APPENDIX A – Flora and Fauna Assessment

North Boambee Valley (west)

Local Environment Study

Prepared for
Coffs Harbour City Council

24 October 2012

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Contents

List of Figures

List of Tables

Abbreviations

ABBREVIATION	DESCRIPTION
ATLAS	Wildlife Database records Administered by National Parks & Wildlife Service
CBD	Central Business District
CHCC	Coffs Harbour City Council
CKPoM	Coffs Harbour Koala Plan of Management
DCP	Development Control Plan
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EPBC	Environment Protection and Biodiversity Conservation Act 1999
GIS	Geographic Information System
GPS	Global Positioning System
LEP	Local Environment Plan
LES	Local Environment Study
LGA	Local Government Area
NBVw	North Boambee Valley (west)
NES	National Environmental Significance
NOW	NSW Office of Water
NPWS	National Parks and Wildlife Service (now known as Office of Environment and Heritage)
OEH	Office of Environment and Heritage
PHaCS	Priority Habitats and Corridors Strategy
PMST	Protected Matters Search Tool
SEPP	State Environmental Planning Policy
TSC Act	Threatened Species Conservation Act
VMP	Vegetation Management Plan
VRZ	Vegetated Riparian Zone
WM Act	Water Management Act

Executive Summary

The North Boambee Valley (west) as a coastal catchment close to the Coffs Harbour CBD has been flagged as a growth precinct for many decades. This report highlights the high value vegetation and corresponding threatened species habitats that still persist in the valley despite long utilisation by the agricultural and forestry industries.

The forested habitats provide a range of resources for a number of threatened flora and fauna species as documented in this report, most notably the Koala (*Phascolarctos cinereus*). This document outlines the species and habitats found through this study and species likely to occur seasonally based on those available habitats. The habitats in the valley have experienced significant disturbance and pressures as well as the species that depend on them. Through clearing controls put in place since LEP 2000 for Koala habitat protection, these disturbances have lessened. The remnant forested habitats are disjunct and fragmented and are likely to stagnate or degrade through edge effects such as weed invasion without re-establishing functional connectivity.

Through a process of environmental assessment and data collation a framework for ongoing protection of high environmental values and a network of riparian and forest corridors has been outlined. Through this data collection process and analysis the various geographic data sets have been combined and refined to produce a significant lands layer (or environmental constraints) creating a framework of lands to be maintained and enhanced and areas to be revegetated (wildlife and riparian corridors) as part of the rezoning process.

1 Introduction

This report was commissioned by Coffs Harbour City Council (CHCC) as part of a local consortium of consultants headed by de Groot and Benson Pty Ltd in preparation for an amendment to the Coffs Harbour Local Environment Plan (LEP) 2000 for a future urban release area for the North Boambee Valley (west).

1.1 STUDY AREA

The North Boambee Valley (west) (NBVw) is situated approximately 4 km south west of the Coffs Harbour Central Business District (CBD) (Figure 1). It is a predominately east-west running valley within the Newport's Creek Catchment. It is bound by Boambee State Forest to the west, ringed by prominent ridges to the north and south, both of which are located outside the study area. The eastern boundary is defined by the proposed Pacific Highway bypass of Coffs Harbour (Figure 2).

The tenure within the NBVw is predominately private owned, zoned Agricultural (1a) and Environmental Protection (7a) under CHCC LEP 2000, with only a small portion of a Residential (2a) and Special Purpose (5a school) land in the north–east of the study area. There are no conservation reserves within the NBVw.

Landuse is dominated by Primary industry and is predominately horticulture (bananas, blueberries and nursery industries), grazing and a hard-rock quarry. The native vegetation in the valley is a mosaic of remnant and regenerating forest and riparian vegetation systems that have been extensively cleared and logged as part of a long history of forestry and agricultural activities.

1.2 OBJECTIVES

This study is not classified as a comprehensive flora and fauna survey. The objectives of the study are to highlight the ecological values through habitat assessment and a range of limited fauna survey techniques. The process will identify major ecological values to be maintained or enhanced and constraints to the development process.

Figure 1: North Boambee Valley (west)

Figure 2: The Study Area

2 RELEVANT LEGISLATION AND POLICIES

2.1 THE ENVIRONMENT PROTECTION AND BIODIVERSITY CONSERVATION ACT 1999 (EPBC ACT)

The Commonwealth EPBC Act establishes a requirement for Australian Government environmental assessment and approval of:

- actions that are likely to have a significant impact on matters of national environmental significance;
- actions that are likely to have a significant impact on the environment on Commonwealth land;
- actions taken on Commonwealth land that are likely to have a significant impact on the environment anywhere; and
- Actions by the Commonwealth that are likely to have a significant impact on the environment anywhere.

The matters of national environmental significance (commonly referred to as matters of NES) are:

- World Heritage properties and National heritage places.
- Wetlands of international importance (Ramsar wetlands).
- Listed migratory species, threatened species and ecological communities.
- Commonwealth marine areas.
- Nuclear actions (including uranium mining).

It is considered that the majority of these matters, areas, actions, species or ecological communities are unlikely to be affected by the proposal. Some nationally listed threatened species occupy the study area such as the Koala (recently listed in 2012) and migratory species will use the study area periodically. Koala is discussed in section 5.1of this report.

2.2 ENVIRONMENTAL PROTECTION AND ASSESSMENT ACT 1979 (EP&A ACT)

The EP&A Act is the principal planning legislation in NSW. Part 3 of the EP&A Act sets the framework for preparation of environmental planning instruments such as LEPs.

Parts 3A, 4 and 5 of the EP&A Act indicate the decision making processes for assessment of proposed development and activities. When deciding if a proposal should be approved, the consent/determining authority (Coffs Harbour City Council, and Department of Planning and Investment) must consider a range of environmental matters including maintenance of biodiversity and the likely impact on threatened species, populations or ecological communities.

Part 5A of the EP&A Act requires proponents to consider likely impacts on threatened species, populations or ecological communities, or their habitats. While the assessment of impacts is conducted at the development application stage, this report highlights environmental values considered a

constraint to development. There are a number of threatened species known to occur in the study area including one Endangered Ecological Community (EEC's). These species and their habitats are taken into account in the planning process and documented in the results section of this report.

2.3 THREATENED SPECIES CONSERVATION ACT 1995 (TSC ACT)

The TSC Act (and amendments in 2002 and 2005) identifies threatened species, communities and populations. The TSC Act indicates the assessment process for proposed development that is likely to have a significant effect on biodiversity. This Planning Proposal takes into account species likely to occur within available habitat based on existing records of threatened species occurrence and new occurrences determined through this assessment process. Threatened species records are generally more prevalent on public land where more survey effort has been performed compared to private tenure.

This Planning Proposal builds on existing threatened species knowledge by considering previously undocumented records for the valley. These records are presented in the results section.

2.4 WATER MANAGEMENT ACT 2000

The *Rivers and Foreshores Improvement Act 1948* has recently been repealed and the controlled activity provisions in the *Water Management Act 2000* (WM Act) have now commenced. A controlled activity approval under the WM Act is required for certain types of developments and activities that are carried out in or within 40 m of a river, lake or estuary.

The WM Act provides a number of mechanisms for protection of water sources via the water management planning process. If a 'controlled activity' is proposed on 'waterfront land', an approval is required under Section 91(2) of the WM Act. 'Controlled activities' include; the construction of buildings or carrying out of works; the removal of material or vegetation from land by excavation or any other means; the deposition of material on land by landfill or otherwise. 'Waterfront land' is defined as 'the bed of any river or lake, and any land lying between the river or lake and a line drawn parallel to and 40 metres inland from either the highest bank or shore'.

Approvals for controlled activities are administered by NSW Office of Water (NOW) and a set of guidelines have been developed to assist applicants who are considering carrying out a controlled activity on waterfront land. The guidelines provide information on the design and construction of a controlled activity, and other mechanisms for the protection of waterfront land and include:

- In-stream works
- Laying pipes & cables in watercourses
- Outlet structures
- Riparian corridors
- Vegetation Management Plans
- Watercourse crossings

These guidelines are available from: http://www.water.nsw.gov.au/Water-licensing/Approvals/Controlled-activities/Controlled-activities/default.aspx

A section describing riparian corridors and associated vegetated buffers has been incorporated into the CHCC Draft Development Control Plan (DCP) Component for Biodiversity (B8.4). The vegetation buffer criteria has been incorporated into this ecological assessment process as they are a potential restriction on development and have been incorporated into the connectivity of isolated vegetation into a corridor network. The permit typically requires the preparation of a Vegetation Management Plan. The proponents' responsibility under the WM Act is to assess impact and adjacency to 'waterfront land' i.e. within 40 m and to apply guidelines for permits required under s91 of the WM Act.

2.5 LOCAL AND STATE PLANNING INSTRUMENTS

2.5.1 Coffs Harbour City Council Local Environment Plan (LEP) 2000

The majority of the study site is zoned as 'Rural 1A Agricultural Zone' under the Coffs Harbour City Council LEP 2000 (Figure 3). The majority of the forest remnants within the valley are zoned 'Environmental Protection 7A' (Figure 3) and are focused on protection of Primary and Secondary Koala Habitat.

The aim of the Rural 1A zone is to provide for the preservation of existing or potentially productive agricultural land. Its objectives are to enable development which is compatible with agricultural practices, with the amenity and character of the rural environment of the area and which can be adequately serviced (CHCC, 2000).

The aim of the 7A zoning is to protect and enhance sensitive natural habitat and waterway catchments. Its objectives are to protect habitat values and water quality and enable development which does not adversely impact upon these, to enable development that is within the environmental capacity of the land and can be adequately serviced, and to enable protection of archaeological sites of Aboriginal significance (CHCC, 2000).

2.5.2 Coffs Harbour City Council Draft Local Environment Plan (LEP) 2012

The new instrument LEP is currently on exhibition (September 2012), no zoning changes are proposed for the subject site, zonings are in similar context with LEP 2000 zones. This planning process will entail rezoning's in line with the Draft LEP 2012. Proposed zones will be expressed in the New LEP format for environmental protection that is, instead of '7A' environmental Protection it will be E2 - Environmental Conservation or E3 -Environmental Management zone under the new LEP.

2.5.3 State Environmental Planning Policy (SEPP) 14: Coastal Wetlands

This Policy ensures coastal wetlands are preserved and protected for environmental and economic reasons. SEPP 14 provides that mapped wetlands in coastal Local Government areas should not be cleared, drained or filled or have a levee constructed on them without the consent of CHCC and the concurrence of the Director- General of the Department of Planning.

No SEPP 14 Wetlands are found within the study area.

2.5.4 State Environmental Planning Policy (SEPP) 26: Littoral Rainforests

This Policy protects littoral rainforests, a distinct type of rainforest well suited to harsh salt-laden and drying coastal winds. The Policy requires that the likely effects of proposed development be thoroughly considered in an environmental impact statement.

The legal definition of littoral rainforest under SEPP 26 includes that which occurs on headlands as well as on sand. This is consistent with the definition of the EPBC-listed 'Critically Endangered' *Littoral Rainforest and Coastal Vine Thickets of Eastern Australia* ecological community. www.threatenedspecies.environment.nsw.gov.au.

No SEPP 26 littoral rainforest is mapped within the study area or any rainforest communities that would equate to any EEC definition.

2.5.5 State Environmental Planning Policy (SEPP) 44: Koala Habitat Protection

This Policy aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline.

SEPP 44 does not apply to the study area as the CHCC Comprehensive Koala Plan of Management (CKPoM) addresses Koala habitat protection issues within the Coffs Harbour Local Government Area (LGA).

2.5.6 CHCC Comprehensive Koala Plan of Management (CKPoM)

The study area contains both Primary and Secondary Koala Habitat under the CKPoM (Figure 4). There is however a need to revise the Koala habitat mapping as it was based on aerial photography that is more than 15 years old. The CKPoM was constructed from LGA wide vegetation mapping program performed by Fisher, Body and Gill from aerial photography flown in 1996. The CKPoM utilised this vegetation mapping and Koala population survey information to delineate a three tiered habitat model.

The underlining vegetation mapping has been revised for this LEP process which has implications for Koala Habitat emphasise and interpretation. This concept is discussed further in the vegetation mapping section.

Primary Koala Habitat

The objective of this habitat zone under the CKPoM is:

To prevent further clearing, disturbance, fragmentation or isolation of existing primary koala habitat, and where appropriate, restore habitat and encourage sympathetic management to ensure the maintenance of koalas.

The consent authority shall not grant consent to the carrying out of development on areas identified as Primary Koala Habitat, whether zoned 7(A) or otherwise, which will remove the following tree species: Tallowwood (Eucalyptus microcorys), Swamp Mahogany (E. robusta), Broad-leaved Paperbark (Melaleuca quinquenervia), Flooded Gum (E. grandis), Blackbutt (E. pilularis), Forest Red Gum (E. tereticornis), Small-fruited Grey Gum (E. propinqua), or Forest Oak (Allocasuarina torulosa), unless the development will not destroy, damage or compromise the values of the land as koala habitat. In assessing an application the consent authority shall take into consideration:

- *That there should be zero net loss of Primary Koala Habitat;*
- *The threats to koalas which may result from the development.*
- *The likely impacts to adjacent or nearby Primary Koala Habitat and existing or potential koala movement corridors;*

- *All other options for preventing or ameliorating impacts from the development on koalas; Whether the land is accredited under the Timber Plantation (Harvest Guarantee) Act 1995*

Secondary Koala Habitat

In regard to this habitat zone, the CKPoM objective is:

"To minimise further loss, fragmentation or isolation of existing secondary koala habitat and the creation of barriers to koala movement and, where appropriate, to encourage restoration of koala habitat.

Areas of Secondary Koala Habitat contribute to the overall habitat available to Koalas and play a vital role in linking areas of Primary Koala Habitat. They are also important to dispersing and juvenile koalas, provide seasonal and drought foraging habitat, and may act as fire refuges.

The consent authority shall not grant consent to the carrying out of development on areas identified as Secondary Koala Habitat which will remove the tree species listed above unless the development will not significantly destroy, damage or compromise the values of the land as koala habitat. In assessing an application the consent authority shall take into consideration:

- *that there will be minimal net loss of Secondary Koala Habitat;*
- *the level of significance to koalas of the trees proposed to be removed;*
- *the number of trees proposed to be removed in relationship to the extent and quality of adjacent or nearby Primary and/or Secondary Koala Habitat;*
- *the threats to koalas which may result from the development;*
- *all other options for protecting koala trees as listed above;*
- *the impacts to existing or potential koala movement corridors; and*
- *whether the land is accredited under the Timber Plantation (Harvest Guarantee) Act 1995.*

The consent authority shall not grant consent to the carrying out of development in areas identified as Secondary Koala Habitat unless the proposal demonstrates that appropriate measures are taken to:

- *minimise barriers to koala movement;*
- *reduce the risk of koala mortality by road kill by appropriate road design, lighting and traffic speed limits;*
- *minimise the removal of koala tree species listed above under Tertiary Koala Habitat;*
- *provide preferred Koala trees in landscaping where suitable;*
- *minimise threats to Koalas by dogs i.e. banning of dogs or confining of dogs to Koala proof yards;*
- *minimise removal or disturbance of Tertiary Koala Habitat in fire protection zones, including fuel reduced zones and radiation zones".*

A comprehensive koala fauna survey was not undertaken as part of the current LES survey effort. Active searching for koala sign was performed at sites where koala habitat was present. Koala activity was determined from the study area and outlined fully in the results section.

2.5.7 State Environmental Planning Policy (SEPP 71): Coastal Protection

This Policy aims to protect and manage the natural, cultural, recreational and economic attributes of the NSW coast and to ensure that the type, bulk, scale and size of development is appropriate for the location and protects and improves the natural scenic quality of the surrounding area.

Developments to which SEPP 71 applies include lands categorised as 'sensitive coastal locations'. These include "*land within 100m of land reserved or dedicated under the National Parks and Wildlife Act 1974 as National Parks estate; and land within 100m above mean high water mark of the sea, a bay or an estuary".*

The site is located at the periphery of the coastal zone but is not within 100m of either any National Park Reserve or any waterway or tidal estuary.

2.6 LOCAL PLANNING POLICY

As part of the change to the new planning instrument LEP 2012 a set of draft DCP's are also proposed. Included in the draft DCP is component 8B Biodiversity requirements. This DCP gives guides lines for environmental assessment at the Development Application Stage, including vegetation protection of Koala Habitat, EECs, significant wetlands and riparian buffers for drainage lines. The vegetation buffers around drainage lines or waterfront land are directly related to the conditions from the NSW Office of Water and are applied to this study area in the Conservation framework (section 6).

Priority Habitats and Corridors Strategy (PHaCS)

There has been significant emphasis in conservation planning about addressing functional connectivity of fragmented landscapes. It has been identified that the planning and rezoning stage of land development is an appropriate vehicle to implement these criteria. In 2003, the then National Parks and Wildlife Service (NPWS) released the paper and geographic data for *Key Habitats and Corridors for Forest Fauna: A Landscape Framework for Conservation in North-east New South Wales* (Scott's 2003). This set the framework for regional scale habitat connectivity.

Local Government has, through the planning process, been encouraged to develop local corridor information. CHCC placed on public display the *Coffs Harbour City Council NSW 2009 Draft Priority Habitats and Corridors Strategy 2010 – 2030*, as the first stage to identifying local corridor networks. This definition of corridors, a key objective of this study, was used in conjunction with other statutory requirements (riparian buffers) to create a practical framework for corridor establishment within the NBVw study area.

