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Ballina Shire Koala Management Strategy

Prepared by Ballina Shire Council

JULY 2017

Strategy Preparation:

Ballina Shire Council in association with Biolink Ecological Consultants and the Ballina Shire Comprehensive Koala Plan of Management Project Reference Group.

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Koala Management Strategy

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EXECUTIVE SUMMARY

Koalas are an iconic part of the Australian landscape. Whilst many local people have lived with and known about koalas living around Ballina Shire, the 2013 Koala Habitat and Population Assessment: Ballina Shire Council LGA (Phillips and Chang, 2013) identified the presence of a “nationally significant” population living in the southern parts of the shire. This study provided significant insights into the distribution and abundance of koalas in the local area and their importance regionally.

Koalas in Ballina Shire are predominantly found around Meerschaum Vale, Wardell, Bagotville, Uralba, the Blackwall Range and on the Alstonville Plateau. Koala habitat in Ballina Shire is generally not in areas subject to planned urban development and so the focus of the Ballina Shire Koala Management Strategy is around infrastructure and rural land management. More specifically, road infrastructure, dogs, rural land use and private native forestry are key considerations of the strategy. The strategy is designed to guide the long term management approach for sustaining a viable koala population in the shire.

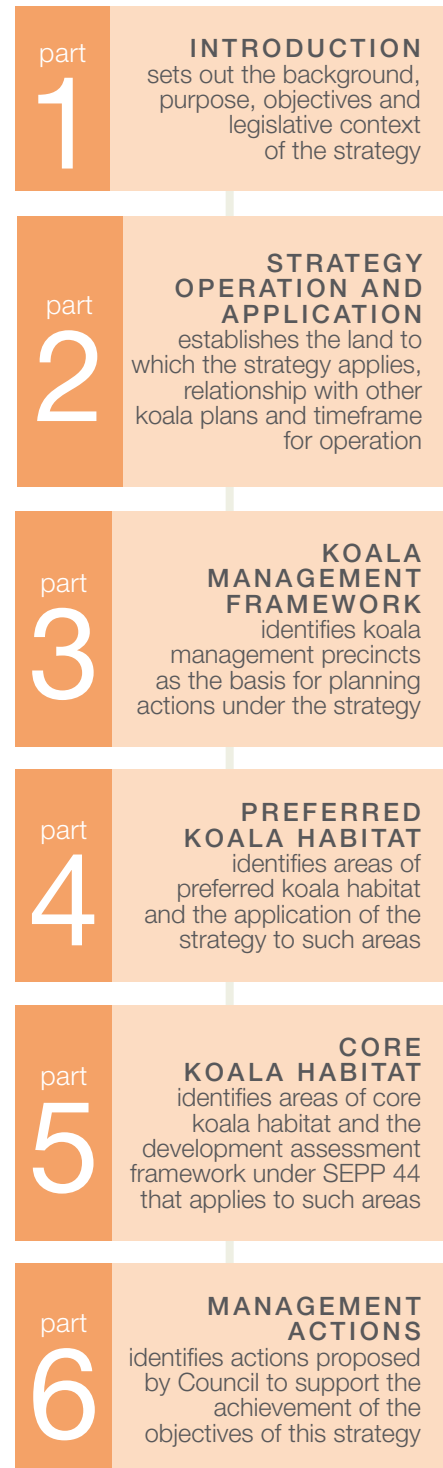
Council sees the management of lands across the shire as a collaborative partnership between community, landholders (particularly rural landholders and farmers) and

government. This document is primarily a strategy to effectively achieve this collaboration but also addresses regulatory aspects of land management where there are identified benefits to the achievement of the objectives of the strategy.

The Strategy also recognises the significant role of the NSW Government in infrastructure and forestry activities, and the impacts these activities may have on koalas. It also addresses elements of koala management where Council has roles and responsibilities.

The Ballina Shire Koala Management Strategy recognises the unique qualities of place that have supported koalas within the shire and recognises significant intrinsic value in the ongoing presence of koalas in the shire into the future.

The Strategy includes provisions that are to be applied under the terms of SEPP 44 as well as a framework for local planning and management decisions to be implemented separate to SEPP 44.



The above flowchart provides an overview of the structure and content of the Ballina Shire Koala Management Strategy

ACKNOWLEDGEMENTS

This Koala Management Strategy was overseen in its development by a project reference group (PRG). The PRG was convened by Ballina Shire Council as a way to ensure that all relevant issues could be included for consideration within the Strategy.

The membership of the PRG was as follows:

Councillor Sharon Cadwallader (Chair, Ballina Shire Council)
Lorraine Vass (Friends of the Koala, Inc)
Kath Robb (NSW Farmers)
Jolyon Burnett (Australian Macadamia Society)
Steve Jensen (Department of Planning and Environment)
John Turbill (Office of the Environment)
Greg Collins (Roads and Maritime Services)
A/Professor Ross Goldingay (Southern Cross University)
Dr Effie Ablett (Ballina Environment Society)
Zofie Lahodny-Gesco (NSW Rural Fire Service)

John Nagle (Local Land Services) provided specialist input on habitat and rural landholder issues, and Ian Gaskell (Environmental Scientist, Ballina Shire Council) on habitat.

Dr Steve Phillips of Biolink Ecological Consultants provided expertise in development of the Koala Habitat Study as well as the Strategy. Biolink prepared the *Koala Habitat and Population Assessment: Ballina Shire Council LGA – November 2013*. This work underpinned further study on vegetation types suitable for the use of koalas in Ballina Shire. Modelling of the impacts on the koala population of various events including dog attack and vehicle strike were also prepared by Biolink. Biolink's work on the project reflects a level of input well above that which was originally contracted for, but which has provided a solid basis for the preparation of the Strategy.

During preparation of the Strategy, rural landholders were separately engaged as a group that had a very practical interest in the provisions of the Strategy. The result of this discussion has shaped many of the strategic and ancillary actions of this Strategy.

Council also received community and stakeholder feedback in response to the public exhibition of the Strategy. This feedback was considered as part of the finalisation of the document.

The Koala Habitat Study and the Koala Management Strategy (incorporating the CKPOM) have been prepared by Council and Biolink Ecological Consultants, with funding support provided by the Office of Environment and Heritage.

All photographs of koalas supplied by Ms Maria Matthes (apart from front cover).

PART 1 STRATEGY PREPARATION OVERVIEW

1.1 Strategy Preparation Overview

Ballina Shire Council commenced investigations into the koala population in Ballina Shire through the Ballina Shire Koala Habitat Study project in late 2012. With funding support from the Office of Environment and Heritage, Council engaged Biolink Ecological Consultants to prepare the *Koala Habitat and Population Assessment: Ballina Shire Council LGA 2013*.

The habitat study, completed in November 2013, was based on historic record analysis and field survey work as well as the involvement of a project reference group comprised of various stakeholder representatives. Following on from the completion of the habitat study, Council resolved to progress to the preparation of a comprehensive koala plan of management for the shire.

This strategy has been prepared having regard for State Environmental Planning Policy No.44 – Koala Habitat Protection. It includes elements that address SEPP

44 as well as actions that Council proposes to achieve the maintenance of a viable koala population in Ballina Shire.

The strategy has also been prepared with involvement from the project reference group.

1.2 Koala Habitat and Population Assessment: Ballina Shire Council LGA

Ballina Shire Council engaged Biolink Ecological Consultants to prepare a habitat study for the local koala population in the Ballina Shire local government area in 2012. The study, being the *Koala Habitat and Population Assessment: Ballina Shire Council LGA*, was completed in 2013 and endorsed by the elected Council at its Ordinary Meeting held on 19 December 2013.

<p>JULY 2012</p> <p>Council resolved to begin preparation of a Koala Habitat Study and Comprehensive Koala Plan of Management (CKPoM)</p>	<p>NOVEMBER 2012</p> <p>Ballina Shire Koala Habitat Study commenced</p>	<p>NOVEMBER 2013</p> <p>Ballina Shire Koala Habitat Study completed</p> <p>Continuation of CKPoM process endorsed</p>	<p>FEBRUARY 2014</p> <p>CKPoM preparation commenced</p>	<p>NOVEMBER 2015</p> <p>Draft CKPoM publicly exhibited</p>	<p>MARCH 2016</p> <p>CKPoM renamed Ballina Shire Koala Management Strategy and endorsed by Council at its March 2016 Ordinary Meeting</p>	<p>JULY 2017</p> <p>Approved by DPE</p>
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This strategy is based on the outcomes and findings of the habitat study and subsequent additional investigations and knowledge arising in relation to koalas in Ballina Shire.

1.3 Strategy Development and Project Reference Group

The development of this strategy was undertaken in consultation with a project reference group and with assistance from the Office of Environment and Heritage and Biolink Ecological Consultants. The foundations of this strategy were developed collectively between Council, the project reference group and Biolink Ecological Consultants and having regard for advice from State government agencies and other councils.

The project reference group (PRG) was convened to provide input to the strategy which covered the diverse range of interests in koala management present within the shire, and also more regionally. The PRG included representation from NSW Department of Planning and Environment, NSW Office of the Environment and Heritage, Roads and Maritime Services, Southern Cross University, Friends of the Koala, NSW Farmers, NSW Rural Fire Service, Ballina Environment Society and the Australian Macadamia Society. Specialist input was also provided by Local Land Services and Council's Development and Environmental Health Group.

The terms of reference for the PRG established the group primarily as a sounding board for the discussion of key elements of the Strategy during its preparation. At times, the PRG and its members were asked to indicate a view on key aspects of the Strategy. The PRG membership followed the process over two years from the initiation and development of the Koala Habitat Study to the finalisation of the basis for the CKPoM. In relation to the CKPoM, the group considered the vision, aims and objectives of the Strategy, the planning framework for the Strategy and a number of key issues associated with ecological, rural land management and development matters in relation to Ballina Shire.

Further to the PRG, a rural landholder engagement process invited members from the peak bodies of rural industry groups with a presence within Ballina Shire to participate in a discussion about koala management and agriculture. Overall, the Strategy recognises the national importance of Ballina's koala population and Council recognises that endeavours to ensure a

future for Ballina's koalas and their habitat requires the involvement of the whole of the Ballina community including rural landholders as well as government.

1.4 Strategy Exhibition and Adoption

Council resolved to publicly exhibit the draft Ballina Shire Comprehensive Koala Plan of Management at its August 2015 Ordinary Meeting. The draft plan was exhibited for a period of five weeks concluding on 3 December 2015.

Council received thirteen written submissions and thirty-six survey responses during the exhibition period. These submissions are addressed in reporting to the Council's March 2016 Ordinary Meeting.

Council resolved to adopt the Ballina Shire Koala Management Strategy inclusive of the Ballina Shire Core Koala Habitat Comprehensive Koala Plan of Management at its Ordinary Meeting held on 24 March 2016 [240316/9].

The Ballina Shire Core Koala Habitat Comprehensive Plan of Management was approved by the Department of Planning under Clause 13 of State Environmental Planning Policy No. 44 - Koala Habitat Protection on 6 July 2017.

1.5 Vision, Aims and Objectives

This Strategy represents a co-ordinated approach to landscape management with regard to providing a viable long term future for the Ballina koala population. It implements the recommendations of the supporting *Koala Habitat and Population Assessment: Ballina Shire Council LGA* study and has been prepared having regard for State Environmental Planning Policy No. 44 (SEPP 44) and the approved Recovery Plan for the Koala (DECC 2008).

Accordingly, this Strategy covers a range of issues including development control, strategic planning, koala habitat retention and restoration, managing threats from roads, dogs, fire and disease, community engagement, implementation, and ongoing monitoring, reporting and review. The Strategy also has relevance to a wide range of stakeholders.

The Strategy has a number of over-arching visions and aims, as well as expected outcomes from its implementation.

Vision

“

A self-sustaining long-term koala population in Ballina Shire

”

1.5.1 Vision and Aims

This vision is intended to be achieved through the following aims:

- a. To retain and consolidate areas of core koala habitat and create or enhance koala habitat linkages.
- b. To support the community in protecting and enhancing Ballina Shire's koala population.
- c. To enhance community awareness of the extent and importance of the koala population in Ballina Shire.
- d. To support the koala population more broadly within the Northern Rivers.

1.5.2 Objectives and Outcomes

The following can be read as objectives or outcomes that Council is seeking to achieve or substantially advance towards over the life of the Strategy.

The objectives (or desired outcomes) of this Strategy are to:

- a. Minimise the potential for adverse impact on koalas within current and future areas of core koala habitat.
- b. Create, manage and/or restore koala habitat

linkages and corridors to re-establish a complex and biodiverse landscape.

- c. Facilitate the mutually productive co-existence of people and koalas by working with landholder communities.
- d. Provide a transparent and consistent framework for decision making with regard to development assessment.
- e. Promote koalas as an asset for Ballina Shire's economic development and tourism.
- f. Improve community knowledge, understanding and awareness of the local koala population and koala habitat.
- g. Ensure that koalas, koala habitat and koala movement patterns are integrated considerations in infrastructure planning.
- h. Underpin a broad community and landholder ethos that values the presence of a sustainable koala population in Ballina Shire.

It is expected that the above objectives will be realised through both management activities and regulatory measures.

To assist in determining whether or not the vision, aims and objectives of this Strategy are being achieved,

Table 1 outlines some indicators and targets that the Strategy can be measured against.

Table 1: Indicators for Consideration in Relation to the Sustainability of the Ballina Shire Koala Population

DESCRIPTION OF MEASURE	UNIT OF MEASUREMENT	WHAT WILL THIS TELL US?	DESIRED OUTCOME
Total number of koalas	Number	Increase or decrease in population/corollary of ongoing viability of Important Population	Increase in the number of koalas within the important population area. Increase in the number of koalas in Ballina Shire.
Age cohort distribution	Number	Measure of healthy population with long term viability	Cohort distribution consistent with a normal distribution. Presence of breeding age males and females in the population suitably proportionate to the population size for population growth.
Area of habitat	Hectares	Increase or decrease in area of potentially inhabitable vegetation	Area of habitat capable of supporting koalas at least 100% of available area as at publication of this Strategy.
Extent of occurrence	Hectares	Area of Ballina Shire where koalas are found	100% within the important population area. At least 90% of the shirewide area defined in the Ballina Shire koala habitat study (43,982 hectares).
Area of occupancy	Percentage (hectares occupied against habitat available)	Vegetation which is actually inhabited. Corollary measure over time in terms of ecosystem structure which supports koala populations	Increase from 32% as identified in the Ballina Shire habitat study to a target of approximately 50%.
Connectivity of habitat	Effective habitat area (monitored by the NSW Government, SoE process)	Effectiveness of planting and bush regeneration programs on both public and private lands. Current measure = Poor (2012 Regional SoE Report)	Improve SOE measure above "poor".
Koala deaths recorded by Friends of the Koala (other native animal assistance by Northern Rivers Wildlife Carers and WIRES)	Number	Measure of known koala mortality and reasons	Reduce annual number of mortalities as a proportion of the population estimate.

1.6 Ballina Shire Koala Population

The analysis of the local koala population undertaken as part of the *Koala Habitat and Population Assessment: Ballina Shire Council LGA (2013)* is one of nine similar studies across NSW (eight) and south-east Queensland (one).

On the whole, the results of these studies suggest there has been an average range contraction of about 30% over the last three koala generations (equivalent to approximately 18 years). Additionally there appears to have been a decrease of about 45% in the amount of otherwise suitable habitat that is being used by koalas over the same time period (pers. comm. Dr S. Phillips). This establishes a picture of declining koala populations in north east NSW and south east QLD as a background to the management of koalas in Ballina Shire.

The local analysis for Ballina Shire provides a complex picture. There was a reduced extent of occurrence and area of occupancy during the early to mid 20th century likely related to clearing for forestry, agriculture and other purposes. Since that time, records of

koala incidence had implied some recovery for both the Ballina and adjoining south-east Lismore LGA populations. It is thought that this is partly due to extensive eucalypt windbreak plantings on the Alstonville Plateau during the 1980s, providing a high nutrient food source as well as a potential movement corridor.

The apparent recovery shire-wide indicated in the records analysis was not borne out by the field surveys. Possible reasons for this include population cycling, the ongoing population isolation effects of habitat fragmentation, as well as an underestimate of numbers of koalas being subject to vehicle strike, dog attack and disease.

Notwithstanding these impacts, it has been concluded that Ballina Shire's koala population within the Bagotville, Meerschaum Vale and Wardell areas (the Southern Koala Management Precinct) meets the criteria for an 'Important Population' for the purposes of the *Environment Planning and Biodiversity Conservation Act (1999)*. This means that the population in Ballina Shire is recognised as a nationally significant one.

Table 2 provides a summary of key koala population statistics derived from the Ballina Shire habitat study.

Table 2: Summary of Key Population Statistics of the Ballina Shire Koala Population

Legislative Status	NSW - Threatened Species Act (1995)	Vulnerable
	Commonwealth – Environment Protection and Biodiversity Conservation Act (1999)	Vulnerable (Southern KMP is defined as an Important Population)
Ballina Shire Koala Population Estimate	285 – 380 individuals	Southern KMP – 170 - 200
		Plateau KMP – 100 - 140
		East Ballina KMP – 3 - 4
Area of occupancy	32%	Trending down
Extent of occurrence	43,982 ha	Trending up
Area of Preferred Koala Habitat	2000 ha	Steady ¹
Generational Persistence	6 generations recorded in Ballina Shire	

¹ The area of Preferred Koala Habitat occurs within the Extent of Occurrence, which is the reason for the much smaller area of PKH in comparison to the Extent of Occurrence.

This Strategy seeks to provide a pathway to support a nationally important koala population, whilst recognising that there are significant barriers to its ongoing sustainability. In assisting this important population the Strategy is also working to support other koala populations within the shire and greater Northern Rivers region through retaining, increasing and connecting available preferred habitat over time, and increasing awareness of koalas and their management needs across the broader community.

1.7 Threats to Koalas in Ballina Shire

The *Koala Habitat and Population Assessment: Ballina Shire Council LGA (2013)* outlines the processes threatening koala populations and their habitat in the shire. These processes include:

- Clearing of koala habitat for urban development, roadwork, forestry, agricultural and mining activities
- Fragmentation of koala habitat which isolates individuals and populations, impedes gene flow and the ability to maintain effective recruitment levels. This includes degradation of habitat by logging of preferred food trees
- Mortalities caused by dog attack and vehicle strike
- Mortalities caused by random events such as fire and/or extreme weather conditions

- Disease, mainly associated with Chlamydia
- Defoliation of Preferred Koala Food trees associated with insect attack and/or extreme climatic conditions.

As a guide to human impacts on koalas, the information in Table 3 shows the numbers of koalas found dead or brought into care by Friends of the Koala from Ballina Shire and surrounding areas during the period between 2012 and 2014. Table 3 and Figure 1 also illustrate regional figures for koala care and mortality as recorded by Friends of the Koala.

Based on a population estimate of 285-380 koalas within the shire and that mortalities due to dog attack and vehicle strike are likely to be under-reported (perhaps by as much as 100%), this represents between a minimum of 3% and 5% of the population dying from anthropogenic (or non-natural) events each year.

