

Warrell Creek to Nambucca Heads

Stage 2 Ecological Monitoring Program

Roads and Maritime Services | June 2018



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Revision History

Revision	Date	Description	Approval
A	6/12/2017	Amendment to original Benchmark Environmental Management plan to : <ul style="list-style-type: none">• Tables 2.1 and 3.3 to align culvert monitoring with the approved Koala and Spotted tailed quoll management plans• Table 3.1 to align the monitoring frequencies with the approved Flying Fox Management Plan• Update references and other editorial corrections• Update Road Kill Monitoring program.• Include DPE as recipient of annual road kill monitoring reports	Chris Clark
B	5/03/2018	<ul style="list-style-type: none">• Update Table 3.1 to align with approved management plans• Update Tables 2.1 and 3.3 to include the combined culvert at chainage 58510 in the underpass monitoring to align with the approved species specific management plans• Minor editorial and formatting corrections• Updating section 3.12 - Landscape Rehabilitation• Inclusion of section 3.15 detailing requirement to undertake Slender Marsdenia and Wools' Tylophora Habitat Condition Monitoring• Addition of giant barred frog monitoring in Butchers Creek in excess to that required by the approved Giant Barred Frog Management Plan.	Chris Clark
C	1/06/2018	<ul style="list-style-type: none">• Minor editorial and formatting corrections• Removal of requirement to undertake monthly photo points during operational landscape rehabilitation monitoring	Chris Clark

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1. Introduction

In June 2003, planning commenced on the upgrade of the Pacific Highway between Warrell Creek to Urunga, south of Coffs Harbour (WC2U). The project involves an upgrade of the existing highway to four lane divided highway from the existing Allgomeria deviation, south of Warrell Creek, to the Waterfall Way at Raleigh.

Project approval was granted on 19 July 2011, under Part 3A of the Environmental Planning and Assessment Act 1979. The project was identified as a critical infrastructure project by the NSW State Government, designed to improve safety, traffic efficiency and increase capacity along the Pacific Highway. It forms part of the overall program for upgrading the Pacific Highway. The proposed upgrade extends over approximately 42 kilometres, which has been divided into two stages:

- Stage 1 - Nambucca Heads to Urunga section (chainage 61265-83682); and
- Stage 2 - Warrell Creek to Nambucca Heads section (chainage 41765-61265).

The construction of the WC2U upgrade project will involve the disturbance of existing structures, native vegetation, and native fauna habitat(s) in the vicinity of the works. It will also involve the removal of up to 255 Ha of native vegetation.

As part of the Proposal's approval, the development of an Ecological Monitoring Program (EcMP) is required for each stage to address the Minister for Planning and Infrastructure's Condition of Approval (MCoA) B10. To satisfy MCoA B10 the ecological monitoring programs involve preconstruction, construction and post construction phases.

Benchmark Environmental Management (BEM)¹ was contracted by the NSW Roads and Maritime Services (Roads and Maritime) to prepare the EcMP for Stage 2 of the WC2U upgrade project in accordance with MCoA B10, which states that:

Prior to the commencement of any construction work that will result in the disturbance of any native vegetation, the Proponent shall develop an Ecological Monitoring Program to monitor the effectiveness of the mitigation measures implemented as part of the project. The program shall be developed in consultation with EPA and prepared by a suitably qualified ecologist and shall include but not necessarily be limited to:

- (a) an adaptive monitoring program to assess the effectiveness of the mitigation measures identified in condition B1 to B6, B7(b), B7(d), B21(c) and B31(b) and allow amendment to the measures if necessary. The monitoring program shall nominate appropriate and justified monitoring periods and performance targets against which effectiveness will be measured. The monitoring shall include operational road kill surveys to assess the effectiveness of fauna crossing and exclusion fencing implemented as part of the project;*
- (b) mechanism for developing additional monitoring protocols to assess the effectiveness of any additional mitigation measures implemented to address additional impacts in the case of design amendments or unexpected threatened species finds during construction (where these additional impacts are generally consistent with the biodiversity impacts identified for the project in the documents listed under condition A1);*
- (c) monitoring shall be undertaken during construction (for construction-related impacts) and from opening of the project to traffic (for operation/ongoing impacts) until such time as the effectiveness of mitigation measures can be demonstrated to have been achieved over a minimum of five successive monitoring periods (i.e. 5 years) after opening of the project to traffic, unless otherwise agreed to by the Director General. The monitoring period may be reduced with the agreement of the Director General in consultation with OEH, depending on the outcomes of the monitoring;*
- (d) provision for the assessment of the data to identify changes to habitat usage and if this can be attributed to the project;*

¹ Benchmark Environmental Management prepared the original version of the Ecological Monitoring program approved on 16/12/14. As Benchmark Environmental Management is no longer in business, Roads and Maritime Services has prepared this Revision A to the report

- (e) details of contingency measures that will be implemented in the event of changes to habitat usage patterns directly attributable to the construction or operation of the project; and
- (f) provision for annual reporting of monitoring results to the Director General and OEH, or as otherwise agreed by those agencies. The Program shall be submitted for the Director General's approval prior to the commencement of any construction work that will result in the disturbance of any native vegetation. Unless otherwise agreed, the Program shall be submitted to the Director General for approval no later than 6 weeks prior to the commencement of any construction that will result in the disturbance of any native vegetation.

In addition, the EcMP incorporates monitoring components associated with several management strategies and plans prepared for the project, including:

- Nest Box Plan of Management (LES 2013b);
- Green-thighed Frog Management Strategy (LES 2013a);
- Giant Barred Frog Management Strategy (LES 2014a);
- Microchiropteran Bat Strategy (LES 2014b);
- Spotted-tailed Quoll Management Plan (GeoLINK 2014b);
- Koala Management Plan (GeoLINK 2014a);
- Yellow-bellied Glider Ecological Monitoring Program (Goldingay 2014);
- Road-kill Monitoring Program (NSW Roads and Maritime 2014);
- Grey Headed Flying-fox Management Plan (Gorecki *et al.* 2014); and
- Threatened Flora Management Plan (Benwell 2014).

There are 64 mitigation measures relevant to the EcMP preparation for Stage 2 of the WC2U upgrade project, which are listed in Table 1.1. The mitigation measures have been grouped into seven categories:

1. Pre-clearing and clearing procedures;
2. Fauna underpass structures and exclusion fencing;
3. Widened vegetated medians;
4. Nestbox installation;
5. Landscape rehabilitation
6. Protection of in-situ threatened flora populations; and
7. Establishment of translocation areas.

1.1. Order of precedence

In the event of any inconsistency, ambiguity or discrepancy between this Ecological Monitoring program and the target species management plans within the Flora and Fauna Management Plan for the Warrell Creek to Nambucca Heads Pacific Highway upgrade project, the following order of precedence must apply:

- (a) Target Species Management Plan².
- (b) The Flora and Fauna Management Plan for the Warrell Creek to Nambucca Heads Pacific Highway upgrade project

The aim of the EcMP, as stated in Revised Statement of Commitment F13, is to assess the effectiveness of fauna and flora impact mitigation measures. The Contractor must address the requirements of this EcMP in design, construction and maintenance of the Project Works, Temporary Works and Maintenance Works where relevant.

The EcMP addresses the requirements of MCoA B10 in five chapters:

1. Chapter one states the aim of the EcMP and identifies those responsible for its implementation;
2. Chapter two identifies which proposed mitigation measures are to be subject to monitoring.
3. Chapter three provides a detailed description of the monitoring methods recommended for each proposed mitigation measure.
4. Chapter four identifies potential contingencies that may be applied if any of the mitigation measures prove to be insufficient; and

² Notwithstanding the order of precedence, Roads and Maritime is also committed to undertaking giant barred frog monitoring in Butchers Creek in excess to that required by the approved Giant Barred Frog Management Plan.

5. Chapter five specifies the reporting requirements.

1.2. Agency Consultation

As a note of clarity, where species specific management plans require consultation with the OEH and/or the EPA, consultation will be with the EPA as per the current Memorandum of Understanding between Roads and Maritime Service and the EPA, as the EPA has taken on the roles of the OEH for the management of Pacific Highway upgrade projects.

2. Mitigation measures requiring monitoring

The EcMP for Stage 2 will focus on all seven groups of mitigation measures proposed as part of the Warrell Creek to Urunga Pacific Highway Upgrade project:

1. Pre-clearing and clearing procedures;
2. Fauna underpass structures and exclusion fencing;
3. Widened vegetated medians and glider crossing structures;
4. Nestbox installation;
5. Landscape rehabilitation
6. Protection of in-situ threatened flora populations; and
7. Establishment of translocation areas.

A description of each proposed mitigation measure nominated for monitoring is provided below.

Table 1.1: Mitigation measures relevant to EcMP preparation for Stage 2 of the WC2U upgrade project. MCoA = Minister's Condition of Approval; SOC = Revised Statement of Commitment; EA = Project Environmental Assessment; FMP = Flying-fox Management Plan; KMP = Koala Management Plan; GBFMS = Giant Barred Frog Management Strategy; GTFMS = Green-thighed Frog Management Strategy; MBMS = Microbat Management Strategy; STQMP = Spotted-tailed Quoll Management Plan.

Source	Mitigation Measure	Relevant Section of EcMP
MCoA B1	The Proponent shall implement the fauna and waterway crossings identified in the documents listed under condition A1(d) at the locations and in accordance with the minimum design dimensions identified in the documents listed under condition A1(d), unless otherwise agreed to by the Director General.	Section 2.2 and 3.8
MCoA B2	As part of detailed design, the Proponent shall further investigate design refinements to improve fauna connectivity between Chainages 19150 and 19820.	Section 2.2 and 3.8
MCoA B4	The Proponent shall in consultation with OEH, ensure that the design of the project as far as feasible and reasonable, incorporates provision for glider crossings (such as widened medians and maintenance or enhancement of habitat within the medians and corresponding carriageway boundaries) where the alignment crosses areas of recognised glider habitat.	Section 2.3 and 3.10
MCoA B6	Prior to the commencement of any construction work that will result in the disturbance of any native vegetation (or as otherwise agreed to by the Director General), the Proponent shall in consultation with OEH prepare and submit for the approval of the Director General a Nest Box Plan to provide replacement hollows for displaced fauna consistent with the requirements of SoC F7. The plan shall detail the number and type of nest boxes to be installed which must be justified based on the number and type of hollows removed (based on detailed pre-construction surveys), the density of hollows in the area to be cleared and adjacent forest, and the availability of adjacent food resources. The plan shall also provide details of maintenance protocols for the nest boxes installed including responsibilities, timing and duration.	Section 2.4 and 3.11
MCoA B7(b)	If investigation under Condition B7(a) reveals translocation of impacted plants is feasible, includes details of a translocation plan for the plants consistent with the Australian Network for Plant Conservation 2004: Guidelines for the Translocation of Threatened Plants in Australia 2 nd Ed, including details of ongoing maintenance such as responsibilities, timing and duration;	Section 2.7 and 3.14
MCoA B7(d)	Includes detail of mitigation measures to be implemented during construction to avoid and minimise impacts to areas identified to contain these species, including excluding construction plant, equipment,	Section 2.6 and 3.13

Source	Mitigation Measure	Relevant Section of EcMP
	materials and unauthorised personnel.	
MCoA B31(b)	A Construction Flora and Fauna Management Plan to detail how construction impacts on ecology will be minimised and managed.	Section 2.1 and 3.2
MCoA B31(b)(i)	Undertake pre-construction surveys to verify the construction boundaries/footprint of the project based on detailed design and to confirm the vegetation to be cleared as part of the project.	Section 2.1.1 and Section 3.2
MCoA B31(b)(iii)	Prepare a Giant Barred Frog management plan, in the case that this species or its habitat is identified to occur in the project corridor or its vicinity.	Section 2.1.1; Section 3.3.2
MCoA B31(b)(iv)	Prepare a micro-bat management strategy, in the case that micro bats or evidence of roosting are identified during pre-construction surveys. The strategy shall detail measures to avoid, minimise and mitigate impacts to these species and identified roost sites, including short and long term management measures.	Section 2.1.1; Section 3.4
MCoA B31(b)(v)	Develop general work practices to minimise the potential for damage to native vegetation (particularly EECs) not proposed to be cleared as part of the project and native fauna during construction.	Section 2.1
MCoA B31(b)(vi)	Develop specific procedures to deal with EEC/threatened species anticipated to be encountered within the project corridor including re-location, translocation and/or management and protection measures.	EcMP
SOC F1	Clearing of native vegetation (including endangered ecological communities) will be restricted to the minimum area necessary for construction.	Section 2.1.1 and 3.2
SOC F2	A qualified ecologist will identify any vegetation (including <i>Marsdenia longiloba</i>) to be retained and to be clearly delineated on work plans within the construction corridor. Erection of flagging/fencing on-site prior to any construction works, which is to remain in place for the full construction period, will clearly delineate this vegetation.	Section 2.1.1 and 3.2
SOC F3	Threatened species directly impacted by the Proposal will be translocated to a suitable location outside the impact zone. A further visual inspection will be conducted post clearance to identify threatened species which may be indirectly impacted outside the cleared zone. Landscape planting to commence	Section 2.7 and 3.14

