

RIVERSIDE, TEA GARDENS

Biodiversity Mapping Report

For:

Crighton Properties

December 2011

Final



PO Box 2474, Carlingford Court 2118
www.cumberlandecology.com.au



Report No. 9116RP4

The preparation of this report has been in accordance with the brief provided by the Client and has relied upon the data and results collected at or under the times and conditions specified in the report. All findings, conclusions or recommendations contained within the report are based only on the aforementioned circumstances. The report has been prepared for use by the Client and no responsibility for its use by other parties is accepted by Cumberland Ecology.

Approved by: David Robertson

Position: Director

Signed: David Robertson

Date: 22 December, 2011

Table Of Contents

EXECUTIVE SUMMARY

1 INTRODUCTION

1.1	Purpose	1.1
1.2	Background	1.3
1.2.1	Location	1.3
1.2.2	Site Characteristics	1.3
1.2.3	Project Background	1.4
1.2.4	Proposed Project	1.4
1.3	Relevant Legislation	1.7
1.3.1	State Environmental Planning Policies	1.7
1.3.2	NSW Environmental Planning and Assessment Act 1979	1.7
1.3.3	NSW Threatened Species Conservation Act 1995	1.9
1.3.4	NSW Fisheries Management Act 1994	1.9
1.3.5	NSW Native Vegetation Act 2003	1.9
1.3.6	Commonwealth Environment Protection and Biodiversity Conservation Act 1999	1.10
1.4	Terms and Abbreviations	1.10

2 METHODOLOGY

2.1	Literature Review	2.1
2.2	Database Analysis	2.2
2.3	Flora Survey	2.2
2.3.1	Introduction	2.2
2.3.2	Vegetation Mapping	2.2
2.3.3	Vegetation Sampling	2.2
2.3.4	Plant Identification	2.3
2.3.5	Plant Community Names	2.3

Table Of Contents *(Cont'd)*

2.3.6	PATN Analysis	2.3
2.3.7	Previous Flora Surveys	2.4
2.4	Fauna Survey	2.6
2.4.1	Fauna Habitat Assessment	2.6
2.4.2	Fauna Species Surveys	2.6
2.5	Survey Effort	2.9
2.5.1	Flora	2.9
2.5.2	Fauna	2.9
2.6	Weather Conditions	2.12
2.7	Limitations	2.14
2.7.1	Flora	2.14
2.7.2	Fauna	2.14
3	RESULTS	
3.1	Introduction	3.1
3.2	Vegetation Communities	3.1
3.2.1	General Features of the Vegetation	3.1
3.2.2	Vegetation Communities	3.2
3.3	Dry Forest/Woodland Communities	3.9
3.3.1	Eucalyptus pilularis Open Forest	3.9
3.3.2	Corymbia maculata - Eucalyptus paniculata Open Forest	3.10
3.3.3	Eucalyptus umbra Open Forest	3.11
3.3.4	Eucalyptus microcorys Open Forest	3.12
3.3.5	Eucalyptus signata Woodland	3.16
3.4	Wet Forest/Woodland/Scrub/Heath	3.17
3.4.1	Corymbia gummifera Open Forest	3.17
3.4.2	Angophora costata - Eucalyptus resinifera Woodland	3.19

Table Of Contents *(Cont'd)*

3.4.3	Eucalyptus robusta Woodland/Open Forest	3.20
3.4.4	Wet Heath	3.23
3.4.5	Casuarina glauca - Melaleuca Regrowth Forest	3.24
3.4.6	Melaleuca quinquenervia Forest	3.25
3.4.7	Melaleuca ericifolia Scrub	3.26
3.5	Wetland Communities	3.28
3.5.1	Casuarina glauca Forest	3.28
3.5.2	Baumea juncea Rushland	3.29
3.5.3	Juncus kraussii Saltmarsh	3.30
3.5.4	Avicennia marina Mangroves	3.31
3.6	Exotic Communities	3.32
3.6.1	Pine Forest	3.32
3.6.2	Exotic Grassland/Pasture	3.33
3.6.3	Disturbed Estuarine Vegetation	3.33
3.7	Flora	3.34
3.8	Fauna	3.43
3.8.1	Fauna Habitat	3.43
3.8.2	Fauna Species	3.45
3.9	Wildlife Corridors	3.77
3.10	OEH Estate and RAMSAR Wetlands	3.81
3.10.1	Myall Lakes National Park	3.81
3.10.2	Port Stephens - Great Lakes Marine Park	3.81
3.10.3	RAMSAR Wetlands	3.81

4 CONCLUSION

REFERENCES

Table Of Appendices

A.	FLORA SPECIES LIST
B.	QUADRAT DATA
C.	FAUNA SPECIES LIST
D.	WETLANDS ASSESSMENT (HUNTER WETLANDS RESEARCH)
E.	SOILS ASSESSMENT (WHITEHEAD & ASSOCIATES)

List of Tables

2.1	Fauna survey techniques	2.7
2.2	Flora survey effort	2.9
2.3	Fauna survey effort	2.10
2.4	Weather conditions during Conacher 2007/2008 fauna surveys	2.13
3.1	Area of each vegetation communities recorded on the subject land	3.3
3.2	Likelihood of occurrence of threatened flora species	3.35
3.3	Blossom periods for dominant tree species	3.44
3.4	Threatened fauna species recorded on the subject land	3.45
3.5	Likelihood of occurrence of threatened fauna species	3.53
A.1	Flora species recorded on the subject land	A.1
B.1	Flora quadrat data (1 of 2)	B.1
B.2	Flora quadrat data (2 of 2)	B.23
C.1	Fauna species recorded on the subject land and adjacent land	C.1

List of Figures

1.1	Location of the subject land	1.2
1.2	Layout of the proposed development	1.6
2.1	Flora survey locations	2.5
2.2	Fauna survey locations	2.8
3.1	Broad community types recorded on the subject land	3.6

List of Figures

3.2	Vegetation communities recorded on the subject land	3.7
3.3	Endangered ecological communities recorded on the subject land	3.8
3.4	Locations of threatened fauna species recorded on the subject land	3.47
3.5	Key habitats and corridors on the subject land	3.79
3.6	Potential local movement corridors for wildlife occurring on the subject land	3.80

List of Photographs

3.1	<i>Eucalyptus pilularis</i> Open Forest	3.10
3.2	<i>Corymbia maculata</i> – <i>Eucalyptus paniculata</i> Open Forest	3.11
3.3	<i>Eucalyptus umbra</i> Open Forest	3.12
3.4	<i>Eucalyptus microcorys</i> Open Forest with regrowth vegetation	3.13
3.5	<i>Eucalyptus microcorys</i> Open Forest with grassy understorey	3.15
3.6	<i>Eucalyptus microcorys</i> Open Forest with shrubby understorey	3.15
3.7	<i>Eucalyptus signata</i> Woodland	3.17
3.8	<i>Corymbia gummifera</i> Open Forest	3.18
3.9	<i>Angophora costata</i> – <i>Eucalyptus resinifera</i> Woodland	3.20
3.10	<i>Eucalyptus robusta</i> Open Forest in the south eastern portion of the subject land	3.21
3.11	<i>Eucalyptus robusta</i> Open Forest/Woodland in the north eastern portion of the subject land	3.23
3.12	Wet Heath in the western portion of the subject land	3.24
3.13	<i>Casuarina glauca</i> – <i>Melaleuca</i> Regrowth Forest along the western boundary of the subject land	3.25
3.14	<i>Melaleuca quinquenervia</i> Forest	3.26
3.15	<i>Melaleuca ericifolia</i> Scrub	3.28
3.16	<i>Casuarina glauca</i> Forest in the eastern side of the subject land	3.29
3.17	<i>Baumea juncea</i> Rushland	3.30
3.18	<i>Juncus kraussii</i> Saltmarsh with <i>Sarcocornia quinqueflora</i> and <i>Sporobolus virginicus</i>	3.31
3.19	<i>Avicennia marina</i> Mangroves with <i>Aegiceras corniculatum</i>	3.32
3.20	Exotic Grassland in the northern eastern portion of the subject land	3.33

Executive Summary

S1 Introduction

Cumberland Ecology Pty Ltd (Cumberland Ecology) has been commissioned by Crighton Properties Pty Ltd (the proponent) to prepare a biodiversity mapping report which presents the findings of a previous assessment undertaken as part of a Part 3A development application for land in Lots 1 (part), 10, 19, 30 and 40 DP 270100 and Lots 1 and 5 (part) DP 270561 Myall Road, Tea Gardens (hereafter referred to as the 'subject land').

The purpose of this report is to describe the biodiversity values of the subject land, particularly threatened species, populations and communities that are listed under the schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

S2 Methodology

The subject land has been subject to numerous flora and fauna studies. The previous assessment made extensive use of pre-existing literature from past studies of the subject land and adjacent areas. Database analysis of flora and fauna records was also conducted for the surrounding locality using both the Department of Environment, Climate Change and Water (DECCW) Atlas of NSW Wildlife Database (DECCW) and the Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) Protected Matters Search Tool (DSEWPC 2010).

Several vegetation mapping studies have been conducted across the subject land and surrounds, including broad scale mapping across the Great Lakes LGA as well as fine scale mapping of the subject land. The most recent detailed vegetation mapping, prior to this study, was undertaken by Conacher Environmental Group (Conacher) in 2007. Cumberland Ecology conducted additional vegetation surveys to revise and update the vegetation mapping prepared by Conacher, and ground-truthed the vegetation on the subject land to examine the condition and extent of different community types. For the purposes of this report, plant community names were determined by the dominant canopy species. Names of corresponding endangered ecological communities (EECs) and equivalent BioBanking community names have also been provided.

Cumberland Ecology conducted flora surveys in accordance with the standards provided in the (then) DEC Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (Working Draft) (DEC (NSW) 2004) and the BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECC 2009). These surveys involved the following:

- Vegetation sampling within quadrats (20m x 20m) to obtain information on floristic composition and community structure;
- Random meander surveys to detect additional flora species not recorded within the quadrats;
- Targeted searches for threatened flora known or considered likely to occur within the subject land; and
- Targeted searches for endangered ecological communities (EECs) known or considered likely to occur within the subject land.

Habitat assessments were undertaken in accordance with the methodology within the BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECC 2009). Fauna surveys have been conducted on the subject land over the past two decades, most recently in 2007 and 2008 by Conacher. As these surveys were completed recently and were comprehensive, it was not considered necessary to undertake additional fauna surveys for the preparation of this report. Survey methods utilised by Conacher included:

- Amphibians: habitat searches, pitfall trapping, nocturnal habitat searches, opportunistic survey, call playback, spotlighting;
- Birds: opportunistic survey, winter bird survey, call playback, spotlighting;
- Mammals: trapping (ground and arboreal), pitfall trapping, hair tubes, diurnal observation, koala spot surveys, call playback, spotlighting, anabat detection, harp traps; and
- Reptiles: habitat searches, pitfall trapping, opportunistic survey, spotlighting.

S3 Results

S3.1 Vegetation Communities

The vegetation on the subject land forms a mosaic of woodland, forest, heath, grassland and wetland and reflects topography, drainage and land use. The subject land is mostly low lying flat land, with slopes extending southwards from low ridgelines along the northern boundary. Nevertheless, vegetation communities on site appear to be strongly influenced by minor changes in elevation and drainage patterns that are associated with this flat landscape.

Within the three broad native vegetation types and the exotic vegetation group, Cumberland Ecology recognised a suite of vegetation communities that are readily distinguishable by the dominant canopy species present. Descriptions, distribution and areas of these communities are provided in the report. Of the vegetation communities recorded, several correspond floristically to the following endangered ecological communities (EECs) listed under the TSC Act:

- Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;

- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions; and
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions.

The species assemblage within Swamp Sclerophyll Forest on the subject land corresponds to the list provided within the final determination. Despite this, the soils analysis undertaken by Whitehead & Associates (2011) across several areas of the subject lands indicates that soil types present within these areas are not of alluvial origin. Based on the assessment by Whitehead & Associates (2011), a significant portion of the subject land does not comprise soils that correspond to those listed in the final determination for Swamp Sclerophyll Forest. Based on the soils assessment, a number of recent Land and Environment Court (LEC) decisions and evidence presented by Smith (2005) in an assessment of floodplain communities, Swamp Sclerophyll Forest could not be considered as occurring above the 1-in-100 year flood line.