This information is regional in nature, presented on a local government area basis, and likely represents an under-estimate of koalas dying from these causes as they only represent animals found and accounted for. The higher numbers of sightings, advice and assistance provided may or may not represent greater numbers of koalas. It is possible that these figures reflect greater awareness of the activities of Friends of the Koalas, or a larger habitat-human land use interface.

Figure 1 Koala Mortality by Cause - 2012 to 2014, Ballina, Byron, Richmond Valley and Lismore LGAs Combined



Table 3 Koala Hospital Admittance and Mortality Information 2012 - 2014

LGA	SIGHTINGS/ ADVICE	ADMITTANCES	INFORMATION	MORTALITIES
Ballina 2013-14	28	11	1 in care 10 mortalities	6 disease 2 injury 2 unknown
Ballina 2012-13	21	17	2 released 15 mortalities	4 disease 4 car hits 1 dogs 2 injury 4 unknown
Byron 2013-14	93	43	3 in care 3 released 35 mortalities	20 disease 4 car hits 3 dogs 3 injury 3 unknown
Byron 2012-13	101	70	3 in care 10 released 3 relocations 55 mortalities	27 disease 13 car hits 15 unknown
Richmond Valley 2013-14	12	6	5 mortalities 1 released	1 disease 1 car hit 1 injury 5 unknown
Richmond Valley 2012-13	10	8	9 mortalities	2 disease 3 car hits 1 injury 1 geriatric 1 unknown
Lismore 2013-14	210	175	12 in care 10 released 3 relocated 150 mortalities	66 disease 30 car hits 10 dogs 6 injury 4 geriatric 4 orphans 30 unknown
Lismore 2012-13	187	161	0 in care 26 released 135 mortalities	74 disease 18 car hits 11 dogs 11 injury 8 orphans 13 unknown

Disease is recognised as having a major impact on koalas, with euthanasia of diseased animals accounting for the majority of known mortalities since 2003. The *Koala Habitat and Population Assessment: Ballina Shire Council LGA* identifies that increases in disease can naturally occur due to reduced metabolic/genetic fitness and/or immunity caused by natural stressors such as reduced food tree availability and/or increased impact of threats to koalas.

However, with human activity in and around koala habitat, koalas face additional stress factors such as habitat loss, impediments to movement (fences, roads), vehicle strike, and dog attack, which consequently leads to increased levels of disease. Where these stress factors are not managed, the impacts of disease on individuals and koala populations are much greater.

The impacts of fire on koala populations have also been well documented for areas such as the Tweed coast and south-east Queensland. The two populations in Ballina Shire of particular concern in relation to fire are the small population located in East Ballina, and the nationally significant population in the Bagotville, Meerschaum Vale and Wardell area. Both these populations live in vegetation adjacent to and contiguous with large areas of coastal heath, which is quite prone to (and well adapted for) fire. The proximity of the heath to the important koala population area means that fire is of particular concern to the Ballina Shire koala population.

One of the most significant threats to koala habitat in Ballina Shire is the potential loss of native forests and feed trees through private native forestry. In addition to direct habitat loss, private native forestry activities may also increase the stress on koalas impacted by forestry operations raising the potential for the emergence of disease.

The siting and construction of Section 10 of the Woolgoolga to Ballina Pacific Highway upgrade also has the potential to negatively impact the koala population in the Southern Koala Management Precinct. Koala habitat will be impacted as a result of clearing for the construction of the highway and the construction and operational phase of the project may lead to increased mortalities through factors such as road strike if not adequately mitigated.

At the time of preparing this Strategy, the NSW Roads and Maritime Service (RMS) was engaged in detailed assessment and evaluation of the koala population in

the southern part of Ballina Shire and identification of mitigation and management options. This work was undertaken in order to meet conditions of approval for the upgrade. The investigation undertaken by the RMS to date (March 2016) has generally aligned with key findings from the *Koala Habitat and Population Assessment for Ballina Shire (2013)* that underpins the Strategy. Collectively, this information will assist with ongoing monitoring and management.

In February 2016, the RMS released the “Ballina Koala Plan – Woolgoolga to Ballina Pacific Highway upgrade”. This plan details how the RMS plans to manage the project’s impact on the environment, including the koala, including issues such as vehicle strike on approach roads.

1.8 Important Population

The study *Koala Habitat and Population Assessment: Ballina Shire Council LGA (2013)* concluded that the southern half of Ballina Shire supports an Important Population of koalas, as defined by the Federal Government’s *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act, 1999)*. Figure 2 outlines the boundaries of the habitat supporting the Important Population.

The population contained within the area defined in Figure 2 is also referred to as a nationally significant population.

Initially it was thought that the northern boundary of the Important Population area was the Bruxner Highway. However further fieldwork and review of the records held by Friends of the Koala has showed that the habitat north of the highway supports a permanently resident free living population of koalas that is considered to be part of the Important Population.

As indicated in section 1.7, a key consideration in relation to the long term viability of the koala population in Ballina Shire, particularly within the boundaries of the Important Population as shown in Figure 2, is the construction and subsequent operation of the recently approved Pacific Highway Section 10 as part of the Woolgoolga to Ballina Pacific Highway Upgrade program.

This Strategy recognises the significance of the ‘important (koala) population’ as defined by the *EPBC Act, 1999* in the southern part of the shire and seeks to respond to identified threats to the shire’s koala population.

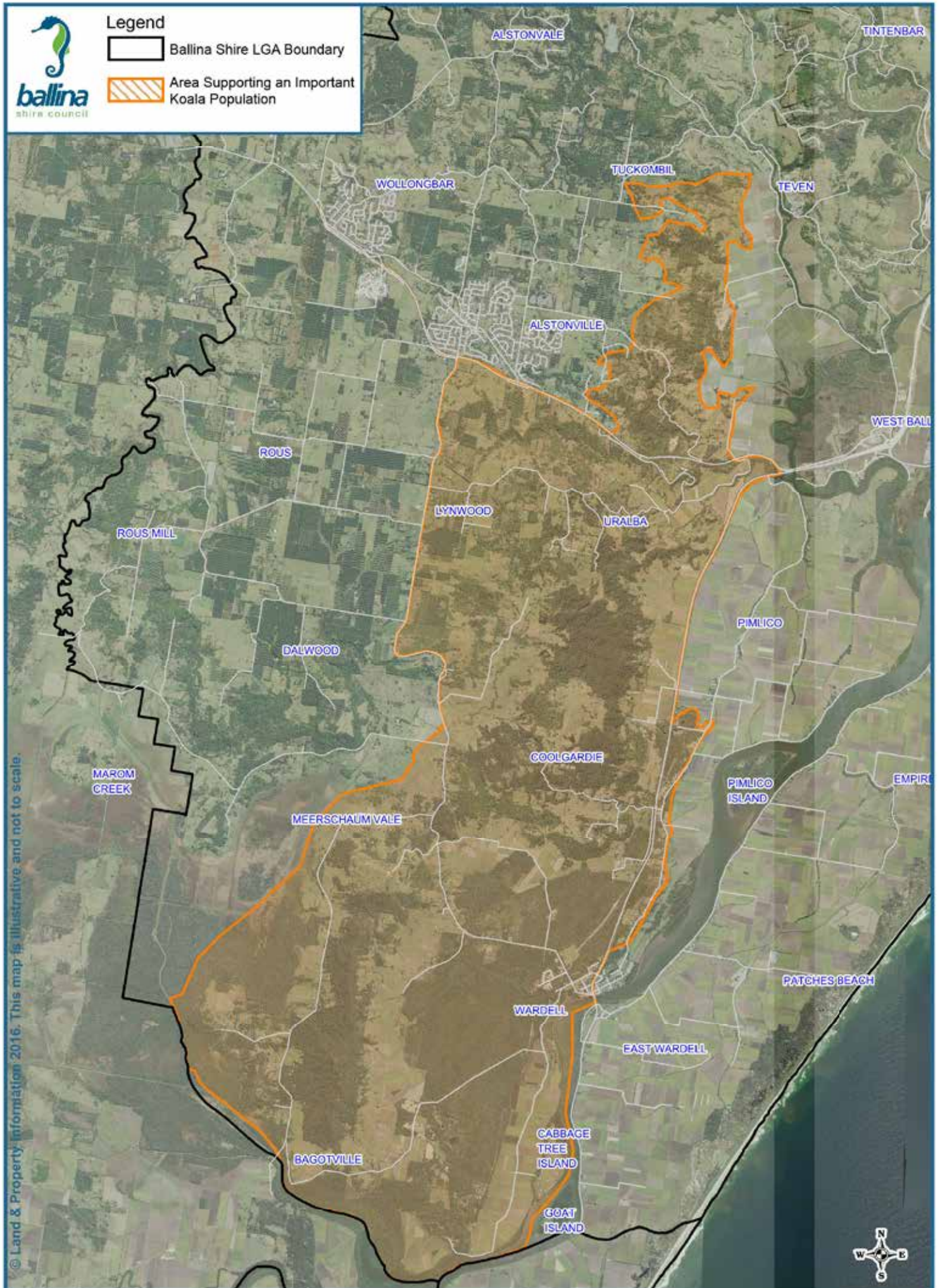


Figure 2: Notional area boundaries for the Important Population

1.9 Statutory Context

State Environmental Planning Policy No. 44 – Koala Habitat Protection

SEPP 44 is made under the *Environmental Planning and Assessment Act 1979* with the aim of encouraging 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:

- a. by requiring the preparation of plans of management before development consent can be granted in relation to areas of core koala habitat, and
- b. by encouraging the identification of areas of core koala habitat, and
- c. by encouraging the inclusion of areas of core koala habitat in environment protection zones.

The policy applies to any development application (DA) on contiguous areas of land under the same ownership that are greater than 1 hectare in area, and where 'potential' and/or 'core' koala habitat (as defined in SEPP 44) is found.

Under SEPP 44, there is provision for preparation of plans of management which aim to protect areas of koala habitat and mitigate negative effects of a proposed development on resident koalas and their habitat. These are known as Individual (IKPoM) or Comprehensive Koala Plans of Management (CKPoM). A CKPoM can be prepared for part of or the whole of a local government area. Individual Koala Plans of Management are prepared for specific land and developments. Subject to the exclusion provisions of SEPP 44 in so far as they relate to the size of the land holding, a proposal for development on land that contains core koala habitat cannot be approved by a determining authority unless an approved comprehensive or individual koala plan of management is in place.

A CKPoM offers a number of significant advantages to both Council and the proponents of development activities. For Council, the CKPoM:

- facilitates a strategic and coordinated approach to management of koalas and their habitat.
- utilises a scientific basis to consider long term koala management and associated planning outcomes in the shire.

- reduces the resources required to process individual DAs.
- facilitates further government, non-government and community involvement in koala conservation in the Ballina LGA.
- identifies the philosophy and management approach taken by Council with respect to koalas.
- identifies priorities for the application of resources and associated rationale.

For development proponents, the CKPoM:

- saves money and resources required to identify the location of koala habitat within the shire, and prepare Individual Koala Plans of Management
- supports the DA assessment process and provides overarching direction in relation to the consideration of koalas.

Ballina Local Environmental Plans and Ballina Shire Development Control Plan 2012

The Ballina Local Environmental Plan 2012 and Ballina Local Environmental Plan 1987 made under the *Environmental Planning and Assessment Act 1979* (EP&A Act) provide a statutory planning framework for Council to regulate development and protect important aspects of the built and natural environment. The LEPs identify land use zones for all land in the LGA. For each zone, the LEPs set out objectives and identify what kinds of development are permitted either with or without development consent.

For development that is permitted with consent, the Ballina Development Control Plan supplements the Ballina LEP 2012 and Ballina LEP 1987 by providing more detailed information and controls. Ballina Shire's DCP provides for the protection and enhancement of ecologically significant areas.

Threatened Species Conservation Act 1995 and Environment Protection and Biodiversity Conservation Act 1999

The koala is listed as a vulnerable species throughout NSW for purposes of both the *NSW Threatened Species Conservation Act 1995* (TSC Act) and the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Both pieces of legislation require individuals and/or Council to determine whether or not their actions are

likely to have a significant impact on koalas or their habitat based on specific criteria.

The koala population in the southern part of Ballina Shire meets the definition of an Important Population definition for the purposes of the EPBC Act. This places particular requirements on individuals and all levels of government when considering development in this area.

Native Vegetation Act 2003

In NSW, the *Native Vegetation Act 2003* regulates the clearing of native vegetation on land zoned for rural purposes. Urban areas and land in conservation and forestry estates are not subject to the provisions of the Native Vegetation Act. Clearing approvals under the Native Vegetation Act are determined by the Northern Rivers Local Land Services. Depending on the zoning of the land, development consent may also be required under the applicable LEP for certain types of development or clearing.

Approval for harvesting timber from native forests on private land (private native forestry) is determined and regulated by the Environment Protection Authority. There is a Private Native Forestry Code of Practice for Northern NSW that should be followed and this is supported by the Native Vegetation Regulation 2013. Forest operations are not permitted within any area identified as 'core koala habitat' within the meaning of State Environmental Planning Policy No. 44 – Koala Habitat Protection.

This Strategy seeks to activate the existing provisions of the PNF Code of Practice for Northern NSW using the mapping of core koala habitat. Under this Strategy, core koala habitat is defined as including Primary Habitat, Secondary A Habitat, Secondary B Habitat and Secondary C Habitat within the Southern Koala Management Precinct (see Part 5.0).

Companion Animals Act 1998

The *Companion Animals Act 1998* and the *Companion Animals Regulation 2008* provide for the identification and registration of cats and dogs, requirements concerning how they are managed and the duties and responsibilities of their owners in NSW. In particular, pet owners must ensure that their dog (or cat) does not threaten or harm a person or animal (such as a koala) and is prevented from straying or causing other nuisance.

The *Companion Animals Act 1998* also provides for Council to prohibit dogs and cats on public land in certain circumstances for the purpose of protecting wildlife.

Local Government Act 1993

The *NSW Local Government Act 1993* establishes and directs the functions of local government. Koala management is a relevant consideration for councils as the Act includes the following requirement by way of the Council Charter:

to properly manage, develop,
protect, restore, enhance and
conserve the environment
of the area for which it is
responsible, in a manner
that is consistent with and
promotes the principles
of ecologically sustainable
development

The Act also requires Council to have in place an Integrated Planning and Reporting Framework to ensure Council operations and strategic planning are meeting the needs of the community. Within this framework, Council's Delivery Program and Operational Plan for 2015/2016 committed to preparation of a Comprehensive Koala Plan of Management for the shire.

PART 2

STRATEGY OPERATION AND APPLICATION

2.1 Name of the Strategy

This document is to be referenced as the Ballina Shire Koala Management Strategy 2016.

The Ballina Shire Core Koala Habitat Comprehensive Plan of Management is contained with the Strategy as Part 5.

2.2 Land to which the Strategy Applies

The land to which this Strategy applies is identified as the Koala Planning Area as shown in Figure 3.

The specific application of Part 4 and Part 5 of this Strategy relating to core koala habitat and other areas within the koala planning area is identified in each section.

Overall, the Strategy does not apply to:

1. Crown lands within the koala planning area that are dedicated as either a conservation reserve or a State Forest under the National Parks & Wildlife Act 1974 (NPW Act) and Forestry Act 1916 respectively.
2. Lands that are outside the koala planning area.

There may be areas of vegetation meet the criteria for identification as preferred or core koala habitat that are not contained within the koala planning area. These areas were not identified in the koala habitat study as a focal point for koala activity at the time of the habitat



study completed for the shire. Notwithstanding, these areas may still be subject to the provisions of SEPP 44 including the need to prepare Individual Koala Plans of Management.

2.3 Relationship to other Koala Plans of Management

The Strategy does not supersede any approved Koala Plans of Management that are currently in force in the koala planning area. Current approved and conditional Individual Koala Plans of Management (IKPOM's) are listed in Appendix 1. Should any of these IKPOM's have a requirement to be reviewed or updated, that review or update should match the aims and objectives, and management actions of this Strategy.

2.4 Duration of the Strategy

The Strategy is to remain in effect for a period of 20 years unless amended or superseded, but may be extended at the discretion of Council.

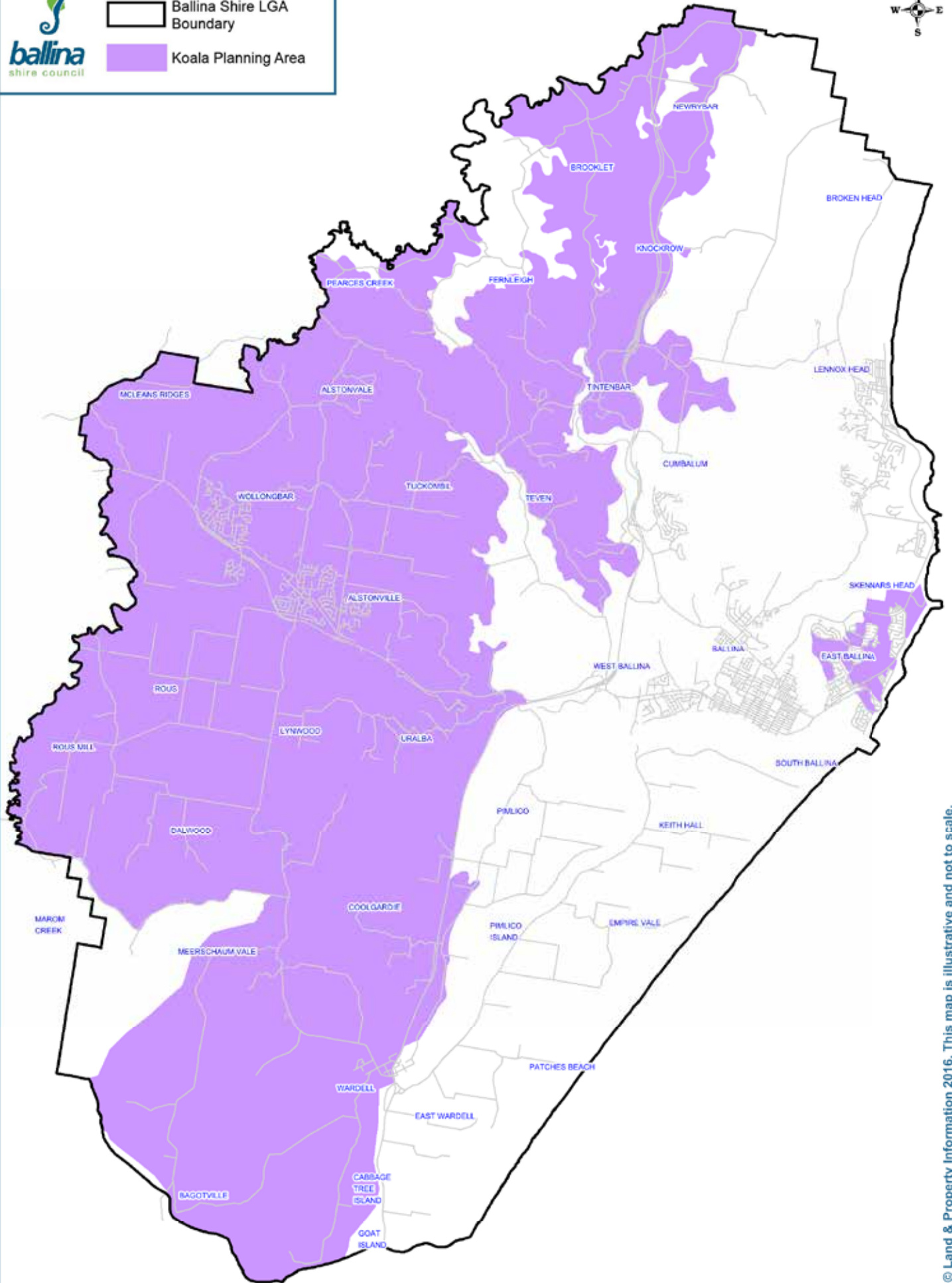
The Strategy is to be reviewed at five yearly intervals, including a comprehensive review at 10 years. The 10 year review must consider any periodic koala surveys, impacts of intervening infrastructure projects, new legislation and management actions taken in meeting the aims, objectives and expected outcomes of the Strategy.

