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# Northern Tablelands Koala Recovery Strategy 2015-2025



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**NORTHERN TABLELANDS**

**LOCAL LAND SERVICES**

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## **PREFACE**

*This koala recovery strategy has been prepared by The Envirofactor for the Northern Tablelands Local Land Services (NT LLS), as part of the requirement of Northern Tableland Local Land Services Agreement No: NT 00105. The purpose of the strategy is to promote recovery, avert any on-going decline and minimise the risk of extinction of koalas within the NT LLS region in NSW. It provides guide for future research and survey activities as well as the strategic delivery of NT LLS on-ground incentives and 'Trees on Farms' program. Within the 10 year life of the strategy the objective is to improve baseline knowledge regarding koala distribution, abundance and ecology; reduce threats to koala populations; raise community awareness about koalas; and enhance koala habitat and landscape connectivity on private land.*

*This strategy is a synthesis of existing scientific knowledge, expert opinion and a community consultative process. A range of interest groups with knowledge, expertise and/or interest in koalas on the Northern Tablelands contributed to the consultative process including; university researchers, state and local government, koala carers, landcare organisations, environmental consultants, environmental NGOs, land owners/managers and community groups/individuals. Our sincere thanks to all these people who generously gave their time, knowledge and data to help in the development of this strategy.*



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## Glossary

**ADC** – Armidale Dumaresq Council

**AKF** – Australian Koala Foundation

**ALA** – Atlas of Living Australia

**ATG** – Armidale Tree Group

**BBS** – Brigalow Belt South IBRA region

**CWC** – Citizens for Wildlife Corridors

**DRP** – Darling Riverine Plains IBRA region

**EPBC Act** – *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)

**GBLC** – Granite Border Landcare

**GLENRAC**: Glen Innes Natural Resources Advisory Committee Landcare

**GWYMAC**: Gwydir and Macintyre Resources Management Committee Landcare

**IBRA** – Interim Biogeographical Regionalisation of Australia

**Indigenous species**- species' that are both native to the northern tablelands koala recovery strategy area, as well as naturally occur at particular location ie on a particular soil type/landscape element or within a defined native vegetation community.

**Nand** – Nandewar IBRA region

**NC** – North Coast IBRA region

**NENWLC** – New England North West Landcare

**NET** – New England Tablelands IBRA region

**NGO** – Non-Government Organisation

**NT LLS** – Northern Tablelands Local Land Services

**OEH** – NSW Office of Environment and Heritage

**Regeneration** – natural germination of young plants from soil seedbank

**SNELC** – Southern New England Landcare

**TSC Act** – Threatened Species Conservation Act 1997 (NSW)





## 1. Introduction

This koala recovery strategy has been prepared for the Northern Tablelands Local Land Services (NT LLS) as part of the requirement of Northern Tableland Local Land Services Agreement No: NT 00105.

As outlined in the brief the objectives of this project is to;

- consolidate and improve baseline knowledge of koala distribution and abundance, threatening processes and impacts upon koala populations on the Northern Tablelands
- develop a recovery strategy in collaboration with stakeholders that prioritises actions for koala protection and areas for effective investment on the Northern Tablelands, and
- to build community capacity and engagement across the region through community monitoring of koala populations.

The koala (*Phascolarctos cinereus*) is an iconic Australian marsupial that occurs across a large area of highly fragmented habitat in eastern Australia. While the koala's iconic status is undisputed its conservation status is cause for local, regional and national concern, having suffered a dramatic decline in its distribution and abundance since European settlement (DECC, 2008; TSSC 2011). Koalas are listed as vulnerable under both the NSW *Threatened Species Conservation Act 1995* (TSC Act) and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This recovery strategy seeks to promote the recovery and avert any on-going decline of the koala on the Northern Tablelands of NSW. The specific objective to be achieved within the life-span of this recovery strategy is to minimise the risk of extinction of the koala within this area through;

- improved knowledge of the distribution, abundance and ecology of the koala across the Northern Tablelands
- identification of good condition koala habitat
- increasing landscape functionality for the koala by way of management and restoration of degraded habitat sites
- increasing the extent of habitat remnants and improving linkages between habitat remnants, and
- changes in community/land manager attitudes and behaviours towards sustainable land management practices to increase the extent, integrity and function of koala habitat on private land.

The recovery strategy provides a guide for future research and survey activities, as well as enabling strategic delivery of NT LLS on-ground incentives to improve koala habitat, landscape connectivity on private land through the *Trees on Farms* program.

Two other documents have been prepared as part of this project and provide the background information upon which this strategy is based;

- Ede A., Hawes W and J Hunter (2016) *Koalas on the Northern Tablelands – Literature Review*. A report prepared for the Northern Tablelands Local Land Services, and
- Hawes W., Hunter J., and A. Lechner (2016) *Northern Tablelands Koala Recovery Strategy Project Report*. Prepared for the Northern Tablelands Local Lands Services.

## 2. Background

As indicated by the NSW ‘*Recovery Plan for the Koala*’, although scattered records exist for the Northern Tablelands koala distribution is poorly understood and the species status remains ‘*unknown*’ (DECC, 2008). A recent study commissioned by the Western Woodlands Alliance (Paull and Hughes, 2016) indicates that only one possibly two koala populations on the Northern Tablelands are stable, the rest were found to be declining or of uncertain status. The Australian Koala Foundation (AKF) believe koalas on the Northern Tablelands are ‘*functionally extinct*’ (D. Tabart. CEO AKF, *pers comm.*, 2015). Existing koala distribution maps developed at both state and national scales are inadequate for local and regional planning.

This recovery strategy has sought to address the deficit of reliable information on koala populations and their status through a community co-operative approach. Existing expert and community knowledge regarding koala populations (distribution, ecology and threats) on the Northern Tablelands was obtained through a koala expert forum and community data collection workshop held in Armidale in 2015 and 2016 respectively. This approach allowed information and data currently held by a range of disparate groups including; university researchers, government agencies, NGOs, environmental consultants, Landcare, community groups and landholders, to be accessed and used in the development of this recovery strategy. These groups also provided important information and insights into methods of community engagement in koala conservation and recovery.

This recovery strategy has been developed using a synthesis of; existing information/data in scientific literature (refer Ede *et al.* 2016), *Atlas of NSW Wildlife* database koala records (OEH, 2016), MaxEnt modelling of koala habitat (refer Hawes *et al.* 2016) and knowledge /data provided local koala experts and community members (refer Hawes *et al.* 2016). It identifies the knowledge gaps and as far a possible issues known to threaten koalas, and seeks to achieve conservation of koala populations on the Northern Tablelands through implementation of recovery actions. The strategy aims to build on existing local approaches and be consistent with, information in the NSW and Commonwealth recovery plans.

## 3. Northern Tablelands koala recovery strategy area

The *Northern Tablelands Koala Recovery Strategy* project area is located in northern NSW. It encompasses the NT LLS region and comprises 7 local government areas; Armidale/Dumaresq, Inverell, Tenterfield, Glen Innes/Severn, Guyra, Uralla and Walcha (refer Figure 1). The area includes parts of the New England Tablelands (NET), Nandewar (Nand), Brigalow Belt South (BBS), North Coast (NC) and Darling Riverine Plains (DRP) IBRA bioregions in NSW (Interim Biogeographical Regionalisation of Australia - Thackway and Cresswell, 1995; Australian Government, 2012).

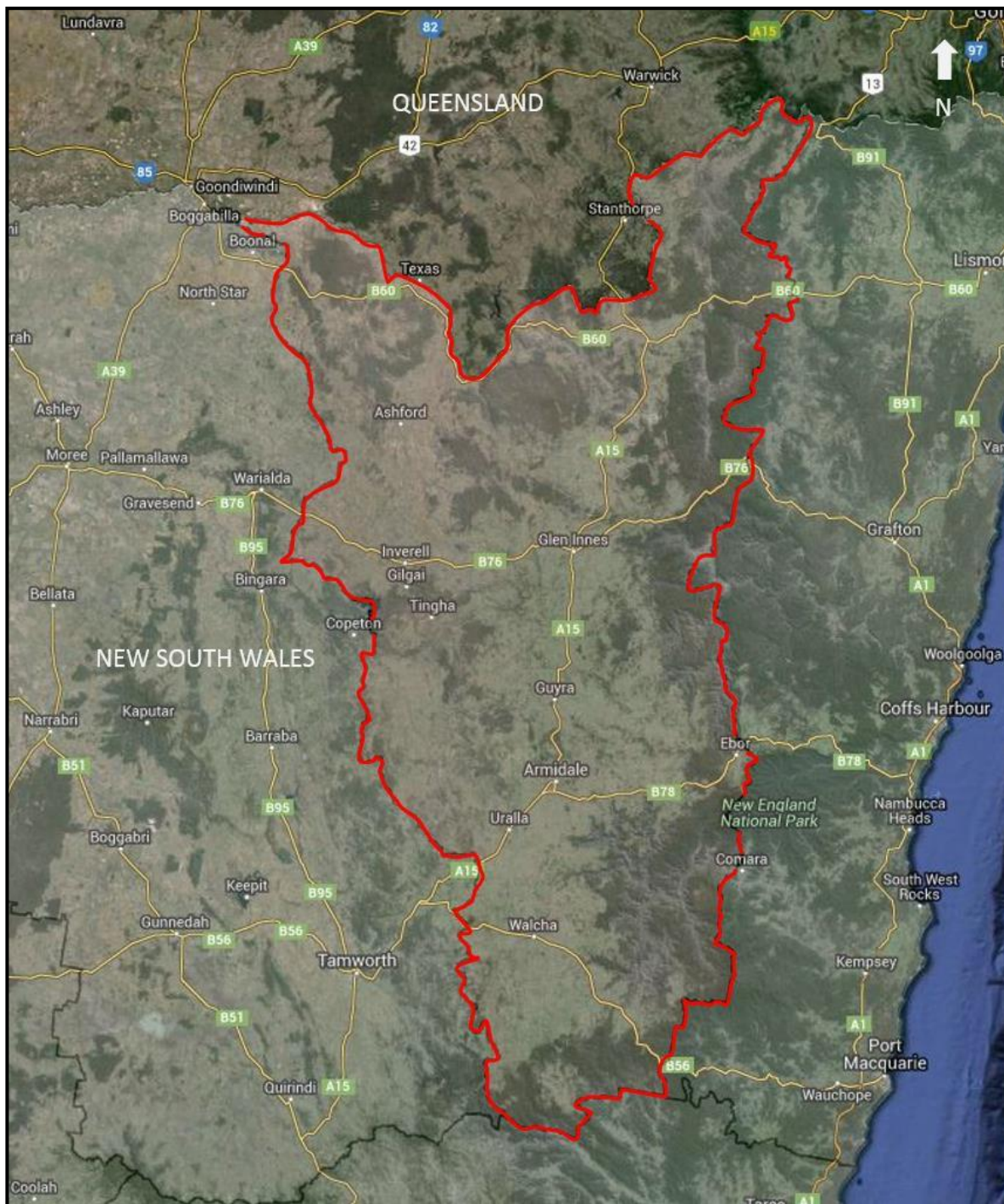


Figure 1: Location of the Northern Tablelands Koala Recovery Strategy Project Area (from Atlas of Living Australia website 2016)

## 4. Previous research, conservation and management initiatives

Koalas in general have been reasonably well studied at a species level. However, the research and study effort applied to koalas has been patchily distributed with many areas across their known distribution being relatively poorly understood. The Northern Tablelands is one of these poorly understood koala areas.

