



# Broulee – Biodiversity Certification Assessment Report

## FINAL

Prepared for  
Eurobodalla Shire Council

22 February 2013



**DOCUMENT TRACKING**

ITEM	DETAIL
Project Name	Broulee – Biodiversity Certification Proposal
Project Number	11NARECO-0011
Prepared by	Ryan Smithers, Naomi De Ville, Joanne Daly, Darren James, Deidre Ellis
Reviewed by	Rob Humphries
Approved by	Darren James
Status	FINAL
Version Number	5
Last saved on	22 February 2013
Cover photos (clockwise from top left)	Typical Bangalay Sand Forest, Bangalay Sand Forest Zone 2, White-footed Dunnart, Bangalay Sand Forest Zone 9

This report should be cited as 'ELA 2013. *Broulee – Biodiversity Certification Assessment Report*. Prepared for Eurobodalla Shire Council, by Eco Logical Australia, Narooma.'

**ACKNOWLEDGEMENTS**

This document has been prepared by Eco Logical Australia Pty Ltd with support from Paula Pollock from Eurobodalla Shire Council (ESC) and the project steering committee.

**Disclaimer**

*This document may only be used for the purpose for which it was commissioned and in accordance with the contract between Eco Logical Australia Pty Ltd and ESC. The scope of services was defined in consultation with ESC, by time and budgetary constraints imposed by the client, and the availability of reports and other data on the subject area. Changes to available information, legislation and schedules are made on an ongoing basis and readers should obtain up to date information.*

*Eco Logical Australia Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report and its supporting material by any third party. Information provided is not intended to be a substitute for site specific assessment or legal advice in relation to any matter. Unauthorised use of this report in any form is prohibited.*

# Contents

Contents .....	ii
List of Tables .....	v
List of Figures .....	vi
Abbreviations .....	vii
Executive Summary .....	1
<b>1</b> Introduction .....	<b>3</b>
1.1 Project Background .....	3
1.2 Broulee Biodiversity Certification Study Area .....	3
1.2.1 Development Area .....	4
1.2.2 Conservation Area .....	4
1.2.3 Retained Lands .....	4
1.2.4 Assessment Area .....	4
<b>2</b> Methods .....	<b>6</b>
2.1 Literature and Database Review .....	6
2.2 Determination of Species Credit Species Requiring Targeted Survey .....	6
2.2.1 Waterbirds .....	7
2.2.2 Cave Roosting Microbats .....	7
2.2.3 Endangered Greater Glider Population .....	7
2.2.4 Grey-headed Flying-fox .....	7
2.2.5 Green and Golden Bell Frog .....	8
2.2.6 Tessellated Spider Orchid .....	8
2.2.7 Waterwheel Plant .....	8
2.3 Field Assessment Overview .....	8
2.4 Vegetation Zone Mapping .....	9
2.4.1 Vegetation Plots .....	14
2.5 Targeted Surveys for Fauna Species Credit Species .....	14
2.5.1 Avifauna .....	14
2.5.2 Giant Burrowing Frog .....	16
2.5.3 Mammals .....	16
<b>3</b> Results .....	<b>24</b>
3.1 Vegetation Type and Condition Mapping within the Certification Area .....	24
3.1.1 Limitations and Assumptions of Final Vegetation Map .....	24
3.2 Vegetation Zones Descriptions .....	24

3.2.1	Zone 1.....	26
3.2.2	Zone 8.....	27
3.2.3	Zone 9.....	28
3.2.4	Zone 10 .....	29
3.2.5	Zone 20 .....	30
3.2.6	Zone 22 .....	31
3.3	Threatened Ecological Community Mapping.....	32
3.4	Threatened Flora .....	32
3.5	Species Credit Fauna Species .....	32
3.5.1	Avifauna.....	32
3.5.2	Giant Burrowing Frog .....	32
3.5.3	Mammals .....	35
4	Biocertification Assessment Results.....	36
4.1	Assumptions and Limitations in Applying the BCAM.....	36
4.2	Biodiversity Certification Assessment Area .....	37
4.2.1	Management of Conservation Lands .....	40
4.3	Vegetation Mapping and Zones.....	46
4.4	Landscape Tg Values .....	50
4.5	Transect/Plot Data and Site Value Scores .....	50
4.6	Landscape Score.....	53
4.6.1	Native Cover in Landscape .....	53
4.6.2	Connectivity Value .....	53
4.6.3	Adjacent Remnant Area .....	54
4.7	Threatened Species Assessment.....	54
4.7.1	Development Area.....	54
4.7.2	Conservation Area.....	54
4.8	Red Flags .....	54
4.8.1	Vegetation .....	57
4.8.2	Species.....	57
4.9	Matters of National Environmental Significance.....	58
4.9.1	Listed Threatened Species.....	58
4.9.2	Listed Threatened Ecological Communities.....	58
4.9.3	World Heritage Properties or National Heritage Places .....	58
4.9.4	Ramsar Wetlands of International Importance .....	58
4.9.5	Migratory Bird Species .....	59
4.10	Indirect Impacts .....	59
4.10.1	Indirect Impacts on Ecosystem Credits .....	60
4.10.2	Indirect Impacts on Species Credit Species.....	61
4.11	Credit Calculations.....	64

4.11.1	Ecosystem Credits.....	64
4.11.2	Species Credits .....	64
<b>5</b>	<b>Conclusion .....</b>	<b>66</b>
	References .....	67
	Appendix 1: Curriculum Vitae of field staff .....	68
	Appendix 2: Site Value Scores for each Vegetation Zone .....	74
	Appendix 3: Area of each Vegetation Zone within Development and Conservation Footprints .....	77
	Appendix 4: Landscape Tg Calculations .....	79
	Appendix 5: Transect/Plot Data.....	82
	Appendix 6: Species Predicted and Requiring Survey.....	84
	Appendix 7: Credits Generated by Conservation Lands .....	87
	Appendix 8: Likelihood of Occurrence for MNES .....	89
	Appendix 9: Results of Mammal Trapping Surveys .....	95

# List of Tables

Table 1: Threatened and migratory species, known, likely or with the potential to occur in the Development Area.....	7
Table 2: Attributes of vegetation zones within the study area.....	12
Table 3: Targeted survey methods and effort for species credit species during the survey period.....	20
Table 4: Vegetation zones within the Assessment Area .....	25
Table 5: Land use breakdown .....	37
Table 6: Area of conservation lands.....	40
Table 7: OLS zone management requirements .....	43
Table 8: Area of vegetation within the Development Area and Conservation Area .....	46
Table 9: Area of vegetation zones assessed within the Development Area and Conservation Area .....	49
Table 10: Landscape Tg assigned to each vegetation type.....	50
Table 11: Vegetation zones and transect/plot data.....	50
Table 12: Site value scores allocated to each vegetation zone .....	52
Table 13: Native vegetation in assessment circle .....	53
Table 14: Connectivity scores allocated for the assessment .....	53
Table 15: Impacts to red flagged vegetation .....	57
Table 16: Impacts to White-footed Dunnart habitat.....	57
Table 17: Indirect Impact Calculations .....	61
Table 18: Final ecosystem credit results .....	64
Table 19: Final species credit results .....	65

# List of Figures

Figure 1: Broulee Biodiversity Certification Study Area .....	5
Figure 2: Properties where Access was Available within the Study Area .....	10
Figure 3: Vegetation Zones within the Study Area .....	11
Figure 4: Vegetation Plots within the Development Area and Identified Conservation Area .....	15
Figure 5: Targeted Surveys for Species Credit Species in the Broulee Urban Precinct Development Area .....	21
Figure 6: Targeted Surveys for the White-footed Dunnart in the Conservation Area (July 2012) .....	22
Figure 7: Targeted Surveys for the White-footed Dunnart in the Conservation Area (August 2012) .....	23
Figure 8: Distribution of Threatened Ecological Communities within the Assessment Area .....	34
Figure 9: Land Proposed for Biodiversity Certification .....	38
Figure 10: Land Proposed for Conservation .....	39
Figure 11: Biodiversity Certification Assessment Area .....	41
Figure 12: Area subject to Additional Reduction as a Result of Existing Conservation Obligations .....	42
Figure 13: Fuel Management Zone (FMZ) .....	44
Figure 14: Obstacle Limitation Surfaces (OLS) Zones .....	45
Figure 15: Biometric Vegetation Types within the Development Area and Conservation Area .....	47
Figure 16: Vegetation Zones Assessed within the Development Area and Conservation Area .....	48
Figure 17: Vegetation Red Flags .....	55
Figure 18: White-footed Dunnart Red Flags .....	56
Figure 19: Indirect Impact Buffer- Broulee .....	62
Figure 20: Indirect Impact Buffer- Moruya Airport .....	63

# Abbreviations

ABBREVIATION	DESCRIPTION
*	Denotes introduced species
ARA	Adjacent Remnant Area
APZ	Asset Protection Zone
BCAM	Biodiversity Certification Assessment Methodology
DECCW	NSW Department of Environment, Climate Change and Water (now OEH)
DoP	NSW Department of Planning (now Department of Planning and Infrastructure)
DPC	NSW Department of Premier and Cabinet
DP&I	NSW Department of Planning and Infrastructure
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
ESC	Eurobodalla Shire Council
FMZ	Fuel Management Zone
ELEP 2012	Eurobodalla Local Environment Plan 2012
NPWS	NSW National Parks and Wildlife Service (part of OEH)
OEH	NSW Office of Environment and Heritage (formerly DECCW)
OLS	Obstacle Limitation Surface
PVP	Property Vegetation Plan
SCIVI	South Coast – Illawarra Vegetation Integration
SRCMA	Southern Rivers Catchment Management Authority
RBVT	Revised Biometric Vegetation Types
TEC	Threatened Ecological Community
Tg	Threatened Species Response to Management Score
TSC Act	NSW Threatened Species Conservation Act (1995)
TSPD	Threatened Species Profile Database



# Definitions

DEFINITION	DESCRIPTION
Affected Species	Those threatened species that are considered likely to be affected by the proposal and were subjected to further assessment in accordance with Section 110(2) of the NSW <i>Threatened Species Conservation Act 1995</i> (TSC Act)
Assessment Area	Those areas proposed for Biodiversity Certification, comprising the Development Area, Conservation Area and Retained Land
Conservation Lands	Individual parcels of land which make up the Conservation Area
Conservation Area	Lands that may be proposed for biodiversity conservation, via 'conservation measures', to offset the impact of conferring biodiversity certification
Development	Has the same meaning as in the EP&A Act
Development Area	Those areas affected directly by the proposed development and proposed for Biodiversity Certification
Locality	The area within a 5 km radius of the subject site
Proposal	The development, activity or action proposed
Retained Lands	Land within the biodiversity certification assessment area that is not proposed for biodiversity certification or subject to a proposed conservation measure
Study Area	The wider area assessed as part of the biodiversity certification assessment project. The study area is a larger area the Assessment Area

# Executive Summary

The Biodiversity Certification Assessment Methodology (BCAM) has been used to conduct a Biodiversity Certification Assessment of proposed urban expansion in the Broulee area and planned development at Moruya Airport. The BCAM was used to facilitate an equitable, transparent and scientifically rigorous outcome in addressing competing urban development and biodiversity conservation issues within the Broulee area. This has been achieved through an ecological assessment of the current biodiversity values within Broulee Biodiversity Certification Assessment Area, an assessment of the biodiversity values to be lost or decreased as a result of future urban and airport development, and an assessment of the increase of biodiversity values within an identified Conservation Area.

The surveys undertaken for this assessment included vegetation zone mapping throughout the study area and targeted fauna surveys within the Assessment Area. The surveys undertaken for the assessment were consistent with the requirements of the BCAM.

The Assessment Area, which includes the identified Development Area, Conservation Area and Retained Lands, included a total of eleven vegetation zones. Of these, only six vegetation zones comprised vegetation within the same vegetation type or vegetation formation as the vegetation types within the Development Area, and thus, In accordance with the BCAM, only these six vegetation zones could be used to offset the impacts of ecosystem values of the Development Area.

The Development Area was found to support two vegetation types (Bangalay – Old-man Banksia open forest and Coast Banksia – Coast Wattle dune scrub), although the vast majority of the Development Area supports Bangalay – Old-man Banksia open forest in various condition states, with less than a hectare of Coast Banksia – Coast Wattle dune scrub within the Development Area. Bangalay – Old-man Banksia open forest comprises the endangered ecological community Bangalay Sand Forest, and the vast majority of the community within the Development Area is in moderate to good condition and thus comprises a red flag under the BCAM.

There are no records on the Atlas of NSW Wildlife of threatened flora species within the Development Area. It was not considered necessary to undertake targeted surveys for any of the predicted threatened flora species on the basis of the absence of suitable habitat. There were no incidental records of threatened flora species within the Development Area during the vegetation and fauna surveys undertaken during survey period.

Seven species credit fauna species, the Little Eagle, Square-tailed Kite, Osprey, Gang-gang Cockatoo, Giant Burrowing Frog, Brush-tailed Phascogale and White-footed Dunnart, were known or considered to have the potential to occur within the Development Area. Targeted surveys were undertaken for these species during the survey period. As a result the White-footed Dunnart was recorded within the Development Area, and the entirety of the Development Area is considered to provide potential habitat for the species. Under the BCAM the White-footed Dunnart is unable to withstand loss. Habitat for this species is therefore considered a red flag.

The Gang-gang Cockatoo was recorded within the Development Area during the survey period. However the Gang-gang Cockatoo was incorrectly classed as a species credit species in the draft BCAM, and was subsequently not assessed further after the incorrect classification was confirmed with OEH. None of the other target species credit fauna species were recorded within the Development Area during the survey period.

Eight properties within the Assessment Area were assessed for their potential to contribute to the Conservation Area. All eight of these properties were selected as the Conservation Area.

The ecosystem credits required and generated by the proposal were calculated based on the BCAM.

The results of the assessment demonstrate that the Conservation Area identified is sufficient to offset the impacts of the proposal, with a surplus of 1,329 credits.

Parts of the Conservation Area are affected by existing and proposed land management activities associated with the safe operation of Moruya Airport and the provision of bushfire hazard management adjoining the Broulee urban area. The impact of these land management activities was acknowledged as far as is possible within the BCAM. However, the BCAM does not allow the future site value to be reduced from its current level in conservation lands. This resulted in a slight over estimation of the ecosystem credits generated in those parts of the Conservation affected by the OSL and FMZ zones.

The species credits required and generated by the proposal were calculated based on the BCAM.

A total of 1,816 credits are required to offset the impacts to 69 ha of White-footed Dunnart habitat. The 372.4 ha Conservation Area generates 1,924 credits, resulting in a 108 credit surplus.

The proposal will meet the maintain or improve test required under the BCAM if the Director General of the NSW Department of Premier and Cabinet (DPC) decides that the impacts on red flag areas may be offset and grants consent for a minor variation to the BCAM. This would allow the full credit generating potential from the proposed offset lands to be realised.

# 1 Introduction

## 1.1 PROJECT BACKGROUND

Eurobodalla Shire Council (ESC) is seeking to apply for Biodiversity Certification (Biocertification) of proposed urban expansion in the Broulee area and proposed development at Moruya Airport.

The NSW Office of Environment and Heritage (OEH - formerly the Department of Environment, Climate Change and Water) has recently developed the Biodiversity Certification Assessment Methodology (BCAM) which is to be applied to Biodiversity Certification applications throughout NSW (DECCW 2011). The Minister for the Environment may confer Biocertification on land if satisfied that the package of conservation measures set out in an application for Biocertification will lead to the overall improvement or maintenance of biodiversity values.

ELA have used the BCAM to assess the proposed Broulee urban expansion and Moruya Airport development, and identified conservation areas, against the ‘improve or maintain’ standard as defined by the BCAM.

This methodology and process has been pursued so as to facilitate an equitable, transparent and scientifically rigorous outcome in addressing competing urban development and biodiversity conservation issues within the Broulee area. This has been achieved through an ecological assessment of the current biodiversity values within the Broulee Biodiversity Certification Assessment Area, an assessment of the biodiversity values to be lost or decreased as a result of future urban and airport development, and an assessment of the increase of biodiversity values within conservation areas.

## 1.2 BROULEE BIODIVERSITY CERTIFICATION STUDY AREA

The Broulee Biodiversity Certification study area (hereafter referred to as the study area) extends south from Candalagan Creek to the Moruya River and west to the Princes Highway at Bimbimbie, as shown in **Figure 1**. It comprises approximately 2,000 ha of land and includes approximately 60 individual properties (beyond the residential areas).

The Broulee Urban Precinct and Moruya Airport lie within the study area. The Broulee Urban Precinct, which is bounded by Broulee Road, George Bass Drive, Candalagan Creek and the coast is characterised by a mix of partially developed residential land, some limited commercial development, schools and recreational facilities. The Broulee Urban Precinct includes more than 43 ha of residential zoned land which supports the endangered ecological community (EEC) Bangalay Sand Forest and a range of other high conservation values. This area of Bangalay Sand Forest and is part of one of the largest remaining occurrences of the Bangalay Sand Forest in NSW, which extends from the Tomaga River to the Moruya River, and is approximately 770 ha in extent. Approximately 36 ha of the Bangalay Sand Forest within the Broulee Urban Precinct is proposed for biodiversity certification.

This area comprises the Broulee Urban Precinct Development Area, as shown in **Figure 1**. The Moruya Airport is located at the southern end of the study area, as shown in **Figure 1**. Approximately 33 ha of remnant native vegetation in varying condition, ranging from derived shrubland to relatively undisturbed forest, is the subject of future airport development investigations. This area comprises the Moruya Airport Development Area, as shown in **Figure 1**.

### 1.2.1 Development Area

The 36 ha of high conservation value remnant vegetation within the Broulee Urban Precinct Development Area and the 33 ha of remnant native vegetation in Moruya Airport Development Area comprise the Broulee Biodiversity Certification Assessment Area - Development Area. Consistent with the BCAM, the biodiversity values of the Development Area have been assessed to determine the impacts associated with the proposed development.

### 1.2.2 Conservation Area

The biodiversity values of the study area were assessed in order to define a potential Conservation Area in order to meet the 'improve or maintain' standard as defined by the BCAM. The BCAM defines a conservation area as lands that may be proposed for biodiversity conservation, via 'conservation measures', to offset the impact of conferring biodiversity certification. In the context of the Broulee Biodiversity Certification Assessment, the Conservation Area comprises those lands proposed for biodiversity conservation to offset the impacts of the biodiversity certified lands of the Broulee Urban Precinct Development Area and Moruya Airport Development Area. The Conservation Area is made up of a number of parcels of land or conservation lands.

### 1.2.3 Retained Lands

Lands immediately adjacent to the Development Area, which are not proposed to be part of the Conservation Area, but which may be subject to indirect impacts associated with the proposal, and/or the subject of measures to mitigate the indirect impacts of the proposal, are referred to as Retained Lands. The Retained Lands include the Yellow-bellied Glider corridor immediately adjacent to the Broulee Urban Precinct Development Area.

### 1.2.4 Assessment Area

The Broulee Biodiversity Certification Assessment Area (hereafter referred to as the Assessment Area) comprises the Development Area, Conservation Area and the Retained Lands as shown in **Figure 1**.

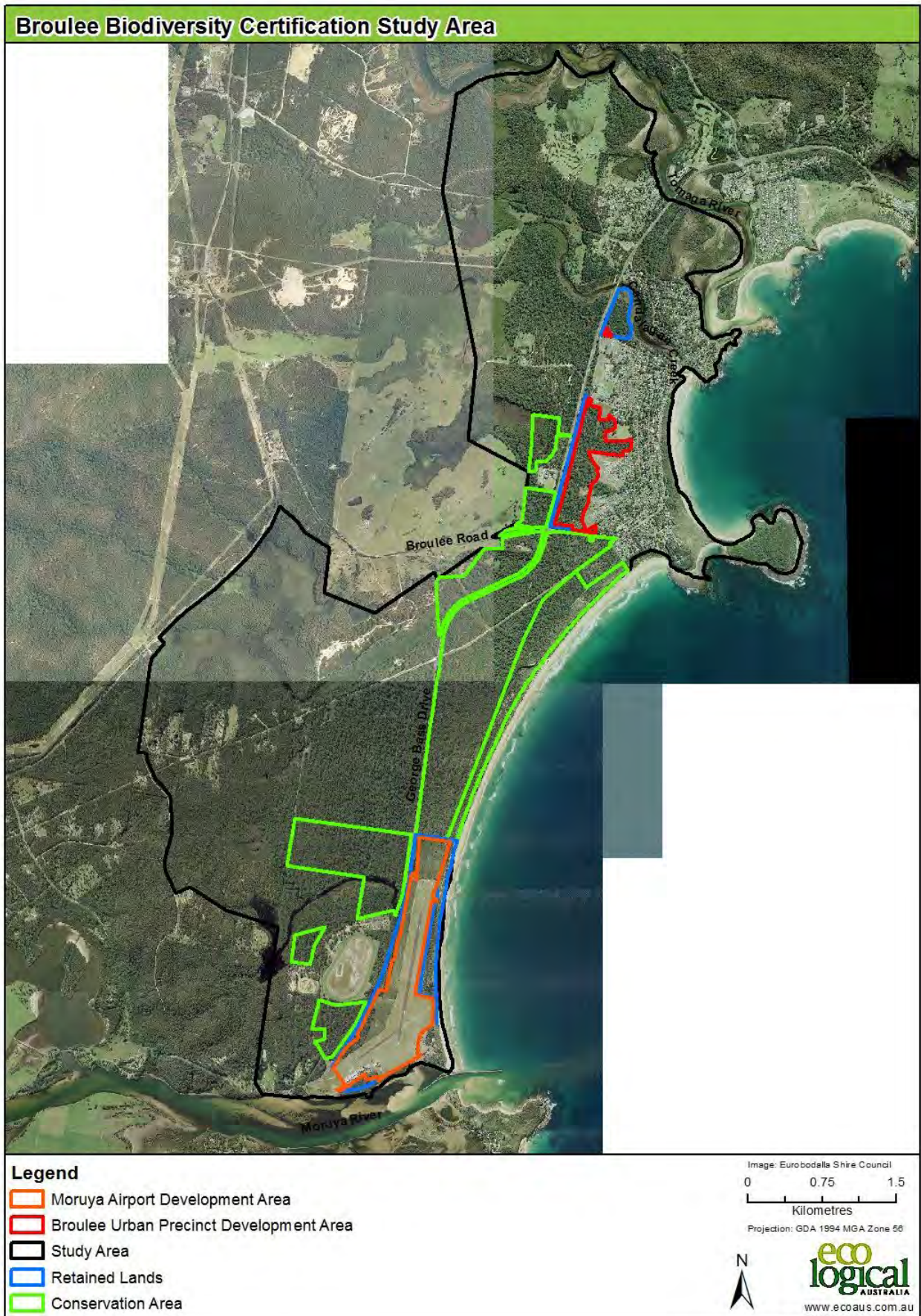


Figure 1: Broulee Biodiversity Certification Study Area



## 2 Methods

### 2.1 LITERATURE AND DATABASE REVIEW

A review of relevant information was undertaken prior to the commencement of field studies. Relevant biodiversity datasets and associated literature for the region were reviewed including:

- Existing vegetation mapping, as well as other available GIS data
- Atlas of NSW Wildlife (Accessed September 2011)
- EPBC Protected Matters Search Tool (DSEWPAC Accessed September 2011)
- Threatened Species Profiles Database, Biobanking Assessment Tool v2.0 (OEH Accessed September 2011)

Vegetation across the study area has been mapped as part of the South Coast – Illawarra Vegetation Integration (SCIVI) (Tozer et al. 2006). This mapping was reviewed and converted into the equivalent Revised Biometric Vegetation Types (RVBT) (DECC 2008) for later validation when undertaking the vegetation zone mapping, and for preliminary assessment of the habitat for “species credit” species potentially requiring targeted survey.

