



Transport
Roads & Maritime
Services

Warrell Creek to Urunga Pacific Highway Upgrade

Biodiversity Offset Strategy

OCTOBER 2014



About this release

Title	Warrell Creek to Urunga Pacific Highway Upgrade – Biodiversity Offset Strategy
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Approval and authorisation		Name	Effective date
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Location	File name

Document status	Date
Final	October 2014

Version	Date	Revision Description
Draft	29/04/2011	Draft version 1
Final draft	14/09/2012	Final Draft
Final draft	18/06/2013	Final Draft
Final draft	28/02/2014	Final draft addressing EPA, DPI Fisheries, Planning and Infrastructure comments.
Final	19/9/14	Final Addressing EPA and DP&E comments
Final	22/10/14	Final addressing EPA (15/10/14) comments

Contents

1	Introduction.....	1
1.1	Background.....	1
1.2	Purpose of this report.....	3
1.3	Objectives of the Biodiversity Offset Strategy	4
1.4	Integration with other ecological reports.....	4
1.5	Structure of this report.....	5
1.6	Nomenclature.....	5
2	Project Impacts.....	6
2.1	Impact of the Upgrade.....	6
2.2	Barrier Impacts.....	10
2.3	Hollow Bearing Trees.....	10
2.4	Microbat Roosts.....	11
3	Management of biodiversity impact.....	12
3.1	Avoid Impacts.....	12
3.2	Mitigate.....	12
3.2.1	Fauna Crossing Measures.....	13
3.2.2	Revegetation Measures	17
3.2.3	Threatened flora protection and translocation	17
3.2.4	Installation of Nest Boxes.....	18
3.2.5	Other Fauna Mitigation Measures	18
3.2.6	Widening of the Median	19
3.2.7	Biodiversity Monitoring Measures.....	19
3.3	Offsets.....	20
3.3.1	Delivery of Option A.....	22
3.4	Management of Unforeseen Additional Impacts.....	33
3.5	Biodiversity Offset Package.....	33
4	Conclusions	35
5	References.....	36

I Introduction

I.1 Background

The NSW Roads and Maritime is planning to upgrade a 42 kilometre section of the Pacific Highway, from south of Warrell Creek to Urunga on the Mid- North Coast of New South Wales (Figure 1). The Warrell Creek to Urunga Upgrade ('the Upgrade') forms part of the Pacific Highway Upgrade Program, a joint commitment by the NSW State Government and the Federal Government to upgrade the Pacific Highway between Hexham and the Queensland border.

The Upgrade will include four new grade separated interchanges and an upgrade to the existing Waterfall Way interchange at Raleigh. New major highway bridges cross the Nambucca River at Macksville, the Kalang River at Urunga and Warrell Creek. The design of the motorway style (class M) upgrade will comprise four lane divided carriageways with a wide median allowing for a six- lane divided carriageway in the future. The Department of Planning and Infrastructure (the then Department of Planning) granted approval for the construction of the Warrell Creek to Urunga Pacific Highway Upgrade on 19 July 2012 subject to a number of conditions.

The Upgrade will be constructed in two stages with the first stage being the 22 kilometre section between Nambucca Heads and Urunga which commenced construction in late 2013. The second stage is the 20 kilometre section between Warrell Creek and Nambucca Heads which is nearing the start of construction (late 2014 / early 2015).

Planning for the Upgrade, and indeed all projects within the Pacific Highway Upgrade program, has generally followed a hierarchy of principles with regard to biodiversity values along the road corridor:

1. Avoid impact
2. Minimise impact
3. Mitigate impacts.

In some instances there are unavoidable impacts that cannot be mitigated. Where impacts are unavoidable, mitigation and management measures are incorporated into the upgrade to reduce impacts. In some instances there are residual impacts that cannot be adequately mitigated. Residual impacts identified for the Upgrade include:

- A loss of native vegetation
- A loss of habitat for a variety of protected and threatened native fauna species.

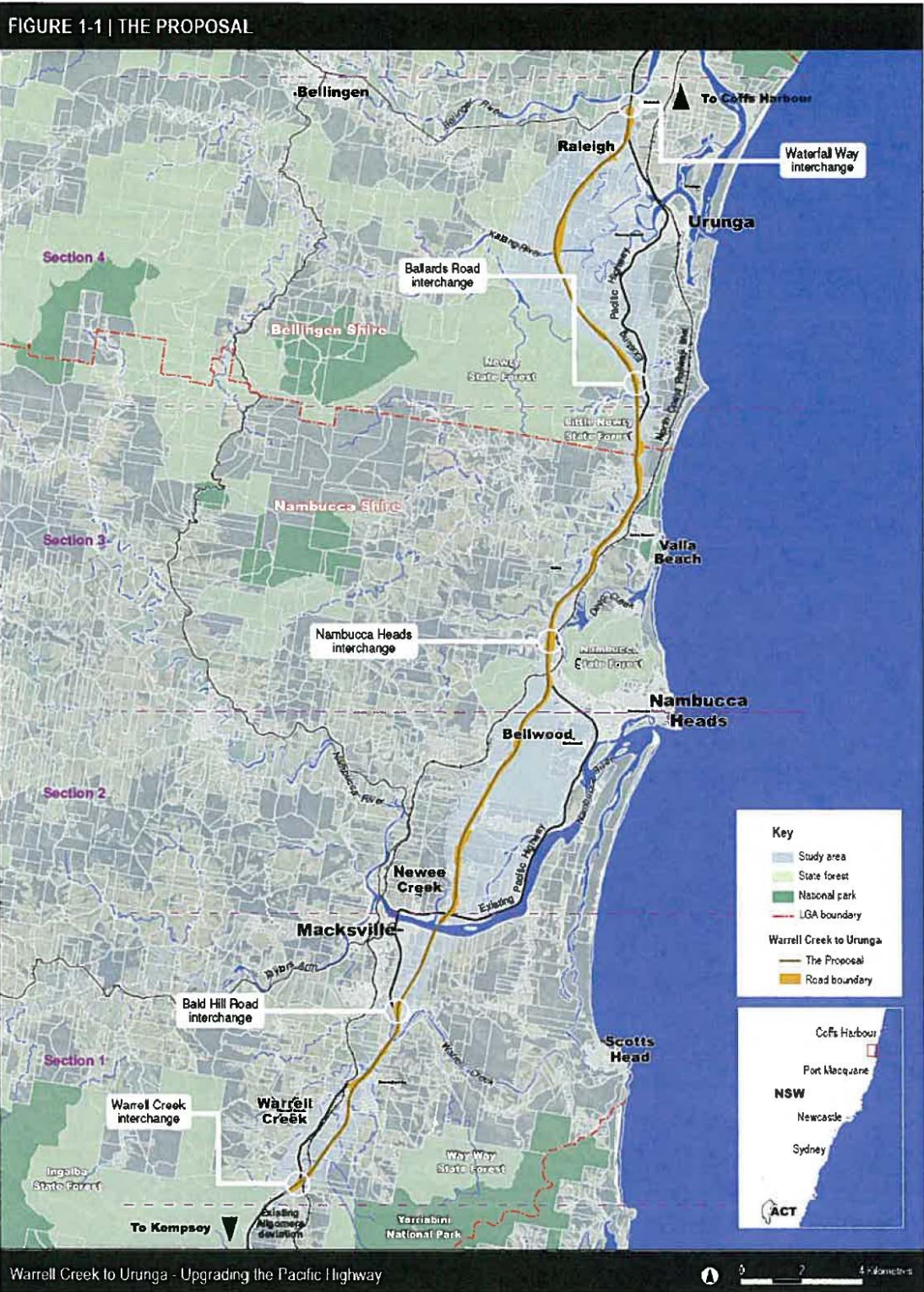


Figure 1 | Overview of the Warrell Creek to Urunga Upgrade

1.2 Purpose of this report

The Warrell Creek to Urunga Upgrade has been approved under Part 3A of the NSW *Environmental Planning and Assessment Act 1979*. The conditions of approval required the development of a Biodiversity Offset Strategy. This report has been prepared to satisfy the Minister's Condition of Approval B8 outlined below.

The Proponent shall, in consultation with the EPA and DPI (Fisheries), develop a Biodiversity Offset Strategy that identifies available options for offsetting the biodiversity impacts of the project in perpetuity, with consideration to EPA's *Principles for the Use of Biodiversity Offsets in NSW* (EPA Website, June 2011). Unless otherwise agreed to by EPA, offsets shall be provided on a like-for-like basis and at a minimum ratio of 4:1 for areas of high conservation value (including EEC and threatened species or their habitat identified in the Environmental Assessment to be impacted by the project and poorly conserved vegetation communities identified as being more than 75% cleared in the catchment management area) and 2:1 for the remainder of native vegetation areas (including mangroves, seagrass, salt marsh and riparian vegetation). The Strategy shall include, but not necessarily be limited to:

- a) confirmation of the vegetation communities/ habitat (in hectares) to be offset and the size of offsets required (in hectares);
- b) details of the available offset measures that have been identified to compensate for the biodiversity impacts of the project, such as (but not necessarily limited to): suitable compensatory land options and/ or contributions towards biodiversity programs for high conservation value areas on nearby lands (including research programs). Where the use of State Forest land managed in accordance with an Integrated Forestry Operations Approval is proposed to offset biodiversity impacts, the Proponent shall clearly demonstrate how this would provide the biodiversity outcomes required under this condition including any additional offset requirements to cover residual impacts;
- c) the decision-making framework that would be used to select the final suite of offset measures to achieve the aims and objectives of the Strategy, including the ranking of offset measures;
- d) a process for addressing and incorporating offset measures for changes to impact (where these changes are generally consistent with the biodiversity impacts identified for the project in the documents listed under condition A1, including:
 - i. changes to footprint due to design changes;
 - ii. changes to predicted impacts resulting from changes to mitigation measures;
 - iii. identification of additional species/habitat through pre-clearance surveys; and
 - iv. additional impacts associated with ancillary facilities; and
- e) options for the securing of biodiversity options in perpetuity.

The Biodiversity Offset Strategy shall be submitted to, and approved by, the Director General prior to the commencement of any construction work that would result in the disturbance of any native vegetation, unless otherwise agreed by the Director General. Unless otherwise agreed, the Biodiversity Offset Strategy shall be submitted to the Director General for approval no later than 6 weeks prior to the commencement of any construction that would result in the disturbance of any native vegetation.