Source	Mitigation Measure	Relevant Section of EcMP
	along the road boundary as soon as possible during construction.	
SOC F4	Plantings of rusty plum (<i>Amorpha fruticosa</i>) in areas of suitable habitat adjacent to the Proposal will follow from seed collection and propagation.	Section 2.7 and 3.14
SOC F6	A suitably qualified ecologist will undertake pre-clearance surveys for threatened species including frogs. Searches will include nests and hollow bearing trees. Re-location of fauna species at risk of injury found in pre-clearance surveys or during construction will be in suitable habitat as close as possible to the area in which they were found. Immediately prior to clearing an inspection will confirm that the sites subject to pre-clearance surveys remain free of fauna.	Section 2.1 and 3.2
SOC F7	Where feasible and reasonable the identification and distribution of natural and artificial habitat features and resources (such as hollow-bearing trees, hollow logs, nest boxes and bush rocks) will occur along the Proposal. This relocation will limit injury to fauna and damage to existing vegetation. A nest box plan will be developed for the Proposal.	Section 2.1 and 3.2
SOC F8	Retention of mature trees in the median at locations identified in the environmental assessment will provide a stepping stone for gliders. Protection of these trees will occur (F2), and lopping and pruning is not to occur without expert advice.	Section 2.3 and 3.10
SOC F9	Provision of fauna crossings will be as identified in the environmental assessment. All fauna crossings will be confirmed with the EPA and DPI during the detailed design phase.	Section 2.2 and 3.8
SOC F11	Erection of fauna exclusion fencing (e.g. floppy-top fencing) along the Proposal at appropriate locations will direct fauna movement towards fauna-crossing structures.	Section 2.2 and 3.8
EA Ch10 – Section 10.5.1.1	Revegetation/rehabilitation of the site should be conducted progressively during the construction phase to ensure the use of collected topsoil and seed and to develop different successional stages of rehabilitation.	Section 2.5 and 3.12
EA Ch10 – Section 10.5.1.1	A weed management plan is to be prepared as part of the flora and fauna management sub plan, outlining weed management actions to be carried out during construction to prevent the spread of weeds and plant pathogens.	Section 2.5 and 3.12

Source	Mitigation Measure	Relevant Section of EcMP
EA Ch10 – Section 10.5.1.2	A suitably qualified ecologist will undertake searches in the construction footprint for native fauna immediately prior to clearing activities. Searches will include nests and large hollow-bearing trees and target habitats of hollow dwelling species, koalas, spotted-tailed quolls and frogs. During the proposed clearing works, an experienced wildlife handler should be present to retrieve any displaced fauna and release the fauna into adjacent habitats safe from construction work.	Section 2.1 and 3.2
EA Ch10 – Section 10.5.1.2	Re-survey immediately prior to construction to identify nest locations for Osprey, Black-necked Stork and brolga. The location of the identified Osprey nest will be checked to confirm if it is present before clearing commences.	Section 2.1 and 3.2
EA Ch10 – Section 10.5.1.2	Provide dedicated and incidental fauna crossing structures at key locations for forest fauna species identified to target the range of large, medium and smaller species present such as Yellow-bellied Glider, Koala and Giant Barred Frog.	Section 2.2, 2.3, 3.8 and 3.10
EA Ch10 – Section 10.5.1.2	A fauna rescue framework for clearing has been developed by the RMS in consultation with the EPA and will be used as a basis for developing a protocol for the handling and translocation of fauna during construction.	Section 2.1 and 3.2
EA Ch10 – Section 10.5.1.2	Nest boxes are to be installed, where required, in accordance with specialist advice and in consultation with the EPA, prior to construction, to replace hollow resources that are proposed to be removed.	Section 2.4 and 3.11
EA Ch10 – Section 10.5.1.2	Bridges at Warrell Creek, Nambucca River, Deep Creek and the Kalang River and culverts identified in this environmental assessment as having a potential role in fauna crossing, will be designed to facilitate fauna movements	Section 2.2 and 3.8
EA Ch10 – Section 10.5.1.2	A strategy would be developed in consultation with Forests NSW, for monitoring the Yellow-bellied Glider population in the affected area of Nambucca State Forest as part of the flora and fauna management plan. This would need to include the identification of home range territories in proximity to the highway, den locations, monitoring movements (marking and radio-tagging), particularly across the future road, and long term fecundity.	Section 3.6
EA Ch10 – Section 10.5.1.2	Strategies will be developed to deal with incidents involving individual animals during construction activities in consultation with the EPA officers, WIRES and/or other relevant local wildlife carer groups.	Section 2.1 and 3.2

Source	Mitigation Measure	Relevant Section of EcMP
EA Ch10 – Section 10.5.2	Native and locally indigenous plants will be used in the landscaping and disturbed areas will be progressively revegetated.	Section 2.5 and 3.12
EA Ch10 – Section 10.5.2	Weeds in areas disturbed by construction activities will be managed for a minimum of two years after construction completion.	Section 2.5 and 3.12
EA Ch10 – Section 10.5.3	Widening of the median at important locations.	Section 2.3 and 3.10
EA Ch10 – Section 10.5.3	Provision of dedicated, combined and incidental fauna underpass structures.	Section 2.2 and 3.8
EA Ch10 – Section 10.5.3	Exclusion fencing will be installed around the crossing structures to prevent access to the carriageway for up to 500 metres either side.	Section 2.2 and 3.8
EA Ch10 – Section 10.5.4	Development of a rehabilitation and weed control strategy as part of the construction environmental management plan, with specific mitigation measures for control of the spread of weeds and habitat rehabilitation, particularly along roadside verges, adjacent to culvert entrances and bridge pylons.	Section 2.5 and 3.12
EA Ch10 – Section 10.5.4	A protocol will be developed for weed infested areas to ensure that all potential weed propagules from soil and vegetative material are appropriately disposed of.	Section 2.5 and 3.12
EA Ch10 – Section 10.5.5	Roadside verges will be rehabilitated adjacent to culvert entrances and bridge pylons.	Section 2.5 and 3.12
FMP – Section 5.3.5	Prior to the commencement of clearing operations, the project ecologist would identify all areas that contain vegetation and habitat to be retained within the flying-fox camp, including exclusion zones	Section 2.1 and 3.2
FMP – Section 5.3.5	Prior to the commencement of clearing operations targeted surveys for flying-foxes would be undertaken.	Section 2.1 and 3.2
FMP – Section 4.4.2	Habitat exclusion zones and construction buffer zones around the flying-fox colony would be designated and fenced/marked prior to construction.	Section 2.1 and 3.2

Source	Mitigation Measure	Relevant Section of EcMP
FMP – Section 5.3.1 & 7.3.3	Construction activities along the approved alignment within the vicinity of the flying fox camp would be restricted to the period between 1 May and 15 September each year. If during this period, GHFF are present in the clearing corridor the contingency strategy would be implemented. Construction would halt if there are heavily pregnant GHFF or female GHFF with dependent young present within 100m of these individuals/groups.	Section 2.1.1 and 3.2
FMP – Section 5.3.8	Impacts to the flying-fox camp from construction noise, vibration and light would be managed through maintaining a works buffer of 300 metres between the perimeter of the camp and major construction activities undertaken between mid-September and the end of April the following year.	Section 2.1.1 and 3.2
FMP – Section 5.3.8	Activities within the 300 metre buffer zone between mid-September and the end of April the following year would be restricted to low noise / low disturbance construction activities required for monitoring, maintenance and incident response purposes. Observational monitoring of the camp for a-typical behavioural responses would be undertaken during the execution of these activities to assess any impacts on the flying-foxes.	Section 2.1.1 and 3.2
FMP – Section 5.3.8	A buffer of 500 metres would be imposed between the flying-fox camp and any ancillary sites throughout the period of construction of the Project.	Section 2.1.1 and 3.2
FMP – Section 7.3.3	An ecologist would be present during clearing activities in the vicinity of the flying-fox roost.	Section 2.1.2 and 3.2
KMP – Section 4.5.7	For all koalas detected on/near the site, the Koala Management Protocol and Koala Relocation Strategy is to be implemented (refer KMP)	Section 2.1
KMP – Section 5.4.4	Pre-clearing surveys will include spotlight surveys within suitable habitat the night before clearing operations commencing in a given area.	Section 2.1
KMP – Section 5.4.5	Where continuous lines of jersey (concrete) barriers are to be installed, gaps are to be provided to allow escape of animals off the highway. Where gaps cannot be provided, a suitable material will be placed over the barrier to enable koalas to climb over.	Section 3.5
KMP – Section 5.4.6 & 6.3.2	Undertake and maintain habitat rehabilitation works within identified areas associated with the Project Site to create additional koala habitat.	Section 2.5 & 3.12

Source	Mitigation Measure	Relevant Section of EcMP
GBFMS – Section 3.5.2	Giant Barred Frog habitat at Upper Warrell Creek (ch. 42565) should be protected from non-essential construction related works.	Section 2.1 and 3.2
GBFMS – Section 4.4.2 & 4.5.3	Within 6 weeks of scheduled clearing/ground disturbance operations in Giant Barred Frog habitat, , the Project Ecologist will perform pre-clearing surveys over a minimum of two non-consecutive nights (i.e. before clearing commences)	Section 2.1 and 3.2
GBFMS – Section 4.5.4	Within Giant Barred Frog habitat the clearing and grubbing activities will be supervised by the Project Ecologist until such a time they are confident no Giant Barred Frogs remain within the work site.	Section 2.1 and 3.2
GBFMS – Section 4.5.6	Permanent frog fencing will be installed in Upper Warrell Creek.	Section 3.3.2
GTFMS – Section 2.2	Areas of suitable habitat for the green-thighed frog should be protected from non-essential construction related works. The locating of access tracks, utilities redistribution, car parking facilities and other ancillary works including topsoil stock piles, lay down areas, wash down bays, site shedding and compound sites should not be located in this area.	Section 2.1 and 3.2
GTFMS – Section 2.3	Searches to detect green-thighed frogs will be undertaken in areas of suitable habitat immediately prior to clearing.	Section 2.1 and 3.2
GTFMS – Section 2.5	Temporary frog fencing will be installed within 3 days of scheduled clearing at all known green-thighed frog locations (i.e. ch.60065 and ch.60865)	Section 3.3.1
GTFMS – Section 2.3	Frog breeding ponds will be constructed at three locations – chainages 58015, 581645 and 60065	Section 2.1 and 3.3.1
GTFMS – Section 2.5.2	Permanent frog fencing will be installed where green-thighed frog ponds have been constructed.	Section 2.1 and 3.3.1
MBMS – Section 3	Installation of microbat roost boxes. Bat boxes should be installed by an ecologist 6 - 12 months prior to planned roost exclusion.	Section 2.4 and 3.4

Source	Mitigation Measure	Relevant Section of EcMP
MBMS – Section 3	The contractor would manage the integrity of drainage lines and associated riparian vegetation so as to not constrict microbat flyways.	Section 2.1.1 and 3.4
STQMP – Section 5.45	A suitably qualified ecologist will undertake searches in the construction footprint for s-t quoll immediately prior to clearing activities focusing on potential dens, large hollow-bearing trees and fallen logs and rock platforms.	Section 2.1
STQMP – Section 5.45	During pre-clearing surveys, the Project Ecologist will identify and mark large fallen logs (>300mm, non-decayed) for relocation within adjacent areas inside the project boundary, particularly near fauna crossings, rehabilitation areas and areas of retained forest.	Section 2.1

2.1. Pre-clearing and clearing procedures

The Revised Statement of Commitments (SoC), WC2U upgrade project Environmental Assessment (EA) and relevant management strategies include a range of procedures to be undertaken during the construction phase of the project aimed at reducing the incidence of wildlife mortality during the clearing process. The procedures include:

- SoC F1 - Clearing of native vegetation, including Endangered Ecological Communities (EECs) will be restricted to the minimum area necessary for construction;
- SoC F2 - A qualified ecologist will identify any vegetation (including *Marsdenia longiloba*) to be retained and to be clearly delineated on work plans within the construction corridor. Erection of flagging/fencing on-site prior to any construction works, which is to remain in place for the full construction period, will clearly delineate this vegetation;
- SoC F6 - A suitably qualified ecologist will undertake pre-clearance surveys for threatened species including frogs. Searches will include nests and hollow bearing trees. Re-location of fauna species at risk of injury found in pre-clearance surveys or during construction will be in suitable habitat as close as possible to the area in which they were found. Immediately prior to clearing an inspection will confirm that the sites subject to pre-clearance surveys remain free of fauna;
- SoC F7 - Where feasible and reasonable the identification and distribution of natural and artificial habitat features and resources (such as hollow-bearing trees, hollow logs, nest boxes and bush rocks) will occur along the Proposal. This relocation will limit injury to fauna and damage to existing vegetation. A nest box plan will be developed for the Proposal;
- EA Chapter 10 Section 10.5.1.2 - A suitably qualified ecologist will undertake searches in the construction footprint for native fauna immediately prior to clearing activities. Searches will include nests and large hollow-bearing trees and target habitats of hollow dwelling species, koalas and frogs. During the proposed clearing works, an experienced wildlife handler should be present to retrieve any displaced fauna and release the fauna into adjacent habitats safe from construction work;
- EA Chapter 10 Section 10.5.1.2 - Re-survey immediately prior to construction to identify nest locations for Osprey, Black-necked Stork and brolga. The location of the identified Osprey nest will be checked to confirm if it is present before clearing commences;
- EA Chapter 10 Section 10.5.1.2 - A fauna rescue framework for clearing has been developed by Roads and Maritime Services in consultation with EPA and will be used as a basis for developing a protocol for the handling and translocation of fauna during construction;
- EA Chapter 10 Section 10.5.1.2 - Strategies will be developed to deal with incidents involving individual animals during construction activities in consultation with the EPA officers, WIRES and/or other relevant local wildlife carer groups;
- Flying-fox Management Plan Section 5.3.5 – (with regard to the flying-fox camp) prior to the commencement of clearing operations, the project ecologist would identify all areas that contain vegetation and habitat to be retained, including exclusion zones;
- Flying-fox Management Plan Section 5.3.5 – (with regard to the flying-fox camp) prior to the commencement of clearing operations targeted surveys for flying-foxes would be undertaken;
- Giant Barred Frog Management Strategy Section 2.4.1 – temporary fencing shall be installed at known giant barred frog sites prior to commencement of clearing operations;
- Giant Barred Frog Management Strategy Section 4.5.3 - within 6 weeks of scheduled clearing/ground disturbance operations in Giant Barred Frog habitat, the Project Ecologist will perform pre-clearing surveys over a minimum of two non-consecutive nights;
- Giant Barred Frog Management Strategy Section 4.5.4 - within giant barred frog habitat the clearing and grubbing activities will be supervised by the Project Ecologist until such a time they are confident no giant barred frogs remain within the work site.
- Green-thighed Frog Management Strategy Section 2.5 – temporary fencing shall be installed at known green-thighed frog sites prior to commencement of clearing operations;

- Koala Management Plan Section 4.5.7 and 5.4.4 - Pre-clearing surveys will also include spotlight surveys within suitable habitat the night before clearing operations commencing in a given area. For all koalas detected on/near the site during construction the Koala Management Protocol and Koala Relocation Strategy will be implemented.
- Spotted-tailed Quoll Plan of Management Section 5.4.5 - During pre-clearing surveys, the Project Ecologist will identify and mark large fallen logs (>300mm, non-decayed) for relocation within areas adjacent clearing footprint and within project boundary, particularly near fauna crossings, rehabilitation areas and areas of retained forest.

Although not specified in the EA or SoCs, vegetation containing hollow-bearing trees will be cleared using a staged clearing process developed in consultation with EPA. Furthermore, information on tree hollow characteristics will be collected during the staged clearing process to enable the quantification of actual tree hollows removed during construction. The resulting information will be used to assess the adequacy of the proposed nest box quantities specified in the project Nest Box Management Plan and as required to comply with MCoA No. B6.

2.1.1. Pre-clearing surveys

Prior to commencement of clearing operations the project ecologist will identify all areas within the project corridor that contain vegetation to be retained (including EECs) and suitable habitat for hollow-dependent fauna, koalas, roosting flying-foxes and threatened frog species.

Delineation of clearing boundaries and exclusion zones

Targeted surveys will be undertaken to delineate the boundaries of vegetation (including EECs) to be retained within the project corridor. The clearing limits will then be subject to geodetic survey to enable accurate installation of protective fencing and inclusion on constraints mapping.

Furthermore, all exclusion zones for the protection of threatened frog habitat, microbat riparian habitat and the flying-fox camp are to be clearly delineated and fenced/marked prior to commencement of clearing or construction works.

Habitat resource surveys

A large proportion of potential hollow-bearing trees within the WC2U upgrade corridor were mapped and marked by Lewis Ecological Surveys (LES) between December 2011 and March 2012. However, further surveys will be conducted up to seven days prior to commencement of clearing to re-mark potential habitat trees, detect additional habitat trees (e.g. trees containing nests, hollows, fissures, termitaria and dreys), hollow logs, ground nests, dens and large rocks within the clearing limits. Suitable release sites for fauna that may be encountered during clearing will be identified during the pre-clearing surveys. Activity levels at known and potential raptor nests identified by LES (2012) will also be assessed during the pre-clearing surveys.

Habitat resources identified during the pre-clearing surveys will be marked with bright coloured flagging tape and numbered with bright coloured spray paint. The location of each habitat resource will be recorded using a handheld GPS (UTM WGS 84). Details of additional habitat resources will then be forwarded to the relevant project Environmental Officer for inclusion on sensitive area mapping.

Hollow-dependent fauna surveys

Spotlighting surveys to detect hollow-dependent fauna will be conducted within areas of forest habitat containing potential hollow-bearing trees. These surveys will be completed up to seven days prior to clearing operations.

Koala surveys

Surveys for koalas will involve spotlighting within areas of suitable habitat on the night prior to clearing operations. Diurnal visual searches will also be conducted in areas of suitable habitat immediately prior to commencement of clearing operations to detect any koalas that enter the area overnight. For all koalas detected on/near the site during construction the Koala Management Protocol and Koala Relocation Strategy will be implemented (refer Koala Management Plan (GeoLINK 2017)).

Spotted-tailed quoll surveys

Pre-clearing surveys conducted immediately prior to commencement of clearing shall include searches of potential denning habitat, including large hollow logs and rock piles. In the event that a quoll is identified,

no works would be undertaken within 200m of the animal until such time as the animal has self-relocated. A Fauna Management Protocol for Spotted-tailed Quoll is described in Table 4.1 of the Spotted-tailed Quoll Management Plan (GeoLINK 2017).

Frog surveys

Targeted surveys for threatened frogs were undertaken by LES in late 2011. The surveys detected two threatened frog species within the project corridor, green-thighed frog (*Litoria brevipalmata*) and giant barred frog (*Mixophyes iteratus*) (LES 2013a, 2014a). Management strategies for both of these species have been prepared by LES.

Frog surveys within suitable microhabitats will also be conducted either the night prior to or immediately prior (ie. less than two hours) to commencing clearing operations depending on the seasonal timing of proposed clearing operations. Nocturnal surveys, consisting of spotlighting searches and call playback census, will be conducted during warmer months (October to May) when frogs are generally more active. Frog surveys conducted during the colder months will be limited to active daytime searches (15 minutes per hectare) immediately prior to commencing clearing operations. Pre-clearing surveys in giant barred frog habitat areas should not take place during winter periods or other periods of likely dormancy including extended dry weather periods (i.e. more than 7 nights without a rainfall event of greater than 10 mm in 24 hrs).

Active searches will involve turning of rocks and logs, raking of debris and peeling of decorticated bark. Captured individuals will be held temporarily in a plastic bag with a small amount of water (1 frog per bag) and relocated in areas of suitable habitat adjacent to the clearing footprint.

All field survey, capture and release tasks will be conducted in accordance with the NPWS (2001) Hygiene Protocol for the Control of Disease in Frogs.

Microbat surveys and management

Bridge and culvert structures along the WC2U upgrade corridor were surveyed by LES in December 2011 and October 2012 to identify sites used for roosting by microbats. Nine of the 69 structures surveyed contained evidence of microbat use, while 22 of the structures were considered to contain suitable roosting habitat for microbats (LES 2014b). Consequently, a microbat management strategy has been prepared by LES.

Flying-fox surveys

During vegetation clearing activities in the remnant patch of swamp forest that contains the Macksville flying-fox camp (note: clearing restricted to between 1 May and 15 September), observation of a dusk exit flight and a dawn entry flight would be used to monitor presence/absence of flying-foxes. Clearing of vegetation within the buffer zone would halt if a heavily pregnant grey-headed flying fox (GHFF) or female GHFF with dependent young were present. An ecologist, experienced with flying foxes would be on site during removal of vegetation in vicinity of the camp. Other construction activities would halt if heavily pregnant GHFF or female GHFF with dependent young were present after 31 August.

Diurnal visual searches will be conducted within the remnant patch of swamp forest that contains the Macksville flying-fox camp immediately prior to commencement of clearing operations to detect any roosting flying-foxes. If a flying-fox is identified within the construction clearing zone, all clearing works will cease within 100 metres of the observed individual, or the edge of the group if a number of individuals are identified. Clearing will not commence in the area where the flying-foxes were identified until clearance is given by the project ecologist.

Final pre-clearing visual searches

A final pre-clearing visual search will be undertaken by the project ecologist immediately prior (ie. less than two hours) to commencement of clearing operations to ensure that the areas to be cleared are as free of fauna as possible.

Captured fauna will be released into adjacent or proximate areas of suitable habitat beyond the project clearing limit. Captured giant barred frogs will be relocated to the nearest side of the clearing limit within 100m of capture site. Captured koalas would be relocated within suitable habitat as identified by the Project Ecologist (refer to Koala Capture Relocation Strategy within Koala Management Plan).

2.1.2. Clearing process

Staged clearing

Following the completion of the pre-clearing surveys described in Section 2.1.1, tree removal will be staged, with non-habitat trees being removed first, then the potential habitat trees being removed with a swivel head harvester at least 48 hours later to enable resident hollow-dependent fauna time to evacuate the tree prior to felling. A suitably qualified, licensed and experienced ecologist and a suitable licensed and experienced wildlife carer will be present to observe the removal of each potential habitat tree. The wildlife carer will manage any injured or displaced fauna residing in felled trees. The ecologist will inspect each felled tree to record tree hollow characteristics and any evidence of habitation.

The project ecologist will be responsible for the relocation and release of any displaced fauna once the health of captured individuals has been confirmed by the wildlife carer. The reporting requirements for the tree clearing phase of the project are provided in Section 3.2.2.

Clearing supervision by ecologist

An ecologist would be present during clearing activities in giant barred frog habitat and in the vicinity of the flying-fox camp. The ecologist would manage any injured or displaced giant barred frogs or flying-foxes with assistance from a wildlife carer or vet for rehabilitating injured wildlife. The ecologist or wildlife carer would relocate and release displaced individuals upon confirmation of the animal's health.

Incidental fauna management

A suitably licensed and experienced wildlife handler will be made available to attend the project site during clearing operations to ensure rapid treatment and management of any displaced fauna detected incidentally by clearing operators or project personnel. The specific procedure for managing incidental fauna is detailed in the project CEMP.

Post-clearing inspections

Weekly post-clearing inspections shall be undertaken by the contractor throughout the construction phase of the project to ensure that all works are compliant with approved clearing limits and exclusion zones, and to check the integrity of exclusion fencing/barricades.

2.2. Fauna underpasses and exclusion fencing

Requirements for fauna underpasses as part of the WC2U upgrade project are stipulated in MCoAs B1, B2 and B3. Relevant SoCs and EA mitigation measures include:

- SoC F9 - Provision of fauna crossings will be as identified in the environmental assessment. All fauna crossings will be confirmed with the EPA and DPI during the detailed design phase;
- SoC F11 - Erection of fauna exclusion fencing (e.g. floppy-top fencing) along the Proposal at appropriate locations will direct fauna movement towards fauna-crossing structures;
- Chapter 10 Section 10.5.1.2 - Provide dedicated and incidental fauna crossing structures at key locations for forest fauna species identified to target the range of large, medium and smaller species present such as Yellow-bellied Glider, Koala, Giant Barred Frog and Green-thighed Frog;
- Chapter 10 Section 10.5.1.2 – all bridges on the project and culverts identified as having a potential role in fauna crossing will be designed to facilitate fauna movements;
- Chapter 10 Section 10.5.3 - Provision of dedicated, combined and incidental fauna underpass structures; and
- Chapter 10 Section 10.5.3 - Exclusion fencing will be installed around the crossing structures to prevent access to the carriageway for up to 500 metres either side.

