NSW Roads and Maritime Services

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE

KOALA MANAGEMENT PLAN

Version 1.0

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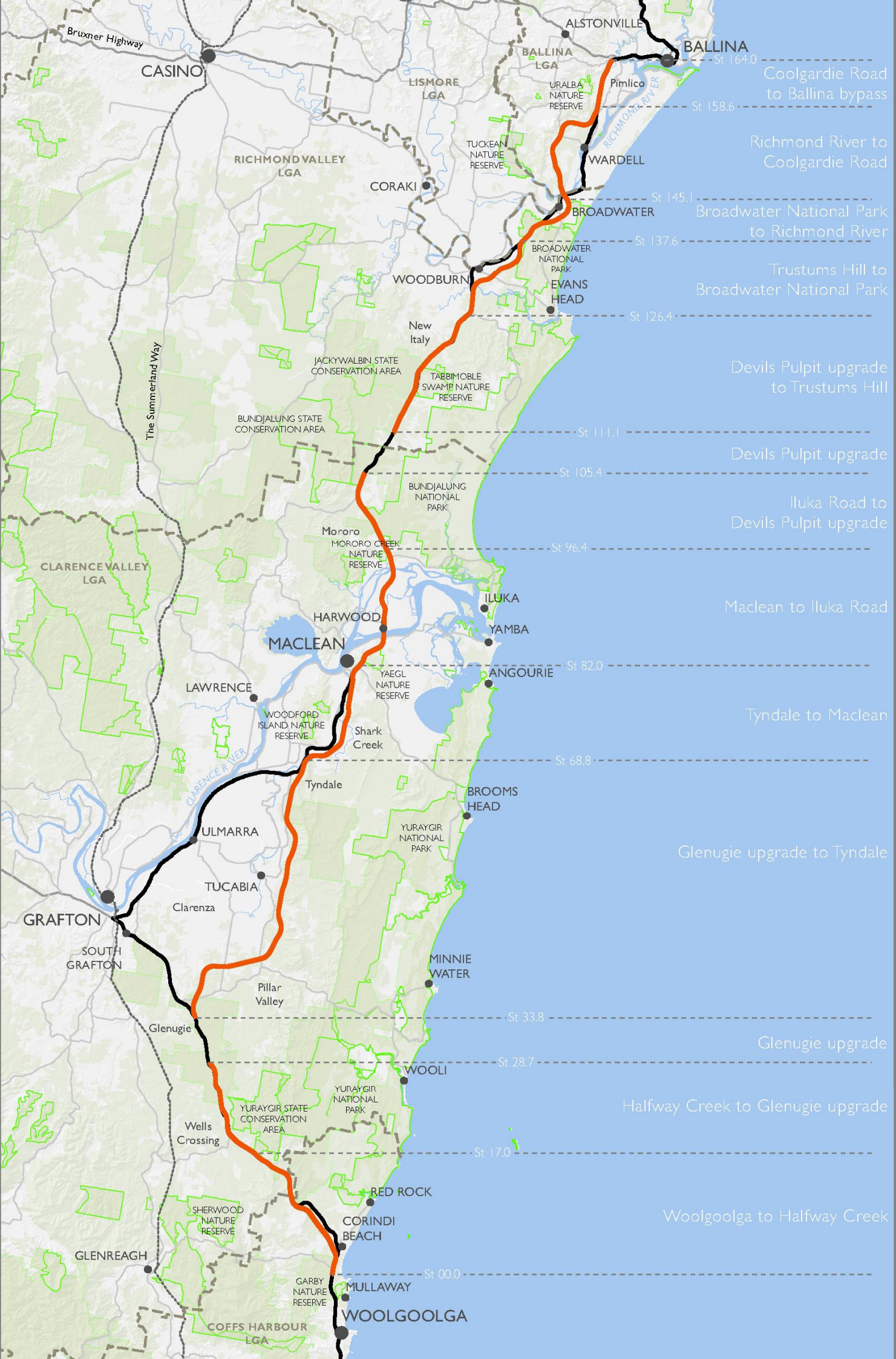

Bruxner Highway
CASINO
ALSTONVILLE
BALLINA
BALLINA LGA
St 164.0
Coolgardie Road to Ballina bypass
11
LISMORE LGA
URALBA NATURE RESERVE
Pimlico
RICHMOND RIVER
St 158.6
Richmond River to Coolgardie Road
10
RICHMOND VALLEY LGA
TUCKEAN NATURE RESERVE
WARDELL
CORAKI
St 145.1
BROADWATER
Broadwater National Park to Richmond River
9
St 137.6
BROADWATER NATIONAL PARK
Trustums Hill to Broadwater National Park
8
WOODBURN
EVANS HEAD
St 126.4
New Italy
JACKYWALBIN STATE CONSERVATION AREA
TABBIMOBLE SWAMP NATURE RESERVE
Devils Pulpit upgrade to Trustums Hill
7
The Summerland Way
BUNDJALUNG STATE CONSERVATION AREA
St 111.1
Devils Pulpit upgrade
St 105.4
BUNDJALUNG NATIONAL PARK
Iluka Road to Devils Pulpit upgrade
6
Mororo
MORORO CREEK NATURE RESERVE
St 96.4
CLARENCE VALLEY LGA
ILUKA
Maclean to Iluka Road
5
HARWOOD
YAMBA
MACLEAN
St 82.0
ANGOURIE
YAEGL NATURE RESERVE
LAWRENCE
WOODFORD ISLAND NATURE RESERVE
Shark Creek
Tyndale to Maclean
4
St 68.8
CLARENCE RIVER
Tyndale
BROOMS HEAD
YURAYGIR NATIONAL PARK
ULMARRA
Glenugie upgrade to Tyndale
3
TUCABIA
Clarenza
GRAFTON
SOUTH GRAFTON
MINNIE WATER
Pillar Valley
St 33.8
Glenugie
Glenugie upgrade
St 28.7
WOOLI
YURAYGIR NATIONAL PARK
YURAYGIR STATE CONSERVATION AREA
Halfway Creek to Glenugie upgrade
2
Wells Crossing
St 17.0
RED ROCK
SHERWOOD NATURE RESERVE
CORINDI BEACH
Woolgoolga to Halfway Creek
1
GLENREAGH
St 00.0
GARBY NATURE RESERVE
MULLAWAY
WOOLGOOLGA
COFFS HARBOUR LGA

Contents

1. Introduction

1.1 Project overview

NSW Roads and Maritime Services (Roads and Maritime) is seeking approval for the Woolgoolga to Ballina (W2B) Pacific Highway upgrade project (the project / the action), on the NSW North Coast. The approval is sought under Part 5.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The location of the project is shown in the figure above.

Since 1996, both the Australian and NSW governments have contributed funds to the upgrade of the 664-kilometre section of the Pacific Highway between Hexham and the Queensland border, as part of the Pacific Highway Upgrade Program.

Both governments have a shared commitment to finish upgrading the highway to a four-lane divided road as soon as possible. For the purposes of the EIS, the NSW Government has nominated the end of 2016 as the planning horizon for a four-lane divided road for the project. However, the actual timing of construction, opening to traffic and completion is dependent on funding negotiations between the Australian and NSW governments. Assessments would be adjusted accordingly based on actual opening dates, for example noise and traffic predictions.

The project would upgrade around 155 kilometres of highway and represents the last priority (known as 'Priority 3' in the upgrade program) in achieving a four-lane divided road between Hexham and the NSW/Queensland Border. The project therefore forms a major part of the overall upgrade program and when constructed, would complete the four-lane divided road program.

The project is estimated to cost $4.2 billion (in 2010 dollars) based on an opening by the end of 2016. It would be jointly funded by the NSW and Australian governments.

The project does not include the Pacific Highway upgrades at Glenugie and Devils Pulpit, which are located between Woolgoolga and Ballina. These are separate projects, with Glenugie now complete and Devils Pulpit under construction. Altogether, these three projects would upgrade 164 kilometres of the Pacific Highway. The project does include a partial upgrade of the existing dual carriageways at Halfway Creek.

A more detailed description of the Woolgoolga to Ballina Pacific Highway upgrade is found in the Pacific Highway upgrade: Woolgoolga to Ballina Environmental Impact Statement prepared by Roads and Maritime in December 2012.

1.2 Purpose and objectives

This plan identifies the potential and residual impacts of the Pacific Highway upgrade on the Koala (*Phascolarctos cinereus*) populations and areas of potential Koala habitat between Woolgoolga and Ballina. The Koala is listed as a vulnerable species under the EPBC Act and the *Threatened Species Conservation Act 1995* (NSW) (TSC Act).

This plan outlines the proposed mitigation measures to be implemented for the Koala and a program for monitoring the effectiveness of these measures.

The objectives of the Koala Management Plan include providing:

- An effective Koala Management Plan with consideration to the concerns of key stakeholders.
- A summary of the locations where Koala populations would likely be impacted by the project.
- Management and mitigation measures that would be implemented during the pre-construction, construction and operation phases of the highway upgrade to minimise impacts on Koala populations potentially impacted by the project.
- A monitoring program to be implemented during the pre-construction, construction and operation phases of the project, to assess the effectiveness of the mitigation measures proposed and inform an adaptive management approach.

1.3 Management structure and plan updates

Management structure

This species management plan provides a framework for any part of the proposed upgrade between Woolgoolga to Ballina. This plan would be updated during detailed design or pre-construction stage of any proposal that may affect threatened species relevant to this plan. The final management plan would be specific to the project section, stage, program of works or singular element of infrastructure which makes-up the overall Woolgoolga to Ballina upgrade. The plan would operate in conjunction with the Construction Environmental Management Plan (CEMP) and project specific flora and fauna management plan (FFMP), or may be incorporated into a wider framework that includes such plans.

Roads and Maritime would finalise this plan in consultation with the NSW Department of Planning and Infrastructure (DoPI) and other relevant agencies.

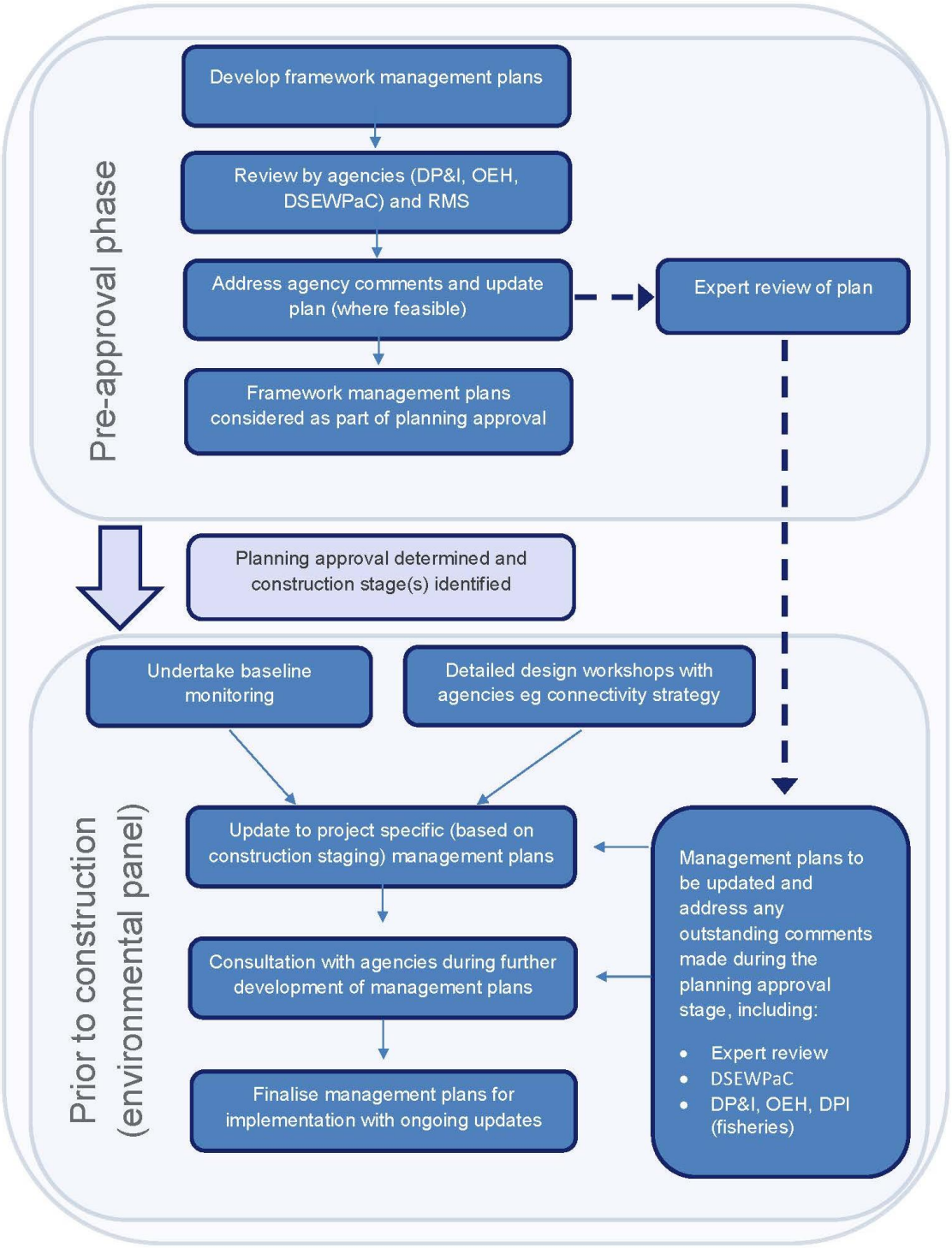
General responsibilities for environmental management would be outlined in the CEMP and FFMP. Responsibilities for implementation of this plan have been described throughout and summarised in Chapter 8. Following approval of the plan, the construction contractor and the contractors ecologist engaged for the relevant project sections would be responsible to oversee implementation of the plan.

Plan updates

The plan is intended to be a dynamic document subject to continual improvement. The management plan would be updated as required to meet the mitigation and management measures committed to in the EIS and PIR reports and any Condition of Approval (CoA) for the project. Prior to implementation, the plan would be updated following independent expert review to incorporate any necessary changes that arise from that review. The process for the update of the plan is illustrated in Figure 1-1 below.

This plan identifies the general locations proposed for conducting monitoring and the methods, variables and timing of the proposed monitoring program. Details have been provided on the parameters for the selection of the final monitoring sites, both impact and control sites. It is not possible to pre-select the monitoring sites at this point in the planning and design process, as this requires consultation with affected landowners. The final selection of monitoring sites would be subject to further interrogation through the implementation of targeted surveys (refer to section 4.3.2) and confirmation of landowner access and would be presented in the first annual monitoring report with the intention of repeated sampling to be conducted at these locations.

Figure 1-1 Process to develop management plan



1.4 Plan authors and expert review

Authors

Table 1-1 details the qualifications and experience of authors of this Koala management plan.

Table 1-1 Author qualifications and experience

Personnel	Qualifications	Experience
Chris Thomson	Bachelor of Applied Science and Graduate Certificate in Natural Resources	Chris is a SKMs practice leader for terrestrial fauna and has a Bachelor of Applied Science and Graduate Certificate in Natural Resources and seventeen years professional experience managing biodiversity assessments and scientific reporting. He is a highly experienced field ecologist with extensive experience on major road projects with the Roads and Maritime, having worked widely throughout NSW as the technical lead on a range of environmental assessments including several Pacific Highway upgrades, in addition to the Hume Highway, Great Western Highway, Princes Highway and New England Highway along with numerous large and small arterial road projects including the M5, M4, Westlink M7 and Westconnex. Chris has comprehensive knowledge of Commonwealth and NSW threatened species legislation, policies and guidelines and has extensive experience in the design of avoidance and mitigation measures for minimising impacts on threatened species with a high level of experience on infrastructure projects including the development of compensatory habitat and offset strategies, biodiversity connectivity strategies, mitigation and monitoring strategies and threatened species management plans.
Valerie Hagger	Bachelor of Applied Science (Environmental Science) with Honours in Ecology (First Class), University of Queensland (2001) Masters of Science (Conservation Biology), University of Queensland (2011)	Valerie is a Senior Ecologist and has ten years environmental consulting experience specialising in environmental impact assessment (EIA), ecological survey and monitoring, ecological assessment, management and approvals, and project management. She has successfully managed numerous environmental and ecological projects for Defence and mining clients, and has been the ecology technical lead on many EIA projects for water supply infrastructure and mining. Valerie is competent in conducting baseline flora and fauna surveys, vegetation (regional ecosystem) surveys and mapping, assessing impacts on ecological values, developing management plans and monitoring strategies for threatened species, ecological communities, weeds and pest animals and rehabilitation, and developing offsets strategies. She is also accomplished in climate change vulnerability assessments on biodiversity
Dr Chris Schell	PhD, BAppSc (Hons)	Fourteen years consulting experience and 24 years research experience (flora and fauna). Chris assisted with updating the plan following the initial agency review.

Expert review

An expert review of the plan was undertaken in August 2013 by Associate Professor Robert Close from the University of Western Sydney and Australian Museum Business Services. Roberts's principal field of interest is marsupial biology which includes cytogenetics, formation of new species, hybridisation of existing species, fertility of hybrids, and ecology. Robert has conducted a study of koalas in the Campbelltown region since 1990 that has included supervision of graduated PhD students. The Campbelltown study has largely been ecological and genetic but has become a community-associated research program, with feedback from the community leading to increased sightings of koalas. Since October 1995, Robert and his colleagues have published a weekly column in the Macarthur Advertiser principally describing their koala research. The project has provided long-term family data for koalas that include four generations of koalas.

In 1999 Robert joined the Australian Museum Consulting team to conduct research on the effects of the Pacific Highway upgrades at Yelgun to Chindera and at Bonville on the respective local koala populations. Robert has published over 50 articles on mammals and marsupials, nine of these have been specifically on the koala.

A curriculum vitae for Associate Professor Robert Close is provided in Appendix A, and a copy of his review is provided as Appendix B. The recommendations provided in this review have been summarised in the Table 1-2. The table also identifies how each of the recommendations have been addressed. Recommendations have been addressed in one of three ways:

- Adopted - plan updated.
- Adopted - plan to be updated prior to implementation.
- To be reviewed - recommendation to be reviewed further by Roads and Maritime prior to implementation.

Table 1-2 Summary of recommendations from the expert review and how addressed in this plan

ID No.	Comment / Recommendation	How recommendations would be addressed
KMP1	Reconsider which sections of the Upgrade require focus. Would like to see a map on which all the various koala sightings are marked and vegetation map so that potential dispersal routes can be visualised.	Adopted- plan updated.
KMP2	Reconsider suitability of methods for gathering base-line data. It will be very difficult to monitor changes, particular in low density areas using the SAT technique	Adopted- plan to be updated prior to implementation
KMP3	Reconsider methods for monitoring roadkill data (more frequent)	To be reviewed prior to implementation
KMP4	Reconsider methods of catching and treating koalas located in the clearing areas Ear tagging of captured / relocated individuals is extremely worthwhile	To be reviewed prior to implementation
KMP5	Captured koalas should go to the vet rather that the vet goes to the koala.	Adopted- plan updated.
KMP6	Examine side-road fencing	Adopted- plan to be updated prior to implementation
KMP7	Consider the approaches to the crossing structure	Adopted- plan to be updated prior to implementation

2. Koala populations

Figure 2-1 to Figure 2-11 at the end of this chapter show the Koala records, habitat critical for survival and connectivity structures.

2.1 Existing knowledge

2.1.1 Conservation status

The Koala (*Phascolarctos cinereus*) is listed as a vulnerable species under the *Threatened Species Conservation Act 1995* (NSW) (TSC Act).

The Koala (*Phascolarctos cinereus*) (combined population in Queensland, New South Wales and the Australian Capital Territory) is listed as a vulnerable species under the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act).

2.1.2 Habitat requirements

The Koala inhabits a range of Eucalypt forest and woodland communities where favoured food trees are present (Phillips 2000), which may also include isolated paddock trees (White 1999). The quality of the habitat for Koalas is influenced by a range of factors (Reed et al. 1990), such as:

- Species and size of trees present.
- Structural diversity of the vegetation.
- Soil nutrients.
- Climate and rainfall.
- Size and disturbance history of the habitat patch.

The Koala is a foliovore with a diet restricted primarily to the foliage of *Eucalyptus* species, however the species is also known to consume the foliage of related genera, including *Corymbia*, *Angophora* and *Lophostemon* species. *Leptospermum* and *Melaleuca* species have also been identified as fodder source for the Koala (DSEWPaC 2013).

A list of Koala feed trees for the NSW North Coast as reported in the Koala Recovery Plan (DEC 2009) is shown in Table 2-1 this includes primary, secondary and supplementary feed trees and links these to the biometric vegetation types listed in the project area.

Table 2-1 Koala feed tree species for the NSW north coast (DEC 2009)

BioMetric vegetation type containing food trees as dominant or sub-dominant	Koala feed tree species		
	Primary	Secondary	Supplementary
Blackbutt - bloodwood dry heathy open forest on sandstones of the northern North Coast	Tallowwood (*E. microcorys*)	-	-
Blackbutt grassy open forest of the lower Clarence Valley of the North Coast	Tallowwood (*E. microcorys*)	-	White stringybark (*E. globoidea*)
Flooded Gum - Tallowwood - Brush Box moist open forest of the coastal ranges of the North Coast	Tallowwood (*E. microcorys*)	Small-fruited grey gum (*E. propinqua*)	-
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast	Forest red gum (*E. tereticornis*)	Small-fruited grey gum (*E. propinqua*) Grey box (*E. moluccana*)	-
Narrow-leaved Red Gum woodlands of the lowlands of the North Coast	Tallowwood (*E. microcorys*) Forest red gum (*E. tereticornis*)	Narrow-leaved red gum (*E. seeana*) Red mahogany (*E.	-

BioMetric vegetation type containing food trees as dominant or sub-dominant	Koala feed tree species		
	Primary	Secondary	Supplementary
	Orange gum (*E. bancroftii*)	*resinifera*) Small-fruited grey gum (*E. propinqua*)	
Orange Gum (Eucalyptus bancroftii) open forest of the North Coast	Orange gum (*E. bancroftii*)		-
Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast	Orange gum (*E. bancroftii*)	-	-
Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast	Forest red gum (*E. tereticornis*) Orange gum (*E. bancroftii*)	Grey box (*E. moluccana*) Small-fruited grey gum (*E. propinqua*)	Thin-leaved stringybark (*E. eugenioides*)
Swamp Box swamp forest of the coastal lowlands of the North Coast	Swamp mahogany (*E. robusta*)		-
Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	Swamp mahogany (*E. robusta*) Forest red gum (*E. tereticornis*)	Red mahogany (*E. resinifera*)	-
Swamp Oak swamp forest of the coastal lowlands of the North Coast	Forest red gum (*E. tereticornis*)	-	-
Tallowwood dry grassy forest of the far northern ranges of the North Coast	Forest red gum (*E. tereticornis*	Small-fruited grey gum (*E. propinqua*)	-
Turpentine moist open forest of the coastal hills and ranges of the North Coast	Tallowwood (*E.microcorys*)	Red mahogany (*E. resinifera*) Small-fruited grey gum (*E. propinqua*)	-
Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast	-	Small-fruited grey gum (*E. propinqua*)	-
Needlebark Stringybark - Red Bloodwood heathy woodland on sandstones of the lower Clarence of the North Coast	-	Red mahogany (*E. resinifera*)	Stringybark (*E. tindaliae*)
Red Mahogany open forest of the coastal lowlands of the North Coast	-	Red mahogany (*E. resinifera*)	-
Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast	-	Small-fruited grey gum (*E. propinqua*) Grey box (*E. moluccana*)	Stringybark (*E. tindaliae*)

Koalas exhibit strong feeding preferences between individual trees within a species. This variability creates a nutritional patchiness such that species-based assessments of habitat likely result in overestimates of the availability of high quality habitat (DSEWPaC 2013).

Table 2-2 provides a list of Koala feed trees from the Australian Koala Foundation website (https://www.savethekoala.com/sites/default/files/Australian%20Koala%20Foundation_National%20Koala%20Tree%20Protection%20List.pdf) for the local government areas Coffs Harbour, Grafton and Ballina.

Table 2-2 Koala feed tree species in Coffs Harbour, Clarence Valley and Ballina LGAs (source: AKF website)

LGA	Scientific name and/or subspecies	Common name
Clarence Valley	*E. amplifolia ssp. sessiliflora*	Cabbage gum by streams or in lower moister sites, in deeper loamy soils
	E. bancroftii	Orange Gum infertile, sandy lowland sites

LGA	Scientific name and/or subspecies	Common name
	E. biturbinata	Grey Gum slopes on soils of medium fertility, annual rainfall>1000 mm
	E. crebra	Narrow-leaved red ironbark, Ironbark, Narrow-leaved ironbark well-drained shallower or sandy/sandy clay soils of medium fertility, >550 mm rainfall
	E. glaucina	Slaty Red Gum deep, moderately fertile moist soils
	E. grandis	Flooded Gum, Rose Gum moist, fertile, well-drained, deep, loamy soils of alluvial or volcanic origin, 725-3500 mm
	E. laevopinea	Silvertop stringybark hills and eastern escarpments, medium to high fertility basalt soils in wetter areas
	E. melanophloia	Silver-leaved ironbark moderately fertile silts, loams, sandy clays on foothills
	E. microcorys	Tallowwood on slopes in deeper moderate to fertile soils, well-drained but moist
	E. moluccana	Coastal Grey Box, Grey box, Gumtopped box loam soils of moderate to high fertility on coastal plains and ranges, tolerates saline soils
	E. obliqua	Messmate Stringybark fertile acidic well-drained loams, > 600 mm rainfall, drought tolerant
	E. planchoniana	Bastard Tallowwood, Needlebark stringybark dry sclerophyll forest or woodland on sandy soils or coastal sand
	E. propinqua	Small-fruited Grey Gum wet coastal forest on soils of low to medium fertility. Drought and frost tolerant
	E. racemosa ssp. racemosa	Scribbly Gum shallow infertile sandy soil, coastal areas or over sandstone
	E. resinifera ssp. hemilampra	Red mahogany sandy or well drained fertile soils, Drought and frost tolerant
	E. robusta	Swamp Mahogany swampy, seasonally waterlogged soils, very moist fertile soils, heavy clay, sandy clay, alluvial sand soils
	E. seeana	Narrow-leaved Red Gum poorly drained shallow soils, swampy sandy soils
	E. siderophloia	Ironbark, Broken Back Ironbark wet forest on soils of moderate fertility
	E. tereticornis ssp. tereticornis	Forest red gum, Blue gum, Red irongum alluvial soils, 600-2500 mm, tolerates salt-laden coastal winds, tolerates saline soils, medium-heavy clays, does not tolerate waterlogged soils
	E. tindaliae	Tindal's Stringbark poorer soils in high rainfall areas, often derived from granite
Coffs Harbour	*E. bancroftii*	Orange Gum infertile, sandy lowland sites
	E. biturbinata	Grey Gum slopes on soils of medium fertility, annual rainfall>1000 mm
	E. crebra	Narrow-leaved red ironbark, Ironbark, Narrow-leaved ironbark well-drained shallower or sandy/sandy clay soils of medium fertility, >550 mm rainfall
	E. globoidea	White Stringybark moist well drained soils in foothills
	E. grandis	Flooded Gum, Rose Gum moist, fertile, well-drained, deep, loamy soils of alluvial or volcanic origin, 725-3500 mm
	E. microcorys	Tallowwood on slopes in deeper moderate to fertile soils, well-drained but moist
	E. moluccana	Coastal Grey Box, Grey box, Gumtopped box loam soils of moderate to high fertility on coastal plains and ranges, tolerates saline soils
	E. planchoniana	Bastard Tallowwood, Needlebark stringybark dry sclerophyll forest or woodland on sandy soils or coastal sand
	E. propinqua	Small-fruited Grey Gum wet coastal forest on soils of low to medium fertility. Drought and frost tolerant
	E. racemosa ssp. racemosa	Scribbly Gum shallow infertile sandy soil, coastal areas or over sandstone
	E. resinifera ssp. hemilampra	Red mahogany sandy or well drained fertile soils, Drought and frost tolerant
	E. robusta	Swamp Mahogany swampy, seasonally waterlogged soils, very moist fertile soils, heavy clay, sandy clay, alluvial sand soils
	E. seeana	Narrow-leaved Red Gum poorly drained shallow soils, swampy sandy soils
	E. siderophloia Ironbark,	Broken Back Ironbark wet forest on soils of moderate fertility
	E. tereticornis ssp. tereticornis	Forest red gum, Blue gum, Red Irongum alluvial soils, 600-2500 mm, tolerates salt-laden coastal winds, tolerates saline soils, medium-heavy clays, does not tolerate

LGA	Scientific name and/or subspecies	Common name
		waterlogged soils
	E. tindaliae	Tindal's Stringbark poorer soils in high rainfall areas, often derived from granite
Ballina	*E. bancroftii*	Orange Gum infertile, sandy lowland sites
	E. grandis	Flooded Gum, Rose Gum moist, fertile, well-drained, deep, loamy soils of alluvial or volcanic origin, 725-3500 mm
	E. microcorys	Tallowwood on slopes in deeper moderate to fertile soils, well-drained but moist
	E. moluccana	Coastal Grey Box, Grey box, Gumtopped box loam soils of moderate to high fertility on coastal plains and ranges, tolerates saline soils
	E. propinqua	Small-fruited Grey Gum wet coastal forest on soils of low to medium fertility. Drought and frost tolerant
	E. racemosa ssp. racemosa	Scribbly Gum shallow infertile sandy soil, coastal areas or over sandstone
	E. resinifera ssp. hemilampra	Red mahogany sandy or well drained fertile soils, Drought and frost tolerant
	E. robusta	Swamp Mahogany swampy, seasonally waterlogged soils, very moist fertile soils, heavy clay, sandy clay, alluvial sand soils
	E. seeana	Narrow-leaved Red Gum poorly drained shallow soils, swampy sandy soils
	E. siderophloia	Ironbark, Broken Back Ironbark wet forest on soils of moderate fertility
	E. tereticornis ssp. tereticornis	Forest red gum, Blue gum, Red irongum alluvial soils, 600-2500 mm, tolerates salt-laden coastal winds, tolerates saline soils, medium-heavy clays, does not tolerate waterlogged soils
	E. tindaliae	Tindal's Stringbark poorer soils in high rainfall areas, often derived from granite

The Koala resides in a specific home range, however the home range of individual animals is not mutually exclusive. Therefore, the home ranges of individual Koalas within an area often overlap extensively. Individuals tend to use the same set of trees, but generally not at the same time. The species spends a lot of time alone and devote limited time to social interactions. Koalas tend to move relatively short distances under most conditions, changing trees only a few times each day (DSEWPaC 2013).

