Comprehensive Koala Plan of Management

for the Ashby, Woombah & Iluka localities in the Clarence Valley LGA

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March 2015	Revised draft completed
October 2015	Final CKPOM adopted by Council

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Acronyms and Definitions

CKPOM – Comprehensive Koala Plan of Management prepared in accordance with Part 3 of SEPP 44.

Core koala habitat – the same meaning as that defined by *State Environmental Planning Policy No. 44 – Koala Habitat Protection*, "*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.*"

CVLEP – Clarence Valley Local Environmental Plan 2011

Council – Clarence Valley Council

DP&E – Department of Planning and Environment

Development – the same meaning as that defined by the *Environmental Planning and Assessment Act 1979*.

DA – Development Application

DCP – Development Control Plan

Development envelope – The area identified within the yellow lines on Figure 2 and Figure 3.

Diameter at breast height over bark (dbhob) – is the diameter of a tree measured 1.4 metres above the ground.

EP&A Act – means the *Environmental Planning and Assessment Act* 1979.

IKPoM – Individual Koala Plan of Management prepared in accordance with Part 3 of SEPP 44.

LGA – means local government area.

Management area – the area subject to this Comprehensive Koala Plan of Management as identified in Figure 1.

Native vegetation – has the same meaning as the *Native vegetation Act* 2003 being:

means any of the following types of indigenous vegetation:
(a) trees (including any sapling or shrub, or any scrub),

(b) understorey plants,

(c) groundcover (being any type of herbaceous vegetation),

(d) plants occurring in a wetland.

OEH – Office of Environment & Heritage (NSW Government)

Potential koala habitat corridors – Any corridor, as identified in Figure 1, that is or could be used by koalas when moving between different areas of their home range or habitat. These areas may include cleared land but do not include "preferred koala habitat".

Preferred koala habitat – any area identified as either Primary, Secondary (Class A) or Secondary (Class B) koala habitat, as defined in the table below.

Preferred Koala Habitat	Primary	Vegetation associations and/or communities wherein "primary" food tree species form ≥ 50% of the canopy.
	Secondary (Class A)	Vegetation associations and/or communities wherein: • "primary" food tree species form30-50% of the canopy or wherein;

		• "primary" and "secondary" species combine to form ≥ 50% of the canopy
	Secondary (Class B)	Vegetation associations and/or communities wherein "secondary" food tree species form ≥ 50% of the canopy

Preferred koala food tree (PKFT) – any of the following tree species.

Primary food trees species		Secondary food tree species	
Tallowwood	*Eucalyptus microcorys*	(Large-fruited) Northern Grey Gum	*E. biturbinata*
Swamp Mahogany	*E. robusta*	Sydney Blue Gum	*E. saligna*
Forest Red Gum	*E. tereticornis*	(Northern) Scribbly Gum	*E. racemosa* (*E. signata*)
Small-fruited Grey Gum	*E. propinqua*	Flooded Gum	*E. grandis*
Orange Gum	*E. bancroftii*	Narrow-leaved Red Gum	*E. seeana*
Cabbage (Red) Gum	*E. amplifolia*	Red Mahogany	*E. resinifera*
		Pink Bloodwood	*Corymbia intermedia*
		Steel Box	*E. rummeryi*
		Grey Box	*E. moluccana*
		Yellow Box	*E. melliodora*
		Stringybark	*E. tindaliae*
		Thin-leaved Stringybark	*E. eugeniodes*

Supplementary food tree species:

Brush Box *Lophostemon confertus*

White Mahogony *Euclayptus acmenoides*

Spotted Gum *Corymbia citriodora (E. maculate)*

Large-leafed Spotted Gum *Corymbia henryi (E. henryi)*

***Supplementary food trees are generally only used by koalas when they occur in association with primary and secondary species. Other native vegetation provides important roles in terms of shelter.*

Recent koala activity – means that there is evidence in the form of koala scat beneath a tree, actual koala in the tree, NSW Wildlife Atlas or record of evidence in surveys undertaken in preparation of this Koala Plan (Phillips S, Forsman H 2002 or Biolink Ecological Consultants 2012).

SAT – 'Spot Assessment Technique'.

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

Suitably qualified and/or accredited koala specialist – an individual with tertiary qualifications and experience in tree species identification and, in the case of koala habitat assessment, qualification in biological science and fauna survey and management, including experience in conducting koala surveys. A brief curriculum vitae of each person involved in conducting these assessments should be appended to the survey report.

The Koala Plan – *Comprehensive Koala Plan of Management for the Ashby, Woombah and Iluka Localities of the Clarence Valley LGA*.

TSC Act – means the *Threatened Species Conservation Act* 1995.

Acknowledgments

Much of the information used to prepare this Plan was compiled by the former Maclean Shire Council's Koala Working Group, prior to the amalgamation of Clarence Valley Council in 2005. The Koala Work Group was composed of the following members:

- Debra Wray – Maclean Shire Council
- Dave Morrison – Maclean Shire Council
- Bill Sansom – Maclean Shire Council
- Clem Rhoden – Maclean Shire Council
- Councillor Joy Matthews – Maclean Shire Council
- John Turbill – Office of Environment and Heritage
- Kay Jeffries – WIRES
- June Richards – WIRES
- Heather Bogie – Valley Watch
- Brian Barnes – Woombah Residents Association
- Fiona Murray – Iluka Koala Reserve Trust
- Helen Ward
- Imelda Jennings
- Barbara Coats

The vegetation mapping and koala habitat assessments that were undertaken by Phillips and Forsman (2002) and Turnbull et al. (2003), are acknowledged as appropriate. Additional fieldwork for the Koala Plan was supported by John Turbill (OEH), and subsequent study completed in 2012 by Biolink Ecological Consultants.

Lismore has kindly provided some of the planning controls and technical information to undertake assessments including Appendix C and these have been applied to ensure proper assessment in a manner that provides some consistency across the region.

Executive Summary

The Clarence Valley Local Government Area (LGA), located in north-east NSW, is approximately 10,440 km^2 in area. It extends along the coastline from near Woody Head in the north to Wooli in the south, and westward to Hernani and Mookimawybra in the Great Dividing Range.

This *Comprehensive Koala Plan of Management for the Ashby, Woombah and Iluka Localities in the Clarence Valley LGA* (**the Koala Plan**) is consistent with the State-wide recovery plan for the koala and has been prepared in accordance with *State Environmental Planning Policy No. 44 – Koala Habitat Protection*.

The primary aims of the Koala Plan are to:

- ensure that the current extent of koala habitat is maintained and improved in the management area, and not reduced; and
- mitigate processes which are limiting koala occupancy rates and/or population sizes.

The area to which the Koala Plan applies consists of three discrete localities located in the north-east, being Ashby (including Ashby Heights), Woombah and Iluka. These localities of the LGA are under the highest development pressure of all koala habitat areas within the Clarence Valley.

This plan has been prepared in accordance with Part 3 of SEPP 44 and for the areas mapped as core habitat at Ashby the plan will be considered a Comprehensive Koala Plan of Management for the purposes of SEPP 44. The provisions of the plan will apply across the entirety of the management area beyond just the core habitat in terms of Council's obligations to comply with various state and federal legislation to maintain and improve the condition of koala habitat and the koala population across the landscape.

Koala numbers within the Ashby area are under threat due to continuing fragmentation of suitable habitat. The Woombah koala population is in imminent danger of extinction and there is only evidence of recent activity in the Norther Western part of Woombah. The NSW recovery plan (research by Luney et al 2002) suggests that the Iluka koala population was extinct in 1999 but ongoing sightings in the village and along Iluka Road suggest there may be a viable population in the National Park to the North.

Section 1 of the Koala Plan provides a background summary of purpose of the Koala Plan, its legislative framework and policy setting, status of the koala and threats to its future in the area.

Section 2 provides General Provisions of the Koala Plan, outlining the area to which it applies, relationship to other plans and its management objectives.

Section 3 identifies the Management Activities to be undertaken by Council and others to assist in achieving the objectives of the Koala Plan, but which may be non-statutory and non-development related activities.

Section 4 identifies the development provisions of the Koala Plan, providing guidance to the land use proposals and development assessment considerations. This includes the mapping of 'development envelopes', designed to assist landowners in the identification of land where there is least constraint to development.

Appendices of the Koala Plan provide additional information and resources relevant to its operation including: a more detailed explanation of the legislative context of the Koala Plan; indicative koala habitat maps within the management area; technical details regarding koala habitat assessment reports and habitat compensation policy.

1. Background

1.1 Purpose of the Plan of Management

The purpose of this *Comprehensive Koala Plan of Management for the Ashby, Woombah and Iluka Localities in the Clarence Valley LGA* (**the Koala Plan**) is to bring together koala related development application assessment matters and non-regulatory koala management initiatives in one place.

In doing this, the Koala Plan provides greater transparency, certainty and more consistent outcomes in regards to how Clarence Valley Council (**Council**) will manage koalas and their habitat. The Koala Plan provides a greater level of regulatory certainty for landholders and developers and consequently, the Koala Plan also provides clarity for all stakeholders engaged in the development assessment process and a greater level of certainty for appropriate decision making.

In accordance with *State Environmental Planning Policy 44 – Koala Habitat Protection* (**SEPP 44**), the purpose of this Koala Plan is to:

- meet the aims of SEPP 44 and ensure that activities threatening koalas and their habitat are avoided, minimised, mitigated and/or compensated;
- ensure that the processing of development applications and other activities under the control of Council achieve the objective of koala sustainability and recovery;
- maintain or improve the koala population and their habitat in Clarence Valley LGA by working with landholders and the community to seek relevant partnerships and funding opportunities; and
- provide a transparent and consistent development assessment framework for Council for the determination of development applications that may have a potential adverse impact on koalas or their habitat.

This plan is based on the scientific findings, results and koala habitat mapping within the Koala Habitat Assessment of the Ashby, Woombah and Iluka areas undertaken by Biolink Ecological Consultants (2012 and addendum 2015), as well as earlier mapping and assessment by Turbill (2003) and Turnbull *etc al.* / Ecograph (2003). A small area between Ashby and Woombah that has not had detailed survey work has been included in the revised draft to reflect the important role this link provides as a wildlife corridor. WIRES records for 2014 identify activity in this area that may provide an important link between the Ashby population and potential koala habitat in Woombah. Some of the technical information contained within the 2010 draft of this plan has been removed to concentrate on management actions and planning provisions. The 2010 draft of this document and other documents including Biolinks reports of 2012 and 2002 provide important reference material.

1.2 Koala Plan Aims and Objectives

The primary aims of this Koala Plan are to:

- ensure that the current extent of koala habitat is maintained and improved, and not reduced; and
- mitigate processes which are limiting koala occupancy rates and/or population sizes.

The objectives of the Koala Plan are to:

- identify and list the koala food tree species in the management area;
- identify koala habitat and linkages within and between the management areas;
- identify the threatening processes acting on local koala populations;

- minimise the potential for adverse impacts and disturbances to current and future areas of koala habitat;
- protect koala habitat in order to, as a minimum, maintain koala populations across their current range;
- create, manage and/or restore koala habitat linkages and corridors;
- ensure that preferred koala food trees are effectively managed and conserved; and
- ensure that all future koala habitat assessments undertaken on land to which the Koala Plan applies are done to a minimum standard using assessment criteria determined by Council, so as to best inform future planning decisions.

The above objectives will be realised through both the management activities and development provisions detailed in this Plan.

1.3 Planning and Legislative Framework

A brief summary of the planning and legislative framework is outlined below. It is however recognised that the statutory planning system in which Council operates is complex and often difficult to understand. Appendix A provides further details of the key legislation and planning instruments relevant to the management and conservation of koalas and their habitats in the Clarence Valley LGA.

1.3.1 State Legislation

Environmental Planning Instruments (**EPI**) are statutory documents that are developed under the *Environmental Planning and Assessment Act* 1979, and include Local Environmental Plans (**LEP**) and State Environmental Planning Polices (**SEPP**). The preparation of Koala Plans of Management are encouraged under SEPP 44 – *Koala Habitat Protection* and form part of the legislative framework.