A total of 23 fauna underpass structures are proposed for Stage 2 of the WC2U upgrade project. These will consist of 13 sites with box culverts, three sites with a pipe culvert and seven bridge sites. Eleven fauna underpass structures are proposed for monitoring (*Table 2.1*).

Table 2.1: Underpass structures within Stage 2 of the WC2U upgrade project proposed for monitoring following EPA and Roads and Maritime meeting 25/9/14.

Chainage Referral	Fauna crossing structure type	Structure form	Dimension	Target Species for Monitoring
42500	Combined	Bridge over Upper Warrell Ck		GBF
55120	Dedicated	Box Culvert	3000x3000	Koala & Quoll
56410	Combined	Box Culvert	2400x2400	Koala & Quoll
57770	Dedicated	Box Culvert	3000x3000	Koala & Quoll
58510	Combined	Box Culvert	3000x3000	Koala & Quoll
58560	Dedicated	Box Culvert	3000x3000	Koala & Quoll
59090	Dedicated	Box Culvert	3000x3000	Koala & Quoll
59550	Dedicated	Box Culvert	3000x3000	Koala & Quoll
59750 NB lanes	Dedicated	Box Culvert	2400x2400	Koala & Quoll
59760 SB Lanes	Dedicated	Box Culvert	2400x2400	Koala & Quoll
60600 NB Lanes	Dedicated	Box Culvert	2400x2400	Koala & Quoll
60610 SB Lanes	Dedicated	Box Culvert	2400x2400	Koala & Quoll

The purpose of the fauna underpasses and associated fauna exclusion fencing will be to maintain the viability of local populations of terrestrial fauna by facilitating wildlife movement between proximate areas of habitat either side of the Upgrade corridor, thus maintaining genetic variation and providing opportunities for species dispersal and recolonisation. Fauna underpass will be designed to accommodate use by several threatened fauna species including the spotted-tailed quoll (*Dasyurus maculatus*), koala (*Phascolarctos cinereus*) and giant barred frog (*Mixophyes iteratus*).

Flying-fox camp exclusion fence

Approximately 530m of three meter high exclusion fencing will be installed along the northbound and southbound carriageways in the vicinity of the Macksville flying fox camp. The fence is designed to minimise the risk of flying fox's striking trucks and vehicles when exiting or entering the camp.

2.3. Widened vegetated median and glider crossing structures

MCoA B4 states “*The Proponent shall in consultation with EPA, ensure that the design of the project as far as feasible and reasonable, incorporates provision for glider crossings (such as widened medians and maintenance or enhancement of habitat within the medians and corresponding carriageway boundaries) where the alignment crosses areas of recognised glider habitat*”. Furthermore, SoCs and EA mitigation measures relevant to the provision of widened medians include:

- SoC F8 - Retention of mature trees in the median at locations identified in the environmental assessment will provide a stepping stone for gliders. Protection of these trees will occur (F2), and lopping and pruning is not to occur without expert advice; and
- Chapter 10 Section 10.5.3 - Widening of the median at important locations.

The purpose of the widened vegetated median will be to maintain habitat connectivity for glider species known or likely to occur in the locality in order to maintain genetic variation and to provide opportunities for dispersal and recolonisation. Threatened glider species targeted by the mitigation measure include the squirrel glider (*Petaurus norfolcensis*) and yellow-bellied glider (*Petaurus australis*).

The only vegetated median within Stage 2 of the project will be located through Nambucca State Forest. The vegetated median will consist of a strip of retained tall sclerophyll forest vegetation (minimum 50 metres wide), which will extend up to 300 metres in length. Continuous lengths of wildlife exclusion fencing will be installed either side of the Upgrade corridor in this locality to limit potential use of the vegetated median by ground-based fauna, thus minimising the incidence of road-strike mortalities.

In addition, MCoA B2 requires the RMS to further investigate design refinements to improve fauna connectivity between chainages 19150 and 19820. Design refinements include the addition of one rope bridge and one glider pole crossing point consisting of three poles. Detailed design requirements are listed in Section 14.3 of Appendix 14 Scope of Works and Technical Criteria.

2.4. Nest box installation

Requirements for the installation of nest boxes are stipulated in:

- EA Chapter 10 Section 10.5.1.2 - Nest boxes are to be installed, where required, in accordance with specialist advice and in consultation with the EPA, prior to construction, to replace hollow resources that are proposed to be removed; and
- Microbat Management Strategy Section 3 - Bat boxes should be installed by an ecologist six to 12 months prior to planned roost exclusion.

2.4.1. Nest boxes for hollow resource replacement

The purpose of nest box installation is to implement nest boxes as a compensatory mechanism for the loss of den, roost and nest resources (LES 2013b). A Nest Box Management Plan (NBMP) has been prepared by LES and approved by DPE in accordance with MCoA B6, which states *“prior to the commencement of any construction work that will result in the disturbance of any native vegetation (or as otherwise agreed to by the Director General), the Proponent shall in consultation with OEH prepare and submit for the approval of the Director General a Nest Box Plan to provide replacement hollows for displaced fauna consistent with the requirements of SoC F7. The plan shall detail the number and type of nest boxes to be installed, which must be justified based on the number and type of hollows removed (based on detailed pre-construction surveys), the density of hollows in the area to be cleared and adjacent forest, and the availability of adjacent food resources. The plan shall also provide details of maintenance protocols for the nest boxes installed including responsibilities, timing and duration”*.

Nest boxes are to be installed at ten locations within Stage 2 of the WC2U project. Detailed descriptions of nest box locations, nest box types and target species for each area are provided in the NBMP (LES 2013b). At least 60 percent of the nest boxes are to be installed prior to or during clearing works to provide alternative shelter for hollow-dependent fauna displaced during the clearing phase. The remaining nest boxes will be installed once the abundance of actual tree hollows removed has been confirmed by the clearing phase monitoring.

2.4.2. Nest boxes targeting microbats

Nest boxes to accommodate microchiropteran bats impacted by project works on existing bridges and culverts would be installed by an ecologist six to 12 months prior to planned roost exclusion in accordance with the Microchiropteran Bat Management Strategy prepared by LES (2014b).

2.5. Landscape rehabilitation

Relevant EA and management plan mitigation measures include:

- Chapter 10 Section 10.5.1.1 - Revegetation/rehabilitation of the site should be conducted progressively during the construction phase to ensure the use of collected topsoil and seed and to develop different successional stages of rehabilitation;
- Chapter 10 Section 10.5.1.1 - A weed management plan is to be prepared as part of the flora and fauna management sub plan, outlining weed management actions to be carried out during construction to prevent the spread of weeds and plant pathogens;

- Chapter 10 Section 10.5.2 - Native and locally indigenous plants will be used in the landscaping and disturbed areas will be progressively revegetated;
- Chapter 10 Section 10.5.2 - Weeds in areas disturbed by construction activities will be managed for a minimum of two years after construction completion;
- Chapter 10 Section 10.5.4 - Development of a rehabilitation and weed control strategy as part of the construction environmental management plan, with specific mitigation measures for control of the spread of weeds and habitat rehabilitation, particularly along roadside verges, adjacent to culvert entrances and bridge pylons;
- Chapter 10 Section 10.5.4 - A protocol be developed for weed infested areas to ensure that all potential weed propagules from soil and vegetative material are appropriately disposed of; and
- Chapter 10 Section 10.5.5 - Roadside verges will be rehabilitated adjacent to culvert entrances and bridge pylons.
- Koala Management Plan Section 6.3.2 - Habitat rehabilitation works will be conducted within areas identified for additional koala habitat/connectivity.

In order to comply with MCoA B21(c) the contractor will prepare and implement an Urban Design and Landscape Plan (UDLP) for the project. The UDLP will include locations along the project corridor directly or indirectly impacted by the construction of the project (e.g. temporary ancillary facilities, access tracks, watercourse crossings, etc.) that are proposed to be actively rehabilitated, regenerated and/ or revegetated to promote biodiversity outcomes and visual integration. The UDLP will provide details of species to be replanted, including their appropriateness to the area and considering existing vegetation and habitat for threatened species.

2.6. Protection of in-situ threatened flora populations

The relevant mitigation measure for the protection of in-situ threatened flora species is stipulated in MCoA B7(d), which states *“the Proponent shall in consultation with the EPA develop a management plan for these species which includes detail of mitigation measures to be implemented during construction to avoid and minimise impacts to areas identified to contain these species, including excluding construction plant, equipment, materials and unauthorised personnel”*.

In situ threatened flora located within the road reserve outside the construction footprint will be protected during highway construction and operation by a range of measures directed at maintaining species and their habitat in good condition. Detailed descriptions of the proposed mitigation and management measures are provided in the threatened flora management plan prepared by Benwell (2017), and include:

- implementation of safeguards during clearing and construction - no-go zones, fencing and signage, toolbox sessions, tagging and marking and population mapping; and
- protection from edge effects - sedimentation fencing, shade/dust screening, landscaping, revegetation and weed control.

2.7. Establishment of translocation areas

The relevant mitigation measure for the establishment of translocation areas for threatened flora species is stipulated in MCoA B7(b), which states *“the Proponent shall in consultation with the EPA develop a management plan for these species which, if investigation under Condition B7(a) reveals translocation of impacted plants is feasible, includes details of a translocation plan for the plants consistent with the Australian Network for Plant Conservation 2nd Ed 2004: Guidelines for the Translocation of Threatened Plants in Australia 2nd Ed., including details of ongoing maintenance such as responsibilities, timing and duration”*.

An additional mitigation measure relevant to the establishment of translocation areas is provided in SoC F4 - *Plantings of rusty plum (Amorphospermum whitei) in areas of suitable habitat adjacent to the Proposal will follow from seed collection and propagation.*

This mitigation measure is also described in SoC F3 - *Threatened species directly impacted by the Proposal will be translocated to a suitable location outside the impact zone. A further visual inspection will be conducted post clearance to identify threatened species which may be indirectly impacted outside the cleared zone. Landscape planting is to commence along the road boundary as soon as possible during construction.*

Within Stage 2 of the WC2U upgrade project translocations are proposed for five threatened flora species directly impacted by the Upgrade, *Niemeyeri whitei*, *Marsdenia longiloba*, *Tylophora woollsii*, *Alexfloydia repens* and *Dendrobium melaleucaphilum* (Benwell 2014). In addition, translocations are proposed for two rare flora species directly impacted by the Upgrade, *Goodenia fordiana* and *Artanema fimbriatum*.

The primary aims of the proposed translocations are to:

- save and re-establish those individuals of significant flora directly impacted by construction; and
- improve the prospective viability of the translocated population by propagating and introducing additional individuals (Benwell 2014).

Details of the proposed translocation areas and procedures are provided in the Warrell Creek to Urunga Upgrade Threatened Flora Management Plan (Benwell 2016).

3. Monitoring methods³

3.1. Timing and duration of monitoring

Details of the timing and duration of monitoring for each mitigation measure are provided in the following sections and summarised in *Table 3.1*.

³ Note: monitoring methodologies may be modified through appropriate consultation (and stakeholder approval when required) where outcomes are still able to be achieved but more efficient methods and/or technology is able to be implemented.

Table 3.1: Summary of the timing and duration of monitoring events for each proposed mitigation measure. P & C = pre-clearing and clearing procedures; GTF = green-thighed frog monitoring; GBF = giant barred frog monitoring; MRB = microbat roost box monitoring; MH = microbat habitat monitoring; MBP&B = Microbat Persistence & Behaviour Monitoring (Crouches Ck Bridge); YG = yellow-bellied glider monitoring; KP = Koala population monitoring; FFH = Flying-fox habitat monitoring; FFP = Flying-fox population monitoring; FFRK = Flying-fox road kill monitoring; FU = fauna underpass and exclusion fence monitoring; RK = Road Kill Monitoring; VM = vegetated median; GCS = glider crossing structures; NM = nest box monitoring; LR = landscape rehabilitation monitoring; ITF = in-situ threatened flora population monitoring; TA = translocation area monitoring; MTH = Marsdenia Tylophora Habitat Monitoring.