Notwithstanding, the Strategy may be reviewed at any time at the discretion of Council.



Legend

- Ballina Shire LGA Boundary
- Koala Planning Area



© Land & Property Information 2016. This map is illustrative and not to scale.

Figure 3 Koala Planning Area - Ballina Shire

PART 3

KOALA MANAGEMENT PRECINCTS



Photo: Maria Matthes 

3.1 Precincts Overview

This Strategy provides for three koala management precincts, within the Koala Planning Area (Figure 3). The precincts have been developed based on the recommendations made in the habitat study for the shire and the subsequent habitat mapping undertaken to support this Strategy. The philosophy behind their selection has been to identify the locational characteristics of koala habitat and the koala population, as well consider existing land use and future land management.

This has resulted in the identification of three precincts managing different aspects of the Ballina koala population, each with a slightly different objective for long-term land management but each with the overall objective of supporting this Strategy's vision of a self-sustaining, long-term koala population in Ballina Shire. The role of the precincts is to provide for a specific management focus for populations within the defined geographic areas.

The precincts are illustrated in Figures 4, 5 and 6 and addressed in further detail below.

It is possible that during the life of this Strategy that koala management precincts may change or expand.

3.2 Southern Koala Management Precinct

The principal objective of this precinct is that of ensuring that the koala population can continue living in the area. To this end, the management objectives for this precinct are to:

- a. Retain koala habitat and food trees.
- b. Build on the above to extend linkages to other preferred koala habitat.
- c. Reduce the incidence of koala mortality by addressing key threats such as habitat loss and fragmentation, road strike and dog attack.
- d. Support the occupation of the broader landscape within the Important Population Area by koalas in the form of a self-sustaining population.

This precinct is the main area in which regulatory provisions are proposed to support retention of koala habitat. This is because the Southern KMP is the core area in which the koalas of Ballina Shire live. Remnant vegetation on lenses of residual soils within poorer erosional soils on slopes provide core koala habitat now, as well as previously providing a refuge from the large clearing events of the early to mid-1900s. The objectives of this KMP are therefore intended to retain koala habitat over time, encouraging the long-term preservation of remaining habitat. Areas that do not currently support trees may provide landholders with an opportunity to engage in the planting of koala habitat. Such planting may create linkages between areas of existing habitat important for this KMP.

Whilst the precinct currently exhibits some good contiguous vegetation with ecotones between topography, soil types and groundwater conditions (with koalas occupying this vegetation between Bagotville, Wardell, Uralba and Rous), construction of Section 10 of the new Pacific Highway has been approved to longitudinally transect this vegetation.

The koala population within the Southern KMP is an 'Important Population' under the provisions of the *Environmental Protection and Biodiversity Conservation Act* (1999). The approval issued by the Federal Government in relation to the highway upgrade notes that a Koala Management Plan must be prepared for Section 10 of the Pacific Highway upgrade to ensure that an unacceptable impact will not occur to the Ballina koala population. This condition indicates the importance of the objective of ensuring that the koala population is supported to continue living in and colonising from the area.

Even without the possibility of issues posed by the Pacific Highway, current figures suggest that the population is experiencing mortality rates of up to 20% per annum. Fifty percent of the mortalities currently experienced within the koala population are due to dog attack, often domestic dogs, and vehicle strike (pers. comm. S. Phillips). Two main cohorts of the koala population are missing from the demographic profile. These are the sub-adult males who are typically the most mobile cohort whilst looking for an unoccupied home range, and older males, who again are relatively more mobile.

3.3 Plateau Koala Management Precinct

The principal objective of this KMP is to support the ongoing viability of the Plateau population in a highly fragmented and working farmland landscape. This area traditionally supported Big Scrub vegetation and is additionally identified as an area of State and Regionally Significant agricultural land. As part of the agricultural history of the area, eucalypt windbreaks were predominantly planted on properties engaged in horticulture during the 1980s on properties predominantly engaged in horticulture. These windbreaks now support up to 30% of Ballina's koala population.

With respect to this KMP, the management objectives of this precinct are to:

- a. Minimise threats to the persistence of the population
- b. Support collaboration between landholders and the community to manage koalas living in windbreaks and isolated pockets of vegetation on the Alstonville Plateau
- c. Identify strategic areas for planting of transitional linkage vegetation
- d. Monitor the use of the area by koalas – that is, in terms of its permanent koala residents and those using the area as a transport corridor – to determine longer-term outcomes for this KMP.

It is understood that many of the trees in which koalas live in this KMP were planted by farmers in response to tree giveaways of Tallowood and less often, Forest Red Gum, during the 1980s and 1990s. These species are not native to the vegetation communities which would previously have grown on the Plateau, but the fertile soils have resulted in long planted avenues of particularly nutritious trees, which have been, and are being, utilised by koalas.

Habitat in this KMP is also held in small pockets of highly fragmented remnant vegetation, supplementing the koala food trees found in windbreaks. Landscape scale changes have significantly modified the Plateau and surrounding landscapes due to widespread clearing. Koalas are now utilising a niche which has effectively replaced habitat areas in which they previously lived.

Over time, it is envisaged that a collaborative approach to managing the availability of koala habitat will result in an increase in areas which are not utilised for agricultural purposes providing koala habitat.

3.4 East Ballina Koala Management Precinct

The East Ballina KMP recognises the presence of a very small population, the establishment of which probably preceded construction of the recently upgraded Pacific Highway Ballina Bypass. Little is known about koalas in this area, particularly their capacity to persist as a viable population. Management actions within this Strategy aim to improve understanding and monitoring of the koala population in East Ballina, to inform reviews of this Strategy and support development of future management objectives.

With respect to this KMP, the management objectives of this precinct are to:

- a. monitor the use of the area by koalas with the aim of reviewing the provisions of this Strategy for this KMP if required
- b. minimise threats to the persistence of the population.

Most vegetated land is held in public ownership here, although the only mapped area of Primary Koala Habitat is situated at North Angels Beach. There are likely adverse impacts from road strike and uncontrolled domestic dogs. Management actions will focus on these aspects in the initial phase of the Strategy's implementation.

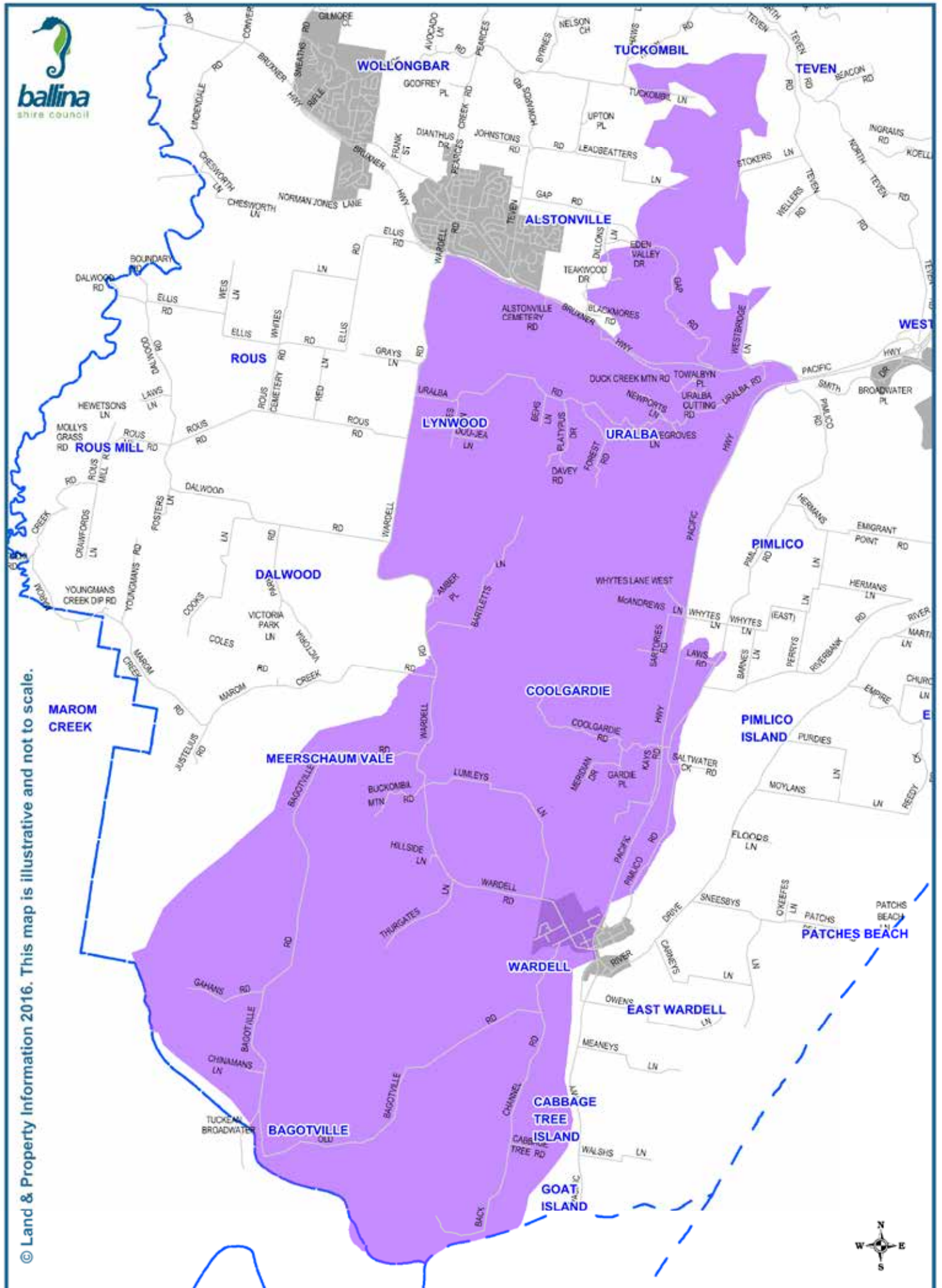
3.5 Special Considerations

Windbreaks on the Alstonville Plateau and some habitat areas within East Ballina, respectively, are identified as Preferred Koala Habitat. They have not been identified as Core Koala Habitat despite supporting koalas over at least 3 koala generations for the following reasons:

- windbreaks on the Alstonville Plateau are typically exempt from clearing regulation due to their location, function and occurrence on agricultural lands. Notwithstanding this, their importance to the ongoing existence of approximately 30% of the Ballina LGA's koala population is evident.

- the East Ballina population is very small, approximately 3 or 4 individuals. This may not be a sustainable population in itself without support, and the population's ability to persist long term in this area is not clear.

Whilst the decision has been taken to place a greater planning emphasis on the Southern KMP as Core Koala Habitat, this does not mean that koalas living in the Plateau KMP or the East Ballina KMP's (see below) are not a focus of this Strategy. Core koala habitat, in areas of native vegetation, may be present in these areas upon investigation. These areas remain the subject of the provisions of SEPP 44 and the requirements of local planning instruments and policy. An Individual KPOM, studies and/or impact assessment may be required for proposed developments in certain circumstances.



© Land & Property Information 2016. This map is illustrative and not to scale.

Figure 4 Southern Koala Management Precinct

© Land & Property Information 2016. This map is illustrative and not to scale.

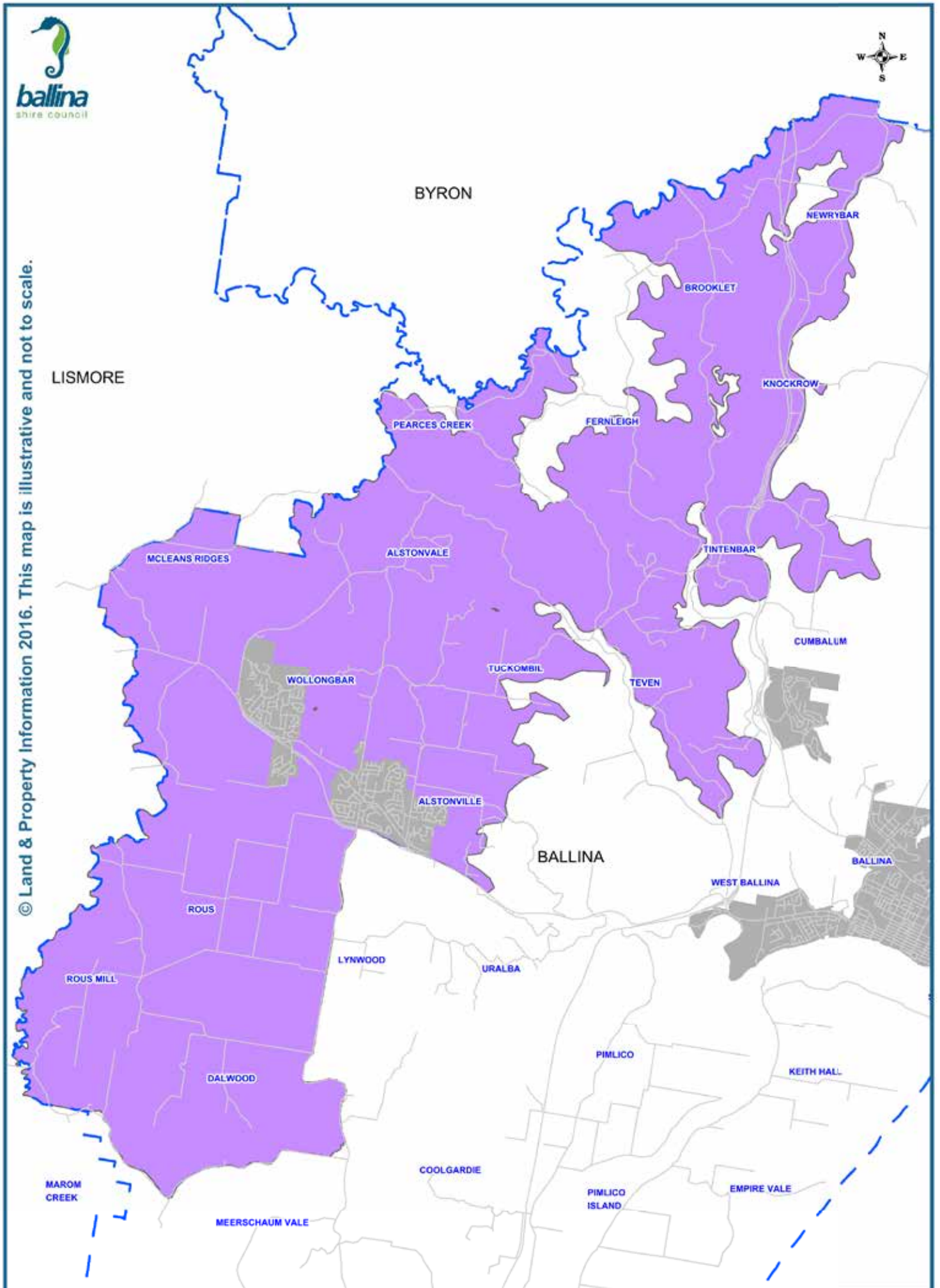


Figure 5 Plateau Koala Management Precinct

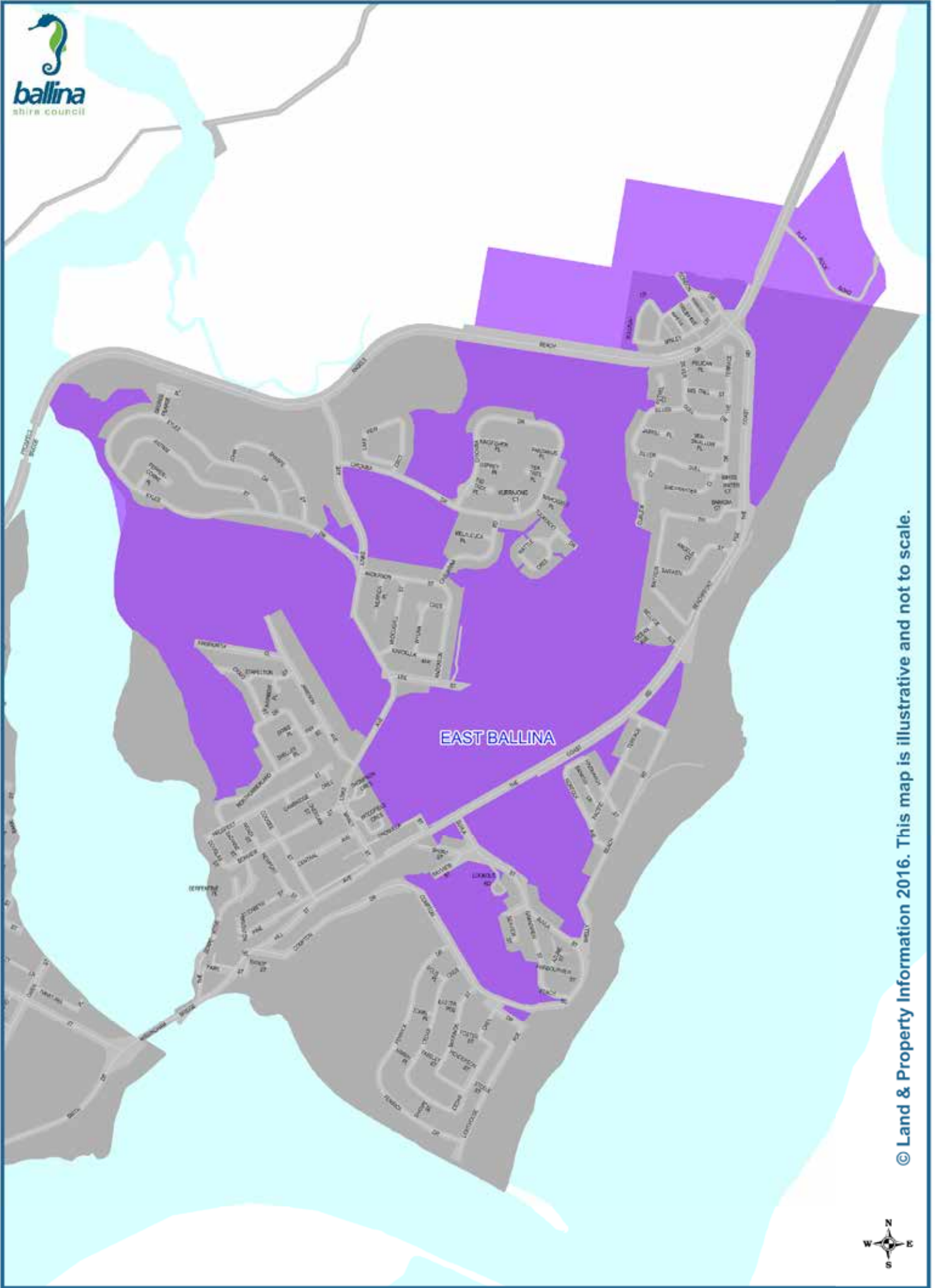


Figure 6 East Ballina Koala Management Precinct

PART 4 PREFERRED KOALA HABITAT



Photo: Maria Matthes 

4.1 Application of this Part

This part of the Ballina Shire Koala Management Strategy identifies areas of preferred koala habitat in the koala planning area.