### 4.1. Recovery plans

Previous recovery plans developed for the koala include the NSW, *Recovery plan for the koala* (*Phascolarctos cinereus*) (DECC 2008) and the *National Koala Conservation and Management Strategy 2009-2014* (DEWHA 2009). This regional recovery strategy aims to be consistent with the objectives of these plans, but provide actions for recovery of koala populations at a more local scale.

### 4.2. Koala Management Areas

Under the *Plan of Koala Recovery* (DECC, 2008) NSW has been split into a number of areas for the purpose of delineating the state according to broad environmental and administrative boundaries. Known as Koala Management Areas (KMAs) their purpose is to facilitate regionally based actions for managing koala populations. This recovery strategy encompasses part of the Northern Tablelands population of koalas (KMA 4) as depicted in Figure 2.

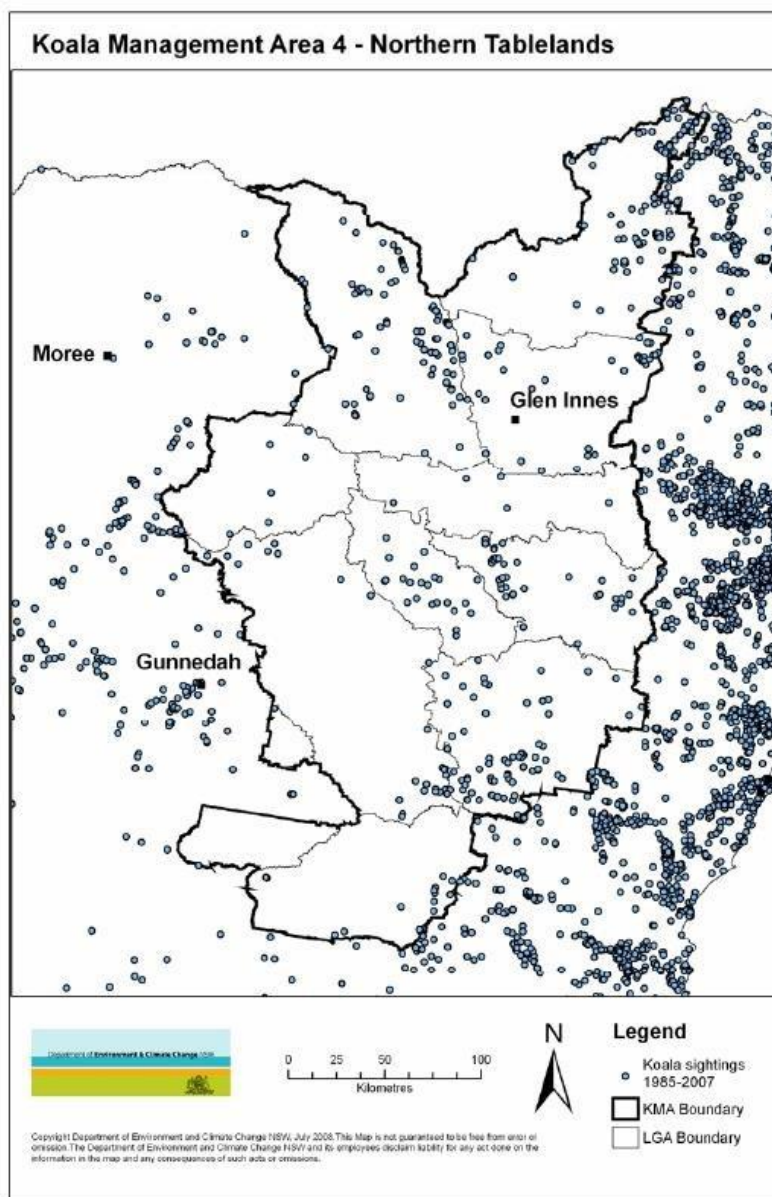
### 4.3. Koala plans of management – SEPP 44

State Environmental Planning Policy (SEPP) 44 – Koala Habitat aims to encourage the conservation and management of areas of natural vegetation that provide habitat for koalas. To ensure a permanent free-living population over their present range and reverse the current trend of koala population decline. The SEPP achieves this aim by:

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

Before an authority can grant consent for a development application it must identify whether or not the land upon which the development is to occur is ‘potential koala habitat’ or ‘core koala habitat’. If the land is identified as ‘core koala habitat’ then a Koala Plan of Management must be prepared for the area, outlining mitigation measures to protect the extant koala population and its habitat.

Under SEPP 44, local councils can develop an approved Comprehensive Koala Plan of Management (CKoPM) which supersede the requirements of SEPP 44 with respect to the investigation of potential and core koala habitat, and the requirement for preparation of individual Koala Plans of Management. To date no CKoPMs have been developed for the Northern Tablelands koala recovery strategy area.



**Figure 2: Koala sighting records and boundary of Koala Management Area (KMA) 4 (DECC, 2008)**

#### 4.4. Saving Our Species program

*Saving our Species* (SOS) is a conservation program run by NSW Office of Environment and Heritage that aims to maximise the number of threatened species that can be secured in the wild in NSW for 100 years (OEH website

<http://www.environment.nsw.gov.au/savingourspecies/about.htm> accessed). The koala is listed as iconic species under this program. Iconic species are defined under this program as 'important species; socially, culturally and economically, that the community expects to be effectively managed and protected' (OEH website, accessed 2016).

Actions being undertaken in 2012–15 for the koala under *Saving our Species* include:

- providing incentives to landholders to manage and improve priority koala habitat on their land
- identifying koala habitat and threats, and recommend mitigation measures for councils and the community
- evaluating the effectiveness of previous tree plantings to better target future conservation actions
- investigating where remedial actions can be most effective in providing drought refuges and reducing the impact of disease
- undertaking community surveys to track changes in koala populations, and
- developing a standard approach to mapping koala habitat (OEH, 2013).

#### 4.5. Koala habitat mapping and modelling

As detailed in the *Northern Tablelands Koala Literature Review* (Ede *et al.*, 2016), previous habitat modelling by Taylor and Drieslma (2012) indicates koala habitat in the north-western corner of the recovery strategy area is highly fragmented and in need of rehabilitation. Koala habitat mapping undertaken by the Australian Koala Foundation (AKF) (2015) identifies the majority of the Northern Tablelands as secondary koala habitat with only a few, small and highly fragmented areas of primary koala habitat. Areas identified by AKF as primary habitat generally coincide with vegetation communities on higher elevations and poorer soil types. This contradicts studies and/or modelling elsewhere that indicate a koala preference for vegetation communities on lower elevations and higher fertility soil types. As a consequence, this map is not considered useful for recovery planning, but does highlight the inadequacies of koala occurrence records and vegetation mapping across the project area.

The inadequacy of existing data sets is supported by modelling undertaken by Crowther *et al.*, (2015) and Predavec *et al.*, (2012) which show that none of the environmental variables tested had a strong relationship to koala occupancy. Although in the Namoi koala occurrence was linked to areas of lower elevation (Crowther *et al.*, 2015). Similarly maximum entropy modelling (MaxEnt) and analysis undertaken for the development of this recovery strategy showed koala occupancy had the strongest relationship with cleared land (Hawes *et al.*, 2016), a perverse outcome given the koala is an arboreal mammal. The reason for the failure of these various models results from the scarcity of koala records within the Northern Tablelands and a lack of any broad scale survey effort across the region and over time.

#### 4.6. Koala distribution and persistence

There is a serious lack of baseline knowledge regarding koala distribution and persistence within the recovery strategy area. A lack of any comprehensive koala/fauna survey program means that existing occurrence records are spatially and temporally biased. These biases arise primarily from the records being the result of;

- opportunistic sightings, concentrated along roads, around urban and peri-urban areas and on cleared land (spatial bias), and

- one-off surveys for state forests/reserves, comprehensive regional assessments for the North East Forests, BBS and Nand bioregions and large infrastructure developments (e.g. *TransGrid and EastLink* powerlines; highway upgrades) (temporal bias).

The identification of koala populations, movement corridors and/or movement barriers for the purposes of this recovery strategy (as shown in Appendices 1 & 2 and detailed in Table 1 below) is based on existing koala records and local expert opinion. Due of the lack of records and their intrinsic biases these should at best be considered preliminary and an initial starting point for targeting data collection, survey effort and rehabilitation/replanting activities.