The Proponent may elect to satisfy the requirements of this condition by implementing a suitable offset package which addresses impacts from multiple Pacific Highway Upgrade projects (including the Warrell Creek to Urunga Project) within the North Coast Bio-region. Any such agreement made with the EPA must be made in consultation with the Department and approved by the Director General within a timeframe agreed to by the Director General.

Additionally the Minister's Condition of Approval MCoA B9 also requires the development of a Biodiversity Offset Package as outlined below.

Within two years of the approval of the Biodiversity Offset Strategy, unless otherwise agreed by the Director General, the Proponent shall prepare and submit a **Biodiversity Offset Package** which identifies the final suite of offset measures to be implemented for the project for the approval of the Director General. The Package shall be developed in consultation with OEH, and shall provide details of:

- (a) the final suite of the biodiversity offset measures selected for the project demonstrating how it achieves the requirements and aims of the Biodiversity Offset Strategy (including specified offset ratios);
- (b) the final selected means of securing the biodiversity values of the offset package in perpetuity including ongoing management, monitoring and maintenance requirements; and
- (c) timing and responsibilities for the implementation of the provisions of the package over time.

The requirements of the Package shall be implemented by the responsible parties according to the timeframes set out in the Package.

1.3 Objectives of the Biodiversity Offset Strategy

The objective of the Biodiversity Offset Strategy is to deliver a Biodiversity Offset Package that achieves a net regional biodiversity benefit as a result of the Upgrade. The measures used to gauge success of this objective will be:

- An outcome that maintains or improves biodiversity values
- Successfully securing the long-term (in perpetuity) protection and management of lands containing endangered ecological communities and habitat for threatened species (key habitat)
- Meeting the minimum requirements for offsets as specified in the conditions of approval
- The total area of lands used to offset the biodiversity impacts would exceed the direct and indirect (edge effects) impacts
- The process for setting the scope and quantum of the biodiversity offsets is transparent and justifiable on environmental, social and economic grounds.

The Upgrade is being constructed in two separate and distinctive stages, which are NH2U (Stage 1) and WC2NH (Stage 2). Both stages are subject to separate approvals under the EPBC Act, and require biodiversity offsets as part of these Commonwealth approvals. Property packages that are utilised to meet EPBC offsetting obligations will also be used where ever possible to assist meeting State offsetting requirements in accordance with MCoA B8 and B9.

1.4 Integration with other ecological reports

The Biodiversity Offset Strategy is part of a suite of reports that document how the biodiversity impacts of the Warrell Creek to Urunga Upgrade will be mitigated or offset, and how mitigation actions will be managed and monitored. These reports address the Minister's Condition of Approval B8.

The process for the development of these reports is outlined below in Figure 2.

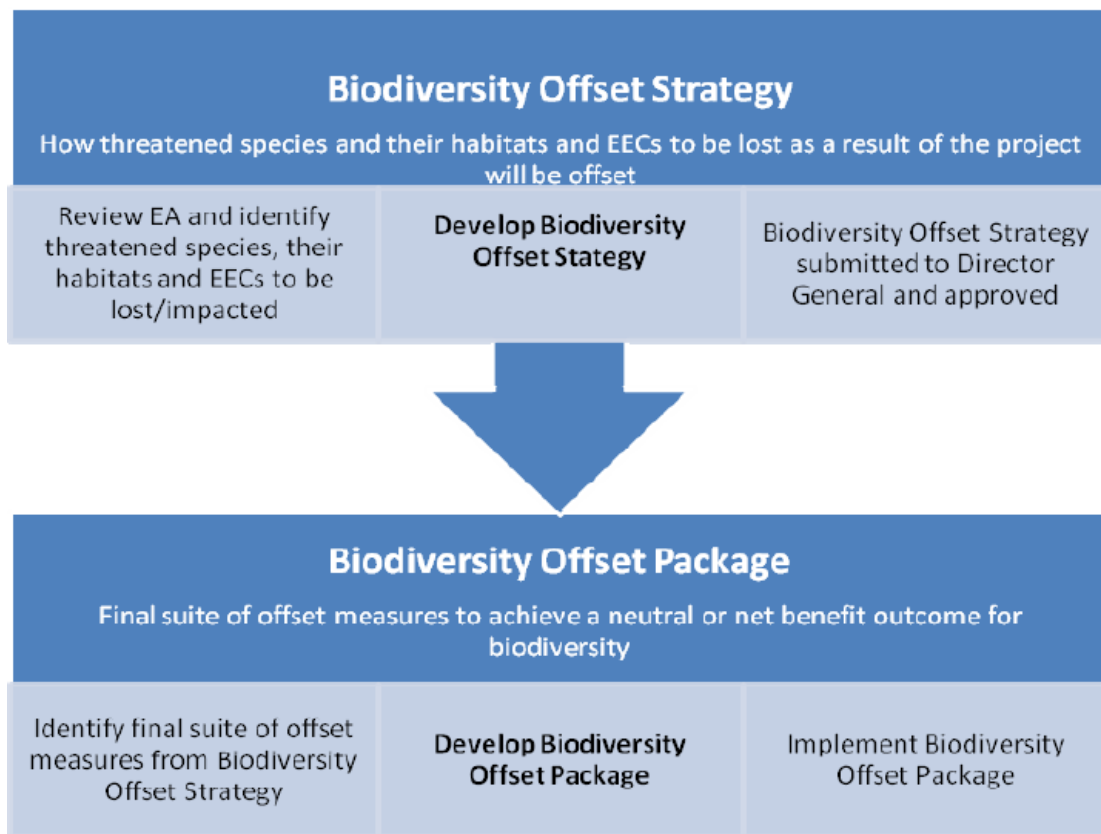


Figure 2 The process for the development of the offset strategy and package

1.5 Structure of this report

The structure of this Biodiversity Offset Strategy is as follows:

- Section 2 identifies the impacts of the Upgrade
- Section 3 details the management of biodiversity impacts, following the principles of avoiding, mitigating and offsetting impacts, and presents the decision making framework for determining offset measures
- Section 4 provides conclusions.

1.6 Nomenclature

In this report plant species are referred to by both their scientific and common names (if applicable) when first mentioned. Subsequent references to these species cite the scientific name only. Conversely, animal species are referred to by both their common and scientific names when first mentioned, and subsequently by their common names only.

2 Project Impacts

2.1 Impact of the Upgrade

The Upgrade traverses low hills and floodplain associated with the Nambucca, Kalang and Bellinger Rivers, and crosses the existing Pacific Highway at several locations (Figure 1). The study area as a whole lies across two landscape types, The Manning Macleay Coastal Alluvial floodplains present on the floodplains of the Nambucca and Kalang Rivers and smaller creeks such as Deep Creek, Boggy Creek and Oyster Creek, and the Ingalba Coastal Hills associated with the slopes on areas elevated above 830 metres. Extensive clearing for agriculture, logging and residential development has occurred throughout these areas.

2.1.1 Vegetation Communities

The Environmental Assessment identified nine vegetation communities that occur in the Proposal study area, with six of these currently listed as Endangered Ecological Communities (EEC) listed under the *Threatened Species Conservation Act 1995* (TSC Act.) None are currently listed under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The methodology for assessing the condition of these communities and their subsequent ranking has been described in Section 10.3.2.2 of the *Warrell Creek to Urunga Environmental Assessment Volume 1 Flora and Fauna*, and were ranked as high, high-moderate, moderate, low-moderate or low condition. These rankings have now been further refined to meet Condition of Approval B8 offset requirements as summarised below in Table 1.

Potential impacts on flora and fauna have been minimised and avoided where possible throughout the route selection and development of the concept design for the Upgrade. The Upgrade would directly remove approximately 283 hectares of native vegetation that comprises endangered ecological communities and habitat for threatened species. During construction of the Warrell Creek to Nambucca Heads (Stage 2 of the Upgrade), design would be further refined and further assessment on the impacted vegetation communities and habitat types undertaken. Table 1 provides a summary of the vegetation communities impacted by the Upgrade.

Table 1 Summary of broad vegetation types impacted by the Upgrade

Broad Vegetation Community	Corresponding Habitat Type	Area impacted by construction ¹ (hectares)
Dry Open Forest - Blackbutt (Non EEC)	Dry Sclerophyll Forests	177.4
Moist Open Forest – white mahogany/grey gum/Ironbark (Non EEC)	Moist Sclerophyll Forest	35.94
Moist Open Forest – Flooded Gum (Non EEC)		26.59

Subtropical Coastal Floodplain Forest (EEC)		14.97
Open Forest – Scribbly Gum		0.03
Swamp Sclerophyll Forest on Coastal Floodplain (EEC)	Swamp Sclerophyll Forests	13.98
Swamp Oak Floodplain Forest (EEC)		11.69
Lowland Rainforest (EEC)	Rainforest	0.23
Freshwater Wetlands on Coastal Floodplains (EEC)	Freshwater Wetlands	2.08
Mangroves (non EEC)	Estuarine	0.1
Total Area		283.02

¹ Area impacted by construction includes the NH2U (Stage 1) Final Detailed Design clearing quantities, and the WC2NH clearing buffer, which comprises-

- The concept design footprint plus 15 metres.
- The operational water quality basins plus 10 metres.
- New or reconstructed access roads within Nambucca State Forest plus 10 metres.
- Utility adjustments within clearing requirements of utility authorities.
- Three metre clearing width for boundary fencing - excluding within Nambucca State Forest and swamp forest where a flying fox camp is located.

This area impacted by construction also includes vegetation that remains as part of the widened medians.

2.1.2 Flora Species

The Environmental Assessment recorded two threatened flora species known as the Slender Milkvine (*Marsdenia longiloba*) and Rusty Plum (*Amorphospermum whitei*). More recent surveys performed by Ecos Environmental (2013) documented populations of a further four threatened plant species; Maundia (*Maundia triglochinosides*), Floyds Grass (*Alexfloydia repens*), Wooll's Tylophora (*Tylophora woollsi*) and Spider Orchid (*Dendrobium melaleucaphilu*). These later surveys also recorded the ROTAP listed Ford's Goodenia (*Goodenia fordiana*) and Bellingen Ironbark (*Eucalyptus ancophila*) and the near threatened Koala Bells (*Artanema fimbriatum*). A summary of the numbers of individual plants either directly or indirectly impacted is provided below in Table 2.