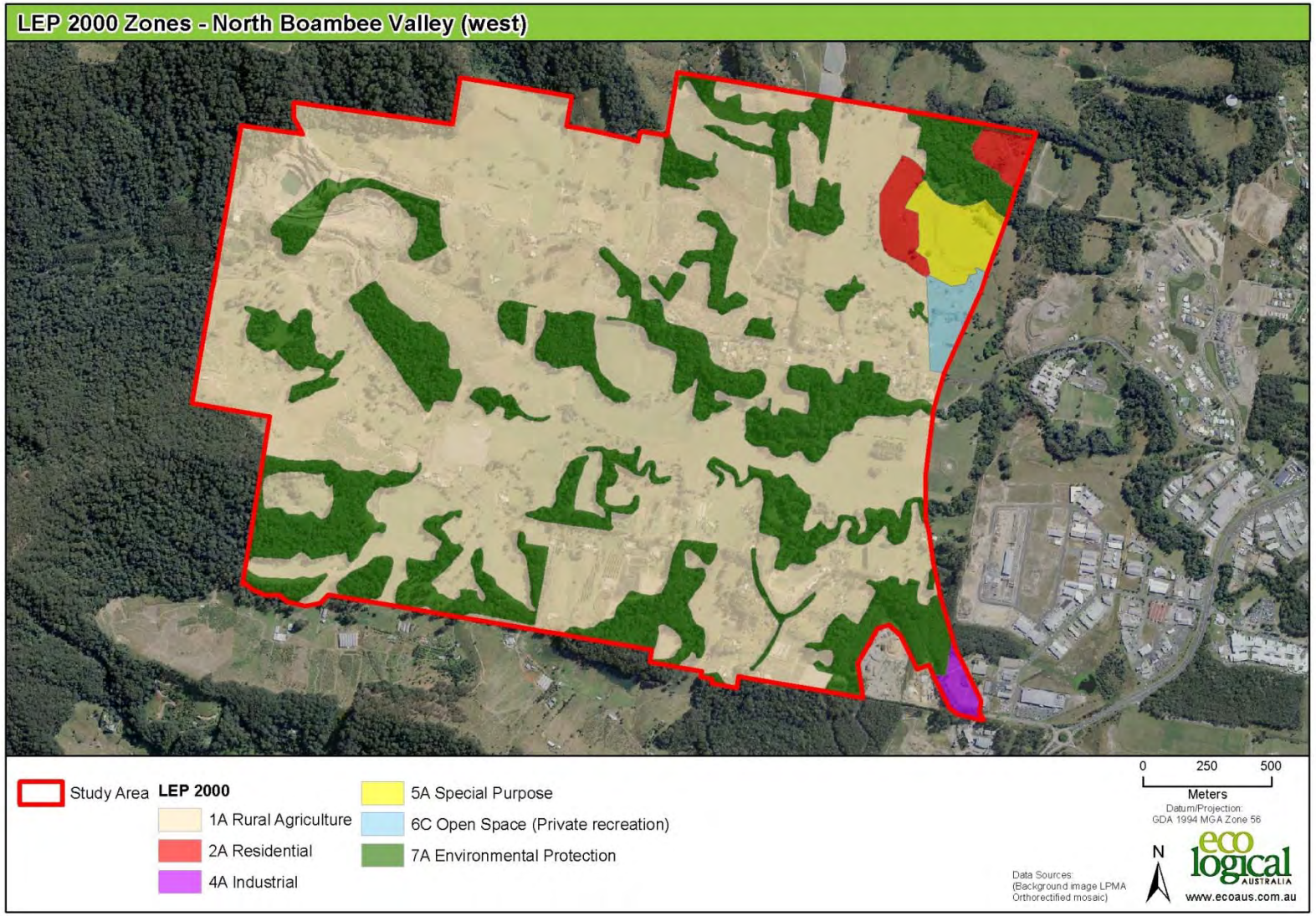

Figure 3: LEP 2000 Zones

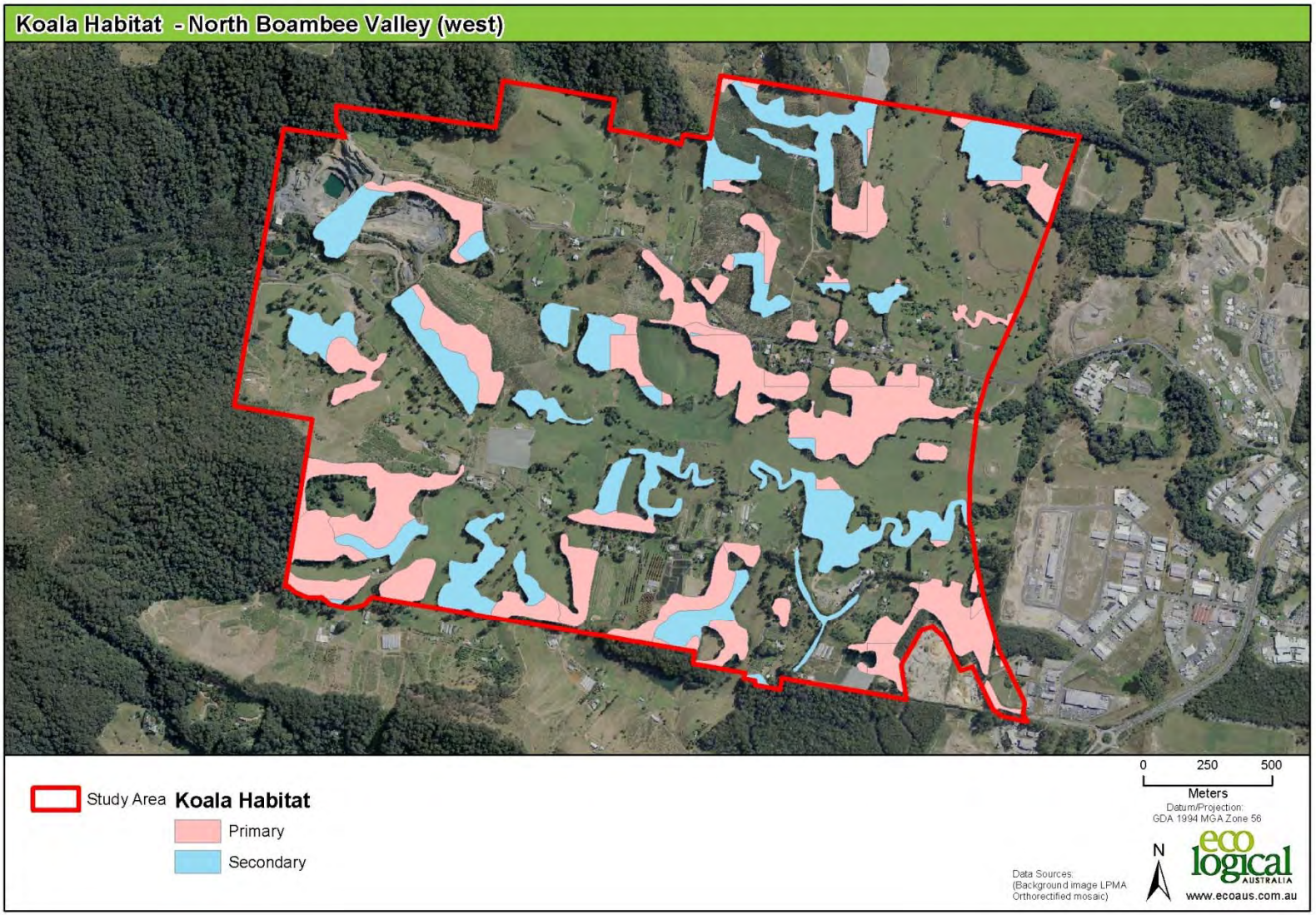

Figure 4: Koala Habitat (Original LEP 2000)

3 Survey Methodology

The assessment included desk-based searches of wildlife databases and review of historical records as well as field survey within the study area.

3.1 DATABASE SEARCHES AND LITERATURE REVIEW

A literature review of the above planning and legislative documents and their associated assessment requirements were conducted prior to fieldwork.

Preliminary lists of species likely to occur within the subject site were obtained by conducting searches of the Office of Environment and Heritage's (OEH) Atlas of NSW Wildlife (Wildlife Atlas), for species listed under the NSW *Threatened Species and Conservation Act 1995* (TSC Act), and the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) Protected Matters Search Tool (PMST) for Matters of National Environmental Significance and species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Threatened species data searches were undertaken on 15 June 2012.

The OEH Wildlife Atlas and PMST data searches were each based upon a 10 kilometre radius from a point centred on the midpoint of the study area and then limited to a 5km buffer of the study area as per the requirement of the brief from CHCC. The resultant lists were filtered to identify threatened species considered likely or with the potential to occur on, or utilise, the subject site and these appear in bold in Appendix C.

3.2 GEOGRAPHIC DATA

A range of Geographic Information System (GIS) datasets were sourced from CHCC applicable to the relevant planning and ecological information available for the study.

GIS layers included:

- Cadastre (Property boundaries)
- Vegetation mapping (Fisher et al)
- Drainage
- Contours (derived from LiDAR data)
- LEP 2000 zonings
- Koala Habitat Mapping
- Corridor information; regional (OEH) and local (PHACS)

3.3 SURVEYS

Flora, fauna habitat and limited fauna assessments were conducted over two field survey periods totalling 8 person days 18, 19, and 20 June and 26-27 July. Survey effort at this time of year (winter) is not optimal for a range of faunal groups that could occupy the range of habitats within the NBVw. Some species are migratory and will only occupy these landscapes at certain times of the year, for example the range of summer migrate bird species. Other species are more easily detected during warmer and optimal whether conditions such as a range of frog species that are detected by call during warm rainy periods. Other species are not active during the winter such as reptiles and are therefore not highly represented during winter surveys.

Land parcels were targeted based on landholders allowing access, size and representative vegetation types. Areas likely to be located close to potential development precincts were also targeted for assessment. Note not all discreet vegetation patches were assessed due to landholder access restrictions and availability.

Meandering transects were performed in vegetation units selected to validate mapped vegetation types, condition, significant species and significant habitat features. Evidence of Koala's and other wildlife was actively searched for, particularly searches for Koala faecal pellets or scats under Tallowwoods, the primary Koala feed tree in the valley.

The locations of significant features or threatened species sightings was recorded with a Global Positioning System (GPS) and are presented in the results section.

Diurnal fauna survey effort included actively searching for any evidence of animals including tracks, scats or scratch marks on trees. Nocturnal survey effort included spotlighting, stag-watching and all night microbat echolocation call recording (Anabat).

3.3.1 Vegetation Assessment

Available Vegetation information for the NBVw for the current assessment was *The Vegetation of the Coffs Harbour City Council LGA 1996*. This dataset is of considerable age however a new class 5 vegetation layer for the CHCC LGA currently being developed was not available at the time of the current assessment process.

As can be expected some change has occurred overtime from the original vegetation layer including loss and regrowth of some vegetation units, some of which underpin koala habitat definition. This change can also be attributed to landuse change which increased or decreased disturbance regimes that affect the quality of the vegetation and habitat quality.

Any anomalies from the original vegetation mapping have been revised by field verification where possible. It is believed most of the discrepancies are associated to age of the data and coding errors due to limited access to verify vegetation polygons located on private property during the first study.

3.3.2 Vegetation Condition

The quality of vegetation was assessed using parameters such as intactness, diversity, history of disturbance, weed invasion and health.

Three categories were used to describe the condition of vegetation communities:

- Good: Vegetation still retains the species complement and structural characteristics of the pre-European equivalent. Such vegetation has usually changed very little over time and displays resilience to weed invasion due to intact ground cover, shrub and canopy layers.
- Medium: Vegetation generally still retains its structural integrity but has been disturbed and has lost some component of its original species complement. Weed invasion can be significant in such remnants.
- Poor: Vegetation that has lost most of its species and is significantly modified structurally. Often such areas now have a discontinuous canopy of the original tree cover, very few shrubs. Exotic species, such as introduced pasture grasses or weeds, replace much of the indigenous ground cover or are co dominant with the original indigenous species.

3.3.3 Fauna Habitat

The fauna survey of the study area was based primarily on the habitats present with species of animal present recorded opportunistically during the habitat assessments. The recording of Threatened species during surveys confirms their presence but alternatively, a lack of Threatened species records cannot necessarily be used to argue the absence of the species from the site when suitable habitat is present. Threatened species are often difficult to detect due to their general rarity, seasonal occupation or cryptic nature. Suitable habitat is therefore the most important factor to consider when determining the potential presence of Threatened species. Fauna habitats were assessed by examining characteristics such as the structure and floristic composition of the canopy, understorey and ground vegetation. The structure and composition of the litter layer and other habitat attributes important for feeding, roosting and breeding was also considered. The following criteria were used to evaluate habitat values:

- Good: A full range of fauna habitat components are usually present (for example, old-growth trees, fallen timber and foraging resources) and habitat linkages to other remnant ecosystems in the landscape are intact.
- Moderate: Some fauna habitat components are often missing (for example, old growth trees and fallen timber), although linkages with other remnant habitats in the landscape are usually intact although sometimes degraded.
- Poor: Many fauna habitat elements in low quality remnants have been lost, including old growth trees (for example, due to past timber harvesting or land clearing) and fallen timber, and tree canopies are often highly fragmented. Habitat linkages with other remnant ecosystems in the landscape have usually been severely compromised by extensive past clearing.

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3.3.4 Targeted Fauna Survey

A limited range of targeted fauna survey methods were used as described below. Locations for fauna survey, flora and fauna habitat assessments are depicted in Figure 5.

Spotlighting

This fauna survey technique targets arboreal, flying and large ground-dwelling mammals, including nocturnal reptiles and amphibians (in appropriate season). Spotlighting was conducted on foot over

three nights (totalling 4 person nights) throughout the study area using handheld 50w spotlights and a 100w variable spotlight.

Microchiropteran Bat Surveys

Ultrasonic Anabat Bat detection (Anabat[tm] Titley Electronics, Ballina) was used to record and identify the echolocation calls of microchiropteran bats foraging at 6 sites in the study area (Figure 5). All Anabat Bat detectors were set to record bat vocalisations throughout the full night, with the recording starting at 6pm and finishing at 6am. Additionally a handheld unit was used on dusk prior to spotlighting sessions, this allows the user to follow the flight of a bat increasing the recorded call profile and generally increasing the ability to identify the call of the species. Calls recorded were analysed by Peter Knock of Eco Logical Australia (ELA) for species identification (Appendix E).

Koala Habitat Assessment

Koala sign was actively searched for as part of the fauna habitat assessment process. Koala feed trees particularly Tallowwoods (*Eucalyptus microcorys*) were searched at their base and immediate surrounds for Koala scats. The search technique was based on the SPOT assessment technique (Philips and Callahan 2000) was a time based search criteria under appropriate trees within habitat patches. A full SPOT survey was not conducted as habitat patches were generally small and linear and a presence absence determination of koala activity was the aim of the survey effort. All habitat patches accessed (Figure 5) were searched for koala activity.

Opportunistic Sightings

Opportunistic recordings of species were made through observation methods such as incidental sightings, identifying bird calls and by sighting indirect evidence of species presence such as scats, nests, roost sites, feathers, hair, tracks, diggings and feeding marks on and around trees.

3.3.5 Survey Limitations

This study was not considered a comprehensive Flora and Fauna survey effort. Selected fauna survey detection techniques were used only, as described above. Not all vegetation remnants were able to be accessed and therefore not assessed. Flora techniques were based on random meanders and not full plot based analysis.

Survey effort was conducted during winter (June and July 2012) which is not generally an ideal time for some fauna gilds such as reptiles and frogs. Microbat species too can be generally less active in winter but good species diversity was obtained.

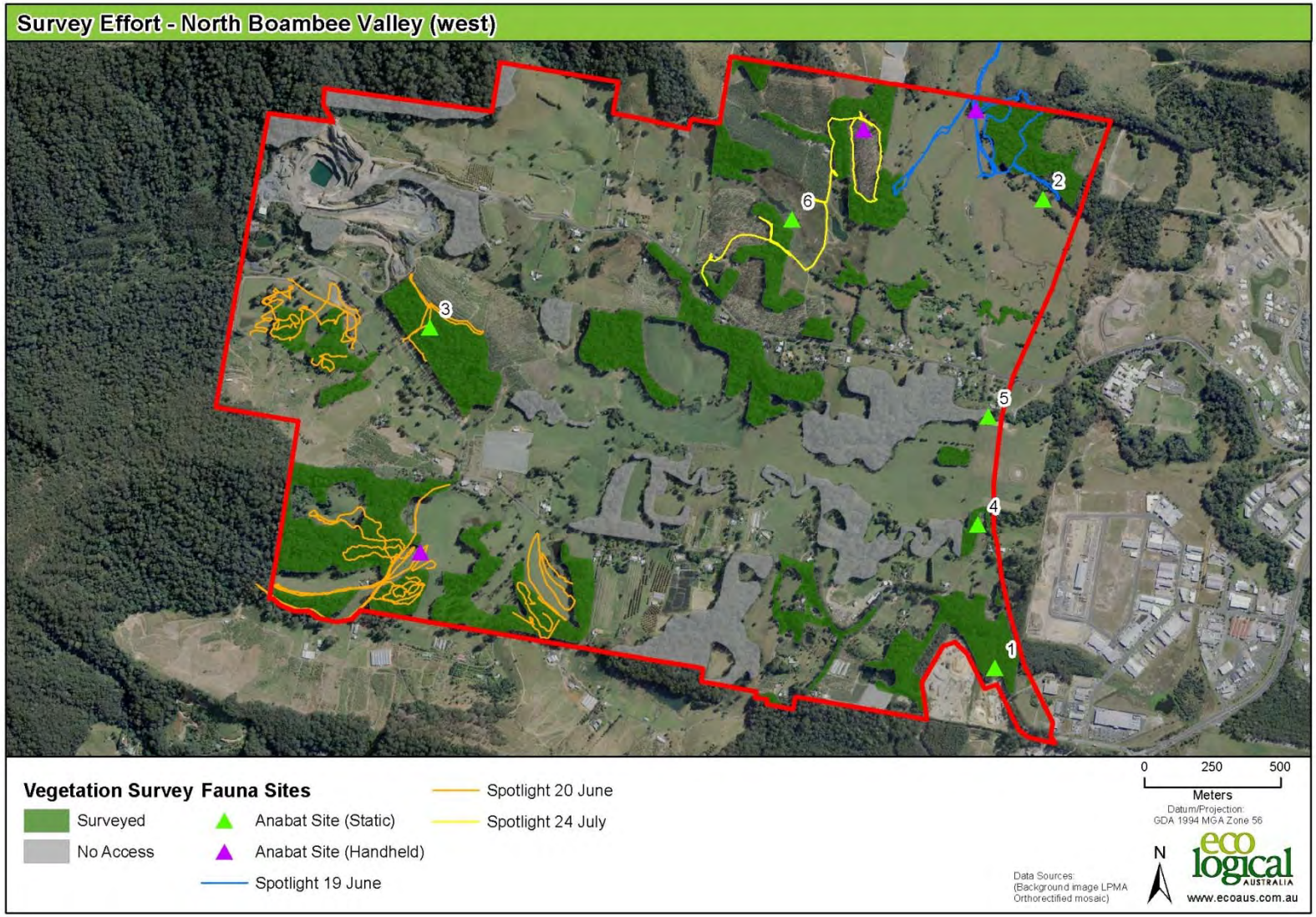


Figure 5: Flora and Fauna Survey Effort

4 Results

4.1 VEGETATION COMMUNITIES

Vegetation communities within the study area are shown in Figure 6 and described in Table 1. The mapping is based on existing vegetation mapping (Fisher et al) and 'ground truthing' undertaken as part of the current survey.

Mapped vegetation within the study area includes areas mapped as native, exotic (Camphor Laurel dominated), and regrowth; totalled 194 Ha within 43 distinct patches (

Table 2). Only 4 vegetation patches were greater than 10 Ha. Areas of derived grassland were not mapped. Riparian zones within the valley are very narrow and therefore two small to delineate and are categorised by surrounding Eucalypt forest types.

Five categories are mapped with three main vegetation communities distinguished from the study area they are:

- Open Forest;
- Tall Open Forest;
- Swamp Forest and
- Camphor Laurel Dominated
- Regrowth

Additionally, some parts of the study area were considered not natural in that they were highly modified by agricultural (horticultural) or for other purposes.

Tall Open Forest

Tall Open Forest class is the largest vegetation community in the valley approximately 86% or 170 Ha. Vegetation types are dominated by Flooded Gum and Tallowwood species. These vegetation types provide most of the Primary and Secondary mapped koala habitat. The vegetation type N27 Flooded Gum (*Eucalyptus grandis*) appears to be over stated in the valley. It is correct around the lower elevation vegetation communities and drainage lines but further upslope Flooded gum gives way to Sydney Bluegum (*E. saligna*). This doesn't change however the vegetation community emphasis or have implications for Koala habitat mapping as both species are listed as important Koala feed trees.

This community has been heavily targeted for timber production in the past resulting in most communities containing few large trees. There were however some large Tallowwoods particularly in the south west corner of the study area. Some large examples of Bluegum and Blackbutt occur along the roadside vegetation along England's Road.

Open Forest

The Open forest community represents approximately 11 Ha in total defined predominately by Coastal Blackbutt vegetation types. This community has generally a more open canopy allowing more light to the mid and lower strata. They tend to contain a drier understorey and are more prone to fire. Blackbutt is also an important Koala feed tree in the Coffs Harbour area. This community also contained one mapped vegetation unit for Turpentine (*Syncarpia glomulifera*) this is a relatively rare or uncommon forest type. Due to past heavy forest disturbance this may be a derived vegetation class with other species such as Tallowwood targeted for removal and therefore Turpentine over represented.

Swamp Forest

The swamp forest community equates to the NSW TSC listed EEC *Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions*. It was confined to the south-east corner of the study area and was the only EEC determined from the NBVw.

This community contains predominately Broad-leaved Paperbark (*Melaleuca quinquenervia*) and Swamp Mahogany (*E. robusta*) both important Koala feed trees. This community is found in low lying

impeded drainage areas which are naturally periodically inundated. They provide a range of foraging resources particularly high nectar producing winter flowering species. These habitats are important therefore for threatened species as the Grey-headed Flying Fox (*Pteropus poliocephalus*) and winter migratory bird species such as the Swift Parrot (*Lathamus discolour*).

This particular area is an important connection from the south east corner of the study area to a larger swamp forest remnant adjacent to the CHCC waste recovery facility outside the study area. This linkage may provide an important feeder point for dispersing Koalas. Moon (2002) found that vacant habitat opportunities was a possible push factor for Koalas to move from east of the Pacific Highway to the western habitats.

Table 1: Vegetation Types within Communities

Community	**Code**	**Species**
Open Forest	N2A	*Eucalyptus pilularis*
	N44a	*Eucalyptus pilularis, E. resinifera, Corymbia intermedia*
	SF49	*Syncarpia glomulifera, Eucalyptus microcorys*
Tall Open Forest	N27	*Eucalyptus grandis*
	N3	*Eucalyptus microcorys and E. saligna*
	N7	*Eucalyptus pilularis, E. microcorys*
	N7A	*Eucalyptus microcorys, E. grandis, Lophostemon confertus*
	N27R	Advanced regrowth
	Un-typed	Edges abutting State Forest Estate
Swamp Forest	N50	*Melaleuca sp., Casuarina glauca, Eucalyptus robusta*

Table 2: Vegetation Patch Statistics

Community	No. of Patches	Hectares
Camphor Dominated	3	2.15
Open Forest	4	11.15
Regrowth	1	1.87
Swamp forest	2	12.12
Tall Open Forest	61	169.99
Total	71	197.28

4.1.1 Habitat Condition

All habitats within the valley have been modified in some form by logging and clearing for agriculture. There were no vegetation remnants that contained all their original structural and floristic components. Most patches were relatively small, some linear and therefore were greatly affected by edge affects such as increased weed invasion (Table 3) (Figure 7).

Hollows were generally rare indicating previous logging and agricultural clearing history. Some patches contained uniform tree size or of similar age ranges indicating either a common regrowth phase post fire, logging or reduction of other disturbance regime. Few old growth remnants are retained in the valley. These forests are still however providing a range of resources for the documented common and listed threatened species. Disturbance regimes associated with tree removal and agricultural activities anecdotally appear to be reduced and the majority of forested patches are in a regrowth phase.

All forested remnants are within the 7a Environmental and Habitat Protection zone (LEP 2000). This zoning which has been in place for approximately 12 years, predominately for Koala habitat protection, is likely to have reduced the disturbance regime within the study area during this time.