**Table 1: Local koala populations on the Northern Tablelands recovery strategy area identified by the Armidale 2015 expert forum and as shown in Appendices 1 & 2**

Local pop <sup>n</sup> ID <sup>#</sup>	Locality description	Reserves within population area *
1	North east of Tenterfield extending into Queensland and North Coast	Captain's Flat NR, Tooloom NP, Koreelah NP, Cataract NR, Cataract NP
2	North east of Tenterfield in and around Bookookoorara	Boonoo Boonoo NP, Basket Swamp NP,
3	Tenterfield urban area and surrounds	Nil
4	North east of Glen Innes	Part Gibraltar Range NP
5	Emmaville to east of Deepwater areas	Nil
6	Ashford and surrounds to Qld border	Kwiambal NP, Maroomba SCA
7	Pindaroi and surrounds to the Qld border	Severn River NR, Kings Plains NP, Crooked Creek NP
8	Inverell north west and west to Mt Russell and Delungra	Nil
9	Gilgai, Tingha southeast towards New Valley	Goonoowigall SCA, Barayamal NP, Tingha Plateau SCA, Single NP, Indwarra NP
10	In and around Mt Mitchell east of Ben Lomond	Warra NP, part Guy Fawkes River NP
11	Armidale and Uralla urban and peri-urban areas and surrounds	Duval NR, Mt Yarrowyck NR, Booroolong NR, Imbota NR, Yina NR, part Oxley Wild Rivers NP
12	Walcha urban area and surrounds	Nil
13	South-east of Walcha in and around Apsley River	Part Oxley Wild Rivers NP
14	Nowendoc and surrounds	Part Mummel Gulf NP, Mummel Gulf SCA, Nowendoc NP, Curracabundi SCA, Tuggolo Creek NR, part Cottan-Bimbang NP, Ngulin NR, Tomalla NR

# Refer Appendix 2

\* NP = National Park; NR = Nature Reserve; SCA=State Conservation Area

#### 4.7. Koala ecology

Across its distribution knowledge regarding koala ecology is patchy. The Northern Tablelands recovery strategy area is one of the more poorly studied areas. Specific knowledge regarding koala ecology within this strategy area comes from; 3 studies on the UNE Newholme Field Laboratory, near Armidale (Carney, 1995; Heinz, 1999; de Raad, 2005) and one at Dorrigo (Roberts, 1998).

What is known, is that koalas within the Northern Tablelands strategy area;

- have home ranges of 35-50ha, which vary in size summer to winter (Heinz, 1999), and
- preferentially use trees between 33-97cm diameter at breast height (dbh), and have a significant penchant for larger trees 60-90cm dbh (Roberts, 1998; Heinz, 1999).

Based on these limited research findings it would appear the protection and enhancement of mature, mixed age, woody vegetation that supports old growth trees is essential for the maintenance of existing koala populations. It also indicates the value of old growth paddock trees in close proximity to remnant patches and across agricultural landscapes.

The knowledge gaps that exist with regards to koala ecology in the strategy area are extensive and include;

- home range sizes
- seasonal or temporal changes in home range size
- dispersal ability across non-feeding/breeding habitat
- feed/shelter tree selection, and
- minimum habitat patch size.

#### 4.8. Koala movement corridors

The large knowledge gaps, regarding koala distribution and persistence on the Northern Tablelands (refer section 4.6) and basic koala ecology (refer section 4.7), makes determination of koala movement corridors problematic. Koala movement corridors have however been identified for the purposes of this recovery strategy based on existing koala records and local expert opinion, as shown in Appendices 1 & 2 and detailed in Table 2 below. Similar to the populations identified in section 4.6, these should at best be considered preliminary and an initial starting point for targeting data collection, survey effort and rehabilitation/replanting activities.



**Table 2: Preliminary koala movement corridors for the Northern Tablelands recovery strategy area identified by the Armidale koala expert forum (2015) and as shown in Appendices 1 & 2.**

Corridor ID*	Location	Connectivity	Reserves/state forests present in corridor
A	NE of Tenterfield	Wooded north south connection between populations #1 & #2 includes Gilgurry SF.	Part Gilgurry SF
B	Emmaville to Deepwater	Corridor overlaps population #5, rehabilitation and revegetation will increase habitat extent for this population and improve its connection with woody vegetation to E.	Nil
C	S of Dundee	SE connection between population #7 and woody vegetation E of the New England H'way and S of Gwydir H'way that includes Butterleaf NP and Mann River NR. This hilly corridor includes large wooded remnants interspersed with small remnant woodland patches, cleared land and a wide section of Travelling Stock Route along the New England Highway	Fladbury NR
D	S of Ashford	SE connection between population #6, Nullamanna NP and population #7. Includes scattered remnant woodland patches within cleared land and the Travelling Stock Route along the Inverell-Ashford Road N of Bukkulla.	Nil
E	S of Ashford	SW connection between population #6 and #8 includes scattered remnant woodland patches within cleared land and vegetation along Travelling Stock Routes on the Delungra-Graman and Cherry Tree Hill Roads	Nil
F	Between Glencoe and Ben Lomond	East west connection between populations #9 and #10 comprises scattered remnant woodland patches within cleared land includes part of the Travelling Stock Route along the Guyra Road	Nil
G	SE of Walcha	SW –NE connection between population #13 and #14 comprises both intact wooded vegetation with Mummel Gulf NP and scattered remnant woodland patches within cleared land	Part Mummel Gulf NP

\* refer Appendix 2

#### 4.9. Important koala tree species

Local expert opinion indicates koalas in the Northern Tablelands recovery strategy area utilise up to 38 indigenous tree species as shown in Table 3. Seventeen eucalypts are considered preferred food trees, 14 eucalypts are considered occasional feed trees and 6 species predominantly non-eucalypts are used for shade and shelter. These feed/shelter trees do not however, have ubiquitous distributions across the strategy area and have therefore been allocated to local government areas that overlap their known distributions (refer Table 3). In the current absence of useful koala habitat mapping these species should be used to identify areas of potential koala habitat for planning, survey and rehabilitation/replanting purposes.

Knowledge gaps that exist regarding important koala trees within the Northern Tablelands strategy area include;

- seasonal or temporal changes in feed/shelter tree selection
- dispersal ability across non-feeding habitat
- feed tree selection and the effects leaf chemistry within food tree species, within vegetation communities on different substrates and under climate change scenarios

- shelter tree selection, and
- minimum habitat patch size.

**Table 3: Important Koala Tree Species for the Northern Tablelands Koala Recovery Strategy Project Area from the Koala Expert Forum, Armidale 2015**

P = preferred food tree species

O = occasional food tree species

H = habitat trees (trees used by koalas for shade and shelter)

Common Name	Scientific Name	Armidale Dumaresq	Glen Innes Severn	Guyra	Inverell	Tenterfield	Uralla	Walcha
Wattle	<i>Acacia</i> spp	H	H	H	H	H	H	H
Apple	<i>Angophora</i> spp	H	H	H	H	H	H	H
Buloak, she-oak, forest oak	<i>Allocasuarina</i> spp	H	H	H	H	H	H	H
White cypress pine	<i>Callitris</i> <i>glaucophylla</i>	H			H		H	
She-oak, river oak	<i>Casuarina</i> <i>cunninghamiana</i>	H	H	H	H	H	H	H
Wattle-leaved peppermint	<i>Eucalyptus</i> <i>acaciiformis</i>	P	P	P		P		P
White box	<i>E. albens</i>		P	P	P	P	P	
Tenterfield woollybutt	<i>E. banksii</i>	O	O	O	O	O	O	
Blakely's red gum	<i>E. blakelyi</i>	P	P	P	P	P	P	P
Apple box	<i>E. bridgesiana</i>	P	P	P	P	P	P	P
River red gum	<i>E. camaldulensis</i>				P			
New England stringybark	<i>E. caliginosa</i>	P	O	O	O	O	O	O
Dirty gum	<i>E. chloroclada</i>				P			
Fuzzy box	<i>E. conica</i>		O	O		O		
Mountain gum	<i>E. dalrympleana</i> ssp <i>heptantha</i>	P	P	P	P	P	P	P
Tumbledown gum	<i>E. dealbata</i>		O	O	O	O	O	
Silver-top stringybark	<i>E. laevopinea</i>	P	P	P	P	P	P	P
Moonbi apple box	<i>E. malacoxylon</i>						O	O
Yellow box	<i>E. melliodora</i>	P	P	P	P	P	P	P
Brittle gum	<i>E. michaeliana</i>	O		O				
Tallowwood	<i>E. microcorys</i>	P	P	P		P		P
Coastal grey box	<i>E. moluccana</i>	O	O	O	O	O	O	O

Common Name	Scientific Name	Armidale Dumaresq	Glen Innes Severn	Guyra	Inverell	Tenterfield	Uralla	Walcha
Narrow-leaved black peppermint	<i>E. nicholli</i>	P	P	P				P
Forest ribbon gum	<i>E. nobilis</i>	O	O	O		O	O	O
Mountain mahogany	<i>E. notabilis</i>	P	P	P		P		
New England peppermint	<i>E. nova-anglica</i>	O	O	O	O	O	O	O
Messmate	<i>E. obliqua</i>	P	P	P		P		P
Small-fruited mountain gum	<i>E. oresbia</i>							O
Snow gum	<i>E. pauciflora</i> ssp <i>pauciflora</i>	P	P	P		P	P	P
Orange gum	<i>E. prava</i>	O	O	O	O	O	O	
Small-fruited grey gum	<i>E. propinqua</i>	P	P	P		P		P
Quinn's mallee	<i>E. quinniorum</i>						O	
Hillgrove box	<i>E. retinens</i>	O	O	O		O		O
Candlebark	<i>E. rubida</i>			P	P	P		
Mugga ironbark	<i>E. sideroxylon</i>		H	H	H	H	H	H
Black sally	<i>E. stellulata</i>	P	P	P		P	P	P
Manna gum	<i>E. viminalis</i> ssp <i>viminalis</i>	P	P	P	P	P	P	P
Youman's stringybark	<i>E. youmanii</i>	O					O	

#### 4.10. Surveys and research

A large amount of research has and is being conducted on koalas across their distribution. Covering a wide range of topics including; genetics, disease, koala distribution, the impact of threats, tree species and habitat preferences, demographics and population viability analysis, social dynamics and translocation. Very little of this research has however been conducted on the Northern Tablelands, so there is scant knowledge regarding koalas in relation to any of the topics listed above for the recovery strategy area.

Similarly, while surveys for koalas have been conducted in many areas of NSW, survey effort within the Northern Tablelands recovery strategy area has been limited both spatially and temporally (refer section 4.6). Current koala surveys are also limited, but include those conducted in the Armidale area as part of the *Quollity Koala Corridors and Questions Project*, a Southern New England Landcare (SNELC) and Citizens for Wildlife Corridors (CWC) project (<http://snelandcare.org.au/landcare-projects/current-landcare-projects/209-quollity-koala-corridors-questions-2015-17.html>).

A range of survey techniques are employed to look for koalas or evidence of koala presence. A NSW-wide postal survey of the regional community by OEH gathered some historical information on koala distribution (Lunney *et al.*, 2009). Field survey techniques for koalas include; searching tree canopies for animals (in daylight), inspecting tree trunks for claw marks, searching the ground for faeces (scats), camera traps, radio-tracking, detection dogs, spotlighting and listening for vocalisations with/without playback of taped koala calls. In any survey it is common to employ a range of these techniques. The most appropriate combination of techniques will depend on the purpose of the survey.