The vegetation communities occurring on the subject land vary in structure and condition as a result of previous and current land uses. A number of vegetation communities mapped have a structure ranging from open woodland to open forest. Previous clearing of the land has altered vegetation community structure primarily in the woodland and forest communities. The site has a history of usage for agriculture and forestry. Some of the original vegetation communities have been at least partially cleared and are now impacted by the current land use of cattle grazing.

S3.2 Flora

Over 500 flora species have been recorded on the subject land, with approximately 85% of the species being native. The plant species that dominate the major forest and woodland types are relatively consistent between the earlier surveys. No threatened flora species have been detected within the subject land. A number of threatened flora species are known from the locality, however given the extensive flora surveys undertaken on the subject land, most of these species are considered as having a low potential to occur.

S3.3 Fauna

Vegetation within the subject land provides potential habitat for a range of native vertebrate fauna species, including amphibians, birds, terrestrial and arboreal mammals, bats and reptiles. Key habitat features recorded during the current surveys included:

- Wetland and riparian environments which provide habitat for wetland birds, frogs and reptiles;
- Ground cover, leaf litter and fallen timber suitable as shelter for small terrestrial fauna species;
- Tree hollows suitable as shelter and nesting habitat for a range of hollow dependant fauna;

- Koala feed tree species; and
- Blossom-producing trees suitable for foraging for a range of nectivorous species.

Fauna surveys of the subject land have resulted in the detection of over 200 vertebrate species. This includes 20 amphibian, 125 bird, 43 mammal and 15 reptile species. A number of threatened fauna species listed under the TSC Act and EPBC Act are known to occur within the locality. The following threatened fauna have been recorded on the subject land:

- Wallum Froglet (*Crinia tinnula*);
- Varied Sitella (*Daphoenositta chrysoptera*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Black Bittern (*Ixobrychus flavicollis*);
- Osprey (*Pandion haliaetus*);
- Barking Owl (*Ninox connivens*);
- Squirrel Glider (*Petaurus norfolcensis*);
- Koala (*Phascolarctos cinereus*);
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Common Blossom-bat (*Syconycteris australis*);
- Little Bentwing-bat (*Miniopterus australis*);
- Eastern Bentwing-bat (*Miniopterus screibersii oceanensis*);
- Eastern Freetail-bat (*Mormopterus norfolkensis*); and
- Greater Broad-nosed Bat (*Scoteanax rueppellii*).

All these species are listed as Vulnerable under the TSC Act. The Koala also forms part of an endangered population in the Hawks Nest and Tea Gardens area. The Grey-headed Flying-fox is also listed as Vulnerable under the EPBC Act. A number of threatened fauna species are known from the locality and have the potential to occur on the subject land.

S3.4 Wildlife Corridors

The subject land has been mapped as forming part of a regional corridor and as a key habitat area. The subject land forms part of the Nerong – Pindimar regional corridor, which provides a link between Nerong Waterholes and Kirks Knoll (Scotts 2003). The regional corridor extends from the west to north east and covers the central and northern thirds of the



subject land. Detailed examination of the vegetation and landscape of the subject land indicates several potential local movement corridors for wildlife.

S4 Conclusion

The subject land contains endangered ecological communities, known habitat for threatened fauna species and potential habitat for threatened flora and fauna. Any future development of the site would be required to consider the impacts to biodiversity, including species, populations and communities listed under the TSC Act and EPBC Act.

Introduction

1.1 Purpose

Cumberland Ecology Pty Ltd (Cumberland Ecology) has been commissioned by Crighton Properties Pty Ltd (the proponent) to prepare a biodiversity mapping report which presents the findings of a previous assessment undertaken as part of a Part 3A development application for land in Lots 1 (part), 10, 19, 30 and 40 DP 270100 and Lots 1 and 5 (part) DP 270561 Myall Road, Tea Gardens (hereafter referred to as the 'subject land') (**Figure 1.1**).

The purpose of this report is to describe the biodiversity values of the subject land, particularly threatened species, populations and communities that are listed under the schedules of the NSW *Threatened Species Conservation Act 1995* (TSC Act) and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Specifically, this report presents to:

- A description and map of vegetation communities within the subject land, identifying any listed threatened communities;
- An identification and map of the location of threatened flora and fauna species; and
- An assessment of the likelihood that threatened flora and fauna species that could occur within the subject land.



Figure 1.1 Location of the subject land

1.2 Background

1.2.1 Location

The subject land comprises Lots 1 (part), 10, 19, 30 and 40 DP 270100 and Lots 1 and 5 (part) DP 270561 Myall Road, Tea Gardens and is approximately 222ha in size (**Figure 1.1**). The subject land falls within the Great Lakes Local Government Area (LGA). It is situated to the north of existing development within Tea Gardens and is bounded to the west by Myall Road, to the north by Toonang Drive and the Shearwater Residential Estate, and to the east by the Myall River. The subject land has approximately 2km frontage to Myall River. Myall Lakes National Park occurs to the east and north east of the subject land.

1.2.2 Site Characteristics

Historically, the subject land has been used for forestry and agricultural purposes. Previous use as a pine plantation is evident from the scattered persistence of both mature and juvenile pines across the subject land. The subject land currently supports a small amount of livestock, currently confined to the central and western portions of the subject land. Slashing has also been undertaken on the subject land to facilitate the agricultural use of the land. Fencing surrounding land zoned 7(b) and 7(a) under the *Great Lakes Local Environment Plan 1996* restricts agricultural activities from occurring in the south eastern portion. A number of unsealed tracks and fences are located throughout the subject land, facilitating current land use. One dwelling currently exists in the central eastern portion of the subject land.

The subject land is mostly low lying flat land, with slopes extending southwards from low ridgelines along the northern boundary. The low lying flat land generally occurs at less than 5m AHD. The lowest area of the subject land occurs in the south eastern portion which experiences inundation from Myall River. The ridgeline along the northern boundary of the subject land reaches approximately 20m AHD.

The subject land has been mapped as comprising the Tea Gardens, Pindimar Road and Fullerton Cove Soil Landscapes (Murphy 1995). The majority of the subject land falls within the Tea Gardens Soil Landscape. The geology of the Tea Gardens Soil Landscape is comprised of Pleistocene beach ridges of marine and Aeolian quartz sands with the soils consisting of deep imperfectly drained Humus Podzols on ridges with poorly drained Peaty Humus Podzols in swales (Murphy 1995).

Several riparian areas occur on the subject land including ephemeral drainage lines and dams. The site has slow drainage, with large areas adjoining Myall River experiencing moderate levels of inundation. The drainage lines in the southern and eastern portion of the subject land flow east into the Myall River. The drainage lines in the north western portion of the subject land flow south to the south western portion of the land where it is impeded.

The vegetation on the subject land includes a mosaic of forest, woodland, heath, grassland and wetland and reflects topography, drainage and land use. Some of the original vegetation communities have been at least partially cleared and are now impacted by the use of the subject land for agriculture. The condition of the vegetation communities varies

across the subject land. The vegetation in the eastern portion of the subject land falls within an area designated as *State Environmental Planning Policy No. 14 – Coastal Wetlands* (SEPP 14).

1.2.3 Project Background

A number of development applications have been prepared for the subject land in the past decade by the proponent, none of which have been determined. Initially, in 2002, the proponent began the process of seeking approval for the development of a portion of the subject land for residential purposes, a nine-hole golf course and tourist facilities. The proponent consulted with the Department of Planning (DoP), the Department of Environment, Climate Change and Water (DECCW) (then the Department of Environment and Climate Change), Great Lakes Council and other agencies about various issues regarding the proposal. In 2004, the nine-hole golf course was removed from the proposal to allow for an increase in the residential component. The increase in the residential component of the proposal was to cater for the growing demand for residential development within the locality, as reflected in the then draft Tea Gardens/Hawks Nest Housing Strategy prepared by Great Lakes Council. In 2006, it was determined that the proposal was a project to which Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) applied. The proposal was amended to align with the requirements of a Part 3A application.

Most recently a Part 3A development application was lodged with the Department of Planning in 2009. The 2009 application proposed residential, commercial and tourist development on the subject land. An ecological assessment undertaken on the subject land by Conacher Environmental Group (Conacher) was submitted as part of this development application. This ecological assessment report was assessed by the NSW Planning Commission (PAC) in July 2009. A number of ecological issues were raised by the PAC including inadequacies of mapping, assessment of EPBC Act issues and proposed offsets. The PAC determined that the proposal was not acceptable in its current form and that the proponent would be required to address any inadequacies prior to seeking further approval. The development application was withdrawn in 2009 pending further assessments.

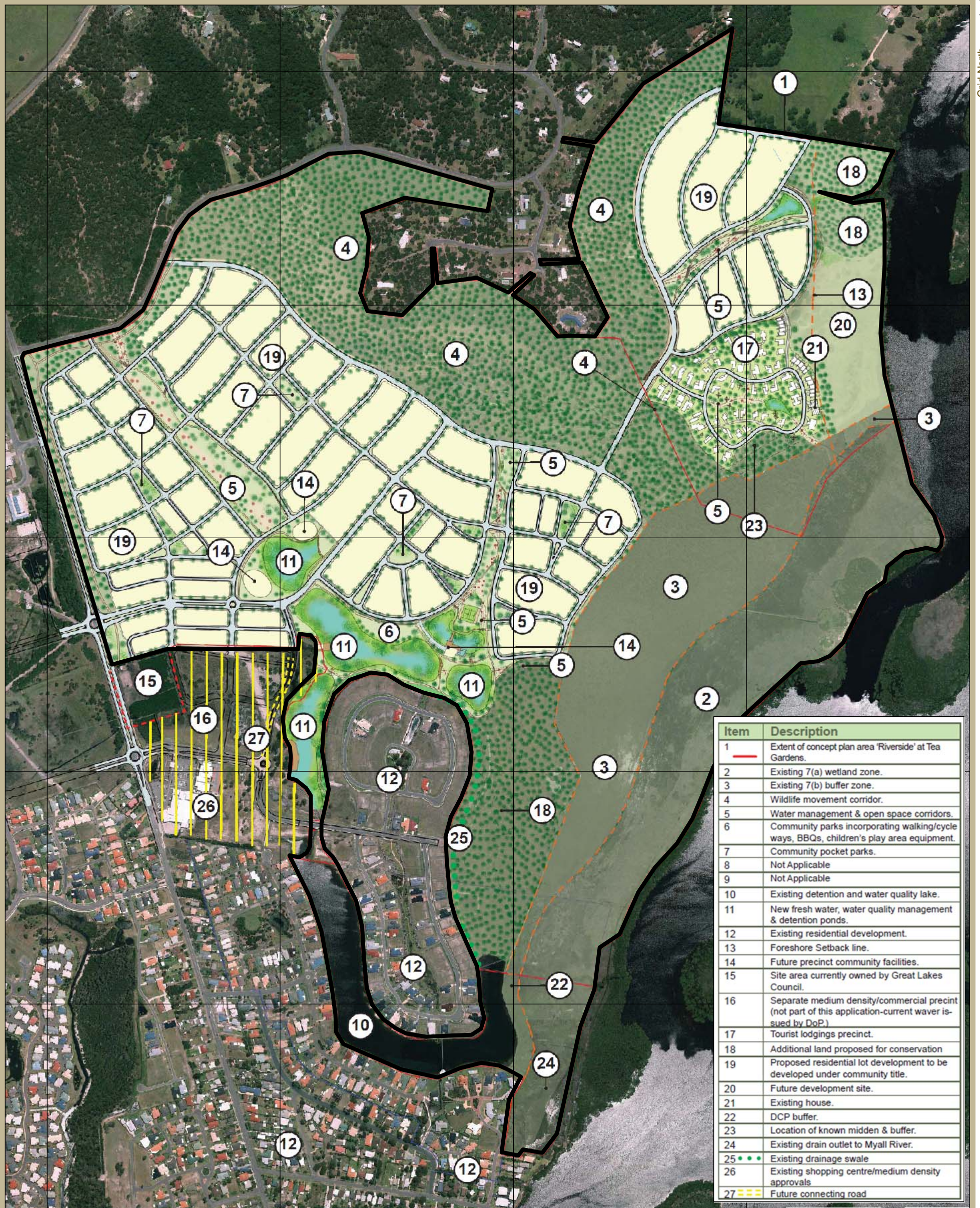
1.2.4 Proposed Project

The subject land is zoned 2(f) Mixed Residential/Commercial, 7(a) Wetlands and Littoral Rainforest and 7(b) Conservation under the *Great Lakes Local Environment Plan 1996*. Concept approval is being sought under Part 3A of the EP&A Act to facilitate the development of part of the subject land for mixed residential use. The proposed project (hereafter referred to as the 'Riverside project') comprises the following key components:

- Residential development;
- Conference and community facilities;
- Low rise townhouse accommodation;
- Low density precinct (tourist component);

- Open space corridors and community pocket parks;
- Water management facilities including, a lake, freshwater detention ponds and a drain outlet to Myall River;
- Retention of existing zone 7(a) and 7 (b) land for conservation; and
- Retention of vegetation land, including a wildlife corridor, for conservation.