Table 3: Vegetation Patch Condition

Patch No.	Condition	Area Ha	Connectivity	Disturbance	Structure	Koala Evidence
1	Medium	6.95	Affected by highway bypass	Logging, fence lines weeds	regrowth elements	Nil
2	Medium	3.12	Possible connection to the north	grazing / logging /weeds	some larger trees	Yes
3	Medium	0.92	Newport's Creek	heavy / weeds / grazing	regenerating	Nil
4	Medium	8.68	Good but bypass will affect	low past logging	good	Yes
5	Medium	3.75	Isolated	grazing / logging /weeds	good	Nil
6	Medium	1.85	Isolated	grazing / logging /weeds	good	Nil
7	Good	13.97	Connected to State Forest	logging / grazing	Intact structure	Nil
8	Medium	2.50	separated but close to larger patches	logging / grazing	some larger trees	Nil
9	Medium	10.53	separated but close to larger patches	logging / grazing	Good size tallowwoods	Nil
10	Medium	9.44	Isolated	logging / some weeds	reasonable structure	Nil

Patch No.	Condition	Area Ha	Connectivity	Disturbance	Structure	Koala Evidence
11	Medium	2.13	Connected to State Forest	logging	regrowth elements	Nil
12	Medium	0.81	separated but close to larger patches	logging	Under-scrubbed	Nil
13	Medium	3.83	separated but can be linked to adjacent patches	logging	Under-scrubbed	Nil
14	Medium	2.65	connected to State Forest northern ridge	edge effects, weeds	reasonable structure	Yes
15	Medium	0.89	very small limited connectivity to north	weeds / logging	regrowth elements	Nil
16	Medium	3.88	disjunct connect with riparian buffers	logging / under scrubbed	regrowth elements	Yes
17	Poor	0.81	linear eroding channel	weeds/ erosion	regrowth / weeds	Nil
18	Medium	9.50	tentatively connected	grazing / logging /weeds	regrowth and mature	Yes
19	Medium	5.39	separated but close to larger patches	logging / grazing	regrowth	Nil
20	Medium	0.77	small and isolated	weeds	large blackbutts	Nil
21	Poor	0.68	Drainage line weed regrowth	tree weeds	Drainage buffer network	Nil
22	Poor	0.66	Drainage line weed regrowth	tree weeds	Drainage buffer network	Nil
23	Medium	3.69	Disjunct and linear	some weeds	regrowth and larger trees	Nil
24	Poor	0.70	Isolated	tree weeds mostly camphor	poor	Nil
25	Medium	12.70	Large patch covers part of drainage line	grazing / logging /weeds	good	Nil
26	Poor	0.35	Very small / isolated	edge effects, weeds	poor	Nil
27	Poor	1.01	isolated but on drainage line	tree weeds	poor	Nil

- Note not all distinct vegetation patches were assessed due to limited access.

4.1.2 Species of Plant

A total of 208 species of plant was recorded within the study area during this survey (Appendix A) of which 176 (83%) are native.

A total 36 species recorded within the study area are exotic species in the Coffs Harbour LGA a number listed as noxious under the Noxious Weeds Act 1993;.including species such as Fireweed (*Senecio madagascariensis*), Giant Parramatta Grass (*Sporobolus fertilis*), Lantana (*Lantana camera*) and Broad and Small-leaved Privet (*Ligustrum lucidum, L. sinense*).

4.1.3 Significant Flora

From the field survey effort for this study two flora species listed under the NSW TSC act were located. They are:

- Slender Marsdenia (*Marsdenia longiloba*) (TSC E and EPBC V) and
- Rusty Plum (*Niemeyera whitei*) (TSC V)

Photo: 1 Slender Marsdenia located in patch 1

Photo: 2 Rusty Plum located in patch 8. Suitable habitat exists throughout the study area for the above two species.

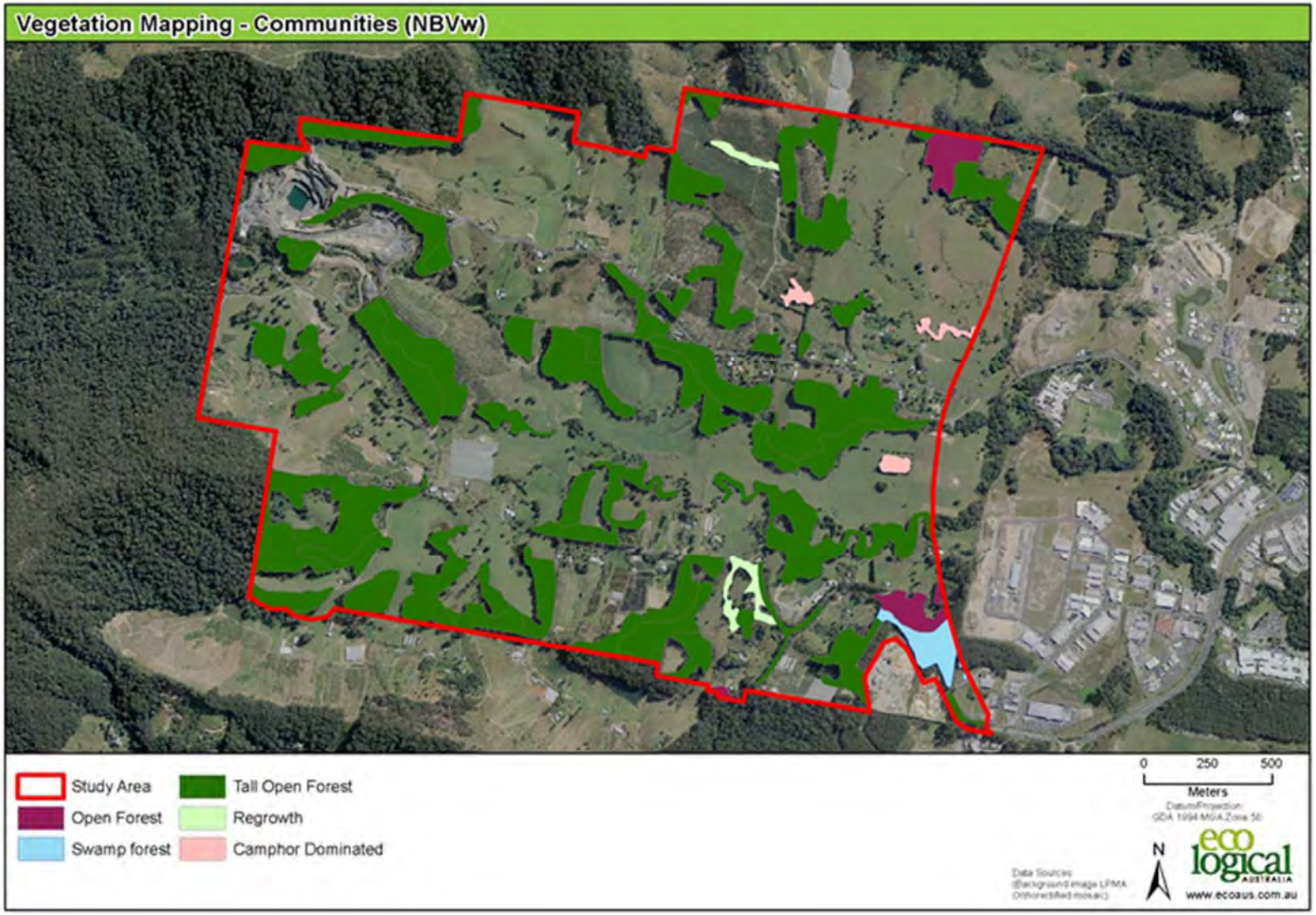


Figure 6: Vegetation Communities

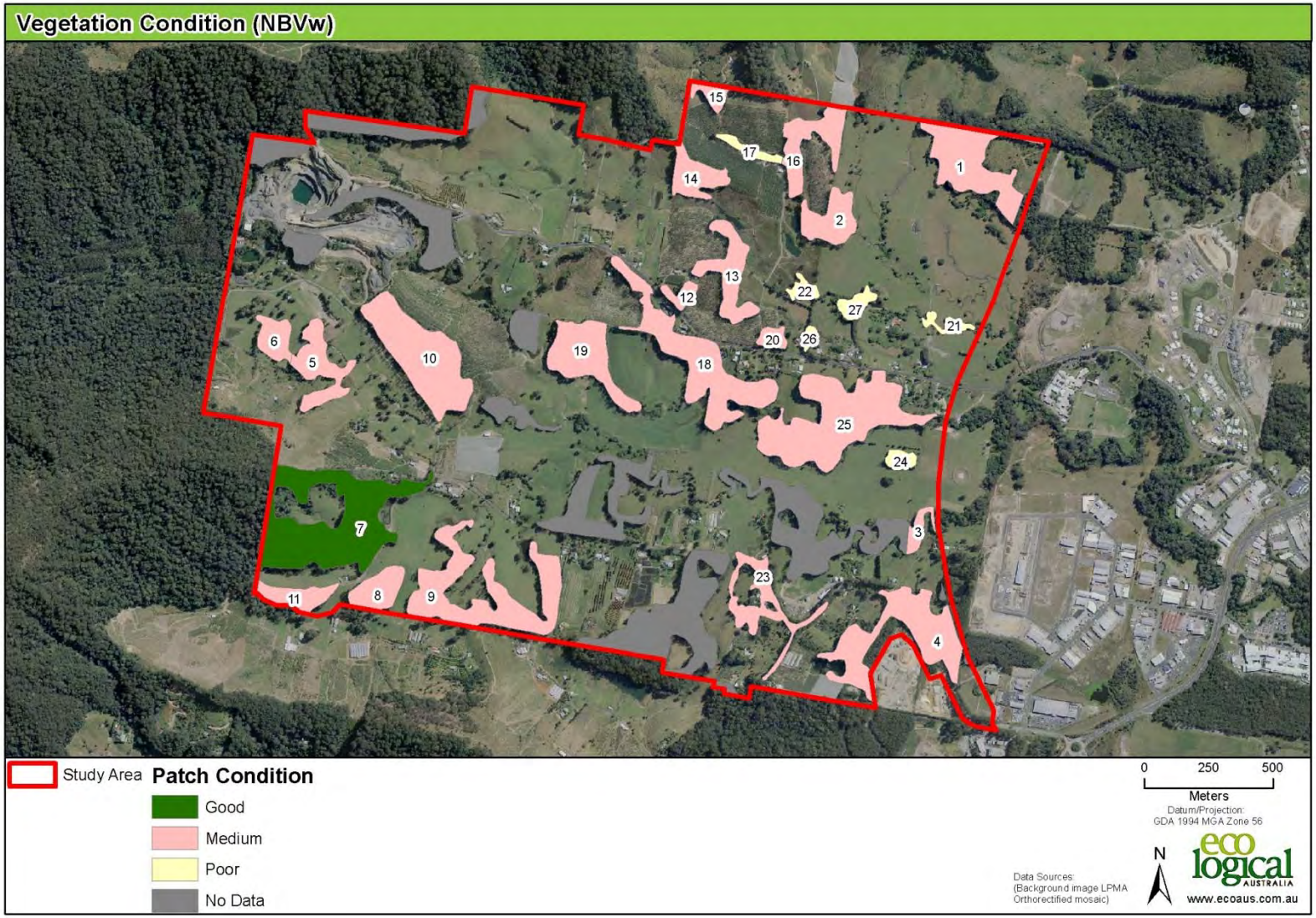


Figure 7: Habitat Condition

4.2 FAUNA HABITATS

The vegetation in the study area composed a mosaic of isolated remnant and regenerating forested patches interspersed with cleared grazing and horticulture land, as well as nested riparian zones along Newport's Creek. These communities are predominately Eucalypt based vegetation systems with little or no rainforest vestiges left. Rainforest and swamp forest ecosystems may have been more wide spread in the valley prior to European settlement. As single remnant rainforest trees adjacent junction of England's Road and Newport's Creek suggest that the valley floor may have contained more wide spread rainforest communities.

Derived exotic grasslands are a widely occurring habitat type in the study area and offer limited resources for native animals, due to the low floristic and structural diversity of the vegetation. Some species do however utilise these areas solely such as the common Tawny Grass-bird and Golden-headed Cisticola.

Isolated paddock trees are generally few and scattered throughout the study area with the majority being exotic Camphor Laurels. Significant native examples of paddock trees are a number of large Morton-bay figs which provide foraging resources for flying fox species. The majority of remnant patches contain distinct boundaries between cleared non-cleared edges. Exotic species such as camphor laurel form a large percentage of these isolated trees and are generally one of the first trees to re-establish cleared drainage lines after the disturbance regimes has been reduced. Remnant trees in paddocks can be important in agricultural landscapes for the conservation of fauna in the region as they provide habitat to a range of fauna and also help to maintain connectivity or stepping stones between larger patches of vegetation thus contributing to the viability of fauna populations (Gibbons & Boak 2000).

The Tall Open forest communities (the majority of the forested habitat types within the valley) contained some areas with intact mesic understorey and rainforest vine foraging habitats. Logs and fallen branches were present in low to moderate numbers and provided breeding, hibernation and sheltering sites for native animals. Medium sized tree hollows were extremely rare and were generally limited to stags (dead standing trees) some of which showed evidence of ring-barking. Hollows were generally at a very low occurrence and represent the long history of logging and agricultural utilisation and show generally the regrowth nature of the forested habitats. The remnant and regrowth Tall open forest areas were generally in moderate condition. This forest community forms a large part of the foraging habitat for Koalas and therefore all remaining Tall Open forested systems are important for the maintenance of this species.

A small portion of Swamp Forest is located in the south-east corner of the study area dominated by Swamp Mahogany (*E. robusta*). This forest community has been found to be very important feed tree to Koala populations in the Coffs Harbour LGA. This ecosystem has however been greatly reduced in extent even in the local area, further reduction of this particular patch is likely with the construction of the Coffs Harbour Highway bypass adjacent to the study area. This forest type equates to Swamp Sclerophyll on coastal floodplains EEC and therefore has high ecological value.

Two small areas of Open Forest community have been mapped in the study area. A small area of predominately Coastal Blackbutt (*E. pilularis*) occurs in the south–east corner of the study area immediately adjacent and upslope of the swamp forest community. This forest type also equates to Koala habitat and will also be potentially impacted on by the Bypass proposal.

The riparian zone of Newport's Creek provided a limited range of habitat features as they are in a highly disturbed state due to previous and on-going agricultural activities. These zones were most likely

predominately cleared in the past and are now regenerating naturally but contain significant areas of tree weed species such as Camphor Laurel and Privet. The riparian vegetation is discontinuous at the present with some areas containing no native vegetation.

The availability of freshwater either in-channel or by in-stream dams provided drinking resources for birds and mammals as well as breeding habitat for wetland birds and common frogs. The riparian habitats of the Newport Creek catchment were in relatively poor condition however do provide important habitat linkage framework throughout the valley. The microbat echolocation data showed that these drainage lines are important flyways for microbats as conduits to access vegetated areas or as immediate foraging habitat zones.

A single Black Bittern, a cryptic and rare water bird was also determined from the riparian vegetation communities and is the first known record within the valley. Two other threatened birds were determined from the study area both are large ranging, highly mobile species. The first the Square-tailed kite flies low over the forest canopy targeting passerine birds such as honeyeaters. They require a large home range in excess 1000 Ha, an area much larger than the study area.

Inter-habitat connectivity within the NBVw is largely fractured and only the highly mobile species are able to take advantage of the available habitat. Fauna habitat usage would be greatly improved by re-establishing links between forested patches.

A fauna list determined from field assessment for this study is located at Appendix B. Species of note are highlighted below in their respective faunal groups.

Photo: 3 Patch 19 Past logging evidence and even age regrowth

Photo: 4 Patch 18, past logging evidence, regrowth forest.

Photo: 5 Young regrowth forest, note little or no understorey, Patch 16.

4.3 FAUNA SPECIES

A total of 102 species of fauna were recorded in the study area during field surveys comprising 76 bird, 19 mammal, 3 reptile and 4 amphibian species. Two bird species recorded were introduced species. The full list of animals recorded during the current survey is shown in Appendix B.

Many of the native fauna species recorded or considered likely to occur in the study area are those that are highly mobile or tolerant of variegated landscapes. Species dependant on mid-range to large hollows appear absent from these habitats. Microchiropteran bats form a large portion of the mammal fauna detected including five vulnerable species.

4.3.1 Significant Fauna

Eight threatened species listed as Vulnerable under the Threatened Species Conservation Act 1995 were recorded during the field surveys; they are:

Birds

- Spotted Harrier (*Circus assimilis*);
- Square-tailed Kite (*Lophoictinia isura*) and
- Black Bittern (*Ixobrychus flavicollis*)

Mammals

- Koala (*Phascolarctos cinereus*)
- Little Bentwing (*Miniopterus australis*)
- Eastern Bentwing (*Miniopterus schreibersii oceanensis*)
- Large-footed Myotis (*Myotis macropus*)
- East coast freetail-bat (*Mormopterus norfolkensis)*

4.4 SPECIES, POPULATIONS AND COMMUNITIES OF CONSERVATION CONCERN

From the database searches 97 animals and 40 plants listed on either the NSW TSC Act or the commonwealth EPBC Ac are recorded within 5km search of the study area. Of these 46 animals and 13 plants are either likely of have the potential to occur based on the available habitats within the study area. Eight EEC's have been recorded within the 5km search with only one present in the study area the Swamp Forest EEC. All listed species identified by the search criteria are located in Appendix C, species known to occur in the study area from current survey effort are highlighted as bold text.

From the literature review the previous studies covering the NBVw area notes a particular species *Endiandra virens* or White Apple on several occasions (Clancy 1990, Gunninah 1996) but this species is not listed as a threatened species on the NSW TSC Act; it is uncommon and the plant is found extensively in the moist understory habitats of the NBVw Tall Open Forest community.

4.4.1 Ultrasonic Microchiropteran Bat Call Identification

Analysis of ultrasonic echolocation bat calls via Anabat recorders identified nine distinct species of microchiropteran bat within the study area (Table 4). Five of these species are listed as Vulnerable under Schedule 2 of the TSC Act. Full echolocation call results are located in Appendix E.

Table 4: Microbat species determined from echolocation recording

Scientific Name	Common Name	Call Confidence	TSC Act	EPBC Act
Chalinolobus gouldii	Gould's wattled bat	D		
Miniopterus australis	Little Bentwing-bat	D	**Vulnerable**	
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	D,Po	**Vulnerable**	
Mormopterus norfolkensis	East coast freetail-bat	D	**Vulnerable**	
Mormopterus sp2	Eastern freetail bat	D		
Myotis macropus	Large-footed Myotis	D	**Vulnerable**	
Myotis macropus / Nyctophilus sp		D		
Nyctophilus sp	Long-eared bat	D		
Rhinolophus megaphyllus	Eastern Horseshoe Bat	D		
Vespadelus pumilus	Eastern forest bat	D,P		

D= Definite, Po = possible, P=Probable

4.5 LINKAGES AND RESILIENCE

They are 43 distinct patches of remnant or regenerating forest within the NBVw study area of which 27 were accessible and assessed. As stated previously they are highly fragmented with only limited connectivity between some patches. From the survey results however the available habitat is providing a range of resources for a number of common and threatened species. Habitat restoration and connectivity will improve habitat potential over time.

Regional wildlife corridors (Scott's 2003) are mapped to the north and south outside of the study area. The sub-regional corridors are indicative at best for highly mobile fauna through the study area. The draft Priority Habitats and Corridors Study (PHaCS) prepared for CHCC in 2009 maps local corridors within the regional framework for the whole LGA. These two corridor frameworks were overlayed with existing GIS datasets to indicate areas to improve connectivity and improve wildlife movement. The main aim for corridor function should be to link existing habitat for the less mobile species particularly for the iconic species the Koala. If connectivity can be achieved for this species then the majority of species will benefit.

Both datasets were constructed tenure blind, that is without consideration of the under lining landuse and existing infrastructure in place. Using statutory requirements from NSW Office of Water under the Water management Act and as a requirement of the draft Biodiversity DCP (8B) for vegetation buffers of drainage lines a more refined corridor network has been defined for the study area detailed section 6.

5 Discussion

First impressions of vegetation type and condition and fauna habitats of the NBVw study area are that they appear in relatively good condition with predominately their structure and floristic content intact. From the collated species lists for this study there are good indications for most faunal groups found utilising the remnant vegetation's resources and the available in-stream and dammed water resources.

Obvious deviations to this theme were the arboreal hollow-obligate fauna such as glider and possum gilds which appear to be at very low numbers. Hollow bearing resources were few particularly in the larger hollow size category suitable for the midsize mammals and bird species. Microbat hollow-dependant fauna were well represented as they require much smaller hollows. Half the detected microbat species will also roost in cave or cave like structures such as timber bridges, culverts and old mine shafts. As identified in the likelihood tables, many more species are expected to utilise the habitats including summer seasonal and annual migrants.

After a decade of Koala habitat protection through local Planning initiatives, disturbance regimes within the majority of habitats appears to have reduced with areas showing active signs of regeneration. This will include weed growth as this too indicates a potential change to land use over time. Koalas were however found only in a limited number of surveyed patches while good quality Koala habitat forest types containing majority Tallowwood showed no Koala evidence at all.

5.1 KOALAS

From the review of previous Koala studies for the greater South Coffs / Boambee Valley area which includes ATLAS database records the NBVw area contains a significant Koala population and significant Koala habitat within the Coffs Harbour LGA. These low land coastal catchments receive high rainfall and are moderately fertile providing good Koala foraging habitat and therefore higher possible population densities.

Anecdotal evidence from local residents' personal observations of Koala occurrence indicates that numbers were considered higher 20 years ago. Most of the Koala studies by Moon in particular for the original CKPoM population study do indicate high numbers in the greater North Boambee Valley precinct. The greatest threat to the Coffs Harbour Koala population as determined from those studies was impediments to movement causing mortality through vehicle impact, dog attack and disease.

The Lindsey cutting underpass was considered a crucial mitigation effort to maintain Koala movement and eliminate a 'Black Spot' along the Pacific Highway. Moon also suggests that because there is potential lower utilisation of quality habitat that dispersing males experience a push factor from high quality Koala habitats east of the Highway to the NBVw. Considerable effort has been initiated to remove known Koala mortality hotspots through CHCC Environmental Levy funding; at several locations along Hogban Drive in particular.

Koala evidence was found in a number of patches north of the North Boambee Road and a single site south of this road. Koala evidence was determined also from the Swamp Forest Community in the south east corner of the study area.

It must be noted also that logging was performed to the west of the study area in the Boambee East State Forest in the first half of the year prior to survey effort and may have had some influence on Koala movement at time of survey particularly in the western forested habitats.

