to in discussion of the combined habitat mapping outcomes).

It was considered that, in addition to the habitat ranking process outlined above, some weighting was considered necessary to accurately reflect the relative threatened status of each species. This weighting process used the following parameters:

- Vulnerable species were assigned a weighting multiplier of 1
- Endangered species were assigned a weighting multiplier of 2
- Critically Endangered species were assigned a weighting multiplier of 3

The purpose of this was to ensure that habitat for the most-threatened species was shown as being relatively more important than for other threatened species.

The combined habitat values map is provided in **Figure 4-17**. The results of this process have been considered and are provided below in relevant sub-sections.

### Overall Habitat Value

Review of the map shows that some areas on the site are relatively more important than others for threatened species. The habitat importance is discussed below, beginning from lower importance habitats and finishing with higher habitat importance. Note that these habitat importance categories are all relative, that is to each other. Generally most of the site supports native vegetation which to some degree is or contains habitat elements for native flora and fauna.

Lower combined habitat values on the site generally fall within the habitat value range of 15 to 29. These areas generally comprise the majority of disturbed tracks and adjoining heath and beach areas. There are exceptions for areas of heath and tracks and this is mostly due to those areas containing known habitat of the TMO. In general, the heath vegetation is a form of monoculture that does not tend to provide a high diversity of habitats when compared to woodlands, forests or wetlands (for example). In general, the disturbed tracks provide poor habitat for native species, although it is recognised that some particular portions of the disturbed tracks provide known habitat for TMO. Apart from TMO occurring in particular parts of the tracks, the tracks are otherwise of lower relative quality habitat importance. The golf course fairways also possess generally lower overall quality habitat due to their obvious regularly maintained condition. Another exception is the recorded occurrences of Pied Oystercatcher on the beach. Pied Oystercatchers are an Endangered species and the beach is important for this particular threatened species, although not generally for other recorded threatened species.

Moderate combined habitat values are shown on the map to be in the range of 29 – 31 and include:

- Areas of heath in the north providing known habitat for Eastern Pygmy Possum and Squirrel Glider;
- Areas of heath in the south with emergent Blackbutt trees; providing a higher complexity of habitats;
- Areas of native vegetation in amongst the golf course fairways that contain Blackbutt trees in the overstorey; and
- Areas of heath containing comparatively low numbers of TMO.

High combined habitat values are mostly directly linked to the occurrence of moderate to high numbers of TMO and the presence of Blackbutt Forest. This is expected and considered reasonable as:

- TMO is a critically endangered species, and areas of (particularly) moderate to high known numbers of TMO are very important;
- Blackbutt Forest provides a complexity of niches not present in the heath environments. This generally includes a structured canopy layer and associated tree hollows. It also includes relatively greater habitat diversity at shrub and ground levels. Such habitats are particularly important for a majority of the threatened fauna recorded, including Brush-tailed Phascogale, Squirrel Glider, Eastern Pygmy Possum, Common Blossom Bat, Osprey (for nesting), Little Lorikeet and hollow-dependent bats. This habitat type also appears to be important for TMO, providing open conditions in which a high density of records of TMO has been recorded.

#### **Connectivity and Disturbance influences**

In terms of the most important areas for habitat connectivity, these generally accord with the areas mapped as high combined habitat values. From a regional connectivity perspective (as shown on the map) the most important areas for connectivity connect habitats to the west of the upper centre of the site northwards towards Darawank Nature Reserve. Future retention of habitats should prioritise conservation of these areas of

---

connectivity. In terms of local connectivity, the strip of land along the western and eastern portions of the site also have some importance for connectivity to the south of the site. The western strip is likely to have importance for TMO connectivity.

While the various disturbances that have been mapped have obviously influenced the current condition of the site, the site has had a sufficient recovery period that has minimised the influence of these disturbances in terms of affecting habitat quality. While some areas of slash pine could be considered to be low priority habitat value, much of the slash pine areas still have a healthy understorey.



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**Legend**

- Site Boundary
- Regional Habitat Connectivity

Combined Habitat Values

- > 32
- 31 to 32
- 30 to 31
- 29 to 30
- 28 to 29
- < 28

The above values are derived from the sum of each habitat score for each species where Low = 1, Medium = 2 and High = 3

Each species/group/community/HBT density is applied a weighting based on legal status as follows:

Species	Status	Multiplier
Brush-tailed Phascogale	V	1
Cave Dwelling Bats	V	1
Common Blossom Bat	V	1
Eastern Osprey	V	1
Eastern Pygmy Possum	V	1
Grey-headed Flying Fox	V	1
Hollow Dependent Bats	V	1
Little Lorikeet	V	1
Pied Oystercatcher	E	2
Squirrel Glider	V	1
Tuncurry Midge Orchid	CE	3
Vegetation Community	-	1
Hollow Bearing Tree Density	-	-



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## 5 Conclusion

RPS was commissioned by Landcom to undertake ecological survey and prepare this *Ecological Inventory Report* over Crown Land (including the Golf Course therein) located at North Tuncurry. The aim of the combined surveys and this report was to identify the flora, fauna and habitat characteristics of the site, to inform due diligence on ecological issues, assist in conceptual planning phases, and ultimately inform the production of an ecological impact assessment documentation as a component of any future development proposal.

A variety of field survey techniques were employed over the course of desktop and fieldwork to document flora, fauna and habitat characteristics of the site. Ecological survey effort was generally underpinned by DEC (2004).

In line with the aim of this Ecological Inventory Report, this report has presented an outline of the methods employed for the ecological survey, subsequent results and brief commentary on the relative habitat value offered by the site for threatened species known from the locality and/or recorded on site.

In summary the following vegetation communities and threatened species have been recorded on site:

### Vegetation Communities

- *Eucalyptus pilularis* Dry Sclerophyll Forest (dunal);
- *Banksia aemula* Dry Heathland;
- *Leptospermum laevigatum* Dry Sclerophyll Shrubland; and
- Foredune Complex.

### Threatened Flora

- *Genoplesium littorale* syn. *Corunastylis littoralis* (Tuncurry Midge Orchid)

### Threatened Fauna

- |  |                         |
|--|-------------------------|
| ▪ <i>Pandion cristatus</i>                   | Eastern Osprey          |
| ▪ <i>Haematopus longirostris</i>             | Pied Oystercatcher      |
| ▪ <i>Glossopsitta pusilla</i>                | Little Lorikeet         |
| ▪ <i>Phascogale tapoatafa</i>                | Brush-tailed Phascogale |
| ▪ <i>Cercartetus nanus</i>                   | Eastern Pygmy Possum    |
| ▪ <i>Petaurus norfolcensis</i>               | Squirrel Glider         |
| ▪ <i>Miniopterus australis</i>               | Little Bentwing-bat     |
| ▪ <i>Miniopterus schreibersii oceanensis</i> | Eastern Bentwing-bat    |
| ▪ <i>Mormopterus norfolkensis</i>            | Eastern Freetail-bat    |



- 
- *Scoteanax rueppellii* Greater Broad-nosed Bat
  - *Pteropus poliocephalus* Grey-headed Flying-Fox
  - *Syconycteris australis* Eastern Blossom Bat