The layout of the development area and retained areas is shown in **Figure 1.2**.

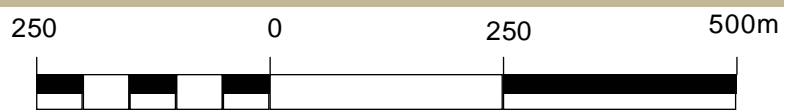


Item	Description
1	Extent of concept plan area 'Riverside' at Tea Gardens.
2	Existing 7(a) wetland zone.
3	Existing 7(b) buffer zone.
4	Wildlife movement corridor.
5	Water management & open space corridors.
6	Community parks incorporating walking/cycle ways, BBQs, children's play area equipment.
7	Community pocket parks.
8	Not Applicable
9	Not Applicable
10	Existing detention and water quality lake.
11	New fresh water, water quality management & detention ponds.
12	Existing residential development.
13	Foreshore Setback line.
14	Future precinct community facilities.
15	Site area currently owned by Great Lakes Council.
16	Separate medium density/commercial precinct (not part of this application-current waver issued by DoP.)
17	Tourist lodgings precinct.
18	Additional land proposed for conservation
19	Proposed residential lot development to be developed under community title.
20	Future development site.
21	Existing house.
22	DCP buffer.
23	Location of known midden & buffer.
24	Existing drain outlet to Myall River.
25	Existing drainage swale
26	Existing shopping centre/medium density approvals
27	Future connecting road

Subject land



Figure 1.2 Layout of the proposed development



1.3 Relevant Legislation

1.3.1 State Environmental Planning Policies

i. SEPP 14 – Coastal Wetlands

The aim of SEPP14 – Coastal Wetlands is to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State.

An area along the eastern boundary of the subject land is mapped as wetland under SEPP 14. The wetland occurring on the subject land is known as Wetland No. 746. This wetland is primarily comprised of saltmarsh vegetation.

ii. SEPP 44 – Koala Habitat Protection

The aim of SEPP 44 – Koala Habitat Protection is to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

The Great Lakes LGA is listed in Schedule 1 as an LGA to which SEPP 44 – Koala Habitat Protection applies. As a result of this, and given that the subject land is greater than 1ha, the subject land is required to be assessed for potential and core koala habitat.

Potential koala habitat is defined as “an area of native vegetation where the trees of the types listed in Schedule 2 constitute at least 15% of the total number of trees in the upper or lower strata of the tree component”. Core koala habitat is defined as an “area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population”. If it is determined that the subject land comprises core koala habitat, a Koala Plan of Management must be prepared prior to consent for the development is granted by council. It is not specified within the SEPP if this is a requirement for Part 3A developments.

iii. SEPP 71 – Coastal Protection

The intent of SEPP 71 – Coastal Protection is to protect and preserve sensitive coastal locations and encourage a strategic approach to coastal management.

A portion of the subject land is considered as a sensitive coastal location, namely that which occurs within 100m of the Myall River, the Port Stephens – Great Lakes Marine Park and within the SEPP 14 Wetland No. 746.

1.3.2 NSW Environmental Planning and Assessment Act 1979

The EP&A Act is the overarching planning document for NSW. This Act provides for the creation of planning instruments that guide land use. The Act also provides for the consideration of biodiversity values, which is addressed in Section 5A (Significant effect on species, populations or ecological communities or their habitats). The Act requires that an

“Assessment of Significance” under Section 94A of the TSC Act, also known as the “Seven-Part Test”, is undertaken in relation to species, communities, habitat and processes listed under either the TSC Act or the Fisheries Management Act 1994 (FM Act).

The Part 3A amendment to the EP&A Act consolidates the assessment and approval regime for all Major Projects previously addressed under Part 4 (Development Assessment) or Part 5 (Environmental Assessment) of the Act. There is no statutory requirement to undertake an “Assessment of Significance” for a development being assessed under Part 3A. An Environmental Assessment (EA) is required for Part 3A development proposals and must be prepared in accordance with the Director-General’s environmental assessment guidelines.

The Riverside project will be assessed under Part 3A of the Act. This report forms the Flora and Fauna component of the EA that is required to enable the Project to be assessed under Part 3A of the EP&A Act. The most recent Director-General’s Environmental Assessment Requirements (DGEARs), pursuant to Section 75F of the EP&A Act, for the Riverside project were issued on 13 October 2010. The relevant flora and fauna requirements within the DGEARs are provided below:

- *General Requirement 7. Consideration of impacts, if any, on matters of national environmental significance under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999;*
- *9.1: Provision of adequate and comprehensive baseline ecological data as described in section 2.6 of the PAC report;*
- *9.2: Address the deficiencies in the previous ecological assessment identified in Section 2.7 of the PAC report;*
- *9.3: Outline measures for the conservation of existing wildlife corridor values and/or connective importance of any vegetation on the subject land;*
- *9.4: Address measures to protect and manage the SEPP 14 wetland and adjacent aquatic habitats;*
- *9.7: Outline measures for the conservation of flora and fauna and their habitats within the meaning of the Threatened Species Conservation Act 1995, Native Vegetation Act, 2003, and the Fisheries Management Act, 1994 including, but not limited to Koala populations, and other EECs;*
- *9.8: The EA must consider how the proposal has been managed to conserve flora and fauna habitats on the subject site and subject area. The measures proposed to mitigate any effects of the proposal must be provided, including any long term strategies to protect areas within the study area with threatened species. This may include elements that restore or improve habitats. Pre-construction monitoring plans or on-going monitoring of the effectiveness of the mitigation measures must be outlined in detail; and*

- 9.9: Prepare a details flora and fauna assessment of the proposed off-site offset area to enable an adequate assessment to be made of its ecological value and the adequacy of the proposed offset, taking account of 'Principles for use of Biodiversity Offsets in NSW'. (Note that the PAC concluded that offsets are not appropriate for some of the ecological values of this site and that development should be precluded in some areas to ensure that values are protected).

1.3.3 NSW Threatened Species Conservation Act 1995

The TSC Act broadly seeks to ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed, and to encourage the conservation of threatened species, populations and ecological communities. The Schedules of the TSC Act comprise lists of threatened marine and terrestrial fauna.

The TSC Act requires consideration of whether a development (Part 4) or an activity (Part 5) is likely to significantly impact threatened species, populations, communities or their habitat. Accordingly, any developments, land use changes or activities would usually need to undergo an "Assessment of Significance" under Section 5A of the EP&A Act.

As the project is being assessed under Part 3A of the EP&A Act, Section 5A assessments of significance are not required. This ecological assessment does however address impacts to species, populations and communities listed under the TSC Act.

1.3.4 NSW Fisheries Management Act 1994

The threatened species schedules of the Fisheries Management Act 1994 (FM Act) comprise lists of threatened marine, estuarine and freshwater fish or other aquatic animal life at any stage of their life history and ecological communities of fish. The FM Act provides for the conservation of key fish habitats and threatened species, populations and ecological communities of fish and marine vegetation. It does not include whales, mammals, reptiles, birds or amphibians.

The FM Act applies to the subject land as there is habitat available that would support a significant community of fish. Available habitat includes Myall River, associated aquatic habitats, the man-made lake and outlet channel to the lake.

1.3.5 NSW Native Vegetation Act 2003

The aims of the Native Vegetation Act 2003 (NV Act) is to provide for, encourage and promote the management of native vegetation on a regional basis, to prevent broad scale clearing, to protect native vegetation of high conservation value, to improve the condition of existing native vegetation, particularly where it has high conservation value, and to encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation.

The NV Act applies to the land zoned 7(a) and 7(b) under the *Great Lakes Local Environment Plan 1996*, but not to land zoned 2(f).

1.3.6 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act provides for the protection of nationally listed matters of environmental significance, including threatened species such as the Grey-headed Flying-fox (*Pteropus poliocephalus*) which has been recorded on the subject land. The EPBC Act is administered by the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (previously Department of Environment, Water, Heritage and the Arts).

A project that may impact on nationally listed matters is referred to DSEWPC. It is determined by DSEWPC whether the impact to nationally listed matters is likely to be significant. If the project is determined to be likely to have a significant impact on nationally listed matters, the project is declared a “controlled action” and additional assessments will be required to gain approval from the Commonwealth Minister for the Environment. The project is in the process of being referred to DSEWPC.

1.4 Terms and Abbreviations

DECCW:	NSW Department of Environment, Climate Change and Water;
DSEWPC:	Commonwealth Department of Sustainability, Environment, Water, Population and Communities;
Development footprint:	The area of land within the subject land which is proposed for development;
CMA:	Catchment Management Area;
EEC:	Endangered Ecological Community;
EP&A Act:	NSW <i>Environment Planning and Assessment Act 1979</i> ;
EPBC Act:	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i> ;
FM Act:	NSW <i>Fisheries Management Act 1994</i> ;
LGA:	Local Government Area;
Locality:	Area within 10km ² of the subject land;
NV Act:	NSW <i>Native Vegetation Act 2003</i> ;
PAC:	Planning and Assessment Commission;
SEPP 14:	<i>State Environmental Planning Policy No. 14 – Coastal Wetlands</i> ;



SEPP 44: *State Environmental Planning Policy No. 44 – Koala Habitat Protection;*

SEPP 71: *State Environmental Planning Policy No. 71 – Coastal Protection;*

Subject land: The land which is covered by the Riverside project development application, that is; Lot 1 (part), 10, 19, 30 and 40 DP 270100 and Lot 1 and 5 (part) DP 270561 Myall Road, Tea Gardens; and

TSC Act: *NSW Threatened Species Conservation Act 1995.*

Methodology

2.1 Literature Review

A number of ecological studies have been conducted on the subject land over the past two decades. The following documents have been reviewed for the preparation of this report:

- Shortland Wetlands Centre (1988) Wetlands Assessment – Tea Gardens Environmental Study, Stage 1;
- Mount King Ecological Surveys (1992) Fauna survey of Lot 10 DP733241 & Lot 31 DP808202 Myall Rd Tea Gardens;
- Ecotone Ecological Consultants (1995) Mammal and Herptofauna Surveys for the proposed Myall Quays development at Tea Gardens;
- Integrated Site Planning & Management (1996) Flora and Fauna Assessment Report - Proposed Residential Subdivision Stage V, Myall Quays Estate Tea Gardens;
- Hunter Wetlands Research & Management (1997) Flora and Fauna Assessment for Myall Quays Stage VI;
- Harris Research (2007) Fish Community Survey of the 'Riverside' Lake;
- Conacher Environmental Group (2008) Ecological Site Assessment (including Threatened Species Assessment); and
- Hunter Wetlands Research (2009) Wetlands Assessment for Riverside, Tea Gardens.