The preferred koala habitat mapping forms the basis for the identification of core koala habitat in the Southern Koala Management Precinct.

The application of the preferred koala habitat mapping and the assessment of other vegetation and wildlife corridors in relation to koalas (outside areas identified as core koala habitat) is to be addressed as part of Council's local planning framework through the local environmental plan and/or the development control plan (see actions under "Regulatory Processes" in Part 6).

4.2 Preferred Koala Habitat Definition

For the purpose of this Koala Management Strategy, Preferred Koala Habitat is defined as vegetation that is classified as primary koala habitat, secondary (class A) koala habitat, secondary (class B) koala habitat and secondary (class C) koala habitat.

Areas shown as preferred koala habitat in the habitat mapping accompanying this Strategy all support or contain one or more of the preferred food tree species that are important to the Ballina koala populations. This is based on an assessment of vegetation community types as opposed to a 'property by property' based analysis. That is, where 15% of the total number of trees in the upper or lower strata of the tree component, for each specific ecological community, are koala food trees, then vegetation in that location is regarded as Preferred Koala Habitat.

It is possible, therefore, that part of a property may constitute koala habitat because it is part of a particular vegetation community, and that another part of the property is defined differently for the purposes of SEPP 44 because it supports a different vegetation community. Additionally, vegetation classified as “Other habitat” may still play an important role for koalas.

4.3 Preferred Koala Habitat Explanation and Mapping

Existing vegetation mapping undertaken by Council staff, along with koala surveys undertaken as part of the 2013 Koala Habitat Study and additional field work and mapping for this Strategy, have been utilised to determine the following:

- The presence or absence of koala food trees and their correlating vegetation communities
- The presence or absence of koalas
- The relationship that can be inferred between the presence of koalas and particular vegetation communities.

This field work has then been reviewed in the context of the geomorphological attributes of the koala planning area at a landscape scale to further determine correlations between vegetation, soils, and geomorphology and the habitat preferences of koalas.

The map of preferred koala habitat for the shire is shown in Figure 7. The complexity and interconnectedness of the different vegetation classifications illustrate how the koala uses the landscape in full, and how the population is dependent on the different vegetation communities within the

landscape. More information is available from the 2013 Ballina Koala Habitat Study.

The Koala Habitat Study and subsequent habitat mapping has informed the development of the koala management precincts, as well as the actions outlined in this Strategy to support the Ballina Shire koala population.

In summary, habitat categorisations used in this Strategy (Table 4) are based on the presence/absence of preferred koala food trees and their geomorphological location within the landscape. To this end the terms “Primary”, and “Secondary” koala food tree species as used in the following definitions are based on the mathematical models and associated definitions of Phillips (2000b) and are thus consistent with terminology used in the approved NSW Recovery Plan for the Koala (DECC 2008).

Ongoing analyses of koala activity data from low nutrient substrates (Phillips and Allen 2014) established the basis for further partitioning of Secondary (Class B) habitat based on differences in the relative abundance of identified Secondary food tree species. Specifically, vegetation communities wherein secondary food tree species are a dominant or co-dominant component of the tallest stratum support significantly higher koala activity levels (and hence have a higher koala carrying capacity) than do vegetation communities wherein secondary food tree species occur at lower densities (Phillips and Allen 2014). This knowledge has resulted in the need to recognise a further habitat category - Secondary (Class C) Koala Habitat - as described in further detail in Table 4.

Table 4 Koala Habitat Categorisations

HABITAT CLASS	EXPLANATION
Primary Koala Habitat	Vegetation communities occurring on soils of medium to high nutrient value whereupon primary koala food tree species are dominant or co-dominant (i.e. $\geq 50\%$) components of the tallest stratum species.
Secondary (Class A) Koala Habitat	Vegetation communities occurring on soils of medium to high nutrient value whereupon primary food tree species are sub-dominant components of the tallest stratum species.
Secondary (Class B) Koala Habitat	Vegetation communities occurring on soils of low to medium nutrient value whereupon primary food tree species are absent, the tallest stratum instead dominated or co-dominated by secondary food tree species only.
Secondary (Class C) Koala Habitat	Vegetation communities occurring on soils of low to medium nutrient value whereupon primary food tree species are absent and secondary food tree species are sub-dominant components of the tallest stratum species.

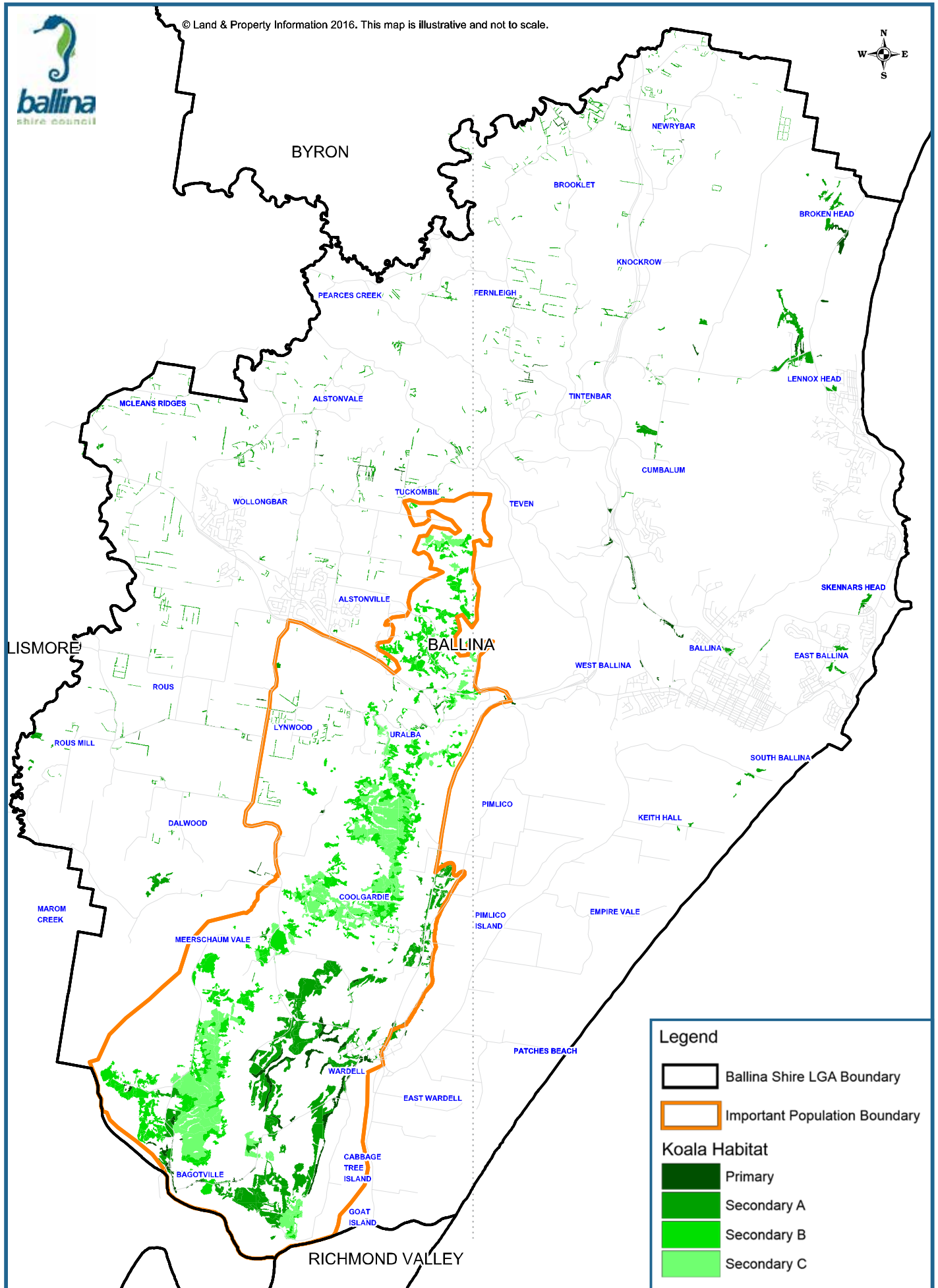


Figure 7 Preferred Koala Habitat Map for Ballina Shire

Each of the preceding classifications reflect the different koala carrying capacities of the associated vegetation communities, with areas of Primary Koala Habitat capable of sustaining high density populations (i.e. > 0.5 koalas ha⁻¹), whereas Secondary (Class C) Koala Habitat will sustain low density populations (i.e. < 0.1 koalas ha⁻¹).

Collectively, the four habitat classifications function to identify areas of Preferred Koala Habitat. As a component of this classification system a habitat code of "Other Habitat" was generally applied to those communities wherein koala food tree species were absent. The "Other Habitat" classification should, however, not be taken to mean that koalas do not live in, or use, these areas.

There are many variables contributing to the distribution of koalas within a landscape. The limited extent of remaining patches of Primary Habitat within the Southern KMP does not reflect the complex nature of the landscape in terms of its ability to support the Important Population that has been identified as resident there. In the Southern KMP, all types of koala habitat and the surrounding vegetation network is important for the continued occupation of the landscape by koalas. The importance of existing vegetation regardless of type and class is also illustrated by the extent of fragmentation in Ballina Shire.

This Strategy is designed to work at a landscape level whilst acknowledging the significance of smaller areas of habitat and the role played by individual trees and species. Management actions within this Strategy are written with the intention to retain the existing complexity of vegetation landscapes and increase the connectivity between those areas which are already vegetated and supporting koalas. This approach is consistent with the application of the precautionary principle and the categorisation methods recommended in the NSW Recovery Plan for the Koala (DECC, 2008).

Koalas living in Ballina Shire on the Alstonville Plateau are primarily dependent on windbreak plantings of Tallowwood (*Eucalyptus microcorys*) or Forest Red Gum (*Eucalyptus tereticornis*). These plantings support a significant number of animals both in residence and in transit to other locations. Due to their location, function and presence on agricultural lands there is typically no

regulatory role for Council in managing these windbreak areas.

Disruption (such as clearing or a mass dying out) of the windbreaks over time is a threat to koala populations that have established themselves in these areas, given the importance of the long-term relationship koalas have with their home range (Mitchell, 1990; Phillips, 1999 as referenced in Phillips 2013). A number of the management actions noted in this Strategy are designed to address this.

As referred to above, a large portion of mapped vegetation is mapped as "Other Habitat". In addition to the possibility of the lack of preferred koala food trees being a reason for this classification, it may also mean that there was insufficient data to enable classification due to the resolution of the mapping. It is possible, therefore, for these areas to support koala food trees and koalas.

Preferred koala food trees scattered across largely cleared land in and around vegetation communities may also be identified and mapped as preferred koala habitat.

PART 5

BALLINA SHIRE CORE KOALA HABITAT COMPREHENSIVE PLAN OF MANAGEMENT

5.1 Legislative Context

This comprehensive koala plan of management (being Part 5 of the Ballina Shire Koala Management Strategy) has been prepared in accordance with State Environmental Planning Policy No.44 and the associated guidelines published by (the former) Department of Urban Affairs and Planning (1995) and National Parks and Wildlife Service (1999) as well as contemporary understandings of koala ecology and management. The plan also has regard for the approved Recovery Plan for the Koala in NSW (DECC, 2008).

This Plan was adopted by Ballina Shire Council by resolution on 24 March 2016.

This Plan was approved by the Department of Planning and Environment under the terms of SEPP 44 on 6 July 2017.

The Plan commenced operation under the terms of SEPP 44 on 6 July 2017.



Photo: Maria Matthes 

5.2 Where does this Plan apply?

The provisions of this plan apply to:

1. Land identified as containing core koala habitat as defined in Section 5.3 and shown on the Core Koala Habitat Map included as Figure 8 in this Plan, and
2. In relation to the entire land parcel, land that has an area of more than 1 hectare, or has, together with any adjoining land in the same ownership, an area of more than 1 hectare.

5.3 Core Koala Habitat Definition

The stated objective of SEPP 44 is to *“to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas to ensure a permanent free-living population over their present range and reverse the current trend of koala population decline”*.

The definition of Core Koala Habitat within SEPP 44 means *‘an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population’*.

Koalas have a long recorded residence time in the Southern KMP, and their contemporary presence has also been comprehensively mapped (2013) as well as being subject to ongoing monitoring. Specifically, the Ballina Koala Habitat Study (Phillips and Chang, 2013) notes that:

- the extent of occurrence of koalas across the LGA has expanded by 24% over the last 3 koala generations
- the Southern KMP appears to be a significant source population for regional population recovery over past 60 years
- approximately 70% of the Ballina LGA koala population lives within the Southern KMP, which exposes the LGA's population as a whole from a risk management point of view.

There is a very clear link between the habitat available and the ongoing persistence of koalas, including breeding females, in this location. The habitat study and subsequent investigations in the area have demonstrated both a contemporary and an historic presence of a koala population throughout the Southern KMP area. The identification of Core Koala Habitat that meets the requirements of SEPP 44 has involved the juxtaposition of areas of generational persistence and contemporary evidence of koala activity derived from the field surveys.

Having regard for the outcomes of the koala population and habitat assessment undertaken in Ballina Shire, all areas of Preferred Koala Habitat within the full geographic extent of the Southern Koala Management Precinct (Figures 4 and 7) is defined as Core Koala Habitat under this Plan. The extent of Core Koala Habitat to which this plan applies is shown in Figure 8.

The above approach is further reinforced as this population has been identified for the purposes of the EPBC Act (1999) as an Important Population.

5.4 Development Assessment Framework

5.4.1 When is the Development Assessment Framework Triggered?

The development assessment framework of this Plan only applies to development activities that require development consent under the Ballina Local Environmental Plan 1987, the Ballina Local Environmental Plan 2012 or another applicable

environmental planning instrument under the *Environmental Planning and Assessment Act* (Figure 9).

Development activities that are permitted without consent under an environmental planning instrument, including development classified as exempt or complying development do not require a development application. Such activities do not trigger the application of this Plan and do not need to comply with the Plan.

Notwithstanding the above, management actions in Part 6 require the application of the standards under this part as a matter of policy in relation to LEP amendments and development the subject of Part 5 of the *Environmental Planning and Assessment Act* where administered by Council.

5.4.2 Information Required with Applications for Development Consent

5.4.2.1 Instances where no clearing is required (No Clearing)

If the proposed development does not involve clearing of vegetation (defined as the removal of trees greater than 3m in height and/or greater than 100mm diameter at breast height above bark) within any mapped area of core koala habitat, the following is required:

- An assessment addressing any likely indirect impacts that the proposal may have on core or preferred koala habitat, koala movement corridors or koala activity in accordance with section 5.5.2 of this Plan.

When determining whether a proposed development will involve the clearing of vegetation, all consequential clearing likely to be associated with the development, such as clearing required for access or bushfire management, must be included.

5.4.2.2 Instances where clearing of vegetation is required (Clearing)

If the proposed development involves clearing of vegetation (defined as the removal of trees greater than 3m in height and/or greater than 100mm diameter at breast height above bark) within any mapped area of core koala habitat, the following is required:

- An assessment of the impact of the proposed development on koalas and koala habitat in the form of a Koala Habitat Impact Assessment Report that is informed by a Koala Habitat Survey (in accordance with 5.4.2.3 and 5.4.2.4).