Mitigation Measure	Pre-construction	Construction Phase (up to 4 years)				Operational Phase (to commence following project completion)									
		Year 1	Year 2	Year 3	Year 4	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
P & C		A; W; Sp; Su													
GTF						Once per year ⁴	Once per year	Once per year	Once per year	Once per year					
GBF	Sp; Su; A	Sp; Su; A		Sp; Su; A		Sp; Su; A		Sp; Su; A		Sp; Su; A					
MRB			A; W; Sp; Su	A; W; Sp; Su	A; W; Sp; Su	A; W; Sp; Su	A; W; Sp; Su								
MH	Once prior to construction	Monthly		Monthly	Monthly										
MBP&B		A; W; Sp; Su	A; W; Sp; Su												
YG	W/Sp		W/Sp			W/Sp	W/Sp		W/Sp			W/Sp			W/Sp
KP	W/Sp	Sp		Sp		Sp		Sp		Sp					
FFH						Quarterly ³									
FFP	Monthly	Monthly; Fortnightly (1 Aug - 30 April)	Monthly; Fortnightly (1 Aug - 30 April)	Monthly;	Monthly;	Monthly ³									
FFRK		Incidental observations	Incidental observations	Incidental observations	Incidental observations	Weekly for 12 weeks then weekly in Oct, Jan, Apr, July	Weekly in Oct, Jan, Apr, July	Weekly in Oct, Jan, Apr, July	Weekly in Oct, Jan, Apr, July	Weekly in Oct, Jan, Apr, July					
FU	W (quoll) as part of baseline					W; Sp/Su	W; Sp/Su	W; Sp/Su	W; Sp/Su	W; Sp/Su					
RK		Daily (Clearing); Weekly (Construction)	Weekly	Weekly	Weekly	Weekly for 12 weeks then weekly in Oct, Jan, Apr, July	Weekly in Oct, Jan, Apr, July	Weekly in Oct, Jan, Apr, July	Weekly in Oct, Jan, Apr, July	Weekly in Oct, Jan, Apr, July					
VM/GCS							Su/A; W/Sp	Su/A; W/Sp		Su/A; W/Sp					
NM				W; Su	W; Su		W; Su		W; Su						
LR			Sp; Su	A; W; Sp; Su	A; W	A; W; Sp; Su	A; W; Sp; Su	A; W; Sp; Su							
ITF		A; Sp	A; Sp	Sp	Sp	Sp	Sp	Sp	Sp	Sp					
TA	A; W; Sp; Su	A; W Sp	Nov	Nov	Nov	Nov	Nov	Nov	Nov	Nov					
MTH		A; Sp	A; Sp	Sp	Sp	Sp	Sp	Sp	Sp	Sp					

Note 1: A; W; Sp; Su - Autumn; Winter; Spring; Summer. Note 2: Monitoring periods may be reduced with the agreement of the Director General in consultation with EPA and DoEE, depending on the outcomes of the monitoring. Note 3: Green thighed frog – once per year at least 10-12 months apart when rainfall >75mm over 24hr or >150mm over 72 hr Note 4: Flying Fox – operational phase when upgrade to Macksville Camp opens to traffic

3.2. Pre-clearing and clearing procedures

3.2.1. Timing of monitoring

Surveys for delineating clearing limit boundaries and exclusion zones, identifying habitat resources and detecting hollow-dependent fauna, koalas and frogs will be completed shortly prior to the commencement of clearing operations. Wildlife rescue and tree hollow inspection procedures will be undertaken in conjunction with the second clearing stage, which involves the felling of potential habitat trees.

3.2.2. Monitoring procedure

The results of the targeted vegetation boundary and exclusion zone delineation surveys (refer to Section 2.1.1) will be incorporated into the project constraints mapping, which will be submitted as part of annual reporting to the Roads and Maritime and EPA.

Monitoring of pre-clearing and clearing procedures will include data collection and reporting tasks that will be submitted to Roads and Maritime, DPE and EPA. Information contained within the annual reporting shall include:

- a habitat tree register – to present the tree hollow data collected from habitat trees removed during clearing operations. The information will be analysed and compared with the potential tree hollow data contained in the NBMP prepared by LES (2012a) to ensure that an adequate supply of nest boxes has been installed to mitigate the impacts of tree hollow removal;
- detailed descriptions of methods used during the pre-clearing and clearing procedures;
- results of pre-clearing and clearing procedures including lists of fauna species displaced by clearing, species captured, species released and any wildlife mortalities resulting either directly or indirectly from the clearing operations;
- discussion of the pre-clearing and clearing procedures in terms of their effectiveness and any problems encountered that relate to the methods employed; and
- any recommended refinements to the pre-clearing and/or clearing procedures that may be adopted during future clearing operations.

The types of information to be collected during each pre-clearing and clearing procedure are provided in Table 3.2.

Table 3.2: Information to be collected during each pre-clearing and clearing procedure.

Mitigation Management Procedure	Required Information
Habitat Resource Surveys	Sampling date; observers; start/finish chainages; sampling start/finish times; threatened flora observations; additional habitat resources; GPS locations for observations.
Hollow-dependent Fauna Surveys Stag Watching (optional technique) Spotlighting	Sampling date; observers; habitat tree number; tree location; tree species; sampling start/finish times, prevailing weather conditions; hollow-dependent fauna species and abundances observed; location and characteristics of occupied hollow(s) on the subject tree. Sampling date; observers; start/finish chainages; sampling start/finish times, prevailing weather conditions; fauna species and abundances observed; fauna behaviour (ie. foraging, emerging from hollow, moving through site); habitat type occupied by observed fauna; GPS locations of fauna observations.
Koala Surveys	Sampling date; observers; start/finish chainages; sampling start/finish times, GPS locations of observed koalas; koala sex and age; species and DBH of occupied trees; method of site marking used; management procedure applied.

Mitigation Management Procedure	Required Information
Koala Surveys	Sampling date; observers; start/finish chainages; sampling start/finish times, GPS locations of observed koalas; koala sex and age; species and DBH of occupied trees; method of site marking used; management procedure applied.
Frog Surveys (including clearing supervision)	Sampling date; observers; location; sampling start/finish times, prevailing weather conditions; frog species and abundances observed/captured; condition of captured individuals; release date, release time; GPS location of release point; habitat type at release point.
Flying-fox Surveys (including clearing supervision)	Sampling date; observers; location; sampling start/finish times, prevailing weather conditions; flying-fox species and abundances observed/captured; condition of captured individuals; GPS locations of observed, captured and released individuals.
Habitat Tree Removal	Habitat tree number; removal date; observers; removal method (e.g. sawn, pushed, hard or soft impact); tree hollow characteristics (e.g. hollow type, entrance diameter, hollow depth, evidence of fauna usage); species breeding status and condition of fauna captured/observed; release date; GPS location of release point; habitat type at release point; release method.
Final Pre-clear Searches	Sampling date; observers; start/finish chainages; sampling start/finish times; fauna observations and captures; GPS locations for observation and release points.
Post-clearing Inspections	Sampling date; observers; start/finish chainages; compliance with clearing limits, compliance with exclusion zones, integrity of exclusion zone fencing/barricades, GPS locations for any non-compliances and photos of non-compliances.

3.2.3. Potential indicators of success

Potential indicators of success for the pre-clearing and clearing procedures will include:

- low rates of fauna injury and mortality resulting from clearing operations, particularly of threatened fauna species;
- successful capture and release of fauna displaced by clearing operations;
- accurate quantification of tree hollow resources being removed; and
- adherence to clearing limits and exclusion zones.

3.3. Threatened frog population monitoring

3.3.1. Green-thighed frog

Timing of monitoring

Monitoring will be undertaken on five occasions, commencing in the first year of the operational phase and finishing five years post-construction. The monitoring events will be at least 10 to 12 months apart but ultimately dependant on rainfall events. Monitoring will commence once the vegetation on the edges of the constructed ponds is considered sufficient (>20% groundcover). Inspections of permanent frog fences for breaches by frogs will be undertaken during population monitoring.

Monitoring methods

Monitoring of the green-thighed frog population will consist of two main components:

- Monitoring of constructed breeding ponds; and
- Monitoring the integrity of frog fences.

Monitoring will be undertaken on a rainfall event basis when 24 hour rainfall totals exceed 75mm or a cumulative total of 150mm over a 72 hour period. Such rainfall events will be monitored via 'on site' weather stations which are to be programmed to generate a sms message to the field survey team phone, and alternatively, the Bureau of Meteorology (BOM) website and specifically the Nambucca Heads Bowling Club (Station No. 059024). Further details of monitoring methods are provided in the green-thighed frog management strategy prepared by LES (2013a).

Potential indicators of success

Performance indicators of success will be based on either the:

- Continued presence of Green-thighed Frogs at breeding ponds;
- Green-thighed Frogs calling from the edge of the constructed ponds; or
- The presence of tadpoles, juveniles or metamorphs during follow up surveys.

3.3.2. Giant barred frog

Timing of monitoring

Baseline population monitoring was undertaken prior to construction, and consisted of one survey in spring, summer and autumn (i.e. three surveys). Subsequent population monitoring events will also consist of three surveys (spring, summer and autumn) to be undertaken for years 1, 3 and 5 of the operational phase (Table 3.1). The timing of monitoring can be varied where approved by DoEE in consultation with EPA. Inspections of permanent frog fences for breaches by frogs will be undertaken during population monitoring.

Monitoring methods

Population monitoring of the giant barred frog (*Mixophyes iteratus*) will be undertaken at Upper Warrell Creek where the species is known to occur and Butchers Creek.. The monitoring program will consist of:

- **Upper Warrell Creek:** Establishment of a one kilometre transect, which would consist of 450m upstream and downstream of the project corridor and 100m within the project corridor;
- **Butchers Creek:** Establishment of a 400m transect, which would consist of 200m upstream and downstream of the project corridor.
- A minimum sampling duration along the transect of two person hours per sampling event;
- Baseline data was collected in three sampling events, spring, summer and autumn, prior to commencement of construction works;
- Captured individuals to be PIT tagged to record re-captures during subsequent surveys. Data to be recorded per individual will include location, sex and breeding condition, snout-vent length, weight and general condition. Individuals captured during the summer survey should be swabbed for presence of Chytrid fungus;
- Tadpole surveys during the spring survey using bait traps (20 traps per transect in Upper Warrell Creek and 8 traps per transect in Butchers Creek) and opportunistic dip netting during spring and autumn surveys; and
- Collection of abiotic data and habitat attributes.

No reference site has been proposed for the monitoring program as a means of managing the potential spread of chytrid fungus. Further details of monitoring methods are provided in the giant barred frog management strategy prepared by LES (2014a).

Potential indicators of success

Performance indicators of success will be based on either the:

- Continued presence of giant barred frog along any part of the 1 km transect. This approach

compensates for the mobile habits of this species and the shifting patterns of seasonal habitat use;

- The recapture of one or more giant barred frog following their relocation from the clearing footprint (if this occurs); or
- The presence of tadpoles, metamorphs or juveniles frogs during follow up surveys post construction (LES 2014a).
- <30% decline in measured habitat parameters;
- <15% increase in bare ground cover;
- No statistically significant changes in measured water quality parameters;
- No road kill of Giant Barred Frog resulting from operation of highway.

3.4. Microbat monitoring

3.4.1. Timing of monitoring

Microbat roost boxes will be monitored quarterly, commencing six months after installation, for a period of five years. Microbat habitat monitoring will be conducted once prior to construction and monthly during construction. Inspection of riparian zones to assess impacts on flyway function will also be conducted once post-construction. A program to monitor bat persistence and behaviour will be developed by the contractor and the Project Ecologist and/or microbat specialist. Monitoring will continue for two years during adjacent construction works.

3.4.2. Monitoring procedures

Microbat roost boxes

The microbat boxes will be inspected quarterly to determine species presence/absence, an estimate or count of numbers and breeding activity. Information will also be collected as to the roost identification number, date and time of the inspection. Bat box inspections will commence six months after installation and finish after two years of operation (Table 3.1).

Habitat monitoring

Habitat monitoring will focus on inspections of the riparian zone to assess whether flyways have been constricted as part of construction works. Therefore, on either side of the construction corridor a photo point will be installed and a visual assessment undertaken to gauge whether the flyway has been maintained or is in need of corrective actions (i.e. vegetation management).

Monitoring of water quality will also be undertaken on both the upstream and downstream sides of the construction works. This monitoring will be undertaken on a monthly cycle in accordance with the Construction Environmental Management Plan (CEMP) and collect the following parameters: turbidity; total suspended solids; conductivity and pH at both upstream and downstream points.

Microbat persistence and behaviour monitoring

A program to monitor bat persistence and behaviour at the Crouches Creek Bridge will be developed by the contractor and the Project Ecologist and/or microbat specialist. This site has been selected because it contained the largest microbat roost during the summer field survey and provides the greatest opportunity to examine the disturbance thresholds of microbats. The monitoring must consider the differences in roost use between summer and winter along with the species that are likely to use it as a roost. Monitoring would be initiated once construction works are adjacent to Crouches Creek and would be conducted seasonally for two years.