Table 2: Impact analysis summary giving the number/area of each recorded species directly impacted, indirectly impacted and not impacted (to remain in-situ) within the road reserve; 'points' are the number of gps points where the species was recorded; 'no.' gives the total number of individuals at gps points. Mat-forming species were recorded as an area in square metres. (note - a few recorded points were outside the project boundary).

WC2U (Whole road corridor)	Directly Impacted		Indirectly Impacted		Road Reserve - in-situ	
	points	no.	points	no.	Points	no.
Threatened Species						
Slender Marsdenia (E) (<i>Marsdenia longiloba</i>)	68	176	7	20	2	4
Rusty Plum (V) (<i>Niemeyera whitei</i>)	13	13 +sdg	0	0	0	0
Maundia (V) (<i>Maundia triglochoides</i>)	~400+ m ²		~120 m ²		~60 m ²	
Floyds Grass (E) (<i>Alexfloydia repens</i>)	1	~2m ²	2	~2m ²	1	~2m ²
Woolf's Tylophora (E) (<i>Tylophora woolfsii</i>)	5	9	-	-	3	6
Spider Orchid (E) (<i>Dendrobium melaleucaphilum</i>)	10	~30	16	35	70	200
ROTAP*						
Ford's Goodenia (<i>Goodenia fordiana</i>)	9	9m ²	1	1m ²	-	-
Potential Threatened Species Listing						
Koala Bells (<i>Artanema fimbriatum</i>)	7	65	2	55	-	-

*Eucalyptus ancophila not included as it was relatively common in the study area.

2.1.3 Fauna Species

The Environmental Assessment recorded 203 fauna species comprising 18 frogs, 24 reptiles, 36 mammals and 125 birds (see Appendix F of Volume 2 of the *Warrell Creek to Urunga Environmental Assessment January 2010*). Fourteen (14) of these species are listed as threatened pursuant to either the TSC Act or EPBC Act (Table 3). Another three species of threatened fauna (Giant Barred Frog, (*Mixophes iterates*) Green-thighed Frog (*Litoria brevipalmata*) and Southern Myotis (*Myotis macropus*) were recorded during pre clearing surveys prior to construction (Lewis 2013 a,b,c). An additional 10 species of threatened fauna are considered likely to inhabit the study area (Table 3).

No fish species currently listed on either the TSC Act or EPBC Act were identified during the Environmental Assessment, nor were any identified for the previous studies conducted in this area, which were reviewed as part of this assessment.

Table 3 Indicative Threatened and migratory fauna species identified during the survey of the study area and considered likely to occur within the study area

Common Name (<i>Scientific Name</i>)	State ¹	National ²
Threatened fauna recorded during fauna surveys		
Black-necked stork (<i>Ephippiorhynchus asiaticus</i>)	E	
Glossy Black Cockatoo (<i>Calyptorhynchus lathamii</i>)	V	E

Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>)	V	V
Wompoo fruit-dove (<i>Ptilinopus magnificus</i>)	V	
Square-tailed Kite (<i>Lophoictinia isura</i>)	V	
Yellow-bellied Sheath-tail Bat (<i>Saccolaimus flaviventris</i>)	V	
Powerful Owl (<i>Ninox strenua</i>)	V	
Osprey (<i>Pandion haliaeetus</i>)	V	M Ma
Little Bentwing-bat (<i>Miniopterus australis</i>)	V	
Eastern Bentwing-bat (<i>Miniopterus schreibersi</i>)	V	C
Yellow-bellied Glider (<i>Petaurus australis</i>)	V	
Koala (<i>Phascolarctos cinereus</i>)	V	V
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	V	
Eastern False pipistrelle (<i>Falsistrellus tasmaniensis</i>)	V	
Southern Myotis (<i>Myotis macropus</i>)	V	
Giant Barred frog (<i>Mixophyes iteratus</i>)	E	E
Green-thighed Frog (<i>Litoria brevipalmata</i>)	V	
Threatened fauna considered likely to occur within the study area		
Swift Parrot (<i>Lathamus discolor</i>)	E	E Ma
Regent Honeyeater (<i>Xanthomyza phrygia</i>)	CE	E M
Spotted-tailed Quoll (<i>Dasyurus maculata</i>)	V	V
Rose-crowned fruit-dove (<i>Ptilinopus regina</i>)	V	
Superb fruit-dove (<i>Ptilinopus superbus</i>)	V	
Eastern freetail-bat (<i>Mormopetrus norfolkensis</i>)	V	
Brush-tailed phascogale (<i>Phascogale tapoatafa</i>)	V	
Masked Owl (<i>Tyto novaehollandiae</i>)	V	
Sooty Owl (<i>Tyto tenebricosa</i>)	V	
Black Bittern (<i>Ixobrychus flavicollis</i>)	V	

1. listed under the Threatened Species Conservation Act 1995 – V = vulnerable, E = endangered
2. listed under the Environmental Protection and Biodiversity Conservation Act 1999 – V = vulnerable, CE = critically endangered, E = endangered, M = migratory, Ma = Marine, C = conservation dependent

2.1.4 Summary of Impacts

Assessments on the impact of the Upgrade on Endangered Ecological Communities (EEC's), populations and species were undertaken as part of the Environmental Assessment or as part of the documentation that formed components of the pre-clearing surveys (Such as the Green-thighed Frog Management Strategy and Threatened Flora Management Plan). These assessments were based on the Draft Guidelines for Threatened Species Assessment for Part 3A Applications (DEC and DPI 2005) and, where applicable, the EPBC Act Significant Impact

Guidelines (Commonwealth of Australia 2009). Species were considered for assessment based on database records, species identified during surveys for the Environmental Assessment and the presence of suitable habitat and distribution ranges. The Environmental Assessment and subsequent assessments found that the Upgrade is not likely to have a significant impact on any of the threatened communities, populations or species considered, provided the recommended mitigation safeguards within those documents are adopted.

Full details of the impact assessments are provided in the following:

- *Warrell Creek to Urunga Environmental Assessment Volume 2 Working Paper 1* (SKM 2010);
- Green-thighed Frog Management Strategy (Lewis 2013 a);
- Giant Barred Frog Management Strategy (Lewis 2014); and
- Warrell Creek to Urunga Threatened Flora Management Plan Version 2 (Ecos Environmental 2014).

2.2 Barrier Impacts

The project traverses 42 km of a landscape containing a range of land uses. The landscape surrounding the study area mostly comprises a mosaic of vegetation fragments, resulting from the history of clearing for farming and more recently residential development in the area. Despite this, the Upgrade would increase the fragmentation of the habitat by impacting on several adjoining forest areas, specifically the larger fragments of the Nambucca and Newry State Forests and the private forested land to the north of the Kalang River (Figure 1). These areas have also been subject to past clearing to accommodate roads, power line easements and various forestry regimes.

The Upgrade would impact a number of identified wildlife corridors, particularly larger vegetation patches contained within the Nambucca, Newry and Little Newry State Forests. Species identified in the Environmental Assessment that occur or potentially occur in the study area that are most likely to be subject to barrier impacts include Koala, Spotted-tailed Quoll, Brush-tailed Phascogale, gliders and some frog, reptile and smaller sedentary bird species. Impacts associated with additional fragmentation would be most evident in the Nambucca State Forest, where an area of up to 1000 hectares of forested lands would be separated to the east of the road and provides known habitat for fragmentation sensitive species including the Yellow-bellied Glider and, Green-thighed Frog and possibly *Wooll's Tylophora* and *Marsdenia longiloba*. While the proportion of habitat remaining to the east of the road is considered sufficient to support populations of these species, further measures are required to minimise the impacts of fragmentation. Measures that have been considered include incorporating wider medians in this area and placing fauna underpass structures at strategic locations along the route within wildlife corridors or in the case of plants translocation strategies. These measures are discussed further in Section 3.2.6 or in some cases outlined within specific management strategies for the Upgrade. For example, the construction of species specific Green-thighed Frog breeding ponds and associated frog fencing (Lewis 2013 a). Highly mobile species such as bats and birds are expected to be less impacted by fragmentation.

The *Warrell Creek to Urunga Environmental Assessment Volume 2 Working Paper 1* provides further detail on the quantitative assessment of the likely landscape-scale impacts including fragmentation and habitat connectivity of the Project.

2.3 Hollow Bearing Trees

Field surveys identified 519 hollow bearing trees occur within the Warrell Creek to Urunga Upgrade containing an estimated 2942 tree hollows (Lewis 2013 d). The survey identified a number of areas as containing a high density (>6 hbt/ha) of tree hollow resources including:

- 15 hollow bearing trees along Albert Drive, Donnellyville (ch.46165)
- 25 hollow bearing trees growing within Old Coast Road reserve and adjacent crown land between ch. 53680-54050
- 14 hollow bearing trees growing partly on Hartman property and Old Coast Road reserve between ch. 55300-55700
- 13 hollow bearing trees where the carriageway first traverses Nambucca State Forest (Old Coast Road and Jacks Ridge Road, ch. 56965)
- 10 hollow bearing trees to the south of Old Coast Road in the central part of Nambucca State Forest (ch. 60065)
- 13 hollow bearing trees to the south of Cow Creek, Valla (ch. 63415)
- 24 hollow bearing trees to the south of Deep Creek, Valla (ch. 64335-64735)
- 38 hollow bearing trees at Blackbutt Drive, Valla Beach (ch. 66365)
- 50 hollow bearing trees in the vicinity of Burkes Lane, Oyster Creek (ch. 68565)
- 12 hollow bearing trees in the Mines Road, Pickett Hill (ch. 70765)
- 14 hollow bearing trees to the south of Ainsworth Road Cut, Newry (ch. 74065)
- 13 HBT's at Raleigh South (ch. 80665).

Further details on the distribution of these hollows, their suitability to fauna and the proposed mitigation measures to be implemented can be found in the *Warrell Creek to Urunga: Nest Box Plan* (Lewis, 2013 d).

