7.0 KOALA PLAN OF MANAGEMENT – JAMES WARREN AND ASSOCIATES, AUGUST 2012

Implementation and Summary Table

Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
Education								
KPoM-1	Construction personnel induction program	Site office	To highlight; • the potential presence of Koalas on the site • 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 • Requirements of the Kings Forest Vegetation Management Plan	Prior to site work commencing	Project 28 Pty Ltd – Site Manager with sign off by Environmental Officer	All construction personnel inducted	Ensure all contractors are inducted prior to commencing work on site	Construction personnel will be prohibited from bringing dogs onto the site
KPoM-2	Erection of signage	Along the margins of Environmental Protection Zones and Roadways	Notification of Koala habitat and the possibility of encountering Koalas	Immediately after bulk earthworks have been completed	Project 28 Pty Ltd – Site Manager	Signage has been erected at intervals no greater than 100m	Signage condition monitored and maintained	Temporary signage will be erected prior to construction that indicates the location of EPZs

Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
KPoM-3	Provide an information package (brochure /booklet and website) for purchasers of properties within Kings Forest	Site wide	To raise community awareness regarding threats to Koalas and mitigation of impacts	Upon each original property purchase within Kings Forest	Project 28 Pty Ltd	Information packages produced and distributed	Ensure access to information packages	N/A
Minimising construction impact on Koalas and Koala habitat								
KPoM-4	Temporary high visibility fencing to be erected along the edge of the 30m inner buffer zone at Precincts 1 and 5 in accordance with AS 4970-2009	Precincts 1 and 5	To protect Koala habitat and minimise Koala contact	Prior to construction	Project 28 Pty Ltd – Site Manager	Temporary fencing has been erected	Daily checks on fencing condition	Proponent assumes maintenance responsibility until revegetation work is self-sustaining i.e. 3 - 5yrs
KPoM-5	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	All roadways including haulage roads	To minimise the risk of vehicle strike	At all times during construction and operation phases	All persons on site	Speed limits obeyed	Restrictions enforced	N/A
KPoM-6	All areas inspected prior to the commencement of clearing	All areas proposed to be cleared	To check for the presence of Koalas and approve clearing activities	Prior to any clearing event	Ecologist / spotter catcher	Experienced Ecologist / fauna handler on site at all times during all clearing activities. All areas proposed for clearing inspected and approved	Report all Koala sightings	Approval for clearing only valid for the day on which the inspection was undertaken
KPoM-7	Earthworks temporarily suspended within 25m radius of any tree in which a Koala is located	All construction areas	To ensure Koalas are not harmed during construction	At all times during construction	Site Manager / Ecologist / spotter catcher	Earthworks temporarily suspended at all times when within 25m of a Koala	Report all Koala sightings and/or incidents	Works will not proceed until the Koala has moved to safety of its own accord

Action No	Action	Location (Reference to Map)	Purpose	Timing and Frequency	Responsibility	Performance Measure	Monitoring and Reporting	Further Details
KPoM-8	Any injured animals to be immediately taken to the nearest appropriately qualified veterinary clinic	All areas	To provide treatment as soon as possible to injured animals	At all times during construction	Ecologist / spotter catcher	Any injured animals receive treatment within one hour of capture where possible	Report all Koala sightings and/or incidents	During operation phase, responsibility becomes that of TSC
KPoM-9	Post-mortem examination completed for any Koalas found dead	All areas	To determine the cause of death	At all times during construction	Suitably qualified person	Post-mortem completed for all Koalas found dead	All incidents reported	Only where cause of death is unknown
KPoM-10	Erection of Koala exclusion fencing and associated gates, grids and underpasses	Around residential precincts and alongside roadways (refer Section 7.8.6 of this KPoM)	To prevent the occurrence of Koala interaction with domestic dogs and to minimise the possibility of vehicle strike	Immediately after bulk earthworks have been completed	Project 28 Pty Ltd – Site Manager for 5 years or until project completion (whichever is earliest), Council responsibility thereafter	All proposed fencing has been erected to effectively exclude Koalas from residential areas and roadways	Condition of fencing regularly inspected and maintained. All instances of disrepair and/or breach reported	Vegetation in close proximity to exclusion fencing to be maintained to ensure fence efficacy
Koala habitat creation								
KPoM-11	Koala food tree planting	Areas indicated in **FIGURES 10, 10A – 10L (APPENDIX 2)** in Precinct 1 & 5 BMP	To create additional Koala habitat and improve Koala dispersal across the site	At the completion of bulk earthworks	Suitably qualified Bush Regeneration company	Approximately 7,875 Koala food trees planted in accordance with the Performance Criteria outlined in the Precinct 1 & 5 VMP, Precinct 2, 3, 4, 6, 7, 8, 9, 10, 11 VMP and Precinct 12, 13 & 14 VMP	Growth and condition of plantings to be monitored and reporting completed until self-sustaining i.e. 3 - 5yrs	Rehabilitation monitoring/ reporting is outlined in the Flora and Fauna Monitoring Report
KPoM-12	Koala food tree planting around underpass openings	On both sides and within a 20m radius of underpasses openings	To facilitate safe Koala dispersal across the site	As soon as practicable during construction phase at the completion of bulk earthworks	Project 28 Pty Ltd – Site Manager / Bush Regeneration company	All fauna underpasses on the site vegetated with Koala food trees within a 20m radius of openings	Growth and condition of plantings to be monitored and reporting completed until self-sustaining i.e. 3 - 5yrs	N/A

7.1 Introduction

7.1.1 Executive Summary

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.

As a result of the submissions, amendments to the project have been made. The amended project contains the following key elements (NB: these elements will be revised and updated as the amended project is finalised).

- Subdivision to create new lots for future development;
    - Bulk earthworks across the site;
    - Road works comprising:
    - construction of the entrance road into the site and associated intersection works on Tweed Coast Road;
    - alignment and construction of the proposed Kings Forest Parkway from Tweed Coast Road via Precincts 4 and 5 through to the western precincts; and
    - alignment and part construction of two proposed roads through SEPP 14 areas to access the southern precincts;
- Development of 2,036 m^2 of floor space for rural supplies development and access arrangements within Precinct 1;
- Construction of subdivision and infrastructure works along the Kings Forest Parkway and within Precincts 1 and 5;
- The Plan of Development for Precinct 5.

This revised Koala Plan of Management (KPoM) addresses the amendments to the project and the key issues raised in the submissions.

7.1.2 Aim & Objectives

The aim of this KPoM is to protect the Koala population utilising the Kings Forest site and facilitate its continued viability during Stage 1 development (Construction and Operation) within Precincts 1 & 5 and bulk earthworks areas (**FIGURES 1 & 2, APPENDIX 5**).

The objectives to achieve this aim 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.
- To embellish the habitat values of the site.
- To ensure that both construction and operational phase activities associated with development do not significantly impact on the local Koala population.
- To ensure that Koala observations are reported and incidents properly managed.
- To promote awareness of Koala issues (and ecological values in general) on the part of residents of Kings Forest.
- To provide for effective monitoring of performance in relation to the provisions of this KPoM.

7.1.3 Plan Requirements

The NSW Minister for Planning approved a Concept Plan for the proposed residential community at Kings Forest on the 19th August 2010. The approved documents included a Koala Plan of Management (Carrick 2009), that proposed the principles upon which the management of Koalas on the Kings Forest site would be based. These principles relate to the following:

- Carrying capacity;
- Connectivity;
- Vehicles;
- Domestic dogs;
- Swimming pools;
- Disease status; and
- Education and awareness.

This Koala Plan of Management (KPoM) has been prepared in response to the NSW Department of Planning Director-General's Environmental Assessment Requirements (DGEARs) dated 23 December 2010 in respect of a Project Application under Part 3A of the *Environmental Planning and Assessment Act 1979* for Stage 1 of the Kings Forest development. The KPoM applies to all bulk earthworks across the site and the development of Precincts 1 and 5.

The DGEARs include the following:

***9.4** – Updates are to be provided, where relevant, for the various management plans for koalas, vegetation, threatened species, feral animals, weeds, the buffers, and the golf course providing where, relevant details on timelines for implementation of recommended works including maintenance periods and measurable performance and completion criteria. Each plan is to consider all other plans for the site to ensure that Management strategies do not conflict and that each plan can be implemented without negatively impacting on the objectives of another.*

***9.5** – Provide an update to the Koala Plan of Management (KPoM) for the site. The update should confirm that the measures identified and proposed in the KPoM to offset the impact of the development on existing and future Koala populations are adequate.*

***9.6** – The KPoM should take into account:*

- *contemporary data/literature on koala management;*
- *the results of the monitoring of management measures operating as part any approved stage/s, in accordance with B2 of the concept plan approval;*
- *the role of additional koala habitat created in protecting koala numbers, and the provision of any additional koala management measures, specifically those relating to dogs.*

***9.7** – The KPoM update should include, but not be limited to:*

- *the identification of dog breeds known to present a significant threat to koalas and measures to effectively mitigate the threat posed to koalas by dogs.*
- *Such measures may include:*
  - *prohibitions/restrictions on particular breeds;*
  - *limitations on the number of dogs per property; and*
  - *specifications on the way dogs are to be housed from dusk to dawn.*

***9.8** – The KPoM update must provide stage specific detail on the following:*

- *revegetation and rehabilitation measures;*
- *measures to ensure that no identified koala food trees are removed within adjacent ecological buffers or identified core koala habitat within adjacent Environmental Protection zoned land;*
- *all obligations regarding the keeping of dogs, including:*

  - *regulatory and enforcement measures,*
  - *specific road design,*
  - *lighting and signage requirements aimed at protecting koalas and maintaining their safe passage between habitat areas.*

- *These requirements shall include fencing to road verges, fauna underpasses and like measures.*

***9.9** – The KPoM update must detail:*

- *procedures to be adopted in the event that koalas are sighted within construction zones or the urban areas;*
- *specifications for any off leash dog exercise areas to ensure appropriate separation from koala habitat;*
- *the detail of the location and construction specification of dog exclusion fencing to any adjacent Environmental Protection zoned land and the timing of its completion;*

- *the detail, content and distribution of koala education and awareness measures aimed in particular at contractors and staff engaged in construction and at future residents; and*
- *a protocol for the reporting of any deaths or injuries to any koala within Kings Forest including collection and recording procedures and where necessary post-mortem procedures or laboratory tests to identify the cause of death to an koala.*

A table demonstrating compliance with the above DGEARs is included as **APPENDIX 1.**

7.1.4 Other Relevant Stage 1 Management Plans

This KPoM should be read in conjunction with the following:

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

7.1.5 Rationale

The philosophy of Koala management within an urban environment must be based on a) the need to provide for the persistence of Koalas in the urban context, or b) otherwise protect them from the associated threats (i.e. habitat loss, domestic dog attack and motor vehicle related mortalities).

This 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;
- The Tweed coast portion of the LGA contains a small population of Koalas which appears to have declined significantly over the last decade;
- 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.

Development outcomes for the Kings Forest site need to:

- Conserve existing core Koala habitat;
- Provide additional areas of potential habitat;
- Provide ongoing access to areas of core 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 core Koala habitat areas from development areas; and
- Prevent Koalas from entering the development zone.

The Carrick KPoM (2009) which accompanied the Concept Plan application noted the difficulty of effectively preventing koalas from entering the development zone. On that basis, a suite of management strategies to minimise exposure of Koalas to threats from domestic dogs, vehicles and swimming pools was proposed. However, in light of the results of a recent five year monitoring study, in accordance with a Koala Plan of Management associated with a road upgrading in the Lismore LGA (Hopkins and Phillips 2009), the approach to Koala management at Kings Forest has been reappraised.

Hopkins and Phillips (2009) demonstrated the ability of exclusion fencing coupled with strategically placed underpasses and the use of cattle-grids at driveways and fence ends to effectively exclude koalas from designated areas (in this case a 3km section of road). The exclusion was achieved within a known area of Core Koala Habitat supporting a high density of koalas; therefore the following results of the five year study are especially notable. Included in the outcomes were:

- No change in the distribution and abundance of koalas throughout the five year monitoring program;
- An estimate of approximately 100 under-road traverses by koalas each year; and
- No evidence of koalas within the exclusion area and no associated road mortalities.

Accordingly, this plan 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.

7.2 Statutory Regulations

7.2.1 Introduction

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

7.2.2 NSW State Environment Planning Policy (SEPP) No. 44

This KPoM addresses the following statutory requirements of SEPP 44:

- 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.

For ease of reference, each of the above requirements is dealt with in a separate section of this KPoM.

7.2.3 NSW Recovery Plan for the Koala

Within New South Wales, Koalas (*Phascolarctos cinereus*) are recognised as a Schedule 2 (Vulnerable) species under the *Threatened Species Conservation Act (1995)*. 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 New South Wales 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.* 1988). 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 NSW *Threatened Species Conservation Act 1995* (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 New South Wales Department of Environment and Climate Change (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 New South Wales. Actions contained within this recovery plan are summarised by the PAS, and this information is available from the NSW threatened species website (**APPENDIX 2**).

7.2.4 Koala Management within the Tweed Shire

A systematic assessment of koala population and their habitat within the Tweed Coast Study Area, 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 8 years, the decline largely attributable to two 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.

A comprehensive Koala Plan of Management for the Tweed Coast Study is currently being finalised for submission to Tweed Shire Council, and thereafter to the NSW Department of Planning and Infrastructure for approval.

7.2.5 Environmental Protection and Biodiversity Conservation Act

The Koala population of NSW has recently been listed as 'Vulnerable' under the Environmental Protection and Biodiversity Conservation Act (EPBC 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.

Given the conservation status of the Tweed Coast koala population, the Kings Forest Koala population is regarded as part of an important population for the purposes of the EPBC Act administration guidelines. The proposed development has thus been referred to the Minister of the Environment through the Australian Government Department of Sustainability, Environment, Water, Population and Communities.

7.3 Estimate of Koala Population Size

7.3.1 Tweed Local Government Area (LGA)

Koala records remain widely distributed throughout the Tweed LGA, which covers approximately 103,000 ha (**FIGURE 3, APPENDIX 5**). 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 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.

7.3.2 Tweed Coast

A recent assessment of Koala populations within the 21,000ha 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 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 Duranbah and Eviron Road. Phillips *et al*. (2011) suggests that occupancy by Koalas within the coastal strip has halved in recent years, with a current population (i.e. inferred by density data) of approximately 144 Koalas **TABLE 1**.

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).

7.3.3 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 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 4, APPENDIX 5**).

7.3.4 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 5, APPENDIX 5**).

Estimates of the population of Koalas occupying Kings Forest have varied. Warren (2000) and Smith (2005) estimated that Kings Forest itself could support around 15 Koalas. Based on the area of core (Primary) habitat on the site (i.e. 18.47 ha) (**FIGURE 6, APPENDIX 5**) and an estimated carrying capacity ranging from 0.17 to 2 Koalas per hectare of core Koala habitat (Philips *et al.* 2011), the Kings Forest site could support between 3 and 37 Koalas.

7.4 Preferred Koala Food Tree Species and Resource Availability

7.4.1 Preferred Koala Food Trees

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 (detailed in Appendix 2 of the Approved Recovery Plan) specified all Eucalypt species known to be preferentially utilised by koalas in the form of Primary, Secondary and Supplementary food tree species (DECC 2008) (**APPENDIX 3**).

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 those in the Eucalyptus sub- Genus *Symphomyrtus*, some species of which are now known to demonstrate both substrate- and intra-specific variation in terms of their palatability to koalas (More & Foley 2000; Phillips and Callaghan 2000; More and Foley 2005; Gleadow *et al.* 2008).

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 5 Primary, 13 Secondary and 5 Supplementary food tree species are known to occur in the North Coast KMA (**APPENDIX 3**).

Tweed Coastal Strip

Phillips *et al.* (2011) established that four species: Forest Red Gum (*Eucalyptus tereticornis)*; Swamp Mahogany (*E. robusta)*; Tallowwood (*E. microcorys)*; and Grey Gum (*E. propinqua)* were the most preferred species within the Tweed Coast Study Area. All four 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) delegated 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.

Kings Forest

Records of Koalas at Kings Forest are primarily associated with vegetation communities that contain the preferred food trees species Swamp mahogany (*Eucalyptus robusta*). Based on cuticle scale anaylsis of koala faecal pellets, Swamp Mahogany comprises nearly half (46%) of the dietary intake, the remainder comprising a mix of more opportunistically browsed species including Swamp box (*Lophostemon suaveolens*) and other non- eucalypt species such as *Lophostemon confertus and Melaleuca quinquenervia* (JWA 2000).

As alluded to in 4.1.3 above, Scribbly gum (*E. racemosa*) 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 KPoM.

7.4.2 Resource Availability

Tweed Shire vegetation mapping describes 46 vegetation communities for consideration as Koala habitat within the Tweed LGA (Kingston *et al.* 2004). Based on this mapping 3,815 ha of *potential koala habitat* is identified. The following three habitat categories as recognised by the approved Koala Recovery Plan (DECC 2008) are represented.

- **Primary Habitat** – areas of forest and/or woodland wherein primary food tree species comprise the dominant or co-dominant (i.e. ≥ 50%) overstorey tree species.

- **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.

The following are the results from Koala habitat mapping for the Tweed Coast Study Area completed by Phillips *et al.* (2011):

- Primary Koala Habitat is limited to 200ha (1.04%) of mapped vegetation and consists of communities that are dominated by *E. robusta* and/or *E. tereticornis* ± *E. microcorys* growing on TAEBAS[2] soil landscapes. There is approximately 18.47ha of primary habitat present on the Kings Forest site.

- Secondary (Class A) Habitat comprises the bulk of potential koala habitat, encompassing 2,300ha (12%) of mapped vegetation communities growing on TAEBAS soil landscapes wherein on average *E. robusta* and/or *E. tereticornis* ± *E. microcorys* are sub-dominant elements. There is approximately 171.09ha of Secondary (Class A) habitat present on the Kings Forest site.

- Secondary (Class B) Habitat comprises 1,315ha (6.8%) of mapped vegetation communities containing *E. microcorys* and/or *E. propinqua*, growing on NFM[3] soil landscapes. There is approximately 6.27 ha of Secondary (Class B) habitat present on the Kings Forest site.