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# Appendix A

## Flora List

### Flora Species Recorded within North Tuncurry Site

Family	Scientific Name	Common Name
ADOXACEAE	<i>Sambucus australasica</i>	Native Elderberry
AIZOACEAE	<i>Carpobrotus glaucescens</i>	Pigface
AIZOACEAE	<i>Tetragonia tetragonioides</i>	Native Spinach
APIACEAE	<i>Actinotus helianthi</i>	Flannel Flower
APIACEAE	<i>Centella asiatica</i>	Indian Pennywort
APIACEAE	<i>Hydrocotyle bonariensis</i>	Pennywort
APIACEAE	<i>Platysace ericoides</i>	
APIACEAE	<i>Platysace lanceolata</i>	
APOCYNACEAE	<i>Parsonsia straminea</i>	Common Silkpod
APOCYNACEAE	<i>Tylophora grandiflora</i>	Small-leaved Tylophora
ASTERACEAE	<i>Bidens pilosa</i> *	Cobbler's Pegs
ASTERACEAE	<i>Conyza bonariensis</i> *	Flaxleaf Fleabane
ASTERACEAE	<i>Chrysanthemoides monilifera</i> *	Bitou Bush
ASTERACEAE	<i>Cirsium vulgare</i> *	Spear Thistle
ASTERACEAE	<i>Erechtites valerianifolius</i> *	Brazilian Fireweed
ASTERACEAE	<i>Hypochaeris radicata</i> *	Catsear
ASTERACEAE	<i>Ozothamnus diosmifolius</i>	White Dogwood
ASTERACEAE	<i>Taraxacum officinale</i> *	Dandelion
ASPARAGACEAE	<i>Asparagus plumosus</i> *	Climbing Asparagus Fern
BIGNONIACEAE	<i>Pandorea pandorana</i>	Wonga Wonga Vine
BRASSICACEAE	<i>Cakile edentula</i>	American Sea Rocket
CAMPANULACEAE	<i>Wahlenbergia gracilis</i>	Sprawling Bluebell
CASUARINACEAE	<i>Allocasuarina littoralis</i>	Black She oak
CASUARINACEAE	<i>Casuarina glauca</i>	Swamp Oak
CHENOPODIACEAE	<i>Rhagodia candolleana</i> <i>subsp. candolleana</i>	Coastal Saltbush
COMMELINACEAE	<i>Commelina cyanea</i>	Native Wandering Jew
CONVOLVULACEAE	<i>Cuscuta campestris</i>	
CYPERACEAE	<i>Caustis flexuosa</i>	Curly Wig
CYPERACEAE	<i>Caustis recurvata</i>	
CYPERACEAE	<i>Cyperus eglobosus</i>	
CYPERACEAE	<i>Cyperus polystachyos</i>	



Family	Scientific Name	Common Name
CYPERACEAE	<i>Ficinia nodosa</i>	Knobby Club rush
CYPERACEAE	<i>Isolepis inundata</i>	
CYPERACEAE	<i>Isolepis nodosa</i>	
CYPERACEAE	<i>Schoenus ericetorum</i>	Heath Bog-rush
DAVALLIACEAE	<i>Nephrolepis cordifolia</i>	Fishbone Fern
DENNSTAEDTIACEAE	<i>Pteridium esculentum</i>	Bracken
DILLENACEAE	<i>Hibbertia aspera</i>	Rough Guinea Flower
DILLENACEAE	<i>Hibbertia dentata</i>	Twining Guinea Flower
DILLENACEAE	<i>Hibbertia fasciculata</i>	
DILLENACEAE	<i>Hibbertia obtusifolia</i>	Hoary guinea flower
DILLENACEAE	<i>Hibbertia scandens</i>	Climbing Guinea Flower
ERICACEAE	<i>Astroloma pinifolium</i>	Pine Heath
ERICACEAE	<i>Leucopogon ericoides</i>	
ERICACEAE	<i>Leucopogon esquamatus</i>	
ERICACEAE	<i>Leucopogon lanceolatus</i>	
ERICACEAE	<i>Leucopogon leptospermoides</i>	
ERICACEAE	<i>Leucopogon muticus</i>	Blunt Beard-heath
ERICACEAE	<i>Leucopogon parviflorus</i>	Coastal Beard-heath
ERICACEAE	<i>Monotoca elliptica</i>	Tree Broom-heath
EUPHORBIACEAE	<i>Homalanthus populifolius</i>	Bleeding Heart
EUPHORBIACEAE	<i>Ricinocarpos pinifolius</i>	Wedding Bush
FABACEAE (FABOIDEAE)	<i>Bossiaea ensata</i>	Sword Bossiaea
FABACEAE (FABOIDEAE)	<i>Bossiaea heterophylla</i>	Variable Bossiaea
FABACEAE (FABOIDEAE)	<i>Bossiaea rhombifolia</i>	
FABACEAE (FABOIDEAE)	<i>Desmodium gunnii</i>	Slender tick trefoil
FABACEAE (FABOIDEAE)	<i>Desmodium varians</i>	Slender Tick-trefoil
FABACEAE (FABOIDEAE)	<i>Dillwynia retorta</i>	
FABACEAE (FABOIDEAE)	<i>Kennedia rubicunda</i>	Red Kennedy Pea
FABACEAE (FABOIDEAE)	<i>Phyllota phyllicoides</i>	Heath Phyllota
FABACEAE (MIMOSOIDEAE)	<i>Acacia longifolia</i>	Sydney Golden Wattle

Family	Scientific Name	Common Name
FABACEAE (MIMOSOIDEAE)	<i>Acacia sophorae</i>	Coastal Wattle
FABACEAE (MIMOSOIDEAE)	<i>Acacia suaveolens</i>	Sweet Wattle
FABACEAE (MIMOSOIDEAE)	<i>Acacia ulicifolia</i>	Prickly Moses
GESNERIACEAE	<i>Fieldia australis</i>	Fieldia
GOODENIACEAE	<i>Scaevola calendulacea</i>	Dun Fan Flower
HALORAGACEAE	<i>Gonocarpus tetragynus</i>	
IRIDACEAE	<i>Patersonia spp.</i>	Purple Flag
LAURACEAE	<i>Cinnamomum camphora*</i>	Camphor Laurel
LOMANDRACEAE	<i>Lomandra glauca</i>	Pale Mat-rush
LOMANDRACEAE	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
LORANTHACEAE	<i>Benthamina alyxifolia</i>	
MALVACEAE	<i>Sida rhombifolia*</i>	Paddy's lucerne
MENISPERMACEAE	<i>Stephania japonica</i>	Snake Vine
MYOPORACEAE	<i>Myoporum boninense</i> <i>subsp. australe</i>	
MYRTACEAE	<i>Angophora costata</i>	Smooth-barked Apple
MYRTACEAE	<i>Corymbia gummifera</i>	Red Bloodwood
MYRTACEAE	<i>Corymbia intermedia</i>	Pink Bloodwood
MYRTACEAE	<i>Eucalyptus pilularis</i>	Blackbutt
MYRTACEAE	<i>Eucalyptus robusta</i>	Swamp Mahogany
MYRTACEAE	<i>Ochrosperma lineare</i>	
MYRTACEAE	<i>Leptospermum arachnoides</i>	
MYRTACEAE	<i>Leptospermum juniperinum</i>	Prickly Tea-tree
MYRTACEAE	<i>Leptospermum laevigatum</i>	Coastal Tea-tree
MYRTACEAE	<i>Leptospermum liversidgei</i>	Olive Tea-tree
MYRTACEAE	<i>Leptospermum polygalifolium</i>	Tantoon
OCHNACEAE	<i>Ochna serrulata</i>	Mickey Mouse Plant
OLACACEAE	<i>Olax stricta</i>	

Family	Scientific Name	Common Name
ORCHIDACEAE	<i>Caleana major</i>	Large Duck Orchid
<b>ORCHIDACEAE</b>	<b><i>Genoplesium littorale</i> syn. <i>Corunastylis littoralis</i></b>	<b>Tuncurry Midge-Orchid</b>
ORCHIDACEAE	<i>Pterostylis longifolia</i>	Tall Greenhood
OXALIDACEAE	<i>Oxalis rubens</i>	
PHORMIACEAE	<i>Dianella caerulea</i> var. <i>Caerulea</i>	Blue Flax-lily
PHORMIACEAE	<i>Dianella crinoides</i>	
PHORMIACEAE	<i>Dianella longifolia</i>	Blue Flax-lily
PHYLLANTHACEAE	<i>Breynia oblongifolia</i>	Coffee Bush
PINACEAE	<i>Pinus elliotii</i> *	Slash Pine
PITTOSPORACEAE	<i>Billardiera scandens</i>	Appleberry
PITTOSPORACEAE	<i>Pittosporum undulatum</i>	Sweet Pittosporum
POACEAE	<i>Andropogon virginicus</i> *	Whisky Grass
POACEAE	<i>Austrodanthonia tenuior</i>	Wallaby Grass
POACEAE	<i>Briza maxima</i> *	Quaking Grass
POACEAE	<i>Chloris gayana</i> *	Rhodes Grass
POACEAE	<i>Cymbopogon refractus</i>	Barbed Wire Grass
POACEAE	<i>Cynodon dactylon</i>	Common Couch
POACEAE	<i>Dichelachne</i> sp.	
POACEAE	<i>Echinopogon caespitosus</i>	Hedgehog Grass
POACEAE	<i>Entolasia marginata</i>	Bordered Panic
POACEAE	<i>Entolasia stricta</i>	
POACEAE	<i>Eragrostis curvula</i> *	African Lovegrass
POACEAE	<i>Imperata cylindrica</i>	Blady Grass
POACEAE	<i>Melinis repens</i> *	Red Natal Grass
POACEAE	<i>Microlaena stipoides</i>	Weeping Grass
POACEAE	<i>Panicum simile</i>	Two-colour Panic
POACEAE	<i>Poa labillardierei</i>	Tussock Grass