Ecological studies have also been completed for areas adjacent to the subject land. The information within the following studies were also considered:

- ERM Mitchell McCotter (1997) Local Environmental Study – North Hawks Nest;
- Conacher Travers (2007) Species Impact Statement – Proposed Rural Residential Subdivision Part Lot 404 Spinifex Avenue, Tea Gardens; and

- Ecobiological (2009) Ecological Assessment for the Draft Local Environmental Study – North Shearwater Precinct, Tea Gardens, Great Lakes LGA, NSW.

2.2 Database Analysis

Database analysis was conducted for the locality in 2010 using both the DECCW Atlas of NSW Wildlife Database (DECCW) and DSEWPC Protected Matters Search Tool (DSEWPC 2010). The Atlas search was used to generate records of threatened flora and fauna species listed under the TSC Act within a 10km radius of the subject land. The Protected Matters search generated a list of potentially occurring flora, fauna and ecological communities listed under the EPBC Act within a 10km radius of the subject land. The lists generated from these databases were initially reviewed against available knowledge of the site to ascertain the likelihood of occurrence of threatened species.

2.3 Flora Survey

2.3.1 Introduction

Cumberland Ecology conducted flora surveys across all parts of the subject land from 14-16 December 2009, 13-15 January 2010 and 10 February 2010. These included vegetation mapping and vegetation sampling, and are described in more detail below.

2.3.2 Vegetation Mapping

Several vegetation mapping studies have been conducted across the subject land and surrounds, including broad scale mapping across the Great Lakes LGA as well as fine scale mapping of the subject land. The most recent detailed vegetation mapping of the subject land, prior to this study, was undertaken by Conacher in 2007. The Conacher vegetation mapping utilised its own survey results and also utilised mapping of the wetland area prepared by Hunter Wetlands Research.

Cumberland Ecology conducted additional vegetation surveys to revise and update the vegetation mapping prepared by Conacher, and ground-truthed the vegetation on the subject land to examine the condition and extent of different community types. Where plant community boundaries were found to differ from the earlier mapping, records were made of proposed new boundaries using a hand-held Global Positioning System (GPS) unit. Vegetation mapping of the wetland area was not altered from that prepared by Conacher.

2.3.3 Vegetation Sampling

Cumberland Ecology conducted flora surveys in accordance with the standards provided in the (then) DEC Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (Working Draft) (DEC (NSW) 2004) and BioBanking Assessment Methodology (DECC 2009). These surveys involved the following:

- Vegetation sampling within quadrats (20m x 20m) to obtain information on floristic composition and community structure;
- Random meander surveys to detect additional flora species not recorded within the quadrats;
- Targeted searches for threatened flora known or considered likely to occur within the subject land; and
- Targeted searches for endangered ecological communities (EECs) known or considered likely to occur within the subject land.

Vegetation within a total of 38 quadrats was sampled according to DEC survey guidelines and BioBanking Assessment Methodology during the survey periods. The relative abundance and cover of each species within these quadrats was approximated using a modified Braun-Blanquet scoring system (Braun-Blanquet 1927). An additional 9 quadrats were surveyed using only the methodology within the BioBanking Assessment. The location of all 47 quadrats is shown in **Figure 2.1**. The locations of these quadrats were stratified so that sampling was conducted in all of the major vegetation types discernable across the subject land.

2.3.4 Plant Identification

Within each quadrat, all vascular flora species present were identified to species level, where possible, and recorded. All vascular plants recorded or collected were identified using keys and nomenclature provided in Harden (Harden 1990-1993). Where known, taxonomic and nomenclatural changes have been incorporated into the results, as derived from PlantNET (Botanic Gardens Trust).

2.3.5 Plant Community Names

Currently within NSW, the naming of plant communities is somewhat confusing owing to a series of potential names that can be used – sometimes three or more names can be used for the same community. If they are EECs listed by the TSC Act they can be named using names that are applied for a specific EEC. However, such EEC names are often used for extensive communities that are found over broad areas of NSW. As such other regional and local names can also apply. This means that some plant communities can have a valid local or regional name and also a separate EEC name.

For the purposes of this report, plant community names were determined by the dominant canopy species and community structure. Where such communities were also recognisable variants of EECs, these names have also been mentioned and used in the report.

2.3.6 PATN Analysis

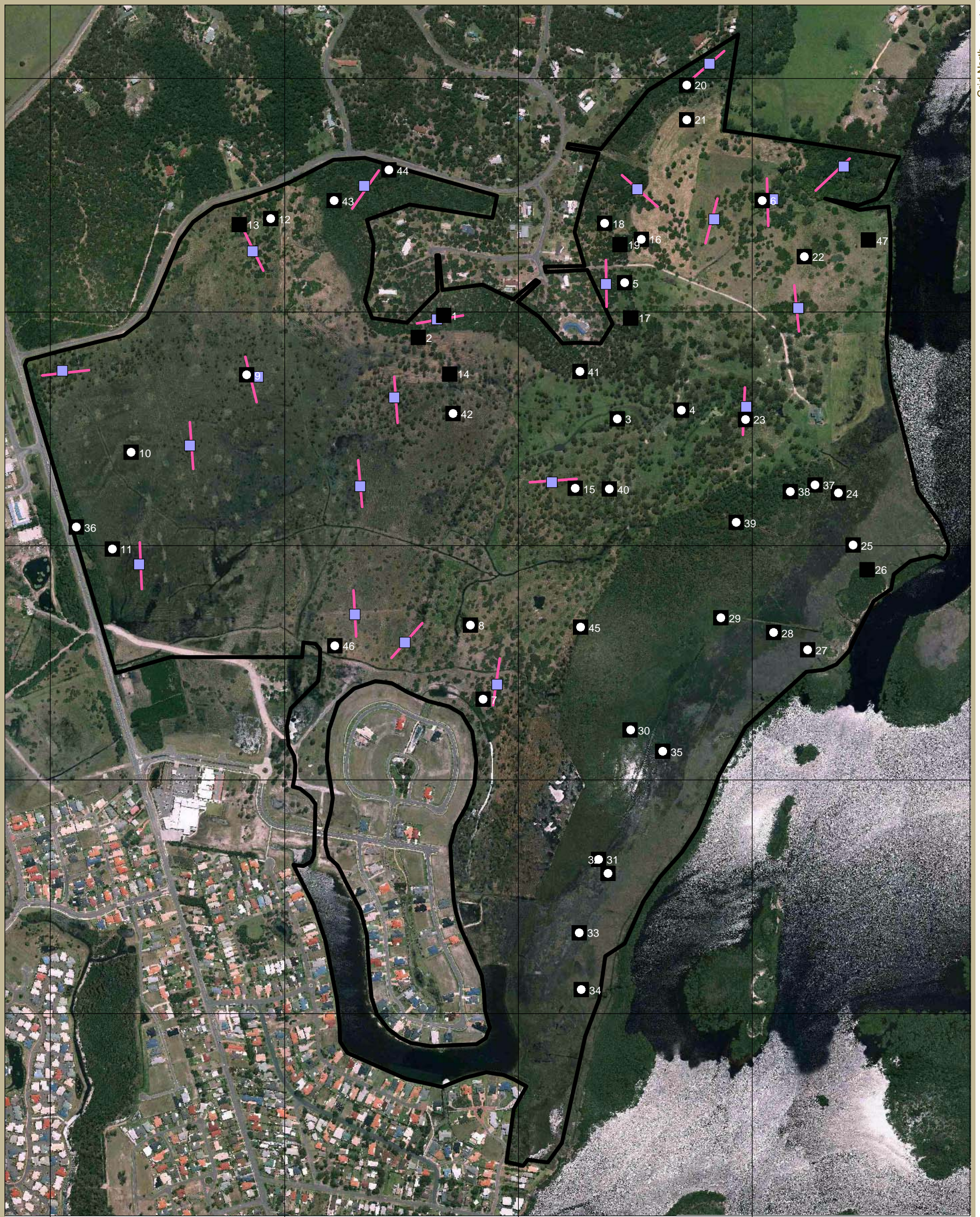
Data analysis was performed on the raw presence/absence scores obtained from the quadrat surveys within native plant communities using the PATN statistical package to examine patterns in vegetation composition across the site. Results from the PATN analysis

are contained within the Vegetation Mapping Report prepared by Cumberland Ecology (Cumberland Ecology 2010).

The patterns in vegetation composition were used to help interpret the occurrence of native vegetation communities on the subject land. Visual inspection of the hierarchical dendrogram confirmed the integrity of the groups defined at this point, thus amalgamation was not considered. Groups containing clusters of high integrity were identified for possible subdivision. Subdivision was carried out by systematically increasing the number of groups across the whole dendrogram. The floristic assemblages derived by cluster analysis were compared to community descriptions contained in the Vegetation Mapping Report.

2.3.7 Previous Flora Surveys

Flora surveys have been conducted on the subject land over the past two decades. The most recent flora surveys prior to the current surveys were undertaken in 2007 and 2008 by Conacher. Quadrat surveys undertaken by Conacher were conducted in accordance with the standards provided in the (then) DEC Threatened Biodiversity Survey and Assessment Guidelines for Development and Activities (Working Draft) (DEC (NSW) 2004). Transect surveys undertaken by Conacher were conducted in accordance with Copper (Cropper 1993). Locations of flora quadrats and transects undertaken by Conacher are shown on **Figure 2.1**.








-  Subject land
-  Cumberland Ecology BioBanking Quadrat
-  Cumberland Ecology Flora Quadrat
-  Conacher Flora Quadrat
-  Conacher Flora Transect



Figure 2.1 Flora survey locations



2.4 Fauna Survey

2.4.1 Fauna Habitat Assessment

Standardised habitat assessment plots were conducted at all locations that flora quadrats were conducted (see **Figure 2.1**). Habitat assessments were undertaken in accordance with the methodology within the BioBanking Assessment Methodology and Credit Calculator Operational Manual (DECC 2009). Habitat assessment plots were 50m x 20m in size and the following fauna habitat attributes were recorded within each plot:

- Canopy cover;
- Mid-storey cover;
- Ground cover;
- Number of tree hollows;
- Total length of fallen logs; and
- Any other significant fauna habitat features (e.g. rocky outcrops, large stand of feed trees, etc).

These plots were then used to gain an understanding of the quality of fauna habitat within representative locations of the habitat types within the subject land.

2.4.2 Fauna Species Surveys

Fauna surveys have been conducted on the subject land over the past two decades, most recently in 2007 and 2008 by Conacher. As these surveys were completed recently and were comprehensive, it was not considered necessary to undertake additional fauna surveys for the preparation of this report.