Koala habitat in the locality is shown in **FIGURE 7 (APPENDIX 5)**. Koala habitat present on the Kings Forest site is shown in **FIGURE 6 (APPENDIX 5)**.

[2] TAEBAS refers to those of transferral, alluvial, estuarine, beach, aeolian and swamp (TAEBAS) **landscapes respectively.**
[3] **NFM refers to sites on all erosional/residual landscapes (i.e. Nerang-Fernleigh Metamorphics)**

7.5 Regional Distribution of Koalas & Alternative Habitat Availability

7.5.1 Distribution of Koalas in Tweed LGA

Koalas are reported to be widely distributed throughout the Tweed LGA, which covers approximately 103,000 ha, as discussed in Section 7.3. **FIGURE 3 (APPENDIX 5)** shows the distribution of Koala records within the Tweed LGA.

7.5.2 Alternative habitat

Long-term fidelity to the home range area is generally maintained by adult koalas in a stable population (Faulks 1990; Mitchell 1990; Phillips 1999; Kavanagh *et al.* 2007). Hence, the concept of providing alternative habitat elsewhere to compensate for the loss of core habitat is delusive. Areas of currently unoccupied habitat known to occur on the Kings Forest site that may provide alternative habitat for Koalas is shown in **FIGURE 4 (APPENDIX 5)**. It should be noted however that this KPoM aims to maintain the current extent of core Koala habitat on and adjacent to the Kings Forest site and therefore preserve the existing social structure for the local free-ranging koala population.

7.6 Core Koala Habitat Linkages and Koala Movements

7.6.1 Core Koala Habitat Linkages

In addition to the fundamental need for habitat patches of sufficient size to support existing populations and provide for future population expansion (McAlpine *et al.* 2008), recommendations by Phillips *et al.* (2011) included maintenance and creation of vegetated linkages between habitat patches and source populations. Here the focus should be on "gap-filling" in large habitat blocks within and adjacent to mapped source populations, on the edges of habitat blocks and within linkage areas themselves (Rhodes *et al.* 2008).

The Koala Plan of Management that accompanied the Concept Plan application (Carrick 2009) proposed an additional east-west corridor in the western portion of the Kings Forest site, based on the presence of a significant land bridge constructed across the alignment of the Pacific Motorway to the west of the Kings Forest site. Carrick (2009) noted that, whilst there are some vegetated linkages (albeit somewhat tenuous ones) abutting the eastern side of this fauna overpass, to the west lies several kilometres of open agricultural fields. Carrick therefore suggested the adoption of the precautionary approach of considering the possibility that, at a time in the future, some native vegetation may be restored to connect with this western side of the fauna overpass to improve its functionality.

Condition B4 of the approved Concept Plan referred to the requirement in the accompanying Koala Plan of Management (Carrick 2009) of an east-west corridor minimum 50 metres in width in the western part of the site. A number of the figures accompanying the Concept Plan indicated the location of such a corridor. Condition B4 also required demonstration, prior to the determination of Stage 1, of the practicality or need for establishing a further 50 metre wide fauna corridor along the southern boundary of the western precincts of the site.

The issue of connectivity and linkages within the Tweed Coast Study area was reviewed by Phillips *et al*. (2011). Like Carrick (2009), Phillips *et al*. (2011) identified that the Pacific Highway represents a barrier to, and limits opportunities for, east-west movement of koalas. In the context of the Kings Forest site, the fauna underpass available at Eviron Road (to the

south-west), is the only opportunity for safe koala passage under the highway (Phillips, 2012 *pers. comm.*). This is also the only underpass along the Yelgun to Chinderah section of the Pacific Highway with recorded koala usage (Phillips *et al*. 2011).

Given that no sufficiently large areas of suitable habitat and no existing resident koala populations occur to the north-west of the Kings Forest site, and that no safe under-highway passages exist for koalas apart from at Eviron Road, it is the view of this KPoM that the value of an east-west corridor is increasingly questionable. It should be noted that Kings Forest adjoins what was known as Forest Hill (now part of the Cudgen Nature Reserve) in the south-western corner. The Forest Hill ridgeline leads directly to the Eviron Road underpass identified as a primary linkage by Phillips *et al.* (2011).

Given the preceding considerations, the east-west corridor proposed by Carrick (2009) is not considered an appropriate allocation of resources, in that the prospect of the long-established sugar cane fields to the west becoming revegetated, so as to offer meaningful koala habitat, is considered extremely remote. For the same reasons, there is not considered to be a need for an additional east-west movement linkage along the southern boundary of the western precincts as discussed in Condition B4. Given the established pattern of koala activity generally within lands to the east and south of the Kings Forest estate, there is no requirement to provide for movements to the west.

Existing Core Koala habitat linkages on the Kings Forest site (**FIGURE 8, APPENDIX 5)** will be retained and embellished, including that which currently offers access to the north of the Kings Forest site by way of existing underpasses to the Tweed Coast Road. The primary goal of retaining habitat linkages is to maintain 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.

7.6.2 Koala movements

Eberhard (1978) and Gall (1980) separate populations of Koalas into three 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 they usually disperse and become nomads. 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. Gall (1980) found that three dispersing Koalas had moved distances of 1, 4 and 11 km and were capable of ranging widely.

Sometimes animals go for random wanders (Smith 1979) and may disappear from a colony for a time with females tending to travel less distances (Gall 1981).

Radio tracking data has provided evidence that Koalas will utilise culverts in order to traverse the landscape (Tayor & Goldingay 2003). Research has shown that habitat links for Koalas include both forested and mainly cleared land as studies have shown that Koalas will travel over cleared land containing only scattered trees. Studies by Callaghan and Phillips (1997, 1998a and 1998b), Hopkins & Phillips (2009) and AMBS (2011) also document the use of underpasses by koalas.

7.7 Threatening Processes

7.7.1 Introduction

A number of environmental pressures have been identified as having a significant impact on Koala populations in eastern Australia (Phillips 1990; DECC 2008; Phillips *et al.* 2011). The following threatening processes are discussed:

- Habitat Removal and Modification;
- Bushfire;
- Drought;
- Vehicular Collisions;
- Dog Nuisance;
- Disease; and
- Swimming Pools.

7.7.2 Habitat Removal and Modification

In a paper submitted for Koala Summit – Managing Koalas in New South Wales, Reed and Lunney (1988) 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 (*Ibid*) 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. 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 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. 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.

7.7.3 Bushfire

Koalas are sedentary animals and not especially mobile and, therefore, stand little chance of surviving large-scale bushfires. Fire throughout the east coast of NSW 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 in the Tweed Coast Koala Habitat Study 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 (Starr 1990; Melzer *et al.* 2000) 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. 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).

7.7.4 Drought

The effects of drought are most likely to be felt by Koala populations living in the more arid areas west of the Great Dividing Range. In general, however, drought causes loss of leaves and loss of leaf quality, which can have deleterious impacts on Koala populations.

7.7.5 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 behaviour in dispersing. 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, as documented by the "road mortality hotspots" identified by Phillips *et al.* (2011), rather than in residential areas with 50kph speed limits.

7.7.6 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. 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. Ninety-six percent of attacks on koalas were by dogs over 10 kg (DERM 2009). Generally, the larger the dog, the greater the likelihood that it could be responsible for a fatal attack on a koala.

7.7.7 Disease

Disease is a fundamental element of wildlife population dynamics and is generally recognised as a density dependent mechanism enacting population regulation. 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.

Although Chlamydia 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.

7.7.8 Swimming Pools

Although drowning in swimming pools is a relatively low order threat (NPWS 2003), any Koala mortality can be significant in a particular context. 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.

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

7.8 Proposed Amelioration of Impacts on Koala Populations from any anticipated development within Core Koala Habitat

7.8.1 Introduction

There are a variety of measures which can be implemented to ameliorate impacts on Koalas on the Kings Forest site. These measures are as follows:

- Management plan strategies;
- Retention of existing core Koala habitat;
- Transfer of land to public ownership;
- Fire management;
- Wildlife exclusion fencing;
- Effective design for roads intersecting fauna linkages;
- Preventing Koala contact with dogs;
- Construction standards on swimming pools; and
- Raising community awareness.

These measures are more fully described in the following sections.

7.8.2 Management Plan Strategies

Koalas will be protected during the pre-construction, construction and operational phases of the development. The construction phase includes all clearing activities, bulk earthworks, road construction and building. Specific management objectives and actions are outlined in **TABLE 2** including who is responsible for the implementation of each action.

Table 2
MANAGEMENT STRATEGIES

Objective	Management Action	Responsibility
Pre-construction Phase		
Education of construction personnel	A construction personnel induction 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.	Construction Manager
	The general induction of all construction personnel aimed at ensuring their 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. – Requirements of the Kings Forest Vegetation Management Plan, particularly protocols for vegetation clearing and measures to protect all other native vegetation.	Construction Manager
	Construction personnel prohibited to bring dogs onto the site	Construction Manager
	Signage to be posted along the margins of the Environmental protection areas stating that the area is Koala habitat.	Construction Manager

Construction Phase		
Minimise construction impact on Koalas and Koala habitat	Assist the protection of retained vegetation from all construction activities. Machinery and contractor access will be restricted.	Construction Manager
	Temporary high visibility fencing to be erected along the edge of the 30m inner buffer zone at Precincts 1 and 5 in accordance with AS 4970-2009 Protection of Trees.	Construction Manager
	Temporary signage at approximately 100m intervals will be provided along all temporary fencing during the construction phase stating "Environmental Protection Zone – No Unauthorised Entry".	Construction Manager
	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 personnel on site
	An experienced ecologist/fauna handler to be on site during all clearing activities.	Ecologist/ Spotter catcher
	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.	Construction Manager/ Ecologist/ Spotter catcher
	A suitably qualified person 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.	Ecologist/ Spotter catcher
	Koalas to be excluded from entering development areas by appropriate fencing in conjunction with the required road underpasses/bridging and grids in accordance with Section 7.8.6 of this report.	Construction Manager
	Report all Koala observations and incidents. All Koala observations and incidents should be reported immediately to the appropriate site personnel, such as the Environmental Officer.	Construction Manager
	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.	Ecologist/ Spotter catcher
	Any injured animals to be immediately taken to the nearest appropriately qualified veterinary clinic for treatment.	Ecologist/ Spotter catcher
Record Koala observations and incidents	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.	Ecologist/ Spotter catcher
	Any 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 DECCW or TSC.	Construction Manager
Operational Phase		
Exclude Koalas from roads and residential precincts	Koala exclusion fencing to be regularly checked and maintenance issues addressed as they arise, including vegetation in close proximity to the fencing, in accordance with Section 7.8.6 of this report	Construction Manager/ TSC
Education of residents	Provide and maintain educational 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.	Construction Manager/ TSC

	Provide an information package (brochure/booklet and website) for purchasers of properties within Kings Forest to raise community awareness regarding Koalas (refer Section 7.8.10).	Proponent
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
	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.	TSC Environmental Officer

7.8.3 Retention of Existing Core Koala Habitat

Monitoring programs and threat mitigation strategies have been devised in the FAMP (JWA 2012) and WMP (JWA 2012) to ensure that suitable existing koala habitat remains viable for the persistence of this species at the Kings Forest site.

There will be minimal losses to Koala habitat as only isolated occurrences of Koala food trees will be removed. **FIGURE 6 (APPENDIX 5)** illustrates the proposed extent of works, the subject of the Project Application, with an overlay of existing "core Koala habitat". The proposed development will result in the loss of eighteen (18) food trees from within 6.68 ha of Secondary (A) habitat, that is currently unoccupied by koalas. It should be noted that a small area of core Koala habitat adjoining Council's landfill in the northern portion of the site was subject to a trade-off during the finalisation of land zones in 2006 (Sainty 2006). In any event, this area occurs in isolation from other habitat areas and outside areas to which Koalas will be restricted on the site.

The proposed easterly access road to the southern portion of the site extends through cleared pine plantation with no vegetation of value to Koalas to be affected by these road works.

7.8.4 Transfer of Land to Public Ownership

The identified areas of "core Koala habitat" in areas of Kings Forest contiguous with Cudgen Nature Reserve will be transferred to public ownership.

The transfer to public ownership (Office of Environment and Heritage) of approximately 150 ha (Per Concept Plan condition C3) and an addition of approximately 30 ha (subject to agreement with OEH) of the Kings Forest site contiguous with Cudgen Nature Reserve (**FIGURE 9, APPENDIX 5**), which includes "core Koala habitat", is an undertaking contained in the Proponent's Statement of Commitments forming part of the approved Concept Plan. In addition, land within Environmental Protection and buffer zones in other areas of the Kings Forest site (which includes areas proposed for Koala food tree planting) of approximately 153 ha will be dedicated (subject to agreement) to Tweed Shire Council (**FIGURE 9, APPENDIX 5**).

7.8.5 Fire Management

Koalas are sedentary animals, not especially mobile and, therefore, stand little chance of surviving high intensity bushfires. They do not typically react to bushfire by attempting to flee, but tend to seek refuge from bushfires high in the canopy and by doing so can generally survive lower intensity bushfires. The design of proposed fencing adjacent to Koala habitat areas has therefore been reconsidered as discussed in **SECTION 7.8.6**.

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 BRMS is to assess and manage fuel loads within the Kings Forest site. The risk of high intensity fires should be reduced within core Koala habitat areas through controlled low intensity burns or mechanical means if and where appropriate. The proponent is responsibile for bushfire management for an estimated period of five (5) years.

Within Kings Forest, the core Koala habitat is proposed to be crossed by roads in three 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 refuge for Koalas and other wildlife in the event of a bushfire (Carrick 2011).

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.

7.8.6 Wildlife Exclusion Fencing

Biolink Ecological Consultants in its report on the Skyline Road Upgrade for Lismore City Council (Hopkins & Phillips 2009) demonstrated that the use of wildlife exclusion fencing, underpasses and the novel use of grids at fence ends and on driveways, successfully ameliorate potential impacts to koalas (such as vehicle strike) as a result of increased traffic volume and vehicle speeds. 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.

As indicated in **SECTION 7.1.5** (Rationale) of this KPoM, Koalas will be excluded from the development areas in Precincts 1, 2, 3, 4 and 5 by appropriate exclusion fencing in conjunction with road underpasses and grids, the extent and locations of which are indicated in **FIGURES 10A & 10B (APPENDIX 5).** It should be noted that **FIGURES 10A & 10B (APPENDIX 5)** currently propose that Precincts 1 – 5 be completely encapsulated by exclusion fencing. However, it should also be noted that there are no areas of koala habitat either adjoining or in close proximity to the north-western corners of the site. Given this circumstance, there is an argument that fencing is not necessary in this area, with any northward koala movement from habitat in the central SEPP 14 area instead being redirected to the south by way of kickbacks/returns such as are used along areas of the Pacific Highway. This should be further considered when future development applications are made for the development of Precincts 7 & 8.

Koala fencing adjacent to Precinct 2 & 3 will include a grid where it crosses Secret Lane and a 2m wide self-locking gate to the northeast of the grid (**FIGURE 10B, APPENDIX 5)** to allow pedestrian and horse access around the grid. Such fencing will be constructed after the completion of bulk earthworks and prior to the occupation of any buildings constructed within these precincts. The specification of such fencing and its extent relevant to Precincts 1, 2 and 5 is discussed below and shall be in accordance with the design shown in **FIGURES 11 & 12 (APPENDIX 5)**.

Appropriate fencing is considered to be floppy-top wildlife exclusion fencing, the bottom 600mm of which must also be clad with galvanised tin plate on the outside face (**FIGURE 11, APPENDIX 5**). As discussed in Hopkins & Phillips (2009), regular checking of fencing, grids and underpasses and the detection and addressing of maintenance issues as they arise are imperative to the ongoing function of these ameliorative measures. Hence, vegetation adjacent to the fence will be maintained to:

- Exclude trees and shrubs from within 3m of the fence;
- Keep canopies of trees trimmed to remove links to tree canopies on the other side of the fence; and
- Remove fallen branches and vines growing on the fence to maintain fence efficacy.

Exclusion fencing will be configured so as to funnel Koala and other fauna to underpasses for facilitated movement between protection areas. As a result of sand- trap monitoring data, Hopkins & Phillips (2009) inferred that between 100 and 150 underpass traverses by koalas were likely to be occurring annually. Therefore, Koala underpasses will be reinforced concrete box culverts (RCBCs) in accordance with Hopkins & Phillips (2009) designs i.e. a minimum of 1.2m high x 1.2m wide and less than 40m long.

Standard cattle grids shall be installed based on 50mm round pipe at 100mm centres at the end of each fence section and on all roads adjoining habitat areas (**FIGURE 10A, APPENDIX 5**). The design of grids will be in accordance with **FIGURE 11 (APPENDIX 5).** Lighting will be provided at all grids and additional potential koala and other wildlife crossing points, to reduce fauna and vehicle collisions. Signage will be provided to ensure motorists are aware of the possibility of encountering koalas and other fauna on roads that traverse through environmental areas. In addition, residents should be made aware of the purpose of the exclusion fencing and grids, by (as a minimum) the fixing of relevant signage to such fencing at intervals of no more than 100m.

The location and design of Koala fencing combined with the use of grids and traffic calming devices through the central Environmental Protection Zones (i.e. SEPP 14 wetlands), rather than constructing fences on both sides of the roadways, will allow for unimpeded Koala movements into other Environmental Protection zones, the golf course area and adjacent vegetated properties. Fencing to exclude Koalas from the residential areas of Precincts 12 and 13 (that is, containing the golf course area, being Precinct 14), and additional required underpasses and/or grids, shall be the subject of a future Project Application or Development Application. Such fencing shall be constructed generally at the boundaries between residential allotments and the golf course, be aesthetically appropriate in such a setting and be covenant protected.

7.8.7 Effective Design for Roads Intersecting Fauna Linkages

Roadways will be constructed through Koala habitat in a number of locations. These intersections have the potential to bring Koalas into contact with motor vehicles and also to allow Koalas to enter and roam through residential areas. The use of exclusion fencing along the length of roadways will mitigate these potential impacts. Exclusion fencing will also funnel koalas and other fauna towards underpasses and other areas that offer safe passage.