Family	Scientific Name	Common Name
POACEAE	<i>Setaria viridis</i> *	Green Pigeon Grass
POACEAE	<i>Stenotaphrum secundatum</i> *	Buffalo Grass
POACEAE	<i>Themeda australis</i>	Kangaroo Grass
POACEAE	<i>Zoysia macrantha</i>	Prickly Couch
POLYGALACEAE	<i>Comesperma ericinum</i>	
POLYPODIACEAE	<i>Pyrrosia rupestris</i>	Rock Felt Fern
PROTEACEAE	<i>Banksia aemula</i>	Wallum Banksia
PROTEACEAE	<i>Banksia ericifolia</i> subsp. <i>Macrantha</i>	
PROTEACEAE	<i>Banksia integrifolia</i>	Coast Banksia
PROTEACEAE	<i>Banksia serrata</i>	Old-man Banksia
PROTEACEAE	<i>Conospermum taxifolium</i>	
PROTEACEAE	<i>Persoonia lanceolata</i>	Lance Leaf Geebung
PROTEACEAE	<i>Persoonia levis</i>	Broad-leaved Geebung
PROTEACEAE	<i>Persoonia linearis</i>	Narrow-leaved Geebung
PROTEACEAE	<i>Persoonia virgata</i>	
PROTEACEAE	<i>Petrophile pulchella</i>	Conesticks
RESTIONACEAE	<i>Hypolaena fastigiata</i>	
RUBIACEAE	<i>Pomax umbellata</i>	
RUTACEAE	<i>Asterolasia correifolia</i>	
RUTACEAE	<i>Boronia pinnata</i>	
RUTACEAE	<i>Correa reflexa</i>	Common Correa
RUTACEAE	<i>Eriostemon australasius</i>	Wax Flower
RUTACEAE	<i>Phebalium squamulosum</i>	Scaly Phebalium
RUTACEAE	<i>Zieria arborescens</i>	Stinkwood
RUTACEAE	<i>Zieria smithii</i>	Sandfly Zieria
SAPINDACEAE	<i>Cupaniopsis anacardioides</i>	Tuckeroo
SAPINDACEAE	<i>Dodonaea triquetra</i>	Large-leaf Hop-bush
SCHIZAEACEAE	<i>Schizaea bifida</i>	

Family	Scientific Name	Common Name
SCROPHULARIACEAE	<i>Veronica plebeia</i>	Trailing Speedwell
SOLANACEAE	<i>Solanum chenopodioides</i>	Whitetip Nightshade
SOLANACEAE	<i>Solanum mauritianum</i>	Wild Tobacco Bush
VERBENACEAE	<i>Lantana camara</i> *	Lantana
XANTHORRHOEACEAE	<i>Xanthorrea spp.</i>	Grass Tree
XANTHORRHOEACEAE	<i>Xanthorrea macronema</i>	Grass Tree

\* Denotes Introduced Species; **Bold** Text Denotes Threatened Species

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# Appendix B

## Fauna Lists

## Fauna Species Recorded within North Tuncurry Site

Family	Scientific Name	Common Name	RPS	ERM
<b>AMPHIBIANS (note: all amphibians were recorded within the golf course)</b>				
HYLIDAE	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog		✓
HYLIDAE	<i>Litoria latopalmata</i>	Broad-palmed Frog	✓	
HYLIDAE	<i>Litoria peronii</i>	Peron's Tree Frog		✓
HYLIDAE	<i>Litoria revelata</i>	Revealed Frog		✓
HYLIDAE	<i>Litoria tyleri</i>	Tyler's Tree Frog		✓
MYOBATRACHIDAE	<i>Crinia signifera</i>	Common Eastern Froglet		✓
MYOBATRACHIDAE	<i>Limnodynastes peronii</i>	Striped Marsh Frog	✓	
<b>REPTILES</b>				
AGAMIDAE	<i>Amphibolurus muricatus</i>	Jacky Lizard	✓	✓
ELAPIDAE	<i>Demansia psammophis</i>	Yellow-faced Whipsnake	✓	
SCINCIDAE	<i>Ctenotus taeniolatus</i>	Copper-tailed Skink	✓	
SCINCIDAE	<i>Ctenotus robustus</i>	Eastern Striped Skink	✓	
SCINCIDAE	<i>Lampropholis delicata</i>	Garden Skink	✓	
VARANIDAE	<i>Varanus varius</i>	Lace Monitor	✓	
<b>BIRDS</b>				
ACANTHIZIDAE	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	✓	
ACANTHIZIDAE	<i>Acanthiza pusilla</i>	Brown Thornbill		✓
ACANTHIZIDAE	<i>Sericornis frontalis</i>	White-browed Scrubwren	✓	✓
ACCIPITRIDAE	<i>Accipiter fasciatus</i>	Brown Goshawk	✓	
<b>ACCIPITRIDAE</b>	<b><i>Pandion cristatus</i></b>	<b>Eastern Osprey</b>		✓
ACCIPITRIDAE	<i>Haliastur indus</i>	Brahminy Kite	✓	
ALCEDINIDAE	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	✓	✓
ALCEDINIDAE	<i>Todiramphus sanctus</i>	Sacred Kingfisher		✓
ANATIDAE	<i>Anas superciliosa</i>	Pacific Black Duck		✓
ANATIDAE	<i>Chenonetta jubata</i>	Australian Wood Duck		✓
APODIDAE	<i>Hirundapus caudacutus</i>	White-throated Needletail	✓	

Family	Scientific Name	Common Name	RPS	ERM
ACCIPITRIDAE	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	✓	
ACCIPITRIDAE	<i>Milvus sphenurus</i>	Whistling Kite	✓	
ACCIPITRIDAE	<i>Elanus axillaris</i>	Black-shouldered Kite	✓	
ARDEIDAE	<i>Egretta novaehollandiae</i>	White-faced Heron	✓	
ARTAMIDAE	<i>Cracticus nigrogularis</i>	Pied Butcherbird	✓	✓
ARTAMIDAE	<i>Cracticus torquatus</i>	Grey Butcherbird	✓	✓
ARTAMIDAE	<i>Gymnorhina tibicen</i>	Australian Magpie	✓	✓
ARTAMIDAE	<i>Strepera graculina</i>	Pied Currawong	✓	✓
CACATUIDAE	<i>Eolophus roseicapillus</i>	Galah	✓	
CACATUIDAE	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	✓	✓
CAMPEPHAGIDAE	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	✓	✓
CENTROPODIDAE	<i>Centropus phasianinus</i>	Pheasant Coucal	✓	✓
COLUMBIDAE	<i>Columba leucomela</i>	White-headed Pigeon		✓
COLUMBIDAE	<i>Geopelia humeralis</i>	Bar-shouldered Dove	✓	✓
COLUMBIDAE	<i>Macropygia amboinensis</i>	Brown Cuckoo-Dove		✓
COLUMBIDAE	<i>Ocyphaps lophotes</i>	Crested Pigeon	✓	✓
COLUMBIDAE	<i>Phaps chalcoptera</i>	Common Bronzewing	✓	✓
COLUMBIDAE	<i>Phaps elegans</i>	Brush Bronzewing	✓	
COLUMBIDAE	<i>Streptopelia chinensis*</i>	Spotted Turtle-dove		✓
CORACIIDAE	<i>Eurystomus orientalis</i>	Dollarbird		✓
CORVIDAE	<i>Corvus coronoides</i>	Australian Raven	✓	✓
CORVIDAE	<i>Corvus orru</i>	Torresian Crow	✓	
CORVIDAE	<i>Corvus tasmanicus</i>	Forest Raven	✓	
CUCULIDAE	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	✓	✓
CUCULIDAE	<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo		✓
DICRURIDAE	<i>Dicrurus bracteatus</i>	Spangled Drongo	✓	✓
DICRURIDAE	<i>Grallina cyanoleuca</i>	Magpie-lark	✓	✓
DICRURIDAE	<i>Rhipidura albiscapa</i>	Grey Fantail	✓	✓