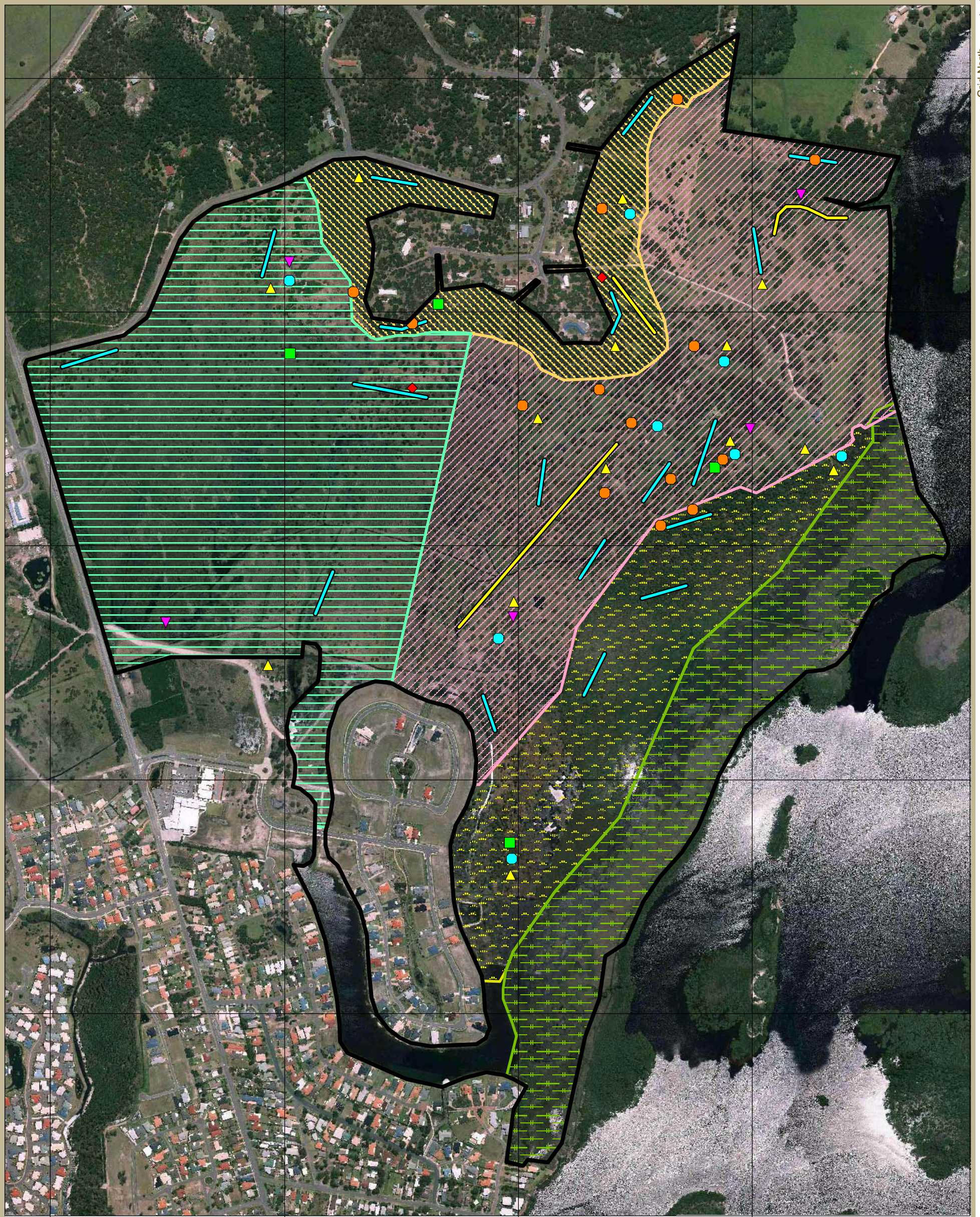
The 2007 and 2008 Conacher fauna surveys were undertaken in a range of habitats and vegetation types using a variety of detection methods. These surveys were conducted in the following stratification units:

- Northern slopes open forest;
- Western lowland woodlands;
- Northern central lowland open forest;
- Eastern swamp forest; and
- Estuarine wetlands.

Table 2.1 lists the survey techniques utilised by Conacher for each fauna group. Stratification units and survey locations are shown on **Figure 2.2**. A description of each of the survey techniques utilised is provided in the EAR prepared by Conacher.

Table 2.1 Fauna survey techniques

Faunal Group	Survey Technique
Amphibians	Diurnal and nocturnal habitat searches Pitfall trapping Opportunistic survey Call playback Spotlighting Call identification
Diurnal Birds	Opportunistic survey Winter bird survey
Nocturnal Birds	Spotlighting Call playback
Arboreal Mammals	Elliot trapping Spotlighting Call playback Hair tubes Koala spot surveys Opportunistic searches
Terrestrial Mammals	Diurnal observations Elliot trapping Cage trapping Pitfall trapping Hair tubes Spotlighting
Bats	Anabat detection Spotlighting Harp traps
Reptiles	Habitat searches Pitfall trapping Opportunistic survey Spotlighting

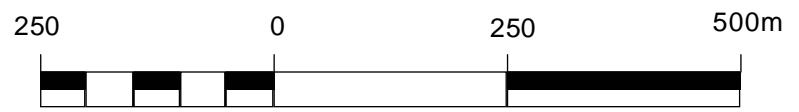


- Subject land**
- Subject land
- Fauna Survey Stratification Areas**
- Eastern Swamp Forest
 - Estuarine Wetlands
 - Western Lowlands Woodland
 - Northern Slopes Open Forest
 - Central-northern Open Forest/Woodland

- Fauna Survey Locations (Conacher 200)**
- Anabat Station
 - Frog Habitat Search
 - Koala survey location
 - Owl Call Playback Station
 - Harp Trap
 - Pitfall Trapline
 - Fauna Trapline
 - Hair Tube Transect



Figure 2.2 Fauna survey locations



2.5 Survey Effort

2.5.1 Flora

The current flora surveys were intended as an expansion on survey work previously conducted by Conacher. For this reason, records and locations of the Conacher surveys have been included within this report. A summary of flora survey effort for both surveys is provided in **Table 2.2**.

Table 2.2 Flora survey effort

Survey Technique	Dates	Survey Effort
Cumberland Ecology 2009-2010		
Vegetation mapping	14-16/12/2009, 13-15/01/2010, 10/02/2010	7 days
Quadrat surveys	14-16/12/2009, 13-15/01/2010, 10/02/2010	47 quadrats
Targeted threatened species searches	14-16/12/2009, 13-15/01/2010, 10/02/2010	7 days
Conacher 2005-2008		
Vegetation mapping	12/01/2007, 5/02/2007, 10/03/2007, 19/03/2007, 15/08/2007, 6-7/09/2007	7 days
Quadrat surveys	14/02/2008, 10-14/03/2009, 7/05/2008	21 quadrats
Transect surveys	14/02/2008, 10-14/03/2009, 7/05/2008	21 transects
Cryptic flora searches	13/08/2005, 1/09/2005, 12/01/2007, 5/02/2007, 10/03/2007, 19/03/2007, 17/07/2007, 15/08/2007, 6-7/09/2007, 22/01/2008, 12-14/02/2008, 10-14/03/2009, 7/05/2008	20 days
Tree identification surveys	22/01/2008, 12-13/02/2008	3 days
Rapid canopy quadrats	19/03/2007	1 day

2.5.2 Fauna

Habitat assessments were undertaken in the current survey to supplement fauna surveys undertaken by Conacher for the previous EAR. No additional fauna surveys were undertaken in the current survey, therefore fauna survey effort is derived from the information provided in the 2008 Conacher EAR, which includes survey effort from 2004-2008. A summary of fauna survey effort for both surveys is provided in **Table 2.3**.

Table 2.3 Fauna survey effort

Survey Technique	Dates	Survey Effort
Cumberland Ecology 2009-2010		
Habitat assessments	14-16/12/2009, 13-15/01/2010, 10/02/2010	47 quadrats
Conacher 2007-2008		
<i>Amphibians</i>		
Call detection and spotlighting	6/09/2007, 12/02/2008, 14/02/2008, 10-11/03/2008	10 hours 15 mins
Spotlighting	12-13/03/2008	5 hours 25 mins
Opportunistic diurnal call detection	22/01/2008, 12-14/02/2008	22 hours
Diurnal habitat searches and call detection	10-11/03/2008	11 hours
Habitat search and opportunistic survey	12-13/03/2008	7 hours
Nocturnal water body search	10-11/03/2008	1 hour 30 mins
Pitfall traps	10-12/03/2008	27 trap nights
<i>Diurnal Birds</i>		
Opportunistic observation	19/03/2007, 6-7/09/2007, 22/01/2008, 12-14/02/2008, 10-14/03/2008	73 hours 30 mins
Winter bird survey	17/07/2007, 15/08/2007, 7/05/2008	14 hours
<i>Nocturnal Birds</i>		
Spotlighting and call playback	6/09/2007, 12/02/2008, 14/02/2008, 10-13/03/2008	15 hours 30 mins
<i>Arboreal Mammals</i>		
Hair tubes	12-3/03/2008	300 trap nights
Trapping (Elliot A)	12-14/02/2008, 10-13/03/2008, 31/03/2008, 1-3/04/2008	120 trap nights
Trapping (Elliot B)	12-14/02/2008, 10-13/03/2008, 31/03/2008, 1-3/04/2008	180 trap nights
Trapping (Elliot E)	31/03/2008, 1-3/04/2008	60 trap nights
Koala spot survey	19/03/2007, 15/08/2007	13 hours
Spotlighting	6/09/2007, 12/02/2008, 14/02/2008, 10-13/03/2008, 31/03/2008, 1-3/04/2008	23 hours 30 mins
Call playback	12/02/2008, 14/02/2008, 10-13/03/2008,	13 hours

Table 2.3 Fauna survey effort

Survey Technique	Dates	Survey Effort
	31/03/2008, 1-3/04/2008	
Opportunistic searches	22/01/2008	6 hours
<i>Terrestrial Mammals</i>		
Hair tubes	12-21/03/2008	300 trap nights
Trapping (Elliot A)	12-14/02/2008, 10-13/03/2008, 31/03/2008, 1-3/04/2008	120 trap nights
Trapping (Elliot B)	12-14/02/2008, 10-13/03/2008, 31/03/2008, 1-3/04/2008	204 trap nights
Trapping (Cage)	12-14/02/2008, 10-13/03/2008, 31/03/2008, 1-3/04/2008	126 trap nights
Pitfall traps	10-13/03/2008	36 trap nights
Habitat search	31/03/2008, 1-3/04/2008	12 hours
Opportunistic observation	10/03/2008	9 hours
Spotlighting	31/03/2008, 1-3/04/2008, 12/02/2008, 14/02/2008, 10-13/03/2008,	21 hours 30 mins
<i>Bats</i>		
Anabat	10-13/03/2008	10 nights
Spotlighting	10-13/03/2008	10 hours 30 mins
Anabat and spotlighting	6/09/2007, 12/02/2008, 14/02/2008, 31/03/2008, 1-3/04/2008	13 hours
Harp Trap	10-12/03/2008	9 trap nights
<i>Reptiles</i>		
Habitat search and opportunistic survey	12-14/02/2008, 10-13/03/2008	36 hours 30 mins
Opportunistic observation	22/01/2008	6 hours
Pitfall traps	10-12/03/2008	27 trap nights
Spotlighting	12/02/2008, 14/02/2008, 10-13/03/2008	17 hours
Conacher 2004-2006		
<i>Diurnal Birds</i>		
Bird census and opportunistic observation	25-26/02/2004, 2-5/03/2004, 3-6/08/2004	32 hours 30 mins

Table 2.3 Fauna survey effort

Survey Technique	Dates	Survey Effort
<i>Nocturnal Birds</i>		
Spotlighting and call playback	25-26/02/2004, 3-4/03/2004, 3-5/08/2004, 1/09/2005,	18 hours
<i>Arboreal Mammals</i>		
Hair tubes	25/02/2004-05/03/2004	400 trap nights
Koala spot survey	3-4/03/2004	14 hours 30 mins
Trapping	2-4/03/2004, 3-5/08/2004, 31/08/2005, 1/09/2005	Not specified
Spotlighting	25-26/02/2004, 3-4/03/2004, 5/08/2004, 1/09/2005	14 hours
Spotlighting and koala call playback	3-4/08/2004	4 hours
<i>Bats</i>		
Anabat and spotlighting	25-26/02/2004, 3-4/04/2004, 4/04/2004, 3-5/08/2004, 1/09/2005	34 hours 25 mins
<i>Amphibians</i>		
Call detection and spotlighting	25-26/02/2004, 3/03/2004, 4/04/2004, 5/08/2004, 1/09/2005	14 hours
Wallum Froglet targeted survey	6/04/2004	5 hours
<i>Reptiles</i>		
Habitat search and opportunistic survey	4/03/2004, 3-6/08/2004	13 hours
Opportunistic observation	1/09/2005	9 hours
Spotlighting	25-26/02/2004	5 hours 15 mins

2.6 Weather Conditions

A summary of weather conditions in the locality of the subject land during fauna surveys conducted by Conacher are provided in **Table 2.4**.