A range of guidelines for the survey of koalas and koala habitat have been prepared including;

- Spot Assessment Technique (SAT)– (Phillips and Callaghan 2011)
- Regularised Grid Based Spot Assessment Technique (RGB-SAT) – Biolink Ecological Consultants (2008)
- Koala optimised Rapid Assessment Methodology (KRAM) - Woosnam-Merchez *et al.*, 2012.

#### 4.11. Habitat restoration projects

Few specific projects have been undertaken within the Northern Tablelands strategy area to restore koala habitat. Those projects specifically targetted at restoration of koala habitat include;

- *Koala and Bird Connectivity on Road Reserves project (2013-2014)* – undertaken by Walcha Shire Council aimed to establish a wildlife corridor linking known koala populations on the northern and southern sides of the Apsley River within the town of Walcha.
- *Quollity Koala Corridors and Questions project (2015-2017)* – undertaken by SNELC and CWC in collaboration with UNE, Armidale Dumaresq Council and NT LLS. This project aims to improve the extent and ecological integrity of a known koala corridor that extends from the Dangar’s Falls area south-east of Armidale, north through Imbota and Yina Nature Reserves and remnant vegetation east and north-east of Armidale, through Puddledock then west through Duval Nature Reserve and south to UNE’s ‘Kirby’ research station and main campus (SNELC website, 2016). To improve habitat land holders will rehabilitate 18 sites on 11 properties in this corridor.

Notwithstanding the limited number of koala habitat restoration projects, over the years there has been significant tree re-planting programs across the Northern Tablelands strategy area. Many targeted at re-establishing native trees (though not necessarily indigenous native trees) in the over-cleared central tablelands region. It is likely these programs have aided koala persistence within the strategy area (Paull and Hughes, 2016).

#### 4.12. Private land conservation measures

A range of initiatives are available for conservation outside the reserve system on private land, including; Conservation Agreements (CAs), revolving funds and LLS incentive programs.

A CA is a joint agreement between a landholder and the Minister for the Environment aimed at permanently protecting the natural or cultural features present on a property. Entered into voluntarily, the CA is attached to the title of the land and exists in-perpetuity regardless of any change in land ownership. It is likely that a number of CAs across the project area support koalas or koala habitat. Nature Conservation Trust also offers similar voluntary conservation agreements for in-perpetuity private land conservation.

Revolving funds (e.g Nature Conservation Trust, Bush Heritage Australia) facilitate permanent protection of potential koala habitat on private land. Land is purchased by the revolving fund for on-selling to a willing landholder with an in-perpetuity covenant on title placed on areas of conservation value.

Land holders interested in the protection and management of koala habitat on their properties can develop an incentive property vegetation plan with Local Land Services. Incentive plans however have a maximum life of 15 years, which may be too short a time period to achieve any real lasting improvement in koala habitat condition or extent.

While the exact area of koala habitat currently protected under these various agreements in the recovery strategy area is unknown, private land conservation will be critical to the protection and persistence of koala populations on the Northern Tablelands, given the majority of current koala records occur on private land (Paull and Hughes, 2016).

#### 4.13. Identification of threats

There is no data regarding threats or their relative importance to koala populations in the recovery strategy area. It is however likely, that many of the threats identified in the literature review (Ede *et al.*, 2016) as detrimental to populations elsewhere also impact on Northern Tablelands koala populations. WIRES and NTWCs indicate that disease, in particular chlamydiosis, is less prevalent in the Northern Tablelands than in populations in Gunnedah area (Hawes *et al.*, 2016). The likely significance potential threats to local koala populations on the Northern Tablelands is detailed in Table 4 below.

**Table 4: Threats to koala populations within the Northern Tablelands recovery strategy project area. Koala population ID as shown in Appendix 2**

Threat	Koala population ID*	Explanatory notes
Habitat loss, modification and fragmentation	All populations	Likely more of an issue in agricultural areas on higher fertility soils and urban/peri-urban areas, but forestry practices in many of the larger remnants on poor soil types is also likely to have an impact
Disease	All populations	WIRES advise that 50% of koalas coming into their care show signs of chlamydiosis
Vehicle strike	3, 8, 11, 12	Likely to be highest in populations in and around in urban and peri-urban areas

Threat	Koala population ID*	Explanatory notes
Dog attack	1, 2, 3, 4, 8, 10, 11, 12, 14	Likely to be highest in populations along the eastern scarp (wild dogs) and in and around urban and peri-urban areas (domestic dogs)
Climate change	All populations	
Bushfire and inappropriate fire regimes	1, 2, 4, 8, 9, 10, 11 13, 14	Likely to be highest in populations along the eastern scarp (annual burning for grazing management) and increased pressure for hazard reduction burns in and around urban and peri-urban areas, and state forest and national parks estate
Eucalypt dieback	3, 5, 8, 11, 12	Likely to be highest in more extensively cleared central area of the tablelands. Impact of Bell Miner induced dieback in eastern scarp areas is unknown.

\* refer Appendix 2 for population identification

#### 4.14. Community education and engagement

There is substantial published material (brochures, pamphlets and flyer) and web pages dedicated to raising community awareness within Australia about koalas, including threats and actions that can be undertaken to reduce those threats. Very little of this material is however specific to the Northern Tablelands recovery strategy area. Material of relevance to the Northern Tablelands includes;

- NSW Office of Environment and Heritage (OEH) - threatened species profile for the koala  
[www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10616](http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10616).
- Commonwealth Department of the Environment (DOE) – SPRAT profile for the koala  
[http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon\\_id=85104](http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=85104)
- Armidale Dumaresq Council (ADC) – *The survival of the koala is in our hands* pamphlet  
[http://www.armidale.nsw.gov.au/sites/armidale/files/public/images/documents/armidale/Environment/Koala\\_pamphlet\\_ver3\\_new\\_logo.pdf](http://www.armidale.nsw.gov.au/sites/armidale/files/public/images/documents/armidale/Environment/Koala_pamphlet_ver3_new_logo.pdf)
- NSW (OEH) – *North East NSW: Koala Habitat*. Natural Resources Management Advisory Note No 9 (2004)  
<http://www.environment.nsw.gov.au/resources/nature/landholderNotes09KoalaHabitat.pdf>.

Education materials specific for the Northern Tablelands could easily be developed from existing materials e.g. OEH advisory note (2004).

#### 4.15. Citizen science

With limited recovery funding and on-ground scientific expertise, citizen science projects are gaining popularity. Citizen science allows lay people to meaningfully contribute to scientific research. Current citizen science models focus primarily on collection of sighting records which in under surveyed areas can significantly increase knowledge regarding species' distributions and abundance. While in well surveyed areas it can provide important data on species' persistence.

Existing community monitoring and/or reporting programs for koalas on the Northern Tablelands include;

- Armidale Dumaresq Council - *Koala Sighting Register* (ongoing)
- National Parks Association - *Koala Count* (7<sup>th</sup>-22<sup>nd</sup> November annually)
- National Parks Association – community biodiversity surveys (occasional).

#### 4.16. Koala data collection and storage

Currently koala occurrence records for the Northern Tablelands are held in four separate databases;

- *Atlas of Living Australia* – Australian Government (national database)
- *KoalaMap* – Australian Koala Foundation (national database)
- *Atlas of NSW Wildlife* – OEH (state database)
- *Koala Sighting Register* – Armidale Dumaresq Council (local database).

While records from the *Atlas of NSW Wildlife* are regularly uploaded to the *Atlas of Living Australia* the other two are stand-alone databases with the potential to dilute important record information. However, as a result of this project local records within the *Koala Sighting Register* are now being uploaded to the *Atlas of NSW Wildlife*.

It is a requirement of an OEH scientific licence that all survey records collected by licensed fauna surveyors be uploaded to the *Atlas of NSW Wildlife*. However this database does not readily allow submission of opportunistic sightings by land owners and community members. In contrast, the other three databases have web site interfaces that allow for easy submission of koala sightings by members of the public. Additionally, the *Atlas of Living Australia* has a phone app *OzAtlas* while the *Koala Sighting Register* allows phone reporting to encourage the community submission of wildlife sightings.

#### 4.17. Wildlife rehabilitation groups

Wildlife rehabilitation groups rescue, rehabilitate and eventually release injured, orphaned and diseased koalas. Substantial time and resources is invested by individual carers into caring for koalas. Guidelines have been developed for the care of koalas in NSW (Lunney and Matthews 1997). Within the recovery strategy area wildlife rehabilitation is undertaken by both WIRES and Northern Tablelands Wildlife Carers (NTWC). These groups hold detailed records of the animals brought into care, their injuries/disease and eventual fate. This information can be useful in identifying threats and population patterns at the local scale and can contribute to ongoing monitoring programs. Carer groups often play an important role in community education and awareness of koalas and their habitat.

## 5. Koala recovery actions

### Strategy 1 - Improve baseline data

Critical to the recovery of the koala on the Northern Tablelands is baseline data regarding the distribution, abundance and persistence of koalas, as well as regionally specific information on koala ecology (dispersal ability, home range sizes, habitat preferences and feed/shelter tree selection) and the impact of known threats. Currently there is a scarcity of koala records. Those that exist are biased both spatially and temporally, due to a lack of systematic survey effort across the region and over time (Hawes *et al.* 2016). Basic ecological data for koalas within the project area is also lacking.

Baseline data enables the prioritising of recovery actions as well as measurement of change as a result of these actions. In the absence of this information it will be impossible to determine whether recovery actions are successful in maintaining/improving the status of koala populations on the Northern Tablelands.

#### *Action 1.1 – Undertake systematic surveys in priority areas*

Given the paucity of koala records across the Northern Tablelands and their existing bias towards urban and peri-urban areas, roads, state forests and large infrastructure project areas there is urgent need to fill both distribution and temporal gaps. Consequently, survey priorities have been identified in three categories as shown on Figure 3:

- A. Areas with old koala records (pre-2001) and few if any recent records. These areas should be a priority for survey in order to establish the currency of the koala population, ie whether populations that may have previously existed within these areas as indicated by the historic sightings are still present and in what numbers. Surveying these areas will address some of the temporal bias in the existing data set, due to previous landscape scale fauna surveys of large tracks of non-urban lands largely undertaken prior to 2001 (e.g. *TransGrid* and *Eastlink* powerlines; comprehensive regional assessments in the BBS and Nand bioregions]
- B. Under-surveyed areas. These areas, with few if any koala records, are a priority for survey as they may or may not support existing populations and/or koala habitat. Surveying these areas will improve our existing knowledge regarding koala distribution within the project area, and will help to address the spatial bias in the existing data set, towards cleared land, urban and peri-urban areas, roads and large infrastructure project areas. Many of these areas were missed by previous landscape scale surveys or are highlighted as being likely habitat by previous habitat modelling such as Taylor and Drielsma (2012).
- C. Areas with known populations and numerous koala records over time. These areas should be a priority for survey in order to better understand population viability by capturing additional data on the demography (age structure, population size), home range, dispersal ability, disease prevalence and habitat preferences for local koala populations.