From evidence collected from this study it appears that significant areas of potential Koala Habitat are currently underutilised in the NBVw at time of survey. Connectivity of Koala habitats north-south within the study area also appears limited.

A number of Koalas have been found to be resident in the NBVw at time of survey or at least include the NBVw as part of their home range. Currently Koalas could be expected to roam freely through cleared agricultural landscapes; development of these areas in theory could have implications to their movements. Establishment of corridors of vegetation between current remnant patches of habitat is fundamental for long term Koala occupation within development zones. Connection of available habitats is crucial for minimising impacts to individuals from their main threats, car impacts and dog attack. Effective planning and instigation of this connectivity is proposed in the following section.

Photo: 6 Koala located in Patch 2 as part of current study.

5.2 ENVIRONMENTAL ZONES

Koala habitat protection was the driver of Environmental Protection (7a) zones through LEP 2000 within the study area. With the transition to the New Instrument, Draft LEP 2012 this intention is carried forward with the majority of 7a zones moved across to the E2 zone including some small boundary adjustments for a net increase. From the recently displayed Draft LEP 2012 the E3 zone has not been utilised.

This planning proposal does consider this zone for potential land use predominately riparian buffer zones and wildlife corridor connections that weren't mapped as 7a previously (detailed in section 6). It is also considered that these lands are transitional between existing land use and their potential as

riparian and wildlife corridors as that intent is realised either through property development or incentive voluntary revegetation.

It is the intention of E3 to contain environmental significant lands as well as a transitional or buffer areas to the E1, E2 zones and areas zoned for rural or residential development (DP&I LEP practice note 2009).

6 Conservation and Management

All native vegetation within the study area contains high ecological status regardless of previous disturbance regimes associated with a long history of utilisation by the forestry and agricultural sectors. All forested landscapes within the study area contain Primary or Secondary Koala habitat as well as providing a range of resources for a number of known threatened plant and animal species and the potential for providing habitat for many more.

LEP 2000 through the need to protect important Koala habitat zoned the majority of forested vegetation for Environmental and Catchment Protection (7a). These lands have been constrained for conservation through these planning controls. Numerous studies have researched Koala populations and issues including impacts on Koala mortality and impediments to Koala movement in the greater area of the Boambee Valley and South Coffs Area (Moon 1996, 1997, 2000; Gardiner 2002 Clancy 1990 & Gunninah 1995). The CKPoM for CHCC LGA was the first in NSW to implement such a plan. The main objective was to place controls over vegetation identified as Koala Habitat and secondarily to improve linkages or not to place barriers to Koala movement in all planning decisions relating to land containing Koala habitat.

6.1 ENVIRONMENTAL CONSTRAINT DERIVATION

The following process is a guide to the implementation of the following criteria:

- Evaluate and protect existing high value vegetation
- Protect existing Koala habitat
- Establish corridor network to link existing vegetation to improve ecological function and catchment protection
- Quantify statutory requirements for vegetation buffers around drainage lines for drainage line stabilisation and to improve water quality.

6.1.1 Riparian Buffers

The draft Biodiversity DCP outlines guidelines for **Riparian Lands**

B8.4.1 Objectives

- To improve water quality within waterways through sustainable design.
- To improve the stability of the bed and banks of waterways through the management of riparian vegetation.
- To improve the relationship between aquatic and terrestrial habitats associated with the riparian lands interface.
- To improve the ecological function of riparian areas within the landscape.
- To identify and protect scenic and cultural values.

B8.4.2 Controls

Riparian Buffers Zones

i) Identified riparian buffer requirements are outlined in Table 5.

ii) Where a riparian buffer is not designated within this Component of the DCP, the riparian buffer must be consistent with controlled activity guidelines for riparian corridors issued by the NSW Office of Water (NOW) for: core riparian zones; and

Vegetated Buffers

iii) Cleared buffer areas are to be revegetated.

iv) Buffer zones are not to be used for private infrastructure purposes, such as onsite effluent disposal, Asset Protection Zones (APZ) and the like.

Table 5: Identified Riparian Buffer Requirements

Waterway	Buffer	Comments
Moonee Creek	100m	
Skinners Creek	50m	
Hearne's Lake and Double Crossing Creek	50m (horizontal and vertical buffer)	Taken from a level of 3.5 Australian Height Datum
State Environmental Planning Policy (SEPP) No. 26 Littoral Rainforests	50m	
SEPP14 Coastal Wetlands	50m	
Willis Creek	50m	
All other creeks	40m	

The guidelines in the Draft DCP are somewhat ambiguous because it does not define what '*All other creeks*' are. A creek is usually a named mapped drainage line on the 1:25000 topographic series. Named streams can be on a multitude of different stream order so application of buffers can be significantly in error. Buffer definition has been determined from the original source of the information the guidelines produced by Office of Water. The full extract from Office of Water is in Appendix F. Note that none of the named streams in Table 5 occur in the NBVw study area.

To understand the buffering criteria a definition of stream order needs to be stated.

Riparian Corridor Widths

The Officer of Water recommends a Vegetated Riparian Zone (VRZ) width based on watercourse order as classified under the Strahler System of ordering watercourses and using current 1:25 000 topographic maps (see Table 6 and Figure 8). The width of the VRZ should be measured from the top of the highest bank on both sides of the watercourse.

Table 6: Stream Order and Buffer Distances

Watercourse type	VRZ width (each side of watercourse)	Total RC width
1st Order	10 Metres	20 m + channel width
2nd Order	20 Metres	40 m + channel width
3rd order	30 Metres	60 m + channel width
4th Order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 Metres	80 m + channel width

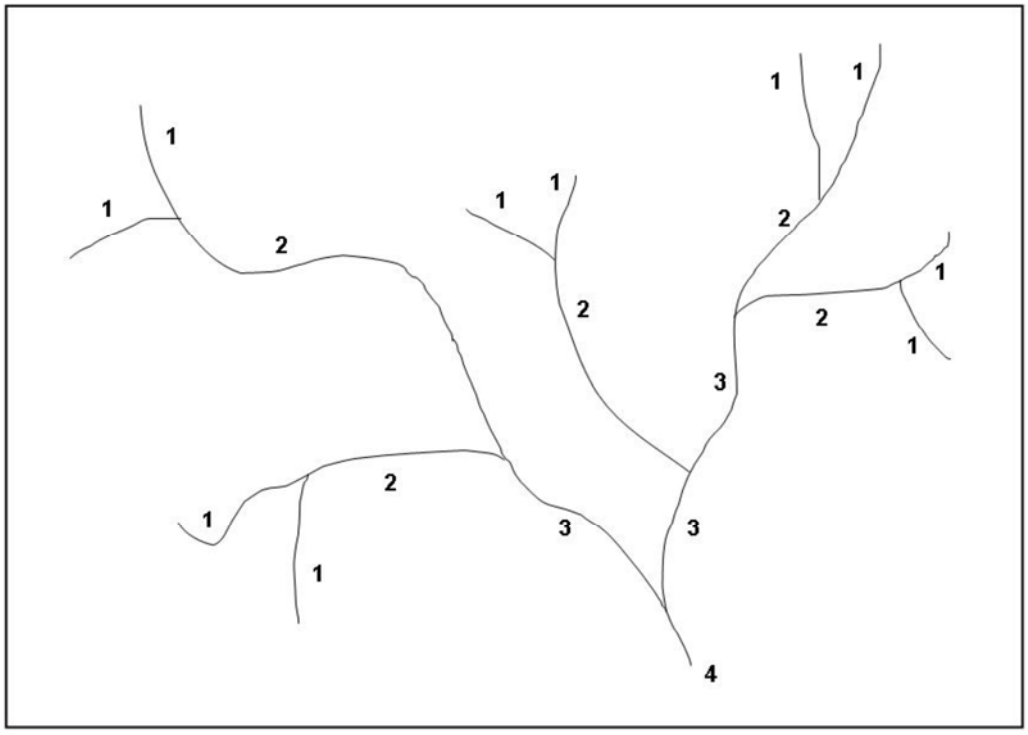


Figure 8: Example of the Strahler Stream Order

Drainage Data

Drainage data was received for the study area from CHCC as part of the larger set of digital geographic data. Topographic drainage was captured by the NSW state mapping agency for their original map production series at 1: 25000 scale. This data set is not accurate enough to define buffered areas from as the drainage is too course to be applied to the drainage of the study area or drainage channels have changed course over time.

An initial step was to remap from the available high resolution imagery (*Nearmap* imagery) available for the study. de Groot Benson captured this data set as they also required finer scale definition of the drainage lines for the flood modelling component for study area.

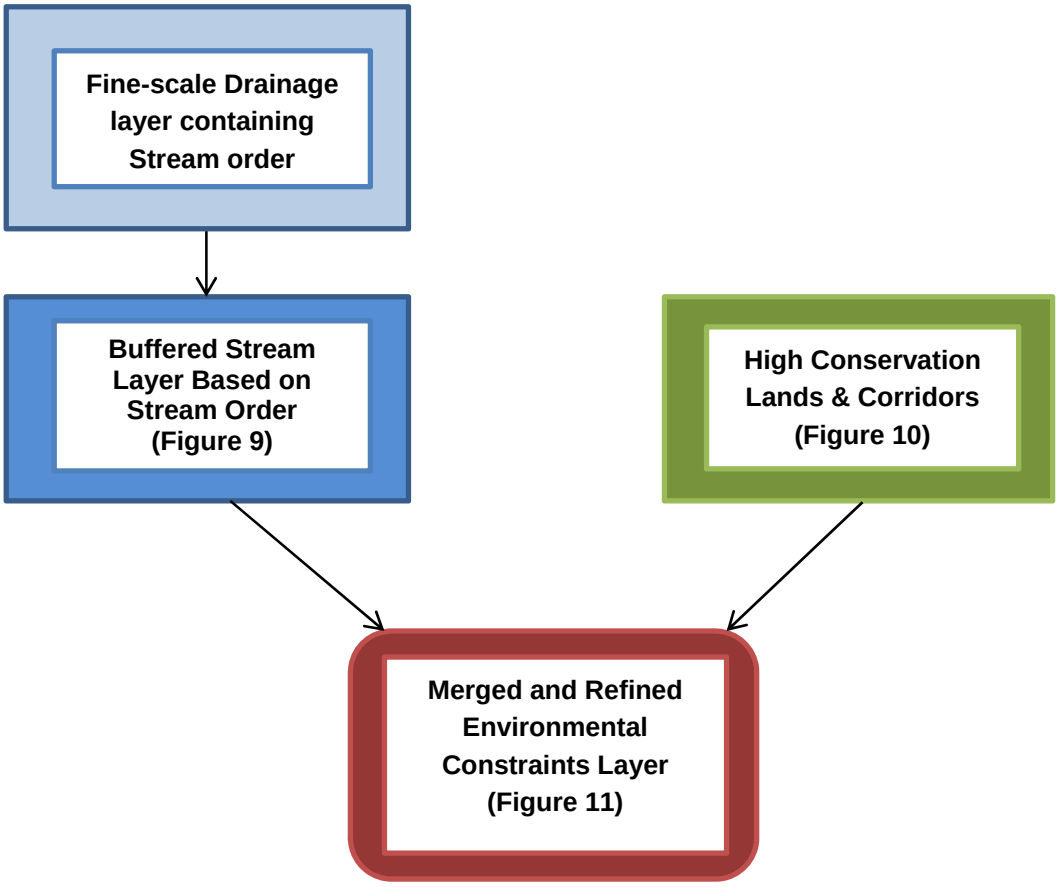
Using the redefined drainage line layer which contained stream order as categorised in the Strahler example in Figure 8 above and applying the buffer distances to all stream orders. A drainage buffer layer was produced (Figure 9).

Stream order ranged from 1st order through to 4th order for the lower section of Newport's Creek. This created buffers ranging from 10m (both sides) through to 40m (both sides). Note that buffers are to be created from the top of bank for all stream orders. This requires fine scale delineation of the entire drainage network using differential GPS technology and was outside the scope of this project. The buffers are designed as a guide to defining environmental constraints and all buffer delineations will need to be performed as part of a Vegetation Management Plan (VMP) for any proposed development application.

A crucial point in the Office of Water guidelines is '*where a watercourse does not exhibit the features of a defined channel with bed and banks, the Office of Water may determine that the watercourse is not waterfront land for the purposes of the WM Act*'. Many of the 1st order streams within the study area that are contained within cleared landscapes do not display defined bed and channel definition as they have been cleared and grazed for many decades. Drainage lines of 1st order only that could not be defined under this principle were not retained in the buffered output.

Data Layer Integration

A simple flow diagram below indicates the GIS steps to defining the environmental constraints layer. High conservation lands equate to all remnant vegetation, Koala Habitat or EEC (ELA refined) are retained and allocated E2 zone as applicable under the new LEP definitions (Figure 10). The remapped drainage and allocated buffer widths data is combined with the high conservation lands and corridors data, with riparian buffers taking highest priority over proposed corridors and existing vegetation takes precedence over corridors in the final layer (Figure 11).



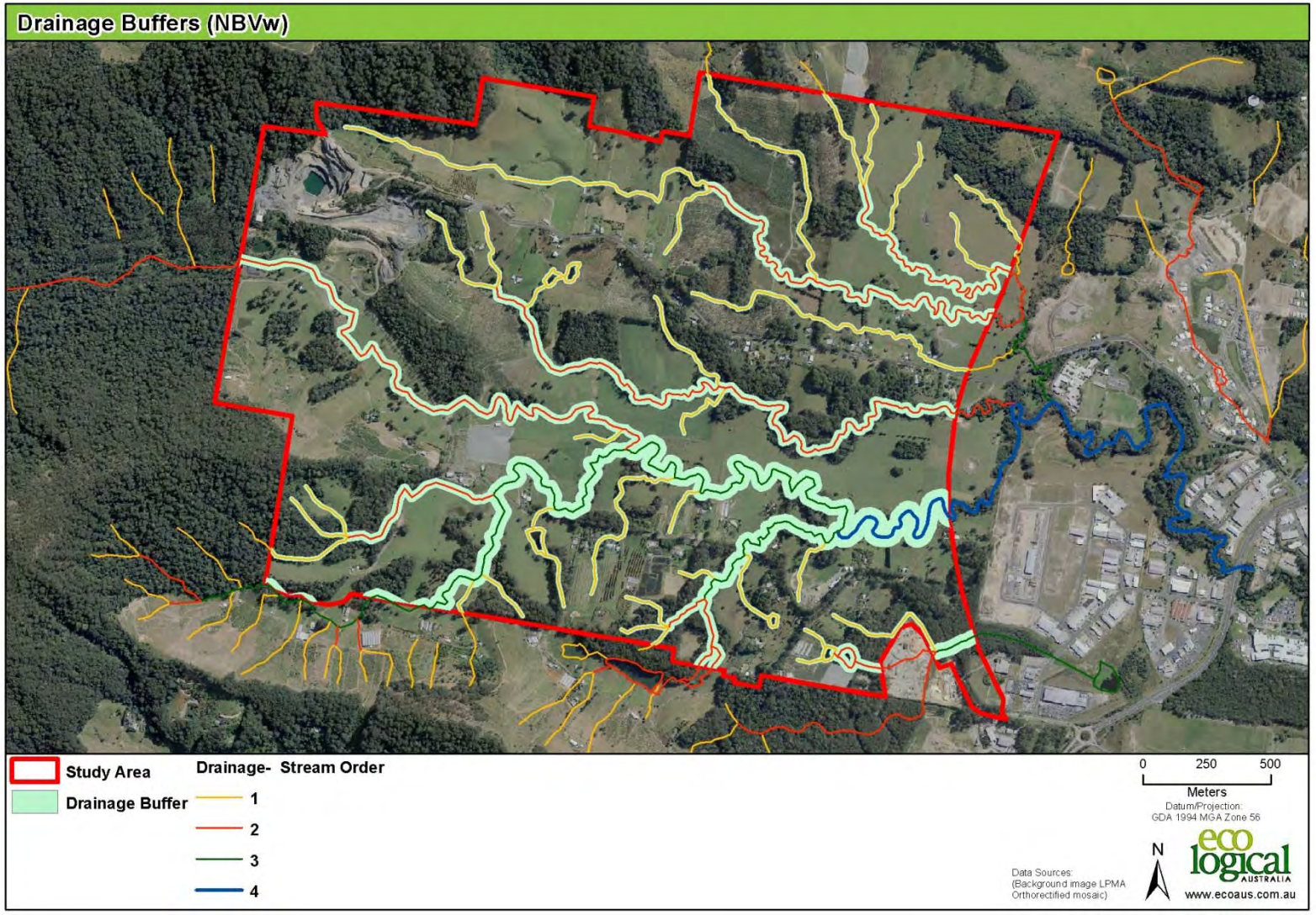


Figure 9: Drainage buffers based on stream order

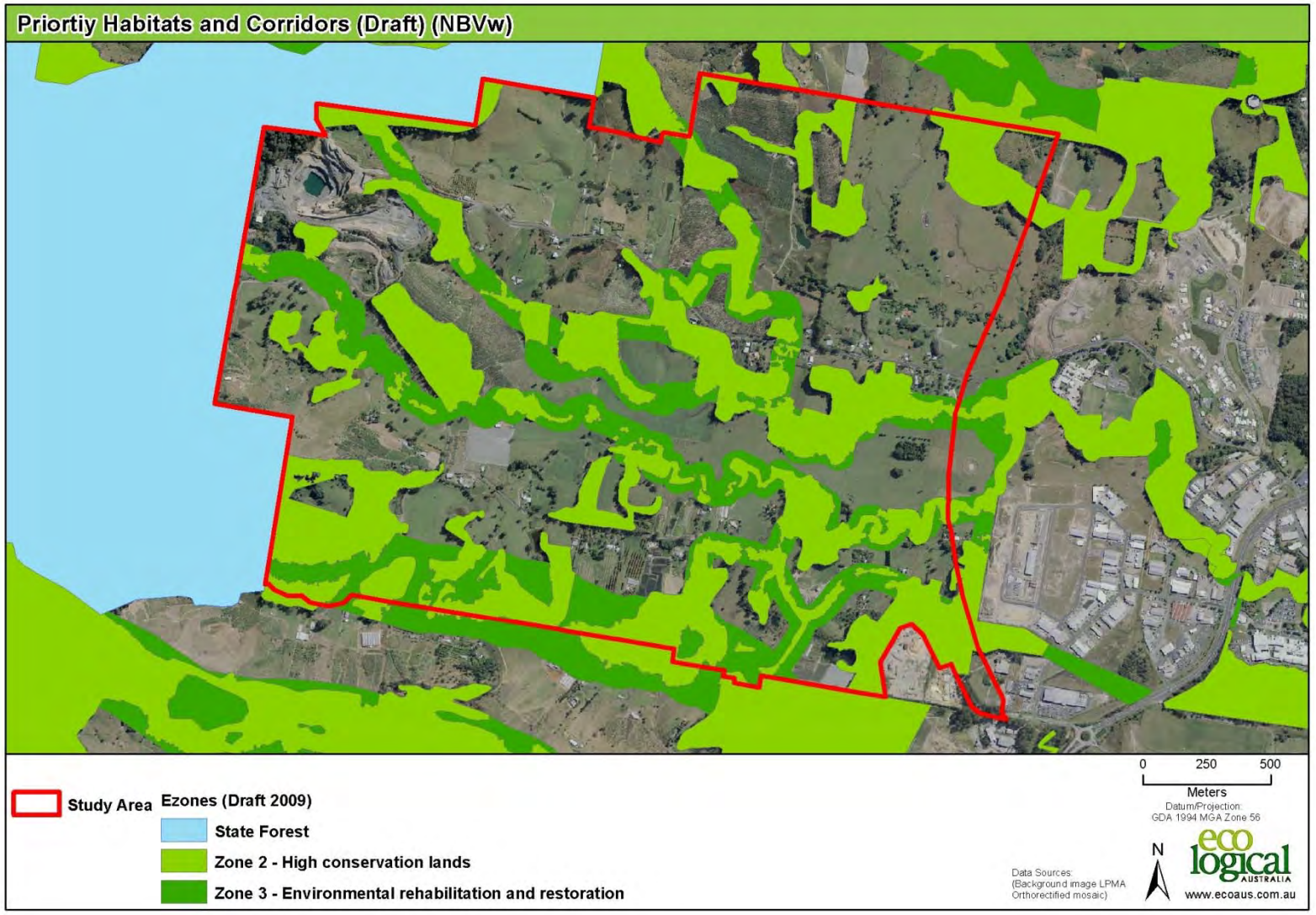


Figure 10: Draft local corridors (PHaCs 2009)

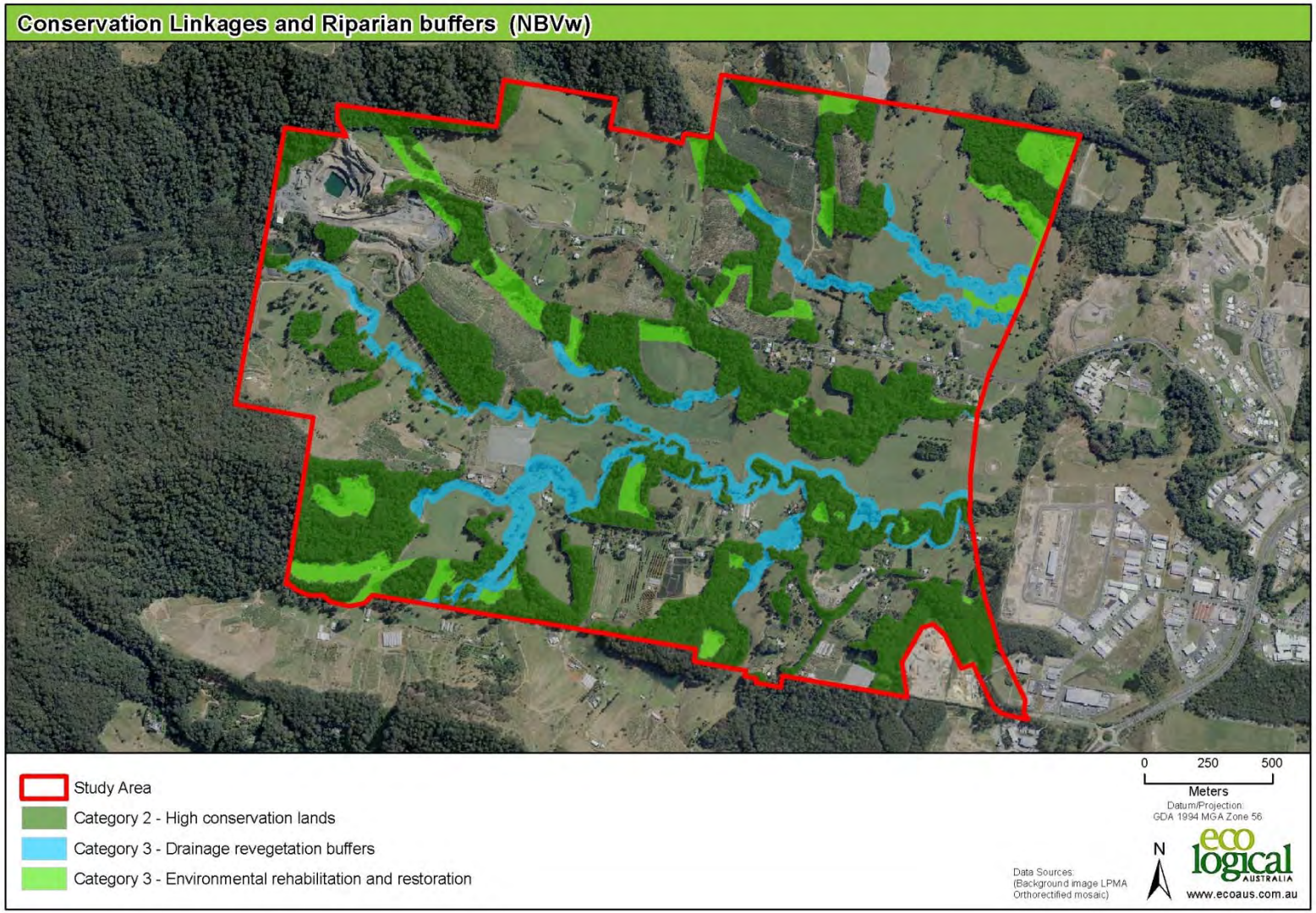


Figure 11: Conservation Linkages and Riparian Buffers

6.1.2 Integration Results

The final output as displayed in Figure 11 shows the environmental constraints within the study area.