Table 2.4 Weather conditions during Conacher 2007/2008 fauna surveys

Date	Time (hrs)	Cloud (8th)	Temp (°C)	Wind	Rain	Comments
19/03/2007	900	4/8	18	calm	nil	
6/09/2007	900	4/8	22	calm	nil	light overnight rain
	1500	6/8	15	calm	nil	
	1900	4/8	18	calm	nil	
7/09/2007	900	3/8	19	light breeze	nil	Showers
	1500	6/8	16	light breeze		
	1900	8/8	15	calm		
22/01/2008	900	6/8	19	light	nil	Overnight shower
	1500	2/8	22	moderate		
	1900	6/8	20	Calm		
12/02/2008	900	8/8	18	nil	light	
	1500	8/8	18	nil	light	
	1900	8/8	17	nil	light	Moon – 1st ¼
13/02/2008	900	6/8	18	light	nil	
	1500	8/8	22	moderate breeze		
	1900	8/8	18	light-moderate	light	
14/02/2008	900	8/8	19	light	nil	
	1500	8/8	19	light	nil	
	1900	8/8 - 2/8	17	light	nil	
10/03/2008	900	1/8	20	light		
	1500	0/8	24	light	nil	
	1900	0/8	17	light	nil	
11/03/2008	900	0/8	24	light	nil	
	1500	0/8	24	light	nil	
	1900	0/8	17	light	nil	
12/03/2008	900	0/8	24	moderate	nil	
	1500	0/8	24	moderate	nil	
	1900	0/8	17	light	nil	
13/03/2008	900	0/8	25	nil	nil	
	1500	0/8	25	nil	nil	
	1900	0/8	20	nil	nil	Moon – 1st ¼

2.7 Limitations

2.7.1 Flora

The weather conditions at the time of the Cumberland Ecology flora surveys had generally been favourable for plant growth and production of features required for identification of most species and no slashing had taken place prior to the surveys. Shrubs, grasses, herbs and creepers were readily identifiable in most instances. However, given the size of the subject land, not all flora species present have been recorded during the current survey. Other species occurring within the locality are cryptic and therefore may occur on the subject land but were not detected.

Despite this, it is considered that the majority of the plant species occurring on the subject land have been recorded and that issues including conservation significance of the flora, condition and viability of bushland and likely impact on native vegetation have been able to be satisfactorily assessed.

A range of threatened flora is known to occur in the locality and while they have not been detected in the subject land to date, there are suitable habitats present for a number of the species. The assessments made of the occurrence of threatened flora are based on the surveys undertaken in summer, supplemented by data collected by other surveys of the subject land.

2.7.2 Fauna

The fauna surveys are limited in that they are a “snapshot” investigation in time and have recorded the fauna that were active during the time of the surveys. The data produced by the surveys is intended to be indicative of the types of species that could occur and not an absolute census of all vertebrate species of the subject land.

Weather conditions during the 2007/2008 period were suitable for detecting most fauna groups. Conditions were cool, and there were several light rainfall periods during the amphibian searches, providing optimal conditions for survey. Relatively few reptiles were recorded however, and higher temperatures may have resulted in the detection of higher numbers of reptiles, however grazing pressure may also be the cause of low detection rates.

Overall, the winter bird surveys were not suitable to detect winter migrants, particularly the State and Commonwealth listed threatened *Lathamus discolor* (Swift Parrot). Several late autumn/early winter surveys would be more suitable for detecting these species should they occur within the subject land. A number of trees occurring on the subject land, including *Eucalyptus robusta* (Swamp Mahogany) and *Corymbia gummifera* (Red Bloodwood) flower profusely during their respective blossom periods. Such heavy flowering activity within the region could potentially attract the Swift Parrot and other nectar feeding bird species.

Taking into account the combined survey effort of all surveys completed to date, it is considered that adequate survey effort has been undertaken for all fauna groups likely to occur on the subject land over an extended period of time.

Results

3.1 Introduction

This chapter presents the findings of flora and fauna surveys across the subject land during the current and previous surveys. A wide variety of woodland and open forest flora and fauna are known to occur in the locality surrounding the subject land and a considerable diversity of species has been identified in previous ecological surveys. Flora survey results are provided in **Appendix A** and **Appendix B**, and fauna survey results are provided in **Appendix C**.

3.2 Vegetation Communities

3.2.1 *General Features of the Vegetation*

The vegetation on the subject land forms a mosaic of woodland, forest, heath, grassland and wetland and reflects topography, drainage and land use.

The subject land is mostly low lying flat land, with slopes extending southwards from low ridgelines along the northern boundary. Nevertheless, vegetation communities on site appear to be strongly influenced by minor changes in elevation and drainage patterns that are associated with this flat landscape.

The site has a history of usage for agriculture and forestry. Some of the original vegetation communities have been at least partially cleared and are now impacted by the current land use of cattle grazing. Historically, *Pinus elliotii* (Slash Pine) were grown across much of the site, but many have been removed, leaving only scattered individuals and regenerating seedlings across broad areas of the site.

Slashing of the understorey to maintain pasture for cattle has modified and reduced shrub and ground strata, however native species continue to persist. The northern slopes of the subject land has experienced underscrubbing, most likely as result of bushfire protection activities for the houses situated upslope.

There are occurrences of exotic grassland and pasture on the subject land, with pasture species encroaching into the groundcover of a number of native vegetation communities. Some communities are characterised by the localised occurrence of native groundcover species at the base of trees within the community, which are then surrounded by exotic

grassland and pasture. There are however, extensive areas of derived understorey vegetation, particularly within the western half of the subject land. The vegetation in these areas is characteristic of the communities that would have previously existed prior to the clearing of trees.

3.2.2 Vegetation Communities

i. Introduction

Classification of the quadrat data using PATN separated the quadrats within native communities into three broad native vegetation groups: dry forest/woodland, wet forest/woodland/scrub/heath and wetland communities. Results from the PATN analysis are contained within the Vegetation Mapping Report prepared by Cumberland Ecology (Cumberland Ecology 2010). In addition to these broad native vegetation groupings, there is an exotic vegetation group. The distribution of the major vegetation groups is shown in **Figure 3.1**. The dry forest/woodland communities occur along the northern slopes and eastern portion of the subject land. The wet forest/woodland/scrub/heath communities are distributed across the subject land, predominately in the central and western portions. The wetland communities occur along the eastern boundary of the subject land, adjacent to the Myall River. The mapping of the wetland communities utilised Conacher vegetation mapping which is derived from the mapping of the wetland area prepared by Hunter Wetlands Research (see **Appendix D**). The exotic communities occur predominately in the north eastern portion of the subject land.

Within the three broad native vegetation types and the exotic vegetation group, Cumberland Ecology recognised a suite of vegetation communities that are readily distinguishable by the dominant canopy species present. Descriptions of these communities are provided in Section 3.2 and their distribution on the subject land is shown in **Figure 3.2**. The area occupied by each of the communities is shown in **Table 3.1**.

The vegetation communities occurring on the subject land vary in structure and condition as a result of previous and current land uses. A number of vegetation communities mapped have a structure ranging from open woodland to open forest. As a result of this wide ranging structure, community names have been based on the dominant or co-dominant structures exhibited. Previous clearing of the subject land has altered vegetation community structure primarily in the woodland and forest communities. A number of the vegetation communities occurring on the subject land have canopy species exhibiting a forest-like growth form, however given the extensive historic clearing, the overall community is of woodland structure. The vegetation in these communities is likely to have previously formed forest or open forest communities.

Of the vegetation communities recorded, several correspond floristically to the following EECs listed under the TSC Act:

- Swamp Sclerophyll Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions;

- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions; and
- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South East Corner bioregions.

The distribution of EECs is shown in **Figure 3.3**. Communities corresponding to EECs and their areas are shown in **Table 3.1**. The determination of the presence of Swamp Sclerophyll Forest on the subject land has been subject to a number of investigations. A discussion on determining the extent of this EEC is provided in the section below. Descriptions of the vegetation communities that conform to these EECs are provided in Section 3.2.

Table 3.1 Area of each vegetation communities recorded on the subject land

Vegetation Community	Subject land (ha)	Swamp Sclerophyll Floodplain Forest (ha)	Swamp Oak Floodplain Forest (ha)	Coastal Saltmarsh (ha)
Dry Forest/Woodland Communities				
Eucalyptus pilularis Open Forest	13.62			
Corymbia maculata - Eucalyptus paniculata Open Forest	7.04			
Eucalyptus umbra Open Forest	2.21			
Eucalyptus microcorys Open Forest	11.38			
Eucalyptus signata Woodland	1.15			
Subtotal	35.40			
Wet Forest/Woodland/Scrub/Heath Communities				
Corymbia gummifera Open Forest	13.24			
Angophora costata - Eucalyptus resinifera Woodland	14.15			
Eucalyptus robusta Woodland/Open Forest	67.64	27.89		
Wet Heath	20.17			
Casuarina glauca - Melaleuca Regrowth Forest	1.05			
Melaleuca quinquinervia Forest	1.43	1.43		
Melaleuca ericifolia Scrub	9.08	9.08		
Subtotal	126.76			
Wetland Communities				
Casuarina glauca Forest	1.09		1.09	
Baumea juncea Rushland	7.75			7.75

Table 3.1 Area of each vegetation communities recorded on the subject land

Vegetation Community	Subject land (ha)	Swamp Sclerophyll Floodplain Forest (ha)	Swamp Oak Floodplain Forest (ha)	Coastal Saltmarsh (ha)
Juncus krausii Saltmarsh	19.63			19.63
Avicennia marina Mangroves	0.40			
Subtotal	28.87			
Exotic Communities				
Pine	0.22			
Exotic Grassland/Pasture	22.37			
Disturbed Estuarine Vegetation	0.14			
Subtotal	22.73			
Total Native Communities	191.03			
Total Exotic Communities	22.73			
Grand Total	213.76	38.4	1.09	27.38

ii. *Swamp Sclerophyll Floodplain Forest*

A suite of the vegetation communities occurring on the subject land comprise species assemblages which correspond to the list of species provided in the final determination of Swamp Sclerophyll Forest. Despite this, the soils analysis undertaken by Whitehead & Associates (2011) (**Appendix E**) across several areas of the subject lands indicates that soil types present within these areas are not of alluvial origin, which is inconsistent with the final determination.

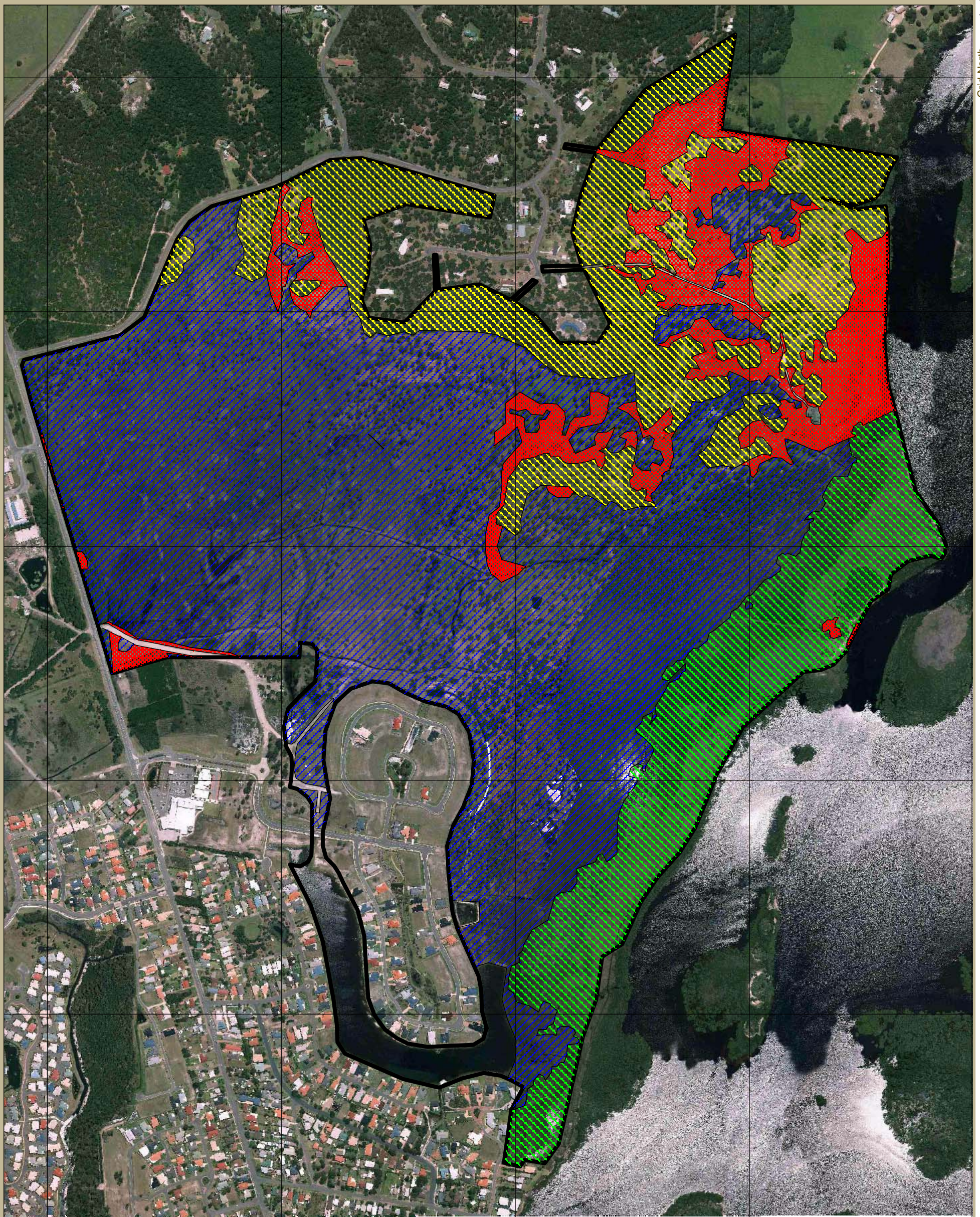
Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (hereafter referred to as 'Swamp Sclerophyll Forest') is listed as an EEC under the TSC Act. The classification of vegetation as Swamp Sclerophyll Forest has been the subject of a number of Land and Environment Court (LEC) cases in recent years. As noted by Smith (2009) two LEC cases, namely Motorplex (Australia) Pty Limited v Port Stephens Council [2007] NSWLEC 74 and Gales Holdings Pty Limited v Tweed Shire Council [2008] NSWLEC 209, have resolved a number of the uncertainties relating to the definition of the EEC, in particular those relating to edaphic, topographical and locational criteria.