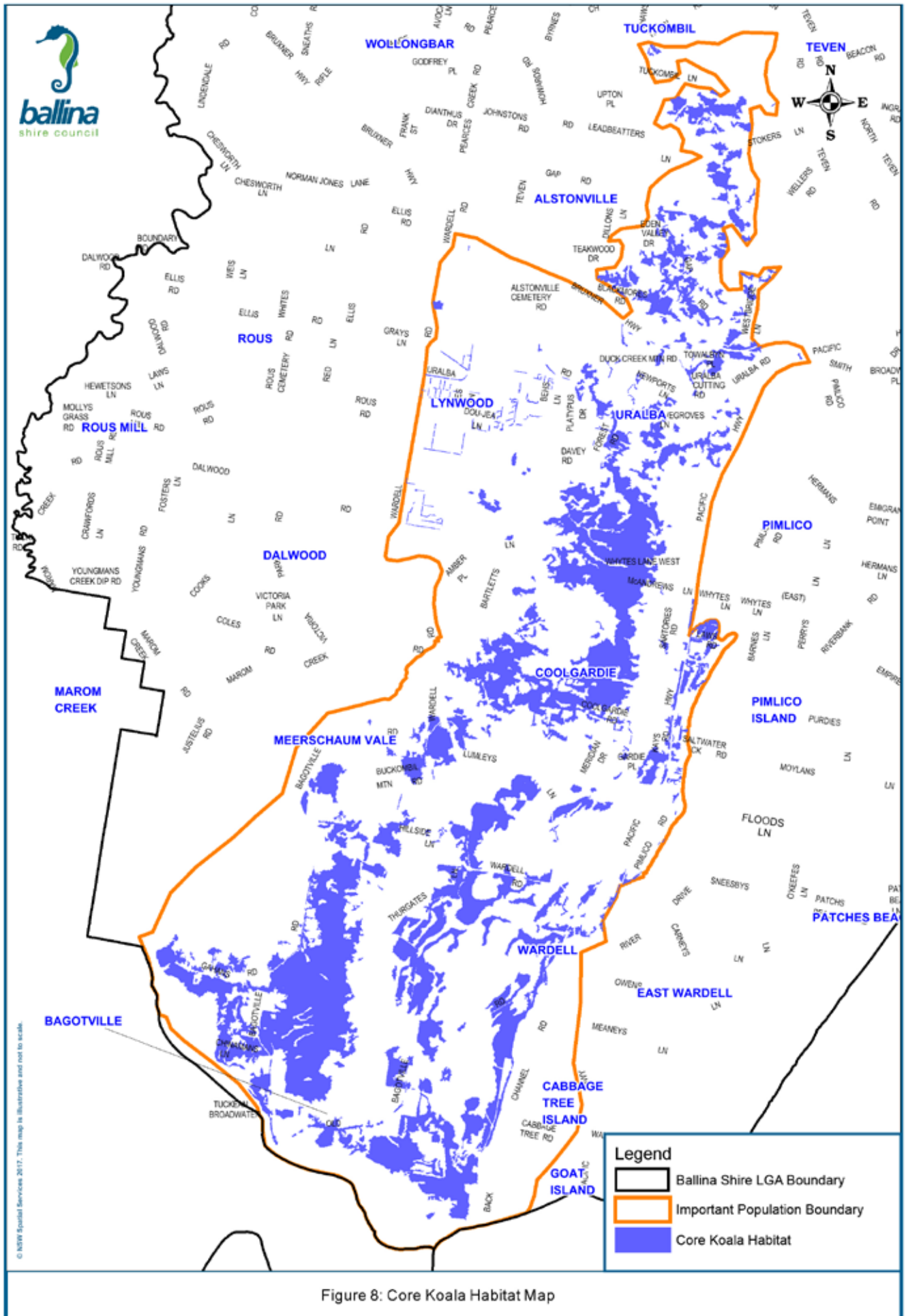
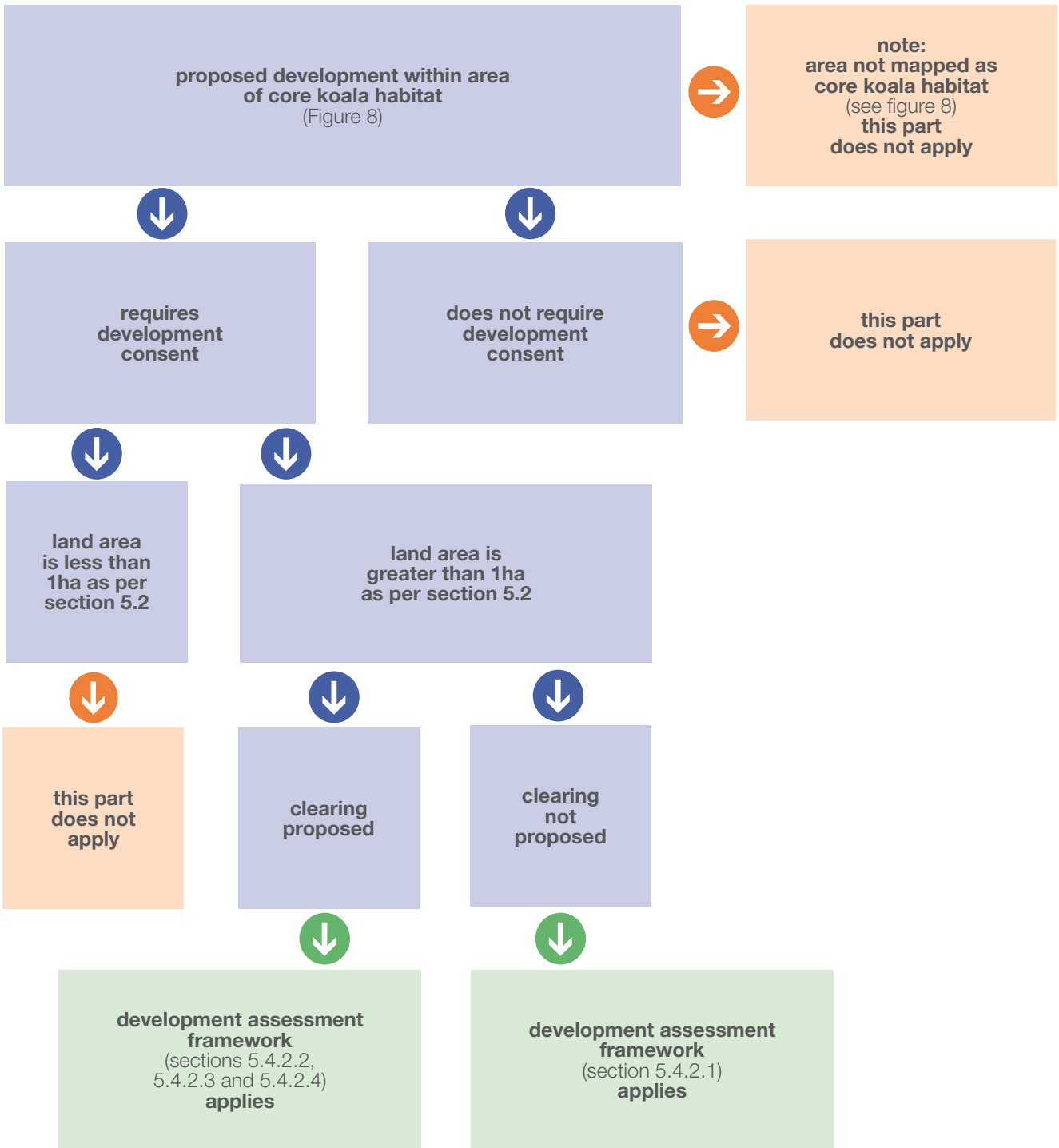


Figure 8: Core Koala Habitat Map

Figure 8 Core Koala Habitat Map

Figure 9 Application of Development Assessment Framework under this Part



5.4.2.3 Koala Habitat Survey

A koala habitat survey must detail the location and extent of the following:

- a. preferred and core koala habitat for any development areas (including areas for associated infrastructure, access and the like) greater than 0.2ha
- b. the location of all koala food trees greater than or equal to 100mm diameter at breast height over bark within any development areas and an associated 20m radius
- c. the location of any recorded sighting of koalas or evidence of koalas within any development areas.

The survey must incorporate the Scat Assessment Technique (SAT) and Regularised Grid-based SAT (Rg-bSAT) methodology (Phillips and Callaghan 2011) as

the standardised sampling tool for determining koala activity and preparing koala habitat impact assessment reports. A guide to the application of this methodology as it relates to this Plan is contained in Appendix 2.

The results of the koala habitat survey must be incorporated into a Koala Habitat Impact Assessment Report and represented in a spatially mapped format in association with explanatory text.

5.4.2.4 Koala Habitat Impact Assessment Report

A koala habitat impact assessment report must be prepared in accordance with the structure set out in Table 5. This includes the address of the matters for consideration set out in section 5.5.

A koala habitat impact assessment report must be prepared by a suitably qualified person.

Table 5 Koala Habitat Impact Assessment Report – Required Content and Format

1.0 BACKGROUND
Describe the nature of the proposed development
Identify the applicable elements of the Ballina Local Environmental Plan (1987 and/or 2012) and the Ballina Shire Development Control Plan 2012, including land use zoning for the subject land and its surrounds.
Outline the context in which the report is being prepared.
2.0 LINKS TO LEGISLATION, OTHER PLANS AND DOCUMENTS
Demonstrate how the report addresses relevant legislation, local, regional and state plans and documents that relate to the proposed development.
3.0 GENERAL DESCRIPTION - STUDY AREA
Identify the location and extent of the study area to be covered by the report, including the proposed development footprint and any other areas that may be directly or indirectly impacted by the proposed development. Depending on the scale of the development, some consideration of context may also be necessary.
Describe the type, extent and current condition of existing koala habitat in the study area. This should occur with reference to Council’s preferred and core koala habitat mapping and the Ballina Koala Habitat Study.
Describe the broader context of other vegetation in the study area and the landscape, including existing and potential corridor linkages.
Detail any environmental constraints and any significant or sensitive environmental features of the study area.

4.0 METHODOLOGY

Describe in detail the methodology used to survey the vegetation in the study area.

Identify how, where and at what intensities habitat is being utilised, as well as possible resident koalas.

Include a map or plan with a grid overlain to identify initial and detailed RG-bSAT sampling sites.

5.0 RESULTS

Provide an accurate map or plan detailing the location of:

- The subject site, proposed development footprint, associated infrastructure and any requirement for an asset protection zone.
- All vegetation communities, including koala food trees and any areas of Preferred Koala Habitat or Core Koala Habitat.
- Any koala food trees and/or koala habitat proposed to be directly and/or indirectly impacted, removed, regenerated and/or revegetated. Each of these trees should be shown on the map marked with a unique identifier.
- Any recorded sightings of koalas or evidence of koala activity.

Provide a table detailing:

- The area of all vegetation by vegetation type (including koala habitat), identifying any area of vegetation to be removed, regenerated or revegetated.
- The species, size class (<100mm dbhob, 100-250mm dbhob and >250mm dbhob) and number of food trees that are proposed to be removed, lopped or permanently isolated from koala use.

6.0 IMPACT ASSESSMENT

Interpret and discuss the results of the koala habitat assessment.

Identify and assess the known or potential direct and indirect impacts of the proposed development on koalas and koala habitat.

Address the matters for consideration set out in sections 5.4, 5.5 and 5.6 of the Ballina Shire Core Koala Habitat Comprehensive Plan of Management.

Include discussion on alternative options considered and why these options have been identified as not feasible.

Outline compensatory habitat and other mitigation measures proposed to address impacts on koala habitat and koalas.

7.0 CONCLUSION

Identify any limitations to the assessment, and further issues which may need to be addressed.

Provide a summary of the findings of the assessment report including mitigation measures that are proposed.

8.0 REFERENCES

Include a list of all references cited in the report.

9.0 APPENDICES

Include any additional information or supplementary material pertinent to the development proposal.

5.5 Matters for Consideration

5.5.1 Impact Assessment – Proposed Development Involving Clearing

Except as provided for under Sections 5.2 and 5.4.1, the following heads of consideration must be addressed by the proponent and the consent authority in relation to any development application for development of land containing core koala habitat that involves clearing.

5.5.1.1 Potential direct and indirect impacts on food trees and/or koala habitat

Council may grant development consent only if it is satisfied that the development:

- a. does not result in any net loss of food trees and/or koala habitat
- b. is located, designed, constructed, and managed to avoid adverse impacts on food trees and/or koala habitat
- c. does not result in the loss of any koala food tree that is actively used by koalas as determined through the Koala Habitat Survey except as provided for under Section 5.6.

Note: This plan provides opportunities for habitat compensation as a Strategy for demonstrating compliance with subclauses a, b and c.

5.5.1.2 Maintain habitat linkages and safe koala movement

Council may grant development consent only if it is satisfied that the development:

- a. maintains any linkages between areas of koala habitat across the landscape
- b. maintains any koala movement corridors across the study area
- c. does not result in development which would impede safe koala movement across the landscape
- d. incorporates measures into its design and construction that provide for the safe movement of koalas
- e. considers the need and potential to improve koala movement corridors and habitat connectivity.

5.5.1.3 Location of bushfire asset protection zones

Council may grant development consent only if it is satisfied that any necessary bushfire asset protection

zones to be created do not result in the clearing of food trees and/or koala habitat unless such clearing has been specifically addressed and compensated for as part of the assessment of the proposed development.

5.5.1.4 No-build zones

Council may grant development consent only if it has considered the following relative to avoiding adverse impacts on koala food trees or koala habitat and the achievement of objectives of the objectives of the Southern Koala Management Precinct:

- a. establishing no-build zones of a minimum 15 metres distance from the trunk of retained trees such that retained trees do not pose a future hazard to persons or property
- b. precluding the construction of dwellings and buildings and the like within no-build zones
- c. identifying the location of any no-build zones on the deposited plan and registering them as a restriction on the land title.

5.5.1.5 Retention of replacement trees and/or koala habitat

Council may grant development consent only if it is satisfied that:

- a. where food tree replacement measures or habitat compensation measures are proposed,
 - i. measures are in place to ensure the long-term retention of replacement food trees and/or koala habitat
 - ii. such measures may include the erection of exclusion fencing and/or covenant restrictions on title.

Note: Council may apply a deferred commencement clause to allow time for the replacement food trees and/or koala habitat to establish sufficiently to support wildlife, including koalas.

5.5.1.6 Protection of koalas, food trees and koala habitat during construction works

Council may grant development consent only if it is satisfied that the following measures are in place to ensure retained food trees and/or koala habitat is/are protected during construction works on the site:

- a. establishment of a tree protection zone beyond the outline of the canopy of any retained food trees
- b. erection of temporary koala fencing around the tree protection zone of any retained food trees to

- protect retained trees during construction works
- c. erection of signage to provide clear and accessible information to indicate that a tree protection zone has been established
- d. preclusion of activities such as construction, excavation, storage of materials and the parking of vehicles and plant within any tree protection zone.

Where approved clearing of vegetation is proposed, development consent may be granted only if Council is satisfied that measures are in place to ensure that:

- a. on the day of clearing and prior to any clearing taking place, all trees within 30 metres of those trees to be cleared are to be inspected for the presence of koalas from at least two locations by an accredited person experienced in koala spotting (and not involved in the vegetation clearing works)
- b. should koalas be found on site during the clearing of native vegetation and/or earthworks the works:
 - i. will be temporarily suspended within a range of 30 metres from any tree which is occupied by a koala
 - ii. will avoid any area between the koala and the nearest areas of habitat to allow the animal to move to adjacent undisturbed areas
 - iii. will not resume until the koala has moved from the tree of its own volition.

5.5.2 Indirect Impact Assessment – All Proposed Development

The following heads of consideration must be addressed by the proponent and the consent authority in relation to any development application for development of land containing core koala habitat.

5.5.2.1 Lot boundary fencing

Council may grant development consent only if it is satisfied that any new lot boundary fencing on land containing, or adjacent to, core koala habitat does not impede safe koala movement across the subject site.

Notes:

Fences that do not impede safe koala movement may include:

- hedges or screens of trees and/or shrubs
- fences where the bottom of the fence is a minimum of 300 mm above the ground to allow koalas to freely move underneath

- fences that are easy for koalas to climb (e.g. sturdy chain mesh fences not topped by barbed wire, or solid style fences with a timber 'post and bridge' system over the fence at regular intervals of less than 20 metres)
- open post and rail fences
- post and 4 or 5 strands of plain wire, barbed wire or some combination of plain and barbed wire, where the bottom strand of wire is a minimum 300 mm above the ground at any in-line fence post and/or dropper.

For land where livestock agriculture is a permitted activity, the design of new lot boundary fencing is subject to the landholders' requirements to secure livestock; however, this does not remove responsibility to seek safe koala movement by use of a fence that will meet the requirements of this provision.

5.5.2.2 Swimming pools

Council may grant development consent for the installation of swimming pools on land containing or adjacent to core koala habitat only if it is satisfied that the pool design:

- a. incorporates features that allow koalas to easily escape from the pool, namely, a shallow ramp and/or a stout rope (minimum 50 mm diameter) that trails in the pool at all times and is secured to a stable poolside fixture
- b. includes a type of fence that excludes entry by koalas, notwithstanding the provisions of the Swimming Pools Act 1992
- c. excludes shrubs and/or trees, within 1m of the pool fence, that koalas could use to climb over the pool fence.

Notes:

Fences constructed of timber or that have timber posts will not usually meet the requirements of subclause b.

This clause does not apply to the installation of farm dams.

5.5.2.3 Keeping of domestic dogs

Council may grant development consent to a proposal on land containing or adjacent to core koala habitat only if it is satisfied that:

- a. the movement of domestic dogs is restricted by a lot boundary fence or internal dog enclosure that effectively contains dogs and excludes koalas
- b. pursuant to subclause a, any fence that is intended

to contain dogs and exclude koalas should be located more than 2 metres away from any trees that koalas could use to cross the fence

- c. measures used to provide for compliance with subclause a are not in conflict with the provisions under 5.5.2.1 (that is the requirements of 5.5.2.1 prevail).

5.5.2.4 Road design standards

Council may grant development consent to proposals on land containing or adjacent to core koala habitat only if it is satisfied that the proposed development has made provision for:

- a. appropriate road design standards, warning signage, traffic calming devices, and roadside lighting which restrict motor vehicles to a maximum speed of 40 kilometres per hour within the subject site where possible
- b. appropriate measures to exclude koalas from roads and minimise the likelihood of impediments to safe koala movement in the case of roads where the maximum speed of motor vehicles must be greater than 50 kilometres per hour in urban areas or greater than 60 kilometres per hour in rural areas

Note:

Specifications for road design standards, signage, koala exclusion fencing, underpasses, traffic calming devices and any other mitigation measures must be included with the development application documentation.

- c. the maintenance of any mitigation measures detailed in relation to the above.

5.6 Habitat Compensation and Offsetting

Where compensatory measures or offsets are proposed to mitigate impacts associated with the removal of koala food trees or koala habitat, the compensatory habitat must be considered and provided in accordance with the Koala Habitat Compensation Policy set out below.

KOALA HABITAT COMPENSATION POLICY

Background

This policy details the provisions for the offsetting of impacts on koala habitat resulting from development activities. The provisions aim to provide a transparent framework for the planning and assessment of an offset proposal where there are unavoidable residual impacts from a proposed development activity.

The provisions are informed by the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Environmental Offsets Policy and other koala management strategies and comprehensive koala plans of management in NSW.

What are offsets?

Offsets are measures that compensate for adverse impacts of development on koalas or on the quantity, quality and connectivity of koala habitat. Offsets are only considered when all options to avoid or mitigate impacts on koalas and koala habitat have been considered.

What types of impacts require offsetting under the Policy?

While there are a range of potential impacts resulting from development proposals, this Policy only allows offsetting of removal of koala food trees and koala habitat in limited circumstances.

Other impacts such as increased exposure to dogs, vehicles, fire or other recognised threats are required to be avoided or mitigated and are unable to be offset under the Plan.

What types of offsets are applicable under the Policy?

This policy requires the use of direct offsets resulting in a measurable conservation gain for koalas and

koala habitat. The use of threat reduction measures or other compensatory measures (indirect offsets) are not acceptable under this Policy.

Offsetting is therefore limited to the creation of new koala habitat at a suitable location on the impact site, or an agreed offsite location, in accordance with the approaches listed below:

1. Provision of compensatory habitat in accordance with the compensatory habitat ratios contained within this koala habitat compensation policy.
2. Provision of compensatory habitat through an approved biobanking arrangement (or biodiversity offset scheme under the *Biodiversity Conservation Act 2016*) located within the Southern Koala Management Precinct.
3. Provision of compensatory habitat on public land (with the agreement of the landholder) that provides for:
 - a. A habitat compensation area equivalent to or greater than that required through the application of the NSW biobanking scheme (or biodiversity offset scheme under the *Biodiversity Conservation Act 2016*), and
 - b. Demonstrated direct benefit for at least three threatened species in addition to the koala, and
 - c. Ongoing maintenance of the compensatory habitat at the proponent's cost for a period of at least five years, and
 - d. Completion of the compensatory planting before commencement of the proposed development (including the commencement of any vegetation clearing).

Where possible, planting should occur on sites of similar fertility (refer *Soil Landscapes of the Lismore-Ballina 1:100000 Sheet*) and contiguous with other locations of preferred or core koala habitat.

Council will not approve offsite offsets where suitable land is available on the same allotment (or adjacent allotment in the same ownership) as the proposed development.

What are the steps to use offsets under the Policy?

Applications for development must provide all the required assessment information in relation to koalas as set out under the Ballina Shire Koala Management Strategy, the Ballina Shire Core Koala Habitat Comprehensive Koala Plan of Management and other applicable planning instruments and policy.