### 2.2 DETERMINATION OF SPECIES CREDIT SPECIES REQUIRING TARGETED SURVEY

Utilising the above information, an assessment of the ‘likelihood of occurrence’ was made for species identified as ‘species credit’ species under the BCAM. Species credits are the class of biodiversity credit created (where conservation measures are applied) or required (where biodiversity certification is conferred) for threatened species that cannot be reliably predicted based on habitat surrogates. The BCAM requires targeted survey within the BCAA for those species considered to be ‘species credit’ species which may be impacted by the proposed development. Where species are confirmed as being impacted by the development, surveys have also been conducted within the proposed Conservation Area to establish whether the species to be impacted are also present within the Conservation Area.

The results of this search identified 17 threatened entities that were either known, or considered ‘likely,’ or to have the ‘potential’ to, occur in the Development Area (**Table 1**). The requirement for targeted site survey for the threatened entities was then assessed in more detail against the suitability of the potential habitat within the Development Area, on the basis of surveys of the habitat resources within the Development Area, and expert knowledge of the status of the specific entity within the study area and region (see Sections 2.2.1 - 2.2.7 below).

As a result, seven species credit fauna species, the Little Eagle (*Hieraaetus morphnoides*), Square-tailed Kite (*Lophoictinia isura*), Osprey (*Pandion haliaetus*), Gang-gang Cockatoo (*Callocephalon fimbriatum*), Giant Burrowing Frog (*Heleioporus australiacus*), Brush-tailed Phascogale (*Phascogale tapoatafa*), and White-footed Dunnart (*Sminthopsis leucopus*), were assessed as potentially occurring within the Development Area and thus requiring targeted survey.

Where targeted survey was required, survey methods and effort were based on the *Draft Threatened Biodiversity Survey and Assessment Guidelines* (DEC 2004) and updated “Threatened species survey and assessment guidelines: field survey methods for fauna - Amphibians (DECC 2009).

**Table 1: Threatened and migratory species, known, likely or with the potential to occur in the Development Area**

SCIENTIFIC NAME	COMMON NAME	POTENTIAL HABITAT WITHIN THE DEVELOPMENT AREA
<i>Botaurus poiciloptilus</i>	Australasian Bittern	No
<i>Ixobrychus flavicollis</i>	Black Bittern	No
<i>Limosa limosa</i>	Black-tailed Godwit	No
<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale	Yes
<i>Miniopterus schreibersii oceanensis</i>	Eastern Bentwing-bat (Breeding Habitat)	No
<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo	Yes*
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	Yes
<i>Petauroides volans</i> - endangered population	Greater Glider population in the Bingi-Congo area of the Eurobodalla LGA	No
<i>Litoria aurea</i>	Green and Golden Bell Frog	No
<i>Pteropus poliocephalus</i> (Breeding Habitat)	Grey-headed Flying-fox (Breeding Habitat)	No
<i>Myotis macropus</i> (Breeding Habitat)	Large-footed Myotis (Breeding Habitat)	No
<i>Hieraaetus morphnoides</i>	Little Eagle	Yes
<i>Pandion haliaetus</i>	Osprey	Yes
<i>Lophoictinia isura</i>	Square-tailed Kite	Yes
<i>Caladenia tessellata</i>	Tessellated Spider Orchid	No
<i>Aldrovanda vesiculosa</i>	Waterwheel Plant	No
<i>Sminthopsis leucopus</i>	White-footed Dunnart	Yes

\*The Gang-gang Cockatoo was subsequently determined by OEH to have been incorrectly defined as a species credit species in the draft BCAM.

The justification for the conclusions in **Table 1** are discussed below.

### 2.2.1 Waterbirds

The Australasian Bittern, Black Bittern and Black-tailed Godwit are waterbirds associated with wetlands, riparian areas and estuarine habitats. These habitats do not occur within the Development Area and, as such, these species would not occur there.

### 2.2.2 Cave Roosting Microbats

Breeding habitats for the Eastern Bentwing-bat and Large-footed Myotis are associated with caves, mines, bridges, stormwater tunnels or similar structures. These habitats do not occur within the Development Area and, as such, the Development Area would not support breeding habitat for these species.

### 2.2.3 Endangered Greater Glider Population

Whilst Greater Gliders do occur within the Development Area, the Development Area is north of the Moruya Area and thus beyond the extent of the endangered population of the Greater Glider in the Bingi-Congo area of the Eurobodalla LGA.

### 2.2.4 Grey-headed Flying-fox

There are no historical records of the Grey-headed Flying-fox roosting within the Development Area. No evidence of the species roosting within the Development Area was observed during the survey period.



### 2.2.5 Green and Golden Bell Frog

Preferable habitat for the Green and Golden Bell Frog includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading. Large permanent swamps and ponds exhibiting well-established fringing vegetation adjacent to open grassland areas are preferable for foraging. The Development Area does not support any suitable habitat for the species and there are no records of the species within the Development Area. The nearest records of the species are from Pedro Swamp, to the south of the Moruya River. The species was not detected within the Development Area during the targeted surveys for the Giant Burrowing Frog.

### 2.2.6 Tessellated Spider Orchid

The Tessellated Spider Orchid is associated with open woodlands and heath, typically occurring in treeless areas or very open areas, which are often rocky and where there are only skeletal soils. It does not occur in forested habitats, and there are no records from forested sites of the type within the Development Area.

Tessellated Spider Orchid plants may lay dormant for 10-20 years, only flowering for one to two years following a mid-late summer fire. Outside this period it is highly unlikely that any plants will flower and thus that there will be any above ground biomass of the species.

The nearest record of the species is approximately 70 km to the north of the study area at Ulladulla where it occurs in low heathy woodland on a clay substrate. The Ulladulla population of the species is now thought to be extinct (Copeland, L. pers. comm. 2012).

Given the absence of suitable habitat within the Development Area, the absence of recent fire within the bulk of the Development Area, and the absence of any known records of the species from the locality, it is considered highly unlikely that the species would occur there. In any case, given the typically dense nature of the understorey within the Development Area and the absence of recent mid-late summer fire, there would be a very low probability of detecting any plants within the Development Area, even if the habitats were suitable and if the species was present.

### 2.2.7 Waterwheel Plant

The Waterwheel Plant grows in shallow freshwater and is widespread but rare in NSW. It traps and digests aquatic insects and generally floats below the water's surface but flowers emerge from the water. The species is known from the Malabar Creek wetlands and from Waldrons Swamp. There is no habitat for the species in the Development Area and it would not occur there.

## 2.3 FIELD ASSESSMENT OVERVIEW

The following sections outline the survey and assessment methodologies undertaken for this report, which were designed to meet the requirements of the BCAM.

Curriculum vitae for all ELA project staff involved in field assessment are provided in **Appendix 1**.

To identify habitat features to inform the targeted fauna surveys, a preliminary assessment of the Broulee Urban Precinct Development Area was conducted by two ELA ecologists, Ryan Smithers and Naomi De Ville, in September 2011. Subsequently, targeted surveys for species credit species commenced on 10 November 2011 and continued until 24 August 2012.

Information on the methods and effort employed for surveying vegetation communities and species credit species are outlined in detail in Sections 2.4 to 2.6, but generally, the following methods were implemented:

- Vegetation communities: quadrat surveys and random meander surveys
- Diurnal birds: habitat assessments, nesting assessments and opportunistic observations
- Amphibians: habitat assessments, call playback, listening and spotlighting surveys
- Mammals: Type A and Type B Elliot traps, Pitfall trapping, Hair funnels, Passive Infrared Motion Detector Camera Surveys, habitat assessments and opportunistic observations

Targeted surveys were initially conducted only within the Broulee Urban Precinct Development Area. However, after the White-footed Dunnart was detected within the Development Area, targeted surveys were then undertaken within lands which were under consideration as Conservation Areas. Vegetation mapping and vegetation plots were undertaken within the study area between November 2011 and October 2012.

## 2.4 VEGETATION ZONE MAPPING

The BCAM requires the mapping of vegetation zones within the study area. The BCAM defines a vegetation zone as a relatively homogenous area that is of the same vegetation type and broad condition state. Vegetation types were determined using the Revised Biometric Vegetation Types (RVBT) (DECC 2008).

Between November 2011 and April 2012, the study area was assessed and vegetation zones mapped. The assessment was aided by existing regional vegetation mapping i.e. SCIVI (Tozer et al. 2006), which was converted to the RVBTs. The mapping was also informed by ELAs existing understanding of the distribution and condition of vegetation within much of the study area as a result of numerous other projects within the study area over the last ten years.

Those properties where access was granted were traversed on foot and in vehicles and the existing vegetation mapping validated and modified where necessary to develop the vegetation zone mapping. Where access was not granted properties were assessed from public vantage points, adjoining properties, or from aerial photo interpretation. **Figure 2** indicates those properties where access was available.

The vegetation zone mapping identified a total of 22 vegetation zones within the study area, which included eight separate vegetation types in a range of condition states, as identified in **Table 2**. The vegetation zones within the study area are identified in **Figure 3**.

As access to private properties within the study area was generally only available for a limited time period i.e. one or two days, vegetation plots were conducted during the period that access was available rather than waiting until the final requirement for vegetation plots was confirmed, and thus requiring a return visit. As a result some redundant and /or surplus vegetation plots were collected during the vegetation zone mapping.

The vegetation zone mapping identified that the Development Area supported five zones in two vegetation types. However, apart from 0.24 ha of '*Coast Banksia - Coast Wattle dune scrub*', the remainder of the approximately 69 ha of native vegetation within the Development Area supports a single vegetation type, '*Bangalay - Old-man Banksia open forest on coastal sands*'.

As the BCAM only allows vegetation impacts (ecosystem credits) to be offset if the offset vegetation type meets a series of requirements to ensure a 'like for like' outcome, subsequent vegetation mapping and condition plots for proposed conservation lands was targeted towards those communities that are allowable as offsets. Initially, the type of threatened species predicted on site, and the percent cleared status of the vegetation type impacted, are used to determine where offsets can be located. Vegetation within the same vegetation class, or vegetation formation, can then be used to offset impacts where other options are not available. In applying the offset rules to the study area, it was determined that the only vegetation types and zones able to provide an offset for the proposed Development Area, are vegetation zones 1, 5, 8, 9, 10, 16, 18, 20 and 22, as shown in **Figure 3**.

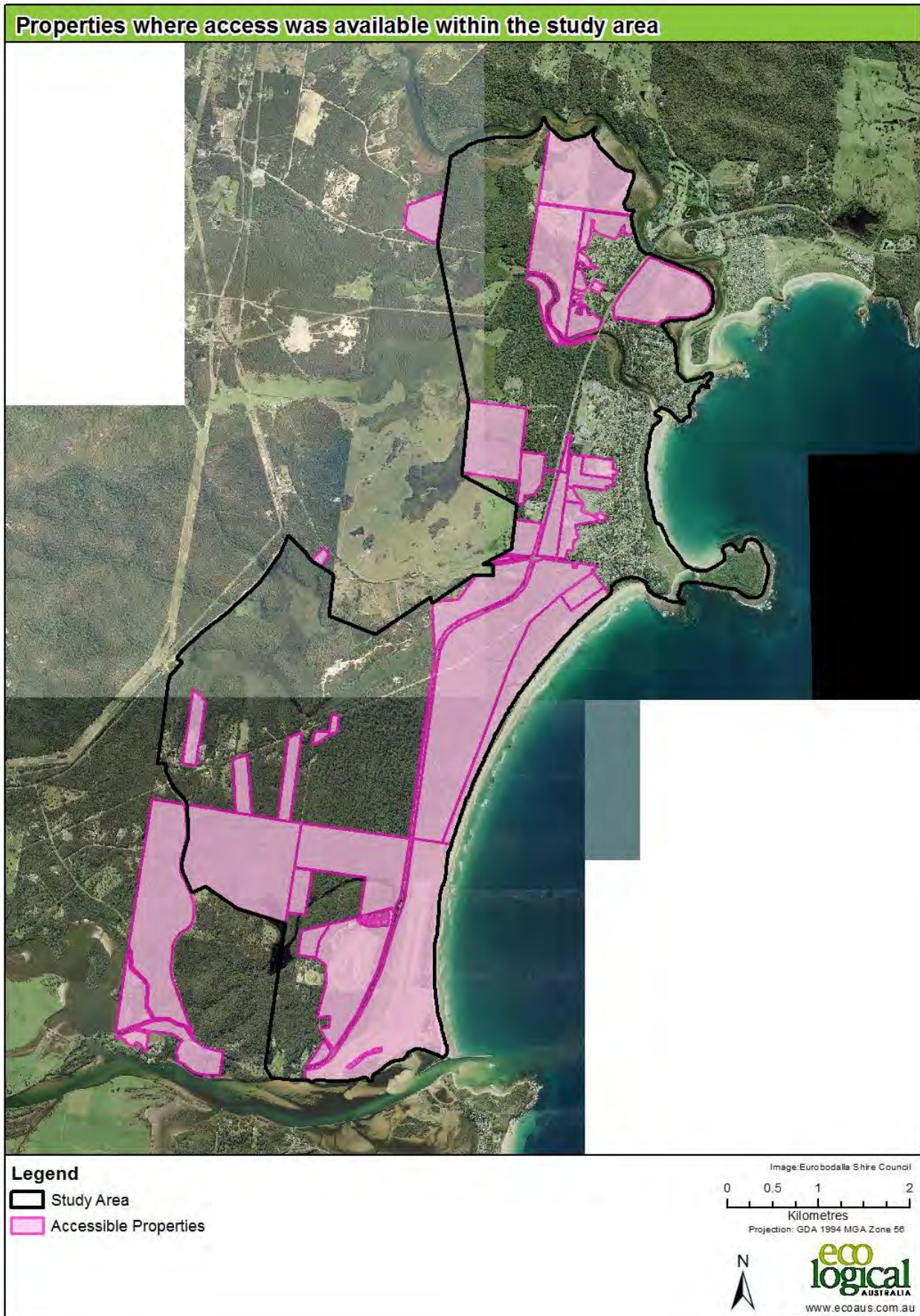


Figure 2: Properties where Access was Available within the Study Area





Figure 3: Vegetation Zones within the Study Area

Table 2: Attributes of vegetation zones within the study area

ZONE	REVISED BIOMETRIC VEGETATION TYPES	ANCILLARY CODE	FORMATION	CLASS	CONDITION
1	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	Good condition with lots of hollows and negligible weeds	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests	moderate to good
2	Spotted Gum - White Stringybark - Burrawang shrubby open forest on hinterland foothills, northern South East Corner	Logged forest with mostly regrowth and only occasional old growth trees	Wet Sclerophyll Forests (Grassy subformation)	Southern Lowland Wet Sclerophyll Forests	moderate to good
3	Coastal freshwater lagoons of the Sydney Basin and South East Corner	<i>Cladium procerum</i> dominated swamp	Freshwater Wetlands	Coastal Freshwater Lagoons	moderate to good
4	Spotted Gum - Grey Ironbark - Woollybutt grassy open forest on coastal flats, southern Sydney Basin and South East Corner	Appears to have been logged but generally in good condition relatively recently burnt with lots of Hop bush	Wet Sclerophyll Forests (Grassy subformation)	Southern Lowland Wet Sclerophyll Forests	moderate to good
5	Red Bloodwood - Silvertop Ash - White Stringybark heathy open forest on coastal foothills, southern South East Corner	Good condition forest with lots of HBTs and negligible weeds	Dry Sclerophyll Forests (Shrubby subformation)	South East Dry Sclerophyll Forests	moderate to good
6	Red Bloodwood - Silvertop Ash - White Stringybark heathy open forest on coastal foothills, southern South East Corner	Heavily logged/cleared. Dense regrowth with few mature or old growth trees. Sparse understorey and groundcover	Dry Sclerophyll Forests (Shrubby subformation)	South East Dry Sclerophyll Forests	moderate to good
7	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin and South East Corner	Excellent condition, mainly inundated during the survey period	Forested Wetlands	Coastal Floodplain Wetlands	moderate to good
8	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	Relatively young regrowth post clearing. No or very few hollows or other old growth elements	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests	moderate to good
9	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	Under-scrubbed or slashed, but with a reasonable abundance of old growth trees	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests	moderate to good
10	Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner	Good condition with some cosmopolitan weeds such as Bitou Bush	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests	moderate to good
11	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin and South East Corner	Generally in good condition, mix of Swamp Oak dominated communities	Forested Wetlands	Coastal Floodplain Wetlands	moderate to good
12	Saltmarsh in estuaries of the Sydney Basin and South East Corner	Good condition. The zone also includes Mangroves. No need to split given unsuitable class and formation	Saline Wetlands	Saltmarshes	moderate to good

13	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin and South East Corner	Regularly slashed	Forested Wetlands	Coastal Wetlands	Floodplain	moderate to good
14	Coastal freshwater lagoons of the Sydney Basin and South East Corner	Large lagoons/swamps generally inundated during the survey period	Freshwater Wetlands	Coastal Lagoons	Freshwater	moderate to good
15	Swamp Mahogany swamp sclerophyll forest on coastal lowlands, Sydney Basin and South East Corner	Good condition with relatively few weeds	Forested Wetlands	Coastal Forests	Swamp	moderate to good
16	Red Bloodwood - Silvertop Ash - White Stringybark heathy open forest on coastal foothills, southern South East Corner	Logged with general paucity of hollows, but not clear-felled as in Zone 6	Dry Sclerophyll Forests (Shrubby subformation)	South East Dry Sclerophyll Forests		moderate to good
17	Spotted Gum - Blackbutt shrubby open forest on the coastal foothills, southern Sydney Basin and northern South East Corner	Logged but otherwise in good condition, not as moist as Zone 19	Wet Sclerophyll Forests (Grassy subformation)	Southern Lowland Wet Sclerophyll Forests		moderate to good
18	Red Bloodwood - Silvertop Ash - White Stringybark heathy open forest on coastal foothills, southern South East Corner	Partially cleared and regularly slashed so that there is very little understorey and a regrowth groundcover	Dry Sclerophyll Forests (Shrubby subformation)	South East Dry Sclerophyll Forests		moderate to good
19	Spotted Gum - Blackbutt shrubby open forest on the coastal foothills, southern Sydney Basin and northern South East Corner	Very moist and in excellent condition	Wet Sclerophyll Forests (Grassy subformation)	Southern Lowland Wet Sclerophyll Forests		moderate to good
20	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	Derived grassland/shrubland	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests		moderate to good
21	Coastal freshwater lagoons of the Sydney Basin and South East Corner	Dominated by <i>Schoenus brevifolius</i> historic draining/clearing/grazing.	Freshwater Wetlands	Coastal Lagoons	Freshwater	moderate to good
22	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	Bangalay dominated typically low forest of the hind dune	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests		moderate to good

### 2.4.1 Vegetation Plots

The BCAM requires a minimum number of vegetation plots/transects be completed for each vegetation zone to satisfy the methodology. The minimum number of vegetation plots/transects required is determined by the number and size of the zones within the Assessment Area.

The assessment required a minimum of 18 transects/plots to be completed based on the final Assessment Area. The transects/plots included five plots which were supplied by the Southern Rivers Catchment Management Authority (SRCMA) and which had previously been undertaken within the Assessment Area.

Consistent with the BCAM, vegetation plots were undertaken within each zone within the Development Area and identified potential Conservation Area. The vegetation plots comprised a 0.1 ha quadrat (50 m x 20 m) within which a range of vegetation structure and abundance attributes and habitat features were assessed. Habitat features assessed included the number of hollow bearing trees and length of fallen dead timber greater than 10 cm diameter. The projected foliage cover of each vegetation stratum and the abundance of exotic flora was assessed along a 50 m transect through the centre of the quadrat. A 0.04 ha (20 m x 20 m) quadrat, where all vascular flora species were recorded, was nested within the 0.1 ha quadrat.

The location of the vegetation plots and transects undertaken within the Development Area and identified potential Conservation Areas, is identified in **Figure 4**.

## 2.5 TARGETED SURVEYS FOR FAUNA SPECIES CREDIT SPECIES

Seven species credit fauna species, the Little Eagle, Square-tailed Kite, Osprey, Gang-gang Cockatoo, Giant Burrowing Frog, Brush-tailed Phascogale and White-footed Dunnart were assessed as having the potential to occur within the Development Area and thus requiring targeted survey.

Targeted surveys for these species were undertaken between November 2011 and August 2012. All targeted surveys were limited to the Development Area, with exception of targeted surveys for the White-footed Dunnart, which were also undertaken in lands which were being considered as potential Conservation Areas.

Requirements were met for all threatened fauna expected to occur in the study area and compliance with the TBSA Guidelines (DEC 2004) are summarised in **Table 3**.

The location of the targeted surveys undertaken during the survey period are identified in **Figure 5**, **Figure 6** and **Figure 7**.

### 2.5.1 Avifauna

Nesting assessments were undertaken across the Broulee Urban Precinct Development Area in the spring – early summer of 2011 for nests of the Little Eagle, Osprey, and Square-tailed Kite, and for any evidence of nesting or roosting of the Gang-gang Cockatoo. The surveys involved random meander surveys by two ecologists through potentially suitable habitat searching for raptor nests or any evidence of the target species. Nesting assessments for the Gang-gang Cockatoo involved late afternoon observations from vantage points by two ecologists on four occasions, each separated by approximately one week.

Opportunistic observations were undertaken for raptors and nests during the vegetation surveys and at all other times i.e. during the setting up, removing and checking of traps.

The survey effort for targeted raptor and Gang-gang Cockatoo nesting assessments involved a total of 14 person hours, as identified in **Table 3**.