Family	Scientific Name	Common Name	RPS	ERM
DICRURIDAE	<i>Rhipidura leucophrys</i>	Willie Wagtail		✓
ESTRILDIDAE	<i>Neochmia temporalis</i>	Red-browed Finch	✓	✓
EUPETIDAE	<i>Psophodes olivaceus</i>	Eastern Whipbird	✓	✓
FALCONIDAE	<i>Falco berigora</i>	Brown Falcon		✓
FALCONIDAE	<i>Falco peregrinus</i>	Peregrine Falcon	✓	
<b>HAEMATOPODIDAE</b>	<b><i>Haematopus longirostris</i></b>	<b>Australian Pied Oystercatcher</b>	✓	
HIRUNDINIDAE	<i>Hirundo neoxena</i>	Welcome Swallow	✓	✓
LARIDAE	<i>Chroicocephalus novaehollandiae</i>	Silver Gull	✓	
LARIDAE	<i>Thalasseus bergii</i>	Crested Tern	✓	
MALURIDAE	<i>Malurus cyaneus</i>	Superb Fairy-wren	✓	✓
MALURIDAE	<i>Malurus lamberti</i>	Variegated Fairy-wren	✓	✓
MELIPHAGIDAE	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	✓	✓
MELIPHAGIDAE	<i>Anthochaera carunculata</i>	Red Wattlebird	✓	✓
MELIPHAGIDAE	<i>Anthochaera chrysoptera</i>	Little Wattlebird	✓	✓
MELIPHAGIDAE	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	✓	✓
MELIPHAGIDAE	<i>Lichmera indistincta</i>	Brown Honeyeater		✓
MELIPHAGIDAE	<i>Manorina melanocephala</i>	Noisy Miner		✓
MELIPHAGIDAE	<i>Meliphaga lewinii</i>	Lewin's Honeyeater	✓	✓
MELIPHAGIDAE	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater		✓
MELIPHAGIDAE	<i>Philemon corniculatus</i>	Noisy Friarbird	✓	✓
MELIPHAGIDAE	<i>Phylidonyris niger</i>	White-cheeked Honeyeater	✓	✓
MELIPHAGIDAE	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater		✓
MELIPHAGIDAE	<i>Plectorhyncha lanceolata</i>	Striped Honeyeater		✓
MOTACILLIDAE	<i>Anthus novaeseelandiae</i>	Australasian Pipit	✓	
MEROPIDAE	<i>Merops ornatus</i>	Rainbow Bee-eater		✓
ORIOOLIDAE	<i>Oriolus sagittatus</i>	Olive-backed Oriole		✓

Family	Scientific Name	Common Name	RPS	ERM
PACHYCEPHALIDAE	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	✓	✓
PACHYCEPHALIDAE	<i>Pachycephala pectoralis</i>	Golden Whistler	✓	✓
PARDALOTIDAE	<i>Gerygone mouki</i>	Brown Gerygone	✓	
PHASIANIDAE	<i>Coturnix ypsilophora</i>	Brown Quail	✓	
PHASIANIDAE	<i>Turnix varius</i>	Painted Button-quail	✓	
PELECANIDAE	<i>Pelecanus conspicillatus</i>	Australian Pelican	✓	✓
PETROICIDAE	<i>Eopsaltria australis</i>	Eastern Yellow Robin	✓	✓
<b>PSITTACIDAE</b>	<b><i>Glossopsitta pusilla</i></b>	<b>Little Lorikeet</b>	✓	
PSITTACIDAE	<i>Platycercus eximius</i>	Eastern Rosella	✓	✓
PSITTACIDAE	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet	✓	✓
PSITTACIDAE	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	✓	✓
PTILONORHYNCHIDAE	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird	✓	✓
STURNIDAE	<i>Acridotheres tristis</i> *	Common Myna		✓
ZOSTEROPIDAE	<i>Zosterops lateralis</i>	Silvereeye	✓	✓
<b>MAMMALS</b>				
<b>BURRAMYIDAE</b>	<b><i>Cercartetus nanus</i></b>	<b>Eastern Pygmy Possum</b>	✓	
CANIDAE	<i>Canis lupus dingo</i> *	Dingo	✓	
CANIDAE	<i>Canis lupus familiaris</i> *	Dog		✓
CANIDAE	<i>Vulpes vulpes</i> *	Fox	✓	✓
DASYURIDAE	<i>Antechinus flavipes</i>	Yellow-footed Antechinus		✓
DASYURIDAE	<i>Antechinus stuartii</i>	Brown Antechinus	✓	
<b>DASYURIDAE</b>	<b><i>Phascogale tapoatafa</i></b>	<b>Brush-tailed Phascogale</b>	✓	✓
LEPORIDAE	<i>Oryctolagus cuniculus</i> *	European Rabbit	✓	✓
LEPORIDAE	<i>Lepus capensis</i>	Brown Hare	✓	
MACROPODIDAE	<i>Wallabia bicolor</i>	Swamp Wallaby	✓	✓
MACROPODIDAE	<i>Macropus rufogriseus</i>	Red-necked Wallaby	✓	
<b>MOLOSSIDAE</b>	<b><i>Mormopterus norfolkensis</i></b>	<b>East-coast Freetail-bat</b>	✓	✓
MOLOSSIDAE	<b><i>Mormopterus sp. 2</i></b>	Eastern Freetail-bat	✓	

Family	Scientific Name	Common Name	RPS	ERM
MOLOSSIDAE	<i>Austronomus australis</i>	White-striped Freetail-bat	✓	✓
MURIDAE	<i>Mus musculus*</i>	House Mouse	✓	
MURIDAE	<i>Rattus fuscipes</i>	Bush Rat	✓	
MURIDAE	<i>Rattus lutreolus</i>	Swamp Rat	✓	
MURIDAE	<i>Rattus rattus*</i>	Black Rat	✓	✓
PETAURIDAE	<i>Petaurus breviceps</i>	Sugar Glider	✓	✓
<b>PETAURIDAE</b>	<b><i>Petaurus norfolcensis</i></b>	<b>Squirrel Glider</b>	✓	✓
PSEUDOCHEIRIDAE	<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	✓	✓
<b>PTEROPODIDAE</b>	<b><i>Pteropus poliocephalus</i></b>	<b>Grey-headed Flying-fox</b>	✓	✓
<b>PTEROPODIDAE</b>	<b><i>Syconycteris australis</i></b>	<b>Common Blossom Bat</b>	✓	
RHINOLOPHIDAE	<i>Rhinolophus megaphyllus</i>	Eastern horseshoe bat	✓	
TACHYGLOSSIDAE	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	✓	
VESPERTILIONIDAE	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	✓	✓
VESPERTILIONIDAE	<i>Chalinolobus morio</i>	Chocolate Wattled Bat	✓	
<b>VESPERTILIONIDAE</b>	<b><i>Falsistrellus tasmaniensis</i></b>	<b>Eastern falsistrelle</b>	✓	
<b>VESPERTILIONIDAE</b>	<b><i>Miniopterus australis</i></b>	<b>Little Bentwing-bat</b>	✓	
<b>VESPERTILIONIDAE</b>	<b><i>Miniopterus schreibersii oceanensis</i></b>	<b>Eastern Bentwing-bat</b>	✓	
VESPERTILIONIDAE	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	✓	
VESPERTILIONIDAE	<i>Saccolaimus flaviventris</i>	Yellow-bellied sheath-tail bat	✓	
<b>VESPERTILIONIDAE</b>	<b><i>Scoteanax rueppellii</i></b>	<b>Greater Broad-nosed Bat</b>	✓	✓
VESPERTILIONIDAE	<i>Vespadelus darlingtoni</i>	Large Forest Bat	✓	
VESPERTILIONIDAE	<i>Vespadelus pumilus</i>	Eastern Forest Bat	✓	✓

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## Appendix C

*Corunastylis littoralis* Tuncurry Midge Orchid Combined Survey  
Results 2010/2011

*Corunastylis littoralis*  
Tuncurry Midge Orchid  
Combined Survey Results  
2010/2011

North Tuncurry

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Report No: 26414

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<i>Draft 2</i>	<i>Ecological Report</i>	<i>PH / SC</i>	<i>TL/MD</i>	<i>20/6/11</i>		<i>MD</i>	<i>23-6-2011</i>
<i>Final</i>	<i>Final for Issue</i>	<i>PH / SC</i>	<i>TL/MD</i>	<i>16/8/11</i>		<i>MD</i>	<i>16-8-2011</i>

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# 1 Introduction

RPS Newcastle has been commissioned by Landcom to undertake detailed surveys for the critically endangered *Corunastylis littoralis* (Tuncurry Midge Orchid). The survey work has been conducted over a proposed development site, Lot 331 DP 1104340, located at North Tuncurry (the site) and over various other lands between Old Bar in the north and Booti Booti National Park in the south.