SEPP 44 requires a plan of management to be prepared before development consent can be granted in relation to core habitat. This can be achieved via a Comprehensive Koala Plan of Management (**CKPoM**) applying to an entire LGA or part thereof (such as this Koala Plan), or via an Individual Koala Plan of Management (**IKPOM**) which apply to a single parcel or area of land. The core habitat that this CKPOM covers is shown in Figure 2.

Other protections are also in place through State (and Commonwealth) listing of threatened species, via the *Threatened Species Conservation Act* 1995 (NSW) and *Environmental Protection and Biodiversity Conservation Act* 1999 (Commonwealth). The koala is listed under both of these pieces of legislation.

1.4 Local Land-Use Planning

At the local level, the Clarence Valley LEP 2011 (**CVLEP 2011**) is the primary land use planning document that provides for the zoning of land and subsequently enables or prohibits certain development. The LEP is supported by a number of Development Control Plans (**DCPs**) which apply according to the zone of the land.

Council has also developed and adopted the *Clarence Valley Council Biodiversity Management Strategy* in 2010, which provides a range of information and development controls that relate to biodiversity protection, including the identification of important habitat links for koalas.

It is further noted that although this Koala Plan provides development assessment framework for the determination of development applications, the Koala Plan does not give rise to a need for development applications over and above what is required by the CVLEP 2011. As such, the

development provisions within this Koala Plan is only triggered when a development application is required/received by Council.

1.5 Status of the Koala

The status of koalas varies from region to region and state to state. For example, population of koalas in south-east Queensland has been significantly impacted by urbanisation, reducing koala numbers to about a quarter of the population in the 1990's. Elsewhere, such as on Kangaroo Island in South Australia, koalas were introduced and are now booming in population, which is now actively controlled through sterilisation and translocation programs. This wide variation in koala numbers from one region to another is one of the major issues confronting the assessment of koalas as a nationally threatened species and the resulting differentiation between states.

In NSW the current koala populations are primarily located on the north and central coast, with small, sparse populations on the south coast and in the west of the State (Environment & Heritage 2014). It is estimated that there are between 5,435 and 8,800 koalas in NSW in total (AKF 2009).

Across the Clarence Valley LGA, there appears to be two distinct populations of koalas: those in the south and west of the LGA around Shannon Creek, Waterview Heights, Clouds Creek State Forest, and north of Nymboida; and those in the north of the LGA in the Ashby, Woombah and Iluka localities. Of these areas within the LGA, this Koala Plan concentrates on northern areas as they are seen as those that are under the greatest threat. It is nonetheless noted that areas in the south and west remain protected by SEPP 44 provisions.

In the area subject to this Koala Plan, being the Ashby, Woombah and Iluka localities, the National Parks and Wildlife Service (**NPWS**) Atlas of NSW Wildlife database includes a number of historical koala sightings with the earliest dating back to 1948. In total, 281 sightings have been recorded since 1980, though the transient nature of the species and potential for multiple observations of the same individual makes it difficult to estimate a precise population. Similarly, community surveys undertaken across the former Maclean Shire in 1998 produced 285 sightings, though again the extent of population remains difficult to predict.

Detailed studies undertaken in 2011 by Biolink Ecological Consultants identify that as per previous studies undertaken in 2002, there is an "ongoing persistence of the Ashby koala population". The report also identifies the presence of koalas in Woombah, with the study indicating "some measure of association with one or more resident populations in the locality" – though the whereabouts of the population are unknown. In Iluka, the evidence of koala activity highlights the importance of understanding the links between the three localities and adjoining reserves and national parks – links that have previously been highlighted through Council's *Biodiversity Management Strategy 2010*. Given the limited areas left in Iluka with development potential however, it is considered appropriate that efforts in this area are concentrated on management activities and that any future development minimises any impact on potential koala habitat.

1.6 Processes threatening to Koalas

There are a number of processes that are threatening to koala populations and their habitat. These processes include:

- Habitat loss through clearing, degradation and fragmentation;
- Road strike typically associated with traffic movement through wildlife corridors;
- Dog attack resulting from domestic pets and wild species;
- Mortalities caused by the introduction of swimming pools;
- Disease with koala populations;

- Bushfire impacts; and
- Severe weather conditions / climate change.

An outline of each of these processes is provided below.

1.6.1 Habitat Loss, degradation and fragmentation

Habitat loss primarily occurs through clearing for agriculture, forestry activities including private native forestry, urban or rural-residential development, roads and other infrastructure. Habitat loss has typically been more widespread on the more fertile soils, often coinciding with higher quality koala habitat. Clearing often results in the loss of preferred food trees, whilst subsequent fragmentation of habitat forces koalas to travel through cleared areas which may require them to cross roads or suburban areas where they are susceptible to dog attacks or drowning in swimming pools. Fragmentation by roads and urban/rural-residential development can also form a barrier between areas of habitat, isolating populations, altering population dynamics and reducing the gene flow. Repairing key habitats and corridors through planting with red gum and other food trees in priority areas such as the southern section of the Ashby around the Broadwater provide opportunities to enhance koala habitat within the management area.

1.6.2 Road strike

Records from carer groups in the Clarence Valley indicate that road strikes are the primary cause of koala injury or death (Lunney et al. 1996 cited in Dique et al. 2003). Higher rates of koala mortality or injury are generally associated with roads with high traffic flow rates, higher speed limits, poor road verge visibility, poor lighting and where peak traffic times coincide with peak koala activity (Turbill 2003). More male koalas are generally involved in road strikes than females, likely due to the fact that males travel to find new territory and as habitats become more fragmented, the distance travelled also increases.

1.6.3 Dog Attack

Records indicate that the majority of dog attacks occur in fenced yards of urban and rural-residential homes, however unreported attacks are also likely to occur in bushland areas (Turbill 2003). Attacks are typically linked to roaming dog packs (feral and domestic), aggressive dog breeds and poor domestic pet control. Dog attacks are expected to be more common during the koala breeding season (September to February) as koalas are more active (DECC 2008).

Clarence Valley WIRES (2009) noted that relatively few dog attacks have been recorded in the Clarence Valley LGA, in comparison to the Northern Rivers care group (Friends of the Koala) and Coffs Harbour WIRES. Data from the Port Macquarie Koala Preservation Society on the health of koalas attacked by dogs indicated that many animals had symptoms of other health problems such as chlamydia or tumours (Turbill 2003).

1.6.4 Swimming pools

Although koalas are able to swim, drowning can occurring in swimming pools where koalas are usually unable to escape due to the slippery nature of wet, tiled surfaces. While not considered to be a major threat to koalas, relatively simple management measures, such as the installation of a thick, sturdy rope (50 mm diameter or greater) attached to a poolside fixture and left draped in the pool can help to prevent animals drowning (DECC 2008).

1.6.5 Disease

The most prevalent health problem for koalas is chlamydia, a bacteria that has been found in all wild populations of koalas studied (Turbill 2003). Most animals do not show any sign of the

infection, however, stress due to habitat disturbance and overcrowding can result in chlamydiosis presenting in a number of forms. These are primarily as conjunctivitis, pneumonia, urinary tract infections and reproductive tract infections.

Koala populations are naturally regulated by reduced fertility due to chlamydiosis (DECC 2008), although additional stress may reduce fecundity levels further and result in low to nil population increase. While chlamydia by itself may not be considered a threatening process, when combined with other threats such as habitat fragmentation and reduced recruitment, populations can quickly decline.

Other diseases, such as leukaemia, lymphoma and immunosuppression, are also becoming more prevalent in koala populations, and have been associated with koala retrovirus. The virus is inherited and prevalent in Queensland koala populations, an estimated 20–60% of koalas in Victoria, but is not present at all on Kangaroo Island in South Australia. Based on the distribution within the national population, koala retrovirus appears to be moving through the national population from north to the south. Further studies are being conducted to determine if the virus can be transmitted between individuals through means other than inheritance.

1.6.6 Bushfire

Bushfires can directly impact koalas through direct radiant heat or the inhalation of smoke and ash, whilst indirect impacts include reduced, altered or complete loss of habitat depending on the intensity of the fire. Fire management regimes within koala habitat is also complex due to the need to reduce the risk of hot crown fires, whilst maintaining enough intensity to avoid altering vegetation floristics (Turbill 2003; DECC 2008).

Unfortunately, controlled fires can also directly affect individual koalas, as they often remain in the trees when hazard reduction burns take place. Individuals can also be affected through contact with burnt lower portions of trees. Indirect impacts of controlled fires are primarily through inappropriate fire regimes (e.g. regular low intensity fires), which promote fire-retardant shrubby species and reduced eucalypt growth.

While koalas will typically re-populate habitat which has been burnt, the time taken and the number of individuals which re-populate the area depends on a number of factors including the intensity and extent of the fire, extent of fragmentation, the proximity of source populations and the scale of other threats (DECC 2008). Large fires in Bundjalung National Park (north of the localities subject to this plan) are thought to have impacted on the Iluka koala population through reduced migration and genetic diversity.

1.6.7 Severe weather conditions and climate change

The quality and quantity of habitat available is one factor which determines the degree to which koala populations are able to survive severe climatic conditions such as drought, heatwave or flood (DECC 2008). Refuge areas – such as vegetated creek lines and rivers where soil moisture is higher – are important during periods of drought (DECC 2008). Historic clearing along watercourses in the Clarence Valley LGA has reduced the availability of this type of refuge habitat. Climate change may result in longer dryer periods and extended days of extreme hot weather. This may impact on koalas through reduced foraging availability, the need for koalas to seek water and travel on the ground and increased risk of and intensity of wild fire.

2. General Provisions

2.1 Area to which this Koala Plan applies

The land to which this Koala Plan applies (**the management area**) is shown in Figure 1. The management area consists of three localities:

- Ashby (including Ashby Heights);
- Woombah; and
- Iluka

Within these areas as indicated in Figure 1 this plan applies to land that is:

a) That is land in relation to which a development application has been made, and

b) That: i. has an area of more than 1hectare,or

ii. has, together with any adjoining land in the same ownership, an area of more than 1 hectare, whether or not the development application applies to the whole, or only part, of the land.

Much of the management area is forested, except some more urbanised areas and parts of the Clarence River foreshore which are used for agricultural purposes.

Although koalas are found within other areas of the Clarence Valley LGA, the management areas comprising the above localities were identified as being under the greatest pressure from urban development, and therefore seen by the State Government (see Recovery plan for the koala – DECC 2008) as a priority area for the preparation of a CKPoM.

There are large areas of state forests and national parks which adjoin the management area, but which do not form part of this Koala Plan. These areas are also likely to contain habitat and koala populations. These areas, which are managed by the State Government, are administered under other legislation.