All three categories should be considered a priority for systemic survey, as data collected will address a number of knowledge gaps that currently exist with regards to koala populations on the Northern Tablelands. However, while it is considered Category A and B areas are of equal priority for survey, Category C is less of a priority if funding is limited.

**Stakeholders:** NT LLS, OEH/NPWS, Forests NSW, LPI, university researchers, environmental NGOs, ecological consultants, land owners/managers, community groups/members

#### *Action 1.2 – Establish appropriate koala survey protocols and apply these on an ongoing basis*

Consistent survey protocols will allow comparison of koala data collected by different surveyors, across the recovery strategy area and over-time. It is recommended the Koala Rapid Assessment Method (KRAM) approach as per Woosnam-Merchez *et al.*, (2012), be used for systematic koala surveys as it provides a simple, reproducible method by which koala presence can be confirmed. The results of the KRAM can then be used to inform the design of larger census surveys using an accepted and consistent technique to determine koala abundance.

**Stakeholders:** NT LLS, university researchers, ecological consultants

#### *Action 1.3 - Increase public reporting of opportunistic koala sightings*

Use citizen science to help fill the knowledge gaps regarding the distribution and abundance of koalas within the Northern Tablelands project area. Regular reporting of opportunistic sightings by landholders and community members will significantly increase the number and distribution of koala occurrence records for minimal cost. Community engagement is critical to increasing koala sighting reports.

**Stakeholders:** NT LLS, landcare organisations, local government, environmental NGOs, land owners/managers, community groups/members

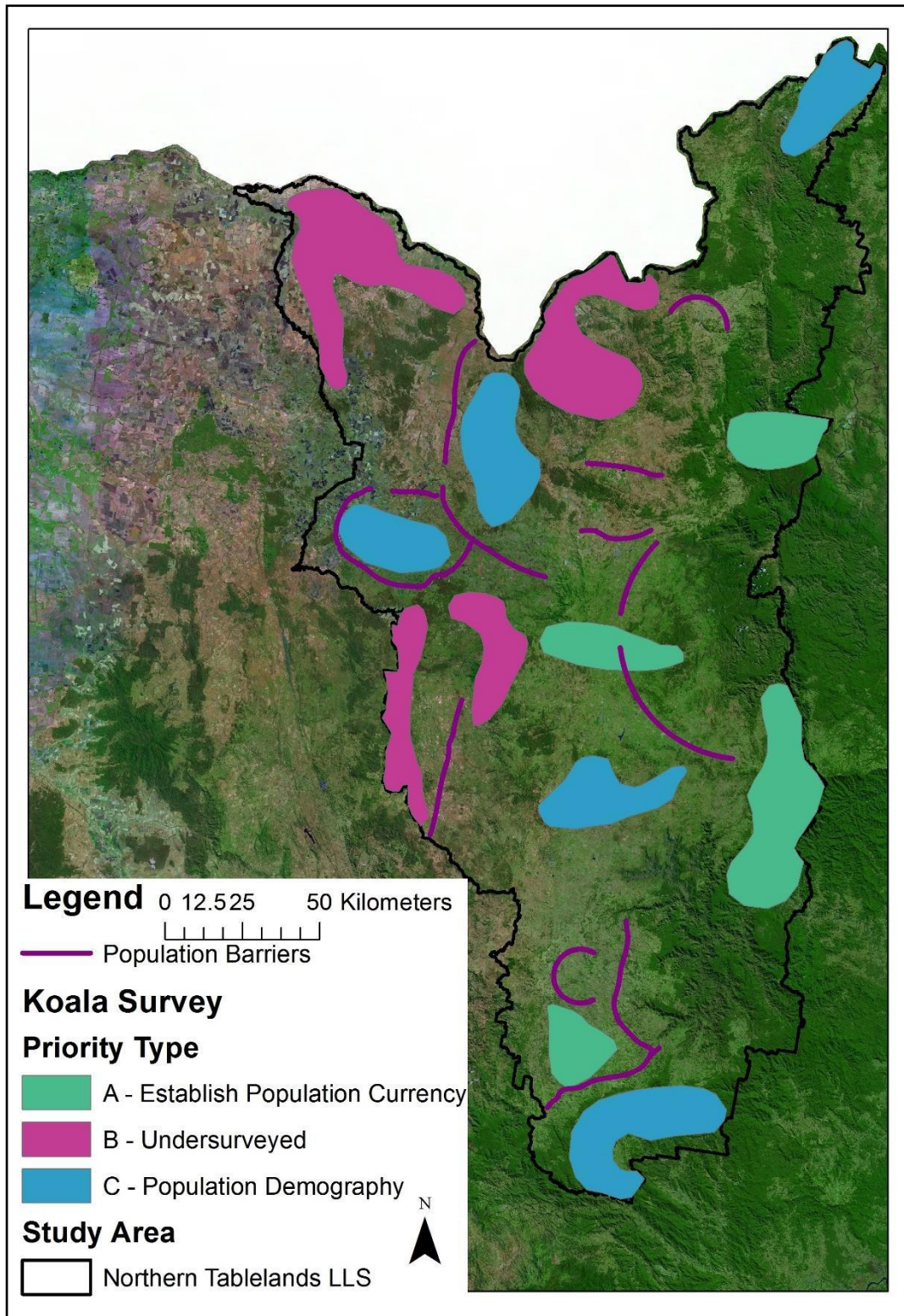
#### *Action 1.4 – Develop method/s to enable public reporting of opportunistic koala sightings*

To ensure community members can easily engage in monitoring, recording and capturing koala records, a range of reporting methods should be made available for the submission of local sightings including; website, phone app and phone reporting.

While a phone app would be beneficial in engaging younger people in koala sight reporting, it is considered more likely rural landholders will report sightings if they are able to phone in their observations. The advantage of using phone reporting as opposed to a website and/or phone app is that sighting accuracy can be vetted immediately by the agency contact. The disadvantage of phone reporting is that it requires a designated agency contact.

If phone reporting is used then it is recommended a glovebox pad of reporting forms be developed for landholders to record sightings while in the paddock that can be then phoned in at a later date.

Figure 3: Survey priorities for the Northern Tablelands koala recovery strategy area



Community reporting of koala sightings will require accurate locational data (eastings/northings or lat/longs) if records are to be useful for recovery planning or research. If using a web based interface then it is recommended satellite images (showing roads, towns and rivers) and/or road maps (e.g. AKF *KoalaMap* or *Atlas of Living Australia*) be employed to allow people to zoom in to identify and mark their sighting location. A GPS location of the sighting record can then be determined by the program. A web based interface has the advantage that a link allowing koala sight reporting could be placed on; NT LLS, local government, landcare and environmental NGO websites, increasing coverage across the region. UNE may be willing to host a web site application.

**Stakeholders:** NT LLS, OEH, UNE, local council, landcare organisations, environmental NGOs, land owners/managers, community groups/members.

#### *Action 1.5 – Employ a designated community koala contact*

Whatever public reporting method is used, it will require someone in an office on an on-going basis who, as part of their job description, is responsible for filtering and uploading sighting reports to state/national databases. It is the conclusion of this report that NT LLS is the agency best suited to provide such a contact person.

**Stakeholders:** NT LLS

#### *Action 1.6 - Establish a regional database for community submission of opportunistic koala records*

To encourage community reporting of opportunistic koala sightings it is important that all regional community data reside in a central repository so that records can be filtered at the local level, consolidated and uploaded to State and or Commonwealth databases. A regional database will facilitate access by koala researchers and agencies (bearing in mind confidentiality of some unpublished data) and enable appropriate planning at all scales.

It is recommended this database be adapted from data fields in an existing database such as the *Atlas of NSW Wildlife*. Information collected should be based on the database capabilities.

**Stakeholders:** NT LLS, OEH, local government, researchers, landcare organisations, environmental NGOs, environmental consultants, land owners/managers, community members

#### *Action 1.7 – Ensure community data is uploaded to state and national databases*

On a regular basis vetted records should be entered into the *Atlas of NSW Wildlife* from where it will be automatically uploaded to the *Atlas of Living Australia*. This should be undertaken by the agency contact.

**Stakeholders:** NT LLS, OEH, local government, university researchers, environmental consultants

### *Action 1.8- Review and investigate koala habitat modelling methods*

Koala habitat modelling will need to be revisited on an on-going basis in light of increased koala records resulting from Actions 1.1 and 1.3. Further research on applying modelling methods to the Northern Tablelands can allow for a greater accuracy and greater understanding of the koala population in the region. With a more field data the following modelling methods may be applied, in order of increasing complexity;

- presence-only MaxEnt species distribution modelling with observation bias layer and/or addressing gaps in koala sampling.
- presence-absence species distribution modelling using absence (no koalas observed) records as well as existing and new occurrence records. This is important for identifying the environmental conditions which are unfavourable for koalas.
- habitat suitability modelling and population abundance modelling.
- population viability analysis. Utilising combinations of the above data derive a model that describes how koala population is affected by habitat availability and other factors (i.e. road mortality) (e.g. Southwell *et al.*, 2008). This method is useful for testing land use scenarios such as clearance or restoration.

**Stakeholders:** NT LLS, OEH, GIS modellers/researchers

### Strategy 2 – Improve landscape connectivity and reduce fragmentation effects

One large habitat patch is likely to support more animals than two smaller patches with the same total area. Habitat loss, modification and degradation are recognised as major contributors to the decline in koala populations (DECC, 2008). Less habitat area results in:

- increased competition for what limited resources remain (feed and shelter trees) both within koala populations and between koalas and other arboreal species (e.g. brush tailed possums)
- increased disease levels due to stress
- increased risk of predation, and
- an inability to disperse across the landscape to source food resources, breed and/or escape catastrophic events such as droughts, bushfires and climate change.