An underpass to facilitate the movement of Koalas (and other fauna) shall be provided to the Kings Forest Parkway at the entrance of the estate in accordance with **FIGURE 12 (APPENDIX 5)**. A second underpass will be provided to Kings Forest Parkway (between Precincts 4 & 7) to ensure safe wildlife passage between habitat areas to the north and south of this roadway, particularly after the development of Precincts in the western portion of the Kings Forest site (**FIGURE 10A, APPENDIX 5**). As discussed in **SECTION 7.8.6** above, cattle grids shall be constructed in roadways at intersections and fence ends to prevent koalas entering exclusion zones and potentially coming into contact with residential areas and subsequently, vehicles and dogs. In addition, appropriate lighting (capped) and signage will be installed at each grid location.

Similarly, a temporary grid shall be provided to the Kings Forest Parkway where it extends from Precinct 5 through to the western precincts. Future fencing of habitat areas in the western precincts would preclude the requirement for this particular grid. Hence, this grid shall be maintained until such time as the permanent bridging over the watercourse there (which shall be designed also to facilitate fauna underpass) has been constructed.

The proposed measures in each case shall be approved by a suitably qualified person prior to the detailed road/bridging designs being submitted to the relevant authority for approval.

7.8.8 Preventing Koala Contact with Dogs

The Companion Animals Act was passed by New South Wales Parliament on 3 July 1998. The Act introduced major reforms for the keeping and control of Companion Animals (Dogs and Cats) and endeavoured to address the concerns of modern society. The Companion Animals Act replaced the provisions of the Dog Act 1966.

The Act was developed with the understanding that all sectors of the Community will benefit through incorporating an educational approach to Companion animal management and the utilisation of more proactive and enforceable laws.

Tweed Shire Council has a Companion Animals Management Plan reflecting the provisions of the Companion Animals Act.

With the emphasis of this KPoM being on restricting Koalas to the identified area within the Environmental Protection zone (including the core Koala habitat areas), it is considered that, other than steps to increase community awareness, the reporting of observations and incidents and the monitoring of performance, no measures additional to those in force through the above regulations are necessary for the control of dogs in relation to the protection of Koalas.

It is not intended to provide any off-leash dog exercise area within Kings Forest specifically to service the needs of residents of Precinct 5. 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 will be considered in future Project Applications/Development Applications in relation to residential subdivision of that part of the property.

7.8.9 Construction Standards on Swimming Pools

The approach in this KPoM of ensuring the effective separation of koalas from the development zone makes it unnecessary to impose construction standards in relation to koala management with respect to swimming pools.

7.8.10 Raising Community Awareness

Prior to entering into any sales agreement with respect to the subdivided allotments within Precinct 5 an environmental awareness and extension program will be undertaken which will include, but not necessarily be limited to, the following:

An information package for purchasers of land at Kings Forest shall be commissioned by the Proponent. This shall be approved by a suitably qualified person and comprise, firstly, a brochure or booklet provided free of charge to all original purchasers of Kings Forest properties and made available through appropriate service outlets within the Kings Forest estate and, secondly, a web page containing the required information.

With respect to the protection of Koalas, the printed and web-based information 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
- Swimming pool construction and fencing requirements
- Need to report *any* Koala sightings or incidents on or near the site and actions to be taken, with relevant telephone numbers and addresses
- Assistance that can be given in the protection of koalas generally
- The contact details of local organisations involved in the care of Koalas, of relevant State agencies such as DECCW and of the Council, and web addresses where further information on Koalas may be obtained.

Additionally,

- Signage pursuant to the objectives of this Plan will be provided in appropriate locations adjacent to Kings Forest Parkway and within Precinct 5, and
- A residents association having as one of its aims the protection of the local Koala population will be established by the Proponent. The residents association will be open to all Kings Forest residents in liaison with Friends of the Koala, Tweed Shire Council, the NSW Environmental Protection Authority and the NSW National Parks and Wildlife Service.

7.9 Opportunities to Increase Size or Improve Condition of Existing Core Habitat

7.9.1 Rationale

Although no primary Koala habitat will be removed, the Kings Forest development proposes a significant vegetation rehabilitation program that includes the planting of Koala food trees. The intent of replanting will be to create additional Koala habitat areas representative of Swamp Sclerophyll Forest, rather than a monoculture of Koala food trees. Therefore, the number of Koala food trees to be planted will comprise no less than 35% of the proposed vegetation cover, with the balance to include other endemic Swamp Sclerophyll species (Phillips, 2012 *pers. comm.*). Stock for the proposed replanting will be grown from seed collected on site or from seedlings grown from seed sourced locally. Plantings will be controlled by the revised Precinct 1 & 5 Vegetation Management Plan, Precinct 2, 3, 4, 6, 7, 8, 9, 10, 11 Vegetation Management Plan, Precinct 12, 13 & 14 Vegetation Management Plan, Precinct 1 & 5 Buffer Management Plan and Precinct 2-4 & 6-14 Buffer Management Plan (JWA 2012). Existing Koala habit and Koala dispersal will be improved and new potential core habitat areas will be created.

It is proposed that additional Koala habitat will be created in concomitance with heath revegetation and Wallum sedge frog compensatory habitat. Overlapping proposals for Koala feed tree plantings and areas of existing or proposed heathland regeneration or other vegetation communities are not necessarily mutually exclusive. Existing vegetation communities on the Kings Forest site (**FIGURE 13, APPENDIX 5**) are indicative that Secondary Koala habitat and areas of heathland are not mutually exclusive. These vegetation communities include:

- 3(c) Mixed wet/dry coastal heathland to shrubland (with Scribbly gum);
- 4(b) Swamp mahogany open forest to woodland & heathland species;
- 4(h) Swamp sclerophyll & heathland species;
- 4(i) Regenerating Broad-leaved paperbark closed forest to woodland & heathland species; and
- 5(e) Regenerating Scribbly gum open forest to woodland & heathland species.

Furthermore, in areas where there is some overlap in the characteristics and objectives of proposed regeneration/revegetation areas, Koala feed tree planting would provide opportunity for revegetation with heath species (i.e. Koala feed tree species would form the canopy with heath species forming the sub-canopy and understory).

A habitat assessment was completed on the 6th August 2012 to demonstrate that these habitat types already occur together on the Kings Forest site. Details of this assessment are included as **APPENDIX 4.**

In addition, the proposed Koala tree planting will be sensitive to the characteristics of the existing vegetation, particularly in vulnerable habitats. For example, Scribbly Gum vegetation communities are identified as locally rare on the Tweed Coast (e.g. RFA & Kingston *et al.* 2004, See Cobaki Lakes, Volume 4, Scribbly Gum Communities). Therefore, Koala tree planting in Scribbly Gum vegetation communities will include Scribbly Gum with the judicious use of other koala food trees.

7.9.2 Calculating the number of Koala food trees to be planted

The number of Koala food trees to be planted has been calculated. In total, 71.12ha at the Kings Forest site has been identified as suitable for planting Koala food trees (refer **FIGURES 10 & 10A – 10L (APPENDIX 2)** within the Precinct 1 & 5 Buffer Management Plan (BMP) (JWA 2012)). No Koala food trees will be planted within the development footprint. Approximately 45.83ha (64%) of the identified Koala tree planting area will be protected within Environmental Protection Zones with 17.43ha (25%) to be located within ecological buffers.. The remaining 7.86ha (11%) will be located within the proposed golf course.

It is considered suitable for Koala food trees to be planted at a rate of one tree per 25m^2. In areas where the proposed Koala food tree planting coincides with proposed Wallum sedge frog compensatory habitat (**FIGURES 10 & 10A – 10L (APPENDIX 2)** in Precinct 1 & 5 BMP), a planting density of one tree per 50m^2 is considered suitable. **TABLE 4** indicates the total area of proposed Koala food tree planting and Wallum sedge frog compensatory habitat, and the total area where the two overlap. Hence, there will be 31.82ha planted at a rate of one tree per 25m^2 and 39.30ha planted at a rate of one tree per 50m^2. This equates to an approximate planting of 20,588 trees.

However, as previously discussed, it is recommended that Koala food trees comprise a minimum 35% vegetation cover. With the above-mentioned planting densities, it is considered that a planting ratio of 1:1 (Koala food trees: other sclerophyll forest species) will achieve the desired minimum vegetation cover of 35%. This equates to an approximate planting of 10,284 Koala food trees and 10,294 other endemic Sclerophyll Forest species.

TABLE 4
AREA OF KOALA FOOD TREE PLANTING AND ACID FROG COMPENSATORY HABITAT

Compensatory Areas	**Area (ha)**
Koala Tree Planting - Site excluding golf course	60.48
Koala Tree Planting - Golf course only	10.64
Koala Tree Planting - TOTAL	**71.12**
Wallum sedge frog Compensatory Habitat - Site excluding golf course	32.40
Wallum sedge frog Compensatory Habitat - Golf course only	6.90
Wallum sedge frog Compensatory Habitat - TOTAL	**39.30**
Overlap - Site excluding golf course	32.40
Overlap - Golf course only	6.90
Overlap - TOTAL	**39.30**

7.9.3 Increase in Kings Forest Carrying Capacity

It is estimated that on the Tweed Coast, 0.17 to 2 Koalas can survive on 1 hectare of core Koala habitat (Phillips *et al.* 2011). As discussed above, a total of 71.12ha of revegetation works including preferred Koala food trees will be completed at the Kings Forest site. Based on the above densities, the Kings Forest area could theoretically carry a further 12 to 142 Koalas in the long-term. To achieve even the low estimate would be a very positive outcome for the rehabilitation program at Kings Forest.

7.9.4 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 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 8, APPENDIX 5**).

A primary goal of this KPoM is to maintain 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). Proposed fences to exclude Koalas from the residential areas of the site are located on the edges of habitat areas only. The use of grids and traffic calming devices through the central Environmental Protection Zones (i.e. SEPP 14 wetlands) rather than constructing fences on both sides of the roadways will allow for unimpeded Koala movements.

It has been noted that the KPoM that accompanied the Concept Plan application (Carrick 2009) proposed an additional east-west corridor in the western portion of the Kings Forest site and subsequently Condition B4 of the approved Concept Plan reflected this proposal. Condition B4 also required demonstration, prior to the determination of Stage 1, of the practicality or need for establishing a further 50 metre wide fauna corridor along the southern boundary of the western precincts of the site. As detailed in **Section 7.6.1,** this is not considered appropriate or necessary.

7.9.5 Koala Habitat Rehabilitation and Maintenance Targets

The requirements for the ecological maintenance and protection of the various elements of the Environment Protection Zone, particularly those including Koala habitat, must be implemented as set out in:

- Precinct 1 & 5 Vegetation Management Plan (JWA 2012);

- Precinct 2, 3, 4, 6, 7,-8, 9, 10, 11 Vegetation Management Plan (JWA 2012);
- Precinct 12, 13 & 14 Vegetation Management Plan (JWA 2012);
- Precinct 1 & 5 Threatened Species Management Plan (JWA 2012);
- Precinct 2, 3, 4, 6, 7, 8, 9, 10, 11 Threatened Species Management Plan (JWA 2012);
- Precinct 12, 13 & 14 Threatened Species Management Plan (JWA 2012);
- Weed Management Plan (JWA 2012); and
- Feral Animal Management Plan (JWA 2012).

In areas where pines are to be removed, it is noted that the close proximity and extent of mature native trees are such that the structural attributes necessary to support Koalas will not require retention of non-native trees.

Revegetation for rehabilitation to include Koala habitat values of the areas identified in the above Vegetation management Plans shall generally commence within 180 days of commencement of any works contemplated by this Project Application and, in the golf course area, will commence as soon as the bulk earthworks there are completed.

7.10 Performance Criteria

The following table contains a list of the objectives of this KPoM and the performance criteria against which achievement of these objectives is to be measured.

TABLE 5
Objectives of the Management Plan & criteria for judging success

Objectives	Recommendations	Criteria for judging success
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. All identified areas of Core Koala habitat will be retained.	• All identified core Koala habitat is retained.
	2. A large area which includes identified areas of "Core Koala habitat" contiguous with Cudgen Nature Reserve (CNR) will be transferred to public ownership.	• The designated 178 ha of "Core Koala habitat" 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).
To ensure that movement corridors for the local Koala population are maintained or improved.	3. Fauna underpasses will be constructed to facilitate connectivity of habitat and fauna movement. Underpasses will be at least 1.2m x 1.2m and no longer than 40m. Where the underpass crosses beneath a dual carriage way 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 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. The 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.	• 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.
	4. Free movement of Koalas through Kings Forest will be preserved and enhanced by existing fauna linkages and the provision of additional linkages.	

Objectives	Recommendations	Criteria for judging success
To protect individual Koalas from injury or other adverse impacts during the development phase.	5. An experienced fauna handler/ecologists will be on site to supervise all clearing activities regardless of whether the area is considered as Koala habitat or not. 6. An education program will be developed and presented to all workers on the site, providing 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 25m 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. 7. Appropriate temporary signage will be placed around the site and on the margins of the environmental protection areas stating that Koala occur on the site, and the appropriate person to report koala sightings to 8. Prompt notification to relevant agency of breaches to environmental mitigation measures	• An experienced fauna handler/ecologists 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. • Breaches are reported and rectified where possible
To embellish, by way of planting preferred feed trees, the habitat value of the portions of the site, which will be retained and facilitate an increase in Koala numbers resulting from the improvement of habitat.	9. Koala food trees will be planted in areas identified in the Precinct 1 & 5 BMP (**FIGURES 10 & 10A - 10L, APPENDIX 2** in P1 & 5 BMP) in accordance with the Precinct 1 & 5 Vegetation Management Plan, the Precinct 2-4 & 6-11 Vegetation Management Plan and the Precinct 12, 13 & 14 Vegetation Management Plan. 10. Tree planting to occur as soon as practicable during the construction phase (after bulk earthworks) on both sides and within a radius of 20m of underpass openings. 11. Koala food trees as per species list in Vegetation Management Plan (local stock)	• 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 and within a radius of 20m of underpass openings. • Koala food trees are planted from the list specified in the VMP. • Annual monitoring of Koalas demonstrates an increase in Koala numbers on the Kings Forest site.

Objectives	Recommendations	Criteria for judging success
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.	12. Exclusion fences will be constructed to keep Koalas out of residential areas in accordance with **FIGURES 10A, 10B, 11 & 12 (APPENDIX 5)**. 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. Regular inspection and maintenance to be completed on a regular basis. Where incidents involving Koala impact are directly attributable to failings of fencing and/or grid design, this shall necessitate the modification of their design. 13. Grids will be constructed to exclude Koalas from the residential areas in accordance with **FIGURE 11 (APPENDIX 5).** 14. Regular checking and prompt maintenance of infrastructure (fencing etc.) 15. Educational signage will be placed at frequent intervals 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. 16. prompt notification to relevant agency of breaches to environmental mitigation measures	• 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. • Grids have been installed and no Koalas have been recorded in residential areas. • Signage has been installed • Breaches are reported and rectified where possible.
To ensure there is no reduction in Koala numbers resulting from the development. To ensure monitoring and management is being carried out and maintained.	17. Any observations of Koalas (including any mortality if it was to occur on Kings Forest during or after development) will be reported in accordance with recommendations of the NSW Department of Environment and Climate Change. 18. Annual Koala monitoring and reporting will be provided to and approved by the Department of Planning, DECCW, Tweed Shire Council and Industry and Investment Fisheries	• Monitoring reports have been submitted to the NSW Department of Environment and Climate Change and compared with baseline data. • The results of monitoring demonstrate that there is no reduction in Koala numbers after the completion of the development. • Annual Koala monitoring and report have been provided to the Department of Planning, DECCW, Tweed Shire Council and Industry and Investment Fisheries.

7.11 Provisions for Continued Monitoring, Review and Reporting

7.11.1 Introduction

This section provides guidelines for the monitoring, review and reporting of Koala management within Kings Forest and should be read in conjunction with the more comprehensive Flora and Fauna Monitoring Report. Koala location records will be provided to DECCW through the NSW Wildlife Atlas, and other information regarding individual animals will be compiled and reported to DECCW (North East Branch), the NSW Department of Planning and Tweed Shire Council.

7.11.2 Monitoring and reporting requirements

An annual Koala Monitoring Report will be provided. DGR 9.6 refers to B2 of the Concept Plan approval which (as modified by MOD 1, 22 December 2010) provides as follows:

B2 Annual Flora and Fauna Monitoring Report
Within 12 months of this approval, or as otherwise determined by the Director-General, the Proponent shall prepare a draft outline of a Flora and Fauna Monitoring Report to the satisfaction of the Director-General. The aim of the report is to collate and synthesise all monitoring and reporting requirements contained in the documents listed in A3.

The draft outline of the Flora and Fauna Monitoring Report shall set out the proposed timeframe and duration for ongoing monitoring with reference to locations within Kings Forest, stages of development and the specific issues listed below.

The Flora and Fauna Monitoring Report shall be prepared by a suitably qualified person/s and include, but not limited to:

1. *Aims, objectives and methodology for monitoring and reporting;*
2. *Baseline monitoring data focusing on existing populations of threatened species, including Wallum frog species and koalas;*
3. *Performance criteria against which the effectiveness of the various separate management plans required as part of this approval dealing with koalas, threatened species, buffers, weeds, vegetation and feral animals can be measured. Relevant benchmark reference vegetation communities are to be nominated from within surrounding conservation estates;*
4. *Actual performance against the above criteria;*
5. *Any required corrective actions;*
6. *Monitoring and reporting of fauna usage within the Environmental Projection zones, ecological buffers and the golf course;*
7. *Adaptive management procedures to ensure that the various separate management plans remain relevant and effective;*
8. *Monitoring and reporting of koala injury and mortality; and*
9. *Specific monitoring to measure any impact of the development on the adjacent Cudgen Nature Reserve and adaptive management procedures to ensure impacts are minimised.*

The Monitoring Reports are to be provided to the Department of Planning, DECCW, Tweed Shire Council and Industry and Investment – Fisheries.