Within the Scientific Committee's final determination, Swamp Sclerophyll Forest is described as being 'associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains'. Within the

above mentioned LEC cases, Judge Chief Justice Preston found that the presence of Swamp Sclerophyll Forest was associated with the presence of alluvial soils. This is supported by Smith's (2009) conclusion that *'any native vegetation in drainage lines below elevation limits (50-250m AHD) specified in Scientific Committee determinations on non-alluvial soils or on sandplain landforms will not qualify as EECs even if they are floristically consistent with descriptions in Scientific Committee determinations, unless they are otherwise expressly specified to be included within Scientific Committee determinations (eg by reference to existence mapped vegetation units'*.

Several soils assessments have been undertaken across portions of the subject land, most recently by Whitehead & Associates (2011). This particular assessment included investigation of soils from 23 pits. Results from this assessment have determined that the soils within the area surveyed comprise sandy soils of marine (beach barrier) or aeolian origin (Tea Gardens soil landscape), clay and clay loam soils of erosional origin (Pindimar Road soil landscape) and sandy loam formed under estuarine conditions on a drained Holocene estuarine flat on a coastal sandplain. None of the soils found within the development footprint are of alluvial origin.

Given the LEC decisions noted above, evidence presented by Smith (2009) and the recent soil assessment, Swamp Sclerophyll Forest could not be considered as occurring within the areas surveyed by Whitehead & Associates. Given that the soils investigation did not investigate soils throughout the subject land some question still remains as to whether soil types present within unsurveyed areas align with Swamp Sclerophyll Foodplain Forest. As a result, a conservative approach has been taken for this assessment whereby vegetation occurring below the 1-in-100 year flood-line has been considered as EEC vegetation.






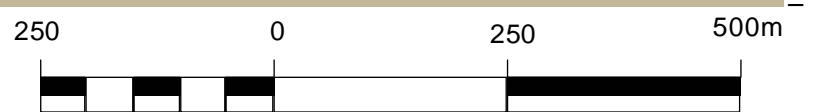
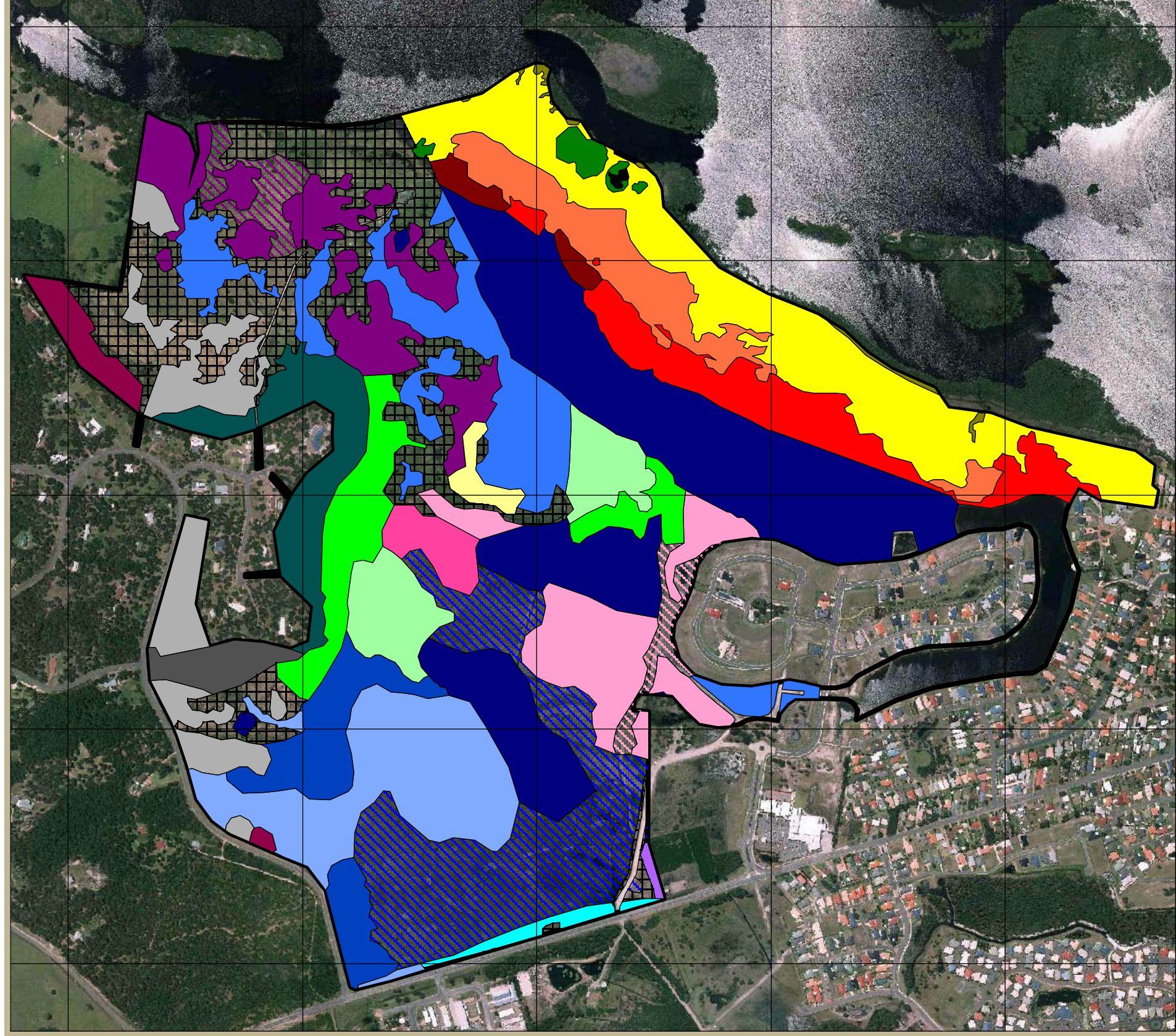
-  Subject land
-  Dry Forest/Woodland Communities
-  Wet Forest Woodland/Scrub/Heath Communities
-  Wetland Communities
-  Exotic Communities



