Koala Plan of Management

Nelson Bay Road upgrade, Bobs Farm to Anna Bay (Stage 3)

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Front Cover Photograph: Blackbutt Forest within the proposed Nelson Bay Road upgrade development footprint

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1 INTRODUCTION

1.1 Purpose

Niche Environment and Heritage (Niche) was engaged by the NSW Roads and Maritime Services (RMS) to prepare a Koala Plan of Management (KPOM) to minimise impacts to the Koala from the Nelson Bay Road Upgrade, Bobs Farm to Anna Bay (Stage 3) Project. The Koala Plan of Management will be included in the Construction Environmental Management Plan (CEMP).

1.2 Background

The NSW Roads and Maritime Services (Roads and Maritime) propose to widen the existing Nelson Bay Road (MR108) between Cromarty Lane, Bobs Farm and Port Stephens Drive, Anna Bay (a distance of approximately 4 km) to a divided, dual carriageway. This project is Stage 3 of the Nelson Bay Road, Bobs Farm to Anna Bay upgrade, with the previous two stages having been completed to the southwest of the proposal.

An ecological assessment conducted by Lesryk (2012) identified that the subject site contained potential Koala habitat, as identified in the Port Stephens Comprehensive Koala Plan of Management (Port Stephens Council 2002).

Niche (2013) undertook a supplementary ecological assessment of the Nelson Bay Road Upgrade Stage 3 study area and found that the project will result in removal of 0.7 hectares of habitat that qualifies as "Core Koala Habitat" and 4 hectares of habitat that qualifies as "Supplementary Koala Habitat" as per the Port Stephens Comprehensive Koala Plan of Management (Port Stephens Council 2002). The 'Core Koala Habitat' also meets the requirements for 'habitat critical to the survival of the Koala' (DSEWPaC 2012). Additionally, while no koalas were recorded within the subject area by Niche (2013) or Lesryk (2012), an opportunistic survey by RMS Environmental Officers in October 2013 recorded five Koala scats within the subject site, adjacent to Trotter Road (immediately adjacent to one of the proposed underpasses). Koalas were recorded within the study area, although at a relatively low density at most sites. From Koala SAT plots, Niche (2013) determined that Koalas occur on both sides of Nelson Bay Road and widening of the road will increase fragmentation. Niche (2013) made a number of recommendations to minimise the effect of the road project on the ecology of the area.

In relation to Koala management, Niche (2013) recommended:

- Preparation and implementation of a Koala Plan of Management.
- Pre-clearance surveys, specifically targeting the Koala.
- Installation of two fauna underpasses.
- Installation of 'Floppy top' fauna exclusion fencing.
- Implementation of ecological monitoring of the Koala within the local landscape including satellite tracking of at least four Koalas.

1.3 Management Objectives

The objectives of this Koala Plan of Management are to:

- Identify potential threats to Koalas during pre-construction, construction and operational phases of the project; and
- Provide mitigation measures and procedures to minimise impact to any Koala found during pre-construction, construction and operational phases of the project.

1.4 Koala Populations within the locality

Port Stephens Shire is considered to have one of the most significant Koala populations in New South Wales (Lunney and Reed 1990).

A "Draft Koala Plan of Management for Port Stephens" (Callaghan *et al*. 1994) reflected the first substantial attempt to address the longer term management requirements of the Port Stephens Koala population. In preparing this plan, a shire-wide community Koala survey was undertaken. The plan linked koala habitat with land use zonings and demonstrated the need for scientifically rigorous foundations to underpin Koala planning and management at a shire-wide level.

Lunney *et al*. (1998) defined, ranked and mapped the distribution of koala habitat in the Port Stephens Shire by merging a field survey and community based survey. Koala habitat was categorised as “Preferred Koala Habitat”, “Supplementary Koala Habitat, “Marginal Koala Habitat”, “Unknown Habitat Quality”, “Other Vegetation” and “Mainly Cleared Land”. The study recommended that areas of Preferred Habitat are afforded the highest level of environmental protection available. It is also necessary to recognise that Supplementary Habitat is widespread and requires protection, with possibly fewer development constraints compared to Preferred Habitat. The majority of the Nelson Bay Road Stage 3 study area has been mapped as “Mainly Cleared” however some of the study area is mapped as either “Supplementary Koala Habitat” or “Unknown Habitat Quality”.