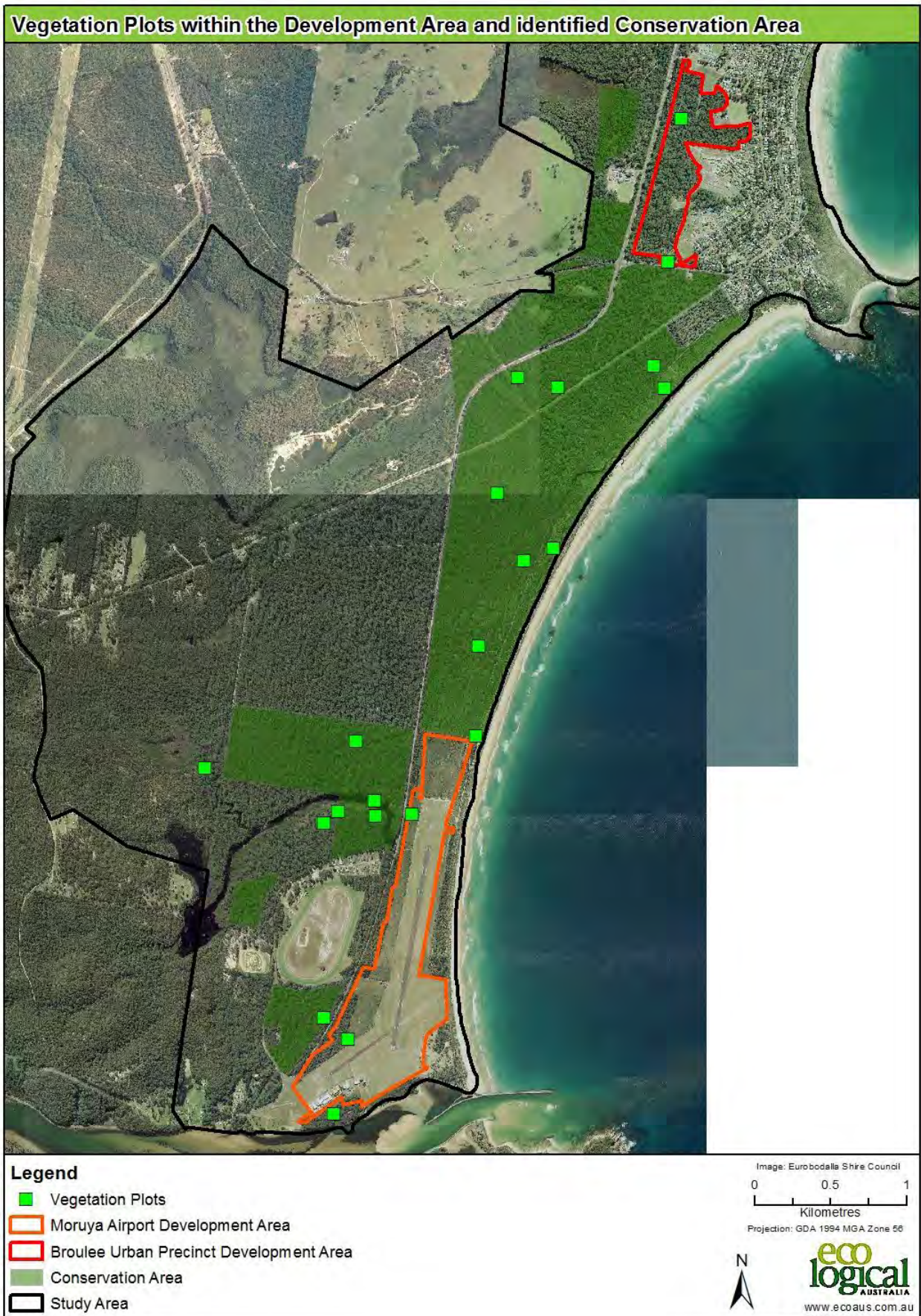


Figure 4: Vegetation Plots within the Development Area and Identified Conservation Area



## 2.5.2 Giant Burrowing Frog

Despite the absence of any recent records of the Giant Burrowing Frog from the locality, nor the presence of any potential breeding habitat, targeted surveys were undertaken for the species, given the presence of a sandy substrate within the Development Area.

Nocturnal call playback, listening and spotlighting surveys were undertaken within the Development Area on three occasions during summer when conditions were suitable i.e. warm weather during or immediately after sufficient rainfall associated with storms.

The survey effort for targeted Giant Burrowing Frog surveys involved 11.5 person hours, as identified in **Table 3**.

## 2.5.3 Mammals

### *January – February 2012 Surveys*

Targeted surveys for the Brush-tailed Phascogale and White-footed Dunnart were undertaken within the Development Area between 16 January and 18 February 2012 using a range of survey methods as described below.

### **Elliot Traps**

Fifty type-A Elliott traps were set along five trapping transects within the Development Area for four consecutive nights from 17 to 20 January 2012. The type-A Elliott traps targeted the White-footed Dunnart. The spacing of trap stations approximately was approximately 25-40 m.

Thirty type-B Elliott traps mounted on platforms on tree trunks approximately 2-3 m above the ground were also set along three of the trapping transects, targeting the Brush-tailed Phascogale. Each trap was baited with a mixture of peanut butter, honey and rolled oats. The tree trunk around the tree mounted type-B Elliott traps was sprayed with a mixture of honey and water as an attractant. The spacing of trap stations was approximately 25-40 m.

### **Hair Funnels**

Thirty Faunatech hair funnels set on tree trunks approximately 2-5 m above the ground were also set along three of the trapping transects for consecutive nights between 20 January 2012 and 15 February 2012, yielding a total effort of 720 hair funnel trap-nights. The hair funnels were targeting the Brush-tailed Phascogale. Hair funnels were baited with a mixture of peanut butter, honey and rolled oats and honey water sprayed around the entrance of the funnels. Honey water spray was reapplied approximately half way through the survey period. Any hair-funnel wafers with obvious hairs attached were sent to Ms. Barbara Triggs for analysis.

### **Pitfall Trapping**

Pitfall trapping was also conducted within the Development Area during the January 2012 trapping period, targeting the White-footed Dunnart. Three sites, containing two pitfall traps each, were set for four consecutive nights to yield a trapping effort of 24 pitfall trap-nights. Each pitfall trap site contained two pits approximately 20 m apart, connected by 30 m of drift netting in a rough line that extending a further approximately 5 m out beyond the pit at each end. Buckets approximately 50 cm deep and 30 cm wide were used for pit traps and were installed so the lip was flush to the ground. Each bucket contained holes in the bottom to facilitate draining and floating material (usually bark) in case of heavy rainfall. Other material such as leaves provided shelter from sunlight and predators. Builder's damp course (30 cm high) was used for the drift fencing.

All traps were checked each morning soon after sunrise. Captured animals were identified and then released at the trap site.



Photo 1: Tree mounted type-B Elliott trap targeting the Brush-tailed Phascogale



Photo 2: Tree mounted hair funnel targeting the Brush-tailed Phascogale

### Passive Infrared Motion Detector Camera Surveys

Between 18 January 2012 and 15 February 2012, three RECONYX™ HC600 HyperFire™ cameras and bait stations were set within the Development Area to target the Brush-tailed Phascogale. The cameras were attached to tree trunks approximately 5 m from the ground, and provided night and day surveillance of fauna visiting the bait stations with the temperature sensitive passive infrared motion detector in the cameras. The camera and bait stations were fixed to trees with hollows and evidence of bark wear from fauna traffic. As described for the trapping surveys, baits were a mixture of peanut butter, honey and oats with honey water sprayed above and below the bait station. The bait was replaced approximately half way through the survey period. The cameras surveys yielded a survey effort of 78 days/nights.

#### *July 2012 Surveys*

As the White-footed Dunnart was recorded within the Development Area during the January February surveys, targeted surveys were undertaken for the White-footed Dunnart in the proposed Conservation Areas in July 2012.

The July 2012 targeted White-footed Dunnart surveys involved:

**Pitfall Trapping** – Seven sites, containing four pitfall traps each, were set for five consecutive nights from 17 to 20 January 2012 to yield a trapping effort of 168 pitfall trap-nights. Each pitfall trap site contained four pits approximately 10 m apart, connected by 30 m of drift netting in a rough line with a pit at each end. Buckets approximately 50 cm deep and 30 cm wide were used for pit traps and were installed so the lip was flush to the ground. Each bucket contained holes in the bottom to facilitate draining and floating material (usually bark) in case of heavy rainfall. Other material such as leaves provided shelter from sunlight and predators. Builder's damp course (30 cm high) was used for the drift fencing.

**Elliot Traps** – 50 type-A Elliott traps set along five trapping transects, near the pitfall traps, within the Development Area for five consecutive nights from 17 to 20 January 2012, yielding a total effort of 210 trap-nights. Each trap was baited with a mixture of peanut butter, honey and rolled oats.

#### *August 2012 Surveys*

The targeted White-footed Dunnart surveys in the proposed Conservation Areas were repeated in August 2012.

The August 2012 targeted White-footed Dunnart surveys involved:

**Pitfall Trapping** – Ten sites, containing four pitfall traps each, were set for four consecutive nights to yield a trapping effort of 160 pitfall trap-nights. Each pitfall trap site contained four pits approximately 10 m apart, connected by 30 m of drift netting in a rough line with a pit at each end. Buckets approximately 50 cm deep and 30 cm wide were used for pit traps and were installed so the lip was flush to the ground. Each bucket contained holes in the bottom to facilitate draining and floating material (usually bark) in case of heavy rainfall. Other material such as leaves provided shelter from sunlight and predators. Builder's damp course (30 cm high) was used for the drift fencing.





Photo 3: Passive Infrared Motion Detector Camera and bait station



Photo 4: Typical Pitfall trap site

**Table 3: Targeted survey methods and effort for species credit species during the survey period**

METHOD	DATE	EFFORT	TBSA GUIDELINES (APPROPRIATE SURVEY OPTIONS)
Nesting assessments for Raptors and Gang-gang Cockatoos	10 November 2011	3.0 person-hours	Opportunistic sightings - time unspecified
	21 November 2011	4.0 person-hours	
	28 November 2011	3.0 person-hours	
	5 December 2011	4.0 person-hours	
	<b>Total</b>	14 person-hours	
Targeted Giant Burrowing Frog surveys (Spotlighting and call playback at 3 locations)	11 February 2012	4.0 person-hours	30 minutes of nocturnal habitat searches on two separate nights At least one call playback on two separate night
	17 February 2012	3.5 person-hours	
	28 February 2012	3.0 person-hours	
	<b>Total</b>	10.5 person-hours	
TARGETED SURVEYS FOR THE WHITE-FOOTED DUNNART AND BRUSH-TAILED PHASCOGALE	DATE	EFFORT	TBSA GUIDELINES (APPROPRIATE SURVEY OPTIONS)
DEVELOPMENT AREA			
A Elliott traps (49)	16 to 20 January 2012	176 trap nights	100 trap nights over 3-4 consecutive nights
B Elliott traps (29, arboreal)	16 to 20 January 2012	116 trap nights	24 trap nights over 3-4 consecutive nights
Pitfall traps (6)	16 to 20 January 2012	24 trap nights	24 trap nights over 3-4 consecutive nights
Hair funnels (30, arboreal)	20 January to 15 February 2012	720 trap nights	3 in minimum 10 trees for at least 4 days and 4 nights
RECONYX™ cameras (3, arboreal)	18 January to 15 February 2012	78 day/nights	Not specified
	<b>Total</b>	1,036 trap nights and 78 camera day/nights	
CONSERVATION AREA	DATE	EFFORT	TBSA GUIDELINES (APPROPRIATE SURVEY OPTIONS)
JULY 2012 SURVEYS			
Pitfall traps (7)	from 17 to 20 January 2012	164 trap-nights	NA
A Elliott traps (50)	from 17 to 20 January 2012	210 trap-nights	NA
AUGUST 2012 SURVEYS	DATE	EFFORT	TBSA GUIDELINES (APPROPRIATE SURVEY OPTIONS)
Pitfall traps (10)	21 and 24 August 2012	160 trap-nights	NA



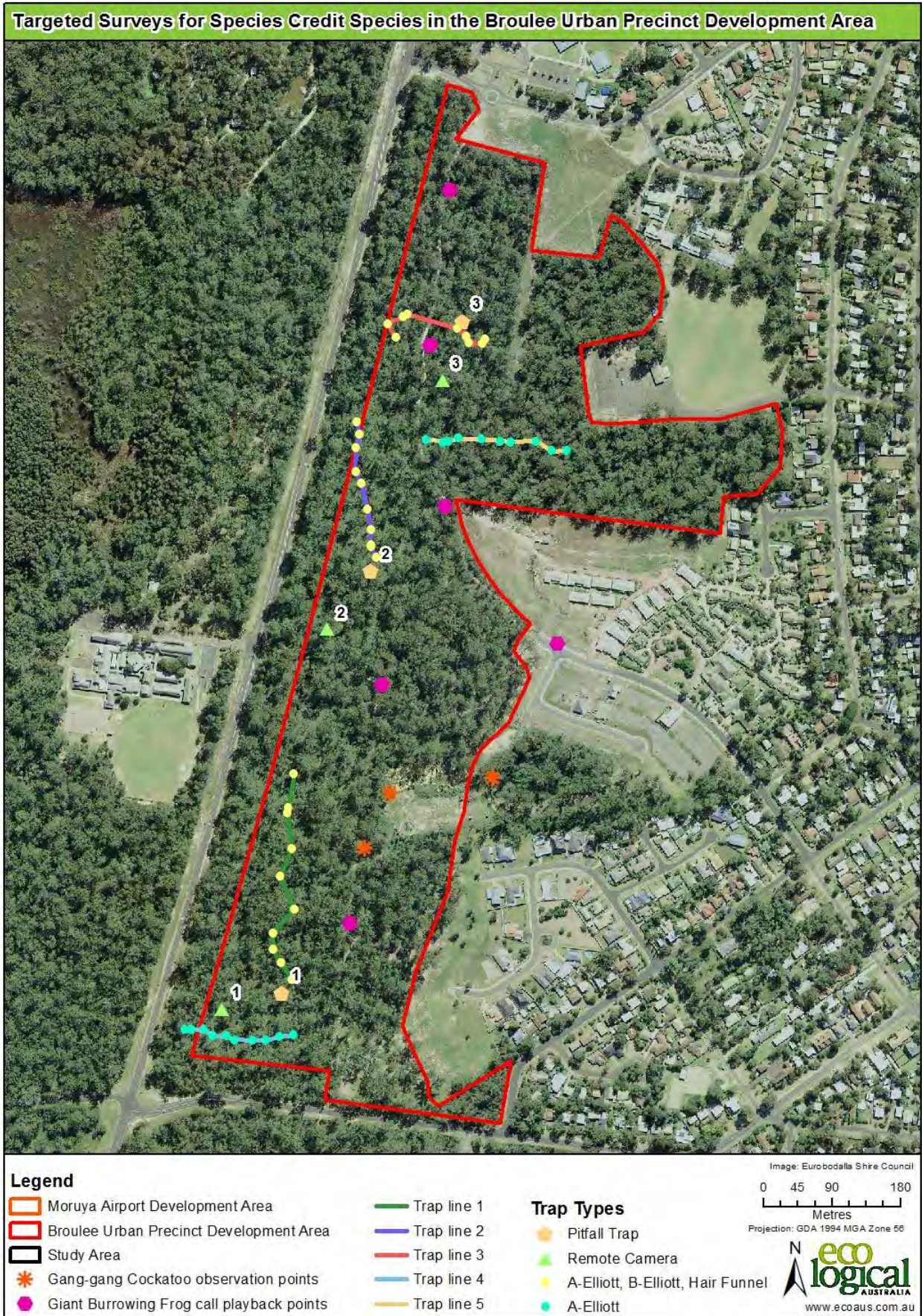


Figure 5: Targeted Surveys for Species Credit Species in the Broulee Urban Precinct Development Area





Figure 6: Targeted Surveys for the White-footed Dunnart in the Conservation Area (July 2012)





Figure 7: Targeted Surveys for the White-footed Dunnart in the Conservation Area (August 2012)



## 3 Results

### 3.1 VEGETATION TYPE AND CONDITION MAPPING WITHIN THE CERTIFICATION AREA

The Assessment Area, which includes the identified Development Area and Conservation Area, included a total of 11 vegetation zones, as identified in **Table 4**. Of these eleven vegetation zones, only six zones comprised vegetation within the same vegetation type or vegetation formation as the vegetation types within the Development Area. In accordance with the BCAM, only these six vegetation zones could be used to offset the impacts of the Development Area.

A description of the vegetation zones within the Assessment Area and the constituent vegetation type and condition is presented in subsequent sections.

The vegetation within each zone within the Assessment Area was assigned to the ‘moderate to good’ condition category as defined by the BCAM. Due to the varying quality of the ‘moderate to good’ condition vegetation within Assessment Area, several ancillary codes were required to stratify the Assessment Area into the final vegetation zones. The ancillary codes describe the key characteristics of the zone which differentiate it from other zones which have the same vegetation type.

#### 3.1.1 Limitations and Assumptions of Final Vegetation Map

Vegetation boundaries are dynamic and vary stochastically via fluctuations in biotic and abiotic factors, as well as anthropogenic land management practices (e.g. mechanical disturbance and under-scrubbing, grazing, selective logging, pasture improvement). As such, boundaries in vegetation types and vegetation zones are only indicative of what is actually found in situ (i.e. on the ground), with each community gradually changing through an ecotone. The vegetation mapping within the Assessment Area was also limited by the level of access available, as described in Section 2.4.

### 3.2 VEGETATION ZONES DESCRIPTIONS

Vegetation descriptions are provided below for:

- Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)
- Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)

These two vegetation types characterise Vegetation Zones 1, 8, 9, 10, 20 and 22.

Vegetation Zones 2, 3, 7, 14 and 19 comprise the following vegetation types:

- Coastal freshwater lagoons of the Sydney Basin and South East Corner (SR536)
- Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin and South East Corner (SR651)
- Coastal freshwater lagoons of the Sydney Basin and South East Corner (SR536)
- Spotted Gum - Blackbutt shrubby open forest on the coastal foothills, southern Sydney Basin and northern South East Corner (SR641)

These vegetation types do not meet the first trading rule under the BCAM, and in addition are not in the same vegetation type or vegetation formation as the vegetation types within the Development Area. As such, they cannot be used to offset the impacts of the proposed development and subsequently are not described further in this assessment.

Table 4: Vegetation zones within the Assessment Area

ZONE	REVISED BIOMETRIC VEGETATION TYPES	ANCILLARY CODE	FORMATION	CLASS	CONDITION
1	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	Good condition with lots of hollows and negligible weeds	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests	moderate to good
2	Spotted Gum - White Stringybark - Burrawang shrubby open forest on hinterland foothills, northern South East Corner	Logged forest with mostly regrowth and only occasional old growth trees	Wet Sclerophyll Forests (Grassy subformation)	Southern Lowland Wet Sclerophyll Forests	moderate to good
3	Coastal freshwater lagoons of the Sydney Basin and South East Corner	<i>Cladium procerum</i> dominated swamp	Freshwater Wetlands	Coastal Freshwater Lagoons	moderate to good
7	Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin and South East Corner	Excellent condition, mainly inundated during the survey period	Forested Wetlands	Coastal Floodplain Wetlands	moderate to good
8	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	Relatively young regrowth post clearing. No or very few hollows or other old growth elements	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests	moderate to good
9	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	Under-scrubbed or slashed, but with a reasonable abundance of old growth trees	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests	moderate to good
10	Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner	Good condition with some cosmopolitan weeds such as Bitou Bush	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests	moderate to good
14	Coastal freshwater lagoons of the Sydney Basin and South East Corner	Large lagoons/swamps generally inundated during the survey period	Freshwater Wetlands	Coastal Freshwater Lagoons	moderate to good
19	Spotted Gum - Blackbutt shrubby open forest on the coastal foothills, southern Sydney Basin and northern South East Corner	Very moist and in excellent condition	Wet Sclerophyll Forests (Grassy subformation)	Southern Lowland Wet Sclerophyll Forests	moderate to good
20	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	Derived grassland/shrubland	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests	moderate to good
22	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	Bangalay dominated typically low forest of the hind dune	Dry Sclerophyll Forests (Shrubby subformation)	South Coast Sands Dry Sclerophyll Forests	moderate to good

**3.2.1 Zone 1**

<b>Vegetation Type</b>	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner
<b>Ancillary Code</b>	Good condition with lots of hollows and negligible weeds
<b>Description</b>	This zone is the largest zone within the Assessment Area, comprising the vast majority of the Broulee Urban Precinct Development Area and the majority of the proposed Conservation Area. It is characterised by excellent condition forest, with Blackbutt in the canopy, good structural and floristic diversity in all strata and an abundance of hollow-bearing trees
<b>Overstorey</b>	Dominant canopy species include Bangalay ( <i>Eucalyptus botryoides</i> ), Blackbutt ( <i>Eucalyptus pilularis</i> ), and to a lesser extent Rough-barked Apple ( <i>Angophora floribunda</i> ). Forest Red Gum ( <i>Eucalyptus tereticornis</i> ), Spotted Gum ( <i>Corymbia maculata</i> ) and Red Bloodwood ( <i>Corymbia gummifera</i> ) are occasionally present
<b>Midstorey</b>	Dominant mid-storey species include Black Wattle ( <i>Acacia mearnsii</i> ), Sydney Golden Wattle ( <i>Acacia longifolia</i> subsp. <i>longifolia</i> ), Burrawang ( <i>Macrozamia communis</i> ), Saw Banksia ( <i>Banksia serrata</i> ) and Common Bracken Fern ( <i>Pteridium esculentum</i> )
<b>Groundcovers</b>	Common groundcover species include Kidney Weed ( <i>Dichondra repens</i> ), <i>Schelhammera undulata</i> , <i>Microlaena stipoides</i> var. <i>stipoides</i> , <i>Commelina cyanea</i> , <i>Pratia purpurascens</i> , Kangaroo Grass ( <i>Themeda australis</i> )
<b>EEC</b>	Bangalay Sand Forest



**Photo 5: Typical excellent condition Bangalay Sand Forest within Vegetation Zone 1**



## 3.2.2 Zone 8

<b>Vegetation Type</b>	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner
<b>Ancillary Code</b>	Relatively young regrowth post clearing. No or very few hollows or other old growth elements
<b>Description</b>	This zone is the second largest zone within the Assessment Area. It occurs primarily in those parts of the Conservation Area that are affected by the vegetation treatments required to maintain Obstacle Limitation Surface (OLS) to Moruya Airport. It is characterised by regrowth Bangalay Sand Forest with good floristic diversity however a general paucity of large eucalypts or hollow-bearing trees as a result of historic and ongoing vegetation management activities
<b>Overstorey</b>	Dominant canopy species include Bangalay ( <i>Eucalyptus botryoides</i> ), Blackbutt ( <i>Eucalyptus pilularis</i> ), and to a lesser extent Rough-barked Apple ( <i>Angophora floribunda</i> ).
<b>Midstorey</b>	Dominant mid-storey species include Black Wattle ( <i>Acacia mearnsii</i> ), Sydney Golden Wattle ( <i>Acacia longifolia</i> subsp. <i>longifolia</i> ), Burrawang ( <i>Macrozamia communis</i> ), Saw Banksia ( <i>Banksia serrata</i> ), Common Bracken Fern ( <i>Pteridium esculentum</i> )
<b>Groundcovers</b>	Common groundcover species include Kidney Weed ( <i>Dichondra repens</i> ), <i>Schelhammera undulata</i> , <i>Microlaena stipoides</i> var. <i>stipoides</i> , <i>Commelina cyanea</i> , <i>Pratia purpurascens</i> , Kangaroo Grass ( <i>Themeda australis</i> )
<b>EEC</b>	Bangalay Sand Forest



Photo 6: Typical Bangalay Sand Forest within Vegetation Zone 2 showing the absence of large eucalypts which characterise Zone 1

### 3.2.3 Zone 9

<b>Vegetation Type</b>	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner
<b>Ancillary Code</b>	Under-scrubbed or slashed, but with a reasonable abundance of old growth trees
<b>Description</b>	This zone occurs at the southern end of the Broulee Urban Precinct Development Area. It is characterised by under-scrubbed and slashed Bangalay Sand Forest below a relatively undisturbed remnant canopy
<b>Overstorey</b>	Dominant canopy species include Bangalay ( <i>Eucalyptus botryoides</i> ) and to a lesser extent Blackbutt ( <i>Eucalyptus pilularis</i> ), Rough-barked Apple ( <i>Angophora floribunda</i> ) and Forest Red Gum ( <i>Eucalyptus tereticornis</i> )
<b>Midstorey</b>	The mid-canopy is characteristically sparse or absent as a result of under-scrubbing
<b>Groundcovers</b>	Common groundcover species include Kidney Weed ( <i>Dichondra repens</i> ), <i>Schelhammera undulata</i> , <i>Microlaena stipoides</i> var. <i>stipoides</i> , <i>Commelina cyanea</i> , <i>Pratia purpurascens</i> , Kangaroo Grass ( <i>Themeda australis</i> ), Common Bracken Fern ( <i>Pteridium esculentum</i> )
<b>EEC</b>	Bangalay Sand Forest



