



KOALA PLAN OF MANAGEMENT

Lot 76, 272, 323 & 326 DP 755701; Lot 6 DP 875446; Lot 2 DP 819015; Lot 1 DP 706497; Lot 40 DP 7482; Lot 37A DP 13727; Lot 38A DP 13727; Lot 38B DP 13727; Lot 1 DP 129737; Lot 1 DP 781633; Lot 7 DP 8750447
Kings Forest

A Report Prepared for
Project 28 Pty Ltd

REVISED MAY 2017

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1 INTRODUCTION

1.1 Background

JWA Pty Ltd has been engaged by Project 28 Pty Ltd (Leda) to complete a Revised Koala Plan of Management (KPoM) for the Kings Forest project site, located in the Tweed Shire between Bogangar and Kingscliff. This Revised KPoM has been prepared by a suitably qualified person¹ (James Warren) and a curriculum vitae is attached as APPENDIX 1. APPENDIX 2 contains a summary of the process Project 28 has undertaken thus far in the approval process for both State and Commonwealth jurisdictions and includes details of extensive stakeholder consultation.

The preparation of this Revised KPoM has been based on a review of the latest literature relating to the protection of Koalas and their habitat. Most of this literature has been relied upon in the preparation of the core documents relating to the threatened species listing of the Koala at a Commonwealth and State level.

The KPoM that accompanied the Concept Plan application (Carrick 2009) noted the difficulty of effectively preventing koalas from entering the development zone. However, the approach to Koala management at Kings Forest has been re-appraised based on a review of recent literature (in particular, Hopkins and Phillips 2009). This Revised KPoM adopts an 'exclusion' approach, proposing effective separation of Koalas and their habitat from development and its related threats, whilst maintaining and enhancing existing habitat linkages. All mitigation strategies proposed in this Revised KPoM are supported by the various Commonwealth and State listing documents (DoE 2014 and DECC 2008).

Project 28 will comply with the Commonwealth conditions and ensure that all exclusion fencing (temporary or permanent), grid construction, installation of signage and traffic calming devices, collection of baseline monitoring data and Koala habitat revegetation is completed prior to the commencement of construction² in each precinct. Fauna underpasses will be, where relevant, constructed as part of road construction.

1.2 Aim and Objectives

The aim of this Revised KPoM is to protect and conserve the Koala population in the Kings Forest area to ensure the ongoing survival of the Kings Forest Koala population through appropriate management of project impacts.

The objectives are:

- To ensure that the proposed development does not remove significant areas of habitat known, or likely to be important for the local Koala population;

¹ Means a qualified ecologist with appropriate training and at least five years of experience in undertaking surveys in relation to the relevant EPBC Act listed threatened species.

² Commencement of construction means any preparatory works, excluding preliminary works, required to be undertaken including clearing vegetation, the erection of any onsite temporary structures and the use of heavy duty equipment for the purpose of breaking the ground for bulk earthworks, buildings or infrastructure for the proposed action.

- To ensure that movement corridors for the local Koala population are maintained and/or improved;
- To protect individual Koalas from injury or other adverse impacts during the development phase;
- To embellish the habitat values of the site, including the creation of Koala habitat as part of a comprehensive offset strategy;
- To ensure that activities generated because of the proposed development (e.g. additional traffic, introduction of dogs) do not significantly impact on the local Koala population;
- To ensure that Koalas continue to utilise habitat at Kings Forest;
- To ensure appropriate monitoring and management programs are undertaken;
- To raise awareness and promote community ownership of environmental management (including the conservation of the local Koala population);
- Compliance with relevant conditions; and
- Further revision of the KPoM as appropriate.

1.3 Rationale

The philosophy of Koala management within an urban environment must be based on the need to:

- a) Provide for the persistence of Koalas in the urban context; and
- b) Protect them from the associated threats (i.e. habitat loss, domestic dog attack and motor vehicle related mortalities).

This Revised KPoM has been prepared in the knowledge that:

- The range of Koalas in the Tweed LGA has contracted by an estimated 18% over the last 18 - 20 years (Phillips *et al.* 2011);
- The Tweed coast portion of the LGA contains a small population, estimated to number approximately 145 Koalas, which appears to have declined significantly over the last decade (Phillips *et al.* 2011);
- The Kings Forest site supports a portion of this small population of Koalas;
- The development of Kings Forest provides an opportunity to generate a significant addition to the available habitat for the Cudgen Nature Reserve Koala population.

With consideration of the above, development outcomes for the Kings Forest site need to:

- Conserve existing Koala habitat supporting resident populations;
- Provide additional areas of potential habitat;

- Provide ongoing access to areas of habitat supporting resident Koala populations and potential habitat in such a way as to protect the population from dog attack and motor vehicle strike;
- Allow for co-operation with the managers of Cudgen Nature Reserve in relation to bushfire management and other conservation matters;
- Buffer Koala habitat supporting resident populations from development areas;
- Prevent Koalas from entering the development zone and being subject to associated risks; and
- Implement an environmental awareness and extension program for new residents.

1.4 Statutory Regulations

There are several key statutory regulations and documents prepared by the Commonwealth, State and local government agencies related to Koalas that were considered during the preparation of this Revised KPoM. These include:

- *Threatened Species Conservation Act (1995)* (TSC Act);
- NSW State Environment Planning Policy (SEPP) No. 44 - Koala Habitat Protection (1995);
- *Environment Protection and Biodiversity Conservation Act (1999)* (EPBC Act);
- *Companion Animals Act (1998)* and the *Companion Animals Regulation (2008)*.
- NSW Recovery Plan for the Koala (2008);
- National Koala Conservation and Management Strategy 2009-2014 (NRMMC 2009);
- Approved Conservation Advice for *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory) (2012); and
- Tweed Coast Comprehensive Koala Plan of Management (TCCKPoM) (2015).

Any determination of the NSW Scientific Committee will be considered in any future amendments to this Revised KPoM.

A summary of these relevant statutory regulations is provided in APPENDIX 3.

1.5 Literature Review

Comprehensive desktop assessments were completed as an integral part of the preparation of this Revised KPoM. APPENDIX 4 provides details of the reports and literature reviewed that is relevant to Koalas and Koala habitat at the Kings Forest site and surrounding areas.

1.6 Other Relevant Stage/Precinct Management Plans & Documents

It should be noted that previous documentation (i.e. the Revised Final Response Report - JWA 2015) and the subsequent EPBC Conditions refer to various Stages of development as follows:

- Stage 1 - Precincts 1-5;
- Stage 2 - Precincts 12-14;
- Stage 3 - Precinct 6;
- Stage 4 - Precinct 7;
- Stage 5 - Precinct 8;
- Stage 6 - Precinct 9;
- Stage 7 - Precinct 10; and
- Stage 8 - Precinct 11.

This Revised KPoM refers to specific development Precincts to avoid any confusion with the proposed 'staging' of the development.

This Revised KPoM should be read in conjunction with the following:

- Commonwealth Approval and Conditions (EPBC 2012/6328) dated 21st May 2015;
- Revised Final Response Report Relating to Matters of NES (Wallum Sedge Frog & Koala) (JWA 2015); and
- Final Preliminary Documentation (JWA 2013).

A number of management plans were completed for the Kings Forest Stage 1 Project Application and approved under Project Approval 08_0194. These management plans are listed below and should also be considered in conjunction with this Revised KPoM. However, it should be noted that there has been a significant amount of work completed subsequent to their approval, e.g. pre and post development groundwater assessments (G&S 2013 & 2014), and aspects of these management plans will need to be amended accordingly (as required by Condition 39 of the MP 08_0194).

- Kings Forest Stage 1 Project Application: Precinct 1 and 5 Vegetation Management Plan (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 2-4 and 6-11 Vegetation Management Plan (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 12, 13 and 14 Vegetation Management Plan (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 1 and 5 Threatened Species Management Plan (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 2-4 and 6-11 Threatened Species Management Plan (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 12, 13 and 14 Threatened Species Management Plan (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 1 and 5 Buffer Management Plan (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 2-4 and 6-14 Buffer Management Plan (JWA 2012);
- Kings Forest Stage 1 Project Application: Feral Animal Management Plan (JWA 2012);

- Kings Forest Stage 1 Project Application: Flora and Fauna Monitoring Report (JWA 2012);
- Kings Forest Stage I Project Application: Precinct 1 and 5 Weed Management Plan (JWA 2012);
- Kings Forest Stage 1 Project Application: Precinct 2-4 and 6-11 Weed Management Plan (JWA 2012); and
- Kings Forest Stage 1 Project Application: Precinct 12, 13 and 14 Weed Management Plan (JWA 2012).

The revision of the Management Plans listed above must not be inconsistent with this Revised KPoM, which addresses the requirements of Condition C2 of the Concept Plan Approval 06_0318 and Condition 39 of the MP 08_0194 (as modified).

2 SITE DESCRIPTION

2.1 Locality

Kings Forest is located on the far north coast of NSW in the Tweed local government area (LGA) approximately 20 km south of the Queensland/NSW border, 5 km north-west of the village of Bogangar and 4 km south-west of Kingscliff (FIGURE 1). The Locality is defined as the area within a 10 km radius of the subject site. The Locality therefore extends from Pottsville in the south to Fingal Head in the north and from the coastline in the east to the Burringbar Range in the West.

2.2 The Study Area

The study area is defined as the subject site together with any proximate areas that may be affected by the proposed development. The Kings Forest site abuts agricultural and rural lands, to the north, west and south west. Cudgen Nature Reserve (including Cudgen Lake and Cudgen Creek) abuts the site boundaries to the south and east. There are a small number of residential properties along Tweed Coast Road to the north of the site.

2.3 Conservation Reserves/Ecologically Significant Areas in the Locality

The Cudgen Nature Reserve adjoins the southern and (in part) eastern boundaries of the subject site (FIGURE 2). A newly gazetted portion of the Cudgen Nature Reserve occurs to the south-west. Stotts Island Nature Reserve is situated approximately 2 km to the north-west of the site. Several areas protected under State Environmental Planning Policy (SEPP) No. 14 - Coastal Wetlands also exist within the site (FIGURE 3). A number of Littoral rainforest communities occur in the locality. Most of the larger patches are protected under SEPP No. 26 (FIGURE 4). Littoral Rainforest is now listed as Critically Endangered under the EPBC Act.

2.4 Land Use Zones

The Kings Forest site is comprised of fourteen (14) land parcels with a total area of 846 hectares:

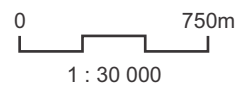
- Lot 76, 272, 323 and 326 in DP 755701;
- Lot 6 in DP 875446;
- Lot 2 in DP 819015;
- Lot 1 in DP 706497;
- Lot 40 in DP 7482;
- Lot 37A in DP 13727;
- Lot 38A in DP 13727;
- Lot 38B in DP 13727;
- Lot 1 in DP 129737;



LEGEND
 □ Kings Forest Boundary



SUBJECT SITE



SOURCE: Google Maps
 SCALE: 1 : 30 000 @ A3
JWA PTY LTD
Ecological Consultants

CLIENT
 Project 28 Pty Ltd
 PROJECT
 Koala Plan of Mangement
 Kings Forest
 Melaleuca Drive, Duranbah, NSW
 Shire of Tweed

FIGURE 1
 PREPARED: BW
 DATE: 19 December 2016
 FILE: N97017_Locality.cdr

TITLE
LOCALITY PLAN



- LEGEND**
- + Cudgen Nature Reserve
 - Kings Forest Boundary



SOURCE: NPWS 05.06.06; Near Map 2011
 Aerial; Google Earth 2011 Aerial
 SCALE: 1 : 30 000 @ A3

JWA PTY LTD
Ecological Consultants

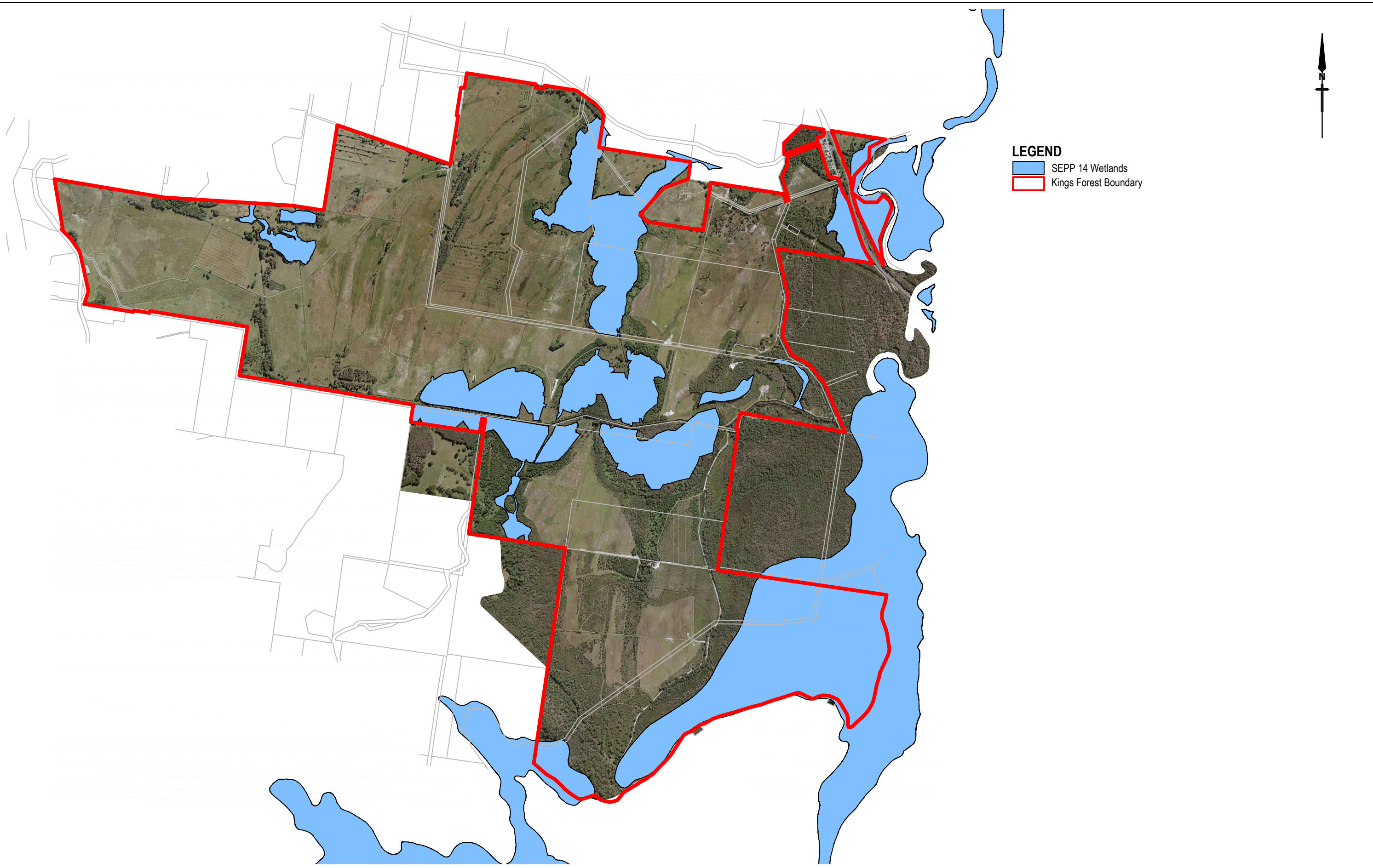
CLIENT
 Project 28 Pty Ltd
 PROJECT
 Koala Plan of Management
 Kings Forest
 Melaleuca Drive, Duranbah, NSW
 Shire of Tweed

FIGURE 2

PREPARED: BW
 DATE: 19 December 2016
 FILE: N97017_Cudgen NR.cdr

TITLE

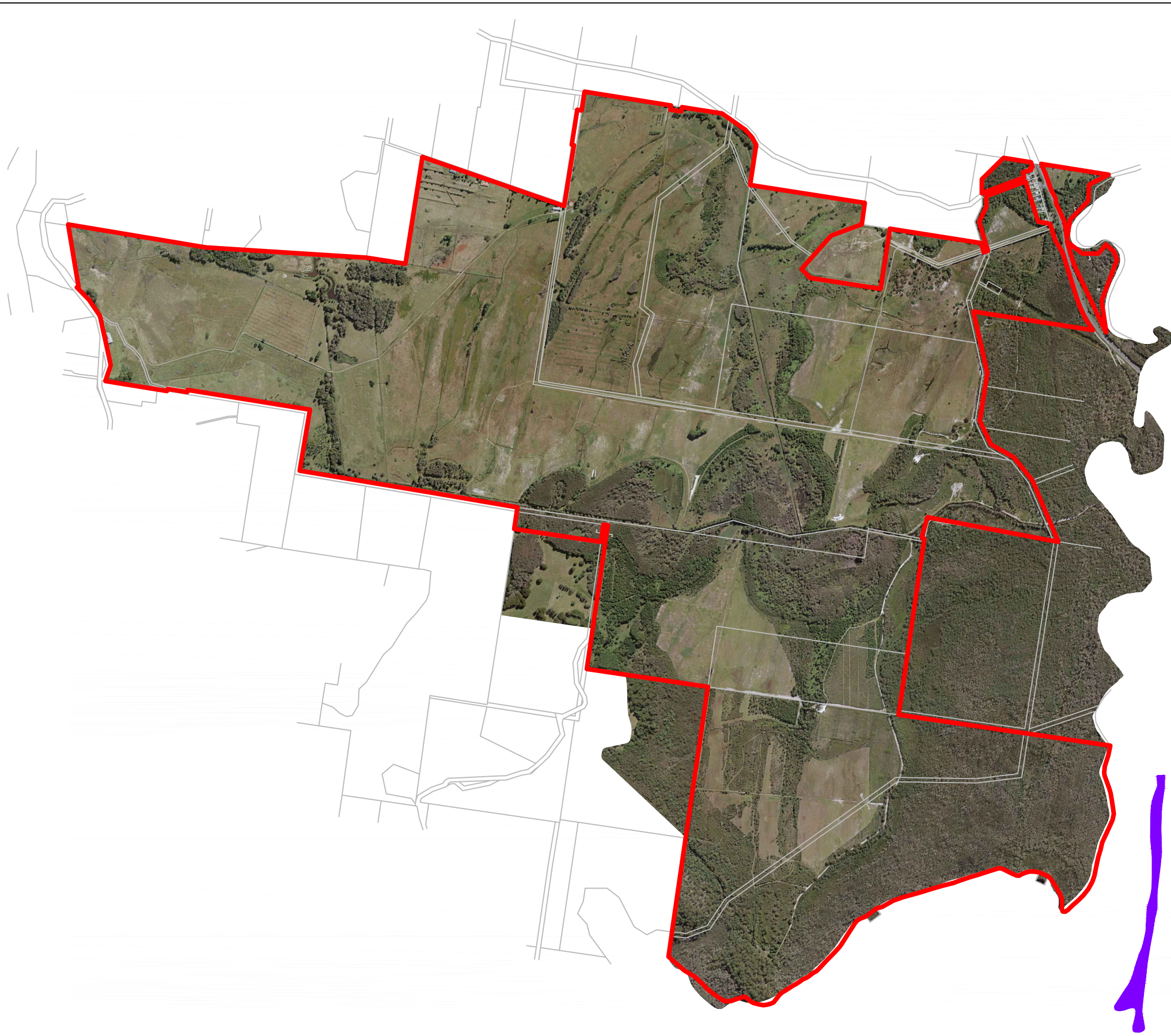
**CUDGEN
 NATURE
 RESERVE**





LEGEND
■ SEPP 14 Wetlands
■ Kings Forest Boundary

0 500m
 1 : 20 000

SOURCE: Landpartners - SEPP14 Wetlands (Amendment 15) Recd 29/07/09	CLIENT Project 28 Pty Ltd	FIGURE 3	TITLE SEPP No. 14 COASTAL WETLANDS
SCALE: 1 : 20 000 @ A3 <i>JWA PTY LTD</i> <i>Ecological Consultants</i>	PROJECT Koala Plan of Management Kings Forest Melaleuca Drive, Duranbah, NSW Shire of Tweed		



LEGEND

-  SEPP 26 Littoral Rainforest
-  Kings Forest Boundary



SOURCE: Landpartners - SEPP26 Littoral Rainforest

SCALE: 1 : 20 000 @ A3

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Ecological Consultants

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Project 28 Pty Ltd

PROJECT
Koala Plan of Management
Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 4

PREPARED: BW
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TITLE

SEPP No. 26
LITTORAL RAINFOREST

- Lot 1 in DP 781633; and
- Lot 7 in DP 875447.

Project 28 Pty Ltd owns and manages the site which is currently used for cattle grazing and silviculture. The site consists of a mosaic of natural, partially natural, modified and regenerating plant communities including Heathland, Swamp sclerophyll (Paperbark) forest, Woodland, Pine plantation, Freshwater wetland and Pasture. The majority of the site is maintained as pasture for cattle grazing.

SEPP 14 wetland areas, as well as a number of smaller wetland and Littoral rainforest parcels have been designated Environmental Protection (Wetlands and Littoral Rainforests) (7a) zones under the Tweed Local Environmental Plan (LEP). Lands in the far south of the property are subject to clause 50b of the Tweed LEP, committing them to conservation. Apart from other smaller areas of Environmental Protection (Habitat) (71), the remainder of the property is zoned Urban Expansion (2c) (FIGURE 5).

2.5 Soils and Geology

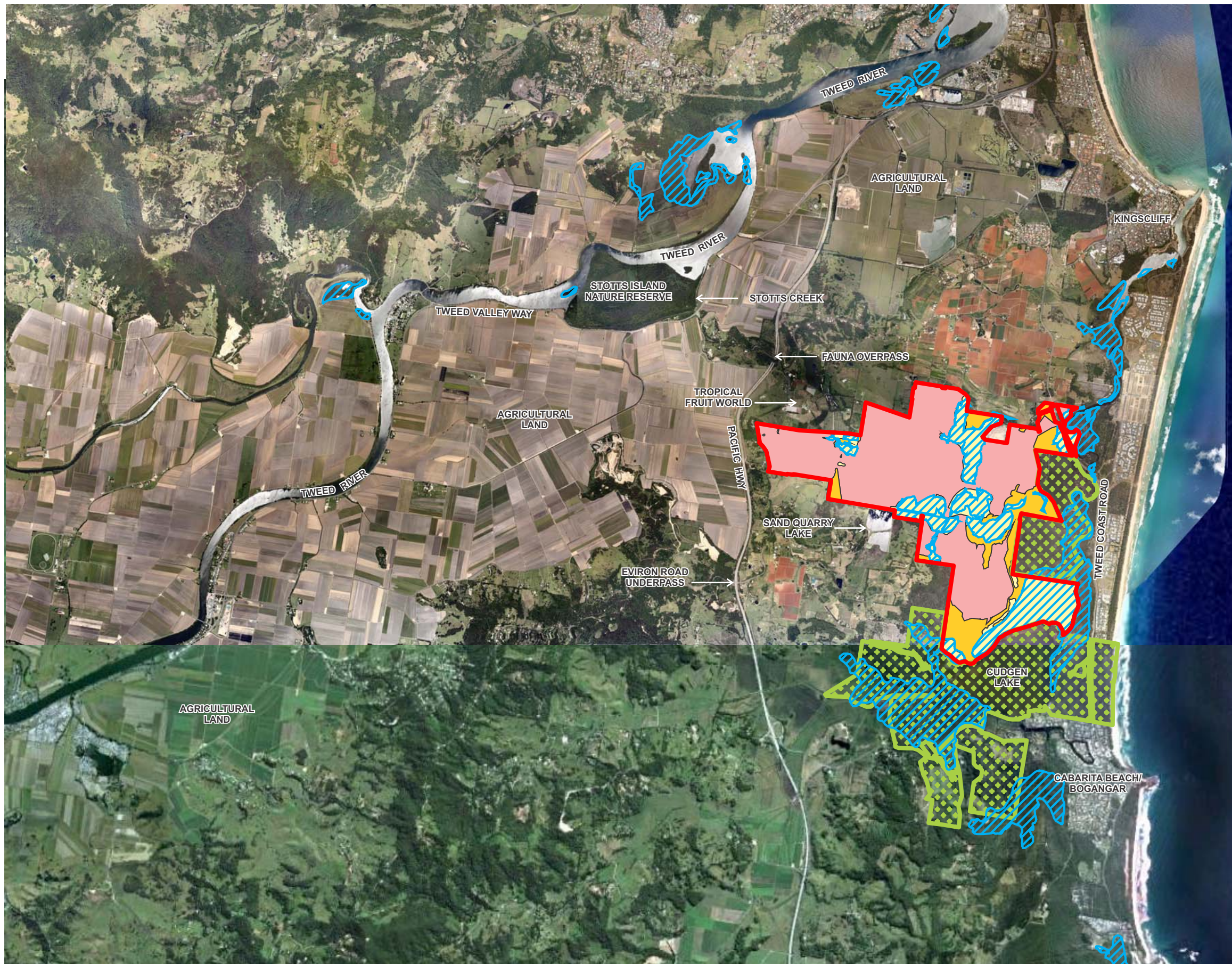
Soil landscapes within the Murwillumbah area have been mapped and described by Morand (1996). Kings Forest is situated within the Murwillumbah map sheet area (Department of Land and Water Conservation (DWLC)). The low-lying areas are predominantly Aeolian and marine formed beach ridge plains of Pleistocene origin (DWLC classification: *Kingscliff soil landscape*).

The south-western portion of the site is depressed and poorly drained and may have once been coastal swamp (DLWC classification: *Pottsville Soil Landscape*). An ancient stream channel cuts through the inner barrier sediments, creating low-lying swampy areas of Holocene origin dominated by Organosols (Gilbert and Sutherland 2011). Low hills of Neranleigh-Fernvale derived material bound the site in part on the western, south-western and southern fringes, with a low hill of basalt derived material present on the north-western boundary.

The beach ridge plain is comprised essentially of Pleistocene sands and extends from Cudgen Lake north to Old Bogangar Road and west to the low hills bordering Duranbah Road. The south of the site, including Cudgen Paddock, consists of a poorly drained depression within Pleistocene sand sheets and dunes. Elevation is less than 3 m in these areas of the site and water ponding is common with the water table generally within 100 cm of the surface (Morand 1996). Artificial drains run north and south through the Cudgen Paddock.

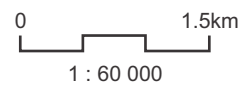
An area of wetland bisects the beach ridge plain at the centre of the site and extends to the northern boundary and along a relict stream channel flowing east towards Cudgen Creek.

Six (6) main soil orders have been identified at the site, according to the Australian Soil Classification (Isbell 2002). These are Podosols, Organosols, Dermosols, Kandosols, Ferrosols and Hydrosols. In general, the soils on the site can be classified into three (3) main areas. Those soils occurring on the Pleistocene beach ridge plain, the more recently deposited Holocene peats and sediments of the wetland areas, and the soils associated with the higher slopes on the western boundaries of the site (Gilbert and Sutherland 2011).



LEGEND

- SEPP 14 Wetlands
- Cudgen Nature Reserve
- 2c Urban Expansion
- 7a Environmental Protection - Wetlands & Littoral Rainforests
- 7i Environmental Protection - Habitat
- Kings Forest Boundary



SOURCE: JWA; Landpartners (Ref: 00001056_C7_PL4D Proposed Zoning Plan 11.03.08); NPWS 05.06.06; Near Map 2011 Aerial; Google Earth 2011 Aerial
 SCALE: 1 : 60 000 @ A3
JWA PTY LTD
 Ecological Consultants

CLIENT
 Project 28 Pty Ltd
 PROJECT
 Koala Plan of Management
 Kings Forest
 Melaleuca Drive, Duranbah, NSW
 Shire of Tweed

FIGURE 5
 PREPARED: BW
 DATE: 19 December 2016
 FILE: N97017_Context.cdr

TITLE
REGIONAL CONTEXT

2.6 Topography and Drainage

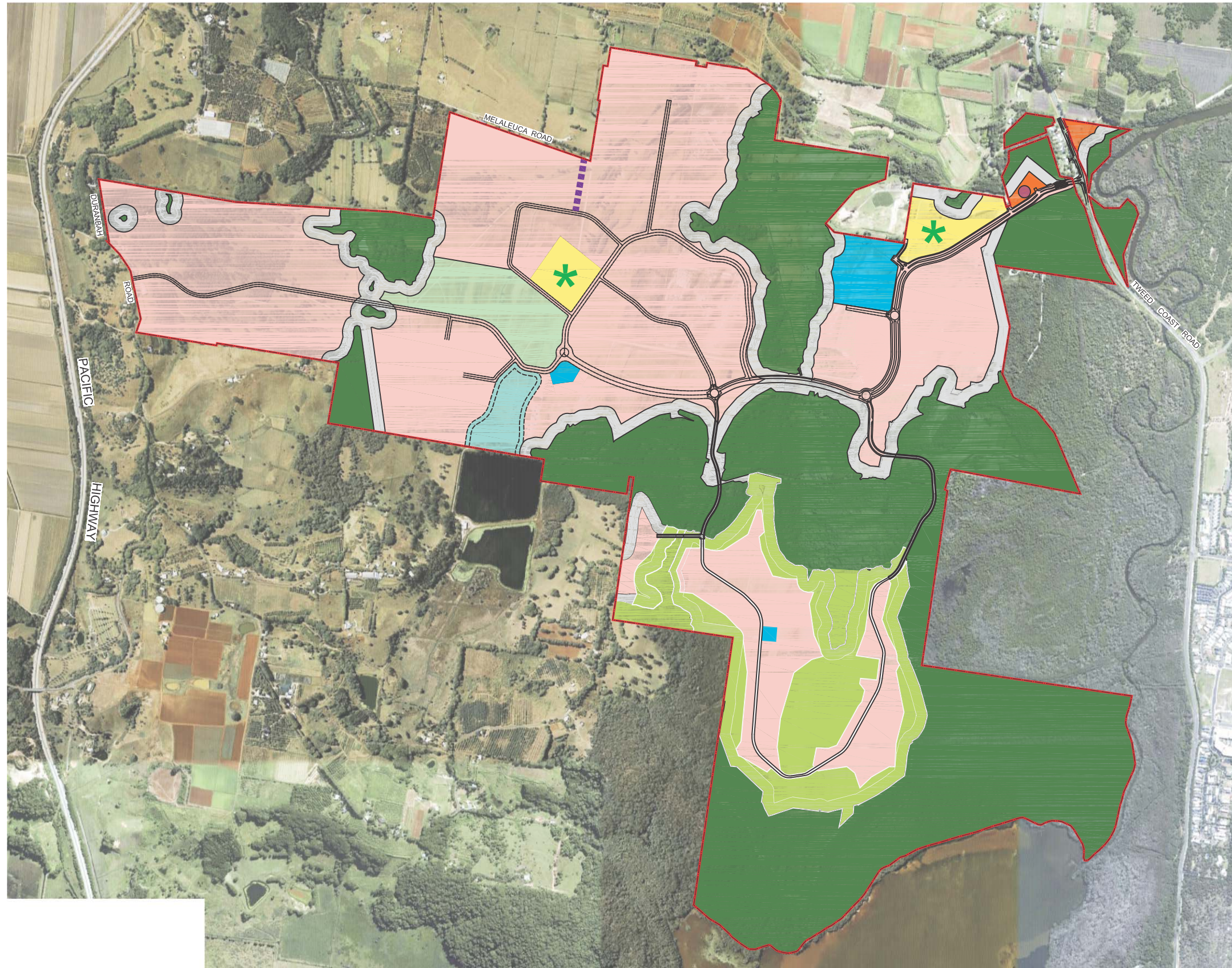
The site is on a gently undulating coastal floodplain with the Duranbah Ridge bordering the western boundary. The majority of the site (and surrounding lands) is generally low lying and of low relief, with a large proportion comprising a beach ridge plain. Approximately 94% of the land is below 10 m AHD and the remainder generally less than 20 m AHD with the exception of two (2) areas in the western portion of the site and an area within the Environmental Protection Zone in the south, which have slopes exceeding 20%. Approximately 25% of the coastal plain within the site is permanent wetland.

3 THE PROPOSED DEVELOPMENT

On the 19th August 2010, Concept Plan Approval No. 06_0138 was issued for Kings Forest. The site is proposed to be developed into a master planned residential community. The areas proposed for residential development are shown on the Revised Concept Plan, Revision B dated the 5th December 2013 (FIGURE 6). The total area of the proposed development is 422.32 ha and will include the following in accordance with the Concept Plan Approval (as modified Mods 1 to 5):

- Residential development for approximately 4500 dwellings;
- Town centre and neighbourhood centre for future retail and commercial uses;
- Community and education facilities;
- Employment land;
- Golf course;
- Open space;
- Wildlife corridors;
- Protection and rehabilitation of environmentally sensitive land;
- Utility services infrastructure;
- Water management areas and lake; and
- Roads and pedestrian and bicycle paths.

The Kings Forest project will likely proceed over many years. The length of time will be dependent, to a certain degree, on the demand for land over time. It is envisaged that the sequence of development will be in accordance with the approved Precinct Plan (FIGURE 7).



LEGEND

- Town Centre / Neighbourhood Centre
 - Residential
 - Community Facilities / Education
 - Employment Land
 - Structured Open Space (Active)
(Passive open space to council standards, location subject to urban design)
 - Environmental Protection Area
 - 50m Ecological Buffer
(includes APZIs & roads where approved)
 - State School Site
 - Proposed Zone Substation
(subject to Country Energy final approval)
 - Potential Road Connection to Melaleuca Road
- Private Open Space
- Golf Course Area
(encompassing ecological buffers where indicated)
 - Private Open Space including Lake
 - Kings Forest Boundary

IMPORTANT NOTE

This plan was prepared as a preliminary concept plan for planning purposes only. As such all particulars, including lot design, areas and densities, are subject to detailed survey, site investigations and to the requirements of council and any other authority which may have requirements under any relevant legislation.
This note is an integral part of this plan.



SOURCE: RPS (Ref: 113691-PSP-4b(CONCEPT PLAN).dwg Rev B dated 05/12/13

SCALE: 1 : 20 000 @A3

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Ecological Consultants

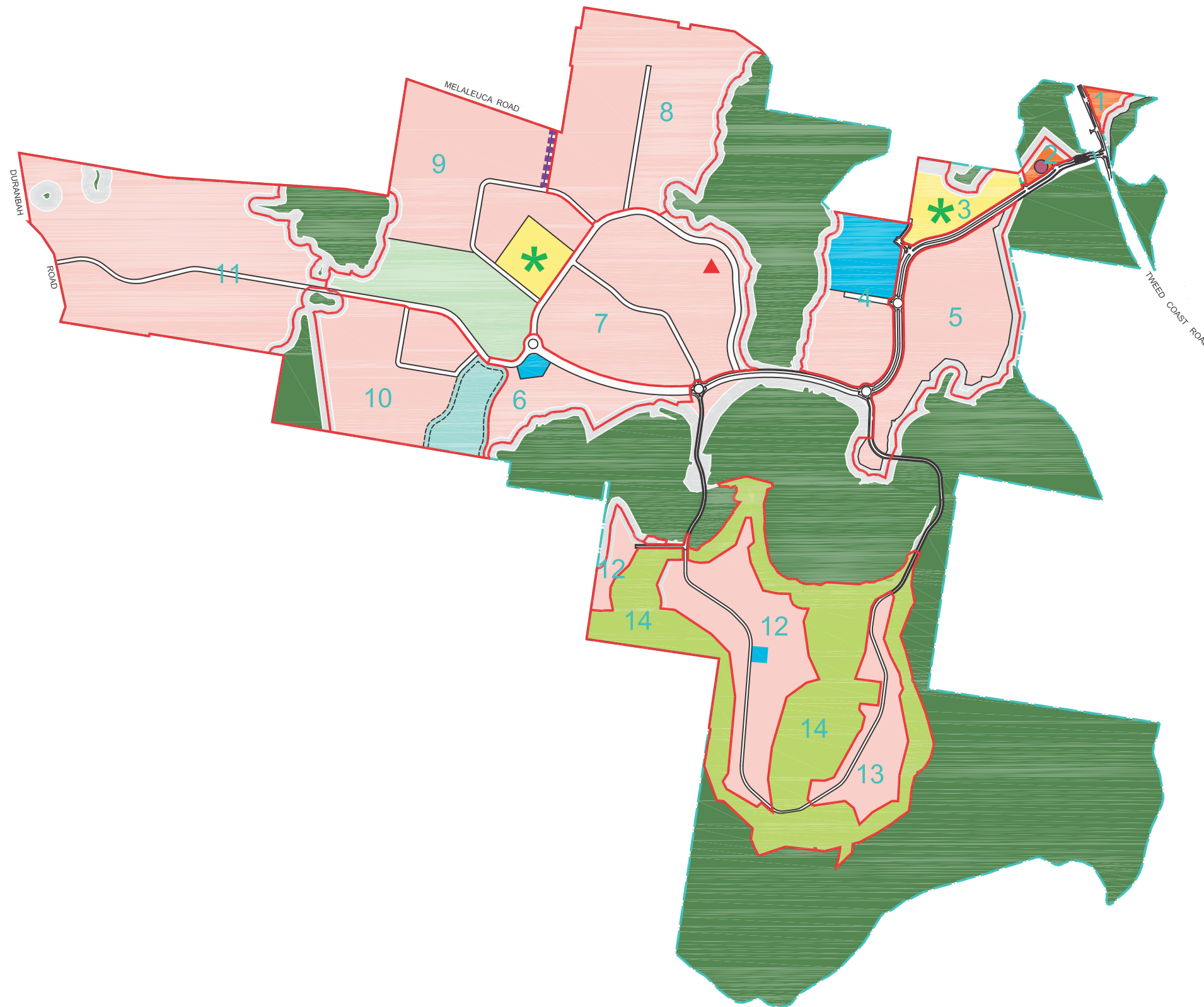
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Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 6

PREPARED: BW
DATE: 19 December 2016
FILE: N97017_Concept Plan.cdr

TITLE

CONCEPT PLAN



LEGEND

- Town Centre / Neighbourhood Centre
 - Residential
 - Community Facilities / Education
 - Employment Land
 - Structured Open Space (Active)
(Passive open space to council standards, location subject to urban design)
 - Environmental Protection Area
 - 50m Ecological Buffer
(includes APZIs & roads where approved)
 - ✱ State School Site
 - Proposed Zone Substation
(subject to Country Energy final approval)
 - Potential Affordable Housing Location
 - Potential Road Connection to Melaleuca Road
- Private Open Space
- Golf Course Area
(encompassing ecological buffers where indicated)
 - Private Open Space including Lake
 - Precinct Boundary
 - Kings Forest Boundary

IMPORTANT NOTE

This plan was prepared as a preliminary concept plan for planning purposes only. As such all particulars, including lot design, areas and densities, are subject to detailed survey, site investigations and to the requirements of council and any other authority which may have requirements under any relevant legislation.
This note is an integral part of this plan.



SOURCE: RPS (Ref: 113691-PSP-4b (PRECINCT PLAN).dwg Rev B dated 05/12/13

SCALE: 1 : 20 000 @A3

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FIGURE 7

PREPARED: BW
DATE: 19 December 2016
FILE: N97017_Precinct Plan.cdr

TITLE

PRECINCT PLAN

4 KOALA POPULATION AND HABITAT ASSESSMENT

4.1 Introduction

This section provides details of the Koala population and habitat resources of the Tweed Local Government Area and the Kings Forest site.

4.2 Koala Population Size on the Tweed Coast

4.2.1 *Tweed Local Government Area*

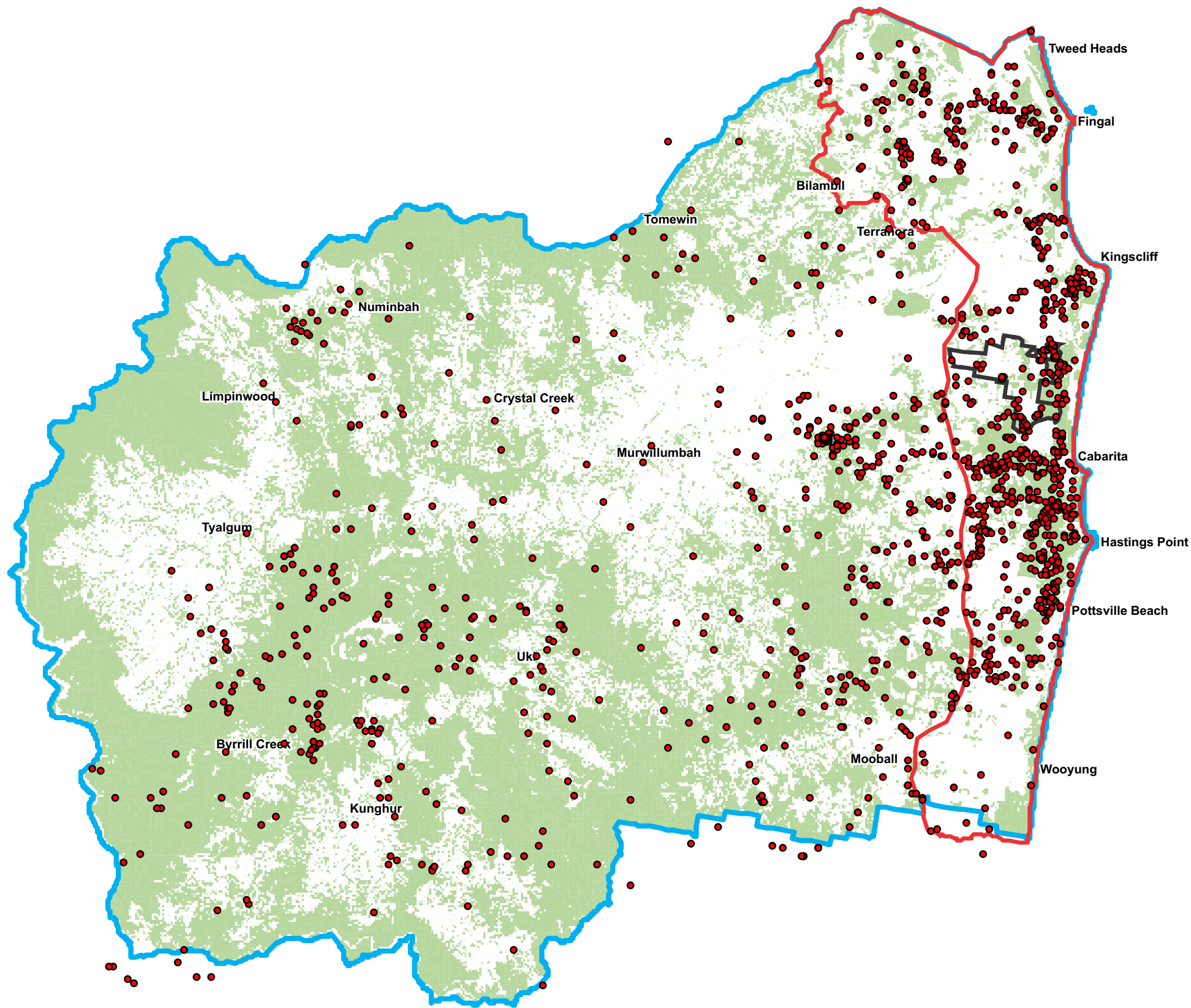
DoE (2014) notes that the number of Koalas in north-east NSW is uncertain and population surveys are required to establish current population size. Nevertheless, they likely numbered in the low thousands in 2010 (approximately 7000), but the nature and extent of exposure to threats suggests that declines have occurred, and will continue, in many areas (TSSC 2012a).

Koala records remain widely distributed throughout the Tweed LGA, which covers approximately 103,000 ha (FIGURE 8). While a reduction in the extent of occurrence of Koalas across the Tweed LGA of at least 18% has recently been documented (Phillips *et al.* 2011), the size of the LGA's Koala population is unknown and beyond the scope of this Revised KPOM.

The Tweed LGA is the fastest growing urban area on the North Coast of NSW, its population is expected to grow from 82,955 (the 2006 census) to a potential 120,000 by 2025. It is predicted that most of this growth will occur along the coastal strip (i.e. Cobaki, Bilambil Heights, South Tweed Heads, Kingscliff to Bogangar and Pottsville) which covers approximately 21,200 ha. This population growth will potentially impact on the density and distribution of the Koala population within the Tweed LGA.

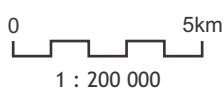
4.2.2 *Tweed Coast*

A recent assessment of Koala populations within the 21,000 ha coastal strip of the Tweed LGA is provided by Phillips *et al.* (2011). Evidence of generational persistence is widespread throughout this area indicating a long history of occupancy and successful reproduction by Koalas. Historically, the Tweed Coast's Koala population has persisted within a fragmented habitat affected by a range of threatening processes. The study by Phillips *et al.* (2011) indicates that north of the Tweed River there are small relic populations in the Terranora-Bilambil Heights and Tweed Heads South areas. South of the Tweed River, three (3) disjunct sub-populations occur: Bogangar/Kings Forest/Forest Hill; Tanglewood/Round Mountain/Koala Beach; and Pottsville Wetlands/Black Rocks. A further small population occurs around Durambah and Eviron Road. The work of Phillips *et al.* (2011) determined that occupancy rates by Koala within the coastal strip had halved in the years immediately preceding their study to result in an estimated population size (i.e. inferred by density data) of approximately 145 Koalas TABLE 1.



- LEGEND**
- Koala Records
 - Bushland
 - ▭ Tweed Coastal Strip
 - ▭ Tweed LGA Boundary
 - ▭ Kings Forest Boundary

Note: Records shown are since 1950 and have been sourced from Tweed Shire Council, DECCW and various other sources.



SOURCE: Biolink Ecological Consultants - Tweed Coast Koala Habitat Study (2011) Figure 2.2
SCALE: 1 : 200 000 @ A3
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FIGURE 8
PREPARED: BW
DATE: 19 December 2016
FILE:N97017_Tweed Koalas.cdr

TITLE
**KOALA RECORDS
WITHIN TWEED LGA
& COASTAL STRIP**

TABLE 1
KOALA POPULATION ESTIMATES (N) FOR CURRENTLY OCCUPIED AREAS OF THE TCSA
BASED ON THE DENSITY ESTIMATE DETERMINED BY FIELD SURVEY
(SOURCE: PHILLIPS *ET AL.* 2011)

Locality	Cell Size (ha)	Available Habitat	Population Estimate		
			Lower 95% CI	N	Upper 95% CI
Bogangar / Kings Forest / Forest Hill	358	71%	5	36	66
Tanglewood / Round Mountain / Koala Beach	578	80%	9	64	120
Pottsville Wetlands / Black Rocks	316	79%	10	35	65
Duranbah / Eviron	625	10%	1	9	16
TOTAL			25	144	267

Fire frequency and intensity within remaining habitat areas over the last decade has been identified as the major contributor to recent population attrition, with recovery potential now impeded in remaining habitat areas by ongoing incidental mortality rates due mostly to motor vehicle strike (Phillips *et al.* 2011).

4.2.3 Bogangar/Kings Forest/Forest Hills

The Koala sub-population of the Bogangar/Kings Forest/Forest Hills area, as modelled by Phillips *et al.* (2011), currently occupies an area of approximately 360 ha, that includes part of the habitat to which this Revised KPoM applies. The area extends from Depot Road in the north to Cudgen Lake in the south encompassing some of Cudgen Nature Reserve and from Forest Hills to the Tweed Coast Road. Approximately 70% of this area is vegetated (FIGURE 9). It is estimated that thirty-six (36) Koalas could occur in this area (Phillips *et al.* 2011).

4.2.4 Kings Forest

Multiple assessments for the occurrence of Koalas at Kings Forest have been completed. These assessments have included direct observation (including spotlight surveys); short-term radio tracking studies; faecal pellet surveys (to detect Koala presence); faecal cuticle analysis (to determine diet) and vegetation assessments (Warren 2000, Callaghan *et al.* 2004, Phillips 2004, Sainty 2006, Phillips *et al.* 2011). Koalas have been recorded over much of the site (FIGURE 10). Estimates of the population of Koalas occupying Kings Forest have varied. Warren (2000) and Smith (2005) estimated that Kings Forest itself could support around fifteen (15) Koalas. Phillips and Pereoglou (2004) estimated the population of seventy-six (76) Koalas in the wider Kings Forest area.