2.4 Microbat Roosts

Field surveys identified 22 of the 69 (32%) inspected culvert and bridge structures provide suitable roost habitat for microbats. In a number of cases they provided habitat for the threatened Southern Myotis and Little Bentwing Bat. Seven management strategies including the installation of additional roosts, implementing additional field surveys, planned roost exclusion, seasonal limitation of construction works, protection of existing habitat, development of an unexpected finds procedure and subsequent monitoring requirements have been proposed as a means to avoid, minimise and mitigate impacts to micro bats and the identified roost sites. Further details relating to this can be found in the *Warrell Creek to Urunga: Microbat Management Plan* (Lewis 2014)

3 Management of biodiversity impact

Measures to manage the impact of the Upgrade on biodiversity have been developed as part of the Environmental Assessment for the project. These are outlined in Section 10.5 of the *Warrell Creek to Urunga Environmental Assessment* and Section 6 of the *Warrell Creek to Urunga Environmental Assessment Volume 2, Working Paper 1*. Management measures for biodiversity impacts were developed following these general principles, in order of preference:

- Avoiding impacts
- Mitigating impacts
- Offsetting impacts.

A summary of the key measures relevant to biodiversity impacts are outlined below. For further detail refer to Section 10.5 of the *Warrell Creek to Urunga Environmental Assessment* and Section 6 of the *Warrell Creek to Urunga Environmental Assessment Volume 2, Working Paper 1* and the revised Statement of Commitments.

3.1 Avoid Impacts

Impacts on biodiversity values within the region have been avoided through the route selection process and development of the concept design alignment. The route selection process was conducted during 2003-2006. For this process, four criteria were developed to assess the potential impacts of each option on biodiversity:

- Impacts on habitat quality
- Assessment of impacts on threatened species habitats and endangered ecological communities
- Extent of impacts on SEPP 14 wetlands
- Severance to wildlife corridors.

Further future measures that would be employed to avoid impacts on biodiversity include:

- All possible engineering solutions to minimise direct impact would be investigated at the detailed design stage to limit the extent of vegetation to be removed
- Protective fencing would be installed to mark the limits of clearing (i.e. 'no-go' areas) surrounding the footprint to ensure that vehicles and other direct disturbances associated with the road construction, including construction compounds and stockpile sites do not enter adjacent areas of vegetation outside the footprint
- Construction staff would be educated with regards to the status and location of protected areas during site induction and/or tool box talks and pre-clearing surveys would be undertaken to flag hollow bearing trees and identify trees where fauna may be present
- Ancillary areas would be selected and constructed in order to minimise the overall impact of construction and avoid unnecessary vegetation and habitat removal
- Vegetation management strategies would be developed for retained areas of vegetation, including weed management, native plantings, and the collection of seed.

3.2 Mitigate

Management measures designed to reduce impacts on biodiversity include:

- Fauna crossing measures
- Revegetation measures
- Threatened flora protection and potential translocation
- Installation of nest boxes
- Other fauna mitigation measures such as implanting the unexpected threatened species finds procedure, and pre-clearance surveys undertaken by a suitably qualified ecologist
- Widening of median
- Installation of microbat boxes
- Biodiversity monitoring measures
- Fauna Fencing (exclusion).

3.2.1 Fauna Crossing Measures

Construction of a range of fauna crossing measures, including fauna underpasses, combined fauna drainage/bridge structures and associated fauna fencing, rope bridges and vegetated medians will be implemented on the Upgrade. Table 4 identifies the indicative sizes, lengths and locations of the proposed fauna crossing points and structures that are being used to provide fauna passage. The fauna crossing details have been finalised for the Warrell Creek to Urunga project in consultation with EPA and DPI (Fisheries), as required by MCOA B3 of the project approval. Any further changes would only be undertaken in consultation with EPA and DPI (Fisheries), and would not be implemented until agreement with the Director General obtained in accordance with the MCoA.

The fauna crossing measures have been provided at strategic locations to ensure habitat connectivity for a range of fauna including but not limited to Yellow-bellied Glider, Spotted Tailed Quoll, Koala and Giant Barred Frog. Fauna underpass structures in forested habitat have also been designed to promote their use by threatened fauna including the Spotted-tailed Quoll, Brush-tailed Phascogale and Koala. Further details on fauna crossing measures and the species targeted for their use can be found in the Warrell Creek to Urunga Pacific Highway Upgrade Stage 1 Ecological Monitoring Program (Benchmark Environmental 2012).

Table 4 Fauna Crossing Point and Structures: Warrell Creek to Urunga Upgrade

Chainage	Current Proposed Structure	Fauna Crossing type	Indicative size and configuration (m)	Indicative length (for culvert and arch structures)	Regional Connectivity (cite the regional connectivity scale/mapping used i.e. Scotts et al, 2003)	Connecting Fauna habitat
42500	Bridge over Upper Warrel Ck	Dedicated		Min 3m wide fauna passage at each abutment		
43325	Box Culverts	Combined	5/3600x1500 RCBC	50		
44905	Box Culvert	Fish passage	1/3300x1800	Includes low flow channel 200mm below existing bed level and 450mm wide		

45525	Box Culvert	Incidental	5/4200x3600			
47000	Bridge over Williamsons Ck	Dedicated		Min 3m wide fauna passage at each abutment		
47525	Box culvert	Incidental	1/3000x1200			
48085 - 48275	Bridge over Warrell Creek	Dedicated	Bridge 230m total length	Min 3m wide fauna passage at each abutment	Not part of a key corridor	Cleared land
49900	Box Culvert	Incidental	1/2400x1200			
50215	Bridge	Incidental				
50985	Bridge	Incidental				
55120	Box culvert	Dedicated	1/3000x3000 RCBC	50		Open Forest - Blackbutt
56410	Box culvert	Combined	1/ 2400x2400	45		Moist Open Forest - Flooded Gum
57770	Box culvert	Dedicated	1/ 3000x3000	50		Moist Open Forest - Flooded Gum
58510	Box culvert	Combined	1/3000x3000	84		Moist Open Forest - Flooded Gum
58560	Box culvert	Dedicated	1/3000x3000	50		Open Forest - Blackbutt
59100	Box culvert	Dedicated	1/ 3000x3000	58		Open Forest - Blackbutt
59550	Box culvert	Dedicated	1/ 3000x3000	50		Moist Open Forest - Flooded Gum
59750 (North Bound)	Box culvert	Dedicated	1/2400x2400	38		Open Forest - Blackbutt
59760 (South Bound)	Box culvert	Dedicated	1/2400x2400	25		Open Forest - Blackbutt
60580 (North Bound)	Box culvert	Dedicated	1/2400x2400	29		Open Forest - Blackbutt

60600 (South Bound)	Box culvert	Dedicated	1/2400x2400	30		Open Forest – Blackbutt
61800	Bridge	Combined	Twin Bridges over railway. Approximate length 25m. Minimum 3m wide fauna passage at southern abutment.		Part of a key corridor	Moist Forest (Flooded Gum)/Open Forest (blackbutt)
62750	Bridge	Combined	Twin Bridges over Boggy Creek. Minimum length 48m.		North of a key corridor	Moist Forest (Mixed Floodplain Forest)
63650	Bridge	Combined	Twin Bridges over Cow Creek and Service Road Bridge over Cow Creek. Minimum length 30m.		West of a key corridor	Open forest (Blackbutt)
661800	Box culvert	Incidental	Box culvert under local access road. 2700mm wide x 900mm high.	20m	Not part of a key corridor	Open forest (Blackbutt)
67125	Pipe Culvert	Combined	1x1350mm diameter	58m	Not part of a key corridor	Open forest (Blackbutt)
68410	Box culvert	Combined	4 x 3600 x 1200mm plus 1 x 3600 x 2400mm	52m (Pacific Hwy), 18m (local service road).	Not part of a key corridor	Moist Forest
69715	Pipe culvert	Incidental	4 x 1200mm	110m	Not part of a key corridor	Moist
70145	Pipe culvert	Incidental	2 x 1800mm diameter	60m	Part of a key corridor	Moist
70435	Box culvert	Combined	3600mm wide x 3000mm high	54m	Part of a key corridor	Moist Forest
71550	Bridge	Combined	Bridge over McGraphs Creek Floodplain No. 1.		Part of a key corridor	Moist Forest

			Minimum length of 48m.			
72720	Box culvert	Combined	2100mm wide x 900mm high.	142m	Part of a key corridor	Moist forest
73370	Bridge	Dedicated	Bridge over Dalhousie Creek. Minimum length 30m.		Part of a key corridor	Dry Open Forest
73780 southbound	Box culvert	Combined	2400 x 2400mm	26m	Part of a key corridor	Dry Open Forest/Moist Forest
73795 northbound	Box culvert	Combined	2400 x 2400mm	27m	Part of a key corridor	Dry Open Forest/Moist Forest
74800	Bridge	Combined	Minimum length 25m		Part of a key corridor	Moist Forest
75275	Box Culvert	Incidental	3000 x 3000mm	57m	Part of a key corridor	Dry Open Forest/Moist Forest
75825	Box Culvert	Incidental	3000 x 3000mm	63m	Part of a key corridor	Moist Forest
76320	Box culvert	Combined	3600 x 3600mm	67m	Not part of a key corridor	Swamp Forest
76560	Box Culvert	Incidental	3600mm wide x 3000mm high	51m	Not part of a key corridor	Swamp Forest
76990	Bridge	Combined	Minimum length 89m.		Not part of a key corridor	Freshwater wetland

All waterway crossings that involve new water crossing structure(s) or replacement of an existing structure will be designed to minimise impact on fish passage in accordance with Department of Industry and Investment guidelines (Fairfull & Witheridge 2003).

Proposed locations for fauna fencing can be found in Figures 10-3a – 10-3d of the Flora and Fauna chapter of the Environmental Assessment. Fauna fencing will comprise diamond-weave fencing with a 400mm “floppy-top” mesh overhanging the vegetated side of the fence. Detailed design of the fauna fencing may be modified in consultation with the EPA and the design, location and extent of fauna fencing will be reviewed and modified as required based on the results of ecological monitoring (see Benchmark Environmental 2012).

Frog and fauna fencing will also be required. This will generally be combined with fauna fencing, and the location and design of this fencing will be determined during detailed design in consultation with the EPA and the approved Green-thighed Frog and Giant Barred Frog management strategies and the RTA Biodiversity Guidelines (2011).