Any impact on koala habitat must be quantified and described.

Where provision of compensatory habitat is proposed as a mitigation measure, an offset proposal in accordance with this Policy must be developed and submitted with the development proposal.

Compensatory habitat ratios

This Policy provides offset ratios to enable direct calculation of offsets based on the residual impact as either number of trees or area of habitat lost (Table 1).

As an example for calculation purposes, if the offset ratio is 1:5, five trees must be replanted for every one lost. Or in the case of habitat, five times the area of habitat lost must be restored – that is 5ha of habitat should be restored for every hectare cleared.

The Important Population status of the koala in the Southern KMP is reflected in the offset ratios required for development within this area. Fragmentation of existing habitat has already affected the population (Phillips, 2013) and therefore there is a focus within this precinct of consolidating existing habitat and increasing connectivity and habitat quality.

The offset ratios herein reflect the significant risk associated with further impact on existing habitat. Further, the offset ratios required have been developed to take into account the:

- extent of correlation of the offset with the impact
- conservation gain from the offset
- time delay involved in achieving the gain
- level of certainty of success
- suitability of the location

- risk associated with achievement of the offset
- required performance measures.

Table 1 Habitat Compensation Ratios

LOCATION	COMPENSATORY HABITAT RATIO
Onsite	1:15
Offsite	1:15

Active koala food tree compensation requirements

An active koala tree may only be removed where compensatory habitat is provided in accordance with the following:

- a) new habitat is provided at a ratio of 2 times that specified in Table 1, and
- b) the compensatory habitat is actively maintained by the proponent for at least five years, and
- c) the compensatory habitat planting is completed 12 months prior to the commencement of the proposed development (including and clearing).

Offset principles

Offset principles are to be prepared in relation to:

1. The primary objective is to achieve no net loss of koala habitat. Offset plantings must protect and enhance, or create koala habitat.
2. Offsets, and particularly offsite offsets, must only be considered once all options to avoid, minimise and mitigate any adverse impacts have been exhausted.
3. Clearing is not a suitable outcome where the impact of clearing cannot be satisfactorily compensated.
4. Offset plantings must lead to a net gain in the area of koala habitat, and an improvement in the

condition of koala habitat.

5. The land receiving compensation works ('receiving land') must be ecologically suitable and appropriate for protection, enhancement or creation of koala habitat.
6. An activity that leads to the loss of koala habitat (especially clearing) should only proceed once the management arrangements on the receiving land are legally secure and arrangements are in place to ensure habitat plantings are at, or can with reasonable certainty reach, an appropriate size to support koalas (may be by way of conditions of consent, restrictions on title or other suitable mechanisms). The extent to which compensatory plantings need to be established prior to clearing is to be determined having regard for the nature and extent of impact arising from the clearing to be undertaken.
7. Compensation works must not lead to permanent adverse environmental impacts and must not be used as a justification for granting approval to a development where the adverse environmental impacts of a development are greater than the benefit to be obtained from the compensation works.
8. Management and monitoring of habitat compensation activities should be undertaken over an ecologically meaningful timeframe being at least five years.

Security of land tenure

Security of tenure for offsite sites is required and is best achieved through legal mechanisms that are permanent and secure. Acceptable options are:

- Application of a restrictive covenant under Part 6 (Division 4) of the Conveyancing Act 1919 to ensure that all areas contributing to the offset are protected from future development (including clearing) and managed for the ongoing benefit of koalas and their habitat.
- Dedicating the area to Council (if acceptable to Council) where the land can be secured for conservation purposes and agreement regarding management funding is achieved.
- Other mechanisms including a conservation land title covenant under the Nature Conservation Act

2001 or a voluntary planning agreement between Council or the NSW Department of Planning and the Environment and the proponent.

Offset management plan

An offset management plan is required for each offset site involved in an offsets proposal. Offset plans must address the following:

- A. The impact of clearing to be undertaken and subsequent offset ratios that have been applied to formulate the offset proposal.
- B. Objectives and outcomes for the offset site setting out the specific relationship with regard to the impact site's values and quality (include soils, aspect and the like).
- C. Mechanism to secure the offset site.
- D. Details of proposed revegetation to meet the required offset, including any tradeoffs required in terms of the quality of the habitat (ie Primary, Secondary A etc). As a minimum, revegetation should not result in habitat reconstruction of a lesser value habitat.
- E. Ongoing management and maintenance arrangements, including any timeframes.
- F. Monitoring and reporting requirements.
- G. Name and contact details of landholder/s.
- H. Property description (and associated mapping).
- I. Other supporting documentation.

The offset management plan must be signed by all relevant parties to the land ownership and ongoing management arrangements.

PART 6 MANAGEMENT ACTIVITIES

This section sets out the management activities that advance the objectives of this strategy.



Photo: Maria Matthes 

Broadly, the management activities are designed to:

- minimise threats to koalas and their habitat
- reduce anthropogenic caused koala mortality
- increase the amount of koala habitat in the koala planning area
- maintain and where possible improve the quality of existing koala habitat in the koala planning area
- ensure effective implementation and monitoring of the Strategy by Council.

Management activities to be conducted by Council to support the achievement of this Strategy's objectives are detailed in Table 6. The actions have been classified into the following categories: implementation and monitoring; regulatory processes; habitat conservation, restoration and management; communication and education; road and traffic management; dog management; koala health and welfare; bushfire management; economic development, tourism and research. A category for aspirational or stretch

actions (marked as A under priority in the table) is also incorporated into the table (with these matters being subject to the availability of opportunistic resources – that is, they are not core priorities of the Strategy but could be beneficial if resources become available).

Some of the management activities and actions outlined in Table 6 can be completed under existing Council service levels and recurrent budgets. Other elements require additional resourcing. Completion of the actions is subject to the allocation of resources, whether time or budget, via Council's Delivery Program and Operational Plan process and/or successful applications for external funding.

Table 6 Schedule of Management Actions

ACTION ID	MANAGEMENT ACTION	PRIORITY 1/2/3	TARGET FOR IMPLEMENTATION	PLANNED RETURN INTERVAL	ESTIMATED COST (per action per time, exclusive of staff time)	RATIONALE
IMPLEMENTATION AND MONITORING						
1	Establish a Koala Advisory Group to monitor the implementation of management activities identified in this Strategy.	1	Initiation within one year of adoption of the Strategy.	Annually	\$250	Monitor implementation of Strategy. Provide an ongoing role for organisations involved in developing the Strategy.
2	Provide a public report on the implementation of the Strategy and the status of the koala population and habitat in Ballina Shire.	2	First report within two years of adoption of the Strategy.	Five yearly	\$500	Provide transparency of process and consistent flow of information. Support community education about the koala population.
3	Establish a regular monitoring program to assess the status of the koala population.	2	Within four years of adoption of the Strategy.	Four yearly	\$10,000-\$20,000	Monitor koala population. Monitor effectiveness of actions and provide scientific basis for decision-making.
4	Integrate koala habitat outcomes associated with development approvals into Council's compliance program.	2	Within three years of adoption of the Strategy.	Ongoing	\$0 integrated into existing compliance program	Monitor effectiveness of conditions including in relation to long-term viability of food tree and habitat compensation measures. Ensure compliance with conditions.
4a	Review provisions of the Habitat Compensation Policy for consistency with <i>Biodiversity Conservation Act 2016</i> once introduced.	1	Within six months of the commencement of the Act.	N/A	\$0 integrated into existing strategic planning program	Condition of DPE approval of Ballina Shire Core Koala Habitat Comprehensive Plan of Management. Ensure consistency with reforms to NSW Biodiversity legislation.
4b	Review compensatory habitat ratios and introduce an associated tree spacing requirement.	1	Within two years of adoption of the Strategy.	N/A	\$1,500	Condition of DePE approval of Ballina Shire Core Koala Habitat Comprehensive Plan of Management. Ensure practical application of compensatory habitat requirements.

ACTION ID	MANAGEMENT ACTION	PRIORITY 1/2/3	TARGET FOR IMPLEMENTATION	PLANNED RETURN INTERVAL	ESTIMATED COST (per action per time, exclusive of staff time)	RATIONALE
REGULATORY PROCESSES						
5	Include preferred koala habitat in best available environmental protection zone and incorporate provisions requiring consideration of koalas and koala habitat in relation to development under the Ballina Local Environmental Plan.	1	Within one year of adoption of the Strategy.	N/A	\$0 integrated into existing strategic planning program	Recognition of habitat values in local planning instrument with accompanying regulatory provisions to address habitat values.
6	Amend the Natural Areas and Habitat Map within the <i>Ballina Shire DCP 2012</i> to incorporate all preferred and core koala habitat.	1	Within six months of adoption of the Strategy.	N/A	\$0 integrated into existing strategic planning program	Ensure consistency in mapping. Ensure recognition and address of habitat values in local planning provisions.
7	Amend the Ballina Shire DCP 2012 to require consideration of koalas and koala habitat consistent with the principles and objectives of this Strategy.	1	Within one year of adoption of the Strategy.	N/A	\$0 integrated into existing strategic planning program	Implementation of koala management provisions into local planning framework.
8	Apply objectives of this Strategy and the identified impact assessment principles of this Strategy to LEP amendment processes.	1	On adoption of the Strategy.	Ongoing	\$0	Incorporation of koala management provisions consistent with this Strategy into strategic planning processes.
9	Apply the objectives of this Strategy and the identified impact assessment principles of this Strategy to projects undertaken by Council under Part 5 of the Environmental Planning and Assessment Act.	1	On adoption of the Strategy.	Ongoing	\$0	Application of koala management provisions consistent with this Strategy to Council as a development proponent.
10	Implement standard conditions of consent giving effect to the objectives of this Strategy and the associated regulatory provisions arising from actions 5, 6 and 7.	1	Within six months of adoption of the Strategy.	Ongoing	\$0 integrated into existing regulatory planning program	Integration of koala management planning outcomes into development assessment and approval framework.
11	Include information regarding the presence of mapped preferred and core koala habitat on certificates issued under Section 149 (5) of the EP&A Act.	2	Within three months of adoption of the Strategy.	Ongoing	\$0 integrated into existing s149 certificate program	Identification and communication of information to landowners and property purchasers.

ACTION ID	MANAGEMENT ACTION	PRIORITY 1/2/3	TARGET FOR IMPLEMENTATION	PLANNED RETURN INTERVAL	ESTIMATED COST (per action per time, exclusive of staff time)	RATIONALE
12	Develop and deliver a training program for Council staff prior to implementation of this Strategy.	2	Prior to adoption by Council.	N/A	\$250	Ensure consistency in understanding of issues and application of this Strategy and associated planning processes.
13	Communicate with planning and natural resource management consulting industry with regard to requirements of this Strategy, incorporating the Ballina Core Koala Habitat Comprehensive Koala Plan of Management.	2	Within one year of adoption of the Strategy.	Ongoing	\$250	Support consultants in understanding the requirements of this Strategy and associated regulatory provisions.
14	Undertake an assessment of the economic value of preferred koala habitat and the koala population in Ballina Shire.	A	Where resources become available.	N/A	\$25,000+	Provide an understanding of the economic contribution of the koala population in Ballina Shire.
15	Implement guidelines for the provision of new or compensatory habitat on public and private land.	2	Within two years of adoption of the Strategy.	Ongoing	\$2,000	Provide a benchmark for compensatory habitat requirements and enhance consistency and clarify. Improve communication in relation to koala management requirements.
16	Create a spatial layer that shows the location of all PKFTs within Council Road reserves for use by BSC officers when planning and undertaking road upgrades and maintenance works.	2	Within one year of adoption of the Strategy.	Update as new information received.	\$0	Provide a planning layer for staff use in both internal and external road planning/works.
HABITAT CONSERVATION, RESTORATION AND MANAGEMENT						
17	Engage the Minister and the responsible Department with regard to PNF to request that private native forestry not be approved in areas of core koala habitat in Ballina Shire.	1	Within two months of adoption of the Strategy.	N/A	\$0 integrated into existing sustainability program	Address a primary mechanism for clearing of significant koala habitat
18	Identify measures to address and manage PNF in Ballina Shire with respect to the aims and objectives of this Strategy.	1	Within two years of adoption of the Strategy.	N/A	\$0 integrated into existing strategic planning program	Reduce potential impact of PNF on koala habitat

ACTION ID	MANAGEMENT ACTION	PRIORITY 1/2/3	TARGET FOR IMPLEMENTATION	PLANNED RETURN INTERVAL	ESTIMATED COST (per action per time, exclusive of staff time)	RATIONALE
19	Identify public lands (such as, parks and other public lands) and areas of possible koala habitat in Council and public ownership potentially suitable for revegetation and restoration projects in partnership with rural landholders.	1	Within two years of adoption of the Strategy.	N/A	\$15,000	Enhance extent of koala habitat. Support Plateau KMP koala population where windbreaks are cleared or lost.
20	Prepare a priority koala habitat restoration program (including map) to prioritise restoration and revegetation of strategic areas within the koala planning area.	2	Within three years of adoption of the Strategy.	N/A	\$5,000	Assist with prioritising grant funding for community, landholders and Council. Support revegetation programs.
21	Support growth of koala food tree leaf sources within Ballina Shire for care and rehabilitation of koalas.	3	Within five years of adoption of the Strategy.	Ongoing	\$0 integrated into existing public land and open space management program	Assist local care organisations with availability of appropriate leaf sources.
22	Implement restoration works identified under the restoration program.	A	After action 20 when grant funding becomes available.	N/A	Dependent on works identified	Obtain funds from other levels of government and grant programs to assist with resourcing restoration works (including Council funds). Enhance extent of koala habitat and quality.
23	Establish a register of landholders who are willing to use their land for habitat restoration, including those who wish to register their 'Koala Friendly' windbreaks.	3	Within five years of adoption of the Strategy.	Ongoing	\$0 integrated into existing sustainability program	Assist with prioritising resources such as grant funding. Establish landholder communication network.
24	Implement a pilot windbreak replacement program for farmers and koalas utilising mutually beneficial species (including consideration of use of alternative eucalypt species for windbreaks).	1	Within one year of adoption of the Strategy.	N/A	\$15,000	Support provision of koala friendly windbreaks on the Plateau that also recognise landholder requirements.

ACTION ID	MANAGEMENT ACTION	PRIORITY 1/2/3	TARGET FOR IMPLEMENTATION	PLANNED RETURN INTERVAL	ESTIMATED COST (per action per time, exclusive of staff time)	RATIONALE
25	Undertake the active restoration of a pilot site to restore or enhance koala habitat.	1	As funding from grant programs becomes available.	N/A	\$85,000	Enhance koala habitat.
COMMUNICATION AND EDUCATION						
26	'Launch' the Strategy utilising a mix of activities 27 – 31, as well as through a formal recognition of the local koala populations in Ballina Shire.	1	Within four months of adoption of the Strategy.	N/A	See estimates for actions 27-31	Provide a formal starting point for collaboration on koalas in Ballina Shire. Encourage communication within and between Council and the community.
27	Develop and implement an integrated communication program to inform and educate the community about threats to koalas and their habitat. Utilise existing avenues such as Community Connect and FoK's 'Treetops' to report regularly.	1	Within one year of adoption of the Strategy.	Four yearly to align with survey and evaluation work	\$1,500	Enhance a collaborative approach to koala awareness and management in Ballina Shire.
28	Provide the Koala Management Strategy and associated maps and information on Council's website.	1	Within one month of adoption of the Strategy.	N/A	\$0 integrated into existing sustainability program	Ensure access and availability of information. Encourage communication within and between Council and the community.
29	Write to all landholders subject to the CKPoM advising of the Strategy and providing key information about koalas in the shire.	1	Within two months of adoption of the Strategy.	N/A	\$0 integrated into existing sustainability program	Inform landholders of the status of koalas in the shire and the CKPoM.
30	Prepare a fact sheet explaining the implications of the Strategy in relation to development proposals and assessment.	1	Within three months of adoption of the Strategy.	N/A	\$0 integrated into existing sustainability program	Provide a simple explanation of Strategy requirements with regard to koalas. Ensure access to information.
31	Develop, in partnership with rural industries on the Plateau, a voluntary code of practice for managing koalas on agricultural land.	A	Where resources become available.	N/A		Consider windbreak management and options for the longer term to support koala populations. Work collaboratively with landholders.

ACTION ID	MANAGEMENT ACTION	PRIORITY 1/2/3	TARGET FOR IMPLEMENTATION	PLANNED RETURN INTERVAL	ESTIMATED COST (per action per time, exclusive of staff time)	RATIONALE
ROAD AND TRAFFIC MANAGEMENT						
32	Collaborate with NSW Roads and Maritime Service in relation to sharing of information and opportunities to enhance outcomes for the shire's koala population.	1	Within one month of adoption of the Strategy.	Ongoing	\$0 integrated into existing sustainability program	Implement koala road safety measures across the road network, both regional and major roads. Keep community informed regarding road construction/ use and koalas. Proactively collaborate on achievement of positive outcomes for koala management.
33	Apply the following for roads within the koala planning area: a. audit existing koala road safety measures. b. develop an integrated program of works for the implementation of a 'toolbox' for koala road safety measures to target vehicle strike black spots on Council managed roads. c. utilise 'toolbox' in design and construction of roads within the Ballina Shire Koala Planning Area.	2	Within one year of adoption of the Strategy.	N/A	\$15,000 (audit and plan)	Provide a suite of tools for use on local and regional roads, to minimise road hazards for koalas (e.g. speed reduction, signage, lighting, road verge maintenance, exclusion fencing and underpasses).
34	Integrate consideration of the objectives of this Strategy and associated planning provisions into Council's planning for, and construction of, road infrastructure.	1	Within three months of adoption of the Strategy.	Ongoing	\$0 integrated into existing sustainability program and civil engineering activities	Apply suitable assessment method in relation to implications of works and their potential for impact on koalas
35	Implement an advisory signage program in key koala habitat areas.	1	Within one year of adoption of the Strategy.	N/A	\$15,000	Improve road user awareness of koala population. Reduce incidence of road strike.

ACTION ID	MANAGEMENT ACTION	PRIORITY 1/2/3	TARGET FOR IMPLEMENTATION	PLANNED RETURN INTERVAL	ESTIMATED COST (per action per time, exclusive of staff time)	RATIONALE
36	<p>Apply the following in relation to dog management within the koala planning area:</p> <ul style="list-style-type: none"> a. identify areas where koalas are at a high risk of contact with unrestrained or roaming domestic dogs. b. target compliance in these areas in accordance with the provisions of the Companion Animals Act 1998. c. undertake an education program on responsible pet ownership with respect to new dog owners and dog owners in high risk areas. d. apply controls for domestic dogs at home as per Chapter 7, Part 4 of the Ballina Shire Development Control Plan. e. review existing dog exercise areas and ensure that use of these areas are compatible with the objectives of this Strategy. f. consider the impacts of dogs in existing properties and rental properties and undertake a community education and compliance program in relation to these. 	2	Within one year of adoption of the Strategy.	N/A	\$2,000	<p>Minimise risk and incidence of koala mortality from dog attacks.</p> <p>Enhance community understanding of the koala population in the shire.</p>
37	Liaise with North Coast Local Land Services with regard to wild dog and fox management issues to improve Council understanding on these issues.	2	Within one year of adoption of the Strategy	N/A	\$0 integrated into existing sustainability program	Improve Council and community understanding of domestic and wild dog management in relation to wildlife.