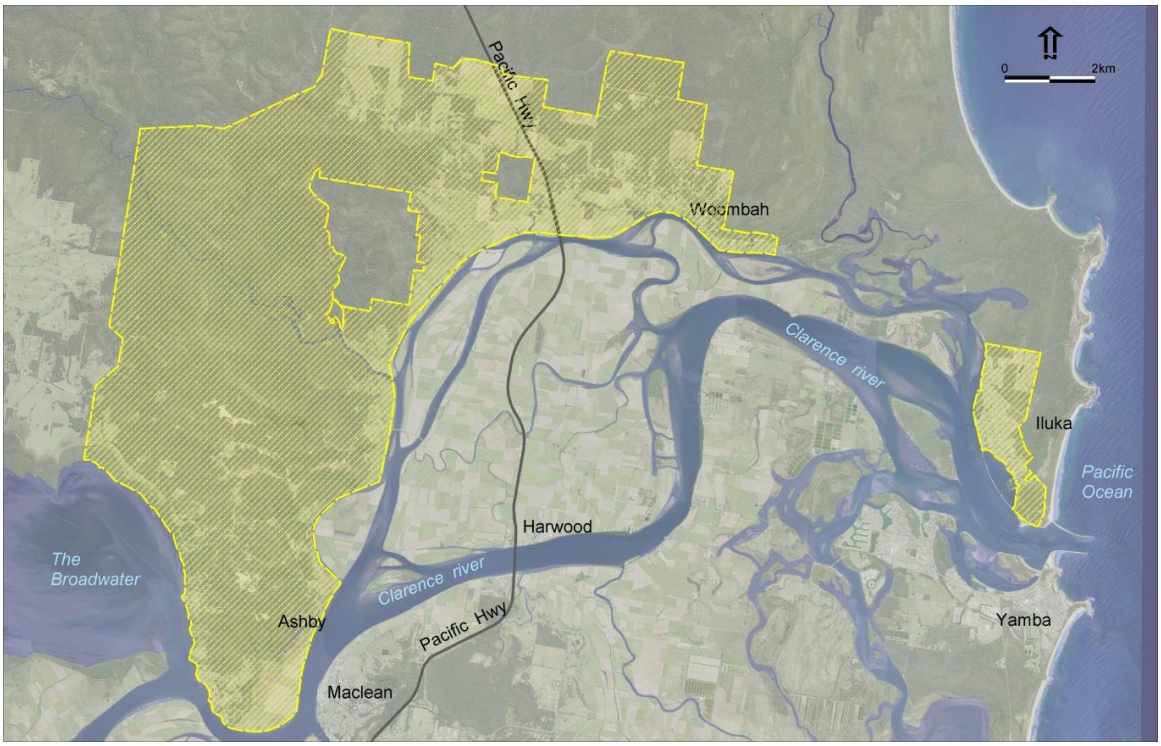

Figure 1: Land to which this Koala Plan applies

2.2 Relationship to other Koala Plans of Management

This Koala Plan does not supersede any approved Individual Koala Plans of Management that (IKPOM) are currently in force over land to which this Koala Plan applies. Should any existing Individual Koala Plans of Management have a requirement to be reviewed or updated, that review or update should be in accordance with this Koala Plan except if the proponent chooses to prepare an IKPOM.

2.3 Duration of the Koala Plan

The Koala Plan will come into effect once approved by the NSW Department of Planning and Environment and shall remain in force for a minimum period of 15 years, unless otherwise amended or superseded.

3. Management Activities

3.1 Aim of Management Activities

The aim of the non-regulatory management activities provided herein is to complement the development provisions presented in Section 4 of the Koala Plan. These management activities are necessary to:

- minimise threats to koalas and their habitat that are not related to development activity;
- increase the amount of koala habitat in the management area;
- maintain and where possible improve the quality of existing koala habitat in the management area; and
- ensure effective implementation and monitoring of the Koala Plan.

Management activities to be conducted as part of this Koala Plan are detailed in Table 1 and have been classified into the following categories: Road and traffic management, fire management, koala care and welfare, community involvement and education, research, domestic pets, and monitoring, evaluation and review. The development of this management framework has been informed by the scientific background study commissioned by Council as part of the development of this Plan (Phillips and Forsman 2002, Biolink Ecological Consultants 2012 etc.), as well as the deliberations of the Koala Work Group. Further survey and research to better understand the movement of koalas across the landscape between key population areas is critical to maintaining a viable population of koalas particularly at Iluka and Ashby.

Many of the management activities and actions outlined in (Table 1) can be completed under existing Council service levels and recurrent budgets. However, it is noted that completion of activities and actions that require funding is subject to the allocation of budget via Council's Delivery Plan process and/or successful applications for external funding.

3.2 Management Objectives

As a result of the varying conditions between the localities of Ashby, Woombah and Iluka, the management objectives are different for each area and are outlined below and should guide the implementation of the management actions in each area.

3.2.1 Ashby Locality

In the Ashby locality, the 2002 study by Phillips and Forsman identified three core habitat areas supporting disjunct breeding aggregations. The more recent 2012 study by Biolink Ecological Consultants confirmed the ongoing persistence of the Ashby koala population, though noted that some attrition of the population had occurred in comparison to 2002. Phillips has subsequently provided an addendum report to the 2012 report to clearly delineate the core habitat areas for the Ashby population. The core areas for Ashby are shown below in Figure 2.

Figure 2: Core Koala Habitat Ashby ref Phillips 2015 *(For purposes of the Plan Core Koala Habitat in Ashby is determined as an area of contemporaneous occupancy and/or generational persistence (i.e. containing one or more koala records for each of the three consecutive koala generations 1994 – 2012) as illustrated by Figure 2 of the Plan. The core area includes a 300metre buffer hashed in yellow in the northern part of the Ashby area.* Note: buffer width of 300 m is determined as the square root of the average koala home range size (in sq meters).

The management objectives for the Ashby locality are to:

- maintain and improve the resident koala population, encouraging an increase in population size so as to allow a viable source population to persist in the area;
- minimise habitat and associated native vegetation fragmentation; and
- facilitate an increase in both habitat quality and extent such that the locality is able to produce and support healthy and increasing koala populations.

3.2.2 Woombah Locality

In the Woombah locality, the koala population is relatively low, with transient use of the area indicating some measure of association with one or more resident population in the broader area (Biolink Ecological Consultants 2012). Historically, the frequency of fires in the area over the past 30-40 years is believed to have impacted on the resident koala population (Phillips and Forsman 2002), with any growth in the population being heavily dependent upon migration of individuals from the adjoining Bundjalung National Park or from the population to the west of the highway. The presence of koala habitat in the Woombah locality has important implications for the survival of nearby koala populations (such as the Bundjalung National Park population), as it acts as an area to which recovering populations can disperse, it reduces the edge effects of rural-residential development, and it could act as a refuge during fires in adjoining areas.

The management objectives for the Woombah locality are to:

- protect koala habitat; and

- protect individual koalas in the remnant koala population
- ensure fire management activities aim to conserve individual koalas, and their habitat and migration corridors

3.2.3 Iluka Locality

In the Iluka locality, the decline of the koala population over several decades and its possible extinction in the local area has been well documented. Moon (1990) estimated that the Iluka population consisted of 20-25 animals, whilst the Lunney et al. survey (1996) identified a population of only 13 animals. Three years later in 1999 surveys failed to identify any resident population. Further survey work by Biolinks in 2012 failed to find any koala activity in the Iluka Township. Nonetheless, calls are still frequent from Clarence Valley WIRES who reported six calls regarding injuries in 2009, suggesting there may still be a residual population surviving in the Iluka area or frequenting the area from the adjoining Bunjalung National Park.

It is therefore important to reduce further clearing and protect and rehabilitate those areas that are remaining. Particular focus should be given to restoring fragmented areas of koala habitat, lands within identified habitat linkages and koala habitat buffers, and lands adjacent to contiguous blocks of existing koala habitat (McAlpine et al. 2007). Further studies and monitoring are also required to establish the current status of the Iluka population.

The management objectives for the Iluka locality are to:

- undertake monitoring to ascertain further evidence of any resident koala population;
- ensure fire management activities aim to conserve individual koalas, and their habitat and migration corridors; and
- protect koala habitat.

Table 1: Management Activities

Activity No.	Management Action	Priority H / M /L	Activity Start	Activity Duration	Indicative Budget	Funding Source
Road and Traffic Management						
1	Review speed limits (by Council's Traffic Committee) in the Ashby area along Murrayville Road to determine the viability of a reduction to 80 km/h.	M	2016		Nil	Recurrent
2	Koala awareness signs, which include Clarence Valley WIRES contact details, shall be established at the following locations: • In the Iluka area approximately 6.8 km east of the Esk River crossing on the Iluka Road, when travelling towards Iluka; • In the Iluka area approximately 0.5 km north of Hickey Street along the Iluka Road, when leaving Iluka; • In the Ashby area approximately 0.2 km north of Ashby Tullymorgan Road along Crisp Drive; • In the Ashby area approximately 0.2 km north-east of Ashby Tullymorgan Road along Murrayville Road; • In the Ashby area approximately 0.5 km south of the Murrayville Road intersection along Ashby Tullymorgan Road; • In the Ashby area approximately 0.5km east of the Crisp Drive intersection along Ashby Tullymorgan Road; and • In the Ashby area approximately 1.2km	H	2015		$2100	PJ 994497

Activity No.	Management Action	Priority H / M /L	Activity Start	Activity Duration	Indicative Budget	Funding Source
	south of the Old Murrayville Road intersection along Murrayville Road (to the immediate north of Ashby Island).					
Fire Management						
3	Working in conjunction with NPWS, and the NSW Rural Fire Service to minimise fires within koala habitat areas in the Woombah and Ashby localities by promoting the Hotspots program and other land management approaches to minimize the risk of wildfires.	H	2015	Ongoing	$2000	PJ 994497
4	Koala habitat maps and desired management responses shall be provided to all Rural Fire Service Stations. Within koala habitat areas, the following fire management guidelines shall be followed to reduce impacts on koala populations: • avoid hot fires and crown scorches; • the construction and maintenance of fire trails should avoid removing koala habitat trees, particularly Tallowwood, Forest Red Gum, Swamp Mahogany and Small-fruited Grey Gum; and • mosaic burning is preferential to broad burning, so as to only affect the minimum area necessary to achieve the management objectives at any one time.	H	2015	ongoing	Nil	Recurrent

Activity No.	Management Action	Priority H / M /L	Activity Start	Activity Duration	Indicative Budget	Funding Source
5	All practical attempts must be made to immediately contain and extinguish wildfires within areas of koala habitat by highlighting these natural assets in the Clarence Valley Bush Fire Management Plan and working with the RFS and local brigades to highlight the importance of these areas.	H	2015	Ongoing	Nil	RFS
6	Council shall work closely with OEH to encourage appropriate fire management within Bundjalung National Park to ensure survival of the Bundjalung koala population and its potential role in supplementing the Iluka koala population.	H	2015	Ongoing	Nil	Recurrent
Koala Care and Welfare						
7	Through consultation with OEH and Clarence Valley WIRES, resources for koala care shall be maximised to ensure adequate koala welfare.	M	2015	Ongoing	$2000pa	994647

Activity No.	Management Action	Priority H / M /L	Activity Start	Activity Duration	Indicative Budget	Funding Source
Community Involvement and Education						
8	Develop and distribute educational material (e.g. brochures) to promote awareness of, threats to, and management of koalas. The material may encourage the planting of primary koala food trees such as Forest Red Gum, Swamp Mahogany, Small-fruited Grey Gum and Tallowwood; and the adoption of koala-friendly practices (e.g. koala-friendly fencing and good swimming pool design).	H	2015	Ongoing	$1500	994497
9	Council, in conjunction with OEH, Clarence Valley WIRES, and other interested parties undertake a community education program to raise awareness of koalas and measures that can be taken to protect and enhance their habitat. For example, informative sessions at schools.	M	2016	Ongoing	$1500	994497
10	Council create a webpage detailing koala management measures and actions that people can take to assist longer-term koala conservation efforts, including incentives for and assistance to landholders to manage vegetation on their property in a sustainable manner.	M	2016	Ongoing	Nil	Recurrent
11	This Koala Plan and associated information / maps be made available on Council's website and hardcopies be made available at Council's chambers in Grafton and Maclean.	M	2015	Ongoing	Nil	Recurrent

Activity No.	Management Action	Priority H / M /L	Activity Start	Activity Duration	Indicative Budget	Funding Source
12	Restore priority habitat and linkages with incentives to landowners to undertake weed control and plant Forest Redgum and other Koala Food trees with highest priority on the southern part of Ashby.	H	2015	ongoing	$200,000	Grant, Offset and some recurrent biodivers-ity funding.
Research						
13	Council work with OEH to encourage research on the impact of fire on koala populations, especially within the Iluka-Woombah-Bundjalung National Park area.	L	2016	ongoing	$5000	OEH
14	Council work with OEH to determine koala population movements within the Bundjalung National Park and Iluka areas, to determine if there is potential for re-establishment of an Iluka population.	L	2016	ongoing	$5000	OEH
15	Undertake further survey work in partnership with other organisations and landowners to better understand the extent of the koala population and movement between Ashby, Woombah and Iluka. When undertaking koala survey work, consideration is to be given to determining the location of appropriate habitat linkages across the landscape.	L	2017	Ongoing	Nil	994497
Regulation						
16	Council rangers should target and impound roaming dogs in areas of known koala habitat.	H	2015	Ongoing	Nil	Recurrent
17	Enforce curfews for dogs to prevent them roaming during the night, and have Council rangers periodically work after-hours to enforce the curfew.	L	2016	Ongoing	Nil	Recurrent