The surveys were conducted over two successive flowering seasons in 2010 and 2011 and the purpose of the surveys was to:

- Ascertain the likely numbers of the orchid on the site;
- Gain a better understanding of the geographical range of the species;
- Establish the habitat preference; and
- Provide insights into the ecology of this poorly understood species.

The 2010 surveys within the site concentrated on habitat type known to support the orchid from previous survey work by others. These surveys recorded the majority of Tuncurry Midge Orchid (TMO) individuals within disturbed areas of the site and within adjacent heath habitats. It was therefore deduced, similar to the available literature on this species, that TMO responds well to disturbance, whether this is through mechanical, fire or other disturbance mechanisms. A question however remained as to whether TMO also occurred within the less disturbed dense core heath habitat, which occupies the majority of the site.

Accordingly the 2011 survey work within the North Tuncurry site focussed on stratified sampling of the under-surveyed heath habitats to ultimately estimate the potential population within this habitat on site. This habitat type had previously been under-surveyed due to the physical difficulty of walking through the dense, spiky heath.

In addition to the on-site surveys, additional off-site surveys were conducted in 2011, principally in lands within proximity to the site, which have had TMO previously recorded and / or have potential habitat present. The results of all survey work to date are presented in this report.

## 1.1 Background

TMO is listed as critically endangered under the Environment Protection and Biodiversity Conservation Act 1999 (Cwlth) (EPBC Act) and Threatened Species Conservation Act 1995 (TSC Act). The species is a small midge orchid which has been recorded in the Tuncurry locality, NSW, within the Great Lakes Local Government Area (LGA). The critically endangered status of TMO is predominately due to its very restricted distribution and hence vulnerability to impacts such as weed invasion and habitat loss.



---

The site was first reported as being potentially important for TMO in Paget A (2008). Paget recorded 452 individuals from 21 locations scattered across the site. Records were mainly along access tracks, along the major power easement running north-south and within a 'core population' within the north of the site. Using this data, Paget estimated a total population size for the current site of between 600 and 1200 plants. Paget also undertook searches within potential habitat to the north and south of the site, particularly within Darawank Nature Reserve and Booti Booti National Park. No additional populations were recorded at that time.

In 2010 RPS undertook additional field surveys targeting the TMO within the site and throughout the wider Forster-Tuncurry area. RPS was able to collect new information on the distribution, abundance and habitat characteristics of the species. The 2010 RPS surveys recorded TMO within three locations:

- North Tuncurry. A total of 1812 individual plants were identified by RPS within the same area as identified by Paget (2008). Hereafter this population is referred to as the 'North Tuncurry population'.
- West of Wallamba River in Nabic locality. A total of 58 individual plants were identified. New location. Hereafter this population is referred to as the 'West of Wallamba River population'.
- Booti Booti National Park. A total of 90 individual plants were identified. New location. Hereafter this population is referred to as the 'Booti Booti NP population'.

The 2011 surveys sought to establish the extent TMO population within lands outside the proposed development site and to further expand the understanding of TMO habitat usage through systematic quadrat surveys of the dense heath environs within the site.

## 2 Methods

### 2.1 On-site Surveys

A number of targeted surveys for TMO have been completed by RPS to date. These have been conducted over a range of areas and over two flowering periods. A standard search methodology has been maintained throughout. The general methodology has consisted of two RPS ecologists walking parallel transects spaced approximately 10m apart within habitat areas, walking transects and quadrat searches within known habitats within the site. These habitats included areas of disturbance such as power easements and tracks. Vegetation communities and habitats where the TMO has been previously recorded were also targeted. Where positive records are made, searches within adjacent vegetation are also undertaken in attempt to record additional individuals and improve the understanding of habitat associations. Above ground stems were counted and mapped using a differential Trimble Geo XH GPS with sub-metre accuracy (after post-processing).

During the 2011 surveys, a variation of this methodology was required to enable a population estimate to be calculated that included the heath environs on the North Tuncurry development site. A series of random plots were set up within the heath vegetation within the site, each being 40 x 40m (0.16ha) in size. Within each of these plots, two RPS ecologists walked parallel transects approximately 2m apart (refer to Figure 2-1 below).

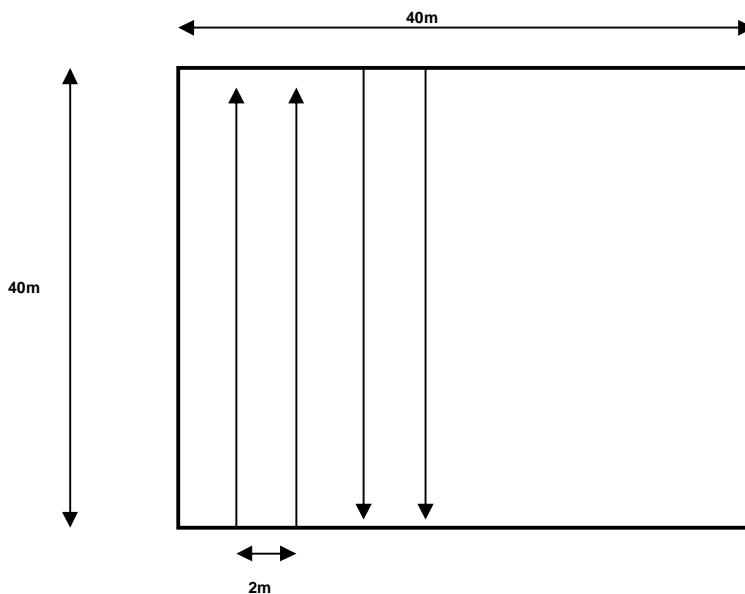


Figure 2-1: Diagram of plot (not to scale)

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Given the variability of heath vegetation within the site, which may have potential implications towards TMO habitat suitability, several parameters were recorded within each quadrat. These included:

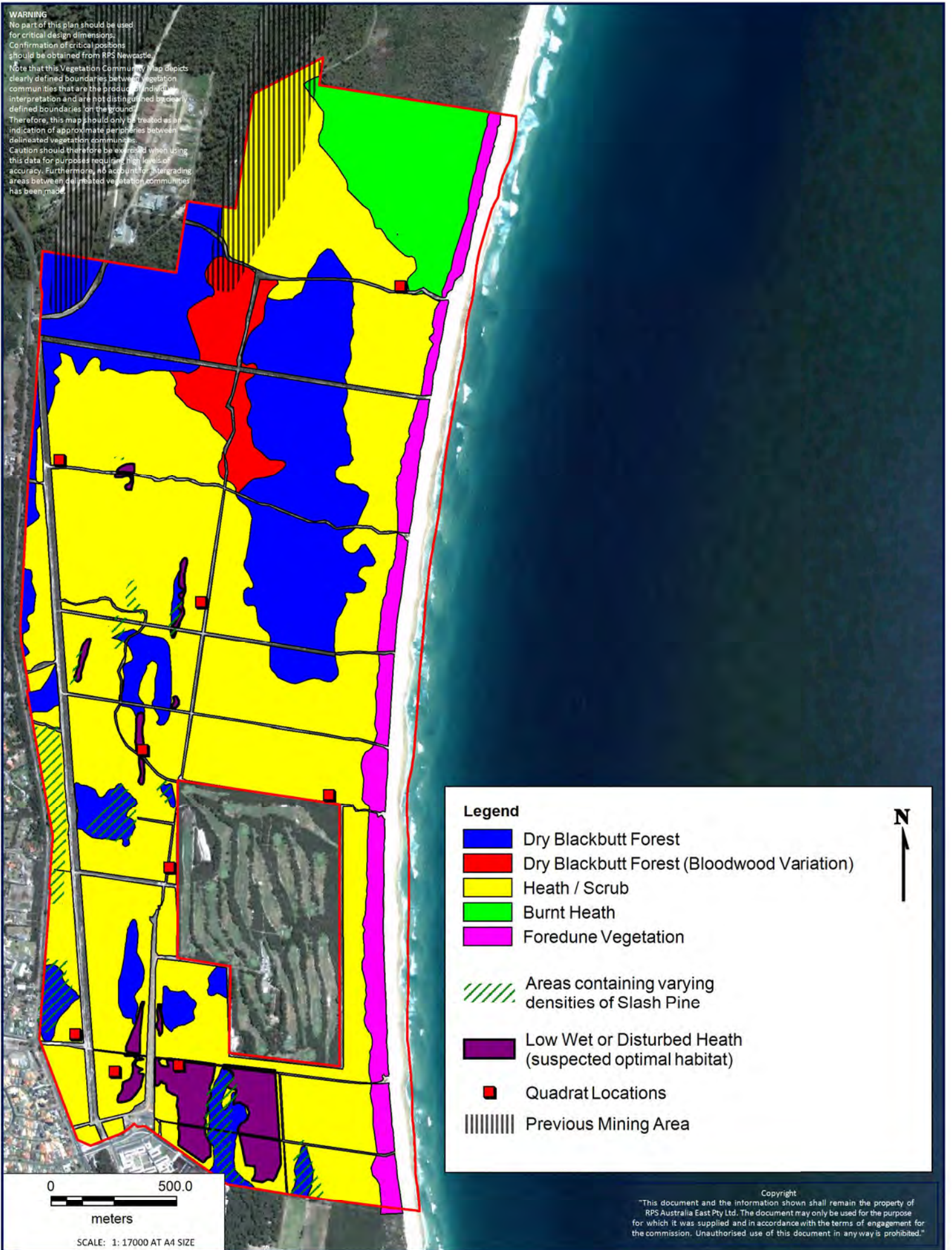
- species and percentage foliage cover (PFC) of each strata;
- height of vegetation;
- thickness of ground debris;
- percentage cover of ground debris; and
- disturbance levels.