3.4.3. Potential indicators of success

Performance indicators of success may include:

- Occupation of roost boxes by a range of target species;
- No constriction of riparian zone flyways caused by construction activities;

3.5. Koala monitoring

Koala population surveys were conducted by GeoLink (2014c) to identify the location and extent of resident koala activity within the WC2NH project corridor. The results of the surveys confirmed that koala activity was limited to low level usage in the Nambucca State Forest/Old Coast Road area. The survey reports concluded that there were insufficient data to provide an accurate population estimate of koalas in the area and that the provision of GPS/VHF fitted collaring and pit tagging koalas or establishing transect survey control sites was not required.

3.5.1. Population monitoring

Transect surveys will be conducted in spring during construction phase (years 1 and 3) and operational phase (years 4, 6 & 8). Transects are to be established on each side of the Project footprint within the Nambucca State Forest/Old Coast Road area between chainage 15600 and 19500 as per the Koala Management Plan (GeoLINK 2017). Both diurnal and nocturnal transect surveys will be conducted during each survey period with the addition of spotlighting on tracks and easements across the survey area.

3.5.2. Injury/mortality from construction activities or road strike

Road mortality monitoring will be conducted during the construction and operational phase. Details on methodology and timing are provided in Section 3.9 and Appendix A. Furthermore, post-clearing inspections of areas cleared should be undertaken to identify any koalas injured or killed.

Where continuous lines of jersey barriers are to be installed, gaps are to be provided to allow animal escape. Where this is not possible, a suitable material will be installed to enable koalas to climb over the barrier. Barriers should be periodically inspected to ensure compliance.

3.5.3. Potential indicators of success

Koala abundance and distribution pre-construction are similar to post-construction and maintained in the vicinity of Nambucca State Forest / Old Coast Road.

No koala injuries or mortalities as a consequence of construction activities or operation of the Upgrade.

3.6. Yellow-bellied glider population monitoring

3.6.1. Population monitoring

It is stated in Section 10.5.1.2 of the EA that a strategy would be developed for monitoring the yellow-bellied glider population in the affected area of Nambucca State Forest as part of the flora and fauna management plan. This requires the development and implementation of a monitoring program to provide baseline data on the yellow-bellied glider population prior to commencement of construction.

The monitoring program proposed aims to assess both individual level and population level responses to the highway upgrade. An individual level response will be measured by comparing forest use adjacent to the highway upgrade before and after construction. A population level response will be measured by comparing proportion of survey sites occupied by yellow-bellied gliders in Nambucca SF with that measured at reference locations before and after construction.

Assessment of individual response (i.e. habitat use) to highway upgrade will be conducted using spotlighting and song meters to detect and record yellow-bellied glider calls in the vicinity of the highway upgrade. Population assessments will be conducted using spotlighting in Nambucca SF and at reference sites located in nearby Yarriabini NP and Ngambaa NR. The sampling methodology and timing will be undertaken in accordance with the yellow-bellied glider ecological monitoring program prepared by Goldingay (2014).

Pre-construction baseline surveys will be conducted on all survey transects (i.e. 6 habitat use transects and 90 population monitoring transects) on three occasions within the one season. Eight song meters installed near the location of the highway upgrade within Nambucca SF will sample for three months pre-construction. Surveys will also be conducted at completion of clearing (i.e all transects spotlighted on three occasions and song meters active for six months) and ideally at a similar time of the year to the baseline surveys (Aug-Oct). Post-construction monitoring will then occur in years 1, 2, 4, 7 and 10. Post-construction monitoring should endeavour to include six song meters in each of the three forest blocks where population monitoring with spotlighting is conducted. This will provide an opportunity to compare

the results of song meters versus spotlighting and if they prove to be a more effective technique then it could be used as the only technique in subsequent years to assess population stability.

3.6.2. Fire / logging events

In the event that either logging or wildfire occur in any of the three Nambucca SF blocks used for population monitoring, an additional round of three surveys should be conducted within six months of the event. Surveys would occur on all baseline transects and six song meters would also be installed and sampled within each of the three forest blocks. Reference sites will only be included if two or more of the three Nambucca SF blocks are affected simultaneously.

3.6.3. Potential indicators of success

- No reduction in proportion of sites occupied by yellow-bellied gliders in Nambucca SF post-construction.
- No reduction in forest use adjacent to the highway in Nambucca SF post-construction.

3.7. Flying fox camp monitoring

3.7.1. Population monitoring

Population monitoring at the flying-fox camp would be undertaken to confirm flying-fox presence and determine patterns of occupation, species composition, demographic composition, key behaviours, and habitat characteristics. These data will inform mitigation measures and monitoring activities during construction and operation. The sampling methodology and timing will be undertaken in accordance with the flying-fox management plan (Gorecki et al. 2017).

Population monitoring commenced in the winter of 2013 to provide a baseline of population condition prior to road construction, which will provide a point of comparison to assess the impacts of the road on the population of flying-foxes and monitor the effectiveness of mitigation measures (Gorecki et al. 2017). Population monitoring will continue to be undertaken monthly throughout the pre-construction phase, construction phase and first year of the operational phase of the project. The fortnightly field monitoring program would continue through construction of the Project during the period when the flying-foxes are expected to be in the camp (i.e. from 1 August until monitoring confirms camp vacated). The monitoring program would be reviewed regularly and refined if considered appropriate.

3.7.2. Habitat monitoring

Monitoring of flying-fox habitat quality adjacent to the Project would be undertaken for the first year after the opening of the Project to traffic unless otherwise agreed with DPE, EPA and DoEE.

3.7.3. Exclusion fence and road mortality / vehicle strike monitoring

Approximately 530m of three meter high exclusion fencing will be installed along the northbound and southbound carriageways in the vicinity of the Macksville flying fox camp. The fence is designed to minimise the risk of flying fox's striking trucks and vehicles when exiting or entering the camp. To monitor its effectiveness, road mortality monitoring would be conducted commencing within one month of opening of the Project to traffic. Surveys would target 500m either side of the Macksville flying-fox camp. Surveys would occur weekly during October (spring), January (summer), April (autumn) and July (winter) for up to five consecutive years post opening to traffic, or until mitigation measures have been demonstrated to be effective.

3.7.4. Potential indicators of success

- No deterioration in the quality of adjacent habitat vegetation as a result of the Project;
- No significant reduction in reproductive output (measured as mean percentage of females with young in target trees) relative to the control site; and
- No incidence of road mortality in vicinity of Macksville camp.

3.8. Fauna underpasses and exclusion fencing

Monitoring of the fauna underpasses and exclusion fencing will be conducted after installation and once the Upgrade has become operational.

Of the 23 fauna underpass structures proposed for Stage 2 of the WC2U upgrade project, 12 structures have been selected for monitoring (Table 3.3). An underpass structure was deemed suitable for monitoring if it was located in an area of suitable habitat for one or more of the target threatened species (ie. koala, spotted-tailed quoll and giant barred frog).

Table 3.3: Proposed fauna underpass structures suitable for monitoring. SQ=spotted-tailed quoll; K = koala; GBF = Giant Barred Frog.

Chainage	Structure	Dimensions	SQ	K	GBF
42500	Bridge				✓
55120	Box Culvert	1 x 3000 x 3000	✓	✓	
56410	Box Culvert	1 x 2400 x 2400	✓	✓	
57770	Box Culvert	1 x 3000 x 3000	✓	✓	
58510	Box Culvert	1 x 3000 x 3000	✓	✓	
58560	Box Culvert	1 x 3000 x 3000	✓	✓	
59090	Box Culvert	1 x 3000 x 3000	✓	✓	
59550	Box Culvert	1 x 3000 x 3000	✓	✓	
59750 North Bound Lanes	Box Culvert	1 x 2400 x 2400	✓	✓	
59760 South Bound Lanes	Box Culvert	1 x 2400 x 2400	✓	✓	
60600 North Bound Lanes	Box Culvert	1 x 2400 x 2400	✓	✓	
60610 South Bound Lanes	Box Culvert	1 x 2400 x 2400	✓	✓	

It was agreed with EPA that bridge underpasses would generally not require monitoring given that such structures have been demonstrated to provide effective fauna movement on other similar road projects. However, it was also agreed with the EPA that, the bridge at chainage 42500 (Upper Warrell Ck) would be monitored for use by giant barred frog.

3.8.1. Timing of monitoring

The timing of fauna underpass/exclusion fence monitoring has been selected to coincide with the breeding seasons and likely dispersal periods of the threatened fauna species targeted by the underpass structures, koala and spotted-tailed quoll (ie. late spring/summer and late autumn/winter). Fauna movements are expected to be more frequent and extensive during the breeding seasons and dispersal periods due to expansion of home ranges and movement of juveniles away from natal areas. Therefore, these periods are likely to represent peaks in fauna movement and increased likelihood of fauna underpass use.

With the exception of pre-construction baseline monitoring for spotted-tailed quoll, monitoring of the underpasses will commence after the Upgrade has become operational. Monitoring events will be undertaken in all structures identified in Table 3.3 in late spring/summer and late autumn/winter. This shall be undertaken each year for up to 5 consecutive years during the operational phase of the project (Table 3.1). The autumn/winter monitoring events will be conducted over 60 days each year, preferably commencing July/August. The spring/early summer monitoring events will also be conducted over 60 days each year, preferably commencing in late November.

3.8.2. Fauna census techniques

Monitoring of the selected fauna underpasses will involve sampling within each underpass structure and its entrances, in retained habitats adjacent to the fauna underpass and in the areas isolated by exclusion fencing leading into the underpass structures. Monitoring should involve the use of several fauna census techniques including:

- motion-sensing cameras;
- hairtube sampling;
- scat and track searches; and
- use of artificial groundcover (e.g. corrugated iron or plywood sheeting).
- Sand pads

Fauna underpass structures

Hairtubes will be attached to fauna furniture within each underpass structure at various heights where possible to sample both ground-based and arboreal fauna. Hairtubes will be baited with a combination of vegetarian and meat baits.

Motion-sensing cameras will be installed at both entrances to each fauna underpass structure to detect mainly medium to large fauna species and their direction of movement. Camera monitoring will continue for the duration of the sampling period.

A single sand pad (~1m wide) will be placed within the centre of each underpass structure. During sand pad inspections, each fauna underpass structure will also be carefully searched for fauna scats, hair and tracks. Sand pad monitoring will be conducted for a minimum of eight nights during each sampling period and scat/track searches at least twice per sampling period.

If the underpass “fauna furniture” does not include logs or rocks to provide suitable shelter for small ground mammals, reptiles and frogs, then artificial groundcover will be placed in the underpass to sample these faunal groups. The artificial groundcover will be installed at the beginning of each monitoring event and checked when conducting sand pad inspections.

Adjacent forest habitat

Forest habitat adjacent to the fauna underpass entrances will be surveyed to assess the range of fauna species occurring in the proximity of each underpass structure. The results will then be compared with the underpass monitoring results to identify which species present in the immediate area are not utilising the underpass structure.

The sampling area in forest adjacent to each underpass entrance shall cover at least one hectare where possible. The census techniques will include spotlighting, arboreal and ground-based trapping (using cage and box traps), pitfall trapping, hairtube sampling, timed diurnal and nocturnal active searches (e.g. under fallen logs, litter, decorticating and fallen bark and rocks) and scat and track searches.

Fauna underpass exclusion fencing

Monitoring of areas isolated by the wildlife exclusion fencing leading into the fauna underpasses will be undertaken. The purpose of the monitoring is to assess the effectiveness of the exclusion fencing design (including drop-down structures) in protecting smaller less mobile fauna species such as frogs, reptiles and small mammals from road strike mortality whilst funnelling them into the underpass structures. Limiting the sampling to within 200 metres either side of the underpass structure should be sufficient to accommodate the predominantly small home ranges of the target species (ie. smaller less mobile fauna).

Monitoring techniques will include the use of remote-sensing cameras or sand pads (possibly in conjunction with drift fencing), hairtubes, timed diurnal active searches (e.g. under fallen logs, litter, decorticating and fallen bark and rocks) and scat, track, foot-based road mortality searches from the inside of the fauna fence and car-based road mortality searches from the roadway side of the fence. Monitoring will also include an inspection of the exclusion fencing to assess fence condition, structural integrity, overhanging vegetation and vine growth.

3.8.3. Potential indicators of success

Potential indicators of success for the fauna underpass and exclusion fence monitoring will include:

- low rates of use of fauna underpasses and adjacent habitats by feral predators;
- high levels of fauna underpass use by a wide variety of native fauna species;
- No change to densities, distribution, habitat use and movement patterns compared to baseline population data of target species
- evidence of use by dispersing individuals and different age cohorts;
- use by cover-dependent species and species with low mobility;
- no breaches in fauna exclusion fencing; and
- low incidences of fauna road strike mortality.