ACTION ID	MANAGEMENT ACTION	PRIORITY 1/2/3	TARGET FOR IMPLEMENTATION	PLANNED RETURN INTERVAL	ESTIMATED COST (per action per time, exclusive of staff time)	RATIONALE
KOALA HEALTH AND WELFARE						
38	Support a genetic study of koala populations in the Ballina, Lismore and Byron areas to establish the relationships between.	1	As funding from grant programs becomes available.	N/A	Unknown	Ascertain genetic characteristics and linkages between populations and movement corridors to aid future planning for koala populations.
39	Provide access to public land containing koala food trees for leaf harvest by Friends of the Koala.	2	Within two years of adoption of the Strategy.	N/A	\$0 integrated into existing sustainability program and open space management programs	Demonstrate community and Council commitment to the koala population. Support local volunteer efforts. Provide a feed source to support koala care activities.
40	Consult with Friends of the Koala and other like groups regarding: a. provision of records to the Atlas of NSW Wildlife. b. standardising and improving the quality of data provided to the Atlas. c. information sharing and community education opportunities.	3	Within three years of adoption of the Strategy.	At time of monitoring surveys	\$0 integrated into existing sustainability program	Ensure best possible information held in Atlas to inform Federal, State and Local Government decision-making. Utilise information to engage community about koala population.
BUSHFIRE MANAGEMENT						
41	Provide mapping of preferred and core koala habitat as a GIS layer to the Rural Fire Service and the Bushfire Risk Management Plan Committee.	2	Within two years of adoption of the Strategy.	N/A	\$0 integrated into existing sustainability program	Ensure best possible information held by RFS to inform decision-making.
42	Write to the Minister and the responsible Department with regard to the 10/50 Bushfire Management regulations and their impact on koala habitat.	1	Within three months of adoption of the Strategy.	N/A	\$0 integrated into existing sustainability program	Indicate potential impacts on koala (and other) habitat of 10/50 regulation.

ACTION ID	MANAGEMENT ACTION	PRIORITY 1/2/3	TARGET FOR IMPLEMENTATION	PLANNED RETURN INTERVAL	ESTIMATED COST (per action per time, exclusive of staff time)	RATIONALE
43	<p>Consult with the Rural Fire Service and the Bushfire Risk Management Plan Committee regarding:</p> <ul style="list-style-type: none"> a. updating the Bushfire Risk Management Plan for Ballina LGA to take into account the location and significance of preferred and core koala habitat. b. providing a GIS layer that maps fire history within the Ballina LGA. c. hazard reduction in Important Population area in terms of koala population as an asset requiring protection, including likely changes in fire regime in response to climate change. d. development and implementation of best practice fire management guidelines in relation to koala habitat by brigades located within the Ballina LGA. e. engaging with the broader community in matters relating to fire management and hazard reduction in relation to koala conservation. 	2	Within two years of adoption of the Strategy.	N/A	\$0 integrated into existing sustainability program	<p>Ensure best possible information held by RFS and to inform decision-making.</p> <p>Support consideration of koala management in bushfire planning.</p>
ECONOMIC DEVELOPMENT AND TOURISM						
44	Investigate feasibility of koala-based ecotourism opportunities within the shire.	A	As resources become available.	N/A		Identify economic development opportunities associated with the koala population.
45	Establish a brand, in conjunction with Lismore City Council, for 'Koala Country' to enhance opportunities for accommodation and other tourism providers to leverage interest.	3	Within five years of adoption of the Strategy.	Ongoing	\$5,000	<p>Provide a point of interest for visitors to the area and a reason to visit hinterland areas.</p> <p>Support economic development opportunities associated with the koala population.</p>
46	Establish an information display at appropriate locations to share information about the Important Koala Population in the shire.	2	Within two years of adoption of the Strategy.	N/A	\$10,000	<p>Identify importance of local population and vegetation supporting that population.</p> <p>Provide information to the community.</p> <p>Encourage communication and information sharing.</p>

ACTION ID	MANAGEMENT ACTION	PRIORITY 1/2/3	TARGET FOR IMPLEMENTATION	PLANNED RETURN INTERVAL	ESTIMATED COST (per action per time, exclusive of staff time)	RATIONALE
RESEARCH						
47	Research the East Ballina population including movement of koalas, fertility, management options and long term outlook for individuals and population.	1	Within four years of adoption of the Strategy.	N/A	\$10,000	Consider long term viability of this population.
48	Monitor existing koala management strategies across Australia and review their success in relation to possible management scenarios for Ballina Shire.	2	Within four years of adoption of Strategy.	4 yearly	\$2,000	Flexibility and responsivity to proven strategies.

DEFINITIONS AND KEY TERMS

In this Strategy, the following definitions apply:

accredited person means a person with demonstrated experience or qualifications in koala management.

building envelope means an area of land designated for construction of a dwelling, buildings and ancillary infrastructure as well as any land required to be cleared for a bushfire asset protection zone (inner zone), ancillary gardens and landscaping.

Comprehensive Koala Plan of Management means a plan of management prepared to meet the objectives of *State Environmental Planning Policy 44 – Koala Habitat Protection*.

core koala habitat means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population. This is the same meaning as that defined by *State Environmental Planning Policy 44 – Koala Habitat Protection*.

development has the same meaning as that defined by the *Environmental Planning & Assessment Act 1979*.

development application or **DA** has the same meaning as that defined by the *Environmental Planning & Assessment Act 1979*.

development footprint means the land that is likely to be impacted by any development including any asset protection zone and ancillary infrastructure.

diameter at breast height over bark or **dbhob** is the diameter of a tree measured 1.4 metres above the ground.

koala habitat means “core koala habitat” and/or “preferred koala habitat”.

koala planning area means the land to which the Ballina Shire Koala Management Strategy applies as described and mapped within the Strategy.

koala management precincts means land within the Southern (Bagotville/Meerschaum Vale/Wardell) precinct, the Plateau precinct or the East Ballina

precinct as described and mapped in the Strategy.

land has the same meaning as that defined by the *Environmental Planning & Assessment Act 1979*.

no-build zone means a designated area of land where the construction of dwellings, buildings and the like are precluded.

preferred koala habitat means any area identified as either Primary, Secondary Class A, B or C koala habitat.

Note: For further explanation of any or all of these categories, refer to the Ballina Shire Koala Habitat Study 2013 and its Addendums.

preferred koala food tree or **koala food tree** means any of the following tree species within Ballina Shire:

	COMMON NAME	SCIENTIFIC NAME
Primary food tree species	Forest red gum*	<i>E. tereticornis</i>
	Tallowwood	<i>E. microcorys</i>
	Swamp mahogany	<i>E. robusta</i>
Secondary food tree species	Tallowwood#	<i>E. microcorys</i>

* includes the naturally occurring *E. tereticornis* x *E. robusta* hybrid referred to as *E. patentinervis* (Bale, 2003).

where occurring on low to medium soil landscapes.

receiving land means the area of land receiving the benefit of food tree compensation measures and/or habitat compensation measures.

RG-bSAT means Regularised Grid-based Spot Assessment.

SEPP 44 means State Environmental Planning Policy 44 – Koala Habitat Protection.

study area means the “subject site” of a proposed development and any additional areas that are likely to

be directly and/or indirectly impacted by a development application, including any asset protection zone, ancillary and off-site works.

suitably qualified person means a person with a minimum of an undergraduate qualification in ecology, environmental management, forestry or similar from a recognised university and with experience in flora and fauna identification, survey and management, including experience in conducting koala surveys. Where such person has less than five years experience, they shall be under the supervision of a suitably qualified person according to this definition. A Council Officer may meet these criteria.

tree means any plant which is over 3 metres in height and/or has a diameter at breast height above bark of more than 100mm.

tree protection zone means the area above and below the ground and at a given distance from the trunk set aside to protect a tree's roots and crown from development activity.

REFERENCES

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APPENDIX 1 APPROVED INDIVIDUAL KOALA PLANS OF MANAGEMENT WITHIN BALLINA SHIRE

BSC DA NO.	ADDRESS	LOT / DP
2007/893	1 Bundaleer Road, Broken Head	Lot 1 DP 259078

APPENDIX 2 KOALA HABITAT SURVEY METHOD

Sampling of koala habitat and population assessment using the Spot Assessment Technique and the Regularised Grid-based Spot Assessment Technique

The SAT approach of Phillips & Callaghan (2011) and associated RG-bSAT are standardised koala habitat and population assessment sampling tools.

Preliminaries

1. For the purposes of this Strategy, the methodology must be undertaken by a *suitably qualified person* with relevant experience and training in both the application and interpretation of the RG-bSAT approach.
2. The koala habitat survey must be undertaken based on the sampling densities set out in Table A1.

Table A1 Regularised Grid-based Spot Assessment Technique (RG-bSAT) Grid Cell Sampling Intensities for Various Land Areas

Area of study area	Initial RG-bSAT sampling intensity	Detailed RG-bSAT sampling intensity
<15 ha	150 m x 150 m	75 m x 75 m
15–50 ha	250 m x 250 m	125 m x 125 m
>50 ha	350 m x 350 m	175 m x 175 m

3. Koala activity levels at each field site are to be interpreted as significant if greater than 10% on erosional or residual soil landscapes (Morand, 1994) or greater than 22.52% if on low-lying aeolian or alluvial or swamp landscapes (Morand, 1994). For any of the “initial sampling intensity” sites that returned significant activity levels, sampling utilising the “detailed sampling intensity” (Table A1) surrounding these sites should also be undertaken.

Methodology

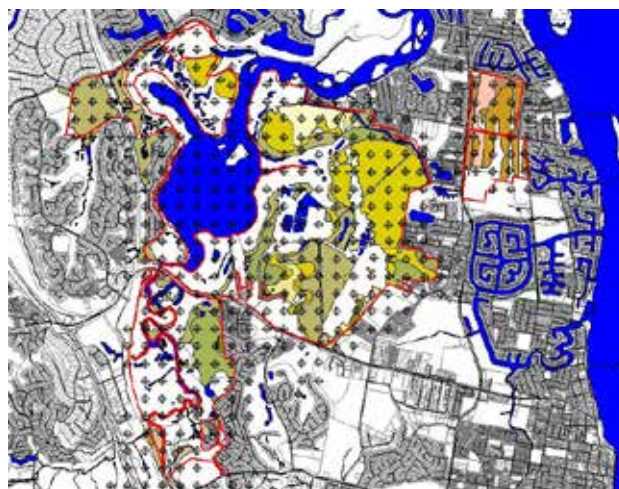
Following is a step-by-step account of how to work with the RG-bSAT approach using a notional 1500 hectare study site.

Step 1

Determine appropriate sampling intensities for the site to be assessed using Table A1 (above).

Step 2

- a. Overlay a map/aerial photo of the *study area* with a square grid the dimensions of which correspond to the “**high** sampling intensity” detailed in Table A1.



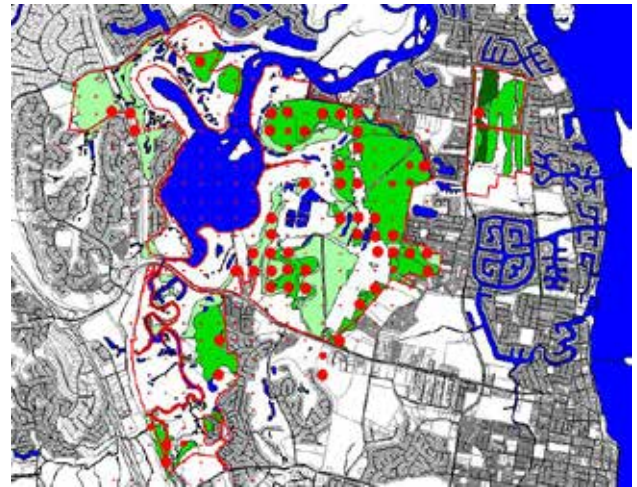
- b. Then, use the resulting grid-cell intersections to identify those points that fall upon areas of land wherein 30 trees of any species that have a dbhob $\geq 100\text{mm}$ could theoretically be sampled within a radius approximately equal to that of 50% of the sampling intensity being utilised (e.g. 75m = 38m radius, 125m = 73m etc). The map/aerial photo should look like the diagram below (σ indicate sampling site locations).
- c. Disregard any potential field sites that fall within areas such as water bodies or areas that do not have measurable forest cover.

Step 3

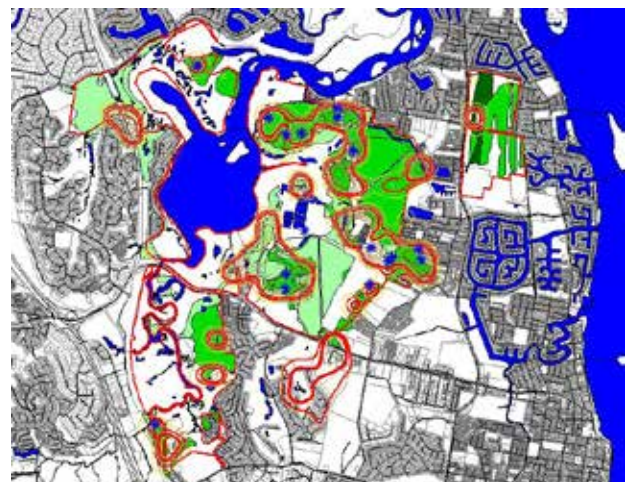
- a. Preliminary sampling of the study area should be undertaken at intervals commensurate with the “initial sampling intensity”.
- b. Sampling is to be undertaken at each sampling point using the Spot Assessment Technique (SAT) (Phillips & Callaghan, 2011).
- c. It is not necessary to sample the “detailed sampling intensity” sites between any two sites that have recorded significant koala activity as defined in b above. The contours will be assumed to be constant.
- d. If no “Medium (normal) use” or “High use” sites are detected, no further assessment of the site is required.

Step 4

- a. In the absence of a suitable spatial modelling technique such as splining, all SAT sites wherein significant koala activity has been recorded must become the central point of a grid cell, the size of which must be commensurate with sampling intensity as follows.
 - For 75m sampling intersections, the grid cell size will be 75m x 75m (0.56ha)
 - For 125m sampling intersections, the grid cell size will be 125m x 125m (1.56ha)
 - For 175m sampling intersections, the grid cell size will be 175 x 175m (3.06ha)
- b. The map/aerial photo should now look like the diagram below (red circles indicate sampling site locations, and the centre of grid cells referred to in (a) above, with size graduations as appropriate to the soil landscape being sampled. The size of the cells should indicate “Low use” ●, “Medium (normal) use” ● and “High use” sites ●.
- c. All areas within a grid cell identified that returned significant koala activity levels as defined by b above must be regarded as core koala habitat. Any RG-bSAT grid cell where koala activity is categorised as greater than 10% on erosional or residual soil landscapes (Morand, 1994) or greater than 22.52% if on low-lying aeolian or alluvial or swamp landscapes (Morand, 1994) is to be regarded as core koala habitat.

**Step 5**

- a. Koala activity data should then be interpolated to cover the assessment area using a suitable spatial modelling technique such as splining (see Phillips et al., 2011, in review).
- b. The map/aerial photo should now look like the diagram below. The model below was created using lightly weighted thin plate splining techniques.

**Final result from Regularised Grid Spot Assessment Technique**

The Spot Assessment Technique: a tool for determining localised levels of habitat use by Koalas *Phascolarctos cinereus*

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ABSTRACT

In order to more effectively conserve Koalas, the National Koala Conservation and Management Strategy 2009 – 2014 promotes the need for reliable approaches to the assessment of Koala habitat. This work describes a point-based, tree sampling methodology that utilises the presence/absence of Koala faecal pellets within a prescribed search area around the base of trees to derive a measure of Koala activity. Confidence intervals associated with Koala activity data from 405 randomly selected field plots within which faecal pellets were recorded have been utilised to assign threshold values for three population density/habitat biomes in eastern Australia. Subject to the need for a precautionary approach to data interpretation in areas that support naturally occurring, low-density Koala populations, the approach is expected to assist field-based assessments by researchers, land managers and others interested in clarifying aspects of habitat utilisation by free-ranging Koalas, especially where identification of important areas for protection and management is required.

Key words: Spot Assessment Technique, Koala, *Phascolarctos cinereus*, SEPP 44.

Introduction

The primary aim of the National Koala Conservation and Management Strategy 2009 – 2014 (NKCMS) is to conserve the Koala (*Phascolarctos cinereus*) by retaining viable populations in the wild throughout the species' natural range (Natural Resource Management Ministerial Council (NRMMC) 2009). In order to assist this aim, Action 1.06 of the NKCMS promotes the need for development of standard monitoring/habitat assessment protocols as a means of addressing the issue of inconsistency and disagreement over how koala populations should be surveyed and mapped (NRMMC 2009).

The primary responsibility for conservation of free-ranging *P. cinereus* populations rests with State, Territory and Local Government authorities. In this regard State Government authorities in New South Wales and Queensland have enacted specific planning policies and/or strategic planning measures to assist *P. cinereus* conservation efforts. However, the ability of such approaches to achieve their stated conservation objectives is impeded in part by the lack of standardised and reproducible methods that can be applied to the task of *P. cinereus* habitat/population assessment in the first instance.

In this paper we present a technique that we believe contributes to the need for a reliable approach to objectively assessing aspects of habitat use by *P. cinereus*. An unreviewed progenitor to this work (Phillips and Callaghan 1995) was originally circulated to a limited audience following the Australian Koala Foundation's

1995 conference on the status of Koalas, its purpose at that time to promulgate an approach that could potentially assist field-based assessments by ecological consultants, land managers and others interested in quantifying aspects of habitat utilisation by free-ranging *P. cinereus*. The purpose of this paper is to further refine the initial approach in the light of feedback and additional field studies and in so doing, formally supersede the earlier work.

Background to the approach

Traditionally, knowledge relating to habitat utilisation by free-ranging *P. cinereus* has been primarily reliant on opportunistic observations or radio-tracking data (Robbins and Russell 1978; Martin 1985; Hindell *et al.* 1985; Hindell and Lee 1987; 1988; White and Kunst 1990; Reed *et al.* 1990; Hasegawa 1995; Melzer and Lamb 1996; Pieters and Woodhall 1996). In other instances, emphasis has been placed on benign indicators such as accumulated faecal pellet counts (Moon 1990; Munks *et al.* 1996; Pahl 1996) and scratch marks. However, all of these approaches can be problematic. Firstly, existing models for determining tree preferences by free-ranging *P. cinereus* (Hindell *et al.* 1985) require a number of assumptions to be met which do not appear to hold in heterogeneous forest communities (Phillips 1999; Ellis *et al.* 2002). Secondly, while careful analysis of accumulated faecal pellet counts can elucidate issues of *P. cinereus* abundance (Sullivan *et al.* 2002, 2004), such

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counts have proved to be of limited value when used to infer the importance of various tree species (Munks *et al.* 1996; Pahl 1996). The ability to census and interpret faecal pellet deposits can also be influenced by other variables including visibility, tree morphometrics and insect activity (Achurch 1989; Jones 1994; Melzer *et al.* 1994; Pahl 1996; Ellis *et al.* 1998; Sullivan *et al.* 2003). Scratch marks on trees are also an unreliable indicator of habitat use – they cannot be detected on some species whereas others retain them for long periods of time - nor is it always possible to confidently distinguish scratches made by *P. cinereus* from those of other arboreal animals.