Collection of these attributes within each quadrat has expanded the knowledge of the habitat preferences of TMO. Additionally it allows identification of areas of similar vegetation structure in the wider Great Lakes area that may accommodate TMO.

The surveyed quadrat locations are shown in Figure 2-2 below.

**WARNING**  
 No part of this plan should be used for critical design dimensions. Confirmation of critical positions should be obtained from RPS Newcastle.

Note that this Vegetation Community Map depicts clearly defined boundaries between vegetation communities that are the product of individual interpretation and are not distinguished by clearly defined boundaries on the ground. Therefore, this map should only be treated as an indication of approximate peripheries between delineated vegetation communities. Caution should therefore be exercised when using this data for purposes requiring high levels of accuracy. Furthermore, no account for intergrading areas between delineated vegetation communities has been made.



**Legend**

- Dry Blackbutt Forest
- Dry Blackbutt Forest (Bloodwood Variation)
- Heath / Scrub
- Burnt Heath
- Foredune Vegetation
- Areas containing varying densities of Slash Pine
- Low Wet or Disturbed Heath (suspected optimal habitat)
- Quadrat Locations
- Previous Mining Area

N  
↑

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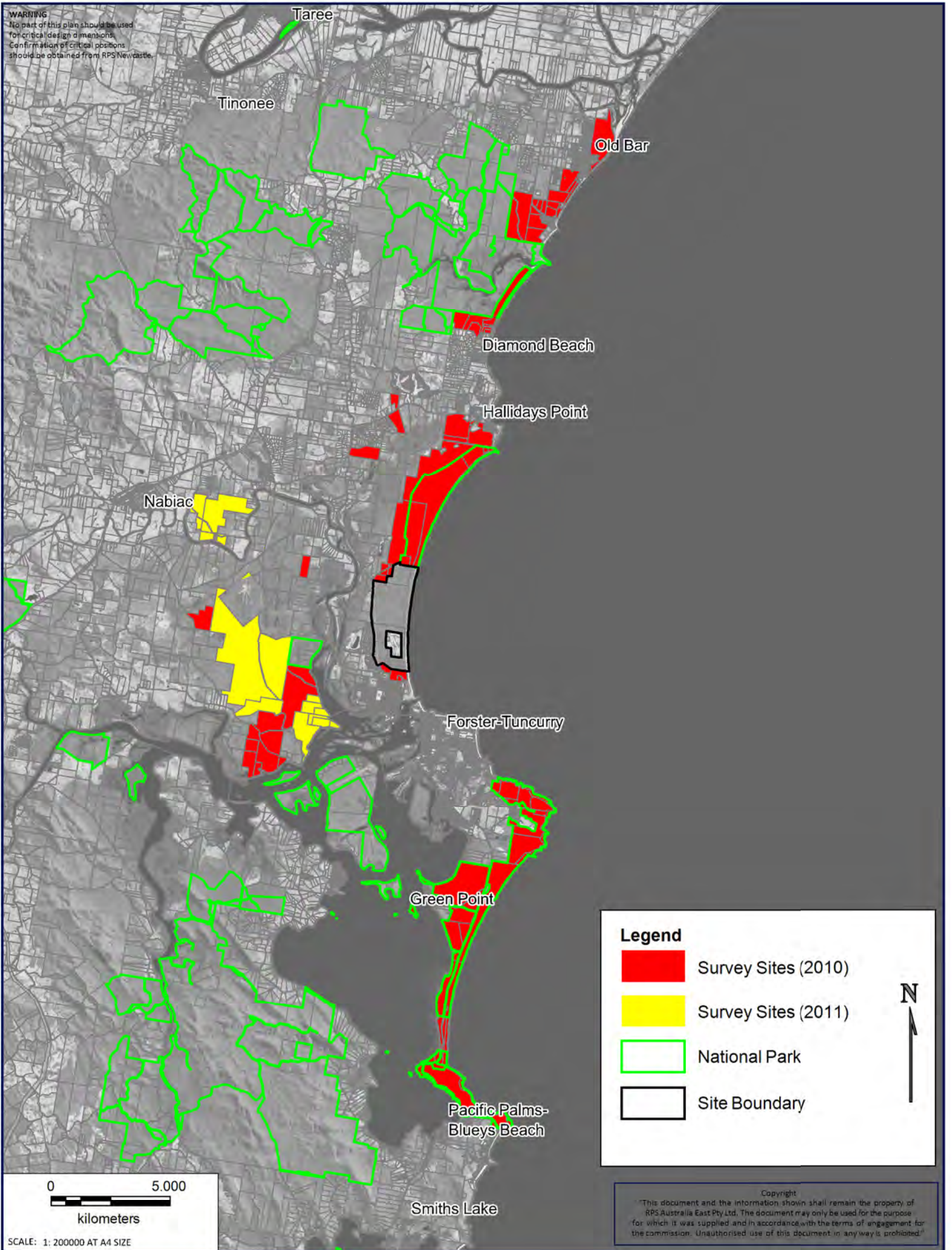
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## 2.2 Off-site Surveys

Off-site areas were targeted by RPS in both 2010 and 2011 in order to ascertain the extent of the orchid population in the wider region (see Figure 2-3). Surveys included lands owned by Crown Lands, MidCoast Water (MCW) and Foster Local Aboriginal Land Council (FLALC).

The general methodology for off-site lands consisted of two RPS ecologists' walking parallel transects spaced approximately 10 m apart within habitat areas, walking transects and quadrat searches within known habitats within the site. This methodology was consistent with the previously outlined on-site survey methodology. These habitats included areas of disturbance such as power easements and tracks. Where positive records were made, searches within adjacent vegetation were also undertaken in an attempt to record additional individuals and improve the understanding of habitat associations. Above ground stems were counted and mapped using a differential Trimble Geo XH GPS with sub-metre accuracy (after post processing).

**WARNING**  
 No part of this plan should be used  
 for critical design dimensions.  
 Confirmation of critical positions  
 should be obtained from RPS Newcastle.



**Legend**

- Survey Sites (2010)
- Survey Sites (2011)
- National Park
- Site Boundary

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↑

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TITLE: FIGURE 2-3: REGIONAL OFFSITE ORCHID SURVEY LOCATIONS

LOCATION: NORTHERN GREAT LAKES

DATUM: DATUM  
 PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 10/6/2011  
 PURPOSE: REPORT FIGURE

LAYOUT REF: 26414 - North Tuncurry\  
 10-Drafting\Orchid Investigation Areas\  
 2011 TMO Report Figures  
 VERSION (PLAN BY): PH (B-A4)

CLIENT: LANDCOM  
 JOB REF: 26414

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## 3 Results

### 3.1 Combined Surveys

In 2010, 1275 individuals were located within the site (Refer to Figure 3-1). An additional 537 individuals were recorded to the immediate northwest of the site adjacent to the tip. The large number of orchids, which were detected within and to the northwest of the site, potentially extends the areas of 'core population' as described by Paget (2008). Additional observations of orchids have also been made within other areas of the site.