3.9. Road mortality monitoring

3.9.1. Methodology

During and up to one month following clearing operations, daily road mortality surveys of the existing highway will be conducted. The frequency of surveys will then shift to weekly for the duration of construction. Upon opening of the project to traffic (i.e. operational phase), the opened sections of the WC2NH Upgrade will be monitored on a weekly basis for 12 weeks and thereafter each section will be monitored weekly for four weeks in October (Spring), January (Summer), April (Autumn) and July (Winter) by a two-person team in a vehicle. Monitoring will continue for up to five consecutive years post construction, or until mitigation measures have been demonstrated to be effective. Refer to Appendix A for detailed methodology.

3.9.2. Performance measures

Lower rates of road kill in proximity to fauna fencing (i.e. areas of the main carriageways within areas adjacent to installed fauna fencing) than in sections of the upgrade not near fauna fencing during monitoring events up to 5 years post construction phase, or until such time as mitigation measures have been demonstrated to be effective.

3.10. Widened vegetated median and glider crossing structures

3.10.1. Timing of monitoring

The timing of monitoring for the widened vegetated median has been selected to coincide with the breeding season and probable dispersal periods of the yellow-bellied glider (*Petaurus australis*), which are likely to represent peaks in glider movement, resulting in greater likelihood of use of the vegetated median.

Monitoring of the vegetated medians will be conducted in years 2, 3 and 5 of the operational phase of the Upgrade project (Table 3.1). Monitoring activities would be conducted during two eight-week periods: Summer/Autumn (e.g. Feb/Mar) and Winter/Spring (e.g. Aug/Sep). Additional years of monitoring may be required if the vegetated median is found to be ineffective and requires modification or supplementation with alternative glider crossing structures.

3.10.2. Fauna census techniques

Monitoring of the vegetated median will involve sampling within the vegetated median and within retained habitat either side of the Upgrade corridor. Monitoring will involve the use of several fauna census techniques including hairtube sampling, spotlighting surveys, call playback. Specific details of each monitoring technique include:

Spotlighting surveys (including call playback):

- Two occasions during each monitoring period
- Each roadside and median
- 500m-long transects

Hairtube sampling:

- One 2-week period during each monitoring period
- Each roadside and median
- Use spotlight transects with 10 tubes/transect (i.e. 50m spacing)

A work method statement will be developed to address traffic safety impacts of spotlighting.

3.10.3. Potential indicators of success

Potential indicators of success for the vegetated median monitoring will include:

- evidence of regular use of median vegetation and crossing structures by yellow-bellied gliders;
- evidence of use by dispersing individuals and different age cohorts; and
- use of vegetated median and crossing structures by other glider species e.g. sugar glider and greater glider.

3.11. Nest box monitoring

3.11.1. Timing of monitoring

LES (2013b) has proposed that nest box monitoring will take place in winter 12 months after the installation period, followed by a summer census to account for seasonal variation in the use of the nest boxes. Winter and summer monitoring events will be conducted in years three and four of the construction phase as well as years two and four of the operational phase (Table 3.1).

During each monitoring event, the following information shall be collected for each nest box using a field proforma:

- inspection dates, weather conditions (i.e. rain, wind, cloud cover, ambient temperature) and time each box was inspected;
- nest box number;
- is the nest box currently occupied by native fauna, if yes, what species;
- if no, are there signs of use and can the species be identified or assigned to a group (i.e. bats, birds);
- has the nest box been used by a pest species (i.e. european bees, common myna, termites);
- is there any deterioration of the nest box;
- is there any maintenance required; and
- has the surrounding landscape changed (i.e. clearing, partial clearing).

Factors to be considered as part of the maintenance schedule include:

- the need to remove exotic pests species such as common mynas, common starling and european bees;
- replacement of fallen, damaged or degraded nest boxes;
- repositioning or relocation of dysfunctional nest boxes;
- checking each box is not holding water or leaking; and
- removing excess nesting material as this may impede access over time.

3.11.2. Potential indicators of success

Potential indicators of success for the nest box mitigation measure will include:

- low rates of nest box occupancy by feral species;
- use of nest boxes by a wide variety of hollow-using native fauna species;

- species use of nest boxes is consistent with the species targeted by the nest box design; and
- high level of nest box durability, with minimal maintenance requirements.

3.12. Landscape rehabilitation

3.12.1. Timing of monitoring

Monitoring frequency for Landscape Rehabilitation shall be undertaken quarterly in the first 4 years of operation as per Table 3.1 of the Ecological Monitoring Program.

Review of the Roads and Maritime Vegetation and Landscaping Specifications (R178, R179 and R174) and Section 5.7.2 of the adopted Pacific Highway Upgrade Warrell Creek to Nambucca Heads Detailed Design Report (Spackman Mossop Michaels 2016) the following matters are required for the Landscape Rehabilitation Monitoring as part of the Ecological Monitoring Program:

- A colour coded and annotated map detailing the treatments applied including
- Treatment type and date of application / treatment for each monitoring site
- Noting if cover crop has been applied to each monitoring site
- Seed or planting mix type (native) applied for each monitoring site
- Topsoil media component mix % for each monitoring site (topsoil, integrated shredded mulch, other ameliorants)
- Fertiliser application rates and types for each monitoring site
- Details of any herbicide application for each monitoring site, in accordance with R178
 - details of any weed removal (by hand) for each monitoring site. To be plotted on map.
 - Photo Points – ensure photos are taken monthly at the established monitoring locations (plotted on map with GPS coordinates and marked onsite with a colour coded stake). Data obtained is to be used to:
 - Monitor progress of rehabilitation works and record using photo points
 - Modify treatments and identify areas requiring further attention
 - Erect signage in accordance with R178 and R179
 - Details of any seed suppliers (name, address, etc.) used (native and cover crop)
 - Details of seed certification or seed treatment by supplier.

3.12.2. Monitoring Locations

To enable effective monitoring of the Landscape Sites, the twelve (12) monitoring locations described in Table 3.4 have been selected to provide a representative sample of landscape treatments as part of the Warrell Creek to Nambucca Heads Project:

Table 3.4: *Landscape treatment monitoring locations.*

Number	Location	Treatment
1	Fill 4 Embankment East – Southern Zone	Seed Mix 1 (hydroseeding)
2	Fill 4 Embankment West – Southern Zone	Seed Mix 2 (hydroseeding)
3	Cut 2 Embankment East – Southern Zone	Seed Mix 3 (hydroseeding)
4	Ancillary Area Fill 19 West – Northern Zone	Seed Mix 4 (direct seeding)
5	Fill 5 Vegetated Drainage Swale – Southern Zone	Seed Mix 5 (hydroseeding)

Number	Location	Treatment
6	Cut 22 Embankment East – Northern Zone	Bushland Reconstruction (see note 1 below)
7	Cut 22 Embankment West – Northern Zone	Bushland Reconstruction
8	Fill 20 Embankment East – Northern Zone	Bushland Reconstruction
9	Cut 18 Embankment East – Northern Zone	Bushland Reconstruction
10	Williamson Creek	Landscape Planting (see note 2 below)
11	Stoney Creek	Landscape Planting
12	Butchers Creek	Landscape Planting

Note 1: Bushland Reconstruction: require a mix of bushland topsoil media, integrated shredded mulch, seed and ameliorants. The ratio required for this mix require a maximum of 40% shredded mulch. The species included in the Bushland Reconstruction mix comprise:

- *Acacia longifolia* (Wattle) @ 0.25kg/ha
- *Acacia floribunda* (Wattle) @ 0.25kg/ha
- *Acacia fimbriata* (Wattle) @ 0.25kg/ha
- *Cymbopogon refractus* (Barbed Wire Grass) @ 1.00kg/ha
- *Hardenbergia violacea* (Purple Twining-pea) @ 1.00kg/ha
- *Themeda australis* (Kangaroo Grass) @ 1.00kg/ha

Note 2: Landscape Plantings: Indigenous species suited to the bioregion as per the UD02 Urban Design and Landscaping Package.

3.12.3. Methodology

A standardised monitoring methodology shall be utilised for the Landscape Rehabilitation, which shall include the following approach:

- Installation of permanent 50 metre monitoring transects at each of the twelve (12) monitoring sites using a 50 metre tape measure and installation of a white wooden stake at each end of the transect. The transect location shall be chosen on the basis of sampling a representative section of the core area of the site and shall be aligned along the face of each batter (usually in a north-south alignment). Monitoring site details shall be written on each peg for ease of identification. Flagging tape shall also be installed on each peg.
- GPS survey of each marker peg
- A photograph shall be taken along the transect from each of the marker pegs at each monitoring event and incorporated into each monitoring report.
- Collection of data based on a field proforma shall be as follows:
 - Treatment percentage cover
 - Braun Blanquet cover class score
 - Weed species present

- Details on plant species present (included in mix)
- Details on plant species present (not included in mix)
- Signs of stress, predation or disease

3.13. In-situ threatened flora populations

3.13.1. Timing of monitoring

The recommended timing for monitoring of in-situ threatened flora populations is as follows: collection of baseline data upon installation of protective barriers, 6-monthly intervals for two years and once a year thereafter for five years post-construction (Table 3.1). The monitoring program will then be reviewed and a strategy developed for further monitoring if required.

3.13.2. Monitoring procedure

Monitoring of in-situ threatened flora populations will aim to assess the effectiveness of protective measures and provide feedback to management on any need for corrective measures if required (Benwell 2014). Each specimen within the in-situ populations will be tagged with an ID code, which will be written on flagging tape and attached to the plant. A map of each in-situ population will be prepared showing the position of all plants (with identification number). The maps can be used to relocate individuals if tags are dislodged or interfered with. The following data are to be recorded for each in-situ specimen:

Identification

- genus;
- species and subspecies;
- plant identification number; and
- location.

Plant condition

- general condition – score on a scale of 0 to 5, where 0 is dead and 5 is excellent;
- leaf condition – healthy/unhealthy, colour, vigour;
- flower/fruit – flower/fruit presence;
- length of new shoots – average length of new shoots (eyeball estimate) and abundance of shoots (many/few etc);
- disease symptoms – evidence of disease;
- recruitment; and
- evidence of any other damage or disturbance.

Site conditions

- plant community canopy height and cover;
- weed abundance and composition;
- climatic events (e.g. drought, unusually cold winter temperatures etc);
- maintenance carried out – when and what kind of maintenance carried out at the site since the last monitoring; and
- any other ecological impacts.

3.13.3. Potential indicators of success

Potential indicators of success for the protection of in-situ threatened flora populations will include:

- no net loss of plant abundance within each in-situ population;

- no reduction in population extent;
- no reduction in reproductive vigour;
- good quality habitat successfully restored around each in-situ population site;
- maintenance carried out each year as described in the threatened flora management plan prepared by Benwell (2014); and
- threatening processes including weed invasion controlled or eradicated.

3.14. Translocation areas

3.14.1. Timing of monitoring

Monitoring frequency for the translocations is as follows: three monitoring periods in the first year (6th , 8th and 12th month), three monitoring periods in the second year (June 2016, November 2016 and January 2017), then once a year in November to the end of the monitoring program. Monitoring to be conducted during construction (~3 yrs) and after construction for 5 years, a total of 8 years.)

3.14.2. Monitoring procedure

Monitoring of translocation areas will aim to record information that can be used to evaluate the success of the translocations and identify causes of survival or mortality. Transplanted individuals will be tagged with the ID code allocated during the targeted survey. This will be written on flagging tape and attached to the plant. A map of each translocation area will be prepared showing the position of all translocated plants (with identification number). The maps can be used to relocate individuals if tags are dislodged or interfered with. Enhancement individuals will also be tagged with flagging tape and numbered and recorded when planted out. The following data are to be recorded for each translocated individual.

Identification

- genus;
- species and subspecies;
- identifier – unique plant number;
- translocation – transplant/cutting/seedling;
- place of origin – original site or source location; easting, northing & description; and
- date – date of monitoring.

Plant condition

- condition when planted – good root-ball, minimal root-ball, bare rooted;
- height – initial height (also later dates as required);
- number of stems – number of stems at transplanting;
- diameter – initial diameter (also later dates as required);
- general condition – score on a scale of 0 to 5, where 0 is dead and 5 is excellent;
- leaf condition – healthy/unhealthy, colour, vigour;
- bark condition – bark damage, healing;
- flower/fruit – flower/fruit presence;
- recent shoot growth – average length of new shoots or recent foliage growth (eyeball estimate) and abundance of new shoot growth (many/few etc);
- insect grazing – evidence of insect grazing;
- mammal grazing - evidence of mammal grazing;
- disease symptoms – evidence of disease;

- recruitment – evidence of recruitment; and
- evidence of any other damage or disturbance.