Extensive clearing and modification of native vegetation of communities within the Northern Tablelands strategy area has occurred since European settlement. With vegetation on fertile soils (koala habitat) preferentially targetted. Although much of the clearing on the Northern Tablelands occurred historically, habitat loss and modification is an on-going issue, the impact of which is yet to be quantified. The serious detrimental impacts of land clearing on flora and fauna species is recognised by the listing of 'clearing of native vegetation' as a key threatening process under the NSW *TSC Act*, and 'land clearance' under the Commonwealth *EPBC Act*.

Strategic re-connection of existing habitat fragments through revegetation will potentially enable koala populations to persist and/or re-colonise currently unoccupied habitat areas. Re-connection of habitat remnants and improvement of landscape connectivity could also allow koalas extend their range as habitats are modified by climate change.

### *Action 2.1 - Undertake revegetation/rehabilitation in identified corridors*

Given the uncertain and/or declining status of the majority of koala populations on the Northern Tablelands (Paull and Hughes, 2016), there is an urgent need to re-connect and rehabilitate remnant habitat koala habitat patches to improve landscape connectivity and ensure the persistence of existing populations. A number of areas have been identified as koala movement corridors as part of this strategy and should be priority areas for revegetation and/or rehabilitation projects targeting koala habitat (refer Figure 4). As shown in Figure 4 these have been classified into 3 categories;

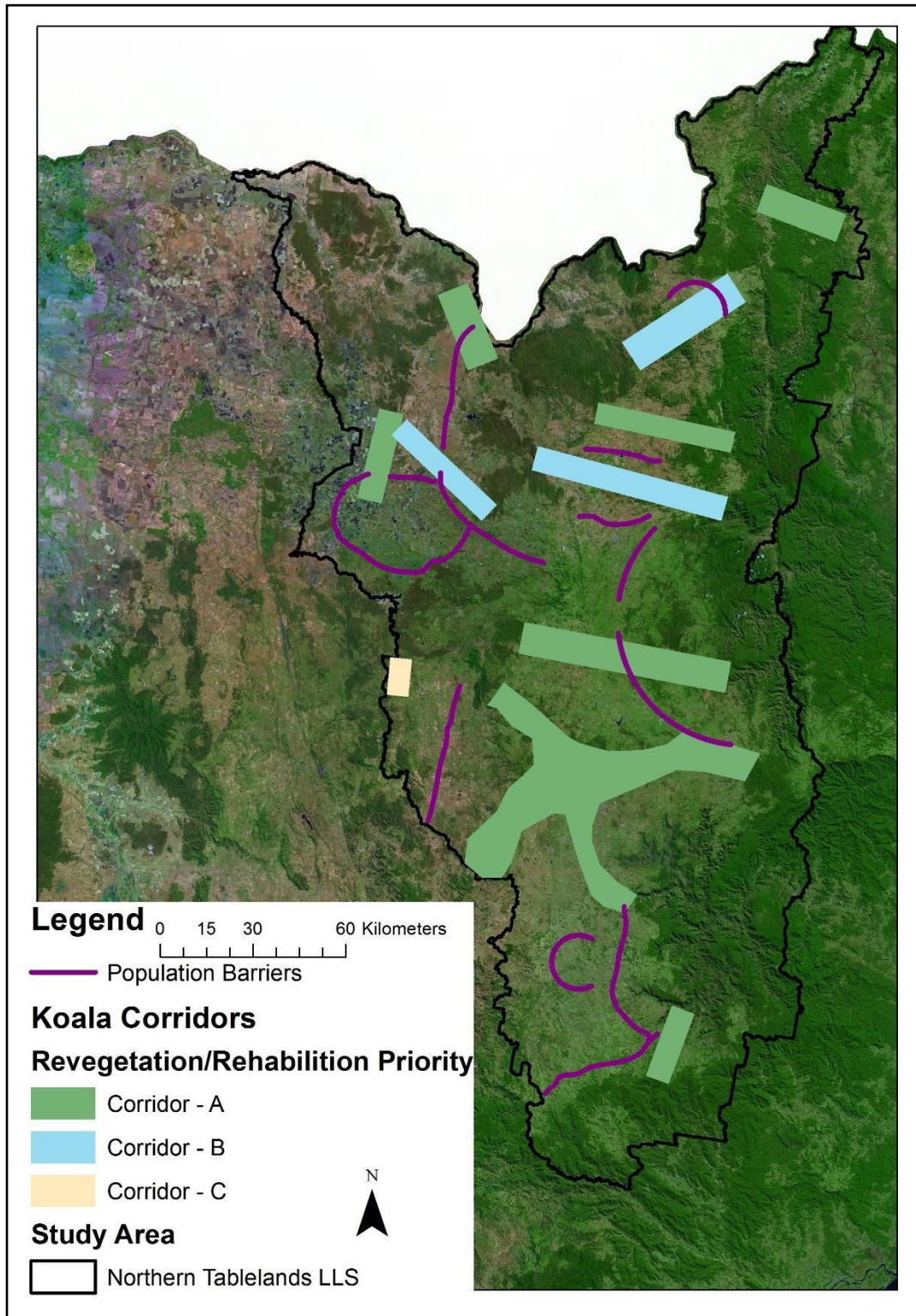
- A. corridors that will re-connect existing koala populations
- B. corridors that connect an existing koala population with large areas of remnant vegetation that may potentially support as yet unidentified koala populations and/or unoccupied koala habitat, and
- C. corridors on lower elevations adjacent to large areas of remnant vegetation that may potentially support as yet unidentified koala populations and/or unoccupied koala habitat.

Re-vegetation works within these corridor areas should focus on rehabilitation of remnant patches of koala habitat increasing their extent and condition by encouraging natural overstorey regeneration. Changes to livestock grazing practices, implementation of a weed control program and where necessary re-planting indigenous native species to re-connect isolated habitat patches will be the primary methods used. Priority should be given to re-vegetating/rehabilitating of habitat patches 10- 50 ha, with the aim of increasing their size. Of lowest priority is the re-vegetation/rehabilitation of very small (< 2 ha in size) habitat patches.

Re-vegetation should focus on planting local indigenous eucalypt species and other indigenous native species consistent within the pre-clearing vegetation types of the area that would have previously comprised koala habitat (refer Action2.2).

**Stakeholders:** *NT LLS, OEH/NPWS, Forests NSW, LPI, local government, environmental NGOs, ecological consultants, land owners/managers, community members, plant nurseries*

Figure 4: Priority corridor areas for re-vegetation / rehabilitation within the Northern Tablelands koala recovery strategy area



### *Action 2.2 – Identify priority vegetation communities for revegetation/rehabilitation*

The corridor areas identified in this strategy are large and support a range of vegetation communities which may or may not constitute koala habitat. Current deficiencies in our knowledge of koala ecology, coupled with the inadequacies of existing vegetation mapping, make the identification of areas of potential koala habitat within these corridor areas problematic. Potential koala habitat can however be identified using the important koala tree species identified for the relevant local government area (LGA) in Table 3. Any plant community type (PCT) which has one or more of the feed tree species (listed in Table 3 for the relevant LGA) as a dominant should be regarded as potential koala habitat.

The order of priority for replanting and/or rehabilitation in any corridor area should be;

1. vegetation communities indigenous to the corridor area dominated by one or more of the preferred food tree species in Table 3, likely to support one or more habitat tree species, and which also occurs on fertile soils (basalts, clays or alluviums)
2. vegetation communities as above but on poorer soil types
3. vegetation communities indigenous to the corridor dominated by one or more of the occasional food tree species in Table 3 that is also likely to support one or more habitat tree species.

First priority for rehabilitation should always be given to potential koala habitat on more fertile soil types; basalts, clay and alluvium.

**Stakeholders:** NT LLS, Forests NSW, LPI, landcare organisations, environmental NGOs, environmental consultants, land owners/managers, community groups/members

### Strategy 3 – Improve knowledge of koala ecology

Improved knowledge of koala ecology within the Northern Tablelands is critical to protecting and enhancing extant koala populations. Without this knowledge the identification of koala populations, movement corridors, unoccupied habitat and potential threats are at best an educated guess, as are proposed priority areas for on-ground recovery actions such as revegetation/rehabilitation. Improving current knowledge regarding koala ecology is therefore vital if this recovery strategy is to be successful.

### *Action 3.1 – Undertake research to address knowledge gaps regarding koala ecology*

Research is required across the recovery strategy project area to address gaps in our existing knowledge of koala ecology including;

- population demography (age structure, longevity, genetics)
- home range size
- seasonal and/or temporal changes in feed/shelter tree/habitat selection
- dispersal ability across non-feeding habitat
- feed tree selection and the effects leaf chemistry within food tree species, within vegetation communities on different substrates and under climate change scenarios

- shelter tree selection
- minimum habitat patch size, and
- disease prevalence.

**Stakeholders:** NT LLS, OEH, university researchers, koala carers

### *Action 3.2 – Incorporate research results into koala recovery strategies*

To ensure koala recovery, an on-going adaptive management approach should be adopted for the inclusion of koala ecology research results into existing recovery strategies.

**Stakeholders:** NT LLS, OEH, local government, university researchers, landcare organisations, environmental NGOs, land owners/managers, community groups/members

## Strategy 4 - Identify threats to koala populations, quantify their impact and implement remedial actions

### *Action 4.1 - Investigate and quantify threats to koala populations*

Threats to koala populations identified in Table 4 should be investigated to assess their relevance to the identified koala populations and quantify their impact. The uncertain and/or declining status of the majority of koala populations on the Northern Tablelands (Paull and Hughes, 2016), means that such investigation are urgently required so that appropriate mitigation actions can be implemented to ensure the persistence of these koala populations.

**Stakeholders:** NT LLS, OEH, local government, university researchers, landcare organisations, environmental NGOs, land owners/managers, community groups/members

### *Action 4.2 – Implement actions to mitigate threats*

The implementation of actions to mitigate threats to koalas is difficult given the lack of specific information regarding threats and their relative impact on koala populations across the recovery strategy area. In the interim, and in line with the precautionary principle, actions as outlined in the *Recovery Plan for the Koala* (DECC, 2008) should be implemented for the identified threats (refer Table 4) within each Northern Tablelands koala population area.