Photo 7: Typical regularly under-scrubbed and slashed Bangalay Sand Forest within Vegetation Zone 9



### 3.2.4 Zone 10

<b>Vegetation Type</b>	Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner
<b>Ancillary Code</b>	Good condition with some cosmopolitan weeds such as Bitou Bush
<b>Description</b>	This zone occurs primarily in the Conservation Area in a narrow zone between the Bangalay Sand Forest and the Beach Strand Grasslands on the hind dune of Bengello Beach. It is characterised by a patchy canopy of Coast Banksia ( <i>Banksia integrifolia</i> ) and characteristic shrubs and groundcovers.
<b>Overstorey</b>	Dominant canopy species include Coast Banksia and very occasionally Bangalay
<b>Midstorey</b>	The mid-canopy is patchy and dominated by species such as Coastal Wattle ( <i>Acacia longifolia</i> subsp. <i>sophorae</i> ), Coast Beard Heath ( <i>Leucopogon parviflorus</i> ), White Correa ( <i>Correa alba</i> ) and Tree Broom-heath ( <i>Monotoca elliptica</i> )
<b>Groundcovers</b>	Common groundcover species include Spiny-headed Matt-rush ( <i>Lomandra longifolia</i> ), Blady Grass ( <i>Imperata cylindrica</i> ), Kidney Weed ( <i>Dichondra repens</i> ), Coast Tussock-grass ( <i>Poa poiformis</i> ), Pig Face ( <i>Carpobrotus glaucens</i> ), knobby club-rush ( <i>Ficinia nodosa</i> ) and Common Bracken Fern
<b>EEC</b>	No



Photo 8: Coast Banksia - Coast Wattle dune scrub within Vegetation Zone 10

**3.2.5 Zone 20**

<b>Vegetation Type</b>	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner
<b>Ancillary Code</b>	Derived grassland/shrubland
<b>Description</b>	This zone occurs primarily in Moruya Airport Development Area. It is characterised by a derived open shrubland or grassland as a result of historic and ongoing vegetation management activities
<b>Overstorey</b>	There is no canopy as a result of historic and ongoing vegetation management activities
<b>Midstorey</b>	The mid-canopy is characteristically sparse but where present is dominated by Coastal Wattle, Coast Banksia, Burrawang and Tree Broom-heath
<b>Groundcovers</b>	Common groundcover species include Spiny-headed Matt-rush, Blady Grass, Kidney Weed, Coast Tussock-grass, knobby club-rush and Common Bracken Fern
<b>EEC</b>	Bangalay Sand Forest



**Photo 9: Typical derived grassland/shrubland within Vegetation Zone 20**



### 3.2.6 Zone 22

<b>Vegetation Type</b>	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner
<b>Ancillary Code</b>	Bangalay dominated typically low forest of the hind dune
<b>Description</b>	This zone occurs entirely in the Conservation Area. It is characterised by good condition Bangalay Sand Forest, a lower overstorey height than Vegetation Zone 1, and an absence of Blackbutt. The zone occurs between Zones 1 and 10 in the hind dune of Bengello Beach.
<b>Overstorey</b>	The dominant canopy species are Bangalay and Saw Banksia
<b>Midstorey</b>	Dominant mid-storey species include Sydney Golden Wattle, Coast Banksia, Burrawang and Tree Broom-heath
<b>Groundcovers</b>	Common groundcover species include Kidney Weed, <i>Microlaena stipoides</i> var. <i>stipoides</i> , Spiny-headed Matt-rush, Blady Grass, Kangaroo Grass, knobby club-rush, Hoary guinea flower ( <i>Hibbertia obtusifolia</i> ) and Common Bracken Fern
<b>EEC</b>	Bangalay Sand Forest



Photo 10: Typical Bangalay dominated low Bangalay Sand Forest within Vegetation Zone 22



### 3.3 THREATENED ECOLOGICAL COMMUNITY MAPPING

The following Threatened Ecological Communities (TECs) occur within the Assessment Area:

- Bangalay Sand Forest
- Freshwater Wetlands on Coastal Floodplains
- Swamp Oak Floodplain Forest

These ecological communities are listed as ‘endangered’ under the TSC Act, i.e. Endangered Ecological Communities or EECs. Only Bangalay Sand Forest occurs within the Development Area.

The location of Threatened Ecological Communities within the Assessment Area is shown in **Figure 8**.

### 3.4 THREATENED FLORA

There are no records on the Atlas of NSW Wildlife of threatened flora species within the Development Area. Whilst no targeted threatened flora surveys were undertaken during the survey period (see Section 2.2) there were no incidental records of threatened flora within the Development Area during survey period as a result of the vegetation and targeted fauna species which were undertaken there.

### 3.5 SPECIES CREDIT FAUNA SPECIES

As described in Section 2, targeted surveys were undertaken during the survey period for seven species credit fauna species, the Little Eagle, Square-tailed Kite, Osprey, Gang-gang Cockatoo, Giant Burrowing Frog, Brush-tailed Phascogale and White-footed Dunnart. The results of these surveys are described below.

#### 3.5.1 Avifauna

##### *Raptors*

Nesting Assessments within the Development Area did not detect any raptor nests nor any other evidence of the target raptor species, Little Eagle, Osprey, and Square-tailed Kite. Whilst it is possible that these species may roost or forage within the Assessment Area from time to time, it is considered unlikely that the Development Area comprises an important area of habitat for these species.

##### *Gang-gang Cockatoo*

The Gang-gang Cockatoo is well known from the locality and was recorded within the Development Area on a number of occasions within the survey period. The classification of the Gang-gang Cockatoo as a species credit species was questioned from the outset of the project as it was inconsistent with the classification of other threatened cockatoos i.e. the Glossy Black Cockatoo, which are classified as ecosystem credit species. Targeted surveys for the species were undertaken in November and December 2011 until such time as it was confirmed by OEH, that the Gang-gang Cockatoo had been incorrectly classified in the draft BCAM as a species credit species and was in fact an ecosystem credit species.

#### 3.5.2 Giant Burrowing Frog

Targeted surveys for the Giant Burrowing Frog during the survey period failed to detect any presence of the species within the Development Area or immediate surrounds. The targeted surveys were undertaken during suitable conditions, however, amphibian activity was generally low within the Development Area, despite it being higher elsewhere in the locality during the survey period. This is not unexpected given the absence of significant water habitats within the Development Area. Several species of common amphibian were observed or heard calling within the Development Area including the Brown Tree Frog (*Litoria ewingii*), Common Eastern Froglet (*Crinia signifera*), Striped Marsh Frog (*Lymnodynastes peronii*), and the Verreaux’s Tree Frog (*Litoria verreauxii*).



Photo 11: Antechinus photographed at bait station by a tree mounted Passive Infrared Motion Detector Camera



Photo 12: White-footed Dunnart within pitfall trap



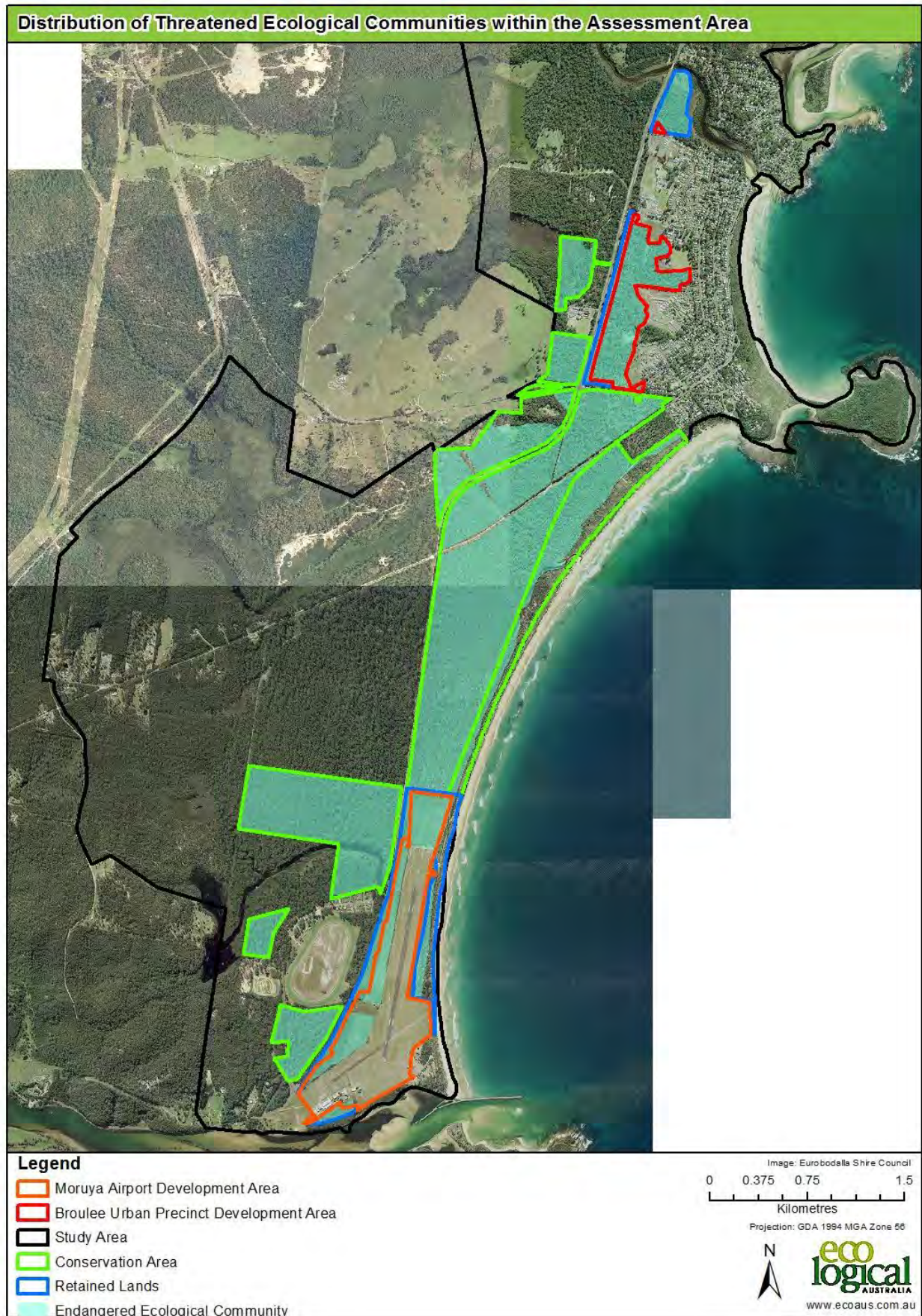


Figure 8: Distribution of Threatened Ecological Communities within the Assessment Area

### 3.5.3 Mammals

#### *January – February 2012 Surveys*

The targeted surveys for the Brush-tailed Phascogale and White-footed Dunnart resulted in the capture of one male White-footed Dunnart in the southern parts of the Broulee Urban Precinct Development Area. The Brush-tailed Phascogale was not detected within the Development Area.

Four other ground dwelling and arboreal mammals were recorded during the January – February 2012 trapping surveys including, the Common Brushtail Possum (*Trichosurus vulpecula*), Agile Antechinus (*Antechinus agilis*), Bush Rat (*Rattus fuscipes*) and Feathertail Glider (*Acrobatus pygmaeus*). Several Jacky Lizards (*Amphibolurus muricatus*) were also caught in the pitfall traps.

The White-footed Dunnart was caught on one occasion in the southern most pitfall trap within the Broulee Urban Precinct Development Area, just to the north of Broulee Road. Subsequently, the White-footed Dunnart was trapped at another site within the Development Area, approximately 500 m to the northeast, during surveys for a separate project (Paula Pollock pers. comm., 2012). These captures suggest that the entirety of the forest within the Broulee Urban Precinct Development Area is likely to provide habitat for the White-footed Dunnart.

#### *July 2012 Surveys*

Given the White-footed Dunnart was detected within the Broulee Urban Precinct Development Area, targeted surveys were undertaken in July 2012 for the species in similar habitats within the study area. The lands surveyed were under consideration as Conservation Areas to offset the impacts of the proposed development.

Despite 164 pitfall trap-nights and 210 A-Elliott trap-nights the White-footed Dunnart was not detected. There were numerous captures of other ground dwelling mammals, particularly the Agile Antechinus and Bush Rat, and also the Dusky Antechinus (*Antechinus swainsonii*.)

#### *August 2012 Surveys*

Targeted surveys for the White-footed Dunnart in lands under consideration as Conservation Areas were repeated in August 2012. Three additional pitfall trap sites were added. No Elliott trapping was undertaken.

Again, despite 160 pitfall trap-nights the White-footed Dunnart was not detected. The Agile Antechinus was captured on three occasions and there were four captures of Verreaux's Tree Frog.

Further information regarding the number and location of the animals captured during the trapping surveys is presented in **Appendix 9**.

## 4 Biocertification Assessment Results

**Section 4** provides the results of the biodiversity certification assessment conducted to the requirements of the BCAM. The information below is technical in nature, and relies on a broad understanding of the BCAM to understand the methods applied. Readers should make themselves familiar with the BCAM before reviewing this section of the document.

### 4.1 ASSUMPTIONS AND LIMITATIONS IN APPLYING THE BCAM

The BCAM provides a repeatable and scientifically robust methodology to determine whether a proposal meets an ‘improve or maintain’ biodiversity outcome. In applying the BCAM to the Assessment Area, however, several assumptions have been made, and are provided below.

In performing the calculations each property included in the proposed biodiversity certification was allocated a biodiversity certification outcome of either:

- Land proposed for biodiversity certification (Development Area);
- Land proposed for conservation (Conservation Area); or
- Retained lands i.e. lands not to be developed or used for conservation purposes.

Land proposed for biodiversity certification (Development Area) includes the remnant vegetation within the Broulee Urban Precinct and clearing associated with proposed future development within Moruya Airport (**Figure 9**). Total clearing of native vegetation is calculated at 69 ha. For these areas total clearing has been assumed within the boundaries identified, and assumes that all infrastructure associated with the development (i.e. roads, asset protection zones, services etc) are contained within the footprint defined).

Eight individual lots (or part lots) were assessed as land proposed for conservation. These lands generally occur to the north, west and south of the proposed development areas (**Figure 10**). The eight lots total 406.9 ha and contain 396.6 ha of vegetation.

Several factors influence the number of credits generated within the conservation lands, including:

1. A lot which is community land and currently subject to a generic Plan of Management (POM). The number of credits generated by this lot have been reduced consistent with the BCAM and discussions with OEH. See Section 4.2.1 for more details
2. A Fuel Management Zone (FMZ) occurring at the northern edge of two conservation lands. Vegetation within the FMZ is proposed to be managed to reduce bushfire risk on neighbouring properties. The number of credits generated by the affected conservation lands have been reduced to account for the FMZ. See Section 4.2.1 for more details
3. A requirement for some of the conservation lands to be managed to allow the safe operation of an extended Moruya Airport runway. A proposed extension of the Moruya Airport runway will require extensions to the Obstacle Limitation Surface (OLS) zones, which limit the height of objects within aircraft flight paths. As the specifications of the OLS zones will require ongoing vegetation management, the number of credits generated by affected conservation lands has been reduced to account for affects of the required management actions. See Section 4.2.1 for more details

The credit calculations associated with 2 and 3 above, while limiting the credits generated due to the future management of the conservation lands, may not adequately reflect the final condition of the vegetation within these areas once the management is applied. The BCAM only allows the current site

value score recorded within vegetation zones to be maintained, and does not allow the site value scores to be decreased. Therefore, while the future site value has been adjusted in these areas to allow no increase in site value with management (and therefore a smaller credit generating potential), in some instances, it may be more appropriate to reduce the score below the current condition within the conservation lands subject to such management. This, however, is not permissible under the BCAM.

Cleared land within the conservation lands totals 10.3 ha, or approximately 2 % of the total area of conservation lands proposed. Due to the difficulty in assessing and rehabilitating these areas, and the fact that Biometric plots have not been conducted at these locations, cleared lands within the conservation lands have been excluded from the assessment. However it is noted that some cleared areas, such as powerline easements, may provide suitable habitat for the White-footed Dunnart and, if assessed, could have contributed to the species credit calculations. In addition, vegetation types that cannot be used to offset the impacts of the Development Area (due to the restrictions on trading credits under the BCAM) have been excluded from the assessment. Therefore several zones mapped within the conservation lands do not generate credits to offset the impacts of the proposed development.

Finally, the White-footed Dunnart was recorded in the Development Area during the targeted surveys undertaken for this assessment. The species has not been recorded within the Moruya Airport Development Area, however due to the similar nature of the habitat available, it has been assumed that the species habitat is also present at this location. In addition, an expert report has been prepared which concludes that, although not recorded within the conservation lands, suitable habitat exists for the White-footed Dunnart within the conservation lands and the species is highly likely to be present there (Keystone Ecological 2013).

#### 4.2 BIODIVERSITY CERTIFICATION ASSESSMENT AREA

An assessment consistent with the BCAM was conducted to determine if the proposed Development Area (Broulee Urban Development Precinct and Moruya Airport Development Area), meets the ‘improve or maintain’ outcome required by the methodology. In conducting the assessment two proposed land uses have been assessed:

- Land proposed for biodiversity certification (development)- requires biodiversity credits
- Land proposed for conservation- generates biodiversity credits

The land proposed for biodiversity certification (Development Area) is 137.1 ha (69 ha of which is currently vegetated) (see **Table 5** and **Figure 11**). The land proposed for conservation totals 406.9 ha (396.6 ha of which is vegetated and 363.4 ha which contains vegetation that matches the ecosystem credit offset requirements of the Development Area and 373.8 ha suitable for White-footed Dunnart). All the lands proposed for conservation (Conservation Area) are owned and managed by ESC and thus available to meet the proposed conservation outcomes.

**Table 5: Land use breakdown**

ASSESSMENT AREA	AREA (HA)
Land Proposed for Biodiversity Certification (Development Area)	137.1
Land Proposed for Conservation (Conservation Area)	406.9
Land within the Assessment Area that is not proposed for biodiversity certification or subject to a proposed conservation measure (Retained Lands)	44.8
<b>Total</b>	<b>588.8</b>





Figure 9: Land Proposed for Biodiversity Certification





Figure 10: Land Proposed for Conservation

As defined in the BCAM, different levels of conservation security and ongoing management results in the generation of a different number of credits. Under the BCAM, the credit entitlement for conservation lands are broken into three broad categories, being:

- Areas that are managed and funded in perpetuity (e.g. registration as Biobank sites or gazetted as national parks) - 100% credit entitlement
- Areas that are managed in perpetuity (e.g. Property Vegetation Plan or Voluntary Conservation Agreements etc) - 90% credit entitlement
- Areas that are secured through a planning instrument (e.g. environmental zoning) - 25% credit entitlement

ESC propose to utilise PVPs (or other means specified in Section 8.1.2 of the BCAM) to secure all conservation lands for the project. Therefore the number of credits generated will be reduced consistent with the 90% credit entitlement scenario outlined above.

#### 4.2.1 Management of Conservation Lands

Eight conservation areas have been identified to offset the impacts of the proposed development (**Figure 10**). The conservation lands total 406.9 ha, and as described previously contain a significant amount of vegetation that will offset the impacts associated with ecosystem and species credits required for Development Area. 363.3 ha can be used to offset the impacts to ecosystem credits, 373.8 ha for credits required for the White-footed Dunnart, and a further 32.9 ha do not match the offset requirements for ecosystem or species credits or contain cleared land. See **Table 6** for details.

**Table 6: Area of conservation lands**

CONSERVATION LAND ID	VEGETATION WHICH MEETS OFFSET REQUIREMENTS OF IMPACTS- ECOSYSTEM CREDITS (HA)	VEGETATION WHICH MEETS OFFSET REQUIREMENTS OF IMPACTS- SPECIES CREDITS (HA)	EXCLUDED AREAS (CLEARED LANDS AND VEGETATION THAT DOES NOT MEET OFFSET REQUIREMENTS) (HA)
1	174.7	174.7	12.5
2	59.3	59.3	2.0
3	69.7	69.7	3.9
4	9.6	10.1	0.4
5	25.0	34.5	3.2
6	0.7	1.1	10.8
7	7.1	7.1	0.0
8	17.2	17.2	0.1
<b>Total</b>	<b>363.3</b>	<b>373.8</b>	<b>32.9</b>

The credits generated by several portions of proposed conservation zones are subject of discounting attributable to existing obligations, fuel management activities, or vegetation management to maintain the OLS zones surrounding the airport. The details associated with each are provide below.

#### *Community Land and the Natural Areas and Undeveloped Reserves Plan of Management (1997).*

One conservation area (ID 1, **Figure 12**) is currently subject to existing conservation obligations created through objectives and targets set in the ESC Plan of Management: natural areas and undeveloped reserves. Following analysis and in reference to additionality rules (Appendix 9 DECC 2009), ESC and OEH have applied discounting at 10%. Consequently, the credits generated by this conservation area have been proportionately reduced. This 10% reduction is in addition to the existing reduction required due to the conservation area being a managed offset (i.e. 90% credit entitlement scenario).



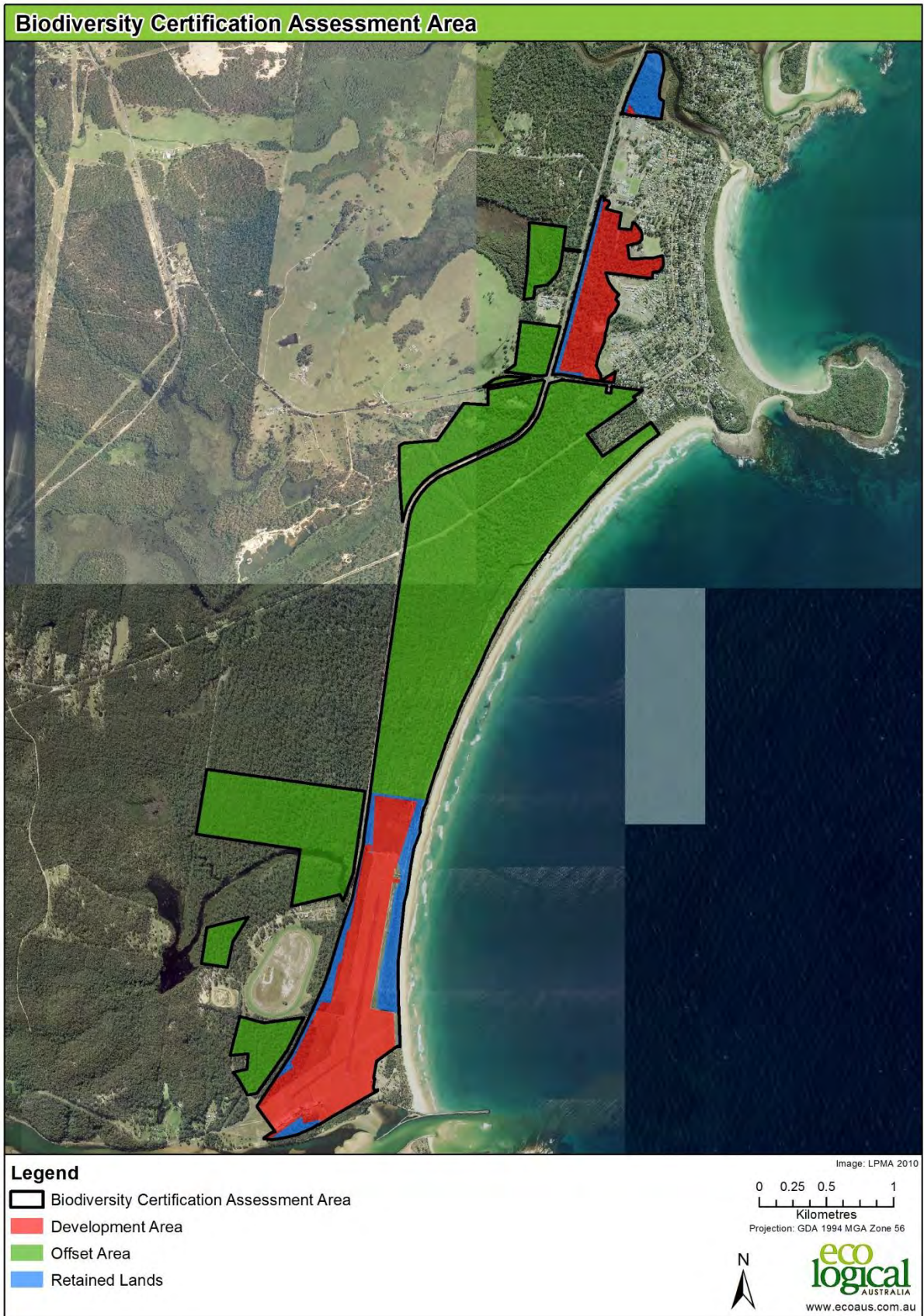


Figure 11: Biodiversity Certification Assessment Area





Figure 12: Area subject to Additional Reduction as a Result of Existing Conservation Obligations

### *Fuel Management Zone (FMZ)*

FMZs are proposed at the northern edge of two of the conservation lands, as shown in **Figure 13**. The area of vegetation affected by the FMZ totals 2.5 ha. The FMZ, although part of the conservation lands, will be managed to reduce bushfire risk on neighbouring properties. Some impacts on biodiversity are anticipated, in particular the thinning of some vegetation and reductions in the abundance of coarse woody debris.