The inverse of this layer is then used to determine the potential developable land for residential, industrial or rural residential.

The majority of corridors have been incorporated in the final constraints layer. Riparian buffers have allowed for additional connectivity in some areas particularly in the North-east of the study area where originally no local corridor was proposed. All widths from the corridor layer have not been directly applied because of underlining existing landuse and infrastructure that does not make it appropriate for outright rezoning. The riparian buffers in most instances mimic the corridors along the riparian zones.

Through this process some small areas of low value vegetation can be removed with a plan to consolidate existing high value vegetation areas by infill regeneration and connection through wildlife and riparian corridor construction. This not only creates the connectivity to existing isolated patches of habitat but maintains and improves on this existing vegetation as a key objective under the CKPoM.

Table 7 shows the sum area of the environmental categories for the study area as displayed in Figure 11. All high value vegetation is retained with an additional 40 Ha of riparian vegetation proposed for rezoning to E3 as well as a further 35 Ha for off stream corridor and infill regeneration of Koala habitat.

Table 7: Environmental Constraints Totals

Label	Area Ha
Zone 2 - High conservation lands	166
Zone 3 - Drainage Revegetation Buffers	40
Zone 3 - Environmental rehabilitation and restoration	35

7 Recommendations

In the process of protecting and maintaining existing threatened species habitat, applying statutory requirements for riparian zones and incorporating the best available data on corridor definition a workable constraints layer has been produced (Figure 11).

A number of recommendations from this process are:

- Retain all high conservation habitats (zone 2 Figure 11) as E2 zone (previous 7a Environmental protection zone)
- Add riparian buffer areas to E 3 zone as a statutory component
- Add corridor linkages Zone 3 – Environmental rehabilitation and restoration to the E 3 zone under new LEP
- CHCC to confirm drainage line derivation particularly on fine scale 1st order streams that do not show bank definition with the Office of Water.
- CHCC to negotiate with the Roads and Maritime Service on design and construction methods for the Coffs Harbour Pacific Highway bypass to establish habitat offsets.
- Bypass across Newport's Creek floodplain should not constrict wildlife movement, preferably bridges not embankment style highway construction to allow ease of movement for wildlife under the proposed highway.

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Appendix A: Flora List: Current Survey

Family Name	Scientific name	Common Name	Exotic	TSC Status	EPBC Status
Acanthaceae	Pseuderanthemum variabile	Pastel Flower			
Adiantaceae	Adiantum hispidulum	Rough Maidenhair		P	
Adiantaceae	Cheilanthes sieberi	Rock Fern			
Apiaceae	Centella asiatica	Indian Pennywort			
Apiaceae	Hydrocotyle sibthorpioides				
Apocynaceae	Marsdenia rostrata	Milk Vine			
Apocynaceae	Parsonsia straminea	Common Silkpod			
Apocynaceae	Tabernaemontana pandacaqui	Banana Bush			
Araceae	Gymnostachys anceps	Settler's Twine			
Araliaceae	Polyscias elegans	Celery Wood			
Araliaceae	Polyscias sambucifolia	Elderberry Panax			
Arecaceae	Archontophoenix cunninghamiana	Bangalow Palm		P	
Asclepiadaceae	Marsdenia longiloba	Slender Marsdenia		E	V
Asteliaceae	Cordyline petiolaris	Broad-leaved Palm Lily			
Asteliaceae	Cordyline stricta	Narrow-leaved Palm Lily		P	
Asteraceae	Ageratina adenophora	Crofton Weed	*		
Asteraceae	Ageratina riparia	Mistflower	*		
Asteraceae	Ageratum houstonianum		*		
Asteraceae	Ambrosia artemisiifolia	Annual Ragweed	*		
Asteraceae	Baccharis halimifolia	Groundsel Bush	*		
Asteraceae	Bidens pilosa	Cobbler's Pegs	*		
Asteraceae	Cirsium vulgare	Spear Thistle	*		
Asteraceae	Conyza spp.	A Fleabane	*		
Asteraceae	Crassocephalum crepidioides	Thickhead	*		
Asteraceae	Hypochaeris radicata	Catsear	*		
Asteraceae	Ozothamnus diosmifolius	White Dogwood			
Asteraceae	Tagetes minuta	Stinking Roger	*		
Blechnaceae	Blechnum cartilagineum	Gristle Fern			
Blechnaceae	Blechnum indicum	Swamp Water Fern			
Blechnaceae	Doodia aspera	Prickly Rasp Fern			
Caprifoliaceae	Lonicera japonica	Japanese Honeysuckle	*		
Casuarinaceae	Allocasuarina littoralis	Black She-Oak			
Casuarinaceae	Allocasuarina torulosa	Forest Oak			
Celastraceae	Denhamia pittosporoides	Veiny Denhamia			
Commelinaceae	Commelina cyanea	Native Wandering Jew			

Family Name	Scientific name	Common Name	Exotic	TSC Status	EPBC Status
Convolvulaceae	Ipomoea indica	Morning Glory	*		
Cunoniaceae	Callicoma serratifolia	Black Wattle			
Cyatheaceae	Cyathea australis	Rough Treefern		P	
Cyperaceae	Baumea rubiginosa				
Cyperaceae	Bolboschoenus caldwellii				
Cyperaceae	Carex maculata				
Cyperaceae	Chorizandra sphaerocephala	Roundhead Bristle-sedge			
Cyperaceae	Cyperus eragrostis	Umbrella Sedge	*		
Cyperaceae	Cyperus filipes				
Cyperaceae	Cyperus polystachyos				
Cyperaceae	Eleocharis equisetina				
Cyperaceae	Gahnia aspera	Rough Saw-sedge			
Cyperaceae	Gahnia clarkei	Tall Saw-sedge			
Dennstaedtiaceae	Hypolepis muelleri	Harsh Ground Fern			
Dennstaedtiaceae	Pteridium esculentum	Bracken			
Dicksoniaceae	Calochlaena dubia	Rainbow Fern			
Dilleniaceae	Hibbertia aspera	Rough Guinea Flower			
Dilleniaceae	Hibbertia scandens	Climbing Guinea Flower			
Dilleniaceae	Hibbertia vestita				
Dioscoreaceae	Dioscorea transversa	Native Yam			
Dryopteridaceae	Lastreopsis decomposita	Trim Shield Fern			
Dryopteridaceae	Lastreopsis microsora	Creeping Shield Fern			
Ebenaceae	Diospyros fasciculosa	Grey Ebony			
Ebenaceae	Diospyros pentamera	Myrtle Ebony			
Elaeocarpaceae	Elaeocarpus reticulatus	Blueberry Ash			
Ericaceae	Trochocarpa laurina	Tree Heath			
Escalloniaceae	Cuttsia viburnea	Elderberry			
Euphorbiaceae	Claoxylon australe	Brittlewood			
Euphorbiaceae	Homalanthus populifolius				
Eupomatiaceae	Eupomatia laurina	Bolwarra			
Fabaceae (Caesalpinioideae)	Senna pendula var. glabrata		*		
Fabaceae (Faboideae)	Austrosteenisia blackii var. blackii	Blood Vine			
Fabaceae (Faboideae)	Desmodium gunnii	Slender Tick-trefoil			
Fabaceae (Faboideae)	Desmodium rhytidophyllum				
Fabaceae (Faboideae)	Glycine clandestina	Twining glycine			
Fabaceae (Faboideae)	Glycine microphylla	Small-leaf Glycine			
Fabaceae (Faboideae)	Hardenbergia violacea	False Sarsaparilla			
Fabaceae (Faboideae)	Indigofera australis	Australian Indigo			
Fabaceae (Faboideae)	Kennedia rubicunda	Dusky Coral Pea			

Family Name	Scientific name	Common Name	Exotic	TSC Status	EPBC Status
Fabaceae (Faboideae)	Pultenaea retusa				
Fabaceae (Mimosoideae)	Acacia floribunda	White Sally			
Fabaceae (Mimosoideae)	Acacia maidenii	Maiden's Wattle			
Fabaceae (Mimosoideae)	Acacia melanoxylon	Blackwood			
Juncaceae	Juncus polyanthemus				
Juncaceae	Juncus prismatocarpus				
Juncaceae	Juncus usitatus				
Lamiaceae	Clerodendrum floribundum				
Lauraceae	Beilschmiedia elliptica	Grey Walnut			
Lauraceae	Cinnamomum camphora	Camphor Laurel	*		
Lauraceae	Cinnamomum oliveri	Oliver's Sassafras			
Lauraceae	Cryptocarya glaucescens	Jackwood			
Lauraceae	Cryptocarya microneura	Murrogun			
Lauraceae	Cryptocarya rigida	Forest Maple			
Lauraceae	Cryptocarya triplinervis	Three-veined Cryptocarya			
Lauraceae	Endiandra muelleri	Green-leaved Rose Walnut			
Lauraceae	Endiandra sieberi	Hard Corkwood			
Lauraceae	Neolitsea dealbata	Hairy-leaved Bolly Gum			
Lindsaeaceae	Lindsaea microphylla	Lacy Wedge Fern			
Lobeliaceae	Isotoma armstrongii				
Lobeliaceae	Pratia purpurascens	Whiteroot			
Lomandraceae	Lomandra longifolia	Spiny-headed Mat-rush			
Luzuriagaceae	Eustrephus latifolius	Wombat Berry			
Luzuriagaceae	Geitonoplesium cymosum	Scrambling Lily			
Meliaceae	Synoum glandulosum	Scentless Rosewood			
Meliaceae	Toona ciliata	Red Cedar			
Menispermaceae	Stephania japonica	Snake vine			
Menispermaceae	Stephania japonica var. discolor	Snake Vine			
Menyanthaceae	Villarsia exaltata	Yellow Marsh Flower			
Monimiaceae	Doryphora sassafras	Sassafras			
Monimiaceae	Wilkiea huegeliana	Veiny Wilkiea			
Moraceae	Ficus coronata	Creek Sandpaper Fig			
Moraceae	Ficus macrophylla	Morton Bay Fig			
Myrsinaceae	Myrsine howittiana	Brush Muttonwood			
Myrtaceae	Acmena smithii	Lilly Pilly			
Myrtaceae	Angophora costata	Sydney Red Gum			
Myrtaceae	Archirhodomyrtus beckleri	Rose Myrtle			
Myrtaceae	Callistemon salignus	Willow Bottlebrush			
Myrtaceae	Corymbia intermedia	Pink Bloodwood			

Family Name	Scientific name	Common Name	Exotic	TSC Status	EPBC Status
Myrtaceae	Eucalyptus acmenoides	White Mahogany			
Myrtaceae	Eucalyptus carnea	Thick-leaved Mahogany			
Myrtaceae	Eucalyptus grandis	Flooded Gum			
Myrtaceae	Eucalyptus microcorys	Tallowwood			
Myrtaceae	Eucalyptus pilularis	Blackbutt			
Myrtaceae	Eucalyptus resinifera				
Myrtaceae	Eucalyptus robusta	Swamp Mahogany			
Myrtaceae	Eucalyptus saligna	Sydney Blue Gum			
Myrtaceae	Eucalyptus siderophloia	Grey Ironbark			
Myrtaceae	Eucalyptus umbra	Broad-leaved White Mahogany			
Myrtaceae	Leptospermum juniperinum	Prickly Tea-tree			
Myrtaceae	Lophostemon confertus	Brush Box			
Myrtaceae	Lophostemon suaveolens	Swamp Turpentine			
Myrtaceae	Melaleuca linariifolia	Flax-leaved Paperbark			
Myrtaceae	Melaleuca nodosa				
Myrtaceae	Melaleuca quinquenervia	Broad-leaved Paperbark			
Myrtaceae	Rhodamnia rubescens	Scrub Turpentine			
Myrtaceae	Syncarpia glomulifera	Turpentine			
Myrtaceae	Syzygium crebrinerve	Rose Satinash			
Myrtaceae	Syzygium luehmannii	Small-leaved Lilly Pilly			
Myrtaceae	Syzygium oleosum	Blue Lilly Pilly			
Myrtaceae	Tristaniopsis collina	Mountain Water Gum			
Myrtaceae	Tristaniopsis laurina	Water Gum			
Oleaceae	Ligustrum lucidum	Large-leaved Privet	*		
Oleaceae	Ligustrum sinense	Small-leaved Privet	*		
Oleaceae	Notelaea longifolia	Large Mock-olive			
Onagraceae	Ludwigia spp.		*		
Oxalidaceae	Oxalis spp.				
Passifloraceae	Passiflora subpeltata	White Passionflower	*		
Philydraceae	Philydrum lanuginosum	Frogsmouth			
Phormiaceae	Dianella caerulea	Blue Flax-lily			
Phyllanthaceae	Breynia oblongifolia	Coffee Bush			
Phyllanthaceae	Glochidion ferdinandi	Cheese Tree			
Phyllanthaceae	Phyllanthus gunnii				
Phyllanthaceae	Phyllanthus hirtellus	Thyme Spurge			
Pittosporaceae	Pittosporum multiflorum	Orange Thorn			
Pittosporaceae	Pittosporum revolutum	Rough Fruit Pittosporum			
Pittosporaceae	Pittosporum undulatum	Sweet Pittosporum			
Poaceae	Andropogon virginicus	Whisky Grass	*		

Family Name	Scientific name	Common Name	Exotic	TSC Status	EPBC Status
Poaceae	Axonopus fissifolius	Narrow-leafed Carpet Grass	*		
Poaceae	Capillipedium spicigerum	Scented-top Grass			
Poaceae	Chloris gayana	Rhodes Grass	*		
Poaceae	Cymbopogon refractus	Barbed Wire Grass			
Poaceae	Cynodon dactylon	Common Couch			
Poaceae	Dichelachne micrantha	Shorthair Plumegrass			
Poaceae	Digitaria parviflora	Small-flowered Finger Grass			
Poaceae	Entolasia stricta	Wiry Panic			
Poaceae	Eragrostis spp.	A Lovegrass	*		
Poaceae	Hemarthria uncinata	Matgrass			
Poaceae	Imperata cylindrica	Blady Grass			
Poaceae	Isachne globosa	Swamp Millet			
Poaceae	Ischaemum australe				
Poaceae	Melinis repens	Red Natal Grass	*		
Poaceae	Oplismenus aemulus				
Poaceae	Oplismenus imbecillis				
Poaceae	Ottochloa gracillima				
Poaceae	Panicum simile	Two-colour Panic			
Poaceae	Paspalidium distans				
Poaceae	Paspalum mandiocanum	Broadleaf Paspalum	*		
Poaceae	Paspalum urvillei	Vasey Grass	*		
Poaceae	Poa labillardierei	Tussock			
Poaceae	Poa sieberiana	Snowgrass			
Poaceae	Sacciolepis indica	Indian Cupscale Grass			
Poaceae	Setaria sphacelata	South African Pigeon Grass	*		
Poaceae	Sorghum halepense	Johnson Grass	*		
Poaceae	Sporobolus fertilis	Giant Parramatta Grass	*		
Poaceae	Themeda australis	Kangaroo Grass			
Polygonaceae	Persicaria lapathifolia	Pale Knotweed			
Polygonaceae	Persicaria strigosa				
Proteaceae	Persoonia media			P	
Proteaceae	Persoonia stradbrokensis			P	
Ranunculaceae	Ranunculus inundatus	River Buttercup			
Ripogonaceae	Ripogonum fawcettianum	Small Supplejack			
Rosaceae	Rubus parvifolius	Native Raspberry			
Rubiaceae	Morinda jasminoides	Sweet Morinda			
Rutaceae	Acronychia oblongifolia	White Aspen			
Rutaceae	Citrus x taitensis	Rough Lemon	*		
Rutaceae	Melicope elleryana	Pink-flowered Doughwood			

Family Name	Scientific name	Common Name	Exotic	TSC Status	EPBC Status
Sapindaceae	Guioa semiglauca	Guioa			
Sapindaceae	Jagera pseudorhus var. pseudorhus	Foambark Tree			
Sapotaceae	Niemeyera whitei	Rusty Plum, Plum Boxwood		V,P	
Smilacaceae	Smilax australis	Lawyer Vine			
Smilacaceae	Smilax glyciphylla	Sweet Sarsparilla			
Solanaceae	Solanum capsicoides	Devil's Apple	*		
Solanaceae	Solanum mauritianum	Wild Tobacco Bush	*		
Thelypteridaceae	Christella dentata	Binung			
Thymelaeaceae	Wikstroemia indica				
Typhaceae	Typha spp.		*		
Uvulariaceae	Tripladenia cunninghamii				
Verbenaceae	Lantana camara	Lantana	*		
Verbenaceae	Verbena bonariensis	Purpletop	*		
Violaceae	Viola banksii				
Vitaceae	Cissus hypoglauca	Giant Water Vine			
Zamiaceae	Lepidozamia peroffskyana			P	
Zingiberaceae	Alpinia caerulea	Native Ginger			

Appendix B Fauna List: Current Survey

Avifauna				
Common Name	**Scientific Name**	**Exotic**	**TSC Status**	**EPBC Status**
Australasian Grebe	*Tachybaptus novaehollandiae*			
Australian Brush-turkey	*Alectura lathami*			
Australian King-Parrot	*Alisterus scapularis*			
Australian Magpie	*Gymnorhina tibicen*			
Australian White Ibis	*Threskiornis molucca*			
Australian Wood Duck	*Chenonetta jubata*			
Azure Kingfisher	*Ceyx azureus*			
Barn Owl	*Tyto alba*			
Bar-shouldered Dove	*Geopelia humeralis*			
Black Bittern	***Ixobrychus flavicollis***		***V***	**-**
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*			
Black-shouldered Kite	*Elanus axillaris*			
Blue-faced Honeyeater	*Entomyzon cyanotis*			
Brown Cuckoo-Dove	*Macropygia phasianella*			
Brown Goshawk	*Accipiter fasciatus*			
Brown Quail	*Coturnix ypsilophora*			
Brown Thornbill	*Acanthiza pusilla*			
Buff-banded Rail	*Gallirallus philippensis*			
Cattle Egret	*Bubulcus ibis*			
Crested Pigeon	*Ocyphaps lophotes*			
Dusky Moorhen	*Gallinula tenebrosa*			
Eastern Rosella	*Platycercus eximius*			
Eastern Spinebill	*Acanthorhynchus tenuirostris*			
Eastern Whipbird	*Psophodes olivaceus*			
Eastern Yellow Robin	*Eopsaltria australis*			
Eurasian Coot	*Fulica atra*			
Fan-tailed Cuckoo	*Cacomantis flabelliformis*			