Activity No.	Management Action	Priority H / M /L	Activity Start	Activity Duration	Indicative Budget	Funding Source
18	Ensure continuing public awareness regarding the impacts of dogs on koalas and the penalties for breaching applicable laws (e.g. for example include brochures with dog registration forms and rate notices).	H	2015	Ongoing	Nil	Recurrent
19	Encourage landholders to appropriately fence yards in accordance with General Development Provision in Section 4.4 to reduce in-yard dog attacks on koalas.	M	2016	Ongoing	Nil	Recurrent
20	Sign posts should be placed in public koala habitat areas requesting that dog owners prevent their dogs entering the area, or as a minimum, requiring that dogs be restrained on a leash.	L	2016	1 week	$2000	994497

Activity No.	Management Action	Priority H / M /L	Activity Start	Activity Duration	Indicative Budget	Funding Source
Monitoring, Evaluation and Review						
21	Council's ecologist undertake periodic monitoring and data collection consisting of: o SATS sites at Ashby be monitored at least every five years to determine changes in activity levels and signs of population recovery such as breeding females. o At Woombah check SAT sites along the Northern section of Woombah every five years to document any recolonisation of potential habitat areas. o At Iluka revisit the sites surveyed by Biolinks to determine the presence of Koala activity at a minimum every five years. o Liaise with NPWS to undertake delineation survey work to the North of Woombah and Iluka in an attempt to quantify the population with the Park. o On an annual basis collect information on call outs for koalas and collate this for presentation in Councils four yearly State of the Environment Report.	H	2020	3months	Nil	Recurrent
22	In reporting of monitoring results, liaison also be undertaken with the NSW Koala Preservation Society, OEH and/or Clarence Valley WIRES to gather data on any koala incidents that may have occurred within the area in the previous two-year period.	M	2016	3 months	Nil	Recurrent

23	Council shall integrate management actions into the Delivery Plan and Operational Plan cycle to monitor: a. Any change in the extent and condition of koala habitat in the management area. Mapping of changes in extent of Koala habitat shall demonstrate the impact of clearing and any offset planting or restoration of habitat. b. Mapping of the changes in the condition of the koala habitat at least every 4 years in conjunction with the State of the Environment Report.	M	2016	ongoing	Nil	Recurrent
24	A report detailing the results of any monitoring program undertaken in accordance with these provisions is to be forwarded to Council, DOPE and OEH within one month of completion of the field assessment. The report must include the following: o a comparison of koala activity with data from past surveys; o a summary of koala incidents having occurred over the previous two year period; o any other observations of relevance to koala management; and o a discussion of the findings of the program and any recommendations for amendment of the Koala Plan or further action by Council.	M	2017	Ongoing	Nil	Recurrent
Planning and Legislative Processes						

25	Council shall forward hardcopy maps and relevant digital data layers delineating the extent of koala habitat to OEH, the Local Land Services – North Coast and the NSW Rural Fire Service.	H	2015		Nil	Recurrent
26	Council shall formally adopt the Koala Plan to inform the assessment of Parts 3, 4 and 5 of the EP&A Act.	H	2015		Nil	Recurrent
27	Council seek the approval of the Director of Planning and Environment in accordance with Clause 13(1) of SEPP 44 for this plan to cover the core areas shown in Figure 2.	H	2015		Nil	Recurrent

4. Development Provisions

4.1 Triggering of Development Provisions

The Development Provisions of this Plan only apply to development activities within the koala management area that require development consent under the Clarence Valley LEP. The requirements of the Koala Plan are 'triggered' for development requiring approval via the lodgement of a development application.

Development activities that are permitted without consent under the Clarence Valley LEP do not require a development application and as such do not 'trigger' this Koala Plan. Whilst the Koala Plan does not technically apply to these forms of development, the application of the Koala Plan would still be strongly encouraged by Council. For example, development activities listed as exempt and complying development listed in any environmental planning instrument do not trigger this Koala Plan.

The following flowchart outlines what development provisions apply to your proposed development. Further details of the various pathways and subsequent development provisions are provided in Sections 0 to 4.4 thereafter.

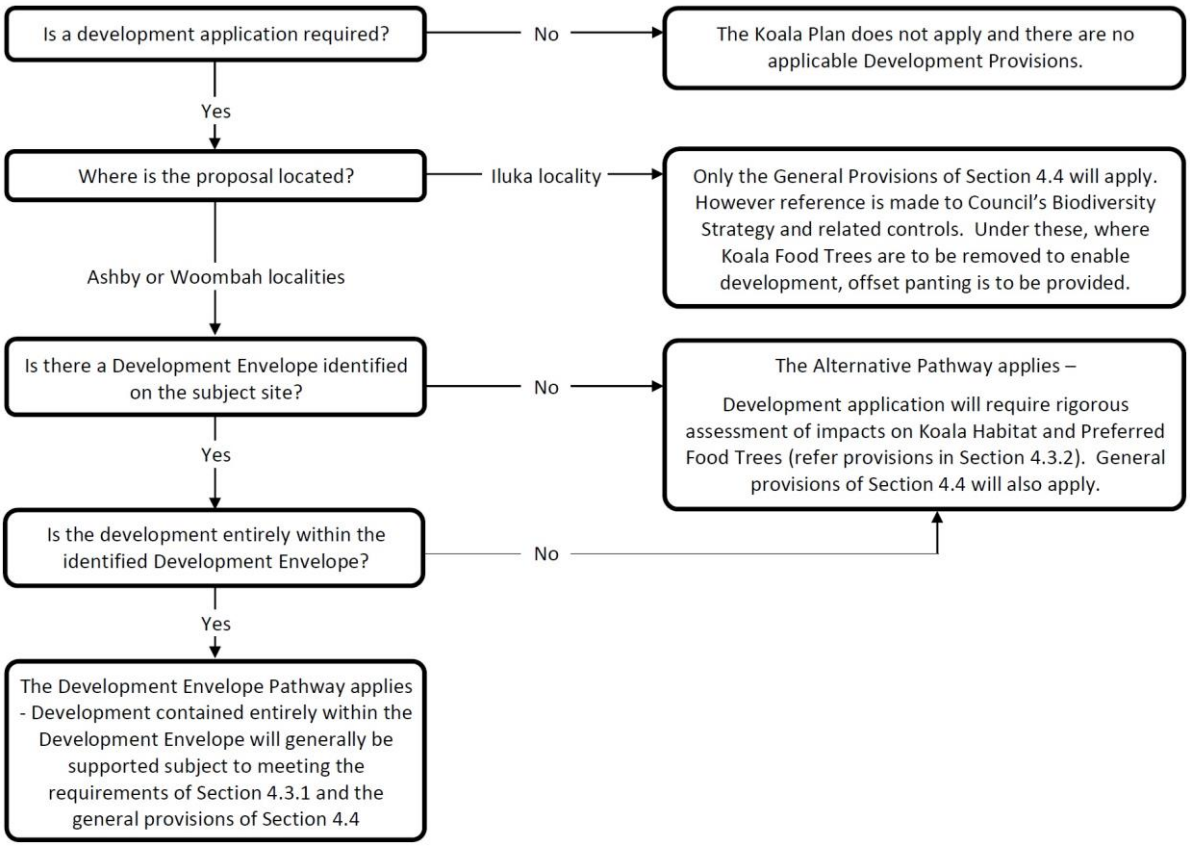

Figure 3: Development Provisions Flowchart

4.2 Development in the Iluka Locality

Recent studies have shown that there is no longer a breeding population within the Iluka Township but there are still periodic sightings of individuals within the township. Any development will nevertheless need to maximise retention of preferred koala food trees and habitat within the broader provisions of Council's Biodiversity Strategy and controls. Where koala food trees are to be removed for development purposes they must be offset with planting of primary food trees within Iluka.

Development within this locality should be accompanied by details of any existing koala food trees on the subject land, measures provided to minimise impacts from the proposed development on those trees and how controls related to the Biodiversity Strategy have been addressed.

General Development Provisions outlined in Section 4.4 will also apply where relevant.

4.3 Development Pathways in the Woombah and Ashby Localities

There are broadly two development pathways that apply to development in the Woombah and Ashby localities under this Plan. These are described as:

- Development proposed in areas where development envelopes have been established within the allotment subject to the development (the '**Development Envelope Pathway**'); and
- Development proposed in other locations (the '**Alternative Pathway'**).

These pathways are further described in the sections below, along with the development and planning provisions that apply. As a general rule, any development located on land that does not contain a development envelope would be subject to the Alternative Pathway.

NOTE: Where a development envelope has been identified on any land, development outside this area will be subject to rigorous assessment and may be refused on the basis of impacts that are contrary to the intent of this Plan.

4.3.1 Development Envelope Pathway

4.3.1.1 Application

This pathway applies to all land where a development envelope has been identified and as shown in Figure 3 for the Ashby locality and Figure 4for the Woombah locality. If you are unsure whether a development envelope is present on your site, please contact Council for further clarification.

Council has sought to assist those making a development application in the Ashby and Woombah localities through the up-front assessment of existing koala constraints. While not covering all areas subject to this Koala Plan, these areas were identified as having the greatest development pressure and potential for koala habitat within the management area. In undertaking these up-front assessments, Council is seeking to provide more certainty with respect to koala constraints for applicants wishing to develop their land.

For many areas that have been subject to this additional assessment by Council a 'development envelope' has been provided that indicates the areas within land parcels where the least constraints exists. Development envelopes only apply to parts of the Ashby and Woombah localities as shown in Figure 3 and Figure 4 respectively.

The boundary of development envelopes shown in Figure 3 and 4 may be reconfigured with the concurrence of Council as part of individual development assessments where it can be demonstrated that reconfiguration to allow for development will reduce the impact of the

development on identified koala habitat. The location and size of the development envelope is to comply with Figures 3 and 4 with the precise size and location of the envelope to be shown on the site plan for new developments. Delineation of the boundaries of the envelope at the individual lot layer shall ensure that development is sited to minimise impact of development and Council will ensure that the envelope is consistent with Figures 3 and 4 in that regard. Where development cannot be contained within the envelope shown and where there is no justification for reconfiguration the *alternative pathway* provisions apply.

NOTE: It is noted that development envelopes have not been applied to all land subject to this Plan and in the absence of a development envelope, the Alternative Pathway will be used to assess development applications.