In order to calculate credits for conservation lands affected by the FMZ the guidance provided in Appendix 4 of the Biobanking Assessment Methodology and Credit Calculator Operational Manual (DECC 2009) for Outer Protection Areas was used to adjust the future site value score and thus limit the number of credits generated. Where possible, the future site value scores for each attribute were limited to the current score to reflect the change in management for these areas. As identified in the Section 4.1, site value attributes could not be reduced below the current score recorded, therefore the calculations only allowed for the site value to remain at its current level, rather than to be reduced by the proposed management actions. **Appendix 2** contains detailed information on the application of the site value reduction for each vegetation zone.

### *Obstacle Limitation Surface (OLS) Zones*

Some conservation lands may be affected by vegetation management actions associated with the OLS zones of an extended Moruya Airport runway. The area of conservation lands potentially affected by the management of the OLS zones totals 138.7 ha.

The OLS zones radiate from the runway, and are identified as OLS zones A, B, C, D and E, as shown in **Figure 14**. The management of OLS zone A will effectively lead to the clearing of this area, therefore this area was included in the Development Area and requires credits before being certified. OLS zones B, C, D and E all require differing levels of management, essentially related to the height of over-storey cover within each OLS zone. As the OLS zones move further from the runway, the height of vegetation is permitted to increase. Thus the management of OLS zone B will be more intense than OLS zone C, and so on. **Table 7** provides details related to the management of each OLS zone.

**Table 7: OLS zone management requirements**

OLS ZONE	MAX VEGETATION HEIGHTS (M)
Zone A	0 – 5
Zone B	0 – 9
Zone C	9 – 15
Zone D	19 – 29
Zone E	29 - 34

In consultation with ESC, the future site value scores of OLS zones B-E were adjusted based on the management required, thus reducing the number of credits generated for some of these areas. Due to the broad benchmarks for the vegetation types being assessed, and the nature of the management actions required in each OLS zone, OLS zone B was the only zone where credits were reduced. All other zones will be managed consistent with the improvement predicted under the BCAM.

As with the FMZs, the BCAM does not allow the reduction of current site value for conservation lands affected by the OLS. As such, the method used to limit the credits generated within the OLS zones may not accurately reflect the full reduction in site value resulting from the associated management actions. **Appendix 2** contains detailed information on the application of the site value reduction for each vegetation zone.





Figure 13: Fuel Management Zone (FMZ)





Figure 14: Obstacle Limitation Surfaces (OLS) Zones

### 4.3 VEGETATION MAPPING AND ZONES

Six vegetation types were identified within the Development Area and Conservation Area (**Table 8** and **Figure 15**). In total 465.5 ha of vegetation was mapped across the Development Area and Conservation Area, with the dominant vegetation type being ‘Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner’ (407.1 ha). Cleared land makes up 78.4 ha of the Development Area and Conservation Area.

**Table 8: Area of vegetation within the Development Area and Conservation Area**

BIOMETRIC VEGETATION TYPE	AREA (HA)
Bangalay - Old-man Banksia open forest	407.1
Coast Banksia - Coast Wattle dune scrub	25.3
Coastal freshwater lagoons*	12.9
Spotted Gum - Blackbutt shrubby open forest**	5.0
Spotted Gum - White Stringybark - Burrawang shrubby open forest**	5.5
Swamp Paperbark - Swamp Oak tall shrubland on estuarine flats, Sydney Basin and South East Corner*	9.8
Cleared Land*	78.4
<b>Total</b>	<b>544.0</b>

\* Excluded from assessment of conservation lands as credits do not match the requirements of the impact sites

\*\* Excluded from ecosystem credits but included in species credit calculations

Of the six vegetation types listed above, two are impacted by development (Bangalay – Old-man Banksia open forest and Coast Banksia – Coast Wattle dune scrub). The other four vegetation types occur only within the Conservation Area, and are not of the same vegetation class or formation as the vegetation being impacted. As such, they cannot be used to offset the impacts of development on ecosystem credits, and as such their credit potential was not calculated for ecosystem credits.

The Spotted Gum communities (Spotted Gum - Blackbutt shrubby open forest and Spotted Gum - White Stringybark - Burrawang shrubby open forest) do provide habitat for the White-footed Dunnart (Ashby 2013) and have therefore been included in the calculations of species credits.

The two vegetation types assessed for ecosystem credits have been separated into six vegetation zones as shown in **Figure 16**. All vegetation mapped is in moderate to good condition, however ancillary codes have been used to further separate vegetation zones

The proposed conservation lands consist of 363.3 ha of vegetation to be conserved which matches the offset requirements of the Development Area for ecosystem credits. 373.8 ha matches the requirements of the White-footed Dunnart. An additional 32.9 ha of cleared land and vegetation which does not match the offset requirements of the impacts occur within the Conservation Area, however will not generate credits in this assessment.

Sixty-nine hectares of vegetation is within the Development Area, and will require credits to offset the impacts of the proposal. Cleared lands within the Development Area (68.1 ha) are excluded from the assessment (**Table 9**). The figures presented in **Table 9** provide the total area of development and conservation for each vegetation zone. Further information on what development the clearing is related to (Broulee Urban Precinct or Moruya Airport Expansion) or which conservation area the vegetation occurs in (and what management is to be applied) is contained in **Appendix 3**.



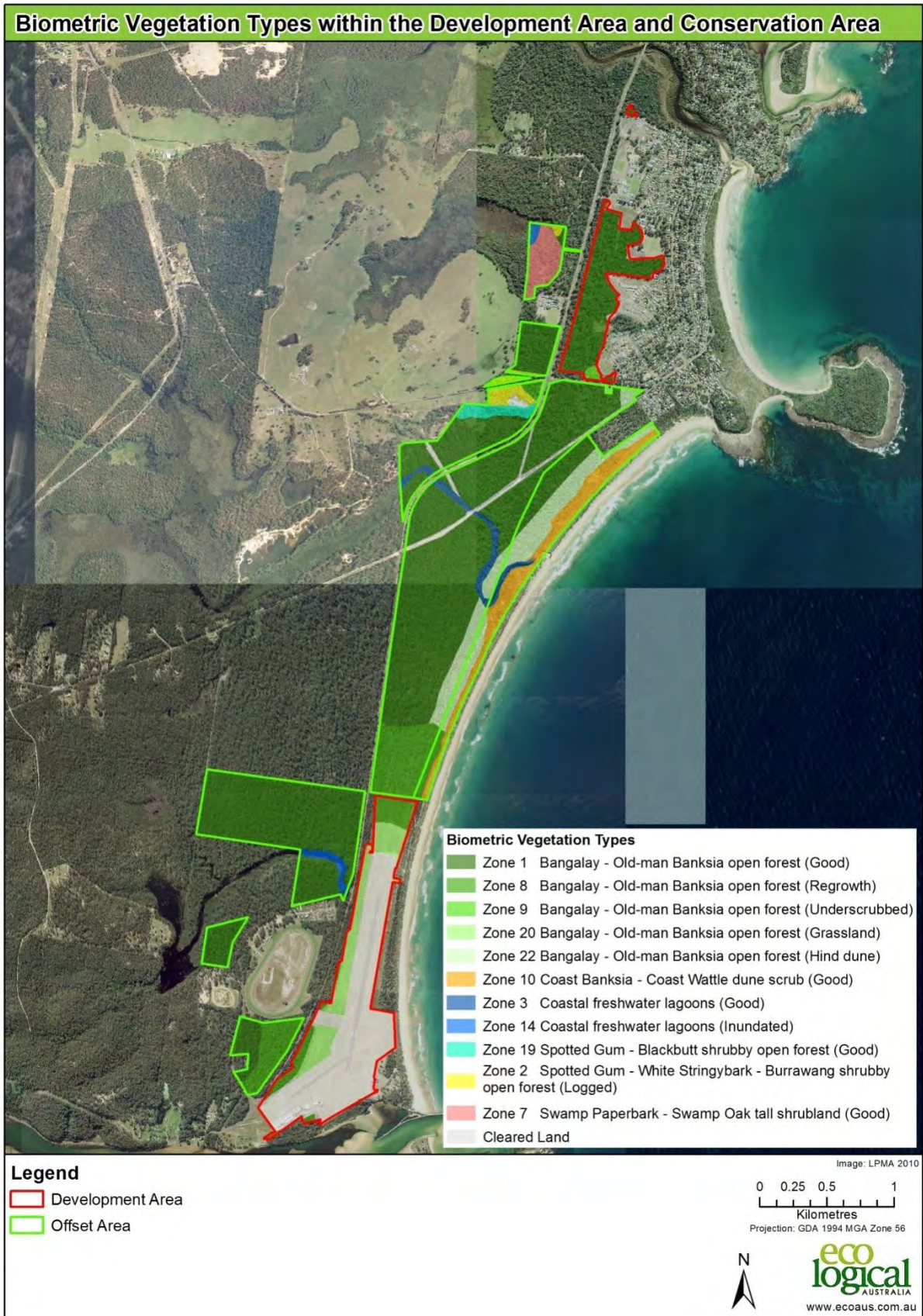


Figure 15: Biometric Vegetation Types within the Development Area and Conservation Area



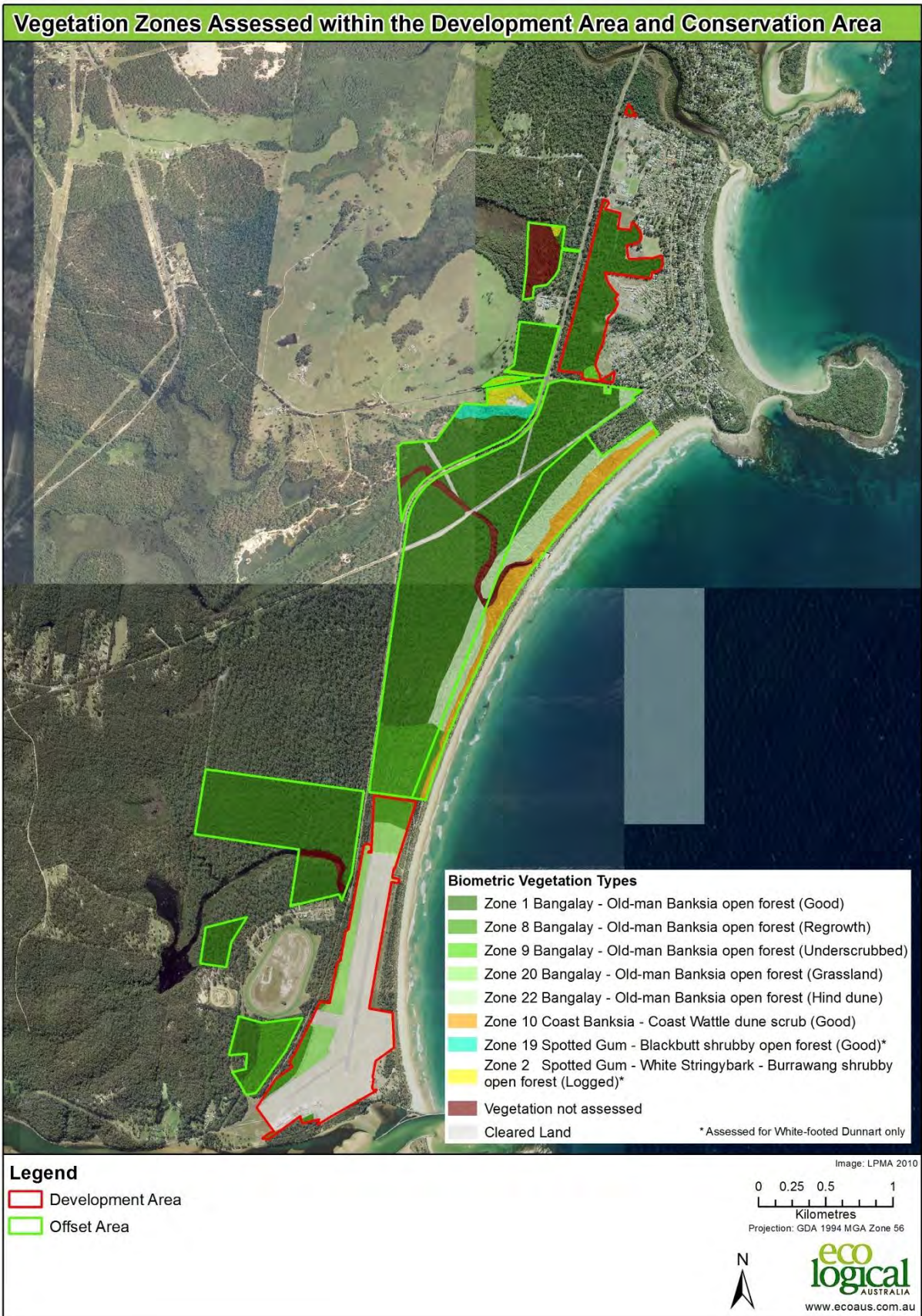


Figure 16: Vegetation Zones Assessed within the Development Area and Conservation Area

Table 9: Area of vegetation zones assessed within the Development Area and Conservation Area

VEG ZONE ID	BIOMETRIC VEGETATION TYPE	CONDITION	ANCILLARY CONDITION CODE	AREA (HA)		
				LAND PROPOSED FOR CONSERVATION	LAND PROPOSED FOR BIODIVERSITY CERTIFICATION	TOTAL
1	Bangalay - Old-man Banksia open forest	M/G	Good condition with lots of hollows and negligible weeds	268.5	35.1	303.6
8	Bangalay - Old-man Banksia open forest	M/G	Relatively young regrowth post clearing. No or very few hollows or other old growth elements	35.5	11.0	46.5
9	Bangalay - Old-man Banksia open forest	M/G	Under-scrubbed or slashed, but with a reasonable abundance of old growth trees	0.0	1.0	1
22	Bangalay - Old-man Banksia open forest	M/G	Bangalay dominated typically low forest of the hind dune	34.4	0.0	34.4
20	Bangalay - Old-man Banksia open forest	M/G	Derived grassland/shrubland	0.0	21.5	21.5
10	Coast Banksia - Coast Wattle dune scrub	M/G	Good condition with some cosmopolitan weeds such as Bitou Bush	25.0	0.2	25.2
2*	Spotted Gum - White Stringybark - Burrawang shrubby open forest on hinterland foothills	M/G	Logged forest with mostly regrowth and only occasional old growth trees	5.5	0.0	5.5
19*	Spotted Gum - Blackbutt shrubby open forest on the coastal foothills	M/G	Very moist and in excellent condition	5.0	0.0	5
<b>Total</b>		<b>N/A</b>		<b>373.9</b>	<b>68.8</b>	<b>442.7</b>

\* Only generates credits for the White-footed Dunnart

#### 4.4 LANDSCAPE TG VALUES

Tg (or threatened species gain) values represent the ability of a species to respond to improvement in Site Value or other habitat improvement at a biobank site with management actions. Tg is based on the lowest value of the following: effectiveness of management actions, life history characteristics, naturally very rare species and very poorly known species (DECC 2009). Landscape Tg values are required to calculate ecosystem credits using the BCAM. The Landscape Tg values are generated for each vegetation type by averaging the Tg values of all species predicted to occur in each vegetation type within the Assessment Area (**Table 10**). The Landscape Tg is effectively the offset multiplier for each vegetation type.

ELA calculated the Landscape Tg value for each vegetation type within the Assessment Area using the Biobanking Credit Calculator to determine which species were predicted in each vegetation type (**Appendix 4**). The Tg values for these species were then averaged to calculate the Landscape Tg. The table below provides details of the landscape Tg score used for each vegetation type assessed.

**Table 10: Landscape Tg assigned to each vegetation type**

VEGETATION TYPE	LANDSCAPE TG
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	0.538
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner	0.555

#### 4.5 TRANSECT/PLOT DATA AND SITE VALUE SCORES

**Appendix 4** of the BCAM defines the minimum number of transects/plots required per vegetation zone area (DECCW 2011). A total of 21 Biometric vegetation transects/plots were captured across the Assessment Area, with a transect/plot requirement of 18 transects/plots calculated from the combined area of Development Area and Conservation Area (**Table 11** and **Figure 4**).

The transect/plot data captured is provided in **Appendix 5**.

**Table 11: Vegetation zones and transect/plot data**

VEG ZONE ID	BIOMETRIC VEGETATION TYPE	ANCILLARY CODE	AREA TO BE ASSESSED (HA)	TRANSECTS/ PLOTS REQUIRED	TRANSECTS/ PLOTS COLLECTED
1	Bangalay - Old-man Banksia open forest	Good condition with lots of hollows and negligible weeds	303.6	6	9
8	Bangalay - Old-man Banksia open forest	Relatively young regrowth post clearing. No or very few hollows or other old growth elements	46.5	3	3
9	Bangalay - Old-man Banksia open forest	Under-scrubbed or slashed, but with a reasonable abundance of old growth trees	1.0	1	1
22	Bangalay - Old-man Banksia open forest	Bangalay dominated typically low forest of the hind dune	34.4	3	3
20	Bangalay - Old-man Banksia open forest	Derived grassland/shrubland	21.5	2	2
10	Coast Banksia - Coast Wattle dune scrub	Good condition with some cosmopolitan weeds such as Bitou Bush	25.2	3	3
<b>Total</b>	<b>N/A</b>	<b>N/A</b>	<b>432.2</b>	<b>18</b>	<b>21</b>



Current site value and future site value scores were calculated for each vegetation zone using the transect/plot data collected. The Biobanking Credit Calculator was used to produce the current and future site value scores for both the Development Area and the Conservation Area (**Table 12**).

Although most of the vegetation within the Assessment Area was identified as being in 'moderate to good' condition, on completion of the required Biometric plots one zone (Zone 20) was identified as 'low' under the BCAM due to its site value score being less than 34/100.

Plots were not completed on cleared land within the Conservation Area. Cleared land has therefore been excluded from this assessment.

Table 12: Site value scores allocated to each vegetation zone

VEG ZONE ID	BIOMETRIC VEGETATION TYPE	ANCILLARY CONDITION CODE	CURRENT SITE VALUE SCORE	FUTURE SITE VALUE SCORE (DEVELOPMENT)	FUTURE SITE VALUE SCORE (CONSERVATION)					
					CONSERVATION LAND ONLY (NO OLS OR FMZ)	WITH OLS ZONE B	WITH OLS ZONE C	WITH OLS ZONE D	WITH OLS ZONE E	WITH FMZ
1	Bangalay - Old-man Banksia open forest	Good condition with lots of hollows and negligible weeds	84.9	0	98.4	93.2	98.4	98.4	98.44	93.2
8	Bangalay - Old-man Banksia open forest	Relatively young regrowth post clearing. No or very few hollows or other old growth elements	64.8	0	75.0	75.0	75.0	75.0	75.0	N/A
9	Bangalay - Old-man Banksia open forest	Under-scrubbed or slashed, but with a reasonable abundance of old growth trees	56.8	0	68.4	N/A	N/A	N/A	N/A	N/A
22	Bangalay - Old-man Banksia open forest	Bangalay dominated typically low forest of the hind dune	87	N/A	95.3	N/A	95.3	95.3	95.3	90.1
20	Bangalay - Old-man Banksia open forest	Derived grassland/shrubland	32.3*	0	N/A	N/A	N/A	N/A	N/A	N/A
10	Coast Banksia - Coast Wattle dune scrub	Good condition with some cosmopolitan weeds such as Bitou Bush	54.69	0	73.4	68.2	73.4	73.4	73.4	N/A

\* Site value score <34, therefore in Low condition as defined by the BCAM.

## 4.6 LANDSCAPE SCORE

### 4.6.1 Native Cover in Landscape

Native vegetation cover within an assessment circle was calculated for the project. The landscape score calculations were completed within a 6000 ha circle, thus a scaling factor of 6 was used in the assessment.

The results of the circle assessment are contained in **Table 13**: A pre-certification score of 19 was allocated. With the relatively small amount of clearing within the Development Area (69 ha) a post certification score of 19 was also calculated.

**Table 13: Native vegetation in assessment circle**

CIRCLE	BEFORE CERTIFICATION			AFTER CERTIFICATION		
	AREA OF VEGETATION WITHIN ASSESSMENT CIRCLE (HA)	NATIVE VEGETATION COVER CLASS (%)	SCORE	AREA OF VEGETATION WITHIN ASSESSMENT CIRCLE (HA)	NATIVE VEGETATION COVER CLASS (%)	SCORE
1 (6000 ha)	3,736 (62%)	61-70%	19	3,667(61-70%)	61-70%	19

The land subject to conservation measures (post biodiversity certification) is 406.9 ha, consisting of 10.3 ha of cleared land and 396.6 ha of vegetated land. This represents 6.5% of the 6,000 ha circle used to assess the Assessment Area. Therefore (using **Table 3** of the BCAM) a gain of 2.2 is recorded for the percent native vegetation score after conferral of biodiversity certification.

### 4.6.2 Connectivity Value

The current connectivity value of the site was assessed according to Section 3.7.2 of the BCAM. The BCAM identifies three components of connectivity, being the status of the area as a 'state' or 'regional' biodiversity link, the importance of each of the drainage lines within the Assessment Area and an assessment of the connectivity of vegetation.

Under the BCAM the highest score is awarded of all connectivity assessments completed for the site. The final results of the assessment are provided in **Table 14**. A description of the scores obtained for each component of the connectivity assessment is provided below.