**Stakeholders:** NT LLS, OEH, local government, university researchers, landcare organisations, environmental NGOs, land owners/managers, community groups/members

## Strategy 5 - Increase community awareness of and engagement in koala conservation

### *Action 5.1 - Develop and distribute educational material and involve the community in koala conservation*

Educational material specific to koalas on the Northern Tablelands should be prepared e.g. pamphlets, flyers and/or brochures. Development of a website/facebook page specific to Northern Tablelands koalas including information such as; koala calls, scats (photos), key food/shelter trees (photos, plant id), how to report sightings, promote community surveys,



koala projects and their results. A website/facebook page could also be linked to a regional database and used as a sight reporting mechanism.

**Stakeholders:** NT LLS, OEH, local government, landcare organisations, environmental NGOs, schools, land owners/managers, community groups/members.

#### *Action 5.2 – Use a range of media to raise community awareness of koalas*

Raising community awareness of koalas is key to encouraging increased sight reporting, community involvement in and/or adoption of koala recovery actions. Methods of raising community awareness should be as varied as possible in order to reach the widest audience (radio, newspapers, newsletters, film, field days and social media). Good news koala stories and projects should be promoted e.g. the stable koala population around Armidale.

**Stakeholders:** NT LLS, local government, landcare organisations, environmental NGOs, media outlets, land owners/managers, community groups/members.

#### *Action 5.3 - Use existing networks to distribute educational materials and promote koala sight reporting*

Existing regional networks should be used to distribute educational materials and promote koala sight reporting. These networks include;

- Landcare network - GLENRAC, GWYMAC, SNELC, Granite Border Ranges Landcare (GBRL) and New England North West Landcare (NENWL) to disseminate information and promote awareness of koalas within the farming community.
- Local councils – Armidale Dumaresq, Inverell, Glen Innes/Severn, Guyra, Uralla, Tenterfield and Walcha. As well as distributing educational materials, council websites could provide a link to a central sight reporting database on their websites.
- Environmental NGOs – The Armidale Tree Group, Citizens for Wildlife Corridors, Tenterfield Naturalists, Greening Australia, National Parks Association (NPA) can help with distributing educational materials but also as in the case of NPA potentially organising community koala surveys targeting under-surveyed areas.
- Koala carers - WIRES and Northern Tablelands Wildlife Carers (NTWC)
- NPWS offices - often the first point of call to report wildlife sightings.

**Stakeholders:** NT LLS, OEH, local government, landcare organisations, environmental NGOs, koala carers.

#### *Action 5.4 – Develop a local koala conservation management network*

Conservation Management Networks (CMNs) is a model (launched in 1999) for the long-term conservation of highly fragmented ecosystems that are difficult to conserve through land acquisition. Although generally applied to vegetation communities (e.g. Grassy Box Woodland and Monaro Grassland CMN) there is no reason a local koala CMN could not be established.

The CMN would aim to link koala habitat remnants and their owners/managers through a single network dedicated to protecting and managing koala habitat. CMN would also aim to provide long-term, targeted, flexible and responsive support to owners/managers, NGOs, researchers and government agencies involved in the management of koalas and their habitats. A local Koala CMN would provide an opportunity to encourage members to consider in-perpetuity conservation mechanisms for areas of koala habitat such as a Conservation Agreement. Potentially the agency contact (refer Action 1.5) could also be the co-ordinator of the CMN.

**Stakeholders:** NT LLS, OEH, local government, university researchers, landcare organisations, environmental NGOs, koala carers, land owners/managers, community groups/members.

#### *Action 5.5 - Investigate crowd-funding for koala survey*

Given limited government funding potential use of crowd-funding should be investigated to enable systematic koala surveys to improve baseline data. This option could potentially be pursued by an NGO such as the Armidale Tree Group or Citizens for Wildlife Corridors.

**Stakeholders:** NT LLS, environmental NGOs.

#### *Action 5.6 - Ensure continuity in resourcing over-time*

Funding cycles, changing agency/funding emphases, staff turnovers and potentially changing database contact people will be a problem for a long-term koala monitoring project in such a large region. One-off events and short-term programs will not be successful in the long-term in increasing baseline data and averting existing koala population declines. Landholders, community members, local government, NGOs and agency staff need to know who the local koala agency contact is and koala conservation needs to be constantly promoted. Continuity is also required to ensure long-term someone has the dedicated responsibility for filtering and entering sighting information into a regional database and uploading record data to state and national databases.

**Stakeholders:** NT LLS, local and state government, environmental NGOs, landcare organisations, koala carers, land owners/managers, community groups/members.

## 6. Progress indicators

The criteria against which the objectives of this recovery strategy will be measured are outlined in detail in Table 5. In general terms, however, the performance criteria for the general objectives of this plan include:

- an increase in the number of systemic koala surveys across the project area
- improved coverage of survey and sight reporting across the project area
- an increase in reporting of opportunistic koala sightings by landholders and community members
- a reduction in the level of specific threats, and
- an improvement in the landscape connectivity between existing koala populations and habitat areas

It is important to note that a decrease in numbers of koalas brought into care can indicate that threats to koalas are being mitigated. This is not always a suitable progress criterion as it may also indicate that koala numbers in an area are decreasing.

**Table 5: Progress indicators against which the objectives of the Northern Tablelands koala recovery strategy will be measured**

Strategy 1: Improve baseline data			
<b>Action</b>	1.1	Undertake systematic surveys in priority areas	<ul style="list-style-type: none"> <li>- number/area of systematic surveys using an agreed/consistent method undertaken in priority areas A, B &amp; C (Figure 3)</li> <li>- data from surveys entered into <i>Atlas of NSW Wildlife</i></li> </ul>
	1.2	Establish appropriate koala survey protocols and apply these on an on-going basis	<ul style="list-style-type: none"> <li>- koala survey protocols established and applied to all systematic surveys in the recovery strategy area</li> </ul>
	1.3	Increase public reporting of opportunistic koala sightings	<ul style="list-style-type: none"> <li>- an increase in the number of community koala sighting reports</li> <li>- an increase in the distribution of community koala sighting reports across the recovery strategy area</li> <li>- education materials regarding koalas and the reporting of koala sightings prepared and distributed</li> </ul>
	1.4	Develop method/protocols to enable public reporting of opportunistic koala sightings	<ul style="list-style-type: none"> <li>- a regional method/protocol for public koala sight reporting established</li> <li>- tools to facilitate public reporting of koalas developed (e.g. website/phone app)</li> <li>- agency contact person employed to facilitate sight reporting (refer Action 1.5)</li> <li>- regional database for community koala records developed</li> </ul>
	1.5	Employ a designated community koala contact	<ul style="list-style-type: none"> <li>- a designated koala community contact person employed</li> <li>- koala community contact person details advertised/promoted across the region</li> </ul>
	1.6	Establish a regional database for community submission of opportunistic koala records	<ul style="list-style-type: none"> <li>- a regional database for the community koala sightings developed</li> <li>- relevant information fields are consistent with/adapted from <i>Atlas of NSW Wildlife</i> to facilitate uploading to state database</li> </ul>
	1.7	Ensure community data is uploaded to state and national databases	<ul style="list-style-type: none"> <li>- person employed who has the dedicated responsibility for vetting and up-loading regional data into <i>Atlas of NSW Wildlife</i> (refer Action 1.5)</li> <li>- data from the regional database uploaded to <i>Atlas of NSW Wildlife</i> on a regular basis.</li> </ul>
	1.8	Review and investigate koala habitat modelling methods	<p>Using outcomes of Actions 1.1 and 1.3:</p> <ul style="list-style-type: none"> <li>- koala habitat modelling is reviewed on a regular basis</li> <li>- application of other koala modelling methods is explored</li> </ul>

<b>Strategy 2: Improve landscape connectivity and reduce fragmentation effects</b>			
<b>Action</b>	2.1	Undertake revegetation/rehabilitation in identified corridors	<ul style="list-style-type: none"> <li>- area of revegetation/rehabilitation of koala habitat undertaken in priority corridor areas A &amp; B identified in Figure 4</li> <li>- koala habitat patches 10-50ha prioritised for re-vegetation / rehabilitation works</li> <li>- koala habitat patches &lt;2ha given lowest priority for re-vegetation / rehabilitation works</li> <li>- areas of revegetation / rehabilitation monitored on an on-going basis and adaptive management applied</li> </ul>
	2.2	Identify priority vegetation communities for revegetation/rehabilitation	<ul style="list-style-type: none"> <li>- priority vegetation communities constituting koala habitat are identified in corridor areas A &amp; B (Figure 4)</li> <li>- koala food tree species listed in Table 1 are used to identify potential koala habitat</li> <li>- areas of potential koala habitat on more fertile soil types (basalt, clay and alluvium) are given priority for revegetation/rehabilitation works</li> </ul>
<b>Strategy 3: Improve knowledge of koala ecology</b>			
<b>Action</b>	3.1	Undertake research to address knowledge gaps regarding koala ecology	<ul style="list-style-type: none"> <li>- research projects developed, funded and completed that address knowledge gaps in koala ecology including:                             <ul style="list-style-type: none"> <li>• population demography (age structure, longevity, genetics)</li> <li>• home range size</li> <li>• seasonal and/or temporal changes in feed/shelter tree/habitat selection</li> <li>• dispersal ability across non-feeding habitat</li> <li>• feed tree selection and the effects leaf chemistry within food tree species, within vegetation communities on different substrates and under climate change scenarios</li> <li>• shelter tree selection</li> <li>• minimum habitat patch size, and</li> <li>• disease prevalence</li> </ul> </li> </ul>
	3.2	Incorporate research results into koala recovery strategies	<ul style="list-style-type: none"> <li>- Research results are incorporated into koala recovery strategies using an on-going adaptive management approach</li> </ul>
<b>Strategy 4: Identify threats to koala populations, quantify their impact and implement remedial actions</b>			
<b>Action</b>	4.1	Investigate and quantify threats to koala populations	<ul style="list-style-type: none"> <li>- threats to koala populations investigated and identified</li> <li>- threats to koala populations quantified through research</li> </ul>
	4.2	Implement actions to mitigate threats	<ul style="list-style-type: none"> <li>- investigation/research results into threats to koala populations incorporated into recoveries strategies</li> <li>- actions to mitigate threats to koala populations implemented</li> <li>- as an interim measure mitigation actions as outlined in the <i>Recovery Plan for the Koala</i> (DECC, 2008) are implemented for the identified threats within each koala population area (refer Table 4)</li> </ul>