The “Port Stephens Comprehensive Koala Plan of Management” (Port Stephens Council 2002) follows on from the "Draft Koala Plan of Management for Port Stephens" (Callaghan *et al*. 1994) and notes that the Port Stephens area has been identified as one of the richest koala sites in the state, and the Tilligerry Peninsula contains prime habitat which supports one of the state's last viable populations.

Matthews *et al*. (2007) monitored fifty-five koalas by radio-tracking for up to 35 months between March 1994 and February 1997, shortly after the extensive wildfire in the area in January 1994. Swamp Mahogany (*Eucalyptus robusta*) was the tree species most frequently used by koalas, particularly at night and by breeding females. Another commonly-used tree species was Smooth Barked Apple (*Angophora costata)*. Females were more frequently sighted in *E. robusta*, Broad-leaved Paperbark (*Melaleuca Quinquenervia)* and Parramatta Red Gum (*E. parramattensis)*. Males were more frequently sighted in Red Bloodwood (*C. gummifera)*, Sydney Blue Gum (*E. signata*) (and its hybrid *E. haemastoma*/*E. signata*), and Blackbutt *(E. pilularis*). Of the two preferred food tree species recognised by Phillips *et al*. (2000) for koalas in Port Stephens, Parramatta Red Gum was used by 11 females and 11 males, and Swamp Mahogany was used by 26 females and 21 males. Breeding females used Swamp Mahogany, Blackbutt and Broad-leaved Paperbark more than other members of the population. Koalas used a wide range of tree sizes, from less than 10 cm DBH to greater than 90 cm DBH, but preferred trees of larger diameter (>30 cm). They used significantly

taller trees during summer. The study showed that resource depletion from intense wildfire is short-term for Koalas because within months of the fire they utilised burnt trees for both food and shelter.

Koalas were recorded within the study area by Niche (2013), although only at a relatively low density at most sites. From the Koala SAT plots, it is known that Koalas occur on both sides of Nelson Bay Road, thus the proposal will require the introduction of effective movement barriers and corridors to allow for the safe movement of Koalas across the road corridor.

2 POTENTIAL THREATS TO KOALA

2.1 Review of threats to Koala during road construction

NSW Office of Environment and Heritage (2013) list the following threatening processes for the koalas in NSW:

- Loss and degradation of habitat;
- Urban and semi-urban development;
- Fire, drought and disease;
- Road deaths and predation by dogs; and
- Climate variability.

Specifically in the Port Stephens area, the following processes have been identified as significantly contributing to the decline of the Koala:

- Dog mortality; responsible for 43% of deaths in Lunney et al. (2004).
- Mortality from planned and unplanned fires; while the specific contribution of deaths from fires has not been quantified, population viability modelling suggests that fires at the current frequency will result in a population extinction within 50 years (Lunney et al. 2007).
- Habitat removal for urban development;
- Road injuries and deaths, which in 2012 are estimated to be at least 35 animals;

The most significant disease in koala populations is Chlamydia, a highly infectious bacterial disease. Koalas in NSW usually carry Chlamydia pathogens but do not always show clinical signs of disease. They may develop symptoms such as conjunctivitis and urogenital tract infections as a result of:

- loss of habitat;
- harassment by predators;
- starvation or malnutrition; and
- overcrowding.

Knowledge of the impacts and threats to Koalas from roads has been studied in Eastern Australia. AMBS (2011) and Lassau et al. (2008) conducted detailed investigations into the impact of roads on koalas along the Pacific Highway. The main findings of this investigation were:

- Koalas can and do maintain home-ranges right to the edge of the Pacific Highway.
- Highways and other cleared landscape features tend to be used as home-range boundaries by roadside Koalas and are rarely crossed by the local residents.
- Koala road mortalities are largely concentrated in the coinciding dispersal season (sub-adults) and breeding season (adults), which is August to October in coastal northern NSW, but may be different in other parts of Australia.
- Other sources of mortality (e.g. Chlamydia) can be higher in roadside Koalas than road mortality.
- 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.