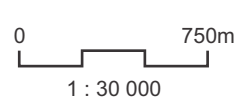
4.3 Preferred Koala Food Trees

4.3.1 Introduction

A review of Koala food tree preferences across NSW was undertaken during the course of preparing the NSW Koala Recovery Plan, the results of which specified all Eucalypt species



- LEGEND**
- Metapopulation Boundaries
 - Significant Activity
 - High Activity
 - - - Undefined Boundary
 - ★ Koala Sighting
 - Field Sites
 - Active
 - Inactive
 - Major Roads
 - Nature Reserve
 - Tweed Coastal Strip
 - Tweed LGA Boundary
 - Kings Forest Boundary



SOURCE: Biolink Ecological Consultants - Tweed Coast Koala Habitat Study (2011) Figure 3.2
 SCALE: 1 : 30 000 @ A3

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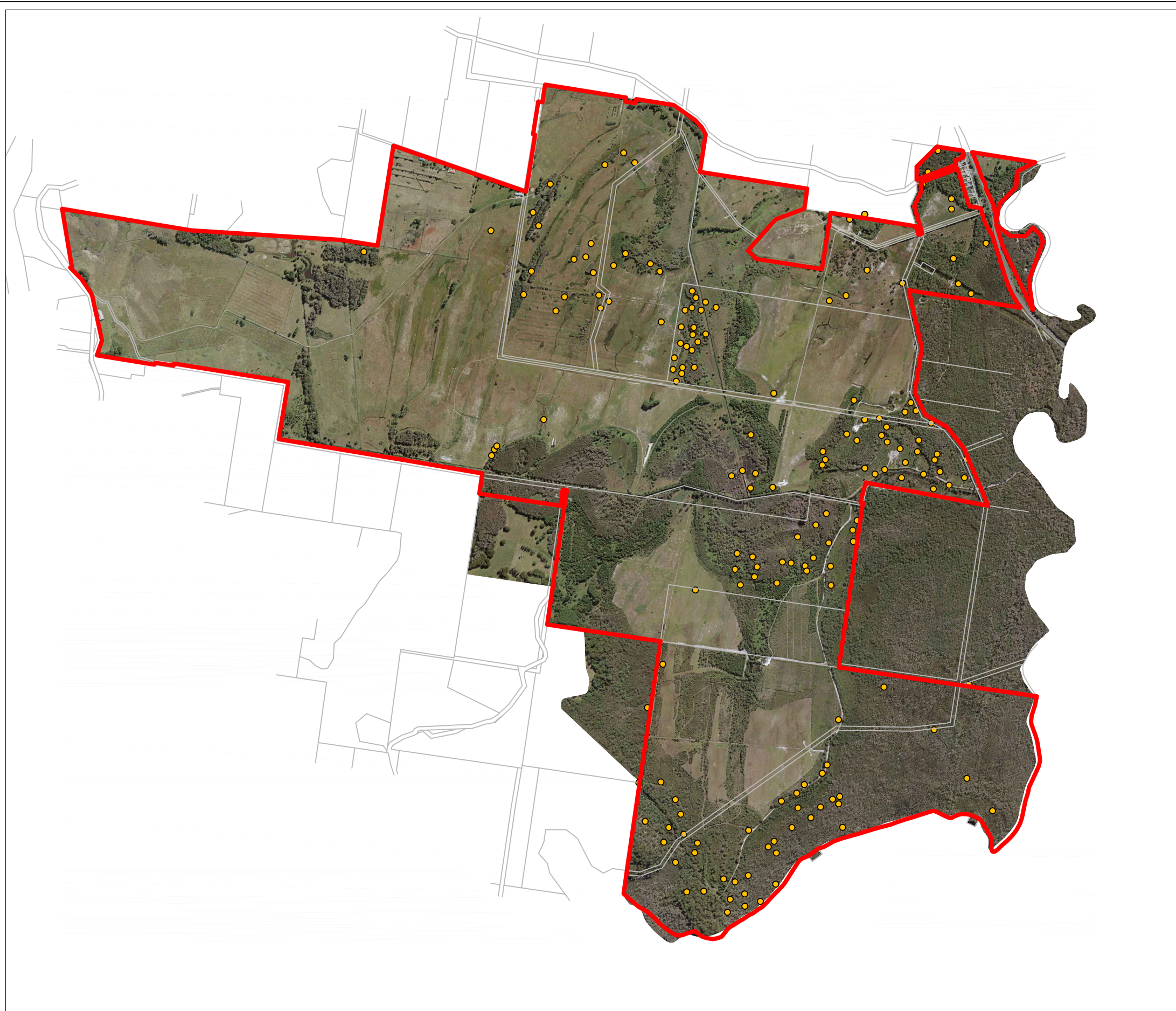
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 Shire of Tweed

FIGURE 9

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 DATE: 19 December 2016
 FILE: N97017_Metapops.cdr

TITLE

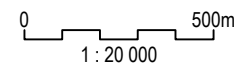
**INDICATIVE
 METAPOPOPULATION
 BOUNDARIES**



LEGEND

- Koala
- Kings Forest Boundary

Note: Records shown on the Kings Forest site are since 1990 and include data collected during radio-tracking programs. The records shown include small-scale movements of Koalas over a number of days/nights.



SOURCE: Landpartners - Threatened Fauna
- Birds & Mammals

SCALE: 1 : 20 000 @ A3

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FIGURE 10

PREPARED: BW
DATE: 19 December 2016
FILE: N97017_KPOM.dwg

TITLE

KOALA
RECORDS

known to be preferentially utilised by Koalas in the form of Primary, Secondary and Supplementary food tree species (DECC 2008) (APPENDIX 5).

Ongoing studies continue to demonstrate the biochemical volatility of some of the preferred food tree species that are utilised by Koalas in NSW. Most notably some species of the Eucalyptus sub-Genus *Symphomyrtus* are now known to demonstrate both substrate and intra-specific variation in terms of their palatability to Koalas (More and Foley 2000; Phillips and Callaghan 2000; More and Foley 2005; Gleadow *et al.* 2008).

4.3.2 North Coast

The Tweed LGA is located in the North Coast Koala Management Area (KMA) for purposes of the approved Koala Recovery Plan (DECC 2008). The North Coast KMA extends from the Hunter Valley to the NSW-QLD border and is bounded in the west by higher elevations of the Great Escarpment which otherwise limit the distribution of the North Coast KMA's indicative preferred food tree species Tallowwood (*E. microcorys*). Additional to Tallowwood, a further five (5) Primary, thirteen (13) Secondary and five (5) Supplementary food tree species are known to occur in the North Coast KMA (APPENDIX 5).

4.3.3 Tweed Coastal Strip

Phillips *et al.* (2011) established that four (4) species - Forest red gum, Swamp mahogany, Tallowwood and Grey gum - were the most preferred species within the Tweed Coast Study Area. All four (4) of these species were confirmed as Primary food species when growing on high nutrient soil landscapes as mapped by Morand (1996). Biochemical volatility (implied by size-class dependent levels of use) relegated Tallowwood and Grey gum to the status of Secondary food tree species when growing on the lower nutrient Neranleigh-Fernvale soil landscapes.

Narrow-leaved scribbly gum (*E. racemosa*), Red mahogany (*E. resinifera*), Grey ironbark (*E. siderophloia*), Blackbutt (*E. pilularis*) and thick leaved and/or white mahogany (*E. carnea/acmenoides*) in addition to Coastal cypress pine (*Callitris columellaris*), Broad-leaved paperbark (*Melaleuca quinquenervia*), Brushbox (*Lophostemon confertus*), Swamp Box (*L. suaveolens*), Pink bloodwood (*Corymbia intermedia*), Red bloodwood (*C. gummifera*) and Swamp Oak (*Casuarina glauca*), were identified by Phillips *et al.* (2011) as non-preferential and/or opportunistically browsed food tree species.

4.3.4 Kings Forest

Records of Koalas at Kings Forest are primarily associated with vegetation communities that contain the preferred food trees species Swamp mahogany. Based on cuticle scale analysis of Koala faecal pellets, Swamp mahogany comprises nearly half (46%) of the dietary intake. The remainder is comprised of a mix of more opportunistically browsed species including Swamp box and other non-eucalypt species such as Brushbox and Broad-leaved paperbark (JWA 2000).

Narrow-leaved scribbly gum is a notable omission in the various studies of food tree use by the Kings Forest Koalas. While Scribbly gum is a commonly occurring tree species on the Kings Forest site, it has not been recognised as a preferred food tree species in either the cuticle

scale analysis work completed by JWA (2000), or other site-specific assessments (Phillips and Callaghan 1996; Phillips 2004; Phillips *et al.* 2011). Moreover, Scribbly gum is also not recognised as either a Primary, Secondary or Supplementary food tree species by the Approved Recovery Plan. On this basis, the value of Scribbly gum as a preferred Koala food tree on the Kings Forest site has been disregarded for the purposes of this Revised KPOM.

4.4 Resource Availability

4.4.1 Tweed Shire

Tweed Shire vegetation mapping describes forty-six (46) vegetation communities for consideration as Koala habitat within the Tweed LGA (Kingston *et al.* 2004). All of these vegetation communities have been categorised by Phillips *et al.* (2011) into three (3) habitat categories.

These habitat categories are recognised by the approved Koala Recovery Plan (DECC 2008) and are described as follows:

- **Primary Habitat** - areas of forest and/or woodland wherein primary food tree species comprise the dominant or co-dominant (i.e. $\geq 50\%$) overstorey tree species (most often associated with breeding habitat).
- **Secondary (Class A) Habitat** - areas of forest and/or woodland wherein primary food tree species are present but not dominant or co-dominant and usually (but not always) growing in association with one or more secondary food tree species.
- **Secondary (Class B) Habitat** - areas of forest and/or woodland wherein primary food tree species are absent, habitat containing secondary and/or supplementary food tree species only.

Areas of each habitat category within the Tweed LGA have been calculated as follows:

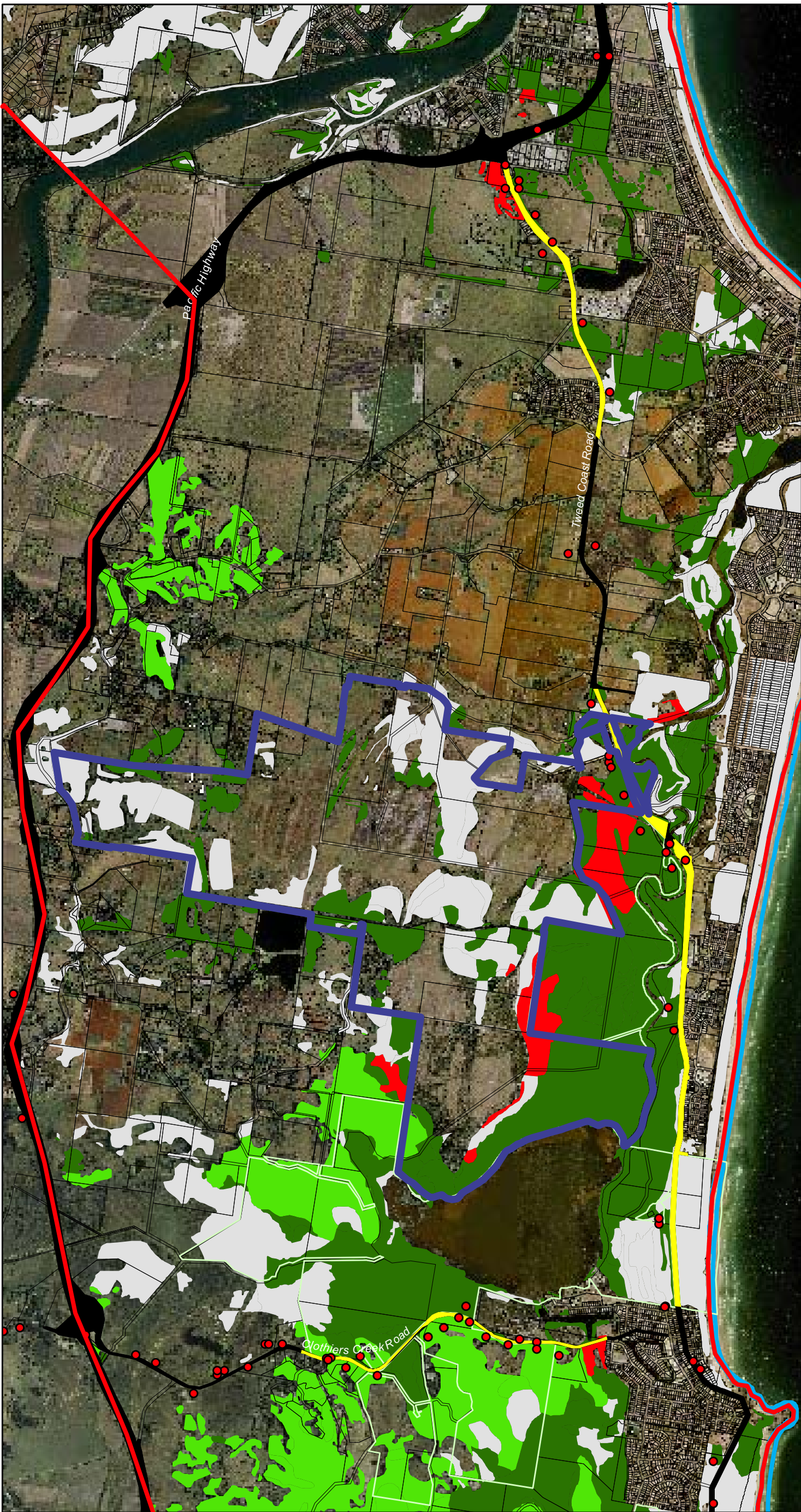
- Primary Habitat is limited to 200 ha (1.04%) of mapped vegetation and consists of communities that are dominated by *Eucalyptus robusta* and/or *E. tereticornis* \pm *E. microcorys* growing on TAEBAS³ soil landscapes.
- Secondary (Class A) Habitat comprises the bulk of potential Koala habitat, encompassing 2,300 ha (12%) of mapped vegetation communities growing on TAEBAS soil landscapes wherein on average *E. robusta* and/or *E. tereticornis* \pm *E. microcorys* are sub-dominant elements.
- Secondary (Class B) Habitat comprises 1,315 ha (6.8%) of mapped vegetation communities containing *E. microcorys* and/or *E. propinqua*⁴, growing on NFM⁵ soil landscapes.

Koala habitat occurring in the wider Tweed locality is shown in FIGURE 11.

³ TAEBAS refers to those of transferral, alluvial, estuarine, beach, aeolian and swamp (TAEBAS) landscapes respectively.

⁴ Apparent inconsistency in statement that Secondary (Class B) habitat should not contain any Primary habitat trees.

⁵ NFM refers to sites on all erosional/residual landscapes (i.e. Neranleigh-Fernvale Metamorphics).



LEGEND

- Blackspots
- Koala Records
- Habitat Category
- Primary
- Secondary (A)
- Secondary (B)
- Other
- Major Roads
- Nature Reserve
- Tweed Coastal Strip
- Tweed LGA Boundary
- Kings Forest Boundary



SOURCE: Biolink Ecological Consultants - Tweed Coast Koala Habitat Study (2011)
 SCALE: 1 : 30 000 @ A3

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FIGURE 11

PREPARED: BW
 DATE: 19 December 2016
 FILE: N97017_Phillips Khabitat.cdr

TITLE

**KOALA
 HABITAT
 IN LOCALITY**

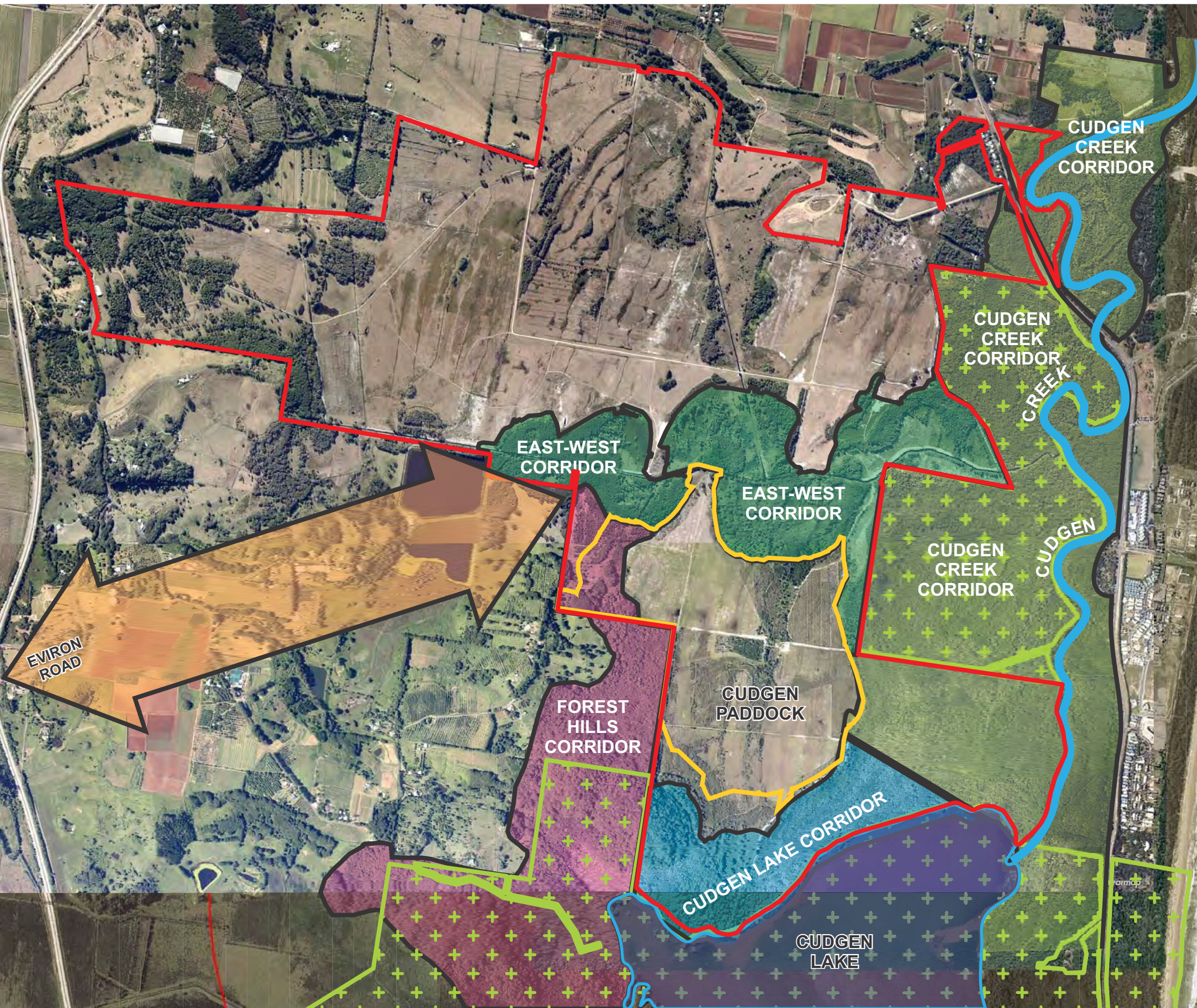
4.4.2 Kings Forest

The distribution and area calculations for Koala habitat [Primary, Secondary (Class A) and Secondary (Class B)] occurring on the Kings Forest site are provided in FIGURE 12 and TABLE 2. It should be noted that the original Koala habitat mapping, completed by Phillips *et al.* (2011) has been refined during the completion of more recent assessments. Existing koala habitat on the Kings Forest site covers a total area of approximately 197.97 ha and is comprised of three (3) habitat categories:

- Primary Habitat - predominantly comprised of Swamp mahogany.
- Secondary (Class A) Habitat - predominantly comprised of Broad-leaved paperbark in low-lying areas with minor occurrences of Swamp mahogany. There are also some occurrences of Narrow-leaved scribbly gum in more elevated areas.
- Secondary (Class B) Habitat - predominantly comprised of Blackbutt with minor occurrences of Tallowwood.

TABLE 2
EXISTING KOALA HABITAT ON KINGS FOREST SITE

Habitat Type	Existing Area (ha)
Primary Habitat	19.69
Secondary (Class A) Habitat	172.01
Secondary (Class B) Habitat	6.27
TOTAL	197.97



- LEGEND**
- East-West Corridor
 - Forest Hills Corridor
 - Cudgen Lake Corridor
 - Cudgen Creek Corridor
 - Corridor Linkages to Eviron Road Underpass
 - Cudgen Nature Reserve
 - Cudgen Paddock
 - Kings Forest Boundary



SOURCE: JWA Site Investigations;
 NPWS 05.06.06; Near Map 2011 Aerial Photo
 SCALE: 1 : 20 000 @ A3

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FIGURE 13

PREPARED: BW
 DATE: 19 February 2016
 FILE: N97017_Wildlife Corridors.cdr

TITLE
**WILDLIFE
 CORRIDORS**

5 KOALA HABITAT LINKAGES AND KOALA DISPERSAL

5.1 Introduction

Fauna dispersal has the potential to play a critical role in the maintenance and regulation of existing populations and in the establishment of new populations (Sharp 1997). Eberhard (1978) and Gall (1980) separate populations of Koalas into three (3) groups:

- Residents;
- Nomads; and
- Dispersing young.

Upon reaching maturity (1-2 years) the young may remain for a time within the maternal home range area, even persisting until their third year (Eberhard 1978), but invariably disperse from the maternal home range area (Dr S. Phillips, 2013 *pers. comm.*). They may travel many kilometres, often in excess of 40-50 km over a period of a few weeks (AKF undated; Gall 1980). This is the group which would most depend upon adequate corridors between habitat patches. Gall (1980) found that three (3) dispersing Koalas had moved distances of 1 km, 4 km and 11 km and were capable of ranging widely. Studies of dispersal patterns in a regional Koala population in south-east Queensland (Dique *et al.* 2003a), demonstrated that the mean straight-line distance between the natal and breeding home ranges for males and females was similar, being 3.5 km (range 1.1 - 9.7 km) and 3.4 km (range 0.3 - 10.6 km) respectively.

Koalas have also been shown to go for random wanders/exploratory movements (Smith 1979; Dique *et al.* 2003) and may disappear from a colony for a time with females tending to travel less distances (Gall 1981). Competition for mates, competition for resources and the avoidance of inbreeding are the three (3) mechanisms for dispersal that are most commonly postulated within the literature (Greenwood 1980, 1983; Dobson 1982; Johnson 1986; Johnson and Gaines 1987; Dique *et al.* 2003).

Research has shown that habitat links for Koalas include both forested and cleared areas, as studies have shown that Koalas will travel over cleared land containing only scattered trees (Ellis *et al.* 2009). Radio tracking data has provided evidence that Koalas will utilise culverts in order to traverse the landscape (Taylor and Goldingay 2003) and studies by Callaghan and Phillips (1997, 1998a and 1998b), Hopkins and Phillips (2009), and AMBS (2012) also document the use of underpasses by Koalas.

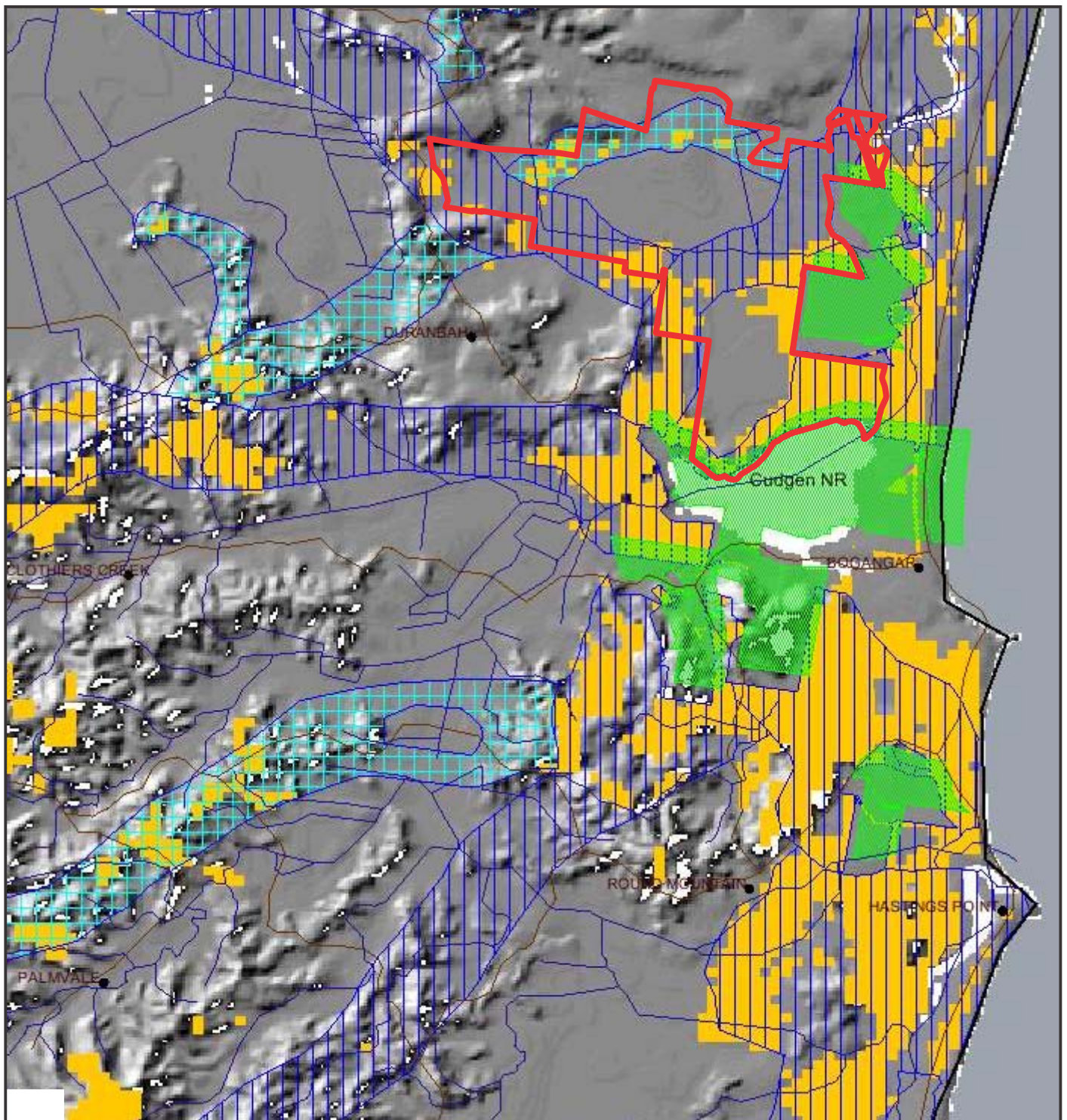
5.2 Kings Forest Dispersal and Connectivity

In a regional context, the Kings Forest site is significantly isolated (in terms of wildlife movement) from areas of regionally significant habitat. This is due to physical barriers to movement including the Tweed River and extensive agricultural and residential development to the north, Tweed Coast Road and the Pacific Ocean to the east and the Pacific Motorway and agricultural lands to the west (FIGURE 5). Fauna linkages to the north and west of the site are highly disturbed. Thus, currently the only effective connections with other significant habitat areas are to the south of the site (Carrick 2009).

This is also demonstrated within the Tweed Coast Koala Habitat Study (Phillips *et al.* 2011) in which indicative meta-population boundaries and linkages between habitat areas are provided (FIGURE 9). Phillips *et al.* (2011) has identified three (3) distinct Koala populations that occur in the general locations of Kings Forest, Round Mountain and Pottsville Wetlands. Although Koala activity was detected outside of these localities, primarily to the north and west, it is stipulated that the long-term viability of these outliers is poor in the absence of connectivity with, and recruitment from, other source populations (Phillips *et al.* 2011).

Although Koalas have been demonstrated to traverse areas that are predominantly cleared, the results of radio-tracking of Koalas across the Kings Forest site (JWA 2000) suggest that Koalas generally move through vegetated corridors on and adjacent to the site. These movement corridors have been designated as the East-West, Cudgen Creek, Cudgen Lake and Forest Hills corridors (FIGURE 13). The evidence appears to indicate that the only effective connections with Koala habitats in the locality will be to the south and south-west of the Kings Forest site. FIGURE 13 shows the general location of a wildlife corridor to the Eviron Road underpass. This corridor area should be the subject of habitat embellishment in the future.

The NPWS Key Habitats and Corridors in North East NSW mapping (FIGURE 14) provides a conservation planning framework for the region with the intention of providing focus areas for the protection, enhancement and restoration of native vegetation. A long-term goal of the Key Habitats and Corridors mapping is to provide habitat linkages between conservation areas such as the Cudgen, Stotts Island and Ukerebagh Nature Reserves. However, this is not considered viable over the short to medium-term as mapped regional corridors to the west and north of the Kings Forest site lead to agricultural land and residential areas respectively. These linkages are substantially cleared of native vegetation (FIGURE 5). FIGURE 15 provides an overlay of the NPWS linkages on Koala habitat mapped by Phillips *et al.* (2011) which further indicates that maintaining/improving linkages to the south will lead to superior outcomes for native fauna due to the quantity and quality of key habitat (NPWS) including known Koala habitat.



- Legend**
-  Regional Corridor
 -  Subregional Corridor
 -  Key Habitat
 -  Nature Reserve
 -  Towns
 -  Rivers
 -  Main Roads
 -  Minor Roads
 -  Wooded Vegetation
 -  Site Outline



0 1.5km

SOURCE: NSW NPWS Key Habitats & Corridors in North East NSW

SCALE: 1 : 60 000 @ A4

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Ecological Consultants

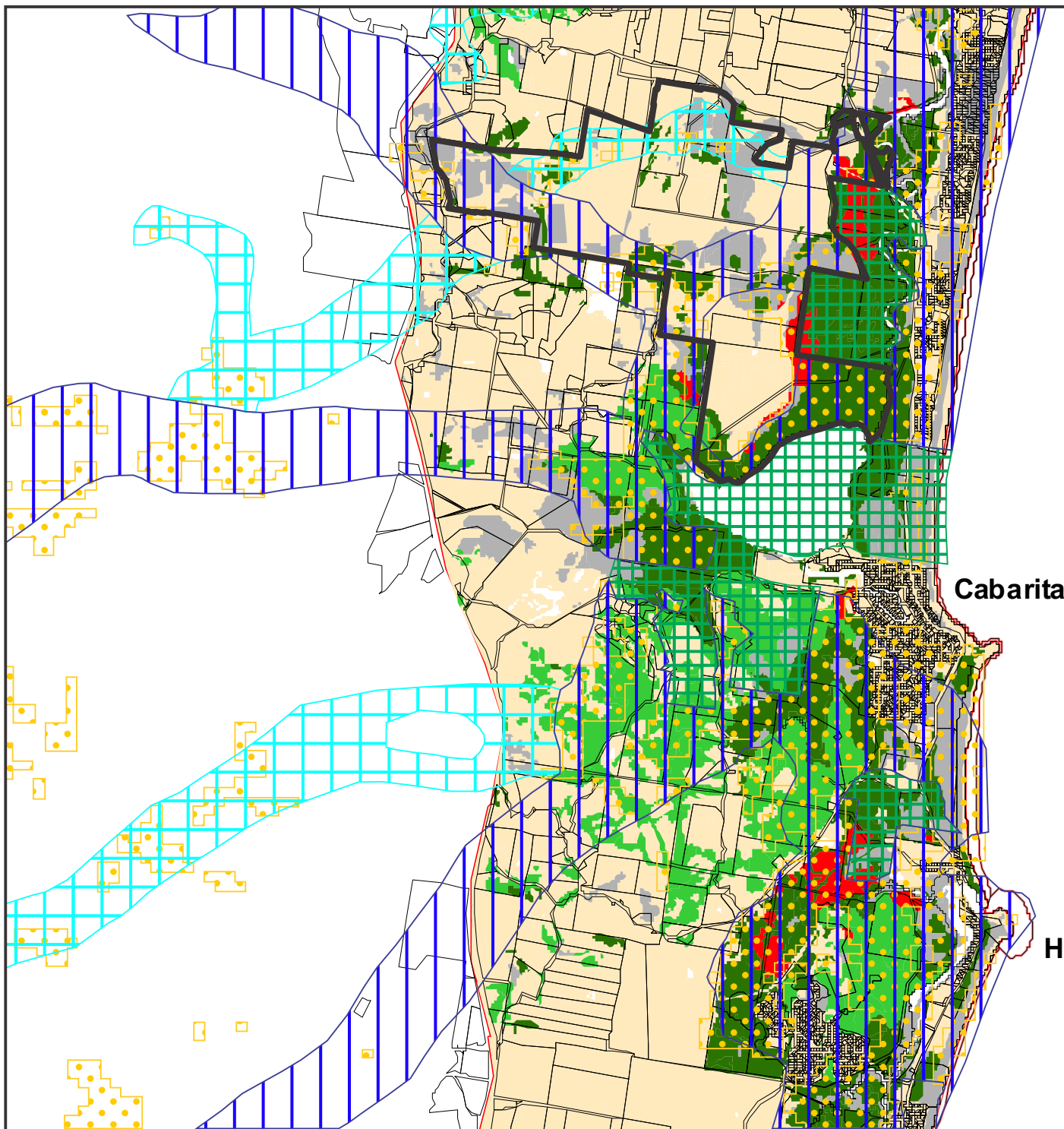
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FIGURE 14

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DATE: 19 December 2016
FILE: N97017_NPWS Corridors.cdr

TITLE

**NPWS
KEY HABITATS
& CORRIDORS**



- Legend**
- | | | | |
|-------------------------------|------------------------|--|-----------------------|
| Koala Habitat Category | | NPWS Key Habitats & Corridors | |
| | Primary | | Regional Corridor |
| | Secondary (A) | | Subregional Corridor |
| | Secondary (B) | | Key Habitat |
| | Other | | Nature Reserve |
| | Unknown | | Kings Forest Boundary |
| | Property/Road Boundary | | |
| | Study Area Boundary | | |
| | Tweed LGA Boundary | | |

0 1.5km



SOURCE: NSW NPWS Key Habitats & Corridors in North East NSW; Biolink Ecological Consultants - Tweed Coast Koala Habitat Study (2011)
 SCALE: 1 : 60 000 @ A4
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FIGURE 15
 PREPARED: BW
 DATE: 19 December 2016
 FILE: N97017_Corridors Koala.cdr

TITLE
**OVERLAY OF
 NPWS KEY HABITATS
 & CORRIDORS ON
 POTENTIAL KOALA
 HABITAT**

6 THREATENING PROCESSES

6.1 Introduction

The TSC Act provides that the Director General of the Department of Environment and Climate Change (now OEH) may prepare a recovery plan for all species, populations and ecological communities listed as critically endangered, endangered or vulnerable on Schedules of the Act (other than species presumed extinct). A recovery plan for the Koala was prepared by DECC (2008) which lists the recognised current threats to Koalas as follows:

- Habitat Loss and fragmentation;
- Habitat degradation;
- Road kills;
- Dog attacks;
- Bushfire;
- Logging (not relevant to this Revised KPoM);
- Disease;
- Severe weather conditions;
- Swimming pools; and
- Over-browsing.

Each of the above threats to Koalas are discussed in further detail in the following sections (with the exception of logging which is not relevant to the proposed development).

Additionally, the following Key Threatening Processes listed in the TSC Act are identified in the Koala Recovery Plan as potentially threatening to the survival of the Koala:

- Anthropogenic climate change;
- Clearing of native vegetation;
- Forest eucalypt dieback associated with over-abundant Psyllids and Bell miners;
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation; and
- Predation by the European red fox (*Vulpes vulpes*).

These Key Threatening Processes are also addressed (where relevant) in the following sections.

6.2 Habitat Loss and Fragmentation

Reed and Lunney (1988) (in a paper submitted for Koala Summit - Managing Koalas in New South Wales), identify habitat loss as the key problem for the long-term survival of Koalas. Loss of potential Koala habitat continues to contribute to population decline across the Koala's range (Phillips *et al.* 2011).

A 1986 survey of the distribution of Koalas revealed that the majority of Koalas occurred on the North Coast of New South Wales, although their distribution west of the Great Divide and in the southern portion of the state was extensive but highly fragmented (Reed *et al.* 1990). The relatively widespread distribution 'masks' the significant losses of Koala habitat since European settlement and reflects the preferential selection of tree species by Koalas. The preferred species typically are restricted to higher nutrient soils (Moore and Foley 2000) of which substantial portions have been converted to farmland and residential development.

The increase in urban development of the coastal areas of Northern NSW has caused a habitat conflict with Koalas. The removal of high quality Koala habitat to accommodate development forces Koalas to occupy sub-optimal habitat, causes fragmentation of core populations and reduces dispersal options. Approximately 965 ha of bushland vegetation was removed between 2000/2001 and 2007 across the Tweed Valley (BRS 2008). It is estimated that about 100 ha of this loss was potential Koala habitat (Phillips *et al.* 2011).

Along with overall habitat destruction, habitat fragmentation is also a significant problem associated with decreasing Koala numbers (Lunney *et al.* 2007; TSSC 2012a, 2012b). The influence of patch size, shape and connectivity are key factors determining the ability of a landscape to support viable Koala populations (Phillips *et al.* 2011). Additionally, the chance of Koalas being present declines as patch sizes become smaller than ~150 ha. Koalas are more likely to occur in patches within ~100 m of one another compared to patches of vegetation that are more isolated. Small populations that are highly isolated tend to suffer higher extinction risks than populations that are connected to each other via animal movement. Immigration or recruitment into a population can provide a 'rescue' effect and can help maintain genetic diversity (McAlpine *et al.* 2007).

A significant result of this process of habitat loss and fragmentation is the increased likelihood of Koalas coming to the ground to access increasingly fragmented habitat.

6.3 Habitat Degradation

Apart from the loss of habitat and fragmentation the following degrading processes can occur as a result of habitat loss:

- 1) Edge effects - Fragmented habitats may be subject to edge effect. When habitats become fragmented, their edges often become more abrupt and transition less smoothly than they would naturally. Edges usually have less diversity and are dominated by a small number of species specially adapted to those areas (usually weeds). Weeds such as Lantana can block access to preferred food and roost trees (BSC 2010). Weeds may also can prevent recruitment of new Koala habitat trees. Also, since habitat fragmentation breaks the original habitat into smaller, isolated patches, movement between these patches can become dangerous.
- 2) Elevation of water table and salinity levels - Higher salt levels in the root zone of habitat trees will cause die-back and eventual loss of the affected trees. There will be no successful recruitment of habitat trees in the affected areas. More salt tolerant species will recruit. These new, more salt adapted species are unlikely to be useful to Koalas.

6.4 Road Kills/Vehicular Collisions

The impact of motor vehicles on Koalas nation-wide is clearly significant although virtually impossible to quantify (Phillips 1990). The construction of roads through Koala habitat or between habitat areas forces Koalas to cross roads as part of their natural foraging or dispersal behaviours. Phillips (2002) documented that approximately 34% of Koala mortality on the Tweed Coast was due to vehicle-strike and Phillips *et al.* (2011) reported that this figure has decreased to 19% in the intervening decade. However, it is acknowledged that this decline in mortalities is likely to be attributable to overall population decline (Phillips *et al.* 2011). It should also be noted that the majority of Koala mortalities resulting from vehicle strike occur within high-speed areas rather than in residential areas with 50kph speed limits, as documented by the “road mortality hotspots” identified by Phillips *et al.* (2011) (FIGURE 12).

6.5 Domestic Dog Attack

Koalas moving between habitat areas sometimes encounter domestic dogs. The incidence of Koala injuries and deaths resulting from altercations with dogs is growing and, in urban areas and adjoining forest habitat, uncontrolled dogs have a serious impact on Koala populations (TSC 2015; Phillips *et al.* 2011; DECC 2008; Qld EPA 2006). The Australian Koala Foundation estimates that approximately 4000 Koalas are killed by dogs and cars each year (AKF undated). On average, approximately 110 koalas are attacked and killed by dogs each year in QLD (DERM 2009). No comparable data is available for NSW.

Most dog attacks are fatal, making dog attacks the third most common cause of death after disease (relating to habitat loss) and vehicle strikes. However, not all dogs attack Koalas. Dogs over 10 kg are attributed to 96% of attacks on koalas (DERM 2009). Generally, the larger the dog, the greater the likelihood that it could be responsible for a fatal attack on a Koala.

6.6 Predation by the European red fox (*Vulpes vulpes*)

It is not considered that the European red fox is a significant predator of Koalas (NSW NPWS 2001). Extensive long-term (up to 3 years) telemetry studies of Koalas have been conducted at a range of sites across New South Wales including Port Stephens, Yamba, the Pilliga and Coffs Harbour. Mortality due to fox predation was positively identified on only one (1) occasion (NSW NPWS 2001).

6.7 Bushfire

Koalas are sedentary animals and not especially mobile and, therefore, stand little chance of surviving large-scale bushfires. Throughout the east coast of NSW, fire continues to threaten Koala populations and is increasingly being recognised as a key factor influencing long-term population viability (Phillips and Pereoglou 2005, Phillips and Hopkins 2010). Bushfire is highlighted by Phillips *et al.* (2011) as one of, if not, the dominant factor responsible for recent declines in koala numbers on the Tweed Coast. Wildfire has the potential to exacerbate Koala population decline by removing animals in a breeding population at a rate faster than the time required for the loss to be replaced by successive Koala generations (Starr 1990; Melzer *et al.* 2000). Regeneration of fire-affected areas is typically slow, so the food resource is reduced for

the remaining Koalas not killed by fire. Widespread canopy scorch presumably results in starvation for the remaining animals (Melzer *et al.* 2000).

6.8 Disease

Disease is a fundamental element of wildlife population dynamics and is generally recognised as a density dependent mechanism enacting population regulation (Phillips and Hopkins 2012). Elevated levels of Chlamydiosis can result from increased levels of stress due to reduced food availability and/or more anthropogenic catalysts such as habitat loss, dog attack and motor vehicle strike. This can in turn affect reproductive output/population size (Phillips *et al.* 2011). Koalas most at risk of disease are those which occupy disturbed or isolated habitats and those which are subject to continual human related disturbance.

6.9 Severe Weather Conditions (including Climate Change)

The Tweed region occurs in a sub-tropical climatic environment. Rainfall is generally plentiful and temperature fluctuations are moderate (mild winters and warm summers). The region does experience cyclones on occasions. These cyclones bring severe wind conditions and flood rains. CSIRO (2010) have indicated that:

The observed changes in the hydro-climatic data may indicate a shift in the climate for south-eastern Australia. A similar shift in climate evidenced via a reduction of rainfall and streamflow has also been experienced beginning in the 1970s in south-west Western Australia. That shift also has been linked to global warming and a range of other factors.

Climate model projections for the coming decades indicate an increasing risk of below average rainfall for south-eastern Australia. South East Australian Climate Initiative (SEACI) research also shows that short-duration storms may become more intense across the region, especially over the inland plains.

The current rainfall decline is at least in part attributed to climate change, raising the possibility that the current dry conditions may persist, and possibly intensify, as has been the case in south-west Western Australia.

It is prudent to plan for conditions that are likely to be drier than the long-term historical average conditions because the current drought appears to be at least partly linked to climate change and climate model projections of a drier future across the south-east.

There are questions remaining about how to apply climate change projections given that the recent observed changes in rainfall and streamflow are larger than the projected changes to mean climate for 2030. Further research is planned for Phase 2 of SEACI aimed at better understanding the relative roles of natural variability and climate change in the recent rainfall decline. This will assist in determining how to best combine the observed climate records with future projections.

Climate change may impact on Koalas by exacerbating the effects of drought (IUCN 2009). In general, drought causes loss of leaves and loss of leaf quality, which can have deleterious impacts on Koala populations. Koalas currently occur throughout eastern Australia in fragmented habitats, where they are under pressure from land-clearing, dogs, cars and disease. Some inland and coastal koala populations have experienced significant declines due to drought, heatwaves and threats associated with urbanisation (ACEAS 2012). Rapid climate change may compound these stressors and cause their range to contract to many regions where these threats are amplified by intensified urbanisation (Adams-Hosking *et al.* 2011).

6.10 Swimming Pools

Although drowning in swimming pools is a relatively low order threat, any Koala mortality can be significant in a particular context (NPWS 2003). Whilst Koalas can swim, pools without a gently sloping side, or a rope/ladder as a means for a Koala to climb out, can cause a Koala to become trapped and drown (AKF undated).

It should be noted that mandatory child-exclusion fencing to swimming pools will not necessarily exclude Koalas, particularly small juveniles (EPA 2006).

The philosophy with the Kings Forest development is to separate the conserved habitat and the terrestrial and non-flying arboreal mammals contained therein (i.e. including Koalas) from the residential development. Hence, there is not considered to be a requirement for any specific construction or design standards, for pools or their fences, to protect Koalas who wander into the residential development area.

6.11 Over-browsing

DSE (2004) notes that in some circumstances in southern Australia, Koala populations grow to unsustainable densities resulting in defoliation of their favoured food trees. This phenomenon is referred to as over-browsing. In severe cases, over-browsing leads to widespread tree death, alterations to the tree species composition of the forest (through the killing of favoured food species) and, in extreme cases, starvation of Koalas (Menkhorst 2004). An alternative hypothesis is that over-browsing is a consequence of ecological stresses placed on eucalypts by fragmentation of forests and woodlands, and ecological changes such as altered fire regimes, nutrient cycles and hydrological patterns. Eucalypts may respond to such 'stresses' by producing foliage with higher nitrogen and sugar content which makes them even more palatable to herbivores (Jurskis and Turner 2002).

DSE (2004) also note that sites at which serious over-browsing occurs invariably have a few easily recognisable characteristics such as being located on an island or are habitat isolates on the mainland or have only one (1), or occasionally two (2), preferred eucalypt species present. DSE (2004) also state that:

In some extensive mixed-species forests, over-browsing of individual trees can occur, particularly along drainage lines where high-quality browse is more likely to be found. In these situations over-browsing has not led to widespread defoliation or to a major

loss of tree cover. However, over time, it may result in a change to the eucalypt species composition in valleys.

DSE recommend that:

- 1) Early detection of high Koala population levels and signs of canopy depletion is essential for successful management. Local knowledge is required to ensure that other potential causes of dieback have been discounted as the cause of canopy depletion; and
- 2) Where canopy depletion is apparent in 50% or more of trees of favoured Koala browse species, a control strategy, including an ecological rationale, should be prepared by the land manager.

6.12 Forest Eucalypt Dieback Associated with Over-Abundant Psyllids and Bell Miners

Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners (often referred to as 'Bell miner associated dieback' or BMAD) was listed as a key threatening process on 31 October 2008 (OEH 2015).

Both psyllids (small sap-sucking insects that secrete a sugary shield, called a lerp), and bell miners, large honeyeater birds (*Manorina melanophrys*), are native and occur naturally in moderate abundance in localised areas. Bell miners feed on the psyllids and their lerps, and may even 'farm' them, possibly selecting large lerps and preferentially feeding on the lerp rather than the insect itself (OEH 2015).

Bell miners are aggressive and extremely effective at excluding other bird species from their territories. This can lead to psyllid populations increasing to the extent that they cause substantial canopy damage (OEH 2015).

The forest types most susceptible to BMAD are those dominated by Dunn's White Gum (*Eucalyptus dunnii*), Sydney Blue Gum (*E. saligna*), Flooded Gum (*E. grandis*), Grey Ironbark (*E. siderophloia*), Narrow-leaved White Mahogany (*E. acmenoides*), Grey Gum (*E. punctata*) and Grey Ironbark (*E. paniculata*) (OEH 2015). These forest types do not occur at Kings Forest. Therefore, this threatening process is not considered to represent a significant threat to the Kings Forest Koala population.

7 IMPACT ASSESSMENT

7.1 Introduction

This section discusses the impacts on Koalas as a result of the development. These impacts can be described as either direct or indirect. Direct impacts are those which can be attributable to an action which will have an immediate effect on the Koalas (e.g. removal of habitat trees (forage and/or roost trees) or the death of a Koala during tree removal or during operational works). Indirect impacts are those which do not affect the Koalas immediately but which can be linked to the development in a tangible sense and may interfere with the recovery of the local Koala population (e.g. an increased risk of fire or disease).

7.2 Direct Impacts - Habitat Loss and Fragmentation

The extent of Koala habitat removal (including area calculations) is depicted in FIGURE 16 and detailed in TABLE 3 below.