Avifauna				
Common Name	**Scientific Name**	**Exotic**	**TSC Status**	**EPBC Status**
Galah	*Eolophus roseicapilla*			
Golden-headed Cisticola	*Cisticola exilis*			
Golden Whistler	*Pachycephala pectoralis*			
Green Catbird	*Ailuroedus crassirostris*			
Grey Butcherbird	*Cracticus torquatus*			
Grey Fantail	*Rhipidura albiscapa*			
Grey Shrike-thrush	*Colluricincla harmonica*			
Grey Teal	*Anas gracilis*			
Hardhead	*Aythya australis*			
Common Myna	*Sturnus tristis*	*		
Intermediate Egret	*Mesophoyx intermedia*			
Laughing Kookaburra	*Dacelo novaeguineae*			
Lewin's Honeyeater	*Meliphaga lewinii*			
Little Black Cormorant	*Phalacrocorax sulcirostris*			
Little Pied Cormorant	*Phalacrocorax melanoleucos*			
Little Wattlebird	*Anthochaera chrysoptera*			
Magpie-lark	*Grallina cyanoleuca*			
Masked Lapwing	*Vanellus miles*			
Nankeen Kestrel	*Falco cenchroides*			
Noisy Miner	*Manorina melanocephala*			
Noisy Pitta	*Pitta versicolor*			
Pacific Baza	*Aviceda subcristata*			
Pacific Black Duck	*Anas superciliosa*			
Pied Butcherbird	*Cracticus nigrogularis*			
Purple Swamphen	*Porphyrio porphyrio*			
Rainbow Lorikeet	*Trichoglossus haematodus*			
Red-browed Finch	*Neochmia temporalis*			
Royal Spoonbill	*Platalea regia*			
Russet-tailed Thrush	*Zoothera heinei*			
Satin Bowerbird	*Ptilonorhynchus violaceus*			
Spotted Dove	*Streptopelia chinensis*	*		

Avifauna				
Common Name	**Scientific Name**	**Exotic**	**TSC Status**	**EPBC Status**
Spotted Harrier	***Circus assimilis***		***V***	***-***
Square-tailed Kite	***Lophoictinia isura***		***V***	***-***
Straw-necked Ibis	*Threskiornis spinicollis*			
Sulphur-crested Cockatoo	*Cacatua galerita*			
Superb Fairy-wren	*Malurus cyaneus*			
Tawny Frogmouth	*Podargus strigoides*			
Tawny Grassbird	*Megalurus timoriensis*			
Torresian Crow	*Corvus orru*			
Varied Triller	*Lalage leucomela*			
Wedge-tailed Eagle	*Aquila audax*			
Welcome Swallow	*Hirundo neoxena*			
White-faced Heron	*Egretta novaehollandiae*			
White-necked Heron	*Ardea pacifica*			
White-throated Gerygone	*Gerygone olivacea*			
Willie Wagtail	*Rhipidura leucophrys*			
Wonga Pigeon	*Leucosarcia melanoleuca*			
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*			
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*			
Mammalia				
Common Name	**Scientific Name**			
Common Brush-tailed Possum	*Trichosurus vulpecula*			
Dingo	*Canis lupis*			
Domestic Cat	*Felis catus*	*		
East coast freetail-bat	***Mormopterus norfolkensis***		***V***	***-***
Eastern Bentwing-bat	***Miniopterus schreibersii oceanensis***		***V***	***-***
Eastern forest bat	*Vespadelus pumilus*			
Eastern freetail bat	*Mormopterus sp2*			
Eastern Horseshoe Bat	*Rhinolophus megaphyllus*			
Gould's wattled bat	*Chalinolobus gouldii*			
Koala	***Phascolarctos cinereus***		***V***	***V***

Avifauna				
Common Name	**Scientific Name**	**Exotic**	**TSC Status**	**EPBC Status**
Large-footed Myotis	***Myotis macropus***		***V***	**-**
Little Bentwing-bat	***Miniopterus australis***		***V***	**-**
Long-eared bat	*Nyctophilus sp*			
Long-nosed Bandicoot	*Perameles nasuta*			
Red-necked Wallaby	*Macropus rufogriseus*			
Short-beaked Echidna	*Tachyglossus aculeatus*			
Sugar Glider (heard - Pete only)	*Petaurus breviceps*			
Swamp Wallaby	*Wallabia bicolor*			
White-striped Freetail Bat	*Tadarida australis*			
Amphibia				
Common Name	**Scientific Name**			
Eastern Dwarf Tree Frog	*Litoria fallax*			
Graceful Tree Frog	*Litoria gracilenta*			
Stripped-marsh Frog	*Limnodynastes peronii*			
Tusk Frog	*Adelotus brevis*			
Reptilia				
Common Name	**Scientific Name**			
Eastern long-necked Turtle	*Chelodina longicollis*			
Delicate Skink	*Lampropholis delicata*			
Red-bellied Blake Snake	*Pseudechis porphyriacus*			

Appendix C Threatened Species - Likelihood of Occurrence

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Animalia	Amphibia	Myobatrachidae	*Assa darlingtoni*	Pouched Frog	V,P		Potential
Animalia	Amphibia	Myobatrachidae	*Crinia tinnula*	Wallum Froglet	V,P		Potential
Animalia	Amphibia	Myobatrachidae	*Mixophyes balbus*	Stuttering Frog	E1,P,2	V	No
Animalia	Amphibia	Myobatrachidae	*Mixophyes iteratus*	Giant Barred Frog	E1,P,2	E	Potential
Animalia	Amphibia	Myobatrachidae	*Philoria sphagnicolus*	Sphagnum Frog	V,P		No
Animalia	Amphibia	Hylidae	*Litoria aurea*	Green and Golden Bell Frog	E1,P	V	Potential
Animalia	Amphibia	Hylidae	*Litoria booroolongensis*	Booroolong Frog	E1,P	E	No
Animalia	Amphibia	Hylidae	*Litoria brevipalmata*	Green-thighed Frog	V,P		Potential
Animalia	Amphibia	Hylidae	*Litoria olongburensis*	Olongburra Frog	V,P	V	No
Animalia	Amphibia	Hylidae	*Litoria subglandulosa*	Glandular Frog	V,P		No

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Animalia	Reptilia	Elapidae	*Cacophis harriettae*	White-crowned Snake	V,P		Potential
Animalia	Reptilia	Elapidae	*Hoplocephalus bitorquatus*	Pale-headed Snake	V,P		Potential
Animalia	**Reptilia**	**Elapidae**	***Hoplocephalus stephensii***	**Stephens' Banded Snake**	**V,P**		**Likely**
Animalia	Aves	Casuariidae	*Dromaius novaehollandiae*	Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area	E2,P		No
Animalia	Aves	Anatidae	*Oxyura australis*	Blue-billed Duck	V,P		Potential
Animalia	Aves	Anatidae	*Stictonetta naevosa*	Freckled Duck	V,P		No
Animalia	**Aves**	**Columbidae**	***Ptilinopus magnificus***	**Wompoo Fruit-Dove**	**V,P**		**Likely**
Animalia	**Aves**	**Columbidae**	***Ptilinopus regina***	**Rose-crowned Fruit-Dove**	**V,P**		**Likely**
Animalia	**Aves**	**Columbidae**	***Ptilinopus superbus***	**Superb Fruit-Dove**	**V,P**		**Likely**
Animalia	Aves	Ciconiidae	*Ephippiorhynchus asiaticus*	Black-necked Stork	E1,P		Potential
Animalia	Aves	Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern	E1,P	E	No

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Animalia	**Aves**	**Ardeidae**	***Ixobrychus flavicollis***	**Black Bittern**	**V,P**		**Yes**
Animalia	**Aves**	**Accipitridae**	***Circus assimilis***	**Spotted Harrier**	**V,P**		**Yes**
Animalia	Aves	Accipitridae	*Erythrotriorchis radiatus*	Red Goshawk	E4A,P,2	V	No
Animalia	Aves	Accipitridae	*Hieraaetus morphnoides*	Little Eagle	V,P		Potential
Animalia	**Aves**	**Accipitridae**	***Lophoictinia isura***	**Square-tailed Kite**	**V,P,3**		**Yes**
Animalia	Aves	Accipitridae	*Pandion cristatus*	Eastern Osprey	V,P		Potential
Animalia	Aves	Gruidae	*Grus rubicunda*	Brolga	V,P		No
Animalia	Aves	Rallidae	*Amaurornis moluccana*	Pale-vented Bush-hen	V,P		Potential
Animalia	Aves	Burhinidae	*Burhinus grallarius*	Bush Stone-curlew	E1,P		No
Animalia	Aves	Burhinidae	*Esacus magnirostris*	Beach Stone-curlew	E4A,P		No
Animalia	Aves	Haematopodidae	*Haematopus fuliginosus*	Sooty Oystercatcher	V,P		No
Animalia	Aves	Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher	E1,P		No
Animalia	Aves	Charadriidae	*Charadrius leschenaultii*	Greater Sand-plover	V,P	C,J,K	No
Animalia	Aves	Charadriidae	*Charadrius mongolus*	Lesser Sand-plover	V,P	C,J,K	No

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Animalia	Aves	Jacanidae	*Irediparra gallinacea*	Comb-crested Jacana	V,P		Potential
Animalia	Aves	Rostratulidae	*Rostratula australis*	Australian Painted Snipe	E1,P	V	Potential
Animalia	Aves	Scolopacidae	*Calidris alba*	Sanderling	V,P	C,J,K	No
Animalia	Aves	Scolopacidae	*Calidris tenuirostris*	Great Knot	V,P	C,J,K	No
Animalia	Aves	Scolopacidae	*Limicola falcinellus*	Broad-billed Sandpiper	V,P	C,J,K	No
Animalia	Aves	Scolopacidae	*Limosa limosa*	Black-tailed Godwit	V,P	C,J,K	No
Animalia	Aves	Scolopacidae	*Xenus cinereus*	Terek Sandpiper	V,P	C,J,K	No
Animalia	Aves	Laridae	*Gygis alba*	White Tern	V,P		No
Animalia	Aves	Laridae	*Onychoprion fuscata*	Sooty Tern	V,P		No
Animalia	Aves	Laridae	*Procelsterna cerulea*	Grey Ternlet	V,P		No
Animalia	Aves	Laridae	*Sternula albifrons*	Little Tern	E1,P	C,J,K	No
Animalia	**Aves**	**Cacatuidae**	***Calyptorhynchus lathami***	**Glossy Black-Cockatoo**	**V,P,2**		**Likely**
Animalia	**Aves**	**Psittacidae**	***Glossopsitta pusilla***	**Little Lorikeet**	**V,P**		**Likely**

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Animalia	Aves	Psittacidae	*Lathamus discolor*	Swift Parrot	E1,P,3	E	Potential
Animalia	Aves	Strigidae	*Ninox connivens*	Barking Owl	V,P,3		Potential
Animalia	**Aves**	**Strigidae**	***Ninox strenua***	**Powerful Owl**	**V,P,3**		**Likely**
Animalia	Aves	Tytonidae	*Tyto longimembris*	Eastern Grass Owl	V,P		Potential
Animalia	Aves	Tytonidae	*Tyto novaehollandiae*	Masked Owl	V,P,3		Potential
Animalia	Aves	Tytonidae	*Tyto tenebricosa*	Sooty Owl	V,P,3		Potential
Animalia	Aves	Atrichornithidae	*Atrichornis rufescens*	Rufous Scrub-bird	V,P		No
Animalia	Aves	Climacteridae	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	V,P		No
Animalia	Aves	Meliphagidae	*Anthochaera phrygia*	Regent Honeyeater	E4A,P	E	Potential
Animalia	Aves	Meliphagidae	*Lichenostomus fasciogularis*	Mangrove Honeyeater	V,P		No
Animalia	Aves	Pomatostomidae	*Pomatostomus temporalis temporalis*	Grey-crowned Babbler (eastern subspecies)	V,P		No
Animalia	**Aves**	**Neosittidae**	***Daphoenositta chrysoptera***	**Varied Sittella**	**V,P**		**Likely**
Animalia	Aves	Campephagidae	*Coracina lineata*	Barred Cuckoo-shrike	V,P		Potential

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Animalia	Aves	Pachycephalidae	*Pachycephala olivacea*	Olive Whistler	V,P		No
Animalia	Aves	Monarchidae	*Carterornis leucotis*	White-eared Monarch	V,P		Potential
Animalia	Aves	Petroicidae	*Petroica boodang*	Scarlet Robin	V,P		No
Animalia	Aves	Petroicidae	*Petroica phoenicea*	Flame Robin	V,P		No
Animalia	Aves	Estrildidae	*Stagonopleura guttata*	Diamond Firetail	V,P		No
Animalia	Mammalia	Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	V,P	E	Potential
Animalia	Mammalia	Dasyuridae	*Phascogale tapoatafa*	Brush-tailed Phascogale	V,P		Potential
Animalia	Mammalia	Dasyuridae	*Planigale maculata*	Common Planigale	V,P		No
Animalia	**Mammalia**	**Phascolarctidae**	***Phascolarctos cinereus***	**Koala**	**V,P**	**V**	**Yes**
Animalia	Mammalia	Burramyidae	*Cercartetus nanus*	Eastern Pygmy-possum	V,P		No
Animalia	Mammalia	Petauridae	*Petaurus australis*	Yellow-bellied Glider	V,P		Unlikely
Animalia	Mammalia	Petauridae	*Petaurus norfolcensis*	Squirrel Glider	V,P		Unlikely
Animalia	Mammalia	Potoroidae	*Aepyprymnus rufescens*	Rufus Bettong	V,P		Unlikely
Animalia	Mammalia	Potoroidae	*Potorous tridactylus*	Long-nosed Potoroo	V,P	V	Potential

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Animalia	Mammalia	Macropodidae	*Macropus parma*	Parma Wallaby	V,P		Unlikely
Animalia	Mammalia	Macropodidae	*Petrogale penicillata*	Brush-tailed Rock-wallaby	E1,P	V	No
Animalia	Mammalia	Macropodidae	*Thylogale stigmatica*	Red-legged Pademelon	V,P		Potential
Animalia	**Mammalia**	**Pteropodidae**	***Pteropus poliocephalus***	**Grey-headed Flying-fox**	**V,P**	**V**	**Likely**
Animalia	Mammalia	Pteropodidae	*Syconycteris australis*	Common Blossom-bat	V,P		Unlikely
Animalia	**Mammalia**	**Emballonuridae**	***Saccolaimus flaviventris***	**Yellow-bellied Sheathtail-bat**	**V,P**		**Likely**
Animalia	**Mammalia**	**Molossidae**	***Mormopterus norfolkensis***	**Eastern Freetail-bat**	**V,P**		**Yes**
Animalia	Mammalia	Vespertilionidae	*Chalinolobus dwyeri*	Large-eared Pied Bat	V,P	V	Potential
Animalia	Mammalia	Vespertilionidae	*Chalinolobus nigrogriseus*	Hoary Wattled Bat	V,P		Potential
Animalia	**Mammalia**	**Vespertilionidae**	***Falsistrellus tasmaniensis***	**Eastern False Pipistrelle**	**V,P**		**Likely**
Animalia	Mammalia	Vespertilionidae	*Kerivoula papuensis*	Golden-tipped Bat	V,P		Potential
Animalia	**Mammalia**	**Vespertilionidae**	***Miniopterus australis***	**Little Bentwing-bat**	**V,P**		**Yes**

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Animalia	**Mammalia**	**Vespertilionidae**	***Miniopterus schreibersii oceanensis***	**Eastern Bentwing-bat**	**V,P**		**Yes**
Animalia	**Mammalia**	**Vespertilionidae**	***Myotis macropus***	**Southern Myotis**	**V,P**		**Yes**
Animalia	Mammalia	Vespertilionidae	*Nyctophilus bifax*	Eastern Long-eared Bat	V,P		Potential
Animalia	Mammalia	Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V,P		Potential
Animalia	Mammalia	Vespertilionidae	*Vespadelus troughtoni*	Eastern Cave Bat	V,P		Potential
Animalia	Mammalia	Muridae	*Pseudomys gracilicaudatus*	Eastern Chestnut Mouse	V,P		Potential
Animalia	Mammalia	Muridae	*Pseudomys oralis*	Hastings River Mouse	E1,P	E	Potential
Animalia	Insecta	Hesperiidae	*Ocybadistes knightorum*	Black Grass-dart Butterfly	E1		No
Animalia	Insecta	Noctuidae	*Phyllodes imperialis southern subspecies*	Pink Underwing Moth	E1	E	Potential
Animalia	Insecta	Nymphalidae	*Argyreus hyperbius*	Laced Fritillary or Australian Fritillary	E1		Potential
Plantae	Flora	Apiaceae	*Gingidia montana*	Mountain Angelica	E1,P,3	E	No
Plantae	Flora	Apocynaceae	*Cynanchum elegans*	White-flowered Wax Plant	E1,P	E	Potential

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Plantae	**Flora**	**Apocynaceae**	***Marsdenia longiloba***	**Slender Marsdenia**	**E1,P**	**V**	**Yes**
Plantae	Flora	Apocynaceae	*Parsonsia dorrigoensis*	Milky Silkpod	V,P	E	Potential
Plantae	Flora	Apocynaceae	*Tylophora woollsii*	Cryptic Forest Twiner	E1,P	E	Potential
Plantae	Flora	Araceae	*Typhonium sp. aff. brownii*	Stinky Lily	E1,P,3		Potential
Plantae	Flora	Asteliaceae	*Neoastelia spectabilis*	Silver Sword Lily	V,P	V	No
Plantae	Flora	Casuarinaceae	*Allocasuarina defungens*	Dwarf Heath Casuarina	E1,P	E	No
Plantae	Flora	Corynocarpaceae	*Corynocarpus rupestris subsp. rupestris*	Glenugie Karaka	V,P	V	Potential
Plantae	Flora	Cyperaceae	*Eleocharis tetraquetra*	Square-stemmed Spike-rush	E1,P		Potential
Plantae	Flora	Euphorbiaceae	*Chamaesyce psammogeton*	Sand Spurge	E1,P		No
Plantae	**Flora**	**Fabaceae (Caesalpinioideae)**	***Senna acclinis***	**Rainforest Cassia**	**E1,P**		**Likely**
Plantae	Flora	Fabaceae (Faboideae)	*Pultenaea maritima*	Coast Headland Pea	V,P		No
Plantae	Flora	Fabaceae (Faboideae)	*Sophora tomentosa*	Silverbush	E1,P		No

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Plantae	Flora	Fabaceae (Mimosoideae)	*Acacia chrysotricha*	Newry Golden Wattle	E1,P		No
Plantae	Flora	Haloragaceae	*Haloragis exalata subsp. velutina*	Tall Velvet Sea-berry	V,P	V	No
Plantae	**Flora**	**Lindsaeaceae**	***Lindsaea incisa***	**Slender Screw Fern**	**E1,P,3**		**Likely**
Plantae	Flora	Menispermaceae	*Tinospora smilacina*	Tinospora Vine	E1,P		Potential
Plantae	Flora	Myrtaceae	*Kardomia silvestris*		E1,P		No
Plantae	Flora	Orchidaceae	*Dendrobium melaleucaphilum*	Spider orchid	E1,P,2		Potential
Plantae	Flora	Orchidaceae	*Diuris venosa*	Veined Doubletail	V,P,2	V	No
Plantae	Flora	Orchidaceae	*Oberonia complanata*	Yellow-flowered King of the Fairies	E1,P,2		No
Plantae	Flora	Orchidaceae	*Oberonia titania*	Red-flowered King of the Fairies	V,P,2		No
Plantae	Flora	Orchidaceae	*Peristeranthus hillii*	Brown Fairy-chain Orchid	V,P,2		No
Plantae	Flora	Orchidaceae	*Phaius australis*	Southern Swamp Orchid	E1,P,2	E	Potential
Plantae	Flora	Orchidaceae	*Phaius tancarvilleae*	Lady Tankerville's Swamp Orchid	E1,P,2	E	No

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Plantae	Flora	Orchidaceae	*Sarcochilus fitzgeraldii*	Ravine Orchid	V,P,2	V	No
Plantae	Flora	Poaceae	*Alexfloydia repens*	Floyd's Grass	E1,P		No
Plantae	Flora	Poaceae	*Arthraxon hispidus*	Hairy Jointgrass	V,P	V	Potential
Plantae	Flora	Proteaceae	*Hicksbeachia pinnatifolia*	Red Boppel Nut	V,P	V	No
Plantae	Flora	Proteaceae	*Macadamia tetraphylla*	Rough-shelled Bush Nut	V,P	V	No
Plantae	Flora	Rhamnaceae	*Pomaderris queenslandica*	Scant Pomaderris	E1,P		Potential
Plantae	Flora	Rubiaceae	*Asperula asthenes*	Trailing Woodruff	V,P	V	No
Plantae	Flora	Rutaceae	*Acronychia littoralis*	Scented Acronychia	E1,P	E	No
Plantae	Flora	Rutaceae	*Boronia umbellata*	Orara Boronia	V,P	V	No
Plantae	Flora	Rutaceae	*Zieria prostrata*	Headland Zieria	E1,P	E	No
Plantae	Flora	Santalaceae	*Thesium australe*	Austral Toadflax	V,P	V	No
Plantae	**Flora**	**Sapotaceae**	***Niemeyera whitei***	**Rusty Plum, Plum Boxwood**	**V,P**		**Yes**
Plantae	Flora	Simaroubaceae	*Quassia sp. Mooney Creek*	Moonee Quassia	E1,P	E	No

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Plantae	Flora	Winteraceae	*Tasmannia glaucifolia*	Fragrant Pepperbush	V,P	V	No
Community			*Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3		No
Community			*Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3		No
Community			*Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3	CE	No
Community			*Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions*	Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions	E3	CE	No

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Community			*Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion*	Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion	E3	CE	No
Community			*Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions*	Montane Peatlands and Swamps of the New England Tableland, NSW North Coast, Sydney Basin, South East Corner, South Eastern Highlands and Australian Alps bioregions	E3	E	No
Community			*Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion*	Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion	E3		No
Community			*Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions*	Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	E3		No

Kingdom	Class	Family	Scientific Name	Common Name	NSW TSC Status	EPBC Status	Likelihood of Occurrence
Community			***Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions***	**Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions**	**E3**		**Yes**
Community			*Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions*	Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions	E3		No
Community			*White Box Yellow Box Blakely's Red Gum Woodland*	White Box Yellow Box Blakely's Red Gum Woodland	E3	CE	No
Community			*White Gum Moist Forest in the NSW North Coast Bioregion*	White Gum Moist Forest in the NSW North Coast Bioregion	E3		No

Appendix D - EPBC Migratory Species

Migratory Terrestrial Species		
Scientific Name	**Common Name**	**EPBC status**
Haliaeetus leucogaster	White-bellied Sea-Eagle	-
Hirundapus caudacutus	White-throated Needletail	-
Merops ornatus	Rainbow Bee-eater	-
Monarcha melanopsis	Black-faced Monarch	-
Myiagra cyanoleuca	Satin Flycatcher	-
Rhipidura rufifrons	Rufus Fantail	-
Xanthomyza phrygia	Regent Honeyeater	E
Migratory Wetlands Species		
Ardea alba	Great Egret, White Egret	-
Ardea ibis	Cattle Egret	-
Gallinago hardwickii	Latham's Snipe, Japanese Snipe	-
Rostratula benghalensis (sensu lato)	Painted Snipe	V
EPBC Status: V = Vulnerable, E = Endangered		

Appendix E - Microbat Anabat Results

Anabat Results – North Boambee Valley, 6 Anabat nights and several hand-held sessions 19, 20 June and 27 July 2012.