- The genetic variation in roadside Koalas in the Yelgun to Chinderah and Bonville study areas prior to these 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).
- Construction activities (in particular, habitat removal) indirectly affected individual Koalas, including the death of at least one animal, the alteration of home ranges and behaviour of others and possibly mortality as a result of home range adjustments.
- Vegetation clearing and construction may operate with other factors, including other vegetation clearing or logging, to create cumulative impacts on a Koala population.
- Of a total of 12 animals that were monitored over a 12 month period, ten animals died, predominantly from vehicle impacts and dog attacks.

AMBS (2011) predicted that the main potential impacts of road construction or widening are:

- direct mortality;
- loss of habitat;
- indirect mortality (increased stress leading to increased disease rates);
- fragmentation of habitat;
- genetic isolation; and
- behavioural modification.

The AMBS (2011) study of the impact on koalas in the Bonville study area of the Pacific Highway upgrade showed that two individuals were very close to the construction zone and it is likely that parts of their home-ranges were removed during the vegetation clearing. Both Koalas crossed the highway at least once and displayed very large home-range sizes during the construction phase (more than twice the average for male Koalas during Phase 1), with clear alterations to the home range of at least one animal. Behaviour and mortality of other Koalas suggests the potential for a 'domino effect', with increased competition for optimum habitat, territorial disputes, and increased stress levels for resident Koalas (AMBS 2011). Typically home ranges in productive Coastal Blackbutt (*Eucalyptus pilularis*) forest are around 10 hectares for females and 20 hectares for males (Lassau et al. 2008).

2.2 Pre-Construction Phase

The Pre-Construction Phase will include the following works (Hills Environmental 2012):

- Marking out the limit of works on site;
- Installation of geotechnical instrumentation to monitor settlements;
- Erection of temporary sediment control structures such as sediment fencing and establishment of site compound and facilities including satellite offices and sheds;
- Temporary works to facilitate construction including access tracks within the disturbance footprint where no clearing is required;
- Installation and/or relocation of utilities;
- Removal of existing concrete kerbs and structures and establishment of traffic management measures;

- Demolition of structures on acquired land;
- Removal of trees;
- Installation of protection fencing for trees to be retained within the works footprint;

2.2.1 Direct Impacts

- Vegetation clearing – loss of habitat and risk to Koalas within the particular habitat;
- Koala mortality – during tree clearing or by equipment during preparations
- Degradation of habitat (i.e. edge effects)
- Fragmentation of habitat requiring increased movements

2.2.2 Indirect Impacts

- Increase in disease occurrence due to stress
- Genetic isolation
- Behavioural modification due to presence of pre-construction works

Measures to mitigate these potential impacts are outlined in Section 3.

2.3 Construction Phase

The Construction Phase will include the following works (Hills Environmental 2012):

- Stripping and stockpiling of topsoil by bull dozers, graders, scrapers, loaders and trucks;
- Reconstruction, removal, extension and construction of culverts where required, including inlet and outlet treatments;
- Cleaning existing formed drainage, both existing culverts and reeds/weeds in drainage channels;
- Construct new carriageway including cut and fill works, import and placement of road base and compaction by rollers and vibrating compactors with trimming by graders or profilers;
- Application of wearing surface by pavers and rollers;
- Divert traffic from existing carriageway to new carriageway;
- Removal of existing road surface as required for reconstruction of existing carriageway;
- Recycling of suitable excavated material and incorporation of unsuitable material in earthworks within the road reserve where possible;
- Forming of new kerbs, gutters, medians and other structures such as signs and bus bays;
- Installation of guard rail and / or wire rope safety barriers including terminals;
- Installation of fencing and removal of old fences;
- Installation of fauna exclusion fencing, two fauna underpass culverts and one glider crossing.
- Landscaping, including median planting;
- Line marking and removal of temporary protection measures;
- Stabilisation/grassing of batters, open drains and other peripheral areas;
- Site clean up and disposal of all surplus waste materials;

- Removal of protective fencing and temporary sediment control structures;
- Removal of construction traffic management and opening of new works to traffic.