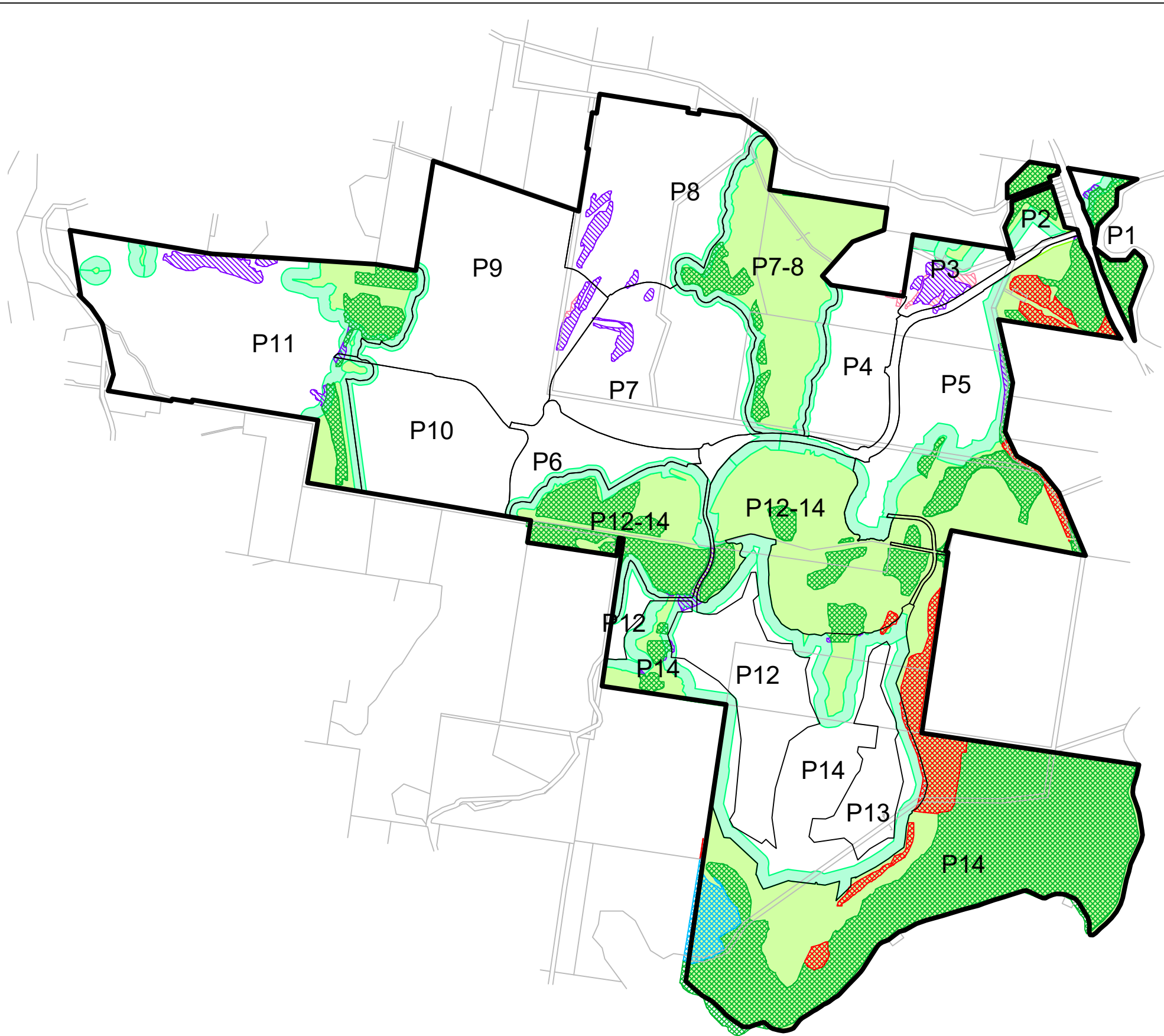
TABLE 3
IMPACTS ON KOALA HABITAT

Habitat Type	Existing Area (ha)	Area to be Removed (ha)	Area Remaining After Development (ha)
Primary	19.69	1.24	18.45
Secondary (Class A)	172.01	13.68	158.33
Secondary (Class B)	6.27	0	6.27
TOTAL	197.97	14.92	183.05

The removal of koala habitat will occur on a staged basis in accordance with the Precinct plan shown in FIGURE 7. Precinct specific koala habitat impact calculations are provided in TABLE 4.

TABLE 4
PRECINCT SPECIFIC KOALA HABITAT IMPACT CALCULATIONS

Precinct	Area of Koala Habitat to be Removed (ha)			TOTAL
	Primary Habitat	Secondary (Class A) Habitat	Secondary (Class B) Habitat	
Precinct 1	0	0.25	0	0.25
Precinct 2	0	0	0	0
Precinct 3	0.86	2.80	0	3.66
Precinct 4	0.19	0	0	0.19
Precinct 5	0	0.41	0	0.41
Precinct 6	0	0	0	0
Precinct 7	0	1.33	0	1.33
Precinct 8	0	2.32	0	2.32
Precinct 9	0.20	1.36	0	1.56



LEGEND

- Environmental Protection Zone (EPZ)
- 50m Buffer to EPZ
- Precinct Boundary
- Kings Forest Boundary

KOALA HABITAT THAT WILL BE REMOVED FOR DEVELOPMENT (14.92ha)

- Primary Koala habitat to be removed for development (1.24ha)
- Secondary (A) Koala habitat to be removed for development (13.68ha)

KOALA HABITAT THAT WILL REMAIN AS HABITAT AFTER DEVELOPMENT (183.05ha)

- Primary Koala habitat to remain after development (18.45ha)
- Secondary (A) Koala habitat to remain after development (158.33ha)
- Secondary (B) Koala habitat to remain after development (6.27ha)



SOURCE: JWA Site Investigations; Biolink Consultants - Tweed Coast Koala Study (2011)
 SCALE: 1 : 20 000 @ A3
 JWA PTY LTD
 Ecological Consultants

CLIENT
 Project 28 Pty Ltd
 PROJECT
 Koala Plan of Management
 Kings Forest
 Melaleuca Drive, Duranbah, NSW
 Shire of Tweed

FIGURE 16
 PREPARED: BW
 DATE: 19 December 2016
 FILE: N97017_KPOM.dwg

TITLE
KOALA HABITAT TO BE LOST & RETAINED

Precinct	Area of Koala Habitat to be Removed (ha)			
	Primary Habitat	Secondary (Class A) Habitat	Secondary (Class B) Habitat	TOTAL
Precinct 10	0	0	0	0
Precinct 11	0	3.82	0	3.82
Precincts 12-14	0	1.39	0	1.39
TOTAL	1.24	13.68	0	14.92

There is a risk of Koala mortality during the clearing of habitat and also during the construction stages of the development. This is, obviously, a short-term risk and is associated only with the land clearing activities and use of heavy vehicles during the bulk earthworks phase.

The loss of habitat during construction works has the potential to reduce the overall occupancy of Koalas at the Kings Forest site. Clearing may impact on the home range of a particular Koala and initiate a random movement response which takes it into danger of vehicle strike or dog attack. This fragmentation of existing habitat can cause stress to affected Koalas until either a new home range is established either before or after new habitat is created.

7.3 Indirect Impacts

7.3.1 Introduction

Indirect impacts can result from the initial habitat removal, construction activities and resultant fragmentation. These indirect impacts can be linked to the:

- Alteration to water table levels surrounding the development area (DoE 2014a);
- Increased risk of vehicle strike as there is a large increase in vehicle numbers after development (DoE 2014a);
- Increased risk of fire due to vandalism (OEH 2012);
- Increased risk of dog attack with the introduction of a large number of pets into Kings Forest (DoE 2014a);
- Increased risk of retained habitat degradation (OEH 2012) i.e. edge effects;
- Creation of a barrier to movement to, between or within habitat critical to the survival of the Koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the Koala (DoE 2014a); and
- Facilitation of the introduction or spread of disease or pathogens for example Chlamydia or *Phytophthora cinnamomi*, to habitat critical to the survival of the Koala, that are likely to significantly reduce the reproductive output of Koalas or reduce the carrying capacity of the habitat (DoE 2014a).

The indirect impacts (as listed above) are discussed in the following sections.

7.3.2 Alteration to Water Table Levels

The proposed development will likely result in changes to site hydrology which has the potential to degrade Koala habitat to the extent that the carrying capacity of the habitat is reduced in the long-term.

Project 28 have completed an extensive assessment of groundwater conditions on and adjacent to the Kings Forest site (Gilbert and Sutherland 2013 and 2014). The collection of groundwater data and input into groundwater models was considered the most efficient and accurate method to determine impacts of filling and/or excavation on groundwater levels. The results of this modelling and the resultant predictions of impacts on groundwater levels surrounding the development allowed an analysis of the future plant/soil moisture environmental conditions. Mapping of vegetation rehabilitation (offset) areas has been completed taking into account the particular plant species moisture requirements. This mapping has been reported in the Revised Final Response Report relating to Matters of NES (Wallum sedge frog and Koala) dated March 2015. FIGURE 11 shows the existing distribution of Koala habitat on the Kings Forest site. FIGURE 16 shows the distribution of habitat on the site after the water table has settled into its altered levels (i.e. 183.05 ha). The settling in period for the water table may take a number of years after the completion of the bulk earthworks.

7.3.3 Increased risk of vehicle strike

The proposed development may result in the injury/death of Koalas in the local population due to vehicle strike.

Two (2) roads close to the Kings Forest site are known to be road mortality hotspots (FIGURE 11). These two hotspots are discussed below:

Clothiers Creek Road

Clothiers Creek Road runs east-west for approximately 4.6 km between the Pacific Highway and the coastal village of Cabarita. Approximately 2.7 km of the eastern section of the road passes through Cudgen Nature Reserve, with the entire length of this section bounded on at least one side by vegetation communities mapped as Primary, Secondary (Class A) and Secondary (Class B) Koala habitat. Twenty-eight (28) records of koala sightings are present for the vicinity of the road, of which eighteen (18) are located in the eastern section. Clothiers Creek Road is a known vehicle strike hotspot for the Tweed Coast, with Phillips (2002) reporting that it accounted for 47% of known road-kills between 1991 and 2000. The eastern section of the road poses greatest threat to individual Koalas occupying or moving through habitat adjacent to the road.

The statutory speed limit for Clothiers Creek Road between Tanglewood and Bogangar is 70km/h, reduced to 60km/h on the approach to Bogangar in the east. Traffic data from between 2002 and 2009 however indicate that actual average traffic speeds range from 65km/h to 85km/h with between 1,971 and 2,315 vehicles utilising this section of road on a daily basis (Tweed Shire Council traffic data, T. Fountain *pers. comm.*). This section of road is densely vegetated for the majority of its length, with poor visibility and no lighting during night hours. “Koala blackspot” signs are in place in the eastern section of the road. The surrounding vegetation and tenure limit the options for ameliorative measures in this blackspot, however a reduction to vehicle speeds is necessary.

Tweed Coast Road

A cluster of twelve (12) records of koala sightings at Cudgen between Kings Forest and Casuarina coincides with the road passing through a vegetated area consisting of Primary and Secondary (Class A) habitat, adjacent to the road on both sides, and adjoining Cudgen Nature Reserve. Traffic data from the south of this location indicates high traffic volumes, the most recent count being 9,954 vehicles per day. The statutory speed limit in this section is 80km/h, while vehicle speeds of between 86km/h and 89km/h on average have been recorded (Tweed Shire Council traffic data, T. Fountain *pers. comm.*).

The known occupancy by Koalas, proximity of vegetation and high speeds in the Cudgen area combine to highlight this area as a major area of concern for vehicle strike on the Tweed Coast Road. Adjacent vegetation cover reduces visibility and increases the likelihood of animals being hit whilst traversing the road. Despite the installation of fauna exclusion fencing and an underpass in the area, their efficacy is likely to be limited due to a lack of maintenance and associated issues. The addressing of these issues and/or investigation into further ameliorative measures in this location is warranted.

A further six (6) records of koala sightings are clustered in and around the urban area of Cabarita. This cluster occurs immediately east of the central mapped source population cell. Small patches of Secondary (Class A) habitat occur on the eastern side of the road in this location. Thus, animals potentially disperse east from this cell. It is expected that low statutory speed limits and good visibility through this urban area currently contribute to a low probability of motor vehicle strike, with koala sightings in this area predominantly resulting from higher human population density rather than high frequency of road strike.

7.3.4 Increased risk of fire

The proposed development may potentially result in an increased risk of wildfires which reach to the canopy and either kill koalas or remove forage resources.

Phillips *et al* (2011) notes that “the majority of the bushland surrounding Cudgen Lake in the centre of the TCSA has been subject to wildfire at some stage in the 15 year history of fire reporting available to this study (DECCW records).” Also, “Fifteen occurrences of wildfire have been recorded and mapped in the area since 1982. The two (2) most recent fires, in 2009 and 2004 extended over much of the forested area to the north, west and south of Cudgen Lake and have been high intensity burns.” A large residential development adjacent to the Cudgen Nature Reserve and with large SEPP 14 wetlands occurring in the middle of the development significantly raises the chances of bushfire occurrence either by natural means (e.g. lightning strike) or by vandals.

7.3.5 Increased risk of dog attack

The proposed development has the potential to result in koala fatalities due to dog attacks including the potential for multiple, ongoing mortalities.

Phillips *et al* (2011) notes that “the record of reported incidence of Koala mortality due to dog attack on the Tweed Coast is incomplete with available records indicating three (3) mortalities over the last 20 years, while the actual number is almost certainly higher”.

7.3.6 Edge effects (weeds, noise and light)

The development of a large residential subdivision in the Kings Forest area will lead to the loss of Koala habitat (FIGURE 16). The newly created edges of habitat as well as the older edges will be subjected to the influence of incursions of weeds, noise and light as the construction proceeds. These impacts may also continue to operate/occur in the long term during the occupational phase of the subdivision.

A wide variety of weed species have been recorded on the Kings Forest site including highly invasive species such as Lantana (*Lantana camara*), Groundsel (*Baccharis halimifolia*), Broad-leaved paspalum (*Paspalum wettsteinii*), Winter senna (*Senna coluteoides*), Blue billygoat weed (*Ageratum houstonianum*) and Bitou Bush (*Chrysanthemoides monilifera*).

There is little information available on the effects of noise on animals, however, the information available suggests that long term exposure to noise may have an effect on the behaviour and possibly even the habitat of some wildlife. In Australia there are no noise studies presently available that deal with noise impacts on native species for long term exposure. Studies of potential impacts from military noise (USACERL 1996) indicate that military and civilian blast noise had no unusual effects beyond those encountered as the result of other human generated noise. Dr S. Phillips (*pers. comm.* July 2015) states that the Bluesfest (Jazz music festival at Yelgun north of Byron Bay) established that episodic loud noise resulted in aversive behaviour by Koalas, with those closest to the source evacuating their home range areas for the duration of the event before returning. He also noted that the University of Queensland completed a radio-tracking program in the same location during a subsequent festival event and also recorded aversive responses but did not consider it to be significant. It is understood that the high noise levels at the Bluesfest was during the day and during the night whereas during construction at Kings Forest, the heavy vehicle noise will be during the daytime only. After construction work has ceased the ongoing residential noise will be relatively low.

The development has the potential to increase the level of artificial light in the nearby habitats. Increased night light levels may adversely impact wildlife by direct glare, chronic or periodic increased illumination and temporary unexpected fluctuations in light levels (Saleh 2007, Longcore and Rich 2010). Koalas are most active at night in terms of foraging and social behaviour. The construction activities will provide very little light spill into nearby Koala habitats. It is highly unlikely that there will be any work at night. There may be lighting in some areas as security for vehicle compounds. Light spill into nearby habitats at night are likely to occur during the occupational phase of the development.

7.3.7 Barriers to movement or dispersal

Creating a barrier to movement to, between or within habitat critical to the survival of the Koala that is likely to result in a long-term reduction in genetic fitness or access to habitat critical to the survival of the koala.

A large residential development such as the Kings Forest development will create a substantial barrier to the movements of most native fauna species. Obviously, flying species such as birds and bats (mega and micro chiropteran species) will be less troubled by this barrier. Species such as the Koala will be affected to some degree. A review of the 1998 and 1999 radio-tracking surveys completed by Callaghan and Phillips (1998a; 1998b) and James Warren and Associates (2000) show that Koalas did not substantially rely on access across the proposed development

portions of the site. This is likely due to the fact that most of the proposed development areas are devoid of forested or woodland vegetation. Although Koalas will cross expanses of cleared land to access distant forest/woodland habitat, they obviously follow forested/woodland habitat as that is the most direct way of accessing additional forage or roost trees within their home range.

The construction of the entry road to Kings Forest from Tweed Coast Road and the roads constructed which will cross through conserved habitats within the site, will create barriers to Koala movements. The main dangers for Koalas in these circumstances will be vehicle strike and dog attack.

7.3.8 Facilitating the introduction or spread of disease

Although the *Chlamydia* bacterium and Koala retro-virus (KoRV) are known to be present in the Tweed Coast Koalas, Phillips *et al.* (2011) did not consider disease *per se* as a direct or overriding threat to long-term Koala population viability. Loss of habitat as a result of the Kings Forest development could lead to an increase in pressure on resources for the existing population. It could also alter population dynamics and social structure. These types of pressures are thought to cause stress and therefore stress related disease such as Chlamydiosis.

8 PROPOSED MITIGATION MEASURES

8.1 Introduction

A variety of measures will be implemented during the pre-construction, construction and operational phases of the development. These measures have been designed to mitigate the potential impacts on the local Koala population. The measures are discussed in SECTIONS 8.2 - 8.16 and include:

- Pre-clearing Koala surveys;
- Education of site personnel;
- Retention of existing Koala habitat supporting resident populations;
- Revegetation/offsetting of Koala habitat;
- Transfer of land to public ownership;
- Fire management;
- Improving habitat connectivity and linkage corridors;
- Wildlife exclusion fencing;
- Implementation of fauna underpasses and road crossing infrastructure;
- Preventing Koala contact with dogs;
- Providing appropriate care/management of diseased Koalas;
- Reducing the impacts of hydrological change on Koala habitat;
- Increasing carrying capacity;
- Engaging with the relevant Local Government, NPWS and community Koala management groups;
- Raising community awareness;
- A monitoring program (discussed in detail in SECTION 10); and
- Additional construction phase management measures.

8.2 Pre-clearing Koala Surveys

Prior to the commencement of construction associated with each precinct (i.e. no more than one day prior to commencement of bulk earth moving activities within each precinct), pre-clearance surveys for Koala will be undertaken by a suitably qualified person agreed to by the Department. Pre-clearing surveys will adhere to the following protocols:

1. A suitably qualified ecologist/fauna handler will be on site during all clearing activities.
2. The suitably qualified ecologist/fauna handler must inspect all areas proposed for clearing for the presence of koalas prior to the commencement of clearing. Approval to commence vegetation clearing is only valid for the day on which the inspection has been undertaken.

3. All native vegetation clearing is to be completed as sequential clearing (i.e. clearing will occur in stages) with at least a 12-hour period between 6pm and 6am during which no trees are cleared on the site.
4. Earthworks and/or the clearing of native vegetation will be temporarily suspended within a 25m radius of any tree in which a koala is located and will not resume until the koala has moved to an area away from construction of its own accord. As a minimum, the tree shall be left overnight to enable the Koala to move away. The tree can only be removed following inspection by an appropriately qualified ecologist/fauna handler to ensure that the Koala has dispersed and that the removal of the tree poses no direct threat to the health or survival of the Koala.

Where a Koala is located in the construction zone, the immediate threats to that animal are to be assessed by a suitably qualified person and intervention limited to instances where it is clear that there is an imminent and serious threat to that animal's welfare. Where threats are deemed to be low or manageable, the animal will be monitored until it moves to more suitable habitat.

8.3 Education of Site Personnel

A Key Action to be implemented in accordance with this Revised KPoM is the development of a construction personnel induction program. The program shall be developed by the Proponent to highlight the potential presence of Koalas on the site. The induction program is to be approved by a suitably qualified person prior to construction commencing.

The general induction of all construction personnel will aim to ensure the awareness of Koala-related issues and of responsibilities and procedures in relation thereto, covering such matters as:

Areas of the site in which Koalas are most likely to be encountered;

- Threats to Koalas associated with construction activities;
- Requirement to report *any* Koala sightings or incidents on or near the site, and actions required;
- Construction personnel are prohibited from bringing dogs onto the site;
- Requirement to report any evidence of dogs within EPZs (sightings, footprints, droppings, dead or injured koalas); and
- Requirements of the Kings Forest Vegetation Management Plan, particularly protocols for vegetation clearing and measures to protect all other native vegetation.

8.4 Retention of Existing Koala Habitat Supporting Resident Populations

There will be a loss of 1.24 ha of Primary habitat and 13.68 ha of Secondary (Class A) habitat as a result of the proposed development (FIGURE 16). These losses represent 6.3% of the existing Primary habitat and 8% of the existing Secondary (Class A) habitat. This means that

over 90% of both the Primary and Secondary (Class A) habitat will be retained. The Koala habitat to be removed is in poor or poor/moderate condition due the level of disturbance and relative isolation from areas of quality habitat. Disturbances include stock grazing, slashing and weed infestation (Camphor laurel and Slash pine). Only isolated occurrences of Koala food trees will be removed as a result of the proposed development. No clearing shall occur outside nominated clearing zones.

8.5 Direct Offset Strategy

8.5.1 Introduction

The retention of existing Koala habitat and the mitigation of indirect impacts will not be sufficient to mitigate all anticipated impacts on the Koalas on or near the Kings Forest site. Offsetting is an accepted method to compensate for lost habitat and indirect impacts. An offset package has been agreed between Project 28 and the Commonwealth Department of the Environment (Condition 7 of EPBC Approval 2012/6328). All offset habitat will be provided on the Kings Forest site.

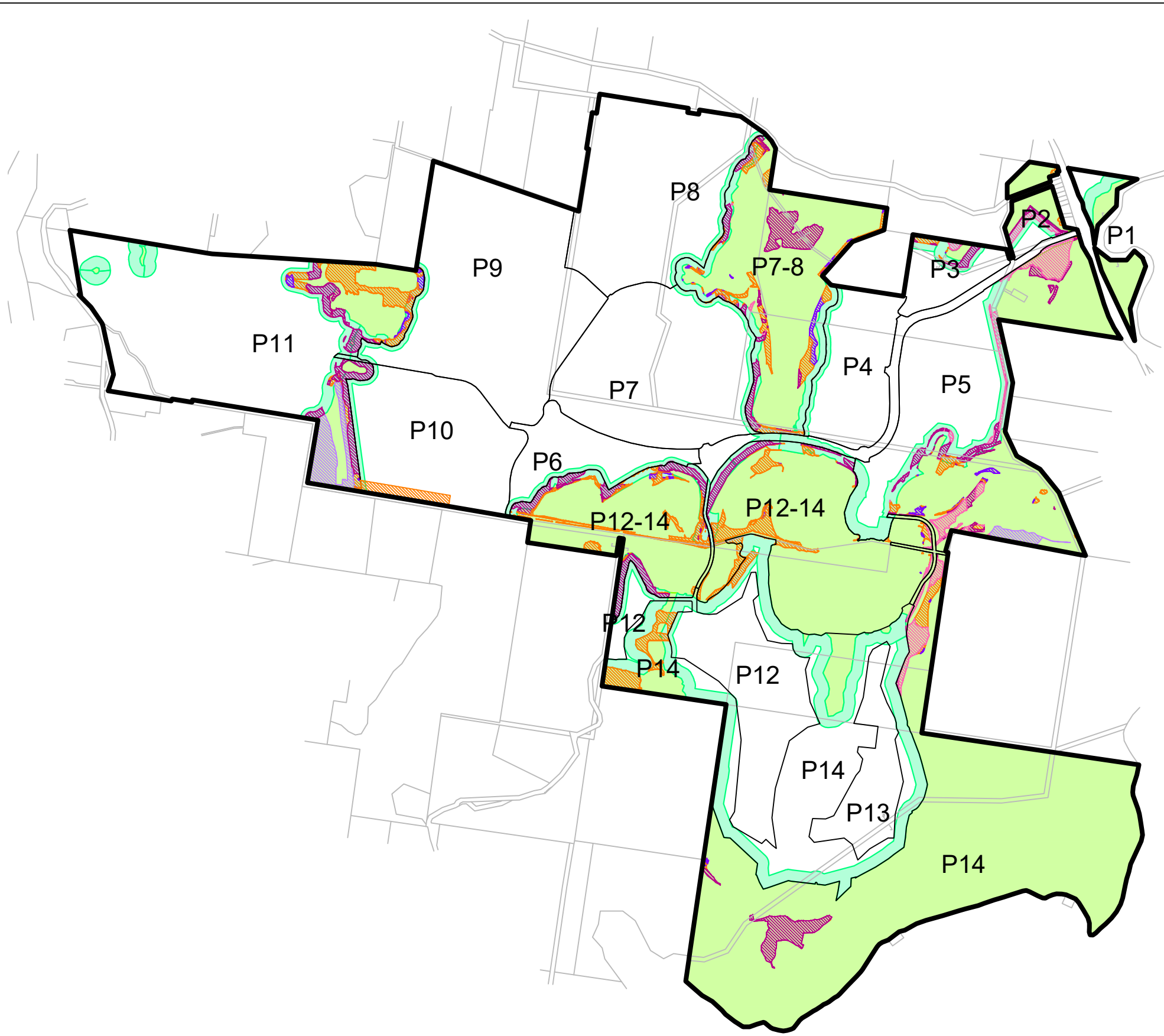
In accordance with the *EPBC Act Environmental Offsets Policy* (October 2012) offsets must contribute to the ongoing viability of the protected matter (the Koala in this case) impacted by the proposed action. Offsets should be tailored specifically to the attribute of the protected matter that is impacted. In this case, the proposed compensatory habitat strategy should improve and maintain Koala habitat at Kings Forest and maintain the viability of the local Koala population. The Kings Forest development proposes a significant vegetation rehabilitation program that includes the planting of Koala food trees.

8.5.2 Proposed Offset Strategy





A Key Action to be implemented in accordance with this Revised KPOM is the provision of offsets for Koala habitat to be removed. Importantly, the proposed Koala Compensatory habitat areas will result in net gain of 41.79 ha (after direct impact of 14.92 ha) of Koala habitat in the medium to long term and will enhance existing movement corridors.

The proposed Koala offset habitat (including area calculations and species to be planted) is shown in FIGURE 17. FIGURE 18 shows the final extent of Koala retained habitat and offset habitat after-development. Offsets will be delivered on a precinct-by-precinct basis in accordance with the precinct plan provided in FIGURE 7 and the calculations provided in TABLE 5. Staging of offsets is the most practical method for offset provision, in this case. A staged approach to providing offsets is practical given that there may well be long periods between the development of the various precincts. Staging will allow habitat creation and subsequent population monitoring to be completed prior to the commencement of subsequent stages.






The created Koala habitat will either be:



LEGEND

-  Environmental Protection Zone (EPZ)
-  50m Buffer to EPZ (only the inner 30 metres to be utilised for offsetting and dedication purposes)
-  Precinct Boundary
-  Kings Forest Boundary

KOALA COMPENSATORY HABITAT (56.71ha)

-  Dry primary Koala habitat (20.61ha)
-  Dry secondary Koala habitat plus dry heath (7.46ha)
-  Wet primary and secondary Koala habitat (21.79ha)
-  Wet secondary Koala habitat (1.60ha)
-  Secondary Koala habitat (5.25ha)

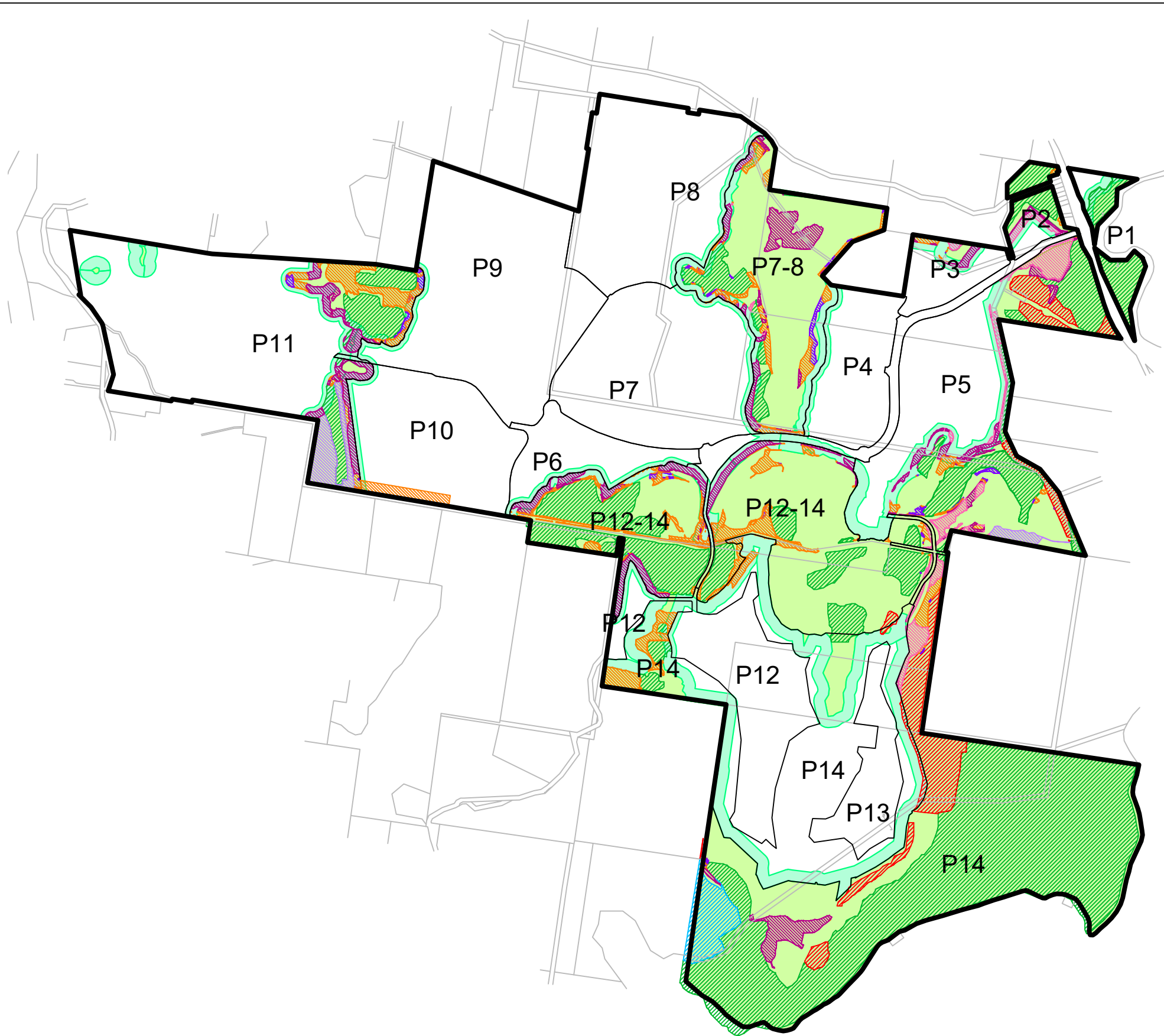


SOURCE: JWA Supp. PD (2014); Terrestria (March 2014); Gilbert & Sutherland (pers. comm. 2014)
SCALE: 1 : 20 000 @ A3
JWA PTY LTD
Ecological Consultants

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Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 17
PREPARED: BW
DATE: 13 March 2017
FILE: N97017_KPOM.dwg

TITLE
**KOALA
COMPENSATORY
HABITAT**



LEGEND

- Environmental Protection Zone (EPZ)
- 50m Buffer to EPZ (only the inner 30 metres to be utilised for offsetting and dedication purposes)
- Precinct Boundary
- Kings Forest Boundary

KOALA HABITAT THAT WILL REMAIN AS HABITAT AFTER DEVELOPMENT (183.05ha)

- Primary Koala habitat to remain after development (18.45ha)
- Secondary (A) Koala habitat to remain after development (158.33ha)
- Secondary (B) Koala habitat to remain after development (6.27ha)

KOALA COMPENSATORY HABITAT (56.71ha)

- Dry primary Koala habitat (20.61ha)
- Dry secondary Koala habitat plus dry heath (7.46ha)
- Wet primary and secondary Koala habitat (21.79ha)
- Wet secondary Koala habitat (1.60ha)
- Secondary Koala habitat (5.25ha)



SOURCE: JWA Supp. PD (2014); Biolink; Gilbert & Sutherland (pers. comm. 2014)

SCALE: 1 : 20 000 @ A3

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FIGURE 18

PREPARED: BW
DATE: 13 March 2017
FILE: N97017_KPOM.dwg

TITLE
KOALA RETAINED &
COMPENSATORY HABITAT
& HEATH REVEGETATION/
REGENERATION

- i. Substantially established⁶ in any precinct prior to the commencement of construction in any subsequent precinct; or
- ii. Planted for the relevant precinct and then a bond of 150% of the estimated maintenance and monitoring costs lodged with Tweed Shire Council (TSC) prior to the commencement of construction. The bond to be forfeited if substantial establishment (see footnote 6) is not achieved.

TABLE 5
PRECINCT SPECIFIC OFFSETS

Precinct	Koala Habitat to be Retained (ha)	Koala Habitat to be Removed (ha)	Koala Offset Created Habitat (ha)
Precinct 1	5.82	0.25	0
Precinct 2	3.62	0	1.14
Precinct 3	0	3.66	1.01
Precinct 4	0	0.19	0
Precinct 5	19.56	0.41	8.70
Precinct 6	0	0	0
Precinct 7	1.89	1.33	3.93
Precinct 8	3.71	2.32	5.51
Precinct 9	0	1.56	0
Precinct 10	0	0	2.05
Precinct 11	8.68	3.82	13.55
Precincts 12-14	139.76	1.39	20.82
TOTAL	183.05	14.92	56.71

Approximately 14.92 ha of Koala habitat will be removed as a result of the proposed development. To compensate for unavoidable losses of Koala habitat, areas of land amounting to 56.71 ha have been identified as suitable for providing compensatory Koala habitat. Based on post-development groundwater levels, this will include the habitat categories shown in TABLE 6. The extent of each habitat category has been determined based on the following post-development groundwater depth range:

- Dry Primary Koala habitat: Depth to groundwater = >1m (areas suitable for planting majority primary food tree species)
- Dry Secondary Koala habitat: Depth to groundwater = >1m (areas suitable for planting majority secondary food tree species)
- Wet Primary and Secondary Koala habitat: Depth to groundwater = 0.2 to 1m
- Wet Secondary Koala habitat: Depth to groundwater = 0 to 0.2m
- Secondary Koala habitat: Outside groundwater model (area SE of Precinct 5 and additional areas in Precincts 10 & 11)

TABLE 6

⁶ “Substantial establishment” of the Koala habitat plantings means “the plantings have progressed beyond the need for intensive maintenance e.g. weed control, watering etc. and are clearly established by way of persisting through a recognised growth period and a suitably qualified horticultural/environmental specialist has provided a short report confirming that the plantings are established.”

PRECINCT SPECIFIC COMPENSATORY HABITAT CATEGORIES

Precinct	Koala Compensatory Habitat					TOTAL (ha)
	Dry primary koala habitat (ha)	Dry secondary koala habitat plus dry heath (ha)	Wet primary and secondary koala habitat (ha)	Wet secondary koala habitat (ha)	Secondary koala habitat (ha)	
Precinct 1	0.00	0.00	0.00	0.00	0.00	0.00
Precinct 2	0.24	0.76	0.14	0.00	0.00	1.14
Precinct 3	0.49	0.19	0.33	0.00	0.00	1.01
Precinct 4	0.00	0.00	0.00	0.00	0.00	0.00
Precinct 5	2.05	4.32	0.95	0.22	1.15	8.70
Precinct 6	0.00	0.00	0.00	0.00	0.00	0.00
Precinct 7	1.20	0.06	2.11	0.56	0.00	3.93
Precinct 8	3.97	0.00	1.46	0.08	0.00	5.51
Precinct 9	0.00	0.00	0.00	0.00	0.00	0.00
Precinct 10	0.00	0.00	2.05	0.00	0.00	2.05
Precinct 11	4.17	0.00	4.76	0.52	4.10	13.55
Precincts 12-14	8.48	2.13	10.00	0.22	0.00	20.82
TOTAL	20.61	7.46	21.79	1.60	5.25	56.71

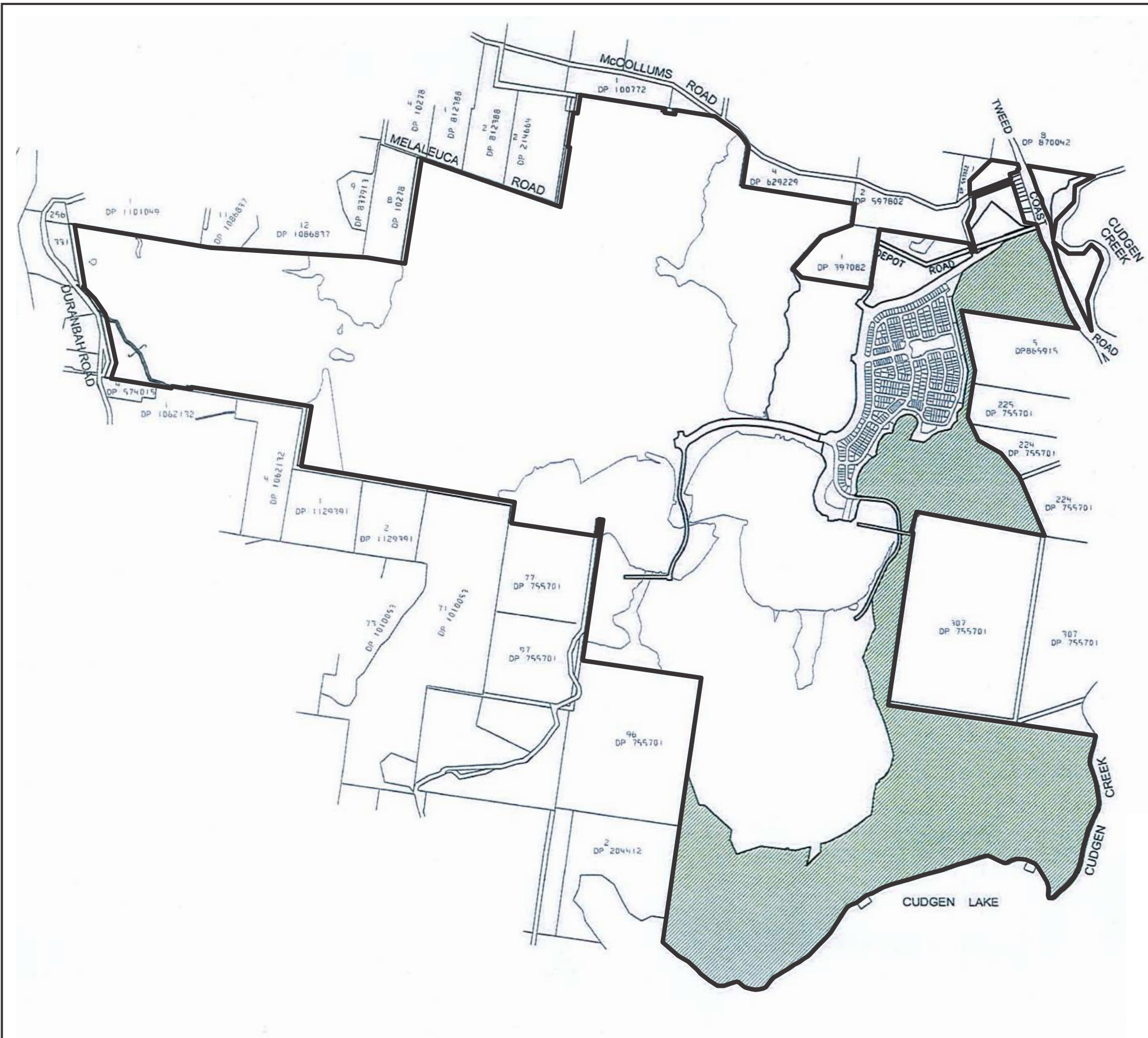
8.5.3 Rehabilitation Specifications

Site rehabilitation works will be completed by a suitably qualified⁷ Bush Regeneration company in accordance with the specifications contained in APPENDIX 6. These specifications provide details of the proposed rehabilitation phases, site preparation, weed control, natural regeneration, revegetation works (including plant species lists) and rehabilitation monitoring.

8.6 Transfer of Land to Public Ownership

A Key Action to be implemented in accordance with this Revised KPoM is the transfer to public ownership (Office of Environment and Heritage) of a minimum of 150 ha (in accordance with Concept Plan condition C3) of the Kings Forest site, contiguous with Cudgen Nature Reserve (FIGURE 19). This undertaking was originally contained in the Proponent's Statement of Commitments forming part of the approved Concept Plan. This area includes approximately 58% of all mapped Koala habitat on the Kings Forest site (FIGURE 20). These areas will be protected by Nature Reserve zoning in perpetuity. A further 34% of Koala habitat (not including ecological buffers) will remain in Environmental Protection Zones (EPZ's) across the site. These areas may also be transferred to public ownership, subject to agreement with Tweed Shire Council. This will ensure the retention and long-term protection of more than 92% of all Kings Forest Koala habitat.

⁷ A Bush Regeneration company that has demonstrable experience in the rehabilitation or revegetation of native vegetation communities in the Tweed region.



LEGEND

- Indicative Areas to be dedicated to NPWS
 - Conservation offset (Nature Reserve addition) land approx total area 180 ha (150 ha per concept plan condition C3, additional 30 ha subject to agreement with NPWS)
 - Kings Forest Boundary
- Note: Final boundaries are subject to agreement with Dept of Planning and Infrastructure

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Planning

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Approved Application No. 08-0194

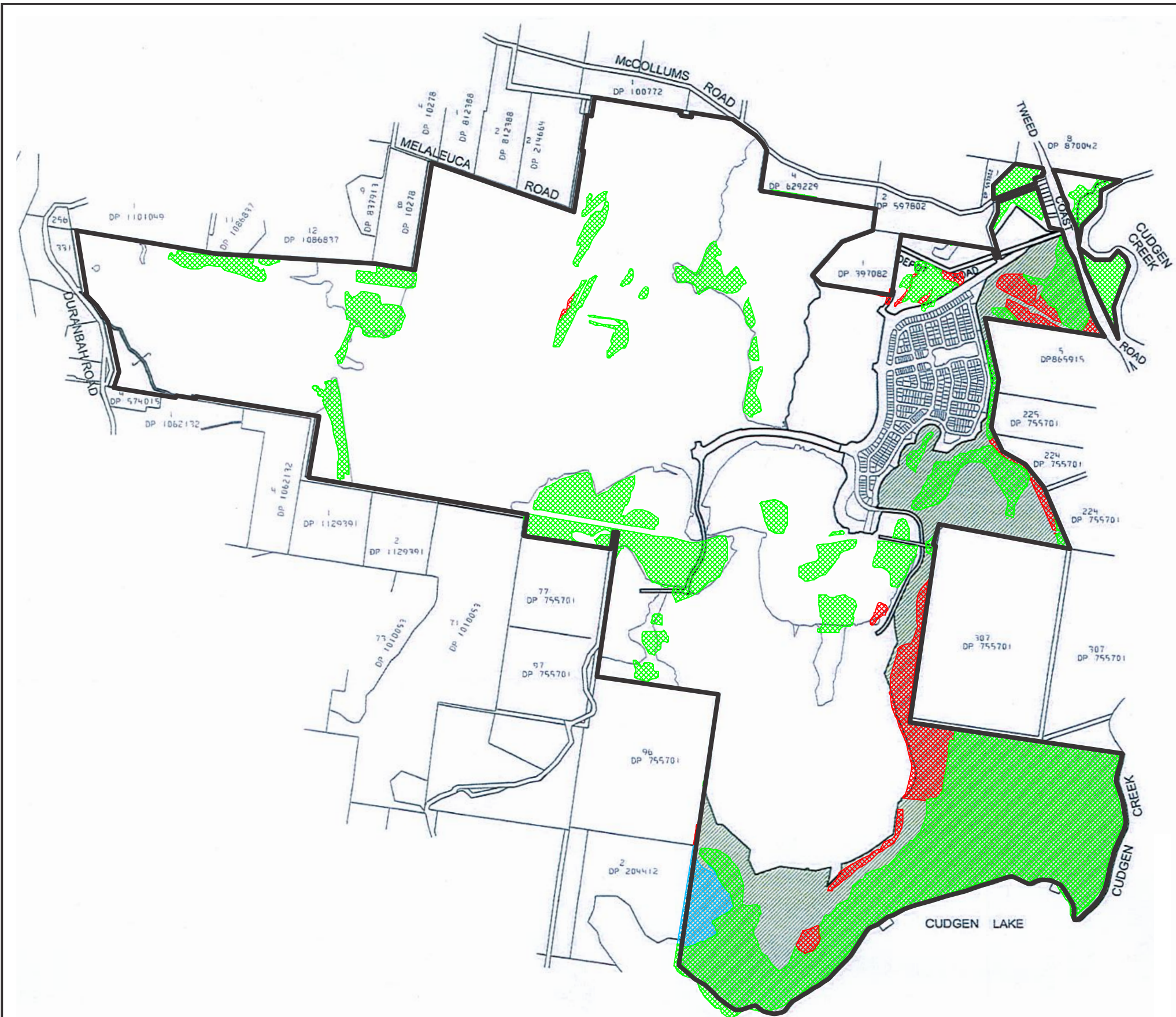
granted on the 11/8/13

Signed [Signature]

Sheet No. 38 of 41



<p>SOURCE: Landsurv (Ref: Landsurv Revision C.pdf dated 23.08.12)</p> <p>SCALE: 1 : 20 000 @ A3</p> <p style="text-align: center;">JWA PTY LTD Ecological Consultants</p>	<p>CLIENT Project 28 Pty Ltd</p> <p>PROJECT Koala Plan of Management Kings Forest Melaleuca Drive, Duranbah, NSW Shire of Tweed</p>	<p>FIGURE 19</p> <p>PREPARED: BW DATE: 19 December 2016 FILE:N97017_Landsurv NPWS ded.cdr</p>	<p>TITLE</p> <p>PROPOSED AREAS TO BE DEDICATED TO NPWS</p>
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LEGEND

- Koala Habitat Onsite**
 - Primary Koala Habitat
 - Secondary (A) Koala Habitat
 - Secondary (B) Koala Habitat
 - Indicative Areas to be dedicated to NPWS**
 - Conservation offset (Nature Reserve addition) land approx total area 180 ha (150 ha per concept plan condition C3, additional 30 ha subject to agreement with NPWS)
 - Kings Forest Boundary
- Note: Final boundaries are subject to agreement with Dept of Planning and Infrastructure

NSW GOVERNMENT Planning

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Approved Application No. 08-0194

granted on the 11/8/13

Signed [Signature]

Sheet No. 38 of 41



SOURCE: Landsurv (Landsurv Revision C.pdf dated 23.08.12); JWA Site Investigations; Biolink Consultants - Tweed Coast Koala Study (2011)
 SCALE: 1 : 20 000 @ A3
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FIGURE 20
 PREPARED: BW
 DATE: 19 December 2016
 FILE:N97017_Habitat NPWS ded.cdr

TITLE **OVERLAY OF EXISTING KOALA HABITAT & PROPOSED AREAS TO BE DEDICATED TO NPWS**

In accordance with Condition 3 of the Major Project Application 08_0194, Project 28 will submit to the Secretary a form of dealing(s) which will be registered on the title to the Potential Council Land (PCL) and future OEH land. This registration will bind all future landowners to manage the dedicated land for conservation purposes (and to prevent any future development activities), ensure compliance with relevant management plans (in particular this Revised KPoM), permit access by the Department, Council and OEH at all times and provide a release for any public authority from the registered dealing(s).

Prior to the commencement of works in a precinct, a registered surveyor will prepare survey plans and permanently mark the boundaries of the PCL and the future OEH land. These plans will be lodged with the Department on a precinct-by-precinct basis.

In accordance with the Kings Forest Concept Plan 06_0318 Consolidated Approval (MODs 1-5 November 2015) Condition B5, Project 28 have amended the Council Land Plan (FIGURE 21). This plan shows the land (environmental and buffer zones) which is to be rehabilitated then dedicated to Council as each precinct is developed, subject to agreement between Project 28 Pty Ltd and TSC in relation to the Terms of Dedication.

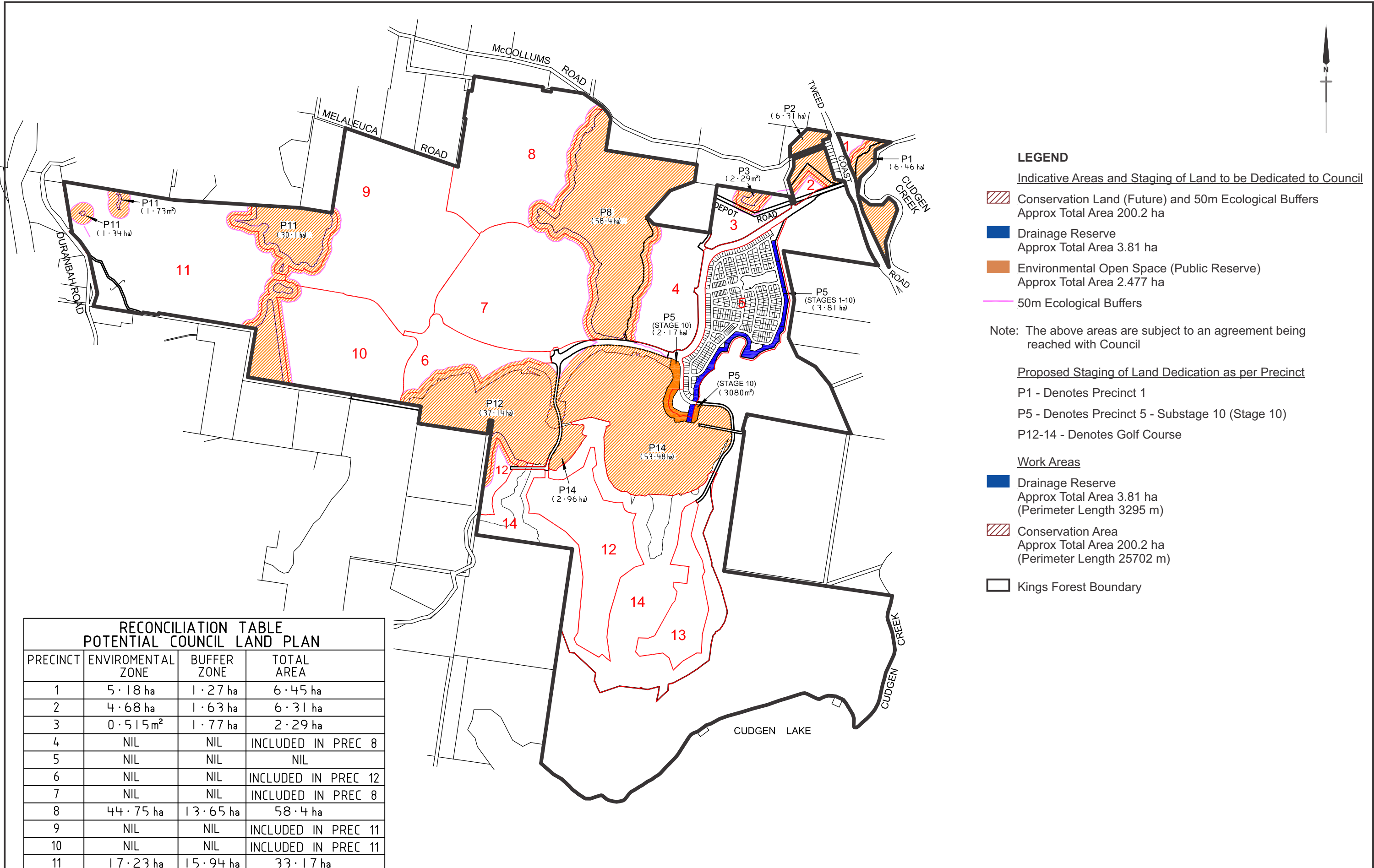
In accordance with Condition A13 of MP08_0194 (as modified) the proponent will manage all Potential Council Land (PCL), future OEH land, and all relevant Koala infrastructure until such time as an agreement is reached regarding the dedication of the land. The Proponent's intention is to dedicate land (FIGURE 21) on a precinct by precinct basis, with all lands proposed to be dedicated prior to 2035. The maintenance of Koala infrastructure on land dedicated with each relevant precinct will become the responsibility of the new land owner at the time of dedication.