7.11.3 Baseline monitoring

With respect to Koala management, the following are accordingly required:

- The proponent shall engage a suitably qualified person to prepare:
    - a baseline monitoring report focusing on existing populations of koalas, to the satisfaction of the Director-General, at the commencement of works on the site, and
    - a draft outline of an Annual Koala Monitoring Report (AKMR), to the satisfaction of the Director-General, prior to construction commencing as determined by the Director-General.

A "suitably qualified person" shall be one having a postgraduate qualification in the field of Koala Ecology or Biology and/or demonstrated experience and expertise in these fields and/or having published research in these fields in the peer reviewed scientific literature.

Baseline Koala monitoring will be completed as a condition of consent. Refer to the Flora and Fauna Monitoring Report (JWA 2012i) for details of the proposed monitoring programs.

7.11.4 Annual Koala Monitoring outline required

The AKMR shall be prepared on an annual basis (as a responsibility of the Proponent) from the date of commencement of construction, for 5 years or as otherwise determined by the Director-General. A review of the need for its continuation thereafter will be conducted 5 years after the commencement of construction. The AKMR shall include, but not be limited to:

1. The aims, objectives and methodology for the report. The aims will include the establishment of basic ecological benchmarks for monitoring Koalas occupying Kings Forest and its surrounds. These parameters should include definition of 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, etc.; how will they be measured, who and resources required
2. Monitoring and reporting on the implementation of the requirements of this KPoM;
3. Performance criteria against which the effectiveness of the various separate management plans dealing with management of koalas and vegetation can be measured;
4. Monitoring and reporting of koala usage within Environmental Protection zones, ecological buffers and the golf course;
5. Adaptive management procedures to ensure that the separate management plans remain relevant and effective;
6. Monitoring and reporting of injuries or mortalities to koalas;
7. Specific monitoring to measure any impact of the development on the Koala habitat values of the adjacent Cudgen Nature Reserve, and adaptive management procedures to ensure any impacts are minimised.
8. *Summary of all actions required to implement KPoM e.g.*Monitoring should evaluate effectiveness of grids, underpasses, fencing, improvements in habitat quality, success of replanting efforts, community education, bushfire management, domestic dog control, feral dog control etc.

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APPENDIX 1 – DGEARs Compliance Table

DGEAR	Compliance in Report
9.5 – *Provide an update to the Koala Plan of Management (KPoM) for the site. The update should confirm that the measures identified and proposed in the KPoM to offset the impact of the development on existing and future Koala populations are adequate.*	*This current report*
9.6 – *The KPoM should take into account:*	
• *contemporary data/literature on koala management;*	*Throughout the report reference has been made to current literature e.g. Phillips et al. (2011) – the most up-to-date study of Koalas on the Tweed Coast.*
• *the results of the monitoring of management measures operating as part any approved stage/s, in accordance with B2 of the concept plan approval;*	*n/a*
• *the role of additional koala habitat created in protecting koala numbers, and* • *the provision of any additional koala management measures, specifically those relating to dogs.*	*SECTION 7.9* *SECTION 7.8*
9.7 – *The KPoM update should include, but not be limited to:*	
• *the identification of dog breeds known to present a significant threat to koalas and measures to effectively mitigate the threat posed to koalas by dogs.* • *Such measures may include:* o *prohibitions/restrictions on particular breeds;* o *limitations on the number of dogs per property; and* o *specifications on the way dogs are to be housed from dusk to dawn.*	*SECTION 7.8.8*
9.8 – *The KPoM update must provide stage specific detail on the following:*	
• *revegetation and rehabilitation measures;*	*SECTION 7.9*
• *measures to ensure that no identified koala food trees are removed within adjacent ecological buffers or identified core koala habitat within adjacent Environmental Protection zoned land;*	*SECTION 7.9*
• *all obligations regarding the keeping of dogs, including:* o *regulatory and enforcement measures,*	*SECTION 7.8.8* *SECTION 7.8.8*
o *specific road design,*	*SECTION 7.8.7*
o *lighting and signage requirements aimed at protecting koalas and maintaining their safe passage between habitat areas.*	*SECTION 7.8.7*
• *These requirements shall include fencing to road verges, fauna underpasses and like measures.*	*SECTIONS 7.8.6 &7.8.7*

DGEAR	***Compliance in Report***
9.9 - *The KPoM update must detail:*	
• *procedures to be adopted in the event that koalas are sighted within construction zones or the urban areas;*	*SECTIONS 7.8.2 & 7.8.10*
• *specifications for any off leash dog exercise areas to ensure appropriate separation from koala habitat;*	*SECTION 7.8.8*
• *the detail of the location and construction specification of dog exclusion fencing to any adjacent Environmental Protection zoned land and the timing of its completion;*	*SECTION 7.8.6*
• *the detail, content and distribution of koala education and awareness measures aimed in particular at contractors and staff engaged in construction and at future residents; and*	*SECTIONS 7.8.2 & 7.8.10*
• *a protocol for the reporting of any deaths or injuries to any koala within Kings Forest including collection and recording procedures and where necessary post-mortem procedures or laboratory tests to identify the cause of death to an koala.*	*SECTION 7.8.10*

APPENDIX 2 - Koala - Priority Actions

A total of 15 strategies have been identified to help recover this threatened [species/population/endangered ecological community]. Each of these strategies has a number of priority actions within it. The table below shows these strategies and priority actions. It also shows which organisation is responsible for each priority action, along with the progress made so far. You can also see details of the broad geographic regions each priority action applies to in New South Wales.

For more general information about this species, see a detailed species profile.

Description of priority action	Priority
Recovery strategy: Aboriginal liaison and/or interpretation	
Investigations into the cultural significance of koalas to indigenous Australians will be encouraged.	Low
Recovery strategy: Assess threats and determine recovery strategies	
In areas where overbrowsing becomes a significant issue, develop management strategies based on the National Koala Conservation Strategy.	Medium
Recovery strategy: Captive Husbandry or ex-situ collection/propagation	
Accredited and licensed wildlife rehabilitation groups will continue to rescue and rehabilitate injured, orphaned and/or diseased koalas according to the NPWS policy "Koala Care in NSW: Guidelines and Conditions", including an upgraded recording system.	High
DECC will analyse NSW koala care records, assist in developing improved protocols to record data to ensure consistency among rehab groups & to provide useful information for koala conservation.	High
DECC will assist wildlife rehabilitation groups to interpret the ecological relevance and application of rescue work and rescue records for koala conservation.	High
Recovery strategy: Community and land-holder liaison/ awareness and/or education	
DECC will make available/disseminate the information gathered during the implementation of the recovery plan.	High
DECC will investigate with stakeholders the value of holding another koala summit (state conference).	Low
DECC will prepare and make available/disseminate information to drivers in areas where koala populations occur regarding the threat posed to koalas by vehicles.	Low
DECC will provide information in relation to the management of dogs and their threat to koalas.	Low
Information regarding koalas and koala habitat, including maps of koala habitat, will be prepared by DECC and disseminated, following discussions, to relevant bush fire management committees.	Low
Recovery strategy: Coordinate the recovery and/or threat abatement program	
DECC, through collaboration with a wide range of researchers & conservation partners, will coordinate & promote implementation of the recovery plan, using the Priorities Action Statement as the primary information & coordination tool.	High
Recovery strategy: Develop and implement protocols and guidelines	
The NSW government will participate in the preparation of a revised National Koala Conservation Strategy to replace the 1998 ANZECC Strategy.	High
DECC will encourage the revision and/or production of a regional list of koala food and shelter trees for catchment management authorities, local government areas and other local/regional koala plans that deal with specific issues and/or locations.	Medium
DECC will prepare environmental impact assessment guidelines for the koala.	Medium
DECC will work with councils to assist in the preparation of Comprehensive Koala Plans of Management under SEPP 44.	Medium
DECC, in partnership with planning research groups, will prepare a generic approach to planning guidelines as an application of the research done on the impacts of habitat loss, fragmentation and the impediments to koala movement between fragments.	Medium
DECC will advise consent and determining authorities on the appropriate measures which should be included in the design and construction of new roads which may have the potential to impact on koala habitat.	Low
Recovery strategy: Establish management agreements with public authorities CMAs and land managers/owners	

DECC will approach key stakeholders to negotiate conservation outcomes for important koala populations in NSW.	Medium
Recovery strategy: Habitat management: Ongoing EIA - Advice to consent and planning authorities	
DECC will provide specific advice arising from the koala recovery plan, as required, to consent & determining authorities regarding their decision-making responsibilities under SEPP 44, the EP&A Act and the NV Act.	Medium
DECC will provide appropriate regional koala food tree species lists to catchment management authorities.	Low
Recovery strategy: Habitat management: Other	
Management of all DECC estate will specifically provide for the protection of koalas.	Low
Recovery strategy: Habitat Rehabilitation/Restoration and/or Regeneration	
DECC will contribute to koala habitat rehabilitation & revegetation activities undertaken by individuals, community groups & government agencies by identifying priority areas for work in each koala management area & providing technical advice & support.	Medium
Recovery strategy: Monitoring	
DECC will design & implement a program to monitor changes in the status of koalas & koala habitat & evaluate the success of recovery actions in improving the conservation status of koalas in NSW.	Medium
Recovery strategy: Other Action	
Consideration will be given to amending Schedule 2 (Feed Tree Species) of SEPP 44 to include additional food tree species of koalas.	High
Implement the objectives of SEPP 44 and the National Koala Conservation Strategy for the conservation of koalas and their habitat in NSW.	High
Consideration will be given to amending SEPP 44 to: allow for other koala plans to be developed by councils on a regional or local government basis; & allow for Schedule 2 (Feed Tree Species) of SEPP 44 to include additional koala food tree species.	Medium
Consideration will be given to having a single definition of koala habitat, instead of 'core' and 'potential' habitat and to expanding the list of koala foods.	Medium
DECC will revise the local government area list on the basis of the 2006 map of koala distribution (from the community survey) and consider whether to recommend its incorporation into SEPP 44.	Medium
DECC, together with Dept. of Planning, will work with councils & CMAs to assist them in developing koala habitat protection measures for incorporation in relevant local environmental plans, & regional natural resource and vegetation management plans.	Medium
DECC will approach Forests NSW to collaborate in developing policy & practice consistent with the NSW Koala Recovery Plan; exchange information, given koalas move across tenure boundaries; & work within the context of agreed regional forest agreements.	Low
DECC will approach RTA to align its policy & practice with the koala recovery plan; exchange info & produce plans; ensure RTA has an active program to implement engineering solutions & other measures to reduce adverse impacts of vehicles on koalas.	Low
DECC will approach the Department of Planning to jointly develop and provide specific advice to local government about the incorporation of koala protection into their new local environmental plans, currently under development.	Low
Recovery strategy: Research	
Analyse community-based survey data on koala distribution in NSW in relation to features such as habitat, tenures, catchment management authority and bioregional boundaries, and compare 2006 survey results with those of the 1986 survey.	High
DECC will analyse patterns of koala road deaths to enable recommendations to road managers on appropriate management measures which limit the risk to koalas on existing roads.	High
DECC will analyse the impact of dogs to identify whether dogs posse a significant threat to koala populations, and alert land managers to the problem.	High
DECC will undertake and encourage other researchers to undertake population studies of koalas in a range of habitats in relation to a range of issues such as fire, drought, dogs, cars, habitat fragmentation, and climate change.	High
DECC will undertake research on koala ecology to better understand the primary issues affecting their conservation, & coordinate/contribute to the disparate interests & activities relevant to understanding & managing koalas in NSW.	High
Define the factors that determine koala habitat including soils, elevation, climate and tree species (food and shelter). .	High

Disseminate the results of the community-based survey on koala distribution in NSW, including in a standard scientific publication.	High
Assess koala population dynamics and habitat use across the NSW range.	Medium
Assess the significance and extent of overbrowsing which is likely to emerge in NSW.	Medium
Compare and assess the reliability of different koala survey and analytical techniques.	Medium
Conduct research on the relative impacts of different levels of habitat loss and fragmentation on koala populations, and on the ability of koalas to move between patches, relating to both daily movements and long-term dispersal.	Medium
DECC will encourage groups to undertake research on any aspect of koala biology & to communicate with DECC when research is being undertaken & when results are published, so officers managing the recovery plan have access to the best available info.	Medium
Investigate the relative importance of different threats to koalas, how to ameliorate them and the effectiveness of mitigation measures.	Medium
Undertake studies of the history of koala management as part of an adaptive management strategy.	Medium
Assess the economic and non-biological values of koalas to the whole community.	Low
Recovery strategy: Survey/Mapping and Habitat assessment	
DECC will determine the distribution of koalas across NSW by conducting a community-based survey.	High
DECC will identify important koala populations in NSW for active management, monitoring and conservation.	High
Undertake local and/or regional surveys in selected koala populations with particular emphasis on repeating earlier surveys to search for trends and causes of changes in koala distribution.	High
Examine the population of koalas in Bongil Bongil National Park to assist in the implementation of the Koala Recovery Plan in this icon forest.	Medium
Undertake coordinated surveys of koalas across a range of scales, using appropriate methods & focusing on different issues at the site, landscape/regional, & state scale, including a mechanism for identifying endangered populations.	Medium
Recovery strategy: Translocation and/or reintroduction	
A translocation proposal consistent with the NPWS Policy for the Translocation of Threatened Fauna in NSW will be prepared for any proposed movement of koalas. DECC will disseminate info regarding translocation of koalas.	High

APPENDIX 3 – Koala food trees

Koala food trees species of the NSW North Coast KMA, as per Appendix 2 of NSW Koala Recovery Plan (DECC 2008):

Primary food tree species:
Tallowwood (*Eucalypotus 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 4 – Compensatory Habitat Assessment

1. Aim

To investigate whether Koala habitat, Acid frog habitat and heath species occur concomitantly on the Kings Forest site.

2. Background

On coastal sand plains, swamp forests form mosaics with wallum sand heaths, coastal heath swamps and coastal freshwater lagoons (Keith 2004). This natural association of vegetation communities and habitat features has been noted as occurring across the Kings Forest site on the Pleistocene dunes and swales.

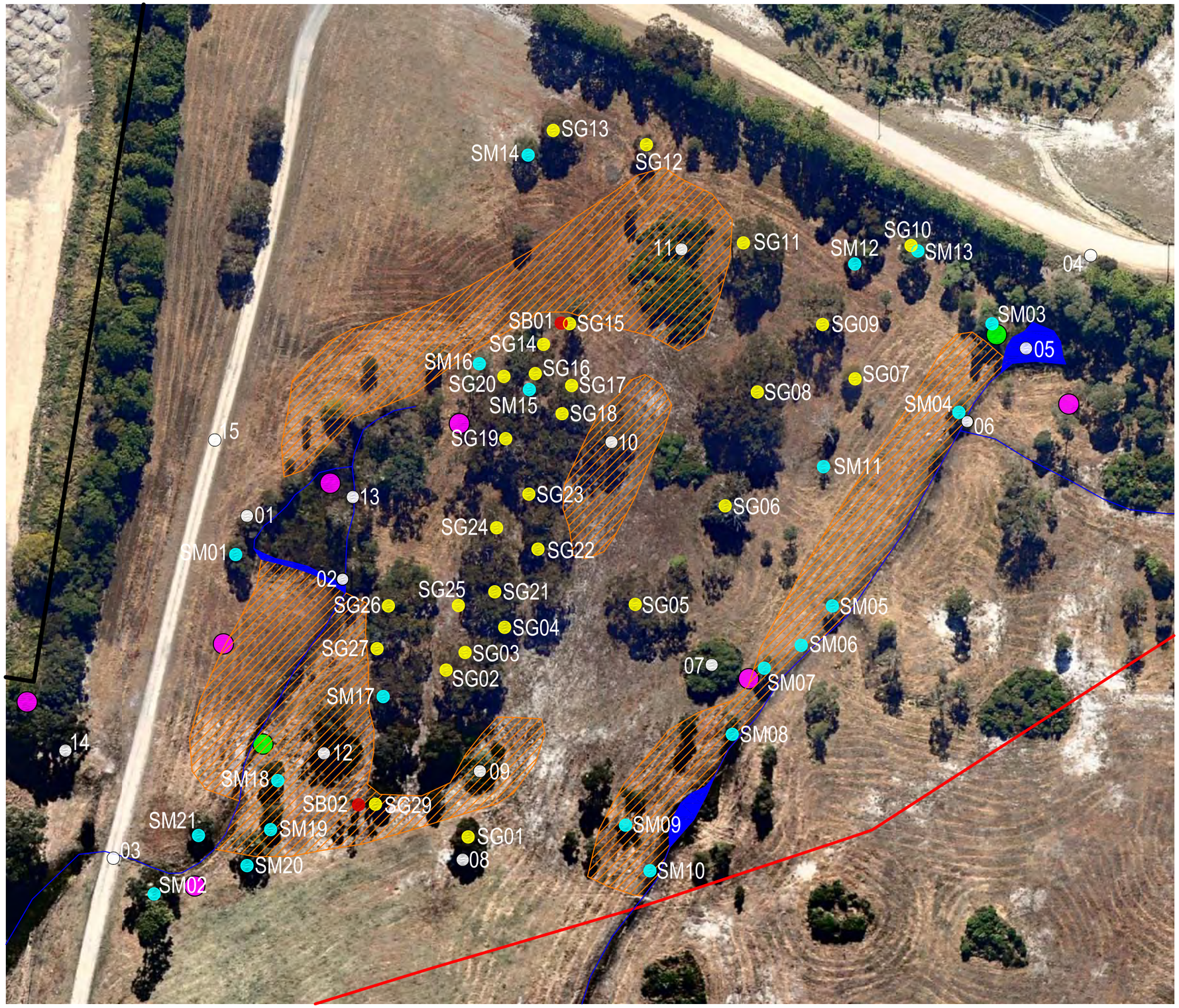
3. Methods

On the 6th August 2012, two (2) ecologists completed a site assessment of a 2.8ha (approx.) plot in the proposed Precinct 3 area (28°17'25"S, 153°33'24"E) of the Kings Forest site. The assessment involved the following methodology:

- Mapping with a handheld GPS the location of:
    - All mature trees (i.e. above 4m in height);
    - Drainage lines and ponds;
    - Areas dominated by wet heath; and
    - Areas dominated by sedges.
- Compiling a flora species list for the plot;

4. Results

The assessment confirmed that 'Acid frog' habitat in the form of ephemeral pools, drainage lines, ponds and associated sedges occurs in association with Koala habitat trees (i.e. Swamp Mahogany, Scribbly Gum and Paperbark) and various heath species (**FIGURE 1, APPENDIX 5**). **TABLE 1** lists the details of each GPS point in **FIGURE 1** (APPENDIX 5) including the number of individual trees that are located at each mark. A complete list of species recorded in this plot is provided in **TABLE 2**.