Home ranges for the Koala are variable depending on the location, with Koalas occurring in "poorer" habitats having larger home ranges than individuals established in higher quality habitats (DSEWPaC 2013). On average, male Koalas usually have larger home ranges than females. For example, at Bonville on the NSW North Coast approximately 40 kilometres south of Woolgoolga, male home ranges were estimated at 20 hectares and female home ranges approximately 10 hectares (Lassau et al. 2008).

Recent genetic research identifies major roads as a barrier to gene flow for Koalas (Lee *et al* 2009; 2010). The project would fragment habitat links for Koalas seeking to access preferred habitats either side of the highway, particularly between Bagotville and Wardell and the southern parts of Coolgardie (Section 10 of the project) and also between Broadwater National Park and Rileys Hill (Section 9 of the project). Distribution of Koala populations in the project area

Koala movements would be expected to be more frequent and extensive during the breeding season (September to February) and peak dispersal period (July to August) due to expansion of home ranges and movement of juveniles away from natal areas. Therefore, these periods would be likely to represent peaks in Koala movement, resulting in higher rates of usage of connectivity structures and thus higher detection rates.

2.2 Important populations in the project area

There are over 11,000 recorded Koala sightings in the NSW Atlas for the NSW North Coast Bioregion. These records are spread over all local government areas (LGA) in a wide range of topographies and habitats, including reserves, State forests and private land. The data indicates that Koalas could occur in all project sections in a range of habitats that would be impacted by the project. Field data collected during the EIS supports this assertion.

Refer to Section 4.3.2 (pp 297-300) of the EIS Biodiversity Working Paper (Roads and Maritime 2012) for a detailed description of the species habitat requirements including primary and secondary Koala food trees. Also Figure 4.1 – Figure 4.5 (pp 301-305 of the EIS Biodiversity Working Paper [Roads and Maritime 2012]) details maps of Koala habitat in the project corridor and distribution of Koala records. Refer to Section 4.5.6 (pp 136-155) of the Supplementary Biodiversity Assessment (Roads and Maritime 2013) for further detail on important Koala populations and habitat critical to the survival of the Koala within the project area.

Locations of were evidence of kolas have been reported from scat search surveys within the project are shown in Table 2-3.

Table 2-3 Location were evidence of Koalas were reported from scat search surveys

Project section	No. of sites with scats	Location description	Distribution of koala records
1	1	Only one site location in Section 1 near the Range Road intersection on the eastern side of the current Pacific Highway.	Very few atlas records between Corindi and Halfway Creek, no evidence of a local population centred near the study corridor.
3	3	Three sites, all between Sommervale Road and the Tyndale interchange on the eastern side of the Tucabia-Tyndale Road in proximity to Pine Brush State Forest.	Scattered low density of records between Red Rock and Tyndale, no evidence of an important population centred near the study corridor.
6	1	One site within Mororo Nature Reserve and adjoining property to the east	Population known at Iluka and records widespread throughout Bundjalung National Park and several state forests to the west of the project corridor. Important population known to the east of the project.
7	1	One site adjacent to Tabbimoble Swamp Nature Reserve to the north	Records are widespread throughout the Tabbimoble area from Bundjalung National Park to several state forests in the west. No concentrated areas showing high density koala records unlikely to be important population near the project corridor.
9	4	Broadwater National Park adjacent to the existing highway on the east and west side of the road. Also south side of the Richmond River at Pine Tree Road Broadwater on the eastern side of the existing highway, within proximity to Broadwater National Park	Population known from Rileys Hill and Broadwater National Park. Numerous records from this area in the atlas and Friends of the Koala have reported road strike in the Broadwater area. Important population present.
10	8	One site along existing highway south of Coolgardie Road, and six sites between the Richmond River and Old Bagotville Road, including Thurgates Road and Old Bagotville Road.	Population known from Coolgardie and Bagotville, particularly from the Richmond river to Wardell road. Important population present.

Koala scats were confirmed and mapped at seventeen sites during surveys for the EIS and Supplementary Preferred Infrastructure Report (S/PIR). The species was also confirmed from another six sites in Project Section 9 and 10, although spatial coordinates are not available and these have not been mapped.

The areas of greatest Koala density records in relation to the project occur in the Richmond Valley LGA between Woodburn and Wardell (Sections 9 and 10 of the project) particularly around Wardell, Coolgardie and Bagotville (Section 10 of the project) and south of the river from Rileys Hill to Broadwater National Park (Section 9 of the project). These northern populations are considered 'important populations' according to the *Interim Koala referral advice for proponents for proponents* (DSEWPaC 2012).

Other important Koala populations in the project area have been identified from Ashby, Iluka and Woombah (Clarence Valley Council 2010) to the east of the project, also the western regions of the Clarence Valley LGA (Clarence Valley Council 2010), northern regions of the Coffs Harbour LGA (Coffs Harbour City Council 1999) and the west of Woodburn in the larger state forests of the Richmond LGA (Australian Koala Foundation 2008). The project would not impact on these populations.

Sections 1 and 2 are not considered to support an important koala population. The initial preferred route studies surveyed 16 scat search sites across Sections 1 and 2 (Ecotone 2007). An additional 32 scat search plots were conducted in Sections 1 and 2 for the EIS (2011) followed by an additional 32 plots surveyed in February 2013. This included plots specifically positioned along range Road to the east of the project to assess presence of a koala population. Scat searches were conducted at Range Road as reported in Geolink (2012) and involved a series of plots and random searches between plots.

As a result of the accumulated survey effort for Koala across Woolgoolga to Wells Crossing (Section 1 and 2) and including Range Road, koala populations in the location are considered most likely limited to transient movements or dispersal of individuals across the landscape and that koalas occur in low densities relative to the amount of habitat available in the locality. There were eight records of Koalas within 10 kilpometres of the project reported in the Wildlife Atlas database between 1983 and 2002. Based on the Wildlife Atlas records and communication with local residents during field surveys occasional road deaths do occur in the area. This is consistent with only two scats being found despite the level of survey effort.

2.3 Key threats

The key threats to Koala populations include:

- Loss of foraging, sheltering and breeding habitat.
- Habitat fragmentation and impacts on habitat connectivity (movement of individual Koalas to different populations and territories allows important genetic exchange which is essential for Koala population viability).
- Vehicle strike (Koala injury or death).
- Domestic dog attacks (Koala injury or death).
- Increased prevalence of disease (increased susceptibility to disease due to stress caused by the above mentioned threats) (DEHP 2012 and DSEWPaC 2013).

Drought and incidences of extreme heat are also known to cause very significant mortality, and post-drought recovery may be substantially impaired by the range of other threatening factors (TSSC 2012).

Koala injuries or death has been reported during the clearing phases of road projects from the removal of habitat trees and has been demonstrated from collisions with vehicles during the operation of the project (AMBS 2011).

Mortality due to vehicle strike has the potential to affect koalas at the sub-population level particularly where individual home ranges may overlap the project corridor and this relates to the distance that the project would cross vegetated areas. However, the presence of the proposed underpass structures and temporary and permanent fauna exclusion fencing would reduce this risk including current road-kill events on the existing highway.

Most Koalas killed by vehicle collisions on the highway are not the local roadside residents but appear to be sub-adults dispersing and perhaps old, weak animals displaced from their former home-ranges away from the highway (AMBS 2011, Dique et al 2003). Consequently the impact of road-kill affects a wider section of the population.

In a radio-tracking study of Koalas on the Pacific Highway at Bonville (AMBS 2011) construction activities in two study areas directly led to only one known death, suggesting that the direct impacts of clearing and construction are relatively minor at a population scale (when appropriate mitigation strategies are in place). Construction activities (in particular habitat removal) indirectly affected individual Koalas, including the mortality of at least one animal through stress, the alteration of home ranges and behaviour of others and possibly mortality as a result of home range adjustments (AMBS, 2011).

Figure 2 -1 Koala records, habitat critical for survival and connectivity structures (section 1)

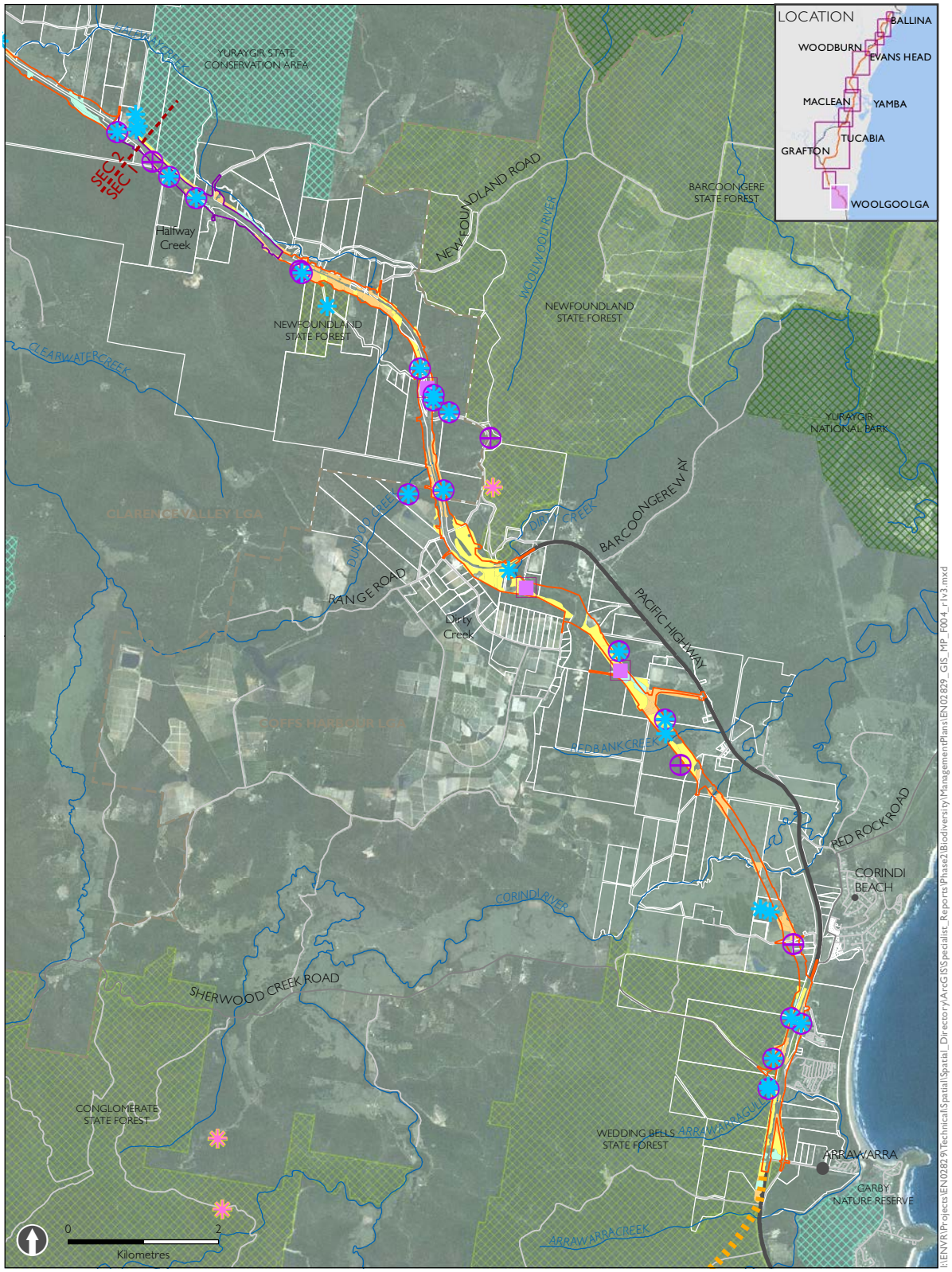
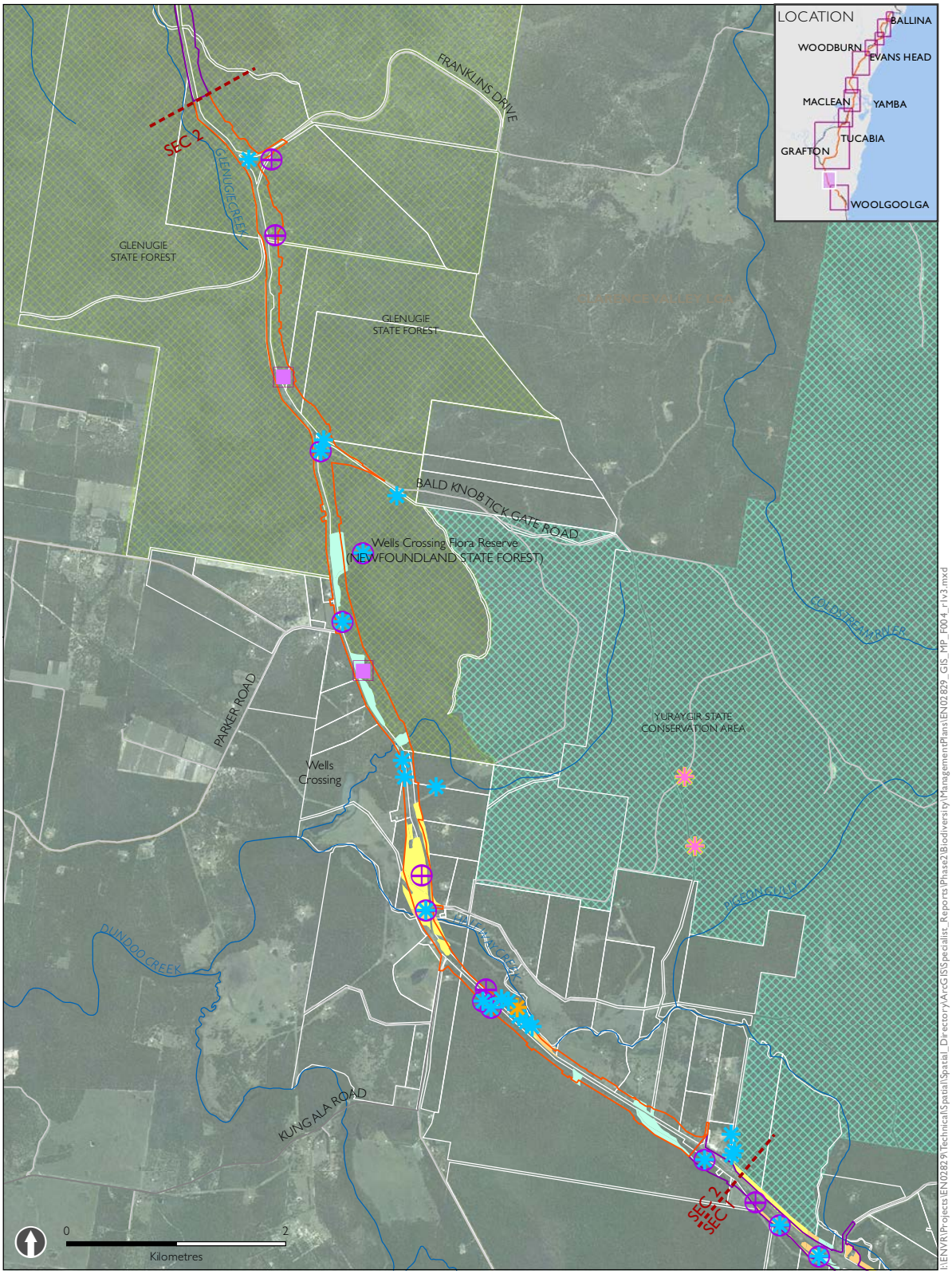


Figure 2 -2 Koala records, habitat critical for survival and connectivity structures (section 2)



The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway
Koala Atlas sightings
Koala scat search plots (Scats No scats)
Koala habitat assessment plots

Koala habitat
Primary habitat
Secondary habitat
Tertiary habitat

Fauna connectivity structures
Dedicated Overpass
Dedicated Underpass

Figure 2 -3 Koala records, habitat critical for survival and connectivity structures (section 3)

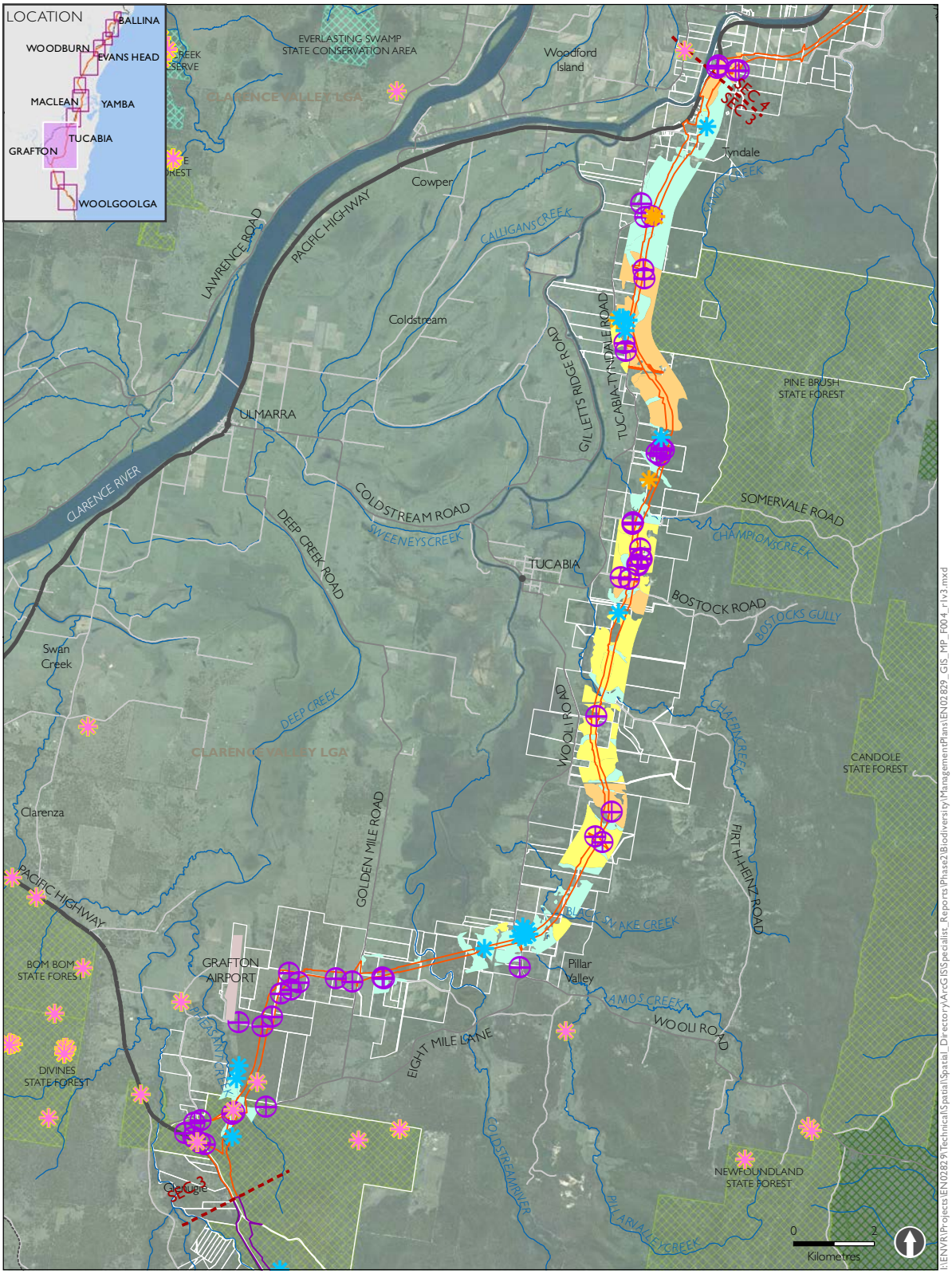
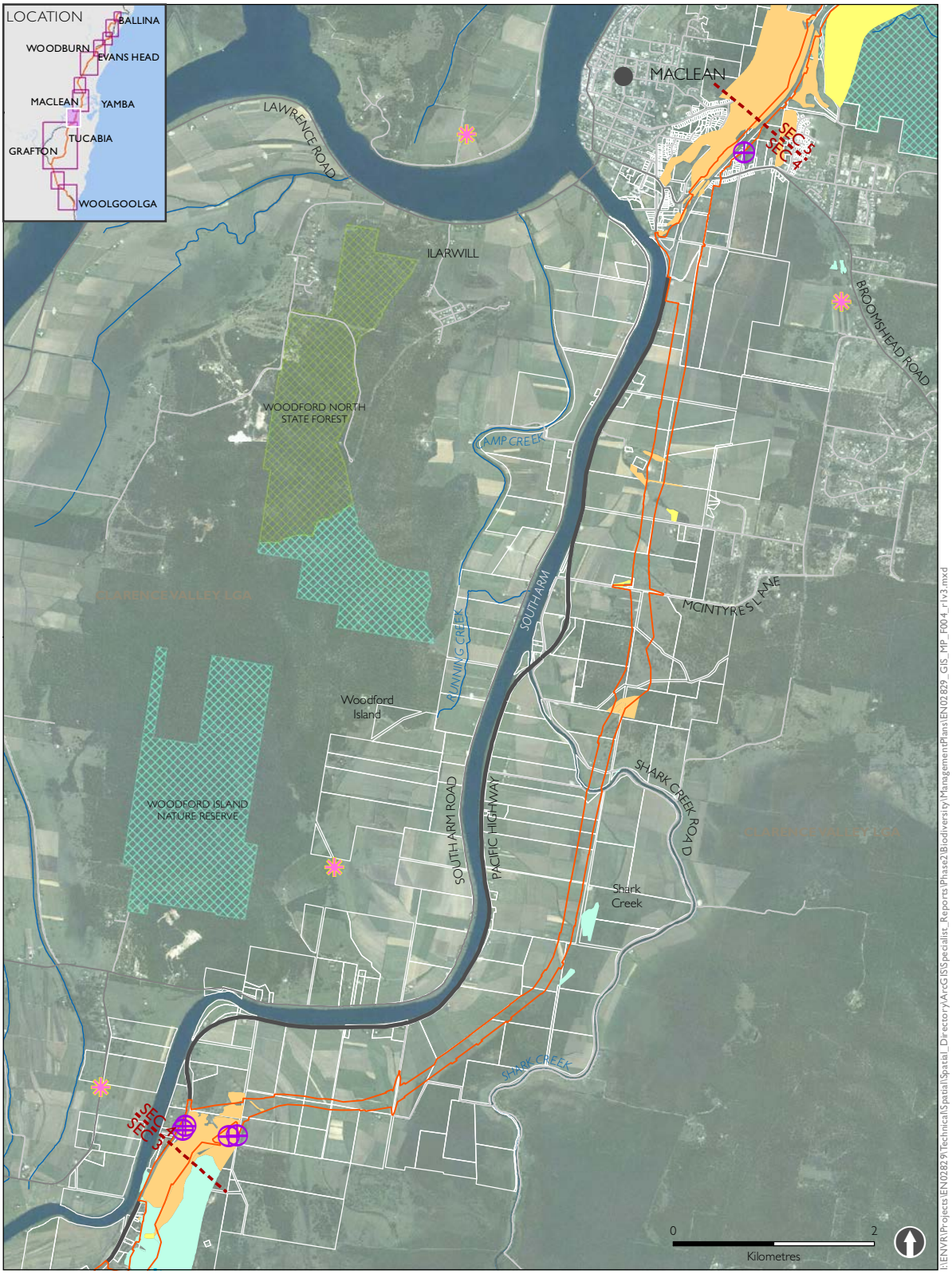


Figure 2 -4 Koala records, habitat critical for survival and connectivity structures (section 4)

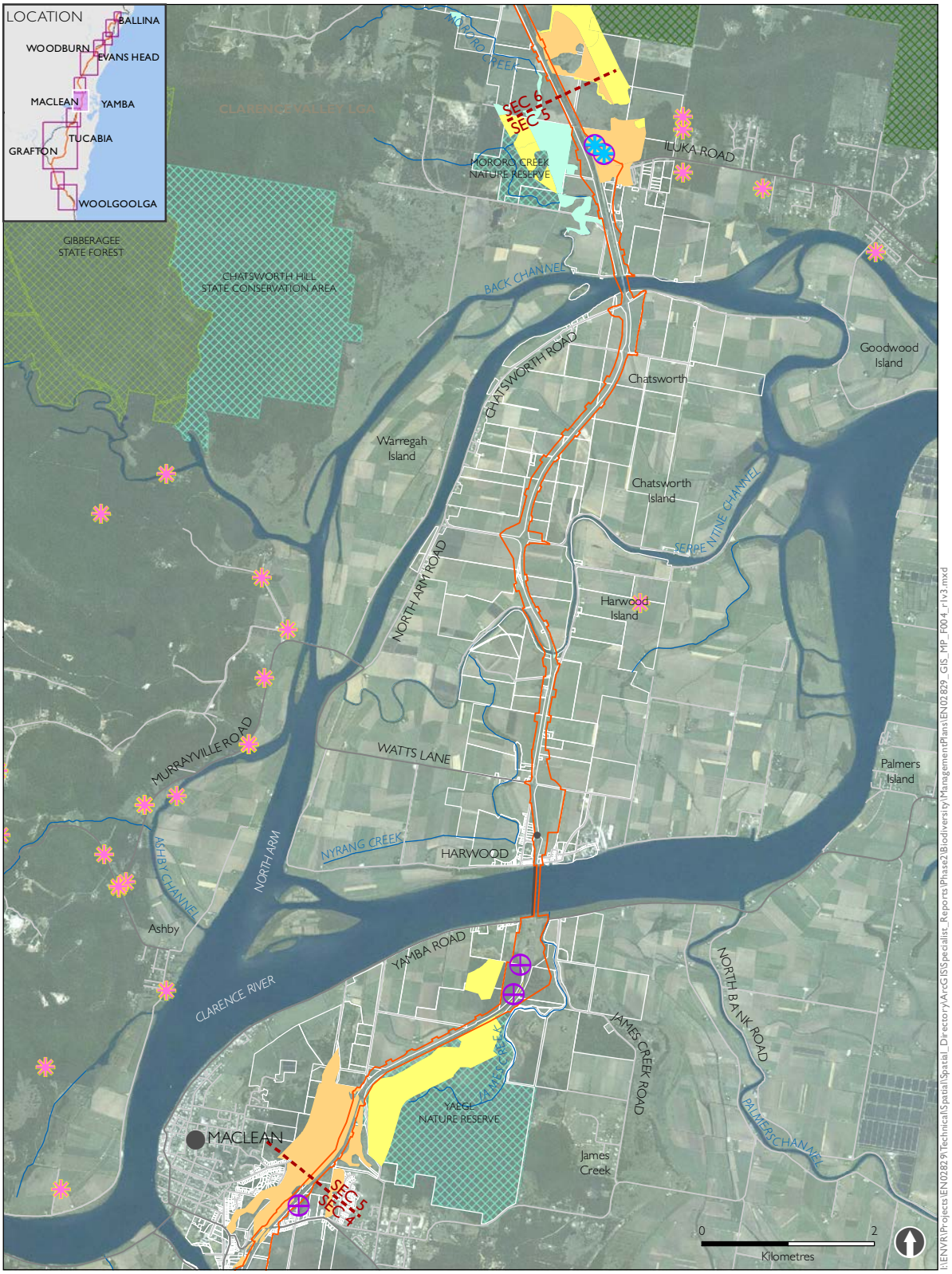


The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway
Koala Atlas sightings
Koala scat search plots (Scats No scats)
Koala habitat assessment plots