**Table 14: Connectivity scores allocated for the assessment**

CONNECTIVITY SCORE	PRE DEVELOPMENT	POST DEVELOPMENT
Development	6	0
Conservation	6	

The Assessment Area does not contain any state biodiversity links, being a state biodiversity corridor identified in a plan approved by the Director General or a riparian buffer 40 m either side of a major river. Similarly, the site does not contain a regional biodiversity link, being a regional biodiversity corridor identified in a plan approved by the Director General or a riparian buffer 30 m either side of a minor river or major creek.



The land proposed for biodiversity certification was, however, assessed as containing local biodiversity links, due mainly to the presence of moderate to good condition vegetation with a width greater than 30 m, and areas of moderate to good condition vegetation being greater than 30 ha. Therefore, a score of 6 was allocated pre-certification, reducing to 0 after certification.

Lands proposed for conservation were also assessed. Several contain minor watercourses as defined by the BCAM, and therefore conserve areas which constitute a local biodiversity link. In addition, the proposed Conservation Area also contains moderate to good condition vegetation with a width greater than 30 m, and areas of moderate to good condition vegetation being greater than 30 ha, which both also meet the definition of a local biodiversity link. A score of 6 was therefore allocated for connectivity related to the proposed conservation measures.

#### 4.6.3 Adjacent Remnant Area

The maximum adjacent remnant area (ARA) was calculated for the proposal in order to determine the score to be allocated for this measure. The site predominantly occurs on the Moruya Barrier Mitchell Landscape, which is 31% cleared. The vegetation on site is well connected, and as such has an ARA of 501 ha. The pre certification score allocated, therefore, is ten (10) points. The conservation lands occur within the same Moruya Barrier Mitchell Landscape, and are also well connected, with an ARA of 501 ha. Therefore the score allocated for the conservation lands is also ten (10) points.

### 4.7 THREATENED SPECIES ASSESSMENT

An assessment was completed for species requiring survey under the BCAM. See **Appendix 6** for details on the species requiring survey for this assessment, and those predicted. Also see **Section 2** for more details regarding the survey methods and effort within the Assessment Area.

#### 4.7.1 Development Area

Targeted survey within the Broulee Urban Precinct Development Area identified the presence of the White-Footed Dunnart. The species was not surveyed for within the Moruya Airport Development Area, however due to the presence of very similar habitats, and the proximity of the Moruya Airport Development Area, the species has been assumed to be present within both development locations. In total 69 ha of White-Footed Dunnart habitat is mapped as present within the Development Area.

#### 4.7.2 Conservation Area

Targeted surveys for the White-Footed Dunnart were also conducted within the Conservation Area. The White-Footed Dunnart was not recorded during these surveys, however due to the similarities between the habitats present within Development Area and Conservation Area and the contiguous vegetation between the two, an expert report has been prepared (Ashby 2013) which concludes that the White-Footed Dunnart is likely to occur within the Conservation Area. A total of 373.8 ha of White-Footed Dunnart habitat has been identified within the Conservation Area. Cleared lands and those vegetation types not impacted by the Development Area, have been excluded from the White-Footed Dunnart habitat credit calculation.

### 4.8 RED FLAGS

Red flags are defined under the BCAM, and biodiversity certification cannot be conferred where an impact to a red flag occurs (unless a variation is approved for such impacts to occur). Impacts to two red flags have been identified within this proposal, including:

- The listed Endangered Ecological Community (EEC) Bangalay Sand Forest in the Sydney Basin and South East Corner Bioregions (**Figure 17**)
- The red flagged species White-Footed Dunnart (**Figure 18**)



Figure 17: Vegetation Red Flags





Figure 18: White-footed Dunnart Red Flags



#### 4.8.1 Vegetation

The vegetation type 'Bangalay – Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner' is part of the Endangered Ecological Community (EEC) Bangalay Sand Forest in the Sydney Basin and South East Corner Bioregions. This vegetation type is therefore 'red-flagged'.

Although most of the vegetation within the Assessment Area was identified as being in 'moderate to good' condition, on completion of the required Biometric plots one zone (Zone 20) was identified as 'low' condition due to its site value score being less than 34/100. This vegetation zone is therefore not red flagged (**Figure 17**) and is not included in the statistics provided below.

A total of 385.6 ha of red flagged vegetation is present within the Development Area and Conservation Area, of which 47.1 ha is impacted by the proposal (**Table 15**). This represents an impact of 12.2% on red flagged vegetation within the Assessment Area.

It is understood that ESC will prepare a red flag variation request for submission to OEH.

**Table 15: Impacts to red flagged vegetation**

BIOMETRIC VEGETATION TYPE	EEC NAME	CLEARED (%)	AREA WITHIN THE DEVELOPMENT AREA AND CONSERVATION AREA (HA)	AREA IMPACTED (HA)	AREA IMPACTED (%)
Bangalay - Old-man Banksia open forest *	Bangalay Sand Forest	50%	385.6	47.1	12.2

\* Excludes Zone 20 which is in low condition and therefore does not trigger a red flag

#### 4.8.2 Species

Under the BCAM the White-footed Dunnart is unable to withstand loss. Habitat for this species is therefore considered a red flag.

Impacts of 69 ha to White-footed Dunnart habitat has been identified, with habitat confirmed within the Broulee Urban Precinct Development Area (through the capture of an individual while trapping) and assumed within the Moruya Airport Development Area. The expert report prepared for the species has identified 373.8 ha of habitat available within the Conservation Area (Ashby 2013).

The impact of 69 ha represents 15.6% of the total habitat available within the Development Area and Conservation Area (**Table 16**). It is understood that ESC will prepare a red flag variation request for submission to OEH.

**Table 16: Impacts to White-footed Dunnart habitat**

SPECIES NAME	AREA WITHIN THE DEVELOPMENT AREA AND CONSERVATION AREA (HA)	AREA IMPACTED (HA)	AREA IMPACTED (%)
White-footed Dunnart	442.9	69.0	15.6

## 4.9 MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

A search of the EPBC Protected Matters Search Tool identified one threatened ecological community, 51 threatened species, and 44 migratory species that may occur in, or may relate to, the Development Area. The bulk of the matters of national environmental significance (MNES) identified in the EPBC Protected Matters Search were marine mammals, birds, reptiles or fish that would not occur within the Development Area given the absence of beach, estuarine, marine or freshwater habitats. The remaining MNES are either known from the locality or from habitats similar to those within the Development Area and the potential for these MNES to occur within the Development area was assessed further. The outcomes of this assessment are detailed in **Appendix 8**.

### 4.9.1 Listed Threatened Species

The EPBC Protected Matters Search Tool identified four EPBC listed threatened flora species which may occur within the locality, Thick-lipped Spider Orchid, Leafless Tongue Orchid (*Cryptostylis hunteriana*), East Lynne Midge-orchid (*Genoplesium vernale*) and the Austral Toadflax (*Thesium australe*). The Development Area does not provide suitable habitat for these species and it is considered highly unlikely that they would occur there.

Of the 47 threatened fauna species identified by the EPBC Protected Matters Search as potentially occurring within the locality, only one species, the Grey-headed Flying-Fox was known to occur within the Development Area. However, the Grey-headed Flying-Fox would only forage within the Development Area, as there are no camps in the Development Area. The amount of foraging habitat within the Development Area is very small compared to that available in the locality for this highly mobile and wide ranging species.

The Regent Honeyeater (*Anthochaera phrygia*) and the Swift Parrot (*Lathamus discolor*) were considered to have the potential to occur within the Development Area, given that there is a recent record (winter 2011) of the Regent Honeyeater from Illawong Nature Reserve (M. Berry pers. comm., 2011) and a substantial proportion of the Swift Parrot population has spent the winter on the south coast feeding in Spotted Gum dominated forests in recent years. Whilst there are occasional records of the Regent Honeyeater and Swift Parrot in the Eurobodalla, neither species would regularly breed in the Eurobodalla, and neither would be dependent upon the habitats within the Development Area. This is particularly the case for the Swift Parrot given the paucity of winter flowering eucalypts or banksias within the Development Area.

The Development Area provides potential habitat for number of other EPBC listed threatened fauna species such as the Spotted-tailed Quoll (*Dasyurus maculatus*), Southern Brown Bandicoot (*Isodon obesulus*), Long-nosed Potoroo (*Potorous tridactylus*) and the New Holland Mouse (*Pseudomys novaehollandiae*). However given rarity of these species as a result of threatening processes, particularly the Southern Brown Bandicoot and the Long-nosed Potoroo, and the absence of any recent records in the locality, it is considered unlikely that these species would occur within the Development Area.

### 4.9.2 Listed Threatened Ecological Communities

The EPBC Protected Matters Search Tool identified one threatened ecological community listed on the EPBC Act which may occur within the locality, *Littoral Rainforest and Coastal Vine Thickets of Eastern Australia*. This community does not occur within the Development Area or immediate surrounds.

### 4.9.3 World Heritage Properties or National Heritage Places

The Development Area does not include any world heritage properties or national heritage places.

### 4.9.4 Ramsar Wetlands of International Importance

The Development Area does not include any Ramsar wetlands of international importance.

#### 4.9.5 Migratory Bird Species

The Development Area does provide some potential habitat for some terrestrial migratory birds, namely, the White-bellied Sea-Eagle *Haliaeetus leucogaster*, Black-faced Monarch *Monarcha melanopsis*, Satin Flycatcher *Myiagra cyanoleuca*, and Rufous Fantail *Rhipidura rufifrons*. None of these species were observed in the Development Area during the survey period. There is no evidence of the White-bellied Sea-Eagle nesting within the Development Area. A nest occurs in Illawong Nature Reserve to the west of the Development Area. Whilst it is possible that the White-bellied Sea-Eagle may roost there on occasion, the Development Area would not support any resources which aren't widely available elsewhere in remnant vegetation within the locality. Similarly, whilst the Black-faced Monarch, Satin Flycatcher or Rufous Fantail could forage or potentially breed within the Development Area on occasion, the Development Area is too small for the proposal to have any substantial effects on these migratory species.

#### 4.10 INDIRECT IMPACTS

The BCAM requires that any application for formal biodiversity certification must demonstrate how the “proposed ownership, management, zoning and development controls of the land proposed for biodiversity certification is intended to mitigate any indirect impacts on biodiversity values” (DECCW 2011).

It is acknowledged that indirect impacts may result from the edge effects associated with the Development Area. The type and degree of indirect impacts will vary depending on a number of factors, and may include:

- Microclimatic changes
- Increased weed invasion
- Increased feral animal predation
- Removal of woody debris and associated habitat
- Pollution or rubbish dumping

The planning associated with the Development Area has not yet progressed enough to contain specific details on how future developments will mitigate indirect impacts. However, it is assumed that the Development Area will include all asset protection zones (APZs), roads and other infrastructure associated with the proposed developments. To this end, ESC have indicated their intention to develop a Development Control Plan (DCP), which will incorporate measures to mitigate against indirect impacts on remnant vegetation adjoining the Broulee Development Area.

The measures incorporated into the DCP are likely to include:

- Sensitive urban design principles
- Ensuring that development is designed such that APZs and perimeter roads provide a buffer which mitigates the impact of edge effects on adjoining vegetation

There are also a range of mechanisms whereby indirect impacts may be mitigated by active management i.e. weed and pest control, which are likely to be incorporated into the Biodiversity Certification Strategy.



#### 4.10.1 Indirect Impacts on Ecosystem Credits

Notwithstanding measures to limit the affects of indirect impacts, it is likely that some indirect impacts associated with the Development Area will affect vegetation adjoining the Development Area. However, given the range of mitigation measures incorporated into best practice urban developments, the indirect impacts affecting adjoining areas are likely to be relatively minor. Furthermore, many of the edge effects that will result from the proposal are already acting on the vegetation adjoining the Development Area i.e. weed invasion, feral animal predation, microclimatic changes, and rubbish dumping, particularly those lands within the Broulee Urban Development Precinct.

Assessment of the Broulee Development Area identifies, that apart from the first 1-2 m at the bushland/cleared area interface, where there is increased weediness, the condition of the vegetation throughout the Development Area appears relatively unaffected by edge effects. Bird dispersed weeds such as Asparagus Fern and Bitou Bush, are scattered throughout the Broulee Development Area (and elsewhere in the locality) and are not any more prevalent at the bushland/cleared area interface. Only a few weed species, such as some weedy grasses, are more prevalent at the bushland /cleared area interface than elsewhere within the Development Area.

Edge effects, such as microclimatic changes, do not appear to adversely affect the native vegetation within the Development Area, with only occasional scattered weeds away from the bushland/cleared area interface. Similarly, the mosaic of floristic and structural heterogeneity throughout the Bangalay – Old-man Banksia open forest within the Development Area does not appear to be affected by the microclimate of the bushland/cleared area interface. In any case, the floristic and structural benchmarks for the Bangalay – Old-man Banksia open forest are so broad as to render it highly unlikely that any floristic or structural changes would have meaningful impacts on the site value of the affected areas.

The sandy substrates within the Development Area associated with the Holocene sand sheet which characterises the Bengello - Broulee area, limit the potential for overland water flows to act as a vector for indirect impacts such as water quality deterioration and weed invasion. The lack of relief and the rates of infiltration are such that there is negligible surface runoff, even during heavy rainfall events, as demonstrated by the complete absence of watercourses within the Development Area.

Indirect impacts such as dumping, and in association with recreational pursuits such as dog walking and the building of bike tracks and cubby houses, are already occurring within the Development Area, although the impacts of these activities is relatively minor. Indirect impacts associated with these activities are probably more likely to reduce after certification is conferred given the reduced amount of vegetation and thus the reduced opportunities to undertake these activities.

Timber-getting does not appear to be a substantial indirect impact affecting the Development Area, and again, is likely to reduce after certification is conferred given the reduced amount of vegetation and thus the increased exposure of those who would engage in unauthorised timber collection.

Predation by domestic and feral animals is already occurring within the Development Area.

Under these circumstances, it is considered that the indirect impacts on vegetation adjoining the Development Area as a result of the proposal, are likely to be limited primarily to increased weediness of the 10 m immediately adjoining otherwise relatively undisturbed parts of the Development Area. As such, indirect impacts have been accounted for by calculating the credits required from reducing the exotic plant site attribute score by 1, for those zones affected by indirect impacts as described above.

A 10 m buffer was applied to both the Broulee and Moruya Airport development footprints where the Development Area will affect remnant forest, thus exposing affected areas to additional indirect impacts as described above (**Figure 19** and **Figure 20**). The area of each vegetation zone was then calculated within the buffer. Three vegetation zones were identified, including Zone 1 (1.8 ha), Zone 8 (1.6 ha) and Zone 20 (0.06 ha). In total 3.46 ha of vegetation was identified as potentially being affected by indirect impacts.

The site value scores were then adjusted for each zone, with the current site value for exotic cover reduced by 1. All other attributes remained as per the current score. The results are provided in **Table 17**.

**Table 17: Indirect Impact Calculations**

ZONE ID	AREA (HA)	CURRENT SITE VALUE	FUTURE SITE VALUE (REDUCING EXOTIC COVER BY 1)	REDUCTION IN SITE VALUE USED TO CALCULATE CREDITS	CREDITS REQUIRED
Zone 1	1.8	84.9	80.73	4.17	3
Zone 8	1.6	64.8	60.59	4.17	3
Zone 20	0.06	32.3	29.18	3.12	1*

\* rounded up from 0 to 1 credit

The site values were reduced by 4.17 for Zone 1, 4.17 for Zone 8 and 3.12 for Zone 20. This reduction in site value was used to calculate the ecosystem credits required to offset indirect impacts (see Section 4.11).

#### 4.10.2 Indirect Impacts on Species Credit Species

The expert report prepared for the White-footed Dunnart indicates that it is likely that the species will continue to utilise vegetation adjoining the Development Area as long as it supports suitable habitats for the species. As discussed in Section 4.10.1, the indirect impacts that may result from certification, and which may affect adjoining vegetation, are already acting on the Development Area. Despite this, the White-footed Dunnart continues to occur within the Development Area. Under these circumstances, it would appear reasonable to assume that the indirect impacts of the proposal on the White-footed Dunnart within lands adjoining the Development Area will not be any greater than the indirect impacts that are currently acting on these lands.

As such, the indirect impacts of the proposal on the White-footed Dunnart are considered to be minor. In any case, the BCAM has limited flexibility with respect to the assessment of indirect impacts on species credit species. As such, any methods to quantify potential indirect impacts of the proposal on the White-footed Dunnart are likely to be subjective and not based on any robust or empirical evidence.





Figure 19: Indirect Impact Buffer- Broulee





Figure 20: Indirect Impact Buffer- Moruya Airport

## 4.11 CREDIT CALCULATIONS

The ecosystem and species credit calculations identified below are based on the assumption that a Ministerial variation to the BCAM will be granted as described in Section 3.5 of the Broulee Biodiversity Certification Strategy (ESC 2013).

### 4.11.1 Ecosystem Credits

Ecosystem credits have been calculated for the impact caused by the proposed development and the improvements to biodiversity values through the management of the conservation lands identified. As described earlier, the conservation security and management of the conservation lands will be secured using a 'managed conservation measure' (PVP, VCA etc). The credit entitlement for the conservation lands within the Assessment Area will therefore be 90%.

In total, 2,350 credits are required for the land proposed to be developed (**Table 18**), the majority of credits being required for the 'Bangalay – Old-man Banksia open forest' community (2,343 credits). Seven (7) credits are required for Coast Banksia - Coast Wattle dune scrub. An additional 7 credits are required for indirect impacts.

Due to the existing conservation obligations over conservation area ID 1, an additional discount of 10% has been applied to the credits generated by this conservation area. Further detail on the number of credits generated on the lands proposed for conservation is presented in **Appendix 7**.

**Table 18: Final ecosystem credit results**

VEGETATION TYPE NAME	CREDITS REQUIRED	CREDITS REQUIRED (INDIRECT)	CREDITS GENERATED* (90%)	CREDIT STATUS (90%)
Bangalay - Old-man Banksia open forest	2,343	7	3,402	1,052
Coast Banksia - Coast Wattle dune scrub	7	0	284	277
<b>Total</b>	<b>2,350</b>	<b>7</b>	<b>3,686</b>	<b>1,329</b>

\* Credits generated also reduced by an additional 10% for conservation area 1

The results of the assessment demonstrate that the conservation lands identified are sufficient to offset the impacts of the proposal, with a surplus of 1,329 credits. Therefore, excluding the impacts on red flag areas, the proposal meets the improve or maintain test required under the BCAM.

### 4.11.2 Species Credits

Species credits were calculated for the White-footed Dunnart, which was confirmed within the development footprint, and for which an expert report was prepared confirming habitat is present within the conservation lands identified within the Assessment Area (Ashby 2013). As described earlier, the conservation security and management of the conservation lands will be secured using a 'managed conservation measure' (PVP, VCA etc). The credit entitlement for the conservation lands within the Assessment Area will therefore be 90%.

A total of 1,816 credits are required to offset the impacts to 69 ha of White-footed Dunnart habitat (**Table 19**). The 373.8 ha of conservation lands generate 1,924 credits, subject to the expert report being accepted, resulting in a 108 credit surplus.

**Table 19: Final species credit results**

SPECIES NAME	CREDITS REQUIRED	CREDITS GENERATED* (90%)	CREDIT STATUS (90%)
White-footed Dunnart	1,816	1,924	108

\* Credits generated also reduced by an additional 10% for conservation area 1

The results of the assessment demonstrate that the conservation lands identified are sufficient to offset the impacts of the certification to the White-footed Dunnart.



## 5 Conclusion

The Biodiversity Certification Assessment Methodology (BCAM) has been used to conduct a Biodiversity Certification Assessment of proposed urban expansion in the Broulee area and proposed development at Moruya Airport.

The ecosystem credits required and generated by the proposal were calculated based on the BCAM as proposed to be varied.

The results of the assessment demonstrate that the Conservation Area identified is sufficient to offset the impacts of the proposal, with a surplus of 1,329 credits.

Parts of the Conservation Area are affected by existing and proposed land management activities associated with the safe operation of Moruya Airport and the provision of bushfire hazard management adjoining the Broulee urban area. The impact of these land management activities was acknowledged as far as is possible within the BCAM. However, the BCAM does not allow the future site value to be reduced from its current level in conservation lands. This resulted in a slight over estimation of the ecosystem credits generated in those parts of the Conservation affected by the OSL and FMZ zones.

The species credits required and generated by the proposal were calculated based on the BCAM as proposed to be varied.

A total of 1,816 credits are required to offset the impacts to 69 ha of White-footed Dunnart habitat. The 373.8 ha Conservation Area generates 1,924 credits, resulting in a 108 credit surplus.

The proposal will meet the maintain or improve test required under the BCAM if the Director General of the NSW Department of Premier and Cabinet (DPC) decides that the impacts on red flag areas may be offset and grants consent for a minor variation to the BCAM.

# References

- Ashby, E. (2013). *Sminthopsis leucopus* White-footed Dunnart, Broulee Biocertification Area. Unpublished report, Keystone Ecological.
- Copeland, L. (2008). *Conservation status of Caladenia tessellata Fitzg. (Orchidaceae) in NSW*. Report to the NSW Scientific Committee.
- DEC (2004). *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities Working Draft November 2004*. DEC, Sydney.
- DECCW (2009). *Threatened species survey and assessment guidelines: field survey methods for fauna- Amphibians*. DECCW, Sydney.
- DEC (2005). *Zieria granulata (Illawarra Zieria) Recovery Plan*. DEC, Hurstville NSW.
- DEC (2005). Threatened species, populations and ecological communities of NSW (<http://threatenedspecies.environment.nsw.gov.au>) (Accessed in September 2011)
- Department of Environment and Climate Change (2008). *Vegetation Types Database*. Website: (<http://www.environment.nsw.gov.au/biobanking/VegTypeDatabase.htm>)
- DECC (2009). *BioBanking Assessment Methodology and Credit Calculator Operational Manual*. Department of Environment and Climate Change, Sydney.
- DECCW (2011). *Biodiversity Certification Assessment Methodology*. DECCW, Sydney.
- Eurobodalla Shire Council (2013). *Broulee Biodiversity Certification Strategy*.
- Keith, D & Simpson, C. (2006) *NSW Extant Native Vegetation- Version 002*. Prepared for NSW Department of Environment and Conservation.
- Tozer, MG, Turner, K, Simpson, C, Keith, DA, Beukers, P, MacKenzie, B, Tindall, D & Pennay, C. (2006). *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands*. Version 1.0. NSW Department of Environment and Conservation and NSW Department of Natural Resources.
- Personal Communications**
- Lachlan Copeland. (2012). ELA Senior Botanist and Orchid Expert.
- Mark Berry. (2011). Owner of the “Bower” adjoining Illawong Nature Reserve.
- Paula Pollock (2012). Natural Environment Planning Coordinator, Eurobodalla Shire Council.

# Appendix 1: Curriculum Vitae of field staff



## CURRICULUM VITAE

### Ryan Smithers

SENIOR ECOLOGIST – NAROOMA OFFICE MANAGER

#### QUALIFICATIONS

- BEnvSc (Land Resources Management), University of Wollongong with 1st Class Honours.
- Accredited Biobanking Assessor
- Bush Fire Fighting Training (Advanced Fire fighter, Village Fire fighter)
- AIIMS -Australian Inter-Service Incident Management Systems training
- Senior First Aid, St. Johns Ambulance 2005.

Ryan brings to ELA 14 years experience in natural resource management (11 yrs as a consultant, and 3 yrs with Sydney Catchment Authority as a Catchment Protection Officer). He has extensive practical experience in flora and fauna surveying, fire fighting, planning and land management throughout southern NSW and has undertaken numerous flora and fauna surveys and has been responsible for the preparation of numerous biodiversity plans, environmental impact assessments, vegetation management plans, fire management plans and weed management plans.