LEGEND

- Swamp Mahogany (SM)
- Scribbly Gum (SG)
- Red Bloodwood (SB)
- Ponds & Drainage Lines
- Regenerating Wet Heath
- Wallum sedge frog
- Wallum froglet
- Kings Forest Boundary

N

0 25m
1 : 1000

SOURCE: JWA Site Investigations;
Near Map August 2012 Aerial Photograph

SCALE: 1 : 1000 @ A3

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APPENDIX 4
FIGURE 1

PREPARED: BW
DATE: 22 August 2012
FILE: N97017_P3_Base.dwg

TITLE

PRECINCT 3
TREE SURVEY

TABLE 1
GPS POINTS

GPS Point	Details
01	1 x Swamp Mahogany 10 x Broad-leaved Paperbark
02	Drainage line with predominantly sedges
03	Plot Reference Point on road
04	Plot Reference Point in Pine Ridge Road
05	Pond with predominantly sedges
06	Drain junction
07	Patch of vegetation predominantly heath
08	Small patch of vegetation with; 2 x Scribbly Gum
09	Disturbed patch of vegetation predominantly heath
10	Disturbed patch of vegetation predominantly sedges
11	Large patch of vegetation predominantly heath
12	Patch of vegetation predominantly heath
13	Pond with predominantly sedges and; 10 x Swamp Mahogany 3 x Scribbly Gum 30 x Broad-leaved Paperbark
14	Plot Reference Point on fence
15	Plot Reference Point on Road
SM01	1 x Swamp Mahogany
SM02	3 x Swamp Mahogany
SM03	4 x Swamp Mahogany
SM04	1 x Swamp Mahogany
SM05	1 x Swamp Mahogany
SM06	1 x Swamp Mahogany
SM07	1 x Swamp Mahogany
SM08	2 x Swamp Mahogany
SM09	3 x Swamp Mahogany
SM10	2 x Swamp Mahogany
SM11	1 x Swamp Mahogany
SM12	1 x Swamp Mahogany
SM13	1 x Swamp Mahogany
SM14	2 x Swamp Mahogany
SM15	2 x Swamp Mahogany
SM16	2 x Swamp Mahogany
SM17	6 x Swamp Mahogany
SM18	2 x Swamp Mahogany
SM19	1 x Swamp Mahogany
SM20	2 x Swamp Mahogany
SM21	1 x Swamp Mahogany

SG01	1 x Scribbly Gum
SG02	1 x Scribbly Gum
SG03	1 x Scribbly Gum
SG04	1 x Scribbly Gum
SG05	5 x Scribbly Gum
SG06	1 x Scribbly Gum
SG07	1 x Scribbly Gum
SG08	12 x Scribbly Gum
SG09	2 x Scribbly Gum
SG10	4 x Scribbly Gum
SG11	3 x Scribbly Gum
SG12	1 x Scribbly Gum
SG13	1 x Scribbly Gum
SG14	1 x Scribbly Gum
SG15	1 x Scribbly Gum
SG16	7 x Scribbly Gum
SG17	2 x Scribbly Gum
SG18	9 x Scribbly Gum
SG19	6 x Scribbly Gum
SG20	1 x Scribbly Gum
SG21	5 x Scribbly Gum
SG22	2 x Scribbly Gum
SG23	4 x Scribbly Gum
SG24	11 x Scribbly Gum
SG25	1 x Scribbly Gum
SG26	3 x Scribbly Gum
SG27	2 x Scribbly Gum
SG28	1 x Scribbly Gum
SG29	1 x Scribbly Gum
SB01	1 x Red Bloodwood
SB02	2 x Red Bloodwood

TABLE 2
LIST OF PLANT SPECIES RECORDED IN THE PLOT

Scientific Name	Common Name
Trees	
*Cinnamomum camphora**	Camphor laurel
Corymbia gummifera	Red Bloodwood
Elaeocarpus reticulatus	Blueberry Ash
Endiandra sieberi	Hard Corkwood
Eucalyptus racemosa	Scribbly Gum
Eucalyptus robusta	Swamp Mahogany
Melaleuca quinquenervia	Broad-leaved paperbark
Phebalium squameum	Satinwood
*Pinus elliottii**	Slash Pine
Heath species	
Acacia suaveolens	Sweet wattle
Acacia ulicifolia	Prickly moses
Aotus ericoides	Eggs and Bacon
Austromyrtus dulcis	Midgenberry
Baeckea sp.	Baeckea
Banksia serrata	Old Man Banksia
Gleichenia dicarpa	Pouched Coral Fern
Gompholobium sp.	Gompholobium
Histiopteris incisa	Bat's wing fern
Kennedia rubicunda	Dusky coral Pea
Leptospermum sp.	Tea trees
Leucopogon lanceolatus	Lance beard-heath
Monotoca scoparia	Prickly broom heath
Smilax australis	Native Sarsaparilla
Zieria smithii	Sandfly Zieria
Zieria sp.	Zieria
Sedge/wetland species	
Baloskion tetraphyllum	Tassel Cord-rush
Baumea sp.	Baumea
Blechnum indicum	Swamp water fern
Caustis flexuosa	Curly wig
Gahnia aspera	Rough Saw-sedge

*Introduced species

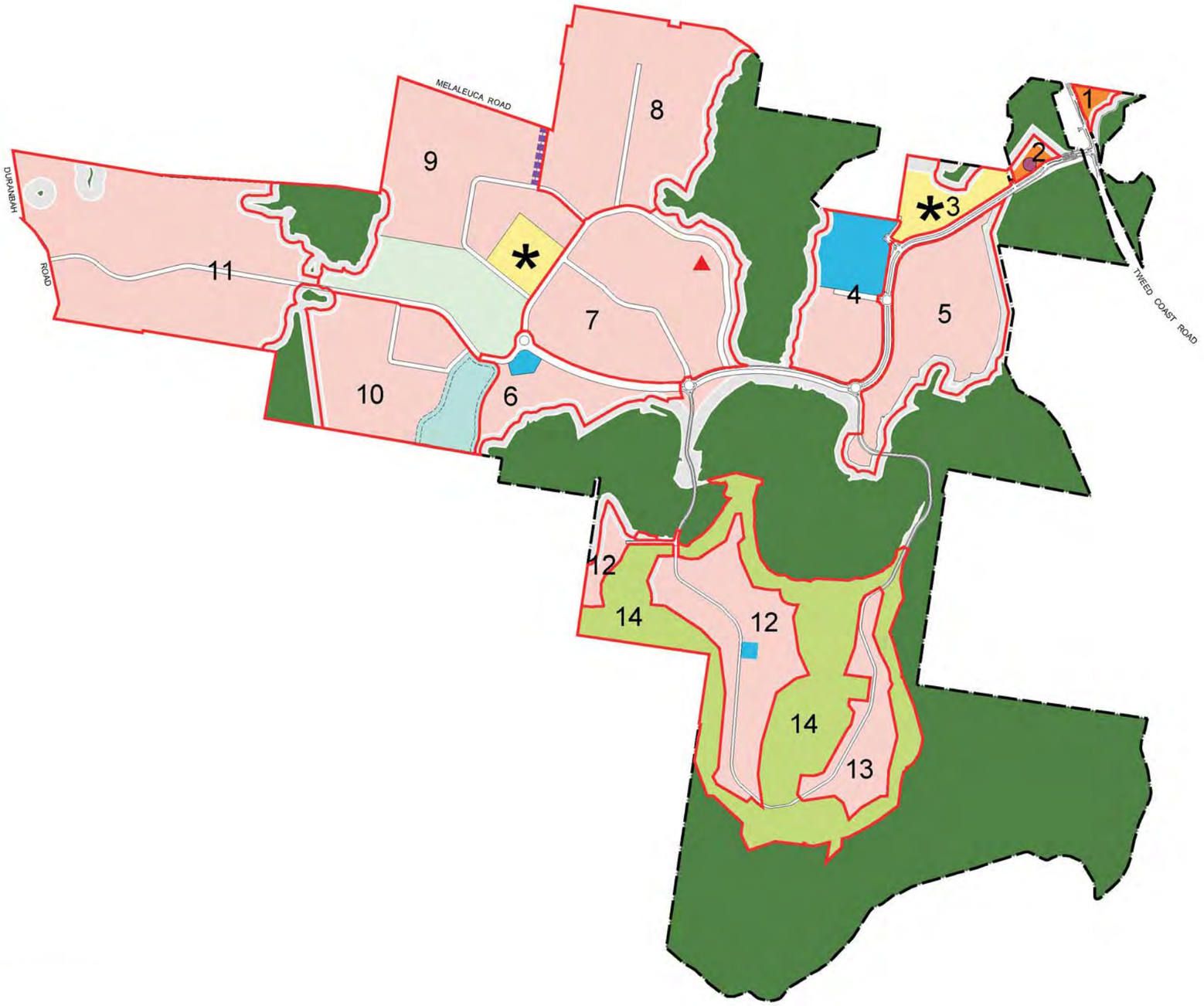
1. Conclusion

This habitat assessment has demonstrated that Koala habitat, Acid frog habitat and heath species occur concomitantly on the Kings Forest site, and that the multiple use compensatory habitat areas, proposed for Kings Forest, would not be incompatible.

2. References

Keith, D. (2004). Ocean Shores to Desert Dunes- The native vegetation of New South Wales and the ACT, Department of Environment and Conservation NSW, Hurstville

APPENDIX 5 – Figures



N

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 to be Dedicated to Council or NPWS
- 50m Ecological Buffer
  (includes APZ's & 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 Boundaries
- Kings Forest Boundary

0 500m

1 : 20 000

SOURCE: RPS (Ref: 113691-PSP-4a (PRECINCT PLAN).jpeg)

SCALE: 1 : 20 000 @ A3

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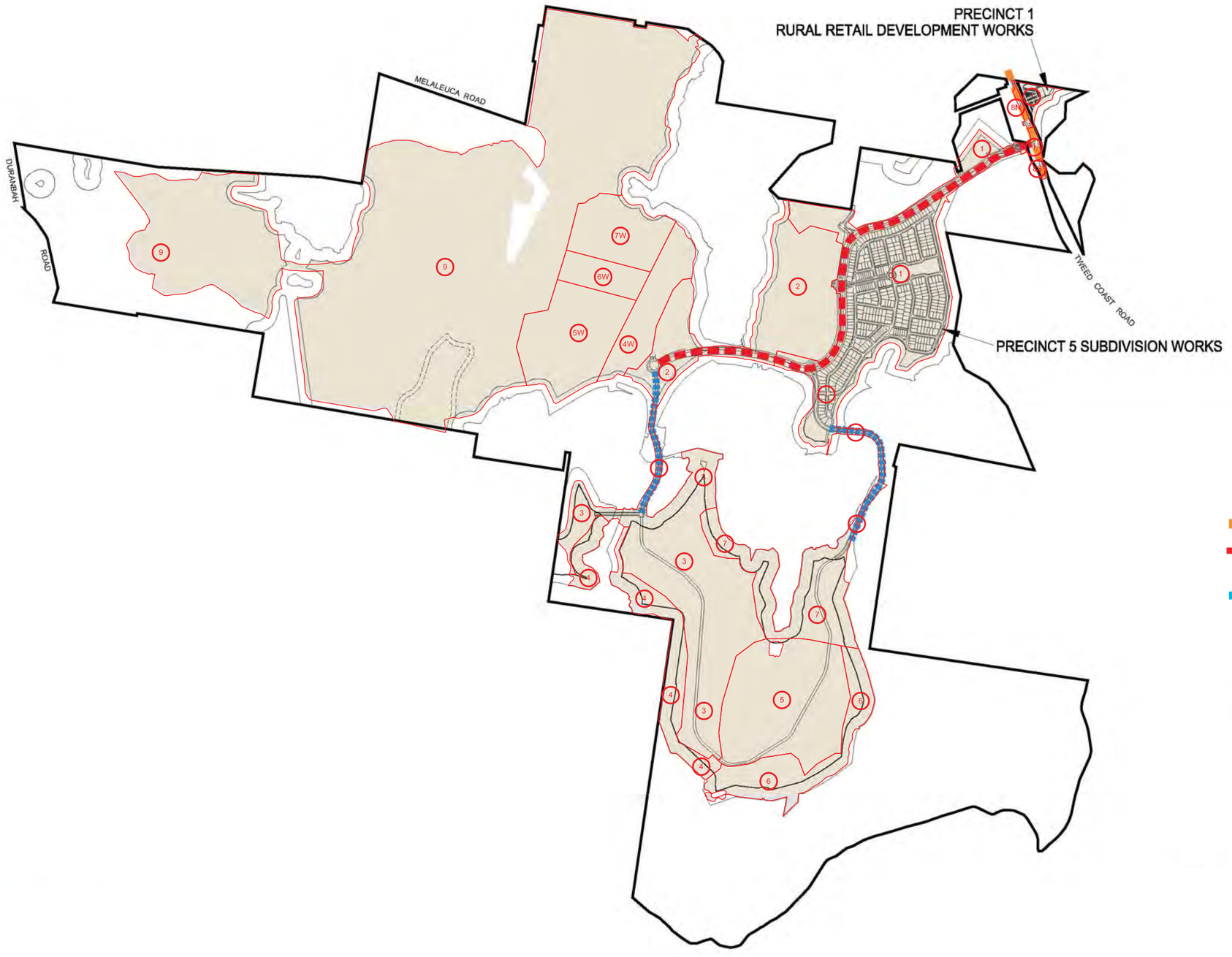
Shire of Tweed

FIGURE 1

PREPARED: BW
DATE: 27 August 2012
FILE: N97017_KPoM_Precincts.cdr

TITLE

PRECINCTS PLAN



SOURCE: RPS (Ref: 113691-PSP-4a (SCOPE OF WORKS).jpeg); Mortons Urban Solutions (Ref: sequencing COLOUR.pdf)
SCALE: 1 : 20 000 @ A3

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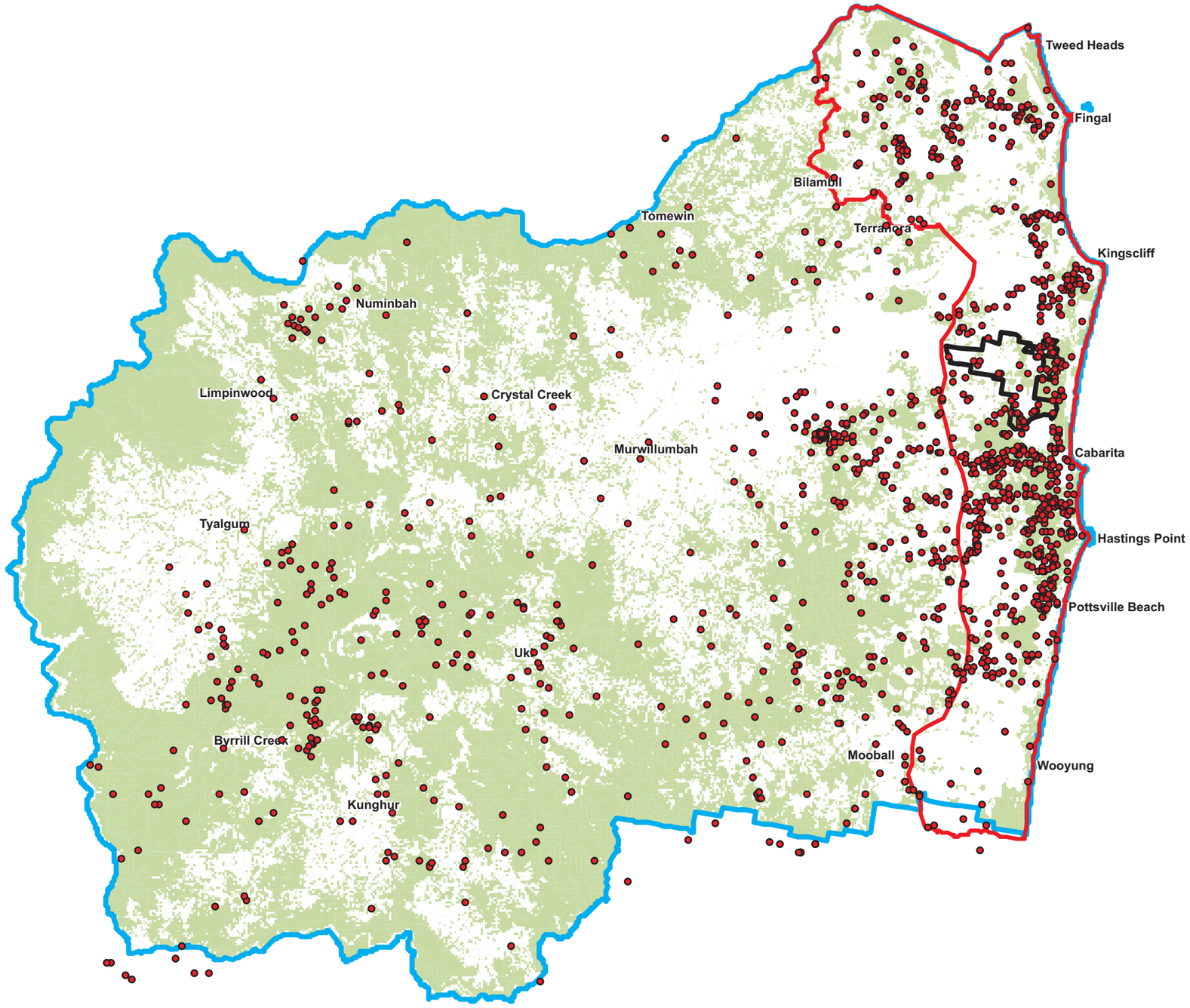
FIGURE 2

PREPARED: BW
DATE: 28 August 2012
FILE: N97017_KPoM_Scope.cdr

TITLE

SCOPE OF WORKS



N

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.