Koala habitat
Primary habitat
Secondary habitat
Tertiary habitat

Fauna connectivity structures
Dedicated Overpass
Dedicated Underpass

Figure 2 -5 Koala records, habitat critical for survival and connectivity structures (section 5)

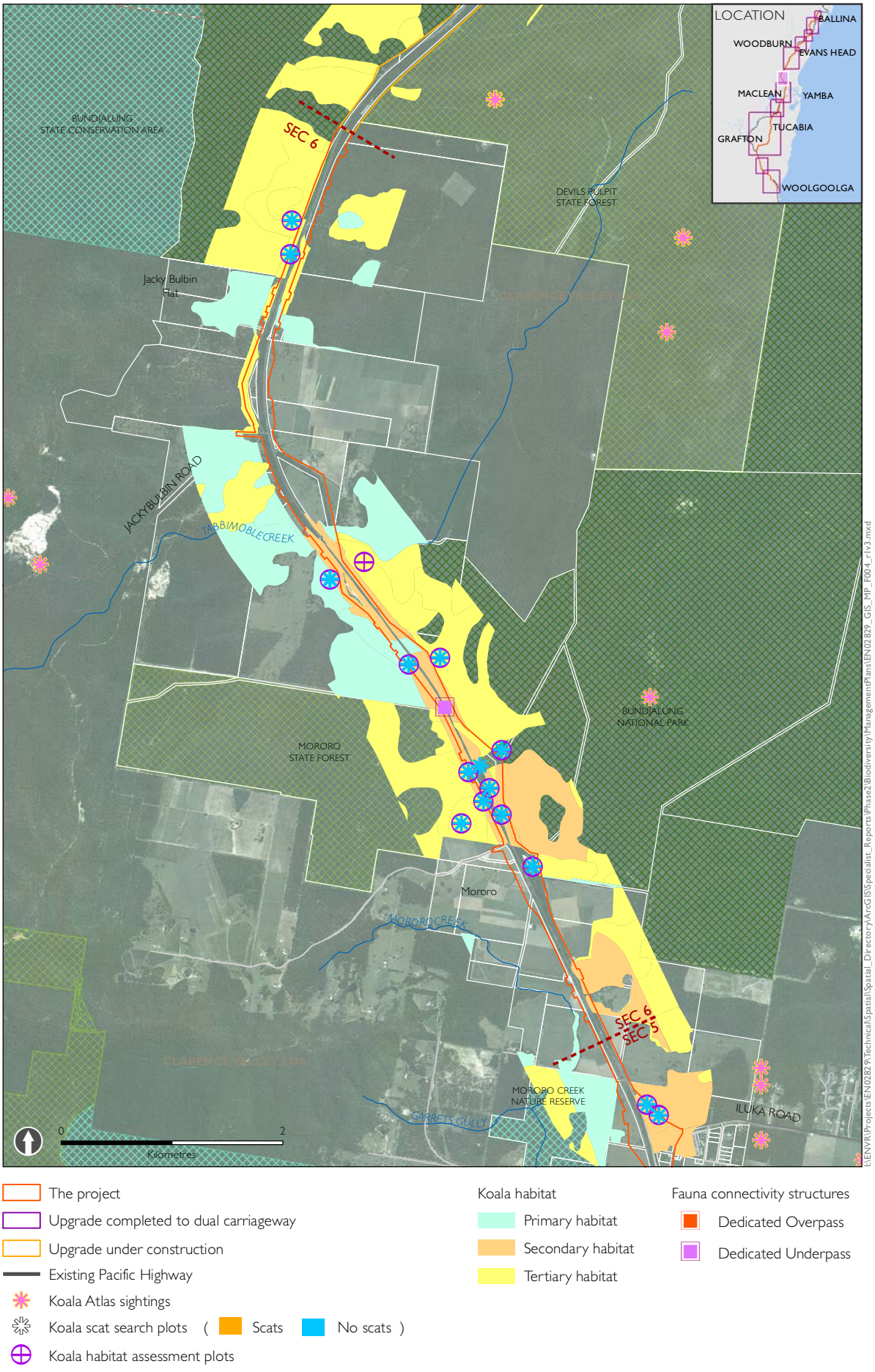


The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway
Koala Atlas sightings
Koala scat search plots (Scats No scats)
Koala habitat assessment plots

Koala habitat
Primary habitat
Secondary habitat
Tertiary habitat

Fauna connectivity structures
Dedicated Overpass
Dedicated Underpass

Figure 2 -6 Koala records, habitat critical for survival and connectivity structures (section 6)

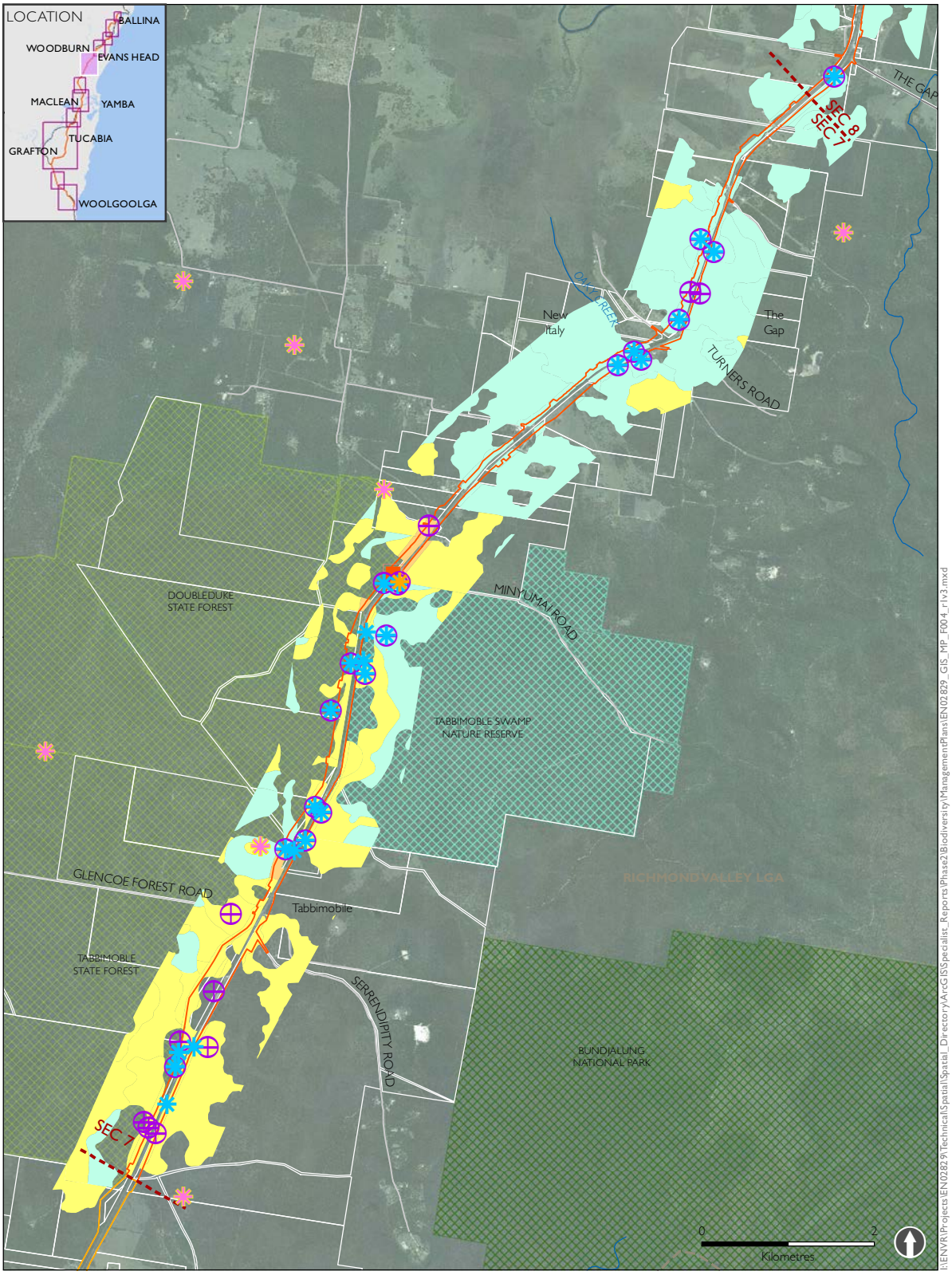


The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway
Koala Atlas sightings
Koala scat search plots (Scats No scats)
Koala habitat assessment plots

Koala habitat
Primary habitat
Secondary habitat
Tertiary habitat

Fauna connectivity structures
Dedicated Overpass
Dedicated Underpass

Figure 2 -7 Koala records, habitat critical for survival and connectivity structures (section 7)

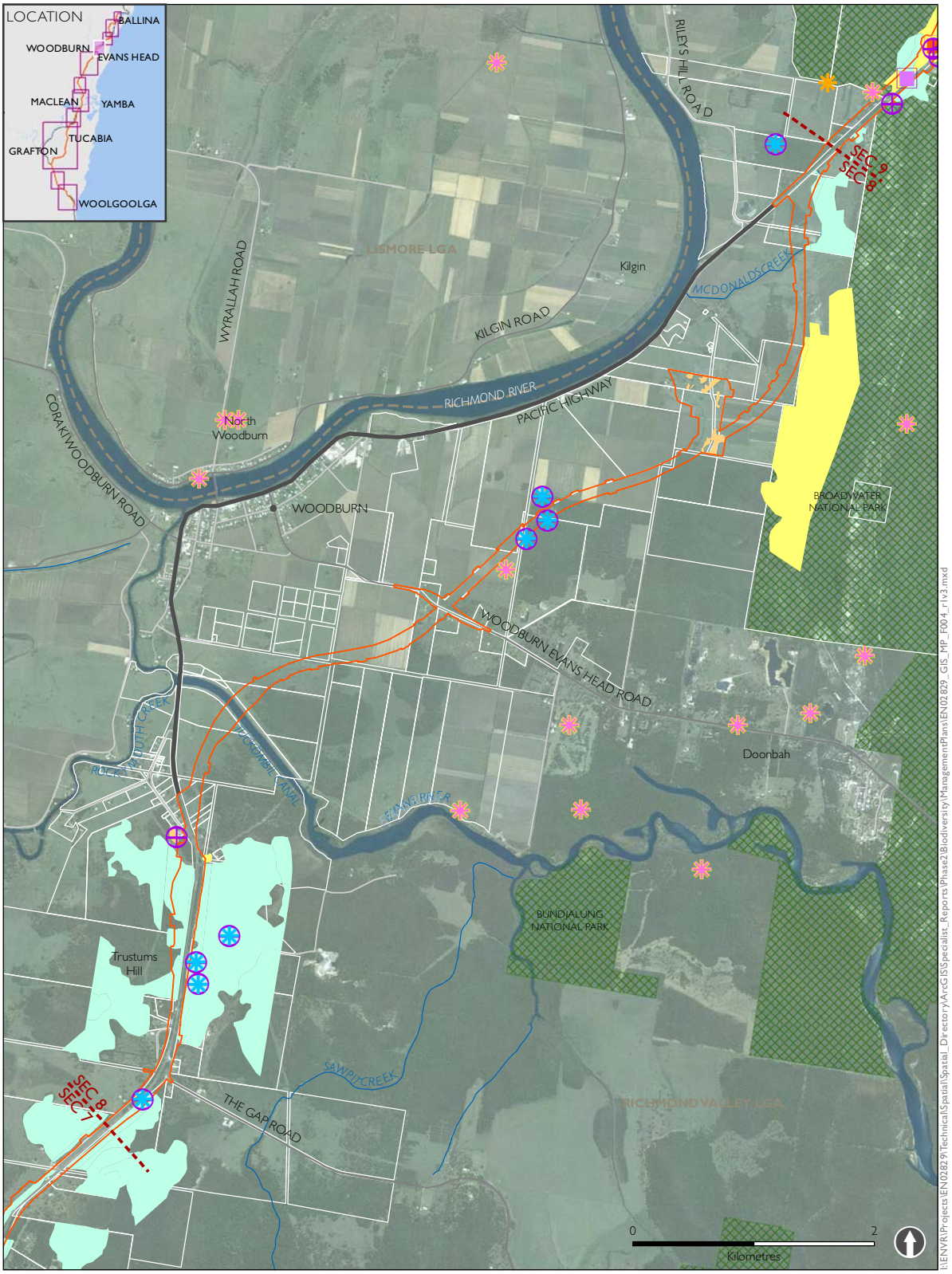


The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway
Koala Atlas sightings
Koala scat search plots (Scats No scats)
Koala habitat assessment plots

Koala habitat
Primary habitat
Secondary habitat
Tertiary habitat

Fauna connectivity structures
Dedicated Overpass
Dedicated Underpass

Figure 2 -8 Koala records, habitat critical for survival and connectivity structures (section 8)

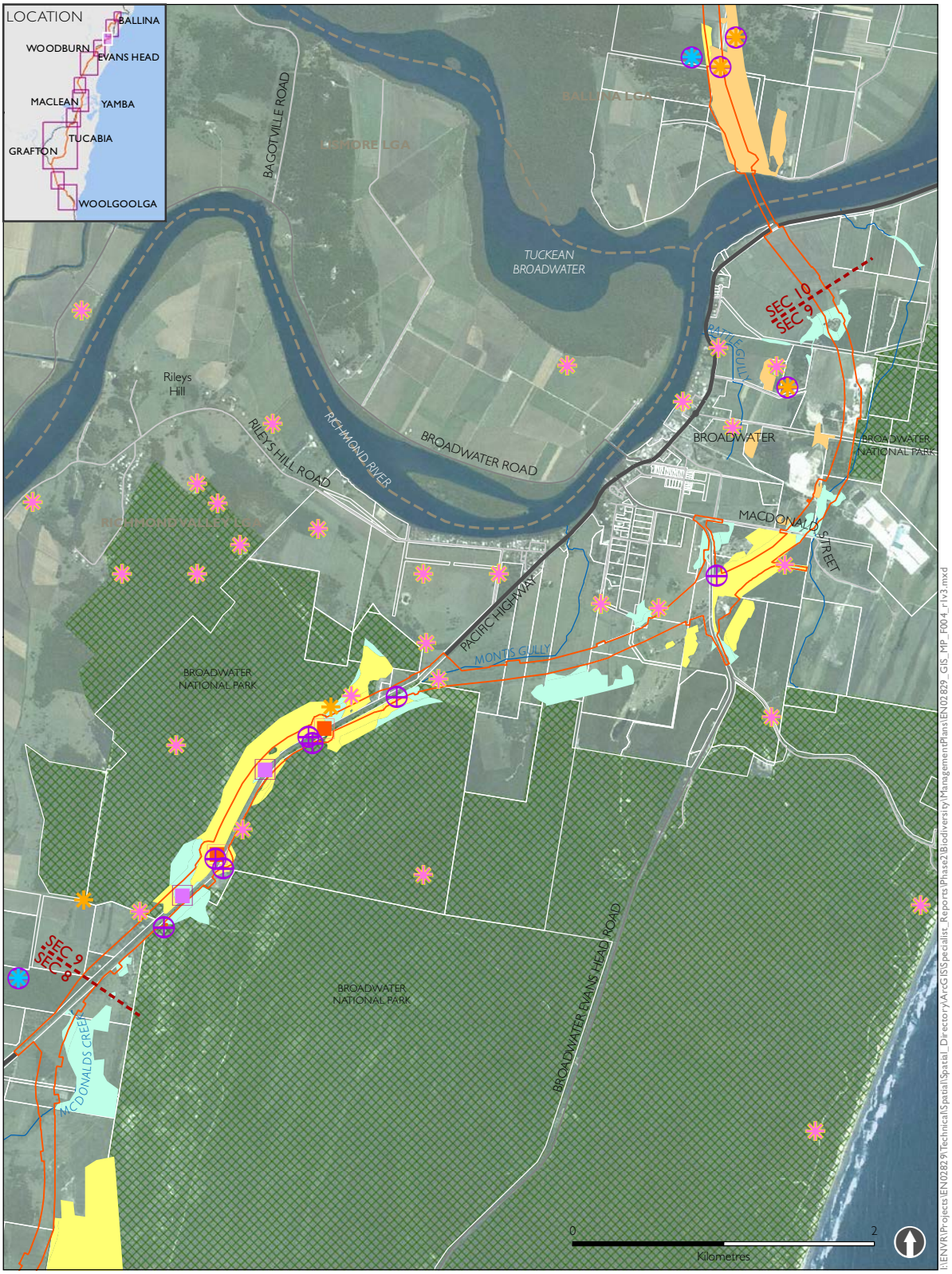


The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway
Koala Atlas sightings
Koala scat search plots (Scats No scats)
Koala habitat assessment plots

Koala habitat
Primary habitat
Secondary habitat
Tertiary habitat

Fauna connectivity structures
Dedicated Overpass
Dedicated Underpass

Figure 2 -9 Koala records, habitat critical for survival and connectivity structures (section 9)

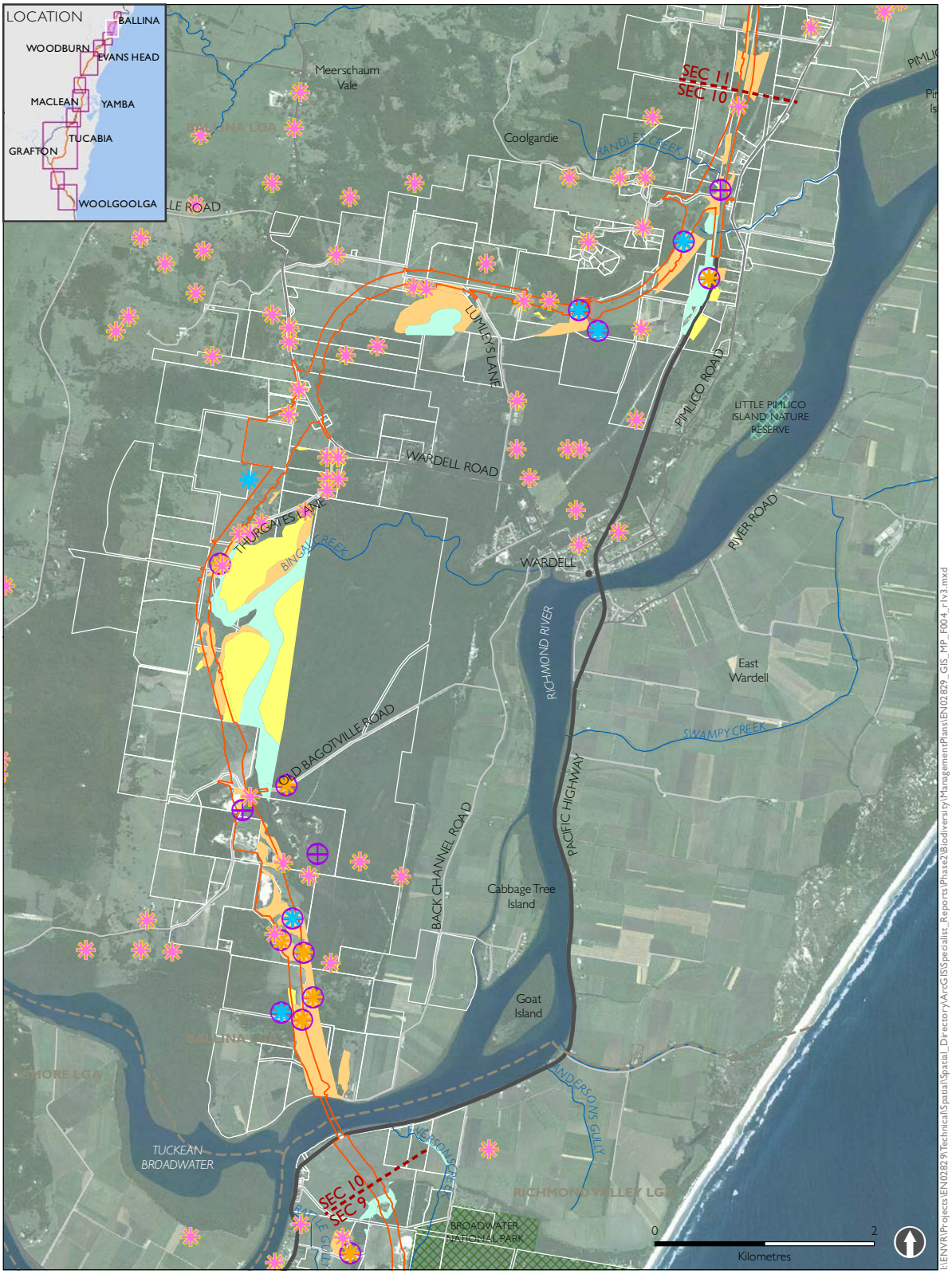


The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway
Koala Atlas sightings
Koala scat search plots (Scats No scats)
Koala habitat assessment plots

Koala habitat
Primary habitat
Secondary habitat
Tertiary habitat

Fauna connectivity structures
Dedicated Overpass
Dedicated Underpass

Figure 2 -10 Koala records, habitat critical for survival and connectivity structures (section 10)

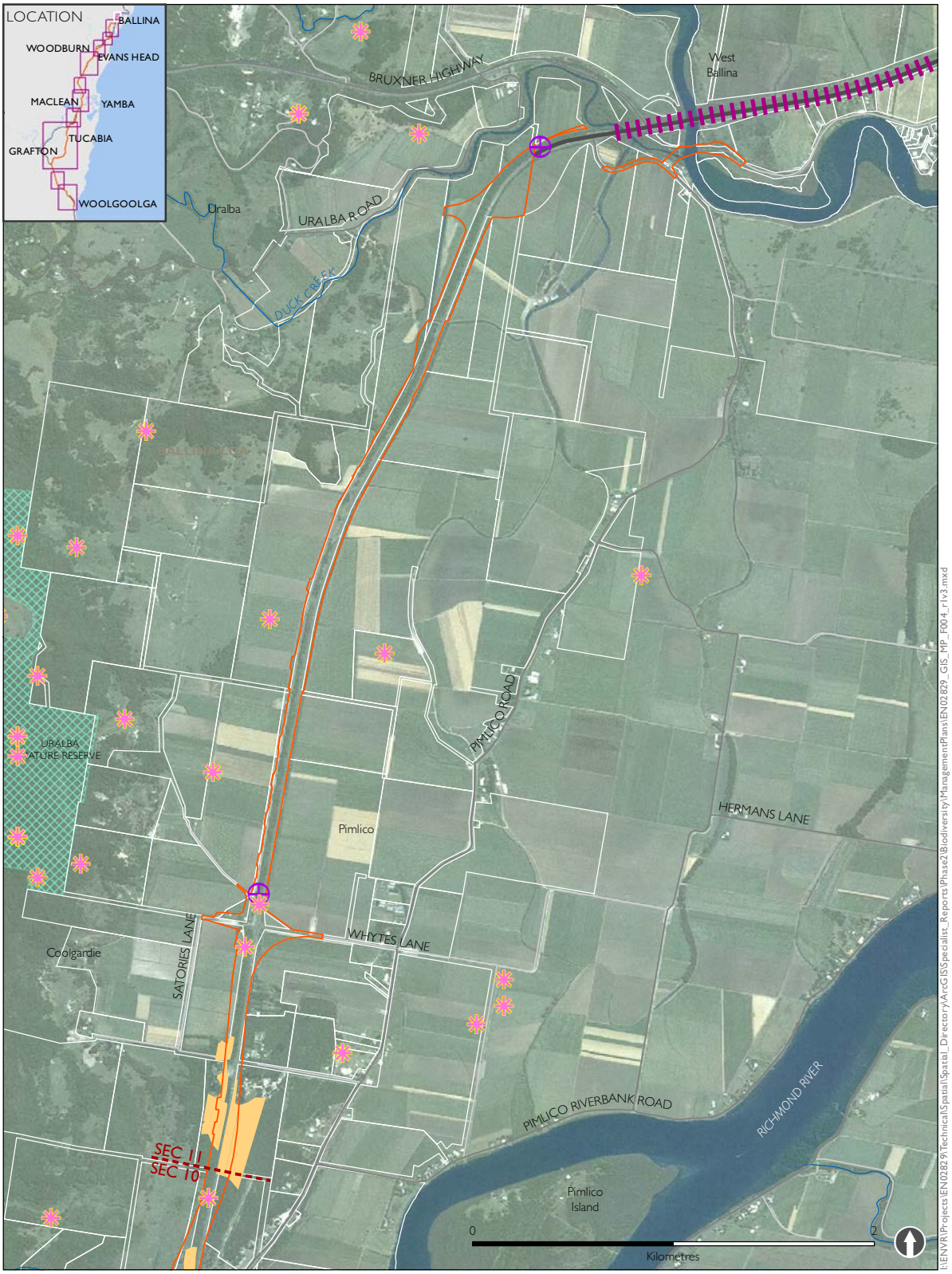


The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway
Koala Atlas sightings
Koala scat search plots (Scats No scats)
Koala habitat assessment plots

Koala habitat
Primary habitat
Secondary habitat
Tertiary habitat

Fauna connectivity structures
Dedicated Overpass
Dedicated Underpass

Figure 2 -11 Koala records, habitat critical for survival and connectivity structures (section 11)



The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway
Koala Atlas sightings
Koala scat search plots (Scats No scats)
Koala habitat assessment plots

Koala habitat
Primary habitat
Secondary habitat
Tertiary habitat

Fauna connectivity structures
Dedicated Overpass
Dedicated Underpass

3. Potential impacts and management approach

The following chapter provides a brief overview of the potential impacts to the Koala populations with reference to the more detailed impact assessment presented in the Section 4.3.2 (pp 298-300, 306 and 314-315) of the Biodiversity Working Paper (Roads and Maritime 2012) and Section 4.5.6 (pp 136-155) of the Supplementary Biodiversity Assessment (Roads and Maritime 2013). It also provides an overview of the effectiveness of mitigation measures proposed for this project which have been based on previous experience with koalas on upgrade projects for the Pacific Highway.

3.1 Potential impacts associated with the project

The main project impacts to Koala populations within the project include:

- Loss of foraging, sheltering and breeding habitat.
- Habitat fragmentation and impacts on habitat connectivity (movement of individual Koalas to different populations and territories allows important genetic exchange which is essential for Koala population viability).

The project would directly impact on around 557 hectares of 'habitat critical to the survival of Koalas' as defined by the Interim Koala referral advice for proponents (DSEWPaC 2012). This includes vegetation types containing primary and secondary Koala food tree species. Primary food tree species are represented by Swamp Mahogany (*Eucalyptus robusta*), Forest Red Gum (*E. tereticornis*), Tallowwood (*E. microcorys*), and Orange Gum (*E. bancroftii*). Secondary food tree species are represented by Red Mahogany (*E. resinifera*), Small fruited Grey-Gum (*E. propinqua*), and Narrow-leaved Red Gum (*E. seeana*). Supplementary tree species included the stringy-barks (*E. tindaliae* and *E. globoidea*).

Refer Table 4-19 (p 141) of the Supplementary Biodiversity Assessment for a breakdown of areas impacted per vegetation type. Table 3-1 provides the information as noted above.

Table 3-1 Vegetation types meeting the criteria for 'habitat critical to the survival of koalas' (DSEWPaC 2012) and the expected loss of habitat from the project

Vegetation types	Direct loss (ha)
Blackbutt - bloodwood dry heathy open forest on sandstones of the northern North Coast	89.3
Blackbutt grassy open forest of the lower Clarence Valley of the North Coast	42.5
Coastal heath on sands of the North Coast	25.2
Forest Red Gum - Swamp Box of the Clarence Valley lowlands of the North Coast	51.9
Grey Gum - Grey Ironbark open forest of the Clarence lowlands of the North Coast	69.0
Orange Gum (Eucalyptus bancroftii) open forest of the North Coast	5.6
Paperbark swamp forest of the coastal lowlands of the North Coast	10.5
Red Mahogany open forest of the coastal lowlands of the North Coast	39.7
Scribbly Gum - Needlebark Stringybark heathy open forest of coastal lowlands of the northern North Coast	66.1
Swamp Box swamp forest of the coastal lowlands of the North Coast	19.0
Swamp Mahogany swamp forest of the coastal lowlands of the North Coast	42.9
Tallowwood dry grassy forest of the far northern ranges of the North Coast	54.1
Turpentine moist open forest of the coastal hills and ranges of the North Coast	41.4
Total	557.2 ha

This loss of habitat would also impact on 'important populations' identified within Sections 9 and 10 of the project, between Woodburn and Wardell including Broadwater, Coolgardie and Bagotville.