2.3.1 Direct Impacts

- Vegetation clearing – loss of habitat and risk to Koalas within the particular habitat;
- Koala mortality – during tree clearing or by equipment during preparations
- Degradation of habitat (i.e. edge effects)
- Fragmentation of habitat requiring increased movements

2.3.2 Indirect Impacts

- Increase in disease occurrence due to stress
- Behavioural modification due to road construction activities

Measures to mitigate these potential impacts are outlined in Section 3.

2.4 Operational Phase

The Operational phase will include the following works:

- Use of the new carriageway by vehicles

2.4.1 Direct Impacts

- Mortality from vehicle collision

2.4.2 Indirect Impacts

- Increase in disease occurrence due to stress
- Behavioural modification due to fragmentation of habitat and presence of vehicles

Measures to mitigate these potential impacts are outlined in Section 3.

3 KOALA MITIGATION MEASURES

3.1 Review of Mitigation Measures

Previous research by AMBS (2011) documented the findings of the effectiveness of Koala mitigation measures for the Pacific Highway upgrade. In general, these measures were:

- Scheduling of vegetation clearing to follow the Koala breeding season and allowing time for the installation of fauna fences before the following breeding season is likely to save individual Koalas.
- Clearance surveys for Koalas prior to and during clearing operations coupled with set protocols for incident management are likely to save individual Koalas.
- Clear and committed protocols and training procedures for construction workers on how to manage Koala incidents on work sites are likely to save individual Koalas.
- '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.
- Significant levels of planning and implementation commitment are needed to get temporary fauna exclusion fencing in place and fully operational (i.e. without gaps) as soon as possible after vegetation clearing is completed and before the next breeding season.
- Underpasses (both constructed culverts and 'natural' underpasses such as gullies) do work in providing safe dispersal routes for Koalas to cross highways.
- The length of underpasses may be a factor in determining whether Koalas make a successful crossing.
- Log 'furniture' in underpasses was used by at least one Koala but was not observed to be used by most koalas. However, such furniture may provide an escape route should a predator appear and should be included in future designs.
- Temporary movement structures may be useful to divert dispersing Koalas safely across the highway.
- Simple gates placed across the entrances to public side roads (requiring manual opening and closing by drivers) can be very effective at plugging holes in exclusion fencing, provided traffic volumes are low and locals are consulted appropriately.

Evidence collected subsequent to this study indicates that Koalas have been present on the Bonville fauna overpass. Koalas may need time to become accustomed to this structure. Maturation of vegetation cover may also improve its effectiveness.

3.2 Summary of Proposed Mitigation Measures

The following management measures would be implemented to minimise potential impacts on the Koala and must be incorporated into the CEMP:

- Environmental induction training
- Pre-clearing surveys for Koalas
- Koala relocation procedures (as discussed below)
- Installation of fauna fencing

- Installation of two fauna underpasses
- Construction works procedures (including timing of clearing)
- Implementation of ecological monitoring
- Reporting procedures
- Koala warning signs in the area not protected by fauna fencing

3.3 Pre-Construction Phase

3.3.1 Environmental induction training

All personnel and contractors would undergo environmental induction training before commencing work on site. Information to be addressed during this training would include:

- Koala profile and identification.
- Identification of Koala habitat areas. Nelson Bay Road Upgrade personnel would be prohibited from entering Koala habitat areas located outside defined construction or operation areas through delineation with temporary fencing (eg star pickets and tape).
- Procedures to be followed in the event that Koalas are found or injured in the proximity of the work zone.

3.3.2 Pre-clearing surveys

Pre-clearing surveys are to be designed and implemented by a wildlife ecologist who has a minimum of 3-5 years of experience working with arboreal marsupials and holds appropriate licences and approvals.