In addition to the fauna underpasses outlined in Table 4, Roads and Maritime proposes to retain

vegetated medians and install rope bridges to facilitate movement of arboreal mammals across the Upgrade. Widened medians are currently proposed to the south of the Nambucca Heads interchange and also within Newry State Forest. The exact locations and designs of these structures will be determined during detailed design in consultation with the EPA.

3.2.2 Revegetation Measures

Revegetation and rehabilitation of areas disturbed as a result of construction of the Upgrade, including ancillary areas, will progressively occur as construction works progress across the two stages.

Revegetation measures will include planting a range of locally occurring native shrubs, trees and ground covers. Species selected will be based on the surrounding vegetation communities that are impacted by the Upgrade. A soil seed bank will be established during clearing operations, and revegetation will be undertaken using local native species from this seed bank, where possible. Revegetation measures will be outlined in the Urban Design and Landscaping Plan which will be developed during detailed design phase of the project in consultation with the EPA and the Department of Planning and Infrastructure (DP&I).

Riparian vegetation will be restored and rehabilitated in and around watercourses affected by the project in consultation with the EPA and the Department of Primary Industries (Fisheries). Consultation will include timeframes and reporting on the completion of works.

Revegetation and rehabilitation works will include measures to provide or enhance fauna habitat features for threatened species, such as:

- Planting preferred foraging species, such as *Allocasuarina* spp for Glossy Black Cockatoo; *Eucalyptus propinqua* (Grey Gum), Tallowwood (*Eucalyptus microcorys*) and *Eucalyptus robusta* (Swamp Mahogany) for Koala; –, Eucalyptus, Melaleucas, and Banksias for the Grey-headed Flying-fox, and *Eucalyptus robusta* (Swamp Mahogany) for the Swift Parrot
- Provide fringing vegetation around riparian zones to enhance habitat for frogs including the Giant Barred Frog. At some specific locations, fringing ground covers will be used to enhance constructed breeding ponds for the Green-thighed Frog
- Incorporation of specific microhabitat features including but not limited to hollow logs and large rocks to provide refuge habitat for ground dwelling fauna including the Spotted-tailed Quoll.

Noxious weeds in areas disturbed by construction activities will be managed for a minimum of one year after construction completion for each major project stage. Weed management will be undertaken in accordance with a Weed Management Plan, to be developed by the construction contractor as part of the CEMP.

3.2.3 Threatened flora protection and translocation

Surveys conducted as part of the Environmental Assessment and more recently targeted works resulted in the detection of six threatened plants; *Marsdenia longiloba*, *Niemeyera whitei*, *Maundia triglochinosides*, *Alexfloydia repens*, *Tylophora woollsii* and *Dendrobium melaleucaphilum* (RTA 2010; Ecos Environmental 2014).

Prior to the commencement of any construction works that will result in the disturbance of the above species, a management plan has been developed in consultation with the EPA (*see Eco Environmental 2014*). This plan investigated the potential for translocation, and concluded *Marsdenia longiloba*, *Amorphospermum whitei*, *Alexfloydia repens*, *Tylophora woollsii*, *Dendrobium melaleucaphilu*, *Goodenia fordiana* and *Artanema fimbriatum* would be subject to translocation. In the case of *Maundia triglochinosides* and *Eucalyptus ancophila* these species

would be included in the process for incorporating appropriate offsets into the Biodiversity Offset Strategy.

This plan has been submitted to and approved by the Director General prior to the commencement of any construction activity that may disturb these species, in accordance with MCoA B7.

If a threatened flora species is identified within the clearing limits during construction, a minimum 10 metre buffer around the individual would be established using exclusion fencing and the Environment Manager or Environmental Officer notified immediately. The Environment Manager or Environmental Officer would then notify **Roads and Maritime**, the project Ecologist and EPA.

A qualified ecologist will identify vegetation to be retained within the construction corridor and clearly delineate this vegetation on work plans. Flagging/fencing, erected before the start of construction, will delineate this vegetation on the project site for the duration of the construction and site restoration periods.

It was originally considered that *Pterostylis sp. nov. aff. oblonga* was discovered in April 2013 by Ecos Environmental during pre-clearing flora survey work for Lend Lease. Specimens were sent to the Royal Botanic Gardens (RBG) Herbarium in Sydney and were initially identified as a new species of *Pterostylis* or Greenhood Orchid, most closely related to *P. oblonga*, hence the name *Pterostylis sp. nov. aff. oblonga* (nov meaning new and aff meaning affinity). However, further analysis by the Herbarium in Sydney confirmed that this was not a new species.

A Construction Flora and Fauna Management Plan will be developed for the project prior to the commencement of construction and will include further details on measures to be implemented during construction to mitigate the potential impacts on flora and fauna. This will address MCoA B7.

3.2.4 Installation of Nest Boxes

A nest box plan of management has been developed in consultation with the EPA and approved by the Director General as per MCoA B6. This plan identified the need for 467 nest boxes of various sizes with:

- 152 nest boxes required for the Warrell Creek to Nambucca Heads (ch. 61265); and
- 303 nest boxes required for the Nambucca Heads (ch. 61265) to Urunga Upgrade.

The use of various designs within this plan are considered suitable for a broad range of fauna including scansorial fauna (*Antechinus*); small gliders (Feather-tail Glider and Sugar Glider); Larger gliders (Squirrel Glider, Yellow-bellied Glider, Greater Glider), Possums (Common Brushtail Possum, Short-eared Possum and to a lesser extent Common Ringtail Possum); Microbats (fluttering and direct flying species that utilise tree hollows); medium sized parrots/lorikeets; cockatoo (Black Cockatoos); small owls (Southern Boobook and Barn Owl) and Large Forest Owls (Masked Owl, Sooty Owl, Powerful Owl).

More details are provided in the Warrell Creek to Urunga Nest Box Plan of Management (Lewis 2013 d).

3.2.5 Other Fauna Mitigation Measures

Additional commitments identified in the Environmental Assessment and Statement of Commitments includes:

- On detection of any additional or unexpected threatened species, the unexpected finds processes in the Construction Environmental Management Plan will be followed.

- A suitably qualified ecologist will undertake pre-clearance surveys, including but not limited to stag watching, spotlighting, call-playback detection and searches of nests and hollow-bearing trees, to identify fauna species at risk of injury that require relocating to alternative, nearby suitable habitat. Follow-up inspections immediately before clearing and during construction will confirm that the sites subject to pre-clearance surveys remain free of fauna. More detailed descriptions of the pre-clearing survey methods will be provided in the Contractor's Environmental Management Plan.
- Appropriate natural habitat features and resources (such as hollow logs, felled branches and bush rocks) removed from the project site will be relocated to adjacent areas, where feasible, to provide alternative temporary or permanent habitat for displaced fauna. Such relocation will be undertaken in a manner to limit damage to existing vegetation and will not occur in high condition remnant vegetation.
- Design and implementation of best practice erosion, sediment and water quality controls as per Managing Urban Stormwater Soils and Construction Volume 2D (2008).
- Adjoining vegetation will be maintained to limit overhang of fauna fences or other barriers.
- Where large woody debris cannot be retained these will be relocated within the river channel, if possible.
- Sediment basins would be designed to avoid habitat trees where possible.
- Habitat trees (hollow-bearing trees, trees currently in flower, sap feeding trees, trees supporting nests or dreys) would be avoided where possible. The distribution of potential hollow-bearing trees would be mapped during the preliminary design phase of the project.

The EPA will be consulted in the event of any new finds and unexpected additional impacts on threatened species.

3.2.6 Widening of the Median

In addition to the fauna underpasses listed above, it is proposed to retain vegetated medians to provide a 'stepping-stone' opportunity for gliders, predominantly Yellow-bellied Gliders as well as temporary refuge for other terrestrial fauna. These have been proposed at strategic locations within wildlife corridors and include a substantial portion of Nambucca State Forest in the vicinity of the identified Yellow-bellied Glider population. The location of the widened medians is detailed below in Table 5.

Table 5. Locations of the widened medians

Location	Average median width (metres)	Length of widening (metres)
Nambucca State Forest	50	300
Dalhousie Creek, Newry State Forest	50 - 80	800
Private Property (north of Kalang River)	40	900
Total		2000

3.2.7 Biodiversity Monitoring Measures

An Ecological Monitoring Program has been developed and will be implemented for the project in consultation with the EPA as part of meeting Minister's Condition of Approval (MCoA) B10. The primary aim of the Ecological Monitoring Program is to measure the effectiveness of mitigation measures implemented for the project and allow for their modification via corrective actions if necessary. The Ecological Monitoring Program includes the full duration of construction and from the opening of the project to traffic until it can be demonstrated that the effectiveness of the mitigation measures has been achieved over five successive monitoring periods (five years) or as otherwise agreed by the Director General of the Department of Planning and Infrastructure. The program would include as a minimum:

- Monitoring of fauna crossings and fauna connectivity structures
- Installation and monitoring of wildlife nest boxes and microbat boxes
- Creation of Green-thighed Frog breeding ponds and subsequent monitoring
- Salvage, translocate and monitoring of *Marsdenia longiloba*, *Amorphospermum whitei*, *Alexfloydia repens*, *Tylophora woollsii*, *Dendrobium melaleucaphilu*, *Goodenia fordiana* and *Artanema fimbriatum* directly impacted by the Upgrade ;
- Revegetation strategies
- Road kill monitoring
- Provision for annual reporting of monitoring results to the Director General and the EPA.

3.3 Offsets

The NSW Government has developed the following seven principles to be used in assessing impacts to biodiversity and determining acceptable offsets for state significant development and state significant infrastructure projects. These principles have been used in the development of this Biodiversity Offset Strategy and have been addressed as follows:

1. Before offsets are considered, impacts must first be avoided and unavoidable impacts minimised through mitigation measures. Only then should offsets be considered for the remaining impacts.

Management measures for biodiversity impacts for the Warrell Creek to Urunga Upgrade were developed following these general principles, in order of preference:

- Avoiding impacts
- Mitigating impacts
- Offsetting impacts.

A summary of the key measures implemented to avoid and mitigate biodiversity impacts have been provided in Sections 3.1 and 3.2 of this strategy. Offset measures have also been proposed to address residual impacts.