The species may also be indirectly impacted by fragmentation and the barrier effect of the highway. It has been identified that Koalas have the potential to be regularly struck by cars where high-density populations occur in fragmented urban habitats (DSEWPaC 2013).

Recent genetic research identifies major roads as a barrier to gene flow for Koalas (Lee et al 2009; 2010). The project would fragment habitat links for Koalas seeking to access preferred habitats either side of the highway, particularly between Bagotville and Wardell and the southern parts of Coolgardie (Section 10 of the project) and also between Broadwater National Park and Rileys Hill (Section 9 of the project).

Koala habitat in the northern region of the project is already extensively fragmented particularly in Section 9 south of Broadwater and is associated with clearing of habitat for farming on the low-lying alluvial areas of the Richmond River floodplain. While the route for the highway predominantly traverses cleared land particularly by moving to the west of Wardell and Wardell Heath, there would be increased fragmentation of habitat for Koalas at the following locations:

- Immediately north of the Richmond River at the proposed bridge location through to Thurgates Lane (Section 10 of the project).
- To a lesser degree at Kays Road at Coolgardie (Section 10 of the project).
- South of the Richmond River near Pine Tree Road at Broadwater (Section 9 of the project).
- Broadwater National Park, east and west of the Highway (Section 9 of the project).

Other areas containing habitat for the Koala within Broadwater National Park have already been subject to fragmentation as a result of the existing highway. It is proposed that the project design would duplicate the travel lanes at this location and two land bridges are proposed to link the national park. In effect, this has the potential to improve the barrier effect of the current highway.

The impacts of the barrier effect and fragmentation have been considered via a focus on this species in the Biodiversity Connectivity Strategy.

Potential indirect impacts would result from:

- Vehicle strike (Koala injury or death) during construction and operation.
- Change in home range and distribution.
- Impacts on fertility breeding due to fragmentation.
- Disease and stress.

3.2 Detailed design considerations

A number of factors were considered in identifying the key connectivity zones for Koala and the types of crossing structures incorporated into the concept design for the Koala, with the aim of developing these further at the detailed design phase. The factors considered in located and sizing structures included:

- Known and potential Koala habitat and connectivity areas.
- Previous experience from monitoring programs looking at the effectiveness of structures for Koalas.

Detailed design for relevant sections of the project would consider the appropriate design and location of Koala exclusion fencing and connectivity structures.

3.3 Mitigation and monitoring

A number of measures to mitigate and monitor the impact of the project on Koala's during construction and operation of the project were suggested in the EIS (Biodiversity Working Paper, Roads and Maritime 2012). In general these measures related to:

- Installation of dedicated and combined connectivity structures including overpasses and underpasses in combination with strategic revegetation and exclusion fencing.

- Development of a Koala Fencing Strategy.
- Provision of Koala fauna exclusion fencing, including fencing of escape points and strategic vegetation.
- Additional targeted Koala surveys as part of a comprehensive monitoring program.
- Pre-clearing surveys to identify Koalas within the construction corridor.
- Identification of exclusions zones and fencing to prevent damage to native vegetation and Koala habitat.
- Siting of ancillary facilities to avoid impacts to known and potential Koala habitat.
- Implementation of a dog policy so no domestic dogs are brought onto the site.
- Induction and training of construction staff to make them aware of Koala habitat requirements, clearing extents and no go areas.
- A licensed wildlife carer/ecologist would be present on site during all vegetation clearing.

3.4 Effectiveness of mitigation measures

A summary of the proposed Koala specific mitigation measures and evaluation of their effectiveness based on past experience with other highway upgrades is described in Table 3-2.

Table 3-2. Mitigation measures and evaluation of their effectiveness

Issue	Mitigation measure	History of success	Effectiveness rating
Impact to Koala habitat outside the construction zone.	Identification of exclusion zones and limits of clearing. Revegetation of lands adjacent to the corridor post construction.	A standard procedure has been developed by Roads and Maritime and documented in the Biodiversity Guidelines for Construction (RTA 2011). The guidelines were developed in consultation with the NSW Office of Environment and Heritage (OEH), NSW Department of Primary Industries (DPI) (Fisheries), biodiversity specialists and Roads and Maritime staff including project managers, construction personnel and designers. Consultation was facilitated through a number of workshops carried out in 2009. These procedures have been developed using knowledge gained from a long history of upgrades on the Pacific highway and other road projects in NSW. Temporary fencing around important fauna habitats (exclusion zones) has been used by Roads and Maritime on multiple highway upgrades including the Pacific Highway and Hume Highway for the past 20 years. It has become a standard procedure as part of the CEMP and is inspected during construction. When combined with standard training of contractors it has become a highly effective measure at avoiding impacts to important habitats adjacent to construction areas. Landscape designs are a standard procedure used on all upgrades and have developed over the last three decades to include the use of locally indigenous plant species and a targeted approach to revegetation where required. This includes the provision of specific keystone species for fauna including koala feed trees. It is particularly useful at crossing zones, to encourage fauna use of underpass and overpass structures.	High
Potential impacts Koalas within the project during clearing works.	Pre-clearing and clearing procedures. Installation of temporary barrier fencing during construction including placement of escape points Koala relocation protocol. Managing Koala construction vehicle collisions during construction.	Guide 1: Pre-clearing procedures of the Roads and Maritime Biodiversity Guidelines (RTA 2011) outline the process to be followed prior to clearing works. The objective of this guide is to provide guidance for the pre-clearing process that would be conducted before any clearing takes place to minimise the impact on native flora and fauna. If fauna is within the identified limits of clearing an ecologist would capture and/or remove the fauna that have the potential to be disturbed, injured or killed as a result of clearing activities. Guide 8: Fauna handling would be followed for the capture and release of fauna. Specifically for the Koalas refer to Section 5.3.6 in this plan for a description of the Koala relocation protocol. The use of ecologists and licensed wildlife carers has been used on Pacific Highway projects over the last 10 years to successfully capture and relocate fauna. Temporary exclusion fencing has also been used on all Pacific Highway upgrade over the last 10 years to exclude fauna from the construction works and the upgrade highway.	Moderate – High. Monitor success and implement corrective actions
Domestic dogs brought on site by contractor could lead to dog attack	CEMP to document dog policy.	A prohibition of dogs policy is implemented as a standard procedure part of the CEMP process and has been used on multiple upgrades on the Pacific Highway including the Bonville and Kempsey upgrade where koalas were an important issues. This policy has ensured that no domestic dogs are brought onto the site by construction contractors and is monitored throughout the construction period with consequences for contractors who bring dogs to the site.	High
Potential impact to Koala habitat when siting ancillary facilities.	Locate ancillary facilities and access roads in disturbed and cleared areas.	Roads and Maritime *Stockpile Site Management Procedures* (RTA 2011). The siting of temporary construction related infrastructure is to be sited where possible within existing cleared or disturbed areas. This approach can substantially reduce the overall area of impact to vegetation and fauna habitat, while also reducing the area required to be rehabilitated at the end of construction.	High

Disruption to Koala movements and gene flow. Koala vehicle collisions on the highway.	Fauna crossing structures – underpasses, including refuge poles and furniture Fauna crossing structures – overpasses (land bridges), including refuge poles. Installation of permanent fauna exclusion fencing. Maintenance of fauna exclusion fencing.	Targeted crossing structures for Koala's have been used on multiple projects in Australia and overseas with high level of success. Roads and Maritime undertook monitoring of the vegetated median and rope bridge for the Bonville underpass in 2010 (SES 2010). This monitoring found that the underpasses were being used by Koalas. A review of the usage of fauna passage structures was undertaken for Roads and Maritime controlled in 2009 (Roads and Maritime 2009). This report found that Koalas have been recorded in fauna tunnels and box culverts. Specifically this study found that: • Koalas were using box culverts within the Yelgun to Chinderah and Brunswick Heads sections. • Within the Yelgun to Chinderah section the purpose-built fauna tunnel in the Taree section was also being used. • The culverts successful in attracting Koalas were united by their close proximity to quality vegetation. • The Koala may require time to acclimatise to the presence of the road and the underpass structures. Alternatively, it may be necessary for vegetation to regenerate before a Koala is comfortable moving over land. • Koalas were recorded in culverts with and without internal poles and logs. Although the sample sizes was too small to comment on whether culverts with poles were more successful than those without. Permanent fauna exclusion fencing has been used on multiple sections of the Pacific Highway to exclude fauna and direct to crossing points. An investigation of the impact of roads on Koalas was undertaken in 2011 for Roads and Maritime (AMBS 2011). Some of the findings from the study include that: • Most Koalas killed by vehicle collisions on the highway are not the local roadside residents but appear to be sub-adults dispersing and perhaps old, weak animals displaced from their former home-ranges away from the highway. Consequently the impact of road-kill affects a wider section of the population. • The genetic variation in roadside Koalas in the Yelgun to Chinderah and Bonville study areas prior to the upgrades was relatively high and had apparently not been impacted by the long existence of the Pacific Highway • Construction activities in the two study areas directly led to only one known death, suggesting that the direct impacts of clearing and construction are relatively minor at a population scale (when appropriate mitigation strategies are in place). • Floppy-top' fauna exclusion fencing can be very effective at reducing the rate of road–killed Koalas, but gaps and other weaknesses (including side-roads) have to be eliminated, and fences that end at the forest edge are likely to be not as effective as those that extend beyond the forest. • Underpasses (both constructed culverts and 'natural' underpasses such as gullies) do work in providing safe dispersal routes for Koalas to cross the highway. Other studies have recorded Koalas using underpasses in NSW including at the Brunswick Heads bypass, Bulahdelah to Coolongolook section of the Pacific Highway, Taree section of the Pacific Highway upgrade and a culvert near Brunswick Heads. • Recommended that clearing activities be undertaken outside the Koala breeding and dispersal period during future road constructions. • Other sources of mortality (e.g. Chlamydia) can be much higher in roadside Koalas than road mortality Roads and Maritime routinely conducts maintenance on exclusion fencing along the Pacific Highway both as a standard procedure and in response to a breach n the fence or speight of fauna road kills.	Moderate – High, monitor success and implement corrective actions
Increased noise and dust during construction impacting on Koala movements and behaviours.	Dust and noise managed in accordance with procedures in the CEMP	Roads and Maritime have developed standard procedures for water quality management on construction sites as part of the CEMP process with a long history of success as reported in auditing reports.	High

3.5 Adaptive management approach

This management plan adopts an adaptive management approach based on the identification of specific goals for management, implementation of management actions, followed by monitoring of the performance of these measures against the goals and identified thresholds. As a final step the monitoring would evaluate the effectiveness of the management measures using identified thresholds for performance and implementing corrective actions to improve mitigation where required.

To ensure the success of this approach the management goals presented in the plan were based on the following SMART principles:

- **S**pecific.
- **M**easurable.
- **A**chievable.
- **R**esults-based.
- **T**ime-based.

Details of the proposed monitoring program is described in Chapter 7 and includes:

- Change in Koala activity in proximity to the upgrade and to the east and west of the road corridor, the methodology includes a Before-After-Impact-Control (BACI) approach.
- The use of crossing zones and crossing structures during the project pre-construction, construction and operational phases.
- The effectiveness of roadside fencing at excluding Koalas from the road corridor and directing Koalas to crossing zones.
- The success of Koala habitat revegetation.

4. Pre-construction management measures

4.1 Potential impacts during pre-construction phase

- Location of infrastructure within ancillary facility sites including heavy vehicle access may impact on Koala habitat, movements, foraging and behaviour.

4.2 Main goals for management

- Koala fencing strategy completed prior to the commencement of construction.
- No impact to Koala habitat outside designated clearing areas and the project boundary.
- No Koala deaths from contractor domestic dogs on the project.

4.3 Management measures

Details on the site specific mitigation measures for Koalas to be implemented during the pre-construction phase are detailed in the following section and summarised in Table 4-1 along with performance thresholds and corrective actions.

4.3.1 Preparation of a Koala fencing strategy

The objective of the Koala Fencing Strategy is to develop a strategy for excluding Koalas from the construction corridor and direct Koalas to fauna crossing zones. The Koala Fencing Strategy would be completed as part of the detailed design. The Koala Fencing Strategy would provide detail on fence types, and specific locations for temporary and permanent fencing including fencing at crossing zones perpendicular to the construction corridor. It would also list the sections of the project that would require fencing for Koala's, ie all sections where there is habitat suitable for Koalas including Section 1 to 3 and Sections 6 to 10 of the project.

The strategy would focus on temporary fencing during construction and permanent fencing during operation. Also to be included in this strategy would be details including design and placement of escape points (for instances where Koalas become trapped in the road corridor) where safety requirements can be meet.

The Koala Fencing Strategy would also detail locations to erect Koala awareness signage on local roads affected by project construction traffic and locations along the highway upgrade nearby to the fauna crossing zones to notify motorists of the potential for Koalas to cross the road.

Monitoring of crossing points would begin prior to construction and is discussed in Chapter 7 of this plan.

Location of Koala exclusion fencing

The EIS assessment noted the requirements for 'Koala-friendly' fauna exclusion fencing at the following locations:

- Station 111.600 to 128.400.
- Station 137.800 to 141.000.
- Station 142.80 to 145.120.
- Station 146.100 to 159.700.

The EIS noted that due to the expansive distribution of Koala records and habitat across the project, further refinement of the location of fauna exclusion fencing would be required. This would be conducted during detailed design for each project section and informed by the additional surveys discussed in 4.3.3.

4.3.2 Commence baseline surveys

Baseline Koala surveys would be required in pre-selected monitoring locations to inform the selection of final monitoring locations which would define the detailed monitoring of targeted connectivity structures.

The EIS confirmed the presence of Koala scats at seventeen sites in Sections 1, 3, 7, 9 and 10 of the project. The Koala was also confirmed from another six locations within in Sections 9 and 10 of the project during investigations outside of the EIS. 'Important populations' were identified around Wardell to Coolgardie and Bagotville (Section 10 of the project) and south of the river from Rileys Hill to Broadwater National Park (Section 9 of the project). Up to thirteen vegetation types have been identified as supporting 'habitat critical to the survival of Koalas' in the project (Roads and Maritime 2013).

The baseline Koala surveys would focus on important Koala populations identified in Sections 9 and 10 of the project. Baseline Koala surveys would be undertaken at pre-selected monitoring locations to confirm Koala presence and activity levels, which would be used to identify final monitoring sites. In addition, assessments related to Koala abundance and the presence of *Chlamydia* (a highly infectious bacterial disease for Koala) would be undertaken. Survey methods are described in Chapter 7.

4.3.3 Pre-clearing surveys

Prior to the commencement of vegetation clearing works, pre-clearing surveys would be conducted to identify Koalas within the construction corridor. This may occur at early works sites as a priority and later across the construction corridor according to the priority stages of the upgrade to be determined. The pre-clearing process targets all fauna habitat and is a requirement of the CEMP. Searches for signs of Koala activity would form a part of this process, and would be particularly relevant in Sections 9 and 10 of the project. The results of the pre-clearing process would inform planning and procedures for the staged habitat removal process and are documented as part of the FFMP.

4.3.4 Identify exclusion zones

An exclusion zone is a designated 'no-go' area that is clearly identified and appropriately fenced to prevent damage to native vegetation and fauna habitat. This procedure is documented in the CEMP and conducted along the entire construction corridor for all threatened species and endangered ecological communities.

Habitat exclusion zones and limits of clearing would include consideration of Koala habitat. Habitat exclusion zones would be established during the on-ground survey of the road corridor and the commencement of construction to ensure that these activities do not remove protected and roadside vegetation in Koala habitat areas.

The identification of exclusion zones may be staged with a priority for early works sites and then remaining areas of the construction corridor. Survey personnel would be inducted to ensure they do not encroach outside the limits of clearing.

4.3.5 Identify sensitive ancillary areas and access roads

The siting of ancillary areas including stockpiles and construction infrastructure is planned to be located within cleared areas and disturbed vegetation. This would occur across all ancillary sites for each stage of the project and would be documented in the CEMP. The procedure would consider avoiding direct and indirect impacts to Koala habitat.

4.3.6 Dog policy

The CEMP would include a policy that no domestic dogs are to be brought onto the site during pre-construction and construction activities. All project personnel would be inducted as part of the CEMP.

4.4 Performance thresholds and corrective actions

Table 4-1 summarises the pre-construction environmental planning measures for Koalas that would be completed prior to the commencement of construction.

Table 4-1. Mitigation measures, performance measures and corrective actions - pre-construction

Main goals for mitigation	Proposed mitigation measure	Monitoring/timing frequency	Performance thresholds (triggers for corrective action)	Corrective actions if deviation from performance thresholds
Koala fencing strategy completed prior to construction commencing.	Detail location of temporary and permanent Koala fencing, encourage use of crossing points and direct Koalas from the road corridor.	One off. Koala fencing strategy to be completed prior to construction commencing.	Fencing strategy signed off as complete at end of design.	Delay construction until fencing strategy has been completed.
No impact to Koala habitat outside designated clearing areas and the project boundary.	Identification and appropriate fencing/marking of exclusion zones.	Identify clearing limits prior to clearing works. Inspection prior to clearing report in the CEMP to be signed off	Exclusion fencing not signed off at start of clearing	Do not commence clearing, hold-off work and complete.
No impact to Koala habitat outside designated clearing areas and the project boundary.	Ancillary facilities and access roads to be planned and sited within cleared or disturbed areas within the project boundary.	Detailed plans to be prepared showing the proposed location of construction related infrastructure and signed off by EMR prior to commencement of clearing and construction activities.	No plans showing facility and access road locations, vegetated areas and limits of clearing.	Amend locations if needed until all known and potential Koala habitat that is not to be impacted is avoided.
No Koala deaths from contractors domestic dogs on the project.	CEMP to document policy that prohibits dogs being brought onto the construction site.	Ongoing during construction.	Domestic dog found on site and connected with construction personnel.	Any breach of the policy to be reported to Roads and Maritime and EMR, with contractors warned that further breaches would require removed from the project.

5. Construction management measures

5.1 Potential impacts during construction

- Impacts during clearing of vegetation.
- Koalas entering the construction corridor and becoming trapped in the corridor.
- Koala vehicle collisions with construction traffic.
- Disturbance and degradation to adjoining Koala habitat.
- Dust and noise impacting on movements and habitat use.

5.2 Main goals for management

- No injuries to Koalas during clearing of vegetation.
- No injuries to Koalas during construction as a result of Koala/construction vehicle collisions.
- No damage to Koala habitat within exclusion zones during construction.
- Dust and noise managed in accordance with the CEMP.
- Replanting of Koala habitat adjacent to the road corridor completed as per landscape design.

5.3 Management measures

5.3.1 Construction work method statements

Construction Work Method Statements would be prepared for specific activities to ensure sound environmental practices are implemented and to minimise the risk of high risk environmental incidents or system failures.

Construction Work Method Statements would be prepared to address all construction Koala management requirements during construction in consultation with relevant agencies, the Roads and Maritime and the relevant project environmental manager prior to the commencement of project activities considered to present risk to the Koala. Construction Work Method Statements would be prepared to ensure that all Koala management measures area implemented.

5.3.2 Construction induction and training

Induction training would be conducted for all contractors and project staff working in areas of known and potential Koala habitat and distribution in the project area. This training would identify areas of Koala habitat, crossing zones and key threats to the species. The importance of following the clearing and rehabilitation protocols would be made clear to all project personnel.

5.3.3 Temporary Koala exclusion fencing

Temporary exclusion fencing would be installed around exclusion zones and Koala habitat to indicate the limits of clearing and to prevent Koalas from entering the construction corridor. Temporary fencing type would be selected in accordance with the *Roads and Maritime Biodiversity Guidelines – Guide 2 Exclusion Zones* (RTA 2011). The location of temporary fencing would be informed by the pre-construction Koala population surveys and targeted in known important population areas at risk of road strike as a result of disturbance during initial clearing activities.

The risk of Koalas being trapped, injured or isolated during construction would be considered. Where construction barrier fencing is used in Section 9 and 10 of the project; nocturnal fauna movements would be considered by placing gaps in the barrier at a minimum of every 500 metres subject to meeting safety requirements. It is strongly recommended that jersey kerbs are not used in areas of known Koala dispersal. In areas of relatively high Koala density and dispersal, the implementation of permanent Koala exclusion fencing would be preferred. At the end of construction, temporary fencing would be removed and replaced with permanent Koala exclusion fencing.

The Koala fencing strategy would identify Koala crossing zones subject to meeting safety requirements, which would be screened off from general construction activities to provide temporary Koala passage areas. Construction traffic would cross the temporary Koala passage areas via controlled vehicle crossing areas. The aim would be to ensure that construction infrastructure and access tracks have been be located so as to avoid creating lengthy barriers to Koala movements along habitat corridors.

A staged construction approach would allow for the completion of fauna movement structures to minimise lengthy interruption to Koala connectivity zones. Exclusion fencing would be installed at areas of known high Koala density and movement as a priority and in areas where there is a high risk of road strike.

5.3.4 Permanent fauna exclusion fencing

Permanent fauna exclusion fencing would be installed at locations along the carriageway identified from the Koala Fencing Strategy to prevent the movement of Koalas across the carriageway and to funnel Koala movements to designated crossing structures. Permanent fauna exclusion fencing would progressively replace temporary fencing (where it has been installed) during construction and be completed by the end of construction. The fauna exclusion fence type and design would be documented in the Koala fencing strategy, and consider issues such as flooding and directing Koalas to crossing zones.

Design principles for fauna exclusion fencing are detailed in the Biodiversity Connectivity Strategy (Roads and Maritime 2012). Specifically for Koalas, fauna fencing must include:

- Construction of fencing on both sides of the carriageway and generally extending at least 200 metres either side of a designated crossing structure.
- Continuous fencing with a 'return area' at their ends to guide animals back into habitat rather than across the highway.
- Installation of fencing with a floppy top that falls in the opposite direction of the carriageway to prevent Koalas from climbing over the fence.
- Construct fencing at least five metres away from established, canopy vegetation. Do not plant trees or shrubs within five metres of the fauna exclusion fence.
- Fence bracing or supports constructed on the road corridor side of the fence to prevent Koala access
- The top of the unclimbable section of fencing is at least 1.5 metres from the ground to prevent Koalas jumping up from the ground and gripping the top of the fencing.
- Fencing should extend to ground level with regard for uneven or undulating ground.

5.3.5 Pre-clearing and clearing procedures

Pre-clearing and clearing procedures would be outlined in the CEMP and FFMP, and would be undertaken in accordance with *Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects* (RTA 2011), in order to minimise impacts on flora and fauna.

Specifically for Koalas, clearing of trees would be undertaken in a way that ensures Koalas living in or near the clearing area have enough time to move out of the site without human intervention. In summary this involves:

- Staged clearing, i.e. sequential thinning or partial removal of trees in progressive stages, to allow Koalas to safely leave the clearing area and relocate to adjacent habitat.
- An ecologist would undertake surveys of the scheduled clearing area prior to vegetation clearing (i.e. early in the morning prior to the commencement of vegetation clearing activities) to identify trees in which a Koala is present and any trees where their crown overlaps trees in which a Koala is present.
- Suspension of clearing works if Koalas have been found within a clearing area for a minimum period of 24 hours to allow Koalas to move out of the construction site on their own volition.

- The direction of sequential clearing should be away from threatening processes or hostile environments, i.e. roads. The ecologist is responsible for verifying that sequential clearing has taken place.
- Each tree identified, by the ecologist, as being a risk to Koalas if felled, would not be felled, damaged or interfered with until the Koala has moved from the clearing site. The ecologist would physically move Koalas as required in accordance with the Guide 9: Fauna handling of the Roads and Maritime Biodiversity Guidelines.
- In the event that a Koala remains in the clearing site for more than 24 hours, it would be captured and translocated by a suitably qualified person to the nearest area of habitat identified as suitable for Koala release where the individual is at no risk of further harm.

These procedures are informed by the sequential vegetation clearing and requirements for clearing Koala habitat trees in Queensland (EPA 2006). Clearing procedures would be outlined in the CEMP and FFMP, and would be undertaken in accordance with Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects (RTA 2011), in order to minimise impacts on flora and fauna in general.

Clearing procedures would also be informed by the Roads and Maritime unexpected finds procedures (RTA 2011) should a Koala be encountered in the construction corridor at any time during conduction.

5.3.6 Koala relocation protocol

An ecologist would be present on site prior to and during all vegetation clearing (to allow Koalas to safely leave the clearing site and relocate to adjacent habitat without human intervention. In the event that a Koala does not move on its own volition after a period of two nights, it would be trapped. The 'corflute method' would be used for trapping Koalas. This typically involves the use of a plastic guard (approximately 60 centimetres tall) and cage trap arrangement place at the base of the target tree, as shown in Photo 1 (AMBS 2011).

Photo 1 Trap designed to capture koalas (source AMBS 2011)

Once captured, the Koala's health would be assessed and details recorded of age, sex, weight, body measurements, and presence of pouch or back young (for females). Any healthy animals would be relocated into adjacent habitat identified for Koala release. Release points would not be more than 100 metres away provided that suitable habitat is present. If injured koalas are captured that are to be transported to an experienced wildlife veterinarian to assess and treat any Koalas considered too unhealthy for release. Details of veterinarians would be provided in the FFMP. The NSW Code of Practice for Injured, Sick and Orphaned Koalas (OEH, 2011) (refer to Appendix B) would be followed for trapping and relocating Koalas and dealing with any injured Koalas encountered during the clearing procedure.

Direct interactions with Koalas must only be conducted by a suitably qualified and experienced ecologist who holds the necessary rehabilitation permits allocated by the OEH or in conjunction with the ecologist and licensed wildlife carer.

Areas where Koalas have been captured would be recorded for considered for inclusion as a monitoring site for the monitoring program discussed in Chapter 7.

5.3.7 Managing Koala construction vehicle collisions

A licensed wildlife carer/ecologist would be present on site during all vegetation clearing and habitat removal activities to redirect Koalas that may be encountered during clearing activities.

Following the clearing works and throughout the remainder of the construction period, any observations of Koalas in the construction corridor would also follow the unexpected threatened species find procedure (RTA 2011).

All construction vehicles would be required to comply with the speed limits set out in the CEMP and to remain within the designated construction corridor.

Given the likely increased traffic on local roads during the construction period, Koala awareness signs are to be erected on local roads in potential road kill areas to make motorists aware of the potential for Koalas to cross the road and the need to restrain dogs, particularly between the hours of 6pm and 6am when Koalas would be most active. Koala awareness signs would also to be constructed along the highway upgrade at locations in close proximity to the fauna crossing zones. Signage locations would be identified in the Koala Fencing Strategy.

5.3.8 Fauna crossing structures

A number of dedicated and combined connectivity structures have been included in the concept design to maintain existing levels of landscape connectivity for important Koala populations identified in Sections 9 and 10 of the project, and other locations where populations have been recorded, ie in Section 1, 3 and 7 of the project. These would be further decreased during detailed design.

Fauna connectivity structures that are targeted to Koala populations or would benefit Koalas in general are summarised in Table 5-1 below and include:

- Underpasses (bridges and culverts).
- Overpasses (land bridges).
- Fauna exclusion fencing.

The ideal dimensions of underpasses to facilitate Koala movements were included in the concept design and include:

- Box culvert of three metres height (H) x three metres width (W) – especially for four or greater lane carriageways.
- Box culvert of 1.5 metres (H) x 1.5 metres (W) – as a minimum for a single or dual carriageway (this size may include Koala furniture).

Fauna furniture would be placed within targeted Koala underpasses, including hard wood horizontal and vertical logs within and outside the culvert to provide a dry passage for Koalas whilst also providing refuge from predators. Previous Koala monitoring on the Pacific Highway in north-east NSW (AMBS 2011) demonstrated that log furniture in underpasses were used by a Koala but not by most. This suggests that furniture may facilitate the use of the underpass by some individual Koalas.

Fauna furniture installed at the targeted Koala underpasses would be finalised in the detailed design and adhere to the connectivity guidelines in the EIS which include:

- Horizontal logs are placed as high off the ground as possible for Koalas to avoid predators with a minimum space of 600 millimetres between the top of the horizontal log and the structure's roof.
- Horizontal logs which are supported by vertical logs at regular intervals (approximately every 2-3 metres) along the underpass for Koalas to ascend or descend the Koala furniture as required.
- Logs are greater or equal to 150 millimetres in diameter, or horizontal planks are greater or equal to 150 millimetres in width.
- Koala furniture extends beyond the underpass into Koala habitat.
- Where fauna furniture is placed inside a culvert, it is to be constructed on the left or right side of the culvert (not in the middle), to minimise incidence of flooding.