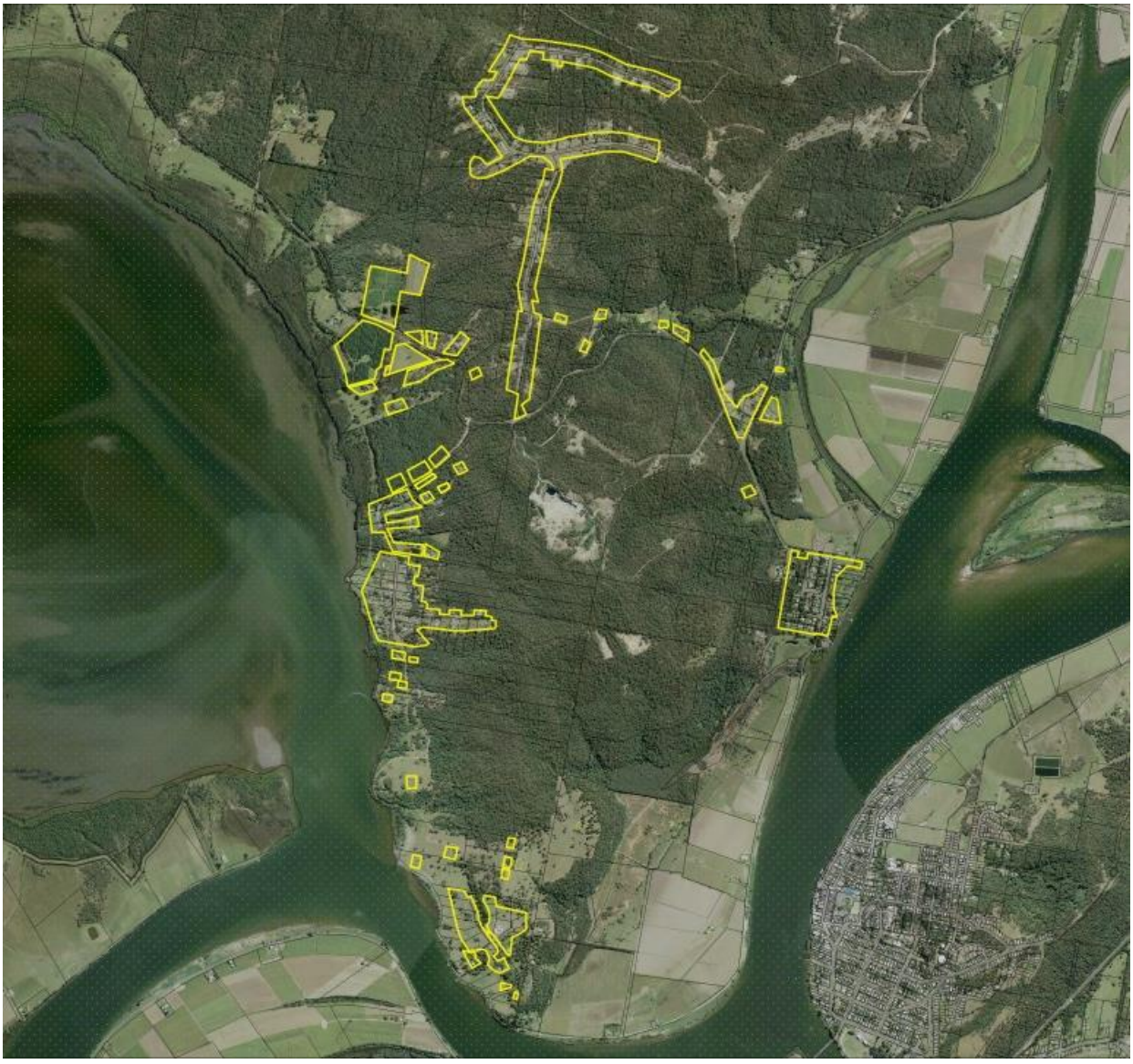

Figure 4: Ashby Locality Building Envelopes

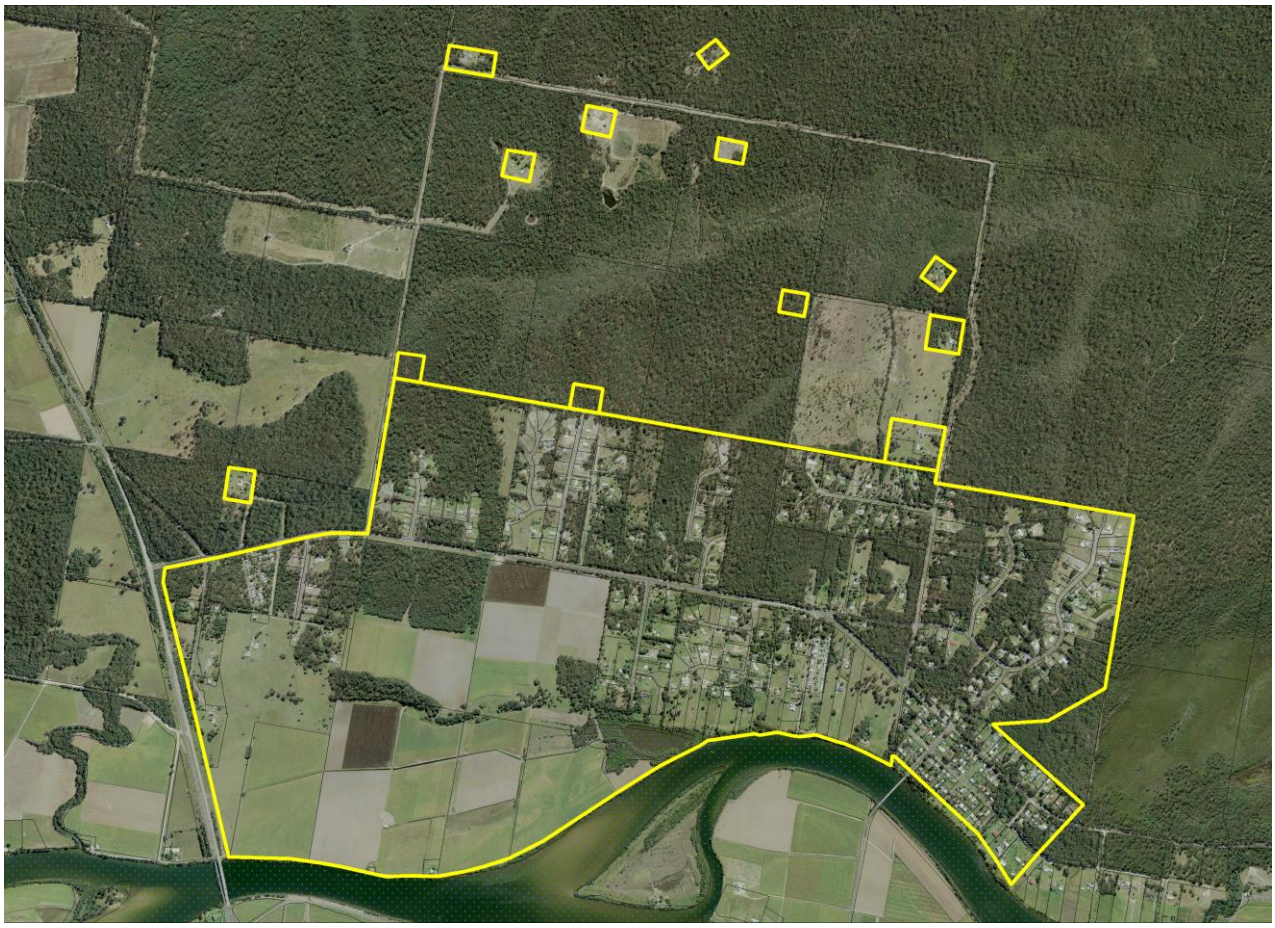

Figure 5: Woombah Locality Building Envelopes

4.3.1.2 Provisions

A. Subdivision

Development consent will not be granted for subdivision of land to which this provision applies unless the consent authority is satisfied that each lot that would be created by the subdivision will contain a sufficient building envelope within the identified development envelope to enable future development of the lot to comply with other provisions of this Koala Plan.

In the context of this provision, the building envelope shall include the footprint of any proposed dwelling, ancillary buildings, effluent disposal areas, access roads/driveways, services and bushfire asset protection zones where required based on a Building Attack Level of between 29 and 40 (AS3959-2009) and taking into account the NSW Rural Fire Service 10/50 Code.

The general development provisions at Section 4.4 also apply where applicable.

B. Other Development

The following provisions apply to development applications within the Ashby and Woombah development envelopes:

I. Site planning of the development must result in the least possible impact on native vegetation in general, and preferred koala food trees in particular. New dwellings must be positioned as close as possible to existing roads in order to minimise clearing of native vegetation.
II. New developments must aim to ensure all elements of the development are within the development envelope. These elements include the dwelling, access routes, effluent disposal areas and bushfire asset protection zones where required based on a Building Attack Level of between 29 and 40 (AS3959-2009) and taking into account the NSW Rural Fire Service 10/50 Code.
III. Any clearing outside the development envelope may threaten the viability of the Ashby and Woombah koala populations and will not be supported for the purposes of further intensification or subdivision subject to the application of the Alternative Pathway Provisions of this Koala Plan.

Where development is proposed outside the development envelope, the Alternative Pathway provisions apply.

The general development provisions at Section 4.4 also apply where applicable.

4.3.2 Alternative Pathway

4.3.2.1 Application

Development assessed under the Alternative Pathway comprises of all development that is not otherwise covered by the *Development Envelope Pathway*.

4.3.2.2 Provisions

A. Retention of Koala Habitat

Where development includes impacts to koala habitat, development consent may only be granted where the Consent Authority is satisfied that:

i. There is no loss of 'Primary' or 'Secondary (A)' habitat which have trees with evidence of recent koala activity or previously recorded koala activity; and

ii. Through compensation works, there is no net loss of 'Primary' or 'Secondary (A)' habitat within the locality to which the development is proposed (i.e. either the Woombah or Ashby locality) as mapped in Appendix D; and

iii. The application demonstrates that retention of koala habitat has been maximised; and

iv. All feasible options to negotiate alternatives to avoid clearing, minimise clearing when clearing is unavoidable, and mitigate the adverse impacts of clearing have been exhausted; and

v. The proposed compensation works will lead to an improvement in the environmental values of koala habitat. In cases where compensation works are not feasible or there is a high risk that the works may fail, application of this framework is not appropriate and should not be considered; and

vi. Application of compensation works has been conducted in accordance with the principles outlined in the Habitat Compensation Policy (Appendix B); and

vii. The Habitat Compensation Plan identified in the Koala Habitat Assessment Report (Appendix C) complies with the above policy.

Koala habitat is generally identified by the mapping at Appendix D (see Biolink Ecological Consultants 2012) or as otherwise confirmed by the undertaking of a Koala Habitat Assessment Report as set out in Appendix C. Council will advise if a Koala Habitat Assessment Report is required based on its assessment of the existing level of information available to asses impacts on the subject site.

B. Retention of Preferred Koala Food Trees

Where development includes impacts to individual koala food trees (i.e. trees which do not form part of Koala Habitat covered in Provision (i) above), development consent may only be granted where the Consent Authority is satisfied that:

i. There is no loss of trees that have evidence of recent koala activity or previously recorded koala activity within the tree or a 20m radius;

ii. The development application demonstrates that retention of preferred koala food trees has been maximised; and

iii. Approval is to be conditional upon the following measures being documented in an Environmental Management Plan where the removal of preferred koala trees is otherwise unavoidable:

    a. Any preferred koala food trees removed are to be replaced at a ratio of 1:10 (removed : replaced). The replacement trees must be planted on the subject site, and should be planted in a suitable location – preferably in groups to form habitat linkages and/or adjacent to larger areas of bushland;

    b. Replacement preferred koala food trees must be of the same species as those removed, and must be sourced from local seed stock;

    c. Preferred koala food trees planted as replacement trees must be a minimum 600mm tall at the time of planting, and be nurtured for a minimum period of 24 months. Any plants that die within this period must be replaced; and

    d. Demonstrate how ongoing maintenance and protection of preferred koala food tree seedlings is to be undertaken – for example exclusion of stock, program for weed suppression and removal, watering regime etc.

    e. Provide for the mechanism for implementation of the actions – for example by a Conservation Vegetation Management Plan attached to the title of the land.

Impact on individual koala food trees are to be determined through review of previous studies undertaken in the locality (for example Mapping at Appendix D), or through undertaking of a Koala

Habitat Assessment Report as may be required by the Consent Authority to enable assessment of the development application.

C. Other Provisions

The general development provisions at Section 4.4 also apply where applicable.

4.4 General Development Provisions

General development provisions apply to all development (where applicable) within the scope of this Koala Plan where the site has been identified as preferred or core koala habitat (refer mapping at appendix D which illustrates preferred koala habitat – being Primary, Secondary A and Secondary B habitat). This CKPOM meets the requirements of SEPP44 for the core habitat shown in Figure 2. These general development provisions aim to reduce the impact of development and urbanisation on individual koalas.

A. Road Design Standards

Where a development application includes the provision of public or private roads, the following standards will apply:

i. Road design standards and/or approved vehicle calming devices must be incorporated such that motor vehicles are restricted to a maximum speed of 60 km/h in preferred koala habitat and 40 km/h in core koala habitat.
ii. In areas where the installation of fencing and underpasses for new roads is not possible due to topographical, engineering or aesthetic constraints, then signage, street lighting and appropriate vehicle calming devices such as speed humps, roundabouts and/or chicanes shall be considered to ensure a low speed vehicle environment.
iii. Detailed design of road shall be prepared in consultation with a suitably qualified and/or accredited koala specialist.