Specifically the pre-clearance surveys must employ a thermal camera before dawn (i.e. before 5am) each day of clearing, to ensure no Koalas are present within any of the trees earmarked for clearance that day. Where Koalas are present, they must be flagged down from the tree using an appropriate method accepted for the humane relocation of Koalas and again be supervised by a suitably qualified wildlife ecologist or veterinarian. Any captured Koalas should be photographed extensively, focusing on the bottom and eyes to determine the presence of Chlamydia. Alternatively captured Koalas should be examined by a suitably qualified veterinarian with experience in the health of Koalas to determine if any wildlife diseases are present.

Any Koalas recorded within the clearance area should be fitted with a GPS collar and their movements monitored for at least six months. Koalas found by wildlife carers within or at a distance of approximately one kilometre from the subject site during the pre-clearance surveys should also be fitted with a GPS collar, with again the movements monitored for at least six months.

AMBS (2012) found that radio-tracking of koalas during vegetation clearing is likely to improve the efficiency of pre-clearance surveys to save koala lives.

3.4 Construction Phase

3.4.1 Installation of fauna fencing

AMBS (2012) recommended the following requirements for use of exclusion fences for koala management during road construction:

- Early and committed design, planning and scheduling are required to get exclusion fences in place as soon as possible after vegetation clearing.
- Exclusion fences must have no gaps, holes or other weak spots or they will leak and direct Koalas on to the highway. All avenues must be used to eliminate gaps, including minimising the number of side roads, placing gates on minor side roads, and using long perpendicular return wings along major side roads.
- Exclusion fences should not end abruptly at the edge of Koala habitat but should continue into cleared country or (where the former is not possible) have long perpendicular return wings along the edge of the habitat.

'Floppy top' fauna exclusion fencing is to be installed along the frontage of the Worimi Conservation Lands within the project area (a distance of approximately 2.5km). Furthermore, as far as is possible, fencing will also be installed on the northern side of Nelson Bay Road in the vicinity of the fauna underpasses at Trotter Road and Helenvale Lane to maximise the effectiveness of the fauna underpasses at those locations. Where practical, any other areas of native vegetation adjacent to the proposal area will have fauna fencing installed. The fauna fencing will be monitored in perpetuity for any breaches and repairs made as required.

This fauna fencing will be installed as early as practicable following clearing or, where possible, prior to or in parallel to clearing.

3.4.2 Installation of fauna underpasses

As recommended by Niche (2013), two fauna underpasses, each consisting of a 1.2m high X 2.4m wide precast concrete culverts, will be installed adjacent to Trotter Road and adjacent to Helenvale Lane to allow for the passage of Koalas, Spotted-tail Quoll and other terrestrial fauna (e.g. Swamp Wallabies) to and from the Worimi Conservation Lands in the south, to other vegetated areas in the north.

These fauna underpasses will be installed as early as practicable following completion of clearing.

3.4.3 Timing of clearing

AMBS (2012) recommends that vegetation clearing prior to construction be conducted after the breeding and dispersal period of September to December. Therefore, where possible, clearing will be undertaken between the months of January and July, which allows allow 5 to 6 months for clearing and installation of fauna exclusion fencing to take place and be finalised well before the next breeding season.

3.5 Operational Phase

3.5.1 Monitoring of Fauna Underpasses

Each underpass should be monitored with a remote motion activated camera, for a three month period, twice annually for two years post construction to determine their usage. At least one of these period should focus on the August to October Koala dispersal period.

The aim will be to determine if dispersal continues despite the road/fence barrier which may be operating as a hard barrier and adversely affecting gene flow or effective habitat utilisation within the koala population.

3.5.2 Monitoring of Koala road mortalities/near misses

A data collection process for koala incidents on the roadway will be implemented to monitor the effectiveness of koala barriers. The data from the remote cameras located within the underpasses will be compared with road mortalities or other incidents and with monitoring of the broader population to determine if underpass use/non-use is due to design, part of a wider decline in the local population or due to regional migration. Due to the region-wide study with 30 Koala SAT plots, over time changes in the relative abundance of Koalas in different areas on the Tomaree Peninsula and Worimi National Park may become known.