Strategic planting of Koala habitat adjacent to targeted connectivity structures would also be undertaken post-construction to improve and maintain connectivity.

Overpasses (land bridges) would facilitate the safe crossing of Koalas between habitat on either side of a road. Overpasses provide a more natural avenue for Koalas to cross roads and negate the lighting and flooding issues associated with underpasses. Ideally, the substrate of the overpass would resemble the forest floor. Overpass design would conform to road safety standards and prevent wildlife from falling from the overpass onto the roadway and oncoming traffic.

Overpass design would consider the following:

- Maintaining a dirt track if access is required for fire-fighting equipment.
- Build the overpass with stable, rigid or semi rigid materials.
- Incorporate vegetation or refuge poles if the overpass is accessible by predators.

Fauna exclusion fencing would be constructed to funnel Koalas to the fauna crossing structures and would be designed with a return at the end to encourage Koalas to move back into habitat and not directly onto the highway. Additionally, additional features would be incorporated into the fauna exclusion fencing design, such as escape poles or points if required.

The monitoring program described in Chapter 7 of this plan would focus on monitoring the effectiveness of crossing structures and exclusion fencing for Koala's. This includes monitoring performance of structures and implementing corrective actions where required.

Table 5-1 Fauna connectivity structures targeted for the Koala as detailed in the concept design

Project section	Station (km)	Connectivity structure (wxhxl*)	Functionality	Comments
1	11.785	RCBC (box culvert 3 x 3 x 71m) linked with fauna fencing	Underpass – Dedicated general fauna crossing. May benefit low density Koala populations in this area.	Dirty Creek Range to Newfoundland State Forest and Yuragir SRA. May benefit the Koala. Evidence of low density Koala populations in this region
1	12.325	RCBC (box culvert 3 x 3 x 41m) linked with fauna fencing	Underpass – Combined general fauna crossing. May benefit low density Koala populations in this area.	Dirty Creek Range to Newfoundland State Forest and Yuragir SRA. May benefit the Koala. Evidence of low density Koala populations in this region.
1	12.885	RCBC (box culvert 3 x 3 x 43m) linked with fauna fencing	Underpass – Combined general fauna crossing. May benefit low density Koala populations in this area.	Dirty Creek Range to Newfoundland State Forest and Yuragir SRA. May benefit the Koala. Evidence of low density Koala populations in this region.

Project section	Station (km)	Connectivity structure (wxhxl*)	Functionality	Comments
1	13.315	RCBC (box culvert 3 x 3 x 25m) linked with fauna fencing	Underpass – Combined general fauna crossing. May benefit low density Koala populations in this area.	Dirty Creek Range to Newfoundland State Forest and Yuragir SRA. May benefit the Koala. Evidence of low density Koala populations in this region.
2	25.950	RCBC (box culvert 3 x 2.4 x 45m) linked with fauna fencing	Underpass – Combined general fauna crossing. May benefit low density Koala populations in this area.	Yuragir NP, Yuragir SCA and Wells Crossing Flora Reserve.
3	37.320	RCBC (box culvert 2.4 x 2.4 x 69m) linked with fauna fencing	Underpass – Combined general fauna crossing. May benefit low density Koala populations in this area.	Glenugie Creek and Pheasant Creek.
3	53.710	RCBC (box culvert 3.6 x 3.6 x 63m) linked with fauna fencing	Underpass – Combined general fauna crossing. May benefit low density Koala populations in this area.	Chaffin Swamp to Chaffin Hill and Yuragir NP, Pine Brush State Forest.
3	59.285	Arch (5.5 m in height and 60m in length) linked with fauna fencing	Underpass – Combined general fauna crossing. May benefit low density Koala populations in this area.	Chaffin Swamp to Chaffin Hill and Yuragir NP, Pine Brush State Forest.
3	60.815	Arch (5.5 m in height and 60m in length) linked with fauna fencing	Underpass – Combined general fauna crossing. May benefit low density Koala populations in this area.	Chaffin Swamp to Chaffin Hill and Yuragir NP, Pine Brush State Forest.
3	64.505	Arch (5.5 m in height and 60m in length) linked with fauna fencing	Underpass – Combined general fauna crossing. May benefit low density Koala populations in this area.	Chaffin Swamp to Chaffin Hill and Yuragir NP, Pine Brush State Forest.
6	99.730	RCBC (box culvert 3.0 x 2.4 x 44m) linked with fauna fencing	Underpass – Dedicated general fauna crossing. May benefit low density Koala populations in this area.	Links Bundjalung NP and Mororo State Forest.
6	101.100	RCBC (box culvert 3.0 x 2.4 x 38m) linked with fauna fencing	Underpass – Dedicated general fauna crossing. May benefit low density Koala populations in this area.	Links Bundjalung NP and Mororo State Forest.
7	118.828	Tabbimoble Nature Reserve Fauna Bridge (bridge 72.6 x 12.2m) with fauna fencing 111600 to 128400	Overpass - Dedicated general fauna crossing, including Koala	Important landscape link between Tabbimoble Swamp Nature Reserve and Bundjalung National Park to the east, with Doubleduke State Forest and Jackywalbin State Conservation Area to the west. The structure targets a range of fauna species including the Koala as there are scattered records of Koalas throughout this location. Koala activity was recorded on the eastern side of the highway at this location.
9	138.796	Broadwater National Park Fauna Bridge 1 (bridge 90.4 x 12.2m) with fauna fencing from 137800 to 141000	Overpass - Targeted Koala structure Recommended inclusion as part of targeted monitoring program	Important landscape link between Broadwater National Park and Rileys Hill. Koala activity reported at this location on both sides of the highway and known Koala population in Broadwater National Park, north-west to Rileys Hill.
9	139.918	Broadwater National Park Fauna Bridge 2	Overpass - Targeted Koala structure	Important landscape link between Broadwater National Park and Rileys Hill.

Project section	Station (km)	Connectivity structure (wxhxl*)	Functionality	Comments
		(bridge 80.3 x 12.2m) with fauna fencing from 137800 to 141000	Recommended inclusion as part of targeted monitoring program	Koala activity reported at this location on both sides of the highway and known Koala population in Broadwater National Park to Rileys Hill.
9	144.280	RCBC (box culvert 3 x 3 x 48m) with Koala furniture and linked with Koala fencing from 142800 to 145120.	Underpass - Targeted Koala structure Recommended inclusion as part of targeted monitoring program	South of the Richmond River A small area of known Koala habitat would become isolated on the western side of the highway between Station 143.700 and 145.000 which is currently connected with Broadwater National Park. The proposed viaduct is too far north and outside of Koala habitat to provide viable connectivity here. This structure was added following the Supplementary Biodiversity Assessment.
9	144.700	2 x RCBC (box culverts 3 x 3 x 48 m) with Koala furniture and linked with koala fencing from 142.800 to 145.120	Underpass – Targeted Koala structure Recommended inclusion as part of targeted monitoring program	
10	146.000	Bridge over the Richmond River	Underpass structure benefit to Koala populations	Regional link across Richmond River. Links two key habitats. Important Koala population in this location. Also strategic planting of Koala habitat in acquired properties post-construction to reinforce connectivity if possible depending on acquisition.
10	146.360	RCBC (box culvert 3 x 3 x 44m) with Koala furniture and linked with Koala fencing from 146100 to 159700.	Underpass – Targeted Koala crossing Recommended inclusion as part of targeted monitoring program	
10	146.620	RCBC (box culvert 3 x 3 x 55m) with Koala furniture and linked with Koala fencing from 146.100 to 159.700.	Underpass – Targeted Koala crossing Recommended inclusion as part of targeted monitoring program	Regional link across Richmond River. Links two key habitats. High Koala activity reported at this location. Also strategic planting of Koala habitat in acquired properties post-construction to reinforce connectivity, if possible depending on acquisition. This structure was added following the Supplementary Biodiversity Assessment.
10	147.600	Land Bridge (length 120 m x width 30 m) in cutting	Overpass – Targeted Koala crossing Recommended inclusion as part of targeted monitoring program	
10	148.600	RCBC (box culvert 3 x 3 m x 60m) with Koala furniture and linked with Koala fencing from 146.100 to 159.700	Underpass – Targeted Koala crossing Recommended inclusion as part of targeted monitoring program	Regional link across Richmond River. Links two key habitats. High Koala activity reported at this location. Also strategic planting of Koala habitat in acquired properties post-construction to reinforce connectivity, if possible depending on acquisition. This structure was added following the Supplementary Biodiversity Assessment.
10	149.227	Wardell Viaduct 4 (twin bridges 18.0 x 11.0m) with Koala fencing from 146100 to 159700	Underpass – Targeted Koala crossing Recommended inclusion as part of targeted monitoring program	Regional link across Richmond River. Links two key habitats. Would benefit Koala populations.
10	151.933	Wardell Viaduct 6 (twin bridges 18.0 x 11.0m) with Koala fencing from 146100 to 159700	Underpass – Combined general fauna crossing.	Floodplain grasslands. Would benefit Koala populations.
10	156.006	North Wardell Fauna Bridge (bridge 62.0 x 12.2m) with Koala fencing from 146100 to	Overpass – Targeted Koala crossing Recommended inclusion as	Wardell Heath - high Koala activity reported at this location. Connects large areas of Koala habitat and

Project section	Station (km)	Connectivity structure (wxhxl*)	Functionality	Comments
		159700. Include Koala furniture on the overpass	part of targeted monitoring program	known population in the Wardell area through to the north in an important corridor linking with habitat in the Meerschaum Vale and Coolgardie area and provides for dispersal of Koalas north and south.
10	156.100	North Wardell Viaduct 7 - Randles Creek (dual bridges 17.5 X 13 - 13.5m NB, 14.8 - 15.6m SB) with Koala fencing from 146100 to 15970	Underpass – Combined general fauna crossing	High Koala activity reported at this location.
10	156.955	RCBC (culvert 1.8 x 1.2 x 53m) with Koala fencing from 146.100 to 159.700	Underpass – Targeted Koala crossing Recommended inclusion as part of targeted monitoring program	Wardell Heath - high Koala activity reported at this location. These structures are planned in low-lying land with limited fill heights. Koala activity was reported on the eastern side of the highway in this location and can be expected between the existing highway and the new highway between Station 156.700 and 157.400. The culvert at 156.900 should be revised and upsized if possible during detailed design. Further connectivity consideration is required here at detailed design. The fauna exclusion fence extends to Station 159.700 and is considered appropriate in this location.
10	157.605[4]	RCBC (culvert 4.2 x 2.1 x 27m) with Koala fencing from 146100 to 159700	Underpass – Combined general fauna crossing. May benefit Koala population	High Koala activity reported at this location. Currently looking at upsizing this as part of the Coolgardie design refinement.
10	157.655[4]	RCBC (culvert 3.6 x 1.8m x 59m) with Koala fencing from 146100 to 159700	Underpass – Combined general fauna crossing. May benefit Koala population	High Koala activity reported at this location. Currently looking at upsizing this as part of the Coolgardie design refinement.
11	158.825	17.5 X 13 - 13.5 NB, 14.8 - 15.6 SB	Underpass – Combined general fauna crossing. May benefit Koala population	Medium Koala activity reported around this location, potential movements across the existing highway

NOTE:
1 - * = width x height x length. Note lengths are indicative and there may be minor changes in length as part of detailed design.
2 - Station 157.825 at North Wardell has been updated to station 156.100 in table above.
3 - The culvert at station 144.280 (noted as 144.290 and 144.770 in the Biodiversity Working Paper) have been increased in size. An additional combined culvert has been added at 146.620.
4 – Currently in Section 10 the revision of structure dimensions is being undertaken.

5.3.9 Habitat revegetation

The landscape design would provide specific details for the re-establishment of native vegetation on batters, cut faces, surrounding sediment basins and other areas disturbed during construction activities. While these areas are not relevant to Koalas it would include approaches to fauna connectivity structures and riparian corridors, which would be directly applicable to Koalas. Methods for topsoiling, seeding and planting would be in accordance with the *Biodiversity Guidelines: Protecting and managing biodiversity on RTA Projects* (RTA 2011).

The landscape design would provide due consideration to the landscape requirements around crossing structures by ensuring that the height and density of vegetation does not obscure the structure and provides a clear line of sight, but also provide some cover for fauna approaching and exiting the structure from predators. Canopy vegetation would be selected and maintained at a height of 20 – 25 metres.

Revegetation around dedicated overpasses (i.e. Tabbimoble Nature Reserve Fauna Bridge, Broadwater National Park Fauna Bridges 1 and 2 and North Wardell Fauna Bridge) would use primary, secondary and supplementary Koala food trees (refer to Section 2.1.3). The use of these tree species would encourage Koalas to use the land bridges and thus provide habitat linkage to the structures. Koala food trees would also be considered in the revegetation of riparian corridors impacted by construction of combined underpasses (i.e. culverts and bridges). Revegetation of acquired properties in Section 10 of the project from Stations 146.36 to 150.6 would also be undertaken. This revegetation would re-establish regional landscape links across the Richmond River. There are numerous Koala records around this area (see Figure 4-5 from the Biodiversity Working Paper [Roads and Maritime 2012]). The revegetation would use primary, secondary and supplementary Koala food trees to restore habitat for Koalas.

Revegetation near crossing structures and overpasses, where the areas are intersected by the project on Roads and Maritime owned land, would commence immediately on completion of the construction activity or may commence earlier in the construction period if applicable.

Details on monitoring the performance of the revegetation as well as corrective actions to be implemented in instances of change from performance measures are provided in Chapter 7.

5.3.10 Location of ancillary facility sites

Ancillary facility sites (i.e. temporary sites for construction related activities) have been located in cleared land or sites of low ecological value. Locations of plants and equipment would be placed in cleared parts of the site. This would avoid unnecessary clearing of Koala habitat, particularly at locations where Koala food trees and Koala activity have been identified (Roads and Maritime 2013).

5.3.11 Minimising dust and noise

Dust and noise impacts would be managed in accordance with the CEMP including dust suppression measures and construction noise limit measures.

5.4 Performance thresholds and corrective actions

Table 5-1 summarises the operational environmental planning measures for Koalas and corrective actions if the measure deviates from the performance criteria.

Table 5-1 Performance indicators and corrective actions – construction

Main goals for management	Management measure	Monitoring/timing frequency	Performance thresholds (triggers for corrective actions)	Corrective actions if performance threshold reached
No injuries to Koalas during clearing of vegetation.	• Documented procedures for clearing and relocating. • Procedure developed in consultation with WIRES and NPWS. • Project ecologist to evaluate situation and approach on each occasion.	• Monitored daily during the clearing works. • Outcome of clearing procedure reported in EMR as per the CEMP requirements.	Koala injured during clearing works.	Stop clearing works and consult with Koala specialists and/or NPWS. Update procedure for emergency management if a Koala is encountered and convey changes to construction staff via induction and toolbox talks.
No injuries to Koalas during construction as a result of Koala construction vehicle collisions	• All vehicles to stay within the construction corridor. No vehicles to enter exclusion zones. • Compliance with construction vehicles speed limits designated in the CEMP. • Implementation of a temporary fauna fencing integrity inspections.	• Monthly fauna incident log to be maintained as per FFMP. • Monthly inspection of exclusion fence and protection zones as part of FFMP.	Koala injured during construction.	Stop construction activities and repair breaches of temporary fencing. Review the Koala fence strategy and traffic control procedures as appropriate. Update strategy and speed limit as required and convey changes to construction staff via induction and toolbox talks.
No damage to Koala habitat within exclusion zones.	• Implement the Koala fencing strategy prior to construction. Install temporary fencing as per Koala fencing strategy.	• Audit fencing integrity prior to commencement of construction. • Monthly inspection of exclusion fence and protection zones as part of FFMP.	Breach in exclusion zone/fencing by construction vehicle or unauthorised construction activities.	Supplementary revegetation of disturbed habitat and monitor recovery for period of 12 months.
Dust and noise managed in accordance with the CEMP.	Implement relevant dust and noise procedures from the CEMP.	Measures to be undertaken in response to weather and construction conditions.	Monthly reporting as part of CEMP including updates on dust and noise control measures.	Increase the frequency of dust and noise measures as appropriate to avoid unnecessary dust and noise events during construction.
Replanting of Koala habitat adjacent to the road corridor completed as per the landscape design	• Roadside plantings to avoid Koala food trees to prevent Koalas being attracted to road edges. • Landscape plantings at fauna crossing zones to use Koala habitat trees to encourage use of the crossing zones by the Koala. • Revegetation in areas disturbed during construction to be restored to the original habitat type at each location. Focus at potential habitat locations	Final audit of Landscape design.	Check landscape plan at end of construction and sign off compliance with regard to koala plantings	Complete plantings where gaps identified

6. Operational management measures

6.1 Potential impacts during operational phase

- Degradation of Koala exclusion fencing leading to Koala vehicle collisions and road deaths or Koala's becoming trapped within the road corridor.
- Degradation of Koala revegetation areas.
- Wild dogs targeting Koalas at designated crossing zones.
- Koalas not using designated crossing structures.

6.2 Main goals for management

- Zero or reduced rate of reported Koala deaths associated with road operations (ie vehicular collisions) within the upgrade area after a five year period following commencement of the operational phase.
- Targeted crossing structures found to be used by Koalas
- Successful koala habitat revegetation on Roads and Maritime owned land in for a period of five year post-construction.
- Zero or reduced rate of reported Koala deaths from dog attacks in vicinity of crossing structures after a 10 year period following commencement of the operational phase.

6.3 Management measures

6.3.1 Maintenance of fauna exclusion fencing and fauna crossings

The Roads and Maritime would maintain fauna crossing structures and exclusion fencing as part of the standard maintenance requirements for stability and damage for perpetuity as required. A small vehicle access track adjacent to the fence would facilitate rapid inspection and repair.

Monitoring would also be conducted in response to observations and reports of fauna road kills in the vicinity of exclusion fencing and structures, which includes Koalas. The work to be commissioned would include repair of any breaches in the exclusion fence, the slashing of overgrown vegetation that breaches the fence and the removal of large debris or vegetation from culvert entrances.

6.3.2 Maintenance of revegetation

Inspection, monitoring and maintenance of revegetated areas would be specified in the landscape design. The recommended monitoring and maintenance schedule for the revegetated Koala habitat areas in the first year is outlined in **Table 6-1**.

Table 6-1 Monitoring and maintenance schedule first year

Monitoring	Timing	Maintenance
Site preparation	Commencement	Weeds and grass controlled within 2 metres of planting locations.
Watering weekly	First month	No plants wilting or with dried foliage.
Monitoring weeds and plant health	3 months	Weeds not smothering plants, plants healthy with active growth, replanting required if plant survival not at required percentage.
Weed control Mulching and fertilising of plants	3 months	Weeds and grass controlled within 2 metres of planting locations, all plants mulched and fertilised.
Monitoring weeds and plant health	6 months	Weeds not smothering plants, plants healthy with active growth, replanting required if plant survival not at required percentage.
Weed control	6 months	Weeds and grass controlled within 2 metres of planting locations,

Monitoring	Timing	Maintenance
Mulching and fertilising of plants		all plants mulched and fertilised.
Monitoring weeds and plant health	9 months	Weeds not smothering plants, plants healthy with active growth, replanting required if plant survival not at required percentage.
Weed control Mulching and fertilising of plants	9 months	Weeds and grass controlled within 2 metres of planting locations, all plants mulched and fertilised.
Monitoring weeds and plant health	12 months	Weeds not smothering plants, plants healthy with active growth, replanting required if plant survival not at required percentage.
Weed control Mulching and fertilising of plants	12 months	Weeds and grass controlled within 2 metres of planting locations, all plants mulched and fertilised.

6.3.3 Predator control

Predatory animals (ie wild dogs) have the potential to exploit the channelling function of the fauna exclusion fence by hunting near the entrance to the underpass or overpass (Harris et al. 2010). Monitoring of predatory animal activity would be conducted as part of the crossing structure monitoring program (refer to Chapter 7). Where monitoring indicates that predators are a threat to Koala movement through the crossing structures, the Roads and Maritime would engage with the Northern Rivers Catchment Management Authority, NSW OEH (Parks and Wildlife Grafton), and Rural Lands Protection Board (North East) and adjacent landowners to identify and implement strategies to reduce this predation risk.

6.3.4 Monitor effectiveness of crossing structure

Monitoring of the targeted Koala connectivity structures (underpasses and overpasses and associated Koala exclusion fencing) would be undertaken to assess their effectiveness to facilitate movement of Koalas across the highway upgrade. Chapter 7 outlines the process that would be used to undertake this monitoring.

6.4 Performance thresholds and corrective actions

Table 6-1 summarises the operational environmental planning measures for Koalas and corrective actions if the measure deviates from the performance criteria.

Table 6-1 Performance indicators and corrective actions – operation

Main goal	Mitigation / control measure	Monitoring/timing frequency	Performance thresholds (triggers for corrective actions)	Corrective actions if deviation from performance criteria
Zero or reduced rate of reported Koala deaths as a result of vehicular/Koala interactions on the highway upgrade after 5 years.	Periodic monitoring and maintenance of exclusion fencing for the life-time of the project. Slashing weeds near fences and repair breaches in fence or replace broken fences.	Conduct Koala mortality surveys as per Chapter 7 The program would include inspections of the fence and structures as part of the standard maintenance requirements at the site for the life-time of the project. Monitoring would also be conducted in response to observations and reports of Koala road kills within 100 metres of exclusion fencing and Koala crossing structures. Monitoring would be conducted for five years initially and the need for further monitoring would be reviewed at the end of this period.	If more than one Koala death reported (ie car strike) in the same location during operational years 1-5.	Locate and repair faulty exclusion fence within 3 days of Koala death being reported. Review Koala mitigation measures if more than one Koala has been reported as killed as a result of car strike.
Maintain habitat revegetation areas on Roads and Maritime owned land in for a period of five year post-construction.	Follow designated maintenance plan.	As per designated maintenance plan.	Planned activities not conducted as per schedule. >30% mortality of trees at revegetation sites.	Increase maintenance period to five years. Remove and replace dead trees Extend maintenance for a further 2 years
Zero or reduced rate of reported Koala deaths from wild dog attacks in vicinity of crossing structures in in years 1-5.	Conduct ongoing monitoring at crossing zones as per methods in Chapter 7.	Monitor predator presence and predator related Koala kills as part of ongoing crossing structure monitoring program.	Koala death near crossing zone attributed to predator attack (as per methods in Chapter 7).	Engage with stakeholders involved with predator control and identify actions to assist in minimising attacks.
Koalas not using designated crossing structures	Monitoring of crossing structures refer to Chapter 7.	As outlined in Chapter 7.	If no evidence of use of the designated underpass or overpass by the Koala reported after 3 years	Review and update the monitoring methods, Check exclusion fencing for damage and rectify Investigate habitat adjoining the crossing structure and improve habitat condition and connectivity

7. Monitoring program

Monitoring would be undertaken to determine the effectiveness of mitigation measures and would specifically focus on 'important populations' identified within Section 10 of the project around Wardell to Coolgardie and Bagotville and south of the Richmond River from Rileys Hill to Broadwater National Park (Section 9 of the project). The monitoring program would be refined if new records of Koala populations are located in vicinity to the project.

7.1 Objectives

Monitoring would provide reliable information such that sound conclusions can be drawn in relation to management of the species. Monitoring would be undertaken during the pre-construction (baseline data) and construction phases until such time as the management measures have proven to be effective.

The overall monitoring objectives include to:

- Evaluate the success of mitigation measures against the performance indicators and corrective actions presented in Table 7-2 and evaluate the extent to which these ameliorate primary impacts of the project on habitat loss and connectivity for the Koala.
- Assess the effectiveness of the fauna crossing structures and fauna exclusion fencing to facilitate movement of Koalas across the upgraded highway.
- Determine the extent to which the upgraded highway creates a barrier for the Koala and fragments their habitat, preventing movement and genetic exchange and causing vehicle strikes.
- Determine the extent of secondary impacts of the project on the Koala population (i.e. disease, predation by dogs) and identify any additional mitigation measures that may minimise these impacts.

The monitoring program may be subject to refinement as a result of the performance of the aforementioned monitoring objectives and assessment against the performance indicators and corrective actions presented in Table 7-2. In order to fulfil these objectives a number of ecological variables would be monitored, with each variable discussed below.

7.2 Koala monitoring program

7.3 Koala activity and fauna crossing structures

Monitoring of the targeted Koala connectivity structures (underpasses and overpasses and associated Koala exclusion fencing) would be undertaken to assess their effectiveness to facilitate movement of Koalas across the highway upgrade.

7.3.1 Selection of monitoring locations

Monitoring locations have been pre-selected and include targeted connectivity structures that have been designed for use by the Koala. Monitoring would focus on those structures where Koala populations have been confirmed from the baseline surveys. Structures have been pre-selected (see Table 7-1). However, these sites presented below would be subject to revision following the baseline surveys and would be finalised and presented in the first monitoring report. This may include additional sites to those discussed below. The final selection of sites should ensure that adequate data is provided for comparison of impacts.

Table 7-1 Fauna connectivity structures targeted for the Koala as detailed in the concept design

Project section	Station (km)	Connectivity structure (width x height x length)
9	138.796	Broadwater National Park Fauna Bridge 1 (bridge 90.4 x 12.2m) with fauna fencing from 137800 to 141000
9	139.918	Broadwater National Park Fauna Bridge 2 (bridge 80.3 x 12.2 x 48m) with fauna fencing from 137800 to 141000
9	144.280	RCBC (box culvert 3 x 3m) with Koala furniture and linked with Koala fencing from 142800 to 145120.
10	146.360	RCBC (box culvert 3 x 3 x 44m) with Koala furniture and linked with Koala fencing from 146100 to 159700.
10	146.620	RCBC (box culvert 3 x 3 x 55m) with Koala furniture and linked with Koala fencing from 146100 to 159700.
10	149.227	Wardell Viaduct 4 (twin bridges 18.0 x 11.0m) with Koala fencing from 146100 to 159700.
10	151.933	Wardell Viaduct 6 (twin bridges 18.0 x 11.0m) with Koala fencing from 146100 to 159700.
10	156.006	North Wardell Fauna Bridge (bridge 62.0 x 12.2m) with Koala fencing from 146100 to 159700. Include Koala furniture on the overpass.
10	156.305	RCBC (culvert 3.3 x 1.2 x 52m) with Koala fencing from 146100 to 15970.
10	156.955	RCBC (culvert 1.8 x 1.2 c 53m) with Koala fencing from 146100 to 15970.

NOTE:
1 - Station 157.825 at North Wardell has been updated to station 156.100 in table above.
2 - The culvert at station 144.280 (noted as 144.290 and 144.770 in the Biodiversity Working Paper) have been increased in size. An additional combined culvert has been added at 146.620.
3 – Currently in Section 10 the installation of additional structures are being review.

Critical Koala habitat mapping from Supplementary Biodiversity Assessment (Roads and Maritime 2013) would be reviewed to assess Koala habitat quality adjacent to the alignment at targeted connectivity structure locations. Koala scat searches (using SAT) would be conducted during the baseline Koala surveys completed during the pre-construction phase at the pre-selected monitoring sites. This would guide the final selection of monitoring locations; only locations with confirmed habitat utilisation would be monitored.

At final monitoring locations, three sites would be established (within and either side of the connectivity structure). Unmitigated control sites may be difficult to locate given the extent of fencing and mitigation to be used on the project. If suitable control sites are available this would be determined during the baseline surveys.

7.3.2 Methods, timing, intensity and duration

Baseline Koala surveys would be completed during the pre-construction phase at the pre-selected monitoring sites to establish Koala activity. Monitoring of underpasses and overpasses would be undertaken using the following techniques:

- Two motion-detecting cameras with infrared flash installed either in the centre of the underpasses facing outwards, or either side of the underpasses facing inwards, positioned to capture Koala movements on the ground and on fauna furniture. Cameras are to operate continuously during the monitoring periods. Standardise camera set up to allow comparison with subsequent monitoring events. Cameras would not be installed in combined underpasses (only dedicated), as these are at risk of flooding.
- Scat, track and scratch searches within underpasses (approximately 1 to 2 metres from the end of underpasses to minimise wind and rain disturbance and around fauna furniture) and in adjoining habitat. Searches to be undertaken when installing and checking camera batteries (on once per month during the monitoring periods. Each track identification would be classified as a definite, probable or possible identification. Photographs would be taken of most tracks using a digital camera, allowing for validation of identifications. Scat samples would be sent to an appropriately

qualified/experienced specialist for identification if necessary. Predator scats will be analysed for Koala hair.