8.7 Fire Management

The Kings Forest Stage 1 Bushfire Risk Management Plan (BRMP) (BushfireSafe 2012) outlines risk management strategies that aim to protect property and life and to reduce the threat to ecological and environmental assets. A fundamental strategy of the BRMP is to assess and manage fuel loads within the Kings Forest site. The risk of high intensity fires should be reduced within Koala habitat areas through controlled low intensity burns or mechanical means if and where appropriate. High-intensity hazard reduction burns and wildfires that result in crown scorch or crown fires should be avoided. The proponent will be responsible for bushfire management in the conserved bushland and wetland areas, for an estimated period of five (5) years or until ownership is transferred.

Within Kings Forest, mapped Koala habitat is proposed to be crossed by roads in three (3) places. These roads will constitute a valuable asset for the control of both prescribed burns as well as any wildfires in these areas, and vegetation adjacent to these roads should be managed with this in mind.

Also, within Kings Forest the bushfire risk to vegetation within the golf course area will be substantially addressed by the proposed distributor road through these precincts, but otherwise vegetation should be managed and other measures taken, where appropriate, to meet this risk in relation to Koala habitat values. The proposed golf course may also provide long-term refuge for Koalas and other wildlife in the event of a bushfire (Carrick 2011).



LEGEND

Indicative Areas and Staging of Land to be Dedicated to Council

- Conservation Land (Future) and 50m Ecological Buffers
Approx Total Area 200.2 ha
- Drainage Reserve
Approx Total Area 3.81 ha
- Environmental Open Space (Public Reserve)
Approx Total Area 2.477 ha
- 50m Ecological Buffers

Note: The above areas are subject to an agreement being reached with Council

Proposed Staging of Land Dedication as per Precinct

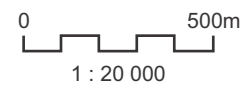
- P1 - Denotes Precinct 1
- P5 - Denotes Precinct 5 - Substage 10 (Stage 10)
- P12-14 - Denotes Golf Course

Work Areas

- Drainage Reserve
Approx Total Area 3.81 ha
(Perimeter Length 3295 m)
- Conservation Area
Approx Total Area 200.2 ha
(Perimeter Length 25702 m)
- Kings Forest Boundary

RECONCILIATION TABLE POTENTIAL COUNCIL LAND PLAN			
PRECINCT	ENVIROMENTAL ZONE	BUFFER ZONE	TOTAL AREA
1	5.18 ha	1.27 ha	6.45 ha
2	4.68 ha	1.63 ha	6.31 ha
3	0.515m ²	1.77 ha	2.29 ha
4	NIL	NIL	INCLUDED IN PREC 8
5	NIL	NIL	NIL
6	NIL	NIL	INCLUDED IN PREC 12
7	NIL	NIL	INCLUDED IN PREC 8
8	44.75 ha	13.65 ha	58.4 ha
9	NIL	NIL	INCLUDED IN PREC 11
10	NIL	NIL	INCLUDED IN PREC 11
11	17.23 ha	15.94 ha	33.17 ha
12	27.79 ha	9.35 ha	37.14 ha
13	NIL	NIL	NIL
14	52.62 ha	3.82 ha	56.44 ha

TOTAL 200.2 ha



SOURCE: Landsurv (Ref: 34860-2_PROJECT APPLICATION NPWS AND COUNCIL DEDICATION _REV J-a_151126_EMAIL.pdf Rev J-a dated 26.11.15)
SCALE: 1 : 20 000 @ A3
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Ecological Consultants

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FIGURE 21

PREPARED: BW
DATE: 19 December 2016
FILE:N97017_Landsurv council ded.odr

TITLE **POTENTIAL COUNCIL LAND WITH WORK AREAS (EXCLUDING PROPOSED LOCAL PARKS)**

Adjacent to Kings Forest, the particular area of concern in terms of bushfire threat is the Cudgen Nature Reserve, including the lands currently forming part of the Kings Forest site to be added to the Reserve. The Cudgen Nature Reserve Fire Management Plan should be amended to include these additional areas. Furthermore, Koalas and Koala habitat should be particularly considered in a review of the Fire Management Plan in light of information provided by Phillips *et al.* (2011) regarding fire and Koalas within the Tweed Coast strip (SECTION 6.7).

Condition 34 of the MP 08_0194 requires that Project 28 engage with OEH, Council and the Rural Fire Service to amend the Bushfire Risk Management Plan so as to ensure that a co-operative effort to minimise the potential for wildfires and fire frequencies that impact on Koalas occurs.

The design of proposed exclusion fencing adjacent to Koala habitat areas has been devised with consideration to fire management issues (i.e. will funnel Koalas towards underpasses) (SECTION 8.9).

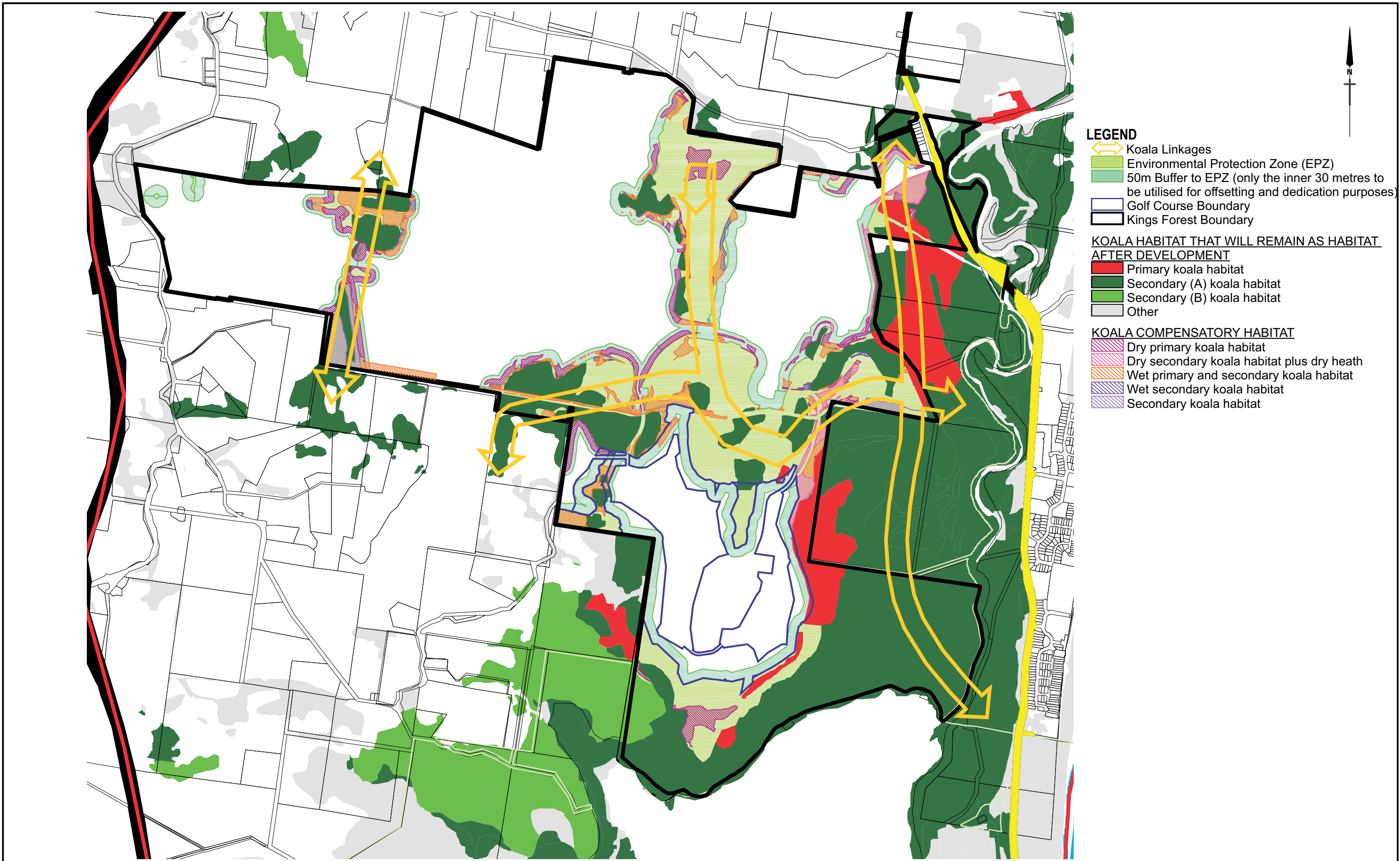
8.8 Improving Habitat Connectivity and Linkage Corridors

The maintenance of habitat patches of sufficient size to support existing populations and provide for future population expansion is fundamental to Koala population and habitat management within the Tweed Coast (Phillips *et al.* 2011). Three (3) recommendations are proposed by Phillips *et al.* (2011) as follows:

- 1) Retention of potential koala habitat *in-situ* in the first instance, with a focus on occupied habitat, and adjoining areas of potential Koala habitat. Protection of bushland containing large size-class Tallowwood and Grey gum is also necessary to preserve the habitat resource on NFM soil landscapes.
- 2) Maintenance and creation of vegetated linkages between habitat patches and source populations.
- 3) Strategic revegetation work with the aim of consolidation of existing habitat patches and habitat creation. Revegetation work should focus primarily on “gap-filling” in large habitat blocks within and adjacent to mapped source populations, edges of habitat blocks and within linkage areas. Indicative linkage areas for the focusing of habitat retention and creation are provided (FIGURE 22).

A Key Action to be implemented in accordance with this Revised KPoM is the maintenance of a high degree of connectivity to service the Koala population whose home ranges are principally located within Kings Forest, as well as those Koalas whose home ranges are located largely on adjacent areas of habitat (e.g. Cudgen Nature Reserve). Koala exclusion fences, designed to exclude Koalas from the residential areas of the site, will be located on the edges of retained habitat areas and within buffer areas (SECTION 8.9.3). The use of grids and underpasses will allow for unimpeded Koala movements.

All significant movement/dispersal corridors (FIGURE 13) will be retained as part of the proposed development and the East-West and Cudgen Lake corridor will be bolstered and enhanced through the revegetation of site-appropriate species including Koala food trees.



LEGEND

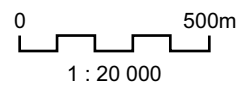
- Koala Linkages
- Environmental Protection Zone (EPZ)
- 50m Buffer to EPZ (only the inner 30 metres to be utilised for offsetting and dedication purposes)
- Golf Course Boundary
- Kings Forest Boundary

KOALA HABITAT THAT WILL REMAIN AS HABITAT AFTER DEVELOPMENT

- Primary koala habitat
- Secondary (A) koala habitat
- Secondary (B) koala habitat
- Other

KOALA COMPENSATORY HABITAT

- Dry primary koala habitat
- Dry secondary koala habitat plus dry heath
- Wet primary and secondary koala habitat
- Wet secondary koala habitat
- Secondary koala habitat



SOURCE: Dr Frank Carrick 2008 in KPoM (2009);
 Ecolndig Resources; Biolink; JWA Supp. PD (2014);
 Terrestria (March 2014); G&S (pers. comm. 2014)
 SCALE: 1 : 20 000 @ A3
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FIGURE 22
 PREPARED: BW
 DATE: 13 March 2017
 FILE: N97017_OM2B Linkages.cdr

TITLE
**PROPOSED
 KINGS FOREST
 KOALA LINKAGES**

Therefore, connectivity and genetic dispersal between significant Koala populations identified to the south of the Kings Forest site will be maintained.

The Kings Forest Concept Plan application discussed the efficacy of promoting a corridor to the north-west, linking Kings Forest and Stotts Island Nature Reserve. Carrick (2009) noted that, whilst there are some sparsely vegetated linkages extending from the eastern side of the Cudgen road fauna overpass to Stotts Island Nature Reserve, several kilometres of open agricultural fields occur to the west of the Pacific Motorway. An extension of the East-West corridor to the north-west may facilitate the dispersal of wildlife from Cudgen Nature Reserve (CNR) to SINR. However, the value this would provide for Koalas is negligible due to limited suitable habitat and the barrier effect of the canal between the south side of the island and the southern bank of the Tweed River. It is also unlikely to provide an effective linkage between other habitats of regional importance due to intervening land-uses and major barriers such as the Pacific Motorway and Tweed River (FIGURE 5).

The following actions would be necessary if an East-West corridor in the northern portion of the Kings Forest site were to provide effective fauna movement to the north-west:

- Revegetation of cleared grazing lands and portions of sugar cane land; and
- Structures provided to funnel fauna to the Motorway land bridge (Cudgen road fauna overpass).

However, the prospect of the long-established sugar cane fields to the north and west of the Kings Forest site becoming revegetated, so as to offer meaningful habitat for native wildlife, is considered extremely remote.

Regardless of the fact that a corridor to the north-west was promoted in the Concept Plan application, it is considered that a more appropriate location for an extension of the East-West corridor would be in the direction of the Eviron Road underpass to the south-west (FIGURES 5 & 13). This may require some revegetation around the decommissioned Turner's sand quarry lake (FIGURE 5) and extensive revegetation within adjacent agricultural properties between the existing East-West corridor and the Eviron Road underpass. This is a view supported by the Tweed Shire Council (M. Kingston, *pers. comm.* 15 June 2012). Extending the East-West corridor in this direction could potentially link the Kings Forest site to habitat areas in the south that are of regional significance, such as the Mooball National Park and Mount Jerusalem National Park (FIGURE 5).

The concept of an East-West corridor with links to the Eviron Road underpass will be a matter for discussions and lobbying involving Tweed Shire Council, Koala interest groups, Project 28 and the various landowners in the proposed path of the corridor. The discussions and planning should not be based on the prospect of the corridor being planned to the north-west (Stotts Island Nature Reserve). Project 28 will complete the revegetation of the relevant Environmental Protection Zones and buffer zones between Precincts 9/10 and Precinct 11, and including a 50m wide vegetated corridor along the southern boundary of Precinct 10, as foreshadowed in the Condition B4 and C28 of the Concept Plan Approval 06_0318 (FIGURE 17). It is anticipated that these Environmental Protection Zones and vegetated buffers will form part of the long-term provision of a habitat linkage to the south-west of the site (i.e. to the Eviron Road underpass).

8.9 Implementation of Exclusion Fencing, Fauna Underpasses and Road Crossing and Other Infrastructure

8.9.1 Introduction

The Kings Forest development proposal adopts an ‘exclusion’ approach, as promoted by both DoE (2014a and 2014b) and Hopkins and Phillips (2009). This method effectively separates Koalas and their habitat from the development and its related threats, whilst maintaining and enhancing existing habitat linkages. By preventing Koalas from entering residential areas, exclusion fencing and associated structures are also likely to prohibit Koalas from dog and swimming pool related injury or death. All future applications for Kings Forest will demonstrate that provision has been made for the construction and implementation of specific traffic features where relevant in compliance with Condition C8 of the Concept Plan Approval 06_0318. All infrastructure designed to mitigate impacts on Koalas (exclusion fencing, grids and signage) will be in place prior to the commencement of construction in each relevant Precinct. Fauna underpasses will be constructed as part of road construction.

8.9.2 Literature Review

DoE (2014a) notes that a reduction in the risk of fragmentation impacts on Koalas can be achieved by the construction of land bridges, road tunnels bridges and underpasses. These mitigation features are discussed below:

Land Bridge - also known as an eco-duct or wildlife bridge. This is a (typically) wide bridge that extends over the road. The bridge has soil placed on it, vegetation planted and enhanced with other habitat features (e.g. logs, rocks, water body). It may include a path or road for human passage across it.

Road Tunnel - the road is tunneled through a hill or under the ground to protect an important patch of habitat or landscape corridor. It may be drilled or constructed as a “cut and cover” tunnel.

Bridge - a strong structure to allow only the access and use of Koalas and other arboreal animals. Design, durability and the necessary maintenance interval will depend on the materials used to construct the bridge and where it is constructed. However, it is recommended that only treated pine logs should be used to construct vertical (or near vertical) climbing poles or frames at each end of the bridge designed for only arboreal animal to access it. It is also recommended that bridges be located at waterway crossings.

Underpasses (reinforced concrete box cell culverts) - are one or more adjacent, enclosed channels below the road formation and typically located where drainage along a watercourse is required. Culverts are laterally square (box culvert), rectangular or semi-circular in shape. So that Koalas will be able to move through, a culvert should be:

- A maximum 40 m in length
- A minimum 2.4 m in height and width, and

- Have a low-flow channel incorporated in the design, especially if they are a combined drainage and Koala-impact-mitigation structure.

Benches along underpasses should be installed:

- Longitudinally along both side walls of a culvert to allow the passage of Koalas and other fauna through it, and
- Well above the average water level in the drainage line running through the culvert so that Koalas can walk along the bench at most times (i.e. water levels will usually be lower than the height of the bench).

Strategically retain preferred food trees near (preferably within 25 m) the proposed roadside as habitat retention and a means of providing assistance to the movement of Koalas to the overpass or underpass (also see Goldingay and Dobner 2014). Use strategic plantings of preferred habitat tree species to supplement retained trees, or compensate for loss of preferred habitat trees. Plantings must occur in depths of soil appropriate for the healthy, long-term survival of the plant species to be grown.

In addition to the specifications listed above, reinforced concrete box culverts (RCBC) height should reflect the length of the under-road traverse. Rule of thumb based on data from monitoring studies show that minimum 1.5 m high culverts will accommodate koala movement needs up to a maximum under road traverse (headwall to headwall) of 35 m, min 1.8 m high culverts will cover koala movement needs up to a maximum under-road traverse (h2h) of 50 m, min 3 m high up to an 80 m traverse. If the RCBC is occasionally wet underfoot, then retro fitting with furniture (including rails and/or ramps) would be advantageous to ensure year-round dry access (Dr S. Phillips *pers. comm* 18 March 2016).

Land bridges, road tunnels and bridges will not be utilised on the Kings Forest site. The topography of the Kings Forest site is such that these structures are either unsuitable because of the relatively flat nature of the site or other more effective structures are preferred (e.g. underpasses).

DoE (2014b) contains an assessment of the effectiveness of mitigation measures designed to reduce the impact of fragmentation on Koalas. All of these measures have been considered in the preparation of this Revised KPoM.

The location and design of Koala fencing combined with the use of grids and underpasses as discussed in the following sections, will allow for unimpeded Koala movements between Environmental Protection Zones, proposed golf course compensatory habitat areas and adjacent vegetated properties.

Hopkins and Phillips (2009) note that regular checking of fencing, grids and underpasses and the detection and addressing of maintenance issues as they arise are critical to the ongoing functionality of these structures as ameliorative measures. Hence, vegetation adjacent to the fence will be maintained to remove fallen branches and vines growing on the fence to maintain fence effectiveness, and trim trees where they may link to tree canopies on the other side of the fence

8.9.3 Fauna Exclusion Fencing

A Key Action to be implemented in accordance with this Revised KPoM is the use of exclusion fencing where necessary to mitigate the potential impacts associated with roads constructed in and adjacent to Koala habitat and preclude the need for any traffic calming devices (other than the relevant speed limits). Koala exclusion fencing will be constructed on both sides of all roads in environmental protection zones. Exclusion fencing will be configured so as to funnel Koalas and other fauna to underpasses for facilitated movement between protection areas. All exclusion fencing will be in place prior to the commencement of construction in each relevant Precinct.

The design of the permanent Koala exclusion fencing to be utilised over the entire Kings Forest site is shown in FIGURE 23. Temporary fencing is to be comprised of 1.5 m high wire mesh held upright by star pickets (FIGURE 24). Where the permanent fencing occurs in buffer zones, the fencing will be located within the 20m Outer Protection Zone, generally three (3) metres to the development side of the boundary between the 30m Inner Protection Zone and 20m Outer Protection Zone (FIGURE 25). Where the length of fencing (permanent or temporary) in buffer zones is greater than 100 metres, a gate will be provided to allow access for routine rehabilitation work and monitoring. Given the number of gates that may be provided on the entire site, no locks on the gates will be required for the duration of the site development. Secure fastening structures must, however, be provided for each gate. At the completion of the monitoring program locks will be provided to all gates. Keys will be held by Tweed Shire Council and OEH (NPWS) where appropriate.

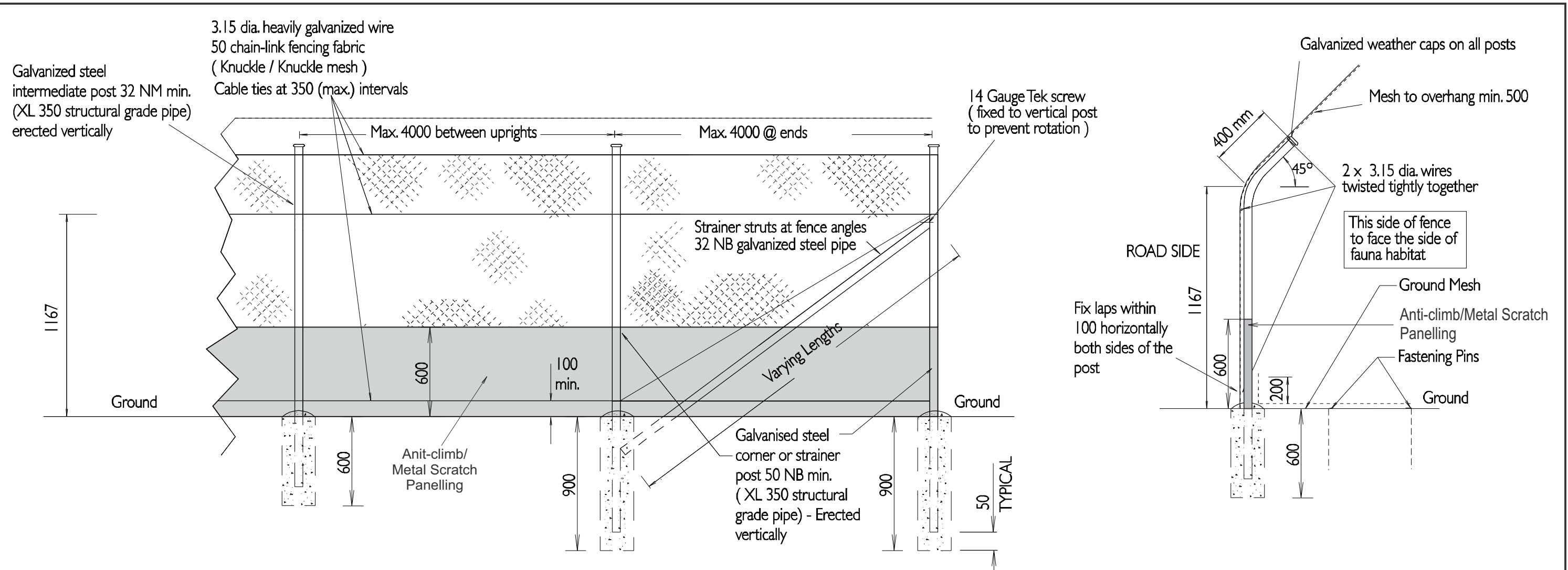
Temporary signage at approximately 100 m intervals will be provided along all fencing during the construction phase stating “Environmental Protection Zone - No Unauthorised Entry”.

Koala exclusion fencing (and associated grids and underpasses etc.) are to be regularly checked and maintenance issues addressed as they arise, including vegetation in close proximity to the fencing, in accordance with SECTION 10 of this Revised KPoM. Fence maintenance will remain the responsibility of the Proponent until ownership of the land is transferred to a third party. The Proponents intention to dedicate land (FIGURE 21) on a precinct by precinct basis, with all lands proposed to be dedicated prior to 2035. Two (2) inspections will be completed per year (at least three (3) months apart) in combination with signage inspections. Any damage to fences will prompt immediate repair, within two (2) working days of the discovery of the damage, by Site or independent contractors as determined by the Site Manager.

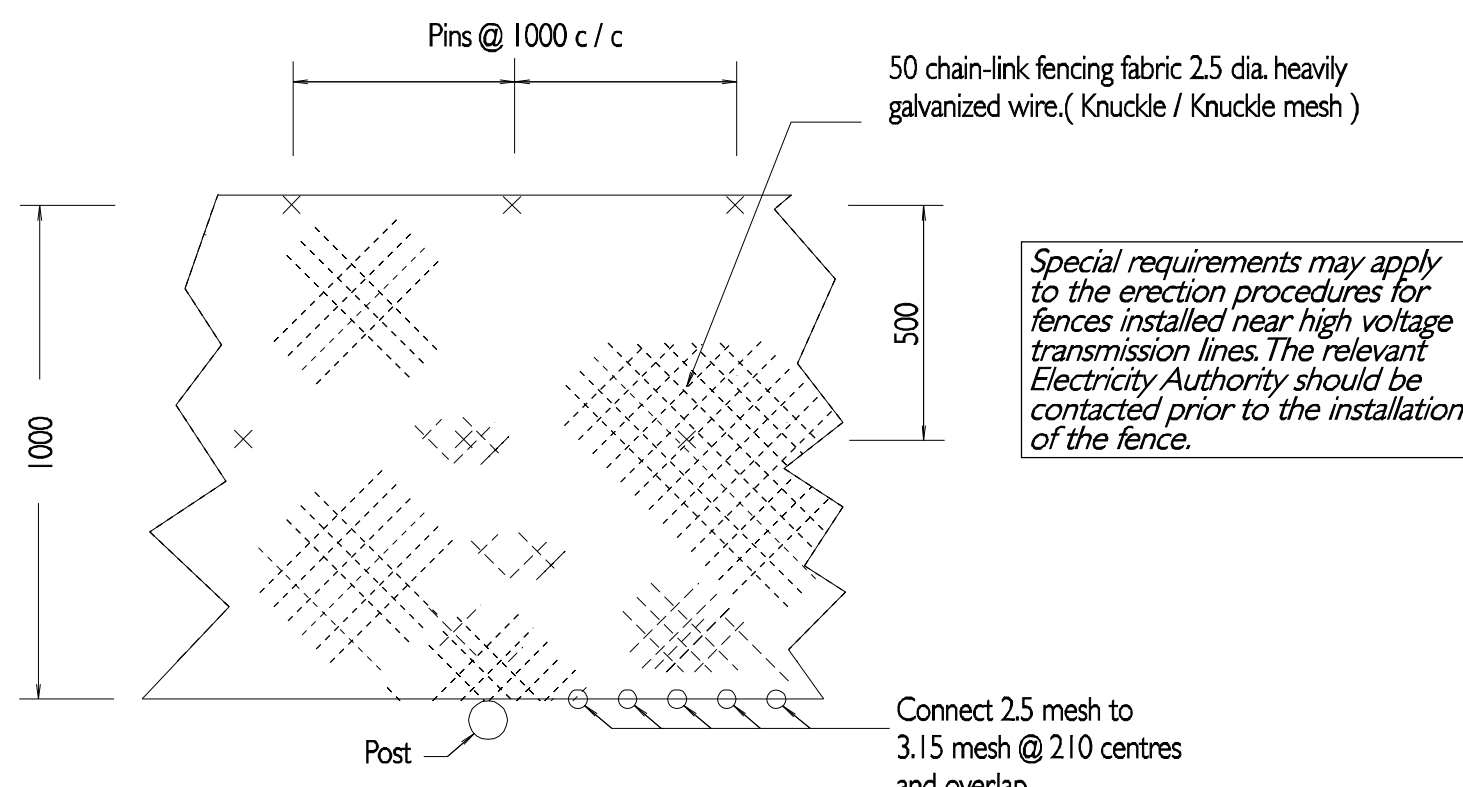
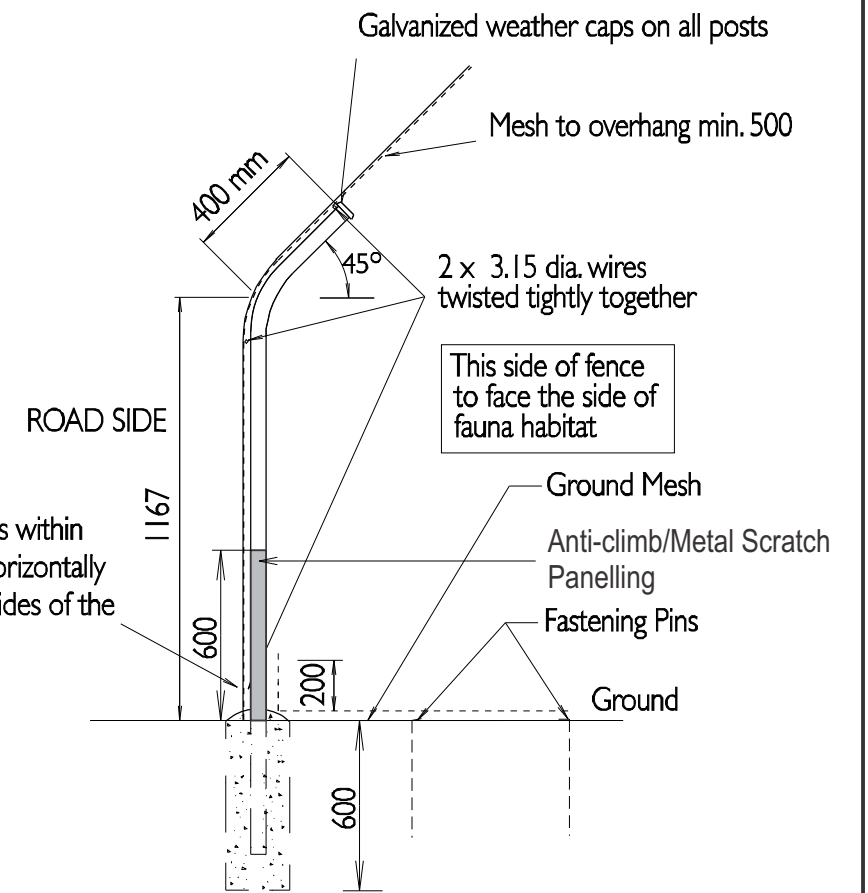
There will be no requirement to trim overhanging canopies where they do not link with canopies on the other side of the fence, nor will tree guards be required to prevent Koalas climbing trees adjacent to fences, as it is very highly unlikely that any Koala would fall from a tree into a road reserve (Dr S. Phillips *pers. comm.* 20 January 2016).

8.9.4 Fauna Underpasses

A Key Action to be implemented in accordance with this Revised KPoM is the installation of fauna underpasses at strategic locations throughout the development to allow for the continued movement/dispersal of Koalas (and other native terrestrial fauna species). All underpasses will be installed during road construction in each relevant Precinct.

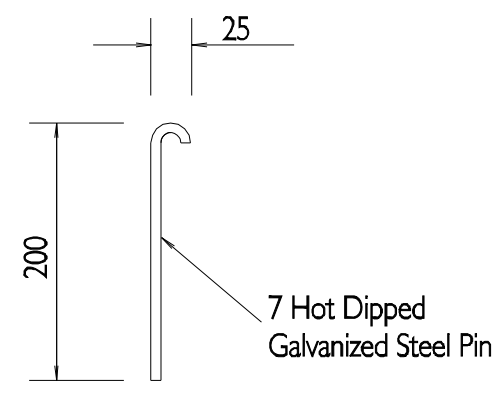


ELEVATION



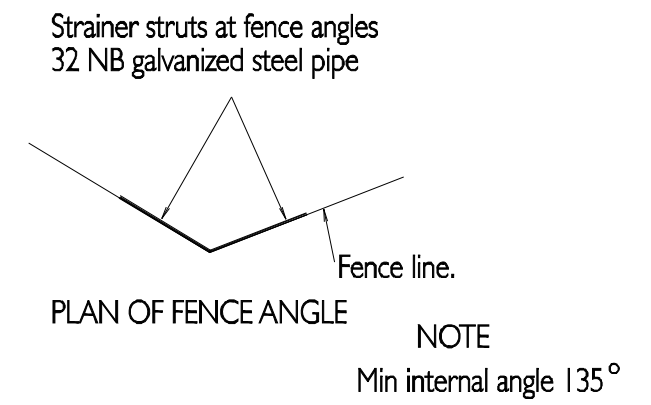
GROUND MESH FIXING DETAIL

Special requirements may apply to the erection procedures for fences installed near high voltage transmission lines. The relevant Electricity Authority should be contacted prior to the installation of the fence.



FASTENING PIN DETAIL

NOTE
For loose or sandy soils 350 (min.) galvanised fastening pins must be used



All dimensions are in millimetres unless otherwise shown.

SOURCE: NSW RTA Design Reference Documents - Koala Exclusion Fence SCALE: Not to Scale JWA PTY LTD Ecological Consultants	CLIENT Project 28 Pty Ltd PROJECT Koala Plan of Management Kings Forest Melaleuca Drive, Duranbah, NSW Shire of Tweed	FIGURE 23	TITLE PERMANENT KOALA EXCLUSION FENCING DESIGN
		PREPARED: BW DATE: 19 December 2016 FILE: N97017_Design Fencing.cdr	



SOURCE: NSW RTA Bonville Upgrade -
Community Update Jan 2008

SCALE:

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Ecological Consultants

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Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

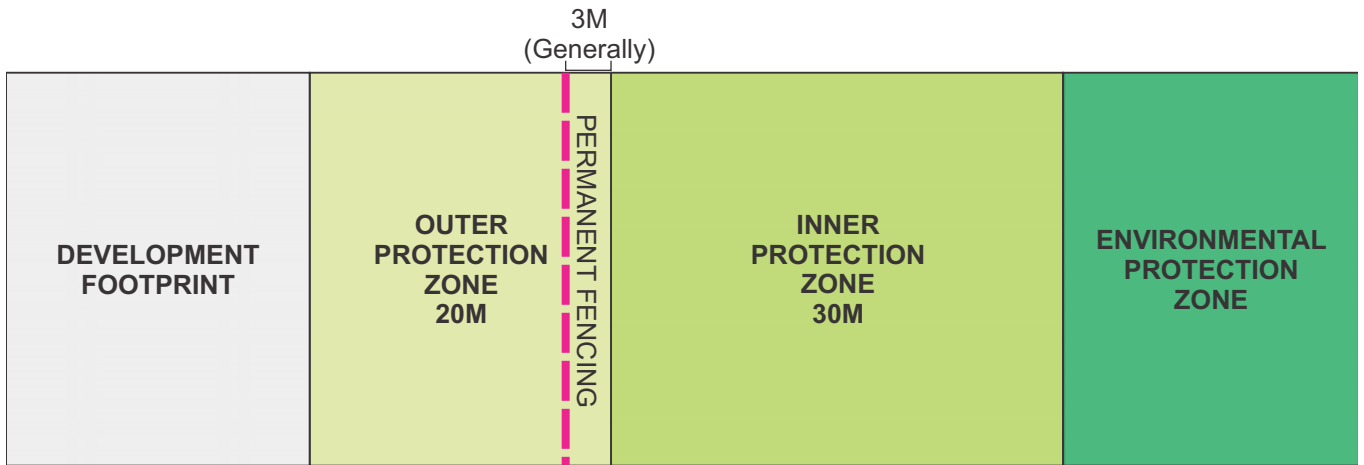
FIGURE 24

PREPARED: BW
DATE: 19 December 2016
FILE: N97017_NPWS Corridors.cdr

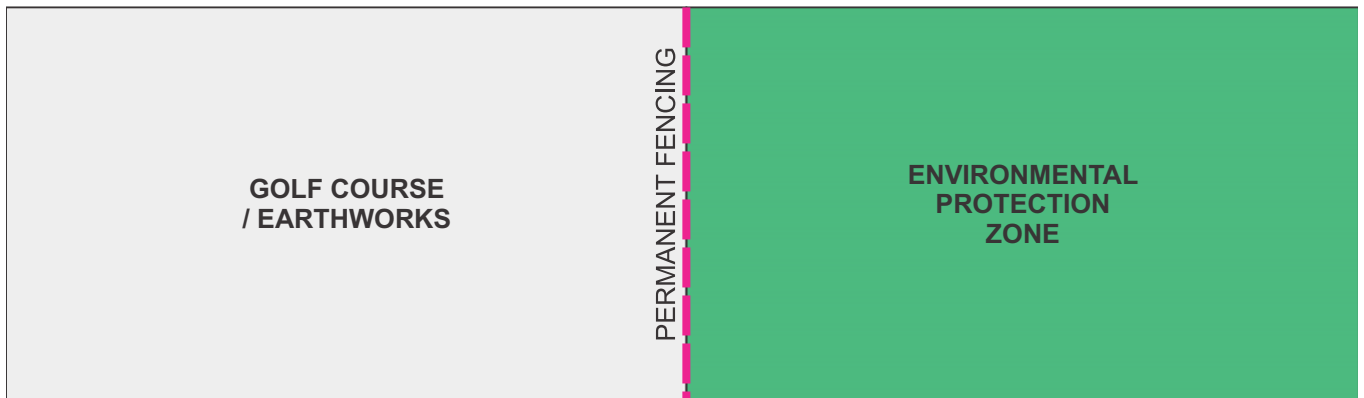
TITLE

**TEMPORARY
FENCING
DESIGN**

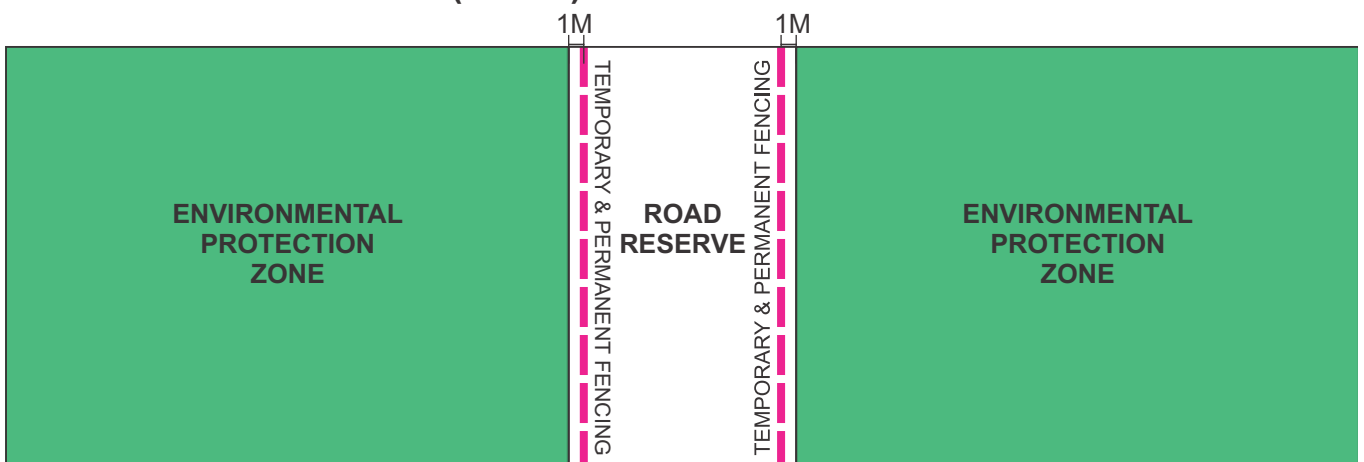
INDICATIVE LOCATION OF PERMANENT FENCING



INDICATIVE LOCATION OF PERMANENT FENCING IN CUDGEN Paddock



INDICATIVE LOCATION OF TEMPORARY AND PERMANENT FENCING ALONG SOUTHERN ACCESS ROADS AND WHEREVER ENVIRONMENTAL PROTECTION ZONES (EPZ'S) OCCUR ON BOTH SIDES OF THE ROAD



SOURCE: JWA

SCALE: 1 : 500 @ A4

JWA PTY LTD
Ecological Consultants

CLIENT
Project 28 Pty Ltd
PROJECT
Koala Plan of Management
Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 25

PREPARED: BW
DATE: 22 December 2016
FILE: N97017_Fencing.cdr

TITLE

**FENCING
LOCATION
GUIDE**

All underpasses will be constructed in accordance with the design features shown in FIGURES 26A and 26B. Koala underpasses will be 1.8 m high x 2.4 m wide reinforced concrete box culverts in accordance with the design recommended in the Koala-sensitive Design Guideline (DEHP 2012) (i.e. a minimum of 1.5 m high x 1.5 m wide when length of under-road traverse is less than 40 m long) and Phillips pers. comm. March 2016. Taylor and Goldingay (2003) found that Koalas were utilising culverts that were 2.4 m wide, 1.2 high and 18 m long. Where an underpass crosses beneath a dual carriageway or a road with a centre island, skylights will be incorporated. The placement of raised interconnecting logs (e.g. treated pine) through underpasses will be utilised to provide a means of Koala access in times of inundation (or to avoid predation) if necessary (EPA 2006; AMBS 2012). The vertical logs will be secured to the invert of the concrete base slab and soffit of the culvert ceilings by suitable attachment brackets. In addition, underpasses will incorporate a low flow channel to ensure dry fauna access is provided during normal flow conditions.

In accordance with the recommendations provided by Hopkins and Phillips (2009), a minimum of five (5) Koala food trees will be planted on both sides of these underpasses within a radius of 20 m of the openings to encourage Koala traverses and ensure safe refuge.

8.9.5 Road Crossing Infrastructure

The design features of the grids to be utilised on the Kings Forest site are shown in FIGURE 27. Appropriate lighting (i.e. directing light towards the road and away from Koala habitat) will be provided at all grids in order to minimise the potential for vehicle related fauna mortalities whilst ensuring that adverse effects to adjacent Koala habitat (from light emanation) are also reduced. Vandal proof signage will also be provided to ensure motorists are aware of the possibility of encountering Koalas and other fauna on roads that traverse environmental areas. Residents will be made aware of the purpose of the exclusion fencing and grids and the possibility of encountering koalas and other fauna on roads that traverse through environmental areas by the fixing and maintaining educational, vandal proof signage (at intervals of no more than 100 m). Signage will include contact information for incident reporting.

Escape mechanisms (treated pine climbing logs designed in accordance with FIGURE 28) will be strategically provided every 50 m within road corridors adjacent to Koala habitat.

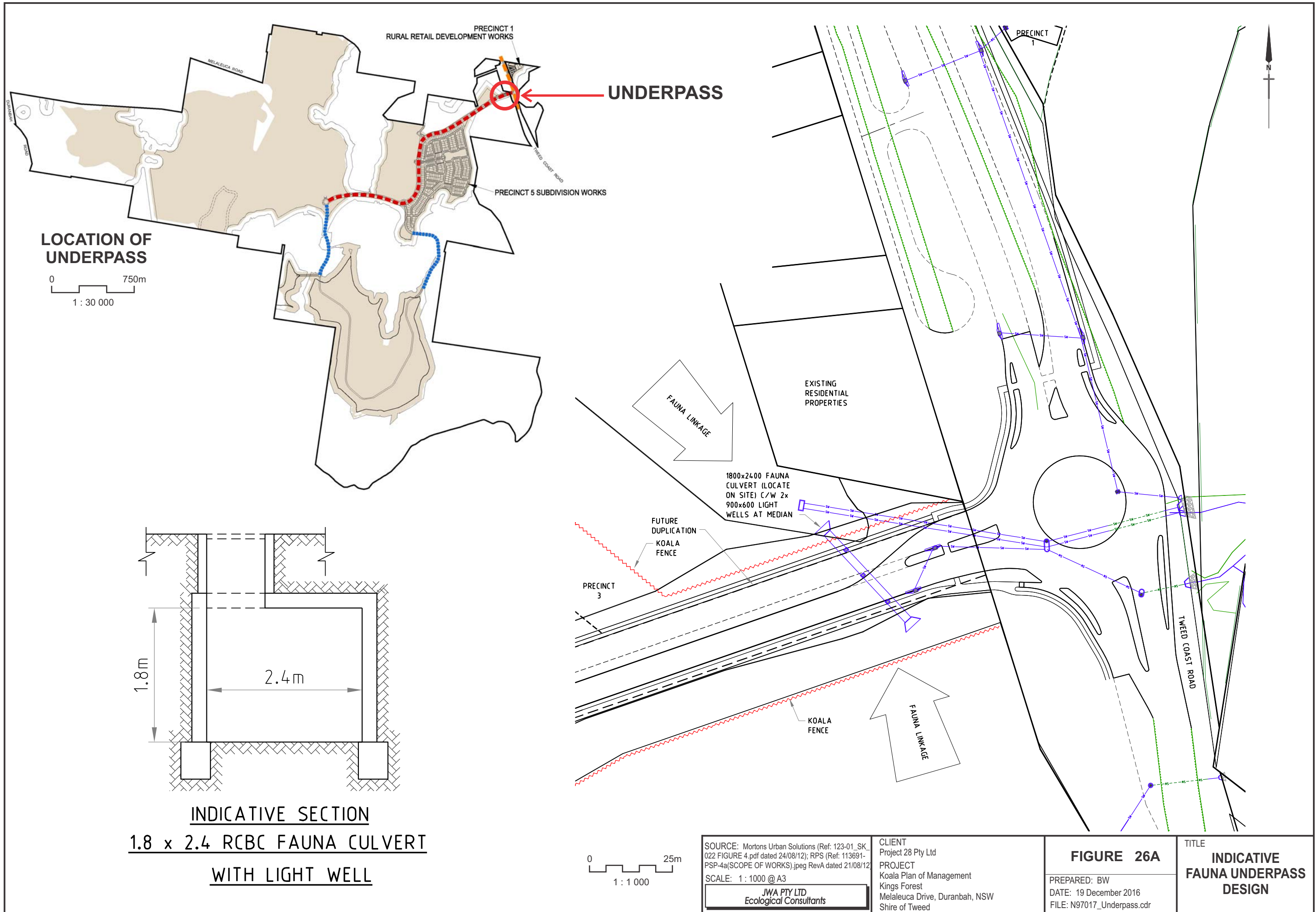
Grids will be installed during road construction in each relevant precinct. All signage and escape mechanisms will be in place prior to the commencement of construction in each relevant Precinct.

8.9.6 Other Infrastructure

All street lighting will be capped and/or positioned to minimise light spill into retained Koala habitat and habitat rehabilitation areas.

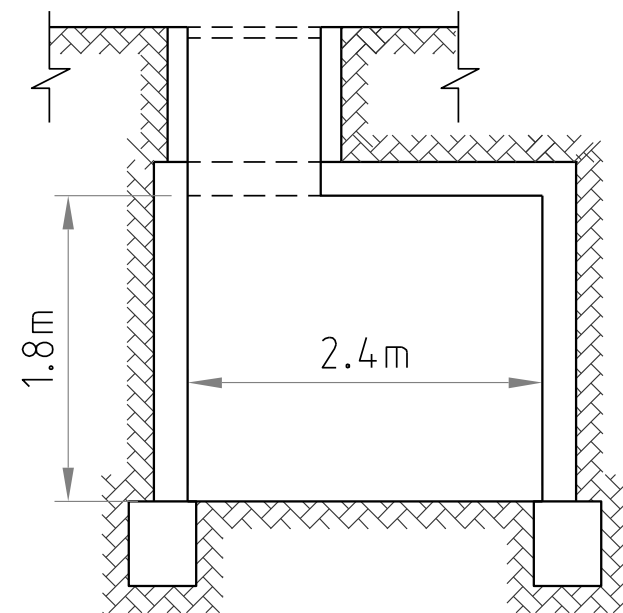
8.10 Preventing Koala Contact with Dogs

The proposed development will emphasise the separation of residential areas (and pet dogs) from Koala habitat. This will be achieved by way of constructing koala proof fencing and installing road grids as discussed in SECTION 8.9 above. The proposed fence design (FIGURE 23) is considered more than adequate to prevent dogs from entering Koala habitat areas (Dr S.