The aim will be to detect failures of the barrier system and adapt management to prevent a broader koala mortality issue developing.

This action will be implemented in a number of ways:

- Roadside signage providing contact details for the carers (e.g. Hunter Koala Preservation Society, Native Animal Trust Fund).
- Maintaining links with local vets, wildlife carers and other authorities who currently collect data (location, health, age, sex) on koala road mortalities and near misses.
- Continuation and support of existing reporting procedures (e.g. Hunter Koala Preservation Society Koala injuries and deaths database).
- Tracking with GPS Collars will also help identify if Koalas are circumventing the Koala control devices.

3.5.3 Implementation of ecological monitoring of the Koala within the local landscape

30 permanent Koala SAT plots will be established, which will require the location of an additional 14 plots to add to the 16 already set in place by Niche (2013). At least 8 of these plots will be located closer to the proposal area to monitor for Koala activity. Liaison with private landholders may be required to locate such sites. These plots will allow for an estimation of changes in the level of Koala activity across the Tomaree Peninsula and, while declines in the relative density of Koalas may not be directly attributable to impacts from the road upgrade, the results of the SAT plots will be supported by data on the level of Koala deaths and injuries from the road upgrade area, along with adjacent roads. However caution should be applied to changes in the level of change from the SAT plots and instead this data should only be used as one component from the monitoring.

Satellite tracking via GPS collars of a minimum of four Koalas will occur in parallel to construction. The Koalas to be tracked will, where possible, be located within two kilometres where possible of the study area and ideally individuals will be located from both the north and south of Nelson Bay Road, although the low density of animals within the Worimi Conservation Lands may mean that this may be difficult to achieve. Male Koalas who are known to disperse more readily than females will be targeted during this stage of the monitoring.

Monitoring of the Koala population will occur within the broader landscape of the Tomaree Peninsula. Koala population monitoring will aim to determine:

- The population trend for Koalas on the Tomaree Peninsula to give a background context to data collected in the vicinity of the road.
- The number of Koalas residing within the vicinity of the road development (including earlier stages).
- The major causes of mortality for Koalas in the local landscape. There are many causes of Koala mortalities within urbanising environments. Road kills may not be the limiting factor for the koala population in the local landscape.
- Sources or sinks causing an increase or decrease in the numbers of Koalas present in the local population. This will assist to identify if koalas are entering or exiting this population via migration

The pilot study proposed by Niche (2013) will be implemented, whereby the following field tasks will be completed:

- Continued surveys within 15 spotlighting transects (300m in length) established throughout the Tomaree Peninsula for the addendum ecological assessment (Niche 2013). Two visits will be conducted prior to the commencement of clearing. During each visit, each transect will be traversed in a forwards direction at a speed of ~1km/h, with call playback for the Koala occurring at the end of the transect for a further five minutes, prior to spotlighting occurring in a reverse direction at a speed of approximately ~2km/h. At the conclusion of these surveys, the value of the spotlighting transects will be assessed for data power to determine if sufficient data has been collected to allow for the determination of population change, should it occur, and recommend a suitable ongoing monitoring strategy, should the RMS wish to continue with this form of monitoring.
- Continued surveys within the already established 16 Koala Spot Assessment Technique (SAT) plots. The four plots that occur within the subject site will require relocation. In order to increase the likelihood for the detection of change (if any should occur), a minimum of 30 SAT plots will be established throughout the Tomaree Peninsula. These plots will be surveyed at least once prior to the commencement of clearing, with additional monitoring to occur with one survey during clearing. The scientific and statistical viability of the project should be assessed after this, to determine if sufficient data is being collected to allow any meaningful conclusions.
- The tracking of Koalas fitted with GPS collars will continue for as long as practical. Consideration will be given to publishing the results of the study in a scientific journal in order to better inform future management of the koala in relation to roads.

Koala population size and density in the project area, and the effectiveness of mitigation actions, will be monitored and reported following the Project's completion.