B. Keeping of Domestic Dogs

Where a development application is proposed for subdivision or multi-unit development, the following standards will apply:

i. Covenants are to be used to prohibit the keeping of domestic dogs in areas of koala activity exceeding the 13% contour as shown on mapping at appendix D, or in areas of core koala habitat if not otherwise included;

C. Fencing

Where a development application involves the construction of fencing (and not withstanding provisions of the *Swimming Pools Act* 1992), or where subdivision is proposed to which covenants relating to fencing can be enforced, the following standards will apply:

i. Koala-friendly fencing is to be provided in situations where domestic dogs are not permitted (refer above), including:
    a. New fencing of residential allotments within koala habitat areas must be designed to enable the movement of koalas through features such as:
        - using materials such as timber post-and-rail or chain wire, that a koala can easily grip and climb;
        - not stringing wire strands too tightly;
        - using rails or slats that are not more than 150 mm wide; and
        - leaving a minimum 300 mm ground clearance.

b. Existing fencing of residential allotments within koala habitat should be modified to provide a means for koalas to climb over a fence by:
    - installing timber posts on either side of the fence that lean against the fence at a 45 degree angle;
    - planting vegetation on either side of the fence so that branches touch the fence, or trunks are within one metre of each side of the fence to provide a natural ladder; and/or
    - installing horizontal panels or planks along the top of the fence to provide a walkway.

ii. Where domestic dogs are permitted, koala exclusion fencing shall be provided, including:
    a. Fencing should be made of a material that koalas cannot easily grip, including (but not limited to) metal sheeting;
    b. Fencing should have a maximum ground clearance of 100 mm; and
    c. Trees and shrubs should be planted at least 3 m away from the koala exclusion fencing.

D. Swimming Pools

Where a development application proposes the installation of a swimming pool, the following provisions apply:

i. All new swimming pools shall either:
    a. have a stout rope (minimum 50 mm diameter), one end of which must be secured to a stable poolside fixture and the other end of which must trail into the pool at all times; or
    b. be constructed with a 'beach' type access where the pool water is level with part of the surrounding pavement; or
    c. Swimming pool fencing must be of a type that prevents access to the pool area by koalas (e.g. not be of timber or have timber posts or have shrubs and trees either side of the fence that would allow koalas to climb over).

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APPENDIX A: Planning and Legislative Framework

Council's Planning Framework

Planning policy in the Clarence Valley is defined through a number of documents, including the Clarence Valley Local Environmental Plan 2011 (**CVLEP 2011**) and various development control plans (**DCPs**). Policies are prepared within the framework of existing legislation such as the *Environmental Planning and Assessment Act* 1979 (**EP&A Act**), and are reviewed regularly to ensure that the implementation of the legislation is consistent with community expectations.

CVLEP 2011 provides the planning framework for encouraging orderly development within the Local Government Area (**LGA**) while protecting important aspects of the natural and built environment. The 2011 LEP was developed to combine the controls of the six existing LEPs applying in the Clarence Valley LGA into a single document. The CVLEP 2011 covers a range of issues and including environmental protection.

In 2014 Council also sought an amendment to CVLEP 2011 to include a clause relating to the consideration of biodiversity in development assessment. The clause seeks to strengthen planning controls over areas where threatened species and their communities exist – such as the koala. The clause was a recommendation of and relates back to the *Clarence Valley Biodiversity Management Strategy* which was adopted by Council in 2010. The amended controls have been adopted by Council and at the time of release of this document are awaiting final approval from the Department of Planning. Council has an adopted DCP and offsets policy to support the proposed LEP amendment.

Below the LEP level, Council uses various strategies and plans of management to guide the management of native vegetation, open spaces and sensitive areas within the Clarence Valley. In a broad sense, strategies set out the philosophy and framework for Council to undertake its work. Plans of management, such as this Koala Plan, set out the manner in which specific objectives are to be achieved on the ground (i.e. implementation/action plans).

CVLEP 2011 contains Clause 5.9 relating to the removal of trees and other vegetation. The clause invokes Council's development control plan covering tree removal in residential zone R1 - General Residential, R2 - Low Density Residential, R3 Medium Density Residential and R5 Large Lot Residential. Removal of trees on rural land is otherwise covered by the *Native Vegetation Act* 2003.

State Environmental Planning Policy (SEPP) 44 – Koala Habitat Protection

The EP&A Act has a range of environmental planning instruments which provide for protection of koala habitat, including LEPs (as discussed above) and State Environmental Planning Policies (SEPPs).

Of particular relevance is SEPP 44 – *Koala Habitat Protection*, which was introduced in 1995 with the aims of encouraging the conservation and management of natural vegetation that provides habitat for koalas to ensure permanent free-living populations over their present range, and to reverse the current trend of population decline. 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. SEPP 44 requires a plan of management be prepared before development consent can be granted on land with core koala habitat.

The SEPP also requires councils to address koala conservation through individual koala plans of management (**IKPoM**) or comprehensive koala plans of management (**CKPoM**) – such as this Koala Plan. Under the SEPP, a site-specific individual koala plan of management must supplement any

development application (**DA**) where core koala habitat is found to occur. However, if a CKPoM has been prepared for the area, then individual DAs do not need to include an IKPoM – as long as the DA is consistent with the requirements of the CKPoM (DECC 2008).

CKPoMs, whether they cover a whole LGA or only part of an LGA, have a number of advantages over IKPoMs. These include:

- coordinated protection, management and restoration of koala habitat;
- cooperation of government and non-government agencies;
- involvement of the community; and
- reduction in the resources required for preparing and assessing IKPoM by councils, development proponents and State agencies (DECC 2008).

SEPP 44 also encourages identification of core habitat, and encourages inclusion of core habitat into environmental protection zones. Definitions for 'potential' and 'core' koala habitat are given in SEPP 44 as:

- Potential koala habitat – an area of "native vegetation where the trees of the types listed in Schedule 2 of the policy constitute at least 15% of the total number of trees in the upper or lower strata of the tree component".
- Core koala habitat – "an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young), and recent sighting of and historical records of a koala population".

For those lands which are exempt from SEPP 44, clearing and/or modification of habitat is regulated by the *Native Vegetation Act* 2003. This Act was introduced to provide a comprehensive system for conserving and managing vegetation in NSW.

Threatened species listings

Under Commonwealth legislation (*Environment Protection and Biodiversity Conservation Act* 1999), the koala is listed as a Vulnerable species in NSW. Across Australian states the legal status of the koala varies from secure to vulnerable (DECC 2008).

In NSW, a 1986/87 koala survey found that the species was in serious decline, having disappeared from 50-75% of its historic range (Reed et al. 1990). The koala was first listed as vulnerable in NSW on the *Endangered Fauna (Interim Protection) Act* 1991, and the vulnerability status was carried over to the *Threatened Species Conservation Act* 1995 (**TSC Act**).

The listing of a species on the TSC Act has a number of ramifications. Where a development or activity is likely to have a significant effect on a listed threatened species, endangered population or endangered ecological community, a species impact statement is required. Listing of a species also may also result in the preparation of a recovery plan – see the State-wide koala recovery plan (DECC 2008).

Other provisions

Other legislation relevant to this Koala Plan includes the *National Parks and Wildlife Act* 1974, *Rural Fires Act* 1997, *Local Government Act* 1993, *Crown Lands Act* 1989, *Native Vegetation Act* 2003, *Water Management Act* 2000 and the *Companion Animals Act* 1998.

APPENDIX B: Koala Habitat Compensation Policy

Background

This policy[1] is designed to provide a system for determining appropriate compensation for development that proposes the removal of koala habitat. The standardised approach presented here is transparent, can be applied in a consistent manner and is less resource-intensive for Council and proponents than the current largely case-by-case method.

Council also has an adopted Biodiversity Offsets Policy, which should be read in conjunction with this policy. In that policy koala habitat is classified as high conservation and any approved clearing of vegetation is required to be offset at the ratio of 10:1.

Aims

The policy aims to provide for ecologically sustainable development, to protect and enhance areas of existing koala habitat, particularly those currently or previously used by koalas, and to create koala habitat where there is a sound ecological reason to do so.

Guiding principles

The principles that underpin this policy are:

1. The primary objective of habitat compensation must be to protect, enhance or create ecologically viable koala habitat;
2. Compensation must only be considered once all options to avoid, minimise and mitigate any adverse impacts have been exhausted;
3. Clearing must not be approved where the impact of clearing cannot be satisfactorily compensated;
4. Clearing must not be approved where trees or habitat demonstrate recent or previously recorded koala activity;
5. Habitat compensation works should lead to a net gain in the area of Primary and Secondary (A) koala habitat, and an improvement in the condition of other koala habitat;
6. The land receiving compensation works ('receiving land') must be ecologically suitable and appropriate for protection, enhancement or creation of koala habitat;
7. An activity that leads to the loss of koala habitat (particularly clearing) should only proceed once the management arrangements on the receiving land are legally secure;
8. Compensation works must not lead to permanent adverse environmental impacts and must not be used as a justification for granting approval to a DA where the adverse environmental impacts of a development are greater than the benefit to be obtained from the compensation works;
9. Compensation works undertaken on rural land should be conducted in a way which achieves best practice farm management;
10. Management and monitoring of habitat compensation activities should be undertaken over an ecologically meaningful timeframe (i.e. a minimum of five years).

Components of the Habitat Compensation Policy

If Council gives approval to clear an area of koala habitat, this policy requires the proponent to undertake compensation works to compensate for the loss of koala habitat. The compensation works must benefit another area of koala habitat or a koala movement corridor to that being

[1] Note this policy is based on the approved Lismore Comprehensive Koala Plan of Management (2014) in view of creating consistency in the application of development assessment procedures across the region.

impacted by development. The policy is based on any loss of vegetation being offset at 10:1 and two key principles:

1. the nature of and level of legal protection afforded an area of receiving land; and
2. that there is no loss of koala habitat where there is recent koala activity.

Where vegetation is protected under the Native Vegetation Act 2003 the clearing of vegetation may also require approval from Local Land Services and before Council can issue consent where this is the case it will require concurrence from Local Land Services.

Habitat Compensation Works

Protection

Should development consent be granted to clear and/or adversely impact an area of koala habitat then the proponent may compensate for the adverse impacts of the development by providing a high level of conservation security to an area of receiving land (i.e. 'Protection'). All classes of koala habitat can receive Protection under this policy. There are three acceptable primary protection mechanisms for this category of habitat compensation works:

1. transfer of land ownership to the Crown for dedication as a conservation reserve (*National Parks and Wildlife Act* (**NPW Act**));
2. dedication of land under a Voluntary Conservation Agreement (NPW Act); or
3. dedication of land under an in perpetuity trust agreement (*Nature Conservation Trust Act* 2001).

Enhancement

Should development consent be granted to clear and/or adversely impact an area of koala habitat then the proponent may compensate for the adverse impacts of the development by appropriately managing an area of receiving land to improve the integrity and viability of koala habitat and/or prevent/minimise threats to koala habitat (i.e. 'Enhancement'). Management activities may include works to restore/regenerate degraded habitat and/or prevent/minimise threats to koala habitat (e.g. exclusion fencing). Under this policy all classes of koala habitat can be afforded Enhancement.

Given that Enhancement works may require significant investment, it is important to ensure that the benefits of Enhancement works are durable over time. The loss of koala habitat and/or adverse impacts for which the Enhancement works is compensating are intended to be long-lasting. Furthermore, there will be a lag between the time that the Enhancement works is undertaken and the time that the ecological benefit is obtained.

All land subject to the habitat compensation measures must be protected by a legally binding management agreement between council, the proponent of the development, the lawful owner(s) of the development area or other receiving land to which the habitat compensation measures apply.

For receiving land afforded Enhancement all enhancement works must be outlined in a VMP/PoM approved by Council and fully funded by the proponent with a minimum five-year management period following the completion of the initial phase of habitat protection works. Compliance with the VMP/PoM must be enforceable and secured by legal agreement.

Long term funding for management of enhancement works beyond the minimum five-year management period detailed above, may also be secured by application of an environmental levy, subject to the approval of the NSW Government.