Ryan is an accredited Biobanking Assessor and has undertaken numerous surveys using DECCW Vegetation Survey Standard or very similar methodologies. Ryan project managed ELAs contributions to the Full-floristic Vegetation Survey and Condition Assessment for the South-east Highlands and Australian Alps of the Upper Murrumbidgee Catchment and South-east Corner Biometric Benchmark projects which involved the collection of more than 250 plots. Other relevant projects include the Eurobodalla Biodiversity Study for future Urban Expansion Lands and Biobanking assessment for the Cobowra LALC (in Eurobodalla Shire). Ryan has particularly expertise with the biodiversity of the south coast, southern tablelands, Australian Alps, south-western and central western slopes and Sydney Basin.

#### RELEVANT PROJECT EXPERIENCE

- Eurobodalla Biodiversity Study for future Urban Expansion Lands
- South-east Corner Biometric Benchmark Project
- Biobanking assessment for the Cobowra LALC
- South-east Highlands and Australian Alps of the Upper Murrumbidgee Catchment Full Floristic Survey and Condition Assessment
- Guthega Quad Chair Flora and Fauna Assessment
- Queanbeyan Biodiversity Study for LEP review
- Upper Lachlan Biodiversity Planning Framework
- Parkes, Upper Lachlan and Temora Shire Natural Resource Management Projects



- Queanbeyan Biodiversity Study for LEP review
- Mount Jerrabomberra Ecological Assessment
- Old Comma Road deviation Species Impact Statement
- Flora and Fauna Assessment Edwin Lane Parkway Extension
- Lake Wallace Flora and Fauna Assessment for Cooma Monaro Shire
- Boco Rock Wind Farm Ecological Assessment and Offsets Analysis
- Numerous flora and fauna assessments within the Sydney Basin, South-eastern Highlands and South-east Corner bioregions.



## CURRICULUM VITAE

### Naomi de Ville

**ECOLOGIST**

#### QUALIFICATIONS

- MSc (Natural Resource Planning and Forest Ecology) School of Resource and Environmental Management, Simon Fraser University 2011
- Certificate II in Bush Regeneration, Ryde/Belrose TAFE 2000
- BSc (Applied Zoology) Department of Natural Resource Sciences, McGill University 1997
- Senior and Wilderness First Aid, St. Johns Ambulance 2009

Naomi has recently joined Eco Logical Australia bringing with her 13 years experience in the environmental and natural resource management field. She is an ecologist currently completing the thesis component of a Masters of Resource Management in the Planning Program within the School of Resource & Environmental Management at Simon Fraser University in Canada (researching the response of understorey plant communities to natural disturbances and forest management in British Columbia).

For 6 years prior to graduate studies Naomi directed an environmental consulting and bush regeneration contracting business based in the Southern Highlands/Illawarra/South Coast areas of NSW. She has also worked in landscape ecology, taxonomy, conservation biology, and conservation management in Canada, USA and Australia, including holding ranger and project officer positions with the NSW Parks and Wildlife Service (Office of Environment and Heritage – OEH).

Naomi is based in our Narooma office and has extensive experience in general and threatened flora and fauna surveys, in establishing and conducting various types of environmental monitoring programs for government (ie Local Government, OEH, NSW Marine Parks, Dept of Defence, Sydney Catchment Authority) and in the preparation of vegetation assessments particularly for weed and bushfire management, environmental impact assessments, and a diversity of plans of management. She brings with her skills in plant identification, biodiversity surveys, project management, planning and facilitation, community consultation, experimental design and statistical analysis.

**RELEVANT PROJECT EXPERIENCE (WITH ELA)**

- Flora and Fauna assessment and Review of Environmental Factors for new sewer carrier in Camden
- South-east Highlands and Australian Alps of the Upper Murrumbidgee Catchment Full Floristic Survey and Condition Assessment
- Guthega Quad Chair Flora and Fauna Assessment and development of the Rehabilitation and Offsets Management Plan in conjunction with Perisher and OEH
- Several Flora and Fauna assessments for property development proposals in both the Shoalhaven and Eurobodalla Shires
- Vegetation and Ecotourism Management Plan, Bermagui
- Terrestrial Ecological Assessment at Nimmitabel (Cooma-Monaro Shire Council)
- A number of Impact Assessments in the alpine and sub-alpine environments for Perisher Ski Resort
- Wanatta Lane Review of Environmental Factors (Bega Valley Shire Council)
- Nocturnal fauna assessments and targeted orchid surveys in various locations in South-east NSW

**CURRICULUM VITAE****Darren James****SUTHERLAND MANAGER****QUALIFICATIONS**

- Bachelor of Science Degree- Macquarie University (Majored in Resource and Environmental Management & Physical Geography)
- Accredited Biobanking Assessor

Darren has worked in the natural resources sector for over 11 years. This time has been spent between Local and State Government and private organisations within Australia and overseas. During this time he has developed extensive knowledge and experience with natural resource management techniques and policies. He has high level analytical skills and has used a number of GIS and other tools to manage and assess spatial information.

He has an excellent knowledge of landscapes and processes throughout NSW and has expertise in assessing and presenting complex environmental datasets. He has intimate knowledge of the processes behind Biobanking having been heavily involved in the development of both the Biobanking Assessment Methodology and draft Biobanking credit calculator. Darren now delivers the Biobanking Credit Calculator Accreditation Course through TAFE NSW and is an accredited Biobanking Assessor.

He has worked on a number of local, regional and state projects and his understanding of policy and process, combined with his knowledge of natural resource management issues and his experience in high level technical analysis, provides him with a unique blend of skills that can be applied to a diverse range of projects.

**RELEVANT PROJECT EXPERIENCE**

- Warnervale Town Centre and Wyong Employment Zone Biodiversity Certification Assessment
- South West Rail Link Biodiversity Offset Strategy and Package
- Ingleside Desktop Biodiversity Certification Assessment

- Hume Highway Biodiversity Banking Offset Assessments
- Glenning Valley Desktop Biodiversity Certification Assessment
- Biobanking Credit Calculator Accreditation Course Delivery
- Ingleside Biodiversity Assessment
- SMCMA Data Compilation and Mapping
- Kalaroo Road Biobanking Feasibility Assessment
- RTA Biobanking Seminar Delivery
- NRC River Red Gum Assessment GIS Support
- Whitehaven Coal Regional Offset Biobanking Assessment
- NRC State-wide Native Vegetation Target Reporting
- Landcom Whitebridge Constraints Assessment
- Marden Park and Area 20 Top of Bank Survey
- Cultural Countries Aboriginal NSW Map and Poster Production
- Strathfield LEP Mapping
- Sydney Water Sensitivity Mapping
- Oxley Highway Biobanking Assessment
- Boco Rock Preliminary Biobanking Assessment



## CURRICULUM VITAE

### Deidre Ellis

GIS OFFICER - NSW SOUTH COAST

#### QUALIFICATIONS

- Bachelor of Applied Science (Parks Recreation and Heritage), Charles Sturt University  
Majors in Geographical Information Systems (GIS) and Ecology.
- Landcare and Environmental Studies, Riverina Institute of Tafe

Deidre is a GIS Officer with experience in Natural Resource Management mapping and analysis, including high quality map production, spatial data collection, analysis and modelling.

Deidre has recently joined the team at Eco Logical Australia as a GIS Officer at the St Georges Basin Office. Previously she was working with the Department of Sustainability and Environment in Victoria within the Land and Fire Business providing GIS support for fire planning and emergency response. This included preparing Fire Operations Plans and running Radio Coverage Models.

In addition she has experience in threatened species mapping and habitat modelling, including Regent Honeyeater, Mountain Pygmy Possum, and several species of orchid, which co-exist in a rare native grassland.

Deidre has operational fire experience with the Department of Sustainability and Environment which has provided her with first hand knowledge of fire behaviour.

#### RELEVANT PROJECT EXPERIENCE

- Invasive species mapping
- Fire Operations Plan Mapping





## CURRICULUM VITAE

### Dr David Bain

#### ECOLOGIST

#### QUALIFICATIONS

- PhD in ecology and conservation. Translocation of the endangered Eastern Bristlebird. – 2006
- Bachelor of Science (Honours). Biology, Geography Double Major.– 2001

David is an ecologist who joined Eco Logical Australia after completing his Doctor of Philosophy at the University of Wollongong. David brings particular expertise in faunal ecology, survey and assessment of habitat characteristics and vegetation associations and survey design.

Whilst preparing his PhD David has completed a number of consultancies for the Department of Environment and Conservation and has published a number of papers within scientific journals. He has considerable experience with the application of Geographic Information Systems and has well developed skills in time, budget management and general project management.

David has been involved with a wide range of projects, from undertaking environmental assessments, reviewing environmental literature for decision making to the development of policy documents and broad landscape planning. During his experience with Eco Logical Australia he has developed liaison skills and has experience consulting with both state agencies and private clients. David has also recently become an accredited biobanking assessor with the Department of Environment and Climate Change.

#### RELEVANT PROJECT EXPERIENCE

- Development Incentives and Land Offsets Policy, Coastal Catchment Initiatives Program, Great lakes Council
- Hunter Councils Roadside Management Guidelines
- Flora and Fauna Assessment of The Lakes Estate, Coffs Harbour
- Liverpool Plains Rezoning Ecological Constraints Assessment
- Heritage Estates Public Environment Report, Shoalhaven Council
- Species Impact Statement, Rouse Hill Reservoir, Sydney Water
- Species Impact Statement, North Warnervale Rail Station, RailCorp NSW
- Hawkesbury Council Vegetation Validation
- Hume Highway Realignment, RTA
- Vegetation Management Plan, Springwood, Blue Mountains
- Flora and fauna assessment at Pipers Creek, Forster
- Habitat assessment for the endangered Eastern Bristlebird around Jervis Bay, NSW



## CURRICULUM VITAE

### Joanne Daly

#### GIS OFFICER AND ENVIRONMENTAL SCIENTIST

#### QUALIFICATIONS

- Bachelor of Environmental Science (Honours)
- Attended the BioBanking Assessor Accreditation training Course, TAFE NSW and DECCW

Joanne joined the Eco Logical Australia team full-time in September 2008 after completing a Bachelor of Environmental Science (Honours) at the University of Wollongong. Jo has worked on mapping wetlands in the Namoi catchment, refining the Mitchell Landscapes data layer and other projects that have required GIS for analysis and mapping.

Jo has a multidisciplinary background with focuses in GIS and geomorphology. She has a range of GIS skills including: map production; vectorisation; and digitizing. She is also able to utilize GIS to determine the inputs for the BioBanking Credit Calculator for a BioBanking Assessment.

#### RELEVANT PROJECT EXPERIENCE

##### GIS Editing and Analysis:

- Natural Asset Management for Urban Waterways Baulkham Hills Shire Council
- Namoi CMA Wetland mapping Namoi Catchment Management Authority
- Liverpool Plains Biodiversity Strategy
- Mainland Islands Conservation Status Prioritisation
- Hunter Councils API Vectorisation
- Regionally Significant Riparian Corridors Assessment
- Species Habitat Modelling for Gold Coast City Council
- Strathfield Local Environmental Plan and Zoning Update
- Sydney Metro CMA Land Use Mapping
- Whitehaven Regional Biodiversity Offset

##### BioBanking Assessments and Biodiversity Offset Calculations:

- Strategic Biodiversity Offsets Overview for Cockatoo Coal Ltd
- Brownlow Hill Biobank Site
- Darkinjung Land Council Biobank Agreement Assessment
- Liddell Colliery Expansion

##### Plans of Management and Masterplans:

- Queanbeyan River Corridor Plan of Management
- Wongawallan Management Plan
- Bonogin Conservation Reserves Management Plan
- Bidjigal Reserve Plan of Management
- Middle Creek Management Plan
- Dunbar Park Plan of Management
- Warriewood and Nareen Wetlands Plans of Management
- Crest to Lansdowne Final Masterplan
- Yeramba Lagoon Catchment Masterplan

## Appendix 2: Site Value Scores for each Vegetation Zone

**Vegetation Zone 1:** Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)- MG (Good)

Offset Zone	Current Site Value	Future Site Value	Development	Offset Areas					
Airport Zone			N/A	None	B	C	D	E	None
Fuel Zone			N/A	None	None	None	None	None	Yes
Native plant species richness	3	3	0	3	3	3	3	3	3
Native over-storey	2	3	0	3	2	3	3	3	3
Native mid-storey	3	3	0	3	3	3	3	3	3
Native ground cover (grass)	2	3	0	3	3	3	3	3	3
Native ground cover (shrubs)	1	2	0	2	2	2	2	2	2
Native ground cover (other)	3	3	0	3	3	3	3	3	3
Exotic plant cover	3	3	0	3	3	3	3	3	3
Number of trees with hollows	3	3	0	3	3	3	3	3	3
Regeneration	3	3	0	3	3	3	3	3	3
Fallen Logs	2	3	0	3	3	3	3	3	2
<b>Site Value Score</b>	<b>84.90</b>	<b>98.44</b>	<b>0.00</b>	<b>98.44</b>	<b>93.23</b>	<b>98.44</b>	<b>98.44</b>	<b>98.44</b>	<b>93.23</b>

**Vegetation Zone 8:** Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)- MG (Regrowth)

Offset Zone	Current Site Value	Future Site Value	Development	Offset Areas			
Airport Zone			N/A	B	C	D	E
Fuel Zone			N/A	None	None	None	None
Native plant species richness	3	3	0	3	3	3	3
Native over-storey	3	3	0	3	3	3	3
Native mid-storey	2	3	0	3	3	3	3
Native ground cover (grass)	1	2	0	2	2	2	2
Native ground cover (shrubs)	1	2	0	2	2	2	2
Native ground cover (other)	2	3	0	3	3	3	3
Exotic plant cover	3	3	0	3	3	3	3
Number of trees with hollows	0	0	0	0	0	0	0
Regeneration	3	3	0	3	3	3	3
Fallen Logs	2	3	0	3	3	3	3
<b>Site Value Score</b>	<b>64.76</b>	<b>75.00</b>	<b>0.00</b>	<b>75.00</b>	<b>75.00</b>	<b>75.00</b>	<b>75.00</b>



**Vegetation Zone 9:** Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)- MG (Underscrubbed)

Offset Zone	Current Site Value	Future Site Value	Development	Offset Areas
Airport Zone			N/A	None
Fuel Zone			N/A	None
Native plant species richness	3	3	0	3
Native over-storey	3	3	0	3
Native mid-storey	0	1	0	1
Native ground cover (grass)	0	1	0	1
Native ground cover (shrubs)	0	1	0	1
Native ground cover (other)	2	3	0	3
Exotic plant cover	2	3	0	3
Number of trees with hollows	2	2.5	0	2.5
Regeneration	3	3	0	3
Fallen Logs	0	0	0	0
<b>Site Value Score</b>	<b>56.77</b>	<b>68.40</b>	<b>0.00</b>	<b>68.40</b>

**Vegetation Zone 20:** Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)- MG (Grassland)

Offset Zone	Current Site Value	Future Site Value	Development
Airport Zone			N/A
Fuel Zone			N/A
Native plant species richness	2	3	0
Native over-storey	0	1	0
Native mid-storey	3	3	0
Native ground cover (grass)	0	1	0
Native ground cover (shrubs)	3	3	0
Native ground cover (other)	3	3	0
Exotic plant cover	2	3	0
Number of trees with hollows	0	0	0
Regeneration	0	0.5	0
Fallen Logs	0	0	0
<b>Site Value Score</b>	<b>32.29</b>	<b>49.22</b>	<b>0.00</b>

**Vegetation Zone 22:** Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)- MG (Hind dune)

Offset Zone	Current Site Value	Future Site Value	Offset Areas				
Airport Zone			None	C	D	E	None
Fuel Zone			None	None	None	None	Yes
Native plant species richness	3	3	3	3	3	3	3
Native over-storey	3	3	3	3	3	3	3
Native mid-storey	3	3	3	3	3	3	3
Native ground cover (grass)	0	1	1	1	1	1	1
Native ground cover (shrubs)	1	2	2	2	2	2	2
Native ground cover (other)	3	3	3	3	3	3	3
Exotic plant cover	3	3	3	3	3	3	3
Number of trees with hollows	3	3	3	3	3	3	3
Regeneration	3	3	3	3	3	3	3
Fallen Logs	2	3	3	3	3	3	2
<b>Site Value Score</b>	<b>86.98</b>	<b>95.31</b>	<b>95.31</b>	<b>95.31</b>	<b>95.31</b>	<b>95.31</b>	<b>90.10</b>

**Vegetation Zone 10:** Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)- MG (Good)

Offset Zone	Current Site Value	Future Site Value	Development	Offset Areas				
Airport Zone			N/A	None	B	C	D	E
Fuel Zone			N/A	None	None	None	None	None
Native plant species richness	2	3	0	3	3	3	3	3
Native over-storey	2	3	0	3	2	3	3	3
Native mid-storey	3	3	0	3	3	3	3	3
Native ground cover (grass)	0	1	0	1	1	1	1	1
Native ground cover (shrubs)	1	2	0	2	2	2	2	2
Native ground cover (other)	3	3	0	3	3	3	3	3
Exotic plant cover	3	3	0	3	3	3	3	3
Number of trees with hollows	0	0	0	0	0	0	0	0
Regeneration	3	3	0	3	3	3	3	3
Fallen Logs	2	3	0	3	3	3	3	3
<b>Site Value Score</b>	<b>54.69</b>	<b>73.44</b>	<b>0.00</b>	<b>73.44</b>	<b>68.23</b>	<b>73.44</b>	<b>73.44</b>	<b>73.44</b>

## Appendix 3: Area of each Vegetation Zone within Development and Conservation Footprints

### DEVELOPMENT

IMPACT LOCATION	VEGETATION ZONE AREA (HA)						
	1	8	9	10	20	CLEARED	TOTAL
Airport Clearing		11.0		0.2	21.5	67.3	100.1
Broulee Clearing	35.1		1.0			0.9	37.0
<b>Total</b>	<b>35.1</b>	<b>11.0</b>	<b>1.0</b>	<b>0.2</b>	<b>21.5</b>	<b>68.1</b>	<b>137.1</b>

### CONSERVATION

CONSERVATION LAND ID	AIRPORT MANAGEMENT ZONE (OLS)	FIRE MANAGEMENT ZONE (FMZ)	VEGETATION ZONE AREA (HA)												
			1	2	3	7	8	9	10	14	19	20	22	CLEARED	TOTAL
1	None	None	66.1		3.0								2.2	5.7	77.0
1	B	None	0.0				18.7								18.7
1	C	None	19.3				1.8						3.8		24.9
1	D	None	26.4										3.7		30.1
1	E	None	27.6		2.5								2.7	1.0	33.8
1	None	Yes	1.8										0.6	0.2	2.6
2	None	None	10.0		2.0				20.9				17.1		50.0



CONSERVATION LAND ID	AIRPORT MANAGEMENT ZONE (OLS)	FIRE MANAGEMENT ZONE (FMZ)	VEGETATION ZONE AREA (HA)											CLEARED	TOTAL	
			1	2	3	7	8	9	10	14	19	20	22			
2	B	None					1.4		0.1							<b>1.5</b>
2	C	None					1.4		1.5				0.5			<b>3.4</b>
2	D	None							1.4				1.7			<b>3.1</b>
2	E	None							1.1				2.2			<b>3.3</b>
2	None	Yes											0.1			<b>0.1</b>
3	None	None	57.8								1.3			0.2		<b>59.4</b>
3	C	None	2.3				0.0			0.2				0.6		<b>3.1</b>
3	D	None	4.5				0.0			1.1						<b>5.6</b>
3	E	None	5.0							0.4				0.0		<b>5.5</b>
4	None	None	9.6	0.5										0.4		<b>10.5</b>
5	None	None	23.6	4.5	1.3		1.4					5.0		1.9		<b>37.7</b>
6	None	None	0.7	0.5		9.8		0.0		1.0				0.0		<b>12.0</b>
7	None	None	7.1													<b>7.1</b>
8	None	None	6.1				5.5							0.0		<b>11.7</b>
8	C	None					0.3									<b>0.3</b>
8	D	None					2.1							0.0		<b>2.1</b>
8	E	None	0.5				2.7							0.1		<b>3.2</b>

## Appendix 4: Landscape Tg Calculations

VEG TYPE NAME	COMMON NAME	SCIENTIFIC NAME	TG VALUE
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Barking Owl	Ninox connivens	0.33
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Eastern Bentwing-bat	Miniopterus schreibersii oceanensis	0.75
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Eastern Freetail-bat	Mormopterus norfolkensis	0.45
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Eastern Pygmy-possum	Cercartetus nanus	0.5
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Glossy Black-cockatoo	Calyptorhynchus lathami	0.55
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Greater Broad-nosed Bat	Scoteanax rueppellii	0.45
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Grey-headed Flying-fox	Pteropus poliocephalus	0.93
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Large-footed Myotis	Myotis macropus (formally Myotis adversus)	0.4
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Little Lorikeet	Glossopsitta pusilla	0.58
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Long-nosed Potoroo	Potorous tridactylus	0.75
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Masked Owl	Tyto novaehollandiae	0.33

VEG TYPE NAME	COMMON NAME	SCIENTIFIC NAME	TG VALUE
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Regent Honeyeater	Xanthomyza phrygia	0.75
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Southern Brown Bandicoot (eastern)	Isoodon obesulus obesulus	0.4
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Spotted-tailed Quoll	Dasyurus maculatus	0.35
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Swift Parrot	Lathamus discolor	0.75
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Yellow-bellied Glider	Petaurus australis	0.43
Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)	Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	0.45
			<b>0.538</b>
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Barking Owl	Ninox connivens	0.33
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Eastern Bentwing-bat	Miniopterus schreibersii oceanensis	0.75
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Eastern Pygmy-possum	Cercartetus nanus	0.5
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Glossy Black-cockatoo	Calyptorhynchus lathami	0.55
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Greater Broad-nosed Bat	Scoteanax rueppellii	0.45
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Large-footed Myotis	Myotis macropus (formally Myotis adversus)	0.4
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Little Lorikeet	Glossopsitta pusilla	0.58



VEG TYPE NAME	COMMON NAME	SCIENTIFIC NAME	TG VALUE
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Long-nosed Potoroo	Potorous tridactylus	0.75
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Regent Honeyeater	Xanthomyza phrygia	0.75
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Southern Brown Bandicoot (eastern)	Isoodon obesulus obesulus	0.4
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Swift Parrot	Lathamus discolor	0.75
Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)	Yellow-bellied Sheath-tail-bat	Saccolaimus flaviventris	0.45
			<b>0.555</b>

## Appendix 5: Transect/Plot Data

**Vegetation Zone 1:** Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)- MG (Good)

PLOT NAME	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	EASTING	NORTHING	ZONE
Plot 1	35	28	40	22	2	46	0	5	1	48	244233	6029270	56
CMACouncil plot 1	35	20	20	5	1	0.5	0	3	0	194	243420	6027502	56
CMACouncil plot 2	20	20	15	0.5	0.5	65	1	3	2	52	243153	6027565	56
CMACouncil plot 3	18	15	5	0.5	0.5	70	0	3	1	42	242087	6025168	56
CMACouncil plot 4	29	10	15	0.5	0.5	55	0	1	1	25	243017	6026801	56
CMACouncil plot 5	27	10	20	7	0.5	12	0.5	2	1	74	243017	6026801	56
CMACouncil plot A	17	18	60	1	1	12	0	4	0	42	241969	6024707	56
CMACouncil plot B	18	5	1	80	0	20	1	1	1	25	241876	6024631	56