Site conditions

- plant community canopy height and cover;
- weed abundance and composition;
- climatic events (e.g. drought, unusually cold winter temperatures etc);
- maintenance carried out – when and what kind of maintenance carried out at the site since the last monitoring; and
- any other ecological impacts.

3.14.3. Potential indicators of success

Potential indicators of success for the translocation plan will include:

- for each translocated species, at least 60% of the transplants and enhancement introductions are surviving after the first year and 50% after five years;
- flowering/seeding occurs in transplanted individuals (unless saplings);
- representatives from a range of individuals from the local population are established;
- the new or enhanced populations have similar growth characteristics to the natural populations;
- good quality habitat successfully restored in and surrounding the recipient site;
- maintenance carried out each year as described in the threatened flora management plan prepared by Benwell (2014); and
- threatening processes including weed invasion controlled or eradicated.

3.15. Slender Marsdenia and Wools' Tylophora Habitat Condition Monitoring

3.15.1. Timing of monitoring

The plots are to be established within one month of the finish of vegetation clearing (baseline monitoring) and then monitored at 12-monthly intervals during construction and the operation phase for a total of 8 years.

3.15.1. Monitoring Method

Monitoring of potential changes in the habitat of Slender Marsdenia and Wools' Tylophora is to be conducted within the indirect impact zone – ie within 10 metres of the edge of clearing/construction. Monitoring is to be conducted in areas of this habitat adjacent to the construction footprint and to be plot-based. Permanent plots were established in the indirect impact zones at 10 representative points in Slender Marsdenia and Wools' Tylophora habitat as mapped by Dr Andrew Benwell in spring 2010. Each plot is 10 m wide and 20 m long, with the long axis parallel to the edge of clearing. The corners of each plot were marked with pink flagging tape and the GPS co-ordinates of the corners of plots also recorded. Plots were established on 26 November 2015 around the time that clearing operations in the northern zone of the project were being completed. The following parameters were measured at each plot (refer to Section 5.4 of the TFMP for more information):

- Native vegetation structure
- Level of weed incursion
- Microclimate class.

3.15.2. Performance Indicators

The following performance indicators are to be used to evaluate changes in habitat condition

- Plot crown-cover of exotic species is no more than 15% (overlapping and/or summed) at the end of Year-1 and no more than 25% at the end of Years-2 to 8.

- Baseline vegetation structure (height and crown cover) remains the same or increases in height and crown cover at the end of year compared to the previous year.
- There is no increase in the microclimate exposure class (e.g. 1 to 2, or 4 to 5) compared to the previous year.

4. Potential contingency measures

The MCoA B10(d) requires the formulation of potential contingency measures that will be implemented in the event of changes to habitat usage patterns directly attributable to the construction or operation of the project.

The type(s) of potential contingency measures available in the event that a mitigation measure is ineffective in preventing impacts on habitat usage patterns by native fauna will vary depending on the nature, location and/or magnitude of the impact. Consequently, this monitoring program provides only a basic list of potential contingency measures that may be applicable to the broader range of potential problems associated with each mitigation measure. The contingency measures are provided in Table 4.1.

Table 4.1: Potential problems and contingencies associated with each proposed mitigation measure.

Mitigation Measure	Potential Problems	Potential Contingency Measures
Clearing Procedures	<ul style="list-style-type: none"> • high rates of fauna injury and mortality resulting from clearing operations; • poor success at capturing and releasing affected fauna. 	<ul style="list-style-type: none"> • review clearing procedures; • increase habitat tree retention times; • increase staff numbers.
Fauna Underpasses / Exclusion Fencing	<ul style="list-style-type: none"> • high rates of feral predator activity; • low levels of native fauna movement and species diversity in underpasses; • no use of underpasses by cover-dependent species or species with low mobility or target threatened species ; • high rates of fauna road mortality. 	<ul style="list-style-type: none"> • modify habitat structure near underpass entrances; • modify underpass “fauna furniture”; • modify or add potential groundcover resources; • modify exclusion fencing design, location or extent depending on the species and location of mortalities.
Vegetated Median	<ul style="list-style-type: none"> • no evidence of use of the vegetated median or glider crossing structures by the target glider species 	<ul style="list-style-type: none"> • modify or install alternative crossing structures (e.g. glider poles and/or rope bridges)
Nest Installation Box	<ul style="list-style-type: none"> • high rates of nest box occupancy by feral species; • nest boxes used by a limited number of native fauna species; • species use is incompatible with nest box type; • poor nest box durability. 	<ul style="list-style-type: none"> • modify nest box designs to exclude undesirable species or relocate affected nest boxes to more appropriate habitat; • review the selection and abundance of nest box designs; • identify causes of nest box failure and modify nest box design or construction accordingly.
Microbat Roost Boxes	<ul style="list-style-type: none"> • low use of nest boxes by target species. 	<ul style="list-style-type: none"> • modify nest box design and/or location; • assess the occurrence of alternative roost sites in the vicinity to determine need for supplementary nest boxes.

Mitigation Measure	Potential Problems	Potential Contingency Measures
Koala Monitoring	<ul style="list-style-type: none"> • Koala killed as a consequence of construction activities • Koala killed on adjacent existing highway 	<ul style="list-style-type: none"> • Notify DoEE and EPA. • Adaptive management response. • Assess future road kill risk • Assess adequacy of fauna fencing
Yellow-bellied Glider Monitoring	<ul style="list-style-type: none"> • reduction in occupancy within Nambucca SF 	<ul style="list-style-type: none"> • review adequacy of crossing structures • consult with SF about forest management practises

5. Reporting and review

Monitoring results for all mitigation measures will be compiled, analysed and discussed in annual reports, which will be submitted to Roads and Maritime Services, the Secretary of Planning & Environment and EPA. The annual reporting will include review and updating of the EcMP to account for any changes in detailed design, inclusion of additional management plans, identification of control sites and any insights relevant to current management practices.

In addition, brief data reports will be provided to Roads and Maritime Services outlining the results of monitoring for the following components:

- Road mortality monitoring – quarterly;
- Grey-headed Flying Fox population monitoring – monthly.

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Appendix A: WC2NH Road Kill Monitoring

Timing of Monitoring

Timing of road kill surveys for the WC2NH Project is described in Table 1.

Table 1 – Timings and locations of road kill surveys

Project Phase	Timing of Survey	Location
During clearing operations	Daily	Portion of existing Pacific Hwy adjacent to clearing operations
One month following clearing operations	Daily	Portion of existing Pacific Hwy adjacent to clearing operations
Duration of construction	Weekly	Entire length of existing Hwy in Project area
Upon opening of each stage of the project to traffic (operational phase)	Weekly for 12 weeks commencing the week of opening each stage to traffic.	Entire length of opened stage.
Upon completion of the Project (operation phase)	Excluding the season/s covered by the initial 12 week monitoring period (refer above), weekly during October (spring), January (summer), April (autumn) and July (Winter) for up to 5 consecutive years post construction, or until mitigation measures have been demonstrated to be effective.	Entire length of completed Project

Monitoring Program Objectives

The aim of the monitoring program is to;

- report on any animal road kill on the project following the opening to traffic; and
- assess the effectiveness of the presence of fauna fencing to prevent fauna being killed by vehicles while attempting to cross the WC2NH Upgrade.

Monitoring Procedure

A two-person team vehicle being driven along the entire length of the highway in the Project area and identifying dead wildlife (road kill) seen on the road and within three metres of the road edge. The passenger will search the road and its verge for road kill. When a road kill is observed from the vehicle, a closer visual inspection of the carcass will be undertaken where safe access is available. If safe access is not possible, due to local traffic conditions, binoculars will be used to try to identify and provide as detailed information as is possible on the carcass.

Road kill fauna will be identified to species level where possible, with reference to field guides. Where there is any doubt to the identification of the carcass, photographs will be taken and forwarded to a qualified ecologist for identification /confirmation of species. Those too seriously damaged to be accurately identified will be recorded as “unknown”.

To assist with the correct identification of road kills, the following will be undertaken –

- a. The provision of a qualified ecologist (shall be a recognised expert in mammal identification in coastal northern NSW) to undertake the initial phase of operational monitoring (first season)

with relevant Roads and Maritime team members providing appropriate detailed training and a baseline of expert monitoring of road kills;

- b. The provision of specialist training (to be provided by an expert as above in point a) in fauna identification for Contractors and Roads & Maritime staff involved in the construction phase monitoring of road kill; and
- c. Where there is any doubt to the identification of the carcass, the provision of photographs of road kill to be sent to a qualified ecologist (an expert as above in point a) to confirm the identity of road kill and to maintain a permanent record of road kill for further comparisons, if needed.

Monitoring Methodology

- The highway will be monitored using the method previously indicated (section 1.3) consisting of a two-person team traversing the Upgrade in a vehicle to locate and identify road kills;
- The speed of travel will be the same in all cases to avoid confounding the data collection, and should be as slow as is safely possible;
- The highway will be surveyed weekly for four weeks in Spring, Summer, Autumn and Winter (see Table 1);
- Where possible, each survey shall be completed within two hours of sunrise in order to maximise the potential to record road kills before either carrion eating animals or traffic render any road kill unidentifiable;
- if possible, each survey will be carried out on the same day of the week to remove the influence of varying environmental conditions and to ensure consistent temporal spacing;
- For each road kill observed, the following attributes will be recorded
 - a. Geographic Coordinates of any road kill.
 - b. Whether fauna fencing was installed at/near the location.
 - c. Species of road kill where possible, however, where there is any doubt as to the identification of the carcass, photographs shall be forwarded to a qualified ecologist for identification /confirmation of the species.

If the animal is identified as an EPBC Act threatened species, the carcass will be photographed and the following information will also be recorded where possible and safety considerations permit

- a. Sex and age class (juvenile or adult).
- b. Presence of pouch young (for marsupials).
- c. Presence of flightless young (for flying-foxes or other bats).
- d. Distance to a fauna connectivity structure.
- e. Distance to drop down structure.
- f. If fauna fencing was installed, is there any damage to the fence in the vicinity.
- g. Weather conditions at the time of the monitoring (from the Bureau of Meteorology) – including temperature, rainfall in the last 24 hours, moon phase
- h. If the animal is identified as a flying-fox:
 - a. Distance to nearest camp,
 - b. Distance to nearest canopy vegetation,

- c. Presence of flowering food trees in neighbouring median or roadside vegetation; plants identified to species and referenced with diet list.

Analysis of data

The data to be collected will be analysed using a suitable nonparametric test such as a Kruskal-Wallis test. The aim will be to test both whether the fenced and unfenced locations have different mean numbers of road kills and if the amount of road kill varies through time in either or both of the two types of areas. Associations with other measured variables will be described as data allow, including sex, age class, presence of dependent young and, in the case of flying-foxes, proximity to roost sites or flowering food trees. Such information will indicate if the mitigation measures in the area are working as expected to keep road kills to acceptable levels and that none of the target species are killed.

Reporting

Quarterly reports

A report will be prepared by the ecologist following the initial 12 week monitoring period (after opening for each stage) to identify any roadkill hotspots and review the mitigation measures. The initial report and ongoing seasonal reports of the data collected will be provided to Roads and Maritime. This will include graphs of the data and any previously collected data to provide simple visual comparisons of road kill. This will also include overall road kill counts as well as separate graphs for each of the target species (if deaths have occurred).

Anecdotal road kill information collected on days that are not monitored as part of this program may be added as a note for discussion.

Annual Reports

The annual report will be prepared in consultation with a qualified ecologist and provided to DPE, DoEE and EPA within one month of completion of the fourth monitoring season. From then on it will be provided within one month of the same monitoring season in subsequent years until monitoring is completed (Table 1).

Analysis of the data itself shall be included in an annual monitoring report. This report will include a statistical analysis of all of the data collected to that time including graphical representations of the road kill that is recorded.

Annual reports will record any potential or obvious failures in road kill mitigation identified in the monitoring program and provide a date by which meetings will take place to discuss any such adverse findings. This will include at least:

- where statistically larger number numbers of road killed animals are detected on fenced sections compared to unfenced sections;
- where any of the target threatened fauna are recorded as killed;
- where there is a clear pattern of unexpected road kill at any point on the Upgrade.

Performance Measures

Lower rates of road kill in proximity to fauna fencing (ie areas of the main carriageways within areas adjacent to installed fauna fencing) than in sections of the upgrade not near fauna fencing during monitoring events up to 5 years post construction phase, or until such time as mitigation measures have been demonstrated to be effective.

Adaptive Management

Where any annual report identifies a significant difference between the road kill numbers of the fenced and unfenced areas, DoEE and EPA shall be notified, and a meeting will be set to discuss such differences with the relevant agencies & Roads and Maritime.

Such a meeting would occur within one month of completion of the annual report, which should ensure sufficient time to consider/review the response to any recorded significant differences.