0 5km

1 : 200 000

SOURCE: Biolink Ecological Consultants - Tweed Coast Koala Habitat Study (2011)

SCALE: 1 : 200 000 @ A3

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Kings Forest Estate
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Shire of Tweed

FIGURE 3

PREPARED: BW
DATE: 21 August 2012
FILE:N97017_KPoM_tweedkoala.cdr

TITLE

KOALA RECORDS WITHIN TWEED LGA & COASTAL STRIP

N

LEGEND

- Linkages
- Metapopulation Boundaries
- Significant Activity
- High Activity
- Undefined Boundary
- Koala Sightings
- Nature Reserve
- Major Roads
- Tweed Coastal Strip
- Tweed LGA Boundary
- Kings Forest Boundary

0 1.5km

1 : 50 000

SOURCE: Biolink Ecological Consultants - Tweed Coast Koala Habitat Study (2011)

SCALE: 1 : 50 000 @ A3

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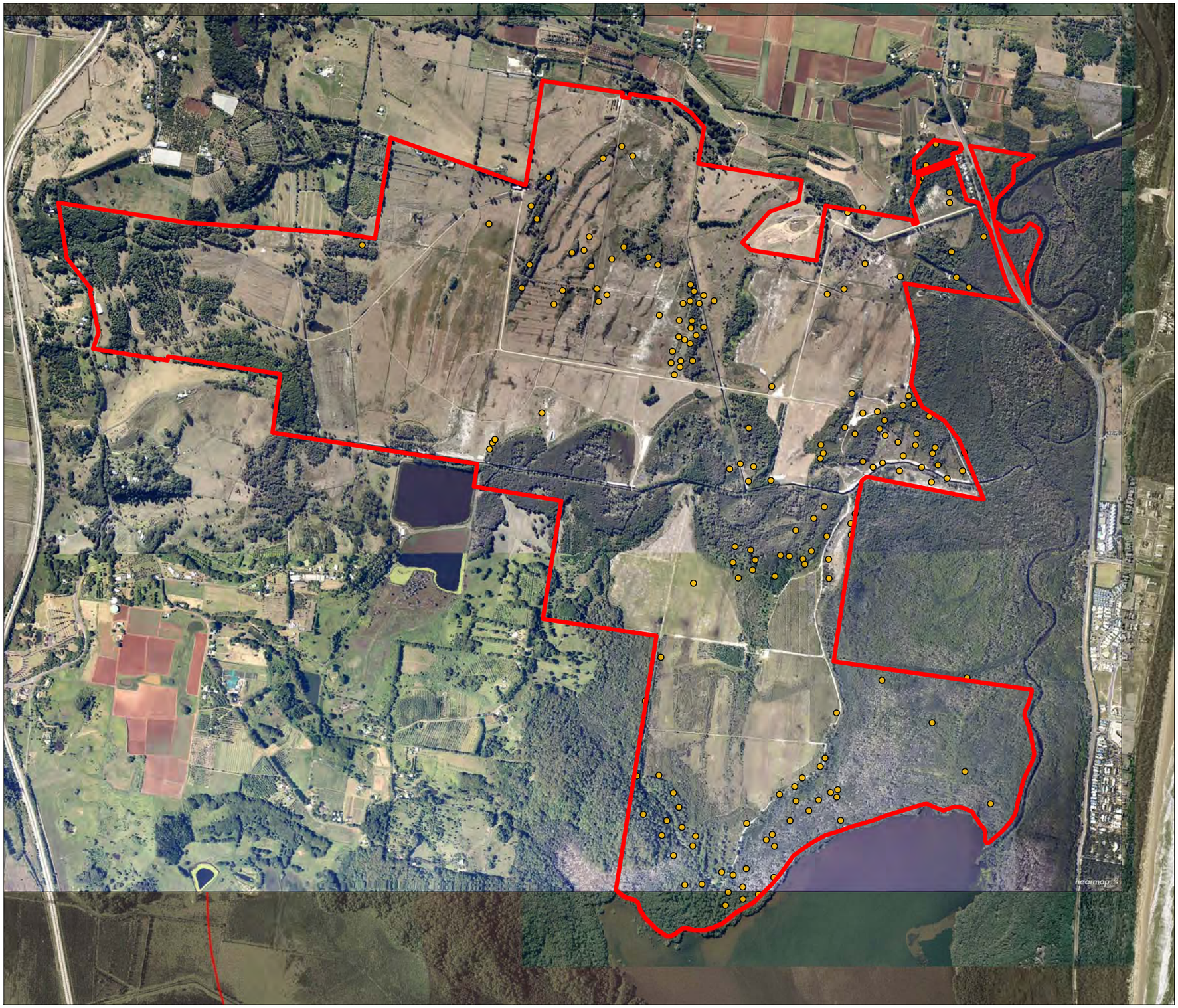
Shire of Tweed

FIGURE 4

PREPARED: BW
DATE: 21 August 2012
FILE:N97017_KPoM_Koala Pop.cdr

TITLE
INDICATIVE METAPOPULATION BOUNDARIES & LINKAGES



N

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.

0 500m

1 : 20 000

SOURCE: Landpartners - Threatened Fauna - Birds & Mammals & 2007 Aerial; Near Map June 2011 Aerial

SCALE: 1 : 20 000 @ A3

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Kings Forest Estate
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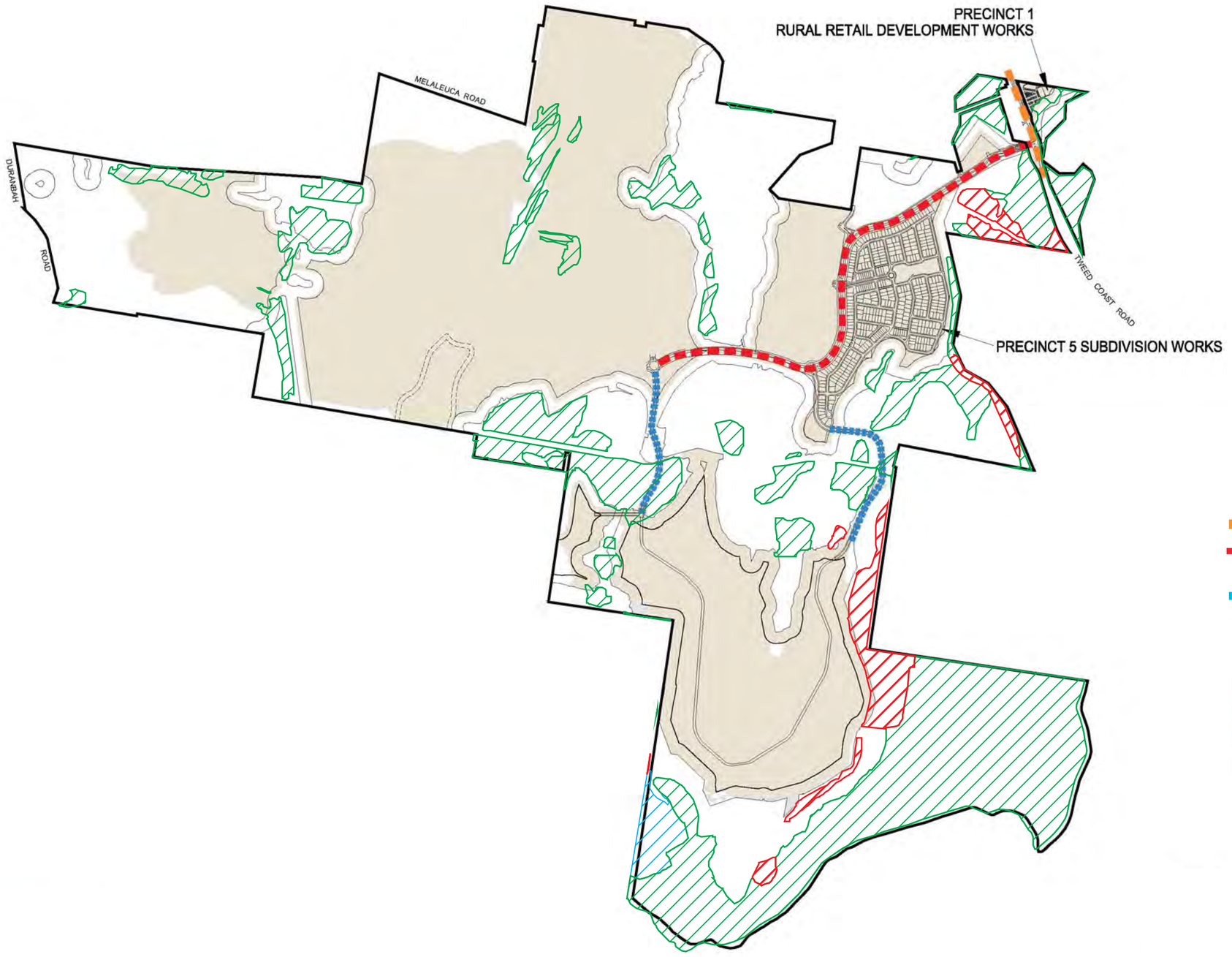
Shire of Tweed

FIGURE 5

PREPARED: BW
DATE: 21 August 2012
FILE: N97017_KPoM_Base.dwg

TITLE

KOALA RECORDS



N

LEGEND

- Tweed Coast Road Intersection Works
- Kings Forest Parkway through to Western Precincts
- Roads through to Southern Precincts
- Indicative Bulk Earthworks Location (Refer to detailed engineering design by Mortons Urban Solutions)
- Primary Koala Habitat (0.81ha to be lost)
- Secondary (A) Koala Habitat (6.68ha to be lost)
- Secondary (B) Koala Habitat (0ha to be lost)
- Kings Forest Boundary

0 500m

1 : 20 000

SOURCE: Biolink Ecological Consultants - Tweed Coast Koala Habitat Study (2011); RPS (Ref: 113691-PSP-4a(SCOPE OF WORKS).jpeg)
SCALE: 1 : 20 000 @ A3

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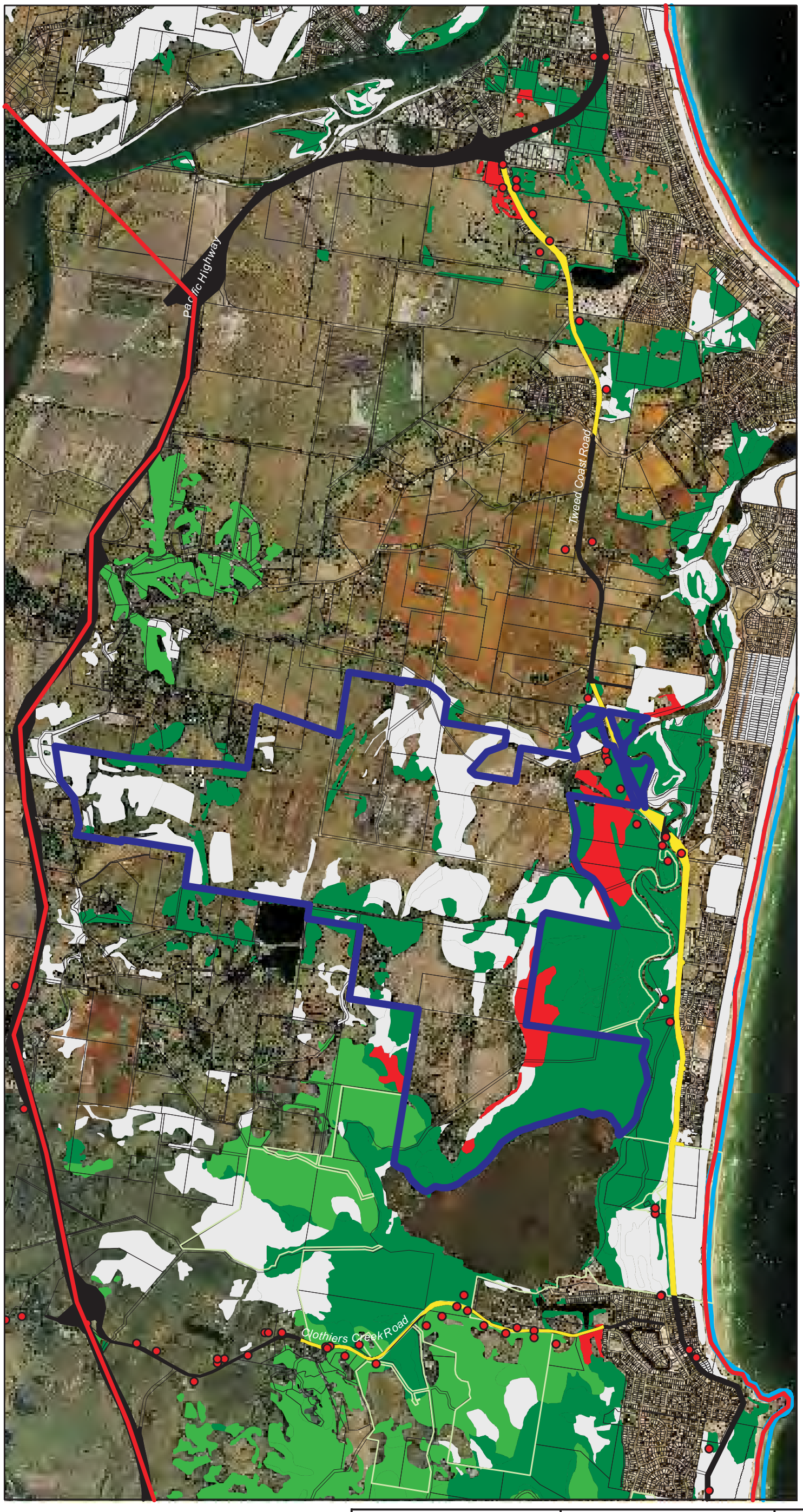
Stage 1 - Koala Plan of Management
Kings Forest Estate
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 6

PREPARED: BW
DATE: 05 September 2012
FILE:N97017_KPoM_Impact Core Koala.cdr

TITLE
OVERLAY OF KOALA HABITAT & SCOPE OF WORKS



0 750m

1 : 30 000

SOURCE: Biolink Ecological Consultants - Tweed Coast Koala Habitat Study (2011)

SCALE: 1 : 30 000 @ A3

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Kings Forest Estate
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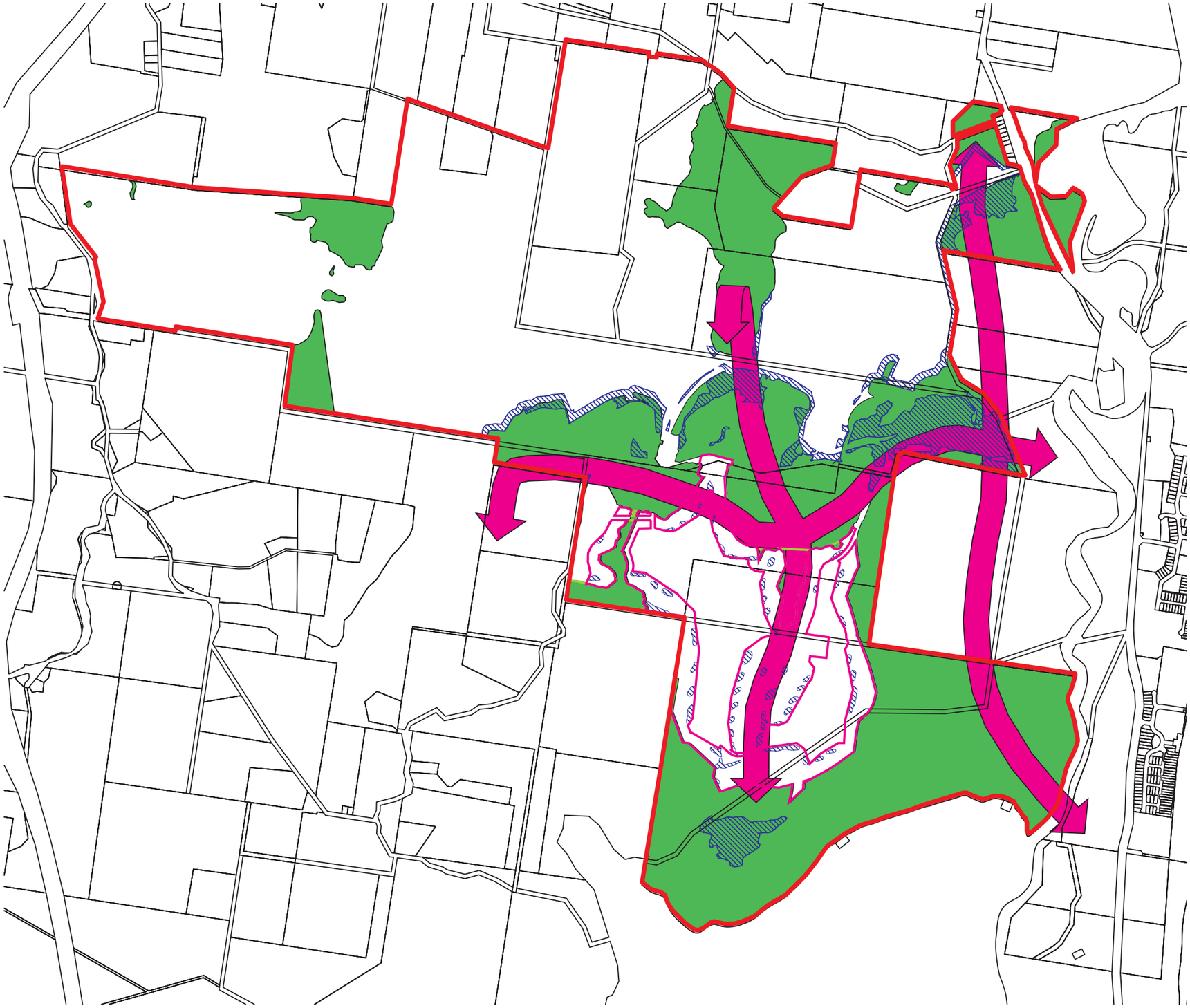
Shire of Tweed