LOCATION OF UNDERPASS

0 750m
1 : 30 000



INDICATIVE SECTION
1.8 x 2.4 RCBC FAUNA CULVERT
WITH LIGHT WELL

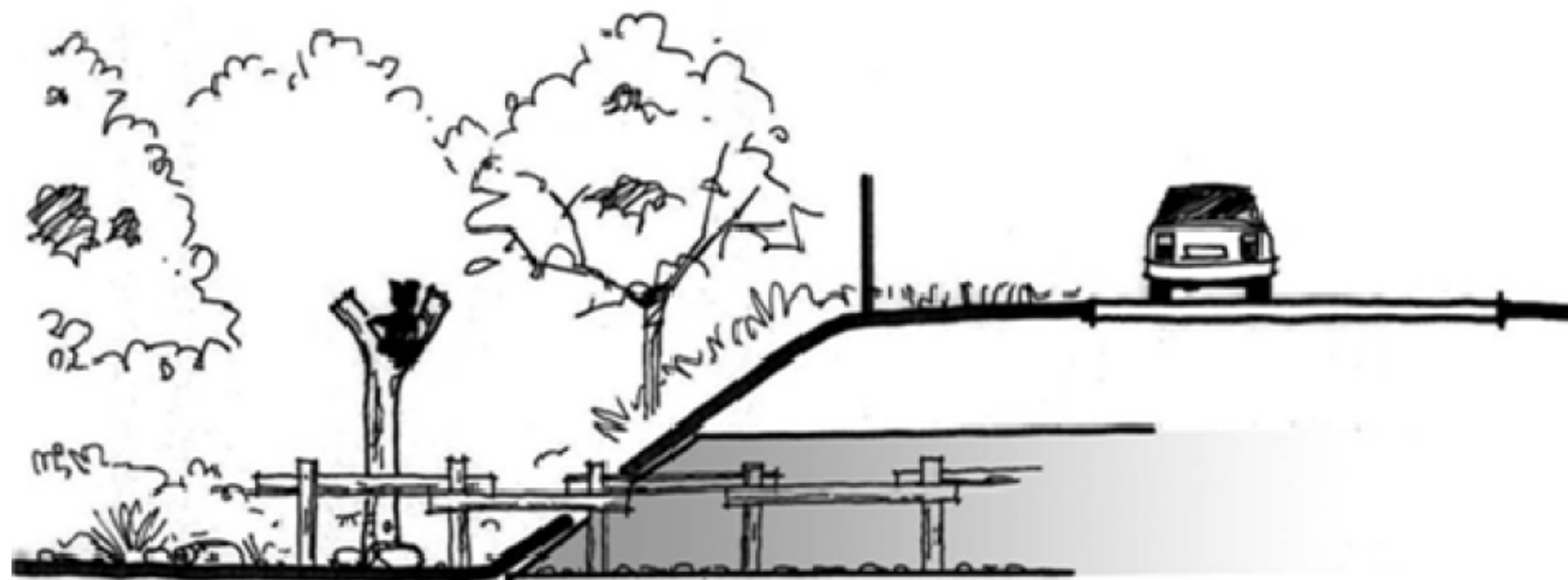
0 25m
1 : 1 000

SOURCE: Mortons Urban Solutions (Ref: 123-01_SK_022 FIGURE 4.pdf dated 24/08/12); RPS (Ref: 113691-PSP-4a(SCOPE OF WORKS).jpeg RevA dated 21/08/12)
SCALE: 1 : 1000 @ A3
JWA PTY LTD
Ecological Consultants

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Project 28 Pty Ltd
PROJECT
Koala Plan of Management
Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 26A
PREPARED: BW
DATE: 19 December 2016
FILE: N97017_Underpass.cdr

TITLE
INDICATIVE FAUNA UNDERPASS DESIGN



SOURCE: DTMR 2010 Fauna Sensitive Road Design Manual Vol 2

SCALE: Not to Scale

JWA PTY LTD
Ecological Consultants

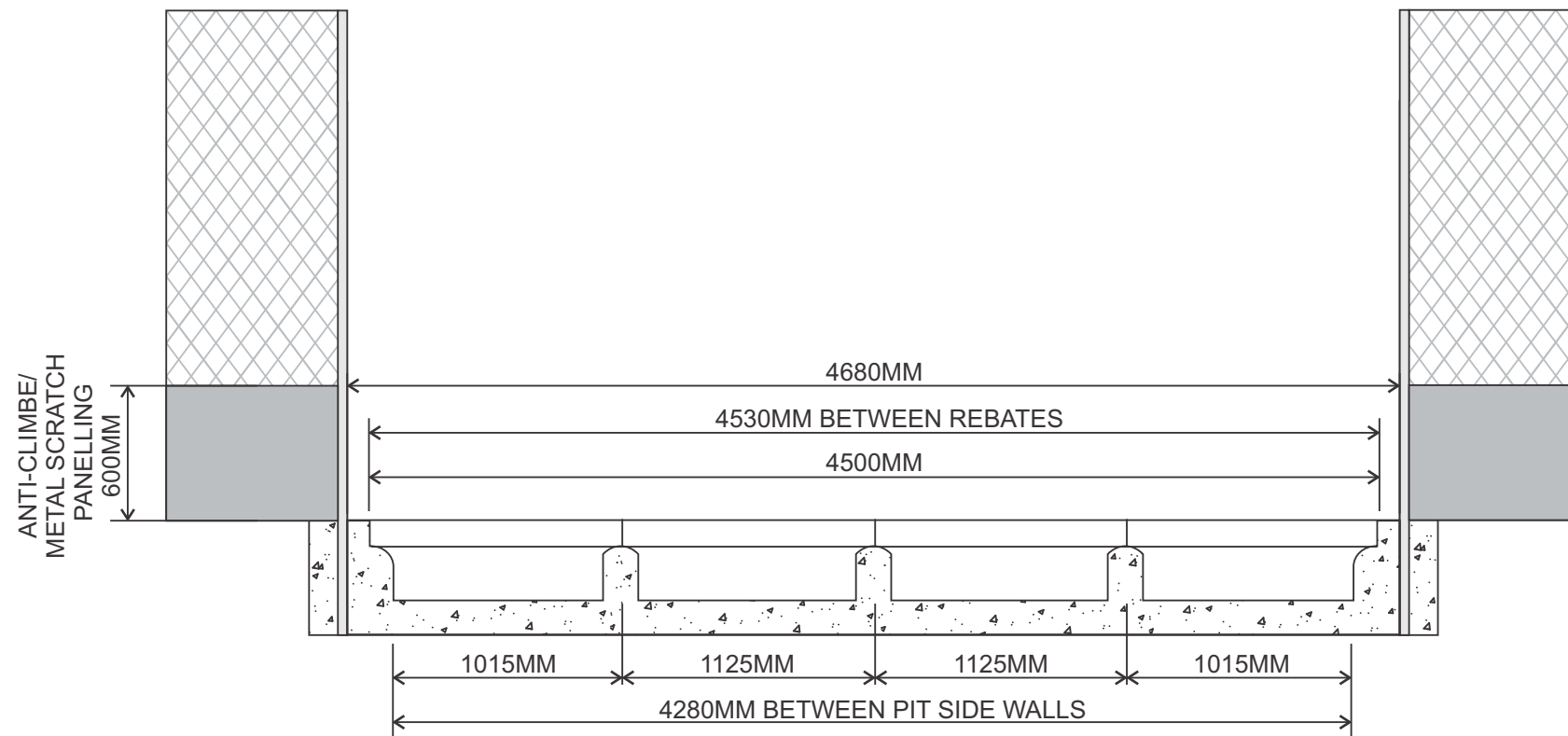
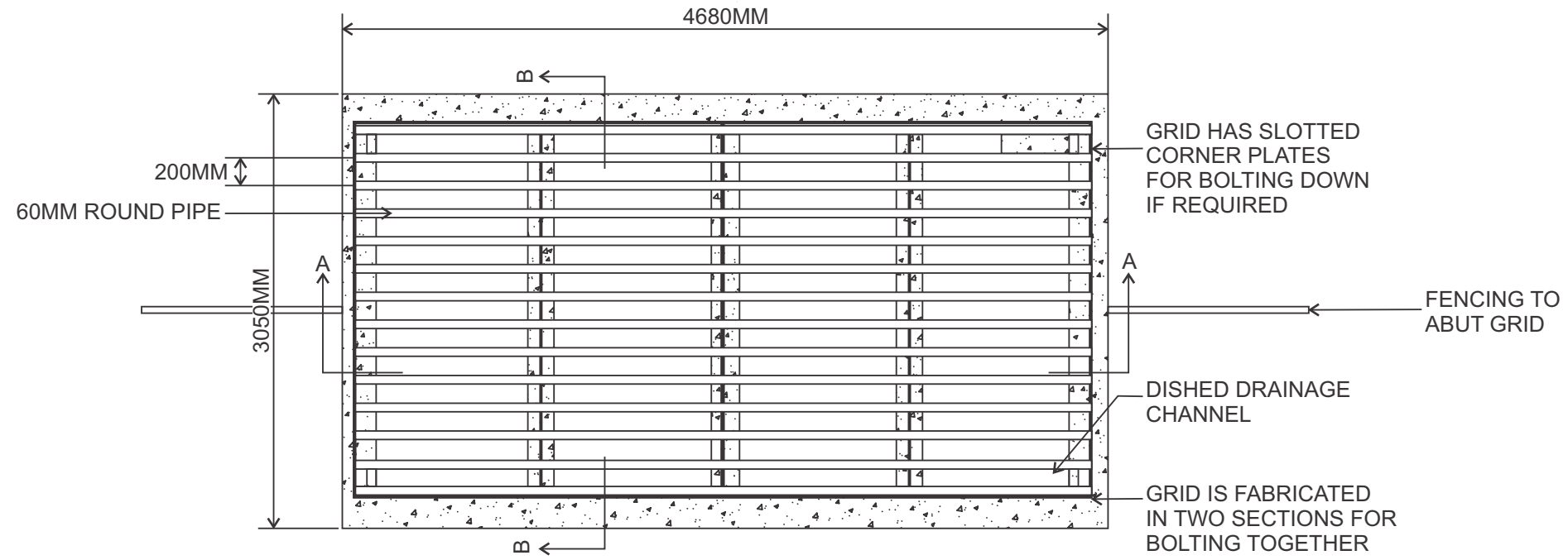
CLIENT
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Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 26B

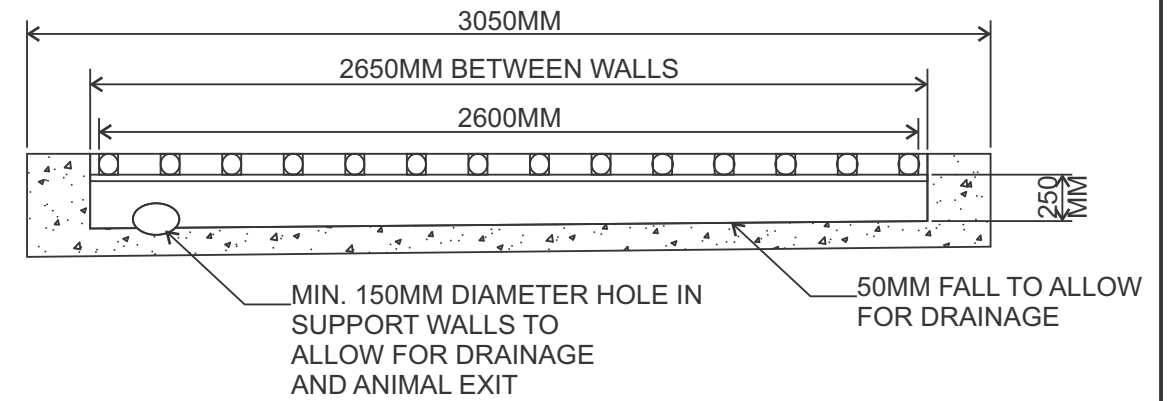
PREPARED: BW
DATE: 19 December 2016
FILE: N97017_Underpass.cdr

TITLE
**INDICATIVE
FAUNA UNDERPASS
FURNITURE**

INDICATIVE DESIGN FOR 40 TONNE CAPACITY SPECIALLY DESIGNED KOALA GRID



SECTION A-A



SECTION B-B

SOURCE: Unknown Source

SCALE: Not to Scale

JWA PTY LTD
Ecological Consultants

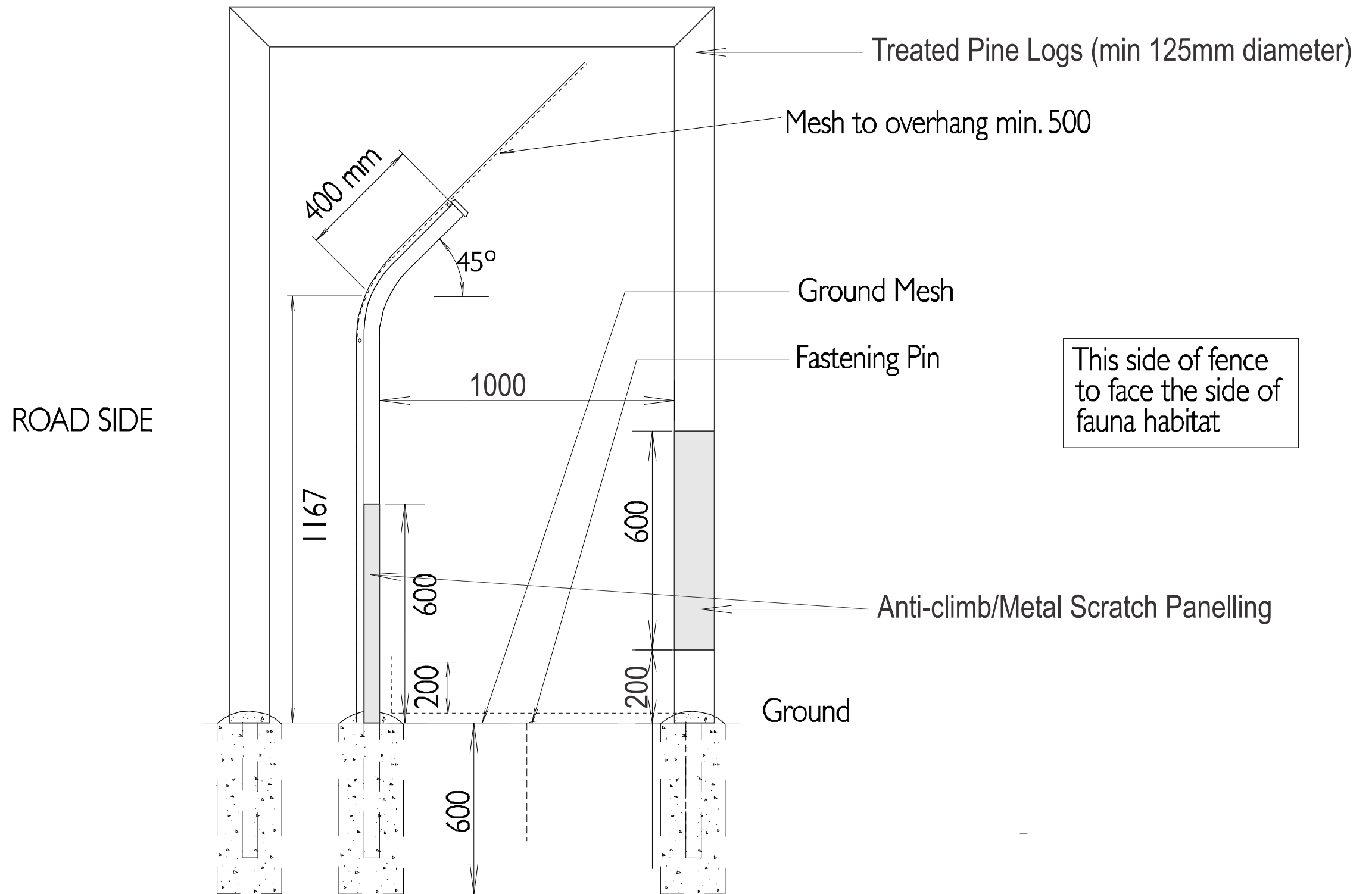
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Kings Forest
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 27

PREPARED: BW
DATE: 19 December 2016
FILE: N97017_Design Grid.cdr

TITLE

INDICATIVE
GRID DESIGN



SOURCE: JWA; NSW RTA Design Reference Documents - Koala Exclusion Fence
 SCALE: Not to Scale
 JWA PTY LTD
 Ecological Consultants

CLIENT
 Project 28 Pty Ltd
 PROJECT
 Koala Plan of Management
 Kings Forest
 Melaleuca Drive, Duranbah, NSW
 Shire of Tweed

FIGURE 28
 PREPARED: BW
 DATE: 19 December 2016
 FILE: N97017_Design Escape.cdr

TITLE
**KOALA
 ESCAPE
 MECHANISM**

Phillips *pers. comm.* 20 January 2016). Escape poles will be provided on the residential side of the permanent fences. Dog control within the confines of the residential development will be a matter for Tweed Shire Council as it is in any other residential area of Tweed Shire. It is contended that the Koala-proof fencing will not only prevent Koalas accessing the residential areas it will prevent pet dogs from accessing Koala habitat.

Signage will be erected in strategic locations within any public open space area and at fauna underpasses advising residents that Koalas are active in the area and dogs should be kept on a leash at all times and encourage residents to keep dogs in enclosed yards between the hours of 6pm and 6am.

Any evidence of dogs within EPZs (sightings, footprints, droppings, dead or injured koalas) observed when conducting routine monitoring or maintenance in or near EPZs should be reported to the Site Manager immediately and will trigger an investigation as discussed further in Section 11.2.3.

It is not intended to provide any off-leash dog exercise area within Kings Forest. Such areas are provided by Council at South Kingscliff beach, South Fingal/Kingscliff beach, South Cabarita beach, Corowa Park and Turnock Park. The provision of an off-leash dog exercise area within the western parts of Kings Forest may be considered in future Project Applications/Development Applications in relation to residential subdivision of that part of the property.

Control of wild dogs in conserved habitat will be discussed by Project 28 during meetings with the Koala Management Committee (KMC). It should be noted that responsibility for wild dog management will only be a matter for Project 28 whilst they are the owners of the conservation land.

8.11 Disease Management

Whilst disease (Chlamydiosis and KoRV) are known to occur in the local population, Phillips *et al* (2011) did not consider it to be a significant factor in the long term survival of the Tweed Coast population. Residents of the Kings Forest development are highly unlikely to come into contact with diseased Koalas as the proposed fencing will stop the Koalas from entering the residential areas. They may see them on or beside roadways nearby. Baseline and monitoring teams are likely to observe diseased Koalas during their survey work in the conserved habitats. If diseased Koalas are detected by survey teams, then procedures compliant with the high effectiveness standards contained in Lunney and Matthews (1997) will be met.

8.12 Reduction of Impacts of Hydrological Change on Koala Habitat

A comprehensive assessment of pre and post development water table levels and quality has been completed by Gilbert and Sutherland (2013 and 2014). The Gilbert and Sutherland report was contained in the Revised Final Response Report (RFRR) submitted to the Commonwealth Department of the Environment in March 2015. The Gilbert and Sutherland assessments have modelled the changes that will occur to the water table after bulk earthworks have been completed. This modelling has allowed the species proposed for rehabilitation (offsetting) on

the site to be targeted to the appropriate areas. The RFRR report contains the modelled final water table levels and thus vegetation community conditions. Revegetation works will utilise species known to specialize in edaphic conditions characterized by the final predicted water table levels.

DoE (2014b) contains an assessment of the effectiveness of mitigation measures designed to reduce the impact of degradation on habitat critical to the survival of the Koala through hydrological change. All of these measures have been considered in the preparation of this Revised KPoM.

8.13 Increase in Kings Forest Carrying Capacity

It is estimated that on the Tweed Coast, a population of approximately 144 Koalas reside at a density of 0.14 Koalas per hectare of contiguous forest habitat (Phillips *et al.* 2011). This density data is also supported by Phillips and Pereoglou (2004) who determined a Koala density of 0.18 ± 0.04 Koalas per hectare within the Kings Forest area. This data suggests that the Kings Forest site could support a density of Koalas ranging from approximately 0.14 to 0.22 Koalas per hectare.

As discussed in SECTION 8.5, a total of 56.71 ha of revegetation works including preferred Koala food trees will be completed at the Kings Forest site. This will result in a net increase of 41.79 ha (after direct impact of 14.92 ha) of Koala habitat. Based on the above densities, the Kings Forest area could theoretically carry a further five (5) to eight (8) Koalas in the long-term. To achieve even the low estimate would be a very positive outcome for the rehabilitation program at Kings Forest.

8.14 Engaging with Local Government, NPWS and Community Koala Groups

Tweed Shire Council engaged Biolink Ecological Consultants to prepare a Comprehensive Koala Plan of Management. Integral to the completion of this plan was the completion of the Tweed Coast Koala Habitat Study (Phillips et al 2011). During this process the Tweed Coast Koala Advisory Group was formed. This Group comprised representatives from Council, NSW Office of Environment and Heritage, NSW Planning and Environment, Friends of the Koala, community members and Team Koala. Tweed Shire Council also formed a group called Koala Connections.

Friends of the Koala is the primary organization for the rehabilitation of sick and injured Koalas on the Tweed Coast. Friends of the Koala is a volunteer organization supported by Tweed Valley Wildlife Carers, wildlife veterinary teams at the Currumbin Wildlife Hospital and Australia Zoo Wildlife Hospital and by Tweed Shire Council (Tweed Coast CKPoM 2015).

A key strategy of the TCCCKPoM is to establish a Koala Management Committee (KMC). The aim of this committee is to ensure broad community representation and inter-agency involvement in the processes of implementation and recovery.

The provisions contained in the TCCCKPoM are:

- i. Council shall establish a KMC to advise and assist Council with implementation and review of the Plan, including any contiguous IKPoMs.
- ii. Within three (3) months of commencement of the Plan, Council shall adopt Terms of Reference for the KMC, and arrange for the first meeting.
- iii. The Terms of Reference for the KMC shall include one (1) Councillor, two (2) Council officers, one (1) representative each from Office of Environment and Heritage, Rural Fire Service, Friends of the Koala, a Koala Conservation/Environmental Group and three (3) representatives from the Tweed Coast community.
- iv. The term of the KMC shall be concurrent with the term of Council.
- v. The chairperson shall be elected from amongst the members and shall retain that position for a period of no greater than twelve (12) months.
- vi. The KMC shall meet at least four (4) times a year for the first five (5) years of the Plan, and thereafter as required but no less than twice a year.

The TCCKPoM contains a provision stating that they encourage property developers to liaise with Council on issues relevant to the operation of this plan (the TCCKPoM)

A Key Action to be implemented in accordance with this Revised KPoM is the liaison of the proponent (Project 28) with Council, NPWS, OEH, Friends of the Koala, Tweed Valley Wildlife Carers and other relevant Community groups through meetings with the KMC.

8.15 Raising Community Awareness and Education

8.15.1 Environmental Awareness and Extension Program

Public awareness of the environment relates to an emotional understanding of the surrounding world, including the laws of the natural environment, sensitivity to changes occurring in the environment, understanding of cause-and-effect relationships between the quality of the environment and human behaviour, an understanding of how the environment works as a system, and a sense of responsibility for the common heritage of the Earth, such as natural resources - with the aim of preserving them for future generations (UNEP-IETC 1999). A Key Action to be implemented in accordance with this Revised KPoM is an environmental awareness and extension program for new residents with the objective of raising awareness and promoting community ownership of environmental management (including the conservation of the local Koala population). Three (3) strategies are proposed to achieve this objective:

1. To help shape the attitude and awareness of members of the community by consulting/connecting with:
 - Parents;
 - Teachers;
 - Media;
 - Local government and
 - State agencies.

2. To investigate sections of the community where public awareness of the environment is shaped (in order to determine the best approach to shaping awareness) such as:
 - Family home/family;
 - Schools and Universities;
 - Churches and religious organisations; and
 - Workplaces and the professional environment.

3. To investigate ways in which awareness of local Koala issues can be shaped including:
 - Schools and academic manuals;
 - Fact sheets and community presentations;
 - Messages transmitted through mass media;
 - Television and radio programmes;
 - Films, including documentary films; and
 - The internet/social media.

In order to implement the strategies outlined above, the following management actions are proposed:

- Provision of an information package for purchasers of land at Kings Forest. The package shall include a brochure or booklet to all original purchasers of Kings Forest properties and made available through appropriate service outlets within the Kings Forest estate. This brochure/booklet shall contain a reference to a web page which will contain the relevant/required information;
- Design and create a web page that contains information intended to raise and shape awareness of Koala issues at Kings Forest. The web site will be maintained for the duration of the construction phase of the project and for 12 months after completion of construction of the final precinct or until 31 December 2035, whichever occurs first;
- Advertise information relating to Koala management in local newspapers;
- Conduct community presentations/information days at local schools and/or public spaces; and
- Provide feedback forms in order to confirm that awareness and education in the community is being built as a result of the environmental awareness and extension program.

With respect to the protection of Koalas, the information provided via the above actions will cover such matters as:

- Koala habitat areas in Tweed Shire and Koala populations; Koala behaviour;
- The importance of protecting the Koala population in the Kings Forest area;
- Areas of the site in which Koalas are most likely to be encountered;

- Threats to Koalas associated with residential development;
- Protection of Koala habitat and habitat linkages;
- Measures to avoid Koala deaths or injuries caused by motor vehicles;
- Requirements for the keeping of dogs (including encouragement to keep dogs in enclosed yards between the hours of 6pm and 6am);
- Swimming pool construction and fencing requirements;
- The need to report *any* Koala sightings or incidents on or near the site and actions to be taken, with relevant telephone numbers and addresses;
- The need to report any evidence of dogs within EPZs (sightings, footprints, droppings, dead or injured koalas) and actions to be taken, with relevant telephone numbers and addresses;
- Assistance that can be given relating to the protection of Koalas generally; and
- The contact details of local organisations involved in the care of Koalas, of relevant State agencies such as OEH and of the Council, and web addresses where further information on Koalas may be obtained.

8.15.2 Kings Forest Residents' Representative

A Kings Forest Residents' Representative will be appointed by the Proponent. The Residents' Representative will attend all meetings of the Koala Management Committee (KMC). It is anticipated that the Residents Representative will also maintain a strong and regular connection with Tweed Shire Council, the NSW Environmental Protection Authority and the Office of Environment and Heritage.

8.16 Additional Construction Phase Management Measures

8.16.1 Introduction

The following management measures relate specifically to reducing impacts of the construction phase of each development precinct on Koalas and their habitat and include:

- Restrictions to be placed on construction vehicles;
- Protocols for the discovery of an injured or dead Koala; and
- Fauna incident reporting protocols.

8.16.2 Restrictions for Construction Vehicles

Vehicles shall be restricted to a maximum speed of 50kph and shall operate only in daylight hours for the duration of the construction phase. Where roads traverse the environmental protection areas vehicles shall be restricted to a maximum speed of 40kph to minimise the risk of vehicle strike.

8.16.3 Protocols for the Discovery of an Injured or Dead Koala

Any injured animals to be immediately taken to the nearest appropriately qualified veterinary clinic for treatment.

Where a dead animal is located and the cause of death is not known, post-mortem examinations should be undertaken by an appropriately qualified person with practical knowledge of Koala anatomy and pathology.

8.16.4 Fauna Incident Reporting

Any Koala observation or incident should result in an observation/incident report. The report should contain as a minimum, the date and location (grid references) of the animal to be recorded. Where appropriate, cause of death (observed), sex of animal, age (teeth wear or other evidence) and any other information such as presence of ear tags, general condition (evidence of disease, weight, etc.) should be collected. This information should be forwarded to OEH and/or TSC.

9 IMPLEMENTATION OF MITIGATION MEASURES

9.1 Introduction

Specific management actions discussed in SECTION 8 will be triggered and completed on a Development Phase (i.e. pre-construction, construction and operational phases) and Precinct basis and are summarised in TABLES 7 - 9 below. These tables contain all pre-construction, construction and operational phase mitigation measures and identify the associated management actions, responsibilities and performance measures. Precinct specific mitigation measures are also depicted in FIGURES 29 - 37 as follows:

- FIGURE 29 - Mitigation strategies to be implemented in Precinct 1;
- FIGURE 30 - Mitigation strategies to be implemented in Precincts 2 to 5;
- FIGURE 31 - Mitigation strategies to be implemented in Precinct 6;
- FIGURE 32 - Mitigation strategies to be implemented in Precinct 7;
- FIGURE 33 - Mitigation strategies to be implemented in Precinct 8;
- FIGURE 34 - Mitigation strategies to be implemented in Precinct 9;
- FIGURE 35 - Mitigation strategies to be implemented in Precinct 10;
- FIGURE 36 - Mitigation strategies to be implemented in Precinct 11; and
- FIGURE 37 - Mitigation strategies to be implemented in Precincts 12-14.

9.2 Pre-construction Phase

TABLE 7 details the specific management actions that will be implemented during the pre-construction phase within each development precinct. Responsibilities and performance measures for each management action are also provided.

TABLE 7
KOALA MANAGEMENT STRATEGIES - PRE-CONSTRUCTION PHASE

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure	Precinct Specific Details
All Precincts	Base line surveys	Prior to the commencement of construction a Baseline Koala Monitoring program will be completed across the entire site.	Qualified ecologist (SECTION 10.3)	Baseline Koala monitoring survey is completed	
	Surveys for the Koala	Prior to the commencement of construction associated with each precinct, pre-clearance surveys for Koala must be conducted (SECTION 8.2).	Ecologist/Spotter catcher	Pre-clearing surveys are completed prior to commencement of construction	
	Education of construction personnel	A construction personnel induction	Construction Manager	All construction personnel inducted and aware of Koala related	



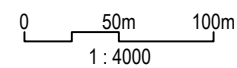
LEGEND

- Permanent Koala Exclusion Fencing
- Environmental Protection Zone (EPZ)
- 50m Buffer to EPZ (only the inner 30 metres to be utilised for offsetting and dedication purposes)
- Kings Forest Boundary

KOALA HABITAT THAT WILL REMAIN AS HABITAT AFTER DEVELOPMENT

- Secondary (A) Koala habitat to remain after development

PRECINCT 1 - RETAINED KOALA HABITAT & KOALA OFFSETS		
Koala Habitat to be Retained (Ha)	Primary Koala Habitat	0
	Secondary (A) Koala Habitat	5.82
	Secondary (B) Koala Habitat	0
Koala Offsets (Ha)	Dry Primary Koala Habitat	0
	Dry secondary Koala Habitat Plus Dry Heath	0
	Wet Primary and Secondary Koala Habitat	0
	Wet Secondary Koala Habitat	0
	Secondary Koala Habitat	0



SOURCE: JWA Supp. PD (2014); Biolink; Gilbert & Sutherland (pers. comm. 2014)

SCALE: 1 : 4000 @ A3

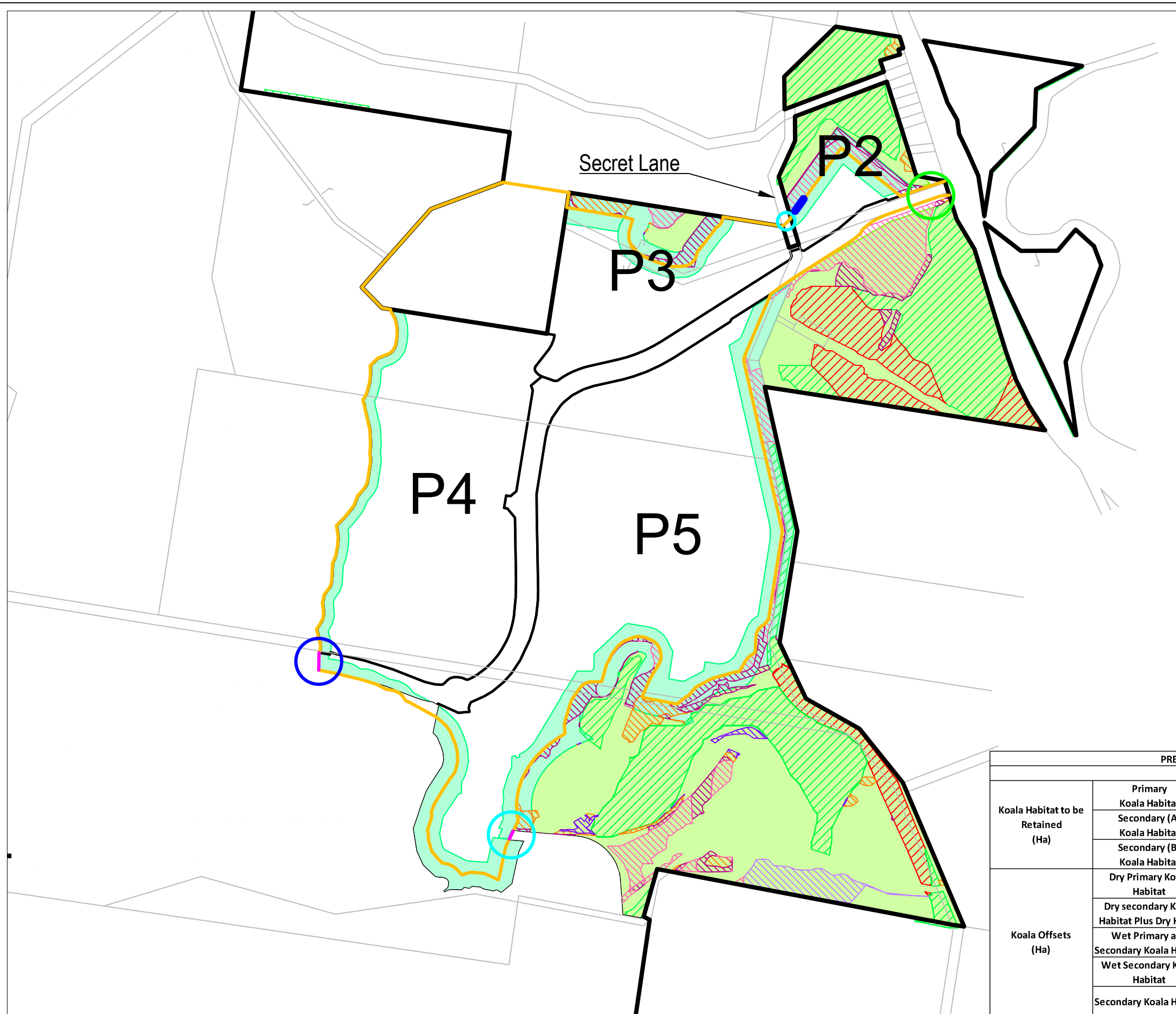
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Shire of Tweed

FIGURE 29

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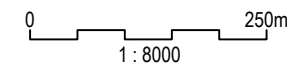
TITLE
PRECINCT SPECIFIC
KOALA
MANAGEMENT ACTIONS
- PRECINCT 1



LEGEND

- Temporary Koala Exclusion Fencing
 - Permanent Koala Exclusion Fencing
 - Approximate Location of Underpass
 - Grid
 - Temporary Grid
 - Approximate Location of Gate
 - Environmental Protection Zone (EPZ)
 - 50m Buffer to EPZ (only the inner 30 metres to be utilised for offsetting and dedication purposes)
 - Precinct Boundary
 - Kings Forest Boundary
- KOALA HABITAT THAT WILL REMAIN AS HABITAT AFTER DEVELOPMENT**
- Primary Koala habitat to remain after development
 - Secondary (A) Koala habitat to remain after development
- KOALA COMPENSATORY HABITAT**
- Dry primary Koala habitat
 - Dry secondary Koala habitat plus dry heath
 - Wet primary and secondary Koala habitat
 - Wet secondary Koala habitat
 - Secondary Koala habitat

PRECINCT 2-5 - RETAINED KOALA HABITAT & KOALA OFFSETS					
		Precinct 2	Precinct 3	Precinct 4	Precinct 5
Koala Habitat to be Retained (Ha)	Primary Koala Habitat	0	0	0	5.57
	Secondary (A) Koala Habitat	3.62	0	0	13.99
	Secondary (B) Koala Habitat	0	0	0	0
	Dry Primary Koala Habitat	0.24	0.49	0	2.05
Koala Offsets (Ha)	Dry secondary Koala Habitat Plus Dry Heath	0.76	0.19	0	4.32
	Wet Primary and Secondary Koala Habitat	0.14	0.33	0	0.95
	Wet Secondary Koala Habitat	0	0	0	0.22
	Secondary Koala Habitat	0	0	0	1.15



SOURCE: JWA Supp. PD (2014); Biolink; Gilbert & Sutherland (pers. comm. 2014)

SCALE: 1 : 8000 @ A3

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FIGURE 30

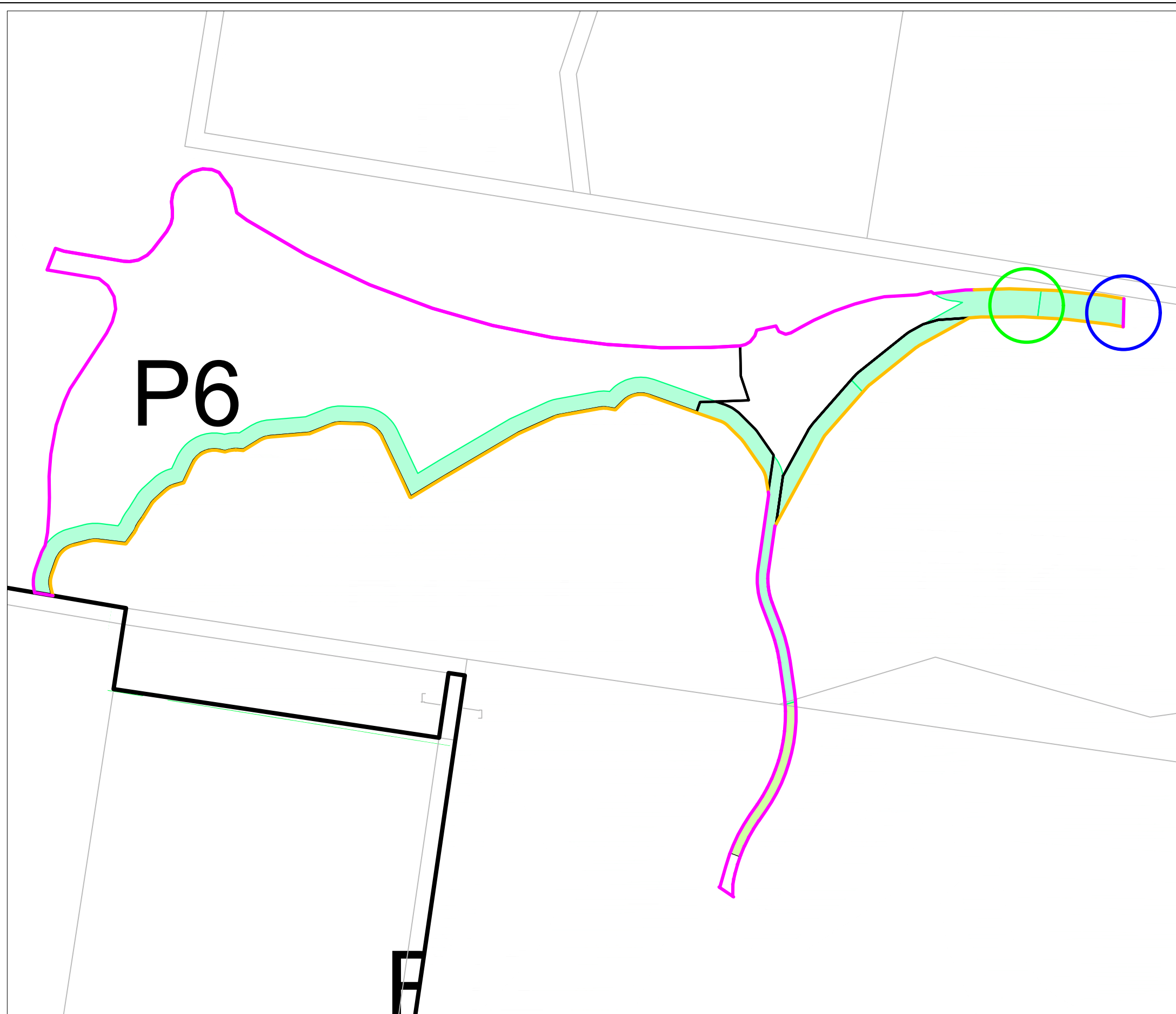
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TITLE
**PRECINCT SPECIFIC
KOALA
MANAGEMENT ACTIONS
- PRECINCTS 2-5**

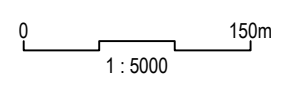


LEGEND

- Temporary Koala Exclusion Fencing
- Permanent Koala Exclusion Fencing
- Approximate Location of Underpass
- Temporary Grid
- 20m Outer Protection Zone Buffer to EPZ
- Kings Forest Boundary



PRECINCT 6 - RETAINED KOALA HABITAT & KOALA OFFSETS		
Koala Habitat to be Retained (Ha)	Primary Koala Habitat	0
	Secondary (A) Koala Habitat	0
	Secondary (B) Koala Habitat	0
Koala Offsets (Ha)	Dry Primary Koala Habitat	0
	Dry secondary Koala Habitat Plus Dry Heath	0
	Wet Primary and Secondary Koala Habitat	0
	Wet Secondary Koala Habitat	0
	Secondary Koala Habitat	0



SOURCE: JWA Supp. PD (2014); Biolink; Gilbert & Sutherland (pers. comm. 2014)

SCALE: 1 : 5000 @ A3

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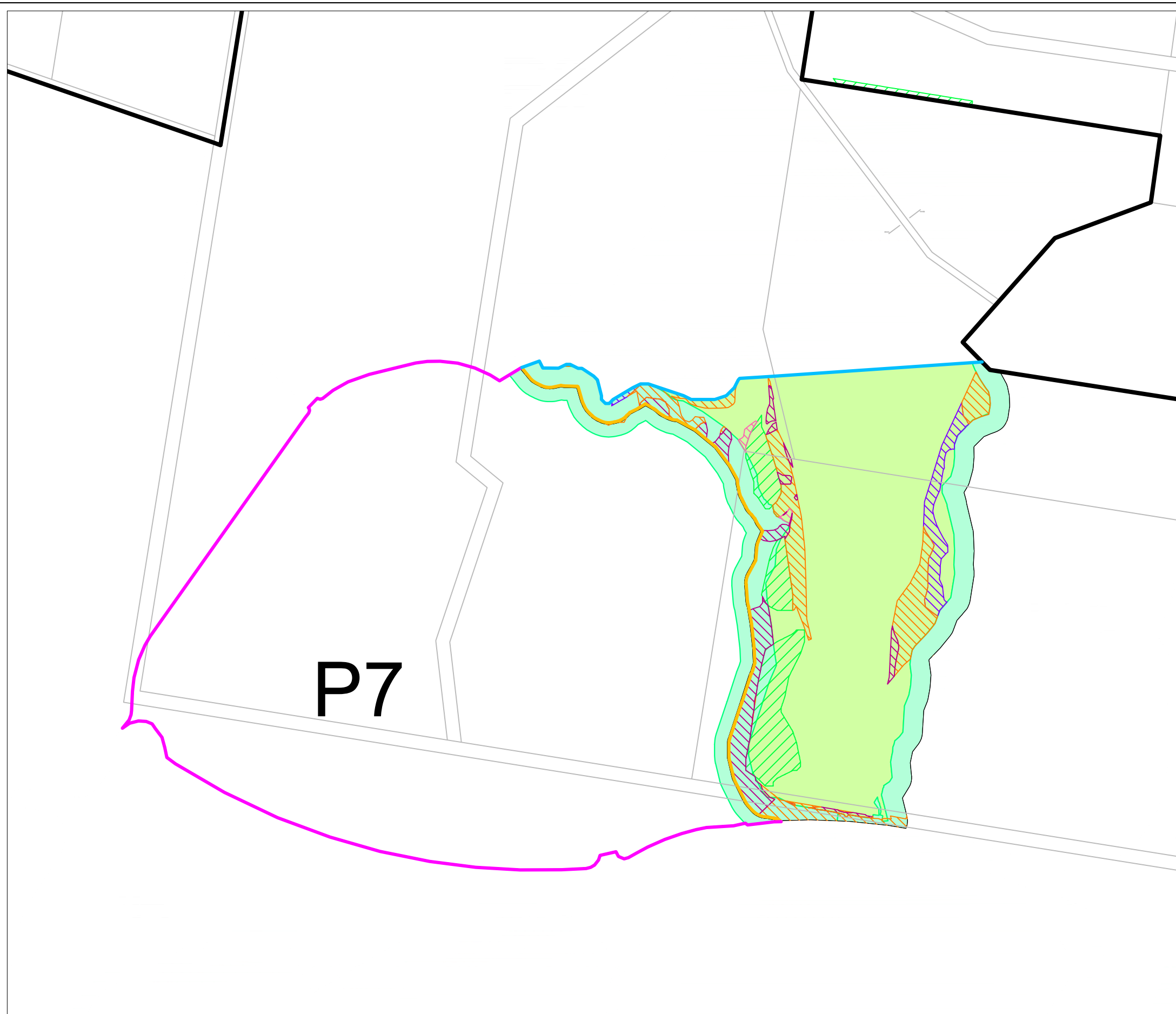
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FIGURE 31

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TITLE
PRECINCT SPECIFIC
KOALA
MANAGEMENT ACTIONS
- PRECINCT 6



LEGEND

- Temporary Koala Exclusion Fencing
 - Permanent Koala Exclusion Fencing
 - Arbitrary Line for Division of Compensatory Habitat Only
 - Environmental Protection Zone (EPZ)
 - 50m Buffer to EPZ (only the inner 30 metres to be utilised for offsetting and dedication purposes)
 - Kings Forest Boundary
- KOALA HABITAT THAT WILL REMAIN AS HABITAT AFTER DEVELOPMENT**
- Secondary (A) Koala habitat to remain after development
- KOALA COMPENSATORY HABITAT**
- Dry primary Koala habitat
 - Wet primary and secondary Koala habitat
 - Wet secondary Koala habitat

PRECINCT 7 - RETAINED KOALA HABITAT & KOALA OFFSETS		
Koala Habitat to be Retained (Ha)	Primary Koala Habitat	0
	Secondary (A) Koala Habitat	1.89
	Secondary (B) Koala Habitat	0
Koala Offsets (Ha)	Dry Primary Koala Habitat	1.20
	Dry secondary Koala Habitat Plus Dry Heath	0.06
	Wet Primary and Secondary Koala Habitat	2.11
	Wet Secondary Koala Habitat	0.56
	Secondary Koala Habitat	0

P7



SOURCE: JWA Supp. PD (2014); Biolink; Gilbert & Sutherland (pers. comm. 2014)

SCALE: 1 : 6000 @ A3

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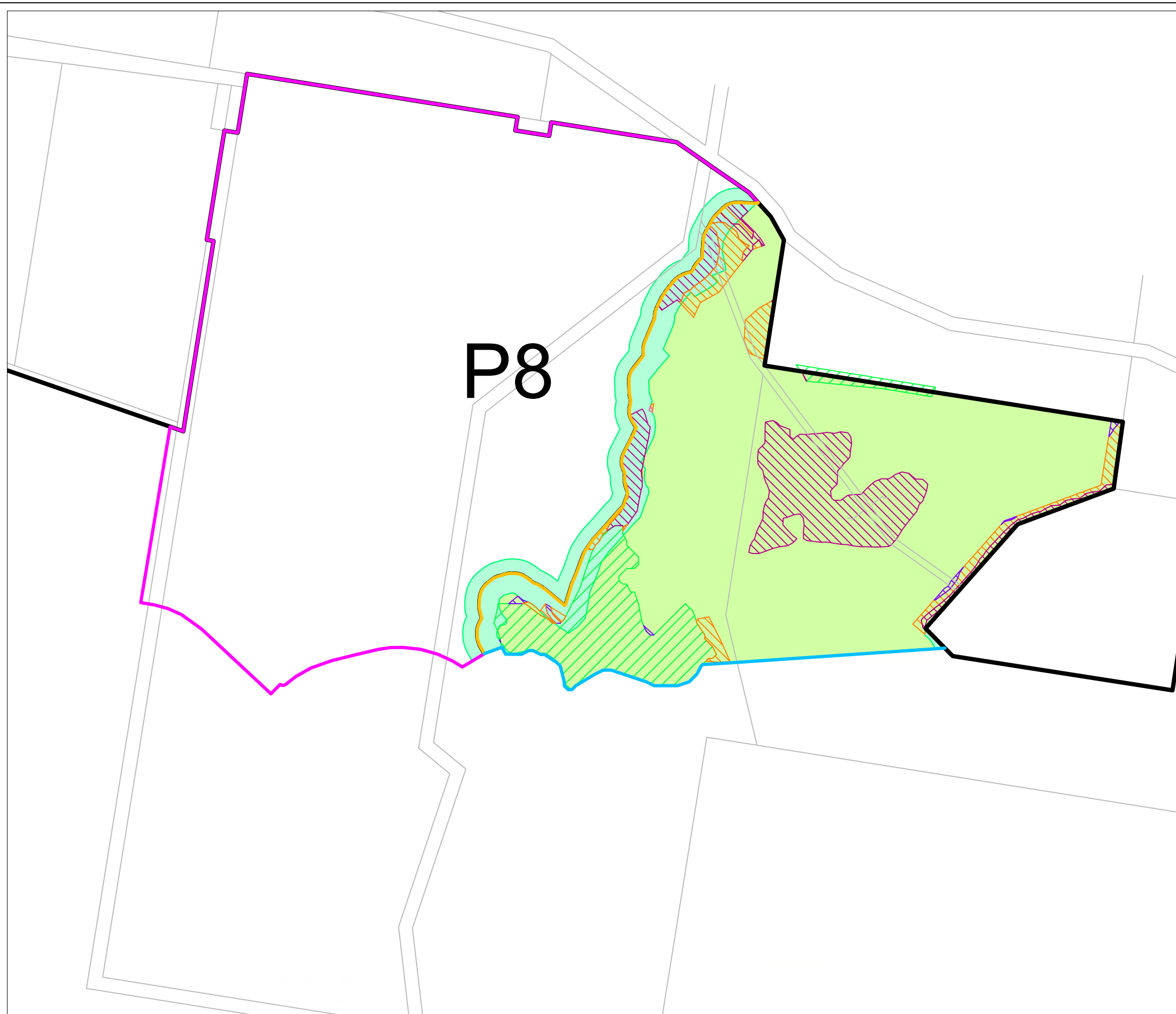
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FIGURE 32