Figure 3.1 Broad community types recorded on the subject land

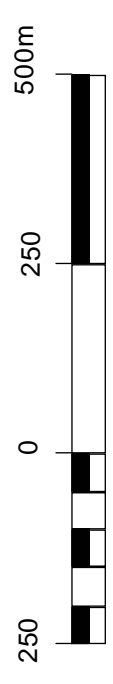


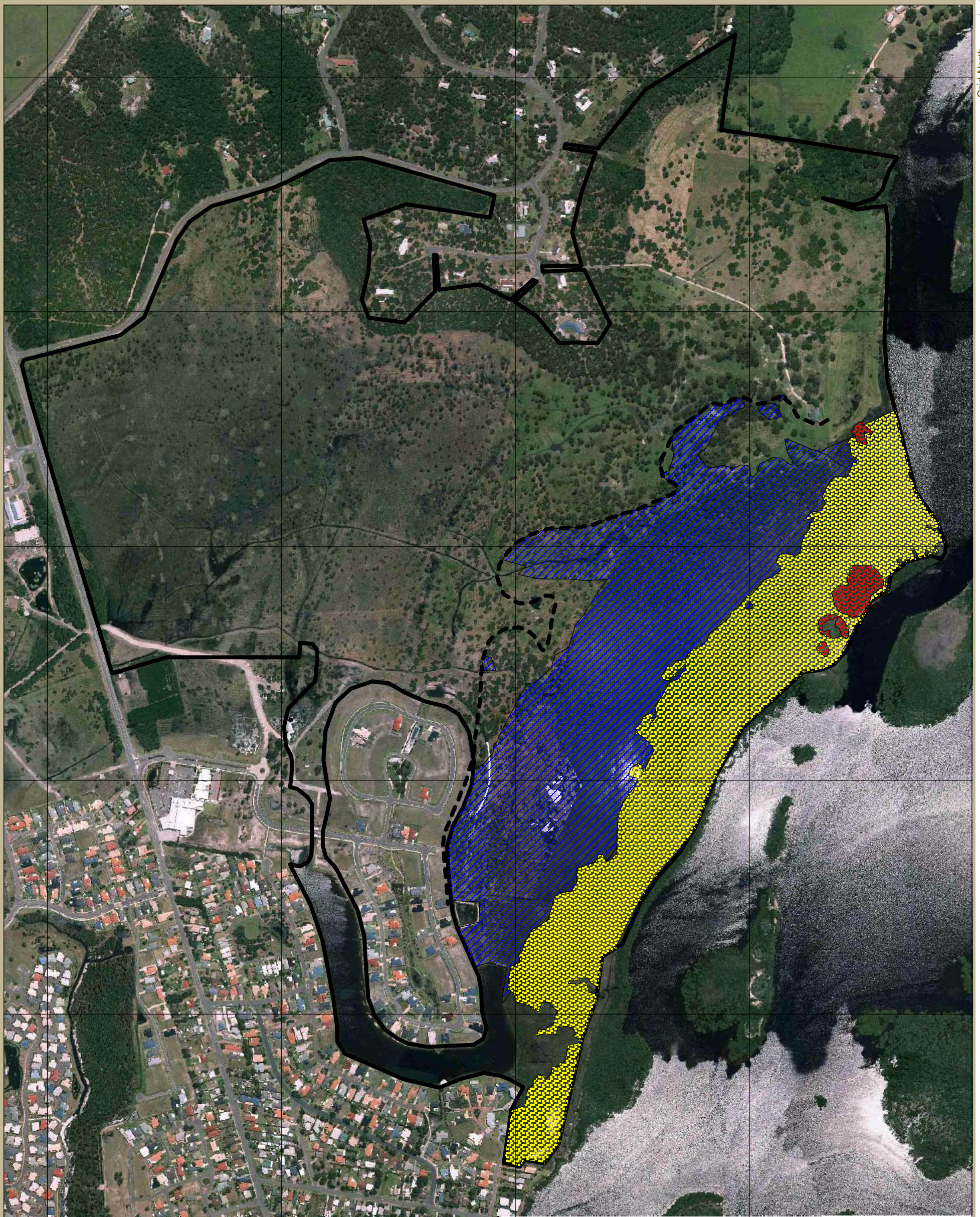


- Subject land**
- Subject land
- Dry Forest/Woodland Communities**
- Eucalyptus pilularis Open Forest
 - Eucalyptus pilularis Derived Grassland
 - Corymbia maculata - Eucalyptus paniculata Open Forest
 - Eucalyptus umbra Open Forest
 - Eucalyptus microcorys Open Forest
 - Eucalyptus microcorys Open Forest (Melaleuca regrowth)
 - Eucalyptus signata Woodland
- Wet Forest/Woodland/Scrub/Heath Communities**
- Corymbia gummifera Open Forest (Corymbia gummifera - Eucalyptus resinifera)
 - Corymbia gummifera Open Forest (Corymbia gummifera - Angophora costata)
 - Corymbia gummifera Derived Grassland
 - Angophora costata - Eucalyptus resinifera Woodland (Angophora costata - Eucalyptus resinifera)
 - Angophora costata - Eucalyptus resinifera Woodland (Angophora costata)
 - Eucalyptus robusta Woodland/Open Forest (Eucalyptus robusta)
 - Eucalyptus robusta Woodland/Open Forest (Eucalyptus robusta - Angophora costata)
 - Eucalyptus robusta Woodland/Open Forest (Eucalyptus robusta - Eucalyptus resinifera)
 - Eucalyptus robusta Woodland/Open Forest (Eucalyptus robusta - Eucalyptus resinifera - Angophora costata)
 - Wet Heath
 - Casuarina glauca - Melaleuca Regrowth Forest
 - Melaleuca quinquinervia Forest
 - Melaleuca ericifolia Scrub
- Wetland Communities**
- Casuarina glauca Forest
 - Baumea juncea Rushland
 - Juncus kraussii Saltmarsh
 - Avicennia marina Mangroves
- Exotic Communities**
- Pine Forest
 - Exotic Grassland
 - Disturbed Estuarine Vegetation



Figure 3.2 Vegetation communities recorded on the subject land










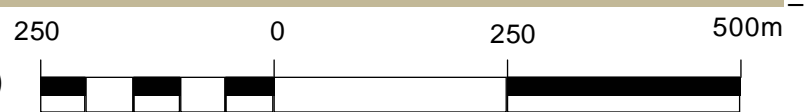
-  Subject land
-  1-in-100 year flood line
-  Swamp Sclerophyll Floodplain Forest
-  Swamp Oak Floodplain Forest
-  Coastal Saltmarsh



Figure 3.3 Endangered ecological communities recorded on the subject lands (showing 1-in-100 year flood line)



3.3 Dry Forest/Woodland Communities

3.3.1 *Eucalyptus pilularis* Open Forest

TSC Act Status: Not listed.

EPBC Act Status: Not listed.

This community occurs in the north eastern portion of the subject land and occupies approximately 11.17ha, which includes a derived grassland component of 2.45ha. Dominant species in the tree stratum are *Eucalyptus pilularis* (Blackbutt) and *Angophora costata* (Smooth-barked Apple). Other trees recorded in this community include *Corymbia gummifera* (Red Bloodwood), *Banksia serrata* (Old-man Banksia), *Glochidion ferdinandii* (Cheese Tree), *Endiandra sieberi* (Hard Corkwood) and *Allocasuarina littoralis* (Black Sheoak). The tree stratum ranges in height from 12-25m with a Projected Foliage Cover (PFC) of 10-50%. Common species in the shrub stratum include *Monotoca elliptica* (Tree Broom-heath), *Leucopogon parviflorus* (Coastal Beard-heath), *Hibbertia obtusifolia* and the exotic *Lantana camara* (Lantana). The shrub stratum ranges in height from 0.2-2m with a PFC of 5-40%. Common native groundcover species include *Pteridium esculentum* (Bracken), *Hydrocotyle peduncularis* (Pennywort), *Pomax umbellata* (Pomax), *Commelina cyanea* (Native Wandering Jew) and *Lomandra longifolia* (Spiny-headed Mat-rush). Common exotic groundcover species include *Bidens pilosa* (Cobbler's Pegs), *Conyza bonariensis* (Flaxleaf Fleabane), *Hypochaeris radicata* (Flatweed) and *Axonopus fissifolius* (Narrow-leaved Carpet Grass). The groundcover stratum ranges in height from 0-1.5m with a PFC of 5-40%. This community is shown in **Photograph 3.1**.

This community has been impacted by the various land uses on the subject land. Removal of canopy trees has resulted in the presence of a derived grassland component of this community. Regular slashing has seen a reduction in native groundcover species and grazing has increased the abundance of exotic species. Despite this, native species continue to persist in the community, with localised occurrences of native groundcover species at the base of canopy trees. The canopy stratum is comprised entirely of native species, and only a few exotic species occur in the shrub stratum. Exotic grasses and pasture species are frequent within this community and occupy approximately 60% of the groundcover stratum. Clearing has resulted in the creation of a number of patches of this community. Native groundcover species persist between these patches of the community, however they also contain moderate-high abundances of exotic species.



Photograph 3.1 *Eucalyptus pilularis* Open Forest

3.3.2 *Corymbia maculata* - *Eucalyptus paniculata* Open Forest

TSC Act Status: Not listed.

EPBC Act Status: Not listed.

This community occurs in the northern slopes of the subject land and occupies approximately 7.04ha. Dominant species in the tree stratum are *Corymbia maculata* (Spotted Gum) and *Eucalyptus paniculata* subsp. *paniculata* (Grey Ironbark). There are also frequent occurrences of *Eucalyptus propinqua* var. *propinqua* (Small Fruited Grey Gum), *Eucalyptus fergusonii*, *Eucalyptus globoidea* (White Stringybark) and *Eucalyptus resinifera* subsp. *resinifera* (Red Mahogany). The tree stratum ranges in height from 15-25m with a PFC of 15-50%. Common species in the shrub stratum include *Pultenaea villosa*, *Melaleuca nodosa* (Ball Honeymyrtle), *Pultenaea paleacea* var. *paleacea*, *Callistemon salignus* (Willow Bottlebrush), *Leptospermum polygalifolium* (Lemon Scented Tea-tree) and *Breynia oblongifolia* (Coffee Bush). The shrub stratum ranges in height from 0.2-3.5m with a PFC of 5-30%. Common species in the groundcover stratum include *Dichondra repens* (Kidney Weed), *Pratia purpurascens* (Whiteroot), *Themeda australis* (Kangaroo Grass), *Entolasia stricta* (Wiry Panic), *Brunoniella pumilio* (Dwarf Blue Trumpet), *Lagenifera stipitata* (Blue Bottle-daisy), *Lomandra longifolia* (Spiny-headed Mat-rush), *Dianella caerulea* var. *producta* (Blue Flax lily) and the exotic *Conyza bonariensis* (Flaxleaf Fleabane) and *Axonopus fissifolius* (Narrow-leaved Carpet Grass). The groundcover stratum ranges in height from 0-2m with a PFC of 20-40%. The vines *Glycine clandestina* (Twining Glycine), *Glycine*

microphylla and *Glycine tabacina* were also recorded in this community. This community is shown in **Photograph 3.2**.

This community has been impacted by underscrubbing activities, most likely as result bushfire protection activities for the houses situated upslope. Native species continue to persist in this community, with only localised occurrences of exotic species. Both the canopy and shrub stratum are comprised of native species. Exotic species occupy approximately 5-10% of the groundcover stratum.



Photograph 3.2 *Corymbia maculata – Eucalyptus paniculata* Open Forest

3.3.3 *Eucalyptus umbra* Open Forest

TSC Act Status: Not listed.

EPBC Act Status: Not listed.

This community occurs in the northern-most portion of the subject land and occupies approximately 2.21ha. Common species in the tree stratum include *Eucalyptus umbra* (Broad-leaved White Mahogany), *Eucalyptus microcorys* (Tallowwood), *Angophora costata* (Smooth-barked Apple), *Eucalyptus globoidea* (White Stringybark), *Eucalyptus resinifera* subsp. *resinifera* (Red Mahogany) and *Corymbia gummifera* (Red Bloodwood). Other tree species recorded in this community include *Livistona australis* (Cabbage Palm), *Allocasuarina littoralis* (Black She-oak) and *Exocarpos cupressiformis* (Native Cherry). The tree stratum ranges in height from 12-20m and has a PFC of 30-60%. Species recorded in the shrub stratum include *Callistemon salignus* (Willow Bottlebrush), *Melaleuca nodosa* (Ball

Honeymyrtle), *Polyscias sambucifolia* subsp. *sambucifolia* (Elderberry Panax), *Breynia oblongifolia* (Coffee Bush) and *Notelaea longifolia* (Large Mock-olive). The shrub stratum ranges in height from 0.5-5m and has a PFC of 5-50%. Species in the groundcover stratum include *Brunoniella pumilio* (Dwarf Blue Trumpet), *Pratia purpurascens* (Whiteroot) *Lepidosperma laterale* (Variable Sword-sedge), *Entolasia stricta* (Wiry Panic) *Lomandra longifolia* (Spiny-headed Mat-rush), *Lomandra filiformis* var. *filiformis* (Wattle Mat-rush). The groundcover stratum ranges in height from 0-1.5m and has a PFC of 20-90%. Common vines recorded in this community include *Billardiera scandens* (Appleberry) and *Pandorea pandorana* (Wonga Wonga Vine). This community is shown in **Photograph 3.3**.

This community has not been impacted from the previous and current land uses on the subject land. There is some weed invasion where this community adjoins exotic grassland, however it is predominately native.



Photograph 3.3 *Eucalyptus umbra* Open Forest

3.3.4 *Eucalyptus microcorys* Open Forest

TSC Act Status: Not listed.

EPBC Act Status: Not listed.

This community occurs in the northern half of the subject land and occupies approximately 11.38ha. One area of this community within the western portion varies floristically to the rest of the community as it contains an abundance of regrowth vegetation. This portion of the community occupies 2.23ha. Descriptions of species composition are provided for the two areas of this community.

The area of this community with a predominately regrowth understorey occurs in the centre of the western portion of this community. The tree stratum is dominated by *Eucalyptus microcorys* (Tallowwood), *Eucalyptus globoidea* (White Stringybark), *Eucalyptus resinifera* subsp. *resinifera* (Red Mahogany) and *Acacia irrorata* subsp. *irrorata* (Green Wattle). Other tree species occurring in this community include *Angophora costata* (Smooth-barked Apple) and *Corymbia gummifera* (Red Bloodwood). The tree stratum ranges in height from 12-18m and has a PFC of 30-60%. Common species in the shrub stratum include *Melaleuca linariifolia* (Snow in Summer), *Callistemon salignus* (Willow Bottlebrush), *Leptospermum polygalifolium* (Lemon Scented Tea-tree), *Melaleuca nodosa* (Ball Honeymyrtle), *Melaleuca sieberi* and the exotic *Lantana camara* (Lantana). The shrub stratum ranges in height from 1-5m and has a PFC of 30-70%. Common groundcover species include *Brunoniella pumilio* (Dwarf Blue Trumpet), *Pratia purpurascens* (Whiteroot), *Gahnia clarkei* (Tall Saw-sedge), *Lomandra longifolia* (Spiny-headed Mat-rush), *Entolasia stricta* (Wiry Panic), *Imperata cylindrica* var. *major* (Blady Grass), *Microlaena stipoides* var. *stipoides* (Weeping Meadow Grass) and *Oplismenus imbecillis*. The groundcover stratum ranges in height from 0-1m and has a PFC of 0-25%. This community is shown in **Photograph 3.4**.

The understorey of this community is predominantly comprised of regrowth *Melaleuca* species as a result of previous land use. This community is not significantly impacted by weed invasion. Some weed invasion is evident in the areas surrounding the drainage line flowing through this community.



Photograph 3.4 *Eucalyptus microcorys* Open Forest with regrowth vegetation

As with the other areas of this community, the tree stratum is dominated by *Eucalyptus microcorys* (Tallowwood). Other trees recorded in this community include *Angophora*