FIGURE 7

PREPARED: BW
DATE: 21 August 2012
FILE:N97017_KPoM_Koala hab.cdr

TITLE

KOALA HABITAT



SOURCE: Dr Frank Carrick 2008 in KPoM (2009) EcoIndig Resources Pty Ltd; JWA

SCALE: 1 : 20 000 @ A3

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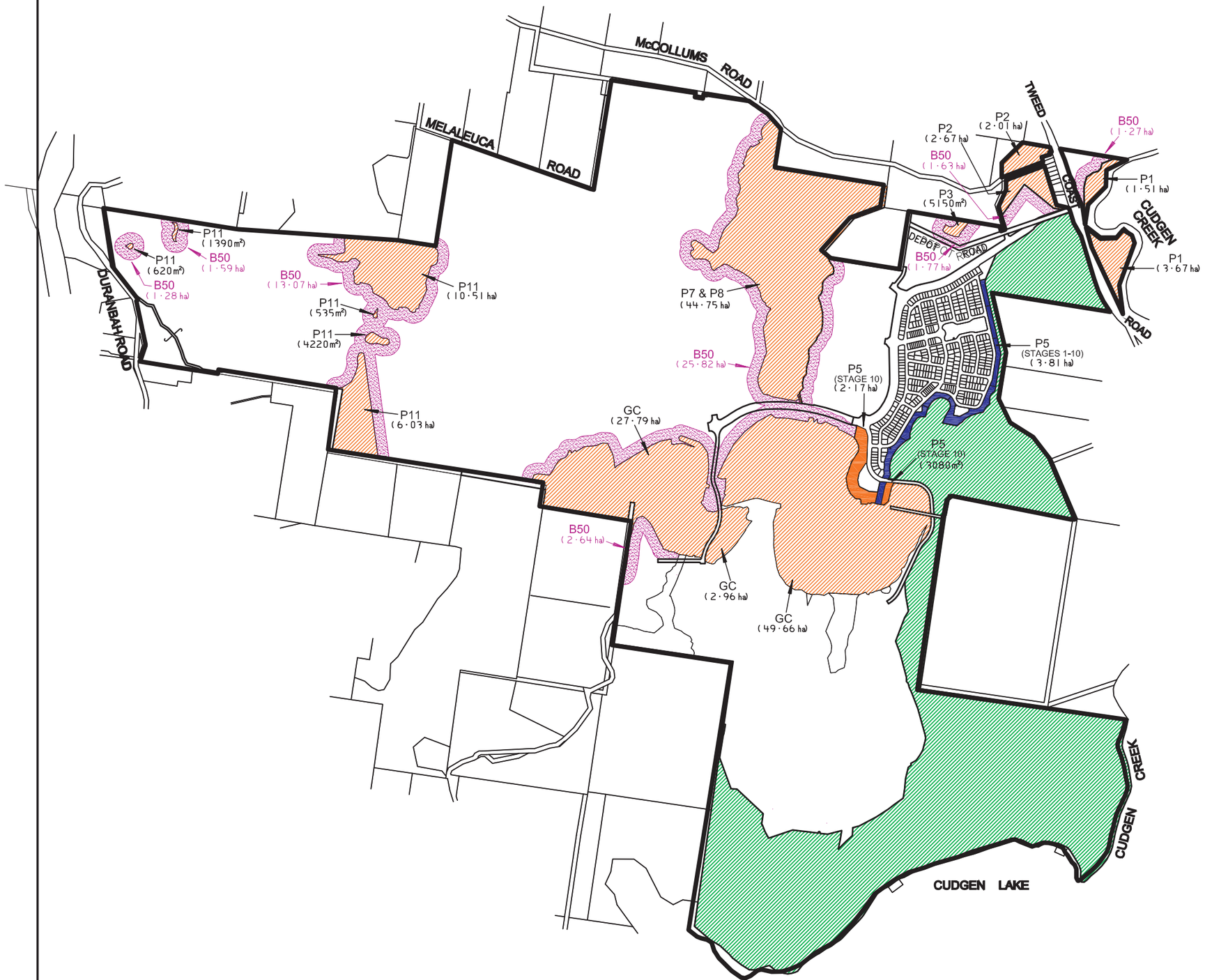
Shire of Tweed

FIGURE 8

PREPARED: BW
DATE: 05 September 2012
FILE: N97017_KPoM_Linkages.cdr

TITLE

PROPOSED KINGS FOREST KOALA LINKAGES



LEGEND

Indicative Areas to be Dedicated to OEH

- Conservation Offset (Nature Reserve Addition) Land (Approx Total Area 180ha) (150ha per concept plan condition C3, additional 30ha subject to agreement with OEH)

Note: Final boundaries are subject to agreement with Department of Planning & Infrastructure

Indicative Areas & Staging of Land to be Dedicated to Council

- Conservation Offset (Future) Land (Approx Total Area 153ha)
- Drainage Reserve (Approx Total Area 3.81ha)
- Environmental Open Space (Public Reserve) (Approx Total Area 2.477ha)
- B50 - 50m Ecological Buffers (Approx Total Area 49.07ha)

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

Proposed Staging of Land Dedication as per Precinct to Council

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

Work Areas

- Drainage Reserve (Approx Total Area 3.81ha)
- B50 - 50m Ecological Buffers (Approx Total Area 49.07ha)
- Conservation Area (Approx Total Area 153ha)

- Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: Landsurv Pty Ltd (Ref: 34860-2_PROJECT APPLICATION_NPWS AND COUNCIL DEDICATION_120822.dwg)
SCALE: 1 : 20 000 @ A3

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Project 28 Pty Ltd

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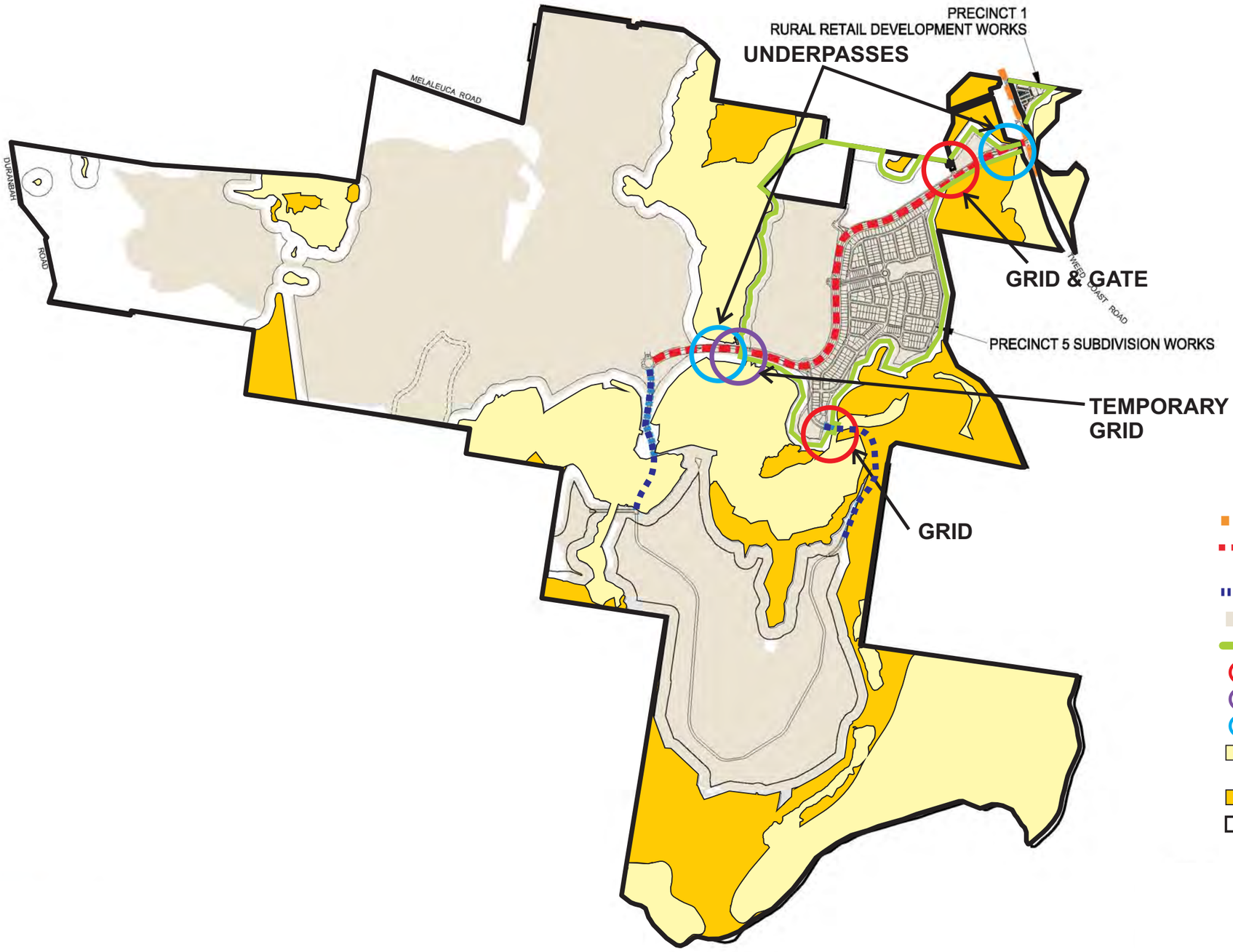
Stage 1 - Koala Plan of Management
Kings Forest Estate
Melaleuca Drive, Duranbah, NSW
Shire of Tweed

FIGURE 9

PREPARED: BW
DATE: 04 September 2012
FILE:N97017_KPoM_NPWS Dedication.cdr

TITLE

AREAS TO BE DEDICATED TO COUNCIL & OEH



N

LEGEND

- Tweed Coast Road Intersection Works
- Kings Forest Parkway through to Western Precincts
- Roads through to Southern Precincts
- Indicative Bulk Earthworks Location
- Koala Exclusion Fencing
- Grid
- Temporary Grid
- Underpass
- 7a Environmental Protection - Wetlands & Littoral Rainforests
- 7l Environmental Protection - Habitat
- Kings Forest Boundary

0 500m

1 : 20 000

SOURCE: JWA; Landpartners (Ref: 00001056_C7_PL4D Proposed Zoning Plan 11.03.08); RPS (Ref: 113691-PSP-4a(SCOPE OF WORKS).jpeg)
SCALE: 1 : 20 000 @ A3

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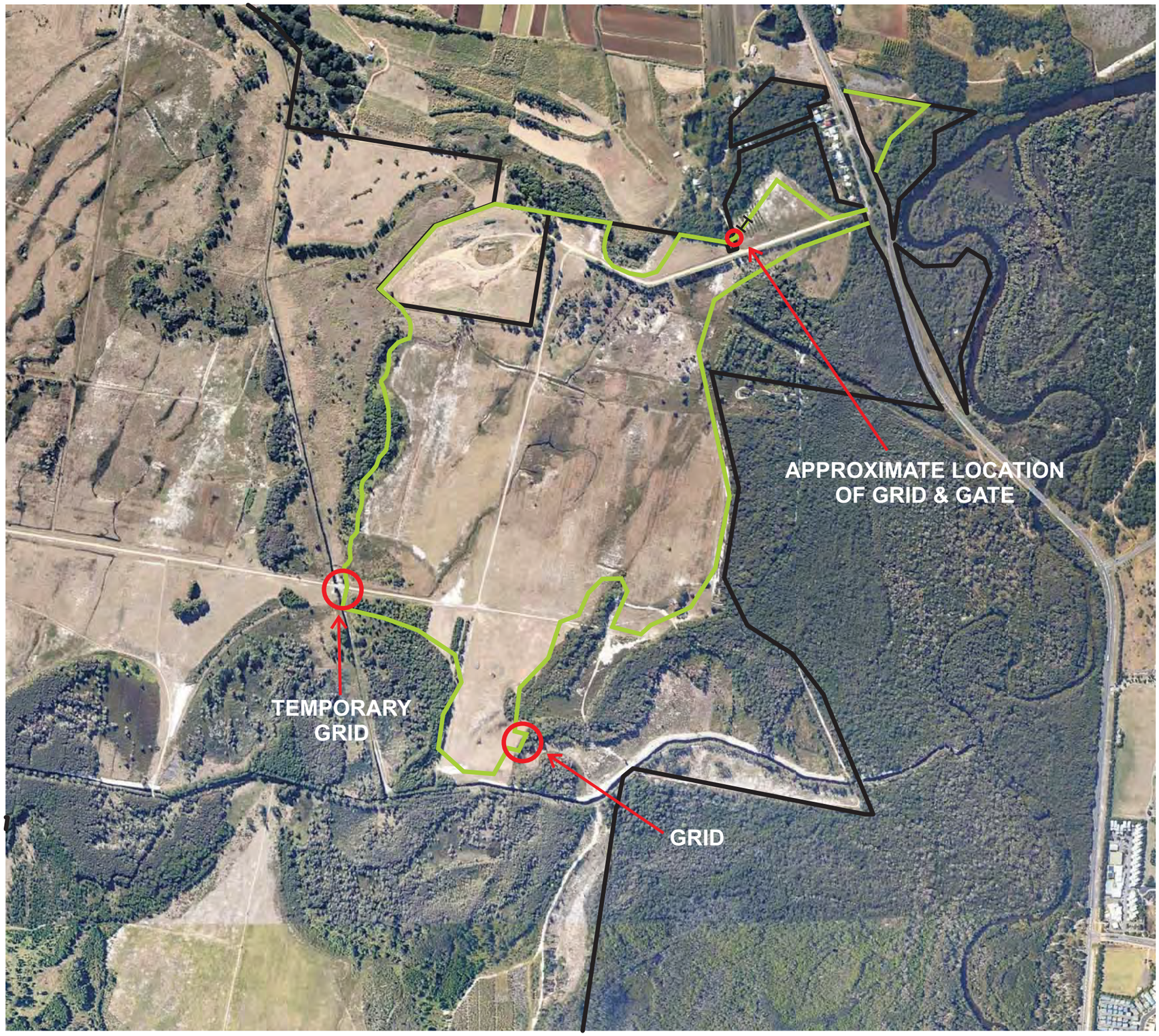
Shire of Tweed

FIGURE 10A

PREPARED: BW
DATE: 05 September 2012
FILE: N97017_KPoM_Fencing.cdr

TITLE

FENCING PLAN



N

LEGEND

- Koala Exclusion Fencing
- Approximate location of Grid
- Approximate location of Gate (min 2m wide)
- Kings Forest Boundary

0 300m

1 : 10 000

SOURCE: JWA; Near Map June 2011 Aerial Photo

SCALE: 1 : 10 000 @ A3

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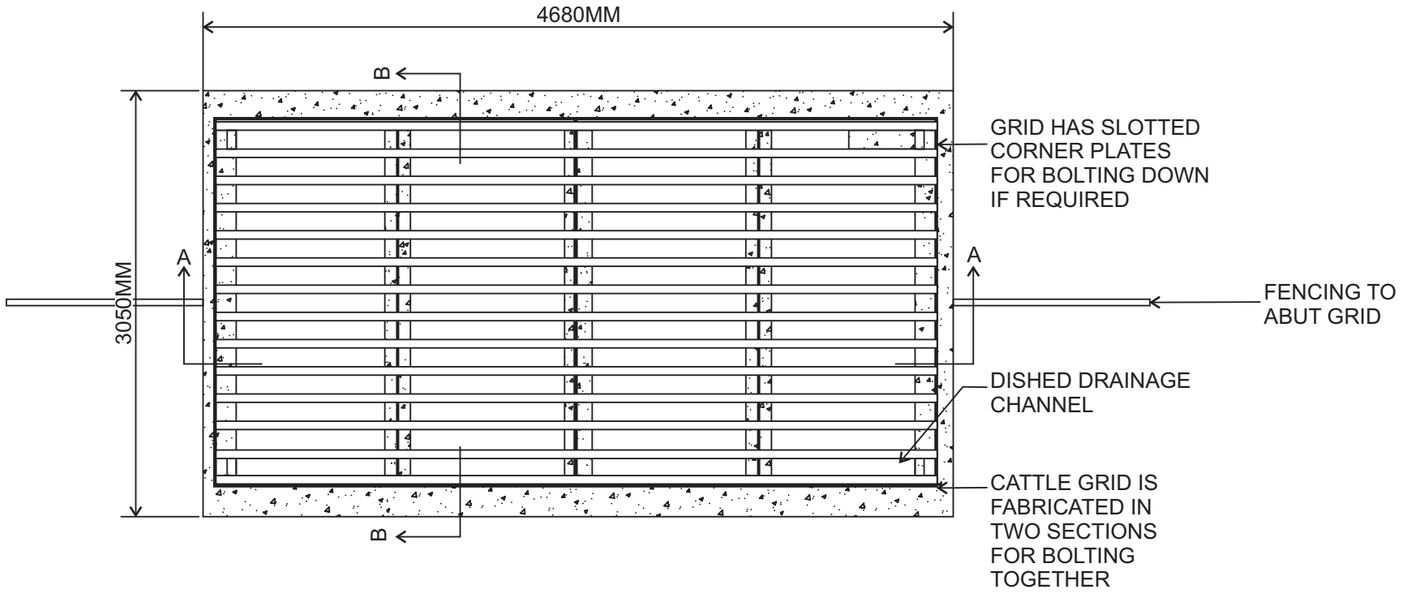
FIGURE 10B