Bat calls were analysed using the program AnalookW (Version 3.7w 31 December 2009, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al. 2004); and south-east Queensland and north-east New South Wales (Reinhold et al. 2001) and the accompanying reference library of over 200 calls from north-eastern NSW (http://www.forest.nsw.gov.au/research/bats/default.asp).

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

1. Recordings containing less than three pulses were not analysed (Law et al. 1999) and are labeled as short.
2.

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

3. Four categories of confidence in species identification were used (Mills et al. 1996):
   a. definite – identity not in doubt
   b. probable – low probability of confusion with species of similar calls
   c. possible – medium to high probability of confusion with species with similar calls; and
   d. unidentifiable – calls made by bats which cannot be identified to even a species group.

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

5. Calls not attributed to microbat echolocation calls are labeled as junk or non-bat calls and don't represent microbat activity at the site. Calls labeled as low are of poor quality and therefore not able to be identified to any microbat species, they can however be used as an indicator of microbat activity at a site.

Anabat results for the June survey effort showed relatively low numbers but as expected for a winter time survey. However the July survey effort contained much greater microbat activity particularly site 6 which was located over a large dam. The July survey night was quite warm with thunderstorms within the locality indicating unseasonably milder conditions.

Overall from all sites including hand held data collection, 8 species were identified including **4 vulnerable** species listed under the NSW TSC Act 1987. They were **Eastern bentwing (*Miniopterus schreibersii oceanensis),* East coast *freetail (Mormopterus norfolkensis*), Little Bentwing (*Miniopterus australis) and* Large-footed Myotis (*Myotis macropus)*.

The most common species were the two threatened East coast *freetail (Mormopterus norfolkensis*), Little Bentwing (*Miniopterus australis) and the common* Eastern Forest Bat *(Vespadelus pumilus)* which were found at the majority of sites.

Table 1: June Survey effort Sites 1, 2, & 3.

Anabat	Sites	Night	Label	Number	Definite	Probable	Possible
AA	1	19/06/2012	*Nyctophilus sp*	4	4	0	0
AA		19/06/2012	*Rhinolophus megaphyllus*	4	4	0	0
AA		19/06/2012	*Miniopterus australis*	4	4	0	0
AA		19/06/2012	*Vespadelus pumulus*	15	12	2	1
AA		20/06/2012	*Miniopterus australis*	24	24	0	0
AA		20/06/2012	*Myotis macropus / Nyctophilus sp*	1	1	0	0
AA		20/06/2012	*Vespadelus pumulus*	8	6	0	2
BB	2	19/06/2012	*Miniopterus australis*	53	45	0	0
BB		19/06/2012	*Myotis macropus*	9	6	0	2
BB		19/06/2012	*Nyctophilus sp*	2	1	0	0
BB		19/06/2012	*Vespadelus pumulus*	6	1	0	0
BB		20/06/2012	*Miniopterus australis*	7	3	0	2
BB		20/06/2012	*Vespadelus pumulus*	2	2	0	0
CC	3	20/06/2012	*Miniopterus australis*	75	75	0	0
CC		20/06/2012	*Vespadelus pumulus*	51	51	0	0
Handheld		20/06/2012	*Miniopterus australis*	97	97	0	0
Handheld		20/06/2012	*Miniopterus schreibersii oceanensis*	1	0	0	1
Handheld		20/06/2012	*Nyctophilus sp*	3	3	0	0

Table 2: July Survey Effort Sites 4, 5, & 6.

Folder1	Sites	Night	Label	Number	Definite	Probable	Possible
AA	4	26/07/2012	*Miniopterus australis*	12	12	0	0
AA		26/07/2012	*Rhinolophus megaphyllus*	20	20	0	0
AA		26/07/2012	*Vespadelus pumulus*	8	8	0	0
AA		26/07/2012	*short*	6			
BB	5	26/07/2012	*Miniopterus australis*	23	23	0	0
BB		26/07/2012	*Rhinolophus megaphyllus*	20	20	0	0
BB		26/07/2012	*Vespadelus pumulus*	61	61	0	0
BB		26/07/2012	*low*	6			
BB		26/07/2012	*short*	41			
CC	6	26/07/2012	*Chalinolobus gouldii*	14	14	0	0
CC		26/07/2012	*Miniopterus australis*	441	441	0	0
CC		26/07/2012	*Miniopterus schreibersii oceanensis*	74	72	0	2
CC		26/07/2012	*Mormopterus norfolkensis*	403	402	1	0
CC		26/07/2012	*Mormopterus sp2*	1	1	0	0
CC		26/07/2012	*Myotis macropus / Nyctophilus sp*	1	1	0	0
CC		26/07/2012	*Vespadelus pumulus*	133	113	0	20
CC		26/07/2012	*low*	15			
CC		26/07/2012	*short*	180			
Handheld		26/07/2012	*Miniopterus schreibersii oceanensis*	1	1	0	1
Handheld		26/07/2012	*Miniopterus australis*	22	22	0	0
Handheld		26/07/2012	*Vespadelus pumulus*	25	25	0	0

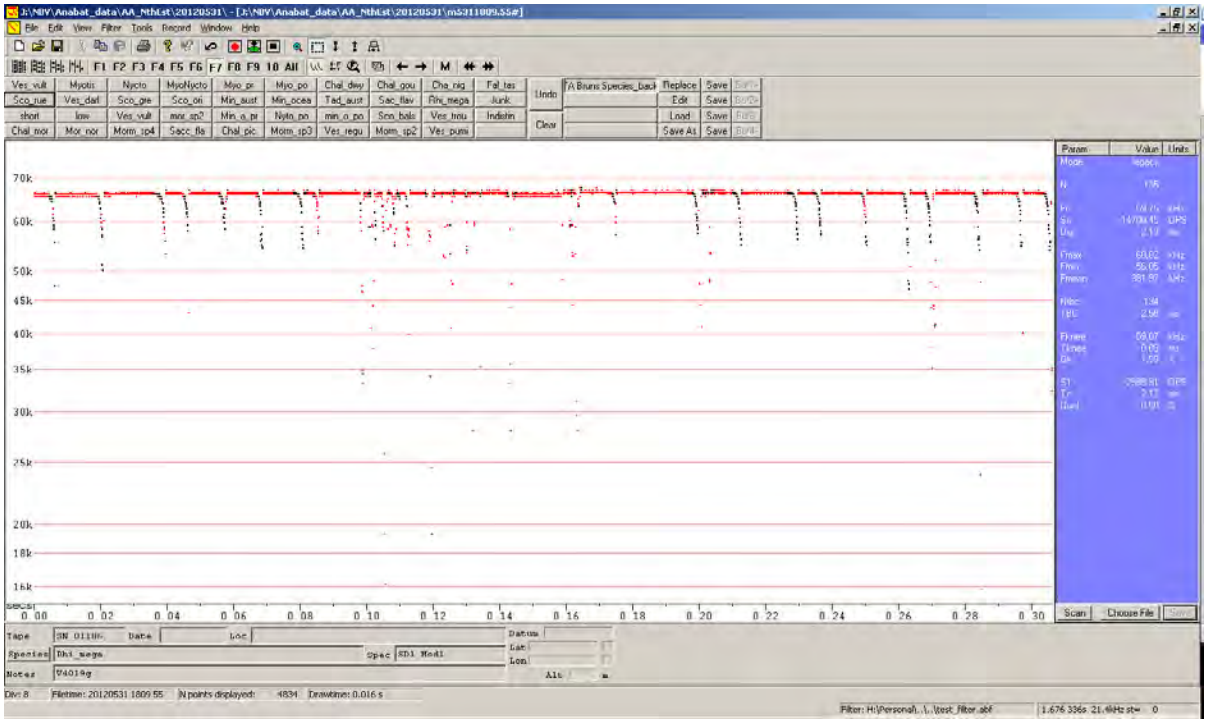

Figure 1: Call profile for *Rhinolophus megaphyllus* recorded in NBVw at 18:09 on 19 June 2012.

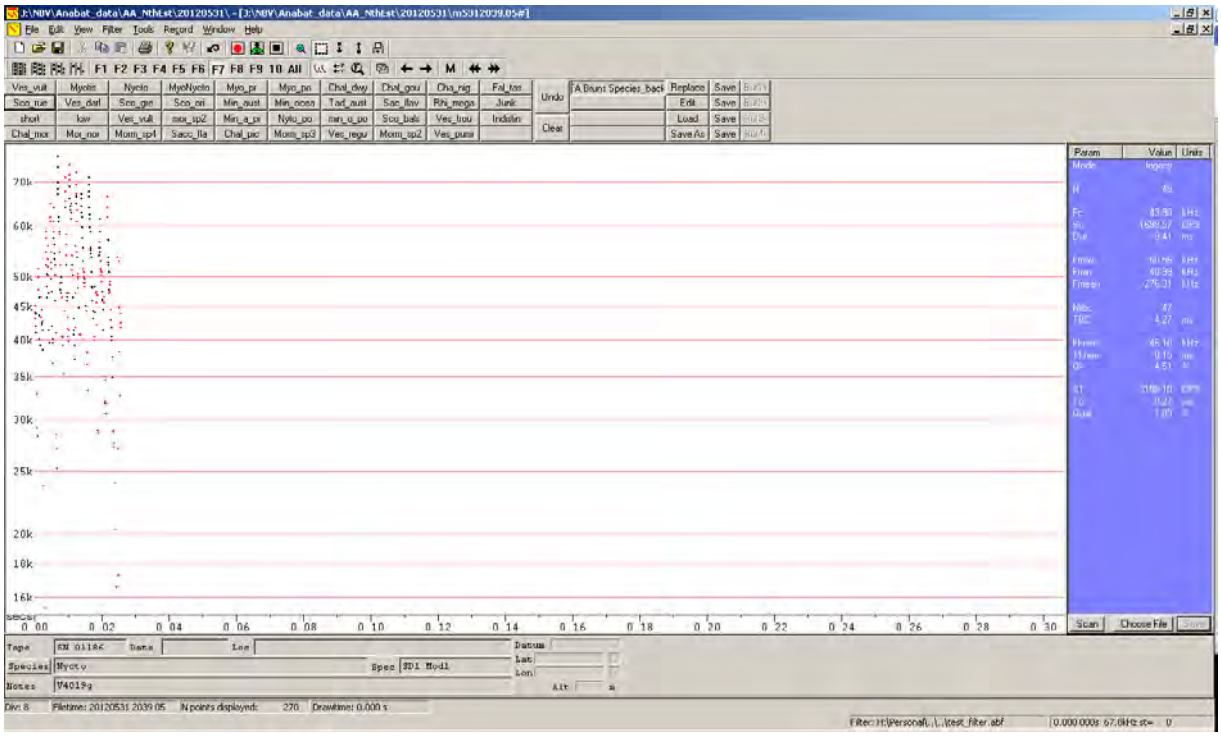

Figure 2: Call profile for *Nyctophilus* species recorded within the NBVw at 20:39 on 19 June 2012.

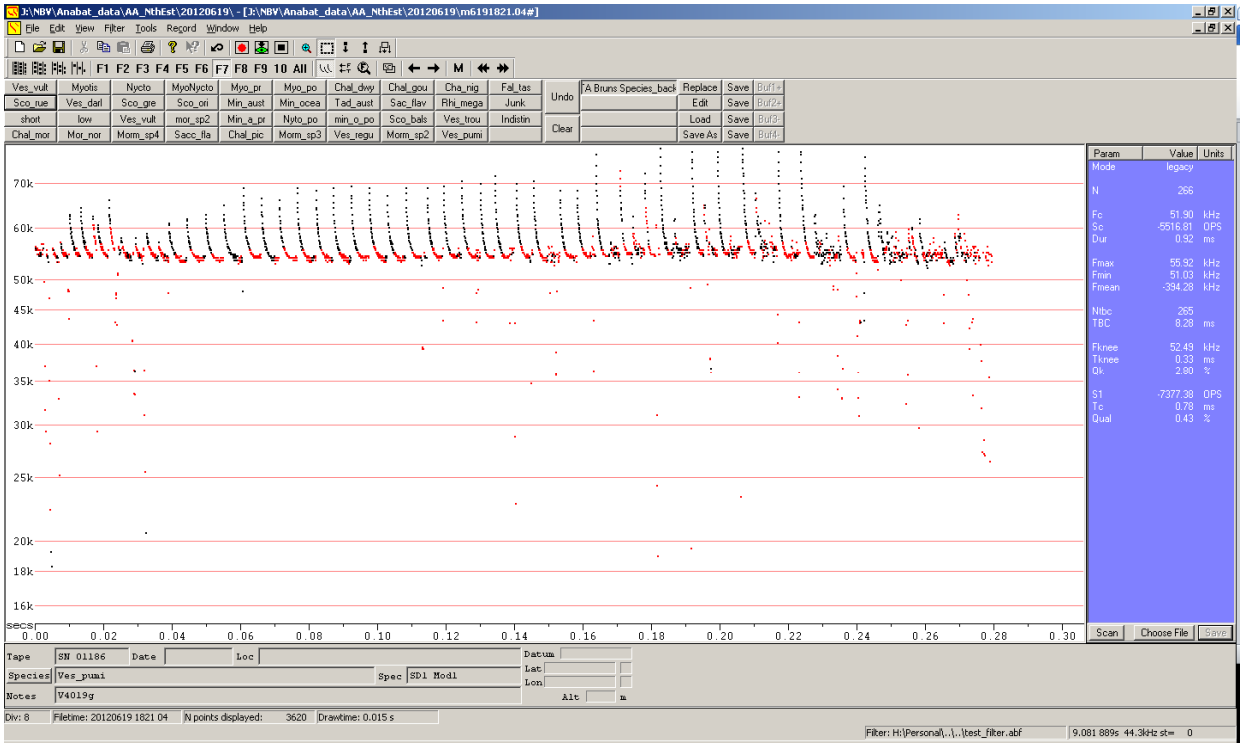

Figure 3: Call profile for *Vespadelus pumulus* recorded within the NBVw at 18:21 on 19 June 2012.

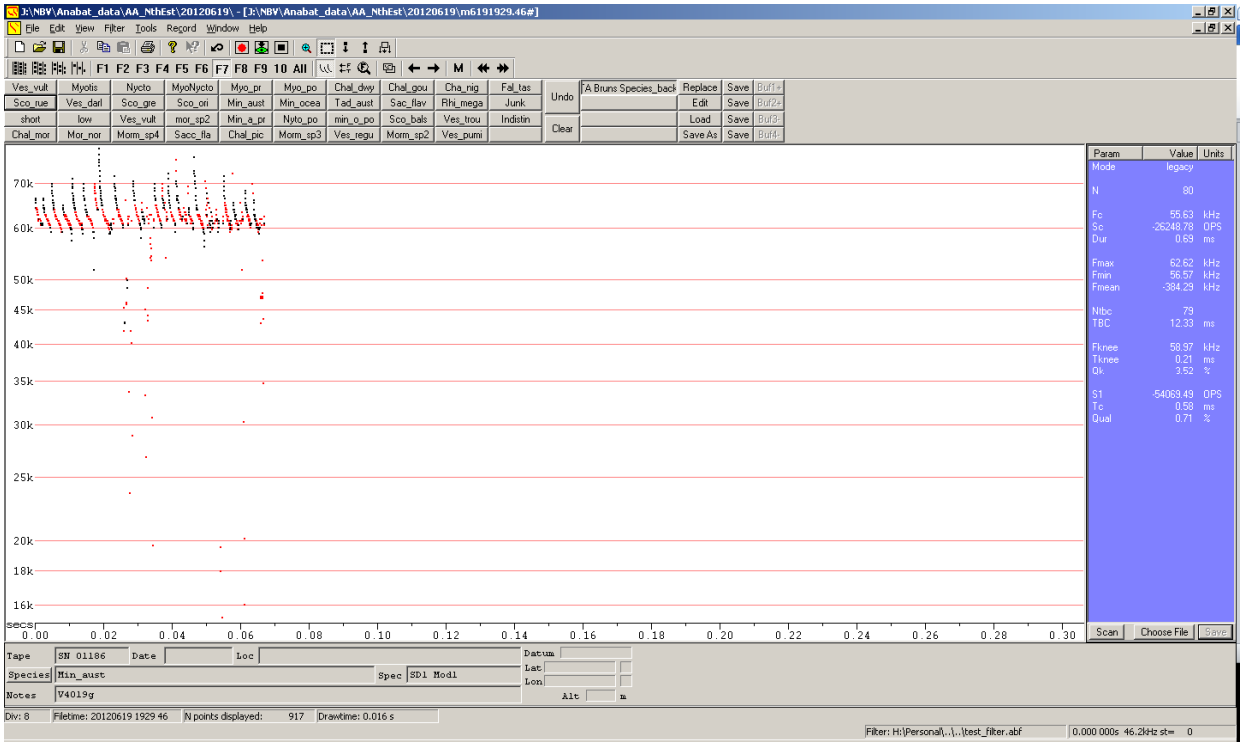

Figure 4: Call profile for *Miniopterus australis* recorded within the NBVw at 19:29 on 19 June 2012.

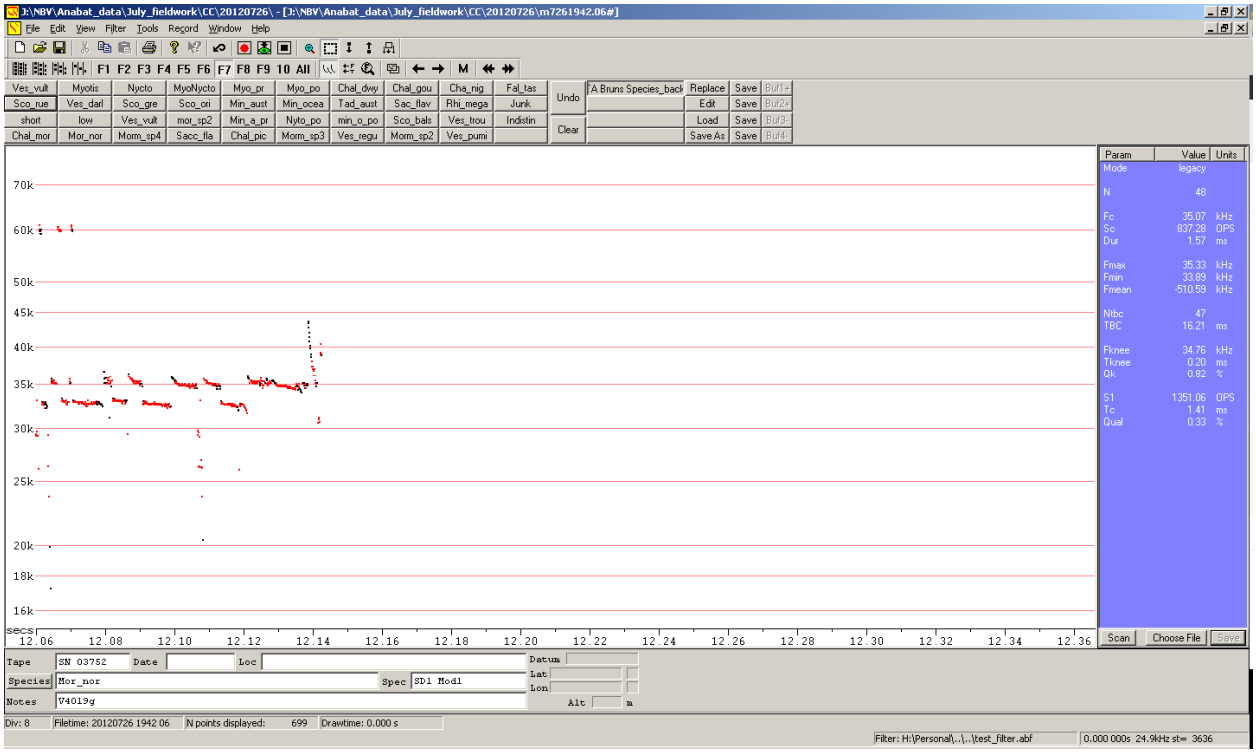

Figure 5: Call profile for *Mormopterus norfolkensis* recorded within the NBVw at 19:42 on 26 July 2012.