In the wider area, surveys undertaken in 2010 and 2011 have established a greater range of occurrence than previously known for this species (Figure 3-1). A total of 90 individuals have been recorded south of Forster in the Booti Booti National Park area. Similarly, 62 individuals have been recorded to the west of Tuncurry, closer to Nabiac. A small number of additional plants were also recorded in 2011.

**Table 3-1: Combined Orchid Results**

Location	Paget (2008)	RPS (2010)	RPS (2011)	TOTAL
North Tuncurry Project Site	452	1275	11	1738
Adjacent to Tip offsite	130	537		667
Crown Lands North		4		4
Crown Lands South		54		54
MidCoast Water Lands North			2	2
MidCoast Water Lands South			2	2
Booti Booti NP		90		90
<b>TOTAL</b>	<b>582</b>	<b>1960</b>	<b>15</b>	<b>2557</b>

Note: The above data assumes that orchid locations recorded by Paget (2008) have not been re-recorded by RPS (2010-2011).

In summary, a total of 1975 stems have been recorded from the RPS combined surveys to date. This is made up of 1286 stems within the study site, 90 within National Parks, 537 adjacent to the tip (in Aboriginal Title Claim Areas), 58 Crown Land and 4 within MCW land. Paget's 2008 survey work recorded 582 stems, predominately within the 'core population' on and adjacent to the site in the north. On this basis, of the total recorded population 1738 stems exist on site and 819 occur offsite.

### 3.2 Site Population Estimates

During the 2011 survey period, two ecologists conducted a number of randomly placed 40 x 40 metre quadrats within the dominant heath vegetation community within the site. Within each of the quadrats, a range of attributes were recorded along with the numbers of TMO, including:

- Floristic dominance within each strata (canopy, mid and ground);
- Foliage cover (percent foliage cover based on the Specht methodology);
- Leaf litter percentage and type; and

- Disturbance level.

This methodology was discussed with OEH prior to undertaking the surveys.

A total of nine quadrats searches were undertaken during the survey yielding a total of 11 individuals. The nine quadrats represent a total area of 1.44ha or 0.5% of the heath vegetation community within the site. All the TMO individuals were recorded from a single quadrat and were located in relatively close proximity to each other (within a 20 metre area).

A basic population estimate was then calculated for the heath community across the site using the mean number of stems recorded per hectare of survey effort. This resulted in an estimate of 2323 plants across the site within the heath community only. Whilst this is a relatively simplistic way of calculating an estimate, it does provide an initial indication of how many TMO might potentially be present within the heath community. Additional calculation methods are outlined below that also provide alternatives for deriving population estimates.

In an effort to qualify this general estimate further, a 95% Confidence Interval (CI) for the mean was also calculated as per the methodology described by Krebs (1999). The CI gives an interval estimate indicating a value range for the mean plants per hectare value for which if the experiment was repeated the likelihood of getting a value between those ranges is 95%. This range can be expanded out using the vegetation community area to extrapolate the population estimate. The 95% CI for the observed data ( $n=9$ ,  $\bar{x}=1.22$ ) revealed a range of 11 – 6861. Although the lower range of the interval is defined by the number of individuals observed during the study, the upper range is quite large and is a result of the high variability in the observed data ( $SD=3.6$ ,  $SE=1.2$ ).

Use of these two methods, gives an estimated TMO population within only the heath vegetation on site of 2323 plants, with the true value likely to be somewhere between 11 and 6861 plants as indicated above.

For further clarification of the distributional patterns, the heath community was further broken down based on the height class structure across the site. The single plot where the orchids were recorded during this survey was floristically similar to the majority of the heath vegetation within the site but differed slightly in that it showed signs of past fire disturbance and/or land clearance. The community structure as a result of these disturbances was very low in height (0.5 – 1m) over most of the quadrat, with the ground layer dominated by more sedges than the surrounding areas. This vegetation has affinities with wet heath and is very similar to the habitats in which orchids have been recorded in other areas off-site. It is considered that this quadrat may skew the results for the core (thick and tall) heath community even though the species diversity is very similar. On this basis if this quadrat was excluded from the heath community in general, the population estimates for the core mature heath theoretically becomes zero and better fits the observed distribution within this community thus far.

Similarly, if the observed frequency of plants found in the “wet heath” quadrat (68.75/ha) is applied to the other areas of wet and / or low heath identified on site (15.77ha) we



obtain a basic population estimate of 1084 plants occurring in the wet and / or low heath community. Again such an estimate is based on pure extrapolation from data obtained within one plot with no replication and should be interpreted with caution, however it is the opinion of the authors that this figure is likely to be the most accurate based on the observed characteristics of this species as a disturbance responsive species. This is particularly the case given that the more open nature of this variation of heath type appears to have a more open or disturbed structure.

Although a number of other attributes were collected during the quadrat searches on site, no comparisons can be drawn as orchids were only located in one plot. What can be ascertained however, is that the vegetation community the orchids were recorded in was floristically very similar to the majority of the heath vegetation within the site but and importantly differed slightly in that it showed signs of past fire disturbance and/or land clearance. The community structure therefore was very low in height (0.5 – 1m) over most of the quadrat with the ground layer dominated by more sedges than the surrounding areas (Refer to Plates 3-1 and 3-2).