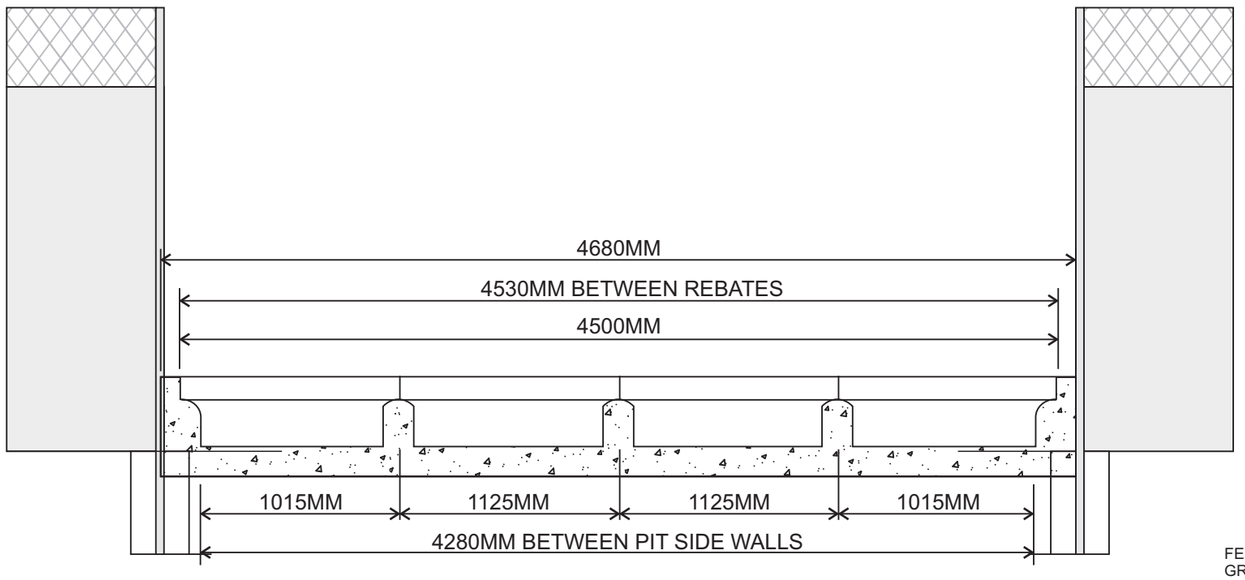
PREPARED: BW
DATE: 05 September 2012
FILE: N97017_KPoM_Fencing.cdr

TITLE

FENCING PLAN - DETAIL

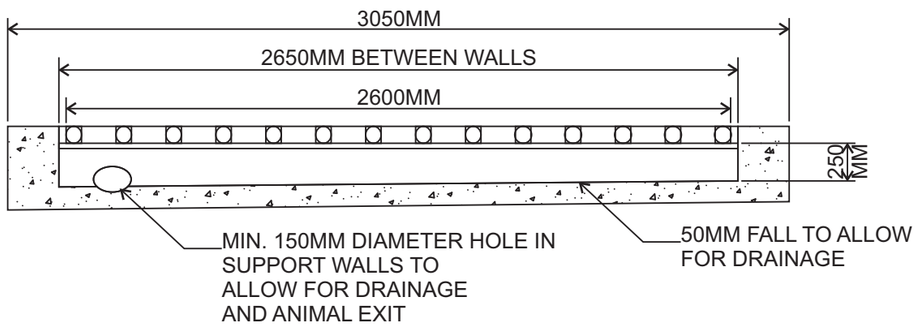
INDICATIVE DESIGN FOR 40 TONNE CAPACITY CATTLE GRID



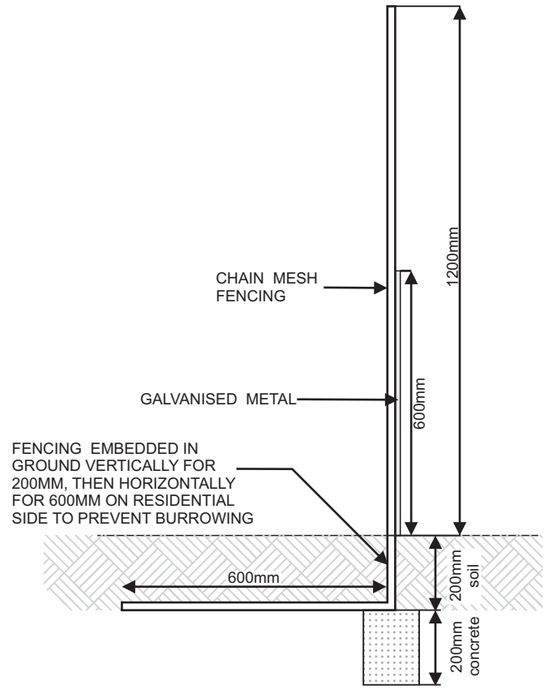


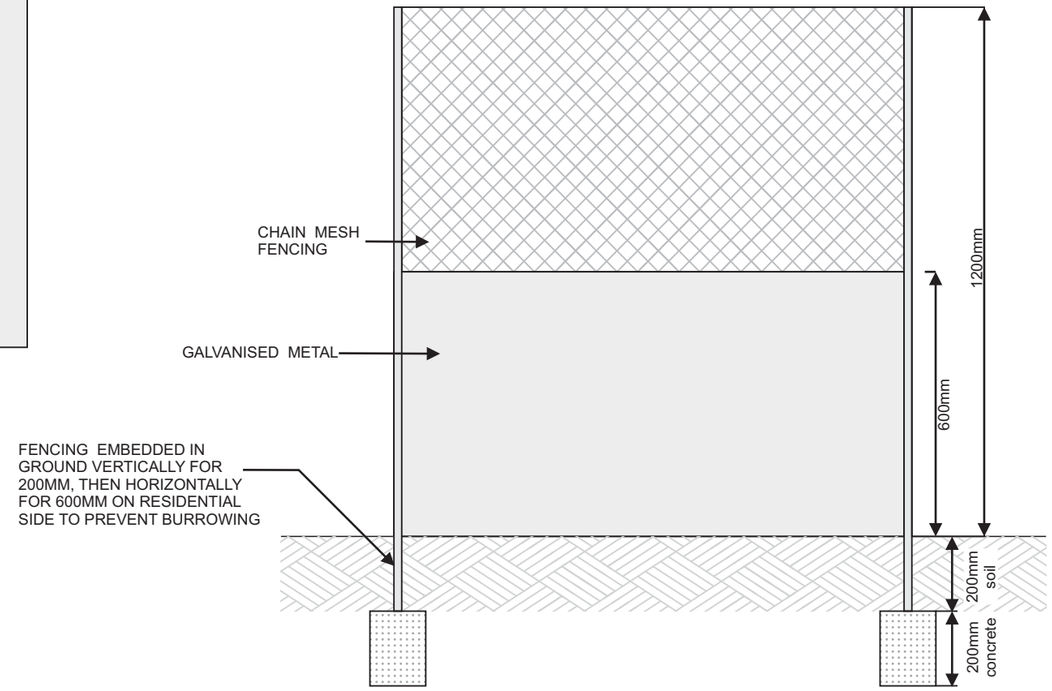
SECTION A-A

SECTION B-B



INDICATIVE KOALA EXCLUSION FENCING





SOURCE: JWA; Cattle Grid - Unknown Source

SCALE: Not to Scale

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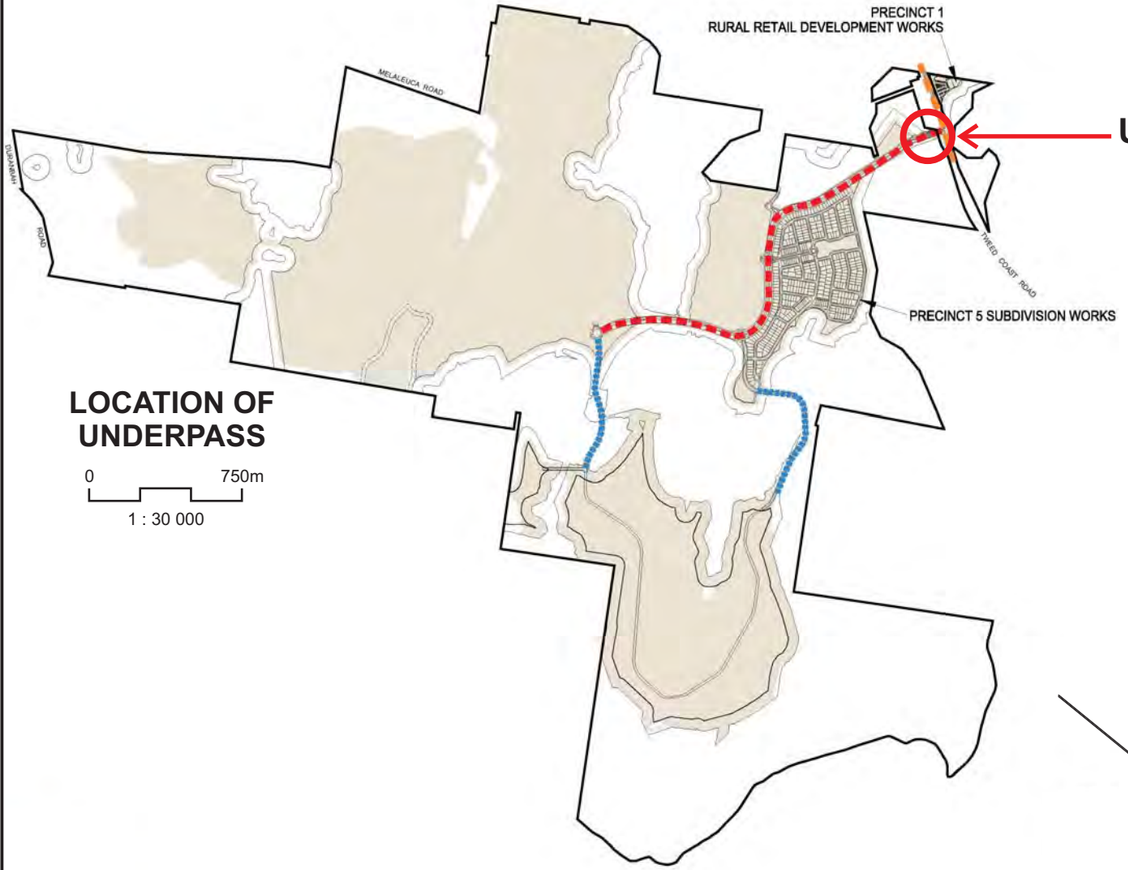
FIGURE 11

PREPARED: BW
DATE: 21 August 2012
FILE: N97017_KPoM_Design.cdr

TITLE

INDICATIVE KOALA EXCLUSION FENCING & GRID DESIGN

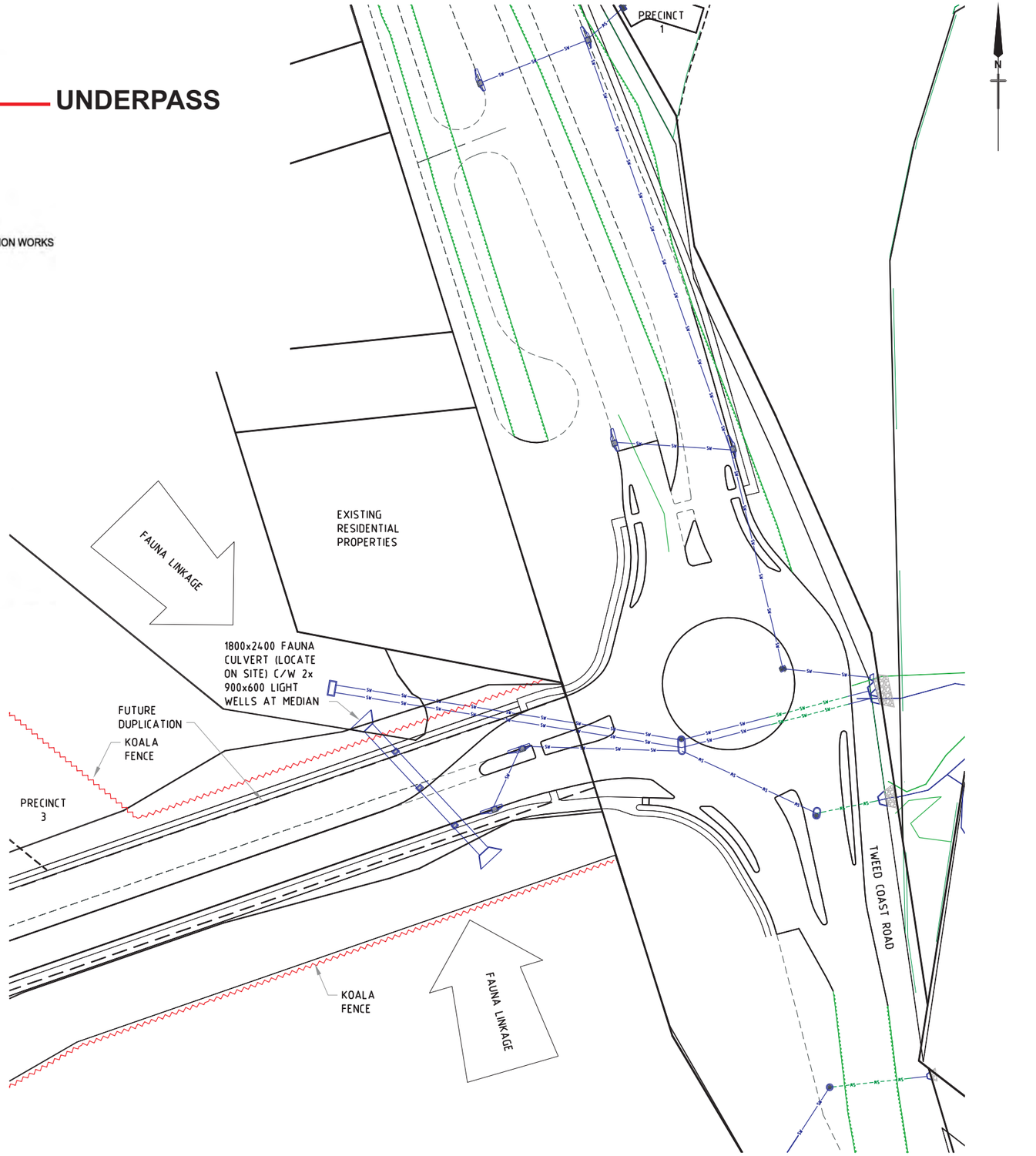


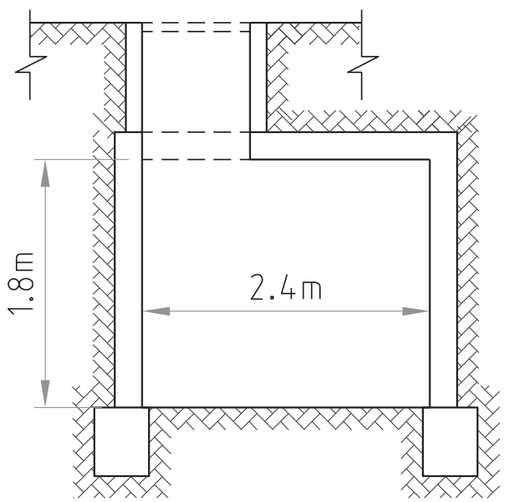
UNDERPASS

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); RPS (Ref: 113691-PSP-4a(SCOPE OF WORKS).jpeg)

SCALE: 1 : 1000 @ A3

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FIGURE 12

PREPARED: BW
DATE: 27 August 2012
FILE: N97017_KPoM_Underpass.cdr

TITLE
INDICATIVE FAUNA UNDERPASS DESIGN

LEGEND

Community 1 - Highly Modified

- 1(a) Substantially cleared of native vegetation
- 1(b) Camphor laurel dominant closed forest (with rainforest species)
- 1(c) Native plantation/plantings
- 1(d) *Leptospermum petersonii* plantation (with heathland species)
- 1(e) Exotic pine plantation
- 1(f) Exotic grassland dominated (with heathland species)
- 1(g) Exotic grassland dominated (with regrowth Acacia & other native species)

Community 2 - Freshwater Wetland

- 2(a) Hillside seepage swamp (with *Eleocharis tetraquetra*)
- 2(b) Ponds & fringing wetland
- 2(c) Sedgeland/rushland

Community 3 - Heathland & Shrubland

- 3(a) Dry coastal heathland to shrubland
- 3(b) Wet coastal heathland to shrubland
- 3(c) Mixed wet/dry coastal heathland to shrubland (with Scribbly gum)
- 3(d) Regenerating wet/dry coastal heathland to shrubland

Community 4 - Swamp Sclerophyll Floodplain Forest

- 4(a) Forest red gum open forest to woodland/Broad-leaved paperbark closed forest to woodland
- 4(b) Swamp mahogany open forest to woodland & heathland species
- 4(c) Scribbly gum/Swamp mahogany open forest to woodland
- 4(d) Swamp box open forest to woodland
- 4(e) Broad-leaved paperbark closed forest to woodland
- 4(f) Broad-leaved paperbark closed forest to woodland (with Scribbly gum)
- 4(g) Broad-leaved paperbark closed forest to woodland (with rainforest species)
- 4(h) Broad-leaved paperbark closed forest to woodland/Swamp mahogany open forest to woodland
- 4(i) Swamp sclerophyll & heathland species (with exotic pines)
- 4(j) Regenerating Broad-leaved paperbark closed forest to woodland & heathland species
- 4(k) Regenerating Swamp mahogany open forest to woodland

Community 5 - Dry to Moist Open Forest

- 5(a) Blackbutt wet to dry open forest
- 5(b) Blackbutt/Tallowwood open forest
- 5(c) Blackbutt with grassy understorey
- 5(d) Scribbly gum open forest to woodland
- 5(e) Regenerating Scribbly gum open forest to woodland & heathland species

Community 6 - Rainforest

- 6(a) Littoral rainforest
- 6(b) Regenerating sub-tropical rainforest
- Open water
- Kings Forest Boundary

0 500m
1 : 20 000

SOURCE: JWA Site Investigations; Landpartners - AKF 2005 Vegetation Mapping

SCALE: 1 : 20 000 @ A3

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FIGURE 13

PREPARED: BW
DATE: 21 August 2012
FILE: N97017_KPoM_Base.dwg

TITLE

VEGETATION COMMUNITIES