- Exclusion fence monitoring: Survey of the Koala exclusion fence for 250 metres either side of the structure to identify and report and breaches and report maintenance requirements.

Sand plots have not been included as part of this monitoring methodology. The inclusion of sand plots would be reviewed following the initial results of the camera monitoring.

The timing of surveys would be selected to coincide with the breeding season and likely juvenile dispersal period of the Koala (September to February and July to August). Koala movements would be expected to be more frequent and extensive during the breeding season and dispersal periods due to expansion of home ranges and movement of juveniles away from natal areas. Therefore, these periods would be likely to represent peaks in fauna movement, resulting in higher rates of usage of connectivity structures and thus higher detection rates.

Fauna crossing structure monitoring would commence six months after installation of connectivity structures (i.e. Veage and Jones 2007). Monitoring would be undertaken annually (in Spring/Summer) for a period. Control sites would be re-surveyed at each monitoring event until structures are proven to be effective in line with adaptive management approach

Additional monitoring may be required in the event the monitoring data suggests an underpass is ineffective in facilitating Koala movement and modification/treatments are required to improve the structural integrity and functionality of the structure.

7.3.3 Performance indicators and criteria

The objectives of the fauna crossing structures are to provide a safe passage for the movement of wildlife, including Koalas, across the highway and to minimise wildlife morality due to vehicle strike, specifically to maintain local and regional wildlife corridors, home ranges and genetic exchange between populations.

Performance of the underpass and overpass structures and associated fauna fencing would be measured by achievement of the following possible outcomes:

- Evidence of use of the designated underpass or overpass by the Koala confirmed to be present in the baseline surveys adjacent to the structure.
- Zero or reduced rate of Koala vehicle strikes in the vicinity of the underpass or overpass.
- No breaches in fauna exclusion fencing or encroachment of shrub or canopy vegetation within five metres of fauna exclusion fencing.

To measure and provide for success in achieving the aforementioned objectives, performance indicators and corrective actions have been set and are provided in Table 7-2.

7.4 Road mortality monitoring

7.4.1 Selection of monitoring locations

Monitoring of Koala mortalities would be undertaken along the project, with particular focus where targeted connectivity structures and Koala exclusion fencing have been designed in Sections 9 and 10 of the project.

The GPS location of each road kill specimen would be recorded and assessed in relation to the closest fauna crossing structure and/or fauna exclusion fence to evaluate their effectiveness.

7.4.2 Methods, timing, intensity and duration

Road mortality monitoring would occur for a period of five monitoring events in the operational stage of the program. The method would involve walking transects along the road edge (500 metres in length) along both sides of the crossing structure and upgraded highway.

A Project Road Mortality Register would be established which would allow for construction personal to report any Koala road mortalities identified during project works.

7.4.3 Performance indicators and criteria

Performance of the fauna connectivity structures in preventing Koala road mortalities would be measured by achievement of a zero or reduced rate from existing rate of Koala vehicle strikes.

To measure and provide for success in achieving the aforementioned objectives, performance indicators and corrective actions have been set and are provided in Table 7-2.

7.5 Habitat revegetation

7.5.1 Selection of monitoring locations

Monitoring locations would be selected at Koala habitat vegetation sites as specified in the project Landscape design to evaluate the success vegetation establishment of the revegetation sites.

7.5.2 Methods, timing, intensity and duration

After the first year of maintenance of revegetation, annual monitoring of revegetated areas in Koala population areas would be undertaken using the BioBanking assessment methodology (DECC, 2008) to evaluate the progress of revegetation against benchmark data for the target vegetation community. These tasks would be integrated into the landscape design for the project, as habitat revegetation would benefit a diversity of species.

BioBanking is a site-based, quantitative and therefore repeatable assessment procedure that provides a numeric score of the condition of native vegetation. Permanent monitoring plots (100 metres x 50 metres) would be established in revegetation areas and assessed for nine site-based vegetation attributes as follows (note the attribute 'number of large trees with hollows' has been removed as revegetation would be from scratch):

1. Native plant species richness.
2. Native over storey cover.
3. Native mid-storey cover.
4. Native ground cover (grasses).
5. Native ground cover (shrubs).
6. Native ground cover (other).
7. Exotic plant cover.
8. Proportion of over-storey species occurring as regeneration
9. Total length of fallen logs.

Revegetation criteria for the site-based attributes would be developed, derived from benchmark data for the target vegetation community.

Monitoring of revegetation areas would commence one to two years after initial establishment and would occur annually (in Spring/Summer) for a period of five monitoring events or until success of the revegetation has been achieved against criteria.

The following information would be collected:

- Record of treatments used, including topsoil source, soil treatment, seeding and planting rates and mixes.
- Photographs of the revegetation areas from permanent photographic points.
- BioBanking site-based vegetation attributes from permanent monitoring plots.
- Slope and erosion.
- Any failure of revegetation works.

7.5.3 Performance indicators and criteria

Success of the revegetation will be measured by achievement of the following outcomes:

- Improvement in measurements of site-based vegetation attributes over-time against revegetation criteria developed for revegetation areas.
- Achievement of revegetation criteria. This includes greater than 70 per cent survival of planted koala feed trees at each site.

To measure and provide for success in achieving the aforementioned objectives, performance indicators and corrective actions have been set and are provided in Table 7-1.

7.6 Evaluation, project review and reporting

Detailed Koala monitoring reports would be prepared outlining the methods and results of the monitoring program.

7.6.1 Responsibility

The contractor(s) employed to undertake the Koala population monitoring for the project would be responsible for the evaluation of the monitoring information collected. Monitoring of fauna crossing structures and habitat revegetation has been anticipated to be undertaken separately for the project, and the success of these mitigation measures would be considered in the evaluation of impacts on the Koala population.

7.6.2 Timing

A brief annual report would be prepared by the contractor(s) for each project for distribution to the Roads and Maritime, OEH and DSEWPaC and document the methods and results from each monitoring period.

A final report would be prepared at the conclusion of the monitoring period. This report would incorporate all the results of the monitoring and recommend any additional measures (if deemed necessary) to facilitate the long term survival of the Koala population in the locality.

7.7 Corrective actions

There is the potential for natural variation in Koala populations for a range of reasons. Further monitoring/assessment would be undertaken if a decline of Koala population numbers is identified as being attributable to the construction and operation of the project. The monitoring / assessment to determine the cause of the decline and/or remedial actions would be commenced as necessary, taking into account potential causes such as dry seasons, population fluctuations and other natural variation, hence the use of unmitigated control sites. The monitoring / assessment would be dependent upon the monitoring already conducted prior to the decline being noted. Any contingency measures to be implemented would be agreed to by the relevant regulatory authorities (OEH and DSEWPaC) prior to being commenced. The corrective actions and responsibilities are listed in Table 7-2.

If during the operational phase Koalas are found to be unable or unwilling to use designated crossing structures provisional options would be developed that could be implemented if research and/or monitoring identify that additional or alternative measures are required.

Depending on the outcome of the monitoring of crossing structures the following four options would be considered in consultation with OEH:

- Maintenance of the existing connectivity measures.
- Modify design of existing measures where feasible and reasonable.
- Consider additional offset measures to improve connectivity elsewhere.

Table 7-2 Performance indicators and corrective actions

Performance monitoring	Performance indicator	Corrective actions	Responsibility
Road mortality monitoring.	A single report of a Koala vehicle strike in the vicinity of the underpass or overpass.	Examine fencing for breach or obstruction with 3 days of report and repair. Compare road mortality at control sites.	Roads and Maritime maintenance responsible for preparing exclusion fencing
Fauna crossing structure monitoring	Monitored population of Koala remain viable but there is little or no use of the designated underpass or overpass. Monitored population of Koala declines although there is evidence of regular use of the designated underpass or overpass No evidence of use of the designated underpass or overpass by the Koala after 3 years. High visitation/usage rates by exotic predators.	Review monitoring methods consider increasing frequency, intensity and duration, to ensure individuals are identified. Review location of the fauna crossing structures and fauna exclusion fencing and consider moving and/or adding structures and extending fencing. Check fauna furniture associated with underpass/overpass for damage and rectify. Investigate habitat adjoining the underpass/overpass. Consider improving habitat condition and connectivity. Check general area, including the underpass/overpass itself, for the presence of predators. Seek advice for predator control.	Roads and Maritime responsible for engaging suitably qualified ecologists to undertake the monitoring and suitably qualified contractors for the maintenance and engaging with regional stakeholders for pest control.
Fauna exclusion fencing monitoring	Breaches in fauna exclusion fencing.	Check fauna exclusion fencing and fauna crossing structures for damage/blockage and rectify.	Roads and Maritime maintenance responsible for preparing exclusion fencing
Habitat revegetation monitoring	Revegetation criteria not been achieved. >30% mortality of planted feed trees	Undertake revegetation maintenance, i.e. replanting, replacing, fertiliser treatment, erosion control, weed control.	Roads and Maritime responsible for engaging suitably qualified ecologists to undertake the monitoring and suitably qualified contractors for the revegetation maintenance.

8. Summary table and implementation schedule

Table 8-1 provides an overall summary of the actions proposed in the above plan. It also identifies the person responsible for the actions and the estimated timing of the project.

The program schedule would be updating following a review of the approval and project timelines.

Table 8-1 Summary table and implementation schedule of management plan

No.	Task	Responsibility	Pre-construction	Construction	Operations				
					Year 1	Year 2	Year 3	Year 4	Year 5
1. Pre-construction management									
1.1	Baseline Koala surveys	Contractor's ecologist	X						
1.2	Preparation of Koala fencing strategy	Contractor's ecologist	X						
1.3	Pre-clearing surveys	Contractor's ecologist	X						
1.4	Identify sensitive ancillary areas and access roads	Contractor and Roads and Maritime	X						
1.5	Dog policy	Contractor and Roads and Maritime	X						
2. Construction management									
2.1	Construction method statements	Contractor		X					
2.2	Construction induction and training	Contractor		X					
2.3	Temporary Koala exclusion fencing	Contractor		X					
2.4	Permanent fauna exclusion fencing	Contractor		X					
2.5	Construction induction and training	Contractor		X					
2.6	Pre-clearing and clearing procedures	Contractor		X					
2.7	Managing Koala / vehicle collisions	Contractor's ecologist		X					
2.8	Koala relocation protocol	Contractor's ecologist		X					
2.9	Location of ancillary facilities	Contractor's ecologist, Roads and Maritime		X					

No.	Task	Responsibility	Pre-construction	Construction	Operations				
					Year 1	Year 2	Year 3	Year 4	Year 5
2.10	Fauna crossing structures	Roads and Maritime		X					
2.11	Fauna crossing structures	Roads and Maritime		X					
2.13	Habitat revegetation	Roads and Maritime		X					
3. Operational management									
3.1	Maintenance of fauna exclusion fencing and fauna crossing structures	Roads and Maritime			X	X	X	X	X
3.2	Maintenance of revegetation	Roads and Maritime			X	X	X	X	X
3.3	Predator control	Roads and Maritime			X	X	X	X	X
4. Monitoring program									
4.1	Selection of monitoring locations	Ecologist	X						
4.2	Koala population monitoring	Ecologist, Roads and Maritime	X	X	X	X	X	X	X
4.3	Fauna crossing structure and exclusion fencing monitoring	Ecologist, Roads and Maritime			X	X	X	X	X
4.4	Habitat revegetation monitoring	Ecologist, Roads and Maritime			X	X	X	X	X
4.5	Road mortality monitoring	Ecologist, Roads and Maritime			X	X	X	X	X
4.6	Evaluation, project review and reporting	Ecologist, Roads and Maritime	X	X	X	X	X	X	X

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10. Acronyms and abbreviations

Acronym / abbreviation	Description
CEMP	Construction Environmental Management Plan
CMS	Construction Method Statements
Cth	Commonwealth
DoPI	Department of Planning and infrastructure
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, People and Communities
EIS	Environmental Impact Statement
EMR	Environmental Management Representative
EMS	Environmental Management System
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FFMP	Flora and Fauna Management Plan
LGA	Local Government Area
NSW	New South Wales
OEH	NSW Office of Environment and Heritage
Project area	Area within the project boundary
Qld	Queensland
Roads and Maritime	Roads and Maritime Service
S/PIR	Suplementary Preferred Infrastructure Report
the project	Woolgoolga to Ballina Pacific Highway Upgrade Project
TSC Act	*Threatened Species Conservation Act 1995* (NSW)
CoA	Conditions of Approval
BACI	Before After Control Impact

Appendix A – Associate Professor Robert Close

ROB CLOSE
MAMMALOGIST / ASSOCIATE PROFESSOR

Australian museum CONSULTING

Qualifications

Ph.D., Macquarie University, 1977

B.Sc. (Hons), University of Adelaide, 1972

Employment History

1996 – present	University of Western Sydney – Associate Professor, School of Biomedical and Health Sciences
1994 – 1996	University of Western Sydney – Senior Lecturer, School of Business and Technology

Professional Experience

My principal field of interest is marsupial biology which includes cytogenetics, formation of new species, hybridisation of existing species, fertility of hybrids, and ecology. My original Ph D research was on the cytogenetics of bandicoots which led to post-doctoral studies of the taxonomy and distribution of this group of marsupials. My main area of research then became rock wallabies (Petrogale) and I have been studying this group since 1976. Since that time, my colleagues and I dramatically changed the taxonomy of the group including the naming of four new species and the discovery of three of them. We also plotted, for the first time, the distributions of many of the species. The research showed that there was some hybridisation occurring at the borders between some of the distributions.

I have conducted a study of koalas in the Campbelltown region since 1990 that has included supervision of graduated PhD student, Steven Ward on his ecological study of koalas in Sydney's South and graduated MSc student Grace Hey for her study of identifying individual koalas from their faecal DNA. We now have 120 animals in the region with individually coloured ear-tags including 8 radio-tracked females. The Campbelltown study has largely been ecological and genetic but has become a community-associated research program, with feedback from the community leading to increased sightings of koalas. I am on 24h call via a pager, the number for which is posted on koala road signs which Campbelltown Council has erected in the LGA. Since October 1995, we have published a weekly column in the Macarthur Advertiser principally describing our koala research, which is important in maintaining the community interaction on which the project depends. The project has developed a momentum that is time consuming and on-going but rewarding in terms of interaction with the University and the community, as well as providing long-term family data for koalas that include four generations of koalas.

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Appendix B - Expert review

AM Consulting Ref: 1300892

23 September 2013

Expert Review of Koala Management Plan

Author: Associate Professor Robert Close

A) Relevant experience

After 15 year's study of mainly bandicoots and rock-wallabies, I began a study of the Campbelltown koala population because it was close to home and I could see it would be an excellent vehicle for under-graduate teaching. Twenty four years later the field study is approaching its end. However, much remains to publish. The study, because it was a low density one (1/10 ha), required community assistance to locate animals for capture, ear-tagging and monitoring. We have received over 2000 community sightings (including many ear-tagged animals), ear-tagged 140, and radio-tracked 30, most of which survived >10 years.

Because of this experience, I was asked in 1999 to join the AMBS team (now Australian Museum Consulting) to conduct research on the effects of the construction of the Pacific Highway upgrades at Yelgun-Chinderah and at Bonville on the respective local koala populations. I stayed with the projects until 2011 (only 2 years with Y2C, the remainder of the time Bonville) when I was one of the authors of the final report (AMBS 2011).

Relevant publications:

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B) Recommendations:

1) Reconsider which sections of the Upgrade require focus.
2) Reconsider suitability of methods for gathering base-line data.
3) Reconsider methods for monitoring roadkill data.
4) Reconsider methods of catching and treating koalas located in the clearing areas.
5) Captured koalas should go to the vet rather than the vet goes to the koalas.
5) Examine side-road fencing.
6) Consider the approaches to the crossing structure.

Rationale for recommendations:

1 & 2) Currently Road Sections 9 and 10 are considered the most suitable areas for focusing crossing structures. This is based on the number of sightings and the number of active sites found during the base-line studies. However, the population densities may be high in Section 9 because dispersal from the area is restricted by the rivers, the sea and the Pacific Highway. I would have liked to see the priorities set by vegetation and potential for dispersing koalas to move without restriction throughout the region. As the MP suggests, koalas are likely to occur all along the 155 km Upgrade in varying densities. Assessing densities of koalas is a very difficult task particularly at lower densities. The method advocated in the MP is the SAT which is a useful technique for detecting presence/ absence and common/uncommon categories; but is not so good for detecting changes unless they are gross. So Section 10 would be a high priority because the highway is the only restriction to movement from the coast to the higher western areas. In sections 7 and 8, likewise, dispersants from the west are only restricted by the highway from moving to and from the coastal forests and the ranges. Sections 3 & 4 are restricted by clearing and the river, while Sections 1 & 2 would receive dispersants from a large area if they could cross the highway. I

would like to see a map on which all the various koala sightings are marked and a vegetation map so that the potential dispersal routes can be visualised.

3) The method of monitoring the effectiveness of the structures from hopefully the absence of roadkills would be more effective if the inspections were more frequent. Ideally the 155 km of highway should be inspected regularly for all species. This could be started now and is the sort of project that a student might take on.

4) At present only the koala trap has been suggested as a means of capturing koalas that are in the clearing zone. However, the trap is only suitable where there are no interlocking branches and the terrain is flat. The method requires regular checks through the night and sometimes the koala will stay aloft for more than one night. It is useful, therefore, to have an extendable pole and flag on hand in case the koala is low in the tree. Catching requires some experience.

5) If an animal is captured it should be placed in a large bag (we use a jute bag from Fodder stores). A check-list should be prepared (clean eyes, clean fur around the cloaca, condition noted {muscle bulge, coat ashy grey rather than brown}, pouch checked, head measured, weight recorded). If in doubt about health, take the animal to the nearest consenting vet. Insert unique combination of ear-tags in koala's ears.

6) Side-roads joining the main highway are a major hazard which can funnel koalas onto the highway. It appears that koalas may choose to follow tracks (Lassau et al 2008 and unpublished observations), perhaps because it's easier to walk and gives better visibility. Short of having a gate across, little can be done except to fence the side-road in conjunction with permanent fencing on the adjacent highway. Alternatively, it might help to remove vegetation from around the road entrance so that the koalas are not attracted.

7) It may help direct the koalas to the structure by having a path leading to it. This path could be maintained by the passage of the camera monitors

C) General notes: The Woolgoolga – Ballina Upgrade (WBU) crosses 155 km of largely coastal country and in doing so separates on its eastern side a large area of forest that includes both Primary and Secondary habitat (WBU koala management plan (WBUKMP or MP). There are two eastern segments: from Woolgoolga to the Clarence River estuary and then from that estuary to the Richmond River estuary at Ballina. Koala Atlas records and recent scat searches show that koalas occur on both sides of the proposed upgrade at regular intervals with the exception of the eastern section from Pillar Valley to Tyndale. That section is largely comprised of Yuraygir National Park. Dispersal in and out of this Park is limited by clearing and the Clarence River which form a western barrier. Why that park has not recorded a sighting is perplexing. However at very low densities, say 1/50 ha, koalas are difficult to detect. Although the number of sightings recorded near the path of the Upgrade is low and might be dispersing males rather than breeding females, it is likely that there will be patches of breeding animals along the route just as there are for the Yelgun-Chinderah Upgrade (AMBS 2011). To avoid genetic stagnation of koalas in the two eastern sections, and to ensure the safety of dispersing animals crossing the road in both directions then functional structures to allow passage must be built. Given the threat of rapid climate change steps should be taken to maximise dispersal amongst as many forest types as possible.

D) Review background information to the project including the EIA and associated Biodiversity Working Paper. These reports were extensive and thorough

E) Agencies' comments: I only commented where there were unresolved differences between the agencies and RMS or where I could contribute to the topic. Section numbers at the start of each query refers to Version RO1 of the MP. The following section should be read in conjunction with the full set of "Agency Comments".

1) Queries re size of underpasses. Clearly the bigger and more, the better for all terrestrial and arboreal animals. RMS response adequate.

2) Query regarding revegetation. RMS responded that properties were still being purchased and decisions were still being made.

3) Comment on priority. I agree that the Bandjalung-Woombah-Ashby link is an important one because there is no river boundary to prevent dispersal from coastal forest to ranges.

4) Request for various maps. RMS gave a vague response to agency. I felt that the koala distribution maps could have incorporated more of the available data. I would have liked to see a vegetation map.

5) Sect 1.1.3. Agency requests expansion of aims. I think they are appropriate.

6) Sect 2.3. Agency want lists of preferred trees for each population. I think that this request is unreasonable. The current list is highly likely to include the main browse trees for each area. A map of vegetation types would have been useful.

7) Sect 2.4.2. Agency wants more info on koala distribution from local sources. RMS responded with a long list of local groups that supplied data. Why then was the map so limited?

8) Sect 2.5. Agency wanted discussion of impacts of side-roads and genetic barriers. Lassau et al (2008) showed more roadkills near entry of side-roads at Bonville. It seems that roaming koalas will use such tracks presumably because it's easier to walk on. Lee et al (2010) showed that highways can be a barrier. However in Lee's situation, the road was some distance from breeding females, few animals are seen in the area and the adjacent vegetation included few known food trees. Even if young male dispersants successfully crossed the road they may never manage to breed. Whereas at Bonville, residents occasionally cross the highway and there is a good supply of young dispersants, some of which would cross safely.

The agency also requested comments on secondary effects of disturbances such as the effects of clearing on road kill. RMS made no response. Some of these effects are potentially serious for the resident koalas (e.g. fertility, disease, fighting). However data from Bonville indicate that koalas are relatively resilient and home-ranges are established soon after the disturbance is reduced.

9) Sect 3.3.2. Agency requested details on choosing fences. RMS responded with plan details of "The koala fencing strategy" (sect 4.3.1).

10) Sect 3.4.3 Agency suggested that escape methods be constructed every 250 m. RMS didn't respond but I suspect that that spacing would be adequate for drop-downs.

11) Sect 3.4.4. Agency asks whether ecologist must be present all day. RMS didn't respond but an ecologist should be present if a koala is in a vulnerable position and looks "uncomfortable". Such animals are likely to descend and move, possibly to a more dangerous position. The ecologist should have proven success in handling koalas (and humans). A project running near to and simultaneously with the AMBS Bonville project generated criticism when local conservationists believed that the welfare of the koalas was being treated as secondary to their scientific value.

12) Sect 3.4.8 The EPA is rightfully very concerned about the distribution, number and size of connectivity structures. RMS referred to the EIS strategy. However, the more crossings the more likely it is that animals will cross successfully. I suspect that the high chance of coming to grief on the road itself overrides the disadvantages of having hydrological structures. That said, purpose-designed structures should be constructed where possible particularly in the critical northern sections of the Upgrade. Furthermore, approach areas to hydrological culverts should be modified by suitable plantings to improve their connectivity quality. See also Recommendation 7.

13) Table 3.1 (5.1 in Plan), generated much discussion about siting of bridges and culverts. The EPA and RMS were largely in agreement over this important issue.

14) Sect 3.4.9. Agency wanted more details on revegetation which was felt to be a very vital issue. The RMS response was vague and I believe necessarily so. Revegetation can be used to re-establish the size and function of an original block of habitat or to develop a corridor to lead koalas to a safe crossing. These 2 uses require different strategies and every site will have its own different features. Such decisions require site by site analysis.

15) Sect 4.1 p.15 Population monitoring discussed. It will be very difficult to monitor changes, particularly in low density areas where there are few base-line data.

16) Sect 4.2.1 Monitoring contd. EPA believes design of monitoring systems requires expert statistical input. As mentioned in 15) above and in the General Introduction, rigorous statistical analysis is often difficult because of low numbers and the variation in the usage of different habitats by koalas. Statistical analysis of road kills was possible at Bonville where the number of dispersing animals was high, whereas at sites in the Yelgun to Chinderah, few data were available.

17) Sect 4.2.2 p16 Monitoring contd. Agencies concerned about methods of surveying. RMS response vague. See Recommendations.

18) Sect 4.2.3 p.16 Objectives. EPA believes two surveys are insufficient to provide base-line data to measure declines in activity levels. See 15) & 16) above. EPA believes that "density is a robust measure". I believe that changes could be detected where the initial densities are high e.g. 1 per ha, but become increasingly less reliable as densities decrease e g < 1/10 ha. I also believe that it is possible that resident koalas whose home-ranges abut the fencing could maintain activity levels while dispersing koalas were being killed on the road. Declines in road-kill rates and camera evidence are the most effective measures of success and the easiest to measure. See recommendations.

19) Sect 4.4.3 (Table7.2) Comments by EPA on Success of Plan. Note: the monitored, resident population may decline as a result of the disturbance then return or be replaced. There also may be a build-up of dispersing animals outside the fence.

20) Sect 4.7 Commitments of Plan: Natural variation in population numbers. Hard to detect given the variation in density measurements. RMS commits to review and consider moving or adding structures, also commits to investigate adjacent habitat and consider improving the habitat quality. Both are big commitments.

21) Sect 3.4.8 (5.3.6 table 5.1) Seeks details of structures, monitoring to demonstrate their success. Table5.1 is comprehensive.

22) Sect 4.4.1 (7.2) DoP wants criteria for Pilot study selection, timeframes, objectives. RMS responds (see sect 7.2) which indicates preselection but with potential for change.

F) Prepare a written review statement on the MP which will provide feedback on the following questions:

a) Is the design of the monitoring project appropriate? See E points 15-19 above. The road-kill method (sect 7.4) could be more valuable if a daily check of each section were undertaken; perhaps commuting volunteers or students could be recruited. Such a system could begin immediately and would deliver much valuable data.

b) Is the frequency and timing of monitoring adequate? See a) above. At present, I doubt whether many data would be collected. Corpses that remain on the road don't last long.

c) Is the MP clear on selection criteria for monitoring sites? For koala activities and crossing structures the sites are pre-selected but apparently still flexible depending on base-line studies. This flexibility is wise. For monitoring road mortalities the MP is vague; for revegetation the MP relies on the project Landscape design (not yet seen).

d) Are appropriate goals being set? Yes, but zero roadkills is unlikely because koalas can still enter the road space at the edges of the fencing.

e) Are the mitigation and management actions sufficiently targeted? Yes fencing, crossing structures and revegetation are all suitable for koalas.

f) Objectives, performance measures, corrective actions and thresholds and corrective actions in accordance with SMART principles? These are appropriate.

g) Do the management measure objectives, performance indicators and thresholds and corrective actions link sufficiently to allow effective implementation?

h) Has the MP provided sufficient evidence where the proposed mitigation has previously been effective? The MP referred to the two similar projects that I am familiar with (Bonville and Yelgun to Chinderah) but did not discuss in any detail any of the several RMS sites where fencing and crossing structures or translocation have been used.

i) Does the MP describe and discuss contingencies should the proposed measures be ineffective? Yes, see E 20 above.

j) If we can't demonstrate mitigation proposed will be effective, can we demonstrate that corrective actions will be effective? That would require a calculated guess for many cases.

k) Where there is no known research /evidence of the effectiveness of the specific measure proposed – have relevant alternative contingencies been committed to?

l) Have indirect impacts been addressed in the MP, as relevant? Yes

k) Are qualifications and experience of authors in subject field relevant? There appears to be no specific experience with major highways but they are otherwise well equipped for the project.

Appendix C – NSW Code of Practice for Injured, Sick or Orphaned Koalas

NSW GOVERNMENT | Office of Environment & Heritage

Code of Practice for Injured, Sick and Orphaned Koalas

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Preface

The Code of Practice for Injured, Sick and Orphaned Koalas (the Code) is intended for anyone authorised by the Office of Environment and Heritage (OEH) to rehabilitate and release koalas (*Phascolarctos cinereus*). It has been developed to protect the welfare of koalas in care and for the conservation of wild koala populations. The Code contains both standards and guidelines for the care of koalas and is designed to be read in conjunction with the *Code of Practice for Injured, Sick and Orphaned Protected Fauna* (OEH 2011).

Koalas are listed as vulnerable under the *Threatened Species Conservation Act 1995*. The koala population in the Pittwater Local Government Area and in the Hawks Nest and Tea Gardens areas are listed as endangered.

Both the *NSW Recovery Plan for the Koala* (DECC 2008) and the *National Koala Conservation and Management Strategy 2009–2014* (Australian Government 2009) have high welfare standards for koalas in care as a key objective. The Code is intended to contribute to this objective.

Compliance with the Code does not remove the need to abide by the requirements of the *Prevention of Cruelty to Animals Act 1979* and any other laws and regulations, for example, the *Local Government Act 1993.*

Compliance with the standards in the Code is a condition of licences issued (under Section 120 of the *National Parks and Wildlife Act 1974* (NPW Act)), to rehabilitate and release sick, injured and orphaned protected fauna. Failure to comply with a licence condition is an offence under the Section 133 of the NPW Act and may result in a Penalty Infringement Notice being issued or the commencement of a prosecution.