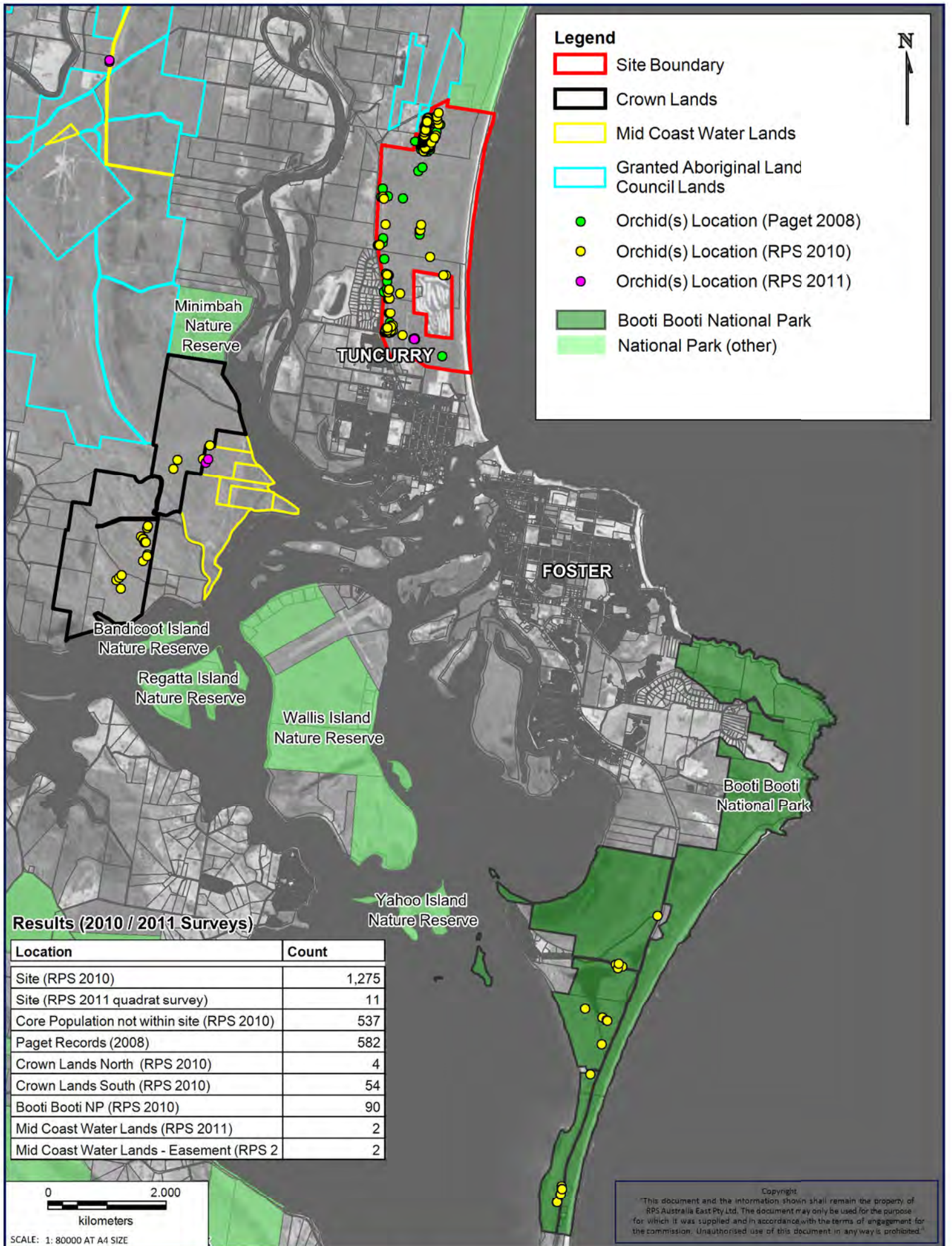


**Plate 3-1: TMO quadrat 5 vegetation structure**



**Plate 3-2 Typical ground cover in TMO plot 5**

As the plot where the orchid was found shows great similarity floristically to other areas of heath both on site and in the wider locality we can start to estimate populations within potential habitat sites. Despite the lack of knowledge about the distribution and flowering regimes of this species, population estimates based on areas of similar habitat where the orchids are known to occur may provide a valuable insight into the potential population size in the Great Lakes LGA.



TITLE: FIGURE 3-1: 2010/2011 TUNCURRY MIDGE ORCHID SURVEY SURVEY RESULTS

LOCATION: NORTH TUNCURRY

DATUM: DATUM  
PROJECTION: MGA ZONE 56 (GDA 94)

DATE: 03/6/2011  
PURPOSE: ECOLOGICAL

LAYOUT REF: 26414 - North Tuncurry\10-Drafting\Orchid Investigation Areas\2011 TMO Report Figures  
VERSION (PLAN BY): PH (B-A4)

CLIENT: LANDCOM  
JOB REF: 26414

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RPS

### 3.3 Habitat Characteristics

#### 3.3.1 SEWPAC Listing Advice

The Listing Advice from SEWPAC for the TMO (TSSC 2011) describes this species as occurring on well-drained, open sand ridges in low dense heath dominated by Straggly Baeckea (*Ochrosperma lineare*), in sparse shrubland of Tree Broom-heath (*Monotoca elliptica*) and Daphne Heath (*Brachyloma daphnoides*), and in Teatree (*Leptospermum* spp.) thickets in Blackbutt (*Eucalyptus pilularis*) woodland, with little ground cover beneath the shrubs (Jones, 2006; Paget, 2008 in TSSC, 2011). The species is described as a coloniser of disturbed spaces in coastal heathland and woodland (TSSC 2011).

#### 3.3.2 Previous Habitat Knowledge

Habitat requirements for this species are however still not well understood and current surveys continue to locate the orchid growing in new areas and within new vegetation associations. Paget (2008) lists a range of habitat types for this species and suggests the favoured habitat to be Blackbutt Woodland with a shrubby understorey as this is what is present at the “core population” to the north of the site. Paget (2008) described the possible habitat characteristics at that time as:

1. *The type location was described in the literature as being Coast Teatree Thickets but on revisiting the site it was determined to be Blackbutt (Eucalyptus pilularis) Woodland with a shrubby understorey of Lemon-scented Tea-tree (Leptospermum polygalifolium ssp cismontanum).*
2. *Nearby to the type site was a dry ridge which was considered to be even better habitat, and this ridge was almost treeless (only a few scattered Blackbutts Eucalyptus pilularis) with a sparse shrubland of Monotoca elliptica and Brachyloma daphnoides.*
3. *Some parts of the site contained a mixed Flaky-barked Teatree (Leptospermum trinervium) and Saw Banksia (Banksia serrata).*
4. *Other parts of the site 100-200m south of the Tuncurry Tip and southwards towards the Tuncurry TAFE were dominated by low (< 1.5m tall) dense heathland dominated by Ochrosperma lineare (syn. Baeckea linearis), with a range of other heathland species (eg. Eriostemon australasius, Dillwynia retorta)*

During the 2010 and 2011 surveys, plants have been observed growing in association with *Caustis recurvata*, young *Leptospermum trinervium* (Flaky-barked Teatree) and *O. lineare*. Within Site 3, TMO was also commonly found within open woodlands dominated by *Eucalyptus signata* (Scribbly Gum).

The largest known occurrence of the species occurs on Crown land located to the north of the Tuncurry township. The crown land at North Tuncurry within which the orchid occurs has a long and diverse disturbance history, and has been for the most partially to totally cleared at various stages of the last 100+ years. In the past, the site was used as a Prisoner Afforestation Camp and operated as a pine plantation with Tuncurry State

Forest declared in 1916 and revoked in 1976 (Whelans, 2007). Records also show that the site was previously occupied by mining leases, with a sand mining path to the north of the site evident on the air photos from 1980 and 1988 (Whelans, 2007). The Foster Tuncurry Golf Club was established in the area in the early 1980's. A rubbish tip and airstrip also occupied parts of the land. Based on these past land uses, it is apparent that TMO is a disturbance responsive species.

All areas of Site 3, where TMO was recorded, were also found to be disturbed, predominately by fire. In addition, those individuals recorded from Booti Booti National Park were within a power easement, similar to that of the on-site areas occupied by TMO. Despite quadrat surveys within denser heath habitats, this species has so far only been recorded within sandy habitats that are disturbed, have been disturbed in the recent past or possibly are low growing / stunted open habitat types, such as wet heaths. The data collected to date suggests that this species is disturbance responsive and potentially disturbance reliant to complete its lifecycle.

### 3.3.3 Preferred Habitat Observations Summary

In summary the preferred habitat characteristics observed so far during the Paget and RPS studies appear to consist of:

- Areas located within the currently known distribution of this species, from Pacific Palms in the south to Darawank Nature Reserve in the north and west to the Minimbah locality, including areas as close to the coastal foredune as 200m;
- Areas with a sand or sandy substrate;
- Vegetation communities such as Blackbutt Forest, Scribbly Gum Woodland and Heath, with an open understorey predominantly resulting from previous disturbances. Specific characteristics of these habitats include:
  - » Disturbed Blackbutt Open Forest;
  - » Re-growth heath communities dominated by *Caustis recurvata*, young *Leptospermum trinervium* (Flaky-barked Teatree) and *Ochrosperma lineare*;
  - » Thick stands on *L. trinervium* with intermittent *Banksia serrata*; and
  - » Low and / or Wet Heath.
- Disturbance which may have included:
  - » Bushfires, resulting in a temporarily more open understorey;
  - » Historical clearing activities and subsequent regrowth (particularly but not only sand mining); and
  - » Construction and maintenance of tracks and transmission easements.
- The Tuncurry Midge Orchid has been found to occur in partial shade, filtered light or full sun positions. It has been recorded growing through foliage of low shrubs, such as regrowth *Leptospermums* and amongst *C. recurvata*.
- This species does not seem to occur where leaf litter is thick, as caused by Banksias, Slash Pine or Eucalypts.

While disturbance does not seem to be essential to the species occurrence it appears evident that disturbance significantly increases opportunities for this species and correspondingly numbers of plants in these disturbed areas.



**Plate 3-3: Typical disturbed *C. littoralis* habitat within the site**



**Plate 3-4 – Typical vegetation structure of *C. littoralis* habitat within the more dense vegetation communities within the site**



**Plate 3-5: Scribbly Gum Woodland Habitat of Site 3**

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## 4 Conclusion

The following conclusions can be gained from the information presented in this document:

- The total number of TMO individuals recorded within the site by RPS, during the 2010 and 2011 surveys, is 1286 stems;
- The total number of TMO individuals recorded outside of the site by RPS, during the 2010 and 2011 surveys, is 689;
- The total number of TMO individuals recorded by Paget (2008), within the site is 452;
- The total number of TMO individuals recorded by Paget (2008), outside the site is 130
- Having regard to all available information on the rationale outlined in this report the estimated population in the heath area on site is approximately 1100; and
- The TMO seems to prefer disturbed habitats in general and within heath habitat it appears to prefer wet and / or low heath or disturbed environs.



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