Performance criteria to measure the success of the Koala Plan of Management require that the number and/or density of Koalas within the study area remains stable over the period of the development. However declines in Koalas across the study area may not be completely (or even partially attributable) to the road project; however, the results from the monitoring should be viewed alongside any other disturbances that occur (eg fires and vegetation clearance).

3.6 Evaluation, project review and reporting

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

3.6.1 Responsibility

The Roads and Maritime appointed Ecologist shall undertake the koala monitoring and evaluate the monitoring information collected. The monitoring information will be used to consider the effectiveness of the mitigation measures on the Koala.

3.6.2 Timing

An annual report shall be prepared by the Roads and Maritime project ecologist documenting the methods and results from each monitoring period for distribution to the federal Department of the Environment and OEH.

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.

3.7 Corrective actions

Any contingency measures to be implemented would be developed in consultation with the relevant regulatory authorities (OEH and Department of the Environment) prior to being commenced.

If the long-term mitigation measures are found not to be effective during the operational phase additional mitigation measures will be investigated and implemented in consultation with OEH and DotE. These may include installation of additional fauna fencing, enhancement of existing connectivity corridors beyond the project limits and/or retrofitting/enhancing connectivity structures and associated fauna fencing.

3.8 Summary Table and Implementation Schedule

Management Action	Timing	Responsibility	Monitoring	Performance Indicators/Thresholds	Corrective Actions	Reporting
Environmental induction training	Pre-construction	Contractor	Site induction records, to be audited by Roads and Maritime	Personnel and contractors working on site not appropriately inducted or not aware of environmental responsibilities or procedures.	Review induction package and procedures.	Monthly by Contractor.
Pre-clearing surveys	Pre-construction	Contractor's Ecologist	Daily Inspections by Contractor and Roads and Maritime	Evidence of Koalas injured or killed during clearing works	Review of methods, timing and procedures.	Monthly by Contractor (to Roads and Maritime). Annually by Roads and Maritime to OEH and DotE.
Timing of clearing	Construction	Contractor	Daily Inspections by Contractor and Roads and Maritime	Evidence of Koalas injured or killed during clearing works	Review of methods, timing and procedures. Consider the need for temporary fauna fencing	Monthly by Contractor (to Roads and Maritime). Annually by Roads and Maritime to

					during clearing.	OEH and DotE.
Installation of fauna fencing	Construction	Contractor	Surveillance by Roads and Maritime	N/A	N/A	Annually by Roads and Maritime to OEH and DotE.
Installation of fauna underpasses	Construction	Contractor	Surveillance by Roads and Maritime	N/A	N/A	Annually by Roads and Maritime to OEH and DotE.
Maintenance of fauna fencing and fauna underpasses	Operation	Roads and Maritime	Regular monitoring of roadway, fencing and underpasses.	Breaches in fauna exclusion fencing. Evidence of Koalas injured or killed during operation phase	Undertake fencing and/or underpass maintenance.	At conclusion of monitoring period by Roads and Maritime to OEH and DotE.
Monitoring of fauna underpasses	Construction and operation	Roads and Maritime	Monitoring program as detailed in Section 3.	No evidence of use of the underpasses by Koalas. High rate of Koala vehicle strikes in the vicinity of the underpasses. High visitation/usage rates by exotic predators.	Review monitoring methods, consider further monitoring and consider implementation of additional mitigation measures (as discussed in Section 3.7).	At conclusion of monitoring period by Roads and Maritime to OEH and DotE.
Monitoring of Koala road mortalities / near misses	Pre-construction, construction and operation	Roads and Maritime in association with local wildlife groups	Twice weekly by Roads and Maritime	High rate of Koala vehicle strikes in the vicinity of the underpasses.	Consider implementation of additional mitigation measures (as	At conclusion of monitoring period by Roads and Maritime to OEH and DotE.

					discussed in Section 3.7).	
Implementation of ecological Monitoring of the Koala within the local landscape	Pre-construction, construction and operation	Ecologist engaged by Roads and Maritime	N/A	Evidence of Koalas injured or killed during operation phase.	Consider implementation of additional mitigation measures (as discussed in Section 3.7).	At conclusion of monitoring period by Roads and Maritime to OEH and DotE.

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