**Vegetation Zone 8:** Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)- MG (Regrowth)

PLOT NAME	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	EASTING	NORTHING	ZONE
Plot 1	30	23	47	30	2	24	0	0	1	37	242582	60254552	56
Plot 2	30	28	58	6	0	12	4	0	1	52	241876	6023342	56
Plot 3	28	31	58	10	0	12	2	0	1	22	241941	6022708	56

**Vegetation Zone 9:** Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)- MG (Underscrubbed)

PLOT NAME	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	EASTING	NORTHING	ZONE
Plot 1	32	37.5	0	66	0	12	16	1	1	0	244145	6028331	56

**Vegetation Zone 20:** Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)- MG (Grassland)

PLOT NAME	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	EASTING	NORTHING	ZONE
Plot 1	21	0	3	92	6	58	2	0	0	0	242035	6023203	56
Plot 2	17	0	9	90	10	80	18	0	0	0	242458	6024688	56

**Vegetation Zone 22:** Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (SR512)- MG (Hind dune)

PLOT NAME	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	EASTING	NORTHING	ZONE
Plot 1	21	31.5	20.5	66	2	16	0	2	1	68	243196	6026356	56
Plot 2	19	29	18	82	0	20	0	4	1	86	244052	6027641	56
Plot 3	24	22.5	15	56	0	24	0	1	1	22	242898	6025798	56

**Vegetation Zone 10:** Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner (SR531)- MG (Good)

PLOT NAME	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL	EASTING	NORTHING	ZONE
Plot 1	15	1.5	21.5	64	0	56	0	0	1	24	243391	6026441	56
Plot 2	15	0.5	22	56	2	30	0	0	1	93	244119	6027493	56
Plot 3	19	32	40.5	58	2	60	4	0	1	3	242881	6025204	56



# Appendix 6: Species Predicted and Requiring Survey

## SPECIES PREDICTED

COMMON NAME	SPECIES NAME
Barking Owl	<i>Ninox connivens</i>
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>
Eastern Pygmy-possum	<i>Cercartetus nanus</i>
Freckled Duck	<i>Stictonetta naevosa</i>
Glossy Black-cockatoo	<i>Calyptorhynchus lathami</i>
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>
Large-footed Myotis	<i>Myotis macropus</i> (formally <i>Myotis adversus</i> )
Little Lorikeet	<i>Glossopsitta pusilla</i>
Long-nosed Potoroo	<i>Potorous tridactylus</i>
Masked Owl	<i>Tyto novaehollandiae</i>
Orange-bellied Parrot	<i>Neophema chrysogaster</i>
Regent Honeyeater	<i>Xanthomyza phrygia</i>
Southern Brown Bandicoot (eastern)	<i>Isodon obesulus obesulus</i>
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>
Swift Parrot	<i>Lathamus discolor</i>
Yellow-bellied Glider	<i>Petaurus australis</i>
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>

## SPECIES REQUIRING SURVEY

COMMON NAME	SPECIES NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Black Bittern	<i>Ixobrychus flavicollis</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Black-tailed Godwit	<i>Limosa limosa</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brush-tailed Phascogale	<i>Phascogale tapoatafa</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eastern Bentwing-bat (Breeding)	<i>Miniopterus schreibersii oceanensis</i>	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
Greater Glider population in the Bingi-Congo area of the Eurobodalla LGA	<i>Petauroides volans</i> - endangered population	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Green and Golden Bell Frog	<i>Litoria aurea</i>	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes
Grey-headed Flying-fox (Breeding)	<i>Pteropus poliocephalus</i>	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes
Large-footed Myotis (Breeding)	<i>Myotis macropus</i> (formally <i>Myotis adversus</i> )	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Little Eagle	<i>Hieraaetus morphnoides</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Osprey	<i>Pandion haliaetus</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Square-tailed Kite	<i>Lophoictinia isura</i>	Yes	Yes	Yes	No	No	No	No	No	Yes	Yes	Yes	Yes
Tessellated Spider Orchid	<i>Caladenia tessellata</i>	No	No	No	No	No	No	No	No	Yes	Yes	No	No
Waterwheel Plant	<i>Aldrovanda vesiculosa</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

COMMON NAME	SPECIES NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
White-footed Dunnart	Sminthopsis leucopus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes



# Appendix 7: Credits Generated by Conservation Lands

## ECOSYSTEM CREDITS

CONSERVATION LAND ID	VEGETATION TYPE	CREDITS CREATED FOR MANAGED OFFSET	DISCOUNT	TOTAL CREDITS CREATED FOR MANAGED OFFSET
1	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	1,854	10%	1669
2	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	345	0%	345
2	Coast Banksia - Coast Wattle dune scrub, Sydney Basin and South East Corner	284	0%	284
3	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	756	0%	756
4	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	104	0%	104
5	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	270	0%	270
6	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	7	0%	7
7	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	77	0%	77
8	Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner	174	0%	174
<b>Total</b>		<b>3,871</b>	<b>N/A</b>	<b>3,686</b>

**SPECIES CREDITS – WHITE-FOOTED DUNNART**

CONSERVATION LAND ID	CREDITS CREATED FOR MANAGED OFFSET	DISCOUNT	TOTAL CREDITS CREATED FOR MANAGED OFFSET
1	944	10%	849
2	320	0%	320
3	376	0%	376
4	55	0%	55
5	186	0%	186
6	6	0%	6
7	38	0%	38
8	93	0%	93
<b>Total</b>	<b>2,018</b>	<b>N/A</b>	<b>1,924</b>

## Appendix 8: Likelihood of Occurrence for MNES

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
<b>FLORA</b>					
<i>Caladenia tessallata</i>	Thick-lipped Spider Orchid	E	V	This terrestrial orchid is associated with treeless areas or low open forests with a heathy or sometimes grassy understorey on skeletal clay-loam or sandy soils. On the coast flowering is thought to occur between August and November depending on the season. In coastal areas it can occur in dense shrubbery and is usually detected only after fire. The species only typically flowers for 1-2 years following fire and then remains dormant for up to 20-30 years until the next fire. There are no recent records of the species in the Eurobodalla LGA with the nearest record being 70 km to the north at Ulladulla. The Development Area does not support suitable habitat for the species which is not known from any tall forests such as those which occur within the Development Area. Apart from a small approximately 1 ha area, the Development Area has not been recently burnt. Under these circumstances it is considered highly unlikely that he species would occur within the Development Area.	No
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	This terrestrial orchid grows in swamp-heath and open forest on clays and sandy soils in coastal districts. Larger populations of the species are typically associated with woodlands dominated by Scribbly Gum, Silvertop Ash, Red Bloodwood and Black Sheoak. The Development Area does not provide suitable habitat for the species with none of the numerous known locations of the species occurring within coastal sand forests. Under these circumstances it is considered highly unlikely that he species would occur within the Development Area.	No
<i>Genoplesium vernale</i>	East Lynne Midge-orchid	V	V	This terrestrial orchid grows in poorer dry woodland and sclerophyll forest between Wamban and Ulladulla. It is associated with Yertchuck, Silvertop Ash, and White Stringybark. The Development Area does not provide suitable habitat for the species and it would not occur there.	No
<i>Thesium australe</i>	Austral Toadflax	V	V	This species is associated with native grasslands and is a hemi-parasite of Kangaroo Grass and is known from Mullimburra Point and Jemisons Point. The species is usually detected in areas where Kangaroo Grass is abundant. Kangaroo Grass is not abundant anywhere within the Development Area and it is considered highly unlikely that it would occur there.	No
<b>ENDANGERED ECOLOGICAL COMMUNITIES</b>					
Littoral Rainforest and Coastal Vine Thickets of Eastern Australia		—	EEC	The Development Area does not include any vegetation that would comprise this EEC.	No
Disclaimer: Data extracted from the Atlas of NSW Wildlife and EPBC Act Protected Matters Report are only indicative and cannot be considered a comprehensive inventory.					



Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
CE = Critically Endangered; E = Endangered; E2 = Endangered Population; V = Vulnerable					
<b>FROGS</b>					
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000). The Development Area does not support any potential breeding habitat for the species but does support potential foraging habitat. Targeted surveys for the species were undertaken during the survey period, however the species was not detected. It is considered highly unlikely that it occurs in the Development Area.	Unlikely
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	This species has been observed utilising a variety of natural and man-made waterbodies (Pyke & White 1996) such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DECC 2007). Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DECC 2007). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes— <i>Typha</i> sp. and spikerushes— <i>Eleocharis</i> sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). The habitats within the subject land are not suitable for the species and there are no recent records of the species in the Eurobodalla Shire. The species was not recorded within the Development Area during the survey period and it is considered highly unlikely to occur there.	Unlikely
<i>Litoria littlejohni</i>	Heath Frog	V	V	It appears to be restricted to sandstone woodland and heath communities at mid to high altitude. It forages both in the tree canopy and on the ground, and it has been observed sheltering under rocks on high exposed ridges during summer (NSW Scientific Committee 2000). It has not been recorded in southern NSW within the last decade. The habitats within the Development Area are not suitable for the species, and it is considered highly unlikely that it occurs there.	No
<b>DIURNAL BIRDS</b>					

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
<i>Rostratula australis</i>	Australian Painted Snipe	E	E	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds ( <i>ibid.</i> ). Breeding is often in response to local conditions; generally occurs from September to December (DECC 2007). Roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (DECC 2007). Feeds on worms, molluscs, insects and some plant-matter ( <i>ibid.</i> ).	No
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	This species favours permanent freshwater wetlands with tall, dense vegetation, particularly bulrushes and spikerushes. It hides during the day amongst dense reeds and feeds at night. It breeds during summer with nest built in secluded places in densely vegetated wetlands on a platform of reeds.	No
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	This species is associated with coastal heaths and woodlands with a particularly heathy understorey. The nearest population of the species is at Jervis Bay. There are no recent records from the Eurobodalla and it would not occur within the Development Area.	No
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	E	E, M	Breeds only in coastal south-west Tasmania and spends the winter in coastal Victoria and South Australia. It nests in hollows in eucalypt trees which grow adjacent to its feeding plains. In early October the birds arrive in the south west and depart after the breeding season usually in March and April. It feeds on the seeds of several sedges and heath plants, including buttongrass. Its main food preferences are found in sedgelands which have not been burned for between 3-15 years. Also included in the diet are seeds of three Boronia species and the everlasting daisy ( <i>Helichrysum pumilum</i> ). After breeding, migrating birds move gradually northwards up the west coast, through the Hunter Group and King Island in Bass Strait and on to the mainland. On the journey the birds usually feed on beach-front vegetation including salt tolerant species such as sea rocket ( <i>Cakile maritima</i> ). They also eat various coastal native and introduced grasses.	No
<i>Anthochaera phrygia</i> Formerly <i>Xanthomyza phrygia</i>	Regent Honeyeater	E	E, M	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak ( <i>Casuarina cunninghamiana</i> ) (Garnett 1993). Areas containing Swamp Mahogany ( <i>Eucalyptus robusta</i> ) in coastal areas have been observed to be utilised (NPWS 1997). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000). There is a recent record of the species just to the west of the Development Area in Illawong Nature Reserve. The species may forage in the Development Area but would not breed there.	Potential

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
<i>Lathamus discolor</i>	Swift Parrot	E	E	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers et al. 1984; Schodde and Tidemann 1986; Forshaw and Cooper 1981). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany ( <i>Eucalyptus robusta</i> ), Spotted Gum ( <i>Corymbia maculata</i> ), Red Bloodwood ( <i>C. gummifera</i> ), Mugga Ironbark ( <i>E. sideroxylon</i> ), and White Box ( <i>E. albens</i> ) (DECC 2007). In recent years a substantial proportion of the population has spent the winter on the south coast feeding in Spotted Gum dominated forests. The species may forage or roost in the Development Area although it is unlikely given the absence of winter flowering eucalypts.	Potential
<b>MAMMALS (EXCLUDING BATS)</b>					
<i>Dasyurus maculatus maculatus</i>	Spotted-tailed Quoll (SE Mainland Population)	V	E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests, more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECC 2007). It is possible although unlikely that the species would occur within the Development Area, given the absence of recent records despite numerous targeted surveys within the Broulee area, and the large home range of the species.	Unlikely
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices. There is no suitable habitat within the Development Area and the species would not occur there.	No
<i>Dasyurus viverrinus</i>	Eastern Quoll	E	V	Associated with a variety of habitats, including dry sclerophyll forest, shrub, heath land, riparian forests and agricultural areas. Requires features such as hollow logs and rock piles for shelter.	No
<i>Phascolarctos cinereus</i>	Koala (Combined populations of QLD, NSW and the ACT)	V	V	The Koala has a sparse and disjunct occurrence on the south coast with most records within the Bega Valley Shire. Whilst there are historic records of a population in the Narira Creek, Dignam's Creek areas and in Wallaga Lake National Park, there have been very few records in recent times suggesting that the population is in decline and Koalas are in low numbers in the Eurobodalla. The last records of the species anywhere near the Development Area are from the 1950's and 1960's with closest relatively recent records near Batemans Bay and Bodalla. Whilst there are a few potential feed trees within the Development Area there is no evidence of a local population and it is highly unlikely that the species would occur there.	Unlikely



Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
<i>Isoodon obesulus</i>	Southern Brown Bandicoot	E	E	This species requires thick contiguous undergrowth where the soil is light and sandy. There are no recent records of the species within the Eurobodalla Shire and within NSW it possibly only remains in the northern suburbs of Sydney and around the Eden area. Despite potentially suitable habitat, it is considered extremely unlikely that the species occurs within the Development Area.	Unlikely
<i>Potorous tridactylus tridactylus</i>	Long-nosed Potoroo (SE Mainland Population)	V	V	Associated with dry coastal heath and dry and wet sclerophyll forests (Strahan 1998) with dense cover for shelter and adjacent more open areas for foraging (Menkhorst & Knight 2004). The species requires dense contiguous undergrowth and sandy substrate. Despite potentially suitable habitat, it is considered extremely unlikely that the species occurs within the Development Area given the absence of any recent records.	Unlikely
<i>Pseudomys novaehollandiae</i>	New Holland Mouse	—	V	This species has a fragmented distribution across its range and is known to inhabit open heathlands, open woodlands with heathland understorey, and vegetated sand dunes. The sites where the species is known from typically have very sandy soils. The species typically peaks in abundance in the 2-3 years post a suitable disturbance such as fire, however it is also known from some long undisturbed sites. The Development Area provides some potential habitat for the species, however it is considered unlikely to occur within the Development Area given the absence of recent records in the locality or any records during the survey period despite targeted small mammal surveys.	Unlikely
<i>Pteropus poliocephalus</i>	Grey-headed Flying-Fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998). There are no camps in the Development Area and the amount of available foraging habitat to be disturbed by the proposal is very small compared to the vast home range of the species.	Yes Foraging only
<b>MIGRATORY TERRESTRIAL SPECIES LISTED UNDER EPBC ACT</b>					
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	—	M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993). A known nest site for the species occurs to the west of the Development Area in Illawong Nature reserve. No nests occur within the Development Area.	Potential Foraging only

Scientific Name	Common Name	TSC Act	EPBC Act	Habitat Associations	Likelihood of Occurrence
<i>Hirundapus caudacutus</i>	White-throated Needletail	—	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	Unlikely
<i>Merops ornatus</i>	Rainbow Bee-eater	—	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May. Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs ( <i>ibid</i> ). Nest is a chamber at the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy bank or cutting ( <i>ibid</i> ).	Unlikely
<i>Monarcha melanopsis</i>	Black-faced Monarch	—	M	This migratory species is known to breed in damp forest types and forage in rainforest and eucalypt forest. The Development Area provides a small amount of marginal potential habitat for this species.	Potential
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	—	M	This species inhabits lowland eucalypt forests. It is known to nest in dense gully vegetation. The Development Area provides a small amount of marginal potential habitat for this species.	Potential
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	E	E, M	SEE DIURNAL BIRDS ABOVE	No
<i>Rhipidura rufifrons</i>	Rufous Fantail	—	M	This migratory species forages by catching flying insects and is known to utilise the aerial foraging space above the dense understorey in damp forests or beside rivers. The Development Area provides a small amount of marginal potential habitat for this species.	Potential
<i>Xanthomyza phrygia</i> ( <i>Anthochaera phrygia</i> )	Regent Honeyeater	E	E, M	SEE DIURNAL BIRDS ABOVE	Unlikely
Disclaimer: Data extracted from the EPBC Protected Matters Search are only indicative and cannot be considered a comprehensive inventory. 'Migratory marine species', 'Migratory wetland species', shorebirds and 'listed marine species' listed on the EPBC Act have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine and wetland habitats.					
CE = Critically Endangered; E = Endangered; E2 = Endangered Population; V = Vulnerable; M = Migratory.					

# Appendix 9: Results of Mammal Trapping Surveys

## Targeted White-footed Dunnart and Brush-tailed Phascogale Surveys – Broulee Development Area - January – February 2012

Five trapping methods were used to target the White-footed Dunnart and Brush-tailed Phascogale in the Broulee Development Area in January and February 2012:

- Three sites, containing two pitfall traps each, were set for four consecutive nights between 16 and 20 January to yield a trapping effort of 24 pitfall trap-nights. The locations of the pitfall stations are shown in **Figure 5**.
- 50 type-A Elliott traps were set along five trapping transects within the Development Area for four consecutive nights from 17 to 20 January 2012. The locations of the A-Elliott trap lines are also shown in **Figure 5**.
- 30 type-B Elliott traps mounted on platforms on tree trunks approximately 2-3 m above the ground were also set along three of the trapping transects, targeting the Brush-tailed Phascogale within the Development Area for four consecutive nights from 17 to 20 January 2012. The locations of the A-Elliott trap lines are also shown in Figure 5.
- Thirty Faunatech hair funnels set on tree trunks approximately 2-5 m above the ground were also set along three of the trapping transects for consecutive nights between 20 January 2012 and 15 February 2012, yielding a total effort of 720 hair funnel trap-nights. The hair funnels were targeting the Brush-tailed Phascogale.
- Three RECONYX™ HC600 HyperFire™ Passive Infrared Motion Detector Cameras and bait stations were set within the Development Area to target the Brush-tailed Phascogale. The cameras were installed between 18 January 2012 and 15 February 2012 yielding a total of 78 camera day/nights.

A total of five mammal species were captured during the survey period. The results are presented in the table below.

Trapping Method	Species detected	No. of captures	Comment
Pitfall Trap and Driftnet	White-footed Dunnart	1	Trap 1
	Jacky Lizard	2	Trap 2
A-Elliott	Agile Antechinus	12	All 5 Trap lines
	Bush Rat	24	Trap lines 1, 2, 3 and 5
B-Elliott	Agile Antechinus	2	Trap lines 2 and 3
	Eastern Whipbird	1	Trap line 3
Hair Funnel	Common Brushtail Possum	9	Trap lines 1, 2 and 3
	Agile Antechinus	2	Trap lines 1 and 3

Passive Infrared Motion Detector Camera	Common Brushtail Possum		Camera 1 only
	Feathertail Glider		Camera 2 only
	Agile Antechinus		Camera 2 and 3

The White-footed Dunnart was captured during the survey period. The Brush-tailed Phascogale was not detected during the survey period.

#### Targeted White-footed Dunnart Surveys - Proposed Offset Lands – July 2012

Two trapping methods were used to target the White-footed Dunnart in the study area in July 2012:

- Seven pitfall traps and driftnet stations were installed between 2 and 4 July. Each station comprised four buckets spaced along and at each end of approximately 30 m of driftnet (28 traps in total). The locations of the pitfall stations are shown in Figures A and B. All pitfall traps were checked early in the morning from 3 to 9 July resulting in a total effort of 164 pitfall trap-nights.
- Five A-Elliott trap lines of 10 traps each (50 in total) were installed near the pitfall traps and driftnet, with one trap line installed on 3 July and the remaining four on 4 July. The locations of the A-Elliott trap lines are also shown in Figures A and B. All A-Elliott traps were checked early in the morning and re-set and re-baited as necessary from 4 to 8 July resulting in an effort of A-Elliott 210 trap-nights.

A total of three mammal species were captured from a total of 58 captures during the survey period. The results are presented in the table below.

Trapping Method	Species detected	No. of captures	Comment
Pitfall Trap and Driftnet	Agile Antechinus	2	In Trap C only
A-Elliott	Agile Antechinus	39	All 5 Trap lines
	Bush Rat	16	Trap line A and E only
	Dusky Antechinus	1	Trap line A only

The White-footed Dunnart was not captured during the survey period.

#### Targeted White-footed Dunnart Surveys - Proposed Offset Lands – August 2012

Ten pitfall traps and driftnet stations were used to target the White-footed Dunnart between 21 and 24 August 2012. Each station comprised four buckets spaced along and at each end of approximately 30 m of driftnet (40 traps in total). The locations of the pitfall stations are shown in Figure A. All pitfall traps were checked early in the morning from 21 to 24 August resulting in a total effort of 160 pitfall trap-nights.

One mammal species and one amphibian species were captured from a total of six captures during the survey period. The results are presented in the table below.



Trapping Method	Species detected	No. of captures	Comment
Pitfall Trap and Driftnet	Agile Antechinus	3	In Trap D and Trap J
	Verreaux's Tree Frog	4	In Trap G and Trap B

The White-footed Dunnart was not captured during the survey period.

**HEAD OFFICE**

Suite 4, Level 1  
2-4 Merton Street  
Sutherland NSW 2232  
T 02 8536 8600  
F 02 9542 5622

**CANBERRA**

Level 2  
11 London Circuit  
Canberra ACT 2601  
T 02 6103 0145  
F 02 6103 0148

**COFFS HARBOUR**

35 Orlando Street  
Coffs Harbour Jetty NSW 2450  
T 02 6651 5484  
F 02 6651 6890

**PERTH**

Suite 1 & 2  
49 Ord Street  
West Perth WA 6005  
T 08 9227 1070  
F 08 9322 1358

**DARWIN**

16/56 Marina Boulevard  
Cullen Bay NT 0820  
T 08 8989 5601

**SYDNEY**

Level 6  
299 Sussex Street  
Sydney NSW 2000  
T 02 8536 8650  
F 02 9264 0717

**NEWCASTLE**

Suites 28 & 29, Level 7  
19 Bolton Street  
Newcastle NSW 2300  
T 02 4910 0125  
F 02 4910 0126

**ARMIDALE**

92 Taylor Street  
Armidale NSW 2350  
T 02 8081 2681  
F 02 6772 1279

**WOLLONGONG**

Suite 204, Level 2  
62 Moore Street  
Austinmer NSW 2515  
T 02 4201 2200  
F 02 4268 4361

**BRISBANE**

PO Box 1422  
Fortitude Valley QLD 4006  
T 0400 494 366

**ST GEORGES BASIN**

8/128 Island Point Road  
St Georges Basin NSW 2540  
T 02 4443 5555  
F 02 4443 6655

**NAROOMA**

5/20 Canty Street  
Narooma NSW 2546  
T 02 4476 1151  
F 02 4476 1161

**MUDGEES**

Unit 1, Level 1  
79 Market Street  
Mudgee NSW 2850  
T 02 4302 1230  
F 02 6372 9230

**GOSFORD**

Suite 5, Baker One  
1-5 Baker Street  
Gosford NSW 2250  
T 02 4302 1220  
F 02 4322 2897