2. Offset requirements should be based on a reliable and transparent assessment of losses and gains.

The total offset ratio resulting from this proposed offset strategy would result in a net improvement in biodiversity over time as the proposed offset area is greater than the potential loss resulting from the Upgrade. As discussed in Section 3.3.2, one of the criteria for selecting offsets would be to ensure that the land is suitable for ongoing management for conservation through an appropriate legal instrument. Offsets will not be chosen that cannot be managed in this way, to ensure the offset results in a net improvement in biodiversity over time.

3. Offsets must be targeted to the biodiversity values being lost or to higher conservation priorities.

Offsets reflect biodiversity values, including threatened species and their habitat, that are being lost. This is on a basis as outlined in the Ministers' Condition of Approval MCOA B8. As required, offsets are being provided on a like-for-like basis and at a minimum ratio of 4:1 for areas of high conservation value (including EEC and threatened species or their habitat identified in the Environmental Assessment to be impacted for the project and poorly conserved vegetation communities identified as being more than 75% cleared in the catchment management area) and also for the remainder of native vegetation areas (excluding mangroves,

seagrass, salt marsh and riparian vegetation). Mangroves, seagrass, salt marsh will be offset in accordance with DPI Fisheries Offset Policy.

4. Offsets must be additional to other legal requirements.

The strategy is being implemented to address biodiversity impacts and satisfy the Minister's Conditions of Approval as part of the project approval under Part 3A of the Environmental Planning and Assessment Act 1979 (EPA Act). This Biodiversity Offset Strategy is not being used concurrently to satisfy an assessment or approval under other legislation.

5. Offsets must be enduring, enforceable and auditable.

The selection criteria, detailed in Section 3.3.2, include the need for the offset to be appropriate for ongoing management for conservation through an appropriate legal instrument. This ensures any land selected under these criteria will be secured in perpetuity.

6. Supplementary measures can be used in lieu of offsets.

Noted. In consultation with DPI(Fisheries) supplementary measures may be considered to offset impacts to mangroves and saltmarsh for the project.

7. Offsets can be discounted where significant social and economic benefits accrue to NSW as a consequence of the proposal.

While an outcome in which biodiversity values are improved or maintained is preferred, it is acknowledged that in some circumstances flexibility may be required, especially in the context of a project providing significant social or economic benefits to NSW.

The Biodiversity Offset Strategy for the Upgrade has been developed to complement other government programs, including other offset strategies along the Pacific Highway corridor and the establishment and management of new national parks, nature reserves and state conservation areas. Roads and Maritime is working with EPA to ensure offsets complement existing conservation areas and are of sufficient quality and are managed appropriately to ensure the offsets are secured in perpetuity.

The NSW Biodiversity Strategy and the Mid and Far North Coast Regional Conservation Plan will be consulted when identifying offset options.

Roads and Maritime acknowledges the NSW State plan's commitment to continue to build and establish national parks and nature reserves as the primary biodiversity conservation mechanism, and also recognises the Commonwealth Government's objective of Building the National Reserve System, through mechanisms such as supporting conservation covenants (DSEWPC, The National Reserve System Fact Sheet 1, April 2010).

The Biodiversity Offset Strategy proposes three options for consideration. These are:

- Option A** Secure additional native vegetation protected through an appropriate legal instrument that ensures the land is managed for conservation.
- Option B** Additional revegetation in strategic locations that have the potential to complement existing natural resource management activities in the area.
- Option C** Investment in management research related to the rehabilitation and protection of relevant threatened species.

Option A is the Roads and Maritime' first priority to achieve the objectives of the Biodiversity Offset Strategy. Option B and Option C would only be considered after every reasonable effort has been made towards offsetting under Option A, and would require further consultation with EPA and the Department of Planning and Infrastructure (refer to Section 3.3.2, Decision Making Framework).

3.3.1 Delivery of Option A

The Minister for Planning and Infrastructure's Condition of Approval (MCoA) B8 states the Biodiversity Offset Strategy must provide offsets on a like for like basis and at a minimum ratio of 4:1 for areas of high conservation value and 2:1 for the remainder of native vegetation to offset the direct and indirect impacts of the project.

Roads and Maritime aims to meet MCoA B8 by offsetting the vegetation communities directly impacted by the project, at a ratio of 4:1. Mangroves, seagrass, salt marsh will be offset in accordance with DPI Fisheries Offset Policy.

The proposed methodology will also take into account the value of key fauna habitat when determining appropriate offsets. This has been done by first matching vegetation type to corresponding habitat type. The 27 threatened species identified in the study area or considered highly likely to occur in the study area were then matched up with appropriate habitat type. A search of the OEH Threatened Species Profile Database was conducted to determine whether any of the threatened species have additional habitat requirements that cannot be offset by vegetation type alone.

State Forest land tenure will not impact on the offset ratio applied.

3.3.2 Threatened Species Habitat

Of the 27 threatened fauna species known or likely to occur in the study area, none are known to be associated with all vegetation types recorded in the study area, according to the Threatened Species Profile Database (TSPD) (OEH 2011). The vegetation types within the study area known or predicted to be associated with each species are outlined in Table 6.

The proposed offset methodology would take into account the value of key threatened species habitat when determining appropriate offsets. To help address the loss of biodiversity values, the NSW Government introduced the Biodiversity Banking and Offsets Scheme (or 'BioBanking'). The BioBanking assessment methodology establishes two classes of biodiversity credits that can be used to address the loss of habitat values for threatened species: ecosystem credits and species credits. Ecosystem credits can be created or required for all impacts on biodiversity values (including threatened species that can be reliably predicted by habitat surrogates), except the threatened species or populations that require species credits. Threatened species recorded or predicted to occur in the study area are listed in Table 6.

3.3.3 Habitat Quality of Dry Sclerophyll Forest

The Environmental Assessment for the Warrell Creek to Urunga Upgrade project identified considerable variation in the habitat quality of some vegetation types within and adjacent to the Upgrade corridor (see SKM 2010). More recently, the development of the Biodiversity Offset Strategy for this Upgrade has used the bio banking assumptions to partly deliver regional net biodiversity gains. This approach has identified a number of threatened species which require ecosystem credits and have been broadly associated with dry sclerophyll forest types in the Upgrade corridor. They include the Glossy Black Cockatoo, Yellow-bellied Glider, Koala, Greater Broad-nosed Bat and Eastern False Pipistrelle. The Giant barred Frog can also be

occasionally found along drainage lines associated with Dry Sclerophyll Forest with this species also identified as requiring a species credit within the Biobanking assessment.

Table 6 Threatened fauna recorded or predicted to occur in the study area that would be offset according to corresponding habitat type or requirements

Common name (<i>Scientific name</i>)	Associated habitat types in the study area
Species identified during fauna surveys	
Glossy Black Cockatoo (<i>Calyptorhynchus lathamii</i>)	Dry sclerophyll forests, wet sclerophyll forests
Wompoo Fruit-dove (<i>Ptilinopus magnificus</i>)	Wet sclerophyll forests.
Yellow-bellied Sheath-tail Bat (<i>Saccolaimus flaviventris</i>)	Wet sclerophyll forests.
Powerful Owl (<i>Ninox strenua</i>)	Wet sclerophyll forests
Yellow-bellied Glider (<i>Petaurus australis</i>)	Dry sclerophyll forests, moist sclerophyll forests.
Koala (<i>Phascolarctos cinereus</i>)	Dry sclerophyll forests, wet sclerophyll forest, swamp sclerophyll forests
Greater Broad-nosed Bat (<i>Scoteanax rueppellii</i>)	Dry sclerophyll forests.
Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)	Dry sclerophyll forest, wet sclerophyll forests.
Threatened fauna considered likely to occur within the study area	
Swift Parrot (<i>Lathamus discolor</i>)	Swamp sclerophyll forests, dry sclerophyll forests, wet sclerophyll forests
Regent Honeyeater (<i>Xanthomyza phrygia</i>)	Swamp sclerophyll forests, dry sclerophyll forests, wet sclerophyll forests
Spotted-tailed Quoll (<i>Dasyurus maculata</i>)	Dry sclerophyll forests, wet sclerophyll forests
Rose-crowned Fruit-dove (<i>Ptilinopus regina</i>)	Wet sclerophyll forests.
Superb fruit-dove (<i>Ptilinopus superbus</i>)	Wet sclerophyll forests.
Eastern Freetail-bat (<i>Micronomus norfolkensis</i>)	Dry sclerophyll forests, wet sclerophyll forests, modified habitats
Masked Owl (<i>Tyto novaehollandiae</i>)	Dry sclerophyll forests, wet sclerophyll forests
Sooty Owl (<i>Tyto tenebricosa</i>)	Wet sclerophyll forests

Species credits can be created or required for impacts on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Six threatened fauna species were identified as requiring species credit. Of these, four have habitat requirements specified in the Threatened Species Characteristics by CMA database (TSCCD), as outlined in Table 7..

Table 7 Threatened fauna recorded or predicted to occur in the study area that require species credits

Common name	Potential habitat in the Warrell	Habitat specified in TSPD	Habitat requirements specified in TSCCD

(<i>Scientific name</i>)	Creek to Urunga study area ¹		
Species identified during fauna surveys			
Black-necked stork (<i>Ephippiorhynchus asiaticus</i>)	Large freshwater wetland on the Kalang River floodplain located between the northern arm of the river and South Arm Road.	Breeding habitat is in live or dead trees within or near foraging habitat. Usually isolated, live, paddock trees in NSW, but also in paperbarks and occasionally low shrubs within wetlands. Foraging habitat includes shallow open freshwater or saline wetlands and estuarine habitats, including swamps, floodplains, watercourses, wet heathland, wet meadows, farm dams, saltmarsh, mud- and sand- flats, mangroves.	Land within 40 m of freshwater or saline wetlands (eg saltmarsh, mangroves, mudflats, swamps, billabongs, floodplains, watercourse pools, wet heathland and/or farm dams)
Square-tailed Kite (<i>Lophoictinia isura</i>)	Drier forest types on the foothills and coastal plains and dry sclerophyll forest habitats on low hills. Potential nests sites were identified at chainage 58015 (Nambucca State Forest, 319-3 trail; chainage 59285 (Nambucca SF, south Bellwood Road; chainage 68365 (Roads and Maritime Road Reserve, Oyster Creek).	Breeding habitat: close to watercourses. Nest sites within a fork or on large horizontal limbs. Foraging habitat: timbered habitat including dry woodland and open forests.	Not specified.
Osprey (<i>Pandion cristatus</i>)	Floodplain areas, near swamps or estuaries and dead trees near the forest edge.	Breeding habitat is emergent living or dead trees or artificial towers within 3km of foraging habitat. Foraging habitat is protected open water.	Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters
Threatened fauna considered likely to occur within the study area			
Giant Barred Frog (<i>Mixophyes iteratus</i>)	Recorded from Upper Warrell Creek at ch. 750. Damp leaf litter in rainforests, moist eucalypt forest and adjacent dry eucalypt forest slopes, with potential for these areas to occur through the Nambucca, Little Newry and Newry state forests.	Breeding habitat is second order or higher streams with some riparian vegetation present. Foraging habitat includes streamside vegetation mostly in subtropical or cool temperate forests, or wet sclerophyll forests.	Land below 1000 m in altitude and within 40 m of rainforest or eucalypt forest with deep leaf litter
Brush-tailed Phascogale	Open, dry sclerophyll forest	Breeding habitat is hollow trees, logs or stumps with entrances > 2.5	Not specified.