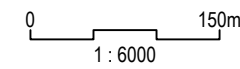
PREPARED: BW
DATE: 14 March 2017
FILE: N97017_KPOM.dwg

TITLE
PRECINCT SPECIFIC
KOALA
MANAGEMENT ACTIONS
- PRECINCT 7



- Temporary Koala Exclusion Fencing
 - Permanent Koala Exclusion Fencing
 - Arbitrary Line for Division of Compensatory Habitat Only
 - Environmental Protection Zone (EPZ)
 - 50m Buffer to EPZ (only the inner 30 metres to be utilised for offsetting and dedication purposes)
 - Kings Forest Boundary
- KOALA HABITAT THAT WILL REMAIN AS HABITAT AFTER DEVELOPMENT**
- Secondary (A) Koala habitat to remain after development
- KOALA COMPENSATORY HABITAT**
- Dry primary Koala habitat
 - Wet primary and secondary Koala habitat
 - Wet secondary Koala habitat

PRECINCT 8 - RETAINED KOALA HABITAT & KOALA OFFSETS		
Koala Habitat to be Retained (Ha)	Primary Koala Habitat	0
	Secondary (A) Koala Habitat	3.71
	Secondary (B) Koala Habitat	0
Koala Offsets (Ha)	Dry Primary Koala Habitat	3.97
	Dry secondary Koala Habitat Plus Dry Heath	0
	Wet Primary and Secondary Koala Habitat	1.46
	Wet Secondary Koala Habitat	0.08
	Secondary Koala Habitat	0



SOURCE: JWA Supp. PD (2014); Biolink; Gilbert & Sutherland (pers. comm. 2014)

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FIGURE 33

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TITLE
**PRECINCT SPECIFIC
KOALA
MANAGEMENT ACTIONS
- PRECINCT 8**

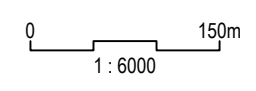


LEGEND

- Temporary Koala Exclusion Fencing
- Permanent Koala Exclusion Fencing
- 20m Outer Protection Zone Buffer to EPZ
- Kings Forest Boundary

P9

PRECINCT 9 - RETAINED KOALA HABITAT & KOALA OFFSETS		
Koala Habitat to be Retained (Ha)	Primary Koala Habitat	0
	Secondary (A) Koala Habitat	0
	Secondary (B) Koala Habitat	0
Koala Offsets (Ha)	Dry Primary Koala Habitat	0
	Dry secondary Koala Habitat Plus Dry Heath	0
	Wet Primary and Secondary Koala Habitat	0
	Wet Secondary Koala Habitat	0
	Secondary Koala Habitat	0



SOURCE: JWA Supp. PD (2014); Biolink; Gilbert & Sutherland (pers. comm. 2014)

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FIGURE 34

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FILE: N97017_KPOM.dwg

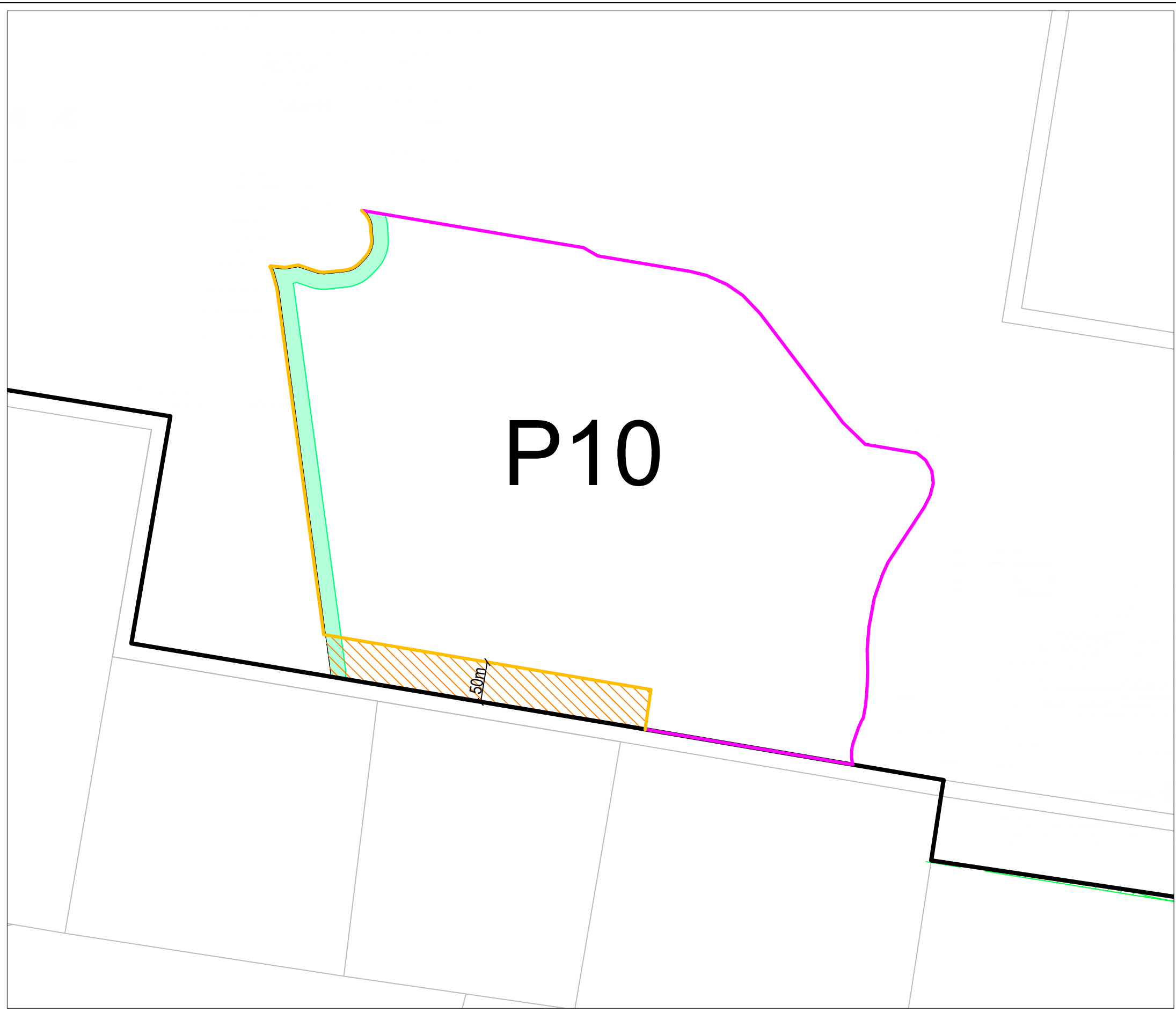
TITLE
PRECINCT SPECIFIC
KOALA
MANAGEMENT ACTIONS
- PRECINCT 9



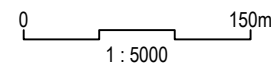
LEGEND

- Temporary Koala Exclusion Fencing
 - Permanent Koala Exclusion Fencing
 - 20m Outer Protection Zone Buffer to EPZ
 - Kings Forest Boundary
- KOALA COMPENSATORY HABITAT**
- Wet primary and secondary Koala habitat

P10



PRECINCT 10 - RETAINED KOALA HABITAT & KOALA OFFSETS		
Koala Habitat to be Retained (Ha)	Primary Koala Habitat	0
	Secondary (A) Koala Habitat	0
	Secondary (B) Koala Habitat	0
Koala Offsets (Ha)	Dry Primary Koala Habitat	0
	Dry secondary Koala Habitat Plus Dry Heath	0
	Wet Primary and Secondary Koala Habitat	2.05
	Wet Secondary Koala Habitat	0
	Secondary Koala Habitat	0



SOURCE: JWA Supp. PD (2014); Biolink; Gilbert & Sutherland (pers. comm. 2014)

SCALE: 1 : 5000 @ A3

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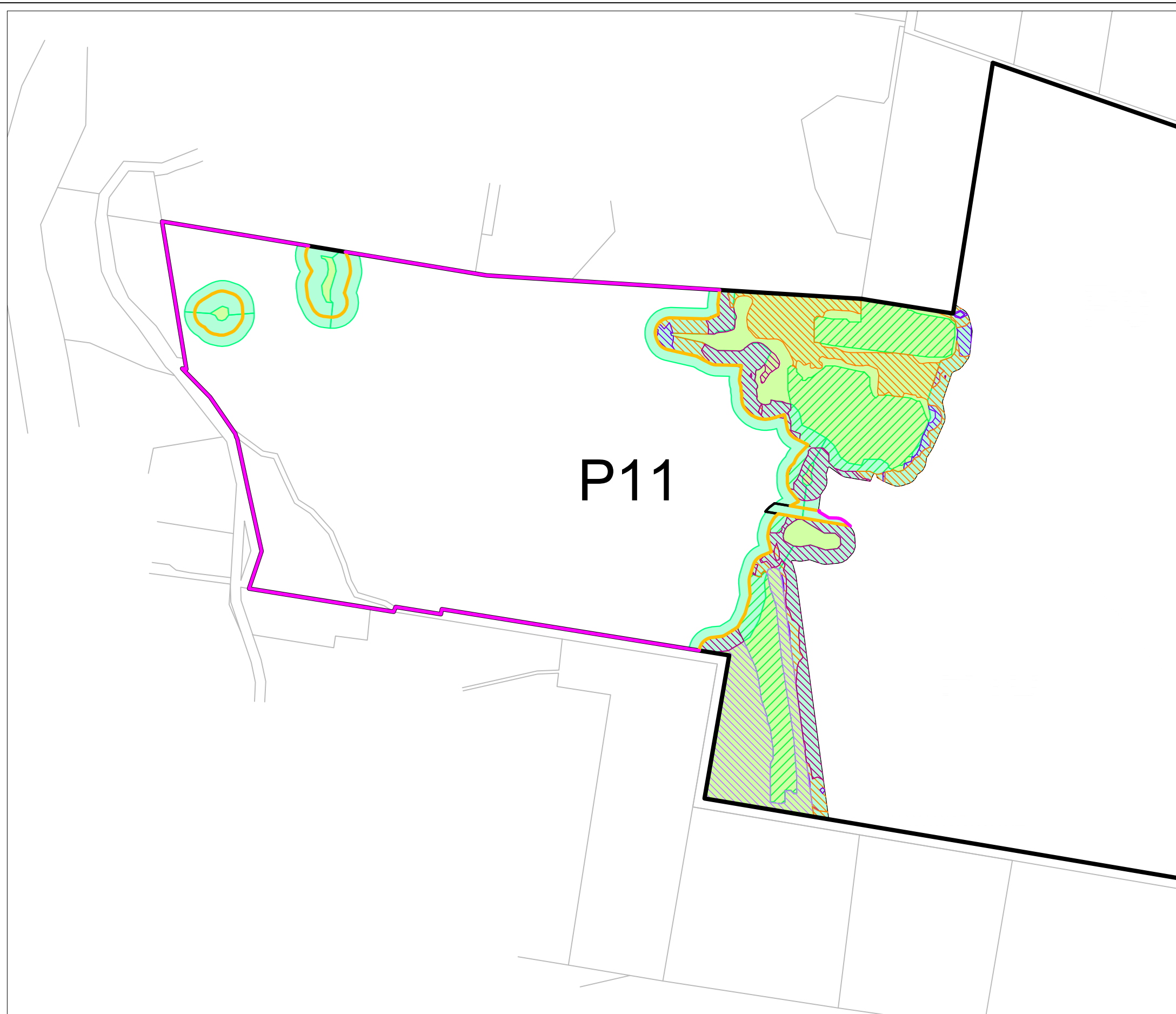
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FIGURE 35

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TITLE
**PRECINCT SPECIFIC
KOALA
MANAGEMENT ACTIONS
- PRECINCT 10**



LEGEND

- Temporary Koala Exclusion Fencing
- Permanent Koala Exclusion Fencing
- Environmental Protection Zone (EPZ)
- 50m Buffer to EPZ (only the inner 30 metres to be utilised for offsetting and dedication purposes)
- Kings Forest Boundary

KOALA HABITAT THAT WILL REMAIN AS HABITAT AFTER DEVELOPMENT

- Secondary (A) Koala habitat to remain after development

KOALA COMPENSATORY HABITAT

- Dry primary Koala habitat
- Wet primary and secondary Koala habitat
- Wet secondary Koala habitat
- Secondary Koala habitat

PRECINCT 11 - RETAINED KOALA HABITAT & KOALA OFFSETS		
Koala Habitat to be Retained (Ha)	Primary Koala Habitat	0
	Secondary (A) Koala Habitat	8.68
	Secondary (B) Koala Habitat	0
Koala Offsets (Ha)	Dry Primary Koala Habitat	4.17
	Dry secondary Koala Habitat Plus Dry Heath	0
	Wet Primary and Secondary Koala Habitat	4.81
	Wet Secondary Koala Habitat	0.52
	Secondary Koala Habitat	4.10



SOURCE: JWA Supp. PD (2014); Biolink; Gilbert & Sutherland (pers. comm. 2014)

SCALE: 1 : 8000 @ A3

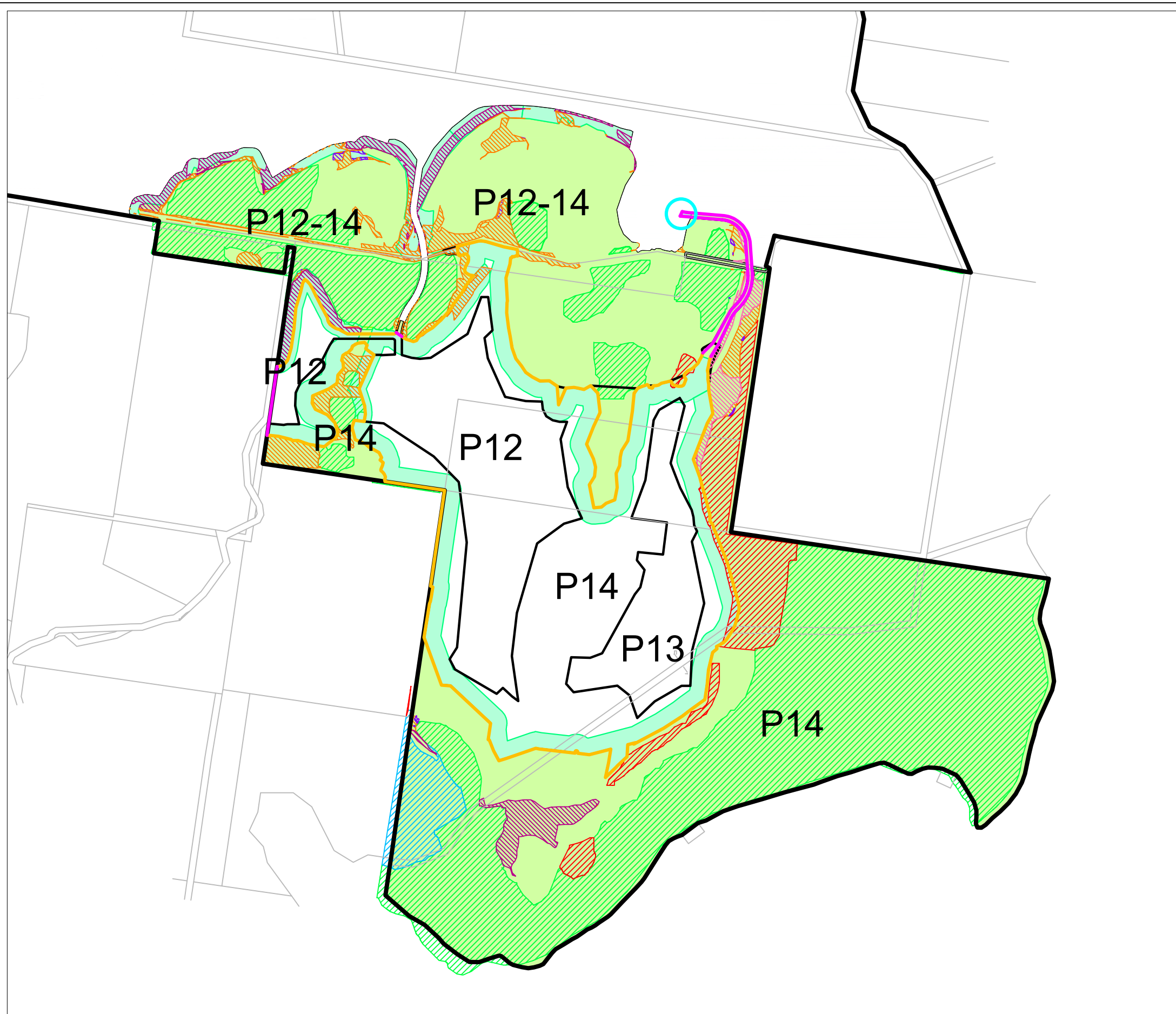
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FIGURE 36

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FILE: N97017_KPOM.dwg

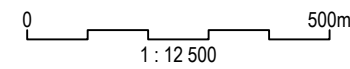
TITLE
PRECINCT SPECIFIC
KOALA
MANAGEMENT ACTIONS
- PRECINCT 11



LEGEND

- Temporary Koala Exclusion Fencing
 - Permanent Koala Exclusion Fencing
 - Grid
 - Environmental Protection Zone (EPZ)
 - 50m Buffer to EPZ (only the inner 30 metres to be utilised for offsetting and dedication purposes)
 - Precinct Boundary
 - Kings Forest Boundary
- KOALA HABITAT THAT WILL REMAIN AS HABITAT AFTER DEVELOPMENT**
- Primary Koala habitat to remain after development
 - Secondary (A) Koala habitat to remain after development
 - Secondary (B) Koala habitat to remain after development
- KOALA COMPENSATORY HABITAT**
- Dry primary Koala habitat
 - Dry secondary Koala habitat plus dry heath
 - Wet primary and secondary Koala habitat
 - Wet secondary Koala habitat

PRECINCT 12-14 - RETAINED KOALA HABITAT & KOALA OFFSETS		
Koala Habitat to be Retained (Ha)	Primary Koala Habitat	12.87
	Secondary (A) Koala Habitat	120.62
	Secondary (B) Koala Habitat	6.27
Koala Offsets (Ha)	Dry Primary Koala Habitat	8.48
	Dry secondary Koala Habitat Plus Dry Heath	2.13
	Wet Primary and Secondary Koala Habitat	10.00
	Wet Secondary Koala Habitat	0.22
	Secondary Koala Habitat	0



SOURCE: JWA Supp. PD (2014); Biolink; Gilbert & Sutherland (pers. comm. 2014)

SCALE: 1 : 12 500 @ A3

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FIGURE 37

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DATE: 14 March 2017
FILE: N97017_KPOM Precincts.dwg

TITLE
PRECINCT SPECIFIC
KOALA
MANAGEMENT ACTIONS
- PRECINCTS 12-14

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure	Precinct Specific Details
		program shall be developed and implemented by the Proponent prior to commencement of construction to highlight the potential presence of Koalas on the site.		issues and responsibilities	
	Construction of Infrastructure	Permanent and temporary exclusion fencing and associated escape mechanisms installed as detailed in SECTIONS 8.9.3. and 8.9.5	Construction Manager/ Principal contractor	All exclusion fences and escape mechanisms are in place prior to the commencement of construction in each relevant Precinct	<p>Precinct 1: Permanent exclusion fencing will be integrated with the existing fencing at Tweed coast Road and be situated at the outer edge of the 50m ecological buffer.</p> <p>Precincts 2-5: Permanent exclusion fencing to be constructed around the entirety of Precincts 2, 3, 4 and 5. This fencing will be integrated with existing fencing at Tweed Coast Road. Gates, similar in design to the Koala proof fencing, will be included at locations where future access for road construction will be required.</p> <p>Permanent exclusion fencing to be constructed on both sides of all roads in environmental protection zones.</p> <p>Permanent exclusion fencing to be constructed:</p> <ul style="list-style-type: none"> - In the buffer zone (to SEPP 14 wetland) along the southern boundary of Precinct 6. - In the buffer zone (to SEPP 14 wetland) along the eastern boundary of Precinct 7. - In the buffer zone (to SEPP 14 wetland) along the eastern boundary of Precinct 8. - In the buffer zone (to SEPP 14 wetland) along the south-

Kings Forest - Revised Koala Plan of Management

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure	Precinct Specific Details
					<p>western boundary of Precinct 9.</p> <ul style="list-style-type: none"> - In the buffer zone (to an environmental protection area) along the western boundary, and on the edge of the vegetated corridor along the southern boundary of Precinct 10. - In the buffer zone (to SEPP 14 wetland and an environmental protection area) along the eastern boundary of Precinct 11. - In the buffer zone (to SEPP 14 wetland and other environmental protection areas) along the northern, eastern and southern boundary of Precincts 12-14. <p>Precinct 6 - 14 Temporary exclusion fencing will be erected in all other boundary locations. Gates, similar in design to the koala proof fencing, will be included at locations where future access for road construction will be required.</p> <p>Prior to the commencement of construction associated with each precinct inspections, monitoring and maintenance of Koala mitigation measures must be undertaken at intervals not less than 6 monthly.</p> <p>If the condition of these structures compromises the structure's function, the structures must be restored to fully functional condition within 2 working days.</p>
	Signage	Signage to be erected at 100m intervals along the margins of the EPZ's and roadways stating "Environmental Protection Zone -	Construction Manager/ Principal contractor	Signage erected at no greater than 100m intervals prior to commencement of construction in each relevant Precinct.	

Kings Forest - Revised Koala Plan of Management

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure	Precinct Specific Details
		No unauthorised entry.”			
	Survey plans & permanent marking of dedication areas	Mark the boundaries of proposed/future dedication areas.	Construction Manager/ Principal contractor/ Registered Surveyor	Survey plans prepared and permanent markers installed showing proposed dedication areas. Survey plans lodged with the Department on a precinct-by-precinct basis.	
	Clearing works	All areas of vegetation to be cleared within each Precinct of the development will be clearly identified on construction plans and on site.	Construction Manager	All areas to be cleared within a specific precinct are identified and marked. No clearing outside of nominated clearing areas.	
		All vegetation to be inspected prior to clearing to check for the presence of Koalas and approve clearing activities.	Ecologist/spotter catcher	Any experienced ecologist/spotter catcher to be on site at all times during clearing. All areas proposed for clearing inspected and approved.	
		Clearing works are to be temporarily suspended within 25m radius of any tree in which a Koala is located to ensure Koalas are not harmed.	Site Manager/ Ecologist/spotter catcher	Clearing works temporarily suspended at all times when within 25m of a Koala.	
		Any injured animals to be immediately taken to the nearest appropriately qualified veterinary clinic to provide treatment as soon as possible to injured animals.	Ecologist/spotter catcher	Any injured animals receive treatment within one hour of capture.	
		Post-mortem examination completed for any Koalas found dead to determine the cause of death.	Suitably qualified person	Post-mortem completed for all Koalas found dead	
Precincts 2-5 Precinct 7 Precinct 8 Precinct 10 Precinct 11 Precincts 12-14	Koala habitat creation	Koala food and habitat tree planting to create additional Koala habitat.	Suitably qualified Bush Regeneration company	A total of 56.71 ha of Koala habitat to be created. The habitat is to reach sustainability prior to dedication on a precinct by precinct basis.	Precincts 2-5: A total of 12.45 ha of Koala habitat to be created within Precincts 2-5 as follows: <ul style="list-style-type: none"> • Precinct 2 = 0.98 ha • Precinct 3 = 1.45 ha • Precinct 5 = 10.02 ha

Kings Forest - Revised Koala Plan of Management

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure	Precinct Specific Details
					<p>Precinct 7: A total of 4.41 ha of Koala habitat to be created within Precinct 7.</p> <p>Precinct 8: A total of 5.50 ha of Koala habitat to be created within Precinct 8.</p> <p>Precinct 10: A total of 2.05 ha of Koala habitat to be created within Precinct 10.</p> <p>Precinct 11: A total of 6.41 ha of Koala habitat to be created within Precinct 11.</p> <p>Precinct 12-14: A total of 14.67 ha of Koala habitat to be created within Precincts 12-14.</p>
		<p>The created Koala habitat will either be:</p> <p>Substantially established (see footnote 6) in any precinct prior to the commencement of construction in any subsequent precinct; or</p> <p>ii. Planted for the relevant precinct and then a bond of 150% of the estimated maintenance and monitoring costs lodged with Tweed Shire Council (TSC) prior to the commencement of construction. The bond to be forfeited if substantial establishment (see footnote 6) is not achieved.</p>	<p>Suitably qualified horticultural/environmental specialist</p>	<p>Created Koala habitat will be substantially established or a bond paid prior to the commencement of construction in any subsequent precinct</p>	

9.3 Construction Phase

TABLE 8 details the specific management actions that will be implemented during the construction phase within each development precinct. Responsibilities and performance measures for each management action are also provided.

TABLE 8
KOALA MANAGEMENT STRATEGIES - CONSTRUCTION PHASE

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure	Precinct Specific Details
All Precincts	Minimise construction impacts on Koalas and Koala habitat	Ensure the protection of retained vegetation from all construction activities. Machinery and contractor access will be restricted. No clearing shall occur outside nominated clearing zones.	Construction Manager	All retained vegetation identified and protected and disturbance minimised	
		Vehicles shall be restricted to a maximum speed of 50 kph and shall operate only in daylight hours. Where roads traverse the environmental protection areas vehicles shall be restricted to a maximum speed of 40 kph to minimise the risk of vehicle strike.	All contractors and construction personnel on site	All operators of vehicles and machinery adhere to relevant speed limits and construction occurs only in daylight hours to minimise light and noise disturbance	
		Koala exclusion fencing to be regularly checked and maintenance issues addressed as they arise, including vegetation in close proximity to the fencing. Any damage to exclusion fencing will be rectified within two (2) working days of the discovery of the damage.	Construction/Site Manager/ Principal contractor until ownership of land is transferred or independent contractor	Condition of fencing/gates regularly inspected and maintained/repaired. All instances of disrepair/ and/or breach etc. reported to the Site Manager.	

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure	Precinct Specific Details
		<p>Earthworks are to be temporarily suspended within 25m radius of any tree in which a Koala is located to ensure Koalas are not harmed. Where a Koala is located in the construction zone, the immediate threats to that animal are to be assessed by a suitably qualified person and intervention limited to instances where it is clear that there is an imminent and serious threat to that animal's welfare. Where threats are deemed to be low or manageable, the animal should be monitored until it moves to more suitable habitat.</p>	<p>Ecologist/Spotter catcher</p>	<p>Earthworks temporarily suspended at all times when within 25m of a Koala. Disturbance to any Koala located within the construction zone is minimised as far as possible and the animal has safely relocated of its own accord or the animal has been safely relocated by a qualified spotter/catcher.</p>	
		<p>Any injured animals to be immediately taken to the nearest appropriately qualified veterinary clinic for treatment.</p>	<p>Ecologist/Spotter catcher</p>	<p>Any injured animals receive treatment within one hour of capture.</p>	

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure	Precinct Specific Details
	Record Koala observations and incidents	Any Koala observation or incident should result in an observation/incident report. The report should contain as a minimum, the date and location (grid references) of the animal to be recorded. Where appropriate, cause of death (observed), sex of animal, age (teeth wear or other evidence) and any other information such as presence of ear tags, general condition (evidence of disease, weight, etc.) should be collected. This information should be available for viewing on request by OEH or TSC.	Construction Manager/ Ecologist	All Koala observations and incidents reported to TSC and OEH.	
Precincts 2-5, Precinct 6	Construction of Infrastructure	Underpass (as detailed in SECTION 8.9.4) to be constructed where applicable to facilitate the movement of Koalas (and other fauna).	Construction Manager/ Principal contractor	All grids and underpasses installed during relevant road construction.	<p>Precincts 2-5: An underpass to be constructed underneath Kings Forest Parkway at the entrance to the estate. This underpass will be constructed as part of the upgrade of the Tweed Coast Road/Kings Forest Parkway intersection.</p> <p>Precinct 6: An underpass to be constructed underneath Kings Forest Parkway where it crosses between the two (2) SEPP 14 wetland areas.</p>

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure	Precinct Specific Details
		<p>Grids will be provided where appropriate as detailed in SECTION 8.9.5.</p>			<p>Precincts 2-5: Koala fencing adjacent to Precinct 2 and 3 will include the construction of a specially designed Koala-grid where it crosses Secret Lane and a 2m wide self-locking gate to the north-east of the grid to allow pedestrian and horse access around the grid.</p> <p>Precinct 6: A grid which shall be provided in the Kings Forest Parkway where it extends from Precinct 5 through to Precinct 6.</p> <p>Precincts 12-14: A grid will be installed during road construction works at the southern end of Precinct 5 where a road is to be constructed linking precinct 5 with Precincts 12-14.</p>

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Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure	Precinct Specific Details
Precincts 2-5, Precinct 6	Koala habitat creation	Koala food tree planting around underpass openings to facilitate safe Koala dispersal across the site. To be completed as soon as practicable during construction phase at the completion of bulk earthworks.	Project 28 Pty Ltd - Site Manager / Bush Regeneration company	Fauna underpasses vegetated with Koala food trees within a 20m radius of openings.	

9.4 Operational Phase

TABLE 9 details the specific management actions that will be implemented during the operational phase within each development precinct. Responsibilities and performance measures for each management action are also provided.

TABLE 9
KOALA MANAGEMENT STRATEGIES - OPERATIONAL PHASE

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure
All Precincts	Self-sustaining koala population	Monitoring surveys to be completed on an annual basis (SECTION 10).	Ecologist	Monitoring reports have been submitted to the Office of Environment and Heritage and compared with baseline data. The results of monitoring demonstrate that there is no reduction in Koala numbers.
	Exclude Koalas from roads and residential precincts	Koala exclusion fencing to be regularly checked and maintenance issues addressed as they arise. Any damage to exclusion fencing will be rectified within two (2) working days of the discovery of the damage.	Site Manager/ Principal contractor until ownership of land is transferred or independent contractor	Condition of fencing/gates regularly inspected and maintained. All instances of disrepair and/or breach reported to the Site Manager.
	Minimise light spill into Koala habitat areas	Street lighting to be capped and/or positioned to minimise light spill into retained Koala habitat and habitat rehabilitation areas.	Construction Manager/ Principal contractor	Light spill into Koala habitat areas is minimised as far as possible by appropriate design and positioning of lighting infrastructure.
	Maintenance of infrastructure	Vegetation adjacent to exclusion fencing will be maintained to remove fallen branches and vines growing on the fence to maintain fence effectiveness, and trim trees where they may link to tree canopies on the other side of the fence.	Construction Manager/ Principal contractor	Vegetation adjacent to exclusion fencing appropriately maintained

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure
	<p>Help shape the attitude and environmental awareness of members of the community.</p> <p>Investigate sections of the community where public awareness of the environment is shaped.</p> <p>Investigate ways in which awareness of local Koala issues can be shaped.</p>	<p>Provide and maintain educational, vandal proof signage (at intervals of no more than 100m) to ensure that residents are aware of the possibility of encountering koalas and other fauna on roads that traverse through environmental areas. Signage will include contact information for incident reporting. Signage will also be erected in strategic locations within any public open space area and at fauna underpasses advising residents that Koalas are active in the area and dogs should be kept on a leash at all times and encourage residents to keep dogs in enclosed yards between the hours of 6pm and 6am.</p>	<p>Site Manager/ Principal contractor until ownership of land is transferred.</p>	<p>Condition of signage regularly inspected and maintained. All instances of disrepair reported to the Site Manager.</p>
		<p>Provision of an information package for purchasers of land at Kings Forest.</p>	<p>Proponent</p>	<p>Information packages produced and distributed and feedback forms indicate that attitudes and awareness are being shaped.</p>
		<p>Design and create a web page that contains information intended to raise and shape awareness of Koala issues at Kings Forest.</p> <p>The web site will be maintained for the duration of the construction phase of the project and for 12 months after completion of construction of the final precinct, or, until 31 December 2035, whichever occurs first.</p>	<p>Proponent</p>	<p>Web page created and feedback forms indicate that attitudes and awareness are being shaped.</p>
		<p>Advertise information relating to Koala management in local newspapers.</p>	<p>Proponent</p>	<p>Advertisements run and feedback forms indicate that attitudes and awareness are being shaped.</p>

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure
		Conduct community presentations/information days at local schools and/or public spaces.	Proponent	Presentations/information days conducted and feedback forms indicate that attitudes and awareness are being shaped.
		Provide feedback forms in order to confirm that awareness and education in the community is being built as a result of the environmental awareness and extension program.	Proponent	Feedback forms provided and indicating that attitudes and awareness are being shaped.
	Engaging with Local Government, NPWS and Community Koala Groups	Liaison of Proponent with Council, NPWS, OEH, Friends of the Koala, Tweed Valley Wildlife Carers and other relevant Community groups through meetings with the Koala Management Committee (KMC).	Proponent	Proponent is actively engaging with Local Government, NPWS and Community Koala Groups and attending meetings with the KMC.
	Residents' Representative	A Kings Forest Residents' Representative will be appointed by the Proponent. The Residents' Representative will attend all meetings of the Koala Management Committee (KMC). It is anticipated that the Residents Representative will also maintain a strong and regular connection with Tweed Shire Council, the NSW Environmental Protection Authority and the Office of Environment and Heritage.	Proponent	Residents' Representative is appointed and attending meetings with the KMC.
	Record Koala observations and incidents	Residents to report all instances of Koalas located within the urban area of Kings Forest and/or injured Koalas to Tweed Shire Council or Office of Environment and Heritage (OEH).	Residents	All Koala observations and incidents reported to TSC and OEH

Relevant Development Precinct	Management Strategy	Management Action	Responsibility	Performance Measure
		Where a Koala is located in the urban area of Kings Forest, or reported by a resident, the protocol will be the same as during the construction phase. I.e. the immediate threats to that animal are to be assessed by a suitably qualified person and intervention limited to instances where it is clear that there is an imminent and serious threat to that animal's welfare. Where threats are deemed to be low or manageable, the animal should be monitored until it moves to more suitable habitat.	Residents/TSC Environmental Officer	Disturbance to any Koala located within the development zone is minimised as far as possible
	Increase in connectivity	Free movement of Koalas through the Kings Forest site will be preserved and enhanced by revegetation of existing fauna linkages and the provision of additional linkages.	Site Manager/Ecologist	Monitoring shows that Koalas are moving along existing and proposed fauna linkages.
Precincts 2-5, Precinct 6	Increase in connectivity	Use of underpasses will be monitored on a yearly basis for a period of five (5) years, or until revegetation on the Kings Forest site is self-sustaining (whichever is the earliest), following completion of exclusion fencing, grid and underpass construction. Monitoring must be undertaken by a suitably qualified biologist/koala specialist. Monitoring may include use of sand beds at either end of underpasses or cameras in a number of randomly selected underpasses across the site.	Site Manager/Ecologist	Monitoring shows that Koalas are utilising these underpasses, with utilisation measured by number of through passes, increasing over time.

10 KOALA MONITORING AND REPORTING

10.1 Introduction

This section discusses the proposed monitoring program for Koalas at the Kings Forest site including the key monitoring objectives, methodologies to be implemented for baseline and annual monitoring (including sand tray monitoring), data to be collected during monitoring events, reporting requirements, performance criteria, thresholds and corrective actions and the specific requirement for Koala monitoring to be completed after bushfire events.

10.2 Key Monitoring Objectives

The key variable of interest for Koala monitoring purposes is the Koala habitat occupancy rate (Dr S. Phillips *pers. comm.* 11 October 2013). The key objectives of monitoring are to ensure:

- An increase in the amount of habitat being occupied by Koalas (notwithstanding stochastic events such as fire that are beyond the control of Koala management actions);
- An increase (over time) of habitat that is suitable for Koalas, and so an increase in the carrying capacity of the landscape outside of the proposed development area;
- Minimal or no encounters with Koalas within the development area (i.e. within Koala exclusion fencing);
- Minimal or no attacks on Koalas by domestic dogs;
- Koala responses to threatening processes are monitored;
- That mitigation measures are effective in minimising impacts to Koalas;
- That movement corridors for the local Koala population are maintained or improved;
- The effectiveness of Koala exclusion fencing and associated underpasses, gates and grids etc. and that Koalas are dispersing along existing and proposed fauna linkages; and
- That data is collected that will allow the detection of any significant impacts to the local Koala population.

10.3 Baseline Monitoring

Baseline Koala monitoring will be completed across the entire site prior to the commencement of works on the site by suitably qualified and/or accredited persons⁸ in accordance with the methodology discussed in APPENDIX 7. Baseline monitoring will include diurnal searches of Kings Forest Koala habitat, a full measure of Koala activity (i.e. application of Spot Assessment Technique (SAT) methodology (Phillips and Callaghan (2011),

⁸ Means a qualified ecologist with appropriate training and at least five years of experience in undertaking surveys in relation to the relevant EPBC Act listed threatened species.

an assessment of the condition of available Koala habitat and the implementation of permanent photo monitoring points.

The survey data collected will be used to compile a Baseline Monitoring Report (SECTION 10.7.1).

10.4 Annual Koala Monitoring

Koala monitoring shall be completed on an annual basis (as a responsibility of the Proponent), from the date of commencement of works, and will continue for a period extending to five (5) years after completion of each precinct.

Annual Koala monitoring will be completed over the Kings Forest site following the methodology described in APPENDIX 7. Annual monitoring will include diurnal searches of Kings Forest Koala habitat, a full measure of Koala activity (i.e. application of Spot Assessment Technique (SAT) methodology (Phillips and Callaghan (2011)), an assessment of the condition of available Koala habitat and the continued monitoring of permanent photo monitoring points. In addition, sand tray monitoring will be completed to assess the usage of underpasses.

10.5 Koala Monitoring Performance Criteria

- For monitoring purposes, the benchmark habitat occupancy rate to be achieved for Koala populations inhabiting the Kings Forest site will be equal to or greater than baseline levels;
- Notwithstanding the influence of events beyond the control of the Proponent, the Revised KPoM can only be considered successful if the extent of habitat being utilised by Koalas across the Kings Forest site increases towards the benchmark or does not deviate significantly from the estimate of habitat occupancy rate established by baseline monitoring;
- Generally, conclusions relating to changes in the occupancy rate across the Kings Forest site should only be made at every fifth monitoring event (i.e. every five (5) years) by examining both the occupancy trend over the intervening five (5) year period and by a direct comparison to the occupancy estimate of five (5) years previous;
- Any statistically significant reduction⁹ in the habitat occupancy rate when compared to that estimated by the previous monitoring period will warrant further investigation as to cause and so trigger a review of the Plan;

⁹ Analysis based on use of Likelihood Ratio Test. This is a statistical test used to compare the goodness of fit of two models. The likelihood ratio, or its logarithm, can be used to generate values to enable a decision to accept or reject the fit of the two models. The Log-likelihood ratios (number of active sites/number of inactive sites) should be utilised with alpha set at 0.10.

- Koalas are utilising underpasses (as evidenced by sand tray monitoring), with utilisation measured by number of through passes, increasing over time;
- Koalas are moving along existing and proposed fauna linkages/corridors as evidenced by monitoring results;
- Inspections, monitoring and maintenance of Koala mitigation measures will occur at not less than 6 monthly intervals from the commencement of construction within each Precinct;
- Any damage to exclusion fencing is reported and rectified within two (2) working days of the discovery of the damage; and
- All reporting is completed as scheduled and provided to OEH and TSC.

10.6 Koala Monitoring After Fire

Koala monitoring will also be completed after any bush fire on the Kings Forest site by a suitably qualified ecologist. This will be completed in accordance with the methodology provided in APPENDIX 7 to monitor the impacts of fire on the local Koala population.

10.7 Reporting

10.7.1 Baseline Report

Subsequent to the completion of baseline monitoring, a report will be prepared outlining the results. The report will be provided to the Commonwealth Department of the Environment, NSW Department of Planning and Environment (DoPE), NSW Office of Environment and Heritage (OEH) and Tweed Shire Council and form the baseline for future monitoring. The baseline monitoring report will be available on the JWA website for 12 months (www.jwaec.com.au/).

10.7.2 Annual Koala Monitoring Report

An Annual Koala Monitoring Report (AKMR) will be prepared which discusses the results of the monitoring against the Monitoring Performance Criteria identified in SECTION 10.5, and the Successful implementation of management actions (with reference to the Criteria for Success, Thresholds and Corrective Actions detailed in SECTION 11.2). The information provided in the AKMR should include, but not necessarily be limited to:

1. An aim will be to provide a scientifically based (repeatable) comparison of the following parameters with the baseline data:

Koala home range sizes, density, seasonal dietary patterns, longer term movement patterns, reproductive output, dispersal patterns of juveniles, immigration to the site, genetic structure of the population, parentage analysis, health profile and disease status.

2. A presentation of the results of the Koala survey for each particular monitoring event;
3. A detailed discussion of the results of each particular monitoring event;
4. A detailed comparison with the baseline parameters and with previous annual survey data, as appropriate;
5. An analysis of the occupancy rate and any statistical changes to this rate over time;
6. A statement of compliance with the Monitoring Performance Criteria identified in SECTION 10.5;
7. Successful implementation of management actions (with reference to the Criteria for Success, Thresholds and Corrective Actions detailed in SECTION 11.2);
8. Koala usage within Environmental Protection Zones, ecological buffers and the golf course;
9. Adaptive management procedures to ensure that the separate management plans remain relevant and effective;
10. Documentation of any reported injuries to Koalas or mortalities;
11. An evaluation of the effectiveness of Koala-grids, underpasses (e.g. sand tray monitoring), fencing, improvements in habitat quality (fixed photo points), success of replanting efforts, community education, bushfire management, domestic dog control, feral dog control etc.; and
12. Comparison of results with the Baseline Monitoring Report and any other previous year's results.

Each AKMR will be provided to the Commonwealth Department of Environment, NSW Department of Planning and Environment (DoPE), NSW Office of Environment and Heritage (OEH) and Tweed Shire Council and will be available on the JWA website for a period of 12 months (www.jwaec.com.au/).

11 CONTINGENCY AND OFFSET STRATEGY

11.1 Introduction

Within one year of commencement of works within each relevant Precinct, the Proponent will prepare and submit a detailed Koala Contingency and Offset Strategy that will be implemented if the created compensatory habitat relevant to each precinct does not meet the defined success criteria outlined in SECTION 11.2 as determined under the monitoring regimes detailed in SECTION 10.4.

Contingency and Offset Strategies will be in accordance with the applicable offset policy in place at the time of writing and will, as a minimum, address the following:

- The relevant offset policy context and requirements;
- The success criteria identified for compensatory habitat creation;
- The potential threats and risks to successful compensatory Koala habitat creation;
- A reiteration of the conservation outcome sought;
- The scenarios to be considered where offset may be required;
- The methodology for calculating offset, particularly if only part of the compensatory habitat created is not successful;
- The potential options for direct offsets including their location and the mechanisms for how tenure and conservation in perpetuity will be secured;
- The nature of the governance arrangements for the offset;
- The role of other compensatory measures; and
- How the offset will be monitored for success and reported on for compliance purposes.

11.2 Criteria for Success and Corrective Actions

11.2.1 Background

To assess the effectiveness of the Revised KPoM the following specific criteria for success have been developed. Assessment against these criteria will be included in the AKMR. Thresholds and corrective actions in relation to specific management objectives are also discussed.

11.2.2 Criteria for Success

TABLE 10 details the specific objectives of the Revised KPoM, the relevant recommendations proposed to achieve these objectives, and outlines the criteria for judging success.

TABLE 10
OBJECTIVES OF THE MANAGEMENT PLAN AND CRITERIA FOR JUDGING SUCCESS

Objectives	Recommendations	Criteria for Judging Success	Suggested Likelihood of Success (and Residual Risk)
To ensure that the proposed development does not remove significant areas of habitat known, or likely to be important for the local Koala population	<ol style="list-style-type: none"> 1. Removal of Koala habitat will be restricted to approved areas (i.e. 14.92 ha in total as shown in FIGURE 16). 2. A large area which includes identified areas of "Primary Koala habitat" contiguous with Cudgen Nature Reserve (CNR) will be transferred to public ownership. 	<ul style="list-style-type: none"> • All Koala habitat outside of approved clearing areas is retained (FIGURE 16). • The designated 150 ha (minimum) of habitat known to be important to Koalas and which is contiguous with Cudgen Nature Reserve (CNR) is transferred to public ownership (i.e. the Tweed Shire Council or the Office of Environment and Heritage (OEH)). 	<ul style="list-style-type: none"> • High likelihood of success (low risk of clearing additional areas) • High likelihood of success (low risk that land is not transferred)
To ensure that movement corridors for the local Koala population are maintained or improved	<ol style="list-style-type: none"> 3. Fauna underpasses will be constructed to facilitate connectivity of habitat and fauna movement. Underpasses will be at least 1.8m high x 2.4m wide and no longer than 40 m. Where the underpass crosses beneath a dual carriageway or a road with a centre island, skylights will be incorporated. Use of underpasses will be monitored on a yearly basis for a period of five (5) years, or until revegetation on the Kings Forest site is self-sustaining (whichever is the earliest), following completion of exclusion fencing, grid and underpass construction. Monitoring must be undertaken by a suitably qualified biologist/koala specialist. Monitoring may include use of sand beds at either end of underpasses or cameras in a number of randomly selected underpasses across the site. 	<ul style="list-style-type: none"> • Monitoring shows that Koalas are utilising these underpasses, with utilisation measured by number of through passes, increasing over time. • Monitoring shows that Koalas are moving along existing and proposed fauna linkages. 	<ul style="list-style-type: none"> • Moderate likelihood of success (a moderate risk underpasses are not utilised) • Moderate likelihood of success (existing linkages likely to continue to be utilised, a moderate risk new linkages will not be utilised)

Objectives	Recommendations	Criteria for Judging Success	Suggested Likelihood of Success (and Residual Risk)
	<p>4. Free movement of Koalas through the Kings Forest site will be preserved and enhanced by revegetation of existing fauna linkages and the provision of additional linkages.</p>		
<p>To protect individual Koalas from injury or other adverse impacts during the development phase</p>	<p>5. An experienced fauna handler/ecologist will be on site to supervise all clearing activities regardless of whether the area is considered as Koala habitat.</p> <p>6. An education program will be developed and presented to all workers on the site. The program will provide information on the potential presence of Koalas and the procedures to be followed if a Koala is encountered (i.e. tree clearing operations and or bulk earthworks will be temporarily suspended within a range of 25 m from any tree which is concurrently occupied by a koala and must not resume until the koala has moved out of the area of its own volition).</p> <p>7. Appropriate temporary signage will be placed around the site and on the margins of the Environmental Protection Zones stating that Koalas occur on the site and providing an appropriate contact for the reporting of Koala sightings.</p> <p>8. Prompt notification to relevant agency of any damage to environmental mitigation measures (e.g. exclusion fencing).</p>	<ul style="list-style-type: none"> • An experienced fauna handler/ecologist is present to supervise all clearing activities. • All workers on the site are made aware of the potential presence of Koalas and the procedures to be followed if a Koala is encountered. • Appropriate temporary signage is installed. • Any damage to mitigation infrastructure is reported and rectified within two (2) working days of the discovery of the damage. 	<ul style="list-style-type: none"> • High likelihood of success (low risk that fauna handler/ecologist is not present to supervise clearing activities) • High likelihood of success (low risk that site works are not properly inducted) • High likelihood of success (low risk that signage is not installed) • High likelihood of success (low risk that damage is not reported and rectified).