Strategy 5: Increase community awareness of and engagement in koala conservation			
Action	5.1	Develop and distribute educational material and involve the community in koala conservation	<ul style="list-style-type: none"> <li>- education materials specific to koalas on the Northern Tablelands prepared and distributed through local networks as per Action 5.3</li> <li>- a website/facebook page specific to Northern Tablelands koalas developed that includes information such as;               <ul style="list-style-type: none"> <li>• koala calls</li> <li>• scats (photos)</li> <li>• key food/shelter trees (photos, plant id)</li> <li>• how to report sightings</li> <li>• promotion of community surveys, koala projects and their results</li> </ul> </li> <li>- a website/facebook page is linked to a regional database and used as a sight reporting mechanism</li> </ul>
	5.2	Use a range of media to raise community awareness of koalas	<ul style="list-style-type: none"> <li>- a wide range of media is used to raise community awareness of koalas including; radio, newspapers, newsletters, film, field days and social media</li> <li>- good news koala stories and projects are promoted in the media e.g. the stable koala population around Armidale</li> <li>- koala information included in existing community events e.g. local shows, Ag Quip</li> </ul>
	5.3	Use existing networks to distribute educational materials and promote koala sight reporting	<ul style="list-style-type: none"> <li>- regional networks are used to distribute educational materials and promote koala sight reporting including;               <ul style="list-style-type: none"> <li>• Landcare - GLENRAC, GWYMAC, GBRL, SNELC, NENWL</li> <li>• Local councils – Armidale Dumaresq, Inverell, Glen Innes/Severn, Guyra, Tenterfield Uralla, Walcha</li> <li>• Environmental NGOs - The Armidale Tree Group, Citizens for Wildlife Corridors, Tenterfield Naturalists, Greening Australia, National Parks Association (NPA),</li> <li>• Koala carers (WIRES and NTWC)</li> <li>• NPWS offices.</li> </ul> </li> <li>- koala website/database/facebook page link is provided on regional network members website/facebook pages</li> </ul>
	5.4	Develop a local koala conservation management network	<ul style="list-style-type: none"> <li>- a local koala conservation management network (CMN) established</li> <li>- a CMN co-ordinator employed (see Action 1.5)</li> <li>- number of land owners/managers managing koala habitat for conservation becoming CMN members</li> </ul>
	5.5	Investigate crowd-source funding for koala survey	<ul style="list-style-type: none"> <li>- opportunities for crowd source funding of koala surveys are investigated</li> <li>- NGOs approached to initiate/coordinate crowd-source funding</li> </ul>
	5.6	Ensure continuity in resourcing over-time	<ul style="list-style-type: none"> <li>- koala recovery is a core NT LLS activity</li> <li>- a designated agency contact is employed on an on-going basis, as a minimum for the life of the recovery strategy</li> <li>- promotion of Northern Tablelands koalas, conservation projects/strategies/research, koala sight reporting , community surveys is on-going</li> </ul>

## 7. Consistency with the objectives of NSW and Commonwealth koala recovery plans

The recovery actions identified in this strategy are consistent with both the NSW *Recovery Plan for the Koala* (DECC, 2008) and the *National Koala Conservation and Management Strategy 2009-2014* (DEWHA, 2009). As a regional recovery strategy not all the objectives of these two overarching state and national plans area relevant. Table 6 shows the relationship of this recovery strategy to the previous recovery plans.

**Table 6: Consistency of the Northern Tablelands Koala Recovery Strategy with the Commonwealth and NSW koala recovery plans**

Northern Tablelands Koala Recovery Strategy	National Koala Conservation and Management Strategy (DEWHA 2009)	Recovery Plan for the Koala (DECC 2008)
<b>Strategy 1:</b> Improve baseline data	<b>Category 1:</b> Habitat identification and protection (Actions: 1.03, 1.06 & 1.08) <b>Category 6:</b> Research (Actions: 6.01 & 6.02)	<b>Objective 1a:</b> Identify and conserve habitat important for koala conservation (Actions: 1.6, 1.7 & 1.8) <b>Objective 1b:</b> Assess the impact of habitat loss and fragmentation on koala populations ( Actions 1.10) <b>Objective 3:</b> Develop a better understanding of the conservation biology of koalas (Action 3.3)
<b>Strategy 2:</b> Improve landscape connectivity and reduce fragmentation effects	<b>Category 1:</b> Habitat identification and protections (Action 1.05)	<b>Objective 1b:</b> Assess the impact of habitat loss and fragmentation on koala populations (Action 1.10) <b>Objective 2a:</b> Revegetate and rehabilitate selected sites (Actions: 2.1 & 2.2)
<b>Strategy 3:</b> Improve knowledge of koala ecology	<b>Category 1:</b> Habitat identification and protection (Action 1.03) <b>Category 6:</b> Research (Actions: 6.02 & 6.06)	<b>Objective 3:</b> Develop a better understanding of the conservation biology of koalas (Actions: 3.2 & 3.3)
<b>Strategy 4:</b> Identify threats to koala populations, quantify their impact and implement remedial actions	<b>Category 1:</b> Habitat identification and protections (Actions: 1.04 & 1.09) <b>Category 3:</b> Direct mortality of individual koala (Actions: 3.02 & 3.03)	<b>Objective 1b:</b> Assess the impact of habitat loss and fragmentation on koala populations (Action 1.10) <b>Objective 1d:</b> Develop appropriate road risk management in koala habitat <b>Objective 1e:</b> Implement strategies which minimise the impacts of dogs on koala populations <b>Objective 1f:</b> Develop and implement strategies to reduce the impact of fires on koala populations <b>Objective 3:</b> Develop a better understanding of the conservation biology of koalas (Action 3.6)
<b>Strategy 5:</b> Increase community awareness of and engagement in koala conservation	<b>Category 4:</b> Community involvement (Actions 4.01 & 4.02)	<b>Objective 4a:</b> Prepare and distribute educational material and involve the community in koala conservation

## 8. Implementation

The responsibility for the implementation of recovery actions outlined in this strategy will largely be the responsibility of the NT LLS working in collaboration with; other government agencies, local government, university researchers, landcare organisations, environmental NGOs, environmental consultants/ecologists, koala carers, land owners/managers, community groups and individuals. These actions are to be implemented during the 10 years operation of this recovery strategy using funding from the Australian Government and resources provided by state and local government bodies, with the assistance of non-government/community organisations and private land owners/managers. Some actions having commenced prior to finalisation of this strategy.

The recovery strategy should be reviewed after 5 years to ensure recovery actions are updated and reflect improved knowledge as a result of increased survey and research effort, as well as monitoring of replanting/revegetation projects.

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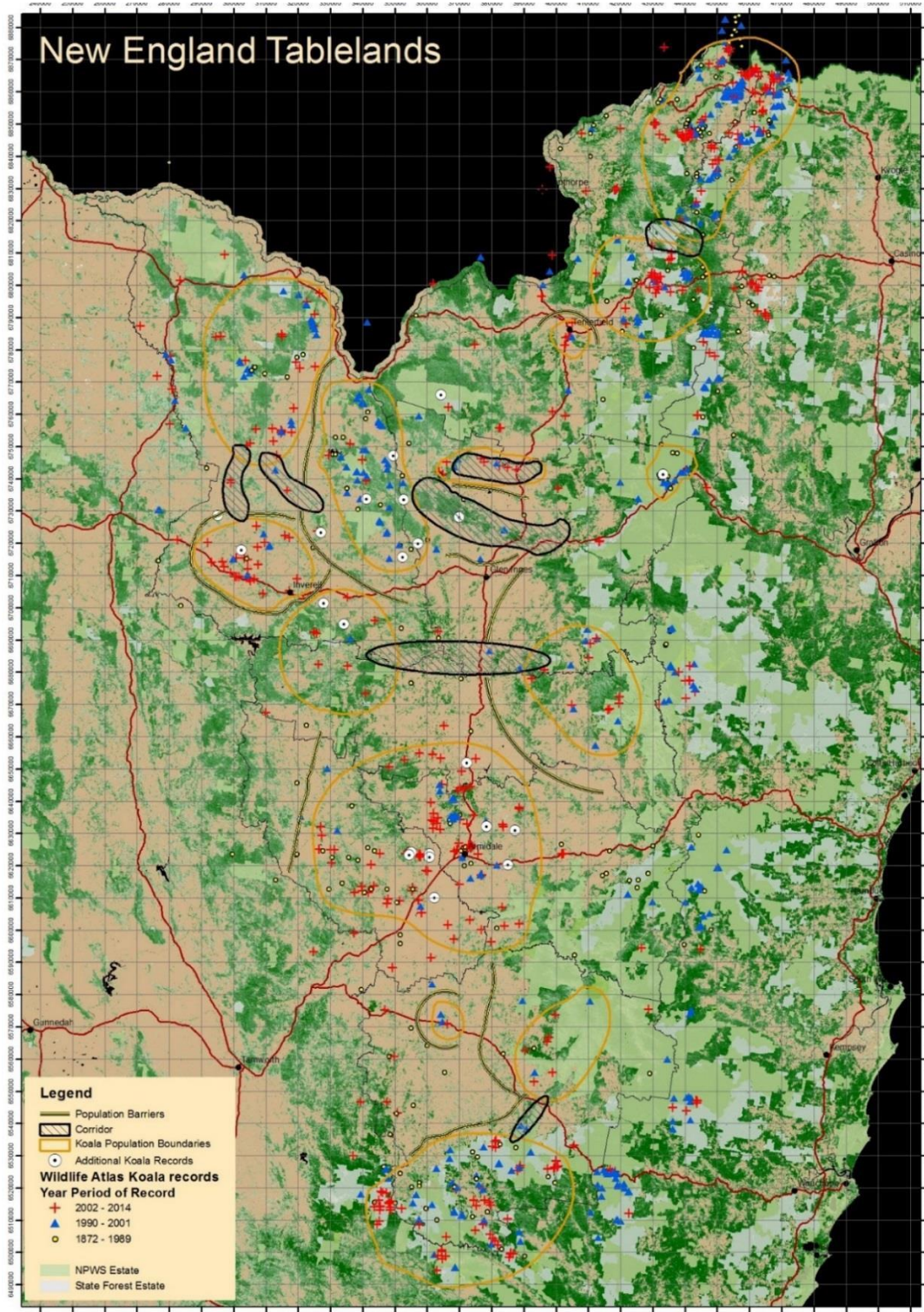
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**APPENDIX 1:**

**Local koala populations, important corridors and barriers to movement identified by the Armidale koala expert forum, Nov 2015**





**APPENDIX 2:**

**Labelled local koala populations, important movement corridors and movement barriers**  
 (Armidale koala expert forum, Nov 2015)