<i>(Phascogale tapoatafa)</i>	with little groundcover.	cm wide. Foraging habitat is trunks and branches of trees in open forest or woodland as per vegetation type.	
Black Bittern <i>(Ixobrychus flavicollis)</i>	Large wetland on the floodplain north of the Kalang River and eastern side of South Arm Road, which may provide thick vegetation at margins of watercourses, swamps, billabongs, mudflats and mangroves in tidal creeks and rivers.	Breeding and foraging habitats are as per vegetation types bordering water bodies or watercourses.	Land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation

¹ From SKM, 2010a.

Although no habitat is defined in the TSCCD for the Brush-tailed phascogale, the TSPD defines breeding habitat for this species as 'hollow trees, logs or stumps with entrances > 2.5 cm wide'. Similarly for the Square-tailed kite, breeding habitat requires forks or large horizontal limbs on trees and that these are close to watercourses.

Based on the habitat requirements for the six threatened species requiring species credits that occur or are predicted to occur within the study area, the proposed offset/s should contain:

- Freshwater or saline wetlands
- Fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters
- Rainforest or eucalypt forest with deep leaf litter, below 1000m in altitude
- Freshwater and estuarine wetlands, in areas of permanent water and dense vegetation or emergent aquatic vegetation
- Hollow trees, logs or stumps with entrances >2.5cm wide.

For five bat species recorded in the study area, there is no specification in the TSPD for whether they require ecosystem or species credits, as particular habitat elements, such as breeding habitat of cave-roosting bats, may require species credits whereas foraging habitat may be offset with ecosystem credits. Given that the study area only represents foraging habitat for most of these species (with the exception of the Eastern long-eared Bat), it is likely that the habitat within the study area for these species can be offset by vegetation type.

These five species and their associated breeding/sheltering habitat are outlined in Table 8. The five species are associated with, or predicted to be associated with dry sclerophyll forests, wet sclerophyll forests, and swamp sclerophyll forests within the study area (SKM, 2010b).

Table 8 Threatened fauna recorded or considered likely to occur in the study area for which no credit type is defined

Threatened species	Habitat within the study area	Breeding/shelter habitat as identified in the TSPD
Species identified during fauna surveys		
Grey-headed Flying-fox <i>(Pteropus poliocephalus)</i>	The study area contains an important maternity camp at ch. 49900. The remainder of the study area provides foraging habitat.	Canopy trees associated with rainforest, or coastal scrub or riparian or estuarine communities and with sufficient forage resources available within 50km.

Little Bentwing-bat (<i>Miniopterus australis</i>)	Recorded in all habitat types in sections 1 and 2. Recorded roosting beneath the Pacific Highway Bridge (1871) over Warrell Creek. Expected to use a number of other bridges and culverts during the cooler winter months. The vegetated areas provide foraging habitat.	Caves, often limestone
Eastern Bentwing-bat (<i>Miniopterus schreibersii</i>)	Foraging habitat only. Roosting habitat expected within a number of culvert and bridge structures identified in the microbat management plan.	Caves
Threatened fauna considered likely to occur within the study area		
Southern Myotis (<i>Myotis macropus</i>)	Recorded roosting in 599205 (Deadman's Gully); Culvert 599222; Culvert 599271 (Cow Creek); Culvert 599293; and Culvert 599306 (Dalhousie Creek). Suspected maternity roosts at Cow Creek and Dalhousie Creek. May also utilise tree hollows surrounding these locations. Foraging habitat largely associated with creeks, rivers, dams, wetlands and estuaries	Live and dead hollow-bearing trees, under bridges or other artificial structures, in caves, or in dense foliage. Forage over streams and pools.

Mitigation measures proposed for the five bat species include: pre-clearing surveys, fauna rescue protocol, avoidance of hollow-bearing trees where possible, and the inspection of culverts and bridges beneath the existing highway prior to their removal or disturbance. These measures are described in more detail in Section 3.2.5 and within the Warrell Creek to Urunga Microbat Management Strategy (Lewis 2013 c).

Hollow bearing trees and logs

Field surveys identified 519 hollow bearing trees containing an estimated 2942 tree hollows occur within the Warrell Creek to Urunga Upgrade (Lewis 2013 d). The number of hollow bearing trees and logs will be tallied at the completion of the clearing to determine the final number of hollow bearing trees and logs required on offset lands.

Assessment of the suitability of potential offset sites will include an assessment of the number of hollow bearing trees. The proposed offset site should contain a commensurate number of tree hollows and hollow logs to the impacted areas.

3.3.4 Quantity of offset required

The total amount of offset required is provided below in Table 9. This table shows the quantity of impacted vegetation community, habitat types, and corresponding amount of biodiversity land proposed as an offset.

Table 9: Summary of broad vegetation types impacted by the Upgrade and the habitat area (hectares) that will be offset.

Broad Vegetation Community	Corresponding Habitat Type	Area impacted by construction ¹ (hectares)	General Condition of Vegetation Community	High flora conservation value? ²	Offset
					at 4:1
Dry Open Forest - Blackbutt (Non EEC)	Dry Sclerophyll Forests	177.4	The most abundant vegetation and habitat type impacted by the upgrade. The Environmental Assessment identifies that this community occurs through large portions of the Nambucca, Newry and Little Newry State Forest and therefore has been substantially modified by logging and frequent fire regime.	Yes for majority	709.6
Moist Open Forest – white mahogany/grey gum/Ironbark (Non EEC)	Moist Sclerophyll Forest	35.94	Moist sclerophyll forest with a rainforest understorey located in steeper gullies and drainage lines have a high floristic diversity as a consequence of being protected from frequent fires. Invasive weeds are prevalent on the edges of this community, although the density of invasive weeds throughout this community was found to be low throughout the environmental assessment process.	No, however, a conservative approach has been taken to offset at 4:1 based on general condition of this community impacted by the alignment and habitat value for threatened fauna	143.76
Moist Open Forest – Flooded Gum (Non EEC)		26.59	The Environmental Assessment identified this community on	No, however, a conservative approach has	106.36

			mid-slope areas and minor gullies around Nambucca State Forest and the Warrell Creek area. Generally, the density of invasive weeds was found to be relatively high in the disturbed areas around Warrell Creek. Areas impacted by fire and logging in Nambucca State Forest were also found to be moderately to highly infested with <i>Lantana camara</i> .	been taken to offset at 4:1 based on general condition of this community impacted by the alignment and habitat value for threatened fauna	
Subtropical Coastal Floodplain Forest (EEC)		14.97	The Environmental Assessment identified that some sites where this vegetation community occurs have been impacted from logging and frequent fires and may exhibit gaps in canopy, encouraging the invasion of weeds.	Yes	59.88
Open Forest – Scribbly Gum		0.03		Yes	0.12
Swamp Sclerophyll Forest on Coastal Floodplain (EEC)	Swamp Sclerophyll Forests	13.98	The Environmental Assessment identified that this community was relatively free of invasive weed species. The better intact examples of this community were found outside the study area. The best preserved areas of swamp forest within the Environmental Assessment study area occurs around low-lying wetlands and as small remnant	Yes	55.92

			patches along the Bellinger, Nambucca and Kalang Rivers. Much of this community has been subject to impacts from clearing, draining and grazing and there are no pristine areas of swamp forest along the Upgrade.		
Swamp Oak Floodplain Forest (EEC)		11.69	Small fragments of this community, mostly along the existing Pacific Highway and in agricultural landscapes, were identified in the Environmental Assessment. Early stages of regeneration were noted in some sites where cattle had been removed. Over 70 per cent of the Swamp Oak floodplain forest was identified in the Environmental Assessment as being of low-moderate condition, located in the areas north of Nambucca River, around Deep Creek and in the vicinity of Short Cut Road.	Yes	46.76
Lowland Rainforest (EEC)	Rainforest	0.23	The isolated stands of this community are generally in poor condition due to prior and current grazing practices and general agriculture. Most patches are highly-moderately infested with camphor laurel.	Yes	0.92
Freshwater Wetlands on Coastal	Freshwater Wetlands	2.08	Sites occurring in grazed paddocks were generally	Yes	8.32

Floodplains (EEC)			found to exhibit exotic pasture species, although areas inundated for long periods were generally free of exotic species. There are few wetlands within the study area of the Environmental Assessment being limited to small wetlands. Several larger wetlands in the locality occur on river flats adjoining the Nambucca and Kalang River, as well as Deep Creek.		
Mangroves (non EEC)	Estuarine	0.1	The Environmental Assessment identified that two species are represented throughout this community. Generally, it was found to be free of exotic species. Narrow stands of mangroves up to 10 metres wide have been retained within the tidal zones of the Kalang and Nambucca Rivers and lower sections of their associated tributaries.	No	
Total Area		283.02			1131.64

Area impacted by construction includes the NH2U (Stage 1) Final Detailed Design clearing quantities, and the WC2NH clearing buffer, which comprises-

- The concept design footprint plus 15 metres.
- The operational water quality basins plus 10 metres.
- New or reconstructed access roads within Nambucca State Forest plus 10 metres.
- Utility adjustments within clearing requirements of utility authorities.
- Three metre clearing width for boundary fencing - excluding within Nambucca State Forest and swamp forest where a flying fox camp is located.