Studies of free-ranging *P. cinereus* populations have established that those in stable breeding aggregations arrange themselves in a matrix of overlapping home range areas (Lee and Martin 1988; Faulks 1990; Mitchell 1990). Home range areas vary in size depending upon the quality of the habitat (measurable in terms of the density of preferentially utilised food tree species) and the sex of the animal (males tend to have larger home range areas than females). Long-term fidelity to the home range area is generally maintained by adult *P. cinereus* in a stable population (Mitchell 1990; Phillips 1999, Kavanagh *et al.* 2007). An additional feature of *P. cinereus* home range use is the repeated use of certain trees, some of which may also be utilised by other members of the population (Faulks 1990; Mitchell 1990; Phillips 1999; Ellis *et al.* 2002).

Given the preceding considerations, it follows that areas being utilised by socially stable/resident *P. cinereus* populations must also be characterised by a higher rate of faecal pellet deposition (see Lunney *et al.* 1998). For the purposes of this paper, we propose the term "areas of major activity" to describe such localities, regarding them as synonymous with the term "Core Koala Habitat" (in so far as this term relates to the presence of a "resident population of koalas") as defined by the NSW Government's *State Environmental Planning Policy No. 44 (Koala Habitat Protection)*, as well as being a fundamental element of "Koala Habitat Areas" as defined by the *Nature Conservation (Koala) Conservation Plan 2006 and Management Program 2006 – 2016* (Environment Protection Agency/Queensland National Parks and Wildlife Service 2006).

The Spot Assessment Technique

The Spot Assessment Technique (SAT) is a truncated form of the methodology originally developed by the Australian Koala Foundation for purposes of the Koala Habitat Atlas project (Sharp and Phillips 1997; Phillips *et al.* 2000; Phillips and Callaghan 2000). The Atlas approach is probability-based and utilises a binary variable (presence/absence of faecal pellets within a prescribed search area around the base of trees) to determine tree species preferences, along with a commensurate measure of *P. cinereus* "activity" (number of trees with faecal pellets divided by total number of trees in the plot) within a 40m x 40m

(1600m²) plot. Given that the selection of Atlas field plots is primarily based on stratification and replication using soil landscape and vegetation association data in the first instance, the data presented for the purposes of this paper reflects a random selection of field sites within which *P. cinereus* faecal pellets were recorded. The SAT approach arose from observations of consistency within the four smaller (20m x 20m) sub-quadrats that otherwise comprise Atlas field plots and the consequent realisation that a smaller plot size essentially provided the same empirical outcomes in terms of both tree species/faecal pellet associations and activity *per se*. However, the number of trees sampled in a smaller site is critical in terms of ascribing meaningful variance to the activity estimate hence we have adopted this measure as the more important variable for the purposes of the technique. Thus, in order to establish a meaningful confidence interval for the activity level of a given SAT site, a minimum of thirty (30) trees must be sampled. For assessment purposes, a tree is defined as "a live woody stem of any plant species (excepting palms, cycads, tree ferns and grass trees) which has a diameter at breast height (dbh) of 100 mm or greater" (Phillips *et al.* 2000); in the case of multi-stemmed trees, at least one of the live stems must have a dbh of 100 millimetres or greater in order to qualify.

Table 1 provides a data summary from Atlas field plots undertaken across a variety of habitat types and landscapes utilised by *P. cinereus* in eastern Australia. To this end, while we consider significant differences between mean activity levels from low and medium - high density *P. cinereus* populations of the eastern seaboard to reflect real differences in habitat carrying capacity (Table 1 - Southeast Forests/Campbelltown vs Port Stephens/Noosa: Levene's test: $F = 0.086$, $P > 0.05$; $t = -7.877$, $P < 0.001$), we speculate that similar differences between medium - high density populations of the eastern seaboard and those from more western areas (areas generally receiving less than 600mm of rainfall annually) (Port Stephens/Noosa vs Pilliga/Walgett - Levene's test: $F = 0.925$, $P > 0.05$; $t = -4.743$, $P < 0.001$) more likely reflect differences in faecal pellet longevity as a consequence of aridity than they do habitat quality *per se*. This said, we acknowledge that there are also likely to be both low and medium-high density populations in western areas of the species' range, the differentiation of which will require further investigation and evaluation.

Applying the SAT

The SAT involves a radial assessment of *P. cinereus* "activity" within the immediate area surrounding a tree of any species that is known to have been utilised by the species, or otherwise considered to be of some importance for *P. cinereus* conservation and/or management purposes. In the field the technique is applied as follows:

1. Locate and uniquely mark with flagging tape a tree (the centre tree) that meets one or more of the following selection criteria:

Phillips and Callaghan

Table 1. Mean activity levels and related measures of central tendency (expressed as percentage equivalents) associated with habitat utilisation by Koalas from six areas in eastern Australia. Data relates to sites within which faecal pellets were recorded and has been pooled to reflect three major categories of activity which correspond to naturally occurring low and med-high density populations of the tablelands and areas east of the Great Dividing Range, and those of more western areas respectively. Koala densities for the east coast, low density category are arbitrarily defined at ≤ 0.1 Koalas/ha. (Data sources: ¹South-east Forests Conservation Council, unpub. data; ²Phillips and Callaghan 1997; ³Phillips and Callaghan 2000; ⁴Phillips et al. 1996; ⁵Phillips et al. 2000; ⁶AKF, unpub.data; ⁷Phillips 1999; ^{8,9}AKF unpub. data).

Area	Pop. Density	No. sites	No. trees	A/level	SD	SE	99% CL
East Coast							
S/E Forests ¹	Low	111	2979	11.85	6.84	0.65	1.70
Campbelltown ^{2,3}	Low	20	1194	6.52	4.72	1.06	3.02
Pooled		131	4173	11.03	6.82	0.60	1.56
East Coast							
Port Stephens ^{4,5}	Med - high	76	3847	23.65	23.63	2.71	7.16
Noosa ⁶	Med - high	63	1647	32.55	22.05	2.78	7.38
Pooled		139	5494	27.68	23.27	1.97	5.16
Western Slopes & Plains							
Pilliga ^{7,8}	Med - high	98	3656	42.52	22.78	2.30	6.05
Walgett ⁹	Med - high	37	990	38.01	27.66	4.55	12.37
Pooled		135	4646	41.28	24.19	2.08	5.44

- a. a tree of any species beneath which one or more *P. cinereus* faecal pellets have been observed and/or
 - b. a tree in which a *P. cinereus* has been observed and/or
 - c. any other tree known or considered to be potentially important for *P. cinereus*, or of interest for other assessment purposes.
2. identify and uniquely mark the 29 nearest trees to the centre tree,
 3. undertake a search for *P. cinereus* faecal pellets beneath each of the 30 marked trees based on a cursory inspection of the undisturbed ground surface within a distance of 100 centimetres around the base of each tree, followed (if no faecal pellets are initially detected) by a more thorough inspection involving disturbance of the leaf litter and ground cover within the prescribed search area.

Strict adherence to the 100 cm search area is a fundamental component of the SAT methodology. As detailed in Appendix 1, it is this distance that both optimises the probability of success in terms of actually finding faecal pellets, while at the same defining a workable search area. Any lesser search area and the probability of success will be significantly reduced (Figure 2 in Appendix 1 refers) such that the mean activity levels and associated activity level thresholds applicable to the approach cannot be justifiably applied.

In terms of search effort, an average of approximately two person minutes per tree should be dedicated to the faecal pellet search. In practice, more time will be spent searching beneath larger trees than smaller trees. For assessment purposes, the search should be concluded once a single faecal pellet has been detected or when the maximum search time has expired, whichever happens first. This process should be repeated until each of the 30 trees in the site has been assessed. Where the location of faecal pellets falls within overlapping search areas

due to two or more trees growing in close proximity to each other, both should be scored for pellet(s). For more detailed reporting purposes, information relating to the site's location (UTM co-ordinates or Lat/Long), selection criteria, tree species assessed (and dbh), and the radial area searched (as measured by distance from the centre tree) should also be recorded. Faecal pellets should not be removed from the site unless some verification (i.e. that they are in fact *P. cinereus* faecal pellets) is necessary.

Calculation and interpretation of Koala activity levels

The activity level for a SAT site is simply expressed as the percentage equivalent of the proportion of surveyed trees within the site that had a *P. cinereus* faecal pellet recorded within the prescribed search area. For example, given a sample of 30 trees, 12 of which had one or more faecal pellets recorded – the resulting activity level would be determined as $12/30 = 0.4 = 40$ per cent.

From the data sets presented in Table 1, we opted for a precautionary approach by proposing use of mean activity levels ± 99 per cent confidence intervals to define the limits of "normal" *P. cinereus* activity. Based on the threshold values that result, three categories of activity – "low", "medium(normal)" and "high" can thus be determined for each of the three area/population density categories detailed in Table 2. Subject to qualifications regarding the need for a cautious approach to low activity levels in some instances (see below), where the results of a SAT site returns an activity level within the low use range, the level of use by *P. cinereus* is likely to be transitory. Conversely, where a given SAT site returns an activity level within the prescribed range for medium (normal) to high use - the level of use is indicative of more sedentary ranging patterns and is thus within an area of major activity.

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Table 2. Categorisation of Koala activity into Low, Medium (normal) and High use categories based on use of mean activity level \pm 99 per cent confidence intervals (nearest percentage equivalents) from each of the three area/population density categories indicated in Table 1.

Activity category	Low use	Medium (normal) use	High use
Area (density)			
East Coast (low)	-	$\geq 3.33\%$ but $\leq 12.59\%$	$> 12.59\%$
East Coast (med – high)	$< 22.52\%$	$\geq 22.52\%$ but $\leq 32.84\%$	$> 32.84\%$
Western Plains (med – high)	$< 35.84\%$	$\geq 35.84\%$ but $\leq 46.72\%$	$> 46.72\%$

A precautionary approach to activity levels in low use areas.

Ideally, SAT site activity levels should only be interpreted in the context of location-specific habitat utilisation data (e.g. Lunney *et al.* 1998; Phillips *et al.* 2000; Phillips and Callaghan 2000; Phillips and Hopkins 2009). Low activity levels recorded in what might otherwise be med-high carrying capacity *P. cinereus* habitat may be a result of contemporary population dynamics, landscape configuration and/or historical disturbances including logging, mining, fire, agricultural activities and/or urban development. Such considerations should not necessarily detract from the potential importance of such habitat for longer-term conservation, particularly if preferred koala food trees are present and populations of *P. cinereus* are known to occur in the general area. Ideally, any determination of the importance of activity levels in such instances should be informed by a broader, soil-based understanding of tree preferences (e.g. Phillips and Hopkins 2009), and in conjunction with an understanding of ecological history (e.g. Knott *et al.* 1998; Seabrook *et al.* 2003).

Low activity levels are also associated with low-density *P. cinereus* populations. Stable, low-density *P. cinereus* populations occur naturally in some areas (Melzer and Lamb 1994; Jurskis and Potter 1997; Phillips and Callaghan 2000; Ellis *et al.* 2002; Sullivan *et al.* 2006). The density of *P. cinereus* in such areas generally reflects the absence of "primary" food tree species and reliance by the population on "secondary" food tree species only (Phillips and Callaghan 2000; Phillips 2000). While secondary food tree species will return significantly higher levels of utilisation when compared to other *Eucalyptus* spp. in the area, their level of use (as determined by field survey) will

invariably be both size-class and/or density dependent when compared to a primary food tree species (Phillips and Callaghan 2000; Phillips 2000; Moore and Foley 2005). Because the autecology of *P. cinereus* occupying habitat areas that do not naturally support one or more "primary" food tree species remains poorly understood at this point in time, again we advocate a precautionary approach whereby the presence of any activity in areas occupied by naturally occurring, low density populations should be regarded as ecologically meaningful for conservation and management purposes until proven otherwise.

Concluding comment

The SAT is intended for application in conjunction with land-use planning activities that require *P. cinereus* habitat to be assessed, especially where identification of important areas for protection and management is required. The technique is suitable for use in conjunction with stratified/random or systematic survey techniques but has proved especially powerful when applied at the landscape-scale using a regularised grid-based sampling design and appropriate spatial modelling techniques (see Phillips *et al.* 2007; Phillips and Hopkins 2007; Phillips and Hopkins 2009; Allen *et al.* 2010; Phillips *et al.* submitted); it is also suitable for long-term monitoring purposes. Further information and advice regarding application and use of the technique and its application to the tasks of koala management can be supplied if required.

In refining the SAT approach over the intervening time period since its initial inception and development, we have deliberately opted for efficiency (in terms of time) and reproducibility in the field, all the while mindful that it must remain a robust sampling tool capable of answering the critical questions associated with koala conservation biology.

Acknowledgments

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APPENDIX Some probabilistic aspects of the SAT approach

Over the years many individuals have contributed to development and refinement of the Koala Habitat Atlas methodology and its derivative progeny the Spot Assessment Technique.

In 1994, Southern Cross University student Maria Jones was set the task of examining the distribution of *P. cinereus* faecal pellets beneath trees used by the species. Thirty spatially independent Forest Red Gums *Eucalyptus tereticornis* were selected for assessment, each of which was confirmed to have been used by *P. cinereus* on the basis of one or more faecal pellets being observed beneath their respective canopies. Forest Red Gum was selected because it was known to be a preferred food tree throughout the range of *P. cinereus* in eastern Australia. Beneath each of these trees both the number and distribution of faecal pellets were recorded at 200 mm radial increments from the base, along with other data such as tree dbh and canopy configuration.

Collectively, Maria recorded 8,565 faecal pellets beneath (and sometimes beyond) the canopies of the 30 trees (mean dbh of sampled trees: 40.51cm ± 24.67(SD), range 95 – 895; mean no. faecal pellets tree⁻¹: 285.6 ± 341.8(SD), range 1 – 1433). From these data it was able to be demonstrated that (i) *P. cinereus* faecal pellets were not uniformly distributed beneath the tree canopy, but (ii) they occurred most commonly near the base of trees (Figure 1).

Given the problems of accumulated faecal pellet counts, one of us (SP) then asked of Maria's

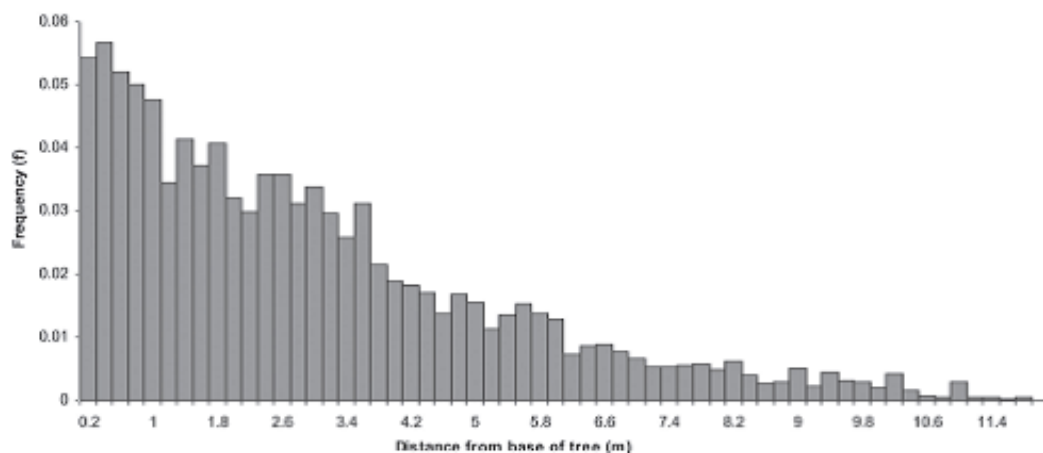


Figure 1. Pooled frequency histogram illustrating the distribution of *P. cinereus* faecal pellets as a function of increasing distance from the base of 30 sampled food trees (Source: Jones 1994).

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data: "Given that each tree is a spatially independent replicate, what - on average - is the relationship between proportion (p) of the total faecal pellet count beneath each of the sampled trees as a function of distance from the base?" Figure 2 illustrates the answer to this question, demonstrating how the probability of success in terms of actually finding pellets can be related to the size of a radial search area. With this knowledge it then became a matter of looking for a search parameter that combined a meaningful probability of encountering one or more faecal pellets, yet also restricting the

search to an area that could be efficiently worked. Further interrogation of the data established that, on average, the equivalent of $47\% \pm 12\%$ (95% CI) of all *P. cinereus* faecal pellets will be located within a distance of 1m from the base of trees that have been utilized by the species. We figured the odds at that distance (i.e. ~50:50) were good. While a smaller search area (i.e. 0.6m) would clearly have increased search efficiency, the probability of finding pellets was almost halved! Conversely, increasing the search area beyond 1m resulted in not just minor increases in the probability of success but also substantively increased the search area in each instance.

The results of the preceding analysis are generally in accord with the observations of other workers, Ellis et al (1998) also recording a disproportionately high density of pellets adjacent to the trunks of some trees utilized by *P. cinereus*, with approximately 18% of daily collection falling within a 1m x 1m area around the tree base. Sullivan et al (2002) used a 30cm search area around the base of trees, reporting a variable tendency (1.9 - 13.5%) for misclassification (i.e. recording absence when in fact pellets were actually present elsewhere beneath the canopy). Interestingly, the potential for such misclassification is strongly supported by Figure 2 which otherwise infers that the proportional representation of faecal pellets using a 30cm basal search area is very low (~10-15%).

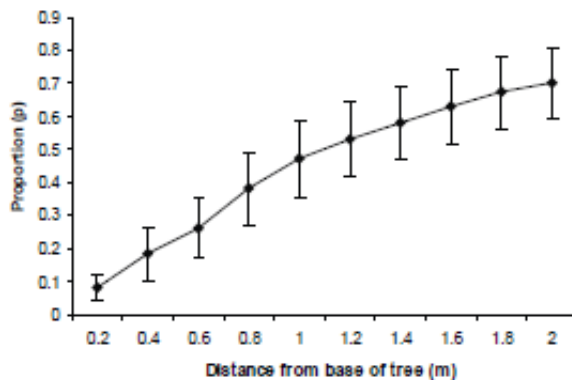


Figure 2. Mean proportional representation (\pm 95% Confidence Interval) of the total faecal pellet counts from beneath a sample of 30 trees known to have been utilised by *P. cinereus* (raw data sourced and re-analysed from Jones (1994)).





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