Creation

Should Council give development consent to clear and/or adversely impact an area of koala habitat then the proponent may compensate for the adverse impacts of development activity by creating koala habitat on an area of receiving land (i.e. 'Creation'). Habitat may be created in an area of receiving land where there is a sound ecological reason to do so (e.g. within gaps of contiguous koala habitat, areas adjacent to koala habitat, within a koala movement corridor or unvegetated riparian corridor). Appropriate works for an area of receiving land afforded Creation will depend on the individual features of the land and the type of ecological community to be created. Revegetation works, landscape plantings, bush regeneration, threat prevention and minimisation activities (e.g. exclusion fencing) all contribute to the Creation of koala habitat. All classes of koala habitat can be afforded Creation under this policy.

Given that Creation works may require significant investment, it is important to ensure that the benefits of Creation works are durable over time. The loss of koala habitat and/or adverse impacts for which Creation works are compensating are intended to be long-lasting. Furthermore, there will be a significant lag between the time that the Creation works is undertaken and the time that the ecological benefit is obtained.

All land subject to the habitat compensation measures must be protected by a legally binding management agreement between council, the proponent of the development, the lawful owner(s) of the development area or other receiving land to which the habitat compensation measures apply.

For receiving land afforded Creation all enhancement works must be outlined in a VMP/PoM approved by Council and fully funded by the proponent with a minimum five-year management period following the completion of the initial phase of habitat protection works. Compliance with the VMP/PoM must be enforceable and secured by legal agreement.

Worked example

Within a 50 hectare proposed subdivision, there are 20 hectares of degraded primary koala habitat located on undevelopable land on the subject site with no recent koala activity. After all efforts to avoid, minimise and mitigate the adverse impacts of the proposed subdivision on koala habitat have been exhausted, clearing of 0.46 hectares of primary koala habitat is proposed to upgrade an existing road servicing the proposed development.

The proponent may offset impacts by Protection, enhancement or creation as the measure to compensate for clearing of 0.46 hectares of primary koala habitat, the area of receiving land required is calculated as follows:

Area of Habitat Compensation Works = 0.46 ha x 10

= 4.6 hectares

APPENDIX C: Koala Habitat Assessment Report Requirements

The following outline provides the minimum structure and content requirements for a Koala Habitat Assessment Report where required to be produced in conjunction with a development application. For regional consistency, these assessment requirements are based on the Lismore CKPOM.

Table 1: Minimum Structure and Content Requirements – Koala Habitat Assessment Report

Section		Content
1	Background	○ Briefly describe the nature of the proposed development. ○ Identify the Clarence Valley LEP zoning(s) of the study area and adjacent areas.
2	Links to legislation, other plans and documents	○ Demonstrate how the Assessment Report links to legislation, other plans and documents that relate to the proposed development.
3	Study Area	○ Identify the location and extent of the study area to be covered by the Assessment Report, including the study area and any other areas that may be directly or indirectly impacted by the proposed development. ○ Describe the type, extent and current condition / use of existing koala habitat in the study area. ○ Describe the broader context of other vegetation in the study area and the landscape in general. ○ Detail any environmental constraints and any significant or sensitive environmental features of the study area.
4	Methods	○ Describe in detail the methodology used to sample the vegetation on the study area. ○ Include a map/plan with the overlain grid used to identify detailed and initial SAT sampling sites.
5	Results	Include a map/plan detailing the location of: ○ the proposed development and associated infrastructure and any requirement for a bushfire asset protection zone; ○ all vegetation including food trees, and any areas of preferred koala habitat or core koala habitat as determined by the SAT assessment; ○ any food trees and/or koala habitat that are proposed to be directly and/or indirectly impacted, removed, regenerated and/or revegetated. Each tree should also be marked with a unique identifier.

Section		Content
		Include a table detailing the: o area of all vegetation by vegetation type (including koala habitat), identifying any area of vegetation proposed to be removed, regenerated and/or revegetated; o a table detailing the species, diameter at breast height over bark (dbhob) and the unique identifier of all trees proposed to be removed, lopped or isolated from koala use; o species, size class (<100 mm dbhob, 100–300 mm dbhob and >300 mm dhob) and number of food trees that are proposed to be removed, lopped or permanently isolated from koala use.
6	Conclusion	o Identify limitations to the assessment and further issues that might need to be addressed. o Interpret and discuss the results of the koala habitat assessment. o Include discussion on any alternative options considered and why these options have been rejected as not feasible. o Include a proposal for a Habitat Compensation Plan that meets the habitat compensation guidelines in this Plan.
7	References	o Include a list of all references cited in the report.
8	Appendices	o Include any additional information or supplementary material pertinent to the DA proposal.

APPENDIX D: Koala Habitat Mapping

Source: Biolink Ecological Consultants (2012)

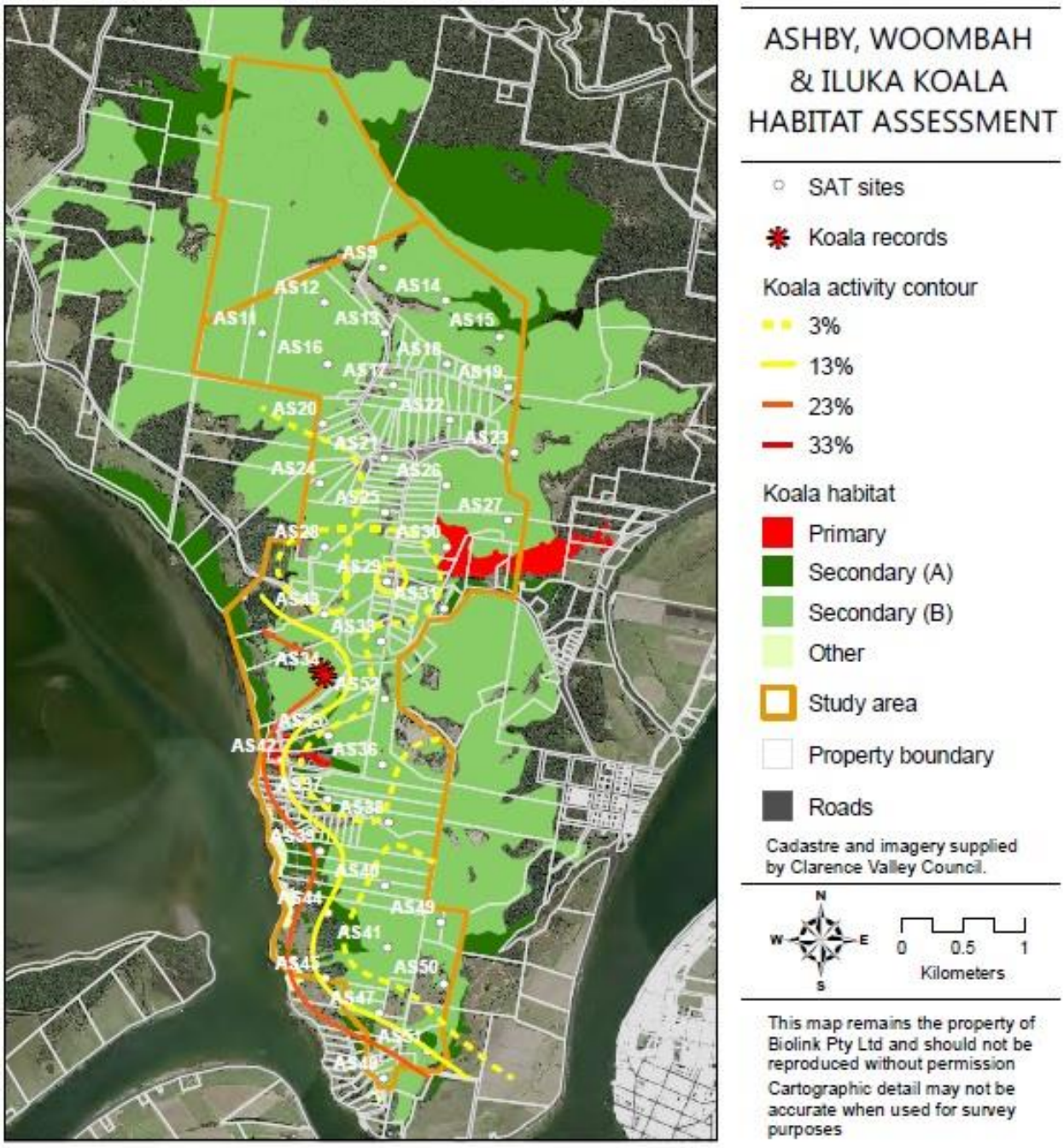


Figure 6: Ashby, Woombah & Iluka Koala Habitat Assessment (Map 1)

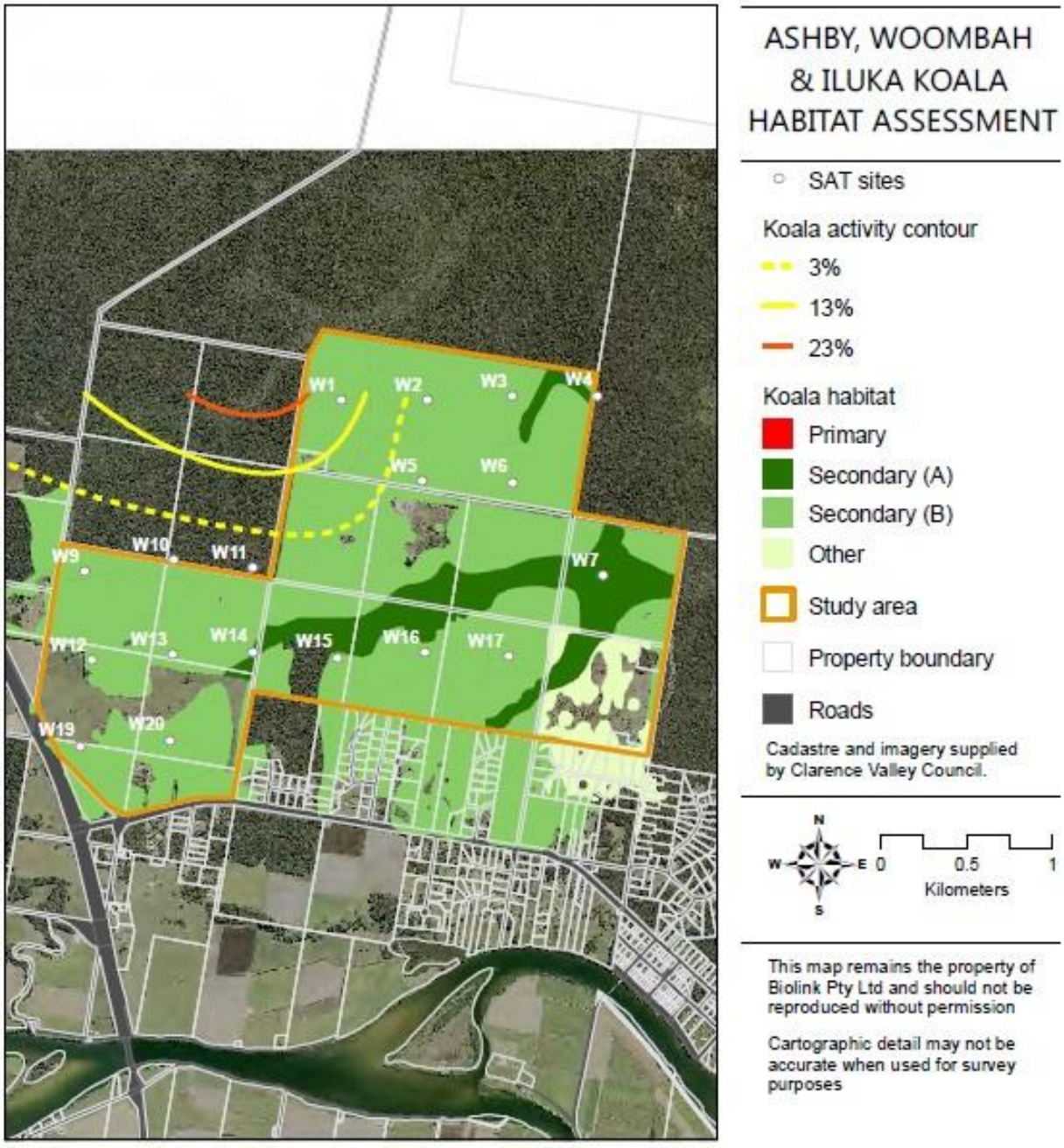


Figure 7: Ashby, Woombah & Iluka Koala Habitat Assessment (Map 2)

APPENDIX E: Koala Habitat Assessment Methodology

Source: Based on Lismore CKPOM

The SAT (spot assessment technique) and RG-bSAT (regularised grid-based spot assessment technique) approach (Phillips & Callaghan 2011) is a standardised sampling tool for Koala Habitat Assessment Reports. For the purposes of this Plan, it is intended that this assessment be undertaken by a suitably qualified person with relevant experience and training in both the application and interpretation of the RG-bSAT approach.