This area impacted by construction also includes vegetation that remains as part of the widened medians.

Decision Making Framework

All biodiversity offsets would be located within the NSW North Coast Bioregion with the aim of offsetting on a like for like basis based on broad vegetation type, which would encompass

ecosystem credits for those species listed in Table 2. The offset areas would be assessed to ensure that habitat for impacted threatened species is included in offset areas. Where it is not feasible to offset on a like for like basis, other vegetation types of a similar conservation value that contain habitat suitable for the impacted threatened species would be considered in consultation with the EPA.

It is recognised that the availability and suitability of land for inclusion in the offset package will be uncertain until the detailed investigation of suitable sites and finalisation of negotiations with landholders occurs. As a result it is necessary to have a staged approach to determining the suitability of sites for inclusion in the package.

Priority 1

The first phase of the offset strategy would be to identify land that could be included in the package that meets the following criteria:

- Properties located within 30km radius of the of the project extending to 100km with the agreement of the DP&I and the EPA where it can be demonstrated that a suitable offset could not be found
- Offset land would contain vegetation communities as per Table 1
- Offset land would be surveyed to determine the likely presence of threatened species impacted. This will apply for “ecosystem credit species”, that being those species which can be reliably predicted using the vegetation surrogate.
- Species specific surveys are required for “species credit species” (Table 7). Survey shall be undertaken to identify the suitability of the offset site/s in meeting the objectives of the Biodiversity Offsets Strategy.
- Land would be assessed as to its suitability as habitat for the threatened species impacted by the project (including patch sizes) based on the EPA Threatened Species Profile Databases (TSPD)
- Offset land would comprise vegetation of at least moderate to good condition (according to OEH native vegetation benchmarks database)
- Offset land would comprise land that enables connectivity between adjacent areas of vegetation, where possible
- Offset land must be suitable for ongoing management for conservation through an appropriate legal instrument.

Tools used to identify potential offset land include, but are not limited to, the OEH twenty-five(25) year investment layer, Roads and Maritime property databases, direct contact with private property owners and potentially through advertisements for expression of interest for the provision of land for conservation purposes. The Roads and Maritime will consult with the EPA regarding the methodology used to assess potential offset sites and the suitability of these sites as offsets.

The offset strategy is considered consistent with OEH's offset principles. Roads and Maritime has made a commitment to conservation of offset lands in perpetuity. There are a number of mechanisms to do this, including transfer of ownership to the National Parks estate or through a Deed of Agreement process developed under the NSW Nature Conservation Trust Act 2001 which has the same status as a conservation agreement developed under the National Parks and Wildlife Act 1974. These agreements are recognised as protected areas under the Commonwealth Protected Area and National Reserve System. In determining a hierarchy of mechanisms the EPA will be given the opportunity to have potential offset lands incorporated into National Parks, however there may be cases where lands are not suitable for inclusion into the National Parks estate, but do have suitable biodiversity values to be included as part of the biodiversity offset package required under MCoA B8.

Roads and Maritime acknowledges the NSW Stateplan's commitment to continue to build and establish national parks and nature reserves as the primary biodiversity conservation mechanism. Roads and Maritime also recognises the Commonwealth Government's objective of Building the National Reserve System, through mechanisms such as supporting conservation covenants (DSEWPC, The National Reserve System Fact Sheet 1, April 2010).

To deliver the biodiversity offset Roads and Maritime would engage the services of an appropriate organisation to act as a third party offset agent to negotiate with landholders to secure conservation management of the land and negotiate appropriate covenant or agreements. Third party offset agents could include conservation organisations established for this purpose. There are also a number of private companies that offer specialist services in finding biodiversity offset lands. If suitable, Roads and Maritime would also consult with EPA to pursue opportunities to purchase land that may be suitable for reserve estate.

Condition and habitat assessment of any proposed offset lands would be undertaken to ensure the potential offset land(s) consist of appropriate vegetation type(s) and are of adequate condition to meet the decision-making framework outlined above. Furthermore, such lands would be surveyed to determine the likely presence of threatened species impacted by the upgrade project.

This assessment would be undertaken by suitably qualified ecologists and the report prepared would be included in the Biodiversity Offset Package.

Priority 2

The second phase, if required would be to identify other land that either comprise properties located within the broader North Coast Bioregion or consists of similar vegetation communities of similar conservation status within the broad vegetation types as identified in Table 1. The other criteria included in Priority 1 would still apply to lands considered under Priority 2.

The second phase would only be undertaken if the offset requirements could not be met from Priority 1 criteria and after consultation with the EPA and DP&I. The package would clearly identify the outcomes of the assessment of properties under Priority 1 criteria and identify if any Priority 2 properties were required to be included in the package to meet the objectives of the Strategy.

Notwithstanding the above and as outlined in the MCoA B8 the Warrell Creek to Urunga Offset package may also be part of a larger offset package where other Pacific Highway projects may be included. The scope of this larger offset package would be determined using the same methodology as described in this Strategy (subject to Conditions of Approval) and would potentially allow larger more continuous areas of land to be acquired leading to improved conservation outcomes and economies of scale. Conservation organisations have shown interest in this approach and are interested in working with Roads and Maritime to identify and manage such lands.

Priority 3

In the event that every reasonable effort has been made and offset land cannot be found through the investigation process outlined in Priority 1 and/or Priority 2 above, then Roads and Maritime would consult further with the EPA and Department of Planning and Infrastructure before proceeding with the delivery of Option B and Option C as described in Section 2.3

To deliver Option B, the Roads and Maritime would invest in the strategic revegetation of the Endangered Ecological Communities impacted by the project adjacent to the road corridor or within the surrounding region. Locations of revegetation would be guided by outcomes of the further investigation and specialist advice from the EPA and/ or other specialist ecologists. Revegetation would be focused particularly on increasing key habitat for threatened species

identified in the Environmental Assessment and known to occur in the area.

To deliver Option C, Roads and Maritime would work with the EPA and other relevant government agencies and stakeholders to identify some key projects aimed at threatened species management in the region that would lead to future opportunities for improving biodiversity outcomes. The amount of investment in this option will depend on outcomes of the other options above.

Notwithstanding the above the NSW Government has recently released the draft NSW Offsets Policy for Major projects and is currently seeking public comment. Should this policy be adopted by the NSW Government, offsets could, with the agreement of Planning and Infrastructure be delivered consistent with this policy and accordingly the Biodiversity Offset Plan required by CoA B8 will be prepared to reflect this.

3.4 Management of Unforeseen Additional Impacts

Throughout the construction period there is a possibility of design changes that may impact on additional areas of native vegetation, including changes resulting from the detailed design process or potential staging options. Where additional clearing is proposed to be undertaken outside of the construction clearing limits a consistency assessment will be undertaken against the Minister's Conditions of Approval for the project. Consistency assessment(s) will take into account the vegetation type, quality, habitat, total area to be cleared, any threatened flora or fauna species or their habitat to be impacted, and whether translocation of any species is required. If the design change is deemed inconsistent with the Minister's Conditions of Approval then a modification under Section 75 W of the Environmental Planning and Assessment Act 1979 will be lodged for determination by the Department of Planning and Infrastructure.

This process will also enable a detailed record of any additional clearing impacts outside of what was anticipated in the Biodiversity Offset Strategy. In addition a survey at the end of the construction phase of the project will be undertaken to compare the 'as built' area cleared for construction against what was envisaged in the Biodiversity Offset Strategy. In the event that there is an increase in the area of native vegetation impacted above what was anticipated in the Biodiversity Offset Strategy then additional offset measures will be implemented. The extent of any additional measures will be determined in consultation with the EPA and DP&I.

Given the often cryptic and mobile nature of many threatened species, this Offset Strategy is not necessarily limited to the threatened individuals and species currently identified as part of the EA or PPR. Roads and Maritime is committed to ensure that any additional threatened species that are identified during the construction period would be documented, managed and suitably offset in accordance with the principals of this Biodiversity Management Strategy.

Additional offset measures may include one or a combination of the following:

- Secure additional native vegetation protected through covenants (or other equivalent protection mechanism)
- Additional revegetation in strategic locations
- Investment in management research related to the rehabilitation and protection of relevant threatened species.

3.5 Biodiversity Offset Package

Within two years of the approval of this strategy, Roads and Maritime will submit to the

Department of Planning and Infrastructure a Biodiversity Offset Package, as per MCoA B9. The package will be prepared in consultation with the EPA and will include details of the final suite of measures to be implemented as a result of this strategy, final selection means of securing the biodiversity values of the offset package in perpetuity, including ongoing monitoring, maintenance and management requirements, and timing and responsibilities for the implementation of the package over time.

4 Conclusions

Measures for managing biodiversity impacts arising from the Warrell Creek to Urunga Upgrade Project were developed following the general principles of avoiding, mitigating and offsetting impacts. Impacts on biodiversity values within the region have been avoided, where possible, through the route selection process and development of the concept design alignment.

Management measures designed to reduce impacts on biodiversity include fauna crossing measures, revegetation measures, threatened flora protection and translocation, development of microbat, Green-thighed Frog and Giant Barred Frog management strategies, additional fauna mitigation measures (i.e. nest and microbat boxes) and monitoring for up to Year 9 of the operation phase of the Upgrade.

The Upgrade will result in impacts to approximately 283 hectares of vegetation. Based on offset ratios of 4:1 for endangered ecological communities and also a 4:1 ratio for non-EEC vegetation communities impacted by the project, which is further to that required by the Minister's Conditions of Approval for the Upgrade. Based on the direct impact to native vegetation of approximately 283 hectares, the indicative offset requirements for the Upgrade are identified to be 1132 hectares.

There are substantial tracts of land potentially available for consideration for the biodiversity offset package within 50 km of the study area, which appears to represent a suitable offset for the vegetation to be cleared for the project.

Within two years of the approval of this strategy, Roads and Maritime will submit to the Department of Planning and Infrastructure a Biodiversity Offset Package, to be prepared in consultation with the EPA and including details of the final suite of measures selected in accordance with this strategy.

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