The Code has been prepared by OEH in consultation with Friends of the Koala, Koalas In Care, Native Animal Trust Fund, WIRES, Hunter Koala Preservation Society and the Koala Preservation Society NSW. It is also supported by the NSW Animal Welfare Advisory Council within the Department of Primary Industries.

The Code is neither a complete manual on animal husbandry, nor a static document. It will be revised as necessary to take into account new knowledge of animal physiology and behaviour, technological advances, developments in standards of animal welfare and changing community attitudes and expectations about the humane treatment of koalas. OEH will consult with licence holders regarding potential changes to the Code and give written notice when the Code is superseded.

Contents

1. Introduction

This Code sets the standards for the care and housing of koalas that are incapable of fending for themselves in their natural habitat. It comprises both enforceable provisions and guidelines. Enforceable provisions are identified by the word 'standards' and these **must** be followed.

2. Interpretations and definitions

2.1. Interpretations

Objectives

Objectives are the intended outcome(s) for each section of the Code.

Standards

Standards describe the mandatory specific actions needed to achieve acceptable animal welfare levels. These are the minimum standards that must be met. They are identified in the text by the heading 'Standards' and use the word 'must'.

Guidelines

Guidelines describe the agreed best practice, following consideration of scientific information and accumulated experience. They also reflect society's values and expectations regarding the care of animals. A guideline usually indicates a higher level of care than the minimum standard, except where the standard is best practice.

Guidelines will be particularly appropriate where it is desirable to promote or encourage better care for animals than is provided by the minimum standards. Guidelines are also appropriate where it is difficult to determine an assessable standard. Guidelines are identified in the text by the heading 'Guidelines' and use the word 'should'.

Notes

Where appropriate, notes describe practical procedures to achieve the minimum standards and guidelines. They may also refer to relevant legislation.

2.2. Definitions

In this Code:

- ***Fauna rehabilitator*** means someone who is either authorised by a fauna rehabilitation group or zoological park or is individually licensed by OEH to rehabilitate and release protected fauna.
- ***Fauna rehabilitation*** means the temporary care of injured, sick or orphaned fauna with the aim of successfully releasing it back into its natural habitat.
- ***Fauna rehabilitation group*** means an incorporated group that is licensed by OEH to rehabilitate and release protected fauna.

- ***Park*** means a national park, historic site, state conservation area, regional park, nature reserve, karst conservation reserve or Aboriginal area, or any land acquired by the Minister under Part 11 of the NPW Act.

3. Case assessment

Refer to Section 4 of the *Code of Practice for Injured, Sick and Orphaned Protected Fauna* (OEH 2011).

4. Rescue

Objective

To conduct a koala rescue so as to minimise further stress and injury to the animal.

4.1. Standards

4.1.1 Prior to a rescue attempt, the rescuer must assess the risks to the koala from environmental hazards and from capture.

4.1.2. Rescuers must employ the correct rescue equipment for the condition and location of the koala and be trained in its use.

4.1.3. The following methods must not be used to capture a koala:

- noosing with a rope that tightens
- shaking the tree
- cutting the tree down.

4.1.4. The rescue attempt must be suspended if the koala is exhibiting signs of stress (e.g. crying or panting).

4.1.5. If the koala is a suspected orphan, the surrounding area must be searched for the mother. If the mother is found and is healthy, attempts must be made to reunite it with its young.

4.1.6. If the koala is an injured female with signs of having a pouch young (e.g. swollen teat), the surrounding area must be searched for the young.

4.1.7. Rescuers must not move a healthy, independent koala unless it is at immediate risk of injury (e.g. on a road). Such relocations will involve moving the koala a safe distance from the hazard and placing it in a climbable tree.

4.1.8. If multiple koalas are rescued (e.g. on a fire ground), the containers the koalas are placed in must be labelled with the capture location.

4.2. Guidelines

4.2.1. The rescue of a koala should not be attempted unless at least two trained personnel are involved.

4.2.2. If the koala has not been captured after being pursued for 10 minutes, the rescue attempt should be suspended to allow the koala to recover.

4.2.3. Rescuers should take steps to protect the koala from additional stressors such as onlookers, loud noises, other animals and extremes of temperature during rescue.

4.2.4. A koala should be picked up from behind using a towel or blanket and held firmly by the wrists/forearms.

Notes

A canvas bag, blanket or towel is suitable for catching a koala on the ground.

A long pole with flagging at one end is suitable for encouraging a koala that is close to the ground to move down.

A hoop net is suitable for catching a koala in a difficult location.

A ground trap is suitable for a koala that is too high to flag

Covering a koala's eyes with a towel, blanket or bag will often assist with calming it down.

Researchers are responsible for the welfare of the koalas covered by their animal research authority. It may be useful for researchers to establish a relationship with local rehabilitation groups should such an animal require rescue.

5. Transport

Objective

To minimise further stress and injury to a koala during transport. This section applies to all movement of the koala including from the point-of-rescue to a veterinary surgery and between rehabilitation facilities.

5.1. Standards

5.1.1. The transport method and container size must be appropriate for the size and condition of the koala. For example:

- an orphaned pouch young requires an artificial pouch that is secured within a container (e.g. cage, box or basket). Artificial heat (e.g. a hot water bottle) may also be required
- an adult or sub-adult requires a padded container.

5.1.2. The container must be designed, set-up and secured to prevent injuries to the koala. Hessian sacks must not be used as the koala's claws can become entangled and threads can be inhaled.

5.1.3. The container must be designed to prevent the koala from escaping.

5.1.4. The koala must be placed upright in the container.

5.1.5. The container must be kept at a temperature which is appropriate for the age and condition of the koala. For example:

- a range of 20–25^{o}C is appropriate for an adult in most circumstances
- a range of 28–32^{o}C is appropriate for an unfurred pouch young.

5.1.6. The container must be ventilated so air can circulate around the koala.

5.1.7. The container must minimise light, noise and vibrations and prevent contact with young children and pets.

5.1.8. The koala must not be transported in the back of uncovered utility vehicles, car boots that are separate from the main cabin or on the rescuer's lap.

5.1.9. The container must be constructed from material that can be easily cleaned and disinfected.

5.2. Guidelines

5.2.1. A container used for transporting an adult or sub-adult koala should contain something for the koala to hold on to (e.g. a rolled up towel).

5.2.2. An adult koala should be transported with fresh eucalyptus leaves to assist with calming it.

5.2.3. Koala transport should be the sole purpose of the trip and undertaken in the shortest possible time.

6. Euthanasia

6.1. When to euthanase

Objective

To end a koala's life in situations where death is imminent, or recovery is impossible, or the likelihood of successful reintegration into the wild population is remote, or the animal poses an unacceptable health risk to wild animals.

6.1.1. Standards

6.1.1.1. A koala must be euthanased without exception when:

- death is imminent or highly likely regardless of the treatment provided, or
- it is suffering from chronic, un-relievable pain or distress, or
- it is carrying (or suspected to be carrying) an incurable disease that may pose a health risk to wild animals, or
- it is permanently unable to consume leaf unaided due to an injured jaw or missing/worn teeth.

6.1.1.2. A koala must be euthanased (unless OEH has granted permission to hold it in permanent care) when:

- there is no suitable release location, or
- its ability to reproduce is lost due to an injury, disease or procedure, or
- it is permanently incapable of climbing trees due to a missing or injured claws, digits, limb, pelvis or back bone, or

- it is permanently vision-impaired, hearing-impaired, or anosmic (can't smell) such that it is unable to survive in its natural habitat, or
- its ability to handle branches is permanently impaired due to a missing or injured digits, or
- its advanced age renders it unable to survive in its natural habitat.

In certain exceptional circumstances, OEH may grant permission to hold such animals in permanent care. See the *Rehabilitation of Protected Fauna Policy* (DECCW 2010) for details.

Notes

A koala with a late-stage Chlamydia infection is extremely difficult to cure and poses a health risk to wild koalas.

The age of a koala can be determined through examining pre-molar and molar wear using a tooth-wear chart. For an example see Figure 8.4 in Vogelnest and Woods (2008).

6.2. How to euthanase

Refer to Section 7.2 of the *Code of Practice for Injured, Sick and Orphaned Protected Fauna,* (OEH2011).

6.3. Disposal of carcasses and animal waste

Objective

To dispose of waste so that the risks of disease transmission are minimised.

6.3.1. Standards

6.3.1.1. Carcasses and organic waste suspected of disease contamination or that have been exposed to chemicals (e.g. barbiturates) must either be incinerated or buried at a depth that will prevent scavengers from reaching them.

6.3.1.2. A koala that has died from disease or chemical means (e.g. barbiturate overdose) must not be fed to other fauna.

6.3.2. Guidelines

6.3.2.1. A deceased koala should undergo a necropsy if the cause of death is uncertain.

7. Care procedures

7.1. Monitoring

Objective

To check the health of a koala undergoing rehabilitation so that issues can be promptly identified and managed. The type and frequency of monitoring will vary with the type of injury or illness and required treatment.

7.1.1. Standards

7.1.1.1. A dependent koala (i.e. pouch young) or a koala in intensive care must be monitored repeatedly during the day and weighed at least twice per week.

7.1.1.2. An independent juvenile koala or a koala in intermediate care must be monitored at least once per day and weighed at least once per week.

7.1.1.3. A koala being prepared for release must be monitored at least every few days to determine if it is physically and behaviourally ready for release (See Section 11 Suitability for Release).

7.1.1.4. Rehabilitators must regularly monitor the temperature within an enclosure that contains thermal support, to ensure that temperatures, appropriate to the animals' condition, are maintained (e.g. blankets, hot water bottles and electric heat mats).

7.1.2. Guidelines

7.1.2.1. On admission, a koala should be checked for:

- bleeding, puncture wounds or matted wet-looking fur
- bone fractures
- rapid breathing or elevated heart rate
- dilated pupils or erratic eye movements
- enlarged lymph nodes
- pale or blue mucous membranes
- cold extremities
- ticks
- discharge from the eyes, nostrils, mouth or cloaca
- odd smells.

7.1.2.2. Monitoring a koala should entail:

- manually assessing body condition and demeanour
- checking for signs of injury, disease and parasites
- assessing hydration using the 'pinch test'
- determining how much leaf has been consumed
- noting the quantity and quality of scats and urine
- looking for indications of activity.

7.2. Controlling disease transmission between animals

Refer to Section 8.2 of the *Code of Practice for Injured, Sick and Orphaned Protected Fauna* (OEH2011).

8. Husbandry

8.1. Food and water

Objectives

To ensure that the koala has a feeding and watering regime that encourages rapid recovery, supports growth if it is a juvenile and assists with the maintenance of foraging behaviour necessary for survival in the wild.

8.1.1. Standards

8.1.1.1. Clean, fresh drinking water must be available at all times and changed daily, except in the case of dependent young (See Section 9.1.1.7).

8.1.1.2. Water containers must be designed and positioned so as to avoid spillage and contamination and must be appropriate for the size, age and mobility of the koala.

8.1.1.3. Fresh leaves must be available for the koala to eat at all times and replaced daily, except in the case of dependent young. Leaves may be harvested every few days and stored prior to use.

8.1.1.4. Stored leaves must not be accessible to pets, pests and wild animals and must be protected from contamination and nutritional and moisture loss (i.e. stored in containers of fresh water for a maximum of three days).

8.1.1.5. Leaves from at least two different eucalyptus species must be offered to the koala each day. At least one of these species must be a preferred eucalyptus species sourced from the area in which the koala was found.

8.1.1.6. Branches must be placed in holders that contain clean water. The water must be emptied and re-filled as necessary to keep the leaf hydrated.

9.1.1.7. A hand-reared koala must be fed a milk formula that is appropriate for its stage of development.

8.1.2. Guidelines

8.1.2.1. Leaves from non-eucalyptus food trees that are sourced from the area in which the koala was found should be offered as a supplement.

8.1.2.2. Milk supplements should be offered to an adult koala in the intensive and intermediate care stages.

8.1.2.3. Contaminant-free dirt and bark should be offered to a koala in the intermediate and pre-release stages.

8.1.2.4. The choice of eucalyptus species offered to a koala should be varied every few days.

8.1.2.5. Leaves should be sprayed with water before being offered to a koala.

8.1.2.6. Both young and mature leaves should be offered to a koala.

8.1.2.7. Leaves should not be collected from the side of a major road as they are likely to be contaminated.

8.1.2.8. Leaves should not be dragged across the ground as they may become contaminated.

8.1.2.9. If multiple koalas are kept within the same enclosure, branches should be placed in different locations so that all koalas can feed simultaneously.

8.2. Hygiene

Refer to Section 9.2 of the *Code of Practice for Injured, Sick and Orphaned Protected Fauna* (OEH2011).

9. Housing

9.1. General requirements

Refer to Section 10 of the *Code of Practice for Injured, Sick and Orphaned Protected Fauna* (OEH2011).

9.2. Intensive care housing

Objectives

To reduce activity for a short period of time in order to facilitate frequent monitoring, treatment, feeding and re-hydration. It is suitable for severely injured or diseased adults and orphaned pouch young.

9.2.1. Standards

9.2.1.1. Intensive care housing must provide sufficient space for the koala to sit upright and to stretch its body and limbs, but not enough space to crawl around.

9.2.1.2. Intensive care housing must contain a prop for the koala to hold on to (e.g. a shortened branch with a fork for an adult and a stuffed toy for a juvenile).

9.2.1.3. Intensive care housing must provide a constant temperature appropriate to the age and nature of the illness or injury.

9.2.1.4. The temperature in intensive care housing must be regularly monitored using a thermometer and electrical heat sources must be regulated by a thermostat.

9.2.1.5. A koala in intensive care housing must experience a light-dark cycle that replicates outside conditions.

9.2.1.6. Intensive care housing must be designed and/or positioned so that visual and auditory stimuli are reduced (e.g. by covering the animal with a towel and placing it in a quiet room).

9.2.1.7. Intensive care housing must be adequately ventilated without allowing excessive drafts.

9.2.1.8. Substrate used in intensive care housing must be replaced daily.

9.2.2. Guidelines

9.2.2.1. Intensive care enclosures should have floor dimensions of at least 0.7 m long by 0.7 m wide.

9.3. Intermediate care housing

Objectives

To provide a mobile koala with enough space to allow some physical activity while enabling it to be readily caught for monitoring or treatment.

9.3.1. Standards

9.3.1.1. Intermediate care housing must provide sufficient space for the koala to move about freely whilst being conveniently sized for capture.

9.3.1.2. Intermediate care housing must contain at least one branch with a fork and one horizontal pole.

9.3.1.3. A koala in intermediate care housing must experience a light-dark cycle that replicates outside conditions. This may be achieved by using a well-lit room or constructing an enclosure in a sheltered area outside.

9.3.2. Guidelines

9.3.2.1. Intermediate care enclosures should have floor dimensions of at least 2 m long by 1 m wide.

9.4. Pre-release housing

Objectives

To give the koala the opportunity to regain its physical condition, acclimatise to current weather conditions and practise natural behaviour. At this stage of rehabilitation, interactions between the koala and humans will be greatly reduced.

9.4.1. Standards

9.4.1.1. Pre-release housing must provide sufficient space for the koala to move about freely, express a range of natural behaviours and withdraw from undue conflict with co-housed koalas.

9.4.1.2. Pre-release housing must provide areas where the koala can gain exposure to prevailing weather conditions and locations where it can shelter.

9.4.1.3. Pre-release housing must contain habitat that enables the koala to perform a range of natural behaviour. A koala requires at least two tree forks to allow climbing.

9.4.1.4. Pre-release housing must be designed and/or positioned so that exposure to humans is kept to the minimum required for monitoring, feeding and cleaning.

9.4.2. Guidelines

9.4.2.1. Pre-release enclosures should have floor dimensions of at least 4 m long by 3 m wide and provide at least 3 metres of usable vertical space.

9.4.2.2. Pre-release enclosures should contain a variety of natural branches oriented both vertically and horizontally. Branches should have different thicknesses and textures.

9.4.2.3. Leaves should be positioned in such as way as to encourage exercise.

9.4.2.4. Pre-release enclosure walls should be smooth, at least 1.5 m high and at least 2 m from the nearest branch to prevent escape.

10. Suitability for release

Objectives

To ensure that the koala is physically fit and possesses the appropriate survival skills prior to its release. Preparations for a koala's release will start at the time of rescue and continue throughout the rehabilitation process.

10.1. Standards

10.1.1. A koala must not be released until it is physically ready. This status has been achieved when:

- it has recovered from any injury and/or disease (e.g. climbs normally)
- its weight is within the appropriate range for that age (koalas are normally independent at 18 months of age weighing 3.5–4 kg)
- its body score is 3 (fair) or better as determined by scapula, cranial and limb musculature examination
- it has appropriate fitness levels as determined by observation
- its pelage is adequate for survival in its natural habitat (i.e. fur covering the entire body)
- it has acclimatised to prevailing climatic conditions.

10.1.2. A koala must not be released until it is behaviourally ready. This status has been achieved when:

- it can recognise and consume eucalyptus leaves unaided
- it can recognise and successfully avoid predators (including pets)
- it is not attracted to humans (i.e. not humanised) or to sights, sounds or smells that are specific to captivity (i.e. not imprinted)
- it can climb effectively.

10.1.3. A koala's readiness for release must be confirmed by either a veterinarian or experienced fauna rehabilitator.

11. Release considerations

11.1. Timing of release

Objectives

To ensure that a koala is released as soon as it is ready and at a time that minimises stress and maximises their chances of survival in their natural habitat.

11.1.1. Standards

11.1.1.1. Once a koala is deemed ready for release, it must be released as soon as conditions are suitable (see 11.1.1.2).

11.1.1.2. A koala must be released when weather conditions encourage high activity levels. Release during extremes of temperature and storms must be avoided.

11.2. Release site selection

Objectives

To ensure that the wild koala population and natural environment are not negatively impacted by the release of the koala. The welfare of the rehabilitated koala after release is a secondary consideration.

11.2.1. Standards

11.2.1.1. If the exact location where the koala was found is known and it is a suitable environment for release, it must be released there.

A suitable environment for release is one that:

- contains appropriate habitat and an adequate number of food trees
- is occupied by other koalas
- does not place the koala at a high risk of injury (e.g. a suburban park surrounded by busy roads).

11.2.1.2. If the exact location where the koala was found is known but it is an unsuitable environment for release, the koala must be released in a suitable environment as near as possible to this location, without transporting it across a physical boundary that it would not normally cross (e.g. a river) or further than it would normally move (10 km for adults; 30 km for hand-reared sub-adults).

If there is no suitable environment within 10 km (adults) or 30 km (hand-reared sub-adults) of the rescue location, the koala must not be released.

11.2.1.3. If only the general location where the koala was found is known and it contains or adjoins a suitable environment for release, the koala must be released there without potentially transporting it across a physical boundary that it would not normally cross, or further than 10 km (adults) or 30 km (hand-reared sub-adults). If the general location where the koala was found is wider than 10 km (adults) or 30 km (hand-reared sub-adults) at its widest point, the koala must not be released.

11.2.1.4. If there is no information about where the koala was found, it must not be released.

11.2.1.5. A koala can only be released in a park if:

- it was originally found in that location
- the release has written consent from the relevant National Parks and Wildlife Area Manager (issued under section 9 of the National Parks and Wildlife Regulations 2009)
- the release complies with the relevant OEH policies on translocation and environmental integrity.

These conditions also apply to the release of a koala in a location where it might reasonably be expected to immediately enter a park (e.g. on a property adjoining a park).

11.2.2. Guidelines

11.2.2.1. A koala should be released in an area that is connected to other suitable koala habitat.

11.2.2.2. If a koala is going to be released in a different area from where it was found, rehabilitators should first survey the area for resident koalas. A sub-adult koala should not be released into the home range of an adult koala.

Note

Rehabilitators who wish to release a rehabilitated or hand-reared koala further than 10 km (adults) or 30 km (hand-reared sub-adults) from where they were found require a translocation approval issued by OEH (under section 132c of the NPW Act).

11.3. Release techniques

Objectives

The use of release techniques that facilitate successful reintegration into the wild population. The collection of information regarding the fate of rehabilitated koalas after release so that the relative merits of different rehabilitation and release techniques can be compared.

11.3.1. Standards

11.3.1.1. Rehabilitators must arrange for the koala to be ear-tagged prior to release (numbered swivel sheep tags are appropriate).

11.3.2. Guidelines

11.3.2.1. A hand-reared koala should be soft released. This can involve putting the koala into a food tree that is surrounded by a temporary fence. After a few days the fence can be removed.

11.3.2.2 A hand-reared koala should be released with a similarly aged koala with which it has been housed.

11.3.2.3. Rehabilitators should not release multiple adult koalas at a single location, as increased competition is likely to have a detrimental effect on the existing koala population.

11.3.2.4. A koala should be fitted with a micro-chip prior to release. Rehabilitation groups and zoological parks are encouraged to develop post-release monitoring programs to determine survivorship.

Note

All research involving protected fauna requires a licence issued under section 132c of the NPW Act and an ethics approval issued under the *Animal Research Act 1985*.

12. Training

Refer to Section 13 of the *Code of Practice for Injured, Sick and Orphaned Protected Fauna* (OEH2011).

13. Record keeping

Refer to Section 14 of the *Code of Practice for Injured, Sick and Orphaned Protected Fauna* (OEH 2011).

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Appendix D - Guidelines and Conditions for Koala Care in NSW

GUIDELINES AND CONDITIONS FOR KOALA CARE IN NEW SOUTH WALES

June 1997

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1. INTRODUCTION

1.1 Standards for the care of koalas

Many reasons have been identified for caring for koalas, including the need to maintain the health and integrity of local populations, the personal satisfaction of rehabilitating and returning a koala to the wild, a moral responsibility for care, an emotional involvement, a commitment to community quality of life and spirit, and the public expectation of government responsibility for both the welfare of individual koalas and for ensuring the long-term survival of koala populations in the wild.

Koalas may require assistance as a result of disorientation through loss or fragmentation of their habitat, disease, injury (often associated with traffic or dog attack), death of a mother with dependent young, bushfire, or the necessity to relocate a koala away from a highly dangerous location. Koala welfare incorporates issues such as rescue, care, hand raising, rehabilitation and release. It is desirable that every temporarily disadvantaged wild animal is given the best available care to maximise its chances of successful return to the wild. In the case of a high profile and vulnerable species like the koala, it is vital to set and maintain the highest standard of care. The koala is listed as a Vulnerable species in New South Wales under the *Threatened Species Conservation Act 1995*. These conditions and guidelines have been prepared to assist in the recovery of this species.

From a welfare viewpoint, the primary aim of wildlife rehabilitation is to return each individual to the wild population with maximum chances of survival. The length of time a koala is held, the means by which it is held and the place of release are crucial factors. Beyond these principles, there are many points that need to be addressed so that there is consistency among individuals and among groups. This document draws together the considerable experience of koala care that exists in the community and frames the conditions of care in the context of this skill and understanding.

1.2 Legislation and policy

The koala is a protected species under the *National Parks and Wildlife Act 1974* and it is an offence to harm a protected species and the definition of "harm" in the legislation (in addition to its normal meaning) includes hunt, shoot, poison, net, snare, spear, pursue, capture, trap, injure or kill. The legislation also imposes restrictions on holding protected fauna, including for the purpose of rehabilitating an animal which is incapable of fending for itself. When a person comes into possession of a sick, injured or orphaned protected species, such as a koala, but has not been licensed to rescue, hold and rehabilitate protected fauna by the National Parks and Wildlife Service, or a licensed wildlife rehabilitation organisation, they are legally required to notify the Director-General of the National Parks and Wildlife Service in writing within seven (7) days and to comply with any direction given. In the case of a koala, in every situation, directions will be given that it immediately be passed to a skilled licensed/authorised koala carer.

Since the mid-1980s the New South Wales National Parks and Wildlife Service has supported the establishment of specialist wildlife rehabilitation organisations. These train their members in the skills of animal care and wildlife rehabilitation, authorise appropriately trained and skilled members who have the necessary facilities and other resources to care for particular groups or species of animals and then supervise and monitor their activities. These groups also ensure that their members are kept up-to-date with advances in wildlife rehabilitation techniques and encourage peer liaison. There are now over 20 such organisations in NSW and some have regional branches. It is only in a very rare situation, and generally only in a region which does not have a licensed rehabilitation organisation, that the Service will licence an individual to care for sick, injured or orphaned native animals.

These conditions and guidelines refer to the care of koalas by carer groups for the purpose of rehabilitation to the wild, rather than for captive management in zoos or fauna parks. Also they were not written to be binding on researchers, who are subject to the *Animal Research Act 1985*, but where those aspects of research protocols require care and handling of koalas these guidelines may be utilised. to fulfil those requirements. This will particularly apply when a researcher and a carer group are working co-operatively.

These conditions and guidelines are consistent with the Australian and New Zealand Environment and Conservation Council (ANZECC) 1996 *Draft National Koala Conservation Strategy* and contribute to fulfilling Objective 5: 'To manage captive, sick or injured koalas and orphaned wild koalas to ensure consistent and high standards of care'. Thus, although parts of this document carry conditions that are binding in New South Wales, it has also been prepared to assist koala carers, other interested parties and the relevant authorities in other states. In doing so, it has provided a worked example of the welfare aspect of wildlife management, a need made explicit by Objective 5 of the *Draft National Koala Conservation Strategy*.

This document has been prepared in two parts: 1) guidelines, and 2) formal conditions for koala care in New South Wales. Both parts have been prepared in conjunction with carers, veterinarians, Service officers and other interested parties through an extended period of negotiation, including workshops, discussions and a wide circulation of drafts for critical comment. The acknowledgments section lists the participants in this process.

Part 1) The guidelines, which outline the concerns, points of interest and importance for koala care. They were prepared to assist carer groups in their detailed response to comply with the conditions when seeking accreditation.

Part 2) *The formal conditions for koala care in New South Wales are presented in italics at the end of each section*. Accreditation is a formal requirement under the *National Parks and Wildlife Act 1974* and is administered through the Field Services Division of the National Parks and Wildlife Service. These are the conditions that need to be met by carer groups prior to, or to preserve, accreditation.

Each of the following topics is dealt with in two parts. The first contains the guidelines, which are in a normal typeface; the other part, which is in italics, states

the condition that must be satisfied to obtain or maintain accreditation as a koala care group in New South Wales.

2. REQUIREMENTS FOR CARERS

Everyone who cares for koalas must be appropriately skilled and have appropriate facilities, access to reliable sources of a variety of recognised koala food tree species and an ability to collect it.

2.1 Training

- Training for new carers should cover all aspects of the care that they will be expected to undertake, and may consist of one or all of the following options:
    a) Carers course/workshop;
    b) Apprentice System (one-on-one training with an accredited carer or fauna park);
    c) Experience in koala hospital situation in districts where this is possible;
    d) Voluntary work in fauna parks or zoos where this is possible.
- Training should cover all aspects of handling, observation, restraint, treatment and tree identification and leaf collection.
- Training should include an assessment of competence and be appropriately recorded.

Conditions: New carers must be trained by an accredited carer or group.

2.2 Licensing

Carers and carer groups in NSW require licences from the NPWS (Wildlife Licensing Unit, NPWS, PO Box 1967, Hurstville NSW 2220) Phone (02) 9585-6481, FAX (02) 9585-6401.

Conditions: New carers must be registered in a licensed group. The group must provide a detailed training program and a list of all registered carers as requirements to gain or continue to hold a licence.

2.3 Accreditation

- An independent Accreditation Committee will be established by the National Parks and Wildlife Service to undertake the accreditation of organisations and in the case of appropriate groups, their regional branches. (Only in special cases will individuals, not part of a group, receive accreditation.) This Committee will comprise at least a Service officer, a carer and a veterinarian.
- Koalas will not be permitted to be held by groups or individuals who have not been accredited to care for koalas. An accreditation system will be established to ensure that each carer group and individual carers are accredited as having the expertise and facilities etc, to provide excellent care for koalas.
- An accredited group/branch will be required to establish its own Accreditation Committee to review the credentials of each of its own carers.

- Koalas will be permitted to be cared for only by accredited carers. Each accreditation committee will establish grievance procedures and undertake grievance resolution.
- Trained and accredited wildlife rescuers may rescue a koala and transport to a vet or accredited carer, or hold temporarily.

Conditions: An independent Accreditation Committee, established by the National Parks and Wildlife Service, and consisting of at least a carer, veterinarian and a Service officer, will undertake the accreditation of organisations applying for accreditation. A carer group is to set up an accreditation committee, keeping all appropriate records (such as minutes and correspondence). The formal procedures for accreditation need to be listed by each committee and this must be used in the accreditation of each carer or carer group.