Following is a step-by-step account of how to work with the SAT approach.

Step 1

The initial step involves determining the appropriate sampling intensities for your site. Table 1 provides an outline of intensity based on land size. The use of the initial and high intensity sampling frequencies is further explained in Step 3.

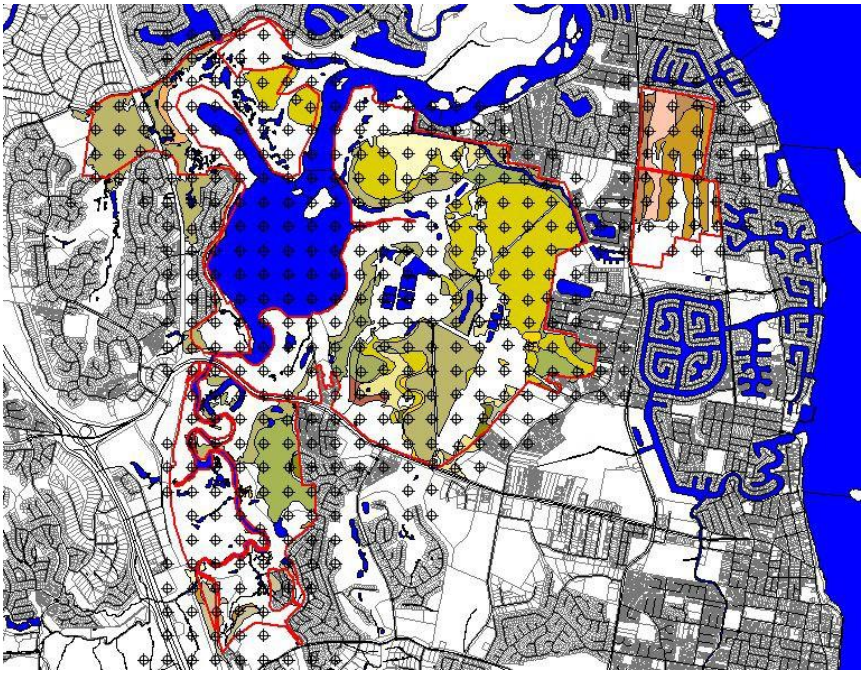
Table 1: Sampling intensity according to land size

Area of Land	Initial SAT sampling intensity	High SAT sampling intensity
< 15 ha	Every 150m	Every 75m
15 – 50 ha	Every 250m	Every 125m
> 50 ha	Every 350m	Every 175m

Step 2

a) Overlay the land subject to the proposal with a square grid at intervals given for "high SAT sampling intensity" in the table above and determine the location of SAT sampling points.

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 ≥ 100mm 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 (⌖ indicates 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) Sampling is to be undertaken at each sampling point using the SAT methodology as detailed in attached Australian Koala Foundation publication (Phillips and Calaghan 2011).

b) Initial sampling must be undertaken at intervals commensurate with the initial sampling intensity shown in Step 1.

c) Resulting koala activity levels at each field site are then interpreted as either "Low use"(less than 22.52%), "Medium (normal) use" (greater than or equal to 22.52% but less than or equal to 32.84%) or "High use" (greater than 32.84%) in line with the "East Coast (med-high)" activity thresholds specified in Table 2 of Phillips & Callaghan (2011);

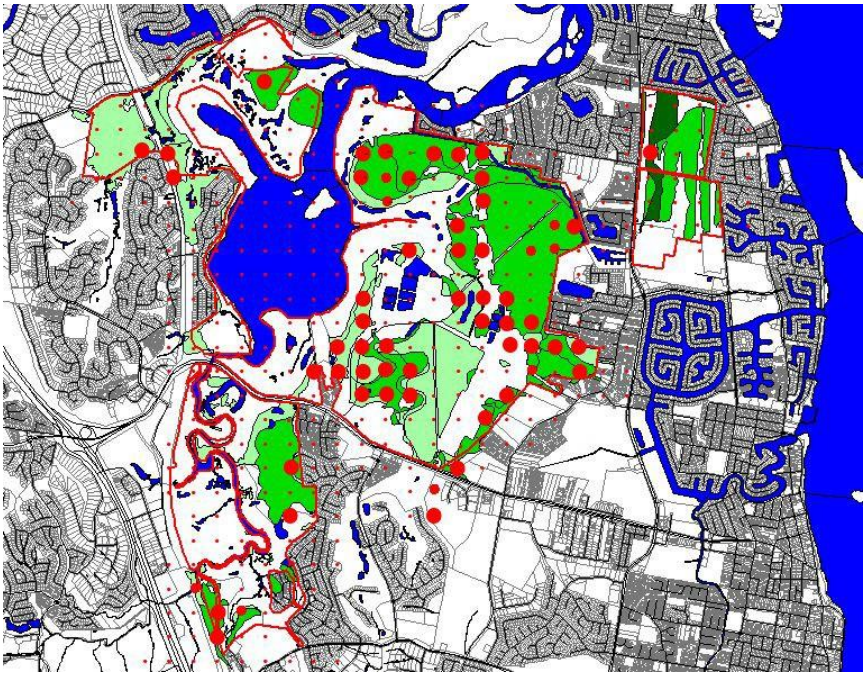
d) For any of the "initial sampling intensity" sites that returned "Medium (normal) use" or "High use" activity levels, sample the "high sampling intensity" sites surrounding these sites. It is not necessary to sample the "high sampling intensity" sites between any two sites with "Medium (normal) use" or "High use" activity levels. If no "Medium (normal) use" or "High use" sites are detected, no further assessment of the site is required.

Step 4

a) 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 75 m sampling intersections, the grid cell size will be 75 m x 75 m (0.56 ha).
   - For 125 m sampling intersections, the grid cell size will be 125 m x 125 m (1.56 ha).
   - For 175 m sampling intersections, the grid cell size will be 175 m x 175 m (3.06 ha).

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 indicating "Low use"(•), "Medium (normal) use"(•) and "High use" sites (●));

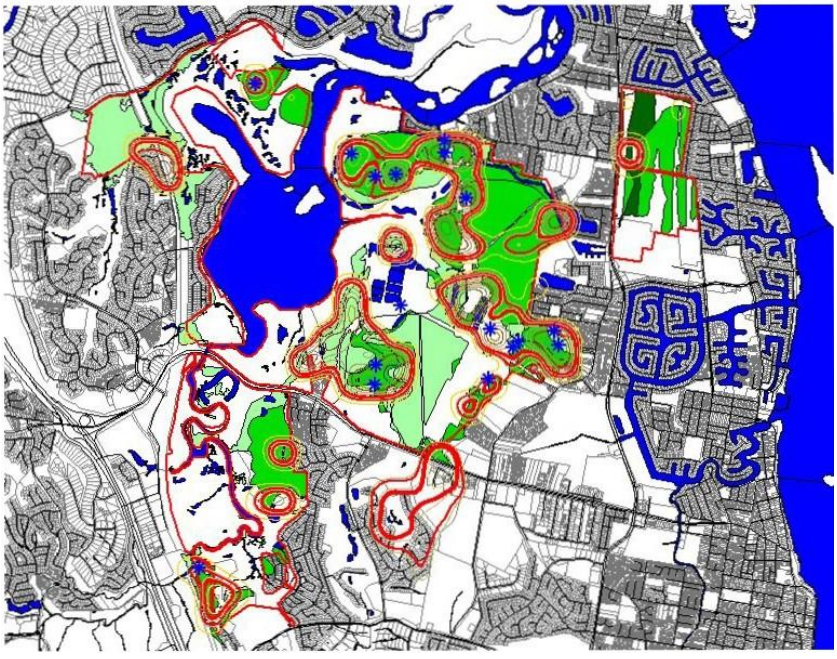
c) All areas within a grid cell identified that returned "Medium (normal) use" or "High use" activity must be regarded as core koala habitat for the purposes of this plan;



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 to delineate the boundaries (red lines) of areas of core koala habitat.



NOTE: All native vegetation assessment is subject to the "Threatened Biodiversity Survey and Assessment Guidelines for Developments and Activities" (DECCW 2004) adopted by Clarence Valley Council.

N.B. Council reserves the right to have any koala habitat assessment work done for the purposes of this plan peer-reviewed.

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

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 ($1600m^2$) 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:

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: [1]South-east Forests Conservation Council, unpub. data; [2]Phillips and Callaghan 1997; [3]Phillips and Callaghan 2000; [4]Phillips *et al.* 1996; [5]Phillips *et al.* 2000; [6]AKF, unpub.data; [7]Phillips 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.

Table 2. Categorisation of Koala activity into Low, Medium (normal) and High use categories based on use of mean activity level ± 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)	-	≥ 3.33% but ≤ 12.59%	> 12.59%
East Coast (med – high)	< 22.52%	≥ 22.52% but ≤ 32.84%	> 32.84%
Western Plains (med – high)	< 35.84%	≥ 35.84% but ≤ 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 incepeion 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.

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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 <u>not</u> 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

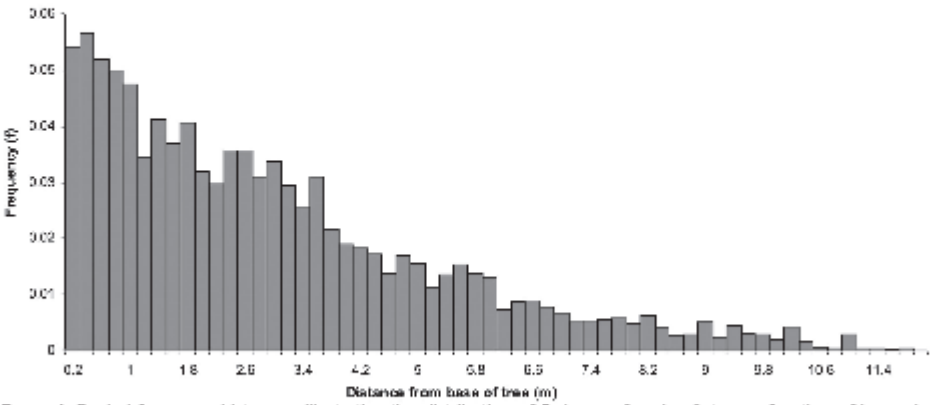

Figure 1. Pooled frequency histogram illustrating the distribution of *P. cinereus* faecal pellets as a function of increasing distance from the base of 30 sampled food trees (Source: Jones 1994).

APPENDIX I

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% ± 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.

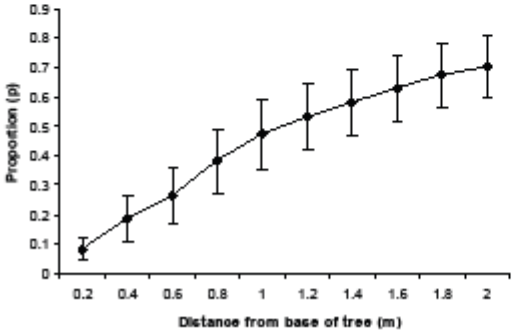

Figure 2. Mean proportional representation (± 95% Confidence Interval) of the total faecal pellet counts from beneath a sample of 30 trees known to have been utilised by *P. cinereus* (raw data sourced and re-analysed from Jones (1994)).

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%).