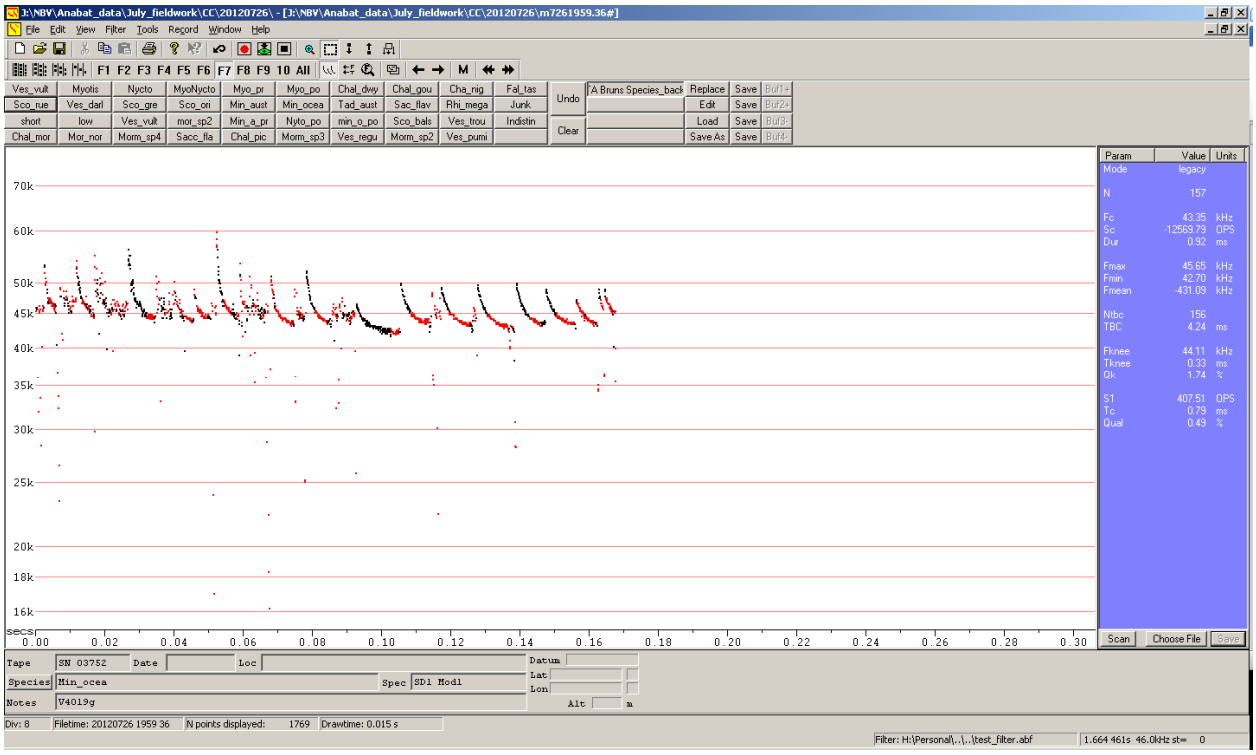

Figure 6: Call profile for *Miniopterus schreibersii oceanensis* recorded within the NBVw at 19:59 on 26 July 2012.

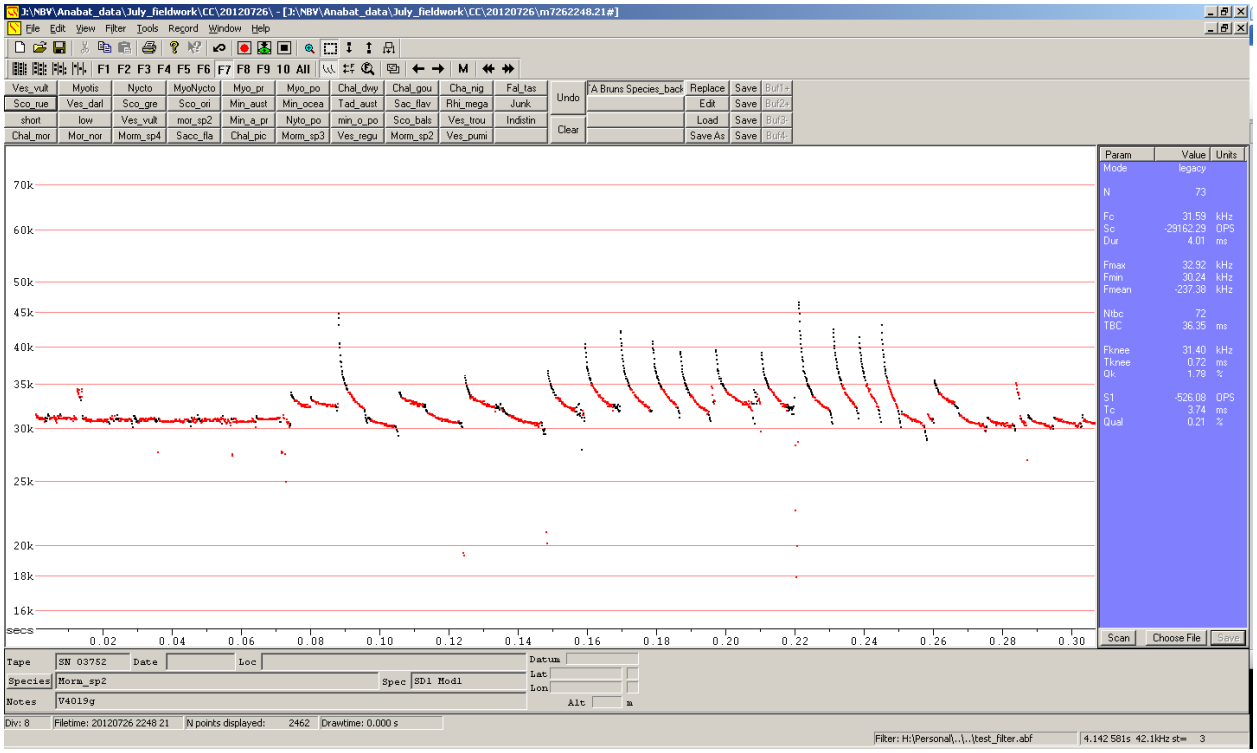

Figure 7: Call profile for Mormopterus sp2 recorded within the NBVw at 22:49 on 26 July 2012.

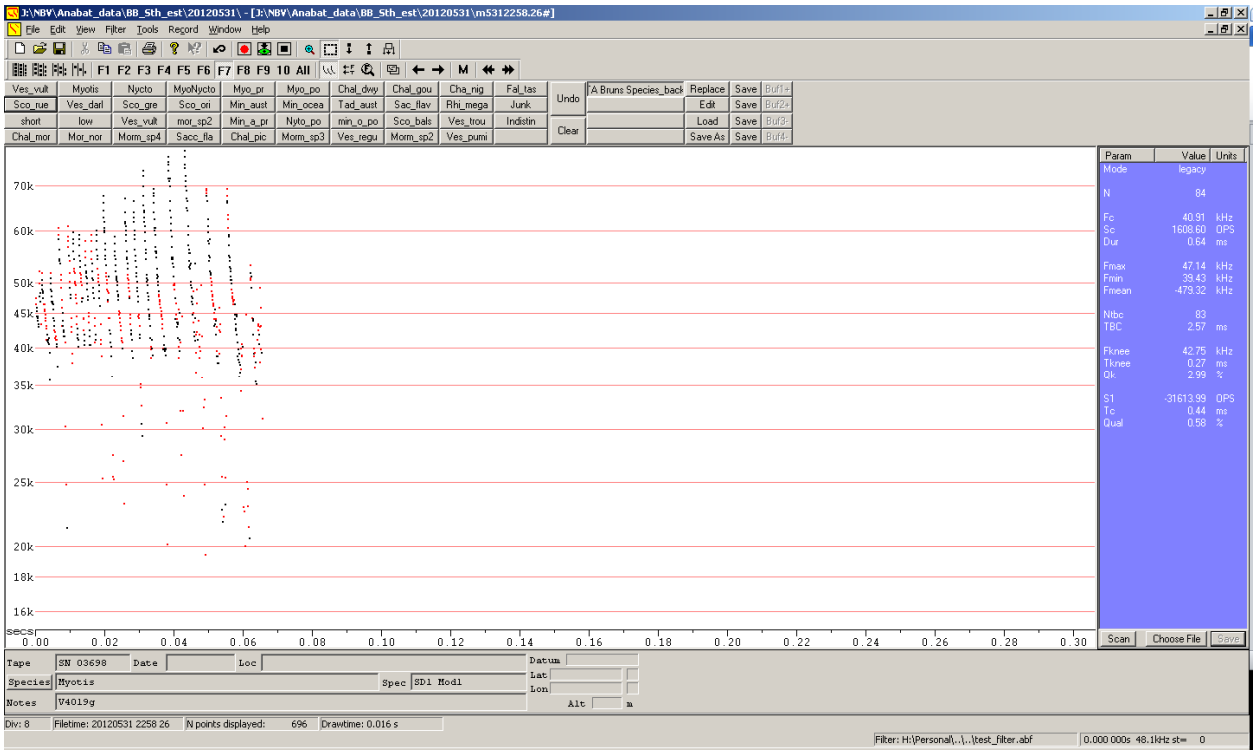

Figure 8: Call profile for Myotis macropus recorded within the NBVw at 22:58 on 26 July 2012.

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Appendix F Riparian Buffer Guidelines

Department of Primary Industries
Office of Water

CONTROLLED ACTIVITIES ON WATERFRONT LAND

Guidelines for riparian corridors on waterfront land

Controlled activities carried out in, on or under waterfront land are regulated by the *Water Management Act 2000* (WM Act). The NSW Office of Water administers the WM Act and is required to assess the impact of any proposed controlled activity to ensure that no more than minimal harm will be done to waterfront land as a consequence of carrying out the controlled activity.

Waterfront land includes the bed and bank of any river, lake or estuary and all land within 40 metres of the highest bank of the river, lake or estuary.

This means that a controlled activity approval must be obtained from the Office of Water before commencing the controlled activity.

What is a riparian corridor?

A riparian corridor (RC) forms a transition zone between the land, also known as the terrestrial environment, and the river or watercourse or aquatic environment. Riparian corridors perform a range of important environmental functions such as:

- providing bed and bank stability and reducing bank and channel erosion
- protecting water quality by trapping sediment, nutrients and other contaminants
- providing diversity of habitat for terrestrial, riparian and aquatic plants (flora) and animals (fauna)
- providing connectivity between wildlife habitats
- conveying flood flows and controlling the direction of flood flows
- providing an interface or buffer between developments and waterways
- providing passive recreational uses.

The protection, restoration or rehabilitation of vegetated riparian corridors is important for maintaining or improving the shape, stability (or geomorphic form) and ecological functions of a watercourse.

Changes to controlled activities within riparian corridors

On 1 July 2012 new rules commenced regarding controlled activities within riparian corridors. The new rules amend the riparian corridor widths that apply to watercourses, providing more flexibility in how riparian corridors can be used and making it easier for applicants to determine the Office of Water controlled activity approval requirements. Key aspects of the changes include:

- Provision of greater flexibility in the allowable uses and works permitted within riparian corridors.
- The core riparian zone and vegetated buffer have been combined into a single vegetated riparian zone (VRZ).
- The width of the VRZ within the riparian corridor has been pre-determined and standardised for first, second, third and fourth order and greater watercourses.
- Where suitable, applicants may undertake non-riparian corridor works or development within the outer 50 per cent of a VRZ, as long as they offset this activity by connecting an equivalent area to the RC within the development site.
- A new 'riparian corridors matrix' enables applicants to determine what activities can be considered in riparian corridors.

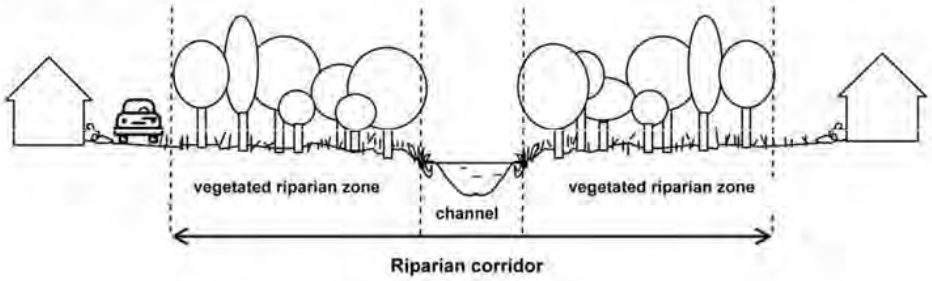
www.water.nsw.gov.au

These changes will simplify the controlled activities application and assessment process, provide greater flexibility, help make more land available for housing, support floodplain, stormwater and bush fire management, and allow riparian corridors to be used for public amenity whilst continuing to deliver environmental outcomes required under the WM Act.

The riparian corridor consists of:

- the channel which comprises the bed and banks of the watercourse (to the highest bank) and
- the vegetated riparian zone (VRZ) adjoining the channel.

Figure 1. The riparian corridor



Riparian corridor widths

The Officer of Water recommends a VRZ width based on watercourse order as classified under the Strahler System of ordering watercourses and using current 1:25 000 topographic maps (see Figure 2 and Table 1). The width of the VRZ should be measured from the top of the highest bank on both sides of the watercourse.

Figure 2. The Strahler System

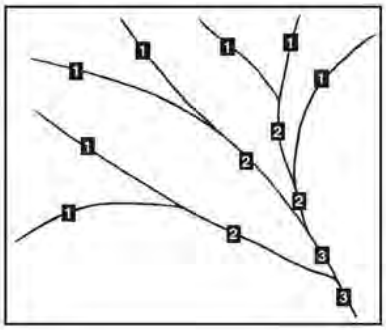


Table 1. Recommended riparian corridor (RC) widths

Watercourse type	VRZ width (each side of watercourse)	Total RC width
1st order	10 metres	20 m + channel width
2nd order	20 metres	40 m + channel width
3rd order	30 metres	60 m + channel width
4th order and greater (includes estuaries, wetlands and any parts of rivers influenced by tidal waters)	40 metres	80 m + channel width

Note: where a watercourse does not exhibit the features of a defined channel with bed and banks, the Office of Water may determine that the watercourse is not waterfront land for the purposes of the WM Act

Objectives for riparian corridor management

The overarching objective of the controlled activities provisions of the WM Act is to establish and preserve the integrity of riparian corridors.

Ideally the environmental functions of riparian corridors should be maintained or rehabilitated by applying the following principles:

- Identify whether or not there is a watercourse present and determine its order in accordance with the Strahler System.
- If a watercourse is present, define the RC/VRZ on a map in accordance with Table 1.
- Seek to maintain or rehabilitate a RC/VRZ with fully structured native vegetation in accordance with Table 1.
- Seek to minimise disturbance and harm to the recommended RC/VRZ.
- Minimise the number of creek crossings and provide perimeter road separating development from the RC/VRZ.
- Locate services and infrastructure outside of the RC/VRZ. Within the RC/VRZ provide multiple service easements and/or utilise road crossings where possible.
- Treat stormwater run-off before discharging into the RC/VRZ.

The Office of Water however, does allow for a range of works and activities on waterfront land and in riparian corridors to better meet the needs of the community, so long as they cause minimal harm as outlined in the riparian corridor matrix below.

Riparian corridor matrix

The riparian corridor matrix enables applicants to identify certain works and activities that can occur on waterfront land and in riparian corridors. Applicants should note that the matrix relates to controlled activity approvals under the WM Act only. They are still required to comply with other relevant government legislation, such as threatened species, flood planning levels and fisheries guidelines.

Table 2. Riparian corridor matrix

Stream order	Vegetated Riparian Zone (VRZ)	RC off-setting for non RC uses	Cycleways and paths	Detention basins		Stormwater outlet structures and essential services	Stream realignment	Road crossings		
				Only within 50% outer VRZ	Online			Any	Culvert	Bridge
1st	10m	•	•	•	•	•	•	•		
2nd	20m	•	•	•	•	•		•		
3rd	30m	•	•	•		•			•	•
4th +	40m	•	•	•		•			•	•

Key

Stream order: The watercourse order as classified under the Strahler System based on 1:25,000, 1:50,000 or 1:100,000 topographic maps whichever is the smallest scale available. A full list is provided at Part 2, Schedule 2 of the Water Management (General) Regulation 2011.

Vegetated riparian zone (VRZ): The required width of the VRZ measured from the top of the high bank on each side of the watercourse.

Riparian corridor (RC) off-setting for non RC uses: Non-riparian uses, such as Asset Protection Zones are allowed within the outer 50 per cent of the VRZ, so long as offsets are provided in accordance with the averaging rule as seen in Figure 3.

Cycleways and paths: Cycleways or paths no wider than four metres total disturbance footprint can be built in the outer 50 per cent of the VRZ.

Detention basins: Detention basins can be built in the outer 50 per cent of the VRZ or online where indicated. Refer to the Office of Water's *Controlled activities. Guidelines for outlet structures* and *Controlled activities. Guidelines for instream works*. Online basins must:

- be dry and vegetated
- be for temporary flood detention only with no permanent water holding
- have an equivalent VRZ for the corresponding watercourse order
- not be used for water quality treatment purposes.

Stormwater outlet structures and essential services: Stormwater outlets or essential services are allowed in the RC. Works for essential services on a fourth order or greater stream are to be undertaken by directional drilling or tied to existing crossings. Refer to the Office of Water's *Controlled activities. Guidelines for laying pipes and cables in watercourses* and *Controlled activities. Guidelines for outlet structures*.

Stream realignment: Indicates that a watercourse may be realigned. Refer to the Office of Water's *Controlled activities. Guidelines for instream works.*

Road crossings: Indicates permitted road crossing methods. Refer to the Office of Water's *Controlled activities. Guidelines for watercourse crossings* and NSW DPI policy and guidelines for fish friendly waterway crossings for Class 1 and 2 waterways.

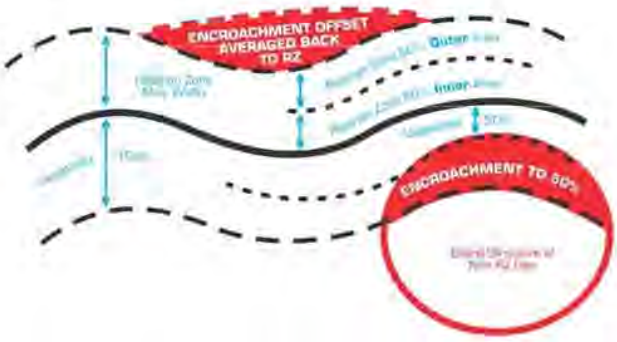
What is the averaging rule?

Non riparian corridor works and activities can be authorised within the outer riparian corridor, so long as the average width of the vegetated riparian zone can be achieved over the length of the watercourse within the development site. That is, where appropriate 50 per cent of the outer vegetated riparian zone width may be used for non-riparian uses including asset protection zones, recreational areas, roads, development lots and infrastructure. However, an equivalent area connected to the riparian corridor must be offset on the site (see Figure 3) and the inner 50 per cent of the vegetated riparian zone must be fully protected and vegetated with native endemic riparian plant species.

Bridges, cycleways, paths, stormwater oulets and other essential services do not need to be offset, but must comply with the requirements set out in the riparian corridor matrix (Table 2) and other relevant Office of Water controlled activities guidelines. Offline detention basins do not need to be offset so long as there is an equivalent VRZ for the corresponding watercourse and they are built in compliance with the Office of Water's *Controlled activities: Guidelines for watercourse crossings* and *Controlled activities: Guidelines for in-stream works*. If a proposed basin will not have an equivalent VRZ for the corresponding watercourse, it may still be built in the outer 50 per cent of the VRZ but must be offset.

The averaging rule should generally be applied to cleared waterfront land. Development proposals involving waterfront lands that contain existing native vegetation should seek to preserve that riparian vegetation in accordance with the minimum riparian corridor requirements outlined in Table 1.

Figure 3. Averaging rule



Applications for controlled activity approvals

Applications for controlled activities approvals should be informed by the riparian corridor matrix shown in Table 2 and prepared using the *Application for a Controlled Activity Approval for works on waterfront land* form and the *Guideline for completing an application for a Controlled Activity Approval*.

Other controlled activity guidelines are available on the Office of Water website and outline relevant considerations for applicants when proposing activities and works on waterfront lands.

Streamlined assessment

Where applications are presented in accordance with the riparian corridor matrix (Table 2) and other Office of Water controlled activity guidelines, they will be assessed under a streamlined process. This may decrease the amount of time it takes the Office of Water to make a determination, saving applicants time and money.

Applications that do not conform to the matrix and/or relevant Office of Water controlled activity guidelines will continue to be subject to merit assessment to ensure that the proposals meet the requirements of the WM Act. All applications will still need to demonstrate that minimal harm will occur to waterfront land before a controlled activity approval will be issued.

Where do I go for additional information?

Find out more about controlled activities at the Office of Water website www.water.nsw.gov.au.

Contact us

Contact a water regulatory officer as listed on the Office of Water website www.water.nsw.gov.au, free call the licensing information on 1800 353 104 or email information@water.nsw.gov.au.

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