Objectives	Recommendations	Criteria for Judging Success	Suggested Likelihood of Success (and Residual Risk)
<p>To embellish the habitat values of the site, including the creation of Koala habitat as part of a comprehensive offset strategy.</p>	<p>9. Koala food trees will be planted in areas identified in FIGURES 29 to 37.</p> <p>10. Tree planting to occur prior to the commencement of construction on a precinct-by-precinct basis.</p> <p>11. Koala food tree planting as per species list in Vegetation Management Plan (local stock).</p> <p>12. Within 12 months of the commencement of construction associated with each precinct, the approval holder must submit a detailed Koala Contingency and Offset Strategy for the Minister's written approval that will be implemented should the created habitat not meet the defined success criteria detailed in this Revised KPoM.</p>	<ul style="list-style-type: none"> • Plantings are completed in designated areas and maintained until established. • Average growth rate, foliage projective cover and species composition targets, based on accepted benchmarks for the specific vegetation communities on the Kings Forest site are met. • Koala food trees have been planted along both sides of underpasses and within a radius of 20 m of underpass openings. • Koala food trees are planted from the list specified in the Vegetation Management Plan. • Annual monitoring of Koalas demonstrates the stability of the local population and an increase in Koala numbers on the Kings Forest site after the completion of the development. 	<ul style="list-style-type: none"> • High likelihood of success (low risk that plantings are not completed) • Moderate likelihood of success (moderate risk that plantings do not meet accepted benchmarks) • High likelihood of success (low risk that plantings are not completed) • High likelihood of success (low risk that specific species are not planted) • Moderate likelihood of success (moderate risk that population numbers do not increase)
<p>To ensure that activities generated because of the proposed development (e.g. additional traffic, introduction of dogs) do not significantly impact on the local Koala population</p>	<p>13. Exclusion fences will be constructed to keep Koalas out of residential areas in accordance with SECTION 8.9.3. Koala incursions into built up areas during the operational phase of the development to be reported to TSC and dealt with by TSC and followed up by inspection of fencing issues. Inspection and maintenance to be completed on a regular basis. Where incidents involving Koala impact are</p>	<ul style="list-style-type: none"> • Exclusion fences have been constructed. Inspection and maintenance regularly conducted (i.e. vegetation in close proximity to fencing and damage caused by machinery, vandalism, fire and deterioration is amended as required). No Koalas have been recorded in residential areas. 	<ul style="list-style-type: none"> • High likelihood of success (low risk that fences are not installed/maintained) • High likelihood of success (low risk that grids are not installed/maintained) • High likelihood of success

Objectives	Recommendations	Criteria for Judging Success	Suggested Likelihood of Success (and Residual Risk)
	<p>directly attributable to failings of fencing and/or grid design, this shall necessitate the modification of their design.</p> <p>14. Grids will be constructed to exclude Koalas from the residential areas in accordance with FIGURE 27.</p> <p>15. Regular checking and prompt maintenance of infrastructure (fencing etc.)</p> <p>16. Educational signage will be placed at frequent intervals on the permanent Koala exclusion fencing. Signage will inform residents of the possible occurrence of Koalas within the Environmental Protection Zones, the purpose of the exclusion fencing around the residential area and imperative directive that dogs are prohibited within the EPZ's. Signage will also detail procedures to be followed when encountering Koalas within the exclusion zone, including the appropriate persons to contact.</p> <p>17. Prompt notification to relevant agency of breaches to environmental mitigation measures.</p>	<ul style="list-style-type: none"> • Grids have been installed and no Koalas have been recorded in residential areas. • Signage has been installed. • Any damage to mitigation infrastructure is reported and rectified within two (2) working days of the discovery of the damage. • A suitably qualified ecological professional inspects the fencing, grids and underpasses and certifies that the infrastructure has been constructed in accordance with the Revised KPoM. 	<p>(low risk that signs are not installed/maintained)</p> <ul style="list-style-type: none"> • High likelihood of success (low risk that breaches are not reported and rectified). • High likelihood of success (low risk that infrastructure is not certified).
<p>To ensure that Koalas continue to utilise habitat at Kings Forest</p>	<p>18. Any observations of Koalas (including any mortality if it was to occur on the Kings Forest site during or after development) will be reported in accordance with recommendations of the Office of Environment and Heritage.</p>	<ul style="list-style-type: none"> • Monitoring reports have been submitted to the Office of Environment and Heritage and compared with baseline data. • The results of monitoring demonstrate that there is no reduction in Koala numbers after the 	<ul style="list-style-type: none"> • High likelihood of success (low risk that reports not submitted). • Moderate likelihood of success (moderate risk that population numbers do not increase)

Objectives	Recommendations	Criteria for Judging Success	Suggested Likelihood of Success (and Residual Risk)
		completion of the development.	
To ensure monitoring and management is being carried out and maintained	19. Annual Koala monitoring and reporting will be provided to and approved by the Department of Planning, OEH and Tweed Shire Council.	<ul style="list-style-type: none"> • Annual Koala monitoring and report have been provided to the Department of Planning, OEH and Tweed Shire Council. 	<ul style="list-style-type: none"> • High likelihood of success (low risk that reports not submitted).
To raise awareness and promote community ownership of environmental management (including the conservation of the local Koala population);	<p>20. Provision of an information package for purchasers of land at Kings Forest. Help shape the attitude and awareness of the community and investigate where and how efforts to shape public awareness are best applied.</p> <p>21. Design and create a web page that contains information intended to raise and shape awareness of Koala issues at Kings Forest</p> <p>22. Advertise information relating to Koala management in local newspapers.</p> <p>23. Conduct community presentations/information days at local schools and/or public spaces.</p> <p>24. Provide feedback forms in order to confirm that awareness and education in the community is being built as a result of the environmental awareness and extension program.</p>	<ul style="list-style-type: none"> • Information packages produced and distributed and feedback forms indicate that attitudes and awareness are being shaped. • Web page created and feedback forms indicate that attitudes and awareness are being shaped. • Advertisements run and feedback forms indicate that attitudes and awareness are being shaped. • Presentations/information days conducted and feedback forms indicate that attitudes and awareness are being shaped. • Feedback forms provided and indicating that attitudes and awareness are being shaped. 	<ul style="list-style-type: none"> • High likelihood of success (low risk that information package, web page, advertisements, presentations/information days and feedback forms are not provided. Low risk that awareness of environmental management is not raised).
Compliance with relevant conditions	25. Within three (3) months of every twelve (12) month anniversary of the commencement of the approved action, Project 28 must publish a report on their website addressing	<ul style="list-style-type: none"> • Publish report on Project 28 website addressing compliance. The report will be available on the website for 12 months. 	<ul style="list-style-type: none"> • High likelihood of success (low risk that reports not published). • High likelihood of success

Objectives	Recommendations	Criteria for Judging Success	Suggested Likelihood of Success (and Residual Risk)
	<p>compliance with each of the conditions of approval relating to Koalas.</p> <p>26. Project 28 must inform the Department of any non-compliance with conditions relating to Koalas within two (2) business days of becoming aware of the non-compliance.</p> <p>27. Project 28 must maintain accurate records. These records may be subject to audit by the Department.</p> <p>28. Project 28 must publish this KPoM on the JWA website (www.jwaec.com.au/) within 1 month of its approval.</p> <p>29. If, at any time 5 years from the date of this approval, Project 28 has not substantially commenced¹⁰ the action, then Project 28 must not substantially commence the action without the written agreement of the Minister.</p>	<ul style="list-style-type: none"> The Revised KPoM is published on the Project 28 website within one (1) month of its approval. The Revised KPoM will be available on the website for 12 months. Project 28 will not commence the action after 21 May 2020 without written agreement of the Minister. 	<p>(low risk that reports not published).</p> <ul style="list-style-type: none"> High likelihood of success (low risk of project commencement after 21 May 2020 without written agreement of the Minister).
Revision of the KPoM as appropriate	<p>30. Project 28 will submit, to the Department, a revised version of the KPoM if they wish to carry out any activity which is not in accordance with the approved KPoM.</p> <p>31. If the Minister believes that it is necessary or convenient for the better protection of the Koala, the Minister may request that Project 28 revise the KPoM. Project 28 must revise the KPoM as directed by the Minister.</p>	<ul style="list-style-type: none"> Revised KPoM when necessary or as directed by the Minister. 	<ul style="list-style-type: none"> High likelihood of success (low risk that Revised KPoM not prepared if necessary).

¹⁰ means the physical commencement of bulk earthworks or construction of housing and other infrastructure, in one or more precincts on the project area.

11.2.3 Thresholds and Corrective Actions

The following actions will be the responsibility of the Proponent and implemented if required:

- Any statistically significant reduction in the habitat occupancy rate when compared to that estimated by the baseline monitoring and/or previous monitoring period will warrant further investigation as to cause and trigger the following actions:
 - Consultation with the OEH to determine whether disease was the cause of decline. If so:
 - A Koala capture and treatment program will be implemented to boost local population numbers; and
 - Further monitoring following the baseline survey methodology would take place six (6) months after treatment.
 - If disease was not established to be the cause of decline:
 - The conditions (biophysical) of the survey will be reviewed e.g. habitat condition assessments, fire regimes, Koala incident reports etc.; and
 - The monitoring survey will be completed again within three (3) months of the initial survey.
 - The detection of any further significant reduction in habitat occupancy rate after the completion of the above actions will be reported to the OEH to allow collaborative corrective actions to be devised.
- Any damage to fences will be reported to the Site Manager and prompt immediate repair, within two (2) working days of the discovery of the damage, will be completed by site personnel or independent contractors as determined by the Site Manager.
- If dogs are shown to have breached the intact fences and entered the Environmental Protection Zones a review of the fence design will occur within 1 month of the breach being detected. Evidence may include: reported sightings by the public, Leda staff or contractor personnel; dog tracks found during koala underpass sand tray monitoring events; dead or injured koalas. The review will be completed by an acknowledged authority in Koala biology/ecology. All recommendations from the review will be implemented;
- Repeated instances of vandalism to Koala mitigation infrastructure will prompt the implementation of mobile security patrols by a commercial security specialist;
- Any instances of diseased/injured Koalas will be investigated and further monitored;
- Any instances of Koala mortality as a result of poor public awareness (i.e. domestic dog attack, vehicle strike) will prompt the installation of additional educational signage;

- If it is evident that public awareness of Koala issues is low, as indicated by non-compliance with Koala management strategies (e.g. domestic dogs allowed to roam, vandalism to Koala mitigation infrastructure), investigations into improved public awareness strategies will be completed. This may involve consulting a specialist;
- The use of underpasses by Koalas will be investigated. SKM (2014) have indicated that evidence of usage of designated underpasses by Koalas should be based on a frequency which maintains population viability. The baseline survey (APPENDIX 7) will provide underpass usage data upon which all subsequent usage data will be measured. The significance (or otherwise) of deviations from the baseline usage data will be determined by an acknowledged authority in Koala biology/ecology when each Annual Monitoring Report is prepared;
- Replanting of Koala trees in close proximity to underpass openings if required (refer APPENDIX 6 for trigger values);
- Assess the adequacy of vegetation surrounding underpass openings, restrictions or disturbances to movement through underpasses etc.
- If pest animals are found to be impacting on native recruitment within rehabilitation areas, installation of protective tree guards, fencing and/or feral animal control will be considered;
- Excessive use of underpasses by feral animals (i.e. if only being used by feral animals - identified through sand tray inspections) will prompt the implementation of appropriate feral animal control programs; and
- All survey data collected for the project will be prepared so as to conform to EPBC Act survey guidelines and/or policy statements. This data must be made available to the Department within thirty (30) days of a request by the Department for this data.

11.2.4 Performance Targets and Corrective Actions for Proposed Offset Strategy

TABLE 11 provides the performance indicators and targets for the proposed rehabilitation strategy. Corrective actions are provided that are to be implemented if performance targets are not met.

**TABLE 11
PERFORMANCE TARGETS AND CORRECTIVE ACTIONS**

Performance Indicator	Target	Corrective Actions
Survival and continued growth of seedlings (i.e. planted stock)	>90% survival of planted stock during all monitoring events	Irrigation if required. Additional planting if required.
Establishment of native ground cover within revegetation areas	>60% after 3 years; >80% after 5 years	Supplementary planting
Establishment of native canopy cover within revegetation areas	>60% after 3 years; >80% after 5 years	Supplementary planting

Performance Indicator	Target	Corrective Actions
Height of planted trees within revegetation areas	>1.5m after 3 years; >2.5m after 5 years	N/A
Natural recruitment of native species throughout rehabilitation areas	Native recruitment occurring in all rehabilitation areas	N/A
All identified weeds controlled to an acceptable level within rehabilitation areas in accordance with the approved Weed Management Plan/s as amended and approved by NSW Department of Planning and Environment (JWA 2012)	<1% cover during all monitoring events	Weed control as necessary
Infrastructure (e.g. protection fencing, signage, erosion and sediment control devices) functional and well-maintained	Relevant infrastructure in condition suitable for hand over to Tweed Shire Council	Maintenance as necessary
Fully structured vegetation communities (with reference to appropriate benchmarks) are provided through assisted regeneration and revegetation plantings	A self-sustaining site is achieved once there is evidence of native recruitment and all weed species have been removed/controlled	Continue until performance targets are met

12 COSTING TABLE

TABLE 12 contains an indicative costing for the implementation of mitigation measures within each precinct of the development.

TABLE 12
INDICATIVE COSTINGS

Precinct	Infrastructure Items and Rehabilitation of Offset Areas	Cost (\$)*
Precinct 1	One-way Koala exclusion fencing (\$130/metre)	\$45,370
	Gates	Included in costs above
	Escape mechanisms	\$1,250/each
	Signage (speed and koala warning)	\$250/sign
	Roadway lighting	\$40,000/km
	Maintenance of infrastructure in the long term (accumulating per year until infrastructure dedicated or the end of the project)	\$7,500/year
	Monitoring & Reporting	\$120,000/year
Precincts 2-5	One-way Koala exclusion fencing (\$130/metre)	\$661,570
	Gates	Included in costs above
	Escape mechanisms	\$1,250/each
	Dedicated fauna underpass and furniture	\$75,000
	Landscape at entry to underpass	\$2,500
	Median strip treatment	\$2,000
	Roadway lighting	\$40,000/km
	Grids (3 x 3 m length @ \$1500 each plus installation)	\$4,500
	Signage (speed and koala warning)	\$250/sign
	Maintenance of infrastructure in the long term (accumulating per year until infrastructure dedicated or the end of the project)	\$7,500/year
	Rehabilitation of offset areas (2,000 plants/hectare @ \$15/plant (includes seedling, fertiliser, watering and weeding until sustainable) i.e. \$30,000/hectare)	\$373,500
	Environmental Awareness and Extension Program	\$15,000
	Monitoring	\$120,000/year
Precinct 6	One-way Koala exclusion fencing (\$130/metre)	\$612,040
	Gates	Included in costs above
	Escape mechanisms	\$1,250/each
	Dedicated fauna underpass and furniture	\$75,000
	Landscape at entry to underpass	\$2,500
	Signage (speed and koala warning)	\$250/sign
	Maintenance of infrastructure in the long term (accumulating per year until infrastructure dedicated or the end of the project)	\$7,500/year

Precinct	Infrastructure Items and Rehabilitation of Offset Areas	Cost (\$)*
	Monitoring	\$120,000/year
Precinct 7	One-way Koala exclusion fencing (\$130/metre)	\$381,420
	Gates	Included in costs above
	Escape mechanisms	\$1,250/each
	Signage (speed and koala warning)	\$250/sign
	Maintenance of infrastructure in the long term (accumulating per year until infrastructure dedicated or the end of the project)	\$7,500/year
	Rehabilitation of offset areas (2,000 plants/hectare @ \$15/plant (includes seedling, fertiliser, watering and weeding until sustainable) i.e. \$30,000/hectare)	\$132,300
	Monitoring	\$120,000/year
Precinct 8	One-way Koala exclusion fencing (\$130/metre)	\$418,730
	Gates	Included in costs above
	Escape mechanisms	\$1,250/each
	Signage (speed and koala warning)	\$250/sign
	Maintenance of infrastructure in the long term (accumulating per year until infrastructure dedicated or the end of the project)	\$7,500/year
	Rehabilitation of offset areas (2000 plants/hectare @ \$15/plant (includes seedling, fertiliser, watering and weeding until sustainable) i.e. \$30000/hectare)	\$165,000
	Monitoring	\$120,000/year
Precinct 9	One-way Koala exclusion fencing (\$130/metre)	\$501,540
	Gates	Included in costs above
	Escape mechanisms	\$1,250/each
	Signage (speed and koala warning)	\$250/sign
	Maintenance of infrastructure in the long term (accumulating per year until infrastructure dedicated or the end of the project)	\$7,500/year
Precinct 10	One-way Koala exclusion fencing (\$130/metre)	\$332,020
	Gates	Included in costs above
	Escape mechanisms	\$1,250/each
	Signage (speed and koala warning)	\$250/sign
	Maintenance of infrastructure in the long term (accumulating per year until infrastructure dedicated or the end of the project)	\$7,500/year
Precinct 11	One-way Koala exclusion fencing (\$130/metre)	\$614,380
	Gates	Included in costs above
	Escape mechanisms	\$1,250/each

Precinct	Infrastructure Items and Rehabilitation of Offset Areas	Cost (\$)*
	Signage (speed and koala warning)	\$250/sign
	Maintenance of infrastructure in the long term (accumulating per year until infrastructure dedicated or the end of the project)	\$7,500/year
	Rehabilitation of offset areas (2000 plants/hectare @ \$15/plant (includes seedling, fertiliser, watering and weeding until sustainable) i.e. \$30000/hectare)	\$192,300
	Monitoring	\$120,000/year
Precincts 12-14	One-way Koala exclusion fencing (\$130/metre)	\$1,164,540
	Gates	Included in costs above
	Escape mechanisms	\$1,250/each
	Signage (speed and koala warning)	\$250/sign
	Maintenance of infrastructure in the long term (accumulating per year until infrastructure dedicated or the end of the project)	\$7,500/year
	Rehabilitation of offset areas (2000 plants/hectare @ \$15/plant (includes seedling, fertiliser, watering and weeding until sustainable) i.e. \$30000/hectare)	\$440,100
	Monitoring	\$120,000/year
*Note: Proposed to be funded from the proponents ongoing cash flow during the development.		

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APPENDIX 1 - JAMES WARREN - CV



JAMES WARREN

MANAGING DIRECTOR

Biography

With 28 years of industry experience, James has specialist expertise in:

- The completion of field surveys and assessments for flora and fauna communities across a broad spectrum of habitats including wetlands, coastal heaths, rainforests, sclerophyll forests and woodlands, heathlands and estuarine communities;
- The assessment of impacts on plant and animal communities and the mitigation of impacts on these communities;
- The completion of environmental management plans;
- The completion of mine rehabilitation plans;
- Acting as a liaison to local councils, state and federal departments as well as other consultants; and
- Project management.

James has extensive knowledge of environmental policy and legislation relevant to development and industry in New South Wales and Queensland and has a proven record of achieving favourable project outcomes.

James has also participated in mediation and Court ordered Joint Experts Reports and has appeared regularly as an expert witness in the NSW Land and Environment and Court in the Queensland Planning and Environment Court.

Major projects James has contributed to:

- **Kings Forest Estate, near Kingscliff (NSW)** - Master planned community and mixed use development of 900 ha and 4,500 lots. James has been involved with this project since 1997 and most recently completed Submissions to the Commonwealth.
- **Cobaki Estate, Cobaki (NSW)** - Master planned community and mixed use development of 550 ha and 5,500 lots. James has been involved with this project since 1997 and most recently completed Submissions to the Commonwealth.
- **Area E, Terranora (NSW)** - The Proposed development consists of residential Lots, open space, shops, community facilities and roads. Residential Lots will comprise the majority of the site with 401 dwellings. Retail shops, a Residents Club and a community building will cover approximately 2.5ha and the remainder will be roads, open spaces and vegetation rehabilitation. Plans completed include a Vegetation Assessment, Wetland Rehabilitation Plan and Habitat Rehabilitation Plan.



JAMES WARREN

MANAGING DIRECTOR

- **Hayman Island (QLD)** - James completed three surveys of the One & Only Hayman Island resort and surrounds to assess the Proserpine Rock Wallaby population size prior to the capture and translocation of 100 wallabies to the mainland.
- **Peregian Springs Estate, Peregian Springs (QLD)** - Proposed Master planned community and mixed use development. James completed a detailed ecological assessment of the site.
- **Cannon Hill Community Links, Minnippi Parklands (QLD)** - James completed a monitoring program for the Squirrel glider population.

Representative Court Expertise

- The Trustee for the Gerald and Catherine Barnard Family Trust T/A Australian Walkabout Wildlife Park Pty Ltd [ACN 662 583 787] v Minister for Planning and Infrastructure & Rocla Materials Pty Ltd, Land and Environment Court of NSW Proceedings No. 14/10024. Ecological Assessment - Calga Sand Quarry Southern Extension.
- Braudmont Pty Ltd ACN 067 531 131 & Gemstone Nominees Pty Ltd & Brian Neil Sings v Gold Coast City Council & Department of Environment & Resource Management, Planning and Environment Court Appeal No. 217 of 2010. Report of Evidence - The Impact of a Walkway Construction on the Ecology of the Frontal Dune Between Len Wort Park and Tomewin Street, Currumbin.
- Tyam Heong Chong & Chon-Jui Yang v Logan City Council Appeal No. 2822 of 2012. Joint Expert Witness Report.
- Roy Somerville Surveys Pty Ltd v Brisbane City Council Planning and Environment Court No's. 1058, 1059 & 1060 of 2010 - 252a Compton Road and 57 Acacia Road, Karawatha.
- Iny Pty Ltd v Brisbane City Council, Land Court of Queensland AQL116-12 - Lot 2 on RP 75292, 211 Underwood Road, Eight Mile Plains.

Education

1974 Bachelor of Science Degree (B.Sc.)
University of New England, Armidale

1989 Master of Applied Science Degree (Thesis) (M.AppSc)
University of Technology, Sydney

The Thesis studied the status and productivity of the Wetland and Riparian Ecosystems in the Parramatta River Basin.



JAMES WARREN

MANAGING DIRECTOR

Relevant Professional Experience

November 1997 - present	Managing Director and Principal Environmental Scientist JWA Pty Ltd, Ballina NSW
1995-1997	Principal Environmental Scientist Woodward-Clyde
1987-1995	Director and Principal Environmental Scientist James Warren Biological and Environmental Consultants
1993	Manager Environmental Division Australian Koala Foundation
1990 -1992	Senior Environmental Scientist Newcrest Mining (Aust. Eastern Division)
1987-1989	Environmental Biologist Planners North
1976-1987	Secondary School Teacher - Sydney, Lismore and Murwillumbah

Professional Memberships

- Member of the Ecological Society of Australia (MESA)
- Member of the Australian Institute of Biology (MAIB)
- Member of the Coast and Wetlands Society (MCAWS)

APPENDIX 2 - APPROVALS PROCESS & STAKEHOLDER CONSULTATION

Background

A KPoM (Carrick 2009) has been approved by NSW Department of Planning as part of the Concept Plan approval (06_0318) process in 2010. JWA (formerly James Warren and Associates) completed a KPoM as part of the Stage 1 Project Application (08_0194) in 2012. The Commonwealth planning process also requires the completion of a KPoM that complies with their approval conditions. The following summarises the process Project 28 have undertaken thus far in the approval process for both State and Commonwealth jurisdictions.

Approvals Process

NSW

On the 19th January 2007, the NSW Minister for Planning authorised a Concept Plan (06_0318) for a proposed residential community at Kings Forest. The Director General's Environmental Assessment Requirements (DGEARs) were subsequently issued on the 21st August 2007. A Preferred Project Report (PPR) (and associated management plans including a KPoM) was prepared, after consultation with the NSW Department of Planning (DoP), addressing the DGEARs.

The Minister for Planning granted part 3A approval for the Concept plan for Kings Forest in August 2010. Modifications to the Concept Plan (and KPOM) were then subsequently approved in the period December 2010 to present.

The Kings Forest Stage 1 Project Application No. MP 08_0194 was lodged in November 2011. The Application and Environmental Assessment Report was advertised from December 2011 to January 2012 following which 302 public submissions and 10 agency submissions were received.

The Project Application (containing the Stage 1 KPoM) was approved with conditions on the 11th August 2013. This KPoM was subsequently amended in 2012 and modified in 2014 (MOD 2).

Kings Forest Major Project Approval No. 08_0194 Modification 4 application to reconcile the inconsistencies between Commonwealth and State approvals were commenced by the Department of Planning and Environment in 2015.

The Department of Planning and Environment (DoPE) has agreed, in their letter of the 3rd November 2015 that a revised KPoM which addresses both Commonwealth and State approval conditions, should be prepared.

The DoPE provided a letter to Project 28, dated 2nd August 2016, in relation to the Department's workshop with Tweed Shire Council (TSC), the Office of Environment and Heritage (OEH) and the Commonwealth Department of Environment (DoE) to identify

whether the State and Commonwealth approvals could be modified to provide a greater level of consistency. JWA Pty Ltd provided a written response (dated 7th November 2016) which aimed to provide the requested information regarding habitat creation at Kings Forest.

Further correspondence ensued (i.e. meetings, letters, emails and telephone conversations) during the period between 7th November and 7th December 2016. In response to issues raised, JWA completed further detailed assessment of the proposed Compensatory habitat areas and made amendments to these areas where relevant. This resulted in the commitment to providing additional areas of Compensatory Koala habitat on the Kings Forest site. Additional responses (including amended Annexures) were provided to DoPE and other relevant parties (dated 18th & 29th November and 1st & 7th December 2016). Overall plant numbers to be installed in each of the proposed Compensatory habitat areas were also provided.

Further consultation occurred with the Department to resolve inconsistencies in the Concept Plan and Major Projects approvals. These matters related to:

- Additional Koala offset habitat;
- The need for a fully revegetated East-West corridor;
- The definition of “commencement” as it relates to commencement of work on the site;
- Spatial overlap of heath revegetation/regeneration areas with Koala food tree plantings and Wallum sedge frog created habitat;
- The requirement under the Project Approval for a 27 hectare Koala habitat offset in the nearby Cudgen Nature Reserve;
- The placement of Koala fencing adjacent to Environmental Protection Zones; and
- the timing for the completion of fauna underpass construction.

Major Project Approval No. 08-0194 MOD4 application to reconcile the inconsistencies between Commonwealth and State approvals are currently being assessed by the Department of Planning and Environment.

Commonwealth

On the 20th March 2012, the proposed action was referred to the Commonwealth under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). On the 12th November 2012, a delegate for the Minister for the then Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (now Department of the Environment (DoE)) determined that the proposed action required approval under the EPBC Act. The basis for the decision was that the proposed action had the potential to have a significant impact on matters protected under Part 3 of the EPBC Act: listed threatened species and ecological communities (Sections 18 and 18A) including the local Koala population.

The DSEWPC indicated that the proposed action would be assessed through Preliminary Documentation (PD). The PD was submitted in April 2013. It contained information already

submitted as part of the referral as well as information acquired from experts and other relevant agencies. DSEWPC comments on the PD were received on the 12th June 2013 and further information was requested in an Analysis of Preliminary Documentation. A further assessment was completed in order to address issues raised by the Department and the data was incorporated into the Final Preliminary Documentation, which was provided along with a Response to Submissions Report on the 24th December 2013.

Negotiations regarding approval conditions commenced in early 2014. A Supplementary Addendum report was provided to the Department on the 28th November 2014. On the 19th December 2014 the Department provided a written response to the Supplementary Addendum report. A Revised Final Response Report was prepared by JWA and submitted on 13th March 2015 to address comments and information requests from DSEWPC.

The Department considered the proposal in accordance with Part 9 of the EPBC Act and decided to grant approval to Leda on the 21st May 2015. The approval specifies a number of conditions in relation to protecting Koala populations. Condition No. 2 specifically requires the preparation of a Koala Plan of Management.

On 25th November 2015, DoE provided Project 28 a “Statement of Reasons for Approval under the Environment Protection and Biodiversity Conservation Act 1999”. The content of this document was considered in the preparation of this Revised KPOM.

A meeting was held at DoE in Canberra on 9th November 2016. During this meeting the DoE raised issues in relation to the compatibility of the proposed Dry Secondary Koala habitat compensatory areas with regenerating heath communities. It was also raised that plant species lists for each compensatory habitat type should be provided. In response to these queries, and in liaison with DoPE and TSC, the proposed Compensatory Koala habitat was amended to minimise the spatial overlap of Dry Secondary Koala habitat and regenerating heath communities. Plant species lists were also provided for each of the proposed compensatory habitat types.

Consultation with DoE occurred in early 2017 with regard to the reconciliation of Commonwealth and State Approvals. In particular, the following matters were discussed:

- Timing for the completion of Koala infrastructure;
- Timing of construction commencement for each precinct as it relates to “substantial establishment” of created habitat; and
- Timing for the submission of the Contingency and Offsets Strategies for each precinct.

In May 2017 a “Variation to Conditions” was attached to the Approval. This document dealt with all of the above issues and provided a reconciliation with the State Approval.

Stakeholder Consultation

Introduction

In accordance with the Director General's Environmental Assessment Requirements (DGEARs) for the Kings Forest Concept Plan proposal, consultation was required with relevant public authorities and the broader community. This section summarises the consultation completed by the proponent during preparation of the proposal and during the public exhibition of the Concept Plan and Preferred Project Report (PPR) prepared for the NSW Department of Planning and Environment and Preliminary Documentation (PD) prepared for the Commonwealth Department of the Environment.

Previous Approvals and Consultations

In November 1987 Tweed Shire Council prepared the Kingscliff South Planning Report. In pursuance of this report, and following public and agency consultation, amendment No. 3 of Tweed LEP 1987 was gazetted on the 30th September 1989. The LEP amendment zoned part of the Kings Forest site to Part 1(b) Agricultural Protection, Part 2(c) Urban Expansion, Part 6(c) Recreation Special Purposes, Part 7(a) Environmental Protection and Part 2(e) Residential Tourist. Those zones applied under Tweed LEP 2000 up until the gazettal of the State Environmental Planning Policy (Major Projects) amendment for Kings Forest on the 10th November 2006.

In June 1989, Tweed Shire Council issued Development Consent No. GS488/182 for a 239 lot subdivision and 18 hole golf course. In 1992 Tweed Shire Council issued a further Development Consent No. S92/1 for a 260 lot subdivision and 18 hole golf course over Kings Forest. Whilst those developments did not proceed the consents were nevertheless granted pursuant to the statutory planning controls in force at those times.

The Proponent submitted a State Significant Site Study for Kings Forest to the Minister for Planning in 2006. The study and a draft zoning plan were publicly exhibited in April and May 2006. Wide ranging submissions were received and considered prior to gazettal of Amendment No. 10 to the Major Projects SEPP on the 10th November 2006.

The proposed Concept Plan, was prepared in accordance with the zonings established by the SEPP Amendment, except for proposed minor changes to the boundaries of Environmental Protection Zones. The development of a golf course was integral to the State Significant Site Study and the broad road pattern accords with exhibited TSC planning proposals. Moreover, the population which the Concept Plan anticipated was of the order that has been projected by TSC for many years. Accordingly, there is little in the current proposal that has not been subject to previous public scrutiny during public exhibitions arranged by both TSC and the Department of Planning. Nevertheless, further consultation with the community ensued as described below.

Council and Agency Consultation

The following public authorities were consulted by the proponent in relation to the Concept Plan:

- Tweed Shire Council - Administrators and officers;
- NSW Department of Environment and Climate Change (now NSW Office of Environment and Heritage (OEH)) - Northern Region;
- NSW Roads and Traffic Authority (now NSW Roads and Maritime Services); and
- NSW Department of Education and Training.

In accordance with Condition C3 of the Concept Plan (as amended) negotiations have commenced with regard to the transfer of a minimum of 150 ha of land as an addition to the Cudgen Nature Reserve.

A comprehensive suite of submissions was received from the following referral agencies during the exhibition period of the Preferred Project Report (PPR) completed for the Project Approval application in late 2011:

- NSW Department of Planning and Infrastructure;
- Tweed Shire Council;
- NSW National Parks and Wildlife Service;
- Eco Logical Australia Pty Ltd;
- NSW Environmental Protection Agency;
- NSW Department of Primary Industries;
- NSW Roads and Maritime Services;
- NSW Rural Fire Service;
- Essential Energy;
- NSW Finance and Services (Housing and Property Group);
- NSW Trade and Investment - Mineral Resources Branch; and
- NSW Office of Water.

During a telephone conversation between James Warren and Dr Mark Kingston (TSC) on 16th November 2016, Dr Kingston raised the following issues:

- There appeared to be areas within the 30m environmental buffer (particularly within the Cudgen Paddock) that were potentially suitable for the creation of Koala habitat but were not being utilised; and
- He would prefer the use of Forest red gum (*Eucalyptus tereticornis*) - a primary Koala food tree species - in lieu of Scribbly gum (*E. racemosa*) - a supplementary food tree species - where possible.

Dr Kingston met with JWA on 30th November 2016 to discuss the proposed Compensatory Koala habitat at the Kings Forest site. During this meeting, Dr Kingston proposed a

significant area of additional created Koala habitat (i.e. 27.61 ha comprising 118 separate areas). JWA completed an inspection of these areas and confirmed that 11.27 ha was viable as additional compensatory habitat. Subsequently, the additional areas amounting to 11.27 ha were incorporated into the proposed Compensatory Koala habitat. Furthermore, the proposed Dry Primary Compensatory Koala habitat now includes Forest red gum in lieu of Scribbly gum. Forest red gum will also be provided in the proposed Dry Secondary Compensatory Koala habitat in addition to Scribbly gum.

Community Consultation

The Major Project Application and its PPR was publicly exhibited from the 22nd November 2011 until the 23rd December 2011 for a period of thirty-two (32) days. The Department of Planning and Infrastructure received 302 submissions during the exhibition period, including ten (10) submissions from public authorities and 292 submissions from the general public and special interest groups. All submissions were made as objections to the proposal.

Following referral of the proposed action to the Commonwealth Department of the Environment, the Amended PD was placed on public exhibition, in accordance with Section 95A of the EPBC Act, from the 11th November until the 6th December for a period of twenty (20) business days. A total of 3,105 public submissions were received during this time consisting of a large proportion (3,094) of form letters and a small number (10) of individual submissions, including one (1) in support of the proposed development. A submission from Tweed Shire Council was also received.

APPENDIX 3 – SUMMARY OF RELEVANT STATUTORY REGULATIONS

Introduction

This section outlines the statutory requirements in relation to the conservation of Koalas and the preparation of Koala Plans of Management.

NSW Threatened Species Conservation Act 1995

The *Threatened Species Conservation Act 1995* (TSC Act) is the key piece of legislation in NSW relating to the protection and management of biodiversity and threatened species. The TSC Act aims to protect and encourage the recovery of threatened species, populations and communities that are listed under the Act through threat abatement and species recovery programs. The TSC Act requires consideration of whether a development (Part 4) or an activity (Part 5) is likely to significantly impact threatened species, populations, communities or their habitat. The Koala is listed as Vulnerable under the TSC Act.

NSW State Environment Planning Policy (SEPP) No. 44 – Koala Habitat Protection (1995)

The aim of SEPP 44 is to “encourage the conservation and proper management of areas of natural vegetation that provide habitat for Koalas, to ensure permanent free-living populations over their present range and to reverse the current trend of population decline.”

SEPP 44 requires that an individual KPoM be prepared to accompany DA’s which affect core Koala habitat in LGA’s for which a comprehensive KPoM has not been completed. The following matters are required to be considered when completing a KPoM:

- An estimate of Koala population size.
- Identification of preferred feed tree species for the locality and extent of resource availability.
- An assessment of the regional distribution of Koalas and the extent of alternative habitat available to compensate for that to be affected by the actions.
- Identification of linkages of core Koala habitat to other adjacent areas of habitat and movement of Koalas between areas of habitat, including provision of strategies to enhance and manage these corridors.
- Identification of major threatening processes such as disease, clearance of habitat, road kill and dog attack which impact on the population as well as provision of methods for reducing these impacts.
- Provision of detailed proposals for amelioration of impacts on Koala populations from any anticipated development within zones of core Koala habitat.
- Identification of any opportunities to increase size or improve condition of existing core habitat, this should include lands adjacent to areas of identified core Koala habitat.

- The plan should state clearly, what it aims to achieve (for example, maintaining or expanding the current population size or habitat area).
- The plan should state criteria against which achievement of these objectives is to be measured (for example, a specified population size in a specific time frame or the abatement of threats to the populations).
- The plan should also make provisions for continuing monitoring, review and reporting. This should include an identification of who will undertake further work and how it will be funded.

The proponent is not required to prepare a KPoM under the provisions of SEPP 44 if they have, or are required, to prepare a site specific KPoM. Although a Comprehensive KPoM has been completed for the Tweed Coast (2015) the requirement to complete an individual Kings Forest KPoM pre-dated the completion of the Comprehensive KPoM.

Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The Koala (combined populations of QLD, NSW and ACT) was listed (May 2012) as 'Vulnerable' under the *Environment Protection and Biodiversity Conservation Act 1999* in recognition of the threat to their survival, particularly in coastal regions, from:

- Vegetation loss and fragmentation;
- Vehicle strike and predation by dogs as a result of urban expansion; and
- Increased susceptibility to the effects of drought, climate change and disease.

The proposed development was considered likely to have a significant impact on a Matter of National Environmental Significance (NES) i.e. the Koalas in the Kings Forest locality, and was therefore referred to the Minister of the Environment through the Australian Government Department of Sustainability, Environment, Water, Population and Communities (DSEWPC). The DSEWPC indicated that the proposed action would be assessed through Preliminary Documentation (PD).

A comprehensive review and public exhibition process was completed in 2013 and 2014 and a Revised Final Response Report was submitted in March 2015. The action was approved in May 2015. This Approval contained twenty-seven (27) conditions. The requirement for the preparation of a KPoM was included in the conditions.

NSW Companion Animals Act 1998

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

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

NSW Recovery Plan for the Koala (2008)

Within New South Wales, Koalas (*Phascolarctos cinereus*) are recognised as a Schedule 2 (Vulnerable) species under the TSC Act. The Final Determination for the listing of the Koala on the TSC Act by the Scientific Committee notes that the Koala has been included in Schedule 2 for the following reasons:

- Koala populations and their distribution have been severely reduced.
- Recovery potential is considered poor.
- Threatening processes are considered to be severe.
- Koalas are ecological specialists, feeding principally on the leaves of particular eucalypt species.
- Most of the state's remaining Koalas occur as a series of fragmented populations in the north coast region, from the Hunter River to the NSW/QLD border.
- Koalas appear largely dependent on areas of fertile soils and either high rainfall or adequate soil moisture. The majority of such lands have already been cleared for agriculture or settled at densities, which may eventually eliminate Koalas.
- Only 24% of Koala sightings obtained by the 1986-87 New South Wales Koala Survey were in National Parks, Nature Reserves or State Forests (Reed *et al.* 1990). The majority of sightings were on private lands in New South Wales, where Koala conservation is a community concern and the responsibility falls largely with the community and local government.

The TSC Act provides that the Director General of the Department of Environment and Climate Change (DECC) may prepare a recovery plan for all species, populations and ecological communities listed as critically endangered, endangered or vulnerable on the Schedules of the Act (other than species presumed extinct). Part 4 of the TSC Act specifies matters to be included in a recovery plan and the process for preparing recovery plans. In 2008 the DECC completed an Approved Recovery Plan for the Koala (*Phascolarctos cinereus*). In addition, the TSC Act provides that the Director General must prepare a Priorities Action Statement (PAS), which specifies the conservation strategies, and actions where known, to recover all threatened species in NSW. Actions contained within this recovery plan are summarised by the PAS, and this information is available from the NSW threatened species website. Any KPOM prepared in NSW would be required to comply with the provisions of the Recovery Plan.

National Koala Conservation and Management Strategy 2009-2014

The National Koala Conservation and Management Strategy (NKCMS) 2009-2014 takes into account the considerable amount of Koala research, planning and management activity

since the 1998 National Koala Conservation Strategy. For instance, the 1998 strategy makes no reference to climate change.

Recent research has also shown that the relative importance of each threat differs from location to location. This requires local solutions, based on local studies and local plans, to manage individual koala populations across their extensive range. The task of this strategy is to give cohesion to all levels of activity, and acknowledge that there is no one universal solution for managing koalas.

Since the 1998 strategy, national and state conservation efforts have increasingly focused on multi-species and landscape-scale protection and recovery. Protecting, restoring and managing koalas and their habitat will have significant benefits for a wide range of other species and ecological communities which also share the koala's habitat. The NKCMS aims to integrate with, and complement, conservation efforts in all areas where the koala exists. Importantly, the koala was identified as a flagship with which to generate public support for these broader efforts.

The NKCMS was developed jointly by the Australian, state and territory governments through the Natural Resource Management Ministerial Council (NRMCC). Its aim was to provide a national framework for the conservation of koalas. The NKCMS was intended to be formally reviewed after five years, to facilitate an adaptive approach to Koala conservation management.

Approved Conservation Advice for *Phascolarctos cinereus* (combined populations of Queensland, New South Wales and the Australian Capital Territory) (2012)

This conservation advice concerns only the koala (combined population in Queensland, New South Wales and the Australian Capital Territory), together listed as vulnerable under the Environment Protection and Biodiversity Conservation Act 1999. Some of the advice described here may also be relevant to koala populations in Victoria and South Australia, but those populations are not the focus of this conservation advice.

This brief advice distils research and management actions previously given in the National Koala Conservation and Management Strategy 2009-2014, many recommendations provided in the Senate Inquiry into the status, health and sustainability of Australia's koala population (Senate Environment and Communications References Committee 2011), and includes some consideration of research and management actions within a series of existing local and regional koala management plans. In many cases, these existing documents may provide far more detail about such actions, and may be more applicable at local and regional scales.

This conservation advice provides a framework which will be developed further through the establishment and implementation of a recovery plan. The recovery plan will commence following the expiration of the National Koala Conservation and Management Strategy in 2014 for the combined populations of Queensland, New South Wales and the Australian Capital Territory.

Koala Management within the Tweed Shire

A systematic assessment of the koala population and their habitat within the Tweed Coast Study Area (TCSA), including the area to which this plan applies, was recently completed on behalf of Tweed Shire Council by Phillips *et al.* (2011). Amongst other things, the results of this study indicated a decline of approximately 50% in koala numbers within the last eight (8) years that was largely attributable to two (2) major fire events in 2004 and 2009. The study also identified motor vehicle strike as a major contributor to incidental mortality rates and overall population attrition. Phillips *et al.* (2011) state that the answer to maintaining a viable Koala population within the Tweed Shire is not necessarily to “lock-up” land, rather the land should be managed accordingly through appropriate planning.

In consultation with the Tweed Coast Koala Advisory Group, Tweed Shire Council engaged the services of Biolink Ecological Consultants to prepare a Comprehensive Koala Plan of Management (TCCKPoM) to address the trend of Koala population decline on the Tweed Coast. The preparation of the TCCKPoM was informed by the scientific background contained in the Tweed Coast Koala Habitat Study (Phillips *et al.* 2011). The TCCKPoM was adopted as a strategy of Tweed Shire Council on the 19th February 2015. As of December 2015, the TCCKPoM has not been approved by the NSW Department of Planning and Environment under SEPP 44.

The Kings Forest Revised KPoM has no statutory requirement to comply with the TCCKPoM.

APPENDIX 4 - LITERATURE REVIEW

Introduction

Comprehensive desktop assessments were completed as an integral part of the preparation of this Revised KPoM. This section provides details of the reports and literature reviewed that is relevant to Koalas and Koala habitat at the Kings Forest site and surrounding areas.

Summary of Documents Reviewed

Numerous documents and assessments were reviewed during the development of this Revised KPoM, including reports and studies completed for the wider locality (i.e. Tweed LGA) and reports and management plans specific to the Kings Forest site. A summary of the literature reviewed is provided below:

- *Interim Report on Monitoring of Impacts on Koalas Associated with the Upgrading and Part Realignment of Old Bogangar Road.* Prepared for Tweed Shire Council by John Callaghan and Steve Phillips. June 1998. The Australian Koala Foundation.

As part of this study, a total of eight (8) Koalas were captured and fitted with radio-tracking collars. The aim of the radio-tracking program was to establish baseline information and to facilitate monitoring of impacts on the local Koala population associated with the upgrading/realignment of Old Bogangar Road.

Two (2) animals whose ranging patterns clearly covered the Old Bogangar Road are known to have been killed since work commenced on the road upgrading. At least two (2) of the eight (8) radio-tracked Koalas, including the likely Alpha male, occupied home ranges that included areas on both sides of Old Bogangar Road. Both of these animals made road crossings (through a large culvert) over the course of the radio-tracking program. Exclusion fencing along the realigned Old Bogangar Road was recommended. This fencing has subsequently been installed.

- *Species Impact Statement for the Proposed Kings Forest Development.* A Report to Narui Gold Coast. December 2000. James Warren and Associates Pty Ltd.

As part of this study, seven (7) Koalas were radio-collared and tracked for several months. Overall, Swamp Sclerophyll Forests were found to be the most important habitats for these animals. As expected, Koalas were closely associated with habitats containing the preferred feed tree Swamp mahogany (*Eucalyptus robusta*). Although no radio-tracking data was gathered for the Dry Sclerophyll Forests occurring on the Kings Forest site, this habitat is also likely to be important for Koalas.

Some Koalas were consistently recorded in Pine forests up to 150 m from preferred feed trees. Faecal pellet analysis revealed that Pine did not appear in the diet of these individuals, and it was concluded that the Pine was used for roost purposes only.

The Species Impact Statement (SIS) also provided details of a Koala Faecal Pellet Analysis. Faecal pellets were collected from six (6) of the radio-collared Koalas. The results establish the importance of Swamp mahogany (*Eucalyptus robusta*) as a feed tree for Koalas. They also highlighted the importance of species such as Scribbly gum (*Eucalyptus signata*), Broad-leaved paperbark (*Melaleuca quinquenervia*) Swamp turpentine (*Lophostemon suaveolens*), Blackbutt (*Eucalyptus pilularis*) and Brushbox (*Lophostemon confertus*) that are typically regarded as secondary feed trees.

Eucalyptus robusta was the most significant component of the majority of pellets. Other species that comprised over 30% of an individual sample were *Eucalyptus pilularis* (>30% in 2 samples), *Lophostemon confertus* (>30% in 1 sample), *Lophostemon suaveolens* (>30% in 3 samples) and *Melaleuca quinquenervia* (>30% in 1 sample).

- *Taylor B and Goldingay R (2003) Cutting the carnage: Wildlife usage of road culverts in north-eastern New South Wales. Wildlife Research 30 (5) 529-537.*

In this study, Taylor and Goldingay (2003) reported the use of nine purpose-built (i.e. for fauna in general, not for Koalas in particular) culverts along a 1.4km section of the Pacific Highway near Brunswick Heads, NSW. These culverts were 2.4m wide, 1.2m high and 18m long. Surveys during two eight-day periods in spring and summer 2000 recorded 1202 traverses by wildlife through the culverts. Frequent culvert users were bandicoots (25% of traverses), rats (25%), wallabies (13%) and cane toads (14%). A Koala was recorded crossing on two occasions. Surveys for road-kills on this section of road suggested that the “floppy-top” fauna exclusion fence (chain-mesh, 1.8m high) bordering the highway prevented mammal road-kills and channeled mammals to the culverts. Some culverts were prone to flooding and these were considered unsuitable as fauna crossings during periods of inundation.

Fauna movement structures were used mostly during September and October, corresponding to the breeding and dispersal seasons.

- *Approved Recovery Plan. Recovery plan for the koala (Phascolarctos cinereus). November 2008. Department of Environment and Climate Change NSW.*

This document constitutes the formal New South Wales State Recovery Plan for the Koala and considers the conservation requirements of the species across its known range in NSW. It identifies actions to be taken to ensure the long-term viability of the Koala in nature and the parties who are responsible for undertaking these actions.

The Koala is listed as a vulnerable species under the NSW TSC Act. At the time this recovery plan was published, the Koala was not listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.

Koalas were formerly widespread in NSW. Remaining populations are concentrated on the central, mid-north and north coasts, and west of the divide in the northern part of the state. Small and isolated populations also occur on the south and far south coasts, and on the tablelands of the Great Dividing Range.

This recovery plan establishes a landscape-scale conservation framework using existing legislative mechanisms for koala conservation and management. The plan provides a framework for localised koala recovery efforts throughout NSW. The recovery actions are aimed at updating and facilitating the implementation of existing legislation to improve outcomes for conservation of koalas and their habitat; identifying areas of koala habitat and prioritising on-ground management actions; identifying research actions; and increasing awareness in the community, as well as within local, state and Commonwealth government bodies regarding the management and conservation of Koalas.