2.4 Facilities

- Homecare specific requirements - facilities must be available for: intensive care, intermediate care and rehabilitation.
- Individual carers need not have all facilities, but all should be available within a care group.
- Facilities are to be checked for suitability by the co-ordinator in the accredited care group.
- If possible, a carer is to have no dogs or cats and the facilities must be in a quiet area. If they are owned by the carer, then they should never have contact with koalas which are in care.

Conditions: All facilities for each stage of care must be available within a group. A detailed list of facilities must be prepared as part of the accreditation process. Each carer must have their facilities checked for suitability by the group co-ordinator and a record kept.

3. LIAISON WITH VETERINARIANS

- Carers should advise vets that they are an accredited carer and offer assistance.
- Common experience and practice shows that an authorised or experienced person is often required to restrain and feed the koala while in veterinary care.
- Carers should be respected for their expertise, but should not tell vets what to do. Rather, they should advise on the best practice, including medication and restraining.
- When koalas are taken directly to the vet, by the public (including police, RTA and council workers), the vet should notify the carer group in the area.
- The carer group has a responsibility to disseminate current information on koala care and a list of experienced vets in koala care to all vets in the area.
- Vets should not hold koalas in care if there are appropriate care facilities available in the carer group.
- Within veterinary facilities, koalas should be in isolation and vets should not hold koalas in pet kennel areas.
- Carers must respect veterinary advice on euthanasia of koalas, but retain the right for a second opinion from another vet.

- Vets instructions relating to medication should be adhered to.
- No animal medication, human medication, ointment or herb should be administered to a koala in care unless it has been approved by a vet.

Conditions: Carers must advise the vets in the area of their existence, what information is available and the best procedures for koala care. Carers must respect the vet's professional rights and responsibilities.

4. RESCUE

- Members of the public who find a sick, injured, orphaned or otherwise distressed koala should note its location and condition and contact the local koala care group or the National Parks and Wildlife Service as soon as possible. Members of the public should not attempt to capture or transport the animal.
- The carer group should attend ASAP with proper catching gear, restraining and transport equipment.
- Carer groups should ensure that all vets, RTA, RSPCA, police and firefighting in the area have the contact numbers of the group.

4.1. Criteria to rescue

- Sick, injured and orphaned wild koalas which are unable to fend for themselves should be rescued.
- Extreme care should be taken when rescuing orphans that the mother is not nearby.
- Juvenile koalas with weights estimated in excess of 3 kg should not be rescued on the grounds of being orphaned.
- Wild koalas should not be handled or moved unless considered absolutely necessary. An example of a dangerous situation would be a koala on a median strip on a highway.
- If a koala is in an unusual place but appears healthy and in no immediate danger it should be left alone and its location reported to the carer group or the National Parks and Wildlife Service.
- Koalas in a research program are the responsibility of the researcher under the *Animal Research Act 1985*. Contact can be made with the researchers to discuss their project or liaise with the researcher via the NPWS District Manager. Research koalas may not be rescued unless by prior arrangement with the researcher. It is in the interests of the researcher to notify the local carers of the program and to discuss contacts and actions should an animal in the program be found sick or injured or in a dangerous situation. If a carer, or anyone, considers that the welfare of a koala in a research program is being neglected, they should contact the researcher and discuss options for change. If that proves unsatisfactory, the concerned person should then contact the chair or secretary of the Animal Care and Ethics Committee (ACEC) that gave the authority to the researcher.

Conditions: Only koalas which have a poor chance of survival from obvious signs of injury or disease, or that are orphaned, or that are in a dangerous location, may be

rescued. No koala known to be covered by an Animal Research Authority may be rescued without consent of the researcher.

4.2. Catching and retrieving injured animals

- Always assess the danger to the rescuer.
- Ask bystanders to stand back and remain quiet. Rescuers must be assertive but not aggressive to onlookers. Rescuers should explain what is happening with the animal.
- Use a blanket or cloth bag to wrap the animal - first place it over the head when catching so the risk of biting to the rescuer is minimised.
- Pick the koala up from behind. A koala can be picked up safely from behind by the lower forearms. Alternatively, bring the koala to the ground and hold it on the ground and ease into an appropriate catching bag. Do not pick up from the front by the ribcage or wrists.
- Put in a carrybox or similar properly-secured container.
- Prop animal up with towels into sitting position.
- Avoid unnecessary handling and avoid loud noise, dogs and unnecessary photos.
- Be conscious of possible injuries, such as fractures, when handling injured animals.
- If attending a road accident at night, rescuers should wear bright-coloured clothing to reduce the risk of being hit by other vehicles, or use a reflective sign.

Conditions: Procedures for catching and retrieving koalas must be specified by the carer groups in seeking accreditation. Procedures should include methods of catching, holding and securing for transportation. Koalas may only be handled by an authorised person.

4.3. Transport

- The koala must be restrained in containers for transport. Suitable containers include garbage bins with plenty of large holes for ventilation and air circulation; two clothes baskets tied together; or custom-made koala boxes.
- In emergency situations, hessian bags are suitable but not preferred- a light canvas bag or large pillowcase is adequate. Do not use hessian bags to contain koalas unless there is no alternative as they can damage claws and shed fibres that can be inhaled. Do not transport koalas suffering burns in canvas bags.
- Koalas are not to be transported on the body of carers.
- The koala should be kept dark, quiet, and warm (15-25 degrees Celsius).
- Do not transport the koala in the boot , or with dogs in the vehicle, or with the radio on.
- Be conscious of the time factor - act quickly and get the animal to a vet or carer by the most direct route.
- If possible, transport the koala with leaves picked from the area. The smell may relieve some stress.
- Do not leave koalas in any container for a long period.
- Ensure that the koala and container are out of direct sunlight when being transported.

- Koalas should not be moved from home care unless for treatment or to an external location within the home care premises or for the purposes of pre-release or release to the wild.

Conditions: Each koala care group is to establish detailed criteria under which koalas are to be transported.

5. CRITERIA FOR ENTERING CARE OR FOR EUTHANASIA

- The following questions should be asked:
    a) Should the koala be released immediately?
    b) Is it able to be rehabilitated?
    c) Is euthanasia the best welfare option?
- The decision on the fate of the koala is to be made by the carer and a vet and/or koala coordinator.
- In deciding, a note is to be taken of the animal's past history if its identification is known (eg. by microchip or eartag).
- Reasons for euthanasia include:
    a) No chance of a normal life, eg. loss of tongue, limb;
    b) Signs of extreme pain and stress;
    c) Serious and multiple wounds eg. from dog bites which usually become infected.
- Euthanasia to be performed by a vet.
- If a fire victim, burns on paws are not always evident for a couple of days, so the animal should be held for later assessment.

Conditions: The decision to take a koala into care or to euthanase is to be made by the carer and a veterinarian and/or group co-ordinator. The carer group must review each decision to assist in refining the decision making process. A record of the reasons for decision must be kept on a standard record form.

6. CARE

There are three stages in the care of koalas:

1. First 12 hours - may be temporary care following rescue;
2. Next 48 hours - koalas are considered wild in care;
3. Long-term care (greater than 48 hours) - koalas are considered captive;

The conditions for long-term care require a substantial commitment of resources, time and record keeping. The only reason for long-term care is that the koala is likely to improve in health and be rehabilitated to the wild.

Conditions: Detailed specifications, record sheets, inspection procedures and care protocol need to be formally established for koalas in long-term care as a requirement for accreditation.

6.1 Assessment

- The initial assessment of the koala needs to be thorough but should be performed with as little disturbance as possible.
- Check the pouch to see if a joey is attached to the teat. If so, do not anaesthetise the mother.
- Koalas should be assessed for wounds, fractures (including jaw area), ticks, swollen lymph glands, anaemia (check colour of gums) as well as more obvious signs such as wet bottom and conjunctivitis.
- Koalas should be weighed. Normal body weights vary across the koala's range. Carers should be aware of the normal body weights for different ages and sex of the koalas in their area.
- *Chlamydia* status can be checked by the clinical presence of conjunctivitis and wet bottom. Clearview test kits may help.
- Dehydration can be critical in sick animals. Hydration status can be assessed by changes in skin tone. In normal condition, the skin over the scapula (shoulder blade) area should slide freely and, when pinched, skin on the top of the head, between the ears, should snap quickly back to place. Dry rough skin on the paws and nose is a sign of dehydration.
- Body condition can be assessed by palpation over the scapula area. In poor condition, the edges and spine of the scapula become prominent.
- Body temperature can be checked. Normal body temperature is 35.5-36.5°C.
- In care having been assessed by a vet.
- There should be a monthly review of koalas in long-term care by the carer group co-ordinator and records to be kept of the decision to remain in care.
- Mature/aged koalas in excess of 8 years, particularly males, should not be held in captive conditions for more than 6 months.
- Koalas in care for more than 6 months should be re-evaluated.
- A check list for assessment should be prepared by the care group. An opportunity exists here for an exchange of information among care groups as to what should be on this list.

Conditions: The health status of the koala must be assessed to decide what treatment the koala requires. A decision must be made and recorded by the carer as to whether the koala is to be released within 48 hours or to go into long-term care.

6.2. Holding /Housing

- Minimum standards should be identified by the group and deal with all aspects of holding and housing. The Standards for Exhibiting Koalas set by NSW Agriculture (Appendix 1) may be used as a guide. Standards should be set for conditions under temporary holding, normal care, intensive care and long-term care.
- Many issues have been identified for consideration. These include:
    - a quiet environment;
    - not accessed by the public;
    - walls and floors should be constructed of materials which can be easily sterilised;
    - design to be such that temperature is controlled, with natural lighting and ventilation;
    - use of lawn lockers, garages and laundries are not suitable.

- Koalas in care for more than 12 hours should be contained in housing more structured than the conditions necessary for the rescue and holding in the first 12 hours.
- Depending on the state of the animal, a licensed carer is to decide how the animal is to be housed. Temporary housing may include baskets, cots or enclosures.
- Diseased koalas should be housed in isolation from other koalas.

Conditions: The minimum standards for enclosure design and management must be prepared by each carer group as a requirement for accreditation. This must include housing requirements for koalas under intensive care as well as non-intensive care, temporary holding and long-term care.

6.3. Diet

6.3.1. Fluid balance

- Dehydration can be critical in sick animals. The following are offered to rectify and maintain positive fluid balance.
- Drip under veterinary supervision.
- Subcutaneous fluids under veterinary supervision.
- Oral fluids can be administered, such as "Lectade" and "Portagen". Dehydrated koalas which don't recognise free water should accept fluids via a syringe.
- Koalas should be encouraged to lap fluid from a shallow container. Feeding by unnatural methods, such as syringes and eye droppers, should be restricted to animals which are incapable of lapping.
- Milk supplements should only be given to injured, sick, dehydrated or juvenile animals.
- Other ways to restore and maintain positive fluid balance are:
    a) feed younger leaves;
    b) spray leaves with water before offering;
    c) ensure leaves are as fresh as possible and standing in water.

6.3.2. Dietary supplements

- Supplementary feeding with:
    a) "Portagen"/ high protein baby cereal. If adding high protein baby cereal, changes in faeces should be closely monitored; excess use can cause diarrhoea.
    b) "Wombaroo"
    c) Glucose and water
    d) "Divetelac"
    e) "Prosobee"
    f) Yoghurt in the milk mixtures.

6.3.3. Leaves

- Offer three to five species a minimum of twice daily in areas where this is possible. Wet the leaves with water spray, and stand leaves in container with water supply. Also offer a supply of clean bark, water and dirt, unless on a drip or immobile.

- Leaves are to be collected from trees in such a manner as not to destroy the bush. Leaves should not be collected from the roadside where they are likely to be contaminated with high levels of lead.
- A list should be prepared of preferred koala browse leaves available in the area of the carer group.
- Carers should demonstrate that they have guaranteed access to adequate supplies of fresh leaves.
- Koalas should be offered the leaf species found in the potential release area.

Conditions: The diet, method of feeding and source and species of leaves must be codified by the carer group as a requirement for accreditation.

7. ORPHANED/HAND-REARED KOALAS

- A hand-reared orphan is back or pouch young raised by a carer.
- Orphaned koalas present the problem of knowing the right age or weight for release. Koalas are normally independent at 18 months (2-3 kilograms; the range generally represents the geographical increase in weight from north to south. However, local population variation on weight is acknowledged and in establishing criteria for orphans, local background data are to be included in the submission for accreditation.) The age or weight at release should not be greater than the age or weight at which the koala would normally be independent of its mother. However, orphans from diseased and aged koalas, or mothers who have been sick or injured for some time before being found, are usually debilitated, dehydrated and hence small for their age and slow to grow. On the other hand, orphans from road kills are often well fed and developed and adapt well to hand rearing. Thus discretion must be taken when assessing the weight/age of orphans.
- The regular weighing of an orphan to ensure adequate weekly weight gains, observing progress, independence and activity should help indicate the time for release.
- The date of release and hence the length of time the koala is kept in care is an issue, especially if it coincides with the tick and breeding season. For males, this release time could cause extra stress. Alternatively, this is the normal time for dispersal and establishment for males.

Conditions: The age or weight at release of orphaned koalas must not be greater than the age or weight at which the koala would normally be independent of its mother. Carer groups must establish criteria for identifying, caring for and releasing an orphan, including a weight that is appropriate for the local area, as a requirement for accreditation.

8. PUBLIC EXHIBITION

At no time should koalas being rehabilitated for eventual release be placed on public exhibition or used for educational purposes. Contact with humans should be minimised at all times to ensure koalas maintain a healthy fear of human presence.

Conditions: Koalas in care undergoing rehabilitation must not be placed on public exhibition or be used for educational purposes.

9. CRITERIA FOR RELEASE

- At regular intervals the carer and vet must consult on the welfare and state of the animal. Communication must be maintained between carer, co-ordinator and vet to decide on release date.
- A set of criteria to assess ability to be released to be developed by each carer group.

For example:

Category	Criteria for release
Age	> weaning age (2 kg)
Teeth wear	not worn down to gums (Vet assessment required for old koalas)
Eyes	bright, clear, clean
Ability to climb	must be able to climb - check for healing of injuries
Ability to feed	independent feeding - check for healing of jaw injuries
Chlamydia status	absence of wet bottom/ conjunctivitis/ swollen lymph nodes
Body weight maintenance	consistent with age and history and holding body weight
Behaviour	appears alert, ears up, etc.
Signs of capture stress, need to be released immediately	pacing behaviour, vocalisations

- Release at the earliest opportunity. For koalas in long-term care, animals may be retained for one week after treatment has finished to monitor if symptoms return.

Conditions: Koalas must be released at the earliest opportunity, after having satisfied the criteria for release.

10. PRE- RELEASE

10.1 Rehabilitation for koalas in long-term care or hand-reared

- Exercise wherever possible. Koalas with fractures should be in an area where it is at least able to walk after 6-8 weeks.
- Appropriately sized tree forks and cross branches should be available to the koala to match its development and confidence. These should be renewed whenever possible so that the bark is fresh.
- Hand-reared koalas should be gradually weaned into different stage trees and away from contact with the carer.

- Koalas in long-term care or hand-reared are to be placed in a rehabilitation area for a period of tree climbing under normal weather conditions prior to release. They should have access to the ground so they become familiar with travelling on the dirt and grass. Koalas should display natural behaviour as much as possible.
- Capture at night when the koalas come down to the ground is a good option to reduce stress and injury.

Conditions: Koalas in long-term care or hand-reared must be placed in a rehabilitation area for a period of tree climbing under normal weather conditions prior to release.

10.2 Identification

- All koalas must be ear tagged. Ear tagging should be done, if possible, a couple of days before release. Koala ears are to be clipped and prepped with alcohol prior to tagging. Males are to be tagged in the left ear, females right ear. The tag should be placed with the point to the front of the ear so the tagger can check for veins and target the tag away from them.
- Ear tags must be numbered so that individual animals can be identified.
- Ear-tagging is to be applied only to koalas which are already in care and only by a trained person or under the supervision of a veterinary surgeon or a National Parks and Wildlife Service officer with appropriate experience, or a researcher holding a current Research Authority from an accredited Animal Care and Ethics Committee. A koala may not be captured for the sole purpose of tagging without both a Research Authority from the National Parks and Wildlife Service and an appropriate Research Authority from an Animal Care and Ethics Committee.
- Records must be kept of all tagged koalas.
- All koalas may be microchip, ie. a microchip inserted with a needle beneath the skin and read with an electronic microchip reader.
- Plucked hair for genetic studies of population is acceptable, and a convenient time to do this is while the koala is being marked, eg tagged and/or microchipped. The easiest way to pluck the hair is with tweezers of a pair of pliers to make sure that the bulb of tissue at the base of the hair is attached. It is this tissue that is analysed. Eight to ten hairs are sufficient, and on or around the ear can be a convenient site.

Conditions: Koalas must be ear tagged prior to release by an appropriately trained person and records kept. The record form needs to part of the submission for accreditation.

11. RELEASE / RELOCATION

- Koalas should be released as close to their original encounter location as possible so that the animal has a reasonable opportunity to resume life in its original home range.

- Relocation should only be considered as a last resort to remove a koala from immediate and imminent danger or threat and where the koala is considered to be independent and appears to be in a healthy condition. The decision to relocate must be made by two people.
- A potential relocation or release site should not be a site of known high danger or threat (eg. beside a busy road). The original capture site can create dilemma for release if it is deemed to cause recurring injury over the short-term (eg. in a killer dog area or near a black spot on the road).
- A potential relocation site should preferably have secure tenure and compatible land management.
- A potential relocation site should be one known to already support a population of koalas.
- Relocations should be part of an approved strategy or local koala management plan which should consider potential adverse effects associated with manipulation of gene pools, spread of disease, potential inability of a koala to cope with relocation, potential disruption of resident koalas at the relocation site and potential destabilisation of koalas at the encounter site due to removal of a key individual. Care groups should prepare a list of potential relocation and release areas (where site of origin unknown), if there is no local strategy, and gain approval of district office of the National Parks and Wildlife Service and relevant landholders.
- The district office of the National Parks and Wildlife Service should be notified of the proposed release of all koalas so they have the option to attend.
- Release of koalas within Service areas will generally not be approved unless it is consistent with a Plan of Management or the animal was originally recovered from the area.
- Knowledge of koala habitat and any previous release or relocation of the animal is essential for deciding on relocation.
- Koalas which are suffering from a communicable disease should not be relocated to an area outside its home range.

Conditions: The site of release of koalas must be as close to the initial encounter site as possible except for koalas being relocated out of immediate danger. The release of all koalas must be made in consultation with the district office of the National Parks and Wildlife Service.

12. OPTIONS FOR NON RELEASABLE KOALAS

- Option 1 - Euthanasia is acceptable for all suffering animals. If no possibility of reasonable care , euthanasia is the preferred option.
- Option 2 - Released into "safe" areas - eg rehabilitation or feral proof areas.
- Option 3 - Place into a licensed zoo or fauna park, which already holds a captive colony of koalas, with approval from the Director-General of NPWS.
- Option 4 - Used for teaching with approval from an Animal Care and Ethics Committee to be obtained by the recipient of the non-releasable koala .
- Option 5 - Used in research programs with approval from an Animal Care and Ethics Committee to be obtained by the recipient of the non-releasable koala.

Conditions: Koalas deemed to be non-releasable must be either euthanased or, following the recipient obtaining an appropriate authority or licence, be placed in a licensed zoo or fauna park, kept in a "safe area" and/or used for teaching and research.

13. PROTOCOL FOR DEAD KOALAS

- Often when a carer is contacted, the koala is already dead, usually killed by a car or a dog. The information on blackspots is valuable to record, and samples from these koalas can contribute to research. Collect all relevant information, where possible, such as location, cause of death, date, sex and aged of koala.
- Samples are to be made available for research, where possible.
- An autopsy protocol is to be established. All koalas should be autopsied where cause of death is not positively known. An option that can be utilised is the Wildlife Pathology Service (University of Sydney free service).

Conditions: Autopsies must be undertaken where possible, a protocol established, and animals or tissues made available to researchers.

14. RECORD KEEPING

- Each koala must be given a registration number, call number or identifying code at rescue.
- Each carer should keep records of all animals which come into their care and a database should be kept by one nominated person to register and regularly update all details within each group. Records should be kept in duplicate, eg. hardcopy and on disc. Copies should be provided to the district NPWS on a regular basis, who then send these at least annually to the licensing unit in Field Services Division in Head Office.
- Records should be kept on standard forms. The care group should develop a detailed standard record form(s) for individual carers.
- The following details should be recorded: time and date of rescue, location of rescue, name and phone numbers of initial contacts, rescuers and carers, circumstances for being taken into care, approximate age, weight, sex of the koala, condition of the koala, treatment undertaken, veterinary details, daily records of eating, urinating, defecating, observations and approximate volumes, treatments and dosages, type of leaf offered and eaten, identification tag number, fate including release or relocation details or autopsy results.
- Recording of the original location of koalas, including details of habitat, on Atlas of NSW Wildlife data cards is encouraged.

Conditions: A standard record sheet must be prepared for each rescued koala. Each koala rescued must be given an identifying code. The record sheet must accompany the koala and a copy kept in a central record system of the carer group. The care group must develop a detailed standard record form(s) for individual carers as a requirement for accreditation.

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APPENDIX 1

Standards for Exhibiting Koalas

(Phascolarctos cinereus)

in New South Wales

Exhibited Animals Protection Act, 1986

A publication of the Director-General, NSW Agriculture
pertaining to the conditions of display of koalas
(pursuant to Clause 8(2) of the Exhibited Animals Protection Regulations, 1995

GENERAL REQUIREMENTS

1.1 Construction

a) Enclosures shall be constructed of such materials and be maintained in sufficiently good repair to ensure that they will contain the animals at all times and are to be safe for the animals, for the staff attending them, and for the public.

b) Enclosures, or the perimeter fence in the case of an establishment where koalas are permitted to free range, shall be designed in such a way as to prevent the entry of wild koalas. This requirement only applies to establishments located in areas where wild koalas are known to occur.

c) Enclosures may be of open, semi-enclosed or totally enclosed design.

d) Sufficient shelter must be provided to allow protection from wind, rain and extremes in temperature and allow sufficient access to shade during the hot periods of the day.

e) The size and shape of enclosures for *P.cinereus* shall provide freedom of movement, both vertically and horizontally.

f) The enclosure shall be well drained and have either a readily cleanable substrate or be of a material which can be replaced to avoid the accumulation of faeces and urine.

1.2 Isolation Facilities

Suitable isolation facilities shall be provided for quarantine of incoming or sick animals.

1.3 Protection from Noise, Harassment and Stress

Each operator exhibiting koalas to the public shall:

a) Provide a sufficient number of experienced, identifiable staff in attendance at any session allowing visitors to handle koalas to protect the koalas from abuse and harassment where koala handling occurs and to ensure that stress on the koalas does not occur.

b) Ensure koalas are not placed directly on any visitor or directly held by any visitor for any purpose. Handling koalas by members of the public shall be restricted to patting, stroking and cuddling to the extent of putting an arm around the koala while the animal remains on a fixed perch.

c) Ensure that koalas are not repeatedly removed from objects to which they are clinging.

1.4 Enclosure Furniture

a) There must be at least two tree forks per koala not less than 1.8 metres above ground and not closer than 0.9 metres to the next fork.

b) All supports and branches shall provide sufficient traction for koalas to climb easily and safely.

Clause 2 Hygiene

Substrate of enclosures shall be cleaned daily. The supports and branches shall be replaced as necessary and be maintained in a clean and hygienic condition, free from the accumulation of faeces and urine.

Clause 3 Records

3.1 Identification

Each koala shall be individually identified by an approved method of identification.

3.2 Record-Keeping

a) Establishments shall keep records of all koalas on an individual basis in a form which can be quickly and easily examined, analysed and compared with those kept by other establishments.

b) All documents and other information pertaining to each animal, including records from previous locations, must be kept safely. Animals moving to new locations must be accompanied by copies of all records relevant to those animals.

c) The records shall provide for each koala at least the following information:

   i) the correct identification number, scientific name, any personal name and any distinctive markings;

   ii) the origin (i.e. details of the wild population or of the parents and their origin, and of any previous location);

   iii) the dates of acquisition and disposal, with details of circumstances and addresses;

iv) the date or estimated date of birth, and the basis on which the date is estimated, or the date of the first emergence of the juvenile from the pouch;

v) weight on arrival, and thereafter monthly. The requirement for weighing animals monthly shall not apply to koalas which are either free-ranging within the perimeter barrier of the establishment, or are not dependent on hand-feeding for nourishment.

vi) clinical data, including results of physical examination by a qualified veterinarian and details of and date when any form of treatment was given, together with results of routine health examinations;

vii) breeding and details of any offspring;

viii) the date of death and the results of the post mortem reports which must be performed by a qualified veterinarian.

d) The Director-General may require records of daily leaf collections to be maintained, including details of -

i) leaf species,

ii) area of collection,

iii) weights of leaves before and after feeding,

iv) the identities of the koalas which fed on the leaves.

Records may be required to be submitted to the Director-General at three monthly intervals for a period of two years from the date of initial issue of a permit to exhibit koalas.

3.3 Transaction Records

a) A written report, including records of any clinical observations, shall be submitted to the Director-General within 30 days, on every transport operation, in particular detailing any problems arising and with suggestions as to how these may be avoided.

b) The Director-General must keep a current summary of transport advice, based on these reports and provide a copy to applicants for their information.

Clause 4 Diet and food collection

4.1 General

a) An establishment applying for a permit to exhibit koalas must satisfy the Director-General that it has guaranteed access to adequate fresh supplies of leaves from at least three suitable koala food tree species. This is important when particular species can be susceptible to insect attack at particular times of the year. Known food trees include the species listed below:

E.botryoides	Southern Mahogany
E.camaldulensis	River Red Gum
E.camphora	Broad-leafed Sally
E.citriodora	Lemon-scented Gum
E.cypellocarpa	Mountain Grey Gum
E.goniocalyx	Long-leafed Box
E.grandis	Flooded Gum
E.haemastoma	Scribbly Gum
E.maculata	Spotted Gum
E.microcorys	Tallowwood
E.nicholii	Small-leafed Peppermint
E.obliqua	Messmate
E.ovata	Swamp Gum
E.paniculata	Grey Ironbark
E.pilularis	Blackbutt
E.propinqua	Small-fruited Grey Gum
E.punctata	NSW Grey Gum
E.radiata	Narrow-leafed Peppermint
E.robusta	Small Mahogany
E.rubida	Candle Bark
E.saligna	Sydney Blue Gum
E.scoparia	Wallengarra White Gum
E.sideroxylon	Red Iron Bark
E.tereticornis	Forest Red Gum
E.viminalis	Manna Gum

b) A sufficient quantity of eucalypt leaves shall be provided continuously and replaced at least once daily.

c) Preferred species of eucalypt should be supplemented by a variety of different species of eucalypt as a precaution against local or seasonal differences in digestibility and palatability of dietary leaf matter. Both young and mature leaves should be provided.

d) Feed must be presented as close and accessible to the koalas perch as possible and care taken to prevent wastage of feed placed out of reach.

e) Fresh soil shall be provided, but not around the base of perches, to provide for supplementation of mineral intake or alternatively a mineral salt lick be provided.

f) Clean accessible drinking water facilities shall be provided. Water shall be replaced at least once daily.

4.2 Quality of Food Leaves

Frequency of leaf cutting and the operation of leaf storage facilities shall ensure the koalas receive palatable, uncontaminated, nutritionally adequate food leaves.

Clause 5 Transport

5.1 Quarantine

a) Koalas to be transferred between establishments must be subject to a period of 30 days quarantine at either the importing or exporting establishment unless an exemption from the quarantine period is advised and certified by a veterinarian following a complete veterinary examination.

The certificate must also establish that the koala is -

i) not in a weakened or emaciated condition; and

ii) is free from
- keratoconjunctivitis,
- pneumonia,
- dermatitis, and
- urogenital discharge,

before release from quarantine.

5.2 Transport Cage

Koalas must be transported individually in solid framed cages measuring at least 95cm x 75cm x 95cm high. The cages must have removable, leakproof metal drop trays fitted at the base. Sides and top must be of stout wire mesh and be fitted with light hessian or shadecloth covers. Each cage must be fitted with a resting branch providing at least two forks.

5.3 Feeding in Transit

a) Koalas must each be accompanied by at least 3.6kg of the leaves on which they are normally fed; the leaves being left on the stem and the base of the stem remaining in water or sealed.

b) One kilogram of these leaves must be placed in the cage with the koala before departure.

5.4 Stress Reduction

a) Koalas must not be subjected to temperatures greater than 30 degrees or less than 10 degrees Centigrade during the trip.

b) Koalas must be accompanied by a keeper familiar with the animals being transported at all times except during air transport.

c) Noise must be minimised during transport.

d) Time from caging to destination must be minimised.

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