It was intended that this recovery plan be implemented over a five (5) year period. Actions were to be undertaken by the NSW Department of Environment and Climate Change and a range of recommended implementation partners. Several actions and initiatives are already underway. Actions from this plan are also included in the NSW Priorities Action Statement, which provides a comprehensive and overarching strategy for recovery of all threatened species in NSW, and provides information to assist a range of regional organisations such as catchment management authorities and local governments to implement koala conservation actions on lands for which they have responsibility.

- *Kings Forest Koala Plan of Management*. Prepared by Dr Frank N Carrick AM EcoIndig Resources Pty Ltd on behalf of Project 28 Pty Ltd. August 2009.

This 2009 KPoM was prepared in response to the NSW Department of Planning The Director General's Environmental Assessment Requirements (DGEARs), issued on the 21st August 2007. These requirements followed from State Environmental Planning Policy (Major Projects) 2005 (Amendment No 10) in NSW Government Gazette No 135 of the 10th November 2006, pursuant to a Concept Plan Application with respect to Kings Forest. In part, the SEPP amendment resulted in the rezoning of various parts of Kings Forest. This 2009 KPoM was prepared in response to the new situation and also incorporated revisions arising from submissions on the Kings Forest KPoM dated March 2008 which were received from the public, conservation groups, local government and state government agencies.

This 2009 KPoM evaluated the likely impacts of the proposed development and made a series of management recommendations relating to carrying capacity, connectivity, vehicles, domestic dogs, swimming pools, disease status, and education and awareness issues.

Various performance indicators and benchmarks were recommended to assess the effectiveness of this 2009 KPoM and to provide for adaptive management modifications to the plan. A commitment to intensive and extended monitoring was provided to ensure compliance with the 2009 KPoM and to inform future planning decisions for development proposals in Koala Management Area 1 - North Coast (DECC 2008).

- *Tweed Coast Koala Habitat Study*. Report to Tweed Shire Council. January 2011. Biolink Ecological Consultants Pty Ltd.

This report describes the results of a Koala habitat and population assessment for the coastal portion of the Tweed Local Government Area (TLGA), an area of approximately 21,200 ha comprising lands surrounding Terranora and Cobaki Broadwaters in the north before extending along the coast for approximately 35 km south of Tweed Heads generally between the coast and the Pacific Highway.

Analyses of 1,119 records of Koala sightings over the period 1949 to 2009 revealed that Koalas were once more widespread throughout the TLGA than they are today. Across the TLGA historical records infer a contraction of approximately 18% in the extent of occurrence over the last three (3) Koala generations, while area of occupancy rates appeared to be unchanged at approximately 44%, a trend also mirrored within the TCSA.

Detailed Koala population assessments in the TCSA involved application of a systematic sampling strategy primarily reliant on Spot Assessment Technique (SAT) methodology to gather data on koala presence and absence, food tree preferences, koala density and activity. Collectively, 134 field sites were sampled comprising 85 primary and 49 supplementary field sites, the latter focused around areas of significant koala activity. Evidence of habitat use by koalas was recorded in 17 of the 85 primary sites to provide a current estimated extent of occurrence of 12,631 ha, with a current area of occupancy of approximately 20%.

This study provides that, north of the Tweed River, Koala activity data indicates the persistence of small relic populations in the Terranora-Bilambil Heights and Tweed Heads South areas, however the short to medium-term viability of these populations is considered low in the absence of recruitment and is further reduced by the escalation of threatening processes arising from ongoing development. South of the Tweed River, three (3) disjunct sub-populations occupy discrete areas of habitat between Bogangar and Pottsville. The presence of an additional small population outlier in the vicinity of Duranbah and Eviron Road is also indicated, the viability of which is clearly contingent upon recruitment from the aforementioned sub-populations to the east.

Evidence of generational persistence is widespread throughout the TCSA, testifying to a long history of occupancy and successful reproduction by Koalas. Until now, the Tweed Coast's Koala population has persisted in an increasingly patchy habitat matrix that is compartmentalised by road barriers and cleared lands, where it is subjected to the full suite of threatening processes. Comparison of historical record analysis and results of field survey suggests that occupancy by Koalas within the TCSA has halved in recent years, with

density data inferring a population estimate of approximately 144 Koalas remaining in areas of currently occupied habitat. This population estimate infers that the population size of the TCSA Koalas may already be below the minimum viable population size required to sustain long-term population survival. Fire frequency and intensity within remaining habitat areas over the last decade has been identified as the major contributor to recent population attrition, with recovery potential now impeded in remaining habitat areas by ongoing incidental mortality rates due mostly to motor vehicle strike.

Data from 2,734 trees collected during the course of the study were augmented by that from other studies in order to better investigate issues associated with utilisation of preferred Koala food trees. Collectively, a total of 8,413 trees comprised the tree use data set. Consistent with previous work, four (4) species - Forest red gum (*Eucalyptus tereticornis*), Swamp mahogany (*E. robusta*), Tallowwood (*E. microcorys*) and Grey gum (*E. propinqua*) - were identified as the most preferred species within the TCSA. Forest red gum and Swamp mahogany were confirmed as primary food tree species, while size-class based variation in use of Tallowwood and Grey gum confirmed a role as secondary food trees when growing on low-nutrient soils. Knowledge of tree preferences and the influence of soil landscape facilitated development of a four-tiered, hierarchical Koala habitat classification decision-tree which resulted in approximately 3,815 ha of potential Koala habitat in habitat classes Primary, Secondary (Class A) and Secondary (Class B) being identified within the TCSA.

- *Advice to the Minister for Sustainability, Environment, Water, Population and Communities from the Threatened Species Scientific Committee (the Committee) on Amendment to the list of Threatened Species under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Prepared in 2011.*

This advice considers the conservation status of the Koala at two (2) levels - across its entire range, and for the Queensland - New South Wales - Australian Capital Territory portion of its range. This advice revises that previously given by the Committee in September 2010, through the consideration of new information mostly arising from the Senate Inquiry (Senate Environment and Communications References Committee 2011).

Of the five (5) eligibility criteria relevant for conservation listing, the Koala approaches or meets only that criterion relating to the extent of population decline over a three (3) generational period (in the Koala's case, 20 years). The data available for this assessment remain extremely patchy, inconsistent and incomplete. The Committee considers that, at the national level, the Koala's decline over the last 20 years approaches but does not meet the required eligibility threshold (loss of 30% of total population size). Accordingly, the Committee advises that the Koala is ineligible for listing as threatened at the national level.

However, the Committee recognises that the Koala faces stark conservation challenges across much of its distribution, particularly in the northern portion of its range. If the Koala populations in Queensland and New South Wales (along with the very small Koala population within the Australian Capital Territory) together are considered as a designatable "species"

for the purposes of the EPBC Act, then their rate of decline over the last 20 years readily meets the eligibility threshold for listing as vulnerable. Such a listing would deliver a conservation benefit most focused at the Koala's major management concerns.

The Committee notes that the circumscription of a "part-range" population and its treatment as a species under the Act has few precedents, and that these few cases involved populations that were notably more distinct and disjunct than that of the "northern" population of koala. The Committee advises that it recognises a pressing priority to develop sound guidelines for the application of "part-range" designations.

The Committee recommended that Koala populations in Queensland, New South Wales and the Australian Capital Territory were most at risk and required listing under the Commonwealth EPBC Act.

Hopkins, M. and Phillips, S. (2009) Koala Monitoring - Final Report. Skyline Road Upgrade, Lismore 2011. Biolink Pty Ltd, Uki, NSW

Hopkins and Phillips (2009) in their report on the Skyline Road Upgrade for Lismore City Council demonstrated the ability of wildlife exclusion fencing, coupled with strategically placed underpasses and the use of specially designed Koala grids at driveways and fence ends, to effectively exclude Koalas from designated areas. In this case Koalas were excluded from a 3 km section of road and associated impacts (such as vehicle strike) resulting from increased traffic volume and vehicle speeds. Included in the outcomes were:

- No change in the distribution and abundance of Koalas throughout the five (5) year monitoring program;
 - An estimate of approximately 100 to 150 under-road traverses by Koalas each year; and
 - No evidence of Koalas within the exclusion area and no associated road mortalities
- *Species Profile and Threats Database (SPRAT Profile) for Phascolarctos cinereus (Combined Populations of Queensland, New South Wales and the Australian Capital Territory). Department of the Environment (2014). Canberra.*

This is a comprehensive document provided in response to the decision to list the Koala as Vulnerable in the EPBC Act. Apart from the detailed discussions on the distribution, habitat requirements, reproductive biology and population estimates it discusses the threats facing the Koala and mitigation measures that should be implemented to halt and reverse the decline in population numbers. The document also contains a comprehensive list of references utilised in its compilation.

The document notes that a reduction in the risk of the impacts of vehicles on Koalas can be achieved by the control of speed limits, user awareness and design features such as

exclusion fencing, escape mechanisms and light and noise reduction. These DoE mitigation features are discussed below:

Speed Limits

Where feasible, set 60km/h enforceable speed limits where a new major road/upgrade intersects with likely Koala habitat patches and landscape corridors. Differential speed limits could be set so that lower speeds are only enforceable during peak, daily, Koala-movement periods (e.g. 60km/h from 7pm to 5am during the local breeding season and 80km/h at all other times).

User Awareness

Road signage to alert drivers to the fact that Koalas may cross the roadway in the area (even though measures are in place to prevent this from occurring). Interpretative signage should educate:

- Construction personnel during the construction stage of the project;
- Road users and the general public (also could be done through letterbox drops or advertising campaigns); and
- Members of the public about the impact-prevention/mitigation measures constructed.

Design Features

Exclusion Fencing

Install Koala-proof fencing to prevent the access of Koalas to the roadway and in conjunction with all structural impact-mitigation measures to increase their effectiveness (for example funneling Koalas to overpasses or underpasses). Fences should:

- Be made of interlock mesh;
- Be a minimum 1.5 m in height;
- Be 5 m from any retained trees or plantings to minimise the potential for Koalas to climb over the fence and to minimise potential damage occurring to the fence from falling trees or tree limbs; and
- Have a minimum 50 cm wide scratch paneling or ‘floppy tops’ installed along the length of the fence to minimize the ability of Koalas to climb the fence.

Escape Mechanisms

Strategically place climbing poles (made of treated pine logs) at appropriate intervals along road corridor side of any Koala-proof fencing to allow Koalas to climb over the fence if they inadvertently enter the road corridor. Include refuge poles/furniture to allow Koalas to escape dogs easily.

Light and Noise Reduction

Incorporate walls (strategically placed to prevent the creation of barriers to Koala movement) and other techniques to prevent or reduce light emanating from the road (streetlights or vehicle headlights) entering adjacent Koala habitat and adversely affecting habitat quality. Use LED lights to reduce light emissions.

- *EPBC Act Referral guidelines for the vulnerable Koala (Queensland, New South Wales and the Australian Capital Territory)*. Department of the Environment (2014) Commonwealth of Australia. Canberra.

These Koala referral guidelines (the guidelines) aim to address the complexity of making a decision as to what constitutes a significant impact on the Koala and provide guidance that can be applied consistently across the entire distribution of the listed koala. The guidelines break down the significant impact decision and guide proponents on important requirements, particularly on information expectations, survey planning, standards for mitigating impacts and guidance on significant impact. This is provided in the context of long term recovery planning for the Koala.

Examples of structures designed to mitigate dog and vehicle impacts on Koalas include:

Dog attack

- fencing that is both dog proof and Koala proof along boundaries, or dog proof fencing with Koala furniture to allow Koalas to escape yards
- Fences are a minimum 3m high (dog proof) and have a minimum 50 cm wide scratch panelling installed along the length of the outer side of the fence (for Koala proof fencing)

Vehicle strike

- Koala proof fencing along entire extent of infrastructure and be a minimum of 1.8m high and be 3 metres from any retained trees or plantings and be clear of all overhanging branches

Underpasses

- include above water, dry longitudinal benches;
 - Ideally be no more than 40m in length;
 - Be a minimum 2.4m in height and width;
 - Have a low flow channel incorporated in the design;
 - Fencing in place to guide Koalas to the underpasses (at least 100m on either side of the underpasses).

- *Tweed Coast Comprehensive Koala Plan of Management (TCCCKPoM)*. January 2015. Tweed Shire Council, Murwillumbah, NSW.

The Tweed Coast Koala Habitat Study (Biolink 2011) was the main supporting document to the TCCCKPoM. The scope and content of the TCCCKPoM, together with the supporting Tweed

Coast Koala Habitat Study, has been prepared in accordance with SEPP 44 and the associated Departmental guidelines. Accordingly, this Plan covers a wide range of issues including development control, strategic planning, koala habitat restoration, managing threats from roads, dogs, fire and disease, community engagement, implementation, and ongoing monitoring, reporting and review. The plan also has relevance to a wide range of stakeholders.

Part 7 of the TCCKPoM commits Council to taking a lead role in Koala habitat restoration and identifies a range of non-regulatory opportunities and benefit for landholders wanting to preserve and/or enhance koala habitat on their land.

In relation to SEPP 44, the TCCKPoM itself has been prepared in accordance with Part 3 of SEPP 44 and addresses the aims and objectives of SEPP 44 (Part 1 of the SEPP) through both the regulatory and non-regulatory provisions. Part 5 of the TCCKPoM represents the regulatory component of the plan and satisfies the development control provisions of Part 2 of SEPP 44. Consistent with the provisions of Part 4 of SEPP 44, Part 6 of the TCCKPoM makes recommendations for the development control provisions (Part 5) to be incorporated in Council's Development Control Plan and also recommends environmental protection zoning and other protections for Core Koala Habitat under Council's LEP. Appendix B contains further detail on the manner in which the TCCKPoM addresses the SEPP 44 departmental guidelines.

Consistent with the SEPP 44 guidelines, the TCCKPoM represents an overarching environmental strategy which will be used to inform Council's response to all aspects of Koala conservation and management across all areas of its jurisdiction. As of December 2015 the TCCKPoM has not received approval under SEPP 44.

APPENDIX D of the TCCKPoM contains recommended Wildlife Infrastructure Design Guidelines such as:

- 1.8m high exclusion fencing;
 - Climbable fencing to include an opaque sheeting of minimum 600mm height attached to the lower portion of the fence to form a visual barrier to fauna encountering the fence;
 - Inclusion of grids where exclusion fencing is intersected by roads;
 - Grids are to consist of 60mm diameter round pipe positioned at 200mm centres;
 - Underpasses are to provide for all-weather dry access by Koalas;
 - Underpass dimensions are to be no less than 1.8m high X 2.4m wide;
 - Fauna crossings are to incorporate furniture, natural flooring and Koala food tree plantings at underpass entrances.
-
- *New South Wales Scientific Committee Preliminary Determination 2015.*

The Scientific Committee, established by the TSC Act, has made a Preliminary Determination to support a proposal to list a population of the Koala (Goldfuss, 1817)

between the Tweed and Brunswick Rivers east of the Pacific Highway as an Endangered Population in Part 2 of Schedule 1 of the Act.

APPENDIX 5 - KOALA FOOD TREE SPECIES OF THE NSW NORTH COAST KMA

*Taken from Appendix 2 of NSW Koala Recovery Plan (DECC 2008)

Primary Food Tree Species

- Tallowwood (*Eucalyptus microcorys*)
- Forest red gum (*E. tereticornis*)
- Swamp mahogany (*E. robusta*)
- Parramatta red gum (*E. parramattensis*)
- Orange gum (*E. bancroftii*)
- Cabbage gum (*E. amplifolia*)

Secondary Food Tree Species

- Narrow-leaved red gum (*E. seeana*)
- Craven grey box (*E. largeana*)
- Slaty red gum (*E. glaucina*)
- Grey gum (*E. biturbinata*)
- Small-fruited grey gum (*E. propinqua*)
- Large-fruited grey gum (*E. canaliculata*)
- Red mahogany (*E. resinifera*)
- Steel box (*E. rummeryi*)
- Mountain mahogany (*E. notabilis*)
- Rudder's box (*E. rudderi*)
- Grey box (*E. moluccana*)
- White-topped box (*E. quadrangulata*)
- Yellow box (*E. melliodora*)

Stringybarks/Supplementary Species

- Stringybark (*E. tindaliae*)
- Blue-leaved stringybark (*E. agglomerate*)
- Thin-leaved stringybark (*E. eugeniodes*)
- Diehard stringybark (*E. cameronii*)
- White stringybark (*E. globoidea*)

APPENDIX 6 - REHABILITATION SPECIFICATIONS

Rehabilitation Phases

Site rehabilitation works will be completed by a suitably qualified¹¹ Bush Regeneration company and be undertaken in six (6) phases as follows:

- Phase 1: Site preparation of offset habitat areas.
- Phase 2: Initial planting - will commence as soon as the Bush Regeneration team is satisfied that weed species have been successfully controlled.
- Phase 3: Establishment and initial maintenance - It is planned that the establishment period will be of a minimum length of twelve (12) months during which time weeds will be controlled and watering will be undertaken on an 'as needs' basis.
- Phase 4: Supplementary planting to replace dead seedlings - will commence within two (2) months of the initial planting in each area. Replacement of seedlings/saplings that have died will continue during the approved monitoring period at a rate that will ensure a >90% survival of planted stock.
- Phase 5: Additional plantings - works can commence where advanced canopy growth is evident and the Bush Regeneration team determines that additional planting is necessary to satisfy the objectives of the offset strategy.
- Phase 6: Ongoing maintenance - will continue indefinitely on an as needed basis until performance targets have been met. If the performance targets have not been met, corrective actions will be implemented in accordance with SECTION 11.2.4.

Site Preparation

Site preparation will include the following actions:

- Erection of protective fencing and signage in accordance with SECTION 8.9;
- Identification of retained vegetation (SECTION 8.4);
- Primary and Secondary weed control in accordance with APPENDIX 6; and
- Propagation of revegetation stock in accordance with APPENDIX 6.

Weed Control

Primary Weeding

Weed eradication will be undertaken within the proposed offset areas on a progressive basis through localised treatment of grass species via mechanical removal (hoe/rake, hand

¹¹ A Bush Regeneration company that has demonstrable experience in the rehabilitation or revegetation of native vegetation communities in the Tweed region.

pulling and/or slashing) or with Roundup Biactive©. Woody weed species will be hand pulled or controlled using best practice weed control techniques.

All chemical users should be experienced and licensed in accordance with the relevant legislation. Utmost care must be taken when utilising chemicals to ensure that no drift occurs outside of the treatment area. Spraying should not occur on windy days or within 24 hours of predicted rainfall.

Primary weeding should commence, prior to the commencement of construction, ideally at the start of the active growing period (approximately November), and on an as needed basis. Preparation before spraying, in the form of manual clearing weeds from around native plants, must be carried out.

Weed material that does not contain any fertile parts will be mulched and spread on the ground and any weeds that may have fertile parts present will be disposed of at an approved waste disposal facility such as Council landfills or transfer stations.

Secondary Weeding

Secondary weeding involves the eradication of weeds that have been overlooked or re-shoot after primary treatment. Secondary weeding will occur 3 to 4 months after primary weeding and no later than 6 months.

Natural Regeneration

Natural regeneration refers to the natural process by which plants replace or re-establish themselves. Natural regeneration can be described as the “regrowth” or “vegetative recovery” which occurs spontaneously, by seed or otherwise, after a stress or disturbance (Temple & Bungey 1980). As long as mature and healthy native plants occur on the subject site, natural regeneration is an option (Petrie 1999).

Natural regeneration is a powerful tool that can be used to re-establish native vegetation. It ensures that the new growth is derived from genetic material (i.e. parents) that currently occupies the site and as such is adapted to local conditions. Additionally, the chance of outbreeding depression is reduced.

Natural regeneration will be encouraged within all rehabilitation areas. Natural regeneration will be continually monitored for the life of the program. Where natural recruitment is poor, active revegetation through planting will be completed. Revegetation methods will follow those outlined below.

Revegetation Works

Introduction

Revegetation will commence no later than six (6) months after the primary weeding is completed. Successful completion of primary weeding will be determined by the appointed Bushland restoration team. At this time, an assessment will be made as to level of natural

regeneration present within these areas. Any areas where the native seedling germination is considered to be low and impeding the achievement of rehabilitation objectives will require revegetation.

Propagation

Plants to be used for revegetation are to be either propagated in a nursery using material (seeds, cuttings, tissues, etc.) from species which occur onsite or obtained from a local nursery able to supply stock from local provenance. Where existing nursery stock from local provenance is not available, collection should be carried out as detailed below. The following details will be collected from each source plant:

- Location (GPS position);
- Date of collection;
- Name of collector;
- Soil type;
- Health of plant; and
- Collection method.

Whenever possible, seed will be removed directly from plants by shaking or cutting branches over a tarpaulin. Secateurs will be sterilised between each use. Seed will be placed in small envelopes with the collection details clearly marked. If the seed is extremely small, it will be stored in glass or plastic vials to avoid undue loss.

It is expected that during the seed collection program, a site will be visited on several occasions to ensure optimum seed ripeness. The seed collection program will be prepared in consultation with Council and NSW National Parks and Wildlife Service (NPWS) prior to commencement. The program will be prepared by the bushland restoration team.

The amount of seed collected will not exceed 5% per plant. Seed will not be collected from isolated populations or rare plants.

The seed will be cleaned, its viability checked and prepared for storage. Seed that has lost viability will not be used in the revegetation works due to the dangers of genetic aberration.

If seed collection proves difficult or impossible, other forms of propagation, such as cuttings, may be attempted.

Planting Program

Seedlings will be sufficiently developed so as to have a significant chance of survival. Seedlings will be at least the sixth leaf stage and/or 20cm in height.

Tube stock seedlings will primarily be used for the plant-out.

Tube stock will be sun hardened (plants should be held in full sunlight and systematically stressed to the point of wilting for at least two months prior to planting).

All exclusionary fencing will be in place prior to the commencement of construction and before planting occurs.

Planting will occur at the optimum time of year when there is high soil moisture (between January and May), unless irrigation is available and accessible.

If required, the restoration team may make minor alterations to this revegetation strategy depending on the site requirements. The following strategy will be employed:

- Secondary weeding - Seedling sites will be spot sprayed with Roundup Biactive© one (1) week prior to commencement;
- All seedlings will be soaked in water overnight prior to planting;
- All seedlings will be provided with a wetting agent such as rain-saver¹² crystals;
- Weeds will be controlled, in the short term, through the application of suitable mulch around individual plantings and with spot applications of an appropriate herbicide.
- All seedlings will be protected by a tree guard (commercial tubing or equivalent); and
- Watering will be undertaken after the seedlings have been planted on an 'as needed' basis.

The plants growing medium should be soaked prior to planting and the plant cores should be buried to approx. 1-2cm deep.

The seedlings shall be planted on the same day (or as soon as practicable) as their transport from the nursery. No seedlings will be left unprotected on the site whilst awaiting planting. Planted seedlings will be marked with a piece of biodegradable tape and staked.

Only nitrogenous fertilisers will be used to avoid the introduction of Phosphorous, Potassium and other micronutrients.

Planting in areas exposed to full sun or westerly sun will be avoided in the peak summer months, where possible.

Planting Density and Species Selection

¹² Rain-saver is a polymer water crystal that has been specifically developed for plants. The polymer absorbs and holds water and nutrients at a specific tension which makes it available to plant roots but does not release to the soil. Rain-saver has proven very successful in more difficult environments (e.g. Roadside plantings on the Pacific Motorway between Brisbane and the Gold Coast and in frontal dunes at Pottsville (R. Keene *pers comm.* 2000).

A list of species to be used for planting within the proposed offset habitat areas is provided in TABLE 1. The following planting densities will be adopted (plants/25 sq. metres):

- One (1) tree;
- Eight (8) shrubs; and
- Sixteen (16) sedges and/or rushes and/or ferns.

**TABLE 1
PLANTING SPECIES LIST**

KOALA COMPENSATORY HABITAT		
Habitat Type	Total Area (ha)	Plant Species
Dry primary koala habitat	20.61	Trees – <i>Eucalyptus tereticornis</i> +/- <i>Corymbia intermedia</i> , <i>Lophostemon suaveolens</i> , <i>Lophostemon confertus</i>
		Small trees/Shrubs – <i>Acacia melanoxylon</i> , <i>Callitris columellaris</i> <i>Persoonia adenantha</i> , <i>Endiandra sieberi</i> , <i>Acronychia imperforata</i> , <i>Allocasuarina littoralis</i> , <i>Banksia integrifolia</i> , <i>Syzygium oleosum</i> , <i>Dodonea triquetra</i> , <i>Austromyrtus dulcis</i> , <i>Elaeocarpus reticulatus</i> , <i>Acacia concurrens</i>
		Ground – <i>Pteridium esculentum</i> , <i>Imperata cylindrica</i> , <i>Panicum simile</i> <i>Ischaemum austral</i> , <i>Ottochloa gracillima</i> , <i>Paspalum orbiculare</i> , <i>Calochlaena dubia</i> , <i>Lomandra longifolia</i>
Dry secondary koala habitat plus dry heath	7.46	Trees – <i>Eucalyptus racemosa</i> +/- <i>Eucalyptus robusta</i> , <i>Eucalyptus tereticornis</i> , <i>Corymbia intermedia</i> , <i>Corymbia gummifera</i>
		Small trees/Shrubs – <i>Banksia aemula</i> , <i>Allocasuarina littoralis</i> , <i>Elaeocarpus reticulatus</i> , <i>Leptospermum polygalifolia</i> , <i>Styphelia viridis</i> , <i>Leucopogon ericoides</i> , <i>Monotoca</i> sp. (Fraser Is P.Baxter 777), <i>Dillwynia retorta</i> , <i>Acacia ulicifolia</i> , <i>Gompholobium virgatum</i> , <i>Leucopogon leptospermoides</i> , <i>Ochrosperma lineare</i> , <i>Leptospermum petersonii</i> , <i>Persoonia virgata</i> , <i>Leptomeria acida</i> , <i>Homoranthus virgatus</i>
		Ground – <i>Caustis recurvata</i> , <i>Cassytha pubescens</i> , <i>Zieria laxiflora</i> , <i>Lepidosperma laterale</i> , <i>Lomandra longifolia</i> , <i>Dianella caerulea</i> , <i>Themeda triandra</i> , <i>Xanthorrhoea latifolia</i>
Wet primary and secondary koala habitat	19.74	Trees – <i>Eucalyptus robusta</i> +/- <i>Eucalyptus tereticornis</i> , <i>Melaleuca quinquenervia</i> , <i>Lophostemon suaveolens</i> and <i>Cupaniopsis anacardioides</i>
		Small trees/Shrubs – <i>Elaeocarpus reticulatus</i> , <i>Syzygium oleosum</i> , <i>Acmena smithii</i> , <i>Omalanthus populifolius</i> , <i>Glochidion ferdinandi</i> , <i>Melastoma malabathricum</i>
		Ground – <i>Gahnia</i> species, <i>Blechnum indicum</i> , <i>Baloskion tetraphyllum</i> , <i>Smilax australis</i> , <i>Dianella caerulea</i> , <i>Calochlaena dubia</i> , <i>Pteridium esculentum</i> , <i>Hypolepis muelleri</i> , <i>Cyperus exaltatus</i> , <i>Baumea</i> species, <i>Lomandra longifolia</i> , <i>Carex appressa</i> , <i>Pandorea jasminoides</i> , <i>Parsonsia straminea</i> , <i>Platynerium bifurcatum</i> , <i>Platynerium superbum</i> , <i>Entolasia stricta</i> , <i>Lygodium microphyllum</i> , <i>Oplismenus aemulus</i> , <i>Leersia hexandra</i>
Wet secondary koala habitat	1.60	Trees – <i>Eucalyptus robusta</i> +/- <i>Eucalyptus tereticornis</i> , <i>Melaleuca quinquenervia</i> , <i>Lophostemon suaveolens</i> and <i>Cupaniopsis anacardioides</i>
		Small trees/Shrubs – <i>Elaeocarpus reticulatus</i> , <i>Syzygium oleosum</i> , <i>Acmena smithii</i> , <i>Omalanthus populifolius</i> , <i>Glochidion ferdinandi</i> , <i>Melastoma malabathricum</i>
		Ground – <i>Gahnia</i> species, <i>Blechnum indicum</i> , <i>Baloskion tetraphyllum</i> , <i>Smilax australis</i> , <i>Dianella caerulea</i> , <i>Calochlaena dubia</i> , <i>Pteridium esculentum</i> , <i>Hypolepis muelleri</i> , <i>Cyperus exaltatus</i> , <i>Baumea</i> species, <i>Lomandra longifolia</i> , <i>Carex appressa</i> , <i>Pandorea jasminoides</i> , <i>Parsonsia straminea</i> , <i>Platynerium bifurcatum</i> , <i>Platynerium superbum</i> , <i>Entolasia stricta</i> , <i>Lygodium microphyllum</i> , <i>Oplismenus aemulus</i> , <i>Leersia hexandra</i>
Secondary Koala habitat	5.25	Trees – <i>Eucalyptus racemosa</i> +/- <i>Eucalyptus robusta</i> , <i>Eucalyptus tereticornis</i> , <i>Corymbia intermedia</i> , <i>Corymbia gummifera</i>
		Small trees/Shrubs – <i>Banksia aemula</i> , <i>Allocasuarina littoralis</i> , <i>Elaeocarpus reticulatus</i> , <i>Leptospermum polygalifolia</i> , <i>Styphelia viridis</i> , <i>Leucopogon ericoides</i> , <i>Monotoca</i> sp. (Fraser Is P.Baxter 777), <i>Dillwynia retorta</i> , <i>Acacia ulicifolia</i> , <i>Gompholobium virgatum</i> , <i>Leucopogon leptospermoides</i> , <i>Ochrosperma lineare</i> , <i>Leptospermum petersonii</i> , <i>Persoonia virgata</i> , <i>Leptomeria acida</i> , <i>Homoranthus virgatus</i>
		Ground – <i>Caustis recurvata</i> , <i>Cassytha pubescens</i> , <i>Zieria laxiflora</i> , <i>Lepidosperma laterale</i> , <i>Lomandra longifolia</i> , <i>Dianella caerulea</i> , <i>Themeda triandra</i> , <i>Xanthorrhoea latifolia</i> .

The overall plant numbers to be installed in each of the proposed Compensatory Koala habitat areas within each Precinct are provided in TABLE 2. Species diversity will be maintained throughout these revegetation areas and consist of the following densities (plants/100 sq. metres):

- A minimum of three (3) different tree species;
- A minimum of ten (10) different shrub species; and
- A minimum of ten (10) different sedge/rush/fern species.

It should be noted that for the proposed Wet Secondary habitat areas, the species diversity provided above for the midstorey and ground layers is unlikely to be achieved due to groundwater characteristics (i.e. depth to groundwater 0m to -0.2m).

TABLE 2
TOTAL NUMBER OF PLANTINGS IN EACH PRECINCT

Precinct	Koala Compensatory Habitat - Number of Plants							TOTAL
	Planting Density (plants / 25 sq. metres)	Dry primary koala habitat	Dry secondary koala habitat plus dry heath	Wet primary and secondary koala habitat	Wet secondary koala habitat	Secondary koala habitat		
Precinct 1	Trees	1	0	0	0	0	0	0
	Shrubs	8	0	0	0	0	0	0
	Ground covers	16	0	0	0	0	0	0
Precinct 2	Trees	1	96	304	56	0	0	456
	Shrubs	8	768	2432	448	0	0	3648
	Ground covers	16	1536	4864	896	0	0	7296
Precinct 3	Trees	1	196	76	132	0	0	404
	Shrubs	8	1568	608	1056	0	0	3232
	Ground covers	16	3136	1216	2112	0	0	6464
Precinct 4	Trees	1	0	0	0	0	0	0
	Shrubs	8	0	0	0	0	0	0
	Ground covers	16	0	0	0	0	0	0
Precinct 5	Trees	1	820	1728	380	88	460	3476
	Shrubs	8	6560	13824	3040	704	3680	27808
	Ground covers	16	13120	27648	6080	1408	7360	55616
Precinct 6	Trees	1	0	0	0	0	0	0
	Shrubs	8	0	0	0	0	0	0
	Ground covers	16	0	0	0	0	0	0
Precinct 7	Trees	1	552	24	944	224	0	1744
	Shrubs	8	4416	192	7552	1792	0	13952
	Ground covers	16	8832	384	15104	3584	0	27904
Precinct 8	Trees	1	1588	0	732	32	0	2352
	Shrubs	8	12704	0	5856	256	0	18816
	Ground covers	16	25408	0	11712	512	0	37632
Precinct 9	Trees	1	0	0	0	0	0	0
	Shrubs	8	0	0	0	0	0	0
	Ground covers	16	0	0	0	0	0	0
Precinct 10	Trees	1	0	0	0	0	0	0
	Shrubs	8	0	0	0	0	0	0
	Ground covers	16	0	0	0	0	0	0
Precinct 11	Trees	1	1668	0	1904	208	1640	5420
	Shrubs	8	13344	0	15232	1664	13120	43360
	Ground covers	16	26688	0	30464	3328	26240	86720
Precincts 12-14	Trees	1	3392	852	4000	88	0	8332
	Shrubs	8	27136	6816	32000	704	0	66556
	Ground covers	16	54272	13632	64000	1408	0	133312
TOTAL	Trees	1	8312	2984	8148	640	2100	22184
	Shrubs	8	66496	23872	65184	5120	16800	177472
	Ground covers	16	132992	47744	130368	10240	33600	354944

Rehabilitation Monitoring

Monitoring is crucial in ensuring the continuing success of the rehabilitation program and will be carried out for the duration of this plan. Details of the rehabilitation monitoring program are provided in APPENDIX 7.

APPENDIX 7 - KOALA AND KOALA HABITAT MONITORING METHODOLOGY

Baseline Monitoring

Introduction

Baseline Koala monitoring will be completed prior to the commencement of works on the site by suitably qualified and/or accredited persons¹³ in accordance with the following methodology.

Monitoring methods will be consistent with the EPBC Act Referral Guidelines for the Vulnerable Koala (2014).

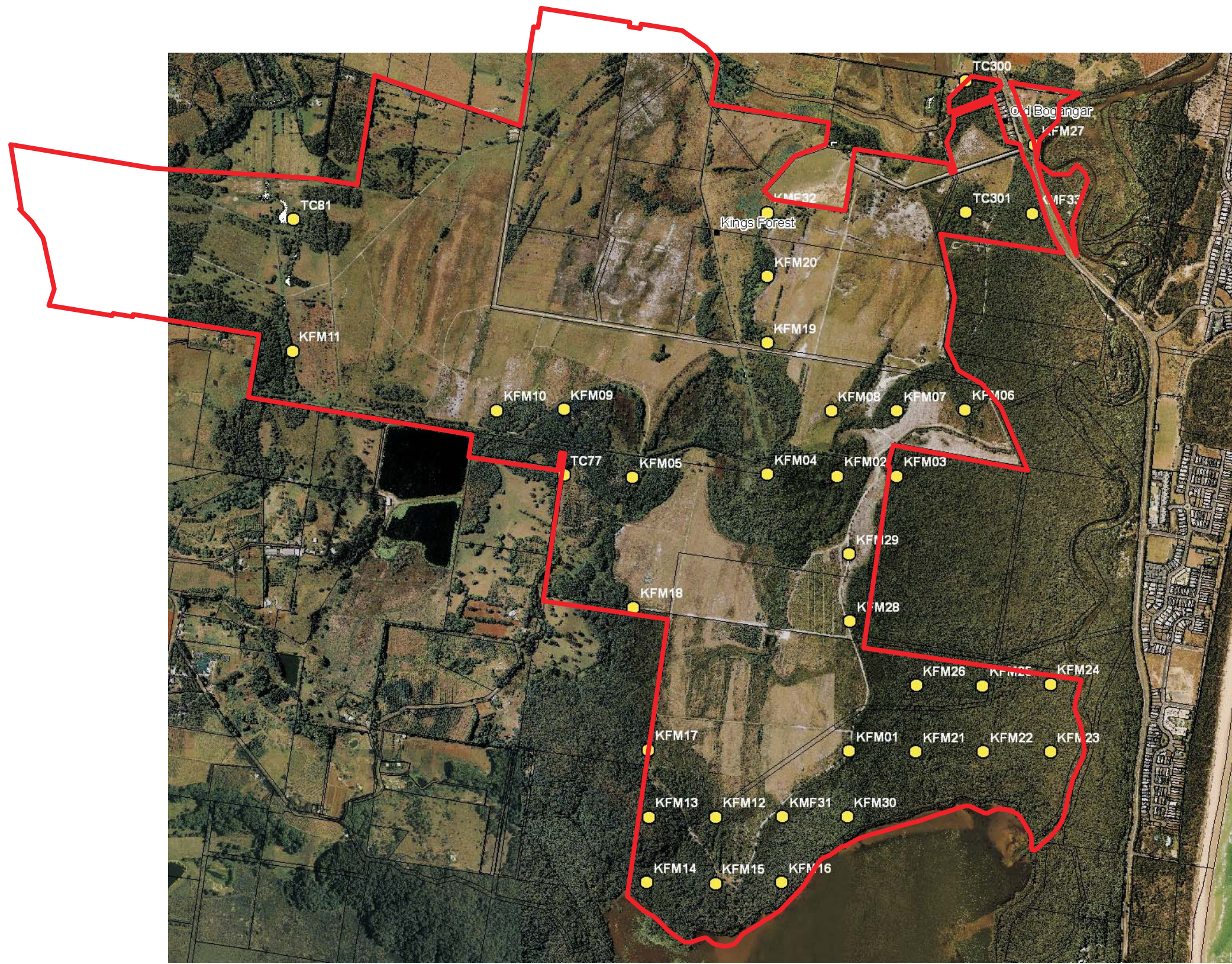
Methodology

Monitoring will be completed over spring/summer during which time Koala activity is high and individual Koalas are more easily detected. Diurnal searches of Kings Forest Koala habitat will be completed over one (1) day only to eliminate duplicate counts of Koalas, by a team comprised of a minimum of three (3) suitably qualified and/or accredited persons. The survey should be completed as follows (Dr S. Phillips *pers. comm.* 11 October 2013):

- i. Within the Kings Forest site, suitably qualified personnel will monitor the amount of habitat being utilised by Koalas by assessing the occupancy rate and levels of Koala activity;
- ii. For purposes of the monitoring program, a series of field sites have been selected (APPENDIX 7 - FIGURE 1), at 300m intervals, within Primary and Secondary Koala habitat across the Kings Forest site as permanent monitoring points;
- iii. Monitoring must involve an assessment of Koala habitat use at no less than 75% of sites that have been randomly selected from the total number of field sites identified above;
- iv. The minimum data set to be collected from each field site that is sampled for purposes of (iii) above must include a full measure of Koala activity (i.e. application of Spot Assessment Technique (SAT) methodology (Phillips and Callaghan (2011)) from a central point located within a determined radius of the site coordinates, along with the number of Koalas sighted in a 250 m x 40 m (1 ha) line transect (*sensu* Dique *et al.* 2003/4); and
- v. Co-ordinates for the centre of each field site must be documented and the precise location permanently identified so as to enable it to be found for the purpose of subsequent monitoring events.

The following information relating to each Koala sighting should be collected:

¹³ A “suitably qualified and/or accredited person” is a qualified wildlife ecologist with suitable experience in completing Koala surveys.



LEGEND
● Annual Koala Monitoring Location
□ Kings Forest Boundary



SOURCE: Biolink Ecological Consultants
(Ref: KF_Monitoring sites.jpg Recd 18.12.15)
SCALE: 1 : 20 000 @ A3
JWA PTY LTD
Ecological Consultants

CLIENT
Project 28 Pty Ltd
PROJECT
Koala Plan of Management
Kings Forest Estate
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

**APPENDIX 7
FIGURE 1**
PREPARED: BW
DATE: 21 June 2016
FILE: N97017_Monitoring.cdr

TITLE
**ANNUAL KOALA
MONITORING
LOCATIONS**

- Age class: Adult, sub-adult (2-4 kg) or juvenile (less than one (1) year old, less than 2 kg, not yet independent);
- Reproductive status: the presence of a pouch young, back young, or no young associated with an adult female;
- Health status: healthy, or showing signs of Chlamydia such as cystitis (wet, stained bottom) and/or conjunctivitis (red swollen eyes discharging pus), or other indicators of poor health such as discharges from nose or mouth, wasted or emaciated appearance etc.;
- Tree species that the Koala is sighted in (including number of individual trees and number of species, tree height, Koala height in tree, Diameter at Breast Height (DBH) and tree crown diameter): the collection of fruit and a leaf sample from trees will assist in the identification of unknown species by a botanist with the use of reference material; and
- Koala location: using a map and/or GPS unit, the location of each Koala should be plotted on a map to gain an overall distribution of Koalas on the site.

A general assessment of the condition of Koala habitat on the site will be completed at each survey point utilising a standardised form and through the use of fixed photograph points as follows:

Koala habitat condition assessment

Habitat assessments will be standardised so that measurable changes over time can be observed.

A 20m x 20m survey plot will be permanently established at each monitoring point discussed above. Habitat monitoring will utilise a standardised proforma. Criteria to be assessed are contained within APPENDIX 8 and will include the following:

- Tree species composition (including juvenile specimens);
- Proportions of each species;
- General vigour of regenerating vegetation;
- Extent of new growth;
- Age structure of vegetation; and
- Presence and degree of infestation of potentially damaging weed species.

Photo monitoring

- Monitoring points will also be used as permanent photo stations for photographic monitoring;
- Four (4) photos are to be taken from each photo point to the north, south, east and west;
- Photos should be labelled with:
 - Photo point code;
 - Direction of view; and

- The date and time.
- Photos must be supplied in the monitoring report in the form of prints no smaller than 4” x 6” and must be colour.

The survey data collected will be used to compile a Baseline Monitoring Report (SECTION 10.7.1 of the Revised KPOM).

Annual Koala Monitoring

Introduction

Koala monitoring shall be completed on an annual basis (as a responsibility of the Proponent), from the date of commencement of works within each precinct, for a period of five (5) years or as otherwise determined by the Secretary for DoPI and Delegate for the Minister.

Methodology

Annual Koala monitoring will be completed over the Kings Forest site following the methodology described for baseline monitoring above. Annual Koala monitoring should consider the following:

- Where one (1) or more randomly selected site or sites may be unavailable for assessment at any given monitoring event, the equivalent number must be randomly selected as replacement sites; and
- Monitoring and any associated data analysis must be undertaken by suitably qualified and/or accredited individuals who must also liaise with the Koala Welfare Group so as to gather data on any koala incidents that may have occurred in the time period that has elapsed since the previous monitoring event.
- Koala ‘activity’ at each site will be determined by dividing the number of trees with a koala faecal pellet by the number of trees searched in the site (a minimum of 30). Activity thresholds of Phillips and Callaghan (2011) will be used to describe the results of field sites. This threshold allows interpretation of the activity level at each site in order to determine its relative importance to the koala population.
- Occupancy rates for a) the presence of any koala activity, and b) the presence of significant activity will be estimated. The first provides a measure of what proportion of available habitat is currently utilised by koalas in any way, the second indicating what proportion of habitat is occupied by resident populations, comprising the majority of the koala population. These occupancy rates will be compared to baseline and previous year’s data.

In addition, sand tray monitoring will be completed to assess the usage of underpasses. Sand tray monitoring will be completed as follows:

- Sand trays will be approximately 2.4 m wide, 1 m long and 5 cm deep trays filled with sand. One (1) tray will be installed at each end of all fauna underpasses,

approximately 1 m inside the entrance and covering the entire width of the underpass; and

- Sand trays will be monitored every four (4) months for the first two (2) years following installation of the underpass and every six (6) months for the following three (3) years. Each sand trap monitoring event will involve checking for signs of footprints and then brushing smooth each morning over a four (4) day period (by a suitably qualified ecologist). This method is in accordance with that described in AMBS (2012).

Koala Monitoring After Fire

Koala monitoring will also be completed after any bush fire on the Kings Forest site by a suitably qualified ecologist. This will be completed in accordance with the methodology provided in the sections above to monitor the impacts of fire on the local Koala population.

Rehabilitation Monitoring

Bush Regeneration Monitoring

The Bush Regeneration team will keep detailed work sheets recording:

- all work completed each day;
- site conditions;
- chemicals used;
- problems encountered; and
- future works required.

General Monitoring

A detailed monitoring program will also be completed by the Bush Regeneration team. Monitoring will be undertaken using the following methods:

- Transects - 50m transects will be established in appropriate locations within the compensatory habitat areas. These will be permanently marked (i.e. star pickets or wooden stakes) and the end positions identified on a sitemap using a hand held Global Positioning System (GPS);
- Quadrats - 5m x 5m quadrats will be established at the ends and at 10m intervals along the transects. These will be permanently marked (i.e. star pickets or wooden stakes) and the corner positions identified on a sitemap using a hand held GPS;
- Photo points - will be established at each transect location. These will be permanently marked (i.e. star pickets or wooden stakes) and positions identified on a sitemap using a handheld GPS; and

- Transects, Quadrats and Photo points will be marked prior to the commencement of rehabilitation works.

The following data should be included in the monitoring programme:

- **General**
 - Management Zone;
 - Name of data recorder (i.e. Bush regenerator); and
 - Date and prevailing weather.
- **Quadrats**
 - Canopy height native and exotic species;
 - Percentage cover of canopy and ground strata - native and exotic species;
 - Number and relative abundance - native and exotic species; and
 - Number of exotic plants that survive control treatments as plants that survive initial treatments will require earlier follow-up treatment if the input of fresh seed is to be limited.
- **Photo Points**
 - Four (4) photos (north, east, south, west) are to be taken at each of the two (2) permanent photo points.
- **Entire Compensatory Habitat Area**
 - Progress against performance targets;
 - Damage which may have occurred since the last visit;
 - General check on the plants growing conditions (water, mulch, nutrients/fertiliser);
 - Notification of weeds species present;
 - Loss or erosion of topsoil from re-vegetated areas;
 - Records of new native volunteer species, their location and number;
 - Increase or decrease in cover of native and weed species within the ground and canopy strata;
 - Flowering and fruiting of native and weed species;
 - Survival rate and condition of planted species;
 - Reasons for their death or failure to thrive; and
 - Fauna observations.

Site visits should occur:

- To set up monitoring transects and quadrats and collect baseline data after 1st event of secondary weeding;
- Six monthly for 1st year; and

- Then annually.

Performance Targets and Corrective Actions for Proposed Offset Strategy

TABLE 1 provides the performance indicators and targets for the proposed rehabilitation strategy. Corrective actions are provided that are to be implemented if performance targets are not met.

**TABLE 1
PERFORMANCE TARGETS AND CORRECTIVE ACTIONS**

Performance Indicator	Target	Corrective Actions
Survival and continued growth of seedlings (i.e. planted stock)	>90% survival of planted stock during all monitoring events	Irrigation if required. Additional planting if required.
Establishment of native ground cover within revegetation areas	>60% after 3 years; >80% after 5 years	Supplementary planting
Establishment of native canopy cover within revegetation areas	>60% after 3 years; >80% after 5 years	Supplementary planting
Height of planted trees within revegetation areas	>1.5m after 3 years; >2.5m after 5 years	N/A
Natural recruitment of native species throughout rehabilitation areas	Native recruitment occurring in all rehabilitation areas	N/A
All identified weeds controlled to an acceptable level within rehabilitation areas	<1% cover during all monitoring events	Weed control as necessary
Infrastructure (e.g. protection fencing, signage, erosion and sediment control devices) functional and well-maintained	Relevant infrastructure in condition suitable for hand over to Tweed Shire Council	Maintenance as necessary
Fully structured vegetation communities (with reference to appropriate benchmarks) are provided through assisted regeneration and revegetation plantings	A self-sustaining site is achieved once there is evidence of native recruitment and all weed species have been removed/controlled	Continue until performance targets are met

Rehabilitation Monitoring Reports

The Bush Regeneration team will submit monitoring reports to Council annually. Monitoring reports should include the following:

- Works undertaken (i.e. A summary of Bush Regenerators daily reports);

- The progress of the restoration areas against the performance indicators listed above;
- Progress of regeneration/revegetation areas using photos and tables showing the results of the monitoring visits;
- Any problems since the previous inspection (death of a significant number of seedlings, broken fences etc.) and what effects these issues have had on the regeneration area;
- Success or failure of measures implemented to rectify previously identified problems; and
- Measures to be taken to rectify new problems.

APPENDIX 8 - KOALA HABITAT CONDITION ASSESSMENT PRO-FORMA

Site No:

Crown	1										
	Cover:	2									
		3									
		5 m.	10 m.	15 m.	20 m.	25 m.	30 m.	35 m.	40 m.	45 m.	50 m.

Community: _____

Structural Summary: Record 'Individual Covers' for Tertiary sites only

Stratum	Av. Top Height	Height Range	Total Cover	Key Species	Individual Covers	Old Growth Characteristics		
						Senescent	Mature	Regrowth
Emergent								
Tree 1								
Stratum	Av. Top Height	Height Range	Total Cover	Key Species	Individual Covers	Key species	Individual Covers	
Tree 2								
Tree 3								
Sub 1								
Shrub 2								
Ground								

B.A. FACTOR	1 cm.	0.5 cm.	E	T1	T2	T3	S1	S2	G
COVER ASSESSMENT AREA	m ²								
STEM COUNT AREA	m ²								

Notes:

