NSW GOVERNMENT

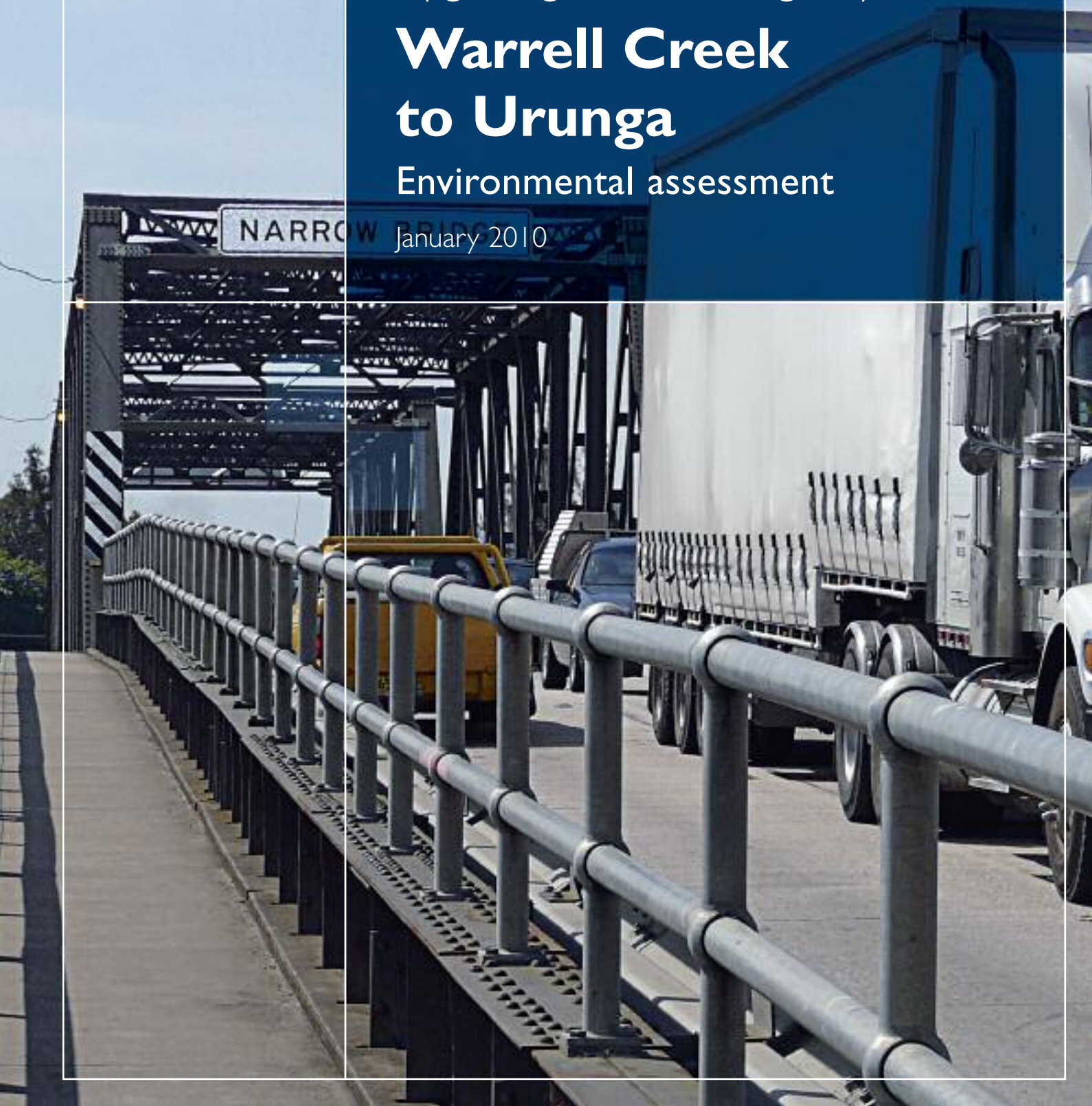
RTA

Upgrading the Pacific Highway

Warrell Creek to Urunga

Environmental assessment

January 2010



Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

January 2010

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Certification

Submission of Environmental Assessment

Prepared under Part 3A of the *Environmental Planning and Assessment Act* 1979

Environmental Assessment prepared by:

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Applicant name:	NSW Roads and Traffic Authority
Applicant address:	101 Miller Street North Sydney NSW
Proposed development:	Upgrading the Pacific Highway Upgrade, Warrell Creek to Urunga, Environmental Assessment

Land to be developed:	Land generally required for the design refinement, construction and operation of the proposed development, as shown in Figures 6–1 to Figure 6–4 of the Environmental Assessment.
Environmental assessment:	An environmental assessment is attached which addresses all matters in accordance with Part 3A of the *Environmental Planning and Assessment Act* 1979
Declaration:	I certify that I have prepared the contents of this Environmental Assessment with the Director- General's requirements dated 13 October 2009 and that to the best of my knowledge, the information contained in the environmental assessment is not false or misleading.

Signature: 	Signature: 
Name: Ross Jones Date: 22 January 2010	Name: Adam Cameron Date: 22 January 2010

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Glossary

- Acid sulphate soils Naturally acid clays, mud and other sediments usually found in swamps and estuaries. They may become extremely acidic when drained and exposed to oxygen and may produce acidic leachate run-off that can pollute waters and liberate toxins.
- Alluvial Sediment deposited by water such as a river or stream.
- Ambient The background level at a specified location, being a composite of all sources. Examples of the use of this term include 'ambient noise' or 'ambient air pollutants.
- Amenity Something that contributes to physical or material comfort.
- Aquaculture The process of raising and harvesting fresh and saltwater plants and animals.
- Aquifer Rock or soil formation containing water in recoverable quantities.
- Aquifer recharge The infiltration or injection of natural waters or recycled waters into an aquifer, providing replenishment of the ground water resource.
- Artefact An object, normally portable, made or modified by human hands.
- Average recurrence interval The average recurrence interval (ARI) (measured in years) is a term used to describe the frequency or probability of floods occurring. Large floods occur rarely, whereas small floods occur more frequently. For example, a 100 year ARI flood is a flood that occurs (or is exceeded) on average once every 100 years.
- B80 this is a biofuel blend comprising 80% of pure biodiesel comprising fatty acid methyl/ethyl esters and 20% fossil fuel diesel.
- Background noise The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the LA90 descriptor.
- Benthic The bed of a body of water, including the silt or mud that lies there.
- Berm This consists of earth or overburden to serve a specific purpose. For example, stabilising berms are used for stabilising purposes.
- Biofuels Fuel that has been derived from biological matter.
- Biological diversity The variety of all life forms, comprising genetic diversity (within species), species diversity and ecosystem diversity.
- Bioregion An area defined by ecological systems and human communities rather than political boundaries.
- Bund A bund is an embankment or wall of brick, stone, concrete or other impervious material, which may form part or all of the perimeter of a compound and provides a barrier to retain liquid.
- Colluvium Loose sediment that accumulates at the base of a hill.
- Combined fauna crossing A culvert structure that is designed for the dual purpose of facilitating drainage and fauna passage. These structures facilitate fauna passage via the inclusion, within a drainage culvert, of

special features such as a raised bench or lowered central floor for elevated dry passage or a raised outer cell that remains dry during average rainfall events but may take flow during heavy rainfall events.

- Compensatory habitat Land acquired to provide a new habitat to offset impacts on key habitat for fauna species.
- Cone penetrometer This device is inserted into the ground and is used to measure soil strength and level of compaction.
- Construction All work in respect of the proposed upgrade other than that defined as pre-construction activity/work.
- Core drilling This procedure is used to obtain soil samples. A drilling machine is used to extract a cylindrical sample so that the strata in the sample remains undisturbed.
- Culvert A pipe, drain or channel which allows facilitates drainage and allows water to pass beneath the road.
- Curvilinear alignment The alignment is a continuous curve with constant, gradual and smooth changed of direction
- Dedicated fauna crossing A structure specifically designed to provide a mechanism for fauna to cross a barrier (i.e. road).
- Design Peak Hour Level of Service The design peak hour Level of Service is the Level of Service corresponding to the actual service flow rate in the design peak hour. The actual service flow rate is calculated taking into account factors relating to traffic composition, road geometry, development, environment and driver population.
- Dicotyledons are characterised by the presence of two seed leaves of a germinating seed.
- Dissipation testing A measure of the rate of dissipation of the pore water pressure.
- E10 Blend of low levels of conventional fuel with petroleum. E10 comprises 10% ethanol and 90% fossil fuel.
- Ecologically sustainable development Using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased.
- Ecosystem A functional unit of energy transfer and nutrient cycling in a given place such as a forest or estuary; it includes all the relationships within the biotic community and between the biotic components of the system.
- Electrofishing A technique used to sample fish populations by using electric currents to immobilise fish.
- Endangered ecological community (EEC) As defined under the *Threatened Species Conservation Act* 1995, an ecological community that is likely to become extinct or is in immediate danger of extinction.
- Endemism Describes species that are native to a particular geographic area or continent. Examples of endemism in Australia are the Koala and the red kangaroo, both of which are not naturally found anywhere else in the world.
- Ephemeral Existing for a short duration of time.

- Erosion The natural process where wind or water detaches a soil particle and provides energy to move the particle.
- Estuarine Relates to the area where the river meets the sea causing freshwater to mix with saltwater.
- Floodplain Large flat area of alluvium adjacent to a watercourse, characterised by frequent erosion and aggravated by channelled and overbank stream flow.
- Fluvial Produced by the action of a river or stream.
- Foliovorous Feeds primarily on leaves and stems.
- Frugivorous Feeds primarily on fruit.
- Fyke netting A sampling method using nets held open by hoops to capture fish in shallow waters.
- Greenhouse gases A gas in Earth's atmosphere that traps heat and can contribute to global warming. Although greenhouse gases are a natural part of the atmosphere, human activity is increasing them mostly through the production and release of carbon dioxide, methane and nitrous oxide.
- Habitat The place where an organism lives; habitats are measurable and can be described by their flora and physical components.
- Hornfels A type of fine grained, non-foliated metamorphic rock. It is usually formed when heated by a nearby intrusive igneous mass.
- Incidental fauna crossing A drainage structure, such as a culvert, that is of an appropriate size to also provide a mechanism for fauna to cross a barrier (i.e. road).
- Intrusive noise Refers to noise that intrudes above the background level by more than 5 dB(A).
- LA(XX) The LA(XX) refers to statistical indicators that represent the percentage of time that a noise level is exceeded. These levels are commonly the LA_1, LA_{10}, and the LA_{90}, and are graphed to show how these levels change over the course of a 24 hour period.
- LA90 An important statistical indicator that represents the A-weighted sound pressure level that is exceeded for 90% of the time over which the noise is measured. This is often termed the background noise.
- LAeq Although the LAeq is not a statistical indicator, it is probably one of the most important of the noise descriptors. It represents the equivalent continuous A-weighted noise level for the measurement period. This is the level of noise energy averaged over the measurement period.
- LAmax Maximum noise level. The highest noise level during a specified time period or during a specified number of events expressed as the absolute maximum value of the root-mean-square (r.m.s.) sound pressure level using time weighting 'F'.
- LAmin Minimum noise level. The lowest noise level during a specified time period or during a specified number of events, expressed as the absolute minimum value of the root-mean-square (r.m.s.) sound pressure level using time weighting 'F'.
- Level of service (LoS) A performance measure used in planning design and operation of roads. It provides the basis for determining the number of lanes to be provided in the road network. The design peak hour LoS is

the level of service corresponding to the actual service flow rate in the design peak hour. The actual service flow/rate is calculated taking into account factors relating to traffic composition, road geometry, development and driver population.

- Longitudinal Along the alignment (of road or bridge).
- Longitudinal section A vertical section, usually with an exaggerated vertical, scale, showing the existing and design levels along a road line or another specified line.
- Macroinvertebrate Refers to aquatic invertebrates including insects, crustaceans, molluscs and worms which inhabit a river channel, pond, lake, wetland or ocean. They are used as environmental indicators to assess the health of aquatic ecosystems.
- Macrophytes Encompass the in-stream flowering plants that may be found attached or floating within a waterway. They include submergent (underwater) and emergent species (such as reeds that emerge out of the water) that inhabit both estuarine and freshwater reaches of a river. Macrophytes are important biological indicators in this study as their distribution depends upon water quality and flow conditions.
- Mesophilic Species growing optimally at moderate temperatures.
- Metamorphism The process of altering the composition, chemical and structure of a rock by heat and pressure.
- Microchiropteran bats Are small bats that use echolocation (emit sound waves and listen for echoes).
- Monocotyledon Are characterised by the presence of one seed leaf of a germinating seed.
- Nectarivorous Feeds on nectar from flowering plants.
- Operation The operation of the Proposal, but not including commissioning trials of equipment, or temporary use of parts of the proposed upgrade during construction.
- Overpass A road which spans over another roadway (in this case usually the highway).
- PAD See Potential archaeological deposits.
- Particulates Dust and other fine particles.
- pH A measure of how acidic or alkaline a solution is. The pH scale is 0-14 with a score of 7 representing a neutral value. Values less than 7 indicate an acid solution, greater than 7 an alkaline solution. Most freshwater and estuarine biota have a tolerance range of between approximately 6.5 and 8.
- Phyllites A fine grained metamorphic rock formed from low grade metamorphism of claystones.
- Photogrammetry The process of extracting three-dimensional coordinate information from imagery, typically aerial stereo imagery.
- Potential archaeological deposit (PAD) A potential archaeological deposit, or PAD, is defined as any location where the potential for subsurface archaeological material is considered to be moderate or high, relative to the surrounding study area landscape. The potential for subsurface material to be present is assessed using criteria developed from the results of previous surveys and excavations relevant to the region.

- Pre-construction Work in respect of the proposed upgrade that includes design, survey, acquisitions, fencing, investigative drilling or excavation, building/road dilapidation surveys, minor clearing (except where threatened species, populations or ecological communities would be affected), establishing ancillary facilities such as site compounds, or other relevant activities determined to have minimal environmental impact (e.g. minor access roads).
- Proponent The person or body proposing to carry out a development or activity.
- Pyritic mineralisation The geothermal deposition of pyrite minerals in a body of rock.
- Receiving water A body of water such as a stream, river, lake, or ocean, which receives stormwater and wastewater.
- Recharge zone A recharge zone is where water flows into the ground to become groundwater through the recharge system.
- Referral This is used to determine whether a proposed action would need formal assessment and approval by a government department or statutory authority. The referral is usually the principal basis for the Minister's decision as to whether approval is necessary. For example, under the *Environmental Protection and Biodiversity Conservation Act* 1999, a referral is a description of a proposed action that allows the Environment Minister to determine if environmental assessment and approval is required under the Act.
- Rehabilitation The restoration of a landscape and especially the vegetation following its disturbance.
- Relic The *NSW Heritage Act* 1977 defines a 'relic' as any deposit, object or material evidence: which relates to settlement of that area that comprises NSW, not being an aboriginal settlement; and which is 50 or more years old.
- Remnant Vegetation Native vegetation remaining after widespread clearing has taken place.
- Riparian Relating to the banks of a natural water way.
- Riparian vegetation In the context of this study riparian vegetation encompasses the woody and non-woody vegetation that inhabits the riverine riparian zone of the Hawkesbury-Nepean River and its tributaries.
- Riparian zone The riparian zone is defined as "the stream channel between the high and low water mark towards the uplands where vegetation may be influences by elevated water tables and flooding and by the ability of soils to hold water ".
- Sag curve A concave vertical curve in the longitudinal profile of a road.
- Schists A type of medium-grained metamorphic rock formed by high temperature and high pressure. This rock has well-developed foliation (layered structure) and is usually formed from mica-bearing rocks.
- Sclerophyll Vegetation that is characterised by hard, tough leaves.
- Sediment Material of varying sizes that has been or is being moved from its site of origin by the action of wind, water or gravity.
- Seismic Relates to movement subject to or caused by an earthquake or other vibration of the Earth.

- Seismic refraction survey This method is used for investigating subsurface geological conditions and structures using seismic waves. Using the seismic velocity, different layers of the subsurface conditions can be determined.
- Select Fill Soil that is placed directly onto geosynthetic materials.
- SEPP 14 State Environmental Planning Policy No 14 – Coastal Wetlands. This policy aims to ensure the protection and preservation of coastal wetlands in NSW.
- Shear vane testing This in-situ method is used to determine the shear strength of the soil.
- Site compound Area enclosing construction machinery, stockpiles and site offices.
- SPOCAS Suspended Peroxide Oxidation Combined Acidity and Sulphate testing is carried out to determine actual or potential acidity of acid sulphate soils.
- Spoil Soil or materials arising from excavation activities.
- Stakeholder An individual or group that has an interest in the project.
- Standpipe piezometer These instruments are used to monitor pore water pressure and water levels.
- Stockpile Temporarily stored materials, e.g. soil, sand, gravel, spoil/waste.
- Stormwater All surface water runoff from rainfall, predominantly in urban catchments; such areas may include rural residential zones.
- Tectonic movements Movement resulting from or causing deformation of the earth's crust.
- Transverse Perpendicular to the alignment (of road or bridge)
- Veining Mineral matter deposited in a fissure or crack of a rock which has been precipitated from a fluid. They may also form when magma is injected into fissures created by intrusion of igneous rock.
- Vertical alignment The longitudinal profile along the design of a road.
- Vertical curve A curve (generally parabolic) in the longitudinal profile of a carriageway to provide for a change of grade at a specified vertical acceleration.
- Water quality The chemical, physical and biological condition of water.
- Wick drains These drains remove excess pore water from saturated compressible soils. The drains create paths to which the pore water flows and decreases the time of soil consolidation.

Executive summary

What is proposed?

The Australian and New South Wales (NSW) governments have been jointly upgrading the Pacific Highway since 1996. Together, $3.6 billion has been committed to continue the upgrade of the highway over five years to mid 2014 as part of the Nation Building Program and Building Australia Fund.

It is planned to complete the upgrading of the Pacific Highway in three stages.

Stage one involves completing dual carriageway by mid 2014 in three key areas:

- From the F3 Freeway near Hexham to Port Macquarie.
- From Ballina to the Queensland border.
- Sections to the north and south of Coffs Harbour.

Stage two involves completing dual carriageway from Port Macquarie to Raleigh, south of Coffs Harbour. The Warrell Creek to Urunga project is one of three projects to complete the Stage 2 link. The other projects are the Oxley Highway to Kempsey upgrade and the Frederickton to Eungai upgrade. The completion of these projects would ultimately provide a four lane divided highway from Hexham to Woolgoolga.

Stage three involves completion of dual carriageway from north of Coffs Harbour to Ballina.

The Warrell Creek to Urunga upgrade is referred to as the "Proposal" in this environmental assessment report.

The NSW Roads and Traffic Authority (RTA) proposes to upgrade a section of the Pacific Highway between the existing Allgomera deviation and Raleigh dual carriageway sections on the Mid North Coast of NSW. The Proposal involves bypasses of Warrell Creek, Macksville, Bellwood and Urunga and an upgrade of the existing highway between Nambucca Heads and south Urunga.

The general features of the Proposal are:

- A 42 kilometre motorway style (class M) upgrade comprising of four-lane divided carriageways (two lanes each way), with a wide median allowing for the future addition of a third lane in each direction and a 110 kilometre per hour posted speed limit.
- Controlled access to the upgrade from four new grade separated interchanges and an upgrade to the existing Waterfall Way interchange at Raleigh.
- New major highway bridges across the Nambucca River at Macksville, the Kalang River at Urunga and Warrell Creek.
- Retention of the existing highway as a local access road between Warrell Creek and Urunga.

- Floodplain bridges and culverts across sections of the Gumma floodplain at Macksville and the Kalang floodplain at Urunga.
- Noise barriers and low noise pavements at various locations.
- At residence noise treatments to houses in locations where required.
- Permanent spill containment basins at environmentally significant watercourse crossings.
- Combined fauna underpasses/drainage structures at river and creek crossings and key habitat locations.
- A dedicated fauna underpass structure, combined drainage/underpass structures and a wide vegetated median for overhead fauna movement in sections of the Nambucca and Newry State Forests.
- A major rest area for heavy and light vehicles at the Nambucca interchange.
- Ancillary construction facilities, including compound sites, batching plant sites and stockpile sites.

Why is it needed?

The Pacific Highway is the major transport link between Sydney and Brisbane, and also serves a growing population on the Mid North Coast of NSW. The section of the existing highway between Warrell Creek and Urunga requires upgrading to the standard that is being applied to all Pacific Highway upgrade projects.

The existing Pacific Highway between Warrell Creek and Urunga is primarily a two-lane single carriageway road with occasional overtaking lanes. Accident histories show unacceptably high levels of traffic incidents in many areas. In particular, areas of accident concentration include Macksville and along the Pacific Highway in the vicinity of Hungry Head Road between Wenonah Head and South Urunga. The majority of crashes occur at intersections and as a result of the large number of private accesses onto the existing highway. The combination of these factors contributes to unacceptable road conditions on the Pacific Highway between Warrell Creek and Urunga.

The Proposal would provide substantial road safety benefits by separating local and through-traffic and improve travel times and traffic efficiency throughout the study area and add to the overall cumulative benefits of the Pacific Highway Upgrade Program.

What alternatives were considered?

The route development process evolved over time and in response to suggestions from the community. It initially started with the intent of developing and assessing route options between Macksville and Urunga, based on geographical constraints. The Proposal was initially divided into four sections, with route options developed as follows:

- Five options that traversed east of the existing highway between Albert Drive Donnellyville and the Nambucca River at Macksville (Section 1).
- Three options that traversed west of the existing highway were considered between the northern bank of the Nambucca River at Macksville to where the existing Pacific Highway crosses the Main North Coast Railway Line, west of Nambucca Heads (Section 2).

- One route option was considered adjacent to the western side of the existing highway due to topographical constraints between the southern end of Section 2, and Ballards Road at south Urunga (Section 3).
- Three options that traversed west of the existing highway were considered between Ballards Road and the existing Waterfall Way interchange at Raleigh (Section 4).

In response to a request from some sections of the Macksville community, two options were developed that traversed west of the existing highway between Warrell Creek and Nambucca Heads. The RTA also investigated options north of the Nambucca River in the vicinity of Old Coast Road that were suggested by the community.

Route options to the east and west of Macksville were publicly displayed for comment in November 2004. The preferred route for the Macksville to Urunga section was announced in November 2005.

When the preferred route was identified for the Macksville to Urunga section, it necessitated a review of the previously approved route at Warrell Creek. This review was undertaken on the basis of changes in RTA road design standards and environmental requirements and resulted in the subsequent inclusion of that section in the overall Proposal. Four route options were developed for the Warrell Creek section between the existing dual carriageway highway south of Warrell Creek (the Allgomera Deviation) and Albert Drive Donnellyville. The route options were publicly displayed for comment in September 2007 with the preferred route being announced in June 2008.

All route options were developed through an iterative process involving a range of environmental, community, engineering, urban design, safety and cost considerations. The preferred route was a combination of the options that on balance, best met these considerations.

What are the main beneficial outcomes expected?

The Proposal would result in a range of benefits such as:

- Improved road safety and travel times.
- Greater transport efficiency and safety for intra-state and inter-state movements.
- Improved regional access.
- Retention of the existing highway as an alternate route to the new highway for local access.
- Safer access to the highway from new grade separated interchanges located strategically along the upgrade.
- Improved amenity in the Warrell Creek Village, Macksville, Bellwood and through Urunga.
- Reduced noise impact on communities such as Bellwood, Nambucca Heads, Macksville and Urunga.
- Reducing greenhouse gas emissions in the longer term, relative to the base case of ‘no upgrade’.

What are the main adverse outcomes expected?

The Proposal would result in some impacts, such as:

- Impacts on Aboriginal heritage.
- Impacts on private property.
- Loss of forestry land.
- Loss of native vegetation and threatened species.
- Potential for noise impacts on some residences.
- Impact on endangered ecological communities.
- Potential for indirect impacts on native vegetation and habitat.
- Minor disruption during construction.

How will the likely impacts be managed?

Measures to mitigate and/or manage the impacts have been proposed. The mitigation measures aim to remove or minimise potential impacts through design in the first instance. Where a potential impact is unable to be mitigated through design, further management measures are outlined.

The impacts, and measures to minimise those impacts, are discussed in Chapters 10 to 18. A *Draft Statement of Commitments*, that lists the intended outcomes and actions proposed to be achieved, is provided in Appendix D.

How can I comment on the proposed upgrade and/or the environmental assessment?

The NSW Department of Planning will make the environmental assessment publicly available for a minimum period of 30 days. During this period, it will be available for inspection at the department's website (www.planning.nsw.gov.au), on the project website www.rta.nsw.gov.au/pacific (click on Warrell Creek to Urunga), at selected RTA offices and in other locations.

The RTA will also be conducting community information sessions. A project information line will also be available throughout the exhibition period – 1800 800 612 (toll free).

Any person may make a written submission to the Director-General of the NSW Government Planning Department during the exhibition period. Submissions should be made to:

The Director, Department of Planning
Pacific Highway Assessment Team, Major Projects Assessment
GPO Box 39
Sydney NSW 2001

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Upgrading the Pacific Highway

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1. Introduction

This chapter provides an overview of how the Proposal fits within the context of the overall Pacific Highway Upgrade Program. It provides a brief description of the Proposal, an overview of the study area, and outlines the structure of this environmental assessment.

1.1 The Pacific Highway Upgrade Program

The Pacific Highway Upgrade Program is a joint commitment by the Australian and New South Wales (NSW) governments to improve the standard and safety of the Pacific Highway between Hexham and the Queensland border.

The upgrading of the Pacific Highway commenced in 1996. Together, the Australian and NSW governments have committed $3.6 billion to continue the upgrade of the highway over five years to mid 2014 as part of the Nation Building Program and Building Australia Fund.

It is planned to complete the upgrading of the Pacific Highway in three stages.

Stage one involves completing dual carriageway by mid 2014 in three key areas:

- From the F3 Freeway near Hexham to Port Macquarie.
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Stage two involves completing dual carriageway from Port Macquarie to Raleigh, south of Coffs Harbour. The Warrell Creek to Urunga project is one of three projects to complete the Stage 2 link. The other projects are the Oxley Highway to Kempsey upgrade and the Frederickton to Eungai upgrade. The completion of these projects would ultimately provide a four lane divided highway from Hexham to Woolgoolga.

Stage three involves completion of dual carriageway from north of Coffs Harbour to Ballina.

The proposed upgrade of the Pacific Highway between Warrell Creek and Urunga is referred to throughout this environmental assessment report as 'the Proposal'.

1.2 Overview of the Proposal and study area

The Proposal, which is located on Mid North Coast of NSW, is shown in the context of the wider study in Figure 1-1. The regional context, including the Pacific Highway Upgrade Program, is shown in Figure 1-2.

The Proposal commences at the northern end of the existing dual carriageway highway at Allgomera (referred to as the Allgomera deviation). It runs south of Warrell Creek and deviates north-east of the Warrell Creek village, before

veering north past Rosewood Road and then north-east to run parallel with the existing highway near Donnellyville. It then connects with the Bald Hill Road interchange, north-east of Donnellyville.

North of the Bald Hill Road interchange, the Proposal traverses the Gumma floodplain to the east of Macksville, before crossing the Nambucca River just to the west of the Nambucca Shire Council's sewage treatment plant. The new bridge to be constructed across the Nambucca River would be approximately 350 metres long. North of the Nambucca River, the Proposal generally follows the ridgeline in the vicinity of Old Coast Road, passing through Nambucca State Forest before running parallel along the western side of the existing highway, west of Nambucca Heads, connecting with the Nambucca interchange at Boggy Creek Road.

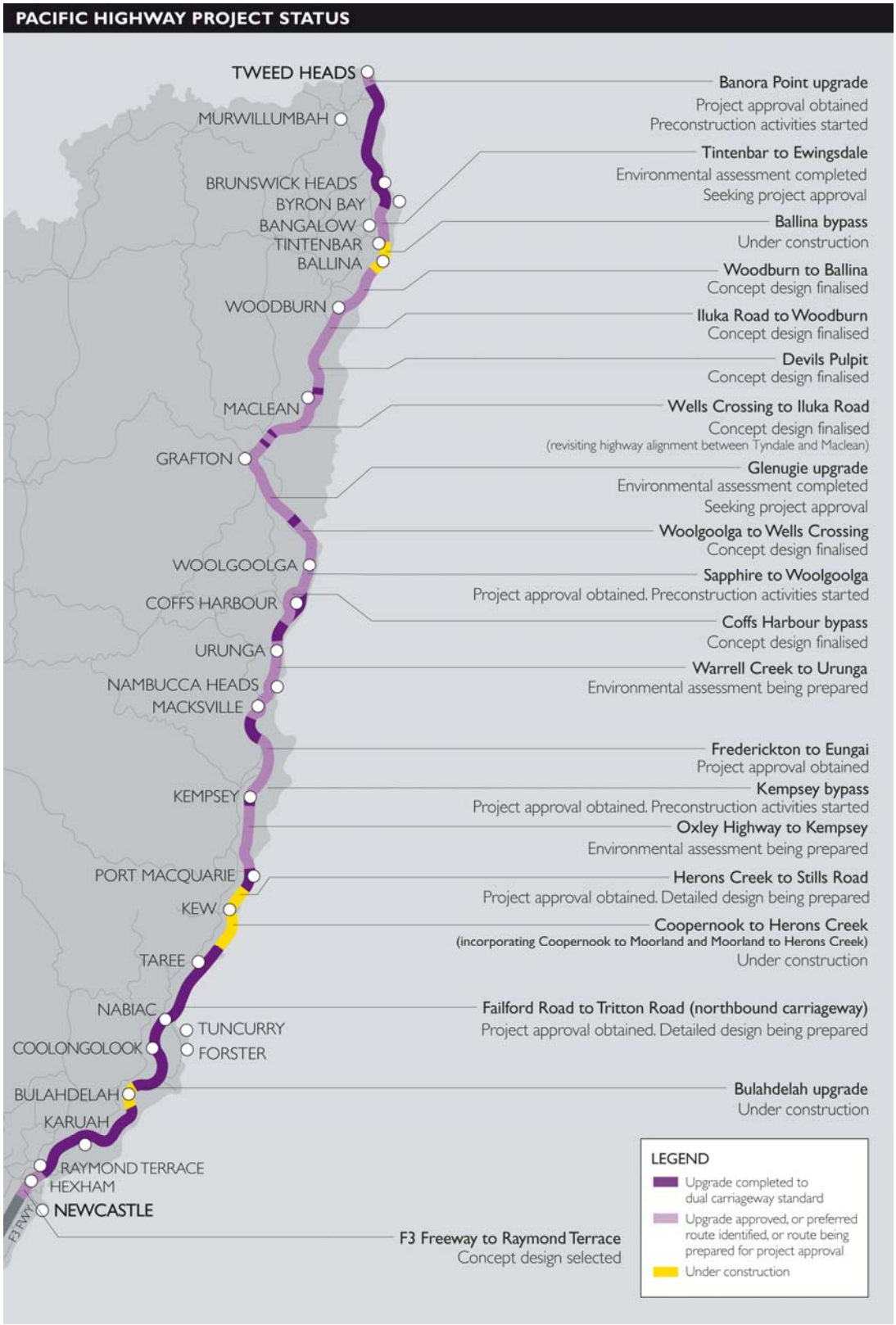
North of the Nambucca interchange, the Proposal runs alongside the western side of the existing highway before deviating north-west at Mines Road through Little Newry State Forest and then connects with a new interchange at Ballards Road. The Proposal then traverses Newry State Forest prior to crossing the Kalang River on a new, approximately 170 metre long, bridge near South Arm Road. It then runs generally to the north, passing to the east of Ridgewood Drive to rejoin the existing highway east of the Raleigh industrial area before connecting with the existing Waterfall Way interchange.

The general features of the Proposal are:

- A 42 kilometre motorway style (class M) upgrade comprising of four-lane divided carriageways (two lanes each way), with a wide median allowing for the future addition of a third lane in each direction and a 110 kilometre per hour posted speed limit.
- Controlled access to the upgrade from four new grade separated interchanges and an upgrade to the existing Waterfall Way interchange at Raleigh.
- New major highway bridges across the Nambucca River at Macksville, the Kalang River at Urunga and Warrell Creek.
- Retention of the existing highway as a local access road between Warrell Creek and Urunga.
- Floodplain bridges and culverts across sections of the Gumma floodplain at Macksville and the Kalang floodplain at Urunga.
- Noise barriers and low noise pavements at various locations.
- At residence noise treatments to houses in locations where required.
- Permanent spill containment basins at environmentally significant watercourse crossings.
- Combined fauna underpasses/drainage structures at river and creek crossings and key habitat locations.
- A dedicated fauna underpass structure, combined drainage/underpass structures and a wide vegetated median for overhead fauna movement in sections of the Nambucca and Newry State Forests.
- A major rest area for heavy and light vehicles at the Nambucca interchange.
- Ancillary construction facilities, including compound sites, batching plant sites and stockpile sites.

FIGURE 1-1 | THE PROPOSAL

Figure 1-2 Pacific Highway Upgrade Program overview



The 42 kilometre long Proposal has been designed as a motorway standard (or Class M) project with direct access available only at the five grade separated interchanges. The existing highway would be retained as a local service road and separate access roads would be provided for local traffic to the nearest cross roads, where required. A detailed description of the Proposal is provided in Chapter 6 – *Description of the Proposal*.

1.3 Environmental Assessment Requirements

The Proposal has been declared to be a project to which Part 3A of the NSW *Environmental Planning and Assessment Act* 1979 (EP&A Act) applies. It has also been declared as critical infrastructure under the EP&A Act. A preliminary environmental assessment report has been prepared for the Proposal under Part 3A of the EP&A Act (RTA 2007a). The Director General of the NSW Department of Planning issued the requirements for the Part 3A environmental assessment on 23 September 2007. These requirements were subsequently reissued on 13 October 2009.

1.4 Structure of the environmental assessment

The RTA is seeking project approval for the Proposal under Part 3A of the EP&A Act. This environmental assessment has been prepared in response to the requirements issued by the Director General of the NSW Department of Planning. The environmental assessment report is divided in two volumes, with the structure shown in Table 1-1.

Table 1-1 Outline of environmental assessment report structure

Chapter	Content
VOLUME ONE – Environmental Assessment	
Executive Summary	
Part A	Background to the Proposal
Chapter 1	Introduction
Chapter 2	Process for assessment and decision making
Part B	Justification and project development
Chapter 3	Strategic justification and project need
Chapter 4	Alternatives considered and route development
Chapter 5	Community consultation
Part C	Project description
Chapter 6	Description of the Proposal
Chapter 7	Construction of the Proposal
Chapter 8	Environmental management
Part D	Assessment of key environmental issues
Chapter 9	Environmental risk analysis

Chapter	Content
Chapter 10	Flora and fauna
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Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

January 2010

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2. Process for assessment and decision making

This chapter describes relevant statutory requirements and explains the steps in the assessment and approval process.

2.1 Statutory context

2.1.1 NSW Environmental Planning and Assessment Act 1979

The Minister for Planning has declared under Section 75C of the EP&A Act, by Order dated 5 December 2006 published in the NSW Government Gazette (No. 175), that development for the purposes of upgrading segments of the Pacific Highway is a project to which Part 3A of the EP&A Act applies (the declared project). The Minister has also declared by Order dated 8 December 2006 published in the Gazette (No. 175) that the same development is a critical infrastructure project under Section 75C of the EP&A Act.

The Proposal requires the Minister's approval. Copies of the Minister's Orders are included in Appendix F.

2.1.2 Other NSW legislation

In addition to the EP&A Act, other NSW legislation contains requirements that may be relevant to the Proposal. The application of these is limited by the provisions in Part 3A of the EP&A Act, however, requirements which remain potentially relevant include:

- Environmental protection licences under the *Protection of the Environment Operations Act* 1997 for road construction and/or for the operation of ancillary facilities.
- Approvals under the *Water Act* 1912 for access to ground or surface water during construction.

The RTA would continue liaising with relevant agencies to identify and satisfy any further requirements under NSW legislation prior to the commencement of works. Provisions of other legislation that would have applied to the Proposal, but for the application of Part 3A, have been reviewed and considered, where relevant, in Chapters 10-19.

2.1.3 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), a referral is required to the Australian Government for proposed 'actions' that have the potential to significantly impact on matters of national environmental significance, or the environment of Commonwealth land.

Matters of national environmental significance of potential relevance to the Proposal and potential impacts on nationally threatened species and ecological communities.

The Proposal may be referred to the Australian Minister for the Environment, Heritage and the Arts to determine whether or not the Proposal constitutes a controlled action. If the proposal is determined to be a controlled action, approval is required from the Australian Minister.

Chapter 10 – *Flora and fauna* provides further discussion on the potential impacts of the Proposal on matters of national environmental significance.

2.2 Environmental planning instruments

2.2.1 State environmental planning policies (SEPPs)

SEPPs only apply to critical infrastructure projects where the relevant SEPP expressly provides that it applies to the particular project. To date, there are no SEPPs that expressly apply to the Pacific Highway Warrell Creek to Urunga upgrade.

2.2.2 Other environmental planning instruments

Other environmental planning instruments (i.e. local environmental plans) do not apply in respect of an approved Part 3A project.

The Minister for Planning may take into account the provisions of any environmental planning instrument when deciding to whether or not to approve a project under Part 3A.

The provisions of relevant Local Environmental Plans have been considered in Chapter 11 – *Land use and property*.

2.3 Planning and approval process

2.3.1 Assessment and approval under Part 3A of the EP&A Act

The steps in the assessment and approval process under Part 3A of the EP&A Act are summarised below and shown in Figure 2-1. Further information on the assessment process is available on the Department of Planning website (www.planning.nsw.gov.au).

Step 1 – lodgement of major project application (EP&A Act Section 75E)

The RTA lodged a major project application with the Department of Planning in July 2007.

Step 2 – environmental assessment requirements (EP&A Act Section 75F)

The Director General of the NSW Department of Planning issued environmental assessment requirements (DGRs) for the project on 23 September 2007, following a planning focus meeting on 23 August 2007. The DGRs were subsequently reissued by the Department of Planning on 13 October 2009. The DGRs, which are included at Appendix A, were prepared following consultation with relevant government agencies.

Step 3 – preparation and submission of environmental assessment (EP&A Act Section 75H)

This environmental assessment has been prepared in accordance with the DGRs and submitted to the Director-General for adequacy review.

Step 4 – public exhibition (EP&A Act Section 75H)

Once the Director-General concludes that the environmental assessment adequately addresses the DGRs, it is placed on exhibition for a period of not less than 30 days. During this period, any person (including a public authority) may make written submissions to the Director-General on the Proposal.

Step 5 – consideration of public submissions (EP&A Act Section 75H)

Following public exhibition, the Director-General will consider the submissions received and provide copies of submissions to RTA or a report on the issues raised in the submissions. The Director-General may require RTA to:

- Submit a response to the issues raised in the submissions.
- Prepare a preferred project report that outlines any changes to the project to minimise its environmental impact.
- Prepare a revised statement of commitments.

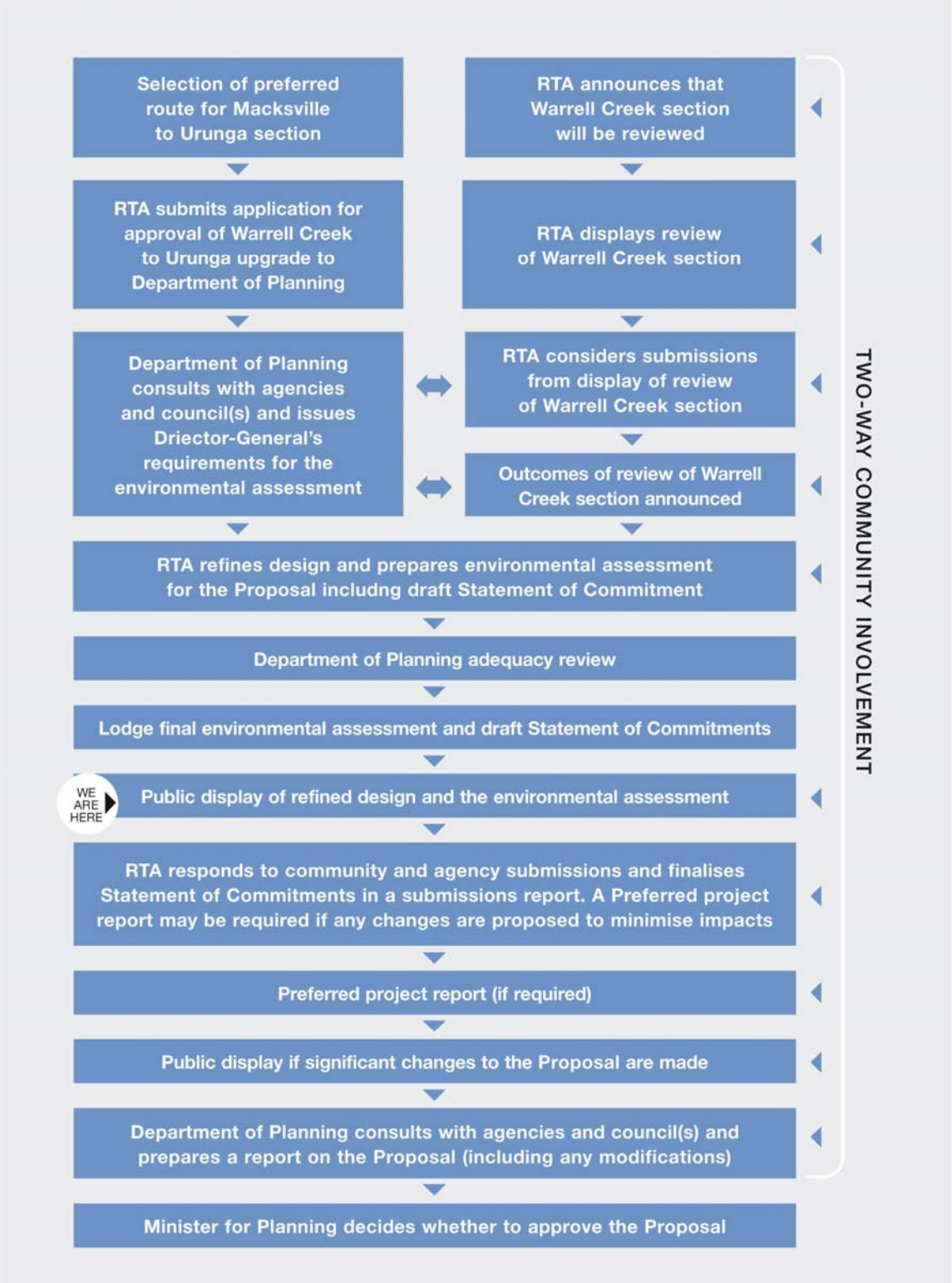
Step 6 – preparation of Director-General's report (EP&A Act Section 75I)

The Director-General, NSW Department of Planning will prepare a report on the project. The purpose of the report is to assist the Minister for Planning in deciding whether to grant approval to carry out the project.

Step 7 – decision (EP&A Act Section 75J)

The Minister for Planning will consider any advice from the Minister for Roads and the Director-General's report. The Minister for Planning will then decide whether or not to approve the project and the conditions to be attached to any approval.

Figure 2-1 Steps in the Part 3A assessment and approval process



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3. Strategic justification and project need

This chapter explains why the upgrade of the Pacific Highway between Warrell Creek and Urunga is needed. It also addresses the strategic planning framework, which supports the need for an upgrade of the highway.

Director-General's requirements	Where addressed in the EA	
Strategic Justification – outline the strategic outcomes for the Pacific Highway Upgrade Program (PHUP), including the respect to strategic need and justification, the aims and objectives of relevant State planning policies, the principles of Ecologically Sustainable Development, and cumulative and synergistic impacts associated with the Program as a whole. Identify how the project fits within these strategic outcomes and how impacts associated with the project will be considered and managed to achieve acceptable environmental planning outcomes across the PHUP.	Section 3.1.1	Relationship of the Proposal to the Pacific Highway Upgrade Program
	Section 3.1.2	NSW and Australian Strategic Planning Policy and Framework
	Section 3.5	Statement of strategic need
	Section 20.2	Integration of the Program and Proposal with Principles of Ecologically Sustainable Development
	Section 20.4	Relationship between the proposed upgrade and the Objectives of the EP&A Act
Project Justification – describe the need for and objectives of the project; alternatives considered (including the assessment of the environmental costs and benefits of the project relative to alternatives), and provide justification for the preferred project (including interchange locations) taking into consideration the objects of the *Environmental Planning and Assessment Act 1979*.	Section 3.2	Need for the Project
	Section 3.3	The "do nothing" option
	Section 3.4	Proposal objectives
	Section 3.5	Statement of strategic need
	Section 4.1	Route planning and development process
	Section 4.3	Macksville to Urunga
	Section 4.4	Warrell Creek options
	Section 4.5	Interchanges
	Section 4.6	Alternatives considered
	Section 4.7	Conformation of the Proposal as the preferred option
	Section 20.1	Cumulative and synergistic impacts
	Section 20.3	Relationship between the proposed upgrade and the Objectives of the EP&A Act
	Section 20.4	Conclusion

3.1 Strategic context

3.1.1 Relationship of the Proposal to the Pacific Highway Upgrade Program

The Proposal is an important component of the Pacific Highway Upgrade Program, which is needed to meet the NSW and Australian governments' commitments to upgrade the Pacific Highway between Hexham in NSW and the Queensland border in response to:

- Current constraints on transport infrastructure and the related need to improve accessibility and transport, both within individual regions and between regions.
- The need to improve the efficiency and integration of transport infrastructure, including improvements in the efficiency and productivity of the freight sector.
- The need to improve road safety.
- Increasing demand for urban development, especially on the Mid North Coast and North Coast of NSW.

The projects that make up the Pacific Highway Upgrade Program, including the Proposal, are intended to achieve the strategic outcomes noted above.

3.1.2 NSW and Australian strategic planning and policy framework

Nation Building Program

The NSW and Australian governments are providing $3.6 billion as part of the Nation Building Program and Building Australia Fund to continue the upgrade of the Pacific Highway over the next five years to mid 2014.

AusLink White Paper

The AusLink White Paper Building our National Transport Future (Australian Government DOTARS 2004) is the Australian government's formal policy statement on land transport and identifies national objectives for the AusLink investment program. The White Paper promotes sustainable national and regional development and connectivity by contributing to the establishment of an integrated national transport network. The Pacific Highway is identified as a key element of the national transport network under the AusLink investment program and is also the key road between Sydney and Brisbane. The Pacific Highway Upgrade Program (including the Proposal) is consistent with the objectives of the AusLink investment program as it aims to improve connectivity within and between communities in the region, increase road safety, and promote sustainable development.

Sydney-Brisbane Corridor Strategy

The *Sydney-Brisbane Corridor Strategy* (DOTARS 2007) has been jointly developed by the Australian Department of Transport and Regional Services, the RTA, the NSW Ministry of Transport, the Queensland Department of Main Roads and Queensland Transport. The strategy identifies the Sydney-Brisbane corridor as one of the busiest links on the Australian transport network. Challenges along the corridor, particularly along the coastal route, include population growth, increased freight movements and rapid growth in passenger and local traffic. The strategy identifies transport deficiencies along the corridor, including safety and amenity issues and increasing congestion. Key objectives of the strategy are to achieve substantial duplication of the Pacific Highway in the short-term and

complete duplication of the Pacific Highway in the long-term. The Pacific Highway Upgrade Program, including the Proposal, is consistent with these objectives.

NSW State Infrastructure Strategy

The *State Infrastructure Strategy – New South Wales* 2008-09 to 2017-18 (NSW Treasury 2008) provides strategic direction for planning and delivery of infrastructure in NSW in response to population growth. The strategy, which comprises a rolling 10-year plan for infrastructure projects, was first published in 2006 and is updated every two years. The strategy highlights the upgrading of the Pacific Highway as a priority investment, with the upgrading of the Warrell Creek to Urunga section of the highway identified as necessary for road safety and transport efficiency.

NSW State Plan

The *NSW State Plan: A New Direction for NSW* (NSW Government 2006) identifies priorities for the NSW Government over the next 10 years. The plan provides goals and targets for regional economies, environmental protection, employment and transport, including improving the efficiency and safety of the road network through maintenance and infrastructure development. The Pacific Highway Upgrade Program, including the Proposal, is consistent with these goals and targets. The expected reduction in crashes would help to meet the State Plan objective for road safety of 0.7 fatalities per 100 million vehicle kilometres travelled (MVKT).

Mid North Coast Regional Strategy

The *Mid North Coast Regional Strategy* (DoP 2009) establishes the guiding principles for the planning and management of sustainable growth in the Mid North Coast region. The strategy recognises the Pacific Highway as the primary north-south corridor for inter and intra-regional movements. It identifies the growth pressures that will be faced by the region and the importance of safe and efficient transport connections within and between regions along the Sydney-Brisbane corridor. The Pacific Highway Upgrade Program, including the Proposal, is consistent with the *Mid North Coast Regional Strategy* as it aims to improve traffic safety and efficiency along the Sydney-Brisbane corridor as the regional population grows.

Action for Air

The NSW Government initiative *Action for Air* (EPA 1998) is a 25 year plan to improve air quality. The plan, which was updated in 2006, identifies the reduction of motor vehicle emissions as a priority action and sets specific targets for reducing the per capita vehicle kilometres travelled. To achieve the targets of the plan, the government has developed two key transport initiatives:

- An integrated transport plan.
- An integrated freight management strategy across road, rail and other transport modes.

Although *Action for Air* has a focus on reducing air pollutants in urban environments, measures to improve traffic flow can also have beneficial effects in non-urban environments. Improving transport efficiency can also have the additional benefit of reducing greenhouse gas emissions per vehicle kilometre travelled. The Pacific Highway Upgrade Program and its component projects, including the Proposal, are consistent with the objectives of *Action for Air*.

3.1.3 Growth pressures

National transport growth

The Pacific Highway serves a large number of major regional centres and supports both local, regional and through freight and passenger transport activity. Centres such as Forster/Tuncurry, Taree, Port Macquarie, Kempsey, Coffs Harbour and Grafton are typically experiencing strong economic and population growth. Major economic activity along the corridor includes:

- A strong and mixed agricultural base, including dairy, beef cattle, fruit, aquaculture and herbs, forest products, plantations and processing which are transported to interstate destinations and also to the Port of Newcastle where the goods are exported.
- A strong manufacturing and agricultural equipment sector.
- Tourism, which is a significant traffic generator on the coast with extensive resort development and leisure attractions.

Sydney-Brisbane corridor

The Sydney Brisbane corridor is one of the busiest links on the Australian transport network with 40 per cent of Australia's population living along the corridor. The Pacific Highway plays a vital role in linking the coastal regions between Sydney and Brisbane, providing access to markets and sources of goods and services. Many of these regions are recording high rates of population and economic growth, particularly due to the development of strong tourism-based industries.

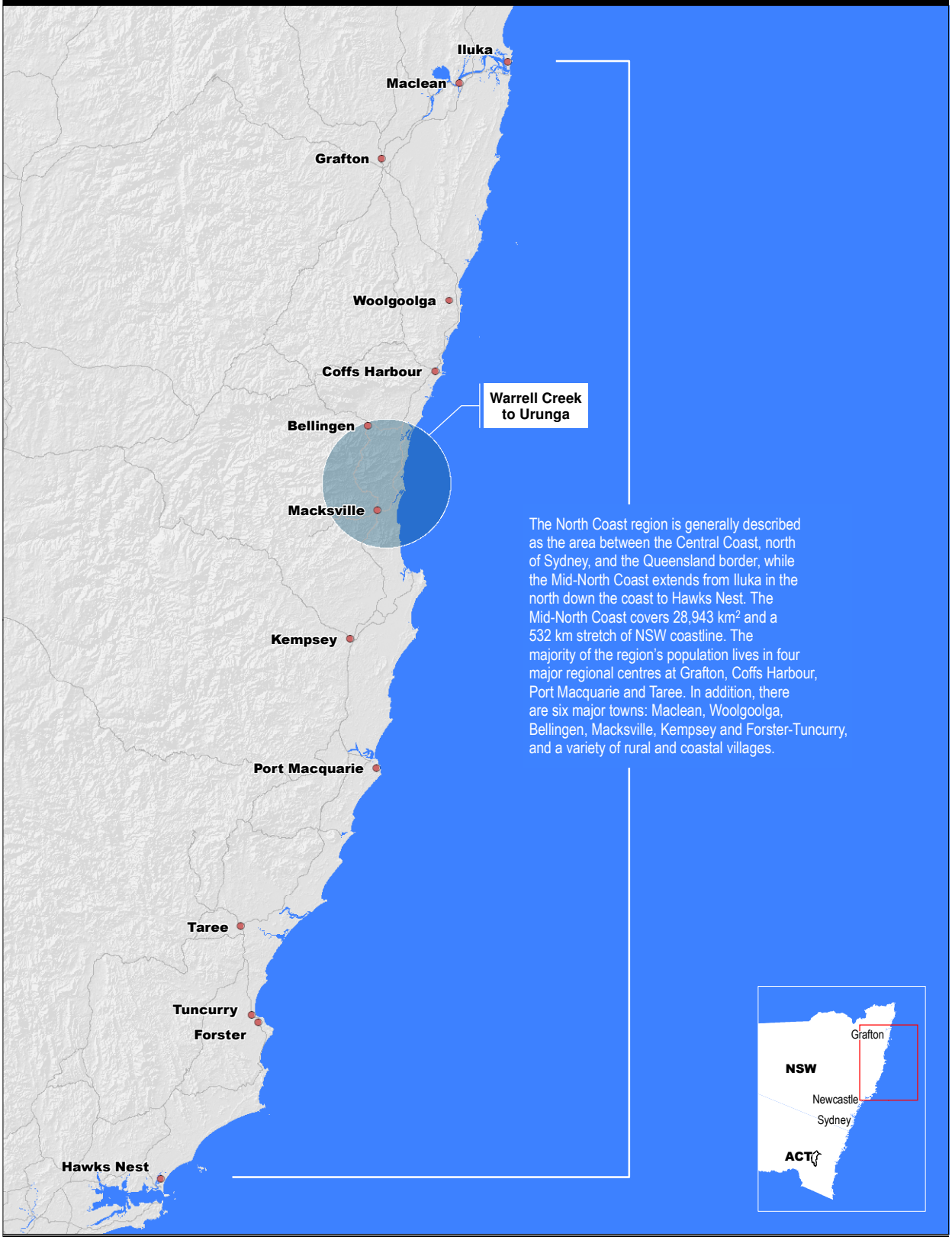
The Pacific Highway is one of the most important strategic corridors within the Australian road network. It acts as a vital link between Sydney and Brisbane as well as providing regional connections along the growing Mid North Coast and North Coast communities of NSW. The highway carries significant traffic volumes especially during the holiday periods.

There is substantial freight movement (with the majority being non-containerised) along the Pacific Highway to the ports located in Brisbane, Sydney and Newcastle. The Pacific Highway carries approximately eight million tonnes of freight annually. Local and intrastate road freight destined for the major cities and major markets is generated through agriculture, manufacturing and other local industries. This freight movement has led to conflicts between local traffic and heavy vehicles in several locations along the Pacific Highway, including Warrell Creek to Urunga.

Mid North Coast

The Mid North Coast region, as shown in Figure 3-1, is expected to experience the most significant gains (through internal migration) of any region in NSW. Population is set to grow from a current population of 333,400 to 424,400 by 2031, an increase of more than 27 per cent over 25 years (Department of Planning 2009a). The average annual growth rate is expected to be one per cent over the next 25 years, which will be among the highest growth rates in NSW (Department of Planning 2009a).

FIGURE 3-1 | MID NORTH COAST REGION



The majority of growth in the Mid North Coast region's population and economy is likely to be focused on coastal towns within the Port Macquarie-Hastings and Coffs Harbour local government areas, including the urban centres of Port Macquarie and Coffs Harbour. By 2031, an additional 58,400 dwellings will be required to satisfy population growth, the changing age structure, declining occupancy ratios and expected tourism demands (Department of Planning 2009a). These dwellings will be predominantly located within the existing urban areas.

The additional population over the next 25 years will generate the requirement for an estimated 47,000 new jobs. Of these new jobs, 75 per cent will be required to meet demands arising from the housing and servicing of the additional population, the remaining 25 per cent will need to be created in new industries or services supplying markets outside of the Mid North Coast (Department of Planning 2009a).

The high growth rates can be attributed to both an influx of retirees from larger urban centres, and to improved prospects due to tourism and retail demands for those seeking employment or to establish businesses. In this regard, the Pacific Highway provides an important transport route for access to employment within the central business district and surrounds, especially for those settled outside Coffs Harbour. Inland areas are not expected to grow at such rapid rates.

The current and forecasted population growth rates, and the growth in tourism within the Sydney–Brisbane corridor and the Mid North Coast region, will place increasing pressure on transport networks on the NSW coast. Improvements to road transport infrastructure are required to meet community expectations for safe and efficient travel, and to accommodate current and projected travel demand.

Levels of social and economic development are linked with population growth and investment. There is a strong connection between land use and transport infrastructure in terms of regional economic development. A high standard road network, linking regional areas and centres of growth, provides more efficient access to markets and sources of goods and services.

3.2 Need for the project

3.2.1 Local government

The Proposal is located within two local government areas, Nambucca Shire in the south and Bellingen Shire in the north, and includes the townships and villages of Warrell Creek, Donnellyville, Macksville, Bellwood, Nambucca Heads, Valla Beach, Urunga and Raleigh.

The population of Nambucca Shire in the 2006 census was 17,897, an increase of one per cent from the 2001 census (Australian Bureau of Statistics (ABS) 2006). More than half of the Shire's population resides in the eastern towns of Nambucca Heads and Macksville. Bellingen Shire has a population of 12,416 according to the 2006 census (ABS 2006). This is a two per cent population increase from the 2001 census. The main towns within the boundary of the Shire are Bellingen, Dorrigo, Urunga and Mylestom.

The Proposal is consistent with the objectives of the local environmental plans of both councils. It would assist in providing a more efficient and safer transport spine within these local government areas. The separation of local and through-traffic and the strategic location of interchanges would assist in providing integrated land use and transport solutions for existing and future urban/commercial areas. The study area is already experiencing

residential demand for commuters to Coffs Harbour. Local government land use and growth pressures are discussed further in Chapter 11 - *Land use and property.*

3.2.2 Road conditions

The condition of the Pacific Highway between Hexham and the Queensland border varies considerably from high-standard, divided carriageways to long sections of narrow two-lane roads. The roads also vary in their pavement condition and road geometry, which affects driver safety and transportation efficiency.

Between Warrell Creek and Urunga, the Pacific Highway is primarily a two-lane single carriageway road with occasional overtaking lanes. Accident histories show unacceptably high levels of traffic incidents in many areas. In particular, areas of concentration include Macksville and along the Pacific Highway in the vicinity of Hungry Head Road between Wenonah Head and South Urunga. The majority of crashes occur at intersections and as a result of the large number of private accesses onto the existing highway. The combination of these factors contributes to unacceptable road conditions on the Pacific Highway between Warrell Creek and Urunga.

The existing highway passes through the town centres of Warrell Creek, Macksville and Bellwood. This creates conflicts between local traffic, pedestrians and highway through-traffic. Local traffic is based around the Pacific Highway and the majority of trips involve travel on the highway. The highway is also the only sealed road providing connections between Warrell Creek, Macksville, Nambucca Heads and Urunga.

The Level of Service (LoS) of a section of road varies from A (good) to F (poor), depending on the number of lanes, traffic volumes and the frequency of intersection and junctions. The LoS on the Pacific Highway in the study area is currently operating at a LoS of E (at capacity). In 2033 the Pacific Highway without the proposed upgrade between Warrell Creek and Urunga would operate at a LoS of F (poor), unless highway upgrades are implemented. The Proposal would operate at a LoS of A (good) in 2013 and beyond to 2033 calculated using the Austroads Guide to Traffic Engineering Practice Part 2: Roadway Capacity (Austroads 1999).

LoS is discussed in more detail in Chapter 17 – *Traffic and transport*.

3.2.3 Traffic and road safety

3.2.3.1 Existing traffic

The RTA publishes historical Annual Average Daily Traffic (AADT) data for various Pacific Highway count stations, which have been used to provide an indication of historical growth in the study area. Traffic has generally increased steadily since 1982. The estimated average growth rate for overall traffic within the study area from 1982 to 2007 is 2.1 per cent per annum (base year 2007).

3.2.3.2 Future traffic

Traffic volumes on the Pacific Highway have grown in recent years due to natural growth in demand for travel, improvements to the Pacific Highway, population growth in the Mid North Coast region and along the eastern seaboard, and the resultant increase in economic activity.

With the overall improved efficiency of the Pacific Highway, some freight transport has shifted from the New England Highway corridor to the Pacific Highway. Although the townships of Warrell Creek, Macksville and Urunga

are expected to contribute little to the projected overall increase in travel demand, the Mid North Coast region in general will generate significant travel demand over the next 20 years. The predicted growth rate for traffic within the study area is 2.2 per cent per year (2007 base year).

3.2.3.3 Road safety

An historical crash analysis was carried out for the area covered by the Proposal. This analysis examined the area's crash history over a five year period from 2003 to 2007, based on crash data from the RTA Traffic Accident Database. A total of 229 accidents were recorded along the Pacific Highway between Warrell Creek and Urunga in this period.

With a crash rate of 25 crashes per 100 million vehicle kilometres travelled, this section of the Pacific Highway has almost twice the Pacific Highway Upgrade target rate of 15 crashes per 100 million vehicle kilometres travelled for the upgraded dual carriageway highway. The improved safety aspects of an M-class motorway would have a beneficial effect on the severity of accidents. Head-on crashes on the upgrade would be largely obviated and because of the required clear zones, the risk of impact with substantial vegetation is significantly reduced.

3.2.3.4 Travel times

There have been substantial improvements to the Pacific Highway in the last 10 years which have resulted in a reduction of travel times between Sydney and Brisbane. However, the Warrell Creek to Urunga section of the highway remains a major bottleneck for road traffic. This particularly applies to heavy vehicles, which must travel at low speed (60 kilometres per hour or lower) through the urban areas of Macksville, Bellwood and Urunga and are subject to an 80km/h limit through the village of Warrell Creek. Due to the limited overtaking opportunities, travel times can be influenced by slow moving vehicles.

Two objectives of the Pacific Highway Upgrade Program are to reduce travel times and freight transport costs. The Warrell Creek to Urunga upgrade would reduce travel time along the highway through the study area by approximately 25 per cent at signposted speed limits – from approximately 32 minutes to 23 minutes. During peak holiday periods, the travel time savings could be much greater. The combined benefits of the reductions in travel times and an efficient high standard dual carriageway highway would result in decreased freight transport costs and more reliability of travel. Duplication of the highway has the potential to significantly improve freight competitiveness for existing vehicles.

3.3 The "do nothing" option

The safety conditions of the section of the Pacific Highway between Warrell Creek and Urunga are discussed in Section 0. Predicted traffic growth would further exacerbate problems currently experienced with the existing road and traffic environment.

Without major upgrading of the Pacific Highway between Warrell Creek and Urunga, the predicted traffic growth would increasingly expose the deficiencies of the existing road environment over the forecast period.

Specific consequences of inaction in relation to the proposed upgrade would include:

- The deterioration of traffic operating conditions to unacceptable levels particularly at holiday times.

- At best, a likely continuation of the unacceptable accident record of this section of the highway, along with the associated social and economic costs. The more likely scenario is an increase in vehicle accidents.
- Increased travel times for both local and through-traffic.
- Increased conflict between local and through-traffic.
- An inconsistency in road standard between the section of highway within the study area and the remainder of the upgraded Pacific Highway.
- Deteriorating road and traffic conditions with consequent adverse environmental effects such as noise, vibration and community disruption.
- Increased limitations for pedestrian access and risk of pedestrian accidents due to traffic growth.
- Exacerbation of community severance as the standard of access to and from the highway deteriorates.
- Failure to achieve the objectives of Australian and State planning and transport strategies, in particular the Pacific Highway Upgrade Program.
- Ongoing limitations on economic development of the area due to deteriorating levels of access for tourists and freight.

3.4 Proposal objectives

Specific objectives for the Proposal have been developed. Table 3-1 details these objectives and how they relate to the overall objectives of the Pacific Highway Upgrade Program.

Table 3-1 Warrell Creek to Urunga Proposal objectives

Pacific Highway Upgrade Program objectives	Warrell Creek to Urunga Proposal objectives
Significantly reduce road accidents and injuries	■ Develop solutions for the ultimate grade separation of the Pacific Highway and local road intersections including consolidation of accesses by the use of service roads. ■ Provide rest areas within the investigation area. ■ Achieve safe driving conditions on the highway for travel speeds of 110 km/h in rural areas and 80 km/h in urban areas.
Improve transport efficiency by reducing travel times and freight costs	■ Have acceptable roadway capacity for traffic volumes 30 years after opening. ■ Develop a dual carriageway road that accommodates all vehicles up to and including B-Doubles.
Develop a route that involves the community and considers their interests	■ Provide acceptable access to properties. ■ Maintain highway access during flood conditions. ■ Integrate input from local communities into the development of the Proposal.
Provide a route that supports economic development	■ Provide connections from the upgraded highway to the key centres of Macksville, Nambucca Heads and Urunga. ■ Develop delay management strategies to minimise disruption to local and through-traffic and maintain access to affected properties and land during construction.
Manage the Program in accordance with ecologically sustainable development principles	■ Provide transport infrastructure that is complementary with surrounding land use.
Provide the best value for money	■ Ensure the Proposal outcomes achieve value for money. ■ Develop solutions that facilitate the staged construction of the Proposal.

3.5 Statement of strategic need

The objectives of the Proposal are consistent with the strategic planning and policy framework, including the goals and targets of key State and Australian government initiatives. The Pacific Highway Upgrade Program is a joint commitment by the NSW and Australian Governments.

The Proposal forms an essential part of the overall upgrade of the Pacific Highway between Hexham and the Queensland border. The projects that make up the Pacific Highway Upgrade Program are intended to achieve the core program objectives of improved road safety and reduced travel times.

The Minister for Planning has declared that segments of the Pacific Highway upgrade, including the Proposal, are a project to which Part 3A of the EP&A Act applies (the declared project). The Proposal has been declared as a critical infrastructure project under Section 75C of the EP&A Act.

Implementation of the Proposal would provide a higher standard road to better serve existing and future road users, with improvements in road safety and travel efficiency. The Proposal would also add to the safety and travel efficiency benefits provided by other Pacific Highway upgrade projects. It would also generate employment, with benefits to the local and regional economy.

Further justification for the Proposal is provided in Chapter 20 – *Justification and conclusion*. This includes consideration of the objects of the EP&A Act, including the principles of Ecologically Sustainable Development, and cumulative and synergistic impacts.

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4. Alternatives considered and route development

This chapter describes the alternatives that were considered during the development of the Proposal and the selection of the preferred route.

Director-General's requirements	Where addressed in the EA	
Project Justification – describe the need for and objectives of the project; alternatives considered (including the assessment of the environmental costs and benefits of the project relative to alternatives), and provide justification for the preferred project (including interchange locations) taking into consideration the objects of the *Environmental Planning and Assessment Act 1979*.	Section 3.2	Need for the Project
	Section 3.3	The "do nothing" option
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	Section 20.3	Relationship between the proposed upgrade and the Objectives of the EP&A Act
	Section 20.4	Conclusion

4.1 Route planning and development process

Planning for the Proposal, as part of the Pacific Highway upgrade, began in June 2003.

Figure 4-1 and Figure 4-2 provide a chronology of the process used for route development for this Proposal. One of the key objectives of the Pacific Highway Upgrade Program is to ".... manage the Program in accordance with ecologically sustainable development principles." A robust route development process provides significant opportunity to address sustainability issues by avoiding significant impacts where practicable. Where it is not practicable to avoid these constraints, the route development process can enable minimisation of impacts through effective route refinement and selection.

An extensive process of constraints identification, route development, consultation and route refinement has been undertaken. The results of this are explained in more detail in the following sections.

The route development process evolved over time and in response to suggestions from the community. It initially started with the intent of developing and assessing route options between Macksville and Urunga. It then looked at community options to the east and west of Macksville that extended further south than the boundary of the initial study area. When the preferred route was identified for the Macksville to Urunga section, it necessitated a review of the Warrell Creek section and resulted in the subsequent inclusion of that section in the overall Proposal.

Public exhibition of the preferred route also generated suggested potential alternative routes from sections of the community. These were reviewed and assessed against the criteria used to identify the preferred route and resulted in the refinement of the preferred route option. Additionally, alternatives or options were developed for the location of interchanges to provide effective access to and from the Proposal.

These iterations of options identification and options assessment are described in the following sections. The resultant preferred Proposal is described in Chapter 6 – *Description of the proposal*.

The various route options which were considered during the development of the Proposal were reviewed and compared against specific measurable criteria to ensure equitable consideration of the functional requirements of the Proposal and the social, environmental and economic goals. These criteria were developed specifically for this Proposal and considered community values obtained through the various consultations with the community described in Chapter 5 – *Community consultation*.

The route development process for the Proposal has been described in the following publicly available documents:

- *Draft Route Options Development Report* (RTA 2004a) – Described the route selection process and feasible route options developed for the Macksville to Urunga section.
- *Draft Assessment of West of Macksville Route Options Report* (RTA 2004b) – Described route options developed in response to a request from sections of the community and the Macksville Chamber of Commerce.
- *Draft Route Options Submissions Report* (RTA 2005a) – Provided a response to written submissions received on the route options for the Macksville to Urunga section.
- *Preferred Route Report* (RTA 2005b) – Described the preferred route for the Macksville to Urunga section and the selection process which determined it.
- *Warrell Creek to Urunga Part 3A Project Application Report* (RTA 2007a) – Prepared for the Director-General of the Department of Planning to accompany the project application.
- *Macksville to Urunga Preferred Route Submissions Report* (RTA 2007b) - Provided a response to written submissions received on the route options for the Macksville to Urunga section, and also provided a detailed response to community suggested options in the Old Coast Road area.

- *Draft Warrell Creek Review Report* (RTA 2007c) - Described the route selection process and feasible route options developed for the Warrell Creek section of the Proposal.
- *Warrell Creek Review Report* (RTA June 2008a) - Described the preferred route for the Warrell Creek section and the selection process which determined it.

4.2 Identification of constraints

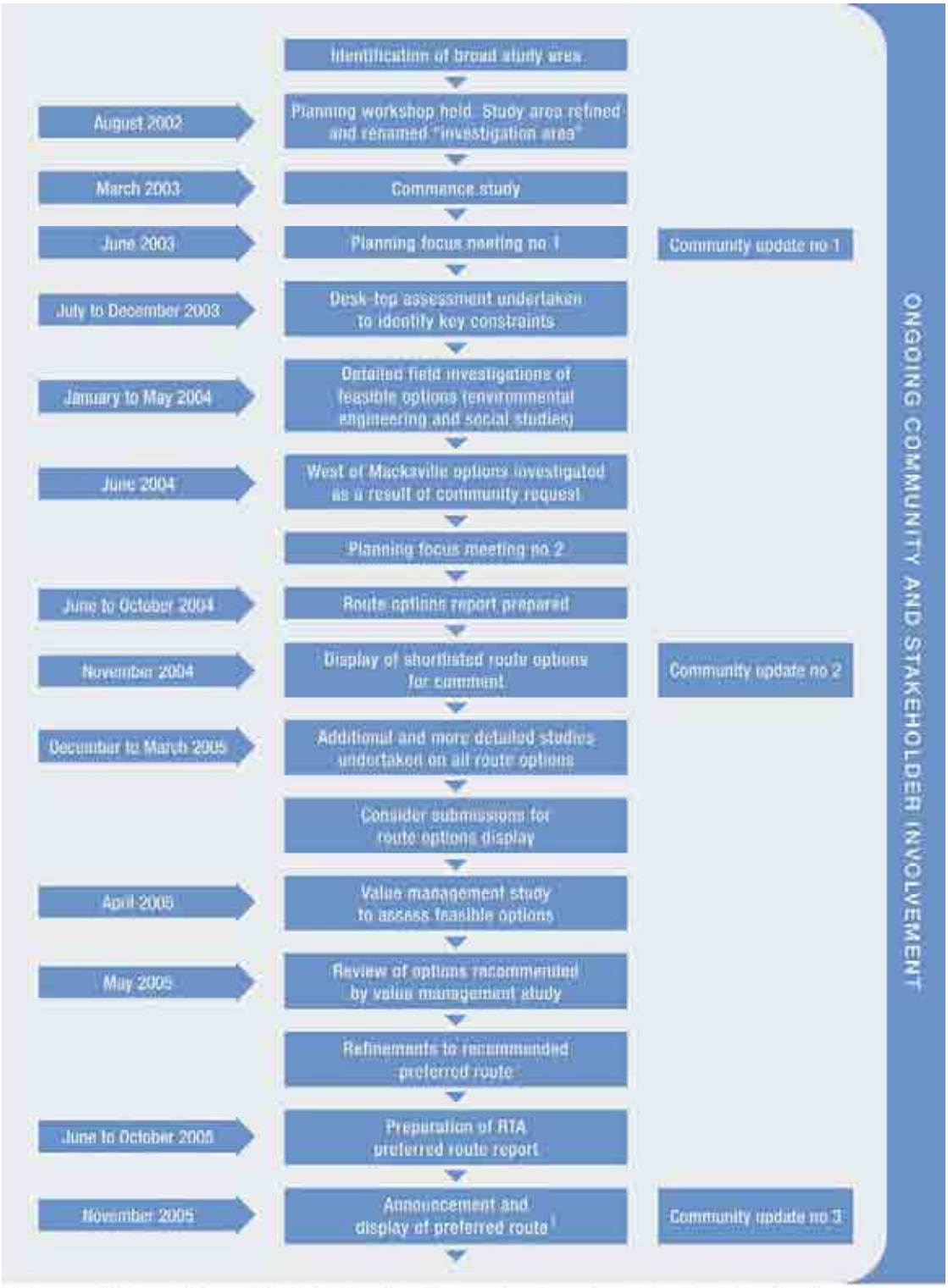
An initial investigations area for the Macksville to Urunga section was defined in June 2003 at a planning focus meeting that included representatives from local government and state government agencies. The shape of the investigation area was influenced by significant environmental, social and topographical constraints. This investigation area was presented to the community in June 2003 to provide community members with an opportunity to comment and identify additional key constraints within the study area. This information was combined with aerial photography and digital constraints mapping information from a range of data sources, including state government agencies and both Nambucca and Bellingen Shire Councils and was supplemented with field investigations throughout the investigation area, both as a verification mechanism and to enhance the desktop assessment. Identified constraints in the investigations area included:

- Existing and proposed urban and rural residential development and industrial and commercial lands.
- Location of watercourses and designated wetland areas.
- Areas of ecological sensitivity, for example endangered ecological communities.
- Items and sites of Aboriginal heritage significance (previously identified items and sites of Aboriginal heritage significance).
- Areas of potential archaeological sensitivity where further investigation is required. Areas of flood prone land.
- Topographical features and geotechnical conditions.
- Environmental protection zones associated with state forests.

Constraints mapping was developed to provide input to the ongoing engineering concept development of possible highway corridors and route options. The Macksville to Urunga study area was divided into four sections to allow for a more detailed assessment of constraints. These sections are further described in Section 4.3.1. The process for the identification of the preferred route for Macksville to Urunga can be seen in Figure 4-1.

The southern end of the Macksville to Urunga route options linked to the previously approved preferred route for the Warrell Creek upgrade. Approval for this section was granted in the 1990s to an earlier standard than that proposed for current upgrades of the Pacific Highway. A review of the route approved in the 1990s identified that the design would need to be modified to meet current design standards for the Pacific Highway and provide an appropriate connection between the existing Allgomera deviation and the Macksville to Urunga upgrade.

Figure 4-1 Identification of preferred route for Warrell to Urunga



1. As a result of one of the east of Macksville options being preferred, a review of the Warrell Creek section was required to ensure a consistent design standard to connect with the Allgomera deviation.

In addition to typical constraints for options development as noted above, further constraints specific to the Warrell Creek area include:

- Potential noise impacts as a result of more stringent criteria and assessment guidelines being adopted by government agencies.
- Impact on properties and severance of agricultural land.
- Presence of endangered ecological communities.
- The existing North Coast Railway line.
- Visual impacts from surrounding residences.

The Warrell Creek section forms part of the Proposal and is described in Section 4.4.1. The process for the identification of the preferred route for the Warrell Creek section can be seen in Figure 4-2.

4.3 Macksville to Urunga

4.3.1 Identification of route options

Initially, broad corridors were developed to avoid or minimise impacts on key constraints within the investigation area. Key constraints in terms of topography and ecology are shown in Figure 4-3 and Figure 4-4 respectively. Constraints information was verified through initial investigations in the field, which also resulted in the identification of additional constraints. These were used in the further development of options. Where practicable, further modifications were then made to minimise potential impacts on communities and sensitive environmental areas.

The investigation area included a large number of dwellings, some of which are clustered, while others are more widely dispersed. Any option to upgrade the Pacific Highway within the investigation area would result in potentially new or increased noise impacts to nearby dwellings and other sensitive receptors such as schools, churches and hospitals. The development of route options was undertaken with this in mind and aimed to avoid large areas of residential development as much as practical, while also achieving the objectives of the Proposal.

The option of upgrading the existing highway through the townships of Macksville, Bellwood, Nambucca Heads and Urunga was investigated. However, it was not considered acceptable due to the potential impacts on the large number of residential and commercial properties within these towns, particularly during construction.

4.3.2 East of Macksville options

Section 1

Section 1 of the investigation area extended from the northern end of the then proposed Warrell Creek realignment to the northern bank of the Nambucca River at Macksville. This was later extended to the northern end of the Allgomera deviation following the decision in November 2005 to review the previously approved preferred route for the adjacent Warrell Creek upgrade (see Section 4.4).

Figure 4-2 Route options development for Warrell Creek and the environmental assessment process

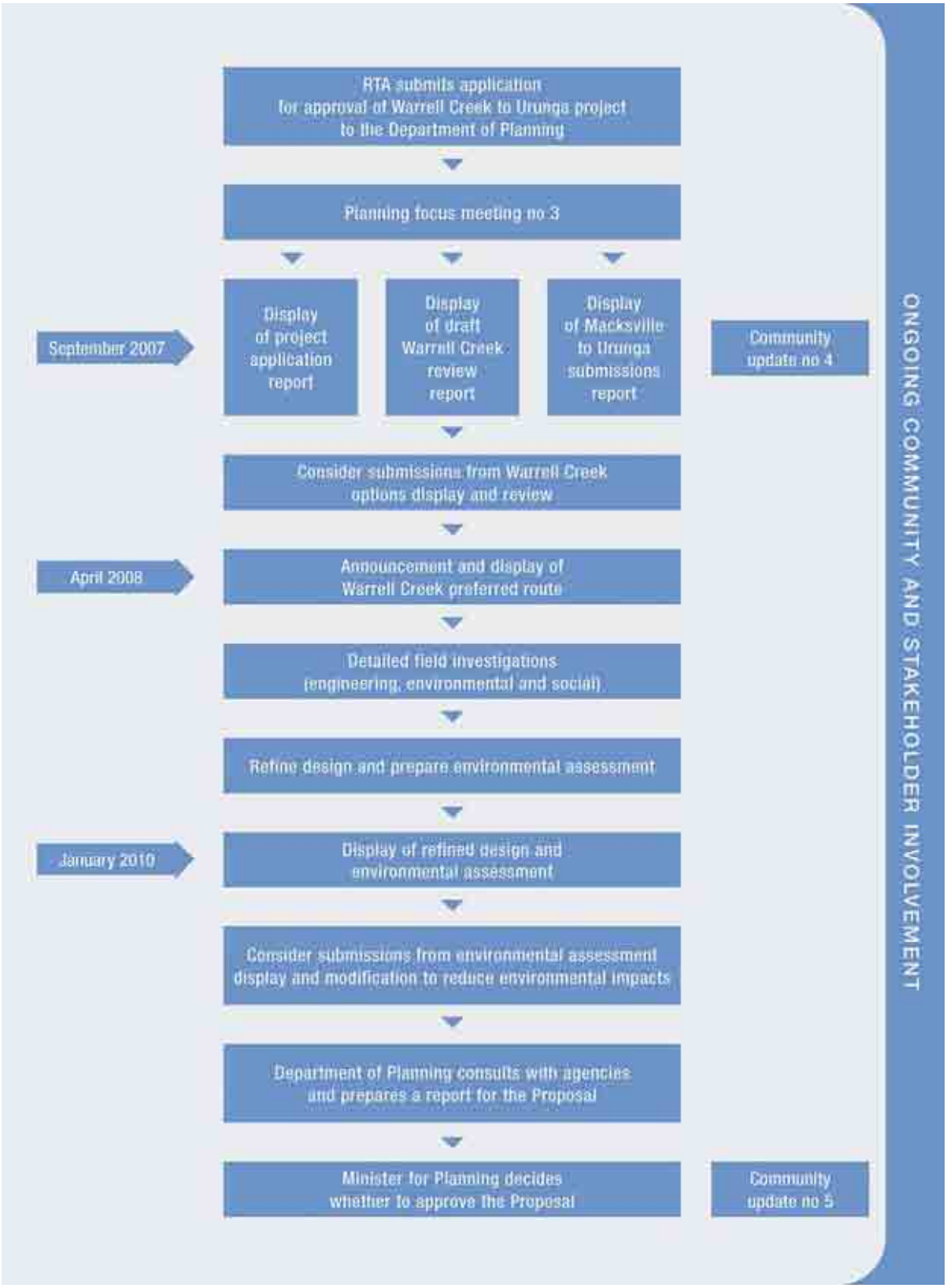


FIGURE 4-3 | TOPOGRAPHICAL CONSTRAINTS AND ROUTE OPTIONS

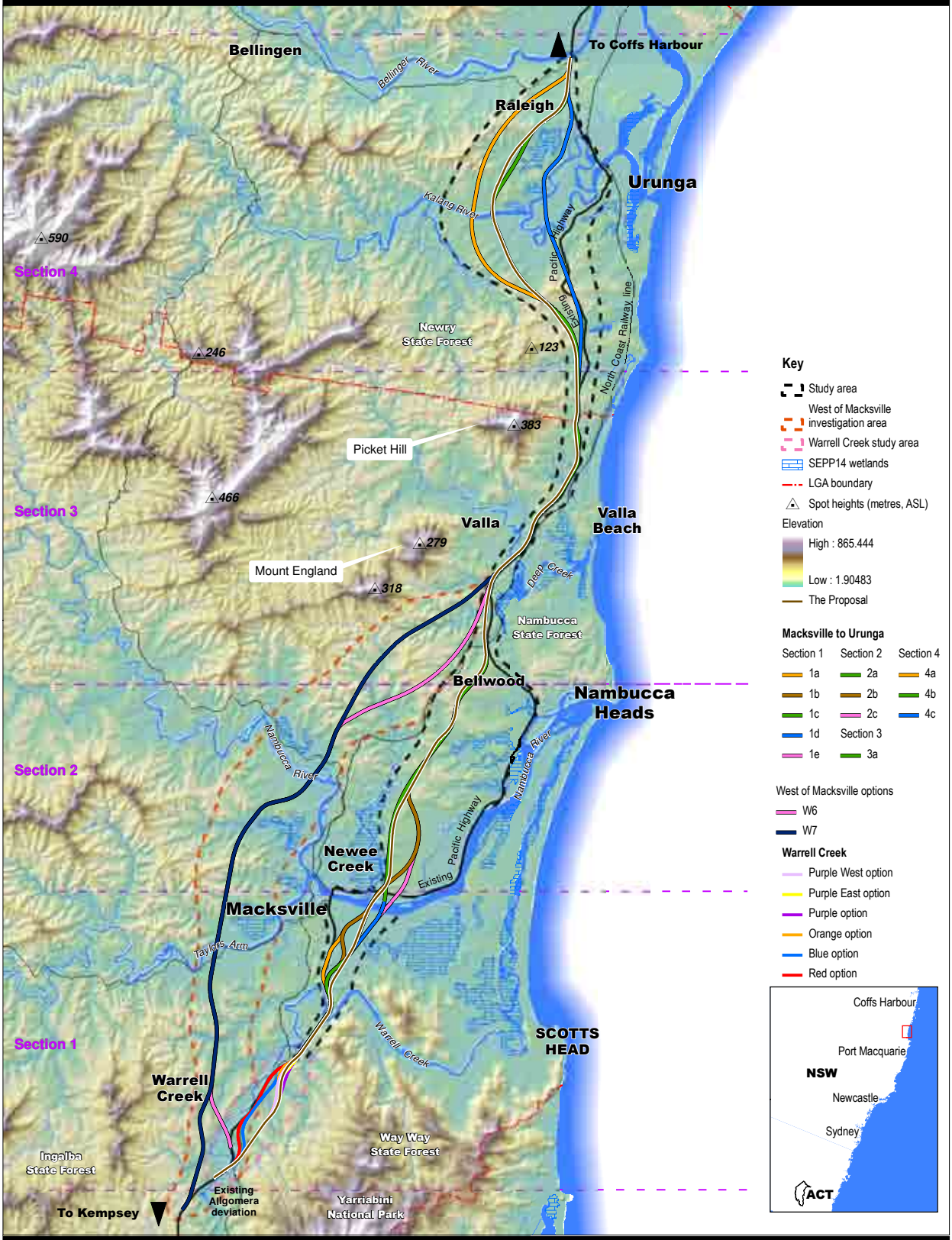
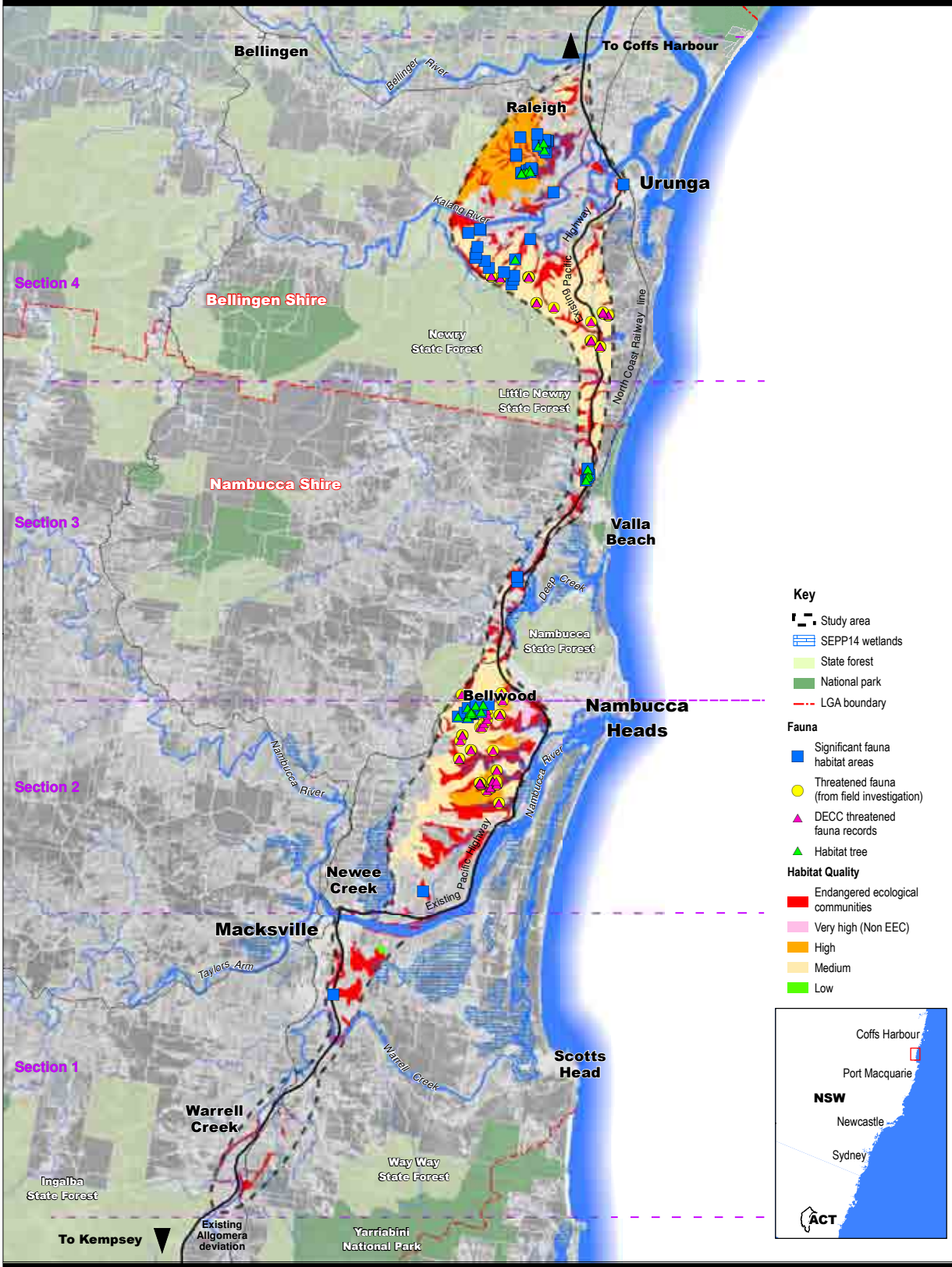


FIGURE 4-4 | ECOLOGICAL CONSTRAINTS



Five options were developed in Section 1 of the study area, all of which were east of Macksville's main commercial and residential areas. The options shared a common alignment at the southern end of the study area from Albert Drive, Donnellyville, to where Bald Hill Road joins the existing Pacific Highway. This common alignment extended for a distance of approximately 2.5 kilometres. All options provided a new dual carriageway bypass of Macksville. The options are described in Error! Not a valid bookmark self-reference. and depicted in Figure 4-3.

Table 4-1 Description of options in Section 1

Option	Brief description
1a	Option 1a maximised the use of the existing Pacific Highway alignment. It was located as close as feasible to the existing highway up to Macksville and avoided impacts on residences along Bald Hill Road and Wedgewood Drive. Option 1a involved the duplication of approximately 4 km of the existing Pacific Highway from Albert Drive, Donnellyville, to just south of Macksville. It then traversed the Nambucca River floodplain to the east of Macksville in a north-easterly direction for approximately 2.4 km, prior to crossing the Nambucca River.
1b	This option commenced at Albert Drive, Donnellyville, and then veered from the existing highway approximately 400 metres south of its intersection with Bald Hill Road. It travelled north-east for a distance of about 1 km, veering north for a length of 1.2 km to avoid wetlands and areas of high habitat quality, and then followed a similar alignment to Option 1a, prior to crossing the Nambucca River.
1c	Option 1c commenced at Albert Drive, Donnellyville, sharing a similar alignment to Option 1b for approximately 3.5 km and then traversed in a north-easterly direction, passing close to SEPP 14 Wetland No. 388 and mostly avoiding the adjacent vegetation. Option 1c passed close to the western side of Macksville sewage treatment plant site. Options 1c, 1b and 1a all crossed the Nambucca River at the same location immediately downstream of the confluence with Newee Creek.
1d	Option 1d commenced at Albert Drive, Donnellyville, and followed the alignment of Option 1c prior to traversing in a north-easterly direction, passing close to SEPP 14 Wetland No. 388 and bisecting the southern portion of the Macksville sewage treatment plant site. The alignment allowed for a crossing of the Nambucca River just to the east of the sewage treatment plant and Option 1a, 1b and 1c.
1e	Option 1e followed the same alignment as Option 1d for most of its length. At its northern end, approximately 100 metres south of the river, it veered further to the east than Option 1d. The alignment would require a skewed bridge crossing of the Nambucca River. This bridge arrangement provided for an option in Section 2 (Option 2c) that was to the east of rural residential development north of the Nambucca River.

Section 2

Section 2 of the investigation area extended from the northern bank of the Nambucca River to where the existing Pacific Highway crosses the main North Coast Railway Line, west of Nambucca Heads. This section of the study area is characterised by scattered rural residential development along the Old Coast Road and rural residential estates (such as Kingsworth Estate located to the north of Watt Creek). The existing highway is located along the southern and eastern boundary of the investigation area in this section and follows the Nambucca River from Macksville to Nambucca Heads. It is primarily single carriageway with limited overtaking opportunities.

Section 2 included the town of Bellwood, which is located on the urban fringe of Nambucca Heads. Bellwood is generally located west of the existing Pacific Highway and incorporates an Aboriginal reserve, shopping centre and low density residential development. There are also commercial and tourist developments along the highway, including motels, service stations and takeaway food premises.

A large portion of Section 2 comprised the Nambucca State Forest. Six gazetted SEPP 14 coastal wetlands exist within or in close proximity to this section of the investigation area, the majority of which are located within the north-eastern portion of the section. All options provided a new dual carriageway bypass of Nambucca Heads. The options developed for Section 2 are described in Table 4-2.

Table 4-2 Description of options in Section 2

Option	Brief description
2a	Option 2a would involve the construction of 9.3 km of new dual carriageway from north of the Nambucca River east of Macksville to where the highway crossed the North Coast Railway Line west of Nambucca Heads. It generally followed a ridgeline in the vicinity of Old Coast Road. Option 2a traversed north from the Nambucca River closely following Old Coast Road in an approximate north-south direction. Option 2a avoided impact on the Newee Creek wetland (SEPP 14 Wetland No 383).
2b	Option 2b would involve the construction of 9.7 km of new dual carriageway from north of the Nambucca River east of Macksville, to where the existing highway crossed the North Coast Railway Line west of Nambucca Heads. Option 2b avoided impact to the Newee Creek wetland (SEPP 14 Wetland No 383). This option crossed Old Coast Road near the existing Pacific Highway then traversed low lying land at the fringe of the floodplain, west of Watts Creek, in a new dual carriageway formation on fill. It joined Option 2a approximately 3.5 km north of the existing Pacific Highway.
2c	The southern portion of Option 2c was further east than Option 2b. While Option 2c avoided impacts on rural residential development in the southern section of the Old Coast Road area north of the river, it increased the impacts on the caravan park on the southern side of the existing highway. Option 2c was located in its southern section to follow property boundaries as much as possible. It joined Option 2b approximately 1.7 km north of the existing Pacific Highway, sharing its finish point with Options 2a and 2b. This option would involve the construction of 9.3 km of new dual carriageway.

Section 3

This section of the investigation area is relatively narrow (less than one kilometre wide) and extended from the existing highway crossing of the North Coast Railway Line, west of Nambucca Heads, to Little Newry State Forest in the vicinity of Mines Road, south of Urunga. This section passes through a series of gently undulating coastal hill slopes separated by a series of creek lines associated with Cedar, Boggy, Cow, Deep and Oyster creeks.

Existing rural residential development occurs on either side of the existing highway and was specifically zoned as such between the existing highway and the North Coast Railway Line, in the vicinity of Cow Creek and around East West Road. Nambucca Shire Council identified future urban land in the vicinity of the Boggy Creek/Cow Creek area.

Option 3a was considered the only feasible route option for this section of the investigation area due to topographical constraints. This option involved the construction of a new dual carriageway highway to the west of the existing highway. The existing highway would be utilised as a local service road, with some realignment and modifications required.

Section 4

Section 4 of the investigation area extended from Mines Road, south of Urunga, to the southern end of the existing dual carriageway at Waterfall Way, Raleigh (Raleigh deviation), a distance of 11 kilometre. The Urunga urban area

is located south of the Kalang River on the eastern side of this section of the investigation area. It comprises low density residential development, with some commercial and industrial uses along the existing highway alignment. Residential development also occurs at the northern end of Newry Island and rural residential development is centred along South Arm Road and Short Cut Road.

The Raleigh industrial area is the only industrial land within this section of the study area. Substantial further development of this area is constrained by the typically moderately steep topography, which falls to low-lying flood prone land. All options provide a new dual carriageway bypass of Urunga. Options within Section 4 are described in Table 4-3.

Table 4-3 Description of options in Section 4

Option	Brief description
4a	Option 4a would involve the construction of 13.5 km of new dual carriageway from Mines Road, south of Urunga, to the southern end of the existing dual carriageway at Raleigh. This route option would involve construction of a new bridge of approximately 170 metres in length over the Kalang River, approximately three km west of Urunga. Option 4a was the most western of options in Section 4, and was furthest from the town of Urunga. It passed through considerable areas of state forest and existing vegetation.
4b	Option 4b would involve the construction of approximately 11.4 km of new dual carriageway from Mines Road, south of Urunga, to the existing Pacific Highway north of Urunga and a one km duplication of the existing highway, before joining the southern end of the existing dual carriageways at Raleigh. Option 4b would involve construction of a new bridge of approximately 155 metres in length over the Kalang River, approximately 2.5 km west of Urunga. Option 4b passed through a section of Newry State Forest and was located in close proximity (within 200 metres) of the existing Raleigh industrial area.
4c	This route option was closest of all options to the town of Urunga. It would involve the construction of approximately 9.3 km of new dual carriageway. It crossed the Kalang River and Newry Island approximately one km west of Urunga. This option would involve new bridges of approximately 160 metres and 195 metres length over southern and northern arms respectively of the Kalang River on either side of Newry Island.

4.3.2.1 West of Macksville options

During the initial public information days in 2003, some sections of the community, including the Macksville Chamber of Commerce, suggested that options outside the identified investigation area, to the west of Macksville, should be investigated. In response to these requests from the community, the RTA undertook a study of the western options.

Three alternative options and two sub-options that provided the required design speed for the Proposal were subsequently developed.

The options commenced south of Warrell Creek - further south than the study area for the Proposal. The west of Macksville options potentially bypassed approximately 2 kilometre of existing dual carriageway that had previously been constructed to the south of the town of Warrell Creek.

Following review of the road safety, transport efficiency and cost implications and potential environmental impacts of the initial options and sub-options, two refined options (option W6 and option W7) were developed for further consideration. These options can be seen in Figure 4-3.

Option W7 was the longer of the options, at 25 kilometre, as it had the most southerly starting point of the two options, starting approximately three kilometres south of Warrell Creek, and potentially bypassed approximately two kilometres of existing dual carriageway. Option W6 was 22.6 kilometres long and had its southern starting point approximately one kilometre south of the Warrell Creek township, at the northern end of the existing dual carriageways. With the exception of the different points of connection to the existing highway, the two options shared a common alignment for most of their length, to approximately Irvines Road at Newee Creek. From that location, Option W7 traversed a more western route and Option W6 a more eastern route, before rejoining the existing highway south of Deep Creek.

Option W6 would require a crossing of Taylors Arm and the Nambucca River and would involve three major bridges. Option W7 would have five major bridges, crossing Warrell Creek (twice), Taylors Arm, Blackbutt Creek and the Nambucca River. Both options would also include bridges and/or culverts across the Nambucca River floodplain where required.

Option W6 and W7 would be required to be constructed as one single project, as there were no available intermediate connections to the existing Pacific Highway. Both options would bypass Warrell Creek village, Macksville and Nambucca Heads.

4.3.3 Options evaluation

Draft selection criteria were developed to assist in the evaluation of options. The selection criteria and the levels of importance attributed to each criterion were reported in the Preferred Route Report (RTA 2005a) and the Warrell Creek Review Report (RTA 2008a). Information was collected against each of the criteria to enable a comparison of options. A value management process was used to provide a structured approach to options assessment and to facilitate greater objectivity in the assessment process.

Detailed analyses of engineering, environmental, social and economic considerations were undertaken for each option. Geotechnical investigations and field investigations for terrestrial ecology, aquatic ecology, Aboriginal and non-Aboriginal heritage, flooding and drainage studies were also carried out.

Information identified through supplementary investigations, as well as data gathered from previous field surveys of the investigation area, enabled a comparison of the western and eastern corridors to be made. The key areas for comparison centred on key design, social, environmental and economic issues.

4.3.3.1 Value management process

A comparative evaluation of the Macksville to Urunga route options was undertaken through a value management study. This included a value management workshop held over three days in April 2005. A total of 43 stakeholders participated in the workshop, including community members, business community representatives, members of the

local Aboriginal community, representatives of state government agencies, and representatives of the NRMA and project team members.

Following the comparative assessment of the options, the workshop participants agreed on the following outcomes from the value management process based on specific functional, environmental, social and economic criteria identified at the outset.

- Options 1a, 1c and 1d initially ranked fairly equally with no option emerging as the best performer overall in Section 1. On the basis of further assessment for Section 1 in light of the preferred option chosen for Section 2, it was unanimously agreed that Option1c/2a was the preferred alignment in the southern part of the investigation area.
- Option 2a was readily adopted as the preferred option in Section 2 as it was considered to be the superior option particularly with regard to "safety and transport efficiency", "impact on threatened species and sensitive environmental areas", "flooding impacts", "impact on rural activities", and "impact on urban businesses".
- When compared against the options for the southern section of the investigation area it was unanimously agreed that the western options should not be considered further due to their low relative performance against the selection criteria, and particularly in terms of 'safety and transport efficiency', the most crucial criteria according to the assigned weightings.
- Section 3 was not considered in the workshop as the only feasible option in this section was an upgrade of the existing highway, Option 3a.
- In Section 4, Option 4b was unanimously endorsed as the preferred option as it had the shortest floodplain crossing, lowest overall grades and least environmental impact.

4.3.4 Selection of the preferred route for the Macksville to Urunga section

Following the value management workshop, the suggestions for improvement were investigated and refinements were made to the recommended preferred route. This included refinement of the alignment where it crossed the Nambucca River, to provide effective connection between the northern end of Option 1c and the southern end of Option 2a. The centreline of the refined alignment was located to provide a minimum 100 metre offset between the alignment and the edge of SEPP 14 wetland No. 383 adjacent to Newee Creek.

Following consideration of project technical investigations, community consultation and the outcomes of the value management workshop, the refined alignment for the Macksville to Urunga sections comprising Options 1c, 2a, 3a and 4b was announced as the preferred route in November 2005. Further refinements to reduce environmental and community impacts have since been made to the alignment based on subsequent detailed survey, community consultation and environmental assessment undertaken during preparation of the concept design. The final alignment (the Proposal) is described further in Chapter 6 – *Description of the Proposal*.

4.3.4.1 Other community options

The project team investigated a number of refinements to the preferred route suggested by members of the community. These included refinements in the vicinity of Bald Hill Road and alternative routes north of the Nambucca River in the vicinity of Old Coast Road.

The investigations into the alternative route options suggested by the community were reported in the Macksville to Urunga - Preferred Route Submissions Report (RTA 2007b). The investigations concluded that although the alternative route options had lower property and residential (including noise) impacts than the preferred route, they also:

- Provided poorer road safety and transport efficiency.
- Had greater impacts on rural activities and flora and fauna.
- Had greater constructability issues and potential flooding impacts due to the longer crossings of the Nambucca River floodplain downstream of Macksville.
- Were more costly and provided less value for money.

The route options, including the community suggested alternative route options, have been assessed at various stages during development of the Proposal. The process for evaluation of the options developed is outlined in the Project Application Report (RTA 2007a). Following detailed assessment and comparison of options it was concluded that the preferred route announced in November 2005 provided the best overall balance between functional, economic, ecological and social considerations.

4.4 Warrell Creek options

4.4.1 Identification of route options

As discussed in Section 4.3.1.2, the west of Macksville options bypassed the village of Warrell Creek, including the previously approved route for the upgrade of the Pacific Highway at Warrell Creek. The preferred route for the Macksville to Urunga section announced in November 2005, did not comprise one of the options to the west of Macksville. Consequently there was a need to review whether the previously approved preferred route at Warrell Creek could provide an appropriate connection between the existing Allgomera deviation and the Macksville to Urunga upgrade, as well as meeting current design and environmental standards. The RTA announced it would review the preferred route for the Warrell Creek section as part of the announcement about the preferred route for the Macksville to Urunga section in November 2005.

The investigations leading to the selection of a preferred route for the Warrell Creek section was approved in the 1990s to an earlier standard than that proposed for current upgrades of the Pacific Highway. The review undertaken in 2005 found that the route approved in the late 1990s and the design for the upgrade would need to be modified. Modifications to the design would be required to meet current design standards for the Pacific Highway and to provide an appropriate connection between the existing Allgomera deviation and the Macksville to Urunga upgrade.

The review also found that the design of the approved route would have significant noise impacts on the village of Warrell Creek and would need to be substantially modified to meet current noise criteria.

As a result of this review, a number of feasible route options for the Warrell Creek section were developed. Comments received from government agencies, Nambucca Shire Council and the community were considered during the identification of route options.

The review of the Warrell Creek section involved the following steps:

- Review of previously approved preferred route for the Warrell Creek section.
- Assessment of the adequacy of the previously approved design.
- Stakeholder consultation, including landowner meetings, community information evenings and public meetings to identify community interests, issues and concerns. This included a planning focus meeting with government agencies and Nambucca Shire Council.
- Site visits and preliminary ecological, heritage, traffic, geotechnical and other investigations.
- Development of feasible route options.
- Shortlisting and assessment of route options.
- Preparation and exhibition of the Draft Warrell Creek Review Report (RTA 2007c).
- Review of community input/submissions on the Draft Warrell Creek Review Report (RTA 2007c).
- Review of data used in the assessment of route options along with incorporation of new and more detailed data.
- Refinement and assessment of route options to address community issues.
- Preparation and exhibition of the Warrell Creek Review Report (RTA 2008a) which identified the preferred route for the Warrell Creek section for incorporation into the Warrell Creek to Urunga proposal.

Desktop studies and field investigations were undertaken to identify environmental, social and functional constraints to building a highway through the Warrell Creek study area. Comments received from government agencies, Nambucca Shire Council and the community were considered during the identification of route options. Of the eight route options developed, a shortlist of four of the most feasible was taken forward for community comment (see Figure 4-3).

Red option

The red option was developed by amending the previously approved preferred route to comply with current road design standards. It largely followed the route of the existing highway and the North Coast Railway Line. This option would require relocating 700 metres of the railway 100 metres to the east of its current location.

The red option commenced 500 metres south of the Upper Warrell Creek bridge at the northern end of the Allgomera deviation. It would require the construction of a bridge 400 metres upstream of the existing bridge across

Upper Warrell Creek. The Red option would then run along the western edge of Way Way State Forest before veering north-west to continue adjacent to the North Coast Railway Line on its western side, towards the village of Warrell Creek.

The route would pass 200 metres to the east of Cockburn's Sawmill and would require the relocation of the rail line as it continued north along the eastern edge of Warrell Creek village. This section of the road would require acquisition of seven residential properties. North of the village, the route followed the existing highway, crossing Stony Creek 50 metres upstream of the existing Stony Creek Bridge. The route then headed north-east to connect to the preferred route for the Macksville to Urunga upgrade.

Blue option

The blue option was designed to create a transport corridor in the Warrell Creek area and was primarily located to the east of the North Coast Railway Line. The route would enable the existing highway to be used as a local access road.

The blue option commenced 500 metres south of the Upper Warrell Creek bridge and ran north-east, crossing Warrell Creek 450 metres upstream of the existing bridge. It then crossed the North Coast Railway Line 450 metres southeast of Upper Warrell Creek Bridge before it veered north-west towards the village of Warrell Creek. The route passed 350 metres to the east of Cockburn's Sawmill and followed the North Coast Railway Line along its eastern boundary, bypassing the Warrell Creek village before it headed north across Rosewood Road and Stony Creek. North of Stony Creek, the route veered north-east to connect to the preferred route for the Macksville to Urunga upgrade.

A local road connection along the eastern side of the highway upgrade was proposed from Donnellyville to the proposed interchange south of Macksville. Access across the highway upgrade was proposed via a western extension of Albert Drive, north of the railway line. New arrangements would be required to provide access to properties east of the route at Warrell Creek village.

Orange option

The orange option started 500 metres south of the existing Upper Warrell Creek Bridge at the northern end of the Allgomera deviation. It headed north-east to cross Warrell Creek 450 metres upstream of the existing bridge. After crossing the North Coast Railway Line the route continued northward along the edge of the Way Way State Forest and passed 450 metres east of Cockburn's Sawmill. North of the mill, the orange option followed the boundaries of the large rural properties located east of the existing highway and west of Rosewood, crossing Rosewood Road 450 metres to the east of the village and connected to the preferred route for the Macksville to Urunga upgrade.

A local road connection along the eastern side of the highway upgrade was proposed from Donnellyville to the proposed interchange south of Macksville. Access across the highway upgrade was proposed via a western extension of Albert Drive, north of the railway line to enable the existing highway to be used as a local access road.

Purple option

The purple option was the most eastern option, traversing agricultural grazing land for the majority of its length and reconnecting with the existing Pacific Highway at Donnellyville. This followed the same alignment as the orange option up to Rosewood Road where the Orange option diverts to the west to connect with the existing Pacific Highway just south of Donnellyville.

4.4.2 Selection of the preferred route for the Warrell Creek section

Comments received from government agencies, Nambucca Shire Council and the community were considered during the identification of route options. Following the development of potential route options, further investigations were undertaken to identify feasible route options. Selection criteria were developed to assess the route options against a range of functional, environmental, social and economic considerations to determine a preferred route for the Warrell Creek section.

The assessment identified a shortlist of the four most feasible routes including the Red, Blue, Orange and Purple options. The four options were placed on public exhibition between 4 September and 30 November 2007. Following the exhibition, the study team obtained more refined data including updated property information, high resolution aerial photography and aerial laser scanning of the study area which allowed further investigation to be undertaken on the route options. Important information was provided by the community on each of the options. In response to concerns raised by residents on the eastern side of the study area regarding the potential indirect impacts (predominantly noise and visual impacts) of the Purple option, the project team investigated a number of options to achieve a greater separation of the route from residences, while still maintaining an improvement in amenity for residents to the west of the railway.

Initially, two refinements, the Purple East and Purple West option were developed and these two options plus the previous four shortlisted options (Red, Blue, Orange and Purple) were re-assessed using the updated and more detailed data. This confirmed the findings that the eastern options out-performed the western options. Of the eastern options investigated, the Purple West option provided the greatest opportunity to increase the separation from residences on the eastern side of the study area, while not adversely affecting people in the Warrell Creek village. In terms of amenity It should be noted that, while on balance the Purple West option performed better than other options, it did result in the acquisition of four more residences than the Purple option. As a result, further design work was carried out to optimise the Purple West route and a modified Purple West was developed which reduced the number of residences to be acquired. This was then assessed against the other six options which resulted in the selection of the modified Purple West as the preferred route. The Warrell Creek Review Report (RTA 2008) was prepared and the preferred route for the Warrell Creek section was announced in June 2008.

4.5 Interchanges

4.5.1 Interchange options

Following identification of the Macksville to Urunga preferred route, preliminary interchange options were developed for south of Macksville, at Nambucca Heads and north of Urunga. The key considerations were to maintain access and connectivity through the study area and to complement major existing and planned urban development and employment land uses.

A workshop was held on 27 February 2006 to obtain input from Nambucca and Bellingen Shire Councils into the most appropriate interchange locations and configurations. This workshop allowed the relative merits, and advantages and disadvantages of each of the proposed locations to be addressed and the options compared. Input received during this workshop was used to further develop the interchange options. During the workshop, various sub-options were considered for the interchanges, generally relating to local roads and connectivity. Further detail on the land use considerations for interchange locations is provided in Chapter 11 – *Land use and property*. As part of the workshop recommendations, specific sub-options were identified as the starting point for concept design development.

In response to concerns from Bellingen Shire Council, the Urunga Chamber of Commerce and the Valla Beach community regarding access to Urunga from the south and Valla Beach from the north, an additional interchange was included in the concept design in 2008 at Ballards Road, just to the south of Urunga.

Following inclusion of the Warrell Creek section a further interchange was proposed south of Warrell Creek to allow access onto the highway from the south.

4.5.1.1 Warrell Creek interchange

The proposed Warrell Creek interchange would be located at the southern end of the upgrade where the proposed alignment leaves the existing highway. It would provide access to the Warrell Creek village from the south. Initial options considered for this location included a grade separated interchange and an at-grade intersection.

Provision for an at-grade T-intersection to connect the Warrell Creek section with the Allgomera deviation was included at the southernmost end of the Proposal in September 2007 as part of the route options display for the Warrell Creek route options. Whilst the inclusion of the intersection matched with the provisions for local road connections south of the project, it did not match with the criteria adopted for this upgrade or with the future planning requirements for full motorway conditions.

The Warrell Creek interchange does not include a northbound on-ramp due to the proximity of the interchange with the bridge over Upper Warrell Creek and the railway line. Consideration was given to inclusion of the ramp on the bridge at Cockburns Lane. However, the expected traffic usage on this ramp did not justify the cost of the option. In reviewing the omission of this ramp in the context of the project as a whole, vehicles travelling north from Warrell Creek village would be able to use the existing highway to the next interchange at Bald Hill Road approximately 5 kilometre to the north.

4.5.1.2 Macksville interchange

Two options were considered for an interchange south of Macksville at:

- Bald Hill Road.
- Scotts Head Road.

Option 1 – Bald Hill Road

This interchange option was located north of Warrell Creek using the proposed Bald Hill Road overbridge as part of the interchange. The key features of this interchange include:

- Located approximately 2.8 kilometre south of Macksville.
- Access to Macksville via Bald Hill Road and the existing Pacific Highway.
- Access to Warrell Creek and Scotts Head via the existing highway and local road network.
- Makes use of proposed Bald Hill Road overbridge as part of interchange.
- Interchange ramps clear of Warrell Creek bridges.

Option 2 – Scotts Head Road

This option was located south of Warrell Creek, at the Scotts Head Road turnoff. Key features included:

- Located approximately 4.1 kilometre south of Macksville.
- Access to Macksville would be via the existing highway and bridge over Warrell Creek.
- Access to Warrell Creek would be via the existing highway.
- Access to Scotts Head would be via the existing Scotts Head Road.
- Interchange ramps would extend onto the proposed Warrell Creek Bridges, requiring wider crossings.

4.5.1.3 Nambucca interchange

Two options were considered for an interchange at Nambucca:

- Old Coast Road.
- Boggy Creek.

Option 1 – Old Coast Road

This interchange option was developed using the proposed Old Coast Road overbridge as part of the interchange. The key features of this interchange included:

- Located approximately 2.5 kilometres west of Nambucca Heads.
- Access to Nambucca Heads via Old Coast Road and Mann Street.

- Access to communities north of Nambucca Heads would be via Old Coast Road, Pioneer Street and the existing Pacific Highway.
- Makes use of proposed Old Coast Road overbridge as part of interchange, with only the need for the inclusion of ramps.
- Interchange is located within the Newry State Forest Area and would require additional acquisition of state forest.

Option 2 – Boggy Creek

This option was located near Boggy Creek, north of the crossing of the main North Coast Railway Line. The key features of this interchange included:

- Located approximately 3.5 kilometres north-west of Nambucca Heads.
- Access to Nambucca Heads via existing Pacific Highway, Pioneer Street and Mann Street.
- Access to communities north of Nambucca Heads would be via the existing Pacific Highway.
- The interchange does not make use of existing infrastructure as part of the connecting roads and would require a new bridge, ramps and a local road connection to the existing Pacific Highway.
- The interchange would provide improved access to Nambucca Shire Council's proposed future urban area.

4.5.1.4 Ballards Road interchange

The need for an access to Urunga from the south to and Valla Beach from the north was identified during consultation with local residents, Bellingen Shire Council, the Urunga Chamber of Commerce, bus companies and local businesses. In response to these concerns an additional interchange was included in the concept design in 2008 at Ballards Road, just to the south of Urunga. This interchange allows better access to and from Urunga, provides access to emergency services and would also service the growing community of Valla Beach. The interchange at Ballards Road would be a conventional diamond interchange and provides access to Urunga from the south and the Valla area from the north. This location was selected as it is approximately where the Proposal leaves the existing highway alignment. The available space and the requirement for the upgrade to pass below Ballards Road meant that this arrangement was the only option considered.

4.5.1.5 Raleigh interchange

Access north of the upgrade is provided by the existing Raleigh interchange, also known as the Waterfall Way interchange at Raleigh. The development of the design required consideration of the local access between Waterfall Way, Raleigh and Urunga as well as review of the existing ramps to ensure compatibility with a design speed of 110km/h.

Two options were considered for providing local access:

- The first option utilised the existing road network through Raleigh to provide access to Urunga. Other than some minor works (signage, linemarking, etc) and decommissioning of a section of the existing highway, little would be required for this option. The option directed all the local traffic back through Raleigh, south of Waterfall Way, and would result in additional traffic through this section of the town. Access to Urunga via this option was slightly longer and less direct than the second option.
- The second option provided a new service road on the eastern side of the upgrade from the Waterfall Way interchange to the existing Pacific Highway. Some modification of the ramps on the eastern side of the highway would be required to facilitate this option. This option was adopted for the concept design.

4.5.2 Selection of preferred interchange options

The selection process led to the development of three new grade separated interchanges at Bald Hill Road south of Macksville, at Boggy Creek north of Nambucca Heads and Ballards Road, south of Urunga and modifications to the existing Waterfall Way interchange to a 110km/hr design standard. Following inclusion of the Warrell Creek section a further interchange was proposed south of Warrell Creek to allow access onto the highway from the south. The location of the five key interchanges is shown in Figure 1-1. Further details of the design concepts for the interchanges are provided in Chapter 6 – *Description of the Proposal*.

The preferred locations for the Macksville, Nambucca and Waterfall Way interchanges include the following:

- The Bald Hill Road interchange north of Warrell Creek (Option 1), as it:
  - Is closer to Macksville than other alternatives considered.
  - Provides improved access to Scotts Head, Warrell Creek and Donnellyville from both the highway and Macksville.
  - Has less impact on adjacent properties.
- Boggy Creek (Option 2), as it
  - Provides improved access to Nambucca Heads, Valla/Valla Beach and adjacent areas and South Urunga.
  - Provides access into the Boggy Creek future urban area north-west of Nambucca Heads.
- New service road at the Waterfall Way interchange (Option 2), as it:
  - Provides more direct access into Urunga and does not divert additional local traffic through Raleigh.

Further design refinement in the southernmost end of the Proposal to connect the Warrell Creek section with the Allgomera deviation was undertaken following the announcement of the Warrell Creek route options. A grade separated interchange was announced concurrently with the preferred route for the Warrell Creek section in June 2008 as it:

- Provides for northbound traffic to leave the Proposal and for southbound traffic to access and leave the Proposal
- Is significantly safer than the T-Intersection originally proposed.

4.6 Alternatives considered

4.6.1 Modal alternatives

Consultation with the Australian Rail Track Corporation (ARTC) confirmed that there was no significant short term investment planned for the upgrade of the North Coast Railway Line. This line is shared by passenger and freight trains and has a number of sections of track that limit its current competitiveness against road freight.

Early feasibility planning has commenced on an inland rail line between Melbourne and Brisbane. However, this is likely to represent a long-term proposal to achieve a greater modal split for rail freight. Therefore, with the expected population increases in the Pacific Highway corridor, there is a need for investment in enhancements to both rail and road transport infrastructure to meet the short term and long term transport tasks.

4.6.2 Route alternatives

The preferred route (the Proposal) is a combination of options comprising purple 1c, 2a, 3a and 4b options. The preferred route was determined following consideration of the options summarised in Table 4-4. The structured sustainability assessment approach and the details of the various options considered are explained in more detail in the following reports, which are available at www.pacifichighwayupgrade.com.au/macksville/:

- Route Options Development Report (RTA 2004a).
- Preferred Route Report (RTA 2005b).
- Draft Warrell Creek Review Report (RTA 2007c).
- Warrell Creek Review Report (RTA 2008a).

The preferred route provided the best overall balance between functional, ecological, social and economic considerations. A comparison of these considerations is provided in Table 4-5 to Table 4-8, which summarises the assessment within the reports listed above.

Table 4-4 Consideration of alternatives for the preferred route

Section of the Proposal	Route option
Warrell Creek and west of Macksville	Purple, green, yellow, red, W6 and W7.
Bald Hill Road to Nambucca River	1a, 1b, 1c, 1d, 1e, W6 and W7.
Nambucca River to Nambucca Heads	2a, 2b, 2c, W6, W7 and community suggested options.
Nambucca Heads to Ballards Road	3a (this was the only feasible option).
Ballards Road to Waterfall Way interchange	4a, 4b, 4c.

Table 4-5 Comparison of Warrell Creek, including west of Macksville route options

Attribute	Route option					
	purple	green	yellow	red	W6	W7
Functional data						
Overall length (km)	5.2	5.2	5.4	5.4	25.7	25
Length of option on lower terrace of floodplain (m)	930	740	475	350	-	-
Length across floodplain (m)	-	-	-	-	5,100	4,500
Length of option adjacent to existing highway	2,250	1,100	1,100	350	-	-
Engineering risk (risk rating out of 10)[1]	2	4	7	8	-	-
Social data						
Number of houses to be acquired	7	2	1	1	16	16
Noise – number of houses between 50 and 60 dB(A) at night (without mitigation)	48	61	26	23	75	73
Noise – number of houses above 60 dB(A) at night (without mitigation)	11	3	0	2	0	0
Noise – number of houses > 5 dB(A) increase	1	5	2	2	-	-
Noise – number of houses > 5 dB(A) decrease	21	30	50	53	-	-
Visual impact (score out of 40)[2]	15	19.5	23	23	-	-
Number of houses severed from largest portion of property	2	0	2	1	-	-
Economic data						
Length through cleared farmland (m)	1,640	3,550	3,350	3,200	-	-
Length through plantation timber (m)	480	200	130	250	-	-
Property severances (ha severed)	9	12	30	39	-	-
Environmental data						
Area of endangered ecological community, high and very high quality habitat impacted (ha)	8.8	10.3	16.1	16.5	84.6	102.1
Number of Aboriginal heritage sites potentially affected	2	2	5	4	5	8
Number of non-Aboriginal sites potentially affected	2	0	0	0	3	4
Cost estimates						
Cost estimate [3]	122	102	91	88	286	296

1 - scale of engineering risk is 1 to 10, where 10 is high.

2 - scale of visual impact is 1 to 40, where 40 represents the highest impact.

3 - preliminary cost estimates for purple, green, yellow, and red options $million 2006 and W6 and W7 options $million 2003.

Table 4-6 Comparison of Bald Hill Road to Nambucca River route options

Attribute	Route option				
	1a	1b	1c	1d	1e
Functional data					
Overall length (km)	6.1	6.1	6.0	6.1	6.3
Length across floodplain (m)	2,400	2,800	2,800	3,000	3,000
Social data					
Number of houses to be acquired	9	6	7	10	9
Noise – number of houses between 50 and 60 dB(A) at night (without mitigation)	238	252	96	79	75
Noise – number of houses above 60 dB(A) at night (without mitigation)	20	19	19	16	19
Environmental data					
Area of endangered ecological community, high and very high quality habitat impacted (ha)	12.3	13.9	14.7	19.6	19.5
Number of Aboriginal heritage sites potentially affected	0	0	0	0	0
Number of non-Aboriginal sites potentially affected	2	2	2	0	0
Cost estimates					
Cost estimate ($million 2003)	124	116	114	117	124

Table 4-7 Comparison of Nambucca River to Nambucca Heads route options

Attribute	Route option			
	2a	2b	2c	Crossing of North Coast Railway to Cow Creek
Functional data				
Overall length (km)	9.3	9.7	9.3	2.4
Length across floodplain (m)	700	2,900	2,800	-
Social data				
Number of houses to be acquired	18	7	14	5
Noise – number of houses between 50 and 60 dB(A) at night (without mitigation)	116	90	75	21
Noise – number of houses above 60 dB(A) at night (without mitigation)	0	7	35	2
Environmental data				
Area of endangered ecological community, high and very high quality habitat impacted (ha)	3.3	10.6	13.4	9.4
Number of Aboriginal heritage sites potentially affected	0	0	0	1

Attribute	Route option			
	2a	2b	2c	Crossing of North Coast Railway to Cow Creek
Number of non-Aboriginal sites potentially affected	0	0	0	0
Cost estimates				
Cost estimate ($million 2003)	87	88	83	-

Table 4-8 Comparison of Ballards Road to Waterfall Way interchange route options

Attribute	Route option		
	4a	4b	4c
Functional data			
Overall length (km)	13.5	12.4	11.3
Length across floodplain (m)	1,300	2,000	3,500
Social data			
Number of houses to be acquired	8	6	5
Noise – number of houses between 50 and 60 dB(A) at night (without mitigation)	77	73	267
Noise – number of houses above 60 dB(A) at night (without mitigation)	1	6	12
Environmental data			
Area of endangered ecological community, high and very high quality habitat impacted (ha)	44.2	36.8	8.7
Number of Aboriginal heritage sites potentially affected	1	1	2
Number of non-Aboriginal sites potentially affected	1	2	2
Cost estimates			
Cost estimate ($million 2003)	166	156	180

4.6.3 Interchange alternatives

Throughout the development of the Proposal, a number of alternatives were considered in respect of interchanges, as discussed in Section 4.5.1.

As part of the concept design process, the interchanges were subject to design development. This design development considered functional requirements of the highway (e.g. inclusion of rest areas), design standards and constructability. Refinements were made to all the interchanges to improve these aspects of the design without significant change to environmental and social impacts.

4.7 Confirmation of the Proposal as the preferred option

The Proposal is consistent with relevant State Government plans, strategies and polices and with the strategic outcomes of the Pacific Highway Upgrade Program. The Proposal addresses safety, traffic and transport issues. It meets requirements for the projected growth in traffic and transport on the highway by providing for a dual carriageway that meets appropriate RTA design standards. When compared to other options and assessed against the Proposal objectives, the Proposal is preferred in relation to social, environmental, design and economic considerations.

The Proposal is the result of extensive analysis of potential options within the study area. This led to the RTA decision on the preferred route. There was extensive community consultation throughout that process and agency, community and stakeholder representatives participated in a number of meetings and workshops that contributed to the decision process.

The Proposal described in detail in Chapter 6 – *Description of the Proposal* performs best in relation to social, environmental and design factors. A justification of the Proposal in consideration of the objects of the *Environmental Planning and Assessment Act* 1979 is provided in Chapter 20 – *Justification and conclusions*.

Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

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5. Community consultation

The RTA has consulted extensively with authorities, interest groups and the general public on this Proposal. This commenced at the time of the identification of the investigation area in 2003 and has continued through the route selection and environmental assessment process. This chapter describes the objectives and extent of the consultation undertaken and how this has influenced the development of the Proposal. Consultation will continue through during the display of the environmental assessment to construction of the Proposal.

Director-General's requirements	Where addressed in the EA	
You should undertake an appropriate and justified level of consultation with relevant parties during the preparation of the EA, including but not limited to: ■ Local, State or Commonwealth government authorities and service providers, including the Department of Environment, Climate Change and Water, the Department of Industry and Investment NSW, Australian Rail Track Corporation, Bellingen Shire Council and Nambucca Shire Council; ■ Specialist Interest Groups including Local Aboriginal Councils, commercial aquatic enterprises such as oyster growers, mineral exploitation licence holders, chambers of commerce; and ■ The public, including affected landowners. The EA must describe the consultation process, document all community consultation undertaken to date and identify the issues raise (including where these have been addressed in the EA)	Section 5.1	Community consultation objectives
	Section 5.2.1	Government agencies and service providers
	Section 1.1.1	Public consultation
	Section 5.2.3	Affected landowners
	Section 5.2.4	Special Interest groups
	Section 5.3	Consultation activities undertaken to date
	Section 5.4	Key issues raised
	Section 5.5	How consultation has influenced the development of the proposal
	Section 5.6	Future consultation

5.1 Community consultation objectives

Community involvement is a key element for project planning and delivery. It enables local knowledge to feed into the identification of constraints and potential opportunities and facilitates development of a project that better integrates into the local setting, while achieving local and regional benefits.

At the commencement of the development of route options, a community stakeholder involvement plan was developed based on the principles of transparency, inclusiveness and responsiveness. These principles were maintained during the various stages of the development of the Proposal and are expected to shape consultation during subsequent stages of the Proposal, should it be approved. The following specific objectives have guided the development and implementation of consultation strategies:

- Provide a planned approach to community and agency communications.
- Create community and agency awareness of the Proposal and the need for the Pacific Highway upgrade.
- Provide the community and agencies with timely and relevant information on the Proposal.
- Provide the community and agencies with opportunities for involvement in the design and assessment of the Proposal.
- Ensure that all relevant issues raised by the community are considered and addressed.
- Minimise the impact of the Proposal on the local community by integrating their needs as much as possible.

The community stakeholder involvement plan was developed to be compliant with RTA community involvement procedures and policies. It is acknowledged, however, that any consultation program undertaken does not always satisfy all participants or resolve all differences of opinion or values.

Community consultation for the development of the Proposal has changed in focus and method through its different stages. The consultation process has evolved coincident with the development of the Proposal from an investigation area to a series of route options, to a preferred option and then to refinements to the concept design. The opportunity for two-way information flow between interested stakeholders and the project team has been ongoing throughout this process and is illustrated in Figure 5-1. For some community stakeholders, their involvement reduces or ceases when they have certainty that they would not be affected by the Proposal, or when their issues and concerns have been satisfactorily resolved. For other community stakeholders, their involvement increases as there is greater certainty that the Proposal is going to affect their interests.

5.1.1 Guidelines for major project community consultation

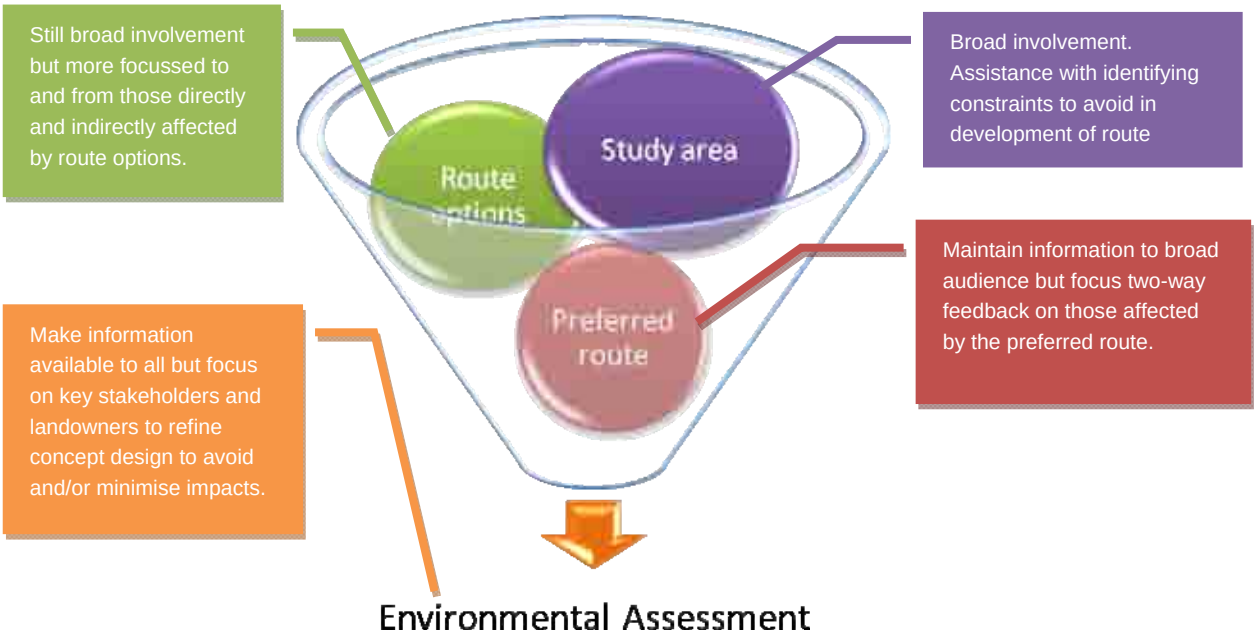
Consultation for the Proposal commenced in June 2003 when the RTA identified the broad investigation area for community comment. While development of the Proposal commenced four years prior to the release of the Guideline for Major Projects Community Consultation, October 2007 (Department of Planning 2007), consultation up to October 2007 has been consistent with the guidelines requirements.

The consultation process as defined in the guideline is addressed in the sections of this environmental assessment as indicated in Table 5-1.

Table 5-1 Consultation process corresponding with consultation guideline

Consultation Process	EA reference
Those individuals and organisations likely to have an interest in the Proposal had enough opportunity to express their views	Section 5.2 and 5.3
Information regarding the nature of the Proposal have been accurately and widely distributed	Section 5.3
Community and stakeholder feedback was encouraged and recorded	Section 5.3 and 5.4. Route options and preferred route submission reports.
Consultation with community and stakeholders was inclusive	Chapter 5

Figure 5-1 Conceptual consultation focus



5.2 Parties consulted

5.2.1 Government agencies and service providers

Consultation with local and NSW state government agencies has been ongoing throughout the development of the Proposal. This includes:

- Officers and elected representatives of Nambucca Shire Council and Bellingen Shire Council.
- Department of Planning.
- Department of Environment and Climate Change (now part of the Department of Environment, Climate Change and Water (DECCW)).
- Department of Primary Industries including the Aquatic Habitat Protection Unit and Agriculture (now part of the Department of Industry and Investment (DII)).
- Forests NSW (now part of the DII).
- Department of Water and Energy (now part of the DECCW).
- NSW Rural Fire Service (now part of the Department of Police and Emergency Services).
- Mid North Coast Police and Coffs/Clarence Police (now part of the Department of Police and Emergency Services).
- NSW Department of State and Regional Development (now part of the DII).
- Australian Rail Track Corporation.
- Commonwealth Department of the Environment, Water, Heritage and the Arts.

As outlined in Chapter 4 – *Alternatives considered and route development*, a planning focus meeting was held at the commencement of the project (June 2003) to provide information about the Macksville to Urunga section of the Proposal to representatives of these agencies and to identify their issues and requirements. A second planning focus meeting was held in November 2004 with representatives of these agencies prior to the display of the route options for the Macksville to Urunga section. Submissions relating to issues and requirements were requested from all agencies following the planning focus meetings and display of the route options. In addition, a number of separate meetings were held with representatives of NSW government agencies to discuss specific issues relating to their areas of interest and responsibility.

In April 2005, a value management workshop for the Macksville to Urunga section was held. Representatives from key government agencies, the community and other stakeholders considered the feasible options and recommended a preferred route. These attendees included representatives from:

- Nambucca Shire Council.
- Bellingen Shire Council.
- Department of Infrastructure, Planning and Natural Resources (now part of the Department of Planning and the DECCW).
- Department of Environment and Conservation (now part of the DECCW).
- State Forests (now Forests NSW, part of the DII).
- NSW Fisheries (now part of the DII).
- Department of Agriculture (now part of the DII).
- NRMA.
- Nambucca Heads Chamber of Commerce.
- Urunga Mylestom Chamber of Commerce.
- Representatives from community liaison groups in Macksville, Nambucca and Urunga.
- Representatives from the Aboriginal community.

At the commencement of the review of the Warrell Creek approved preferred route (February 2006) a planning focus meeting was held with representatives of NSW state government agencies and Nambucca Shire Council to provide information about the review and to identify issues and requirements.

During the course of the Proposal's development, the project team has also attended several meetings with the Nambucca and Bellingen Shire Councils, including meetings with both Councils' officers to discuss specific issues. Council officers also provided representation on the community liaison groups listed in Section 5.2. Meetings have also been held with individual government agencies on specific issues. A summary of issues raised by Government agencies and service providers and where they are addressed in this environmental assessment is included in Table 5-2.

5.2.2 Public consultation

The Proposal is located within the Nambucca and Bellingen local government areas. The communities within these local government areas have been engaged throughout the development of the Proposal (refer to Section 5.3). Consultation has been undertaken with the following:

- Residents in Warrell Creek village, Donnellyville, Nambucca Heads, Valla, Valla Beach, Raleigh, Macksville and Urunga areas.
- Potentially affected groups (residents, property owners, local businesses, schools and churches near the Proposal from Warrell Creek to Urunga).
- Potentially affected landowners and those living nearby the Proposal.
- Aboriginal community through the Aboriginal Focus Group (see Section 5.2.4).
- Community focus groups to provide information and feedback at the route development and preferred route phase.
- Advisory, community, local environmental groups, focus groups for the study area (e.g. members of community liaison groups from previous phases of the Proposal
- Special interest groups set up for further investigation of specific issues including noise and ecology.
- Access groups including one for the whole project and one specifically for Section 3 (Nambucca Heads to Ballards Road) which include local residents, council, bus companies and local businesses.
- Local businesses within the study area.
- Extractive industries in the study area.
- Commercial aquatic enterprises (primarily oyster farmers).
- Utilities and emergency services.
- Wider community (motorists, cyclists, tourists).

5.2.3 Affected landowners

The RTA's approach during each phase of the development of the Proposal was to give priority to contacting potentially directly affected landowners. All properties within the investigation area were initially considered to be potentially directly affected. As such, each property owner was contacted directly by the project team to discuss the implications of the RTA's *Land Acquisition Policy Statement*. This occurred initially when route options were exhibited and was repeated when the preferred routes for the Macksville to Urunga and Warrell Creek sections were announced.

Table 5-2 Summary of consultation with government agency and service providers

Agency / service provider	Issues Raised	EA reference
Department of Planning	■ Negative impacts of bypasses on town business.	Chapter 12
	■ Impacts on noise and water quality.	Chapters 14 & 16
	■ Impacts on threatened species and their habitat.	Chapter 10
	■ Impact on Aboriginal cultural heritage values.	Chapter 15
	■ Avoidance and mitigation of impacts, or compensation for unavoidable impacts upon threatened species and Aboriginal cultural heritage.	Chapters 10 & 15
	■ Impacts on biological, ecological and physical characteristics of estuarine and salt marshes.	Chapter 10
	■ Protection, rehabilitation and ongoing management of estuarine river banks, including mitigation of impacts on waterway stability to control erosion and sedimentation.	Chapters 10 & 18
	■ Flooding impacts on land, infrastructure and assets during and post development.	Chapter 16
	■ Methods used to address acid sulphate soils when found.	Chapter 18
	■ Consultation with others undertaking natural resource management projects in the area.	Chapter 5
Department of Environment and Climate Change (now part of the DECCW)	■ Existing acoustic environment should be assessed and reported with reference to the relevant sections of the DECC Guidelines 'Environmental Criteria for Road Traffic Noise' (ECRTN) and the NSW Industrial Noise Policy.	Chapter 14
	■ Assessment of predicted operational noise impacts of Proposal in accordance with ECRTN and RTA's Environmental Noise Management Manual (ENMM).	Chapter 14
	■ The Proposal will result in significant noise impacts for rural residential areas including those located in the vicinity of Donnellyville, Bald Hill Road, Letitia Close/Mattick Road, Old Coast Road, Florence Wilmont Drive, East West Road, South Arm Road, Short Cut Road and Ridgewood Drive. The environmental assessment should place particular emphasis on these locations with the aim of incorporating operational noise mitigation measures into the design of the highway.	Chapter 14
	■ Location of sensitive receivers (such as schools, residences or hospitals for example) should be clearly identified on any diagrams provided by the Noise Assessment Report (NAR).	Chapter 14

Agency / service provider	Issues Raised	EA reference
	■ Criteria used to develop the proposed mitigation measures to control noise, vibration and blasting impacts caused by construction activities and associated traffic should be included in the NAR. The NAR should provide details of measures proposed to mitigate noise and vibration in relation to construction and blasting activities.	Chapter 14
	■ Assess the requirement for, and feasibility of, implementing operation stage noise mitigation measures prior to commencement of construction to provide a construction stage benefit, particularly for those rural residential areas listed above, and for those residences on Gumma Road, adjacent to the Nambucca River Bridge.	Chapter 14
	■ Impacts of the Proposal on watercourses along the road corridor should be assessed.	Chapter s10 & 16
	■ Ambient water quality conditions and the impact of the Proposal on SEPP 14 wetlands (Numbers 388, 353 and 351) should be assessed with reference to the *National Water Quality Management Strategy* (ANZECC, 2000) and River Flow and Water Quality Objectives.	Chapter 16
	■ Identification of the number and types of bridges and culverts for the Proposal. Should consider whether structures are to be placed in the watercourse and demonstrate how construction and operation stage impacts will be mitigated.	Chapters 6 & 10
	■ Description of any potential changes to flooding and drainage patterns arising from the Proposal.	Chapter 16
	■ Assessment of the presence of acid sulphate soils (ASS) on the site and determine the likelihood of the Proposal's construction processes disturbing ASS and appropriate measure that will be implemented to mitigate these impacts. This assessment should be conducted in accordance with the Acid Sulphate Soils Manual (ASSMAC, 1998).	Chapter 18
	■ Details of stormwater management with particular regard to soil dispersability (including imported fill), operational spill containment measure and approximate locations of temporary sediment basins.	Chapters 6 & 16
	■ Water usage requirements and potential supply sources of the construction stage of the Proposal and wastewater re-use opportunities should be considered.	Chapter 7
	■ Threatened biodiversity field surveys and assessments following steps listed in NSW Threatened Species Survey and Assessment Guidelines: June 2006, should be carried out under seasonal and climatic conditions, specifically within the preferred route corridor.	Chapter 10
	■ Detailed analysis of up-to-date biodiversity study data for the study area.	

Agency / service provider	Issues Raised	EA reference
	■ Describe, quantify and address likely direct and indirect impacts associated with the Proposal to threatened biodiversity, their habitats and native vegetation distribution, including cumulative impacts and a qualitative and quantitative landscape impact assessment.	Chapter 10
	■ Where biodiversity impacts are unable to be demonstrably mitigated or avoided, these should be described and quantified to determine the extent to which compensatory habitat or other offsets will be required. Consideration should be given to applying the DECC Biobanking Credit Calculator.	Chapter 10
	■ Identify whether the Proposal constitute Key Threatening Processes (KTPs) listed under the *Threatened Species Conservation Act* 1995. Where KTPs are identified, relevant threat abatement measures proposed to be implemented are required.	Chapter 10
	■ Describe objectives and assess the feasibility of implementing appropriate flora and fauna mitigation measures during construction and operation, including nature and extent of expected impacts.	Chapter 10
	■ Where appropriate and feasible mitigation measures are identified, environmental assessment should define and commit to measure to ensure impacts to threatened species and biodiversity are managed in accordance with current environmental best practice. Where fauna crossing structures are proposed, the environmental assessment must consider the suitability of such structures by gaining a thorough understanding of pre-development threatened fauna population dynamics including a habitat assessment of the adjacent landscape. Any proposed mitigation measures should be evaluated against a clearly defined and measurable goal.	Chapters 6 & 10
	■ Flora survey work needs to target *Marsdenia longiloba* (Slender Marsdenia), *Amorphospermum whitei* (Rusty Plumb), *Acacia chrysotricha* (Newry Golden Wattle), *Achronychia littoralis* (Scented Acronychia), *Parsonia dorrigoensis* (Milky Silkpod) and any additional threatened flora species known or predicted to occur along the Proposal.	Chapters 6 & 10
	■ Evaluate direct and indirect impacts to EECs (endangered ecological communities) including Swamp Sclerophyll Forest on Coastal Floodplains, Freshwater Wetlands on Coastal Floodplains, River-Flat Eucalypt Forest on Coastal Floodplains, Subtropical Coastal Floodplain Forest, and Swamp Oak Floodplain Forest. These contain indigenous plant and animal assemblages that are generally poorly conserved in the region and are subject to further fragmentation and erosion of genetic stock. Must evaluate and propose mitigation measures for EECs.	Chapter 10

Agency / service provider	Issues Raised	EA reference
	■ Determine direct and indirect impacts and mitigation measures for SEPP 14 wetlands through alteration of hydrological regimes, particularly near Gumma Swamp south of Nambucca River, Newee Creek, Deep Creek complex near Boggy and Cow Creeks, and wetlands west of Urunga and Newry Island. Evaluate impacts of altered hydrological regimes on EECs associated with SEPP 14 wetlands.	Chapter 16
	■ Address how the RTA has met the information, survey and consultation requirements as set out in the draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation.	Chapter 15
	■ Identify nature and extent of impacts on Aboriginal cultural heritage values across Proposal. Identify direct and indirect impacts of the Proposal and document the number, nature and significance of Aboriginal sites to be impacted including consideration of impacts resulting from ancillary activities and infrastructure.	Chapter 15
	■ Aboriginal cultural values should be assessed in consultation with the Aboriginal community and appropriate mitigation measures determined to offset or avoid these impacts for incorporation in concept designs and future environmental management plans.	Chapter 15
	■ Describe actions that will be (or have been) taken to avoid or mitigate impacts on Aboriginal cultural heritage values during construction and operation of the Proposal. Describe activities and actions which will be undertaken and any agreements made with the Aboriginal community and DECC, which will attempt to compensate for unavoidable impacts of the Proposal on Aboriginal cultural values. This should include an assessment of likely effectiveness and reliability of the measures proposed and any residual impacts after these measures are implemented.	Chapter 15
	■ Demonstrate that effective Aboriginal community consultation has been undertaken in determining and assessing impacts, developing options, determining Aboriginal site management and salvage requirements and making final recommendations.	Chapters 5 & 15
Bellingen Shire Council	■ Improved access to the south of Urunga to avoid isolation of the Urunga township.	Chapters 4 & 6
	■ Consider threatened species habitat located north of the Kalang River and south of the Short Cut Road.	Chapter 10
	■ Noise mitigation measures to land adjacent to and either side of Short Cut Road, zoned Rural 1 (c1) Rural Residential.	Chapter 14
	■ Minimisation of environmental and visual impact of highway between Raleigh and Raleigh Industrial estate,	Chapter 13

Agency / service provider	Issues Raised	EA reference
	within 7(s) Special emphasis zone, on surrounding forest.	
	■ Design for dual carriageway at South Arm Road will need to ensure that there is no change to flood effects for this section of road.	Chapter 16
	■ Provision will need to be made to enable convenient pavement rehabilitation of the section of road under the dual carriageway at South Arm Road.	Chapter 6
	■ Extensive sections of the existing highway will be used as local access roads (such as bridge over Kalang River). Consideration of options required as ongoing maintenance will impose significant additional cost burden on Council.	Chapter 6
	■ Assessment of south bound exit at the Raleigh deviation to ensure that traffic does not back up the south bound carriageway.	Chapters 4 & 6
	■ The Proposal should be referred to the Rural Fire Service to assess whether there are any adverse impacts on fire trails.	Chapters 5 & 6
	■ Provision of new Rest Area / Visitor Information Centre at Waterfall Way Interchange to replace existing facility.	Chapters 4 & 6
Nambucca Shire Council	■ Impact on local infrastructure and access to local towns ■ Access to Valla, Boggy Creek and Cow Creek urban release areas.	Chapters 4 & 12
State Emergency Services (now part of the Department of Police and Emergency Services)	■ Access for emergency vehicles on to and off the highway.	Chapters 6 & 12
Department of Primary Industries (Forests NSW) (now part of the DII)	■ Loss of productive land for timber production and impact on local forest agreements.	Chapter 12
	■ Impact on productive native forests, plantation estates, and conservation areas (as Special Management Areas established under s21A Forestry Act).	Chapter 12
	■ Impacts on state forest access, including the effect upon local road and forest roads during and post construction.	Chapter 12
	■ Severance of roads and fire trails, therefore alternate road and fire management needs to be addressed.	Chapter 12
	■ Parts of the areas have a high wildfire frequency and the assessment should consider the impact of the	Chapter 12

Agency / service provider	Issues Raised	EA reference
	proposed upgrade on fire management in bush fire prone areas, particularly in relation to access.	
Department of Primary Industries (Fishing and Aquaculture) (now part of the DII)	■ Potential impacts on SEPP14 wetlands. ■ Impacts on aquacultures. ■ Number of waterways and the ability to construct structures over these waterways. ■ Impact on marine vegetation including mangroves, sea grass and salt marsh. Any impact on marine vegetation will need to be address through compensatory habitat. ■ Proposed width of the alignment including predicted temporary crossings and haulage routes to identify footprint over waterways and their impacts on aquatic vegetation. ■ Potential staging or timing of works (to consider migratory fish movements). ■ Provide description of temporary or permanent sediment retention ponds adjacent to waterways. ■ The environmental assessment should capture the area known as Gumma Flat where low lying tidal flats and wet lands are identified as potential acid sulphate soils conducive to the production of iron sulphides. This may result in acid run off during earth moving works and a poor outcome for water quality. ■ The environmental assessment should include that the impact of acid water is directly linked to red spot disease in fish and high mortality in oysters. Water-flows from the proposed alignment form a direct link to Gumma Creek which confluences with Nambucca River just upstream of commercial oyster growing leases. ■ Detailed risk assessment of all potential impacts to fish habitat during and after works. Include consideration of impacts on the oyster industry, commercial fisheries, and any recreational fishery issues. ■ Description of measures and initiatives to avoid, minimise, manage and mitigate impacts of the project to waterways and fish habitat.	Chapters 4 & 10 Chapters 5 & 2 Chapter 6 Chapter 10 Chapter 6 & 10 Chapter 7 Chapter 6 Chapter 16 Chapter 10 Chapter 9 Chapters 8 & 10
Department of Primary Industries (Minerals) (now part of the DII)	■ Consultation with operators of the Nambucca Valley Quarry and assessment of risks associated with blasting is recommended.	Chapter 5
Department of Primary Industries (Agriculture) (now part of the DII)	■ Property dislocation and machinery access.	Chapters 6 & 12
Department of Primary Industries (North Coast	■ The *Draft Mid North Coast Regional Strategy* should be addressed in the environmental assessment.	Chapter 3

Agency / service provider	Issues Raised	EA reference
Region) (now part of the DII)		
Department of Water and Energy (Water) (now part of the DECCW)	■ If extraction of water from a surface water source or the course of a river is changed, a permit or licence is required under Part 2 of the *Water Act* 1912.	Chapter 2
	■ If the Proposal is in a gazetted Water Sharing Plan (under provisions of the Water Management Act 2000), approval requirements may be satisfied under the Act.	Chapter 2
	■ Address the decommissioning of bores in accordance with Chapter 18 of Minimum Construction Requirements for Water Bores in Australia, Edition 2 Revised September, 2003.	Chapter 16
	■ Details of any proposed works likely to intercept groundwater.	Chapter 16
	■ Details of any proposed groundwater extraction and use.	Chapter 16
	■ Details of proposed method of disposal of any water extracted and approval from the relevant approval authority.	Chapter 16
	■ Details of any existing bores on the development site and in the immediate vicinity.	Chapter 16
	■ Details of the existing groundwater users (including the natural environment) within the area of the proposed development and any potential impacts on these users.	Chapter 16
	■ Management strategy to deal with potential impact on groundwater with the disturbance of acid sulphate soils.	Chapter 16
	■ Details on protective measures for groundwater dependent ecosystems.	Chapter 10
	■ Details to prevent groundwater pollution, so that future remediation is not required.	Chapter 16
	■ Monitoring program for assessment on groundwater.	Chapter 16
	■ Contingency plans linked to the groundwater monitoring program.	Chapter 16
Australian Rail and Track Corporation	■ Alternatives to road transport.	Chapter 3
	■ Construction method for railway crossings.	Chapter 17

Agency / service provider	Issues Raised	EA reference
NSW Heritage Council	■ Assessment of heritage significance of identified sites and any impacts upon heritage sites, including those of Aboriginal, historic or archaeological significance. Also consideration of wider heritage impacts in areas surrounding the Proposal.	Chapters 15 & 19
	■ Lists maintained by the National Trust under the EPBC Act and the local council should be reviewed to determine areas of historical significance which may be affected by Proposal.	Chapter 19
	■ Non-Aboriginal heritage items within the study area affected by the Proposal should be identified by field survey. A statement of significance and an assessment of the impact of the Proposal on the heritage significance of these items should be undertaken. Measures to conserve their heritage significance should be identified.	Chapter 19
	■ The field survey and assessment should be undertaken by a qualified practitioner/consultant with historic sites experience.	Chapters 15 & 19
	■ Where it is likely that the project will impact on Aboriginal heritage, adequate community consultation should take place regarding the assessment of significance, likely impacts and management/mitigation measures.	Chapter 15
Ministry of Transport (now part of the Department of Transport and Infrastructure (DTI))	■ Potential for disruption of existing school bus services during construction.	Chapters 6 & 12
	■ Opportunity for provision of cycle way connections along the highway and to adjoining communities.	Chapter 6
Maritime NSW	■ Identified the necessary vertical and horizontal clearances required on the Nambucca and Bellingen River bridges to ensure adequate clearances for river vessels.	Chapter 12
Coffs Harbour Local Aboriginal Land Council	■ Management of Aboriginal artefacts.	Chapter 15
Nambucca Heads Local Aboriginal Land Council	■ Methodology for investigation of Cow Creek Aboriginal Reserve.	Chapter 15

Information on the route options and the potential impacts of the Proposal was also provided to potentially indirectly affected property owners. These were defined as those being within 400 metres of the centreline of the route options.

Letters were sent to potentially directly affected and indirectly affected property owners prior to the display of the route options. The letter to potentially directly affected property owners also contained a copy of the RTA's *Land Acquisition Policy Statement*. Property ownership information was obtained from existing data sets provided by Nambucca and Bellingen Shire Councils.

Where it was possible to do so, potentially directly affected property owners were contacted by telephone with an offer to arrange an appointment with project team members to discuss the implications of the route options for individual properties. The project team has met with most directly affected property owners along the preferred route to discuss the implications of the Proposal. The project team has also received input from affected property owners that has resulted in modifications to the design that have minimised land acquisition and also impacts on the operation and amenity of some properties. Briefings on property impacts were also provided to both Councils.

5.2.4 Special interest groups

Local Aboriginal Land Councils and registered stakeholders

The investigation area lies with the Coffs Harbour and District, Bowraville, Nambucca and Unkya Local Aboriginal Land Council areas and within an area of interest to the Gumbular Juliri and Gumbaynggirr Elder groups. Contact with these parties was initiated during the route options stage in 2003.

Subsequent to commencing consultation with the Aboriginal community, two key guidelines have guided the project team in the development of the Aboriginal and cultural heritage investigations and the associated consultation. These guidelines are the Interim Community Consultation Requirements for Applicants (DECC 2005) and the Procedure for Aboriginal Cultural Heritage Consultation and Investigations (RTA 2008b).

Following initial consultations with the local Aboriginal land councils, it was determined by the project team that the establishment of a dedicated Aboriginal focus group would be the most effective ongoing mechanism to liaise with the various key stakeholders in the study area. As a result, an Aboriginal focus group was formed in accordance with the then draft Procedure for Aboriginal Cultural Heritage Consultation and Investigations (RTA 2008b). The Aboriginal focus group included stakeholders who registered an interest in the Proposal and was generally comprised of representatives of the Coffs Harbour and District, Bowraville, Nambucca and Unkya local Aboriginal land councils. Members of the focus group participated in a sample field survey of the various route options during the development of the Proposal and provided information regarding the location and significance of ceremonial, spiritual, historical and other types of sites to facilitate the selection of a preferred route that would minimise impacts on Aboriginal heritage.

Details of consultation with members of the Aboriginal community are in Chapter 15 – *Aboriginal heritage*.

Commercial aquatic enterprises

Commercial fishing and oyster growing are the key aquatic enterprises undertaken in the study area. Potential impacts to oyster lease areas were considered in the route development process. Discussions have been held with representatives of the Oyster Farmers Association of NSW and the Nambucca River Sydney Rock Oyster Growers Association.

Finfish and crabs account for most of the commercial production of the Nambucca River. The whole of Bellinger River, Kalang River and Deep Creek were closed to commercial fishing in May 2002 after these river systems were declared Recreational Fishing Havens (RTA 2004c).

Input has been provided on measures to effectively manage run-off upstream of existing oyster leases and provide the necessary vertical and horizontal clearances required on the bridges to ensure that passage of commercial and recreational fishing vessels is not impeded. These management measures have been included in the concept design.

Extractive industries and mineral exploration licence holders

The Nambucca Valley Quarry is present in the vicinity of the Proposal. Consultation with the owner of Nambucca Valley Quarry led to design refinement of the Proposal to enable effective truck access to and from the quarry. It also resulted in confirmation of quarry planning that verified that the quarry face would be outside the blast risk distance by the time of opening of the upgrade.

The historic Valla Gold Mine was confirmed to be beyond the road boundary of the Proposal and would therefore not be affected. The Proposal passes through an existing mining exploration lease (No. 6702) owned by Norvale Pty Ltd. Consultation with that company confirmed that it is not considering utilising the location of the Proposal for any potential mining or extractive industry operations. The company's area of interest was further west of the Proposal.

Chambers of Commerce

The following Chambers of Commerce operate within the study area:

- Bellingen Chamber of Commerce.
- Macksville and District Chamber of Commerce and Industry.
- Nambucca Heads Chamber of Commerce and Industry.
- Urunga/Mylestom Chamber of Commerce.

As part of the community liaison groups formed during route development, the Chambers of Commerce were instrumental in facilitating communication between the project team and the local community and provided opportunities for detailed discussions of key project issues. A key focus of the groups was efficient access to town centres, and an important outcome of consultation with the Chambers of Commerce was the addition of the Ballards Road interchange (south of Urunga) to provide better access to and from Urunga.

5.3 Consultation activities undertaken to date

5.3.1 During route development

The project team implemented a range of different communication mechanisms to facilitate effective two-way flow of information between the project team, the community, Councils and agencies. Seven community update newsletters were publicly released corresponding to key milestones of the development of the Proposal. The community update newsletters provided an update on the Proposal's development, and provided details on how to obtain further detailed information (project reports) and details about staffed and static displays. Copies of these community updates are included as Appendix G. The key aspects of the consultation program included:

- Formation of a contact database that members of the public were able to register to receive community updates.
- Advertising open information sessions and public displays (both static and staffed).
- Provision of a freecall project information line (1800 800 612) for direct inquiries to the project team.
- Distribution of seven community update newsletters inviting written submissions and completion of survey forms by individuals and interest groups.
- Advertising in local and regional newspapers.
- Distribution of a survey to 85 businesses in Macksville, Nambucca Heads and Urunga during 2003 to collate socio-economic data and consult businesses over potential impacts.
- Formation of, and meetings with, three community liaison groups (Macksville, Nambucca/Bellwood and Urunga) comprising residents in and around the study area and members of the local Chambers of Commerce.
- Meetings and presentations with local interest groups.
- Formation of, and meetings with, the Aboriginal focus group formed with representatives from Coffs Harbour and District, Nambucca Heads, Bowraville, and Unkya local Aboriginal land councils and Aboriginal Elders.
- Value management workshop with diverse agency, Council and community representation.
- Interviews / meetings with relevant stakeholders including property owners and local businesses.
- Public notices and media coverage (print and electronic).
- Establishment of a project website at www.rta.nsw.gov.au/pacific.
- Information evenings and staffed displays which provided the community with an opportunity to discuss and provide input into the development of the Proposal.
- Community meetings.
- Interchange workshop held with Council representatives to assist with the identification of interchanges.

5.3.2 Consultation during environmental assessment preparation

Following the announcement of the preferred route of the Macksville to Urunga section of the Proposal, a review was undertaken of the effectiveness of the community liaison groups in moving forward through the preparation of the environmental assessment. The focus was changed from area based liaison groups to issues based focus groups. These included:

- Ongoing consultation with community stakeholders by telephone, email and on-site meetings.
- Meetings with noise and flora and fauna interest groups in October 2007 and August 2008.
- A meeting with the Bellingen Shire Council Floodplain Management Committee in November 2007.
- Meetings with access groups in the Valla and Valla Beach areas to gauge initial thoughts and concerns, after preliminary local access concepts had been completed in October 2007 and December 2007.
- Meeting with emergency services to seek input into the preliminary concept design.
- Public display of interchange layouts, local access designs and preliminary concept designs, including static and staffed displays and briefings to both Nambucca and Bellingen Shire Councils in June 2008.

The consultation process has provided the project team with important insights into the key issues raised by the local community and agencies. The public displays held at key stages of the project provided an important opportunity to obtain input and feedback from the wider community. The project team has also responded to queries received through the project information telephone line, website and email.

5.4 Key issues raised

Much of the feedback obtained throughout the development of the overall Proposal has been from people potentially directly affected or nearby the various corridors and routes assessed. Many of these issues have been addressed in the development of the route options and the selection of the preferred route, as part of the Warrell Creek Review Report (RTA 2008a) and the Macksville to Urunga Preferred Route Submissions Report (RTA 2007b). The key issues raised through the consultation process during the development of the preferred route between the Macksville and Urunga section of the Proposal, the review of the Warrell Creek section and the sections where they are addressed in the environmental assessment are provided in Table 5-3.

Table 5-3 Issues raised by community and government agency stakeholders and corresponding location within the environmental assessment

Issue raised by stakeholders	EA reference
Property impacts, e.g. area of land required for Proposal and access arrangements	Chapter 11
Biodiversity impacts	Chapter 10
Noise	Chapter 14
Concept design issues	Chapter 6
Transport / safety issues	Chapter 17
Amenity	Chapter s12 & 13

Issue raised by stakeholders	EA reference
Severance of properties	Chapters 11 & 12
Loss of wildlife corridors	Chapter 10
Water quality	Chapter 16
Air quality	Chapter 19
Economic impacts in localities	Chapter 12
Minerals issues	Chapter 11
Aboriginal heritage issues	Chapter 15
Route options development process	Chapter 4

5.5 How consultation has influenced development of the Proposal

Throughout the development of the Proposal, many issues have been raised or options have been put forward by the community, government agencies and Councils. The project team has responded by investigating the issues raised and, where appropriate and possible, by implementing suggested options.

Key influences of the community consultation on the development of the Proposal include:

- Community input was a significant factor in the decision to cease further consideration of options to upgrade the existing highway through Macksville, Nambucca Heads and Urunga.
- Examination of options to the west of Macksville (outside the original investigation area) in response to requests from sections of the community and Macksville Chamber of Commerce.
- Consideration of alternatives to the preferred route to the north of the Nambucca River suggested by community members.
- Information in regard to the potential presence and location of threatened flora and fauna species.
- Identification of flooding behaviour and drainage issues.
- Identification of revised property access arrangements and modifications to local roads between the Nambucca Heads interchange and the Ballards Road interchange, south of Urunga.
- Identification of a number of significant Aboriginal sites.
- An increased understanding of Aboriginal heritage issues in the study area.
- Identification of European heritage items within private property.
- Inclusion of an interchange at Ballards Road, south of Urunga in response to concerns raised by Bellingen Shire Council, the Urunga Chamber of Commerce and local emergency services. This provides improved access into Urunga and Valla Beach.
- Location of the Nambucca Heads interchange to facilitate the growth of Nambucca Shire Council's future urban area at Boggy Creek.
- Inclusion of noise barriers and visual mounds to reduce the noise and visual impacts at some receivers.

5.6 Future consultation

5.6.1 Exhibition of the environmental assessment

This environmental assessment report will be advertised and placed on public exhibition for a period of no less than 30 days or as determined by the Department of Planning. The full environmental assessment report would be available for viewing at the following locations:

- Nambucca Shire Council, 44 Princess Street, Macksville (Mon- Fri 9am – 4pm).
- Bellingen Shire Council, 33-39 Hyde St, Bellingen (Mon- Fri 8:30am – 4:30pm).
- Urunga Post Office, 19 Bonville Street, Urunga (Mon- Fri 10am – 5pm).
- Nambucca Heads, RTA Motor Registry, Shops 11 and 13 Seascape Shopping Centre, Ridge Street (Mon-Fri 9am to 4pm).
- Warrell Creek Community Hall, Albert Drive, Warrell Creek.
- NSW Department of Planning, Information Centre, 23-33 Bridge Street, Sydney (Mon- Fri 9am- 5pm).
- NSW Roads and Traffic Authority, 101 Miller Street, North Sydney (Mon- Fri 8.30am- 5pm).
- RTA Pacific Highway Office, 21 Prince Street, Grafton (Mon- Fri 8.30am- 4.30pm).

Staffed displays and stakeholder meetings will be held during the exhibition of the environmental assessment to enable community representatives to ask questions about the details in the environmental assessment and provide further information for consideration in the assessment process.

The environmental assessment will also be available on the NSW Government Planning website as follows:

- http://www.planning.nsw.gov.au (click on “Development Assessment”, then “On Exhibition”, then “On Exhibition Major Projects Part 3A”).
- Direct link for Part 3A projects on exhibition - http://majorprojects.planning.nsw.gov.au/page/on-exhibition/.

During the exhibition period, the community, government agencies and other interested parties are invited to make written submissions on the Proposal to the Department of Planning. Following exhibition of the environmental assessment, the Director General, Department of Planning will consider the submissions received and provide copies of submissions or a report containing a summary of the issues raised to the RTA. The Director-General, Department of Planning will prepare a report on the project. The Minister for Planning will consider any advice from the Minister for Roads and the Director-General’s report. The Minister for Planning will then decide whether or not to approve the project and the conditions to be attached.

5.6.2 Post environmental assessment community involvement

Following the display of this environmental assessment report, the RTA will consider community and agency submissions. The Proposal will then be assessed by the Department of Planning and considered for approval by the NSW Minister for Planning. If approved by the Minister for Planning, the Chief Executive of the RTA will decide whether to proceed with the Proposal.

Community involvement would continue as part of the construction of the Proposal. A community involvement plan would be developed and implemented at a point nearer to construction.

Further details regarding the communication and consultation procedures that the RTA has committed to are contained in Appendix D - *Draft Statement of Commitments*.

Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

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6. Description of the Proposal

This chapter provides a detailed description of the Proposal, including the main design features. It also describes the key inputs and considerations in the development of the design of the Proposal.

Director-General's requirements	Where addressed in the EA	
A detailed description of the project including: ▪ route alignment and corridor width; ▪ design elements (e.g. requirements for LOS, pedestrian and cyclists , rest areas and service centres etc); ▪ differentiate the limits of the Project with respect to the existing Pacific Highway, including operational/maintenance responsibilities; ▪ potential staging; ▪ ancillary facilities (e.g. compound sites, batching plants etc); and ▪ resourcing (e.g. construction material needs, spoil disposal, natural resource consumption including water).	Section 6.2.4	Requirements for Level of Service
	Section 6.4	Description of the Proposal
	Section 6.4.1	Route alignment
	Section 6.4.2	Corridor width
	Section 6.5	Design elements
	Section 6.5.7	Cyclists and pedestrians
	Section 6.5.10	Rest areas and service centres
	Section 7.2	Potential staging
	Section 7.3	Earthworks and Resources
	Section 7.3.7	Ancillary facilities
	Section 19.4.2	Management measures (waste)

6.1 Background and key Proposal features

The description of the Proposal is based on the concept design. The concept design has been developed in response to design, community and environmental constraints. Urban design and sustainability principles have shaped the development of the route options, selection of the preferred route and the development of the concept design. Where warranted, the design has been refined in response to the outcomes of this environmental assessment to avoid and/or minimise environmental and social impacts.

The general features of the Proposal are:

- A 42 kilometre motorway style (class M) upgrade comprising of four-lane divided carriageways (two lanes each way), with a wide median allowing for the future addition of a third lane in each direction and a 110 kilometre per hour posted speed limit.
- Controlled access to the upgrade from four new grade separated interchanges and an upgrade to the existing Waterfall Way interchange at Raleigh.
- New major highway bridges across the Nambucca River at Macksville, the Kalang River at Urunga and Warrell Creek.
- Retention of the existing highway as a local access road between Warrell Creek and Urunga.

- Floodplain bridges and culverts across sections of the Gumma floodplain at Macksville and the Kalang floodplain at Urunga.
- Noise barriers and low noise pavements at various locations.
- At residence noise treatments to houses in locations where required.
- Permanent spill containment basins at environmentally significant watercourse crossings.
- Combined fauna underpasses/drainage structures at river and creek crossings and key habitat locations.
- A dedicated fauna underpass structure, combined drainage/underpass structures and a wide vegetated median for overhead fauna movement in sections of the Nambucca and Newry State Forests.
- A major rest area for heavy and light vehicles at the Nambucca interchange.
- Ancillary construction facilities, including compound sites, batching plant sites and stockpile sites.

6.2 Influences on the design of the Proposal

The general standard of design for the Proposal is consistent with the Upgrading the Pacific Highway, Upgrading Program beyond 2006: Design Guidelines (RTA 2006) to ensure that there is a consistency of form and quality along the whole Pacific Highway corridor from Hexham to the Queensland border. Other major design influences include environmental opportunities and constraints, requirements for local road and property access connections and diverse issues raised through the community consultation process.

6.2.1 Key design standards

The main design standards adopted for the Proposal were:

- Dual carriageway highway with a 110 kilometres per hour design speed for both the horizontal and vertical alignment unless approved otherwise for specific locations by the RTA.
- Curvilinear horizontal alignment with a desirable minimum curve radius of 1200 metres, and an absolute minimum curve radius of 750 metres.
- Desirable vertical grade of 4.5 per cent, with a maximum of six per cent.
- Desirable minimum median width of 12 metres.
- Lane width of 3.5 metres with minimum width of outside shoulder of 2.5 metres and minimum width of median shoulder of 0.5 metres.
- Controlled access conditions.
- Flood immunity has been provided to the highway for the 1 in 100 year flood event.

6.2.2 Other influences on the design

The concept design has been developed in accordance with the above key design principles, but has also responded to a range of more specific influences, including:

- Input into design criteria by Nambucca and Bellingen Shire Councils, government agencies, special interest groups and the local community through community liaison groups and special interest meetings, landowner meetings and submissions made to the project team on the route options and the preferred route, as detailed in Chapter 5 – *Community consultation*.
- Provision of connections to the local road network to ensure safe and efficient road access for local communities in the study area.
- A hierarchy for potential impacts which would involve in the first instance avoiding a known potential impact where possible through route selection or refinement. If the impact cannot be avoided it would be managed or mitigated to reduce the impacts to acceptable levels.
- Continued access for local landowners or land managers, especially where landholdings are severed by the Proposal.
- Minimisation of disruption to local and through-traffic during construction.
- Avoidance of geotechnical constraints such as the old municipal tip site identified in Nambucca State Forest.
- An immediate reduction of conflict between local and through-traffic at opening.
- Maximum use of the existing highway road reserve and existing road infrastructure where possible.
- Provision for safe movement of fauna across the proposed highway alignment where fauna movement corridors exist.
- Maintenance of fish passage.
- Avoidance or minimisation of the extent of physical impact on state forests, nature reserves and SEPP 14 wetlands.
- Alignment considerations to minimise the extent of physical impact on Commonwealth listed species *Marsdenia longiloba* within areas of state forest.
- Provision of measures to maintain movement corridors for glider communities within areas of state forest.
- Realignment to avoid a potential item of Aboriginal heritage significance in Section 1 and refinement to reduce potential impacts on Aboriginal heritage sites identified during field investigations and through consultation of the Proposal.
- Alignment considerations to mitigate effects on Aboriginal and non-Aboriginal heritage sites and potential areas of significance, visual amenity and property boundaries where possible.
- Avoidance or minimisation of the extent of physical impact on proposed future urban areas and proposed investigation areas.
- Geotechnical, soil, hydrology and water quality considerations.

6.2.3 Urban and landscape design

The following key objectives were developed specifically for the Proposal in accordance with the Pacific Highway Urban Design Framework (RTA 2005c):

- Design the upgraded highway to integrate with immediate context.
- Design for safe, yet convenient, connections to local roads and access to adjacent properties.
- Ensure and enhance visual connections to significant landscape features.
- Integrate the new highway landforms and landscape with adjoining lands where appropriate.
- Provide a positive contribution to landscape.

The landscape plan and urban design features proposed as part of the Proposal are summarised in Section 6.4 of this environmental assessment and are described in detail in Chapter 13 - *Visual amenity and design* and Working paper 2 – *Visual amenity and design*.

6.2.4 Requirements for Level of Service

The Level of Service (LoS) of a section of road varies from A (good) to F (poor), depending on the number of lanes, traffic volumes and the frequency of intersection and junctions. The LoS on the Pacific Highway in the study area is currently operating at a LoS of E (at capacity). In 2033 the Pacific Highway without the proposed upgrade between Warrell Creek and Urunga would operate at a LoS of F (poor), unless highway upgrades are implemented. The Proposal would operate at a LoS of A (good) in 2013 and beyond to 2033 calculated using the Austroads Guide to Traffic Engineering Practice Part 2: Roadway Capacity (Austroads 1999).

LoS is discussed in more detail in Chapter 17 – *Traffic and transport*.

6.3 Flexibility in design and construction

This environmental assessment is based on the current concept design which has been developed through a number of iterations of the initial functional layout. It addresses and responds to all the constraints and principles identified and established as part of the route development and environmental assessment phases of the Proposal. The concept design is intended to illustrate and describe the sustainable outcomes of a design process that has attempted to balance functional, environmental, social and cost considerations.

- The detailed design would require further investigations to be undertaken, particularly detailed survey, geotechnical and ecological investigations to identify habitats or individual plants to be retained and protected during construction. These further investigations may lead to possible refinement of the design prior to construction.
- The proposed concept design and construction methods suggested in this and the following chapter are presented as a functional solution to the Proposal objectives and constraints. They may be refined by the RTA and its construction contractor within the limits of any conditions imposed and the design constraints,

principles and standards presented in this chapter, and as such, sufficient flexibility and allowance has been provided to allow refinement of design to be consistent with the concept design principles and any conditions of approval.

- The Proposal facilitates the retention of some construction water quality basins for the operation on the new highway.

6.4 Description of the Proposal

The concept design of the Proposal, including its horizontal and vertical alignment is shown in Figure 6-1 to Figure 6-4. The overall length of the Proposal is approximately 42 kilometres. The upgrade commences at the northern end of the existing Allgomera deviation of the Pacific Highway, south of Warrell Creek and ends at the existing Waterfall Way interchange to the north. The Proposal has been divided into four geographical sections for assessment purposes which include:

- From the northern end of the existing Allgomera Deviation of the Pacific Highway, south of Warrell Creek, to the northern bank of the Nambucca River, a length of approximately 11 kilometres (Section 1).
- From the northern bank of the Nambucca River to the railway crossing west of Nambucca Heads, a length of approximately 7.5 kilometres (Section 2).
- From the Railway crossing west of Nambucca Heads to Ballards Road, south of Urunga, a length of approximately 11.5 kilometres (Section 3).
- From Ballards Road to the existing Waterfall Way interchange, a length of approximately 12 kilometres (Section 4).

Descriptions of these four sections and accompanying figures are provided in Section 6.4.1.

6.4.1 Route alignment

6.4.1.1 Section 1 - Allgomera deviation to Nambucca River

The southernmost section of the Proposal, extending from the northern end of the Allgomera deviation to the northern bank of the Nambucca River, is approximately 11 kilometres long. The proposed Warrell Creek interchange represents the southern limit of the Proposal. Its layout and operations are described in Section 6.4.2. This section of the Proposal would be controlled access (motorway standard upgrade), with no access from the local road network, other than via the interchanges provided. It would be a dual carriageway highway and would deviate from the existing highway just north of the northern end of the Allgomera deviation. It would involve bridging across Upper Warrell Creek and the North Coast Railway Line prior to traversing vegetated land to the east of Cockburn's sawmill.

The Proposal would then traverse in a north-easterly direction, avoiding flood prone land and passing as close as practicable to property boundaries to minimise property severance. The Proposal would then veer north, crossing under Rosewood Road and deviating north-east to run parallel with the existing highway. In this area, it would also

pass under Albert Drive. At this point, the Proposal would be located adjacent to and east of the existing highway, with the existing highway alignment being retained as the local access road.

The Proposal would run parallel to the existing highway between Albert Drive and Warrell Creek and then veer north just south of Bald Hill Road, south of Macksville. After crossing under Bald Hill Road, the Proposal would extend north-east through predominantly cleared agricultural floodplain land. It would pass close to SEPP14 wetland No.388 and has been designed to generally avoid adjacent vegetation. The Proposal would cross over River Street on the western side of the Macksville sewage treatment plant and bridge over the Nambucca River immediately downstream of the confluence with Newee Creek. Between the southern end of the Proposal and the Nambucca River, the existing highway would be retained as a two-way local access road on the western side of the new highway.

Key features of the design in the Allgomera deviation to Nambucca River section can be seen in Figure 6-1 and include:

- A grade-separated interchange at the southern end (in the vicinity of Browns Crossing Road) to provide safe entry and exit to and from the Proposal for local traffic accessing the Warrell Creek village and Donnellyville.
- New twin bridges over Upper Warrell Creek and the North Coast Railway Line.
- A bridge would be provided at Cockburns Lane to maintain access between the existing Pacific Highway and properties to the east of the Proposal.
- Realignment of Albert Drive to provide a new bridge across the Proposal and a new intersection onto the existing highway.
- Closure of the northern intersection of Albert Drive and the existing highway to rationalise crossings of the Proposal.
- An underpass connecting the existing Nambucca Valley Quarry on the eastern side of the highway to Scotts Head Road on the western side of the highway to avoid the need for quarry vehicles and other vehicles travelling through Donnellyville to head south.
- New twin bridges to the east of the existing bridge crossing of Warrell Creek.
- A grade-separated interchange at Bald Hill Road. The interchange has been designed to cater for the predicted traffic volumes associated with existing and future development in Macksville, Warrell Creek, Donnellyville and Scotts Head. It provides access on and off the upgrade and also enables local traffic to pass over the upgrade.
- A series of floodplain bridge or culvert structures, integrated with fill embankments, across the Gumma floodplain.
- Fauna underpasses combined with drainage structures across the floodplain and provision of dry fauna passage beneath structures at Warrell Creek and the Nambucca River.
- New, high level twin bridges crossing the Nambucca River approximately 11 metres above water level.

FIGURE 6 - 1 : Sheet 1 | THE PROPOSAL **ALLGOMERA DEVIATION TO NAMBUCCA RIVER**

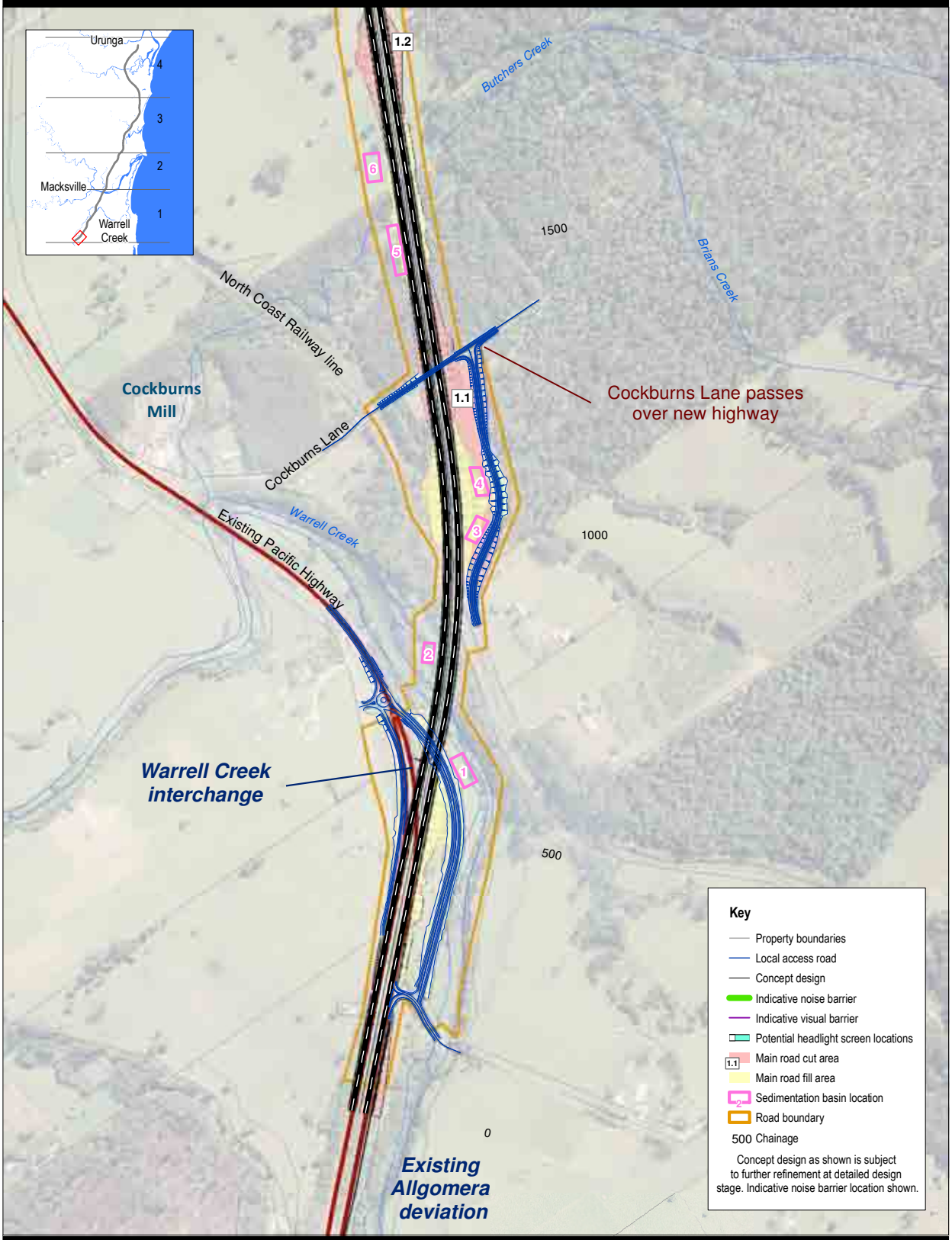


FIGURE 6 - 1 : Sheet 2 | THE PROPOSAL **ALLGOMERA DEVIATION TO NAMBUCCA RIVER**

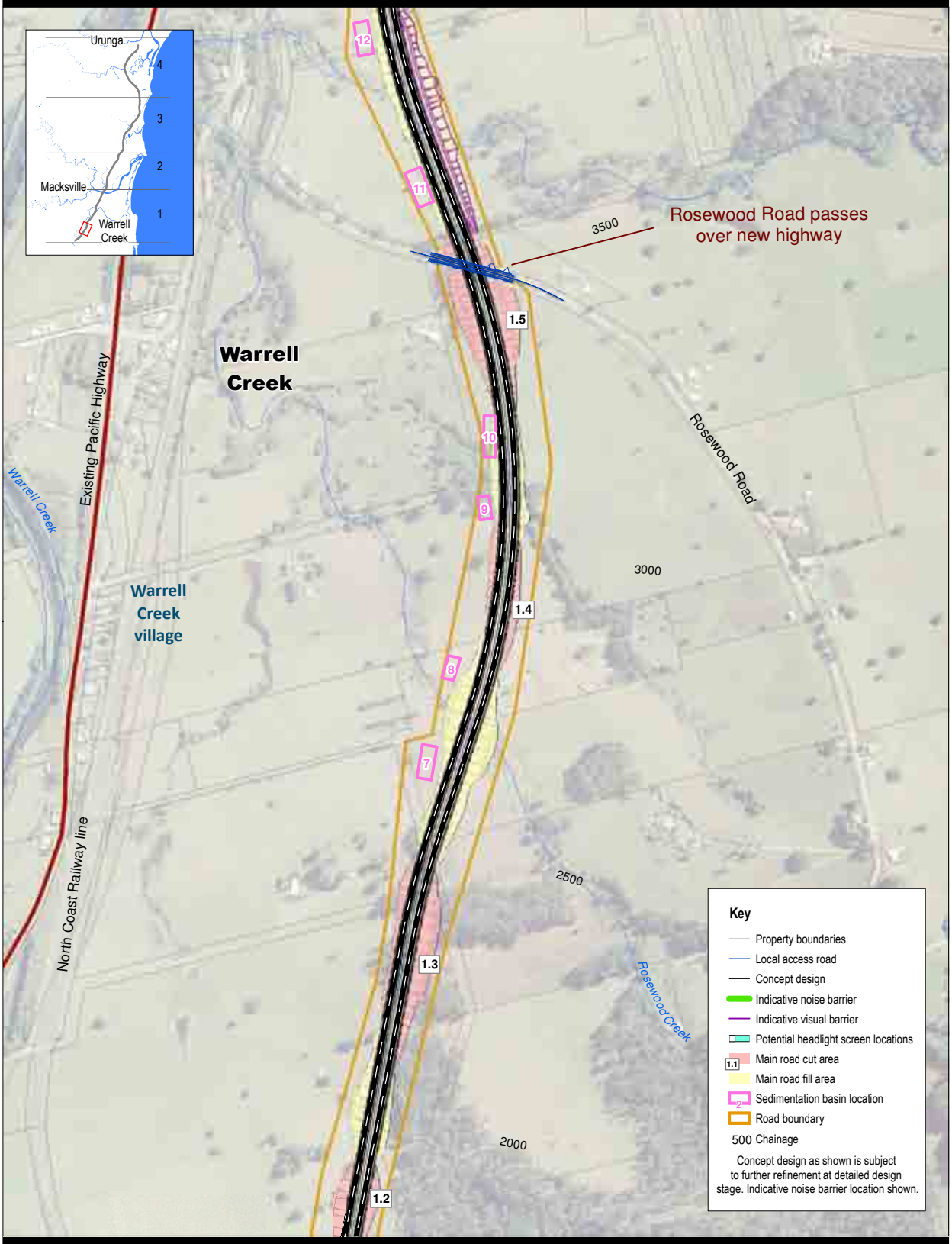


FIGURE 6 - 1 : Sheet 3 | THE PROPOSAL **ALLGOMERA DEVIATION TO NAMBUCCA RIVER**

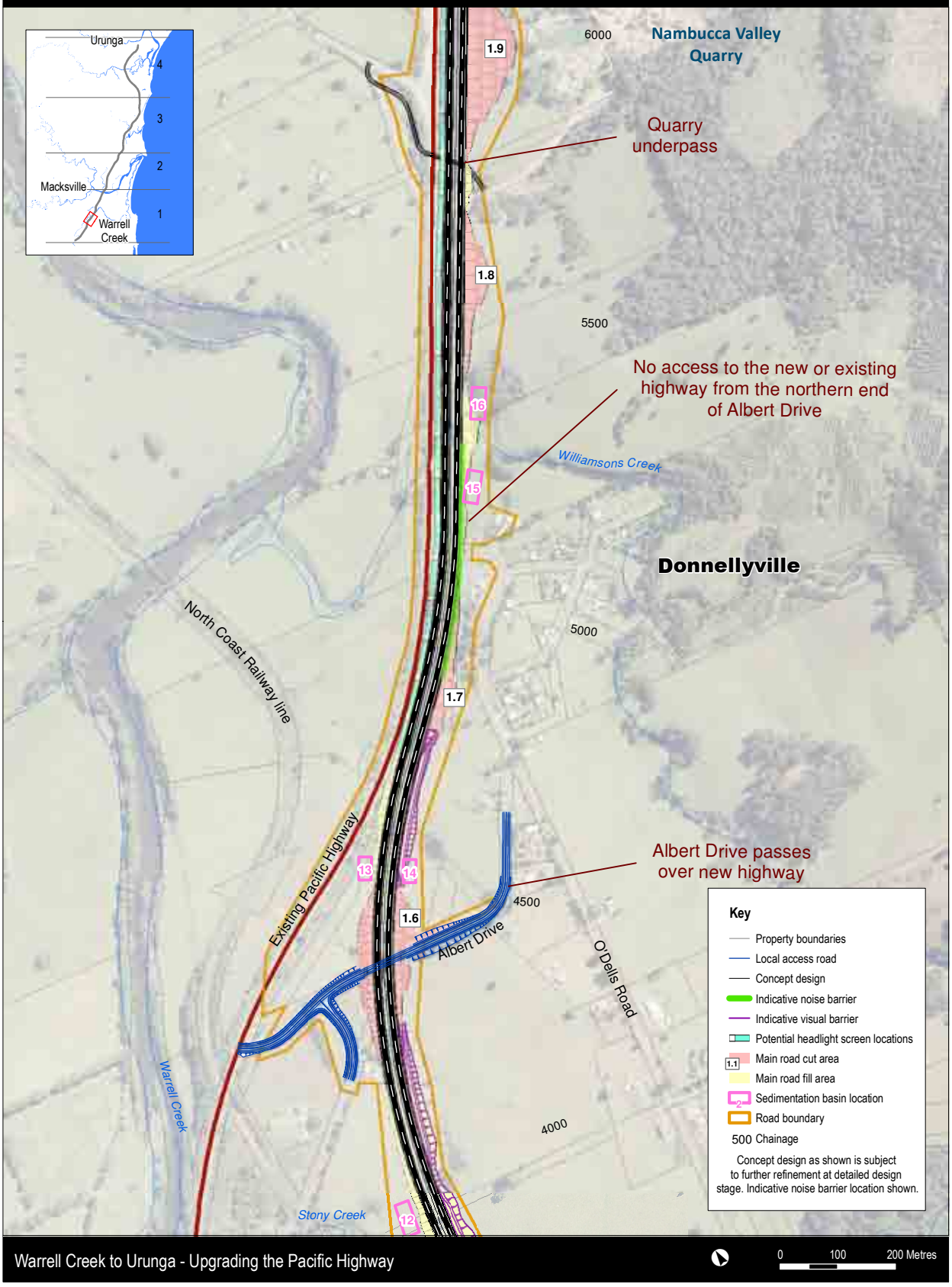


FIGURE 6 - 1 : Sheet 4 | THE PROPOSAL **ALLGOMERA DEVIATION TO NAMBUCCA RIVER**

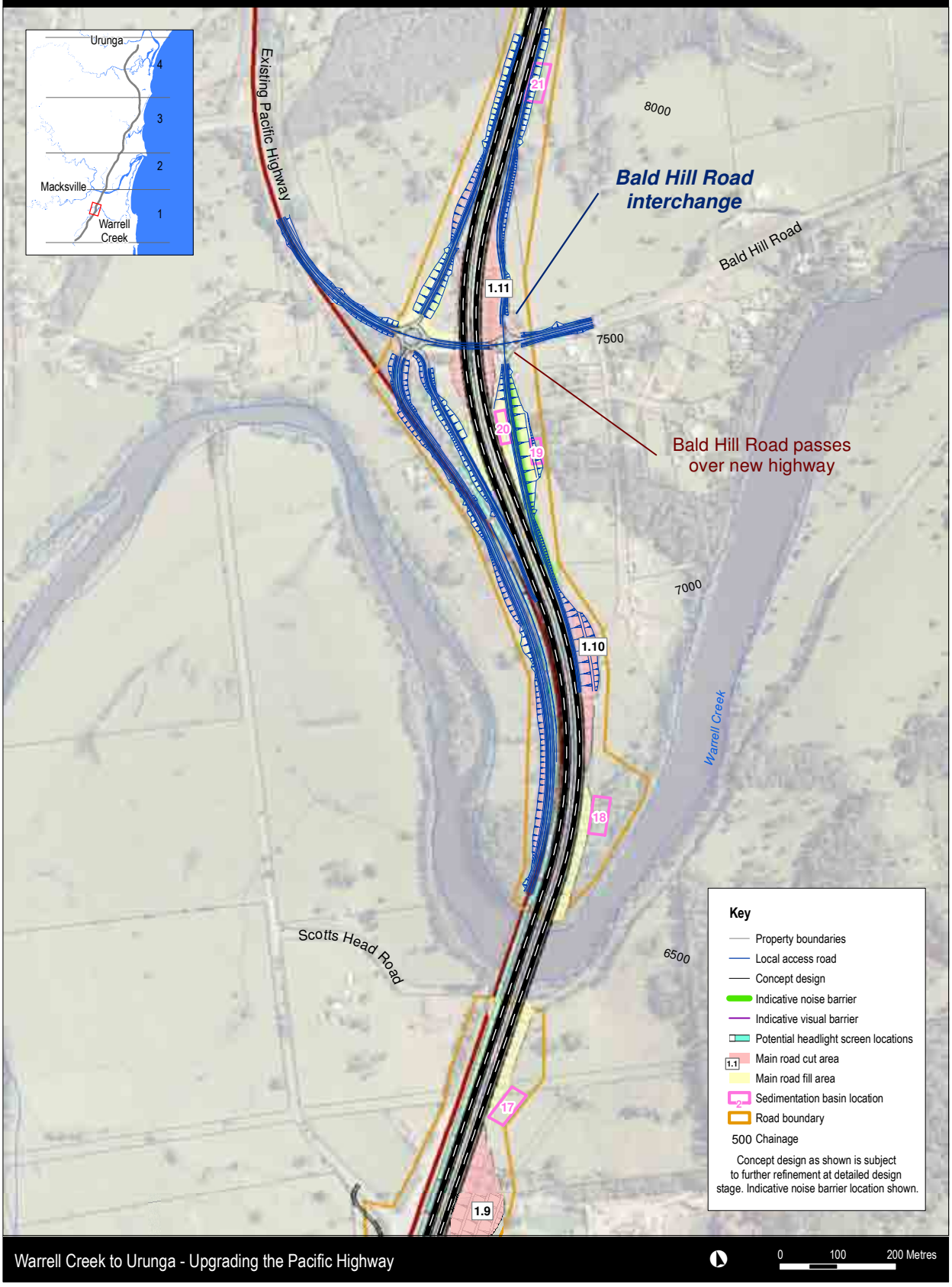


FIGURE 6 - 1 : Sheet 5 | THE PROPOSAL **ALLGOMERA DEVIATION TO NAMBUCCA RIVER**

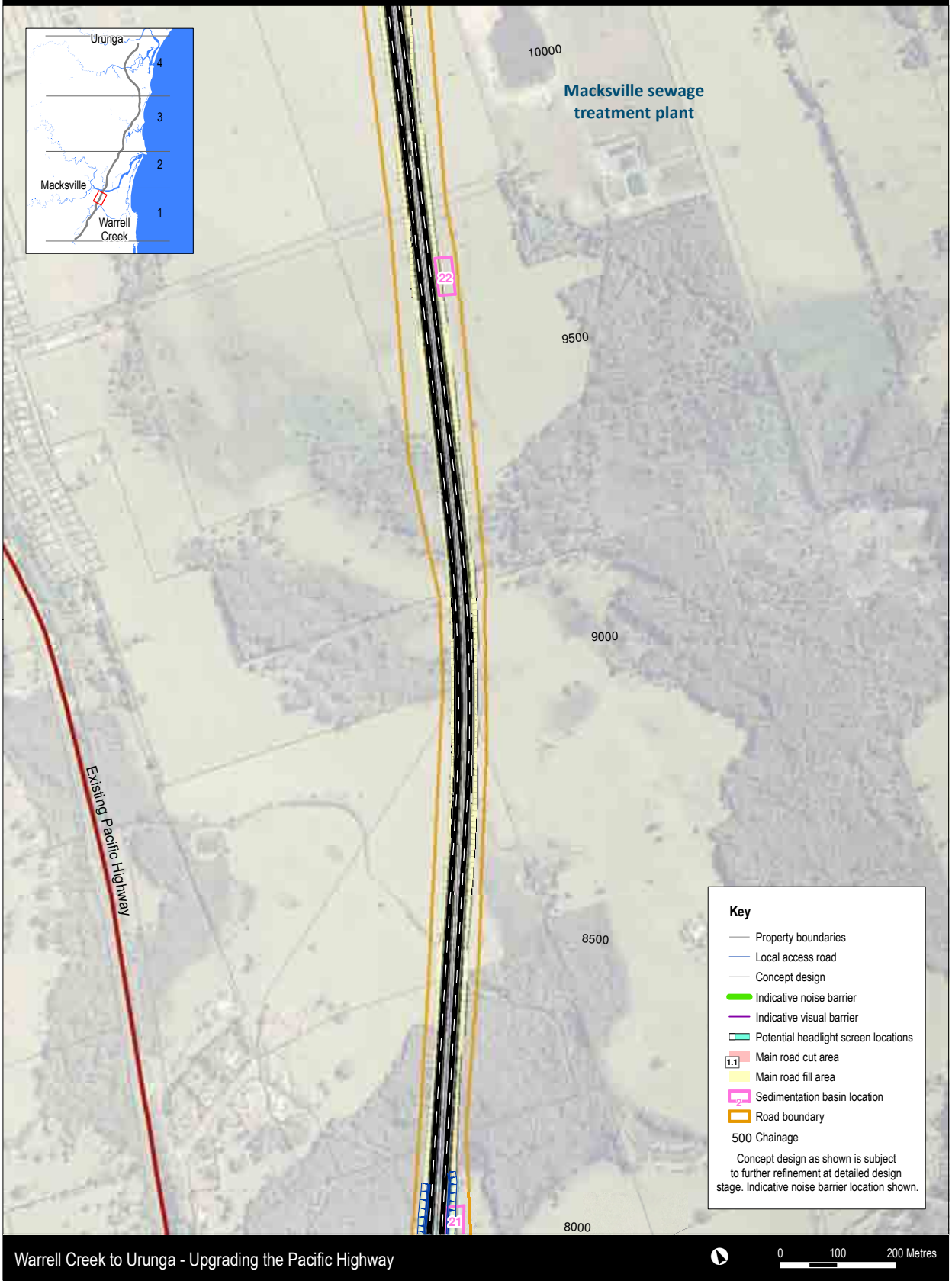
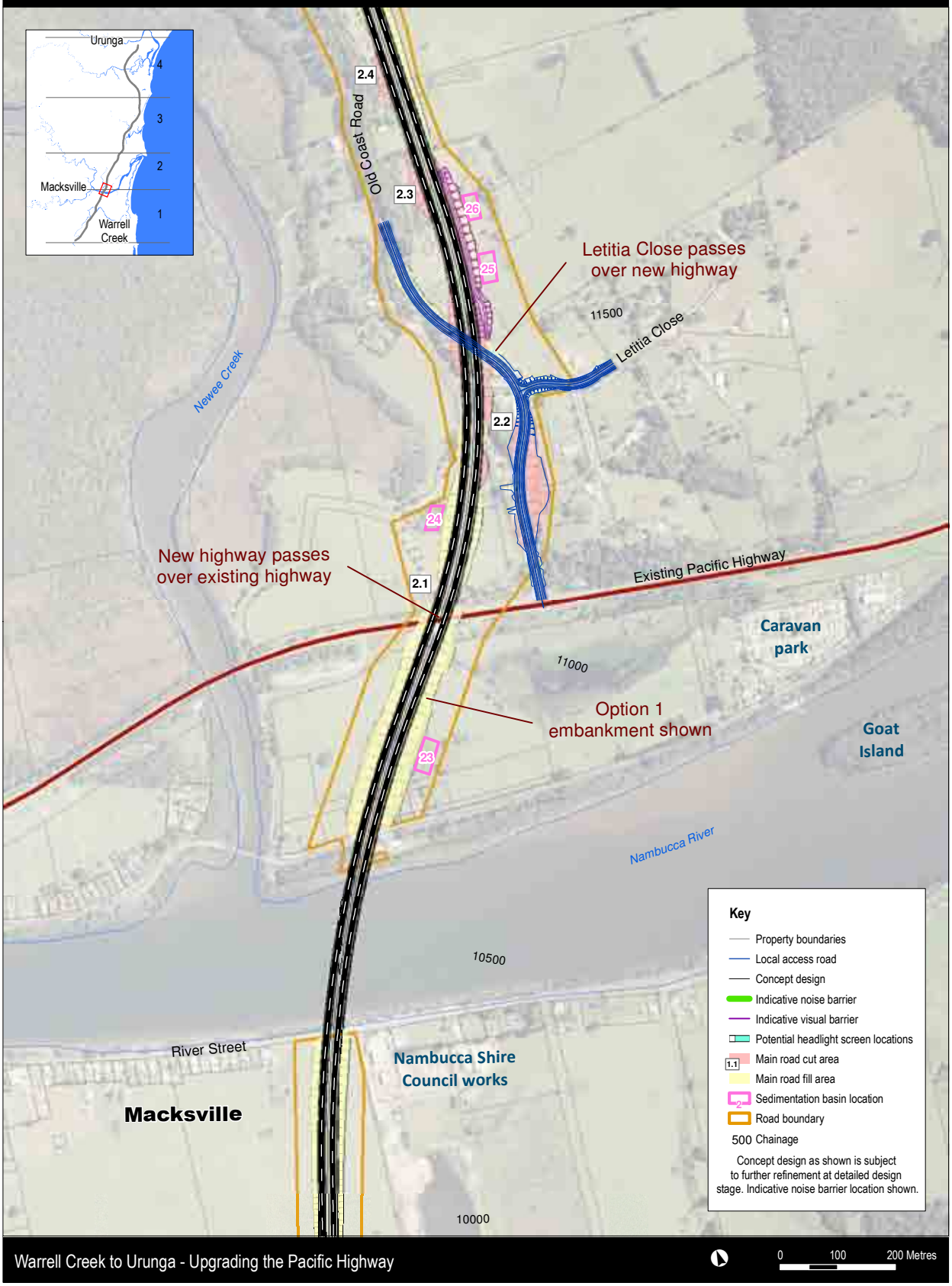


FIGURE 6 - 1 : Sheet 6 | THE PROPOSAL **ALLGOMERA DEVIATION TO NAMBUCCA RIVER**



- Indicative locations for low noise pavements at Warrell Creek (approximately 2.3 kilometres in length) and the northern abutment bridge over Warrell Creek to Old Coast Road (approximately 5.15 kilometres in length) (see Chapter 14 – N*oise and vibration* and Working paper 3 – *Noise and vibration*).
- Indicative locations for noise barriers at Albert Drive to Donnellyville (approximately 1.5 kilometres long, approximately 4.5 metres high above pavement level), at Donnellyville (approximately 300 metres long, approximately 4.5 metres high above pavement level) and at the Bald Hill Road interchange (350 metres long, four metres high above pavement level) (see Chapter 14 – *Noise and vibration* and Working paper 3 – *Noise and vibration*).
- Indicative locations for visual mounds constructed from surplus spoil from Rosewood Road to Albert Drive, approximately 570 metres long and up to three to four metres high (above natural surface).

6.4.1.2 Section 2 - Nambucca River to Nambucca Heads

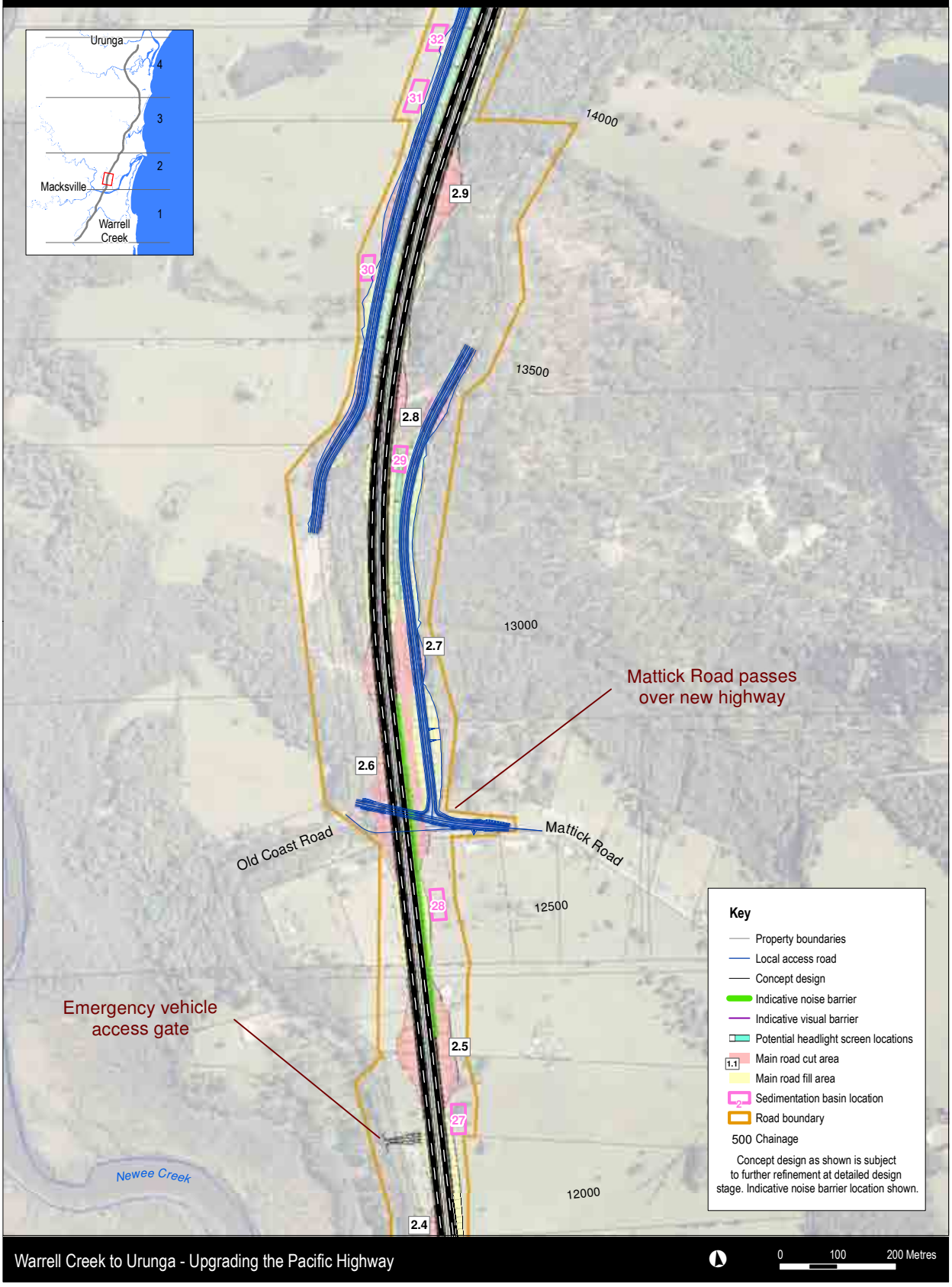
This section of the Proposal extends from the northern bank of the Nambucca River to where the North Coast Railway line crosses the existing highway to the north-west of Nambucca Heads (refer to Figure 6-2). As for all sections, the Proposal in this section is a fully controlled access (motorway style) dual carriageway and is approximately 7.5 kilometres long. It largely follows the alignment of Old Coast Road, requiring sections of parallel local access road to be constructed to provide a local access route adjacent to the Proposal.

A complex part of the concept design in this section is the elevated roadway from the northern bank of the Nambucca River to the high ground north of the existing highway at Old Coast Road. Two options have been considered for this area; a bridge and an earthworks embankment over the floodplain. There are benefits and disadvantages associated with each option.

The bridge would have reduced settlement risk, would maintain existing drainage patterns and would have lower ongoing maintenance costs than the embankment option. It would also have lesser property and ecological impacts due to the smaller footprint. The visual impacts of the bridge would be greater as the higher vertical alignment for the southern part of Section 2 would provide fewer opportunities for visual screening. Noise mitigation options would be limited to construction of noise barriers.

The embankment option was investigated with and without wick drains. In terms of operational performance, long term consolidation of the soft soils on the floodplain is likely to result in differential settlement between the bridge and the earth embankment and reduce the driver experience. The embankment option has a larger footprint which may increase property impacts. Further, the residual settlement would result in higher ongoing maintenance costs across the floodplain. There are greater opportunities for screening across the floodplain with an embankment through growth of vegetation on the fill batter, and as such, the embankment would have beneficial outcomes in terms of visual screening. Noise mitigation options for an embankment include a mound or a barrier, however consideration is required to flow paths during large flood events.

FIGURE 6 - 2 : Sheet 1 | THE PROPOSAL **NAMBUCCA RIVER TO NORTH COAST RAILWAY OVERBRIDGE**



Warrell Creek to Urunga - Upgrading the Pacific Highway

0 100 200 Metres

FIGURE 6 - 2 : Sheet 2 | THE PROPOSAL **NAMBUCCA RIVER TO NORTH COAST RAILWAY OVERBRIDGE**

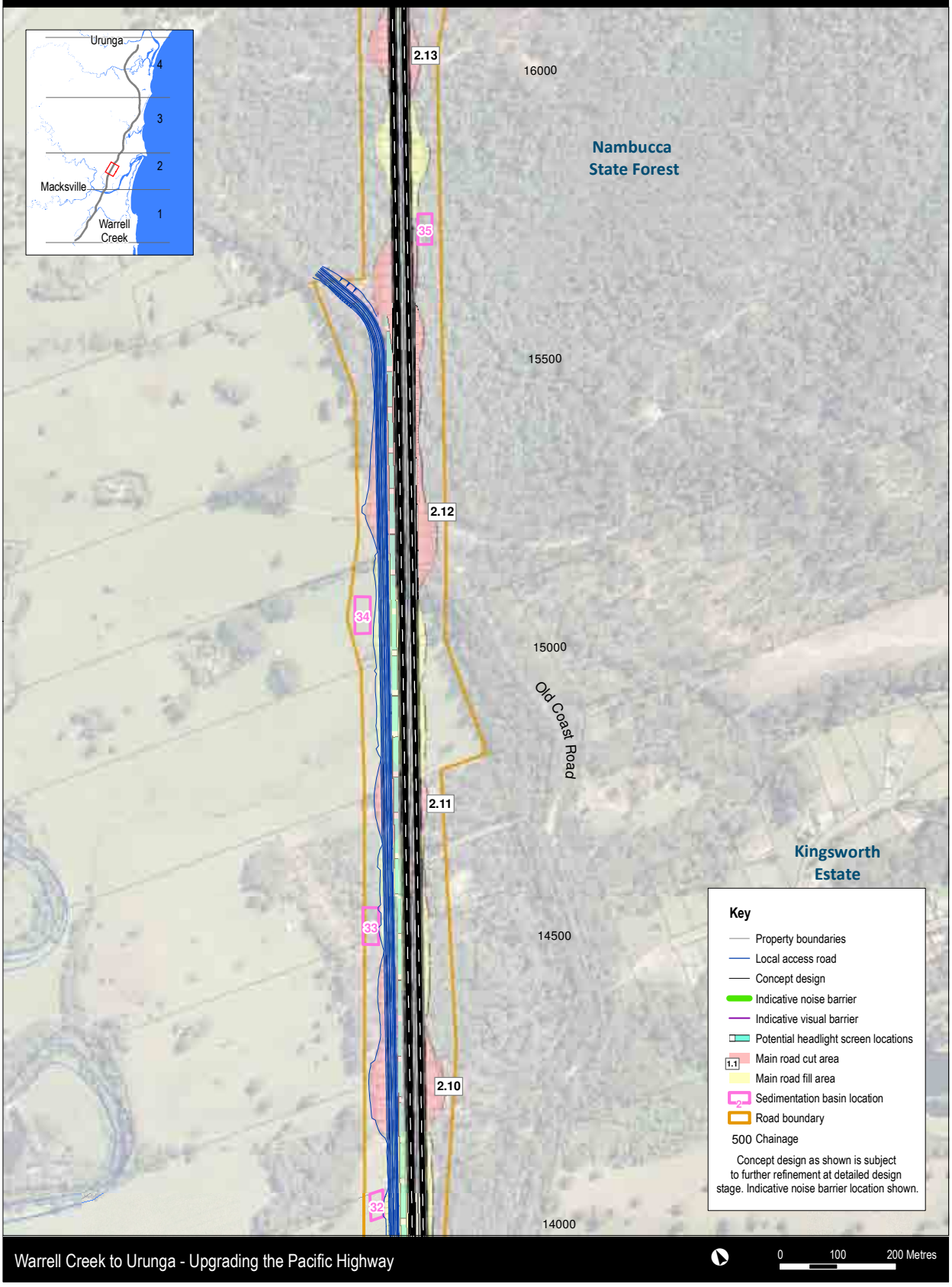


FIGURE 6 - 2 : Sheet 3 | THE PROPOSAL **NAMBUCCA RIVER TO NORTH COAST RAILWAY OVERBRIDGE**

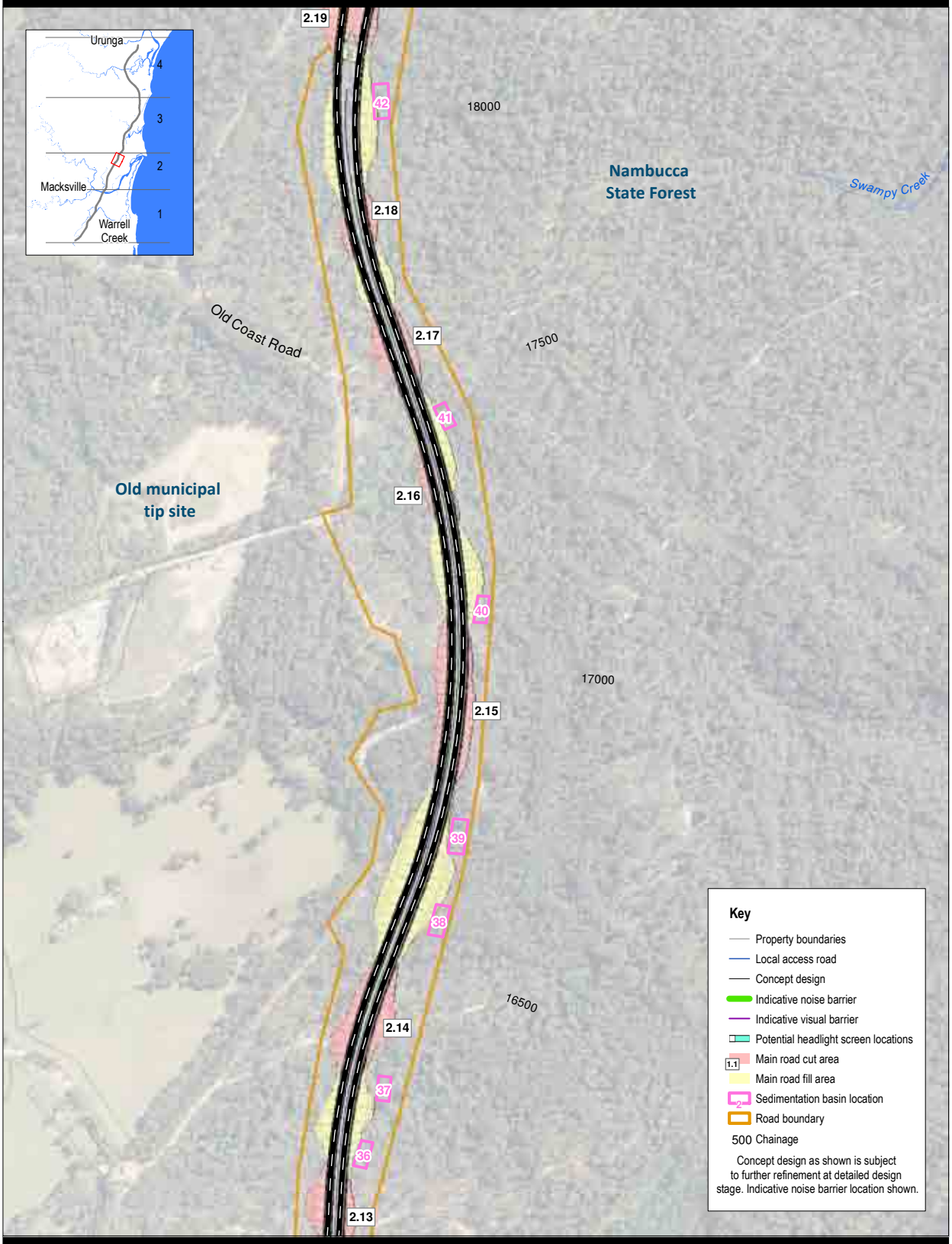
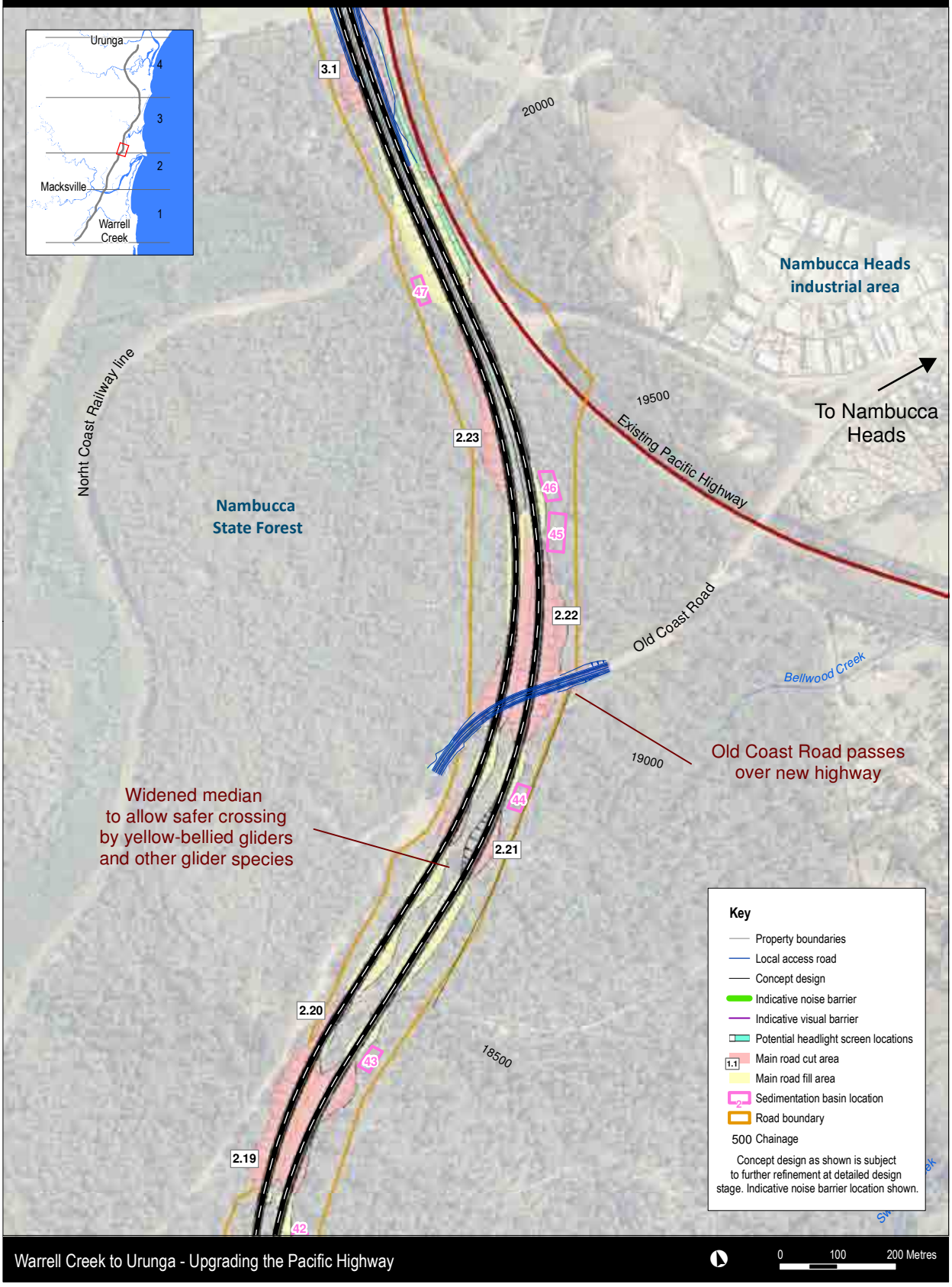


FIGURE 6 -2 : Sheet 4 | THE PROPOSAL **NAMBUCCA RIVER TO NORTH COAST RAILWAY OVERBRIDGE**



Drainage across the embankment would be facilitated by cross drainage culverts to achieve the overall design objectives. However, the lower overall vertical alignment and potential impedance to flow has the potential to exacerbate future climate change impacts (if any) which may occur in the area.

The embankment option would be cheaper to construct than the bridge option and is likely to achieve the project/design objectives at a lesser cost than the bridge option. There is also the greater potential to achieve a cut / fill balance with the embankment option. The embankment option would have a larger footprint and as such has been used as the base case for the concept design.

Both options are considered feasible for construction, and have similar impacts. Therefore, to maintain flexibility for an innovative and cost effective solution, approval is being sought for either option with a final decision to be made regarding the option to be adopted as part of the detailed design stage.

Key features of the Nambucca River to Nambucca Heads section include:

- Continuing north from the proposed high level bridge crossing over the Nambucca River, bridging over the existing highway just to the west of its existing Pacific Highway and Old Coast Road intersection.
- Locating the alignment on the eastern side of the ridgeline in the southern section to provide greater protection for the Newee Creek wetland (SEPP 14 wetland No. 383) from potential runoff from the Proposal. At this stage, an earthen embankment is proposed for the crossing of the floodplain north of Nambucca River, however, as detailed above there is flexibility to allow for creation of a bridge in this location during the detailed design phase.
- Provision of a new overbridge for Old Coast Road to cross over the upgrade in the vicinity of Letitia Close.
- Provision of a padlocked gate for emergency vehicle access onto the Proposal from Old Coast Road approximately 500 metres south of Mattick Road.
- Provision of a new overbridge at Mattick Road and an access road on the eastern side of the Proposal to provide access into the state forest.
- Widened medians in the northern part of the section to retain mature vegetation to facilitate the safer movement of yellow-bellied gliders across/over the upgrade and to retain individual plants of threatened species *Marsdenia longiloba* a Commonwealth 'vulnerable' listed species.
- Fauna underpasses combined with drainage structures through the state forest area to maintain east-west fauna movement.
- Noise barrier at Mattick Road, approximately 575 metres long and 4.5 metres high above pavement level.
- Visual mounds at Letitia Close (300 metres long, up to two metres high above natural surface).

6.4.1.3 Section 3 - Nambucca Heads to Ballards Road

North of the crossing of the North Coast Railway Line, the Proposal traverses parallel to, and just to the west of the existing highway. The Proposal would involve the construction of a new, controlled access dual carriageway to the west of the existing highway up to the Ballards Road interchange, a length of approximately 11.5 kilometres. The existing highway would be utilised as a local access road. Details of the Proposal in this section are shown in Figure 6-3.

The Proposal in this section includes the Nambucca Heads interchange. This would be a full interchange which includes provision for a light and heavy vehicle rest area. The interchange was located to provide access into the proposed commercial/industrial area to the west of the Proposal at Boggy Creek.

Key features of the Nambucca Heads to Ballards Road section include:

- New twin bridges over the North Coast Railway Line.
- The Nambucca Heads interchange and rest area. The rest area would be for light and heavy vehicles. Access to the rest area for both northbound and southbound traffic would be via the interchange.
- New bridges over Boggy Creek that would also provide for fauna movement under the Proposal.
- New twin bridges over Cow Creek as well as a new bridge on the existing highway, which needs to be relocated at this location.
- New twin bridges over Deep Creek, adjacent to and west of the existing highway bridge crossing that would also provide for fauna movement under the Proposal.
- Rationalisation of crossings of the Proposal with the provision of an underpass for Valla Road and an overbridge at East West Road to connect with the existing Pacific Highway. This would include construction of local access roads to maintain property access.
- Realignment and construction of a 2.5 kilometres section of Old Coast Road on the western side of the upgrade to provide local access.
- Utilisation of the existing highway as a local access road.
- Combined drainage structures and fauna underpasses approximately 500 metres south of East West Road and in the vicinity of Oyster Creek to enable fauna movement between west of the highway and the SEPP 14 wetland areas east of the highway.
- Indicative location for low noise pavement at Valla Beach approximately 1.7 kilometres in length.

FIGURE 6 -3 : Sheet 1 | THE PROPOSAL **NAMBUCCA HEADS TO BALLARDS ROAD**

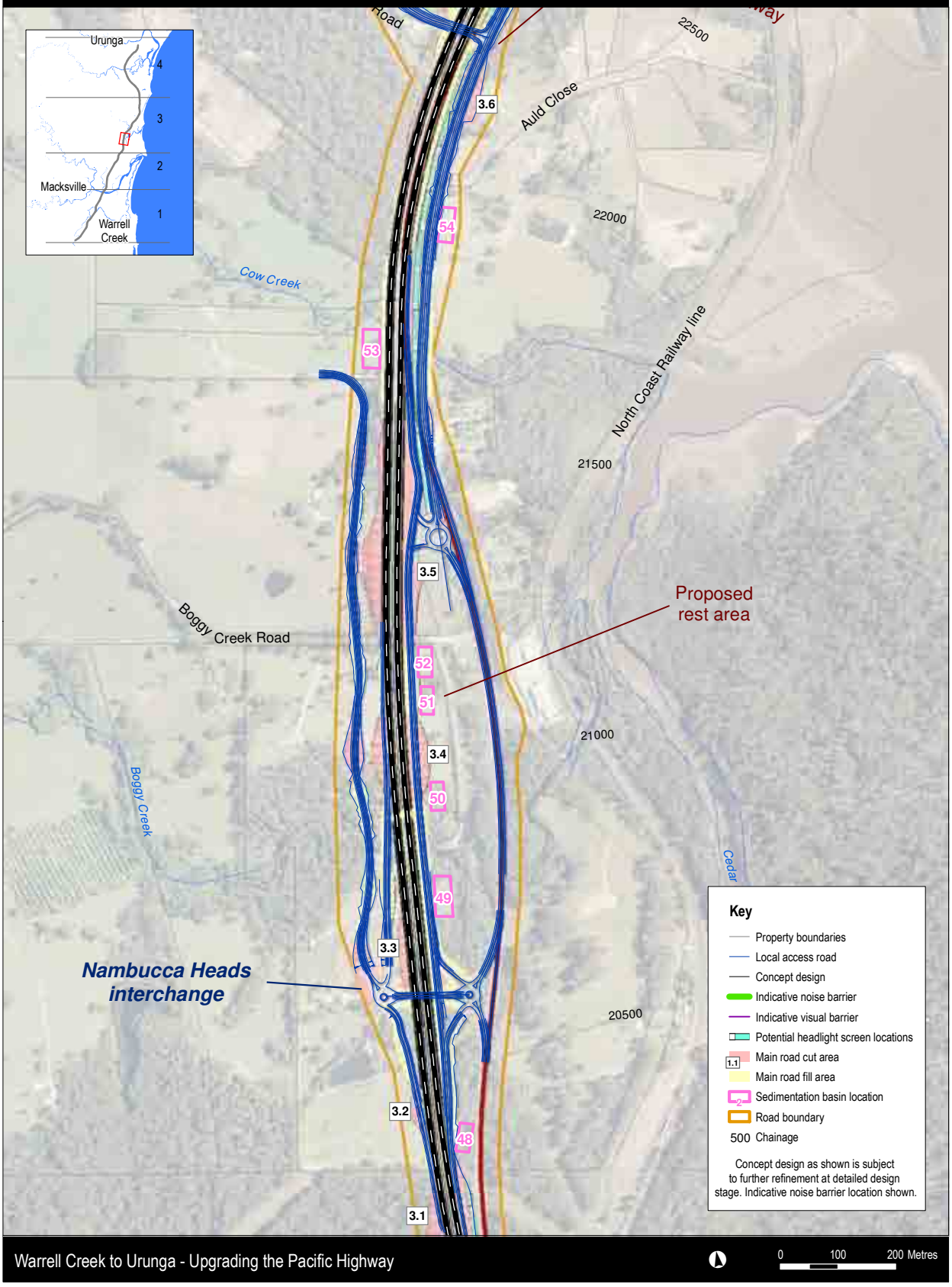


FIGURE 6 -3 : Sheet 2 | THE PROPOSAL **NAMBUCCA HEADS TO BALLARDS ROAD**

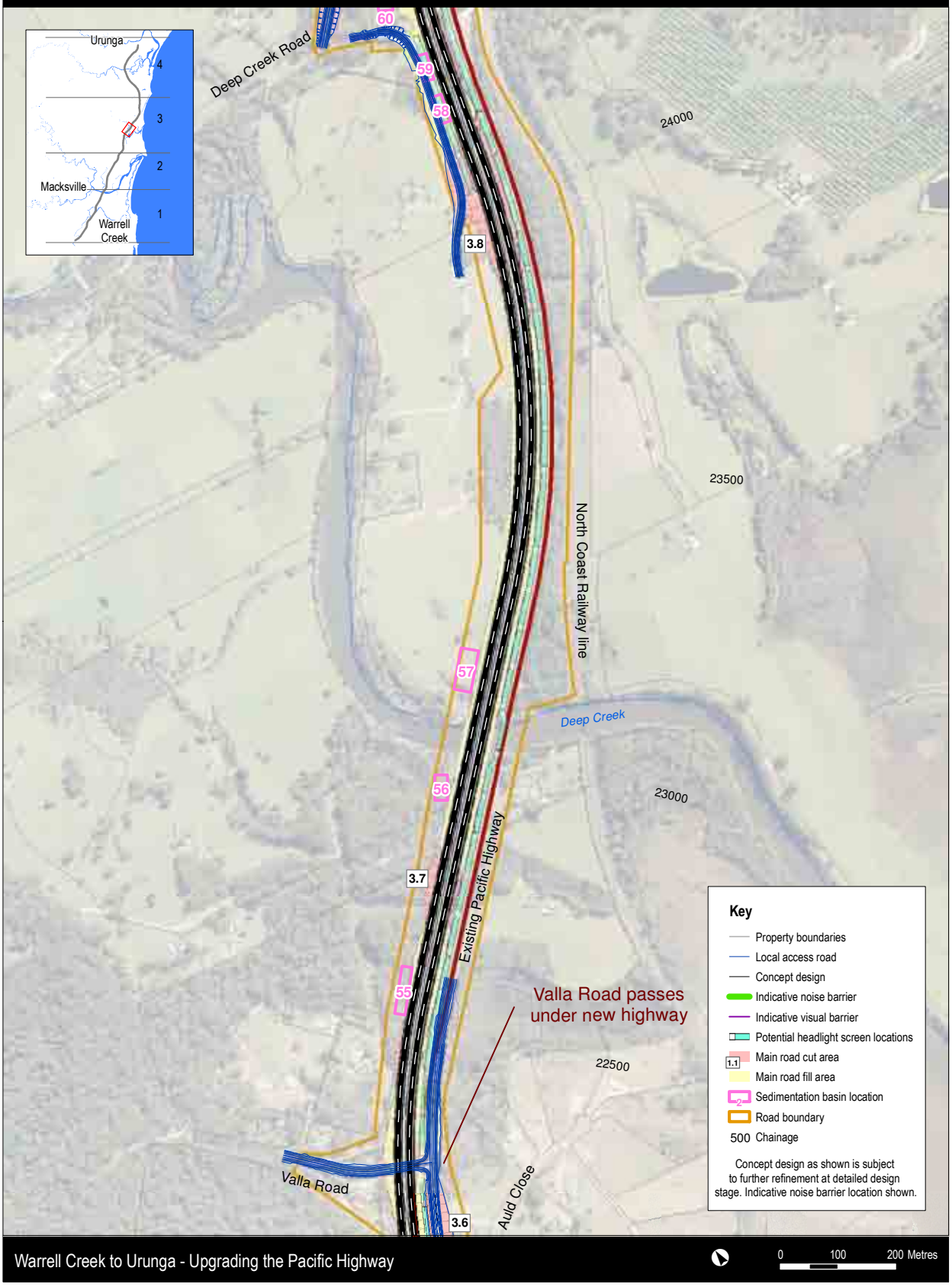
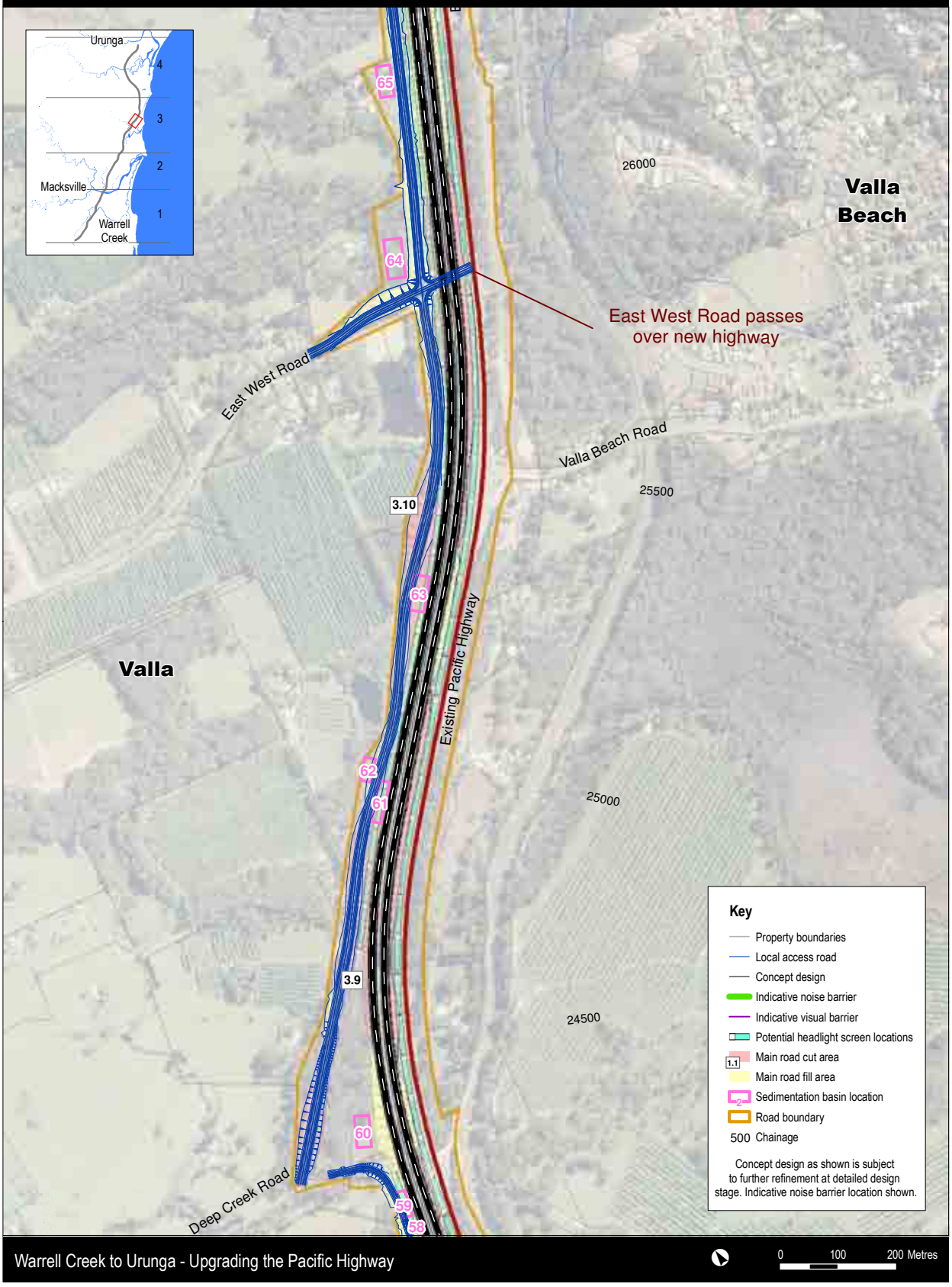


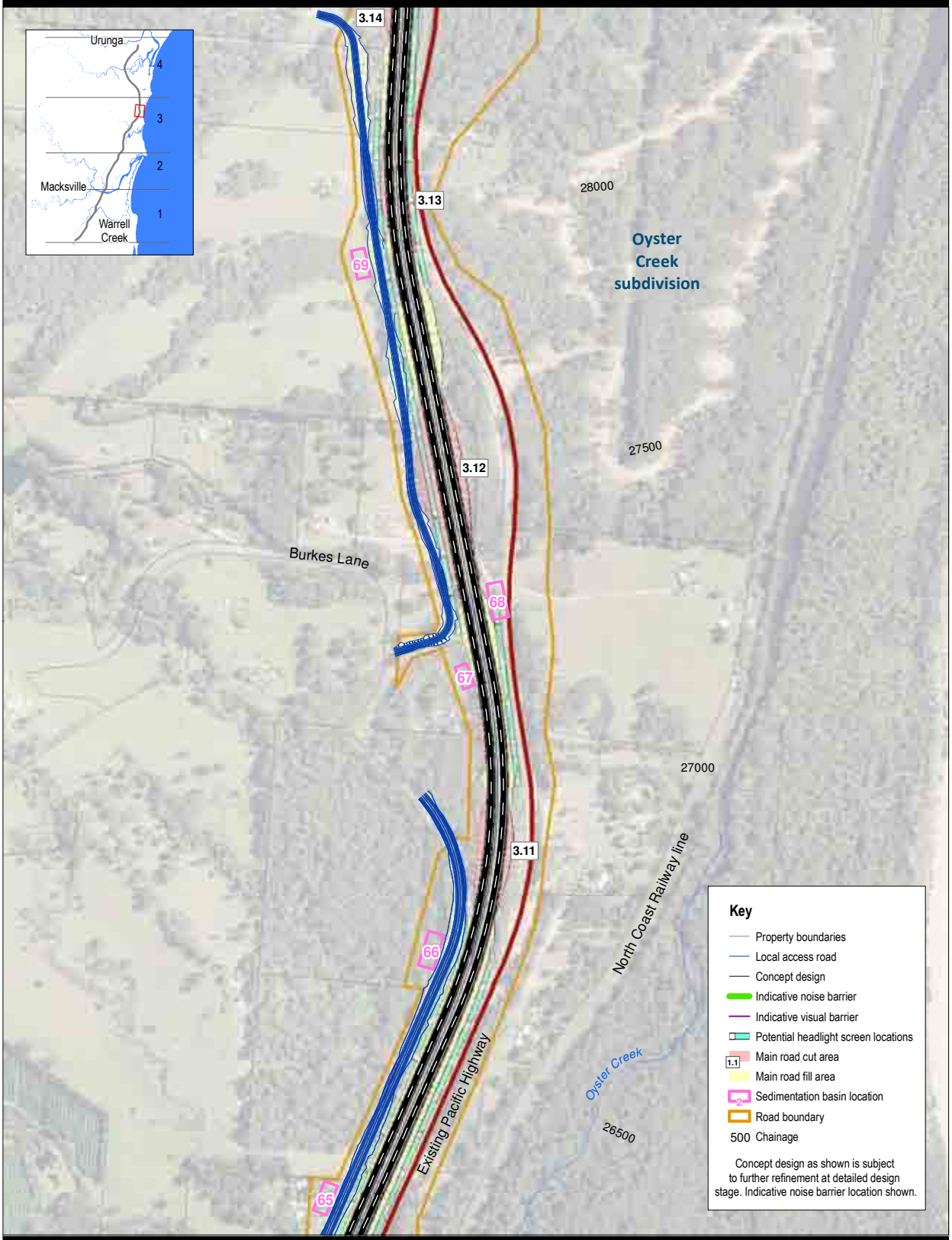
FIGURE 6 -3 : Sheet 3 | THE PROPOSAL **NAMBUCCA HEADS TO BALLARDS ROAD**



Warrell Creek to Urunga - Upgrading the Pacific Highway

0 100 200 Metres

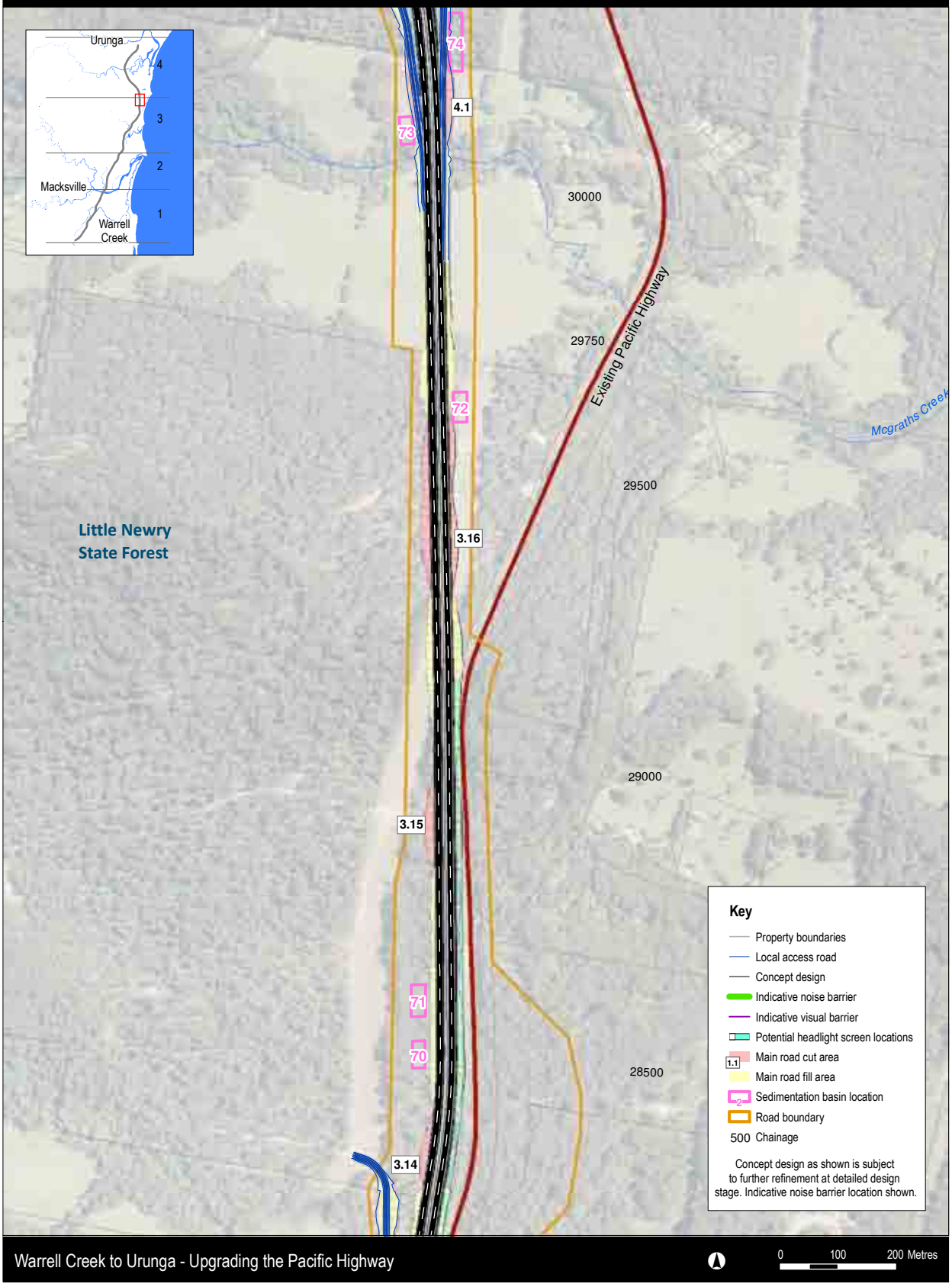
FIGURE 6 -3 : Sheet 4 | THE PROPOSAL **NAMBUCCA HEADS TO BALLARDS ROAD**



Warrell Creek to Urunga - Upgrading the Pacific Highway

0 100 200 Metres

FIGURE 6 -3 : Sheet 5 | THE PROPOSAL **NAMBUCCA HEADS TO BALLARDS ROAD**



6.4.1.4 Section 4 - Ballards Road to Waterfall Way

From the proposed Ballards Road interchange, the Proposal deviates from the existing highway and reconnects with the Pacific Highway in the vicinity of the existing Waterfall Way interchange at Raleigh, north of Urunga. The Proposal would require construction of approximately 12 kilometres of new controlled access dual carriageway (refer to Figure 6–4). A new grade-separated interchange is proposed at Ballards Road to:

- Provide efficient access to the upgrade for emergency services
- Provide efficient access to and from Urunga.
- Provide improved access to Urunga from the south.
- Service the growing community of Valla Beach.

From the Ballards Road interchange, the Proposal would veer north-west through the Little Newry State Forest, prior to crossing the Kalang River approximately 2.7 kilometres west of the existing Pacific Highway. The Proposal then traverses rural and rural residential lands, west of SEPP14 wetland No. 351 at Urunga and then veers north-east, past the Raleigh industrial area, prior to connecting with the existing Waterfall Way interchange at Raleigh.

Key features of the Ballards Road to the existing Waterfall Way section include:

- The Ballards Road interchange that would provide improved access to Urunga from the south and to service the growing community of Valla Beach.
- Widened medians are proposed through sections of the Newry State Forest to avoid *Marsdenia longiloba* (Slender Marsdenia) and north of the state forest to retain mature vegetation to facilitate the safer movement of yellow-bellied gliders and other glider species across/over the upgrade.
- Two substantial cuttings of approximately 20 metres in depth; one south and one north of the Kalang River.
- New local road access overbridge at Martells Road to maintain access to remote rural properties.
- Indicative location for low noise pavement at Ridgewood Drive to the existing Waterfall Way interchange, approximately 2.2 kilometres in length.
- Dedicated fauna underpass at chainage 32755, approximately 600 metres south of Martells Road in a DECCW regional fauna movement corridor.
- Dedicated fauna movement structure that has been positioned in a known fauna movement corridor within Newry State Forest.
- Indicative location for visual mound at Ridgewood Drive (approximately 100 metres long, up to approximately four metres high above natural surface).
- A series of combined fauna underpass/drainage structures through the section.
- A floodplain bridge or culvert south of the Kalang River.
- A high level twin bridge crossing of the Kalang River. The bridge also needs to clear South Arm Road on the northern side of the Kalang River, resulting in a bridge height of approximately 12 metres above water level.

FIGURE 6 -4 : Sheet 1 | THE PROPOSAL **BALLARDS ROAD TO WATERFALL WAY**

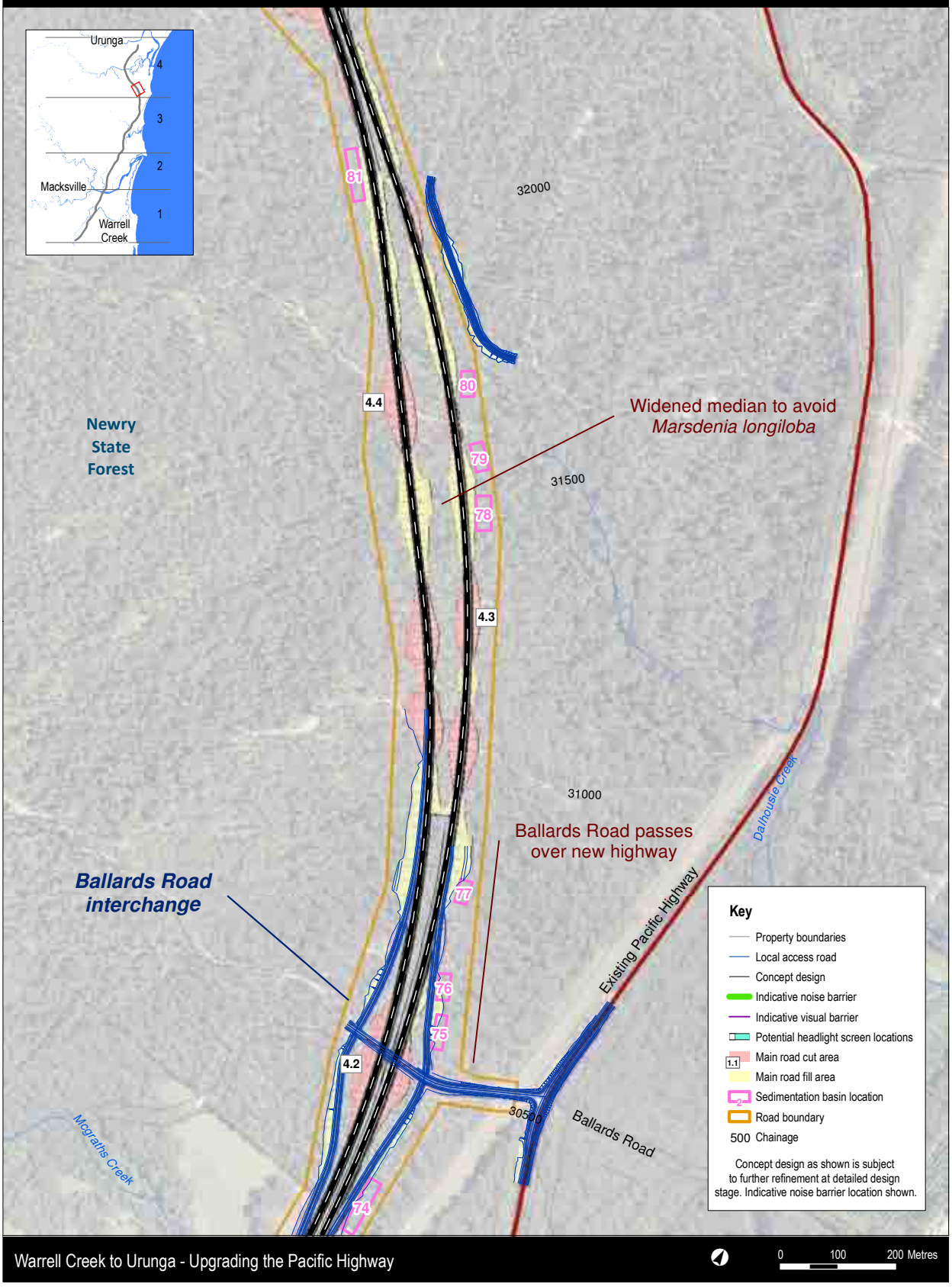


FIGURE 6 -4 : Sheet 2 | THE PROPOSAL **BALLARDS ROAD TO WATERFALL WAY**

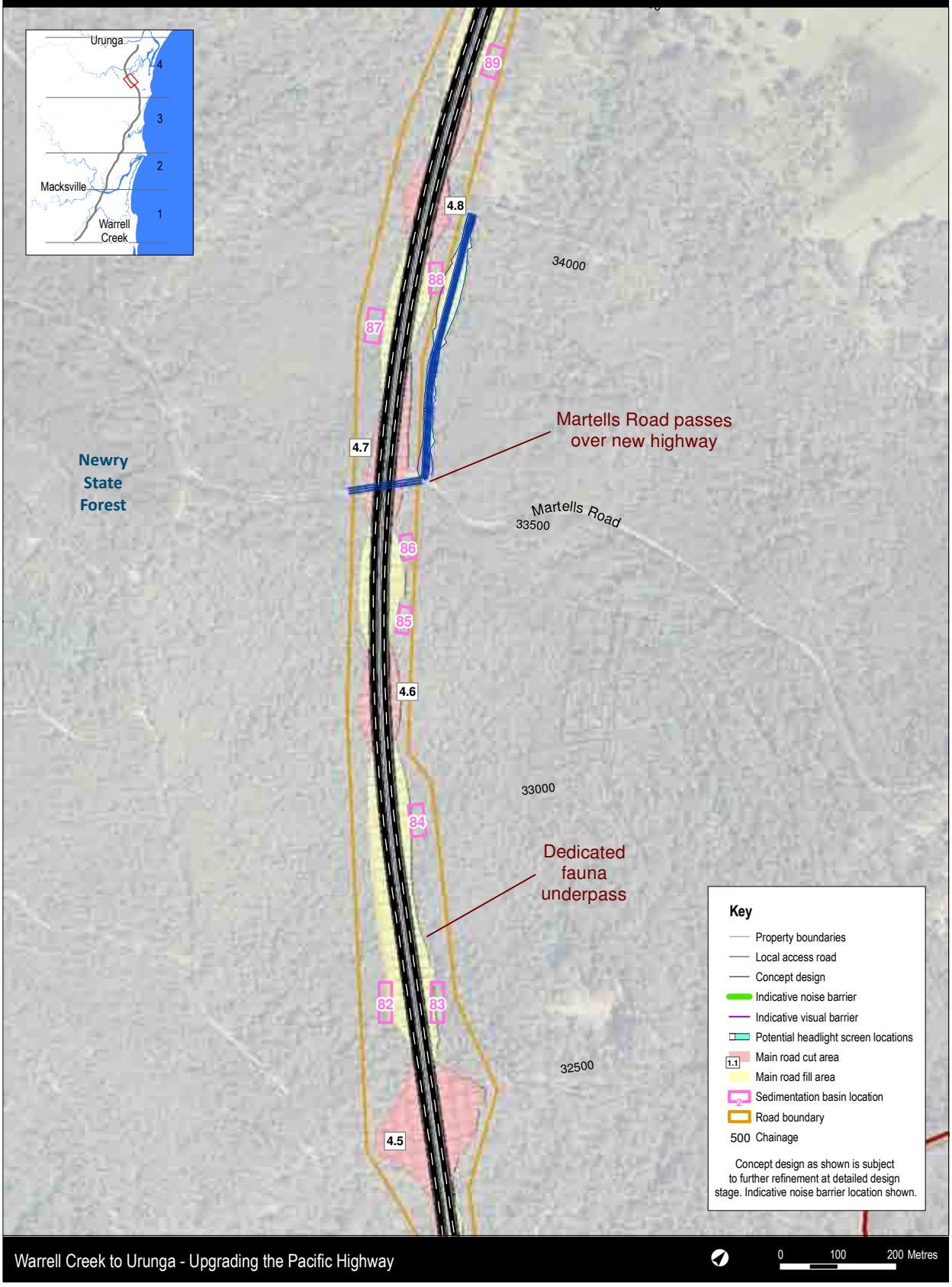


FIGURE 6 -4 : Sheet 3 | THE PROPOSAL **BALLARDS ROAD TO WATERFALL WAY**

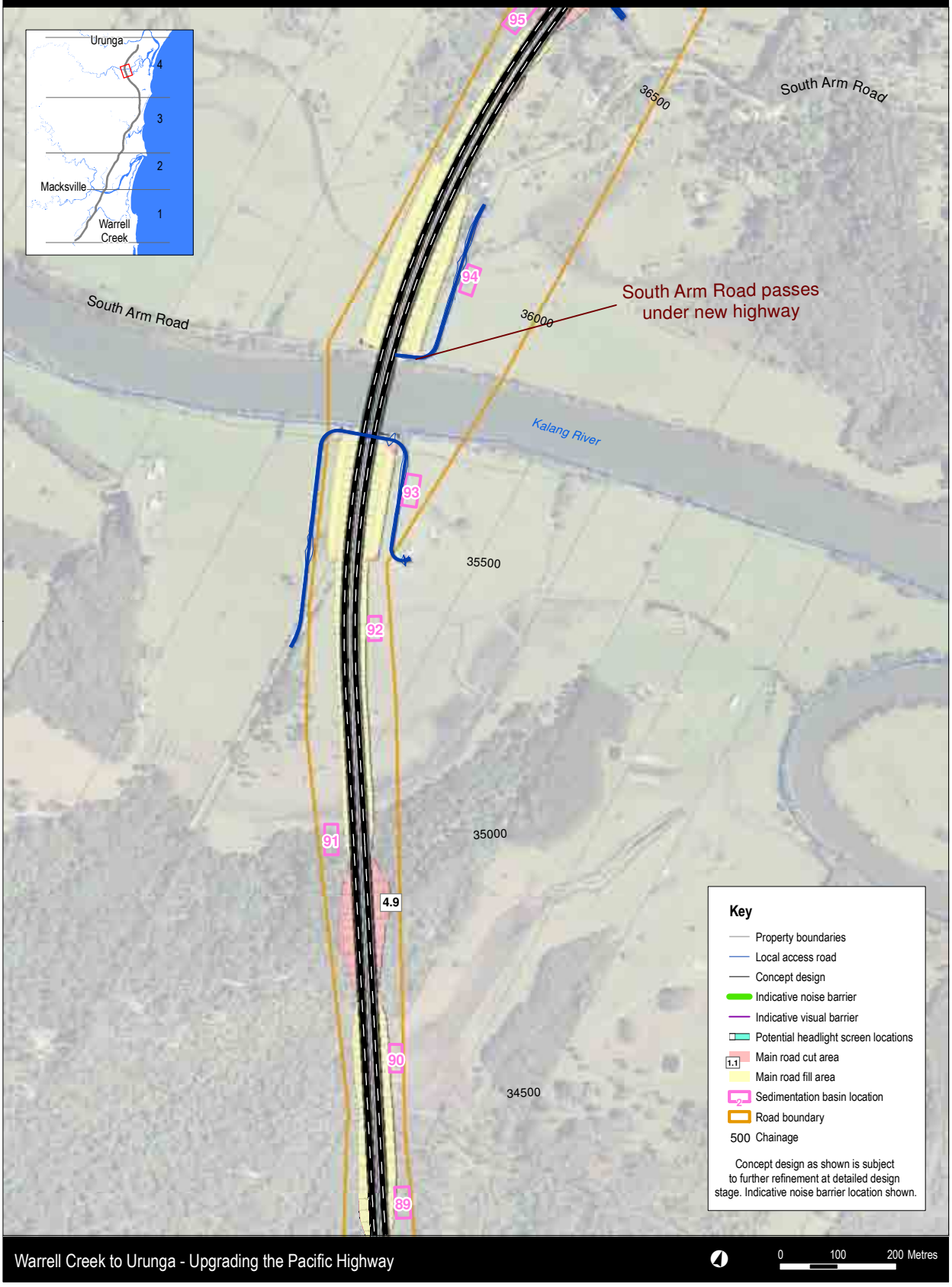


FIGURE 6 -4 : Sheet 4 | THE PROPOSAL **BALLARDS ROAD TO WATERFALL WAY**

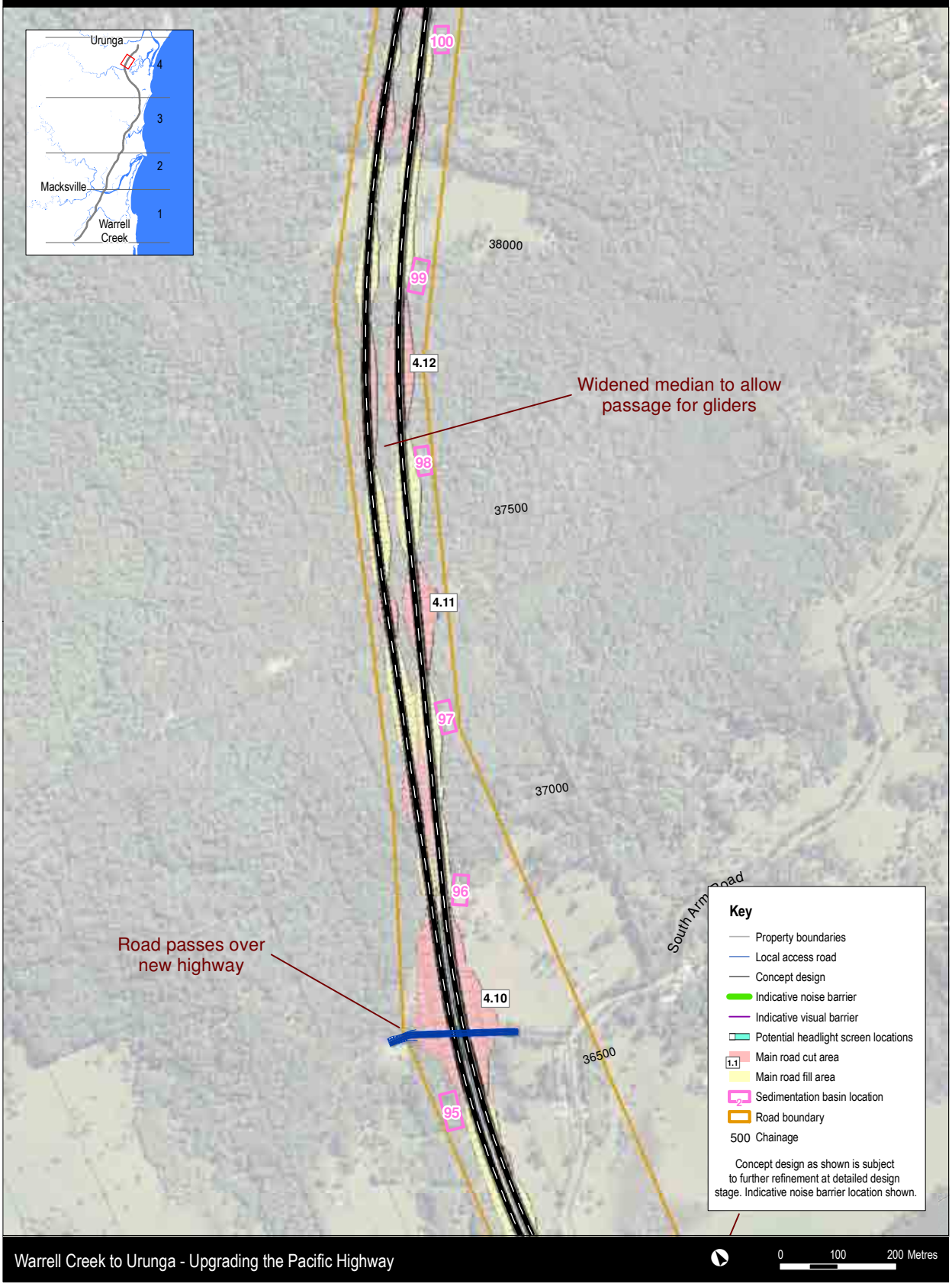


FIGURE 6 -4 : Sheet 5 | THE PROPOSAL **BALLARDS ROAD TO WATERFALL WAY**

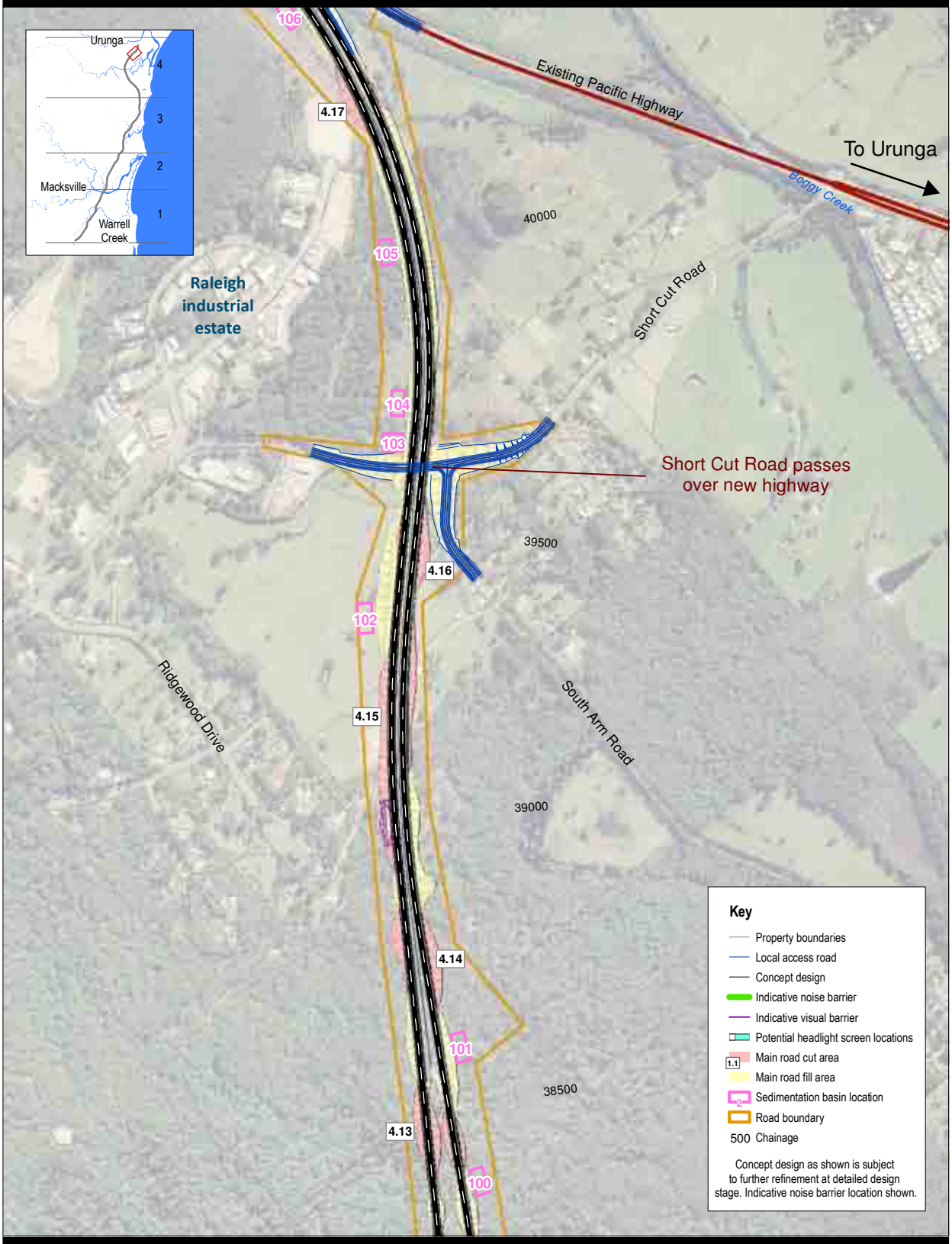
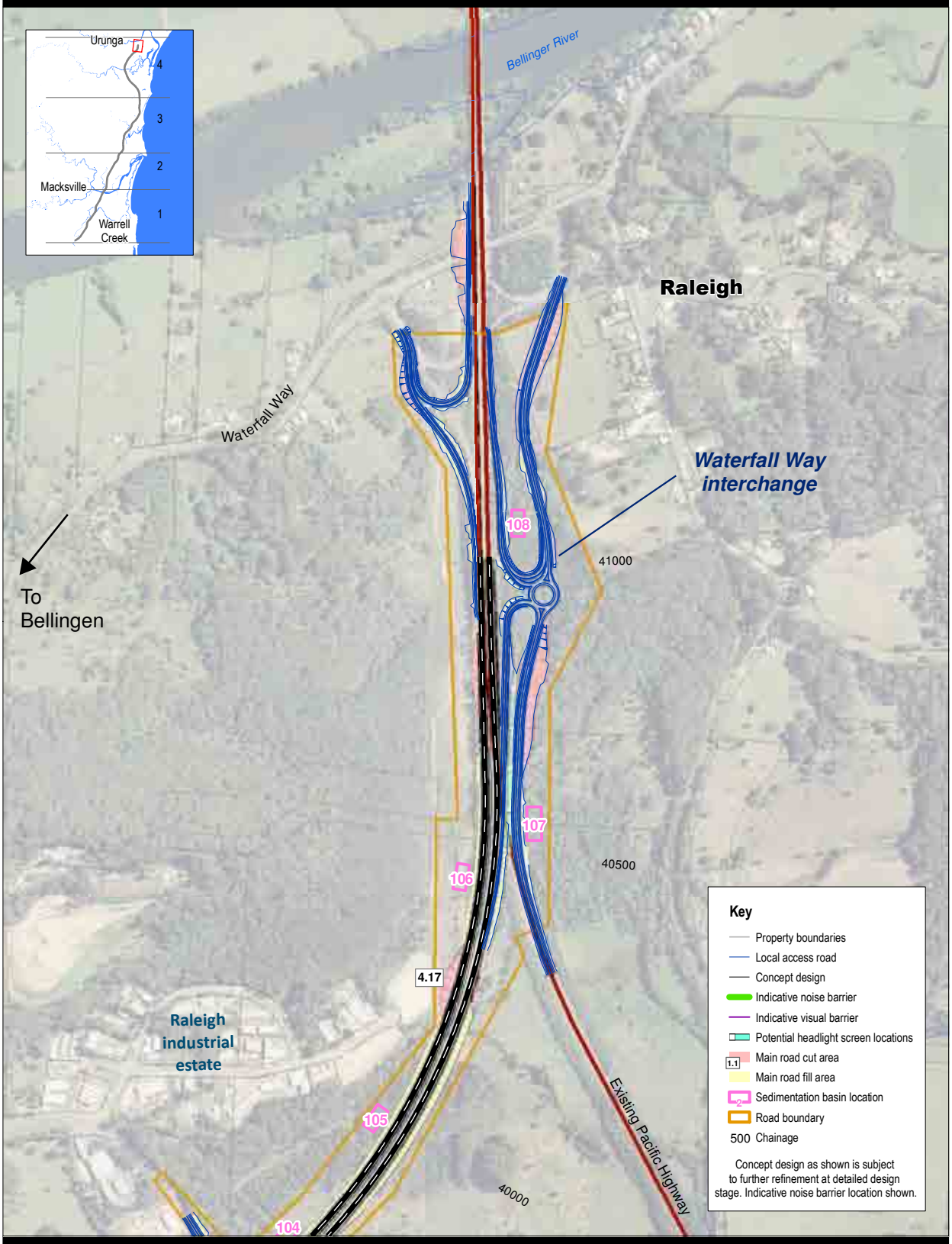


FIGURE 6 -4 : Sheet 6 | THE PROPOSAL **BALLARDS ROAD TO WATERFALL WAY**



- Provision of an overbridge to enable Short Cut Road to cross over the Proposal.
- Realignment of the South Arm Road and Short Cut Road intersection to enable the raising of Short Cut Road over the upgrade.
- Refinement of the existing Waterfall Way interchange to allow access to Urunga from the north and improve road safety by providing greater vehicle storage capacity on off-ramps and avoid queuing back into high speed traffic. The modifications to the ramps are also consistent with the required design standards for a motorway style upgrade.

6.4.2 Corridor width

The corridor width of the Proposal is variable. Generally, the corridor width is approximately 80 to 100 metres wide in low-lying floodplain areas and widens up to 250 metres in areas of major cuttings, and approximately 150 to 200 metres throughout areas of the state forest where the median has been widened to facilitate fauna movement over the Proposal. In most cases, the corridor is widest at the proposed interchange locations to accommodate interchange ramps and overbridges.

6.4.3 Access, interchange and local roads

Warrell Creek interchange

Northbound traffic using the Allgomera deviation would be able to use the proposed Warrell Creek interchange northbound off-ramp to connect with the existing highway to access the Warrell Creek village and Donnellyville. Traffic from those villages heading south could use the new access road under the upgrade and connect to Browns Crossing Road where a southbound on-ramp would be provided to facilitate safer access to the southbound dual carriageway.

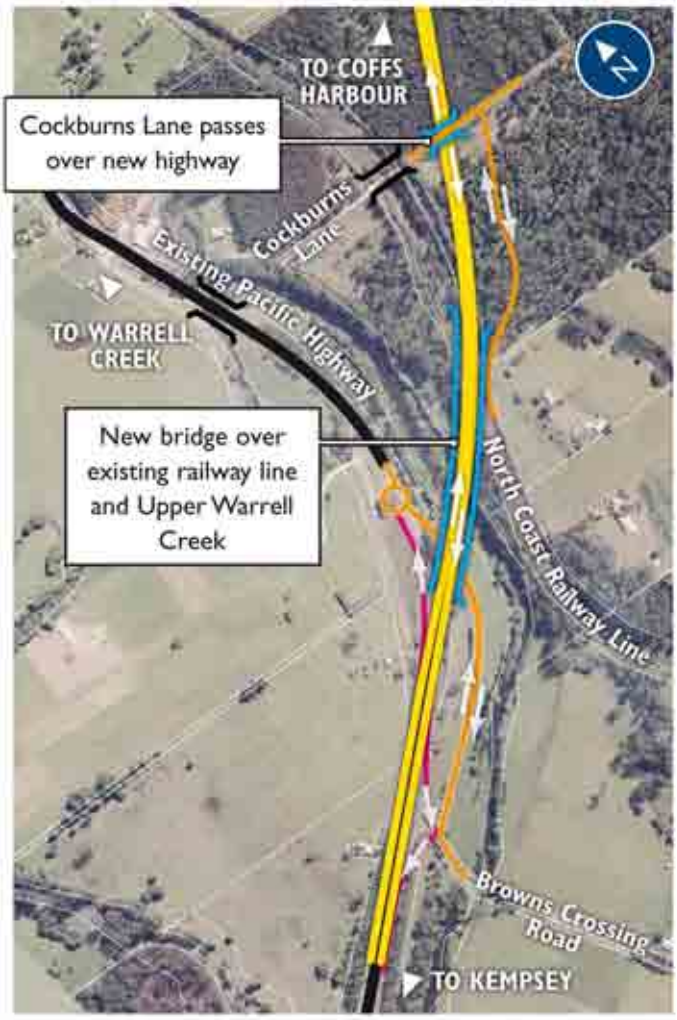


Figure 6-5 Schematic of the Warrell Creek interchange

Southbound vehicles on the Proposal wanting to access Warrell Creek village would either exit at the proposed Bald Hill Road interchange or at the existing Pacific Highway at Allgomera at the southbound off-ramp at Browns Crossing Road, which would connect with the new two-way access road under the upgrade. Traffic would then reconnect with the existing highway to travel into Warrell Creek village. Northbound traffic from Warrell Creek village and Donnellyville would access the Proposal at the Bald Hill Road interchange (see Figure 6-5).

Bald Hill Road interchange

Access to Macksville from the north and south is at the proposed Bald Hill Road interchange. Northbound and southbound on and off ramps are provided at the interchange. This provides access to Scotts Head and Macksville as well as Donnellyville and Warrell Creek from the north and access onto the Proposal from Warrell Creek for northbound traffic.

The interchange would provide for all traffic movements, with intersections such as roundabouts proposed to the west and east of the main highway carriageways to connect to Bald Hill Road and the existing highway. The western intersection would provide access from the northbound off-ramp, access to and from Macksville, Donnellyville and Warrell Creek, the northbound on-ramp and the interchange bridge. The eastern intersection would provide access from the southbound off-ramp, the southbound on-ramp, and the interchange bridge and Bald Hill Road (see Figure 6-6).

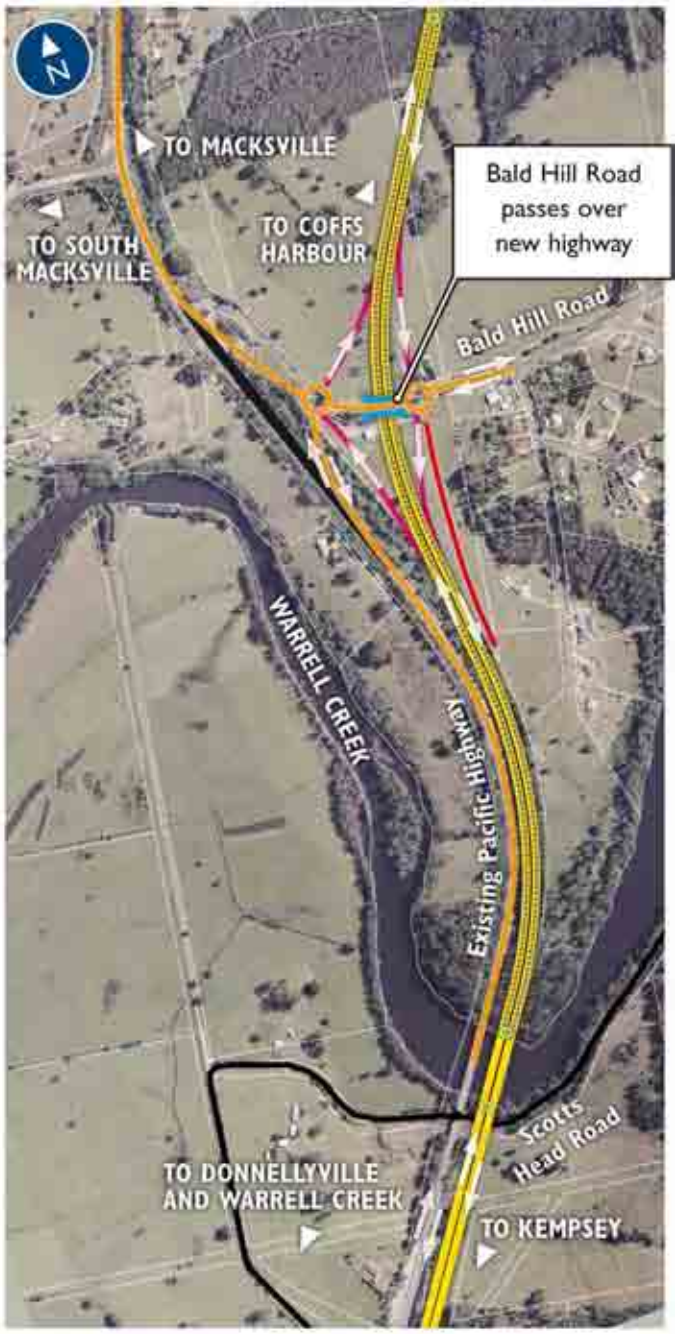


Figure 6-6 Schematic of the Bald Hill Road interchange

Nambucca Heads interchange

The proposed interchange would provide for all traffic movements to and from the Proposal. The proposed interchange, to the north-west of Nambucca Heads, provides access to Nambucca Heads, Bowraville, Valla, Valla Beach and adjacent areas.

The interchange has been located and designed in consultation with Nambucca Shire Council to support future land use plans and provide efficient access to and from the proposed Boggy Creek industrial/commercial area. It allows for full access onto and from the upgrade as well as providing a connection between the existing highway and the proposed industrial subdivision to the west. The area between the existing Pacific Highway and the upgrade has also been identified as a rest area and future heavy vehicle trailer exchange facility (see Figure 6-7).

Ballards Road interchange

Following consultation with the Urunga Chamber of Commerce, members of the Valla Beach community and emergency services in Urunga, an interchange was added to the concept design for the Proposal in June 2008 at Ballards Road, where the upgrade heads north-west away from the existing highway. The interchange would provide for all traffic movements, with access from the existing highway being at Ballards Road. The interchange would provide access for southbound traffic from Urunga onto the upgrade and also for northbound traffic from the growing area of Valla Beach (see Figure 6-7).

Figure 6-7 Schematic of the Nambucca Heads interchange

Refinements to the existing Waterfall Way interchange

The Waterfall Way interchange provides access to the township of Urunga from the north as well as Raleigh and Bellingen. The layout of the interchange would be reconfigured to ensure sufficient acceleration and deceleration is provided on all ramps. A service road east of the upgrade would provide a connection between Waterfall Way and the existing Pacific Highway. The Waterfall Way interchange would improve road safety by providing greater vehicle storage capacity on off-ramps and avoid queuing back into high speed traffic (see Figure 6-8).

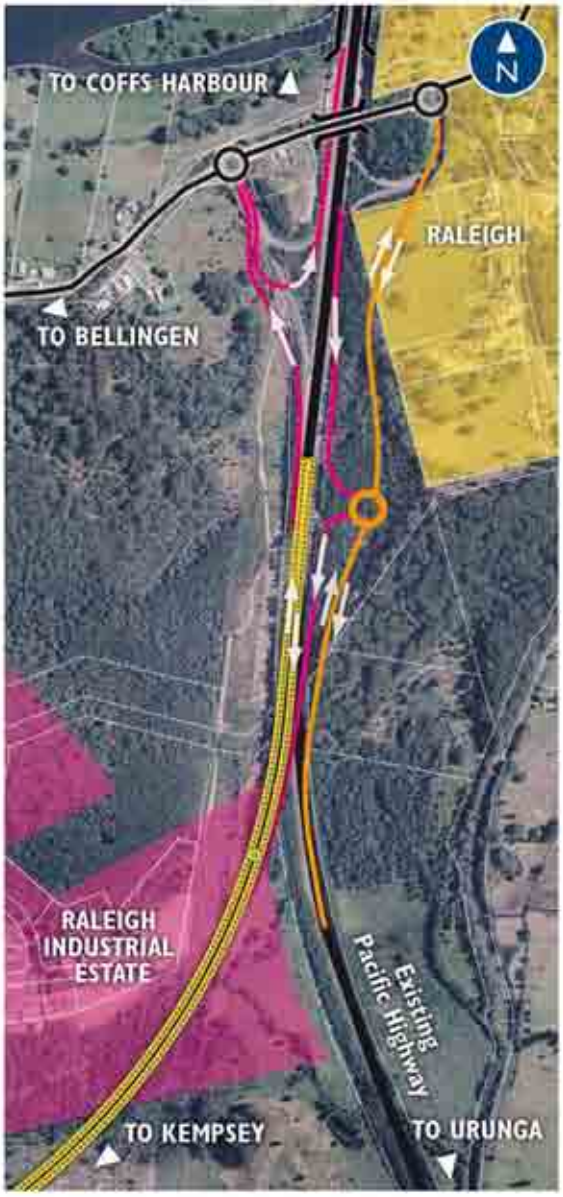


Figure 6-8 Schematic of the proposed refinements to the existing Waterfall Way interchange

Existing Pacific Highway (including operational/maintenance responsibilities)

The existing Pacific Highway would be retained and would serve as a local access road, providing direct access for local traffic into Warrell Creek, Macksville CBD, Bellwood and Urunga (as outlined in Table 6-1). The existing highway would connect with the Proposal at the five grade separated interchanges, as discussed earlier in Section 6.4.3.

Operational and maintenance responsibilities would be determined in consultation with the relevant road authorities.

Local access roads

To improve road safety and maintain the continuity of Bellingen and Nambucca Shire Council's local road network, a number of separate local access roads have also been incorporated into the Proposal to separate local and through-traffic and to remove the need for local traffic to access the Proposal for movement within the study area. This local access road network would allow travel within the study area in a lower speed environment which would be more amenable to pedestrian, cyclist and bus traffic. There would be a complete grade-separation of all cross highway movements. Table 6-1 provides an overview of the proposed local access road network along the Proposal.

Where required, local access roads would pass over or under the Proposal. Although there would be some lengths of newly constructed local access roads the existing road infrastructure is to be included in the access road scheme where possible.

All access to the Proposal would be at the proposed grade-separated interchanges and no other direct access to properties or local roads would be available. Local traffic would have the choice of accessing the highway at these access points or continuing along the local access road network.

A local access road working group was established to seek community input regarding possible refinements to existing local access roads in the section of the Proposal between the Nambucca and Ballards Road interchanges. The project team met with the working group initially to obtain thoughts and ideas in relation to the location of new local access roads, and then reported back to the group with the design outcomes that considered input from the initial meeting. The design outcomes were on balance supported by the group. Consequently, a number of new local access roads have been incorporated into the Proposal.

Table 6-1 Local access road strategy

Local access road location	Local access road strategy
Warrell Creek interchange to Scotts Head Road.	The existing highway through the township of Warrell Creek would be maintained as a local access road. Access to and from the upgrade from Warrell Creek and Donnellyville would be from the Bald Hill Road interchange or the interchange south of Warrell Creek. Over-bridges across the Proposal would be provided for local access east of the saw mill on Cockburns Lane, at Rosewood Road and at Albert Drive to prevent local severance between the Warrell Creek and Donnellyville communities. An underpass would be provided for the local quarry access, connecting to the existing highway on the western side of the upgrade via Scotts Head Road. Access to Scotts Head would be unchanged with vehicles using the existing Scotts Head Road intersection. Local access roads would be constructed south of Cockburns Lane and at Albert Drive across the upgrade.
Scotts Head to the Nambucca River	The Proposal would run parallel to, and on the eastern side of, the existing highway. The existing bridge over Warrell Creek would be retained for local traffic, along with much of the existing highway pavement north of Warrell Creek. Local traffic from Macksville would utilise this road to access Warrell Creek and Donnellyville. Motorists heading further north than Macksville could use the Bald Hill Road interchange to access the Proposal with northbound on-ramps provided. Likewise, those heading further south than Warrell Creek could access the Proposal at this location using the southbound onramps. Northbound and southbound off-ramps are also provided for motorists on the Proposal wanting to access the local road network. A local access road would be constructed between the northern approach of the existing highway bridge over Warrell Creek and the proposed bald Hill Road interchange.
Nambucca River to Nambucca interchange	Access into Macksville from the north would be via the Nambucca Heads interchange. Following consultation with local emergency services, an emergency service access would be provided between Old Coast Road and Mattick Road. Bridges for local access are provided across the Proposal where it crosses the existing highway and Old Coast Road, Letitia Close and Mattick Road. These changes, along with the realignment of some sections of Old Coast Road north of Mattick Road, would enable local access to be maintained in this area. A local access road to provide access into the state forest north of Mattick Road has also been included. Additionally, the existing highway would be maintained as a connector/local access road between Macksville and Nambucca Heads.
Nambucca Heads interchange to Ballards Road interchange	The Nambucca Heads Interchange provides access to Nambucca Heads, Bowraville, Valla, Valla Beach and Macksville from the north. Through this section, local access is maintained east of the upgrade via the existing highway. West of the upgrade, local access is provided across the upgrade via an underpass at Valla Road and an overpass at East West Road. A new local access road connects Deep Creek Road and Burkes Lane to the East West Road overbridge, also providing access to the state forest in the north and various properties west of the Proposal. The existing Pacific Highway would be realigned to the east between Cow Creek and Boggy Creek to avoid an important Aboriginal site on the western side of the existing highway.
Ballards Road interchange to Kalang River	Access is provided to the existing Pacific Highway at the Ballards Road interchange giving access to Urunga from the south and Valla Beach from the north. A minor access is realigned at Dalhousie Creek and an over-bridge is provided at Martells Road to maintain property access.

Local access road location	Local access road strategy
Kalang River to Waterfall Way interchange	An overbridge is provided for a severed property access road approximately 1 km north of the Kalang River crossing and an overbridge is provided at Short Cut Road to maintain local access. The Waterfall Way interchange has been modified to allow access to Urunga from the north.

6.5 Design elements

As noted in Section 6.2, all components of the Proposal would be designed to be consistent with the Upgrading the Pacific Highway, Upgrading Program beyond 2006: Design Guidelines (RTA 2006). These guidelines provide minimum geometric standards and treatments in relation to cut and fill batters, bridge widths, typical pavement designs, drainage and water quality requirements, and roadside furniture details. The various design components, specific to the concept design for the Proposal, are outlined in the following sections.

6.5.1 Carriageways

The Proposal consists of two carriageways, each comprising two 3.5 metre traffic lanes, a 2.5 metre left-hand (outer) shoulder and 0.5 metre right-hand (inner) shoulder. The minimum width of the median separating the carriageways would be generally 12 metres and would generally be depressed to facilitate drainage. The 12 metre wide median would also provide sufficient width to upgrade the Proposal to six lanes if required in the future. The median would be landscaped to assist in reducing headlight glare across the carriageways. Typical cross-sections of the Proposal have been prepared and are provided in Figure 6-9 and Figure 6–10 to Figure 6-19.

Where possible, a minimum separation of 25 metres between local roads and the carriageways of the Proposal has been provided to allow for landscaped headlight screening. In areas where this is impractical, the requirement for headlight screening and methods to accomplish this would be developed as part of the detailed design. Medians would be revegetated to reduce headlight glare and to break up the hard paved carriageways of the Proposal. Sight distance curves would be considered in the placement of median planting.

FIGURE 6-9 | LOCATION OF TYPICAL CROSS SECTIONS OF THE UPGRADED HIGHWAY

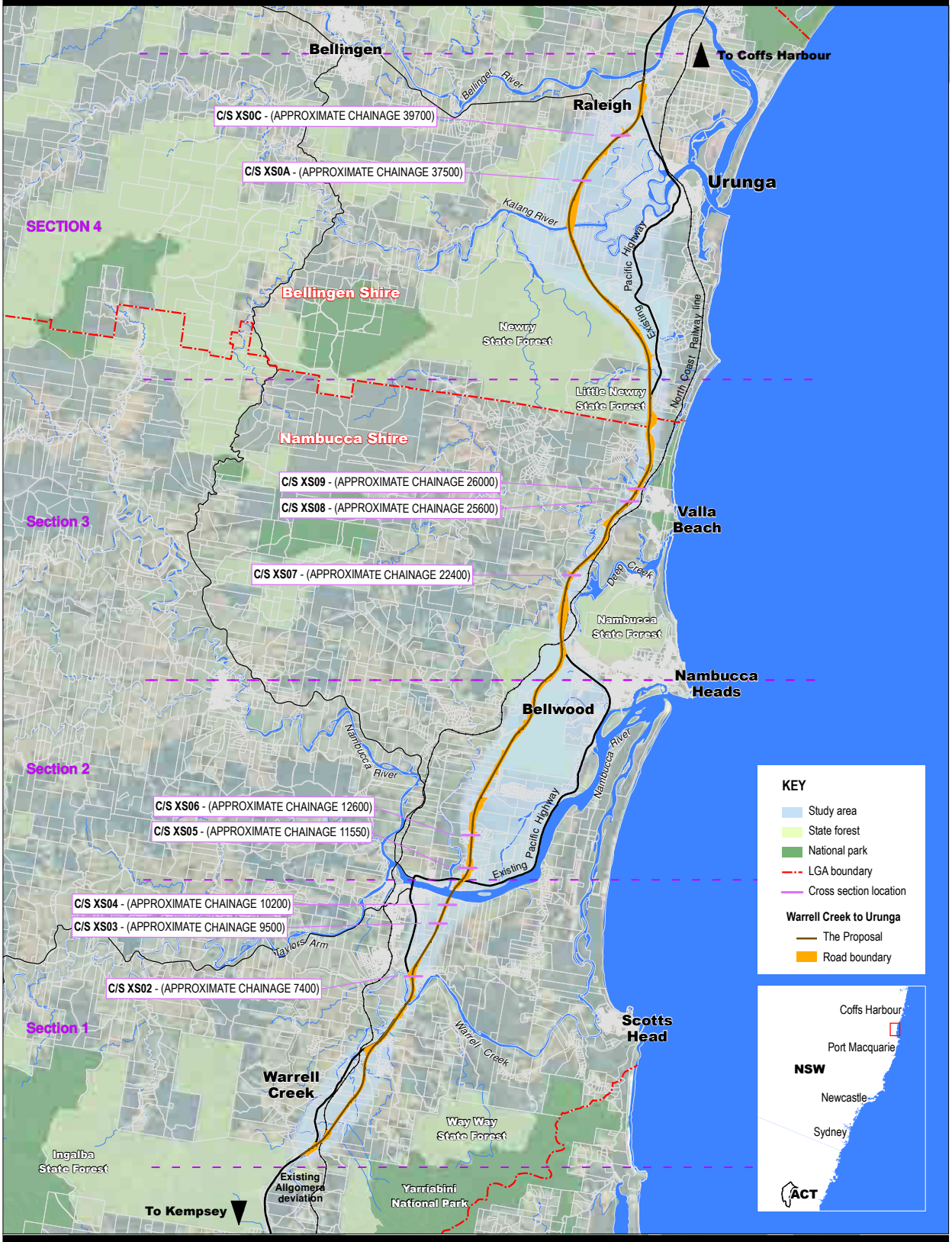


Figure 6-10 Typical cross section at Bald Hill Road interchange looking north (approximate chainage 7400 m)

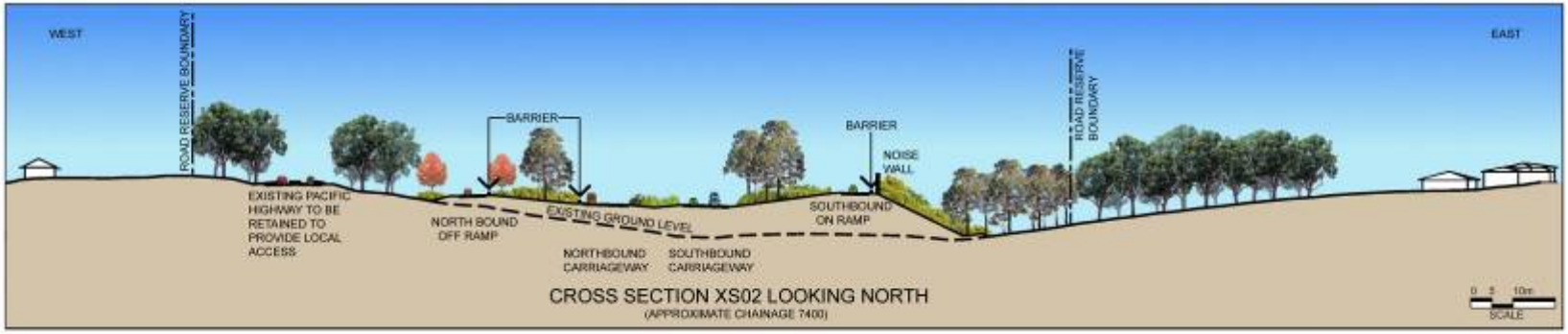


Figure 6-11 C/S XS03 Typical cross section east of Macksville looking north (approximate chainage 9500 m)

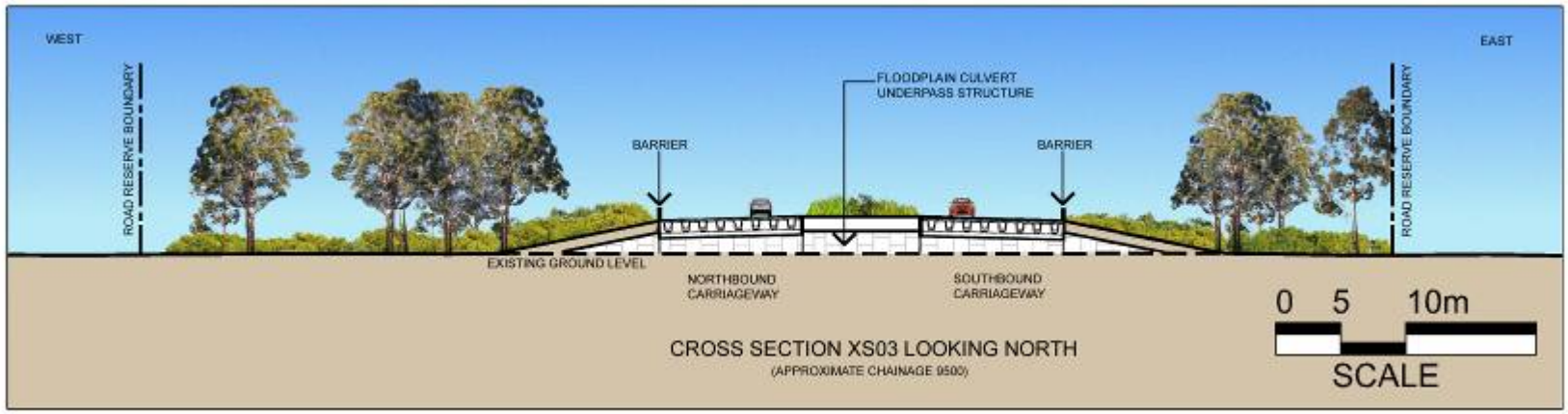


Figure 6-12 C/S XS04 Typical cross section south of Nambucca River looking north (approximate chainage 10200 m)

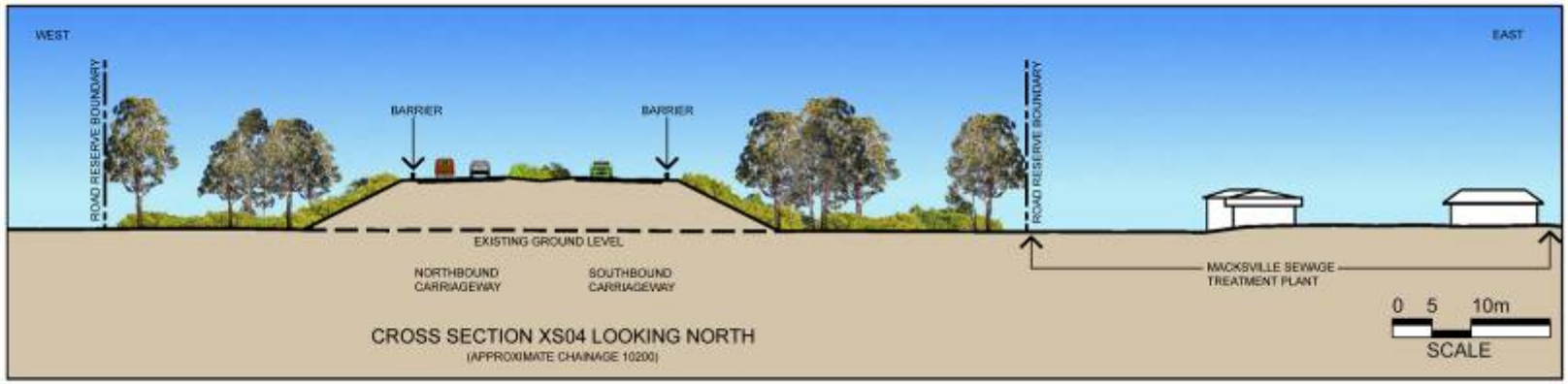


Figure 6-13 C/S XS05 Typical cross section at Old Coast Road near Letitia Close looking north (approximate chainage 11550 m)

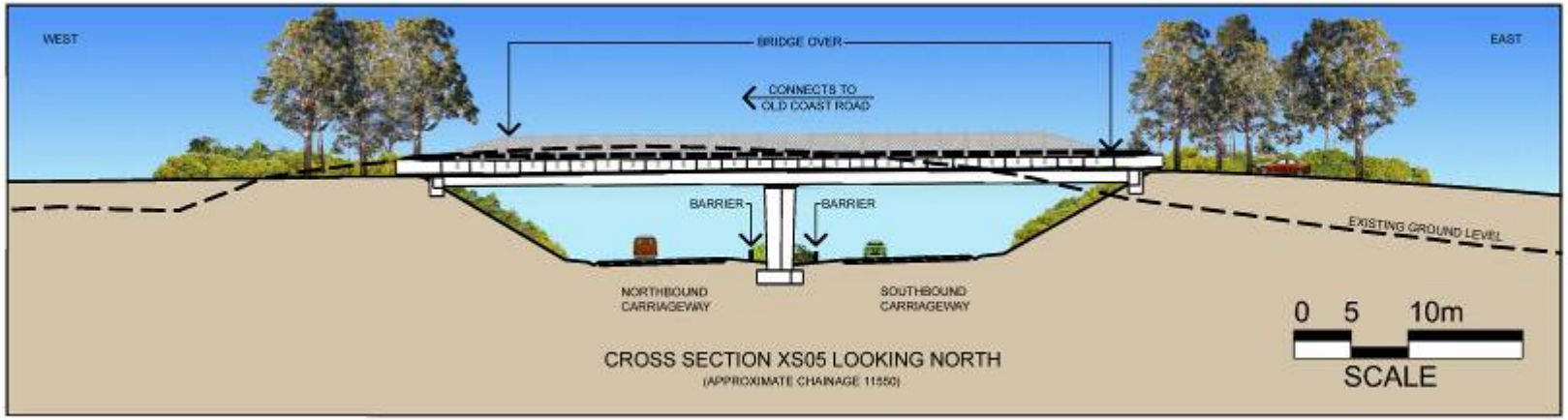


Figure 6-14 C/S XS06 Typical cross section at Mattick Road looking north (approximate chainage 12600 m)

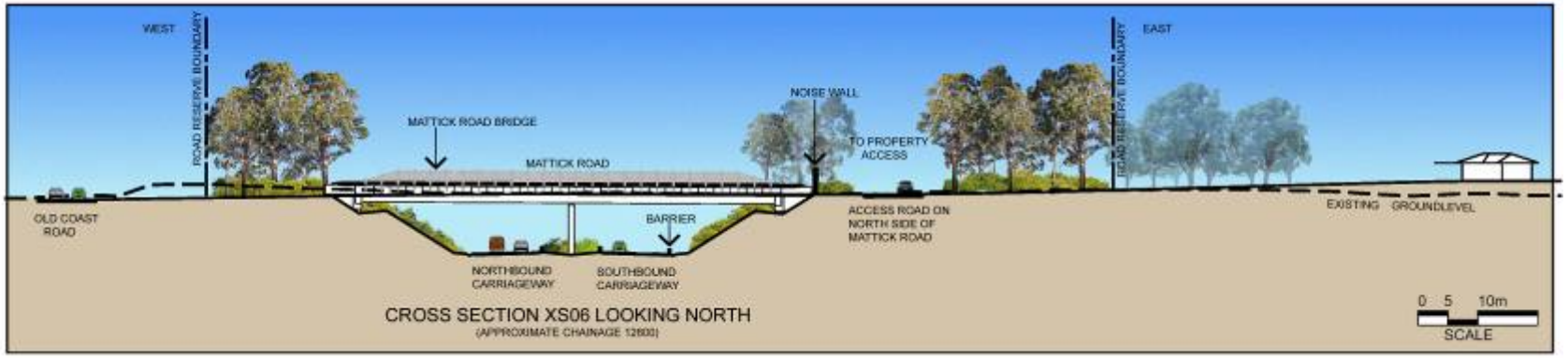


Figure 6-15 C/S XS07 Typical cross section at Valla Road looking north (approximate chainage 22400 m)

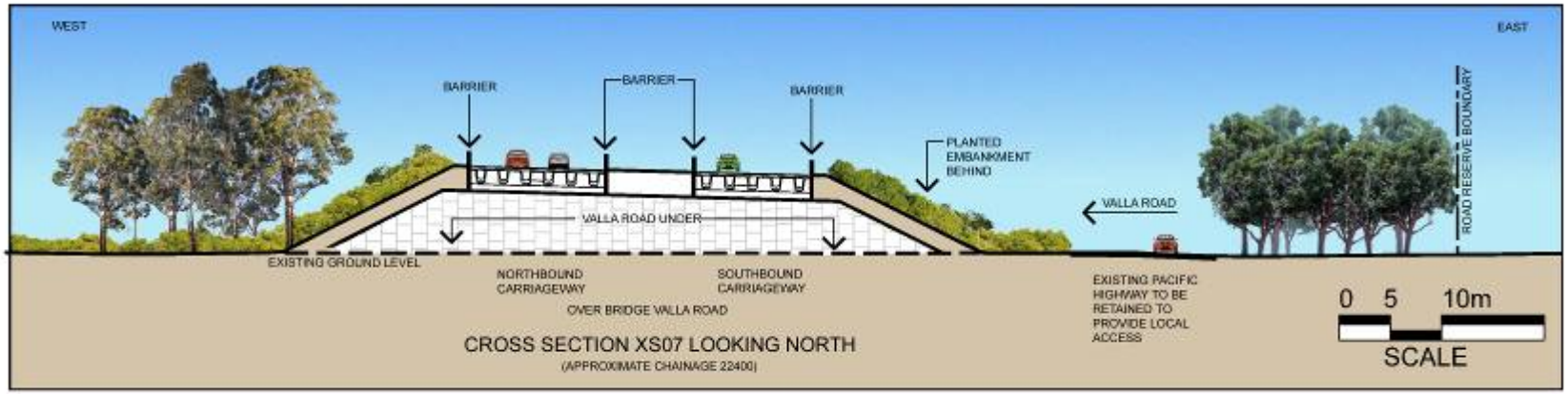


Figure 6-16 C/S XS08 Typical cross section near Valla Beach looking north (approximate chainage 25600 m)

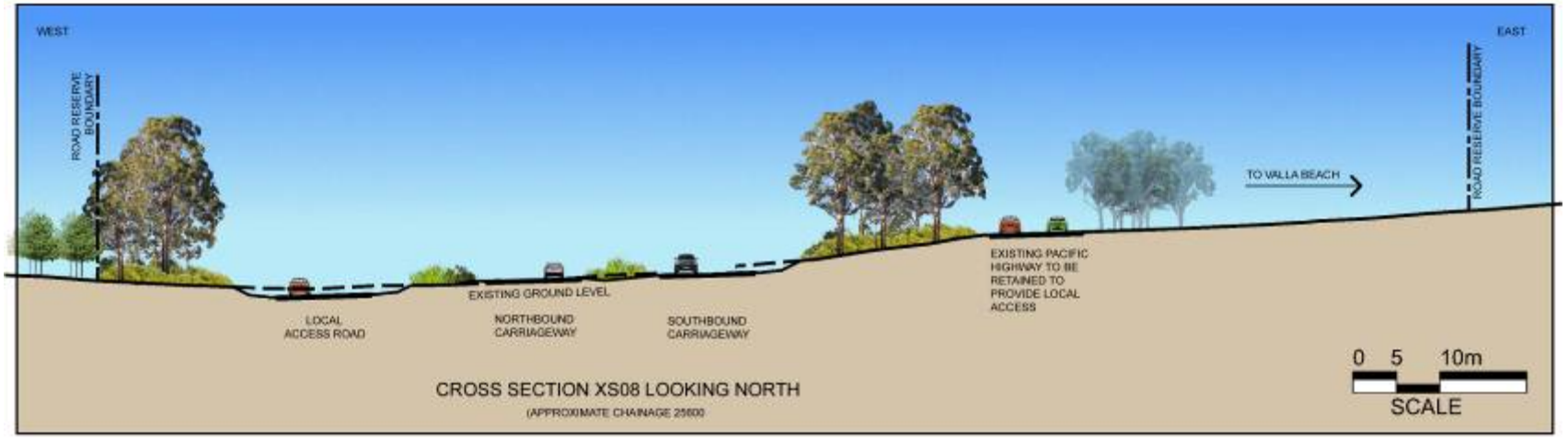


Figure 6-17 C/S XS09 Typical cross section at East West Road looking north (approximate chainage 26000 m)

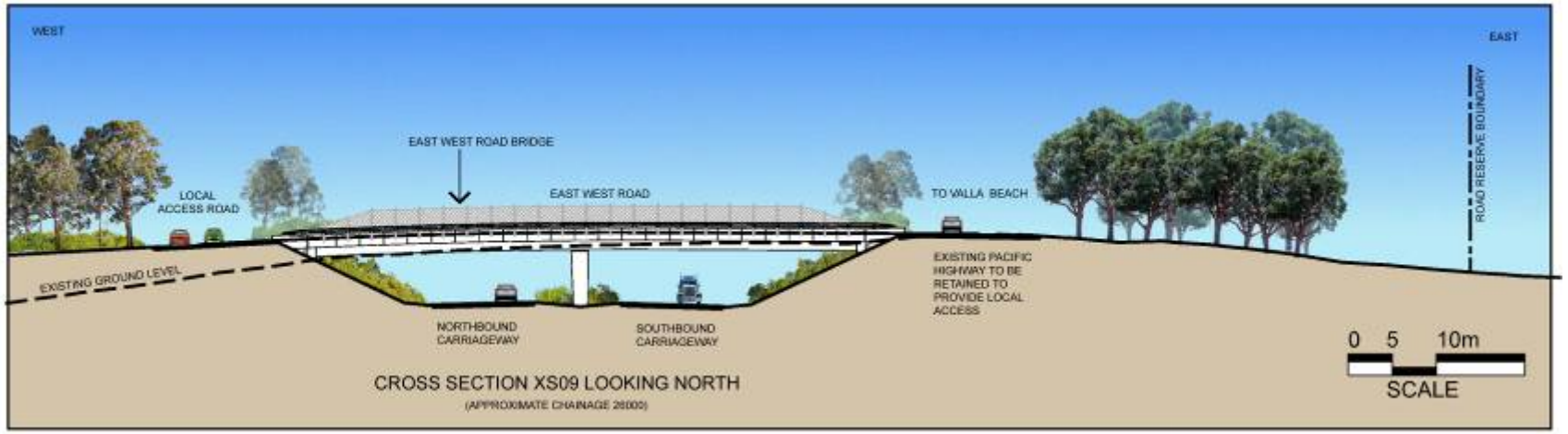


Figure 6-18 C/S XS0A Typical cross section through the forest north of Kalang River looking north (approximate chainage 37500 m)

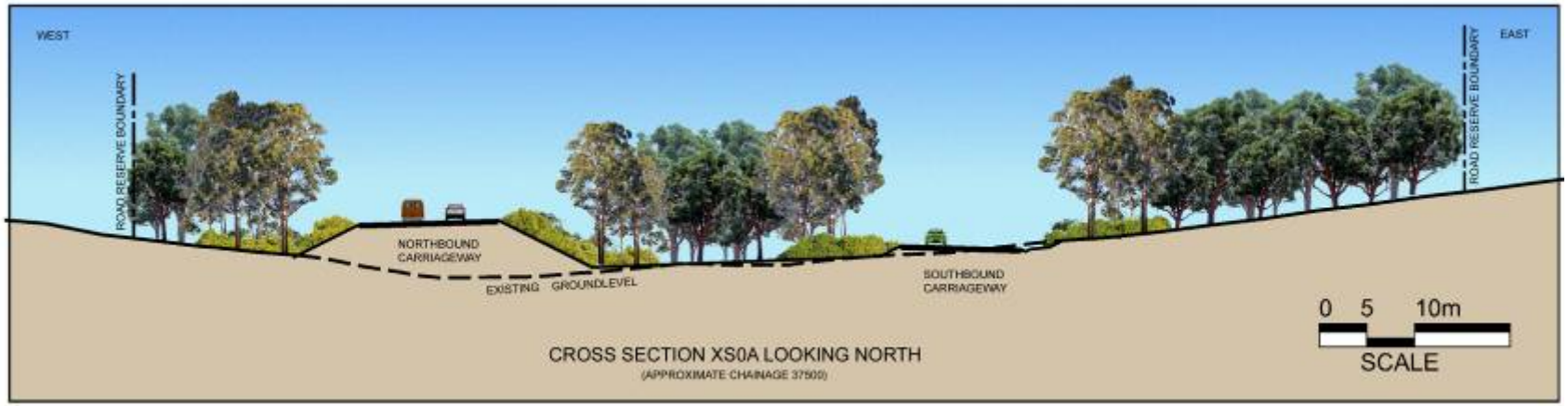
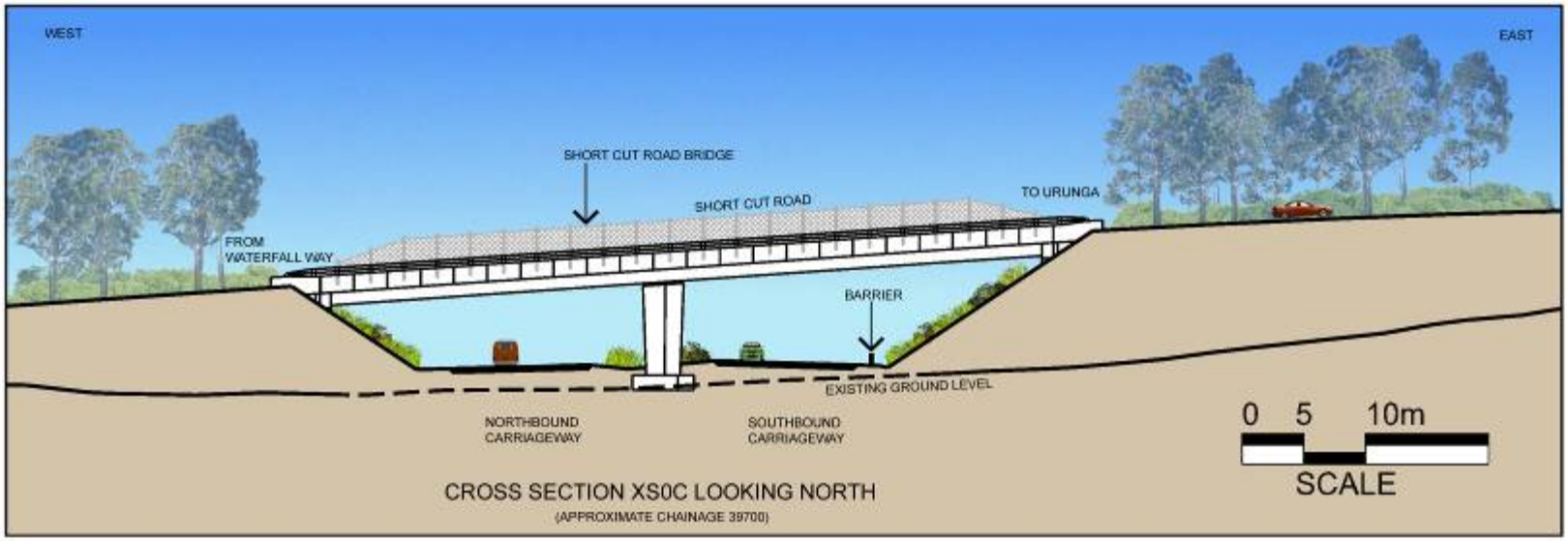


Figure 6-19 C/S XS0C Typical cross section at Short Cut Road looking north (approximate chainage 39700 m)



6.5.2 Earthworks

Cut and fill batters would be provided where the outer extremities of the Proposal and / or the local access roads are respectively below or above the natural ground level. Where the Proposal would be below the existing ground level, a cut batter would be established in earthworks to meet desired pavement and sub-grade levels. Where the Proposal would be on embankment (or fill), the earth formation would be initially wider and then progressively reduced as it is raised to meet the required level of the road surface. Chapter 7 – *Construction of the Proposal* provides further detail regarding earthworks.

The concept design has been developed to provide an earthworks cut and fill balance within individual sections and between major river crossings in order to reduce possible spoil transportation difficulties and associated costs. The typical cutting and fill heights are shown in Table 6-2.

Table 6-2 Typical Cutting Depths and Fill Heights

Section	Approximate cutting depth[1, 2]		Approximate fill height[1, 2]	
	Max cut	Typical cut	Max fill	Typical fill
Allgomera Deviation to Nambucca River	17 metres	12 metres	18 metres	8 metres
Nambucca River to Nambucca Heads	16 metres	8 metres	16 metres	7 metres
Nambucca Heads to Ballards Road	12 metres	8 metres	9 metres	5 metres
Ballards Road to Waterfall Way interchange	24 metres	10 metres	12 metres	8 metres

[1] - The cutting depths and fill heights would be further refined during the detailed design phase.

[2] - Some cut batters may be widened for additional fill material.

In general terms both cut and fill batters would be sloped at a 2:1 horizontal to vertical ratio. Where deeper cuttings are expected to encounter competent rock, or where localised property constraints require a narrow formation, the cut slope could be steepened from the 2:1 horizontal to vertical, subject to further detailed geotechnical investigation to be undertaken at the detailed design stage.

The extent and locations of potential steepening to cut slopes would be confirmed following future geotechnical investigations undertaken at the detailed design phase.

Both cut and fill batters would be revegetated with native trees, shrubs and groundcovers, consistent with clear zone and sight line requirements and in accordance with the planting and seeding scheme described in Chapter 13 – *Visual amenity and design*.

6.5.3 Bridges

A total of 27 bridge or bridge sized structures are included in the Proposal, including new or replacement bridges over existing creeks or for underpasses / overpasses associated with grade separations at interchanges, local road crossings or property accesses. The bridges or large box culvert structures required as part of the Proposal are identified in Table 6-3 and can be categorised as follows:

- Transverse bridges at interchanges and local road overpasses that provide safe cross-highway access. Throw screens would be installed on all transverse overpass structures.
- Transverse underpass structures that provide for local road and / or multiple property accesses.
- Longitudinal bridges where the proposed highway upgrade and / or the local access roads cross major creeks.

The bridge concept designs included in the Proposal were developed to meet specific functional and operational requirements. Designs are indicative and would be further refined during the detailed design phase of the Proposal. The detailed design of bridges would be based on the following principles:

- Bridges would be designed to comply with *Australian Standard AS 5100 – Bridge Design, RTA Policy Circulars and RTA Technical Directions*.
- Achieve span configurations, elements and components consistently throughout the whole corridor which meet safety and environmental requirements and also minimise maintenance cost. Where necessary, span configurations would be matched to existing structures and/or matched to the requirements of Maritime NSW to ensure adequate clearances for river vessels.
- Bridges would be designed to ensure that they minimise flooding impacts.
- Hydraulic design, ground surveys and geotechnical investigations would be ongoing throughout the detailed design process. The results of these designs, surveys and investigations would be used to refine the concept design during the detailed design phase of the Proposal.

Table 6-3 Proposed bridge locations and descriptions

Approximate location	Bridge type[1]	Description
Transverse structures		
1300 km	Overbridge	Local access road bridge at Cockburns Lane
3500 km	Overbridge	Local access road bridge at Rosewood Road
4370 km	Overbridge	Local access road bridge at Albert Drive
7450 km	Overbridge	Local access road bridge as part of Bald Hill Road interchange
11430 km	Overbridge	Local access road bridge at Old Coast Road
12680 km	Overbridge	Local access road bridge at Mattick Road
19050 km	Overbridge	Local access road bridge at Old Coast Road
20650 km	Overbridge	Local access road bridge as part of Nambucca Heads interchange
25830 km	Overbridge	Local access road bridge at East West Road
30530 km	Overbridge	Local access road bridge as part of Ballards Road interchange
33630 km	Overbridge	Local access road bridge at Martells Road
36640 km	Overbridge	Property access off South Arm Road
39590 km	Overbridge	Local access road bridge at Short Cut Road
Longitudinal structures		
620 km	Upper Warrell Creek and North Coast Railway Line	Twin highway bridges

Approximate location	Bridge type[1]	Description
5750 km	Adjacent to quarry	Twin highway bridges to provide underpass for quarry vehicles
6300 km	Warrell Creek	Twin highway bridges to match the existing bridge which is to be retained.
9050 km	Gumma floodplain	Floodplain No 1 twin highway bridges
9450 km	Gumma floodplain	Floodplain No 2 twin highway bridges
10250 km	Nambucca River	Twin highway bridges over River Street, Nambucca River and existing Pacific Highway north of the Nambucca River
19940 km	North Coast Railway Line	Twin highway bridges
20880 km	Boggy Creek	Twin highway bridges plus two slip lane bridges and a local access road bridge all part of the Nambucca Heads interchange
21740 km	Cow Creek	Twin highway bridges plus local access road bridge
22340 km	Valla Road	Twin highway bridges over Valla Road
23040 km	Deep Creek	Twin highway bridges
35120 km	South of Kalang River	Floodplain No 3 twin highway bridges
35800 km	Kalang River	Twin highway bridges over Kalang River and South Arm Road north of the Kalang River – refer to Table 6-4.
38000 km	North of Kalang River	Twin highway bridges to provide fauna underpass

[1] - The indicative bridge structures would be further refined during the detailed design phase.

The bridges over the Nambucca and Kalang Rivers would be substantial structures. Table 6-4 provides information on the features of the two bridges.

Table 6-4 Key features of the Nambucca River and Kalang River bridges

Feature	Nambucca River	Kalang River[1]
Minimum NSW Maritime requirement	Two adjacent spans with a 35m horizontal clearance over the navigation channel or a single span with a 60m horizontal clearance.	Two adjacent spans with a 35m horizontal clearance over the navigation channel or a single span with a 60m horizontal clearance.
Length	Approximately 390 metres.	Approximately 170 metres.
Vertical clearance	Minimum 7.5 metres at the southern end and 8.8 metres at the northern end.	Minimum 8.3 metres.
Lane width	2 x 3.5 metres with 2.5 metres inside shoulder and 1 metre outside shoulder.	2 x 3.5 metres with 2.5 metres inside shoulder and 1 metre outside shoulder.
Pedestrian facilities	Nil	Nil
Bicycle facilities	On shoulder only –alternative (local access) route available using existing highway bridge.	On shoulder only –alternative (local access) route available using existing highway bridge.

[1] - The indicative bridge structures would be further refined during the detailed design phase, for example the Nambucca bridge length is variable depending upon the option used to cross the existing highway.

Bridge features (both superstructure and substructure) would be consistent with the Upgrading the Pacific Highway, Upgrading Program beyond 2006: Design Guidelines (RTA 2006). If the Proposal is approved, the contractor would have the opportunity to further investigate appropriate structure types and construction methods during the detailed design phase and consistent with the conditions of approval.

Abutment areas beyond the bridge deck would, where appropriate and in line with clear zone and sight line requirements, be revegetated with native trees, shrubs and groundcover species. Vegetation would comply with the urban and landscape design plans for the Proposal and, in the case of underpasses that allow fauna movement, would provide cover for fauna that may use the structures for movement under the highway. In addition to the bridge structures, there are numerous drainage and/or fauna crossings that would be incorporated as part of the Proposal. These structures are discussed in Section 6.5.4.

6.5.4 Drainage and water quality treatments

The drainage system for the Proposal would comprise the following key components:

- Cross–drainage (transverse drainage).
- Pavement drainage (longitudinal drainage) and subsurface drainage.
- New open channels.
- Existing channel and waterway diversions.
- Water quality treatment, where required.

The design is based on the requirements of the RTA's Upgrading the Pacific Highway, Upgrading Program beyond 2006: Design Guidelines (RTA 2006) and Road Design Guide (RTA 2000b). The Managing Urban Stormwater: Soils and Construction series (Department of Housing 2004 and DECC 2008c), known as the "Blue Book", has been used for sizing the proposed temporary sediment basins. In addition, the requirements of Australian Rainfall and Runoff (Pilgrim et al 1998) have been incorporated into the design. Any updating of these design standards would need to be considered in the detailed design process.

6.5.4.1 Cross drainage

Cross drainage of the Proposal would be by bridges and culverts to allow the passage of a 1 in 100 year flood event. The outside edge line of the road would also be designed to be above the water levels generated by such an event. The different sections of the Proposal require alternative design treatments for cross drainage structures. The section of the Proposal which traverses generally parallel to the existing highway between the Nambucca interchange and Ballards Road interchange largely requires the extension and / or augmentation of existing culverts and the provision of new bridges at the major creek crossings. All drainage and bridge structures on sections of the Proposal deviate from the existing Pacific Highway would be new.

Bridges and culverts have been designed in accordance with the Fairfull and Witheridge guidelines (2003) Why do fish need to cross the road? Fish passage requirements for waterway crossings. Additionally, construction of 'fishways' at potential barriers to enable migration of fish and macroinvertebrates during construction and operation has been included in the design (see Section 10.5.3).

Table 6-5 identifies the main watercourses crossed by the Proposal and the proposed drainage structure for each watercourse. The table also identifies the drainage structures that serve the dual function of both drainage structure and wildlife crossing. The combined structures would include ledges where required to allow dry passage for fauna

across the alignment. There are a number of major drainage structures that would require augmentation, and these are also identified in Table 6-5. However, there are also a number of minor drainage structures that would require augmentation.

6.5.4.2 Proposed pavement drainage (longitudinal drainage)

The pavement drainage system for the Proposal includes gutters, pits, channels and pipes, which in turn:

- Collect stormwater safely from the road pavement in a gutter, a median drain, or in catch drains at the toe of the road embankment. Pavement drainage would be designed as part of the detailed design of the Proposal.
- Convey the collected 'dirty' stormwater from the road pavement through a water quality treatment device, where installed. Clean runoff from external catchments would bypass water quality treatment devices and be conveyed directly to receiving waters via diversion drains.
- Discharge the stormwater from a ten-year Average Recurrence Interval (ARI) storm.

When the alignment crosses a floodplain, a 4:1 horizontal to vertical ratio batter slope has been adopted to avoid the need for longitudinal drainage on the tops of the batters. In adopting this approach, the slopes used in the medians would be varied to generate some longitudinal grades for drainage purposes. Batter slopes would be refined during the detailed design stage.

In areas of cut, pavement drainage lines would be directed towards the median and in areas of high fill, batter drains would be used to reduce scouring.

6.5.4.3 Open channels

Open channels would be used to:

- Re-direct surface runoff away from the highway pavement and formation.
- Direct road water runoff to water-quality treatment facilities.
- Direct uncontaminated water around water-quality treatment facilities.
- Direct water to transverse culvert and bridge openings.

In designing new open channels, the following design criteria would be considered in the detailed design of the Proposal:

- Channel capacity is to be greater than or equal to a five-year ARI storm event.
- Consideration is to be given to impacts in the event of channel overflows, with the channel capacity increased as necessary to manage the risk of adverse impacts. The channel capacity would be designed for a 100-year ARI storm event where overflows would affect the Proposal or adversely impact on adjoining properties.
- Median channels would be provided with a minimum longitudinal grade of 0.5 per cent.

Table 6-5 Indicative proposed cross-drainage structures

Watercourse[1]	Approximate chainage (m)	Proposed treatment	Indicative size and configuration[2]	Fauna crossing	Watercourse[1]	Approximate chainage (m)	Proposed treatment	Indicative size and configuration[2]	Fauna crossing
	1050	Box Culvert	3300 x 900			22640	Circular Culvert	2 x 1200	
	1070	Box Culvert	2 x 3300 x 900			24305	Box Culvert	2700 x 900	Incidental
Butchers Creek	1560	Box Culvert	13 x 1800 x 1500			24340	Circular Culvert	750	
	1995	Circular Culvert	1200			25165	Circular Culvert	3 x 600	
	2675	Circular Culvert	600			25255	Box Culvert	2400 x 2400	Combined
Rosewood Creek	2715	Box Culvert	5 x 2100 x 900			25820	Circular Culvert	4 x 1200	
	3140	Box Culvert	2 x 2700 x 1200			26220	Box Culvert	7 x 2100 x 1500	
Stony Creek	3760	Box Culvert	3 x 3600 x 3600	Incidental		26535	Box Culvert	5 x 3600 x 1200	Combined
	3815	Box Culvert	3 x 3600 x 3600			27005	Circular Culvert	2 x 600	
	3845	Box Culvert	3 x 3600 x 3600			27245	Circular Culvert	1200	
	3920	Circular Culvert	1200			27280	Box Culvert	1800 x 900	
	4660	Circular Culvert	900			27750	Circular Culvert	2 x 900	
	4730	Circular Culvert	750			27845	Circular Culvert	4 x 1200	Incidental
	5760	Box Culvert	3000 x 1200	Incidental		28195	Circular Culvert	3 x 900	
	7300	Box Culvert	1500 x 600			28275	Circular Culvert	3 x 1200	Incidental
	8115	Box Culvert	2 x 1800 x 900			28565	Box Culvert	2 x 2400 x 1200	Incidental
	8450	Box Culvert	14 x 3600 x 1800	Incidental		29215	Circular Culvert	2 x 1200	Incidental
	9010	Box Culvert	6 x 2100 x 1800			30645	Circular Culvert	600	
	9220	Box Culvert	14 x 3600 x 2100	Incidental		30855	Box Culvert	2100 x 900	Combined
	9515	Box Culvert	16 x 3600 x 1800			30950	Circular Culvert	600	
	11180	Circular Culvert	600			31190	Circular Culvert	750	

Watercourse[1]	Approximate chainage (m)	Proposed treatment	Indicative size and configuration[2]	Fauna crossing	Watercourse[1]	Approximate chainage (m)	Proposed treatment	Indicative size and configuration[2]	Fauna crossing
	11680	Circular Culvert	2 x 600			31480	Box Culvert	4 x 2100 x 1200	
	11890	Circular Culvert	2 x 600			31510	Box Culvert	4 x 2100 x 1200	Combined
	12130	Circular Culvert	2 x 600			31760	Circular Culvert	4 x 1200	
	12505	Circular Culvert	2 x 900			31890	Circular Culvert	4 x 1200	
	12855	Circular Culvert	2 x 600			31920	Circular Culvert	3 x 1200	
	13055	Circular Culvert	2 x 750			32075	Box Culvert	2400 x 1200	Combined
	13185	Circular Culvert	450			32710	Circular Culvert	1200	
	13285	Box Culvert	2400 x 1200	Combined		32780	Box Culvert	2400 x 2400	
	13540	Circular Culvert	2 x 600			33010	Circular Culvert	4 x 1200	
	13630	Circular Culvert	2 x 600			33395	Circular Culvert	3 x 1200	Incidental
	13970	Circular Culvert	900			33880	Box Culvert	2400 x 1200	Incidental
	14060	Circular Culvert	900			34150	Circular Culvert	750	
	14555	Circular Culvert	3 x 750			34380	Box Culvert	3 x 2700 x 1200	Combined
	14665	Circular Culvert	900			34615	Box Culvert	3 x 2700 x 1200	Incidental
	14855	Circular Culvert	900			35095	Box Culvert	23 x 3600 x 3000	Combined
	15000	Circular Culvert	900			36025	Box Culvert	8 x 3600 x 3600	
	15765	Circular Culvert	2 x 600			36300	Circular Culvert	900	
	15885	Box Culvert	2400 x 1200	Combined		36460	Circular Culvert	900	
	16205	Circular Culvert	2 x 900			36905	Box Culvert	2 x 2400 x 1200	Combined
	16630	Box Culvert	3 x 3600 x 1200	Combined		37155	Circular Culvert	900	
	17205	Box Culvert	2400 x 1500	Combined		37470	Circular Culvert	900	
	17445	Circular Culvert	2 x 600			38145	Circular Culvert	3 x 1200	
	17695	Circular Culvert	900			38330	Box Culvert	2 x 3000 x 1500	Combined

Watercourse[1]	Approximate chainage (m)	Proposed treatment	Indicative size and configuration[2]	Fauna crossing	Watercourse[1]	Approximate chainage (m)	Proposed treatment	Indicative size and configuration[2]	Fauna crossing
	17720	Box Culvert	2400 x 2400	Adjacent dedicated crossing		38600	Circular Culvert	1200	
	17935	Circular Culvert	3 x 1200			38870	Circular Culvert	2 x 900	
	18395	Circular Culvert	750			39010	Circular Culvert	2 x 600	
	18515	Box Culvert	2400 x 1200	Combined		39395	Circular Culvert	2 x 600	
	18570	Box Culvert	2400 x 1200			39615	Circular Culvert	2 x 600	
	18695	Circular Culvert	750			39675	Box Culvert	2 x 2100 x 600	
	18940	Circular Culvert	600			39990	Box Culvert	17 x 3300 x 2100	Incidental
	19350	Circular Culvert	750	Incidental		40510	Box Culvert	9 x 3000 x 2100	
	19820	Box Culvert	5 x 2400 x 2100	Combined		41075	Circular Culvert	4 x 1200	
	20330	Circular Culvert	2 x 900			41115	Circular Culvert	4 x 600	
	20505	Circular Culvert	2 x 900			41195	Circular Culvert	2 x 900	
	21130	Circular Culvert	2 x 1200			41215	Circular Culvert	4 x 600	
	22310	Box Culvert	3 x 2400 x 600			41300	Circular Culvert	2 x 900	
	22640	Circular Culvert	2 x 1200						

[1] - Where no watercourse name is given, structures are located at natural low points (depressions) along the alignment.

[2] - The indicative size and configuration would be further refined during the detailed design phase.

- Median channels with a height difference between the channel invert and the edge of a road of less than 250 millimetres or grades generally less than one per cent would be concrete-lined.
- Channels would be protected against erosion for storms up to the 20-year ARI storm event.

Preliminary sizings have been undertaken for major catch drains along the length of the Proposal to ensure sufficient width is available within the Proposal boundary. Final sizings and sizing of minor catch drains would be confirmed during the detailed design stage.

6.5.5 Provision for fauna movement

A number of culverts included in the Proposal have been designed to, as far as practical, cater for effective fauna movement and drainage and areas as described in Table 6-5.

The fauna movement structures (including combined drainage / fauna friendly structures and dedicated fauna movement locations) are identified in detail in Chapter 10 – *Flora and fauna*. Examples are provided in Plate 1 and Plate 2. Dedicated structures for fauna movements would occur mostly within state forest areas and/or where there is movement toward and from SEPP 14 wetlands. In order to encourage the use of these fauna movement structures, fauna exclusion fencing would be erected along the majority of the alignment of the Proposal where it is bordered by native vegetation to direct fauna movement to appropriate crossing points.

Plate 1 Example fauna movement structure

The Proposal also includes a dedicated fauna movement structure that has been positioned in a known fauna movement corridor within Newry State Forest. This would assist with east-west movements for species in the area including Koalas, quolls and phascogales, which may not use the combined drainage structures associated with the riparian habitats.

Plate 2 Example combined fauna / drainage structure

Combined fauna / drainage structures may include the following features:

- Fauna refuge poles may be provided around selected underpasses.
- Revegetation would favour fauna species likely to use the underpass.

To facilitate fauna movement under the Proposal, under-bridge structures such as refuge poles would be installed as appropriate. Additionally, in known fauna corridors, tree and shrub vegetation would continue to the edge of the bridge to provide protection from predators to the animals that may use the riparian habitats. Fauna refuge poles would also be installed.

In consultation with the DECCW, medians have been widened in areas of known glider movement with the intention of retaining mature vegetation in the median. This enables gliders to negotiate a crossing of one carriageway to mature vegetation in the median. The gliders can then negotiate the crossing of the next carriageway. Exclusion fencing would be required in these wide median areas to prevent fauna from entering the carriageways from the median.

6.5.6 Pavements

A number of different pavement design types would be applied to various sections of the Proposal. The new dual carriageways would consist of a heavy duty pavement, as outlined in the Upgrading the Pacific Highway, Upgrading Program beyond 2006: Design Guidelines (RTA 2006) with a nominal design life of 40 years. Interchange ramps and intersections with connecting local roads, including the sections of new local access roads, could have a different pavement configuration. Local road pavements would be designed in accordance with Council requirements and would generally be granular with a sprayed surface unless a heavy duty pavement is required. The design of the Proposal and local access road pavements would be undertaken during the detailed design stage.

Where opportunities exist to incorporate the existing highway into the Proposal (such as the local access roads or tie-in points), pavement treatments could include a series of different designs, ranging from resealing with very fine aggregate, to thin asphalt overlays or more substantial pavement restoration and overlay works. In all cases, a pavement design would be undertaken for the expected traffic composition and foundation conditions.

An integral part of the pavement design is the proposed wearing surface of the respective carriageways and the contribution that can make to reducing noise from traffic. A low noise pavement assists in reducing road traffic noise to nearby receptors and is included in the Proposal at the indicative locations identified in and summarised in Section 6.5.11 and in more detail in Chapter 14 – *Noise and vibration*. These locations have been determined following a detailed analysis of reasonable and feasible measures to achieve the required noise criteria.

6.5.7 Pedestrians and cyclists

No longitudinal pedestrian facilities have been included in the Proposal for safety reasons. Cyclists are provided for on the 2.5 metre shoulder. Alternative cycle access is also available using the existing highway which would become a local access road. Footpaths on the overbridges nominated above would provide access for cyclists across the Proposal.

On local road overbridges, a footpath may be provided on one or both sides, depending on the likely pedestrian traffic. Elsewhere, pedestrian access would be on the shoulder of the local roads. Initial investigations and following

consultation feedback have resulted in the provision of footpaths on the Mattick Road, Nambucca Heads interchange and East West Road overbridges.

Signposting and crossing points would be provided for cyclists at the interchange ramps. Cycle access on local roads and accesses would only be available on the road or shoulder provided unless a specific need for a separate cycleway was identified through the detailed design phase.

6.5.8 Local bus stop arrangements

The existing highway is currently used by a number of bus routes, including routes servicing school bus travel. The Proposal has been designed to enable these bus services to continue on their current routes. Where the Proposal affects any local bus stops as a result of minor realignment of the existing highway, stops would be reinstated on the realigned section of the existing highway. The expected lower levels of traffic on the existing highway are anticipated to improve safety for local bus passengers using the existing highway.

6.5.9 Road furniture and fencing

On completion of the earthworks, structures, drainage and pavement construction, the Proposal would be fitted with a variety of "roadside furniture" elements to provide for safety, delineation, directional guidance and security along the length of the Proposal. These elements form an integral part of the Proposal and are outlined below. The location and design of these facilities would be refined during the detailed design of the Proposal.

6.5.9.1 Street lighting

All street lighting would be designed in accordance with the Upgrading the Pacific Highway, Upgrading Program beyond 2006: Design Guidelines (RTA 2006) for illumination of major highways.

Specific design treatments are proposed to reduce or eliminate light spill or glare to nearby residential areas, particularly where no street lighting currently exists. This may involve special light fittings or luminares to contain light spill within the required area.

6.5.9.2 Safety barriers

A range of safety barriers would be provided as part of the Proposal to protect vehicles from potential collision hazards within the clear zone. These safety barriers would be tailored for each location at the detailed design stage where they are required and would include:

- Appropriate fencing on fill embankments.
- A combination of barrier types on the approaches to longitudinal bridges.
- Barriers on embankments where noise barriers are proposed.

6.5.9.3 Line marking and signposting

Line marking would be in accordance with the appropriate RTA standards and would feature painted lines and reflective pavement markers. Additional delineation would also be provided by way of standard reflectors on safety barriers and guideposts.

A signposting scheme would be developed as part of the future detailed design of the Proposal. The signposting scheme would be developed in accordance with RTA guidelines, and in consultation with relevant stakeholders such as the Macksville and Urunga Chambers of Commerce and Nambucca and Bellingen Shire Councils. The need for other road signposting would also be determined during the detailed design phase of the Proposal and would comply with current RTA practices and standards. These would be applicable to highway facilities such as emergency access points, highway crossovers, u-turn facilities and speed zonings which are described in Chapter 17 – *Traffic and transport*.

6.5.9.4 Headlight screens

Headlight screens are proposed where traffic on a local access road has the potential to cause headlight glare to either highway carriageway, or vice versa. The potential for highway or local access road motorists to experience headlights on their left hand side from the adjoining carriageway has been considered in the context of:

- The separation of the different traffic streams.
- The ability to maintain existing vegetation or provide new vegetation between the conflicting carriageways.

Headlight screens would be necessary where the nominal separation (12 metres) between the proposed dual carriageways and parallel local service roads is reduced because of the provision of intersections and / or bus bays on the local access roads. At these locations, headlight sight screens are proposed to minimise potential driver confusion and, therefore, improve safety for both local and through-traffic.

Headlight screens would comply with RTA requirements relating to the lifespan of the structures. They would be painted in an appropriate colour so as to blend into the background. Low screen planting would also be utilised where practical to ensure that the headlight screen blended with the roadscape. The proposed locations of headlight screens are shown in Figures 6-1 to Figure 6-4 and would include:

- Between the existing highway and the Proposal between Donnellyville and Bald Hill Road.
- Between Old Coast Road and the Proposal just north of Mattick Road.
- On the western side of the Proposal, south of Nambucca State Forest as well as through parts of the state forest.
- Over long lengths between the existing highway and the Proposal between Boggy Creek and Ballards Road (where there is limited separation between the two roads).
- On the eastern side of the Proposal, south of the Waterfall Way interchange.

6.5.9.5 Fencing

Controlled access fencing would be provided on (or close to) either boundary of the Proposal. The nature and location of controlled access fencing would be determined in consultation with adjacent property owners. Where the local roads / accesses do not directly impact on privately owned properties, controlled access fencing would not be provided. Fauna fencing would be provided at locations identified as areas of high fauna activity. Where fauna fencing is required, it would be located within the proposed road corridor where possible in locations that reduce clearing and allow easy maintenance, but away from the road. The location of fencing would be confirmed as part of the detail design of the Proposal.

The Proposal passes through various land use types and a variety of fence types would be installed as follows:

- Barrier type fencing in areas where high pedestrian activity in adjacent areas could generate inappropriate and unsafe pedestrian traffic on the highway.
- Rural or general motorway type fencing adjacent to areas of agricultural production or cleared land.
- Floppy top fauna exclusion fencing to prevent random access of fauna onto the roadway and direct fauna to the fauna underpasses provided as part of the Proposal. The exclusion fencing would be provided where the Proposal crosses fauna corridors and /or passes through heavily vegetated natural habitat.

In some locations it would be necessary to provide separation between the Proposal and local access roads. In the majority of these instances, headlight screens are proposed, which would also act as a physical barrier, separating the local service roads and the Proposal.

6.5.10 Rest areas and service centres

In the Pacific Highway Safety Review (RTA 2004d), a strategic plan for rest areas on the Pacific Highway recognised that additional areas needed to be developed south of Coffs Harbour. There are currently no truck or light vehicle rest areas along the existing highway between Warrell Creek and Urunga. The two closest truck rest areas are situated at Raleigh, just north of the Bellinger River crossing of the existing highway for northbound and southbound traffic and approximately 14 kilometres north from the intersection with the Oxley Highway near Port Macquarie (northbound traffic). There are two driver reviver facilities along the existing highway between Warrell Creek and Urunga: at Urunga and Donnellyville. These facilities only operate during peak holiday periods and opening times are subject to the availability of volunteers.

A new rest area is proposed between the existing highway and the Proposal at the Nambucca Heads interchange (refer to Figure 6-3 Sheet 1). The rest area would cater for both light and heavy vehicles and has the potential to include a trailer exchange area. Truck drivers would also be able to check their loads and complete log books. The rest area would assist in reducing incidents related to driver fatigue along the highway. The maximum area of the site would be approximately 700 metres in length and up to 115 metres in width.

Access to the rest area from the Proposal is via the Nambucca Heads interchange. Northbound traffic would enter and exit via the overbridge at the southern end of the rest area. Southbound traffic would enter and exit directly off the interchange ramps.

No service centres are included as part of this proposal. A search of relevant development application registers and the major projects applications register has not revealed any approved or proposed service centres in the study area.

6.5.11 Noise attenuation

A noise and vibration assessment of the Proposal has been undertaken and is discussed in Chapter 14 – *Noise and vibration.* This section describes features of the Proposal that would be introduced to manage the noise issues identified in the noise and vibration assessment.

A number of options exist for managing road traffic noise associated with the Proposal. Management solutions are applied based on a reasonable and feasible approach to managing traffic noise and in accordance with the NSW Government's Environmental Criteria for Road Traffic Noise (EPA 1999). One or more of the following solutions for this Proposal are applied in areas where noise criteria are exceeded:

- Provide low noise pavement surfacing.
- Provide noise barriers adjacent to Proposal to attenuate noise at locations with clustered receivers where the noise modelling has identified that relevant criteria would be exceeded and where the proposed barriers would meet relevant RTA cost effectiveness criteria.
- Provision of architectural or 'on property' noise reduction treatments for individual receivers (subject to discussions between the RTA and individual property owners) where noise criteria would be exceeded, with or without the introduction of a noise barrier.

6.5.11.1 Low noise pavements

An analysis was undertaken of areas where the required noise criteria could be achieved with the provision of low noise pavements, or by a combination of the solutions outlined above. Table 6-6 provides details of the locations where low noise pavements have been incorporated into the Proposal.

Table 6-6 Indicative location of low noise pavements

Location of low noise pavements	Approximate chainage[1] (km)	Approximate length[1] (metres)
Warrell Creek to Donnellyville.	3,100 to 5,400	2,300
Northern abutment bridge over Warrell Creek to north of Letitia Close.	6,600 to 11,750	5,150
Valla Beach.	25,100 to 26,800	1,700
Ridgewood Drive to Raleigh.	38,800 to 41,000	2,200

[1] - To be refined during detailed design.

6.5.11.2 Noise barriers

Noise barriers of up to 4.5 metres (above pavement level) are included in the Proposal. Based on a consideration of urban design principals, noise walls in excess of four metres have been avoided due to potential adverse visual impacts. Where noise modelling has indicated a requirement for a barrier height of greater than four metres, a cost

benefit assessment has been carried out to determine a suitable height, and take into account urban design issues and community input.

Assessment of future road traffic noise (inclusive of sensitivity analysis for higher traffic speeds) was undertaken based on the proposed design inclusive of the assumed low noise pavement. Based on the results of the noise modelling undertaken, the location and proposed height of noise barriers that form part of the Proposal are detailed in Table 6-7 and illustrated in Figure 6-1 to Figure 6-4. Noise barrier heights and location would be further refined during the detailed design of the Proposal and may vary from that nominated in Table 6-7.

Table 6-7 Indicative proposed location and height of noise barriers

Location and approximate chainage[1] (metres)	Barrier type / Effective height[1] (metres)	Comments
Allgomera deviation to Nambucca River		
4500 - 5000	Noise barrier – height to 4.5	Albert Drive to Donnellyville – eastern side
5000-5300	Noise barrier – height to 4.5	Donnellyville - eastern side of the Proposal
7100 – 7450	Noise barrier – height to 4	Bald Hill Interchange – eastern side of southbound on-ramp
Nambucca River to Nambucca Heads		
12325 – 12900	Noise barrier – height to 4.5	Mattick Road – eastern side
Nambucca Heads to Ballards Road		
Nil		
Ballards Road to Waterfall Way interchange		
Nil		

[1] – To be refined during detailed design.

6.5.11.3 Architectural noise reduction treatments

Architectural or 'on property' noise reduction treatments have also been included in the Proposal where required (subject to discussions between the RTA and individual property owners) and are identified in Table 6-8. If the Proposal is approved, further noise assessment undertaken during the detailed design may result in changes to the number of architectural or 'on-property' noise reduction treatments identified.

Table 6-8 Proposed architectural (on-property) noise treatments

Location	Number of residences at which treatment is proposed[1]
Allgomera deviation to Nambucca River	65
Nambucca River to Nambucca Heads	39
Nambucca Heads to Ballards Road	40
Ballards Road to Waterfall Way interchange	37

[1] – To be refined during detailed design.

6.5.12 Arrangements for emergency access

During the preparation of this environmental assessment, the project team met representatives of local emergency service organisations and agencies to discuss their particular requirements for access to the Proposal. It was generally agreed that emergency access from interchanges would provide an acceptable level of service. However, the area just to the north of Macksville was identified as having limited emergency access. This situation was addressed by including a locked emergency services access gate between the crossing of Old Coast Road and Mattick Road (see Figure 6-2 sheet 1). Additionally, where existing fire trails were severed, forestry access tracks would be reinstated.

Additional traffic management facilities included in the Proposal comprise:

- Emergency cross-over points at approximately five kilometre intervals.
- U-turn bays at approximately 2.5 kilometre intervals.
- Truck stopping bays at approximately five kilometre intervals.
- Break down bays at approximately 2.5 kilometre intervals.

6.5.13 Utility services

Potential utility impacts and service adjustments as a result of the Proposal are summarised in Table 6-9. These were identified in consultation with the relevant service providers.

Table 6-9 Potential utilities and services adjustments

Utility type	Potential effect
Allgomera Deviation to Nambucca River	
Power	Impacts on local distribution network within the area.
Water	Impacts on existing water main along Bald Hill Road (east of upgrade) and north of Bald Hill Road (upgrade in cut). Impacts on water main located along Gumma Road (upgrade on fill).
Sewer	Impact on existing sewer rising mains leading to Macksville sewage treatment plant (upgrade on fill).
Telecommunications	An optical fibre cable is located within the existing North Coast Railway corridor. The upgrade is bridged over the railway so no impact is expected. Impacts on local distribution network within the area.
Nambucca River to Nambucca Heads	
Power	Impacts on local distribution network within the area.
Water	Impacts on water main located along Nursery Road (upgrade on fill). Impacts on water main located along Old Coast Road, crossing at Ch 15500 and Ch 19000 (upgrade in cut in both locations).
Sewer	No impacts
Telecommunications	An optical fibre cable is located within the existing North Coast Railway corridor. No impact is expected. Impacts on local distribution network within the area.
Nambucca Heads to Ballards Road	
Power	The Proposal passes beneath overhead transmission cables, approximately 1km south of Ballards Road.
Water	No impacts.

Utility type	Potential effect
Sewer	No impacts.
Telecommunications	Impacts on local distribution network within the area. An optical fibre cable is located within the existing North Coast Railway corridor. No impact is expected.
Ballards Road to Waterfall Way interchange	
Power	Impacts on local distribution network within the area.
Water	Impacts on existing water main located along Short Cut Road. Upgrade crosses Short Cut Road in fill.
Sewer	No impacts.
Telecommunications	Impacts on local distribution network within the area. An optical fibre cable is located within the existing North Coast Railway corridor. No impact is expected.

[1] - The potential utility relocations would be further refined during the detailed design phase, in consultation with the approval authorities.

None of the potential utility impacts represent significant design or construction challenges. The nature and extent of utility relocations (if required) would be finalised in consultation with relevant authorities, organisations and property owners through the detailed design and construction of the Proposal.

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Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

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7. Construction of the Proposal

This chapter describes the proposed construction issues associated with the Proposal.

Director-General's requirements	Where addressed in the EA	
A detailed description of the project including: ▪ route alignment and corridor width; ▪ design elements (e.g. requirements for LOS, pedestrian and cyclists , rest areas and service centres etc); ▪ differentiate the limits of the Project with respect to the existing Pacific Highway, including operational/maintenance responsibilities; ▪ potential staging; ▪ ancillary facilities (e.g. compound sites, batching plants etc); and ▪ resourcing (e.g. construction material needs, spoil disposal, natural resource consumption including water).	Section 6.2.	Requirements for Level of Service
	Section 6.4	Description of the Proposal
	Section 6.4.1	Route alignment
	Section 6.4.2	Corridor width
	Section 6.5	Design elements
	Section 6.5.7	Cyclists and Pedestrians
	Section 6.5.10	Rest areas and service centres
	Section 7.2	Potential staging
	Section 7.3	Earthworks and resources
	Section 7.3.7	Ancillary facilities
	Section 19.4.2	Waste management measures

7.1 Construction activities and methods

Table 7-1 provides details of the potential pre-construction and construction activities to be undertaken. The types of equipment and plant requirements would be refined during detailed design and during the development of the construction methodology by the construction contractor.

The methods used to construct the roadwork elements of the Proposal would generally be conventional techniques employed on major highway projects which would be adapted to account for the various Proposal-specific environmental and social constraints. Local access requirements and the geotechnical conditions would influence the final choice of construction techniques to ensure the project was constructed in a safe and efficient manner.

Geotechnical investigations undertaken for the concept design have identified that some soft soils would be encountered where embankments are constructed across flood plains and at the various river and creek crossings. Various construction techniques for these areas are described in Chapter 18 – *Soils characteristics and erosion controls*.

Table 7-1 Potential pre-construction and construction activities

Component	Typical activities	Typical plant and equipment
Procurement, award and environmental management system set-up	■ Tendering and award of contract ■ Identification of sensitive areas ■ Preparation/processing of construction environmental management plans, licenses and approvals	Not applicable
Obtain authorisation to use land	■ Confirmation of property boundaries ■ Obtain written authorisation from Forests NSW to occupy and use State Forest land for purposes of constructing the project	Not applicable
Site establishment	■ Fencing of corridor ■ Establishment of construction site facilities and access ■ Implementation of initial environmental safeguards ■ Pre-clearing and habitat surveys	Fences, portable sheds, portable toilets, fuel storage tanks, concrete and asphalt batching plants.
Relocation of services	■ Identification of utility services and consultation with utility authorities ■ Relocation or protection of services as required	Trucks, cranes, excavators, elevated platform vehicle, backhoes, trenchers, small equipment.
Site preparation	■ Harvestable timber felled and removed. This would be done by the Forests NSW. ■ Clearing and grubbing and processing (including recycling) of various materials for use in landscaping activities ■ Stripping and stockpiling of topsoil for reuse	Trucks, bulldozers, scrapers, excavators, backhoes, small equipment.
Earthworks	■ Earthworks, including movement of materials along the alignment from cutting to fill embankment areas ■ Removal and stockpiling of spoil and unsuitable material ■ Batter treatments	Trucks, bulldozers, excavators, scrapers, graders, water carts, compactors, rollers, blasting equipment,
Bridges, interchanges, and drainage and fauna crossings	■ Construction of diversion drainage and sediment basins ■ Construction of transverse drainage structures ■ Construction of subsurface and pavement drainage ■ Construction of drainage culverts and combined fauna crossings ■ Construction of interchange bridges and ramps ■ Construction of major bridge crossings of Nambucca and Kalang Rivers ■ In-stream works at water ways ■ Construction of local road overbridges and underpasses	Piling rigs, concrete pumps, cranes, excavators, trucks, small equipment, elevated platform vehicle, barges.
Pavements	■ Construction of pavement layers including selected material, sub-base and base layers	Trucks, graders, water carts, compactors, asphalt paver, vibratory rollers, rubber-tyre rollers.
Improvements to existing highway	■ Earthworks ■ Construction of pavement layers including selected material, sub-base and base layers.	Graders, backhoes, trucks, water carts, vibratory compactors, bitumen sprayers, vibratory rollers, rubber-tyre rollers.

Component	Typical activities	Typical plant and equipment
Other works	■ Installation of safety barriers, fencing and roadside furniture ■ Linemarking ■ Landscaping	Trucks, fencing and barrier materials, landscaping materials.
Finishing works	■ Remove temporary works ■ Restore and landscape temporary sites	Trucks, landscaping materials.

7.2 Potential staging

The Proposal could be constructed and operated in stages with the final staging to be determined by the RTA to suit funding and priority requirements. There are a number of possible staging opportunities which could include, but are not limited to, construction and operation of the Proposal in the following sections:

- Bypass of Warrell Creek.
- Warrell Creek to Pacific Highway just north of the Nambucca River.
- Pacific Highway just north of the Nambucca River to the Nambucca Heads Interchange.
- Nambucca Heads interchange to Ballards Road interchange.
- Ballards Road interchange to Waterfall Way interchange.
- Early works packages, for example construction of floodplain embankments.
- Construction across the soft soil areas identified in Chapter 18 in advance of other sections of the Proposal.

Other potential staging options could be identified during development of the detailed design. Combinations of the above staging options could also be possible, for example, constructing the section between the Warrell Creek interchange and Nambucca Heads interchange.

Opportunities could also be available to provide temporary connections between the Proposal and the existing highway within these potential staging options to provide early benefits for motorists by opening sections of the Proposal sooner.

If the Proposal is delivered in stages, a Staging Report would be prepared. The report would:

- Describe the proposed staging arrangements.
- Identify and assess any additional potential environmental impacts associated with the proposed staging arrangements.
- Identify any additional management measures (commitments) that would be implemented as a result of the staging process.

7.3 Earthworks and resources

7.3.1 Construction materials

The construction of the Proposal would require the use of various types of materials including, but not limited to:

- Fill (of varying quality) for use in earthworks.
- Pavement materials including selected material and road base.
- Aggregate for use in concrete batching.
- Materials for lining drainage channels.
- Sand for use as backfill around pipes.
- Cement and concrete.
- Materials to allow traffic to access soft areas.
- Safety barriers, signage and other road furniture.
- Lighting poles and lamps.
- Pre-cast materials (e.g. bridge components).
- Steel.
- Geotextiles and geofabrics.
- Fencing.
- Water.

The availability of raw and manufactured materials and prefabricated components has the potential to impact on the program of delivery of the Proposal. Preliminary estimates of raw materials for construction have been determined as part of the concept design. A preliminary study was undertaken to identify existing and potential sources of quarry materials in and around the study area and the effect of depletion of resources to the broader community, in particular in terms of other construction projects in the region.

The substantial number of bridges and culverts required for the Proposal would result in the need for a large amount of prefabricated items. As a number of the bridges cross floodplains, it is anticipated that multiple, shorter spans could be used to improve construction efficiencies through the use of prefabricated bridge beams rather than more complex cast in situ methods. Prefabricated items are likely to include:

- Bridge beams.
- Bridge headstocks and abutments.
- Box culverts.
- Drainage pipes.

- Drainage pits.
- Drainage headwalls.
- Noise barriers.

7.3.2 General, select and fill materials

The Proposal has been designed to achieve an approximate balance of cut and fill material, including allowances for topsoil and some unsuitable material. Materials for the selected fill may be sourced from the deeper cuttings throughout the Proposal. However, this is not expected to generate sufficient materials and the remainder would need to be imported. Based on the initial geotechnical investigations, pavement materials and concrete aggregates are not expected to be available from site materials. Table 7-2 identifies the concept design earthwork quantities for the Proposal.

Table 7-2 Concept design earthworks quantities

Section	Cut[1] (m^3)	Fill[1] (m^3)	Surplus/(Deficit)[1] (m^3)
Allgomera deviation to Nambucca River	1,500,000	1,190,000	310,000
Nambucca River to North Coast Railway overbridge	1,450,000	1,320,000	130,000
Nambucca Heads to Ballards Road	980,000	770,000	210,000
Ballards Road to Waterfall Way	1,880,000	1,730,000	150,000
Totals (rounded)[1]	5,810,000	5,010,000	800,000

[1] The quantities of materials would be further refined during the detailed design phase.

Material removed from cuttings would be used to construct fill embankments unless it is found to be unsuitable for that purpose. Cut material that is deemed unsuitable or is excess (as noted in Table 7-2) would be stockpiled until needed as part of the landscaping design or possibly used as visual screening or noise mounding during the construction phase. The better quality material may be processed and stockpiled on-site for use in the construction of the pavements.

The earthworks model for the concept design has been developed to balance cut and fill between the following areas:

- Warrell Creek interchange and the southern bank of the Nambucca River and from the northern bank of the Nambucca River to the Nambucca interchange so that haulage of material does not occur across the existing Pacific Highway bridge at Macksville.
- Nambucca interchange and southern bank of the Kalang River and from the northern bank of the Kalang River at Urunga to the Waterfall Way interchange so that minimal haulage of material is required across the existing Pacific Highway bridge at Urunga.

During the detailed design phase, the earthworks model would be further refined to confirm the volumes of different fill materials available from cuttings. Alternatives for sourcing additional material as part of the Proposal may include:

- Changing the vertical alignment of the Proposal to increase cut and reduce fill in areas.
- Modification of material to meet select material classifications (select refers to material required to construct the pavement and the material under the pavement that complies with a specification (e.g. strength or grade)).
- Flatten cut batters to provide more excavated material and gentler slopes for landscaping.
- Widen cut batters to provide wider verges and clear areas adjacent to the carriageway.
- Increase or lower some sections of the new local access roads.

Estimates of imported materials are based on the current concept design and available geotechnical information and have assumed that most of the selected material zone underneath the pavement and all the pavement materials may need to be imported.

Table 7-3 shows potential areas where rock cuttings are likely to produce material for use as select material.

Table 7-3 Anticipated rock units along the Proposal suiteable for use as select material

Section	Approximate chainage (m)		Formation	Potential for reuse
	From	To		
1	6700	7050	High to very high strength Hornfels	Upper zone formation or selected material
2	18120	18380	Medium to high strength phyllite	Upper zone formation
4	32300	32500	High to high strength phyllite	Upper zone formation
	36500	36900	Medium to high strength phyllite	Upper zone formation

7.3.2.1 Quarry material

It may be necessary to source some materials from nearby quarries. Table 7-4 lists the quarries within 100 kilometres of the Proposal, including the materials available and the production capacity. The Nambucca Valley Quarry is located alongside the Proposal, north of Donnellyville. Materials available from the Nambucca Valley Quarry include pavement materials, selected material, sand and concrete aggregates.

The Nambucca Valley Quarry is licensed to extract 250,000 m^3 of quarry materials per year. However, the quarry also supplies local building and construction activities which could limit the resources available for construction of the Proposal. This would necessitate obtaining imported material, if available, from other quarries as identified in Table 7-4. Access to materials from quarries near Coffs Harbour and Kempsey may be limited if construction of the Proposal occurs concurrently with the construction of other Pacific Highway upgrades on the NSW Mid North Coast.

It is expected that the local industry would be able to supply select material and aggregate required for the Proposal.

Table 7-4 Quarries within 100 kilometres of the Proposal

Name	Raw material	Pavement materials	Selected material	Sand	Concrete aggregate	Production capacity
Volcanic Resources, Wauchope	Ryalite		Yes			30,000 tonnes/year
Volcanic Resources, Kempsey	Riverstone			Yes	Yes	Commercial-in-confidence
Hurd Haulage, Dunbogan		Yes	Yes	Yes	Yes	100,000 – 500,000 tonnes/year
BJ and NJ Penson, Kempsey	Riverstone	Yes		Yes	Yes	Commercial-in-confidence
Monro Earthmoving, Valla	Granite	Yes	Yes	Yes	Yes	Commercial-in-confidence
Nambucca Valley Gravel, Macksville	Basalt	Yes	Yes	Yes	Yes	250,000 tonnes/year
Ready-mix, Boambee	Greywacke				Yes	Commercial-in-confidence
T.C Jung Quarries, Coffs Harbour	Argillite	Yes	Yes			285,000 tonnes/year

7.3.2.2 Cement

Sources of cement are likely to be Sydney, Newcastle or Brisbane, requiring transportation to site via road or rail. It is expected that storage silos would be constructed on-site adjacent to any temporary batching plants.

7.3.2.3 Bitumen

Requirements for bitumen would be dependent on the pavement type selected for the Proposal. As a minimum, bitumen would be required at the top of the select material zone (SMZ) and for local and service roads. Bitumen would be available from either Kempsey or Coffs Harbour.

7.3.3 Concrete precasting yard

There are existing concrete precasting yards at Macksville and Coffs Harbour that may be used to supply precast elements for the Proposal.

7.3.4 Spoil and waste disposal

Specific requirements for waste minimisation and management during the construction of the Proposal would be finalised during detailed design and managed through the Construction Environmental Management Plan (CEMP).

This would comply with relevant State government legislation and policies and any conditions of approval, including the Waste Avoidance and Resource Recovery Strategy 2007 (DECC 2007).

Where possible, materials would be re-used either on or off-site. These would include tree and plant material which would be mulched or chipped, and material from demolished structures, as well as any soil and rock material.

7.3.5 Natural resource consumption (including water)

The resources required for the construction of the Proposal and indicative quantities are provided in Table 7-5. Water requirements are shown in Table 7-6.

Table 7-5 Resources and indicative quantities required for construction

Resource	Source	Indicative quantity
General Fill	Cut to fill on-site	5,810,000 m^3
Steel	From sources in Sydney, Newcastle or Brisbane.	20,000 t
Sand	Local quarry materials	150,000 m^3
Pavement quality materials	From deep/rock cuttings within the corridor (SMZ)/local quarry materials	400,000 m^3
Concrete aggregates	Local quarry materials	300,000 m^3
Cement	From sources in Sydney, Newcastle or Brisbane.	200,000 t

Table 7-6 Estimated water sources and volumes required for construction

Activities and locations	Source	Estimated quantity
Manufacture of concrete	Potable water supply, groundwater	80 ML
Compaction of earthworks	Sediment basins, farm dams, creeks and/or groundwater	725 ML
Dust suppression	Sediment basins, farm dams, creeks and/or groundwater	320 ML
Vegetation water	Sediment basins, farm dams, creeks, groundwater and/or potable water supply	20 ML

Where possible, water used during construction would be sourced from sustainable sources. Construction water is generally sourced from local water resources, such as groundwater, streams and dams. Where local water or groundwater resources are utilised, any necessary licenses or agreements would be obtained. Water may be transported to where it is required on site via water carts, or stored on site in detention basins. Alternative water supply sources such as mobile desalination plants and other recycled water sources may also be used to supply some construction water. For worksites, potable water could be obtained from local authorities. Facilitates such as rainwater tanks would also be considered. The use of fit for purpose reclaimed (recycled) water from local wastewater treatments plants would be investigated for use during construction

Energy consumption and the associated greenhouse gas emissions anticipated during construction and operation are detailed in Chapter 19 –*Other environmental issues*.

7.3.6 Construction work hours

Construction would normally be limited to the following hours:

- Between 6am and 6pm Monday to Friday.
- Between 7am and 4pm Saturday.

There would be no works on Sundays or public holidays except:

a) Works that do not cause construction noise to be audible at any sensitive receivers.

b) For the delivery of materials required outside these hours by the Police or other authorities for safety reasons.

c) Where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.

d) Any other work as agreed through negotiations between the RTA and potentially affected sensitive receivers. Any such agreement must be recorded in writing and a copy kept on site for the duration of the works.

e) Where the work is identified in the Construction Noise and Vibration Management Plan (CNVMP) and approved as part of the Construction Environmental Management Plan (CEMP).

f) As agreed by the DECCW.

Local residents and the DECCW must be informed of the timing and duration of work approved under items (d) and (e) at least 48 hours before that work commences. Hours of work would be addressed in the CNVMP, which would be finalised in consultation with the Department of Planning and the DECCW.

7.3.7 Ancillary facilities

A number of ancillary facilities would need to be established during the construction period for the Proposal. These facilities would include construction site compounds, asphalt or concrete batching plants, lay-down areas and stockpile sites.

The locations of ancillary facilities must allow for efficient and cost-effective construction of the Proposal while minimising biophysical and social impacts. Preliminary potential locations for major work sites and ancillary construction facilities are described in Table 7-7 and shown in Figure 7-1. While it is unlikely that all of these locations would be used for construction facilities, a range of potential sites have been identified to provide flexibility for the final site selection. The criteria for the location of these ancillary facilities are described in Table 7-7.

Table 7-7 Location of potential ancillary facilities

Chainage[1]	Eastern/western side	Location
1800	Eastern side	North of Upper Warrell Creek and the North Coast Railway Line
2800	Western side	Between the North Coast Railway Line and Rosewood Road
4200	Western side	Albert Drive
5050	Eastern side	Albert Drive
7800	Western side	Bald Hill Road
9800	Eastern side	South of River Street
11150	Eastern side	North of existing Pacific Highway
11100	Western side	North of existing Pacific Highway
11900	Eastern side	Off Old Coast Road
21050	Eastern side	Nambucca Interchange
22200	Western side	Valla Road
26200	Western side	North of East West Road
29800	Split both sides	South of Ballads Road
30200	Split both sides	South of Ballads Road
35550	Eastern side	South of Kalang River
35600	Western side	South of Kalang River
35900	Eastern side	North of Kalang River
36700	Eastern side	North of Kalang River
40400	Western side	Adjacent to Raleigh Industrial Estate

[1] The potential ancillary facilities would be determined during the detailed design phase.

The final location of work sites would be determined during detailed design. The location for any ancillary facilities not identified in this environmental assessment would be located to take into account the criteria outlined in Table 7-8.

Table 7-8 Criteria for location of ancillary facilities

Location criteria	Compound site	Batching plant site	Stockpile site
Environmental			
More than 100 metres from SEPP 14 wetlands and 40m from waterways	Yes	Yes	Yes
In areas of low ecological and heritage conservation significance	Yes	Yes	Yes
In areas requiring no substantial clearance of vegetation	Yes	Yes	Yes
The distance from dwellings or other activities that may be affected by noise or other plant impacts	200 metres	200 metres	200 metres
Construction			
Easy and safe access to the main road network	Yes	Yes	Yes

Location criteria	Compound site	Batching plant site	Stockpile site
Electricity and phone services are available or able to be provided without additional environmental impacts (except for stockpiles)	Yes	Yes	No
A relatively level ground elevated to assist drainage and allow treatment of runoff	Yes	Yes	Yes
Easily accessible potable water supply or suitable dam (except for stockpiles)	Yes	Yes	No
Minimum area preferred	1 hectare	1 hectare	1 hectare

7.3.7.1 Compound sites

Construction compounds (major and minor) would be required for personnel, portable offices, vehicle parking areas, materials and plant. A number of construction compounds would be required for the Proposal.

Construction compounds could be co-located with, or separated from, the potential batching plant sites (see Section 7.3.7.2). Potential construction compounds would generally be located on:

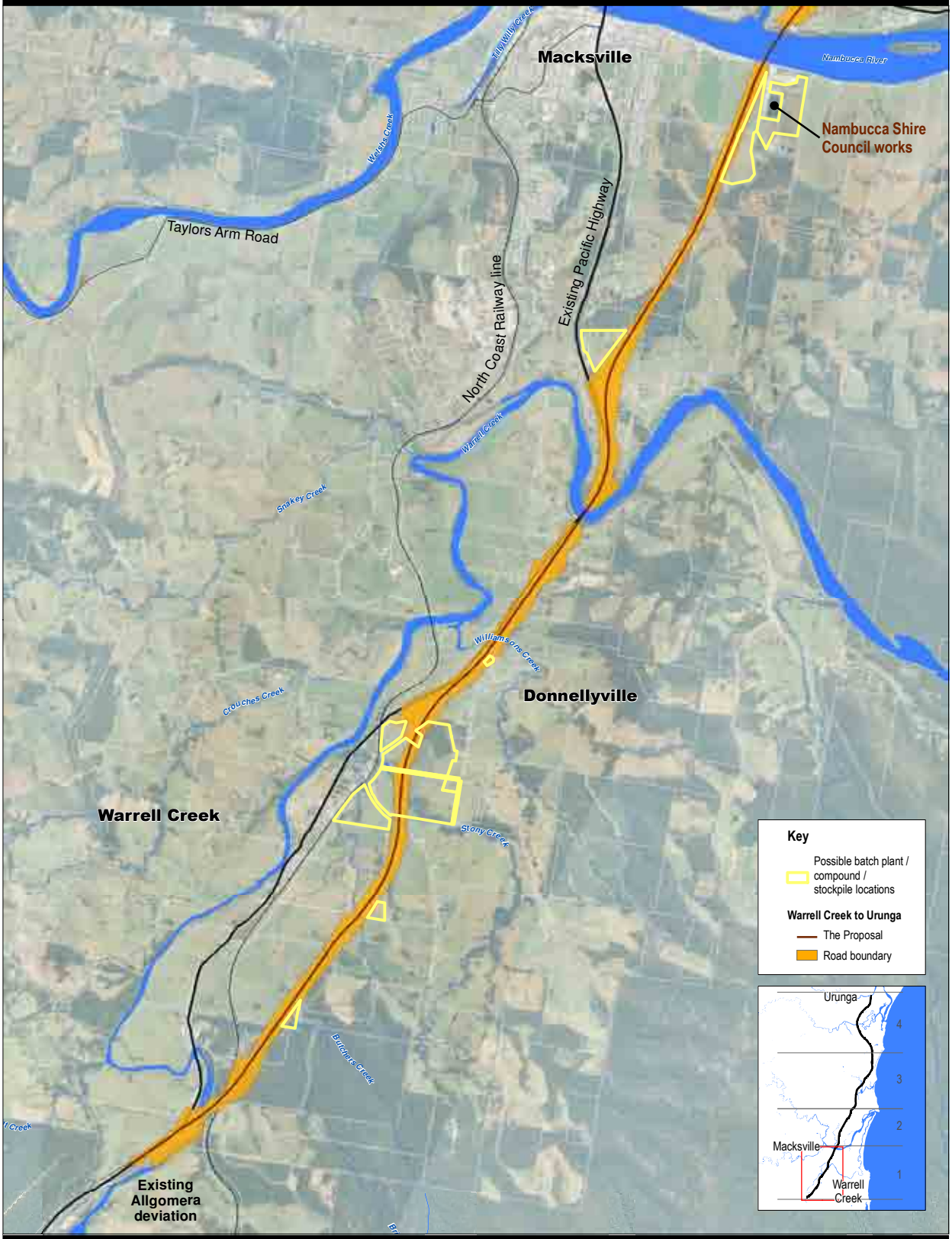
- Land owned by the RTA.
- Existing cleared areas or areas to be cleared for the Proposal.
- Available land within the road reserve.
- Leased cleared land on private property or within state forests.

7.3.7.2 Batching plants

As identified in Table 7-5, it is expected that more than 300,000 m^3 of concrete would be required for the Proposal (depending on the extent of precast materials used). It is likely that the construction contractor would establish a number of concrete batching plants on-site for bulk supply of concrete for major paving and other operations. The batching plants would also require temporary buildings for staff offices and other facilities.

The batching plant sites would result in considerable incoming and outgoing traffic movements and, as such, they can be noisy and create localised air quality impacts if stockpiles are not covered. Where possible, batching plants would be located away from sensitive residential receivers. If the Proposal is approved, the construction contractor would be required to identify specific management measures for batching plants within a CEMP and relevant sub-plans and consistent with the conditions of approval.

FIGURE 7-1a | LOCATION OF POSSIBLE CONSTRUCTION COMPOUNDS, BATCH PLANTS AND / OR STOCKPILE SITES SECTION 1 OF 4



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0 400 800 Metres

FIGURE 7-1b | LOCATION OF POSSIBLE CONSTRUCTION COMPOUNDS, BATCH PLANTS AND / OR STOCKPILE SITES SECTION 2 OF 4

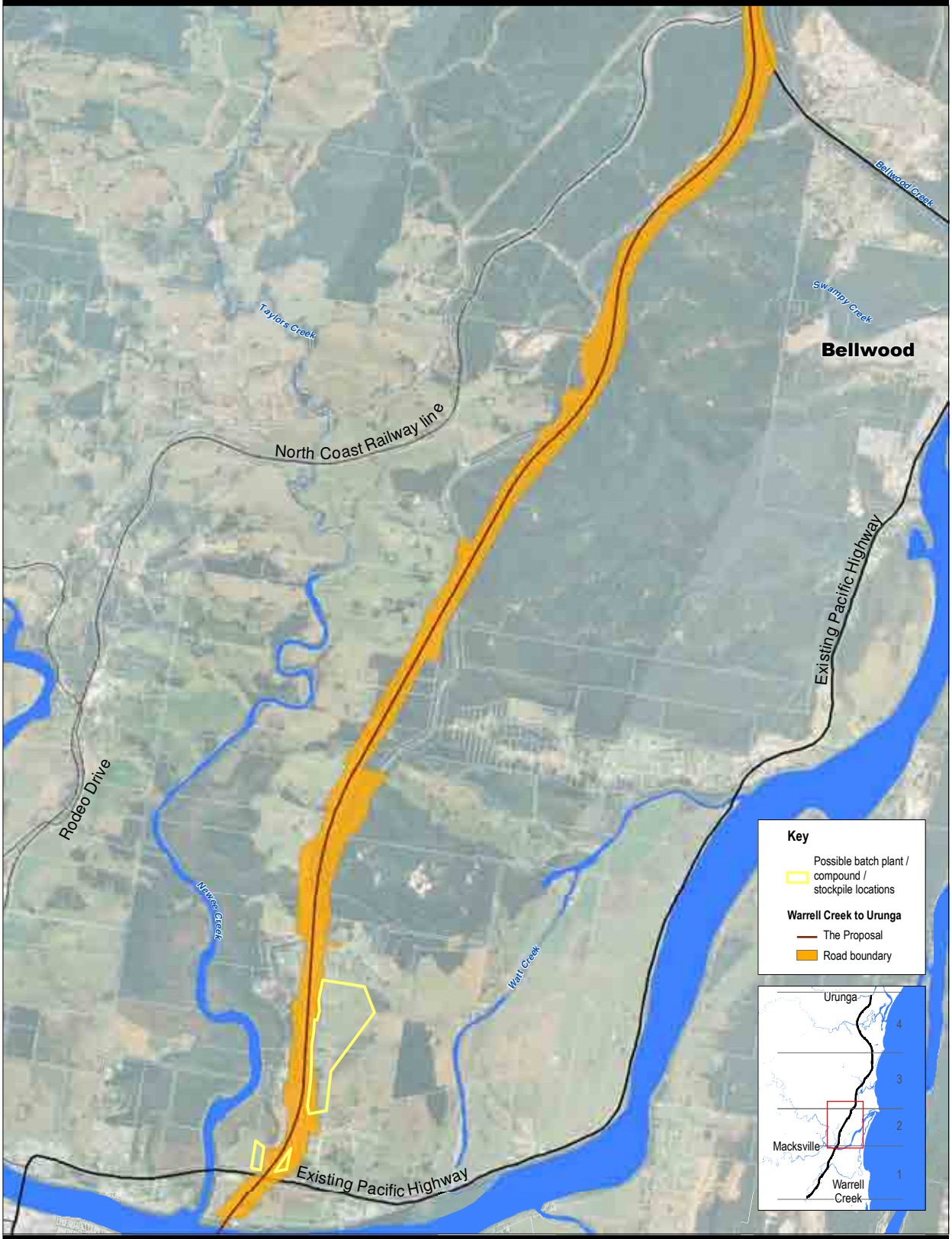
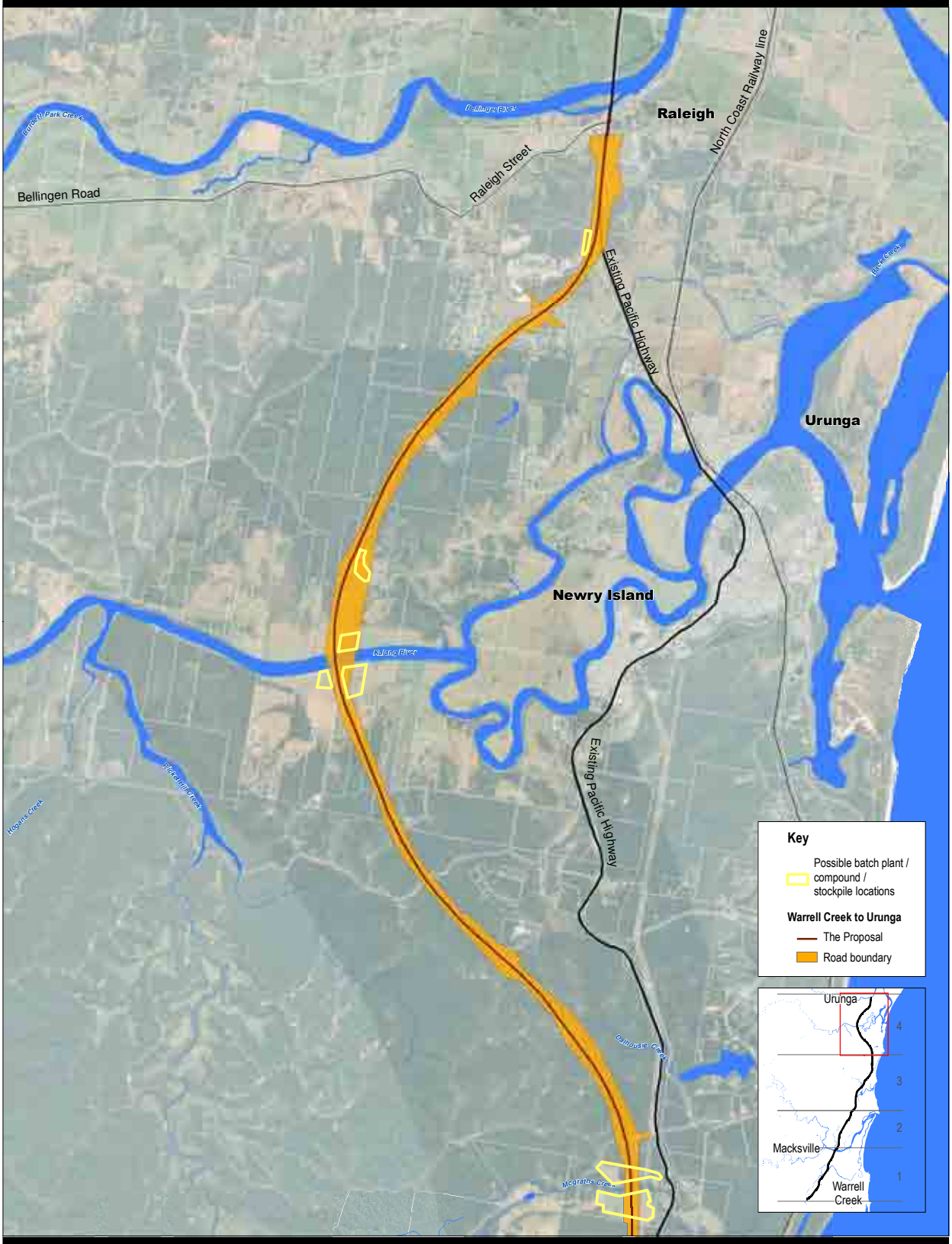


FIGURE 7-1c | LOCATION OF POSSIBLE CONSTRUCTION COMPOUNDS, BATCH PLANTS AND / OR STOCKPILE SITES SECTION 3 OF 4

FIGURE 7-1d | LOCATION OF POSSIBLE CONSTRUCTION COMPOUNDS, BATCH PLANTS AND / OR STOCKPILE SITES SECTION 4 OF 4



7.3.7.3 Stockpile sites

A number of stockpile sites would be required along the Proposal. These would be used to store, prepare and distribute aggregate and other bulk materials such as topsoil, sands, pre-cast culverts, drainage pipes and drainage pits required for the construction.

Materials such as topsoil, mulched timber and any unsuitable cut material would need to be stockpiled during construction prior to being re-used in the final landscaping. The selection of these sites would be the responsibility of the successful contractor(s) and would need to comply with the relevant criteria detailed in Table 7-8.

7.3.7.4 Sediment basins

Sediment basins would be constructed along the route as shown in Figure 6-1 to Figure 6-4. Further details on the sizing of these basins, is included in Section 16.4.1.

7.3.7.5 Other ancillary facilities

Other ancillary facilities may be needed for specific activities such as surveying/ GPS towers and temporary haul roads to reduce haulage distances.

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ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

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8. Environmental management

This chapter outlines the RTA's environmental management framework and the management procedures to be followed during construction and operation of the Proposal.

8.1 RTA environmental management framework

The RTA's Environmental Policy provides the framework for continually improving the RTA's environmental performance. The policy sets commitments for managing potential environmental impacts. The RTA is committed to undertaking its activities in an environmentally responsible manner and effectively managing any risks that may lead to an impact on the environment. The RTA would do all that is reasonably practical to ensure that there is continuous improvement in its environmental performance, including ongoing communication and awareness raising, active reporting of environmental incidents and continuous learning from experience.

8.2 Environmental management plans

A CEMP would be prepared by the construction contractor(s) prior to construction of the Proposal to address management measures that need to be implemented to ensure compliance with the Minister for Planning's conditions of approval, including the commitments made in this environmental assessment. The CEMP would cover the environmental protection practices, resources and the sequence of activities required.

The plan would provide a centralised mechanism through which all environmental aspects, impacts, risks and obligations relevant to the Proposal would be managed. In addition, it would outline a management framework of procedures and controls for managing the environmental impact of construction.

The plan would:

- Outline how environmental safeguards and mitigation measures identified in this environmental assessment would be incorporated in the Proposal.
- Document mechanisms for demonstrating compliance with the Statement of Commitments and Conditions of Approval.

The construction environmental management plan would ensure specific environmental management measures are implemented during construction and would include the following:

- Roles and responsibilities for planning, approval, implementation, assessment and monitoring of environmental controls.
- Required licences, approvals and permits.
- Proposal control and mitigation measures to be implemented.

- Objectives and targets for environmental performance.
- Environmental monitoring programs and a mechanism for evaluating environmental performance.
- Communication procedures.
- Document control procedures.
- Emergency response and environmental incident procedures to mitigate potential environmental damage.
- Training, competence and awareness assessment procedures and programs.
- An environmental auditing program and a mechanism for control and management of non-conformances.

8.3 Operational environmental management plan

An operational environmental management plan would be prepared to coordinate ongoing monitoring and maintenance after the Proposal is opened to traffic. It would include details of statutory and other obligations that would be required to be fulfilled, and requirements for maintenance, monitoring, auditing and reporting. The operational environmental management plan would be consistent with the commitments made in this environmental assessment and the Minister for Planning's Conditions of Approval.

Chapters 10 to 19 identify individual design and management responses to potential key environmental impacts identified within this environmental assessment. Appendix D - *Draft Statement of Commitments* provides a summary of proposed management measures, demonstrating the RTA's commitment to preparing and implementing environmental management plans and associated mitigation measures.

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9. Environmental risk analysis

This chapter explains how environmental issues for the Proposal were identified and evaluated through an environmental risk analysis process. It also provides a summary of the environmental risk analysis results. The environmental risk analysis covered bio-physical, social and economic risks.

Director-General's requirements	Where addressed in the EA
Environmental Risk Analysis – notwithstanding the above key assessment requirements, the EA must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the EA.	Section 9.2. Results of the environmental risk analysis No additional key impacts identified.

9.1 Environmental assessment risk review

The consideration of environmental risks associated with the Proposal has been comprehensive through the route development and environmental assessment phases, spanning bio-physical aspects as well as social and economic matters. Input from the community as well as key government agencies, Councils and other stakeholders have been considered during the risk reviews.

For the environmental assessment, an analysis was undertaken which:

- Identified environmental issues, including but not limited key issues in the Director-General's Requirements.
- Examined potential impacts and proposed mitigation measures in relation to the identified issues.
- Examined impacts likely to remain after application of proposed mitigation measures.

Based on this analysis, an environmental risk category was assigned to each impact using a qualitative approach. This enabled the identification of any matters that might be considered as additional key issues and established the basis for an appropriately detailed assessment of those additional key issues to be included in this environmental assessment. The environmental risk categories assigned to each impact are described in Table 9-1.

Impacts that have been assigned a risk category of 'A' are considered in all cases to indicate key issues. The environmental risk analysis has automatically allocated a risk category of 'A' to all key issues identified in the Director-General's requirements.

Table 9-1 Environmental risk categories

Risk category	Description
A	May have high or moderate impacts. Detailed assessment necessary to determine the level of potential impact and to develop appropriate measures to mitigate and manage the impacts.
B	May have high or moderate impacts. These can be mitigated by the application of standard environmental management measures.
C	Has low impacts. These can be managed by standard environmental management measures.

9.2 Results of the environmental risk analysis

The environmental risk analysis is summarised in Table 9-2. The analysis confirmed that the Director-General's requirements included all key issues. No additional key issues were identified.

The analysis identified four 'other' environmental issues which have been included as part of the environmental assessment. The environmental risk of the other issues was not assessed as being as significant as that associated with the key environmental issues. These additional issues are discussed in further detail in Chapter 19 – *Other environmental issues*.

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Table 9-2 Environmental risk analysis

Issue	DGRs key issue	Potential impacts	Analysis – proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis	EA reference
Flora and fauna	Yes	Impacts on State (TSC Act) and Nationally (EPBC Act) listed threatened species.	Targeted field surveys have been conducted to identify locations of listed threatened species and subsequently refine the Proposal to retain individual flora and habitat, where possible. There would be no net loss of endangered ecological communities and habitat as a result of replanting and offset.	A	Chapter 10
		Impacts on threatened terrestrial fauna, including loss of habitat area and habitat connectivity.	Pre-clearance surveys would be carried out to identify the presence of native fauna within vegetation clearance zone and relocate fauna as required. Although fauna underpasses and glider crossing structures are provided, efficiency of fauna movement may be reduced. Identified habitat trees and mature vegetation in widened medians would be retained. There would be no net loss of habitat as a result of replanting and offset.	A	
		Severance of areas of key corridor, leading to erosion of genetic stock and habitat fragmentation.	Combined fauna underpasses and drainage structures and a dedicated fauna underpass included in design. Fauna exclusion fencing (e.g. floppy-top fencing) would be erected along the Proposal at appropriate locations to direct fauna movement towards fauna-crossing structures.	A	
		Clearing of native vegetation.	The clearing area would be kept to the minimum area necessary for construction. 'No-go areas' would be delineated with protective fencing. Existing native vegetation to be retained within road boundary and widened medians where possible to minimise overall vegetation loss. There would be no net loss of endangered ecological communities and habitat as a result of replanting and offset.	A	
		Proposal passes close to five State Environmental Planning Policy (SEPP) 14 wetlands and crosses four floodplains.	Avoidance of SEPP14 wetlands during route development.	A	
		Impacts on aquatic ecology, including aquatic and riparian habitat.	Major creeks and rivers to be bridged and design to be undertaken in accordance with government guidelines.	A	
		Impact on groundwater dependent species.	Cuttings and drainage designed to minimise potential impact on groundwater recharge and flow to avoid impacts to groundwater dependent ecosystems.	A	

Issue	DGRs key issue	Potential impacts	Analysis – proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis	EA reference
		Potential regional scale impacts through loss of habitat, corridors and impact on threatened species.	The clearing area would be kept to the minimum area necessary for construction. Provision for fauna passage along the length of the Proposal. There would be no net loss of habitat as a result of landscape plantings comprising native species within the road reserve and offset.	A	
Land use and property	Yes	Changes to property access and access to the local and regional traffic network.	Access would be maintained to all properties. Property access to be re-arranged to link to the local access road network. Interchange locations to be sited to facilitate local access to major centres.	A	Chapter 11
		Severance of properties and sterilisation of land on individual properties.	The Proposal has been refined to minimise severance impacts and to ensure local access is maintained. Acquisition of the whole or part of properties affected by the Proposal in accordance with the RTA's *Land Acquisition Policy Statement.*	A	
		Severance and sterilisation of state forest resources.	The Proposal has been aligned to minimise impacts to forest harvesting zones and would not alter existing access arrangements to the Nambucca and Newry/Little Newry state forests. No sterilisation and fragmentation to resources would occur.	A	
		Impact on future urban development associated with investigation areas and proposed future urban areas. Impact on existing and future rural residential development.	Discussions have been held with relevant Councils to enable the concept design to facilitate access to potential future urban and industrial areas. Facilitates the implementation of the *Mid North Coast Regional Strategy*.	A	
		Impact on connectivity including for pedestrians and cycleway.	Pedestrians and cyclists would be able to use the existing highway under much lower traffic conditions than currently experienced, providing a safer walking or cycling environment. Opportunities for inclusion of pedestrian/cycle ways on bridges have been included in concept design.	A	
		Potential loss of contiguity of existing and planned settlements and activity clusters.	Connectivity across the Proposal and between existing and planned settlements and activity clusters, has influenced the concept design. This would be maintained during construction and operation.	A	

Issue	DGRs key issue	Potential impacts	Analysis – proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis	EA reference
		Impact on the operation of Nambucca Valley Quarry.	Consultation with quarry established that quarry expansion was to be to the east and away from the existing highway. No anticipated impact on the future expansion of the Nambucca Valley Quarry.	A	
		Attainment of the objectives of the *Mid North Coast Regional Strategy*.	The aims of the *Mid North Coast Regional Strategy* would be facilitated by the Proposal, including growth in the region, while protecting high value environments and the coastal areas.	A	
Social and economic impacts	Yes	Potential for impacts on productivity, profitability and regional economic impacts to agricultural sector including regional and State significant farmland.	The *Mid North Coast Farmland Mapping Project* mapped regionally significant farmland representing the best farmland on the Mid North Coast and did not specifically distinguish between regional and State significant farmland. Proposal aligned to minimise severance of agricultural land and impacts on regionally significant farmland. 0.06 per cent of regionally significant farmland in the Mid North Coast Region would be affected by the Proposal.	A	Chapter 12
		Loss of businesses, or reduced exposure to passing traffic.	Appropriate signposting and visual prompts in design in accordance with RTA signposting standards. No existing businesses on industrial zoned land would need to be acquired as a result of the Proposal. Some impacts on businesses along the existing highway reliant on through-traffic. Access arrangements have been designed to facilitate access to communities bypassed by the Proposal.	A	
		Potential amenity impacts associated with increasing road infrastructure through the study area.	Visual and noise mitigation measures have been incorporated into design.	A	
		Impacts on land use viability, and natural resource values of business. Impacts on property infrastructure including farm water supplies, sheds etc.	Consultation has been undertaken with potentially affected landowners and issues associated with farming viability and property infrastructure incorporated into design. The potential for sterilisation and severance of land has been minimised as far as possible Further consultation with all directly affected land holders on how to best minimise the impact on the function and amenity of their land use arising from any land sterilisation or severance is proposed during detailed design.	A	
		Impacts on recreational and commercial fishing operations including oyster priority areas. Impact on sustainability, productivity and profitability.	No direct impacts on recreation, commercial fishing or oyster farms are anticipated. Indirect impacts would be prevented through the implementation of effective water quality management measures.	A	

Issue	DGRs key issue	Potential impacts	Analysis – proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis	EA reference
		Impact on local residents from construction activities, construction sites, storage and batching plants.	Short term disruption to the local community during construction. Criteria for location of ancillary facilities include minimising biophysical and social impacts. Construction would be confined to approved construction hours. Local residents would be informed of any exceptions.	A	
Visual amenity and design	Yes	Urban design and landscape to be consistent with rest of Pacific Highway, considering the existing and desired characteristics of affected localities.	Urban design has been developed in accordance with the provisions of the RTA's Pacific Highway urban design guidelines, taking into consideration the affected localities	A	Chapter 13
		Impacts to local viewsheds arising from bridge embankments, interchanges and alterations to natural landscape features.	Guidelines for interchanges, bridges, viaducts and road furniture, noise attenuation, cuttings and embankments, landscaping and planting have been incorporated in the concept design. Permanent changes would occur to existing viewsheds, particularly for residences and receivers previously not exposed to road infrastructure. The Proposal is consistent with the RTA's Pacific Highway urban design guidelines.	A	
		Impacts of crossing the Nambucca and Kalang Rivers on local and district views across the floodplains.	Crossings have been designed to minimise impacts and a landscape plan has incorporated features to minimise impacts on district views. The Proposal is consistent with the RTA's Pacific Highway urban design guidelines.	A	
		Impacts on general visual amenity.	Location and alignment of Proposal has been designed to minimise visual impacts (both horizontal and vertical alignments). The Proposal is consistent with the RTA's Pacific Highway urban design guidelines.	A	
		Adverse visual impacts anticipated where the Proposal would be visible in the foreground.	Urban design and landscape management strategies include planting and mounding to minimise potential impacts.	A	

Issue	DGRs key issue	Potential impacts	Analysis – proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis	EA reference
Noise and vibration	Yes	Impacts from construction noise and vibration including construction traffic noise and blasting.	Impacts from construction activities would occur during the construction period. Construction would be confined to approved construction hours. Local residents would be informed of any exceptions. Site-specific blast designs would be developed following trials to satisfy relevant performance criteria. Construction noise and vibration would be minimised as far as practical through the implementation of all feasible and reasonable measures, consistent with government guidelines.	A	Chapter 14
		New noise source along bypass sections with a number of sensitive noise receivers.	Noise impacts on sensitive noise receivers close to the Proposal which were not previously exposed to road infrastructure.	A	
		Operational road traffic noise impacts.	Long term positive noise impacts for receivers in areas which are to be bypassed by the Proposal. Design of Proposal incorporates measures to minimise noise impacts (both horizontal and vertical alignments, grading, and low-noise pavement). Topographical features have limited the effectiveness of noise barriers in some locations so property treatments are proposed. While this addresses noise experienced indoors, there would be some residual outdoor noise effects.	A	
		Potential secondary noise impacts from proposed noise mitigation measures.	Secondary noise from reflections from noise barriers are not expected to be significant for the Proposal due to the location of receivers with respect to the proposed barriers.	A	
		Impacts on specific noise receptors may vary depending on meteorological conditions.	Incorporation of meteorological data into the traffic noise model is not possible and no valid criteria exist for any such assessment (if possible). Appropriate site specific meteorological data were not available for the study area. In general, temperature inversions may increase noise levels by between 3-5 dB(A) during cooler months depending on conditions and are likely to affect residences greater than 100 m from the road. However, it is likely that windows and doors would be closed, providing attenuation of potentially increased noise impacts. Although an estimate of impacts may be made to account for potential increases in noise levels, as a result of temperature inversions, these estimates have no valid basis and may ultimately be an under or over estimate of noise impacts from these weather conditions.	A	

Issue	DGRs key issue	Potential impacts	Analysis – proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis	EA reference
Aboriginal heritage	Yes	Potential impact on landscape cultural features including watercourses, spur lines, raised areas in floodplains.	Items uncovered during subsurface investigations of potential archaeological deposit sites would be managed through implementation of a CEMP, in consultation with the relevant LALC.	A	Chapter 15
		Direct impacts on nine archaeological sites and indirect impacts on one archaeological site and 34 areas of potential archaeological deposits.	Subsurface testing has been undertaken and detailed mitigation measures developed in consultation with the LALC for each of the impacted sites.	A	
		Potential impact on Cow Creek Aboriginal Reserve. Potential impact on undisclosed burial sites.	Subsurface testing has been undertaken in the Proposal corridor adjacent to the Cow Creek Aboriginal Reserve and further consultation undertaken with landowners and Aboriginal stakeholders to determine the site's history. If previously unidentified burial sites or other sites of potential Aboriginal heritage significance are uncovered during works, activities would cease in the locality and specific management procedures.	A	
		Potential impacts on 5 cultural places, the exact location of which is not known but identified in the area.	Mitigation measures for cultural sites have been developed in consultation with the LALCs, where appropriate.	A	
		Cumulative impacts on Aboriginal heritage in a regional context associated with the overall Pacific Highway Upgrade Program.	Cumulative impacts are not considered to be significant as much of the study area has been highly disturbed. Regionally, the loss of cultural heritage values and knowledge for the Gumbaynggirr people of the Nambucca Valley would be impacted by the loss of sites as a result of the Proposal.	A	
Water	Yes	Impact on waterway and wetland water quality due to runoff or accidental spillage during construction and operation.	Permanent sediment basins and spill containment devices have been incorporated into concept design to minimise the risk of impact as a result of accidental spillage during operation. Construction compounds and storage facilities to be located away from sensitive watercourses and waterbodies. Provided pollution management controls are implemented, maintained and managed through the life of the Proposal, no residual impacts on water quality are anticipated.	A	Chapter 16
		Potential acidic leachate from exposure of acid sulphate soils.	Management of works within areas of potential acid sulphate soils to minimise the risk of acidic leachate.	A	
		Changes to hydrology and impact on infrastructure, property and future development areas.	Future development taken into consideration during flood modelling and design.	A	

Issue	DGRs key issue	Potential impacts	Analysis – proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis	EA reference
		Potential impacts on groundwater levels and quality and subsequent impacts on groundwater use and groundwater users particularly areas of steep cuttings in Sections 1, 2 and 4.	Groundwater users in proximity to the Proposal are unlikely to be significantly impacted as a result of cuttings or dewatering during construction. Environmental management measures have been included to minimise potential impacts to groundwater. Monitoring of selected bores would be undertaken prior to and during construction phase.	A	
		Potential impact on the existing flood regimes.	Design of Proposal incorporates measures to minimise impacts on flood levels and flooding regimes, with culverts, bridges and underpasses designed to ensure natural flow paths are not impeded.	A	
		Community concerns regarding potential impacts on flood regime in Nambucca River as a result of Council development in the region of Tilly Willy Creek.	Hydrological investigations have identified that the Proposal would have minimal impact on the flooding regime in Tilly Willy Creek and the surrounding area.	A	
Traffic and transport	Yes	Operational traffic and transport impacts to the local, regional and fire trail networks (existing and planned), including impacts from traffic rerouting and modified access to the upgraded highway.	Significant improvement in north-south travel times between Warrell Creek and Urunga. Regional, local and fire trail networks have been refined to accommodate traffic movement requirements.	A	Chapter 17
		Impacts on local traffic movements as a result of construction traffic (including spoil haulage).	Movement of construction vehicles and plant would be managed with a construction traffic management plan to minimise impacts on local traffic.	A	
		Disruption to local public transport networks including local bus services.	Public transport requirements to be discussed with the relevant parties to develop appropriate management measures during construction. Existing public transport routes have been maintained in the concept design.	A	
		Impacts on the interaction of rail infrastructure and the viability of shared road and rail corridor.	Shared rail/road alignments were discussed with ARTC. Significant upgrades of the North Coast Railway Line in the study area were not part of ARTC's forward works program for the foreseeable future.	A	
		Disruption to cyclist/pedestrian movements through the study area.	Pedestrians and cyclists would be able to use the existing highway under much lower traffic conditions than currently experienced, providing a safer walking or cycling environment. Opportunities for inclusion of pedestrian/cycle ways on bridges have been included in concept design.	A	
		Emergency vehicle access.	Provision for emergency vehicle access has been made in the design.	A	

Issue	DGRs key issue	Potential impacts	Analysis – proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis	EA reference
Soils and Fill	Yes	Potential impacts on surface soils and geological characteristics.	Geotechnical investigations have been undertaken to identify surface and geological characteristics to inform the concept design. The Proposal concept design minimises earthwork quantities and balances over sections of the Proposal.	A	Chapter 18
		Soil contamination, including potential impacts on uncapped old municipal tip site in Nambucca State forest.	No significant contamination sources within the Proposal corridor have been identified. The route has been aligned to avoid impacting areas of potential large scale contamination such as the old municipal tip site in Nambucca State Forest. In the event that contamination was identified, it would be managed in accordance with relevant guidelines. Targeted groundwater monitoring may be conducted around the tip site to monitor potential impacts associated with leachate. If contamination is identified, a remediation action plan would be developed and implemented.	A	
		Soft soils - potential impacts on design including cost implications, long term settlement and timing.	Develop design and construction options to address short and long term settlement.	A	
		Acid sulphate soils – Areas of high risk of acid sulphate soils are present in low lying areas along the length of the Proposal.	Acid sulphate soils and potential acid sulphate soils would be managed in accordance with relevant guidelines.	A	
		Erosion of soil and sedimentation of waterways, particularly in sensitive wetland systems such as Gumma Flat tidal and wetland area.	Temporary erosion and sedimentation controls would be confirmed during detailed design. The boundary of the Proposal includes capacity for permanent sediment basins in sensitive areas, including SEPP14 wetlands and key watercourses such as the Nambucca River and Kalang River, to protect fisheries and oyster beds.	A	
		Instability of cutting slopes.	Generally slopes have been conservatively designed at 2:1 slope. Cutting slopes achieve slope stability requirements.	A	

Issue	DGRs key issue	Potential impacts	Analysis – proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis	EA reference
Hazardous substances	No	The hazards and corresponding risks to human health and the environment associated with incidents that could arise during operation (e.g. accidental release of toxic, flammable or explosive substances.	It should be noted that these risks exist now with few available mitigation measures. Spill containment has been considered in the drainage design of the Proposal. Measures such as permanent detention basins have been incorporated to protect waterways and surrounding areas from spills related to accidents on the upgrade. The risk of accidental collision of vehicles using the highway would be reduced due to improved safety as a result of the upgrade of the highway to dual carriageway.	C	Section 19.1
		Spillage of hazardous materials used in the construction process.	Construction phase handling and risk management procedures, including emergency response to be incorporated in the construction environmental management plan.	C	
Air quality and climate	No	Air pollution (including dust) from construction works or motor vehicle emissions.	There may be localised impacts arising from dust generation during construction. The risk of emissions from construction motor vehicles is negligible. An Air Quality management sub-plan would be prepared to effectively manage air quality during construction. It would focus on preventative actions using anemometers to trigger when increased site watering activities are required.	C	Section 19.2
		Operational air quality impacts from with increased vehicle traffic and associated vehicle emissions, including greenhouse gases and particulates.	The risk of impacts from air pollutant emissions during operation is minimal. Modelling indicates that likely increases in traffic are not significant enough to result in a noticeable difference in background pollution levels.	C	
		Impact of particulates on private properties, businesses and tank drinking water resources.	Particulates occur as a result of the incomplete combustion of fuel and are greater from diesel vehicles. Combustion is improved with free-flowing traffic that experiences consistent grades. The design of the Proposal attempts to minimise grade changes and enables a consistent speed of between 100-110 kilometres per hour. An exceedance of health criteria for drinking water in rainwater tanks is unlikely.	C	

Issue	DGRs key issue	Potential impacts	Analysis – proposed impact mitigation measures and impacts remaining after their application	Risk category following analysis	EA reference
Non-Aboriginal heritage	No	Impact on the following items of potential heritage significance. ■ Farm house, North Macksville(Nambucca Shire) ■ Tangye pump. (Nambucca Shire) ■ South Arm Road scenic road landscape. (Bellingen Shire) ■ Farm house, Kalang River. (Bellingen Shire) ■ Fire trail and right of carriageway.(Bellingen Shire) ■ Possible house site. (Bellingen Shire)	European heritage items have been avoided through design where possible. A Statement of Heritage Impact prepared for all six items potentially impacted by the Proposal, indicated no significant impact to heritage would occur. Mitigation measures for construction and operation have been developed. The following historical sites would be lost: ■ Farm house, North Macksville(Nambucca Shire) ■ Tangye pump. (Nambucca Shire) ■ Farm house, Kalang River. (Bellingen Shire) ■ Possible house site. (Bellingen Shire) South West Arm Road scenic road landscape would require protection during construction. The Heritage Office and Bellingen and Nambucca Shire Councils would be consulted during development of the detailed design of the Proposal and in preparation of the construction environmental management plan. Detailed archival records would be made prior to dismantling of the sites.	B	Section 19.3
Sustainability	No	Impacts of greenhouse gas emissions during the construction phase of the Proposal as well as the demand on resources in terms of utilities, energy and resources and wastes.	Sustainability principles have been considered throughout the route development/selection, concept design and environmental assessment. There would be further opportunities during detailed design and construction to innovate in terms of material use and recycling and reduced resource use.	B	Chapter 16, 19 and 20
		Impacts of climate change and sea level rise on the Proposal.	The potential implications of climate change and sea level rise have been considered for the Proposal. Structures have been designed with consideration given to scenarios involving higher sea levels and altered weather patterns.	C	
		Impact of Proposal on climate change.	Construction and operation of the Proposal would release greenhouse gases into the environment. Construction greenhouse gas emissions would be managed through the construction environmental management plan. Improving traffic flow as a result of the operation of the Proposal would reduce greenhouse gas emissions on a per vehicle basis. Government policy will dictate the efficiency of vehicles in the future.	C	

[1] - Issues falling within risk category 'A' are considered to be key issues. All DGRs key issues are designated category 'A'.

Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

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10. Flora and fauna

Flora and fauna is identified as a key issue in the Director-General's requirements. A detailed flora and fauna assessment for the Proposal was undertaken and is presented in this chapter. This assessment is supported by Working paper 1 – Flora and fauna.

Director-General's requirements	Where addressed in the EA
Flora and fauna – including but not limited to: ■ threatened terrestrial and aquatic species, populations, ecological communities and/or critical habitat including erosion of genetic stock; and ■ targeted surveys of threatened flora and fauna species including *Marsdenia longiloba* (Slender Marsdenia), *Amorphospermum whitei* (Rusty Plumb), *Acacia chyrsotricha* (Newry Golden Wattle), *Acronychia littoralis* (Scented Acronychia) and *Parsonsia dorrigoensis* (Milky Silkpod); ■ terrestrial habitat and biodiversity including native vegetation loss, habitat fragmentation, weed infestation, wildlife and riparian corridors, riparian habitat, and groundwater-dependant communities; ■ aquatic habitat and biodiversity including wetlands, mangroves, and seagrass; ■ regional scale cumulative impacts and the significance of the impacts of the project in the context of the PHUP; and ■ including consideration of draft *Guidelines for Threatened Species* Assessment (DECC/DPI July 2005) and *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation 1999* (Section 6.4 and 6.5 specifically) (NSW Fisheries, 1999).	Section 10.3 Existing environment Section 10.3.2 Terrestrial vegetation Section 10.3.3 Terrestrial fauna Section 10.3.4 Aquatic fauna Section 10.4.2 Potential flora impacts Section 10.4.3 Potential fauna impacts Section 10.4.4 Potential impacts to aquatic habitats and biodiversity Section 10.4.5 Cumulative impacts Section 10.5 Management of impacts Section 10.5.6 Compensatory habitat

10.1 Background

Flora and fauna issues have been considered during the development of the route options, selection of the preferred route and preparation of the environmental assessment. Data collated from surveys undertaken in the route selection phase of the Proposal (2003-2006) together with targeted surveys along the Proposal in 2007-2008 have been used in this environmental assessment to identify the existing conditions and potential impacts of the Proposal.

Potential impacts on biodiversity have been reduced as a result of the planning and preliminary assessment of impacts undertaken during the route options development process. Nevertheless, any proposed route within the region would have some impacts on biodiversity. These potential impacts are discussed in the following sections.

10.2 Assessment approach

10.2.1 Assessment stages

The terrestrial and aquatic flora and fauna investigations within the study area were conducted in a number of stages as detailed below:

- Review of existing information on protected and threatened flora and fauna species, populations and ecological communities and their habitats within the study area (as listed in the *Commonwealth Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act), *NSW Threatened Species Conservation Act 1995* (TSC Act), *Fisheries Management Act* 1994 (FM Act) and the *National Parks and Wildlife Act* 1974 (NPW Act)).
- Detailed evaluation of the terrestrial and aquatic flora and fauna habitats of the study area, drawing from the results of previous investigations as well as specific ground-truthing and assessment. This aimed to delineate the separate structural habitats of the study area and compile information on the type and availability of habitat features.
- Analysis of those threatened flora and fauna species deemed potential inhabitants of the study area (i.e. potential subject species). This analysis utilised the listings of threatened species in the locality and wider sub-region and the nature of the preferred habitats of these threatened species.
- Design and implementation of flora and fauna field surveys (terrestrial and aquatic) within the study area to describe and map the extent of vegetation communities, compile lists of the biological species diversity and adequately target the potential presence of threatened biota.
- Assessment of the Proposal under the provisions of the State and Commonwealth legislation to determine whether there was likely to be a significant impact from the Proposal on threatened species, populations, ecological communities or their habitats.
- Devise and formulate protective and mitigatory measures that could be applied to minimise potential ecological impacts with due consideration of relevant recovery plans for species and the *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation* (NSW Fisheries 1999) (Sections 6.4 and Section 6.5 specifically).

The various ecological studies for terrestrial and aquatic species undertaken as part of the environmental assessment process are detailed in Working paper 1 – *Flora and fauna.*

10.2.2 Study areas

The study area for the terrestrial flora and fauna investigations was taken to be the design footprint plus a 10 metre buffer to allow flexibility in design. In reality, clearing would be undertaken three metres or five metres from the edge of the construction footprint, with scope to retain individual trees or vegetation communities within the road boundary of the Proposal. The study area also includes any proximal areas that could potentially be affected by the Proposal either directly or indirectly. This included areas within the road boundary, ancillary construction areas, drainage areas and local and regional corridors.

The study area for the aquatic investigations extended upstream and downstream of the twelve creeks and rivers sampled to take into account the fisheries in the locality.

10.2.3 Data collection

The data collection for the environmental assessment involved literature and database reviews and field survey, as described below.

Literature and database reviews for the study area including key habitats, corridor and ecosystem mapping including:

- Discussions with personnel from the DECCW and the DII, including the Aquatic Habitat Protection Unit and Forests NSW.
- A landscape assessment including a review of aerial photography, review of NSW landscapes mapping (Mitchell 2003) and visual analysis of vegetation patches and connectivity across the landscape.
- A review of the Climate Change Wildlife Corridors for north-east NSW (DECC 2007b).
- Anecdotal reports from authorities, local ecologists, naturalists and aquatic studies undertaken by the Ecology Lab.
- DECCW's *Draft Sea Level Rise Policy Statement* (February 2009).

Flora assessment:

- Comprehensive flora field surveys over the three seasons between November 2007 and April 2008 including transects, traverses and quadrat based surveys.
- Targeted survey for *Marsdenia longiloba* (Slender Marsdenia), *Amorphospermum whitei* (Rusty Plum), *Acacia chrysotricha* (Newry Golden Wattle), *Acronychia littoralis* (Scented Achronychia) and *Parsonsia dorrigoensis* (Milky Silkpod). Slender Marsdenia is listed as vulnerable and Scented Achronychia and Milky Silkpod are listed as endangered under the Federal EPBC Act. All are listed as either endangered or vulnerable under the TSC Act.
- Collection of general ecological landscape, baseline and habitat data across the study area between 2003 and 2005 as part of the route options assessment phase. Comprehensive flora field surveys over the three seasons between November 2007 and April 2008 including transects, traverses and quadrat based surveys within the Proposal boundary.

Fauna assessment:

- Development of a robust survey design Development of a robust survey design in accordance with the *Draft Threatened Biodiversity Survey and Assessment Guidelines* (DEC 2004).
- Four seasonal fauna sampling between 2005 and 2008 using various live mammal trapping, cage traps, hair tubes, harp traps (for bats), bat call recording, spotlighting, bird survey, call playbacks, frog and reptile searches, stagwatch surveys and scat searches.
- Targeted surveys for threatened species known or likely to occur in the study area.
- Hollow bearing tree survey.
- Aquatic ecology assessment:
- Electrofishing, bait trapping, fyke netting, macro-invertebrate sampling, gill and seine netting upstream and downstream of the Proposal in freshwater and estuarine waterways traversed by the Proposal.
- Water quality readings at each of the twelve sites.

10.2.4 Assessment team

The team associated with the completion of this assessment is listed in Table 10-1, together with details of their qualifications and role. All work was carried out under the appropriate scientific investigation licences as required under Clause 22 of the National Parks and Wildlife Regulations 2002, Section 132C of the *National Parks and Wildlife Act* 1974 and Section 37 of the FM Act, in addition to animal research authority under the DII.

Table 10-1 Assessment team

Name	Qualification	Role
Chris Thomson	BAppSc	Ecologist - Team Leader Terrestrial Ecology, fauna survey and assessment
Andrew Carty	BEnvSc	Botanist – field surveys, targeted threatened flora surveys, reporting, GIS
Martin Sullivan	BSc	Botanist – field surveys, reporting, condition assessment
Sarah Foy	BSc; MEnvStud	Aquatic Ecologist – fish and macro-invertebrate field surveys, reporting
Vanessa Bain	BEnvSc	Ecologist – fauna field surveys
Dr. Adam Cohen	BEnvSc; PhD	Ecologist – Team Leader Aquatic Ecology, fish surveys and impact assessment
Peta Johnston	BMarSc	Aquatic ecologist, field surveys

10.3 Existing environment

10.3.1 Landscape context

The study area lies within the NSW North Coast Bioregion (Thackway, R. and Cresswell, I. D. 1995). Two hundred and two flora species found in the bioregion are listed in the schedules of the TSC Act. Of these, 108 are endangered, 89 are vulnerable and five are considered extinct in the bioregion (NSW NPWS 2002). A major factor

that contributes to this high species diversity is the location of the Macleay – McPherson overlap zone. This is defined as the area of eastern Australia where the tropical and temperate zones overlap.

The NSW North Coast Bioregion has the second highest proportion of lands under conservation reserves of the NSW Bioregions. In total 1,061,709 hectares or 18.65 per cent of the bioregion is conserved. There are twelve national parks and nature reserves located within 20 kilometres of the Proposal. A number of state forests are located within the landscape, these properties are managed primarily for forestry activities although they also have some conservation values. There are numerous records of threatened flora and fauna species within these state forests.

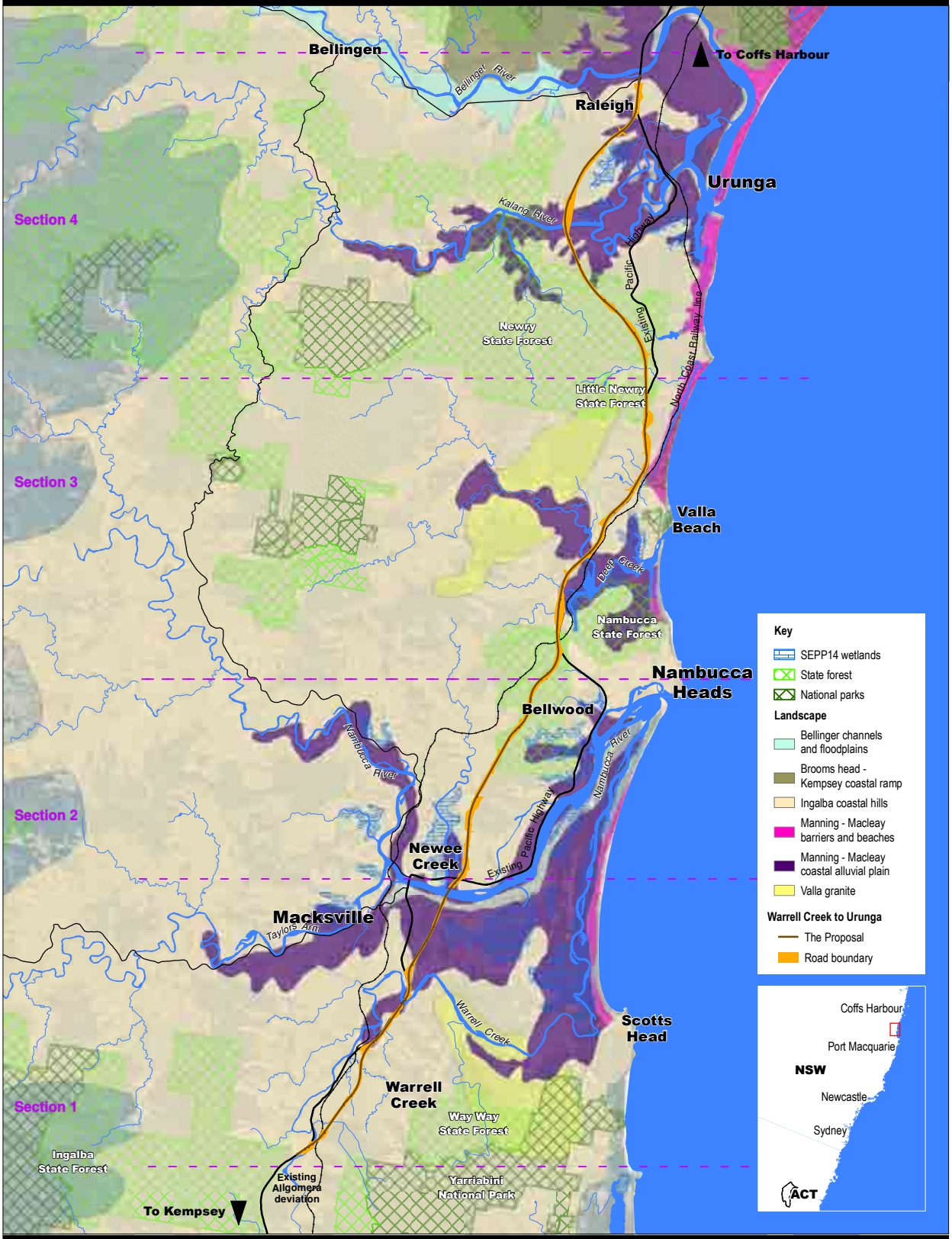
According to the Landscapes of NSW (Mitchell 2003), the study area lies across two landscape types described below and shown in Figure 10-1. The Manning Macleay Coastal Alluvial floodplains are present on the alluvial floodplains of the Nambucca and Kalang Rivers and smaller creeks such as Deep Creek, Boggy Creek and Oyster Creek. Soils are generally dark organic loams and silty clays on the floodplain, gradational brown loam and yellow-brown texture contrast soil on terraces, and organic silty mud in swamps.

The Ingalba Coastal Hills are associated with the slopes on lower Permian slate, phyllite, schistose sandstone and schistose conglomerate with a general elevation of up to 830 metres. Soils include thin, stony gradational loam and sandy loam on slopes grading to yellow brown texture contrast soils on lower slopes and in valleys. Within the study area the Ingalba Coastal Hills can be identified as the hills and slopes rising above the floodplain reaches of the Nambucca and Kalang Rivers. Remnant forested areas are dominated by dry sclerophyll forests with moist sclerophyll forests in gullies.

The Proposal traverses low hills and floodplains associated with the Nambucca, Kalang and Bellinger Rivers. Extensive clearing for agriculture, logging and residential development have been prevalent through many of these areas and are most obvious within Nambucca, Newry and Little Newry state forests, the lands surrounding the townships of Macksville, Nambucca Heads and Urunga and adjoining floodplain areas. Logging within the state forests has been most evident within the easily accessible areas close to tracks and forestry roads in contrast to the steep sloping creek and riparian areas where some remnant tree cover has been retained as creek buffers with fewer disturbances. Comparatively smaller areas of unlogged and selectively logged forests occur on privately owned lands north of the Kalang River where logging has been of a reduced scale.

Much of the pre-European vegetation of the lowland floodplain in the study area would have comprised lowland rainforest, swamp forests, wetlands and wet floodplain eucalypt forests. The vast majority of the vegetation has been cleared due to the fertile soil types for agriculture and proximity of the river and coast for transport and settlement. Fragments of vegetation remaining on the floodplain are characteristic of vegetation associations of the NSW North Coast Bioregion which have been scheduled as endangered ecological communities (EECs) under Part 3 of Schedule 1 of the TSC Act.

FIGURE 10-1 | LANDSCAPE TYPES



10.3.2 Terrestrial vegetation

10.3.2.1 Vegetation Communities

In total, seven vegetation structural types, with 590 different plant species from 132 families were represented in the Proposal study area (see Table 10-3). This total comprises 166 species of monocotyledon, 390 species of dicotyledons, 27 fern species, two cycad species and three conifer species. Of the 590 flora species recorded, 99 (17 per cent) are introduced species, and the remaining 83 per cent are native species indigenous to the local area. Exotic species are dominant along many roadsides, cleared paddocks and areas of disturbed vegetation.

10.3.2.2 Endangered ecological communities

No nationally EECs, as listed under the Commonwealth EPBC Act have been located in the study area. However, several EECs listed in NSW under the TSC Act have been located in the study area. These are described in Table 10-2 and their locations are shown in Figure 10-2.

Table 10-2 Endangered ecological communities within the study area

Vegetation community	Endangered ecological community (*Threatened Species Conservation Act* 1995)	Habitat	Study area section
Mixed floodplain forest	Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion	Gully areas along creek lines on metasediments and alluvium	1,2,3,4
Lowland rainforest	Lowland Rainforest of the NSW North Coast and Sydney Basin Bioregion	Riparian corridors and alluvial flats	1,2,4
Swamp forest – swamp mahogany/paperbark	Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion	Floodplain areas on waterlogged humic soils	1,2,3,4
Swamp forest/swamp oak	Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregion	Floodplain areas on alluvial soils with a saline influence	1,3,4
Freshwater wetland	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregion	Low elevated depressions on floodplains, alluvial soils.	1,3,4
Coastal saltmarsh	Coastal Saltmarsh of the NSW North Coast, Sydney Basin and South East Corner Bioregion	Edges of estuaries	2

The condition of the EECs present in the study area was assessed in the field by assigning a subjective rating score based on the degree of naturalness versus modification and disturbance. The structural and floristic diversity, level of weed invasion, the size of the patch and connectivity or proximity to other patches of the same community in the landscape were assessed and used to determine the ecological condition of EECs. Sites were ranked as either high, high-moderate, moderate, low-moderate or low condition. High condition areas include larger patches of intact vegetation that are relatively free of significance disturbance, whilst low condition areas include small fragmented areas of vegetation with an abundance of weed species that have been disturbed from clearing, grazing and other disturbances. Condition classes are shown in Figure 10-2.

Table 10-3 Vegetation types identified in the study area

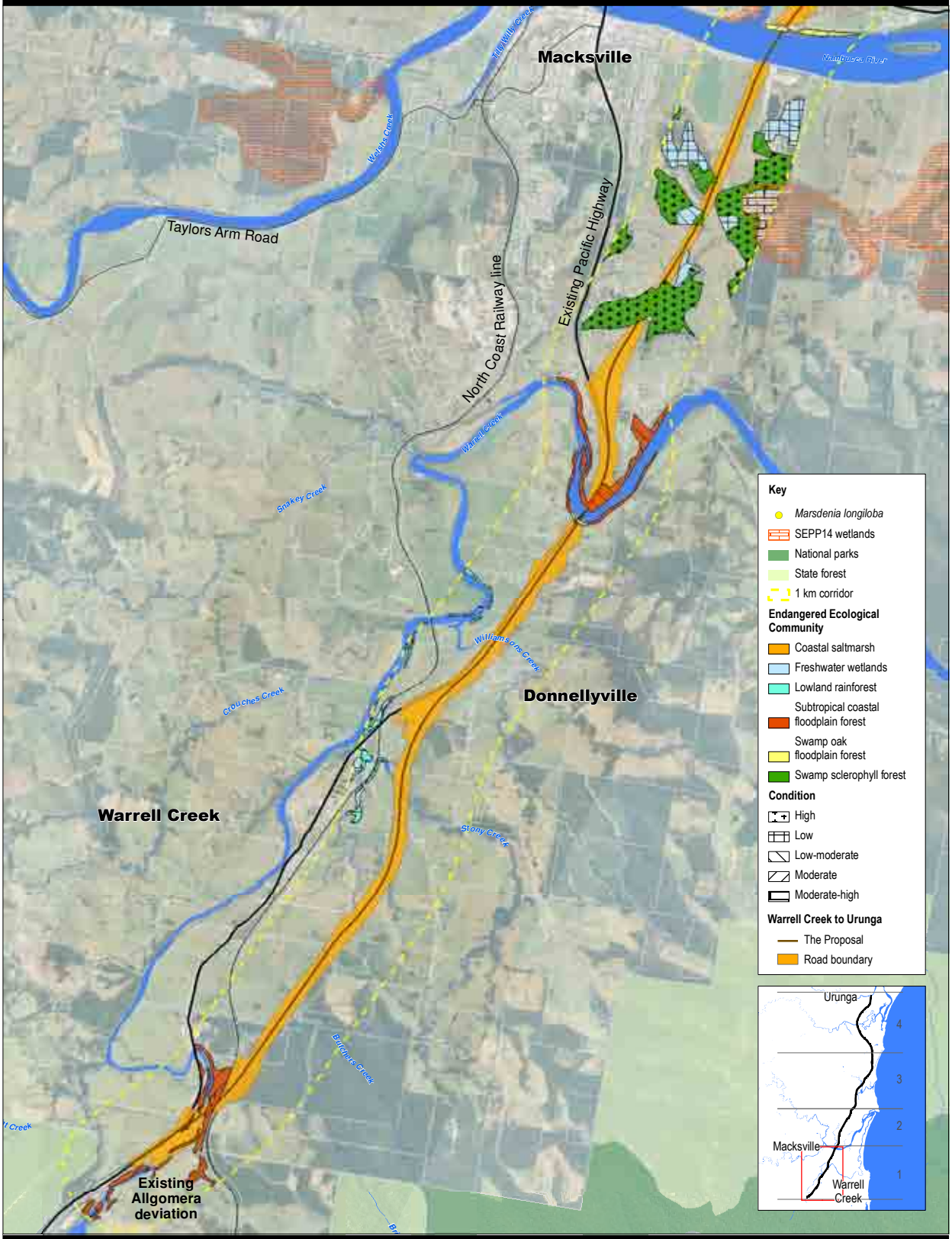
Vegetation structural type	Structure and floristics
Dry sclerophyll forests Dry sclerophyll forest associations occupy upper slopes and crests of the study area. The vegetation structure comprises a canopy dominated by Eucalypts with a diversity of sclerophyll shrubs, grasses and forbs. The structure and diversity of the understory varies depending on the fire regime and degree of disturbance of each area.	Blackbutt association Blackbutt forest occupies the dryer more exposed and elevated areas with well drained soils. This forest type is dominated by Blackbutt (*Eucalyptus pilularis*), with Grey Gum (*Eucalyptus propinqua*), Tallowwood (*Eucalyptus microcorys*), White Mahogany (*Eucalyptus acmenoides*), Ironbark (*Eucalyptus paniculata*) and Pink Bloodwood (*Corymbia intermedia*). Dry blackbutt forest occurs throughout large portions of Nambucca, Newry and Little Newry State Forest and has been heavily logged. This forest contains a moderate diversity of shrub and groundcover species particularly older regrowth. Smooth-barked apple/scribbly gum/bloodwood association. This association typically occurs in slightly elevated coastal lands, adjoining the lower slopes of wetland and swamp forest communities. These communities have fewer impacts from past logging due to an absence of suitable timber species in the canopy. Representative dominant species are Smooth-barked Apple (*Angophora costata*), Scribbly Gum (*Eucalyptus signata*) and Red Bloodwood (*Corymbia gummifera*). The presence of fertile soils and a generally high water table has resulted in these forest types being more floristically and structurally diverse than the surrounding dry blackbutt forests. They also comprise a greater percentage of large remnant trees and subsequently tree hollows, particularly mature Smooth-barked Apple and Red Bloodwood. Scribbly gum/bloodwood association. This association is generally positioned in elevated areas in similar locations to the dry blackbutt dominated communities, although on poorer soils. The largest stands within the study area were located on the ridgelines in the centre of the Nambucca State Forest and the forested portion just to the south. This community exhibits a generally young age structure as a result of the removal of blackbutt in most locations, although there appears to be areas containing larger and more mature trees outside the state forest boundary. Scribbly Gum (*Eucalyptus signata*) dominates this forest type with scattered individuals and small stands of both Blackbutt (*Eucalyptus pilularis*) and Red Bloodwood (*Corymbia gummifera*). The community merges into both the Blackbutt (*Eucalyptus pilularis*) dominated communities and the open forest dominated by Smooth-barked Apple (*Angophora costata*). The understorey typically comprises numerous shrub species, particularly wattles (*Acacia sp.*).
Wet sclerophyll forests These communities occupy the steep sloping creek and riparian areas where remnant tree cover has been retained and to a degree protected from frequent fire regimes. They comprise moist forest types and rainforest communities.	Moist blackbutt association. Moist blackbutt forest occupies areas of relatively fertile and moist soil characteristics, particularly along sheltered creeks and south facing slopes. Characteristic canopy species include Blackbutt (*Eucalyptus pilularis*) and Tallowwood (*Eucalyptus microcorys*) with Flooded Gum (*Eucalyptus grandis*), Grey Ironbark (*Eucalyptus paniculata*), Pink Bloodwood (*Corymbia intermedia*) and occasionally Red Mahogany (*Eucalyptus resinifera*) and Turpentine (*Syncarpia glomulifera*). Within the study area, moist blackbutt forest occurs within Nambucca, Newry and Little Newry State Forests. This habitat type was targeted in surveys for *Marsdenia longiloba*, *Amorphospermum whitei* and *Acacia chyrsotricha.* Flooded gum association. The flooded gum association occurs over a range of topographic positions, however, in the study area this forest type predominantly occurs in the sheltered south facing gullies and along creeklines along the fringe of waterlogged zones. This community type is dominated by Flooded Gum (*Eucalyptus grandis*), Tallowwood (*Eucalyptus microcorys*), Grey Ironbark (*Eucalyptus paniculata*) and occasionally Brush Box (*Lophostemon confertus*) and Turpentine (*Syncarpia glomuifera*). The mid-canopy and small-tree layer is relatively moist and dense and commonly includes mesophilic species such as Cheese Tree (*Glochidion ferdinandi*), Black Wattle (*Callicoma serratifolia*) and Scentless Rosewood (*Synoum glandulosum*). Within the study area this vegetation type occurs in all areas containing forested gullies, including all state forests. Griffith (1993) considers this community to be widespread on the NSW North Coast. This habitat type was targeted in surveys for *Marsdenia longiloba*. *Amorphospermum whitei* and *Acacia chyrsotricha*. *Marsdenia longiloba* was recorded as being present.

Vegetation structural type	Structure and floristics
	White mahogany/grey gum/grey ironbark association. This association occupies mid-slopes and minor gullies in the north-western parts of Nambucca State Forest and steeper slopes between the Kalang River and Short Cut Road. Subject to a long history of logging resulting in an open tree canopy and younger age structure dominated by White Mahogany (*Eucalyptus acmenoides*), Grey Gum (*Eucalyptus propinqua*), and Grey Ironbarks (*Eucalyptus paniculata* and *Eucalyptus siderophloia*). Tallowwood (*Eucalyptus microcorys*) is sub-dominant and Forest oak (*Allocasuarina torulosa*) occupies the lower tree strata. Also represented in lower abundance are Turpentine (*Syncarpia glomulifera*), Blue Gum (*Eucalyptus saligna*), Brush Box (*Lophostemon confertus*), Flooded Gum (*Eucalyptus grandis*) and Pink Bloodwood (*Corymbia intermedia*). *Marsdenia longiloba* was recorded as being present.
Swamp sclerophyll forests Swamp forests refer to vegetation retained or established in low-lying areas experiencing soil waterlogging and typically in proximity to creek flats, wetlands and rivers. Within the study area the best-preserved areas of swamp forest occurs around low-lying wetlands and as small remnant patches along the Bellinger, Nambucca and Kalang Rivers. Much of this community has been subjected to impacts from clearing, draining and grazing and there are no pristine areas of swamp forest along the Proposal.	Swamp mahogany/broad-leaved paperbark association. This community is typically located in low-lying waterlogged land and often positioned between and merging with the paperbark / swamp oak association, as well as rainforest and wet sclerophyll communities and as such the community often includes mesophilic rainforest species in the understorey. Generally characterised by dense stands of Broad-leaved Paperbark (*Melaleuca quinquenervia*) and Bottlebrush (*Callistemon salignus*) within the mid to lower canopy but also occasionally present in the upper canopy. Characteristic species of the overstorey includes Swamp Mahogany (*Eucalyptus robusta*), Red Mahogany (*Eucalyptus resinifera*) and various other tree species at different densities including Forest Red Gum (*Eucalyptus tereticornis*), Flooded Gum (*Eucalyptus grandis*), Gwamp Gum (*Lophostemon sauveolons*) and Smooth-barked Apple (*Angophora costata*). Other indicative species include Prickly-leaved Paperbark (*Melaleuca styphelioides*), Snow-in-Summer (*Melaleuca linariifolia*) and Ball Honeymyrtle (*Melaleuca nodosa*). Within proximity to the Proposal this community is represented to the south of the Kalang River in Newry State Forest and adjacent to South Arm Road, to the south of Raleigh. Broad leaved paperbark/swamp oak association. Primarily dominated by Broad-leaved Paperbark (*Melaleuca quinquenervia*) with a lower density of Swamp Oak (*Casuarina glauca*). This community would have historically been more widespread throughout the floodplain areas particularly south of Macksville although has been extensively cleared for grazing land. Remnant isolated fragments occur in waterlogged areas exhibiting a low dense canopy. Scattered eucalypts are represented in slightly elevated lands, mainly swamp mahogany. Several mature stands of paperbark and swamp oak association are represented in the south of the study area, associated with the floodplains of Warrell Creek and the Nambucca River and also to the north associated with the Kalang and Bellinger Rivers. This community often occurs as a transitional zone in floodplain areas between the swamp mahogany / broad-leaved paperbark association of primarily freshwater environments and the salt-water environments of the swamp oak dominated vegetation. Swamp oak association. Only a small component of this community is represented in the study area, often in areas that are inundated with brackish waters or in low-lying lands adjacent to several watercourses, including Warrell Creek and both the Nambucca and Kalang Rivers. The community is generally represented as stands of almost pure Swamp Oak (*Casuarina glauca*), although occasional paperbarks (*Melaleuca sp.*) or remnant eucalypts may also be represented in fringing areas. This community often adjoins mangrove forest and merges with other swamp and riparian forest types. Monospecific stands of *Casuarina glauca* forest are poorly reserved on the NSW North Coast (Griffith 1993).

Vegetation structural type	Structure and floristics
Rainforest As a result of historical land clearing throughout the Nambucca Valley extant rainforest is restricted to small and isolated linear fragments along creek gullies or as a smaller component of the wet sclerophyll associations. In all cases the canopy is dominated by eucalyptus species with a suite of rainforest tree species represented in the sub-canopy.	Gallery rainforests were noted from the mid and northern sections of the study area through Nambucca and Newry State Forest and north of the Kalang River. It occurs in cool, moist gullies and as riparian vegetation along permanent creeks such as Boggy Creek. The canopy tends to be dominated by eucalyptus species rather than rainforest emergents and is typically associated with Flooded Gum (*Eucalyptus grandis*) although Brush Box (*Lophostemon confertus*) is also dominant. The community includes a diversity of mesophylic species typical of warm temperate gully rainforest pockets in the locality. The canopy often comprises scattered emergent Flooded Gum and Brush Box with a dense sub-canopy of rainforest species, including Bangalow Palm (*Archontophoenix cunninghamiana*), Jackwood (*Cryptocarya glaucescens*), Scentless Rosewood (*Synoum glandulosum*), Scrub Beefwood (*Stenocarpus salignus*), Lily Pilly (*Acmena smithii*), Brush Wilga (*Wilkiea huegeliana*) and several vines including Water Vine (*Cissus hypoglauca*). Groundcovers and shrubs are generally absent. This habitat type was targeted in surveys for *Marsdenia longiloba*, *Amorphospermum whitei, Acronychia littoralis* (Scented Acronychia) and *Parsonsia dorrigoensis* (Milky Silkpod). *Marsdenia longiloba* was recorded as being present.
Wetlands There are few wetlands within the actual study area being limited to small wetlands. Several of the larger wetlands in the locality occur on river flats adjoining the Nambucca and Kalang River as well as Deep Creek and are often within or associated with wetlands listed under SEPP 14. 'Freshwater Wetlands' are listed as an EEC under the TSC Act.	Rush/sedgeland. Wetland communities occur in low-lying areas associated with the floodplain of the larger rivers (Nambucca and Kalang River) and permanent creeks such as Deep Creek and Oyster Creek some of which are listed under State Environmental Planning Policy No.14 – Coastal Wetlands (SEPP 14). Wetland communities in the study area comprise a mix of both freshwater and saltwater flora, evolved through periodic tidal influences on freshwater soaks and drainage depressions. A diversity of sedge and rush species form dense stands in shallow water and fringing areas and are dominated by Eleocharis, Cyperus, Juncus and Schoenoplectus spp, with Saw-sedge (*Gahnia melanocarpa*), Native Rush (*Phragmites australis*) and Cumbungi (*Typha orientalis*).
Estuarine vegetation Estuarine vegetation consists of narrow bands (1-5 m) of mangroves surrounding tidal creeks such as Newee and Deep Creek and large portions of the Kalang and Nambucca River foreshores. Mangrove communities are recognised for providing significant habitat for estuarine fish and are protected as important fish habitat under the *Fisheries Management Act* 1994.	Mangrove association. Narrow linear stands of mangroves up to 10 metres wide have been retained within the tidal zones of both the Kalang and Nambucca Rivers and lower sections of their associated tributaries. This vegetation is dominated by Grey Mangrove (*Avicennia marina*). Mangroves are also present on the southern bank of Deep Creek. Beds of seagrass are present within the lower areas of the Kalang River estuary. Saltmarsh association. Saltmarsh communities are very restricted in distribution and size being limited to several very small and isolated fragments within modified pastures occupying former swamp communities. As for the mangrove community it is restricted to the tidal zones of both the Kalang and Nambucca Rivers and some of the lower portions of their associated tributaries. The saltmarsh association is characterised by the presence of Samphire (*Sarcocornia quinqueflora*), New Zealand Spinach (*Tetragonia tetragonioides*) and Saltwater Couch (*Sporobolus virginicus*).

Vegetation structural type	Structure and floristics
Modified communities Modified communities are defined as former forest associations which have been modified through land clearing and draining for the development of farm land and now exist as introduced pasture, remnant trees with a grassy pasture understorey or regrowth forest either of the same origin or different species. Small isolated fragments of the former forest communities often occur with an understorey dominated by introduced pasture or weeds. Occasional remnant paddock trees have been retained in the landscape.	Cleared grassland and introduced pasture. Cleared grassland and introduced pasture occurs on fertile soils associated with the floodplains of Warrell Creek and the Nambucca River in the south and Deep Creek and the Kalang River through the central and northern parts of the study area. Such areas contain very limited remnant vegetation and are characterised by a generally low native floral diversity. Commonly, scattered remnant trees and small fragmented native vegetation patches are present, as are planted areas for windbreaks and landscaped gardens. The areas are dominated by introduced pasture grasses, including Paspalum (*Paspalum dilatatum*), Rhodes Grass (*Chloris gayana*) and Kikuyu (*Pennisetum clandestinum*). Modified riparian forest. Historically retained on private properties as narrow vegetated strips along watercourses, in otherwise cleared paddocks. This modified vegetation comprises a combination of both native and introduced flora species and often dominated by weeds, particularly Lantana (*Lantana camara*). This vegetation has primarily been retained for the purpose of stabilising and reducing bank erosion and exhibits elements of wet sclerophyll, rainforest and swamp sclerophyll associations. Modified sclerophyll forest. Several relatively small and isolated fragments of dry and wet sclerophyll forest have been retained on private properties throughout the landscape. Such areas are dominated by a suite of eucalypt species as described above depending on the location, soil type and topography and are characterised by remnant trees and a depleted native understorey replaced by grazed pasture or a dense regrowth of weeds where grazing has ceased.

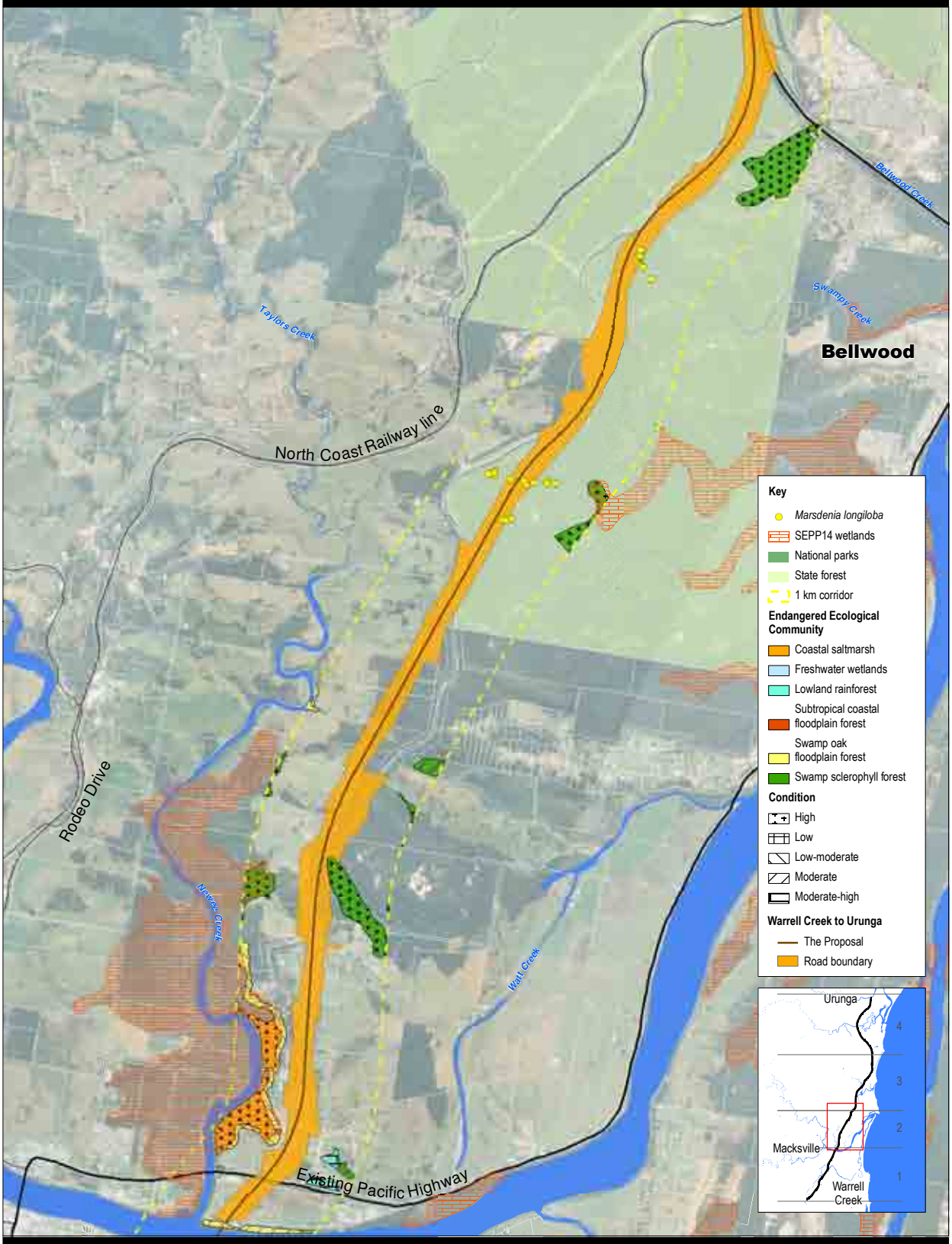
FIGURE 10-2 a | LOCATIONS OF ENDANGERED ECOLOGICAL COMMUNITIES — SECTION 1 OF 4



Warrell Creek to Urunga - Upgrading the Pacific Highway

0 400 800 Metres

FIGURE 10-2 b | LOCATIONS OF ENDANGERED ECOLOGICAL COMMUNITIES **SECTION 2 OF 4**



Warrell Creek to Urunga - Upgrading the Pacific Highway

0 400 800 Metres

FIGURE 10-2 c | LOCATIONS OF ENDANGERED ECOLOGICAL COMMUNITIES SECTION 3 OF 4

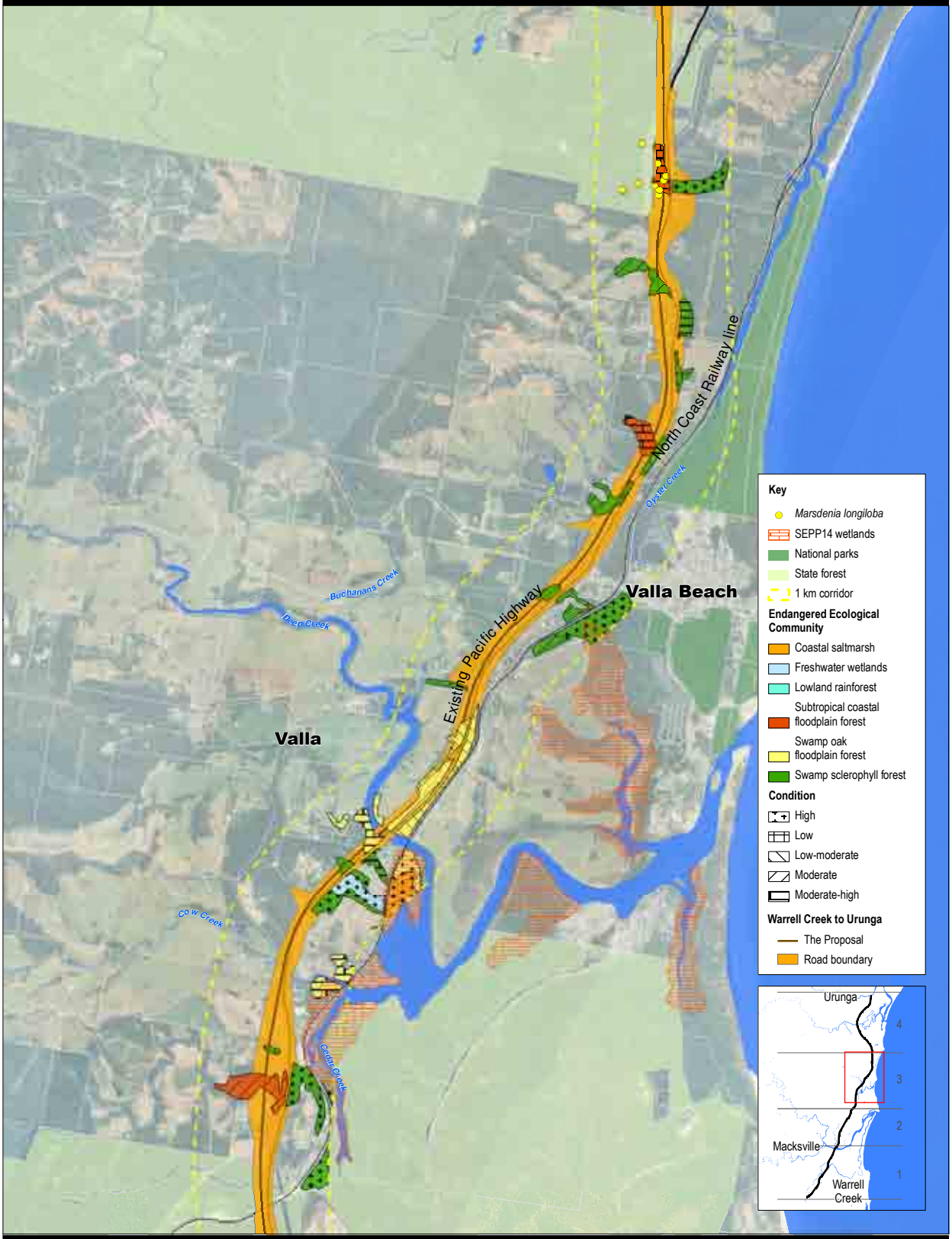
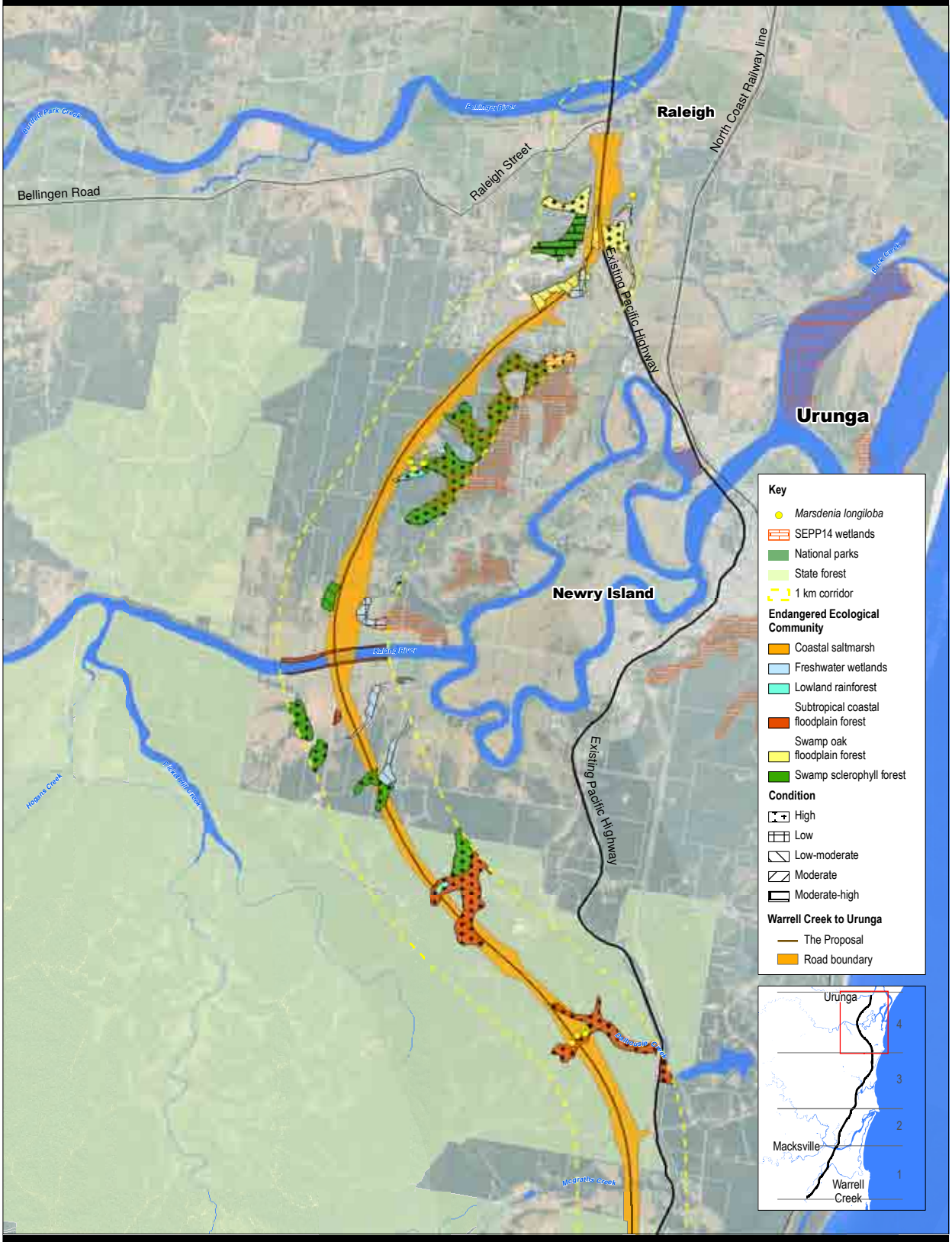


FIGURE 10-2 d | LOCATIONS OF ENDANGERED ECOLOGICAL COMMUNITIES — SECTION 4 OF 4



Warrell Creek to Urunga - Upgrading the Pacific Highway

0 400 800 Metres

10.3.2.3 Threatened species

Of the native flora species represented in the Proposal corridor, there was one nationally vulnerable species (also listed as endangered in NSW), one NSW listed vulnerable species, two rare or threatened Australian plants species (RoTAP) and five species considered to be regionally significant in the local area.

Of the 12 threatened species identified, eight have suitable habitat attributes in the study and have potential to be present. Targeted surveys were conducted to locate rare or threatened plant species occurring, or with the potential to occur within the study area including those specifically highlighted in the Director General's requirements including Marsdenia longiloba (Slender Marsdenia), Amorphospermum whitei (Rusty Plum), Acacia chrysotricha (Newry Golden Wattle), Acronychia littoralis (Scented Achronychia) and Parsonsia dorrigoensis (Milky Silkpod). In addition to the species specified in the Director General's requirements, targeted surveys also were also conducted for Peristeranthus hillii, Maundia triglochinoides and Hicksbeachia pinnatifolia (Red Bopple Nut). Of these only Slender Marsdenia and Rusty Plum were identified.

Table 10–4 provides the results of the surveys for threatened plant species protected under State and Commonwealth legislation. Individual threatened species found to be present include Slender Marsdenia which is listed as vulnerable under Commonwealth legislation and endangered under NSW legislation and rusty plum which is listed as vulnerable under NSW legislation. In addition to the species in Table 10–4 seven rare species listed under the RoTAP database (Briggs and Leigh 1996) and other flora species which are at the limit of their distribution, are generally uncommon in the area or are regarded as being regionally significant were located in the study area. These are listed in Table 10–5.

10.3.3 Terrestrial fauna

10.3.3.1 Habitat types

Five fauna habitat types (Table 10-6) are represented in the study area in association with the structural vegetation types described in Table 10-3. The distribution of habitats is shown in Figure 10-3. The highest diversity of fauna was found to occur in the moist and swamp forest habitats, particularly those located on privately owned land. Despite the level of disturbance in the habitats of the state forests, these habitats represented the largest fragments of bushland in the study area and as such are identified as key habitats and important corridors and are of high conservation value due to their relative size and strategic location, linking the coast to extensive forests to the west of the study area.

Table 10-4 Threatened flora located within the Proposal corridor

Species	Conservation status			Distribution and abundance
	Cwlth (EPBC Act)	NSW (TSC Act)	RoTAP	
Slender Marsdenia (*Marsdenia longiloba*)	V	E	3RC-	Slender Marsdenia occurs in six locations associated with gullies and creek line habitats. Locations include Nambucca, little Newry and Newry State Forest as well as a private property. The total number of individuals within these populations was estimated to comprise approximately 156 individuals.
Rusty Plum (*Amorphospermum whitei*)	-	V	3RCa	This species was recorded in the Boggy Creek area. Only one individual was recorded.
Newry Golden Wattle *(Acacia chrysotricha)*	-	E	2R	Newry Golden Wattle was not recorded in the study area despite targeted searches in areas of suitable habitat. In particular areas of Newry State Forest and Nambucca State Forest had suitable areas of habitat comprising narrow gullies on quartzite soils. There are records of this species to the west of the study area in Newry State Forest.
Scented Acronychia (*Acronychia littoralis*)	E	E	3ECi	Scented Acronychia was not recorded in the study area despite targeted searches. The preferred habitat for this species is littoral rainforest on sand which does not occur in the study area. There is a low possibility this species is present in rainforest and wet sclerophyll forests of the study area however these habitats are marginal.
Red Bopple Nut (*Hicksbeachia pinnatifolia*)	-	V	3RC	Red Bopple Nut was not recorded in the study area despite targeted searches in areas of suitable habitat. There are no records for this species in the locality, however this species is recorded as occurring from Nambucca Valley to southeast Queensland. Red bopple nut may occur in rainforest and wet sclerophyll forests habitats in the study area, however better quality examples of habitat are restricted to a few small areas of rainforest.
Maudia triglochinoides	-	V	-	*Maudia triglochinoides* was not recorded in the study area despite targeted searches in wetlands, creeks and dams with shallow freshwater 30-60 centimetres deep. The Proposal would result in the removal of only a small area of suitable habitat comprising up to 2 hectares of dams, creeks and wetland areas. There are several creeks and farms dams which provide suitable habitat for *Maudia triglochinoides*, however many of the wetland habitats in the study area are relatively disturbed and generally provide marginal habitat qualities. There are no records of this species in the locality.

Species	Conservation status			Distribution and abundance
	Cwlth (EPBC Act)	NSW (TSC Act)	RoTAP	
Milky Silkpod (*Parsonsia dorrigoensis*)	E	V	2VCi	Milky Silkpod was not recorded in the study area despite targeted searches in areas of suitable habitat. There are records for this species in the locality.
Brown Fairy-chain Orchid (*Peristeranthus hillii*)	-	V	-	Brown Fairy-chain Orchid is an epiphytic orchid that was not recorded in the study area despite targeted searches in areas of suitable habitat. There are no records for this species in the locality. The preferred habitat for this species is littoral rainforest which does not occur in the study area. There is a low possibility this species is present in rainforest and wet sclerophyll forests of the study area however these habitats are marginal.

V=vulnerable, E= endangered, RoTAP=Rare or Threatened Australian Plant

RoTAP Codes

2 = geographic Range in Australia less than 100km

3 = geographic Range in Australia greater than 100km

V = Vulnerable – at risk over longer period (20-50years)

E= Endangered – at risk within 10-20 years.

R = Rare – uncommon plants with no current threats

K = Poorly known – taxon that is suspected but not definitely known to belong to one of the above categories

C = Reserved

a = 1000 plants or more know from conservation reserves

i = less than 100 plants in conservation reserves

- = reserved population size not accurately known

Table 10-5 Rare and regionally significant flora recorded in the study area

Threatened Flora	Status	Source, Distribution and Abundance
Artanema fimbriatum	Regionally significant, southern limit	Southern limit listed as the Brunswick River (PlantNET 2008). This species was recorded in several locations between Nambucca State Forest and Newry State Forest.
Swamp Lily (*Crinum pedunculatum*)	Regionally significant, sparse species occurring in depleted habitat	Listed as a regionally significant species (Kendall and Kendall 2003). Occurs in areas of swamp forest at several locations, including areas adjacent to Warrell Creek at the southern end of the study area.
Cymbidium madidum	Regionally significant, southern limit	Southern limit Clarence River (PlantNET 2008), distribution in the study area represent extreme southern limit. Occurs in several locations at the northern end of the study area including private property north of the Kalang River.
Cyperus filipes	Regionally significant	Listed as a regionally significant species (Kendall and Kendall 2003). Occurs in protected areas in Newry State Forest, and on private property north of the Kalang River.
Eucalyptus ancophila	RoTAP: 2K	Recorded in several gully areas in Nambucca and Newry State Forest.
Swamp Turpentine (*Lophostemon sauveolens*)	Regionally significant, southern limit	The southern limit for this species is Scotts Head (PlantNET 2008), and is listed as a regionally significant species (Kendall and Kendall 2003).
Corky Milk Vine (*Marsdenia lloydii*)	Regionally significant	Listed as a regionally significant species (Kendall and Kendall 2003). Occurs at numerous locations along the entire study area.

Table 10-6 Terrestrial fauna habitats

Habitat type	Description
Dry open forests	Dry open forest habitats occupy approximately 65 per cent of the route corridor. These are largely contained within Nambucca, Newry and Little Newry State Forests although also on privately owned lands. Of particular importance to fauna is the diversity of canopy plant species which provide seasonal food and shelter resources for nectarivorous and foliovorous birds and mammals. Additional features of importance include an abundance of logs and dense understorey in parts providing sheltering and breeding opportunities for reptiles and small ground dwelling mammals. In general, the dry forest habitats present appear to lack maturity and indeed their value has been reduced from the long history of logging and burning. Hollow-bearing trees and standing dead trees are scarce and the resulting lack of nesting and denning opportunities is likely to have restricted populations of hollow-dependent fauna from competition. The dry open forests support species rich populations of birds (i.e. 70 species) represented from several families. Other fauna represented included 28 mammal species, dominated by rodents, microchiropteran bats, gliders, and possums and 13 reptile species dominated by skinks. Diversity and abundance across the open forest sites reflected the degree of disturbance.

Habitat type	Description
Moist closed forests	Smaller linear fragments and regrowth moist forests occur in sheltered gullies and along creek areas and occupy approximately 15 per cent of the study area. Generally the moist forest communities adjoin and grade into open forest habitats and as such the majority of fauna occurring in these areas would utilise both habitat types and are not exclusively linked to either. However, the moist forest habitats tend to exhibit a higher floristic diversity and may comprise a greater percentage of fruiting and flowering resources which are particularly important for specialist frugivorous fauna. Similarly a larger percentage of dead standing trees or mature trees were found to occur in moist gullies where fire has been suppressed. As such hollow-dependent fauna may be more concentrated in gully areas. In some instances these habitats are found in association with flowing streams that are suited to a small diversity of stream dwelling frog species. It is apparent that these moist forest habitats are limited in extent and provide essential habitat for a small range of threatened fauna species known from the NSW North Coast and as such are regionally significant. Despite the smaller size the moist forest habitats were found to support a species rich assemblage of birds (i.e. 63 species), other fauna represented included 26 mammal species mostly microchiropteran bats, possums, gliders and bandicoots. 11 species of frogs and 11 reptile species were also identified.
Swamp forests	Swamp forest habitat refers to the vegetation retained or established in low-lying areas adjoining creeks, wetlands and rivers. Along the Proposal corridor, the best-preserved areas of swamp forest occur around the lower reaches of creeks and as small fragments on the floodplains. The dominant species vary from individual stands of one tree species to combinations of species which may include swamp mahogany, red mahogany, paperbarks or swamp oak. The swamp forest habitats are generally characterised by high structural diversity and provide dense cover for ground-dwelling mammals and birds. Swamp mahogany is a winter flowering eucalypt and important food resource for nectarivorous fauna. Other important habitat features present include large trees, tree hollows and logs, and persistent surface water in poorly drained areas providing important refuge habitat for frogs. The swamp forests support the most species rich populations of frogs (i.e. 14 species) represented by both ground-dwelling and tree frogs. Other fauna represented included 28 bird species, mainly small cover-dependent birds such as wrens and thornbills, 11 species of mammals and 6 reptile species.
Aquatic and estuarine habitats	Permanent and ephemeral creeks, freshwater wetlands and farm dams provide high value fauna habitat and often represent significant features in the landscape, particularly within modified agricultural and floodplain landscapes. Such areas provide habitat for fauna dependent on aquatic and semi aquatic habitats, especially frogs, some reptiles and several common wader and waterbird species and can exhibit a comparatively species rich habitat. Riparian habitats may also provide important fauna movement corridors and provide refuge during fire and drought events. The Proposal crosses the Nambucca River in the south and the Kalang River in the north. These river channels provide significant estuarine fauna habitats including open water, intertidal sandflats, sandy shores and oyster leases and provide important habitat for bird groups such as waders, waterfowl, cormorants, pelicans, herons, oystercatchers and their allies. This includes the osprey (*Pandion haliaetus*), a threatened raptor that requires extensive areas of open water for fishing, frequenting fresh and saline habitats and adjacent coastal forests with tall trees for nesting. Several osprey and nest sites have been recorded on the Nambucca and Kalang River floodplains across the study locality. Fauna represented in freshwater and aquatic habitats included 10 species of bird, 10 frog species and four reptile species.
Modified habitats	Modified fauna habitats comprise former forest lands that have been cleared for grazing and subsequently exist as grassy paddocks with small isolated fragments of disturbed tree cover. Such open habitats provide few important habitat features for fauna and generally comprise lower faunal diversity as a result of the degree of disturbance. In general, these areas lack significant vegetation or habitat for threatened species and are dominated by common and introduced fauna, particularly those tolerant of modified landscapes. Although the value of isolated mature remnant trees has been documented previously in terms of their ability to provide food and sheltering resources for mobile fauna species (Law, et al. 2000). These features, particularly large dead trees are often selected as preferred nest sites for raptors including the threatened osprey (Clancy 1991) as a result of their absence from forest habitats.

Nambucca, Newry and Little Newry State Forests are known to be important habitat for a number of threatened species including Koala, Yellow-bellied Glider, Glossy Black Cockatoo, Square-tailed Kite and several microchiropteran bats.

Moist sclerophyll forests with rainforest understorey located in steeper gullies and drainage lines have a high floristic diversity as a consequence of being protected from frequent fires. They contain more hollow-bearing trees and a diversity of food resources and sheltering microhabitats for threatened species such as the Wompoo and Superb Fruit Dove, Grey-headed Flying Fox, Powerful Owl, Yellow-bellied Glider, Glossy Black Cockatoo, Square-tailed Kite and several micropchiropteran bats.

Many of the swamp forest habitats have been disturbed through clearing, draining and grazing, particularly on the floodplain and any remaining areas are of high conservation value. They comprise a high diversity of frog and reptile species.

Habitat trees comprise hollow bearing trees and standing dead trees and are used by a variety of species. These are sparsely scattered through the landscape and provide potential nesting hollows for species such as Glossy Black Cockatoo, Powerful Owl and Yellow-bellied Glider.

10.3.3.2 Threatened species

A total of 203 terrestrial fauna species were recorded in the study area comprising 125 bird, 36 mammal, 24 reptile and 18 amphibian species. Fourteen vertebrate fauna species of conservation significance were recorded in surveys undertaken between 2005 and 2008. Of the 14 species, the Grey-headed Flying Fox is considered vulnerable under both Federal (EPBC Act) and State (TSC Act) legislation. The remaining 13 species are all considered vulnerable under the TSC Act, except the Black-necked Stork which is listed as endangered. Threatened fauna species identified during survey (confirmed) and those which have been previously recorded in the area are listed in Table 10-7. The 14 fauna species of conservation significance are listed along with species that have been recorded in wildlife atlas (DECC 2008) and are considered to potentially occur in the study area. Migratory bird species are listed in Table 10-8.

Nine EPBC Act listed migratory bird species were identified during the field investigations, as shown in Table 10-8. However, the majority of species were considered uncommon and widespread with no specific congregations or habitat represented. The most widespread and abundant species was the Cattle Egret present through cleared farmland, and Rufous Fantail and Black-faced Monarch in moist, densely forested gullies. White-throated Needletail were observed in the study area on several occasions.

FIGURE 10-3a | FAUNA HABITATS, THREATENED FAUNA AND PROPOSED FAUNA CROSSING LOCATIONS SECTION 1 OF 4

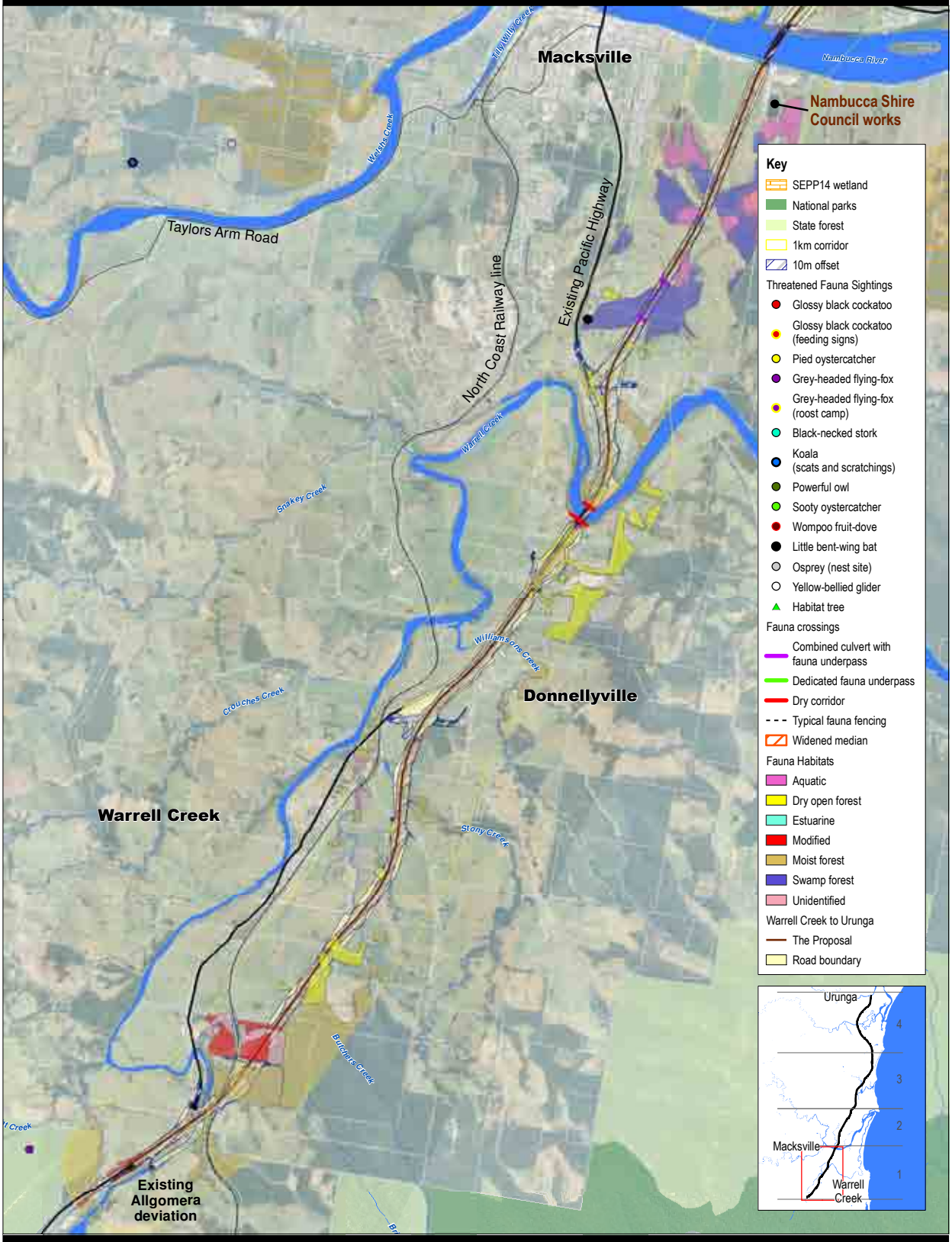


FIGURE 10-3b | FAUNA HABITATS, THREATENED FAUNA AND PROPOSED FAUNA CROSSING LOCATIONS **SECTION 2 OF 4**

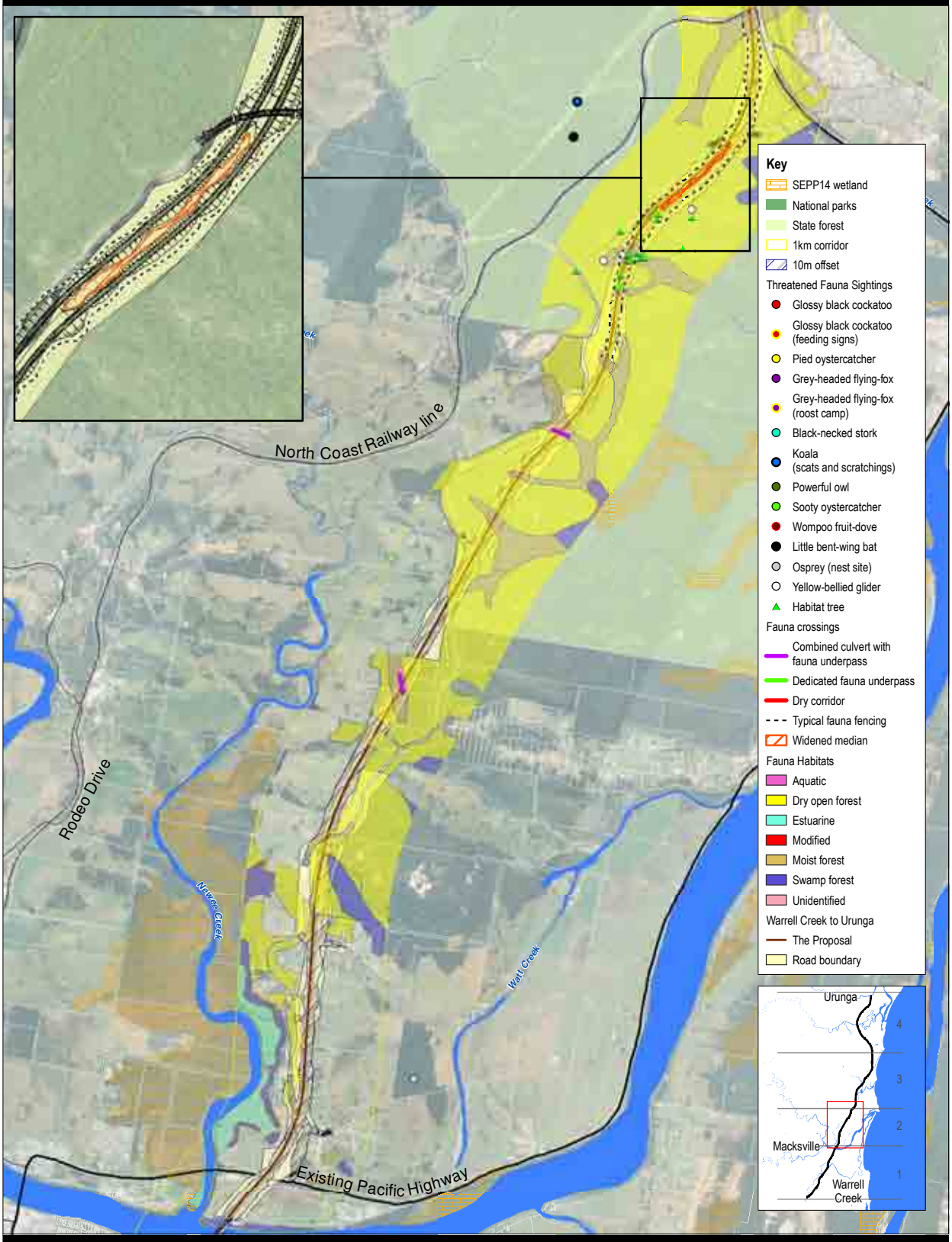


FIGURE 10-3c | FAUNA HABITATS, THREATENED FAUNA AND PROPOSED FAUNA CROSSING LOCATIONS **SECTION 3 OF 4**

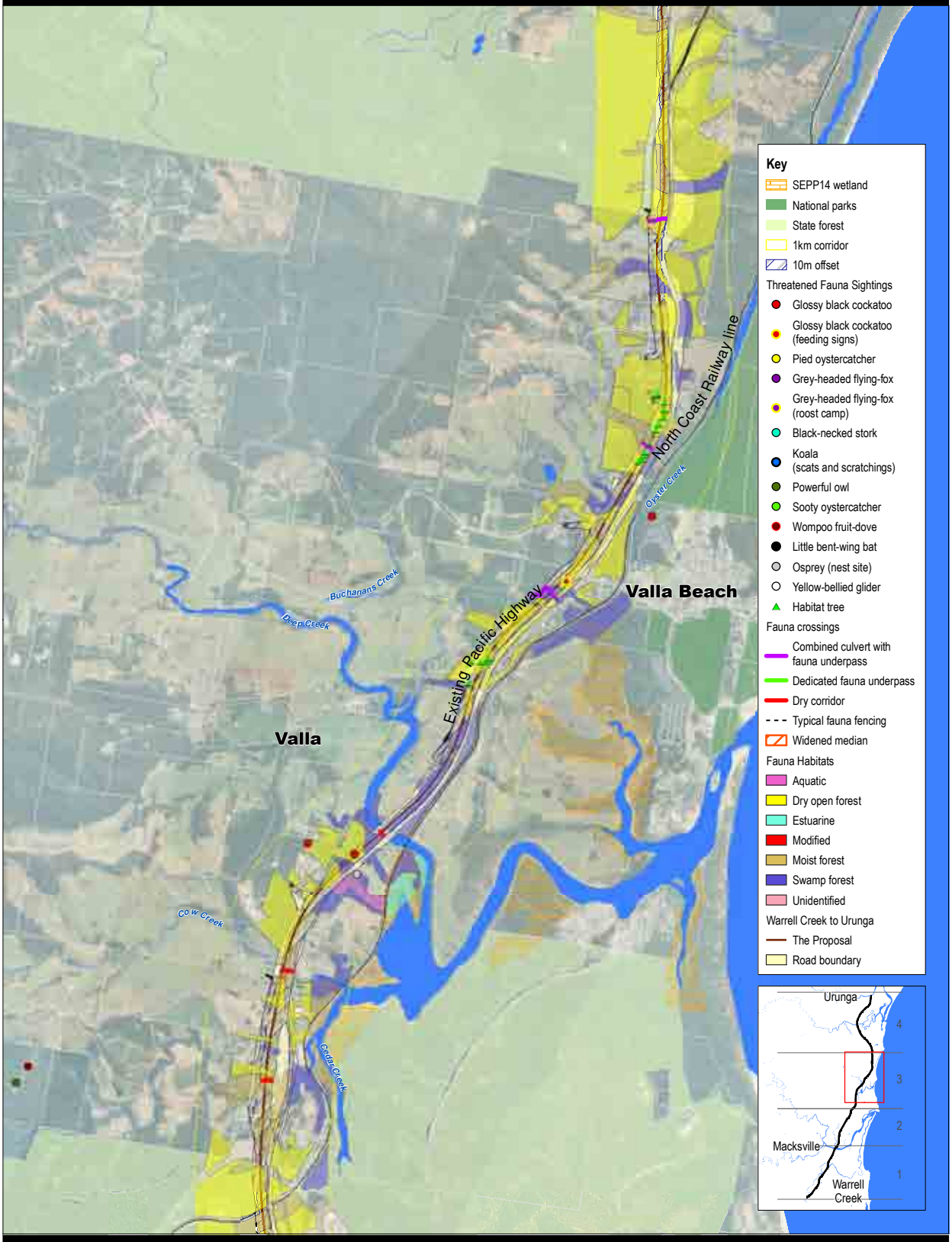


FIGURE 10-3d | FAUNA HABITATS, THREATENED FAUNA AND PROPOSED FAUNA CROSSING LOCATIONS SECTION 4 OF 4

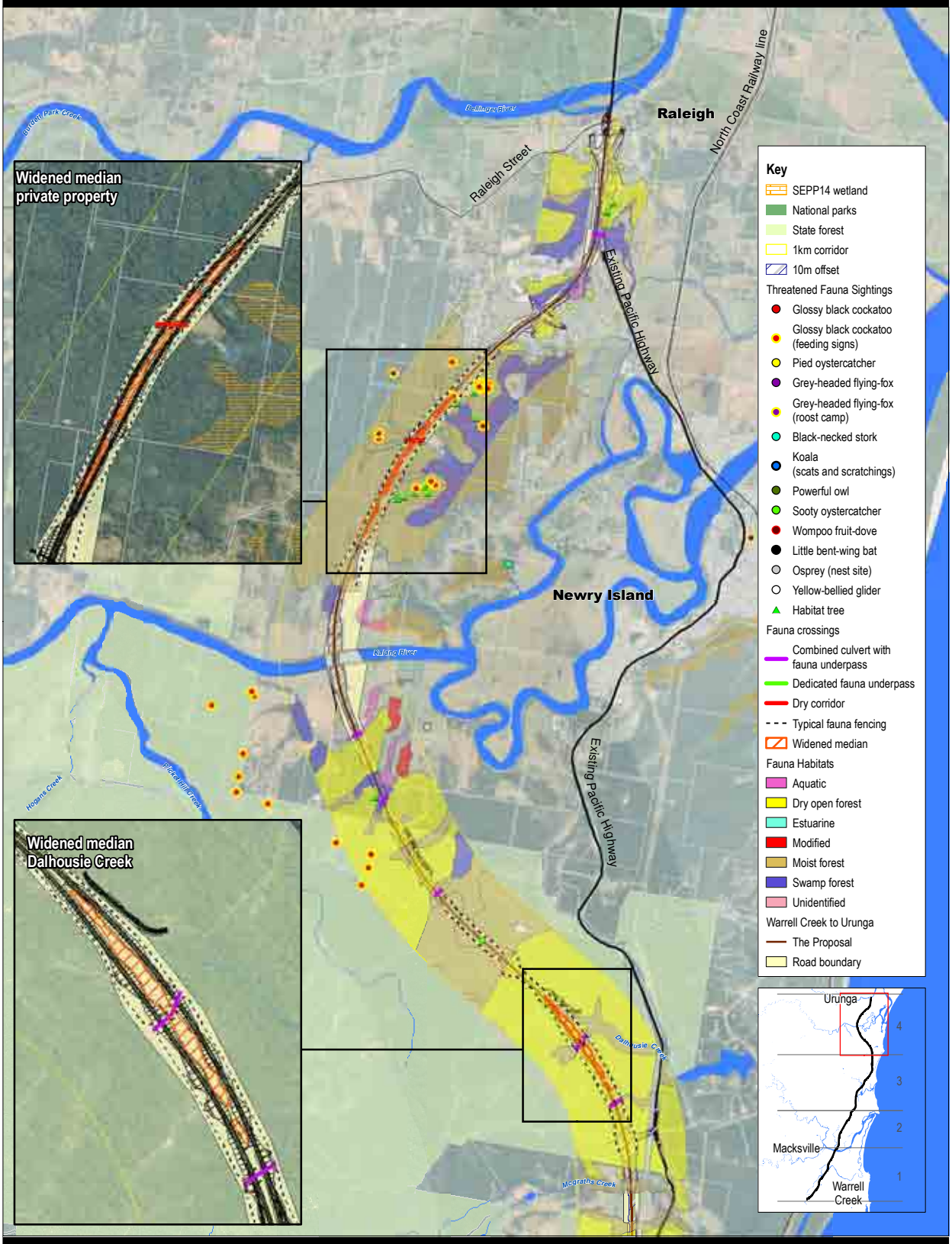


Table 10-7 Threatened fauna

Species	Status Federal (EPBC Act)	Status NSW (TSC Act)	Presence in the study area
Black-necked Stork (*Ehippiorhynchus asiaticus*)		Endangered	Confirmed
Spotted-tailed Quoll (*Dasyurus maculatus*)	Vulnerable	Vulnerable	Potential
Brush-tailed Phascogale (*Phascogale tapotafa*)		Vulnerable	Potential
Yellow-bellied Glider (*Petaurus australis*)		Vulnerable	Confirmed
Koala (*Phascolarctos cinereus*)		Vulnerable	Confirmed
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)		Vulnerable	Confirmed
Square-tailed Kite (*Lophiotinia isura*)		Vulnerable	Confirmed
Emu (*Dromaius noveahollandia*)		Endangered	Potential
Black Bittern (*Ixobrychus flavicollis*)		Vulnerable	Potential
Red-tailed Black Cockatoo (*Calyptorhynchus banksii*)	Endangered	Endangered	Potential
Osprey (*Pandion haliaettus*)		Vulnerable	Confirmed
Amphibians			
Green and Golden Bell Frog (*Litoria aurea*)	Endangered	Endangered	Potential
Giant Barred Frog (*Mixophyes iteratus*)	Endangered	Endangered	Potential
Migratory nectivores			
Swift Parrot (*Lathamus discolour*)	Endangered	Endangered	Potential
Regent Honeyeater (*Xanthomyza phrygia*)	Endangered	Endangered	Potential
Cave-roosting Microchiropteran Bats			
Little Bentwing-bat (*Miniopterus australis*)		Vulnerable	Confirmed
Eastern Bentwing-bat (*Miniopterus schreibersii*)		Vulnerable	Confirmed
Common Blossom bat (*Syconycteris australis*)		Vulnerable	Potential
Hollow-roosting Microchiropteran Bats			
Greater Broad-nosed Bat (*Scoteanax rueppellii*)		Vulnerable	Confirmed
Eastern Freetail-bat (*Mormopterus norfolkensis*)		Vulnerable	Potential
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)		Vulnerable	Confirmed
Megachiropteran bats			
Grey-headed Flying-fox (*Pteropus poliocephalus*)	Vulnerable	Vulnerable	Confirmed
Yellow-bellied Sheathtail bat (*Saccolaimus flaviventris*)		Vulnerable	Confirmed

Species	Status Federal (EPBC Act)	Status NSW (TSC Act)	Presence in the study area
Frugivorous Birds			
Wompoo Fruit-dove (*Ptilinopus magnificus*)		Vulnerable	Confirmed
Large Forest Owls			
Powerful Owl (*Ninox strenua*)		Vulnerable	Confirmed
Masked Owl (*Tyto noveahollandiae*)		Vulnerable	Potential
Sooty Owl (*Tyto tenebricosa*)		Vulnerable	Potential

Table 10-8 Migratory bird species within the study area

Scientific name	Common name	Habitats[1]						Recorded in the study area
		DSF	MSF	SSF	FW	EST	RC	
Bubulcus ibis	Cattle Egret						•	•
Ardea alba	Great Egret			•	•		•	•
Haliaeetus leucogaster	White-bellied Sea-eagle						•	•
Pandion haliaetus	Osprey			•		•	•	•
Gallinago hardwickii	Latham's Snipe						•	•
Lathamus discolor	Swift Parrot							
Hirundapus caudacutus	White-throated Needletail	•	•				•	•
Merops ornatus	Rainbow Bee-eater							
Xanthomyza phrygia	Regent Honeyeater							
Rhipidura rufifrons	Rufous Fantail	•	•					•
Monarcha melanopsis	Black-faced Monarch	•	•	•				•
Monarcha trivirgatus	Spectacled Monarch							
Acrocephalus australis	Australian Reed-warbler						•	•

[1] DSF – Dry sclerophyll forest, MSF - moist sclerophyll forest, SSF - swamp sclerophyll forest, FW -freshwater wetlands, EST -estuary, RC – rural and cleared land.

10.3.4 Aquatic fauna

Freshwater and estuarine habitats were surveyed to determine the baseline for species distribution within waterways between Warrell Creek and Urunga during 2007 and 2008. The findings are shown in Table 10-9. Full details of the species identified are provided in Working paper 1 – *Flora and fauna*.

Table 10-9 Aquatic fauna recorded as part of the field investigations

Habitat	Location	Species
Freshwater	Butchers Creek, Rosewood Creek, Stony Creek, Williamson Creek, Boggy Creek, Cow Creek and Oyster Creek.	273 fish were caught from 12 species. The most widely distributed was the Striped Gudgeon (*Gobimorphus australis*) and the Empire Gudgeon (*Hypseleotris compressa*). No state or nationally threatened species were present. One exotic species, the Mosquito Fish (*Gambusia holbrooki*) was identified. 60 families of macroinvertebrates were identified from 450 individuals recorded. None of the families were state or nationally threatened or protected.
Estuarine	Warrell Creek, Nambucca River, Deep Creek, Kalang River, Bellinger River	4836 fish were caught from 17 species. The most widely distributed species at all sites was the Grass Shrimp (*Macrobrachium intermedium)*. The Estuary Perchlet (*Ambassis marianus*), Estuary Perch (*Macquaria colonorum*), Flathead Gudgeon (*Philypnodon grandiceps*) and Sea Mullet (*Mugil cephalus*) were also widely distributed across the sites. No state or nationally listed species were recorded.

There were two migratory species identified in the study area, namely the Australian bass, one specimen of which was recorded from the Kalang River and Estuary Perch, which was recorded in Warrell Creek, Deep Creek and the Kalang River.

10.4 Potential impacts on flora and fauna

10.4.1 General impacts

Potential impacts on ecology have been minimised and avoided where possible during route selection and development of the concept design for the Proposal. During this process, a number of important measures to reduce or avoid potential impacts relating to key threatening processes have been incorporated in the Proposal design.

The main impact on flora would be during the construction phase of the Proposal, while potential impacts on fauna could occur both during construction and operation phases of the Proposal. Likely and potential impacts associated with Proposal would include the loss of threatened plant species and endangered ecological communities, fragmentation of habitats and wildlife corridors, barrier effects on wildlife and riparian corridors (such as the erosion of genetic stock), edge effects (such as weed invasion, pests and disease), disturbance to aquatic and riparian habitats potentially resulting in contamination and siltation of waterways, and cumulative impacts in association with the Pacific Highway Upgrade Program. These potential impacts, and others, have been described in the sections below.

Key threatening processes are processes that threaten, or could threaten, the survival or evolutionary development of species, populations or ecological communities. The Proposal would contribute to two key threatening processes listed under the NSW TSC Act and FM Act. These are:

- Clearing of native vegetation.
- Removal of dead wood, in-stream woody debris and dead trees.

The environmental management measures identified to avoid and/ or minimise the impacts on ecology are detailed in Section 10.5 and the *Draft Statement of Commitments* (refer Appendix D).

10.4.2 Potential flora impacts

10.4.2.1 Native vegetation and habitat loss

Approval is being sought for works to be undertaken within the construction footprint including batters, cuttings and ancillary sites, plus a 10 metre buffer. In reality, this provides a worst case scenario for clearing and impacts on native flora and fauna. The area of clearance would not be this extensive and is likely to be in the region of three to five metres from the edge of the footprint. Obtaining approval for this additional area ensures there is sufficient space to allow for slight modifications during detailed design, and providing these do not extend outside the area assessed, would be covered by the approval. Where clearing is required within the buffer area, there is the potential to retain individual plants or communities, and protect them through the construction process. It is the RTA's aim to reduce clearing of individual native species and EECs where possible on this Proposal.

The construction corridor and area of potential impact (10 metre buffer) equates to 431 hectares of which 255 hectares (59 per cent) is occupied by native vegetation, which includes approximately 60 hectares of endangered ecological community. The remaining 176 hectares (41 per cent) consists of cleared agricultural land, plantations, modified rural residential zones and river crossings.

Loss of native vegetation communities would predominantly occur where the alignment passes through Nambucca, Newry and Little Newry state forests and vegetation parcels on private land north of the Kalang River. Much of this loss relates to the dry sclerophyll forest communities which are widespread and abundant in the region. The area of vegetation directly impacted by a 10 metre, five metre and three metre buffer is presented in Table 10-10. The area of habitat loss associated with that vegetation is presented in Table 10-10.

Table 10-10 Direct impact of the Proposal on native vegetation and fauna habitats

Vegetation associations	Corresponding fauna habitat type	Impacted area (hectares)		
		10 metre buffer	5 metre buffer	3 metre buffer
Dry open forest – blackbutt	Dry sclerophyll forest	144.11	123.84	114.93
Moist open forest – white mahogany/grey gum/ironbark	Moist sclerophyll forest	28.76	24.79	22.99
Moist open forest – flooded gum		21.91	18.73	17.33
Mixed floodplain forest (EEC)		12.49	10.69	9.98
Swamp forest – swamp mahogany/paperbark (EEC)	Swamp sclerophyll forests	12.47	11.02	10.33
Swamp forest – swamp oak (EEC)		33.07	9.17	8.62
Lowland rainforest (EEC)	Rainforest	0.58	0.52	0.50

Vegetation associations	Corresponding fauna habitat type	Impacted area (hectares)		
		10 metre buffer	5 metre buffer	3 metre buffer
Freshwater wetlands (EEC)	Freshwater wetlands	1.58	1.22	1.09
Mangroves	Estuarine	0.19	0.15	0.14
Total		255.15	200.13	185.90

10.4.2.2 Endangered ecological communities

Table 10-10 shows there would be a loss of 186-255 hectares of vegetation as a result of the Proposal. Approximately 30-60 hectares (16-24 per cent) of this can be characterised into five separate EECs (listed under the TSC Act). No EECs listed under the EPBC Act were identified. Table 10-11 provides details of the potential impact on these EECs and their condition applying a 10 metre construction buffer.

Table 10-11 Direct impact of the Proposal on EECs (TSC Act) with a 10 metre buffer

Endangered ecological community	Direct impact (ha) (EEC quality)					Total (ha)
	Low	Low-mod	Mod	Mod-high	High	
Swamp Sclerophyll Forest on Coastal Floodplain	0.38	0.29	5.86	-	5.94	12.47
Subtropical Coastal Floodplain Forest	0.24	1.93	2.23	3.25	4.84	12.49
Swamp Oak Floodplain Forest	-	9.21	14.88	3.86	5.12	33.07
Lowland Rainforest on Floodplain	-	-	-	-	0.6	0.6
Freshwater Wetlands on Coastal Floodplains	0.88	0.31	0.18	-	0.21	1.58
Total	1.5	11.74	23.15	7.11	16.71	60.21

The greatest impact in terms of area (33 hectares) would be the removal of Swamp Oak Floodplain Forest, of which over 70 per cent was identified as of low to moderate condition. This is located in areas north of Nambucca River, around Deep Creek and in the vicinity of Short Cut Road. Approximately 12 per cent of each of Swamp Sclerophyll Forest on Coastal Floodplain and Subtropical Coastal Floodplain Forest would be removed. Only small areas of lowland rainforest and freshwater wetlands would be impacted. If the area of removal can be reduced to the three metre or five metre construction buffer there is the potential to decrease the overall loss of EECs, particularly for Swamp Oak Floodplain Forest.

These losses represent a relatively small proportion of the total remaining area of each EEC on the Macleay Coastal Floodplain. It is estimated that approximately 700 hectares of swamp sclerophyll forest, 400 hectares of Swamp Oak Floodplain Forest and 11,000 hectares of freshwater wetlands on the coastal floodplain are remaining. The total extent of remaining Subtropical Coastal Floodplain Forestand Lowland Rainforest on Floodplain is not known.

10.4.2.3 Threatened flora species

The impact on threatened flora species was assessed using the Threatened species assessment guidelines: the assessment of significance (DECC 2007c) for species listed under the TSC Act and the Significant Impact Guidelines – Matters of National Environmental Significance (Department of Environment and Heritage 2006) for species listed under the EPBC Act Table 10-12 provides details of the potential impacts on the threatened flora.

Targeted surveys of the distribution and abundance of vulnerable species Marsdenia longiloba were undertaken and resulted in the modification and refinement of the design of the Proposal in several locations to reduce direct and indirect impacts on identified populations. As Table 10-12 shows, the Proposal would result in the loss of 12 individual Marsdenia longiloba (8 per cent of the population). The table also indicates that this impact could be reduced if individuals are retained within the construction corridor. An additional 32 individuals have the potential to be indirectly impacted as they occur within the road boundary of the Proposal. The remaining 112 individuals (72 per cent) would remain in surrounding areas outside the road boundary.

One specimen of the Rusty Plum located in riparian vegetation along Boggy Creek would be removed. This was the only individual found in the study area and the extent of the local population is not known. Removal of this individual would be considered a significant impact on the local and regional population.

Table 10-12 Threatened flora

Species	Conservation status		Conclusion of assessment
	Cwlth	NSW	
Slender Milkvine (*Marsdenia longiloba*) - a slender vine, growing to five metres in height in moist open forest	V	E	Occurs in seven sub-populations along the route in Nambucca State Forest, Little Newry State Forest and within densely vegetated private properties to the north of the Kalang River. Five of the populations would be directly impacted to some degree. The total number within these populations was estimated to comprise 156 individual plants, of which 12 would be directly impacted with a 10 metre buffer. However this impact can be reduced if individuals are retained within the construction corridor. An additional 32 would potentially be indirectly impacted as they occur within the road boundary of the Proposal and may be subject to altered biophysical conditions. The Proposal would lead to changes in potential habitat for colonisation of the species, resulting from increased run-off of untreated surface water and edge effects, resulting in increased potential for weed invasion. Life cycle attributes of remaining plants are unlikely to be significantly impacted from habitat fragmentation.
Rusty Plum (*Amorphospermum whitei*) - a medium-sized tree with typical habitat consisting of gully rainforest or wet sclerophyll forest with a well developed rainforest understory	-	V	Removal of one individual. The Proposal would potentially lead to changes in potential habitat for colonisation of the species, resulting from increased runoff to untreated surface and edge effects, mostly resulting in increased weed evasion. Life cycle attributes are unlikely to be significantly impacted from habitat fragmentation.

V=vulnerable, E=endangered

10.4.2.4 Edge effects

Introducing edges as a result of the Proposal has the potential to impact the existing vegetation structure through alterations to the chemical and physical environment such as changes to sunlight availability, hydrological regimes and soil nutrients.

The edge effects would be expected to be greatest where the Proposal would create 'new' edges, such as through large areas of remnant vegetation in Nambucca and Newry state forests and private forested lands north of the Kalang River. The edge effects were estimated to extend for a distance of up to 50 metres into the area fragmented. The extent of possible edge effect impacts for the Proposal were calculated based on 0.6:1 ratio consistent with the data presented by Bali (2005) (i.e. 0.6 x 50 m wide) along the length of the Proposal footprint only (taking into account only where a new edge is created through vegetation and not adjoining the existing highway or cleared land). This calculation resulted in a total area of impact of about 126 hectares.

The higher light availability in particular may favour invasive species such as Lantana Camara which could shade out native understorey species. Slender Milkvine (Marsdenia longiloba) which would be retained in habitats adjacent to the Proposal are likely to be impacted from edge effects, including competition with weed species and changes to physical attributes such as sunlight, hydrological regimes and soil nutrients.

10.4.2.5 Erosion of genetic stock

This is the process whereby an already limited gene pool of a species of plant or animal diminishes even more when individuals from the surviving population die off without getting a chance to breed with others. Low genetic diversity in a population of wild animals and plants leads to a further diminished gene pool, inbreeding and a weakening immune system and fast tracks that species towards extinction.

The direct removal of vegetation and fauna habitat and the associated fragmentation of habitat have the potential to have long-term impacts on genetic diversity in flora and fauna. This impact would be greatest on species with high levels of endemism and in particular species with small restricted home ranges within the study area.

None of the flora species identified from the field surveys are considered to be restricted in distribution within the study area, with all species recorded known to occur across the entire North Coast Bioregion. The recording of the Slender Milkvine (Marsdenia longiloba) in this location is consistent with the southern limit of the species distribution, a factor of climatic conditions and not habitat fragmentation. This factor highlights the importance of local populations and the consideration of the individuals in the design of the Proposal.

10.4.2.6 Groundwater dependent communities

Groundwater dependent ecosystems in the study area include terrestrial vegetation, base flows in streams, aquifers, or wetlands. Those vegetation communities and habitats with the greatest potential to be affected by changing ground-water levels consist of terrestrial vegetation and wetlands located in the low-lying floodplain areas intersected by the route of the Proposal, including:

- Swamp oak floodplain forest.

- Swamp sclerophyll forest.
- Subtropical coastal floodplain forest.
- Lowland rainforest.
- Freshwater wetlands.

Other communities within riparian areas may have some level of ground-water dependence, including wet sclerophyll forests in proximity to creek flats. The Proposal may impact on vegetation by either, altering runoff and aquifer recharge rates, and potentially altering the sub-surface flow. Potential blocking of drainage passages could also occur which has the potential to effectively raise the upslope water table and killing vegetation by root inundation, whilst lowering the downslope water table.

Wetland crossings have been generally avoided within the study corridor with the exception of a small number of isolated wetlands occurring in cleared agricultural areas. Such sites have been highly disturbed from grazing, pasture improvement and weed invasion. One higher quality area of this community is present adjacent to the eastern side of the existing highway near Deep Creek which comprises open areas of water, dense sedges and interspersed paperbarks.

The most likely impacts to groundwater dependent communities are from altered hydrology regimes which change groundwater levels. For example, cuttings required in gully areas may intersect the watertable and effect groundwater levels downstream, including SEPP14 wetlands. There are several areas where cuttings in gullies areas are required and there would be potential impacts to the ecology of several drainage lines as a result of changes to groundwater flow, including:

- Gully areas in Nambucca, Newry and Little Newry state forests.
- Creeks and gullies on private property including Boggy Creek, Deep Creek and gully areas in the relatively extensive areas of remnant vegetation north of the Kalang River.
- Major river crossings including the Kalang and Nambucca Rivers.

There is potential for EECs adjacent to the Proposal to be impacted from altered hydrology and experience die-back and/or changes to floristics and vegetation structure.

10.4.3 Potential fauna impacts

Fauna species have the potential to be affected during both the construction phase, through habitat loss and modification, and in the operation phase, through increased threat of road kill and increased barriers to movement within the local area. These potential impacts are further discussed below.

10.4.3.1 Habitat removal

The habitat types along the corridor include dry sclerophyll forests, moist sclerophyll forests/rainforest, swamp sclerophyll forests, freshwater wetlands and mangroves. These habitats provide fauna resources such as hollow bearing trees, fallen timber and leaf litter, dense understorey vegetation, grassy understorey vegetation, winter

flowering flora species and creeks and drainage lines. The area of loss from each of the habitat types is shown in Table 10-10.

The majority of habitat removal is from the cleared and modified agricultural and semi-rural land. Although the diversity of this habitat type is considered low in comparison to the moist or dry forests, the isolated remnant paddock trees provide nesting and sheltering opportunities for a range of potential species including threatened species such as osprey.

Where vegetation clearance is required the greatest habitat loss is from the dry forests. These forests have been modified and degraded to differing degrees as a result of logging and altered fire regimes. However, the dry forests provide a range of microhabitat features including shelter and food resource capable of supporting breeding populations and refuge for a diversity of sedentary and transient fauna including several listed threatened species.

10.4.3.2 Habitat fragmentation

Habitat fragmentation is the division of a single (contiguous) area of bushland into two or more areas. This has the potential to disrupt wildlife movement corridors, genetic exchange, decrease the available area of habitat and increasing edge effects. Large areas of contiguous habitat are particularly important for species which have large habitat ranges such as spotted-tail quoll and large forest owls. The larger the area of habitat, the greater the potential carrying capacity and the higher the chance of finding a mate. Large areas of contiguous habitat also decrease the likelihood of local extinctions from stochastic events such as wildfire and disease as individuals can repopulate an area more effectively.

Fragmentation due to road construction can be problematic when it creates areas of native vegetation, which become too small to support viable populations of native flora and fauna. This may lead to the fragmented area becoming weed infested and degraded and potentially utilised by aggressive fauna species suited to edge environments such as the introduced Noisy Miner (Manorina malanocephala).

The landscape surrounding the Proposal area supports a mosaic of vegetation fragments which reflects the history of clearing for farming and development. The Proposal would increase the fragmentation of habitat in the landscape by impacting on several contiguous forest areas, particularly the larger fragments associated with Nambucca and Newry State Forest in Section 2 of the study area and private forested land to the north of the Kalang River in Section 4. While the impacts of fragmentation on flora and fauna and threatened species in the study area are difficult to determine without more extensive population viability assessments, it is important to note that all areas of habitat affected by the Proposal have already been fragmented in the past by roads, clearing and power easements. The Proposal would be contributing to this cumulative fragmentation of the habitat in the landscape.

The impacts of additional fragmentation would be most evident in Nambucca State Forest in Section 2, where an area of up to 1000 hectares of forested lands would be separated to the east of the road. This habitat was identified as being occupied by a population of yellow-bellied gliders as well as other threatened species including Marsdenia longiloba, Glossy Black-cockatoo, Masked Owl, and a number of microchiropteran bats. While the proportion of

habitat remaining to the east of the road (around 1000 hectares) is considered sufficiently large to support populations of these species, further measures are required to minimise the impacts of fragmentation. Such measures have been considered in the design of the road by incorporating a wider median through the northern end of Nambucca State Forest and placing fauna underpass structures in strategic locations along the route within wildlife corridors and areas which would be used by fauna. Highly mobile species such as bats and birds are expected to be less impacted by fragmentation. The location of the fauna underpasses and widened medians can be seen in Figure 10-3a to Figure 10-3d.

The impact of additional fragmentation in Newry State Forest is difficult to assess as this area is already fragmented from coastal habitats to the east in Valla Nature Reserve as a result of the existing Pacific Highway and existing wide electricity transmission easements. Further widening of the median and construction of fauna underpass structures are also proposed through portions of Newry State Forest to maintain opportunities for fauna crossing.

Up to 360 hectares of habitat would be fragmented to the east of the Proposal in Section 4 and associated with forest on private lands. This area provides important habitat for the local population of glossy black-cockatoo and would remove a portion of potential habitat. This species is expected to be able to cross the new roadway with limited constraint.

To mitigate the effects of fragmentation from the Proposal it would be beneficial to re-establish links with historically isolated fragments of habitat in proximity to the new road through increasing the size of smaller remnant fragments adjoining the road. Particular opportunities for this exist in low-lying agricultural areas adjoining the corridor. To offset the residual impacts of the Proposal, a biodiversity offset package would be developed in consultation with the DECCW (refer to Section 10.5 and Appendix D - *Draft Statement of Commitments*). Other mitigation measures to reduce the fragmentation impact of the Proposal include widening the median and the inclusion of fauna crossing structures to facilitate movements across the road. This is particularly aimed at providing movement opportunities for gliders (i.e. Yellow-bellied glider, Squirrel Glider, Sugar Glider, Greater Glider, and Feathertail Glider) by reducing the barrier effect of two carriageways side by side. Natural vegetation and tree cover would be retained within the median in key corridor locations as identified in Table 10-14.

10.4.3.3 Edge effects and weed infestation

The fragmented habitats are also subject to potential edge effects which can include increased fauna mortality during construction and in the long term, modified animal behaviour and a modified physical and chemical environment and a spread of exotic species. These impacts would be most profound for moist vegetation communities where invasive weed species are likely to increase, which would act to shade out native understorey species and affect fauna habitats. Edge effects can potentially be reduced through general mitigation and rehabilitation measures as described in Section 10.5.4.

The highest priority is to implement measures that aim to minimise and intersect surface water run-off into adjacent remnant vegetation. Dense roadside seeding and plantings using a diversity of local indigenous plant species may also help to reduce the affects of rapid weed invasion into disturbed edge habitats.

10.4.3.4 Erosion of genetic stock

The Proposal would isolate the habitat remaining on the eastern (coastal) side of the highway to some degree. Less mobile fauna species such as terrestrial and arboreal mammals, reptiles and amphibians conserved on the eastern side of the highway would have greater difficulty accessing the areas and potential mates to the west beyond the highway. The potential issues associated with genetic erosion are reduced for highly mobile species (particularly bats and birds).

Examples of potential isolation of fauna populations include:

- The fragmentation of approximately 1000 hectares of forest in the vicinity of the Old Coast Road associated with a portion of the Nambucca State Forest and adjoining property to the south which would remain isolated on the eastern side of the highway. The large proportion of habitat retained may lessen the impacts on genetic isolation. However, the absence of opportunities for genetic dispersal means there is the potential for significant longer term impacts on remaining populations of species such as the yellow-bellied glider.
- The cumulative loss of connectivity is expected to impact on coastal forests such as the Valla Nature Reserve and surrounding habitats located to the east of the proposed traverse of Little Newry and Newry State Forests.
- Measures to mitigate these impacts have been addressed via the appropriate placement of dedicated, combined and incidental fauna underpasses and the proposed widening of the median at these locations to minimise the barrier effect of the dual carriageway and to provide a 'stepping stone' opportunity for gliders. These measures are detailed in Table 10-13 and Table 10-14. Fish friendly crossings of culverts would be included where required to maintain fish passage within creeks.

10.4.3.5 Impact on wildlife corridors (including riparian corridors)

Wildlife corridors play an important role for biodiversity conservation particularly as they allow for migration and dispersal of plants and animals, reduce competition, and provide refuge and important movement pathways for maintaining genetic diversity in populations. Corridors are particularly important in fragmented and agricultural areas as they provide pathways for fauna movement for species that are reluctant to move through cleared landscapes. Outside of the state forests, strips of vegetation have been retained mostly along road reserves such as the existing Pacific Highway and as riparian habitat along creeks and rivers. There are very few areas of high corridor value in the study area due to the extent of previous clearing and the existing network of roads and rail. The Proposal would sever 12.7 kilometres of regional 'moist' and 11.9 kilometres of key corridors as identified by the DECCW. Moist corridors have been identified by the DECCW, as areas most likely to be used by fauna species which utilise mesic (moist) environments.

Fauna species most likely to benefit from adequate wildlife corridors include migratory species, species in search of unoccupied habitats, species which make small scale migrations seasonally and species with a large habitat range including large forest owls, Koalas, spotted-tail quoll, brush-tailed phascogales, gliders and some bird species. These wildlife corridors are particularly important for fauna during large disturbances such as wildfire and habitat clearance. Many fauna species may disperse from an area due to high levels of competition with other fauna species or to seek out seasonal food resources such as flowering trees and shrubs.

Fauna crossings have been included in the concept design of the Proposal and have been located to ensure movement within the existing wildlife corridors are maintained. The location of the fauna crossings are shown in Table 10-13 and Table 10-14 and Figure 10-3a to Figure 10-3d.

10.4.3.6 Impact on riparian habitat

Riparian habitat is represented along the banks of the major river ecosystems in the study area (i.e. Nambucca and Kalang) as well as several named creeks including Warrell Creek, Boggy Creek, Deep Creek, Newee Creek and Oyster Creek. Other riparian vegetation is found in gully habitat representing moist forest, swamp forest or rainforest habitat adjoining open forest on slopes. The addition of bridges or culverts at the creeks and rivers along the highway would require removal of riparian vegetation to accommodate the new crossings. Riparian habitat varies from narrow linear strips of vegetation (<5 m wide) and restricted to river banks adjoining agricultural lands to broader strips in low-lying fringes of the tidal creek systems. The riparian vegetation in the study area consists of:

- Mixed floodplain forest situated in the riparian zones of Warrell Creek, the Kalang River, Boggy Creek and Oyster Creek, comprises both narrow bands and broader patches.
- Swamp oak forest and swamp mahogany / paperbark forest which is represented along the edges of Warrell Creek, Deep Creek and the Nambucca River, generally as restricted linear strips and small patches adjoining cleared agricultural lands.
- Estuarine vegetation consisting of narrow bands (<five metres) of mangroves surrounding tidal creeks such as Newee and Deep Creek and large portions of the Kalang and Nambucca River foreshores. Mangrove communities are recognised for providing significant habitat for estuarine fish and are protected as important fish habitat under the FM Act. This association occurs along banks of tidal estuaries subject to inundation by salt-laden water. Two species are represented, Grey Mangrove (*Avicennia marina*) and River Mangrove (*Aegiceras corniculatum*).

Impacts on riparian vegetation would occur directly within the road footprint of the Proposal at proposed bridge locations and indirectly through changes to local hydrological regimes and edge effects, including possible shading of proximal vegetation and potential weed invasion. The exact area to be directly lost as a result of the Proposal is difficult to quantify as many sites are very narrow and small in area. Mangroves and swamp oak are difficult to quantify as they are particularly restricted in distribution and may occur as single rows of trees located along river banks. An example includes the northern bank of the Kalang River adjoining South Arm Road. An estimate of the area of mangrove directly impacted by a 10 metre, five metre and three metre buffer is presented in Table 10-10.

Impacts on riparian habitats adjoining the road footprint are to be mitigated through minimising the construction footprint at all proposed bridge crossings, installing run-off storage structures, minimising erosion and rehabilitation post-construction through plantings of locally indigenous riparian species.

10.4.3.7 Wildlife injury and mortality

The potential for wildlife injury or death would occur during both the construction and operation phases of the Proposal. During the initial stages of construction, the clearing of vegetation may result in injury or death of resident

fauna. Species at risk include nocturnal species such as possums and gliders which shelter during the day, and ground dwelling species such as snakes, lizards and amphibians, and small mammals which may not be able to move fast enough or cover large enough distances to avoid clearing activities. There is also the risk of displaced fauna succumbing to predation or stress induced by competing with existing resident populations for resources, particularly shelter/refuge habitat.

Operation of the Proposal introduces an increased risk of wildlife injury or mortality as a result of wildlife being struck by vehicles. The risk is greatest for less mobile species, which may include small terrestrial mammals, reptiles and amphibians. The greater the distance fauna must travel across the road, the greater the risk of collision. The upgrade section of the Proposal would potentially result in an increased risk of road kill or injury because the additional sections of road (additional carriageway and local access road) that must be crossed by fauna. To mitigate this risk, 36 fauna crossings and associated fauna fencing, have been included in the concept design at locations where the highway bisects relatively large areas of native vegetation where fauna are likely to cross and at known wildlife corridors. These are listed in Table 10-13 and shown in Figure 10-3a to Figure 10-3d and have been designed to allow dry passage during wet periods via the inclusion of raised outer cells and internal ledges. Dry passage access has been included for fauna under major bridge crossings. In addition, one dedicated fauna crossing has been included within a key and regional wildlife corridor (as identified by the DECCW) within Newry State Forest to provide passage for both riparian and non-riparian fauna.

Table 10-13 Indicative fauna crossings

Approximate chainage	Details	Indicative size and configuration [1]	Fauna crossing
3760	Box culvert	3 x 3600 x 3600	Incidental
5760	Box culvert	3000 x 1200	Incidental
6320	Fauna corridor under bridge over Warrell Creek		
6510	Fauna corridor under bridge over Warrell Creek		
8450	Box culvert	14 x 3600 x 1800	Incidental
9220	Box culvert	14 x 3600 x 2100	Incidental
13285	Box culvert	2400 x 1200	Combined
15885	Box culvert	2400 x 1200	Combined
16630	Box culvert	3 x 3600 x 1200	Combined
17205	Box culvert	2400 x 1500	Combined
17720	Box culvert	2400 x 2400	Adjacent dedicated crossing
18515	Box culvert	2400 x 1200	Combined
19350	Circular culvert	750	Incidental
19820	Box culvert	5 x 2400 x 2100	Combined

Approximate chainage	Details	Indicative size and configuration [1]	Fauna crossing
20880	Fauna corridor under bridge over Boggy Creek		
21740	Fauna corridor under bridge over Cow Creek		
23040	Fauna corridor under bridge over Deep Creek		
24305	Box culvert	2700 x 900	Incidental
25255	Box culvert	2400 x 2400	Combined
26535	Box culvert	5 x 3600 x 1200	Combined
27845	Circular culvert	4 x 1200	Incidental
28275	Circular culvert	3 x 1200	Incidental
28565	Box culvert	2 x 2400 x 1200	Incidental
29215	Circular culvert	2 x 1200	Incidental
30855	Box culvert	2100 x 900	Combined
31510	Box culvert	4 x 2100 x 1200	Combined
32075	Box culvert	2400 x 1200	Combined
33395	Circular culvert	3 x 1200	Incidental
33880	Box culvert	2400 x 1200	Incidental
34380	Box culvert	3 x 2700 x 1200	Combined
34615	Box culvert	3 x 2700 x 1200	Incidental
35095	Box culvert	23 x 3600 x 3000	Combined
36905	Box culvert	2 x 2400 x 1200	Combined
37950	Fauna corridor under bridge		
38330	Box culvert	2 x 3000 x 1500	Combined
39990	Box culvert	17 x 3300 x 2100	Incidental

[1]- The indicative size and configuration would be further refined during the detailed design phase.

The approach to selecting fauna crossing locations was based on a review of typical fauna within the area and opportunities for use of combined drainage structures, such as box culverts and bridges as fauna crossings. This focused on providing dedicated fauna underpasses for species of high conservation value (i.e. Koala, quoll and phascogale) in addition to a range of structures for a diversity of common fauna. The locations of the proposed combined and incidental fauna crossings were then subject to detailed review and additional structures added where appropriate. Long-term monitoring of fauna underpass structures has shown success for a range of small to medium sized fauna in eastern Australia (e.g. Goosem 1997; 2001, AMBS 2001, 2002a, 2002b and Taylor and

Goldingay 2003). This includes ground-dwelling mammals as large as Red-necked Wallaby and Swamp Wallaby, reptiles and some arboreal mammals such as the Koala which have been reported using box culverts (2.4 x 1.2 metre and 3 x 3 metre) and 10 metre spanning bridge and arch structures (AMBS 2001, 2002a, 2002b).

Large mammals (such as Eastern Grey Kangaroo) require much wider and higher areas for daily movements. Factors that are considered to deter larger terrestrial fauna from using underpass structures include flooding, boggy ground, presence of stumps blocking the entrance or long, narrow (and therefore dark) passages. These factors have been considered in the design of underpass structures for the Proposal, which include cells raised above the flood level and light within the median in longer passages. Images of typical fauna crossings are provided in Chapter 6 – *Description of the Proposal*.

With all terrestrial fauna, security from predators is important. Therefore, it is necessary to provide a clear line of sight to light and vegetation at both ends of the crossing where possible. For smaller species, provision of protective cover and structures such as ledges or horizontal logs that are designed to restrict access by larger predators would aid their security. Approaches to the structure should allow good visibility, provide some protective cover and not be obscured by dense vegetation.

Large fauna require exclusion fencing for guidance through the crossing structure and to prevent access to the carriageway. Fencing is to be provided at strategic locations including each of the three widened medians (internal and external) and up to 500 metres on either side of dedicated fauna underpass structures shown in Table 10-13 and Table 10-14 and Figure 10-3a to Figure 10-3d.

Table 10-14 Details of the proposed widening of the median for terrestrial and arboreal fauna crossing

Location	Average median width (metres)	Length of widening (metres)
Section 2 – Nambucca State Forest	50	300
Section 4 – Dalhousie Creek, Newry State Forest	50-80	800
Section 4 – Private property	40	900
Total		2 km

10.4.3.8 Threatened fauna

The results of the assessments confirmed the presence of 14 threatened fauna species of conservation significance. An additional 13 species are considered to potentially occur in the study area on the basis of suitable habitat. These are listed in Table 10-7. Species with similar taxonomy or habitat requirements have been grouped together.

Threatened species listed under the TSC Act and recorded during surveys of the study area, or with the potential to occur in the study area, were assessed using the Threatened species assessment guidelines: the assessment of

significance (DECC 2007). A summary of the likely impacts on the species listed in Table 10-7 and are presented below, with further details available in Working paper No 1 – *Flora and fauna*.

None of the threatened fauna species recorded or with the potential to occur are considered likely to be significantly affected by the Proposal, under NSW or Commonwealth legislation.

10.4.3.9 Reptiles and amphibians

Of the 24 reptile species recorded in the study area, all identified are considered common and widespread species in eastern NSW. Eighteen frog species were recorded across all habitat types with tree frogs the most abundant. No threatened species were identified during survey. However, the green and golden bell frog has previously been recorded south of Macksville, but is since thought to be locally extinct. In addition the great barred frog has the potential to occur in several creeks and drainage lines in the northern half of the study area, through Nambucca, Little Newry and Newry State Forests. The Proposal has the potential to impact on this species as it would directly traverse streams and rivers across the study area. Design measures have been incorporated to provide appropriate fauna passage and protection of waterways during construction and operation to ensure potential habitat is not impacted further.

10.4.3.10 Birds

A total of 125 bird species were recorded during the field investigations, representing a moderately high species richness due primarily to the diversity of habitats available, topographic variation and floristic diversity in the study area. Several of these species are of conservation significance including Black-necked Stork, Glossy Black-cockatoo, Square-tailed Kite, Osprey, Wompoo Fruit-dove and Powerful Owl. A number of nocturnal bird species were also recorded including the Australian Owlet Nightjar, Tawny Frogmouth, Southern Boobook and Powerful Owl. These nocturnal species roost predominantly in tree hollows, although may also roost in dense foliage.

The Black Necked Stork was mainly associated with the wetland on the Kalang River floodplain. However, other wetlands in the study area provide potential habitat. This and other wetlands would not be significantly impacted by the Proposal.

The Osprey is associated with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers. The Osprey feeds on fish over clear open water and may nest on the ground, on sea cliffs or in trees. Several breeding pairs are expected to occur in the catchment of the Nambucca and Kalang Rivers, and one active nest site was recorded near Deep Creek in 2008. While the Proposal would have a negligible impact on the foraging habitat of this species, and no impact on the identified nest site, there is the potential for other nest sites to be built which may be impacted. For the Osprey, although the loss of habitat is unlikely to significantly impact on this species, there is the potential for loss of nest sites. As such it would be necessary to survey the area prior to construction.

No nest sites of the Square Tailed Kite were located along the Proposal or within the affected areas of state forests. The potential habitat for foraging and roosting is very common and widespread for this species. Therefore, the

impact on breeding activities of the local populations is not considered significant. However, a survey would be undertaken to identify nest sites prior to construction.

A population of the Glossy Black Cockatoo was identified in the northern half of the study area, north from Nambucca State Forest to Raleigh, comprising several groups occupying parts of Nambucca, Newry and Little Newry State Forests as well as dry sclerophyll forest habitats on private land north of the Kalang River and east of the existing Pacific Highway near Valla. The abundance of food resources and distributional range of the local population together with the high mobility of the species suggests there are several localised family groups in the study area and that these are adapted to moving across modified landscapes to access food resources. The Proposal would clear up to 144 hectares of blackbutt open forest, a portion of which would provide potential habitat for this species. However, this loss is unlikely to represent a significant impact, despite the loss of food resources. There is the potential to remove large hollow bearing trees lying in close proximity to the Proposal, which may currently or potentially provide nest sites. Further surveys of habitat trees would be necessary prior to construction.

The Wompoo Fruit Dove is wide-ranging and locally nomadic, capable of moving large distances between remnant vegetation in response to the sporadic availability of food resources. Local populations are expected to be small and nomadic compared to west of the study area in the Dorrigo / Bellingen area where subtropical rainforest habitats are more widespread. The Proposal would involve removal of a small percentage of moist forest habitat (circa 65 hectares) which is marginal for the species and up to one hectare of lowland rainforest which is better suited. The potential for these species to forage in the study area is expected to remain following the works and the impacts on life-cycle activity would be very minimal.

There is also a low incidence of potential roost sites/nest hollows for the Powerful Owl. Again, a survey would be required prior to construction to minimise the impacts to potential nests. The loss of vegetation resulting from the Proposal would potentially impact on the prey species of these owls and increased fragmentation of habitat may impact on the dispersal of juveniles.

The Proposal is not considered likely to have a significant impact on the other threatened bird species that could potentially occur within the study area. However, a survey for nesting sites and hollow bearing trees would be undertaken prior to construction to minimise impacts on any previously unidentified species.

10.4.3.11 Mammals

A total of 29 mammal species were recorded during the surveys undertaken in the study area comprising six species of ground dwelling mammals, seven species of arboreal mammals and 16 bat species. Of these species, eight were listed as threatened species, being the Grey-headed Flying Fox, Spotted-tailed Quoll, Koala, Brushtailed Phascogale, cave and tree roosting bats and yellow bellied gliders

The Grey-headed Flying Fox is listed as vulnerable under both NSW and Commonwealth legislation. It inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas. The Proposal would clear approximately 253 hectares of potential foraging habitat for this species. This represents a relatively minor impact for the species in the local area. This area is also used as potential

foraging habitat for Miniopterus spp. (Cave Roosting bats). Comparable habitats are well represented through the locality and regional area and it is unlikely that the Proposal would have a significant impact on the foraging life-cycle events for a local population of these bat species and continued foraging over the site and adjacent lands could be expected. The same 253 hectares would provide habitat and potential foraging habitat for tree-roosting bats. Important life-cycle activities include roosting and breeding and are typically associated with tree hollows as well as foraging for insect prey which occurs in a variety of habitat types. The size of local populations is not known, although expected to be moderately large given the expanses of suitable habitat. Much of the habitat to be removed has been identified as of young age or even age and the abundance of hollows is very low throughout the corridor. Nonetheless the Proposal would involve clearing of habitat trees. Comparable habitats are very well represented throughout the locality and regional area and it is unlikely that the Proposal would have a significant impact on the foraging or roosting life-cycle events for local populations of these bat species and continued presence in the locality could be expected.

The Spotted Tailed Quoll, which is expected to occur in the area, is an opportunistic predator and would feed on a variety of prey including macropods, birds, reptiles, arboreal mammals and small terrestrial mammals. The Proposal would remove part of its habitat and associated prey, leading to further fragmentation of habitat, a known threat to the species. Provided measures to conserve fauna corridors and movement avenues have been incorporated into the Proposal, then breeding and foraging opportunities likely to sustain local populations would remain in the region.

There is evidence that Koalas are present in Nambucca State Forest and along the coast around Valla. Potential habitat for Koalas would be lost as a result of the vegetation clearing, areas of which would contain identified tree food species. The impact of this activity on the local population is likely to be minimal as suitable food resources are common and widespread in the region, particularly to the north west of the route. As such there is little evidence to suggest that Koala populations or movements are centred around the Proposal route.

The Brush-tailed Phascogale is likely to occur in the study area. This species inhabits a range of arboreal environments, particularly dry sclerophyll forest with little ground cover. Despite the proposed vegetation loss, these habitats are well represented in the study area, and populations would persist following development of the highway route.

The Proposal is likely to remove a portion of the home range territory of at least one family group of yellow-bellied gliders, including possible denning trees. This group is part of a larger population which extends into the surrounding state forests and private land. Individuals have also been recorded in Newry State Forest in contiguous habitats to the north. Additionally, this area is part of a larger east-west corridor suggesting other populations are likely to occur to the west of the study area. The long term persistence of yellow-bellied gliders requires a landscape mosaic of old growth trees which meets both their foraging and sheltering needs. Such habitat is present through the remaining portions of Nambucca State Forest to the east and west of the route. In order to assist with movement across the Proposal in this location, the median has been widened through the northern end of Nambucca State Forest and also Newry State Forest which was specifically located at strategic glider locations. Where possible the concept design footprint has been refined to avoid identified habitat trees.

10.4.3.12 Migratory fauna

Nine migratory bird species listed under the EPBC Act were identified from the field investigations together with four more potential species based on the presence of suitable habitat. These migratory species are listed in Table 10-8.

The majority of migratory species identified were considered uncommon and widespread vagrants with no specific populations represented in the study area. From the field investigations conducted, there is no evidence to suggest that an area of important habitat exists or that the study area is occupied by an ecologically significant proportion of a migratory species population.

The rufous fantail occupies wet forests and less often open forests. The Proposal would require the removal of a combined area of approximately 253 hectares of open forest and rainforest communities. Due to the availability of suitable habitat in the remaining areas of state forest, the impacts on this species as a result of the Proposal are not considered significant on a local, regional or state level.

The Black-faced Monarch occupies tangled understoreys of rainforest and eucalypt forest. The Proposal would require the removal of a combined area of approximately 253 hectares. Alternative habitat for the Black-faced Monarch is available in the remaining areas of state forest. As such, the Proposal is considered unlikely to affect this species at a local, regional or state level.

The White Throated Needletail would occasionally roost in trees and feeds on flying insects, such as termites, ants, beetles and flies which it catches in flight. The Proposal would not affect foraging areas for this species and would have negligible impact on roosting sites. Therefore the Proposal is not considered likely to impact this species on a local, regional or state scale.

10.4.4 Potential impacts to aquatic habitats and biodiversity

No State or Commonwealth listed macroinvertebrate or fish species were identified in the freshwater and estuarine habitats occurring within the study area. The aquatic species identified during the field investigations are listed in Table 10-9.

Estuary Perch (Macquaria marianus) was found to be present in Warrell Creek, Deep Creek and the Kalang River and one Australian bass was captured from the Kalang River. These are migratory species and to ensure their lifecycles are not adversely impacted during construction, activities which are likely to cause impact to these species within the waterway should be timed to occur outside of the spawning period of June through to August.

The preferred habitat of the Eastern Cod is clear, flowing streams with rocky beds and deep holes with plenty of boulders or large woody debris (snags). This habitat is not present within the study area and therefore the Eastern Cod and its habitat would not be affected by the Proposal.

Potential impacts on aquatic habitats include overshadowing, pollution of waterways and change to the hydrological regime. Potential water quality issues and mitigation measures are addressed in Chapter 16 – *Water quality and hydrology* of this environmental assessment. The greatest potential for impact on local waterways is during

construction, therefore, the adoption of best practice water quality controls and protection measures would be implemented to minimise impact on aquatic habitats.

The activities with the potential to impact on the aquatic flora and fauna during construction and operation include:

- Installation of in-stream structures such as pylons is listed as a key threatening process under the *Fisheries Management Act 1*994. Culverts and causeways can modify the natural flow of rivers by increasing, decreasing or altering the seasonality, frequency, magnitude and timing of flow which can disrupt natural reproductive cues, and natural sediment movement patterns. Culverts can also act as a physical barrier to native fish and invertebrates. The construction of bridges is not considered a key threatening process as the impact on flow is considered minimal.
- Increased sedimentation and erosion, which is considered a threatening process under the *Fisheries Management Act* 1994. Increased suspended solids can impact fish and macroinvertebrate abundance through clogging gill structures and benthic smothering. Increased particulates in the water column can also reduce water infiltration which may limit plant growth and influence predator foraging behaviour.
- Removal of in-stream woody debris (snags) is listed as a key threatening process under the *Fisheries Management Act* 1994 as it can provide crucial habitat to juvenile fish, macroinvertebrates and other aquatic organisms.
- Predation by exotic species and in particular the Mosquito Fish (*Gambusia holbrooki*) which is most likely to occur in highly disturbed freshwater streams.

The Proposal has been developed so that the existing hydrological regime would generally be maintained through the use of culverts and bridges where required. Detailed design of culverts would provide fish friendly crossings where applicable and culverts combined with fauna crossings so that barriers to fauna passage are not created. In operation, runoff from the Proposal would be directed to sedimentation basins before being discharged. The operational basins would be located in positions along significant water courses, to protect sensitive environmental areas from an unexpected spill from an incident.

The main operational activity that would impact the associated watercourses is increased traffic flow, which may lead to increased pollutant load in the road run-off. Road run-off can contain a variety of pollutants, which may impact negatively on the aquatic environment and in turn reduce commercial and recreational fishing viability, including aquaculture present in the study area. Pollutants can include cigarette butts, nutrients, heavy metals, pesticides, herbicides and petroleum hydrocarbons. Management and mitigation measures have been proposed to reduce the amount of pollutants entering the waterways as described in Chapter 6 – *Description of the Proposal*.

Management and mitigation measures have been proposed to reduce the amount of pollutants entering the waterways as described in Section 6.5.6. These have been based on Road Runoff and Drainage: Environmental Impacts and Management Options (Austroads 2001) and Procedure for selecting treatment strategies to control road runoff (RTA 2003) as outlined in Chapter 16 – *Water quality and hydrology* and Working paper 5 – *Water (Flooding and water quality)*.

10.4.5 Cumulative impacts

10.4.5.1 Regional scale

At the landscape scale, the major potential ecological impacts of increasing road networks are likely to be the disruption of landscape processes and loss of biodiversity (Forman and Alexander 1998). An extensive and complex road network is already in existence in the study area and the Proposal would be a contributor to this network. However, as the Proposal would, in effect, traverse a landscape which is already dominated by human activities, such as farming, logging and urban development, as opposed to a completely forested landscape, the cumulative impacts on biodiversity could reasonably be expected to have a low detectability.

Notwithstanding this fact, the Proposal would contribute to an increased density of roads versus remaining habitat in the region. Impacts could be offset to a degree by the re-establishment of a few large patches of forest and habitat on currently cleared areas in the region. Any such efforts would be based on the objective of reducing habitat fragmentation by re-establishing connectivity and increasing forest patch sizes. Further details of the rehabilitation and compensation measures are detailed in Section 10.5.5 and 10.5.6.

10.4.5.2 Cumulative impacts of the Pacific Highway Upgrade Proposal

The ecological impacts of the combined Pacific Highway upgrade projects are detailed in Table 10-15. The total contribution of the 12 existing projects to vegetation loss equated to approximately 1798 hectares and the removal of approximately 370 hectares of EEC. The loss of up to approximately 255 hectares of vegetation as a result of the Proposal represents approximately 14 per cent of the cumulative vegetation loss and 16 per cent of the cumulative EEC loss.

In the context of the Pacific Highway upgrade, the Proposal would result in additional habitat loss and fragmentation, particularly in areas where a bypass of the existing Pacific Highway would occur through the state forests. The Pacific Highway Upgrade Program would result in the installation of a barrier to east and west movement along the entire length of the upgrade. However, the area along the east coast through which the Pacific Highway Upgrade Program runs is subject to settlement with residences and associated infrastructure having caused significant habitat loss and fragmentation to date. Through the route selection process, options with significant direct impacts on vegetation were removed or altered to reduce impacts. Similarly, fauna crossings facilities have been included in the design of the Pacific Highway Upgrade Program to increase the permeability of the infrastructure to local species.

Opportunities for revegetation of acquired land parcels would be investigated as part of the detailed design to help to offset some of the vegetation losses associated with the Proposal.

Table 10-15 Approximate habitat loss associated with the Pacific Highway Upgrade Program

Project name	Project stage	Project length[1] (km)	Vegetation disturbance[1] (ha)	EEC disturbance[1] (ha)
Proposed upgrade Banora Point	Project approval	2.5	7.7	3.82
Tintenbar to Ewingsdale	Environmental assessment completed	17	10	2
Woodburn to Ballina	Preferred route selected	36	131	56
Iluka Road to Woodburn	Concept design selected	35	Not yet available	Not yet available
Wells Crossing to Iluka Road – Glenugie upgrade	Environmental assessment completed	7.3	85	5.3
Wells Crossing to Iluka Road (remaining)	Concept design selected	63.6	345	55
Woolgoolga to Wells Crossing	Concept design selected	27	230	51 (preliminary estimate)
Sapphire to Woolgoolga upgrade	Project approval	25	83.1	18.2
Coffs Harbour Bypass	Concept design selected	55	21.0	Concept design selected
Warrell Creek to Urunga	Environmental assessment being finalised	42	255	60.3
Kempsey to Eungai	Project approval	40	286	63
Oxley Highway to Kempsey	Environmental assessment being finalised	37	229	66
F3 to Raymond Terrace	Preferred route selected	14	49.0	Not yet available
Total		401.4	1731.8	380.62

[1] Approximate distances and areas.

10.5 Management of impacts

The potential impact on native flora and fauna has been considered during the route investigation phase and subsequently through the refinement of the concept design of the Proposal. During this process a number of important measures to reduce and avoid potential impacts have been built into the design of the Proposal. Mitigation measures to minimise the impacts on the local environment during construction and operation are detailed in Sections 10.5.1 to 10.5.10 and have been included in Appendix D - *Draft Statement of Commitments*. These requirements would be incorporated in the construction environmental management plan, which would be prepared prior to construction in consultation with relevant government departments and local councils. Management measures identified below are listed only once. However, some measures are relevant to more than one area.

10.5.1 Native vegetation and fauna habitat loss

10.5.1.1 Flora

Commitments identified to manage identified impacts to native flora include:

- Identification of threatened plants and vegetation to be retained and protected during construction would be undertaken by a qualified ecologist.
- Location and tagging of threatened plant species is to be undertaken along the construction corridor prior to clearing for construction.
- Installation of protective fencing to mark the limits of clearing (i.e. 'no-go' areas) surrounding the construction footprint to ensure that vehicles and other direct disturbances associated with road construction, such as construction compounds and stockpiles sites, do not enter adjacent vegetation, particularly endangered ecological communities and widened medians to avoid the spread of weeds and plant pathogens.
- Education of construction workers in relation to proposed protection measures through the site induction process.
- Where vegetation is to be retained, vegetation management measures are to be implemented, including weed removal, native plantings, broadcasting of collected native seed and relocation of specific habitat resources such as bush rocks, hollow logs, hollow tree trunks and branches.
- Seed collection of native plant species to be removed from the construction footprint would be undertaken prior to commencement of clearing and seed stored for use in revegetation works.
- Seeds from the individual rusty plum plant would be collected, propagated and planted in areas of suitable habitat adjacent to the Proposal such as Boggy Creek and gully areas within state forests that are protected as riparian exclusion zones.
- The feasibility of translocating the individual Rusty Plum plant affected and Slender Milkvine, would be investigated and, if deemed to be feasible, a translocation strategy would be developed and implemented in consultation with the DECCW and in accordance with relevant guidelines such as *Guidelines for Translocation of Threatened Plants in Australia* (ANPC 2004).
- Vegetation clearing where *Marsdenia longiloba* is present adjacent to the construction footprint is to be strictly minimised and controlled. Protective fencing is to be installed surrounding identified locations of this plant to avoid incursions from construction machinery and the potential spread of weeds and plant pathogens.
- Native vegetation cleared from the construction footprint is to be mulched along with collection of topsoil for reuse in rehabilitation works and erosion control. Mulch and topsoil should not be stockpiled in 'no-go' areas and cleared vegetation should not be pushed into 'no-go' areas.
- During the initial stages of clearing for the Proposal, the collection of topsoil is to be carried out to preserve the soil stored seed bank for reuse in revegetation/rehabilitation post construction, particularly construction. Sclerophyll species in particular are suitable for tube stock propagation and hydro-seeding in roadside verges. Where applicable, collected seed should be utilised for species which are unlikely to be present in the seed-bank of salvaged soil, such as species from the Myrtaceae, Casuarinaceae and Proteaceae plant families.

- Clearing of EECs to be restricted to the minimum area possible and protected vegetation outside the construction corridor to be clearly flagged and signed.
- 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.
- 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.
- Erosion and sediment controls and their maintenance are to be used during construction of the Proposal in accordance with the 'Blue Books' (Landcom 2004 and DECC 2008). These structures would aim to limit excess nutrients and water entering the habitat of threatened species and communities.
- There is a risk that altered groundwater levels may result in impacts to EECs in floodplain areas. Potential changes to existing surface and groundwater levels would be minimised through appropriate placement and design of culverts and providing adequate drainage to reflect existing conditions.

10.5.1.2 Fauna

Commitments to manage identified impacts to native fauna include:

- A suitably qualified ecologist would undertake searches in the construction footprint for native fauna immediately prior to clearing activities. Searches would 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.
- Re-survey immediately prior to construction to identify nest locations for Osprey, Black-necked Stork and brolga. The location of the identified Osprey nest would be checked to confirm if it is present before clearing commences.
- 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.
- A fauna rescue framework for clearing has been developed by the RTA in consultation with the DECCW and would be used as a basis for developing a protocol for the handling and translocation of fauna during construction.
- Nest boxes are to be installed, where required, in accordance with specialist advice and in consultation with the DECCW, prior to construction, to replace hollow resources that are proposed to be removed.
- Fauna species found in areas to be cleared would be relocated prior to clearing activities into suitable habitat as close as possible to the area in which they were found.

- Habitat features and resources for native fauna (such as hollow logs and bush rocks) would be distributed along the route of the Proposal where feasible and reasonable. Such relocation would be undertaken in a manner to limit damage to existing vegetation and would not occur in high condition remnant vegetation.
- 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, would be designed to facilitate fauna movements (see Figure 10-3a to Figure 10-3d).
- Waterway crossings would be designed to facilitate fish passage in consultation with relevant government agencies.
- Mature trees to be retained within the median as a stepping stone for the glider population are to be specifically protected and lopping or pruning is not to be undertaken without expert advice. 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.
- Fauna exclusion fencing (e.g. floppy-top fencing) would be erected along the Proposal at appropriate locations shown in Figure 10-3a to Figure 10-3d to direct fauna movement towards fauna-crossing structures. This would be subject to routine monitoring to check for damage.
- Water quality control measures would be installed as early as possible in the construction program and would be designed / selected to meet identified receiving water objectives to protect the habitats of threatened wetland birds.
- Strategies would be developed to deal with incidents involving individual animals during construction activities in consultation with the DECCW officers, WIRES and/or other relevant local wildlife carer groups.

10.5.2 Habitat fragmentation and wildlife corridors

The primary mechanism for reducing the incidence of habitat fragmentation and its subsequent impacts was developed as part of the route investigation phase. The subsequent refinement of the route and development of the concept design of the Proposal involved further consideration of habitat fragmentation. Where possible, areas of disturbance were located on one side of a vegetation community so as to avoid additional fragmentation and increased edge effects.

Other proposed measures to mitigate the impacts of fragmentation include:

- Native and locally indigenous plants would be used in the landscaping and disturbed areas would be progressively revegetated.
- Weeds in areas disturbed by construction activities would be managed for a minimum of two years after construction completion.

- Review opportunities for re-establishing links with historically isolated fragments of habitat in proximity to the new road to mitigate the effects of fragmentation from the Proposal. Further details are provided in Section 10.5.6.

10.5.3 Barrier effects and impacts on wildlife and riparian corridors

The primary mechanism for mitigating the effects of barriers to wildlife movement is the incorporation of fauna movement features, such as fauna underpasses, into the Proposal. Although it is not possible to design a single crossing structure that accounts for all species, it is feasible to develop a strategy for making the Proposal more permeable to wildlife passage for a wider diversity of species. This approach has been incorporated in the Proposal by including two key design considerations:

- Widening of the median at important locations.
- Provision of dedicated, combined and incidental fauna underpass structures.

The median would be widened in three locations in Section 2 – Nambucca State Forest, Section 4 – Dalhousie Creek, Newry State Forest and Section 4 – private property. The details of width and length of the area of proposed widening is provided in Table 10-14 and Figure 10-3a to Figure 10-3d. Fauna underpass structures and exclusion fencing are to be used in conjunction with the wider median to provide a temporary refuge and safe passage for ground-dwelling fauna. Proposed measures to mitigate the impacts of barrier effects include:

- Provision of a minimum of 34 combined or incidental fauna underpass structures plus one dedicated fauna underpass and additional dry passage for fauna under major bridge crossings (Warrell Creek, Nambucca River, Boggy Creek, Cow Creek, Deep Creek and Kalang River) for species including Koala, quoll and phascogale as detailed in Table 10-13.
- Underpasses and culverts would include some cells raised above the flood level and light within the median in longer passages would be included in the design. A clear line of sight to light and vegetation would be included at both ends of the crossing wherever possible.
- For smaller species, provision of protective cover and structures such as ledges or horizontal logs that are designed to restrict access by larger predators would aid their security. Approaches to the structure would be managed to ensure that vegetation does not obscure the entrance or exit.
- Combined drainage culverts and bridge structures with fauna passage capabilities would be designed to allow dry passage during non-extreme wet periods via the inclusion of raised outer cells or internal ledges.
- Exclusion fencing would be installed around the crossing structures to prevent access to the carriageway for up to 500 metres either side.
- Bridges and culverts have been designed in accordance with the Fairfull and Witheridge guidelines (2003) *Why do fish need to cross the road? Fish passage requirements for waterway crossings*.
- Construction of 'fishways' at potential barriers to enable migration of fish and macroinvertebrates during construction and operation.

- Construction activities over Warrell Creek, Nambucca River, Deep Creek and the Kalang Rivers would be management to minimise the potential impacts on migratory species such as the Estuary Perch and Australian bass particularly during the spawning season between June and August. Specific management measures for each of the waterways are provided in Working paper 1 – *Flora and fauna*.

10.5.4 Edge effects and control of weeds, pests and diseases

During construction there is the potential for noxious and invasive weeds to be spread via earthworks and clearing activities, from seeds and other propagules in the soil and vegetative material. Rehabilitation and weed strategies would include:

- 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.
- A protocol would be developed for weed infested areas to ensure that all potential weed propagules from soil and vegetative material are appropriately disposed of.
- To minimise the potential for various pests and diseases to be introduced to the study area, the following activities would be incorporated into the construction management plan. All construction equipment would be washed or brushed down prior to arriving on-site to remove all sediments and debris.
- Washing procedures to ensure that insect pests and their eggs/larvae are not present on equipment such as red imported fire ants, large earth bumblebees, feral honeybees, yellow crazy ant and cane toad.
- Bacteria, viruses and other diseases would also be removed from equipment through washing such as *Phytophthora cinnamomi*, amphibian chytrid fungus and beak and feather disease.

10.5.5 Habitat rehabilitation

Opportunities for habitat rehabilitation would be investigated. The greatest potential for habitat rehabilitation exists in low-lying agricultural areas adjoining the Proposal corridor. To reduce or to compensate for the impacts associated with habitat loss, the following rehabilitation measures would be incorporated into the construction management plan

- Roadside verges would be rehabilitated adjacent to culvert entrances and bridge pylons.
- Consideration of the potential for increasing the size of smaller remnant habitat fragments adjoining the road.
- Topsoil would be salvaged from areas of cleared vegetation with low weed abundance.
- Seed collection would be undertaken before and during vegetation clearing activities from sclerophyll species, Slender Milkvine and Rusty Plum, suitable for tube-stock propagation and hydro-seeding in roadside verges.

10.5.6 Offsetting environmental impacts

Planning for the Proposal in regard to biodiversity values along the road corridor has generally followed the hierarchy of principles, being:

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

Where impacts are unavoidable, mitigation and management measures are incorporated into the Proposal to reduce impacts. These have included provision of 36 fauna underpasses, two kilometres of widened vegetated medians, and 20 kilometres of fauna fencing to provide fauna movement and connectivity between fragmented habitats. In some instances there are residual impacts that cannot be adequately mitigated, for example the net loss of native fauna habitat. Accordingly, the RTA is committed to developing offset agreement in consultation with the DECCW. Options for offsetting include, but are not limited to:

- Management by the DECCW or the DII:
  - Purchase freehold property and transfer into NSW National Parks Estate.
  - Purchase freehold property and transfer into Forests NSW Estate, with a management zoning of Zone 1 (Special Protection).
  - Negotiation with Forests NSW for extension of existing portions of Zone 1.
- Management by RTA:
  - Negotiation with Forests NSW to transfer land currently identified as Zone 4 (General Management) and preserve in a "road reserve" under RTA management.
- Management non-government conservation organisations or by private landholders:
  - Secure additional native vegetation protected through an appropriate legal instrument that ensures the land is managed for conservation transfer ownership to non-government conservation organisations.
  - Negotiation of a conservation agreement under the *National Parks and Wildlife Act* 1974 or *Nature Conservation Trust Act* 2001 with private landowners.

It is envisaged the quantum of the offsets would be based on a set-ratio approach offset impacts to EECs and broad vegetation types on a like for like basis that clearly accounts to loss of native vegetation and associated edge effects.

In addition to providing land offsets the RTA may also consider, in consolation with the DECCW including additional revegetation in strategic locations and or investment in management research related to the rehabilitation and protection relevant threatened species.

10.5.7 Wildlife mortality

In relation to wildlife injury and mortality, fauna rescue and relocation procedures and procedures for clearing non-habitat and habitat trees are identified in various sections above. Additional measures proposed to manage wildlife injury and mortality are:

- Adjoining vegetation would be maintained to limit overhang of fences or other barriers.
- Flora species used in landscaping would be selected such that wildlife is not attracted for feeding or other purposes, except at the proposed fauna crossings.

10.5.8 Aquatic disturbance

Water quality impacts on the aquatic environment would be controlled through the construction environmental management plan which would include a soil and water management plan as described in Chapter 6 – *Description of the Proposal*. This plan would comply with the principles and practices in:

- *RTA Road Design Guide, Section 7 – Stormwater Management and Drainage Design and Section 8 – Erosion and Sedimentation* (RTA 2000b).
- *Managing Urban Stormwater: Soils and Construction* (Department of Housing 2004).
- *Soils & Construction, Volume 1, 2004, and Volumes 2C and 2D, 2008 manuals* (known as the Blue Book).

Additional measures proposed to manage impacts on aquatic habitats include:

- Retention of large woody debris within watercourses where possible.
- In-stream structures such as bridges and culverts have been designed and managed to minimise any potential impact to flow regimes and fishways would be constructed at potential barriers to enable the migration of fish and macroinvertebrates during construction and operation where applicable.
- Riparian and aquatic habitat would be protected during construction works with fencing and any mangroves or areas of riparian vegetation impacted by construction would be rehabilitated.
- Management of acid sulphate soil to ensure sulphuric acid leachate does not enter watercourses as described in Chapter 18 – *Soils characteristics and erosion controls*.
- Inclusion of appropriate erosion and sediment controls and silt curtains would be deployed in situ where required where any dredging or excavation of sediments is required.
- Any management measures adopted would be consistent with the *DPI Policy and Guidelines: Aquatic Habitat Management and Fish Conservation*.

10.5.9 Management of regional scale impacts

The cumulative impacts that the Proposal would contribute to would be minimised by the mitigation measures and compensatory habitat outlined in this assessment. Other mitigation measures outlined in this section would contribute to minimising cumulative impacts for vegetation loss, EEC loss, threatened species, groundwater dependent communities and wildlife corridors.

10.5.10 Monitoring

An adaptive monitoring program would be developed to assess the effectiveness of mitigation and offset measures and allow for refinement and modification of these measures if monitoring results suggest that this is required. The program would be implemented prior to construction to establish baseline numbers of threatened flora and fauna and would continue for a minimum of two years after construction is complete. A monitoring protocol would be developed for threatened plant species. Further details are provided in Section 6.2.3 of Working paper 1 – Flora and fauna.

10.6 Summary

Potential impacts to flora and fauna issues were considered at each of the planning and development stages of the Proposal, including the development and selection of the corridor and route options, as well as development and selection of the preferred route.

Likely and potential impacts associated with Proposal include the loss of threatened plant species and endangered ecological communities, fragmentation of habitats and wildlife corridors, barrier effects on wildlife and riparian corridors (such as the erosion of genetic stock), edge effects (such as weed invasion, pests and disease), disturbance to aquatic and riparian habitats potentially resulting in contamination and siltation of waterways, and cumulative impacts in association with the Pacific Highway Upgrade Program.

Targeted surveys of the distribution and abundance of threatened and endangered species and communities were conducted. Assessment in relation to the potential impact on these species and communities identified during the surveys and those species potentially occurring were also undertaken.

Of the threatened terrestrial species identified, there is the potential for significant impacts on the plant species Marsdenia longiloba (Slender Marsdenia) in the absence of appropriate mitigation measures being implemented as part of the Proposal.

The mitigation measures proposed to be implemented in order to minimise the impacts on Marsdenia longiloba include the protection and relocation of individual plants within the road corridor during the construction of the Proposal where feasible.

The Proposal would result in the loss of 255 hectares of native vegetation (based on a 10 metre buffer from the construction footprint) including approximately two hectares of wetland and mangroves. The majority of vegetation to be removed is located within state forests and private properties within Section 4 of the Proposal. Habitat compensation and rehabilitation measures would be developed in consultation with the DECCW during the detailed design phase of the Proposal in order to mitigate anticipated habitat fragmentation and wildlife corridor impacts.

There is unlikely to be significant residual impacts associated with the construction and operation of the Proposal, following the adoption of the proposed mitigation and management measures identified in this environmental assessment.

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Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

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11. Land use and property

Land use and property is identified as a key issue in the Director-General's requirements. A detailed land use and property assessment for the Proposal was undertaken and is presented in this chapter.

Director-General's requirements	Where addressed in the EA
Land Use and Property – including but not limited to: ■ directly-affected properties and land uses adjacent to the project, including property access, property allotment, land sterilisation and severance; ■ the connectivity (including pedestrian and cycleway opportunities) and contiguity of existing and planned settlements and activity clusters; ■ the operation of Nambucca Valley Quarry south of Warrell Creek; ■ the operation of Forests NSW estate including potential for fragmentation and sterilisation of resources; and ■ the attainment of the objectives of the *Mid North Coast Strategy* (Department of Planning, March 2009).	Section 11.3.1 Property acquisition Section 11.3.2 Land connectivity and contiguity Section 11.3.3 Land sterilisation and severance Section 11.3.4 Access Section 11.3.5 Planned development (including the *Mid North Coast Regional Strategy*) Section 11.3.7 Forestry operations (including potential for fragmentation and sterilisation of resources) Section 11.3.9 Extractive industries (Nambucca Valley Quarry)

11.1 Assessment approach

The following land use and property impact assessment combines information from field investigations, council databases and one-on-one and small group consultation with affected land owners and the wider community. The information collected about land uses within the study area was originally obtained and mapped during the route options investigations, updated for the selection of the preferred route and further updated during the preparation of this environmental assessment. Existing zoning and development permissibility, along with strategic land use planning was assessed in consultation with Bellingen and Nambucca Shire Councils.

The approach included the following considerations:

- Existing land uses within the study area.
- Potential land use and property impacts as a result of the Proposal.
- Potential changes to land use.
- Proposed management measures.

The assessment of potential land use and property impacts as a result of the Proposal has been reported for the four sections of the Proposal:

- Section 1 - Allgomera deviation to Nambucca River.
- Section 2 - Nambucca River to North Coast Railway overbridge.
- Section 3 - Nambucca Heads to Ballards Road.
- Section 4 - Ballards Road to Waterfall Way.

11.2 Existing land use

The Proposal is located within the Nambucca and Bellingen local government areas which are characterised by a mix of agricultural land uses, bushland, forests, small settlements and the townships of Macksville, Nambucca Heads and Urunga, which are situated on the Nambucca and Kalang Rivers. The general pattern of land use in the study area is controlled mainly through zoning provisions in the Bellingen Local Environmental Plan 2003 and the Nambucca Local Environmental Plan 1995. Although the provisions of these Local Environmental Plans do not apply in respect of the Proposal (as the Proposal has been declared as critical infrastructure under Part 3A of the Environmental Planning and Assessment Act 1979), they have been considered in the design and location of key features of the Proposal.

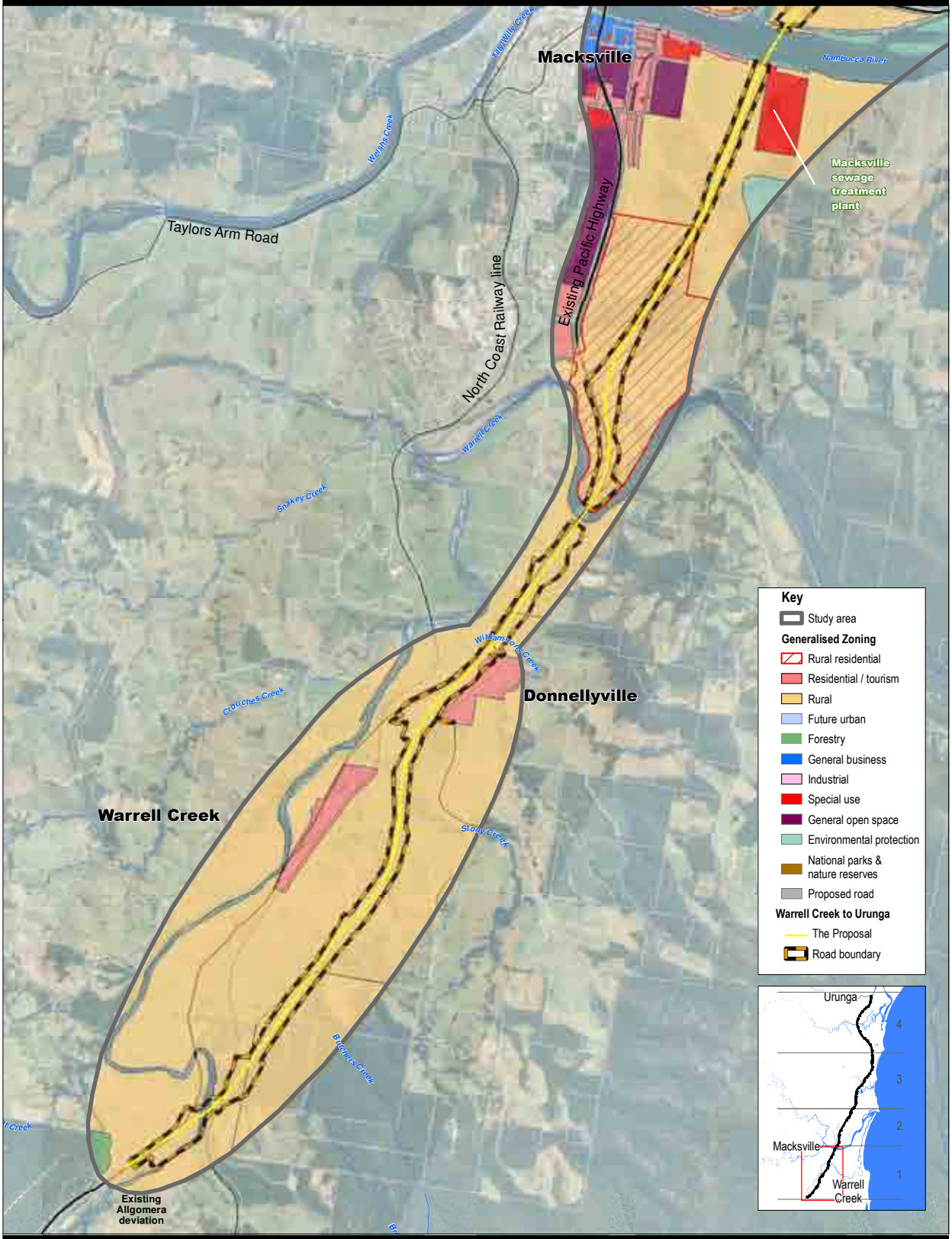
The broad land use zones adopted in the Nambucca Local Environment Plan 1995 and Bellingen Local Environment Plan 2003 are shown in Figure 11-1 a-c and Figure 11-2. The state forest management zones are shown in Figure 11-3a and Figure 11-3b and regionally significant farmland in Figure 11-4.

The land use zones under the Nambucca and Bellingen Local Environmental Plans near the Proposal are shown in Table 11-1.

Table 11-1 Zonings

Nambucca Local Environment Plan 1995	Bellingen Local Environment Plan 2003
■ Rural (prime flooding)	■ Secondary agriculture
■ Rural residential	■ Public recreation (state forest)
■ Residential	■ Rural small holdings
■ Public recreation	■ Rural settlement
■ Rural (forestry)	■ Industrial
■ Rural (future urban)	■ Special emphasis

FIGURE 11-1 a| NAMBUCCA LEP ZONINGS **SECTION 1 OF 3**



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0 400 800 Metres

FIGURE 11-1 b| NAMBUCCA LEP ZONINGS **SECTION 2 OF 3**

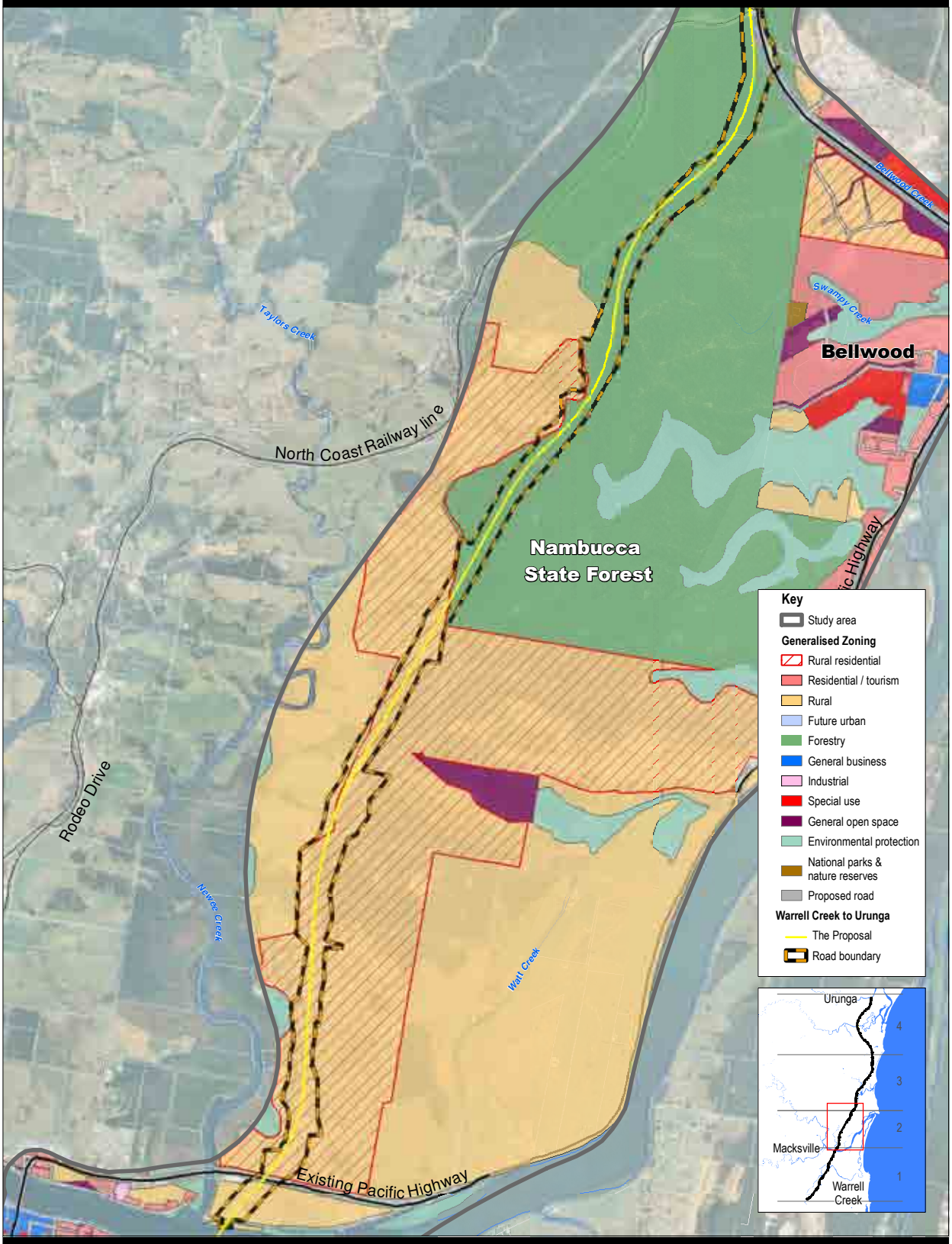

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FIGURE 11-1 c | NAMBUCCA LEP ZONINGS **SECTION 3 OF 3**

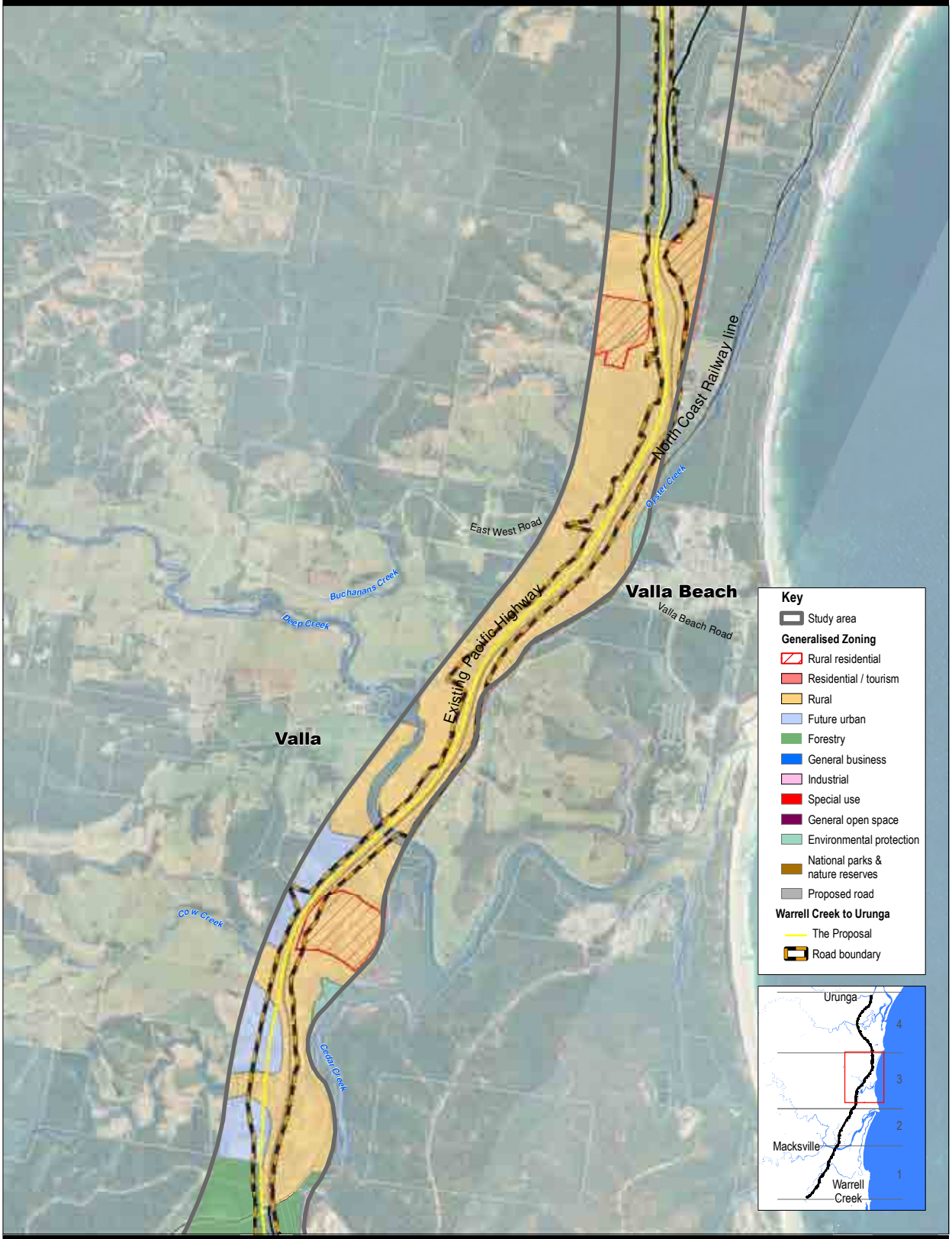

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FIGURE 11-2 | BELLINGEN LEP ZONINGS

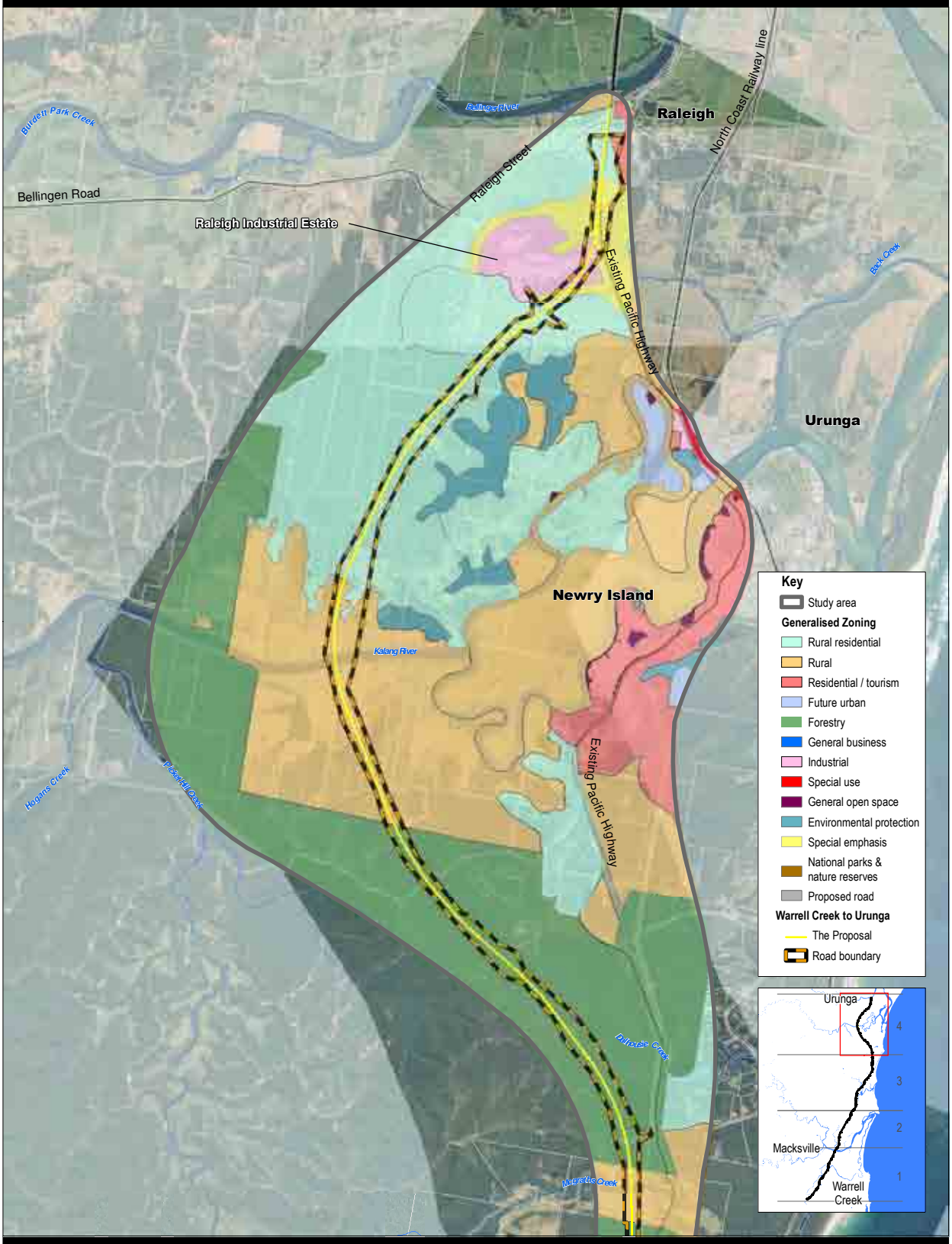

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FIGURE 11-3a | STATE FOREST MANAGEMENT ZONES — SECTION 1 OF 2

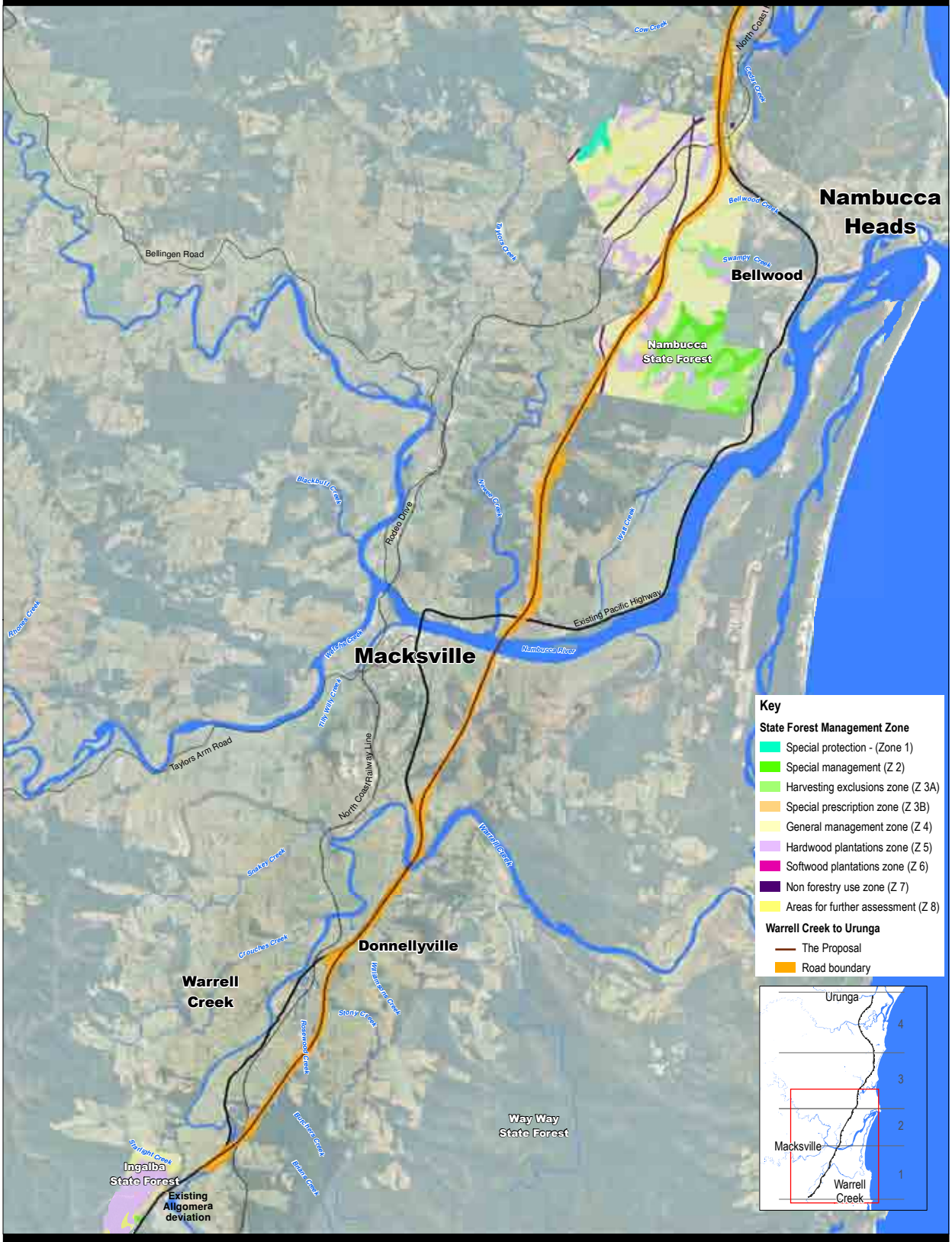

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FIGURE 11-3b | STATE FOREST MANAGEMENT ZONES — SECTION 2 OF 2

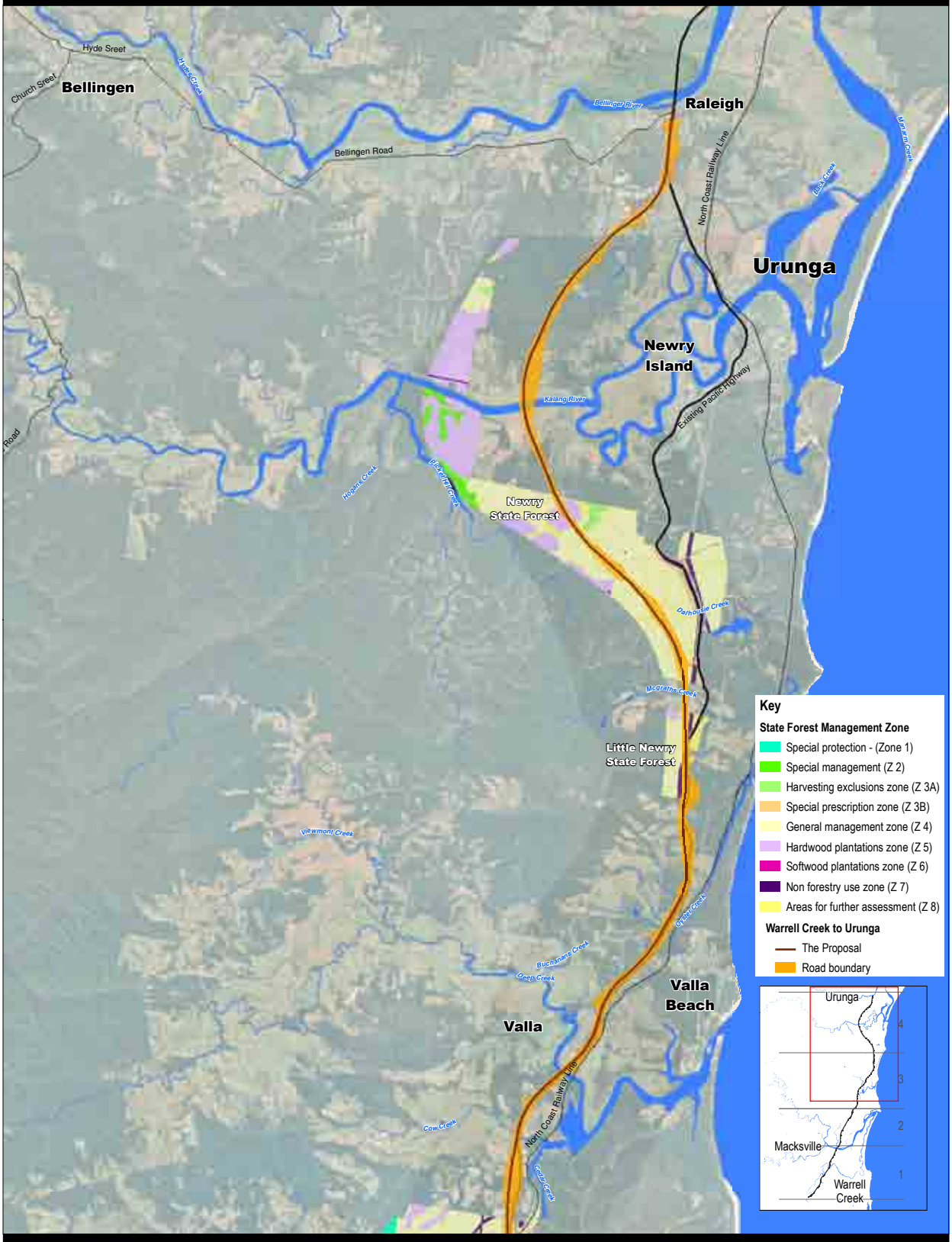
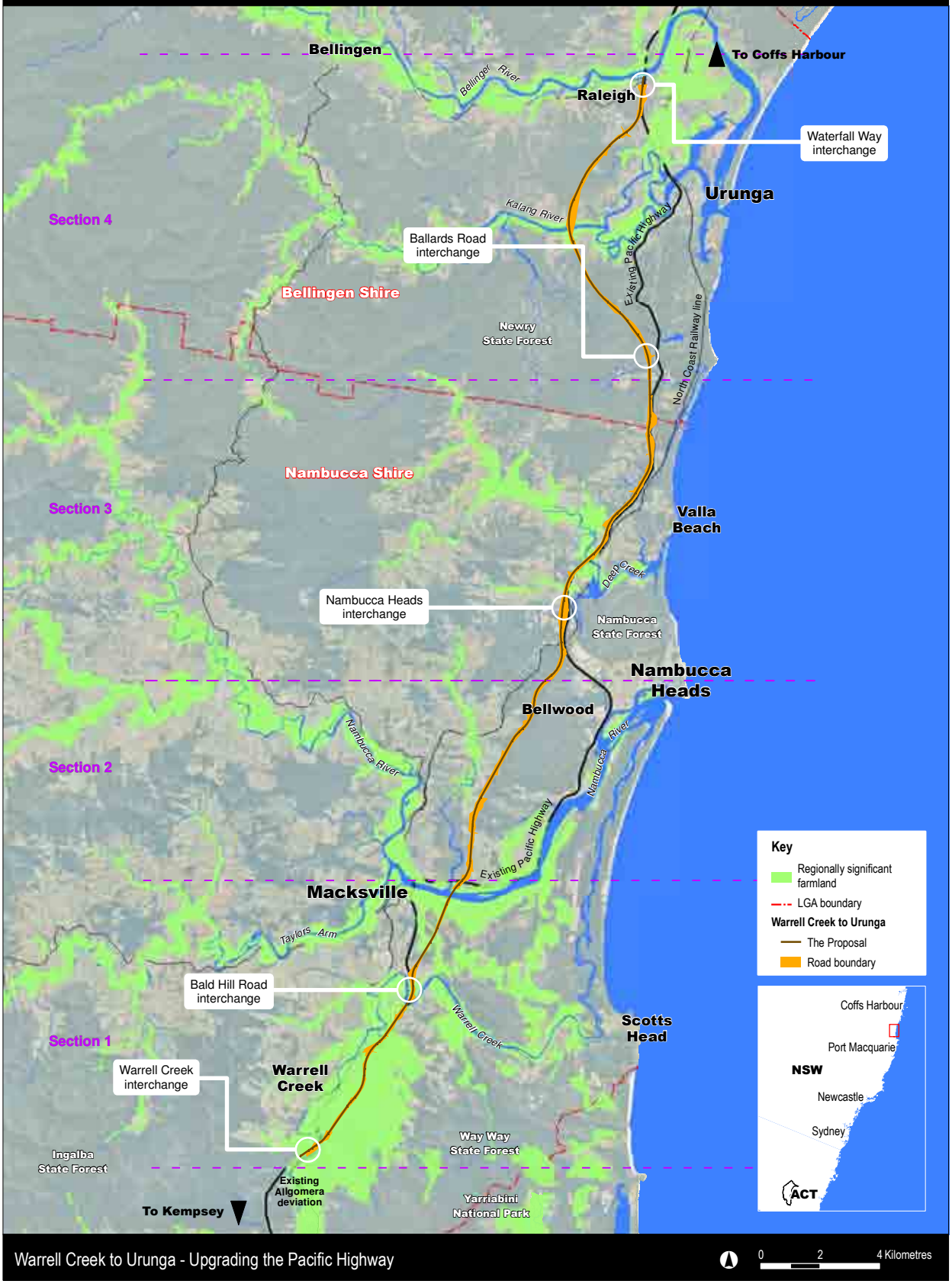


FIGURE 11-4 | REGIONALLY SIGNIFICANT FARMLAND



11.2.1 Section 1 - Allgomera deviation to Nambucca River

The land uses in this section are mixed. South of Warrell Creek the land use is predominantly rural with land used mainly for grazing and limited cultivation.

The rural uses are integrated with the small villages of Warrell Creek and Donnellyville, both of which are located adjacent to the existing highway. An area of rural residential land along O'Dells and Rosewood Roads has become more popular in recent years. The villages of Warrell Creek and Donnellyville have been identified by the Department of Planning as growth areas in the Mid North Coast Regional Strategy 2006–31 (Department of Planning 2009a).

Commercial operations in this area include a fruit stall, a day care facility and a glass repair / supply business.

Two industrial operations are located in the area south of Warrell Creek. Cockburn's Saw Mill is located south of the Warrell Creek village on Cockburns Lane, and the Nambucca Valley Quarry is located adjacent to the existing highway immediately south of Warrell Creek.

Way Way State Forest and Yarrahappini National Park are located to the south-east of Warrell Creek and Ingalba State Forest is situated to the south-west. The main transport uses in this area of Section 1 are the North Coast Railway Line and the existing Pacific Highway.

North of Warrell Creek, the land use becomes more urban as proximity to Macksville increases. Macksville is a key commercial and administrative centre in the Nambucca Shire. The residential areas of Macksville extend east and west of the existing highway. Much of the commercial and administrative development is located along the existing highway and Wallace Street.

Macksville has become a stopping point for some through-traffic because of its location approximately mid-way between Sydney and Brisbane.

Through and local traffic pass through Macksville at slow speeds as a result of general congestion, traffic lights and the narrow lanes associated with the Macksville bridge. As a result of these traffic characteristics, businesses such as service stations and food outlets that service through-traffic have been located alongside the existing highway, whereas commercial outlets, which are used predominantly by the local community, have been located east and west of the existing highway.

Residential land extends east along the Nambucca River on the southern side of Gumma Road (also referred to as River Street), for approximately 1.2 kilometres. Cleared land to the south of this residential land makes up part of the Gumma floodplain and is used predominantly for grazing. The Macksville sewage treatment plant, a council works depot and animal pound are located to the east of the residential land, in the vicinity of the Proposal. Rural residential development is located south of Macksville, along Scotts Head Road and Bald Hill Road, between Snakey Creek and Taylors Arm, and from Irvines Road to Hawks Road, Newee Creek.

The Macksville industrial area is located to the west of the existing highway. The south-western portion of this section has been identified as the 'Macksville and Congarinni Future Urban Areas' in the Nambucca Shire Council 20 Year Structure Plan (Nambucca Shire Council 2008). The Mid North Coast Regional Strategy 2006-31 has extended this future urban area to include the area south of Macksville, along the western side of the existing highway. This proposed growth area incorporates both future urban release areas and proposed employment lands. Areas to the south and east of Macksville have been identified as regionally significant farmland in the Mid North Coast Farmland Mapping Project (Department of Planning 2009b) as shown in Figure 11-4. The regionally significant farmland has been generally constrained to the flatter areas, along the floodplains of Warrell Creek and the Nambucca River, and their tributaries.

The majority of land directly impacted by the Proposal in this section is rural. Land use data provided by Nambucca Shire Council indicate that, based on the road boundary of the Proposal, approximately 66 ha of land classified as 'rural (prime/flooding)' and approximately 38 ha of land classified as 'rural' would be directly impacted.

11.2.2 Section 2 - Nambucca River to North Coast Railway overbridge

The southern part of this section contains mixed uses of limited commercial, residential and rural residential land, along with floodplain grazing land. A marine repair/painting operation is located on the northern banks of the Nambucca River. Additionally, a caravan park is also located in this vicinity. The caravan park includes holiday and permanent tenants. The Nambucca ambulance station is located to the north of the existing highway.

The Nambucca State Forest occupies the majority of the Nambucca River to Nambucca Heads section. The state forest is located predominantly in the northern two-thirds of this section.

Residential and rural residential properties have developed north of the existing highway along Old Coast Road and in Letitia Close. To the west of the Nambucca State Forest, Nambucca Shire Council operates a waste management depot off Old Coast Road. Old Coast Road also provides access to grazing land and rural residential development. Grazing is generally confined to the river flats, with rural residential development occurring on the more elevated land further north.

Additionally, a large area of land, known as Kingsworth Estate, has been developed for residential use west of Bellwood. This is accessible from the existing highway and extends west, almost to Old Coast Road. Some residential areas are also located north of the Nambucca River, generally to the west of the confluence with Newee Creek, west of Gordons Knob Road and on the fringe of Macksville.

The township of Nambucca Heads is situated to the east of the Nambucca State Forest. It is the main tourism destination in the Nambucca Shire. The existing highway currently bypasses the western edge of Nambucca Heads. The townships of Nambucca Heads and Bellwood have been identified as proposed growth areas in the Mid North Coast Regional Strategy extending to the boundaries of the state forest and south along the Nambucca River. The strategy has also identified proposed employment lands at the southern extent of this proposed growth area. A limitation to growth in the area south of Bellwood and Nambucca Heads has been the proximity of the existing highway and associated traffic noise.

The majority of land directly impacted by the Proposal in this section is rural. Land use data provided by Nambucca Shire Council indicate that, based on the road boundary of the Proposal, approximately 70 ha of land classified as 'rural' would be directly impacted.

11.2.3 Section 3 - Nambucca Heads to Ballards Road

The Proposal in the Nambucca Heads to Ballards Road section is constrained by the substantial forestry and nature reserve areas and the steeper topography to the west of the existing highway and the wetland areas to the east. Relatively narrow valleys exist around the creeks including Deep Creek, Oyster Creek and Boggy Creek. These valleys are used for smaller scale agricultural enterprises or are occupied by rural small holdings or dwellings on acreages. A proportion of these valleys have been identified as regionally significant farmland, especially along the floodplain areas of Deep Creek and its tributaries. The zoning throughout this section predominantly comprises rural, with small patches of rural residential. These areas have been classified as regionally significant farmland by the Mid North Coast Farmland Mapping Project in an attempt to protect the region's most significant agricultural land.

Large parts of the southern portion of this section have been identified as the Boggy Creek and Valla Beach future urban areas under the Nambucca Shire Council 20 Year Structure Plan. This has been supported by the Mid North Coast Regional Strategy, with proposed growth areas, future urban release areas and proposed employment lands located on both sides of the existing highway.

The North Coast Railway Line and the existing highway provide the main transport options through this section.

The majority of land directly impacted by the Proposal in this section is rural. Land use data provided by Nambucca Shire Council indicate that, based on the road boundary of the Proposal, approximately 47 ha of land classified as 'rural (prime/flooding)' and approximately 22 ha of land classified as 'rural-future urban' would be directly impacted. Similar data from Bellingen Shire Council indicate that approximately 18 ha of land classified as 'rural-secondary agriculture' would be directly impacted.

11.2.4 Section 4 - Ballards Road to Waterfall Way

This section is characterised by mixed land uses. It is essentially split by the Kalang River creating north and south parts. South of the Kalang River, the land use is dominated by the Newry and Little Newry state forests. Closer to the Kalang River, the land use changes to limited grazing on the river flats.

To the north of the Kalang River, land uses are mixed and characterised by rural and rural residential zones, generally between South Arm Road and the Kalang River. The Raleigh industrial area is located to the north of Short Cut Road.

The town of Urunga is located in the northern part of this section to the east of the existing highway. Urunga is a key tourist destination in the Bellingen Shire. Unlike Macksville, the existing highway bypasses the main street of Urunga, but does go through residential areas to the west of the main town centre. Two service stations, the

Urunga Tourist Information Centre, a substantial holiday caravan park and a series of small roadside motels are located along the existing highway in this area.

Areas around the Urunga and Raleigh industrial estate have been identified in the Bellingen Local Environmental Plan 2003 as urban areas. According to the Bellingen Shire Growth Management Strategy (Bellingen Shire Council 2007), future development within this section is likely to include rural residential development around South Arm Road, development of a new urban area in South Urunga and infill and / or redevelopment in Urunga. The location of this future development is supported through the Department of Planning's Mid North Coast Regional Strategy, which also identifies future employment lands at the confluence of the existing highway and the North Coast Railway line, north of Urunga.

The majority of land directly impacted by the Proposal in this section is either rural or forestry land. Land use data provided by Bellingen Shire Council indicate that, based on the road boundary of the Proposal, approximately 62 ha of land classified as 'rural-small holdings', approximately 37 ha of land classified as rural-secondary agriculture' and approximately 60 ha of land classified as 'rural-forestry' would be directly impacted.

11.3 Potential land use impacts

Potential impacts of the Proposal relating to land use require consideration of the following aspects:

- Property acquisition.
- Land connectivity and contiguity.
- Access arrangements.
- Planned development.
- Forest land.
- Agricultural land.
- Commercial land.
- Residential land
- Land use change.
- Land sterilisation.
- Land severance.
- Contiguity of existing and planned settlements and activity clusters.

There would also be a range of potential land use related amenity impacts, particularly for owners, occupants and operators of properties along and near the Proposal. Land use impacts relating to amenity, such as visual amenity (Chapter 13 – *Visual amenity and design*), noise (Chapter 14 – *Noise and vibration*), and traffic (Chapter 17 – *Traffic and transport*) are discussed in detail in the stated chapters. Social and economic impacts of the Proposal

are discussed in detail in Chapter 12 – *Social and economic impacts* and alterations to existing access arrangements are detailed in Chapter 6 – *Description of the Proposal*.

11.3.1 Property acquisition

Throughout the development of the route options, selection of the preferred route, and the preparation of the concept design and environmental assessment phases of the Proposal, the RTA has held discussions with directly affected landholders (and those living on properties that are wholly or partially within the boundary of the Proposal) with the aim of minimising the impact on the function and amenity of properties. This process has resulted in refinements to the alignment and design of the Proposal in some places to minimise impacts on land use. In rural areas, the aim has been to develop a design that minimises land acquisition, severance and fragmentation of properties by closely following property boundaries, where possible.

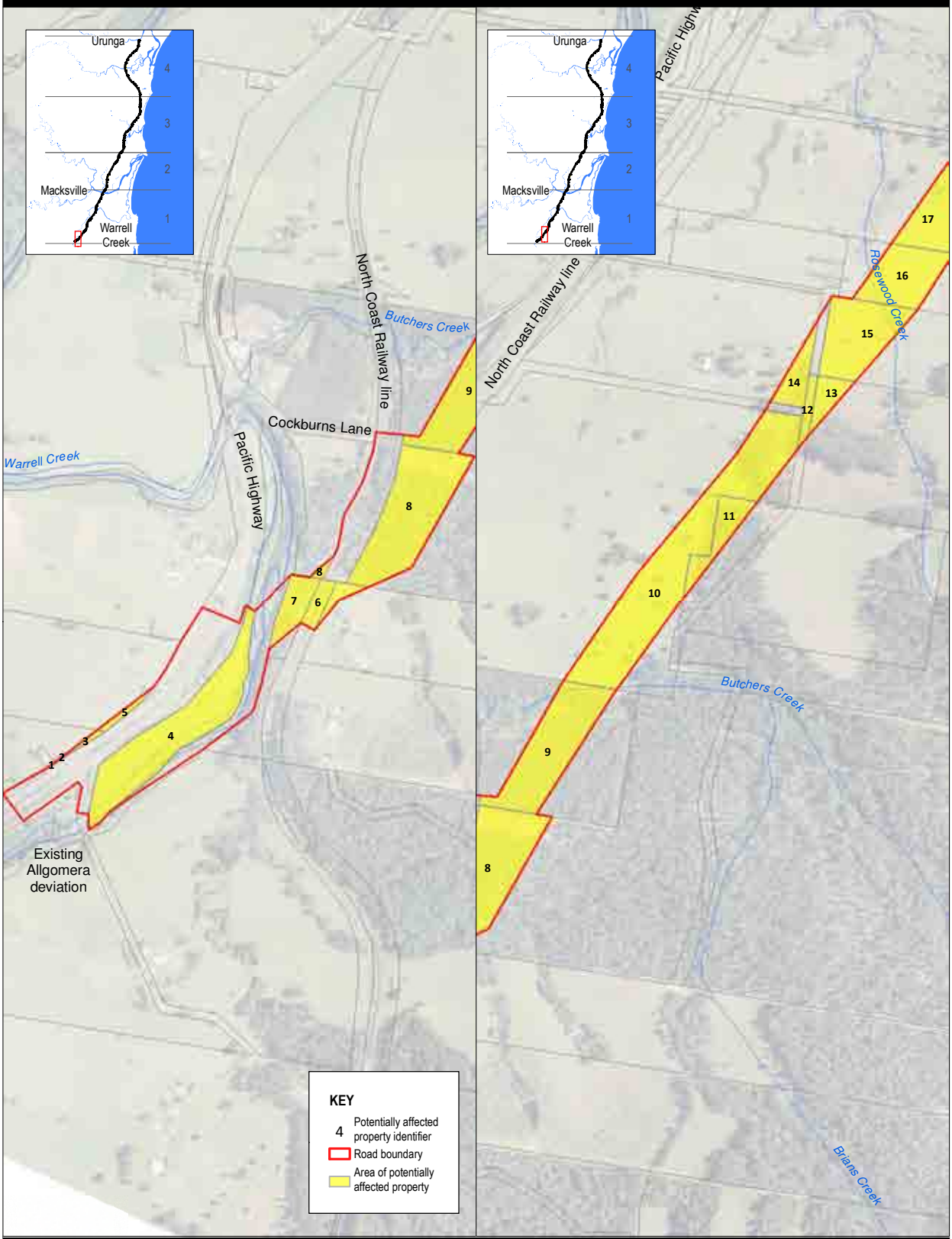
Based on the road boundary shown in Chapter 6 – *Description of the Proposal*, 192 properties would be directly impacted by the Proposal and require total or partial acquisition. Details of the proposed land acquisition and likely impacts on individual properties are shown in Figure 11-5a to Figure 11-5k and summarised in Table 11-2. The boundaries have been derived from a combination of ground survey and cadastral overlay and would be subject to further refinement during detailed design.

Property acquisitions would be subject to negotiation between the landholder and the RTA in accordance with the RTA's Land Acquisitions Policy Statement and the requirements of the Land Acquisition (Just Terms Compensation) Act 1991. It is not expected that acquisitions would result in long-term changes in land use. In some cases, acquired land would be used during construction site activities only. In the case of state forest land required for the Proposal, acquisition or exchange would be undertaken in accordance with the Forestry Act 1916.

11.3.2 Land connectivity and contiguity

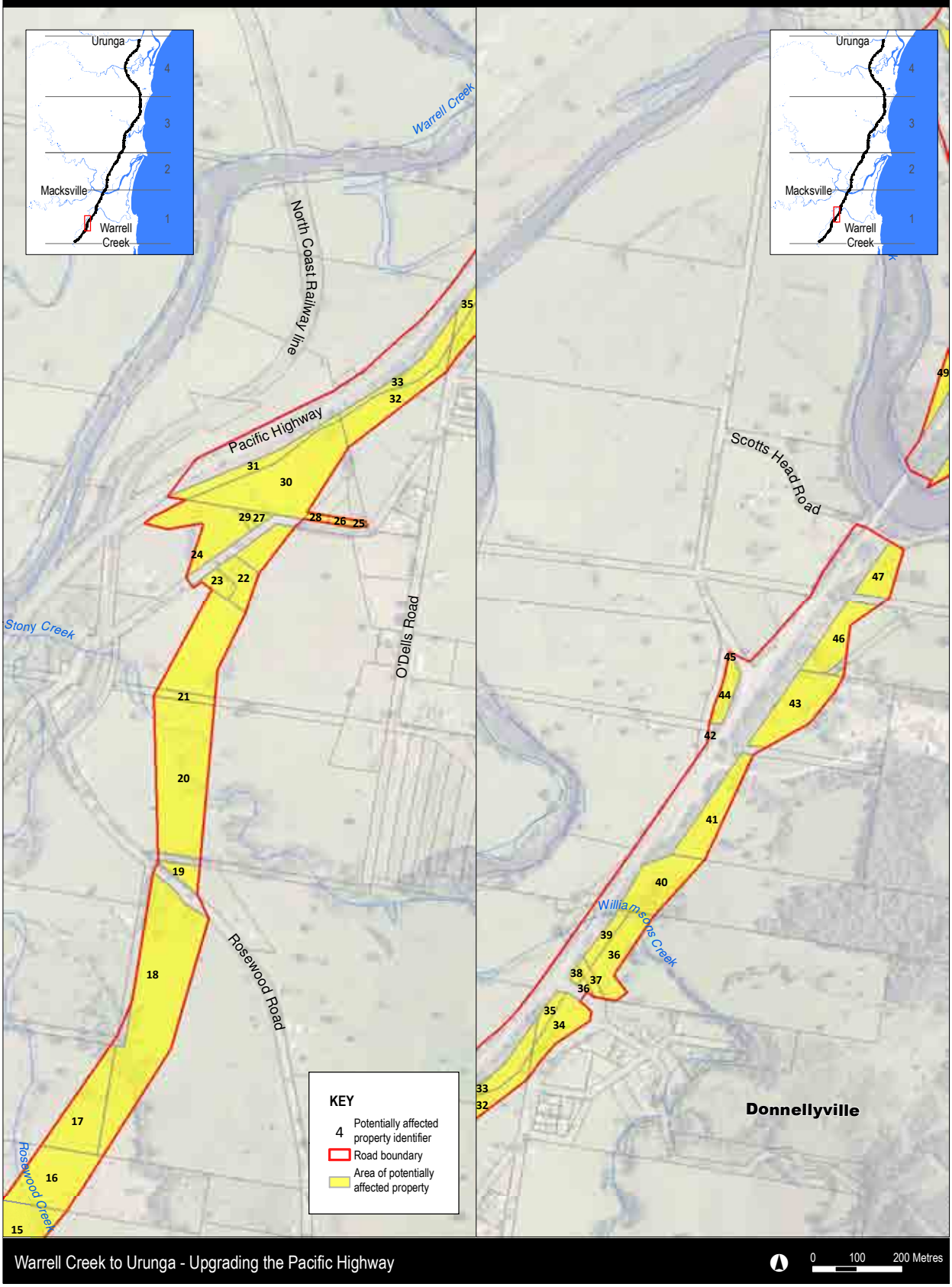
The Proposal has been designed in accordance with the RTA's Upgrading the Pacific Highway, Upgrading Program beyond 2006: Design Guidelines (RTA 2006) which aim to maintain connectivity between communities. The existing highway currently provides a barrier to east-west connectivity. People avoid crossing the highway due to their perception of safety risk. The proposed enhancement of local road connections is expected to improve connectivity by removing the safety risks currently associated with east-west movement across the highway. The existing Pacific Highway would also be maintained for local access and use by cyclists. The proposed overbridges as part of the Proposal have been designed to enhance existing east-west movements across the highway. Access to the Proposal would be gained via the strategic location of key interchanges. Connectivity across the Proposal would be maintained during construction and operation.

FIGURE 11-5a | PROPERTY AFFECTED BY ACQUISITION



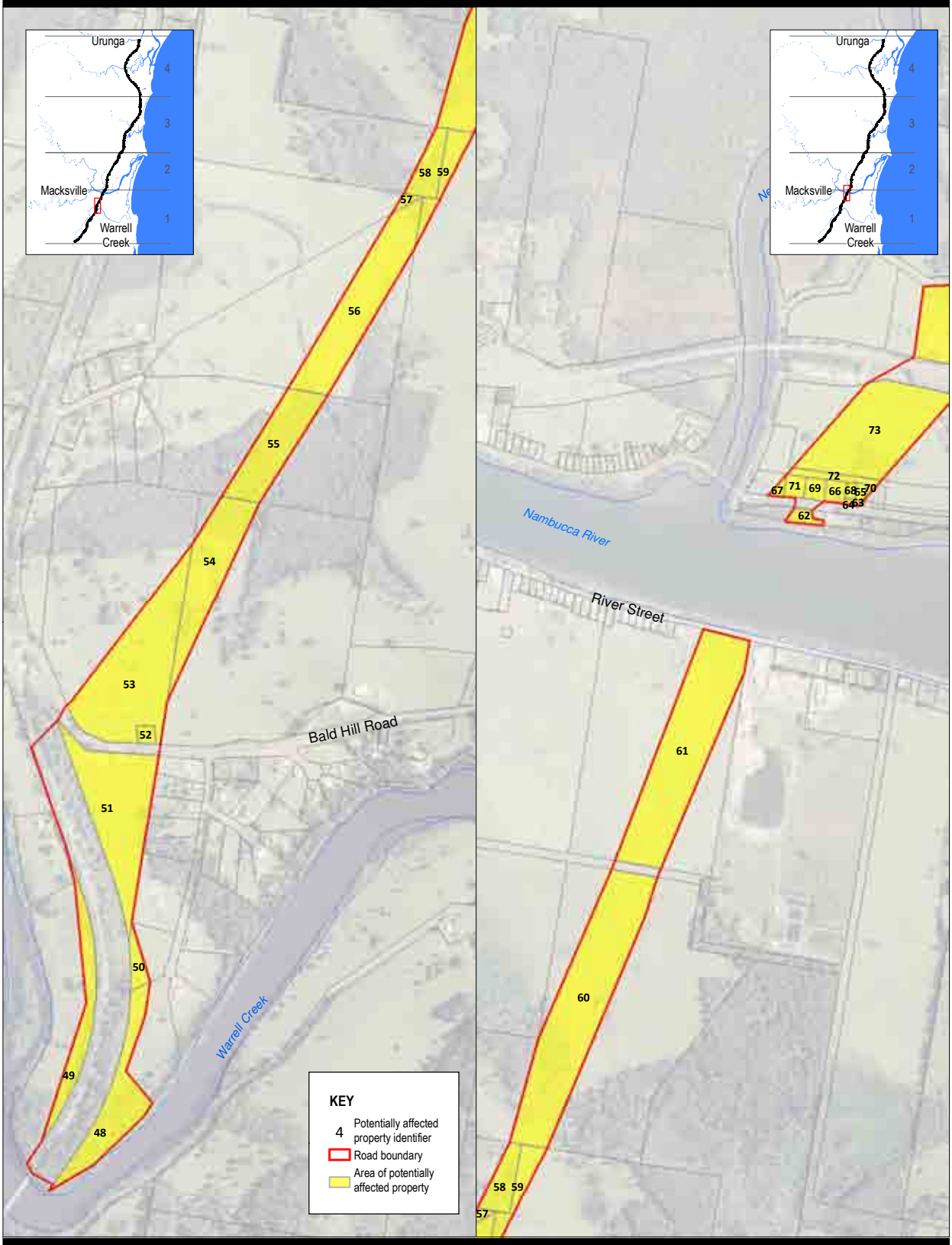
PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

FIGURE 11-5b | PROPERTY AFFECTED BY ACQUISITION



PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

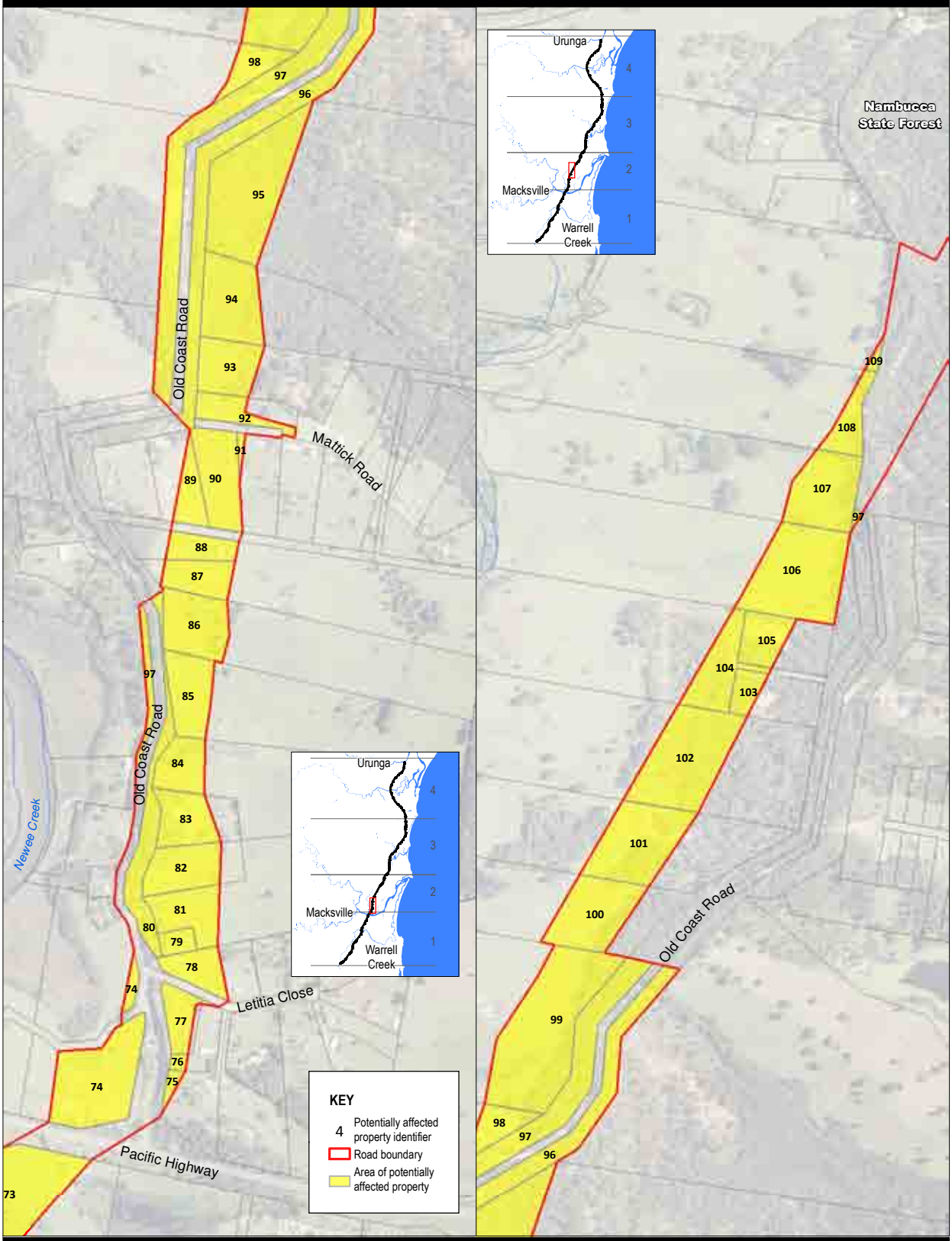
FIGURE 11-5c | PROPERTY AFFECTED BY ACQUISITION



Warrell Creek to Urunga - Upgrading the Pacific Highway

PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

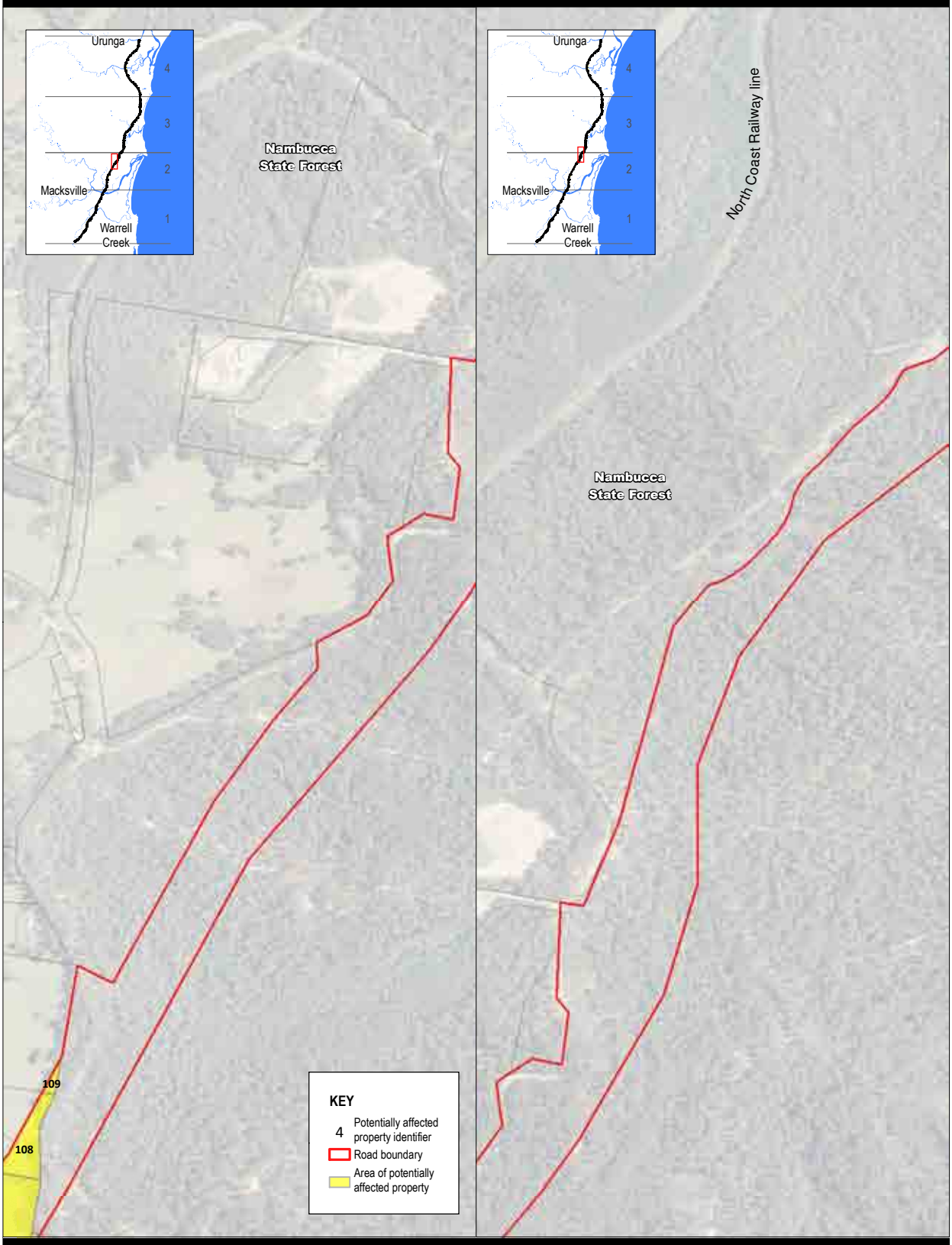
FIGURE 11-5d | PROPERTY AFFECTED BY ACQUISITION



Warrell Creek to Urunga - Upgrading the Pacific Highway

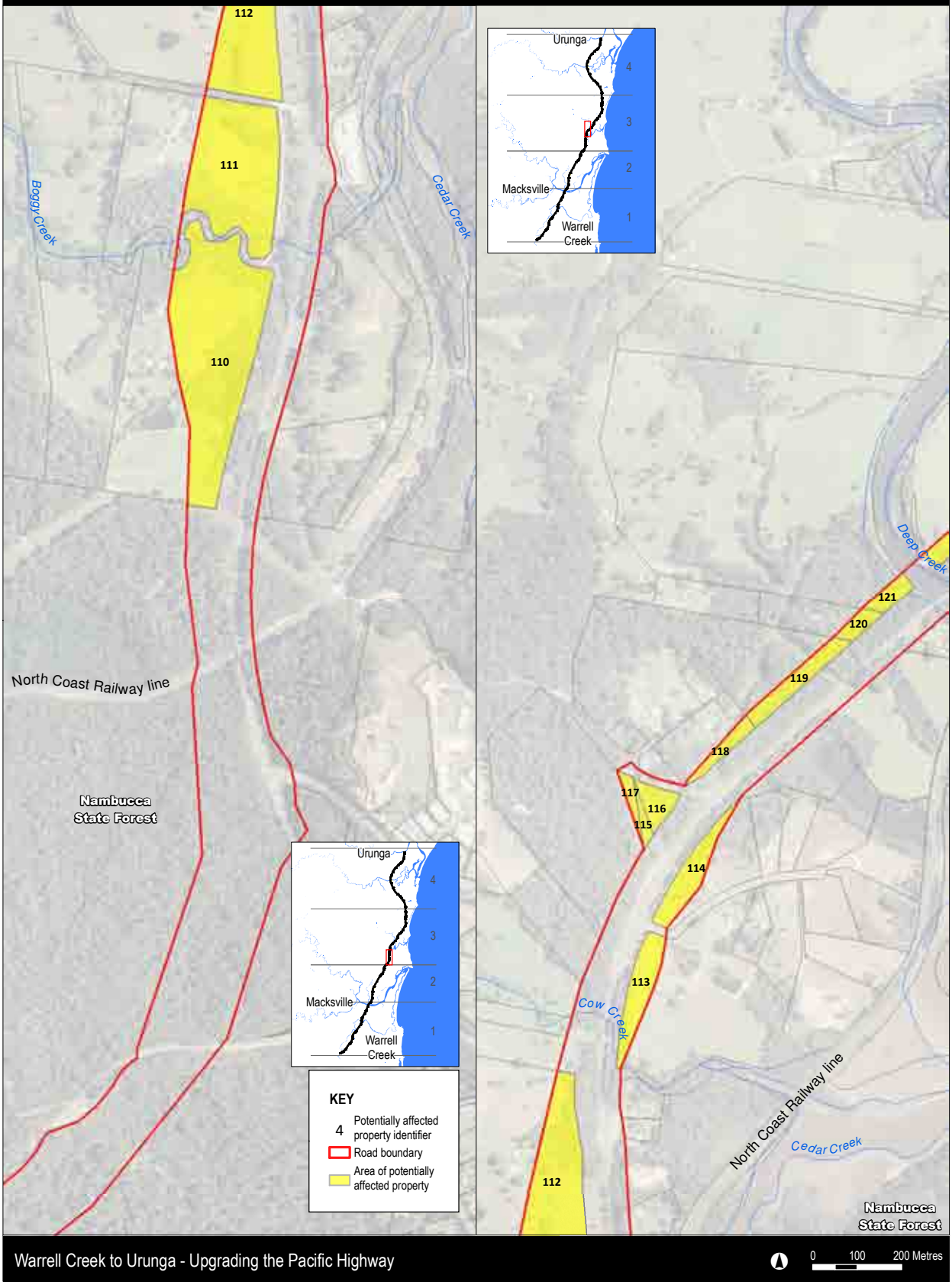
PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

FIGURE 11-5e | PROPERTY AFFECTED BY ACQUISITION



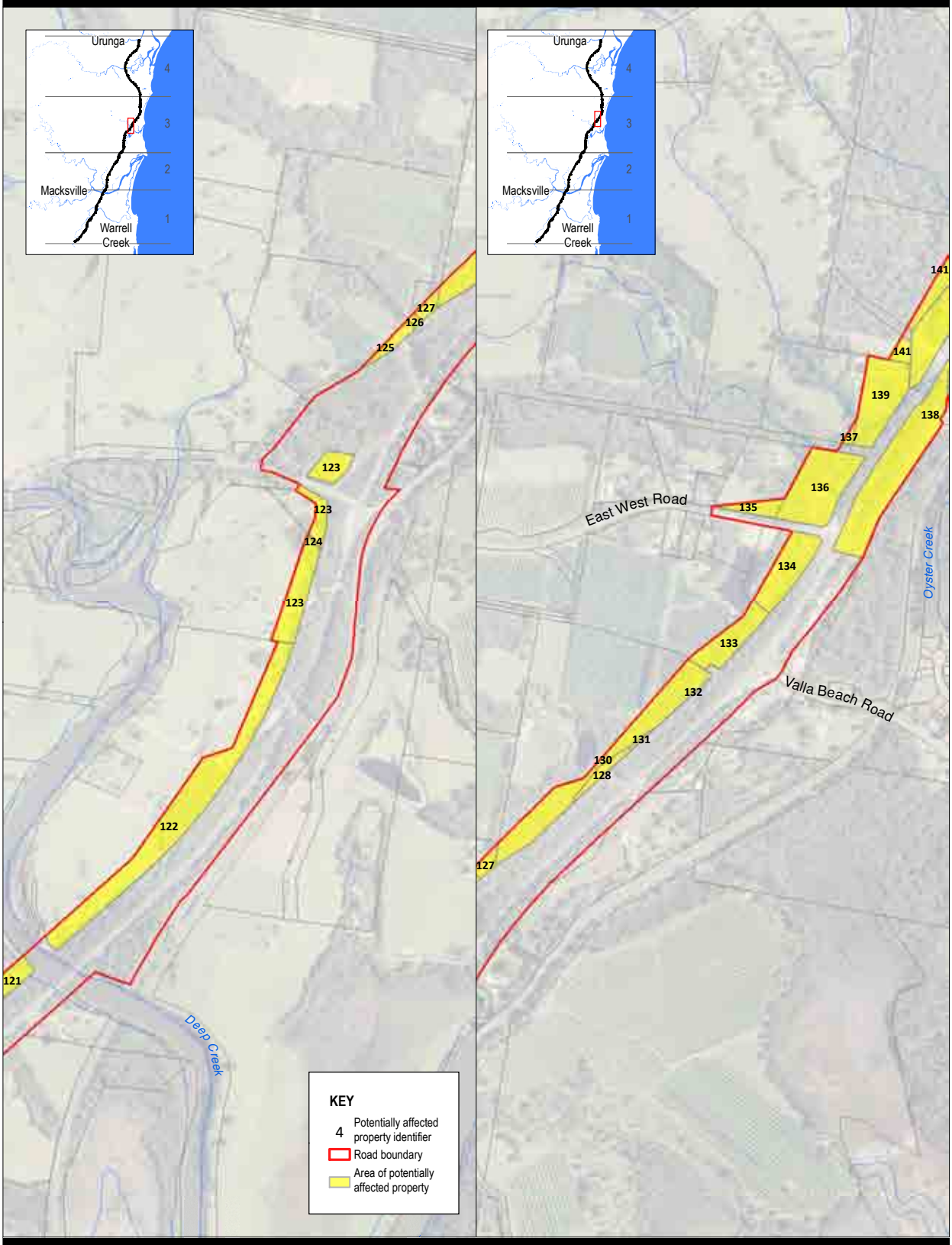
PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

FIGURE 11-5f | PROPERTY AFFECTED BY ACQUISITION



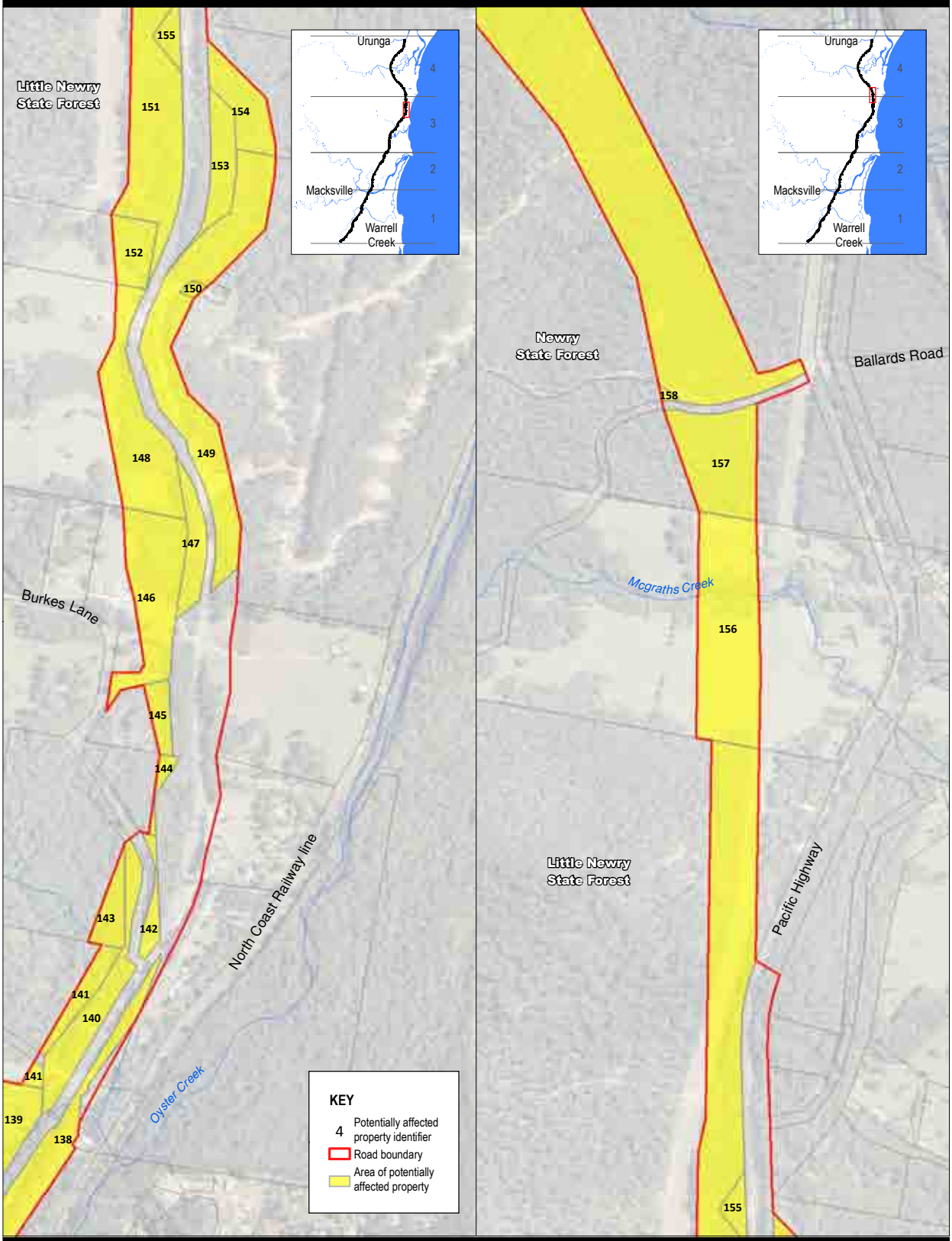
PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

FIGURE 11-5g | PROPERTY AFFECTED BY ACQUISITION



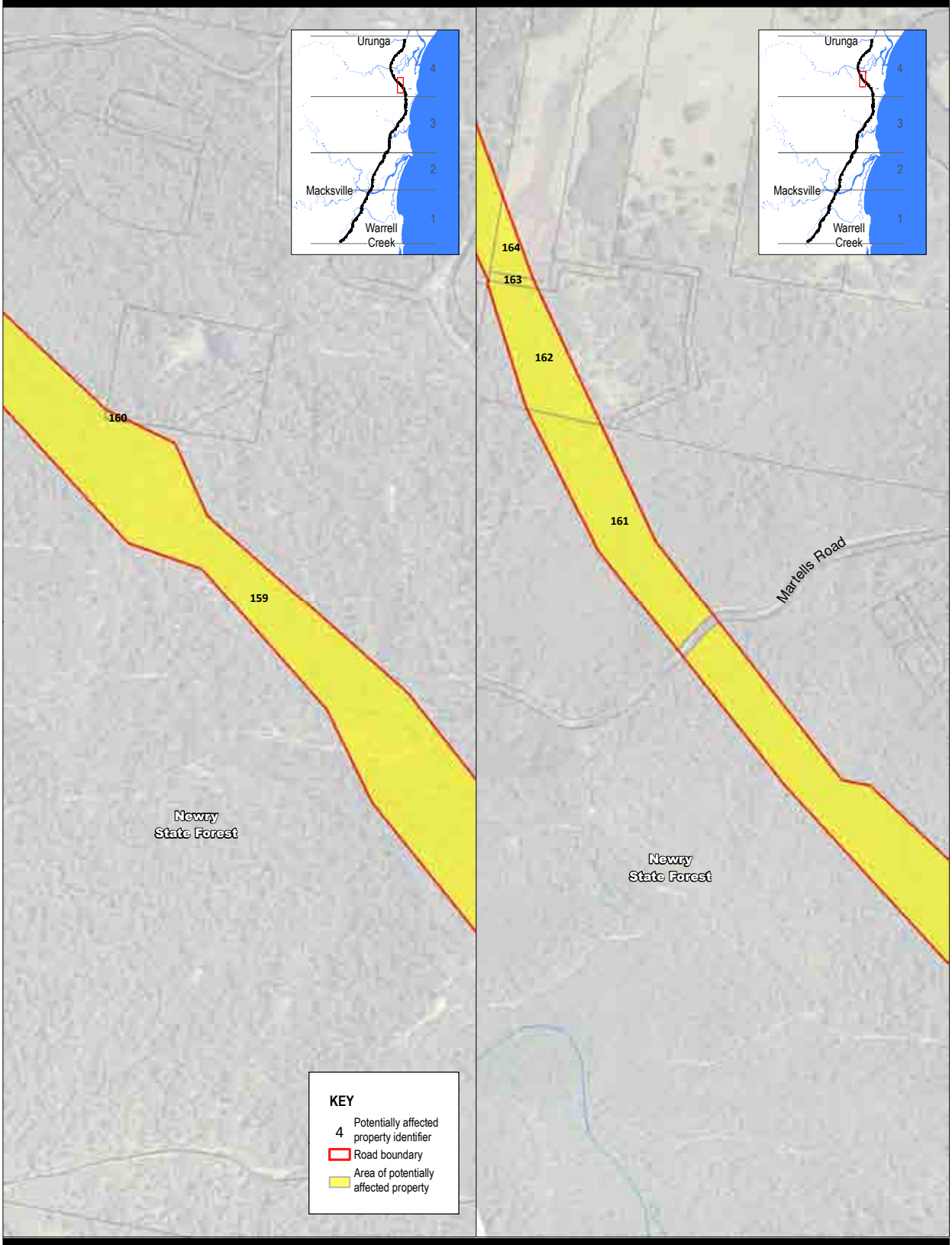
PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

FIGURE 11-5h | PROPERTY AFFECTED BY ACQUISITION



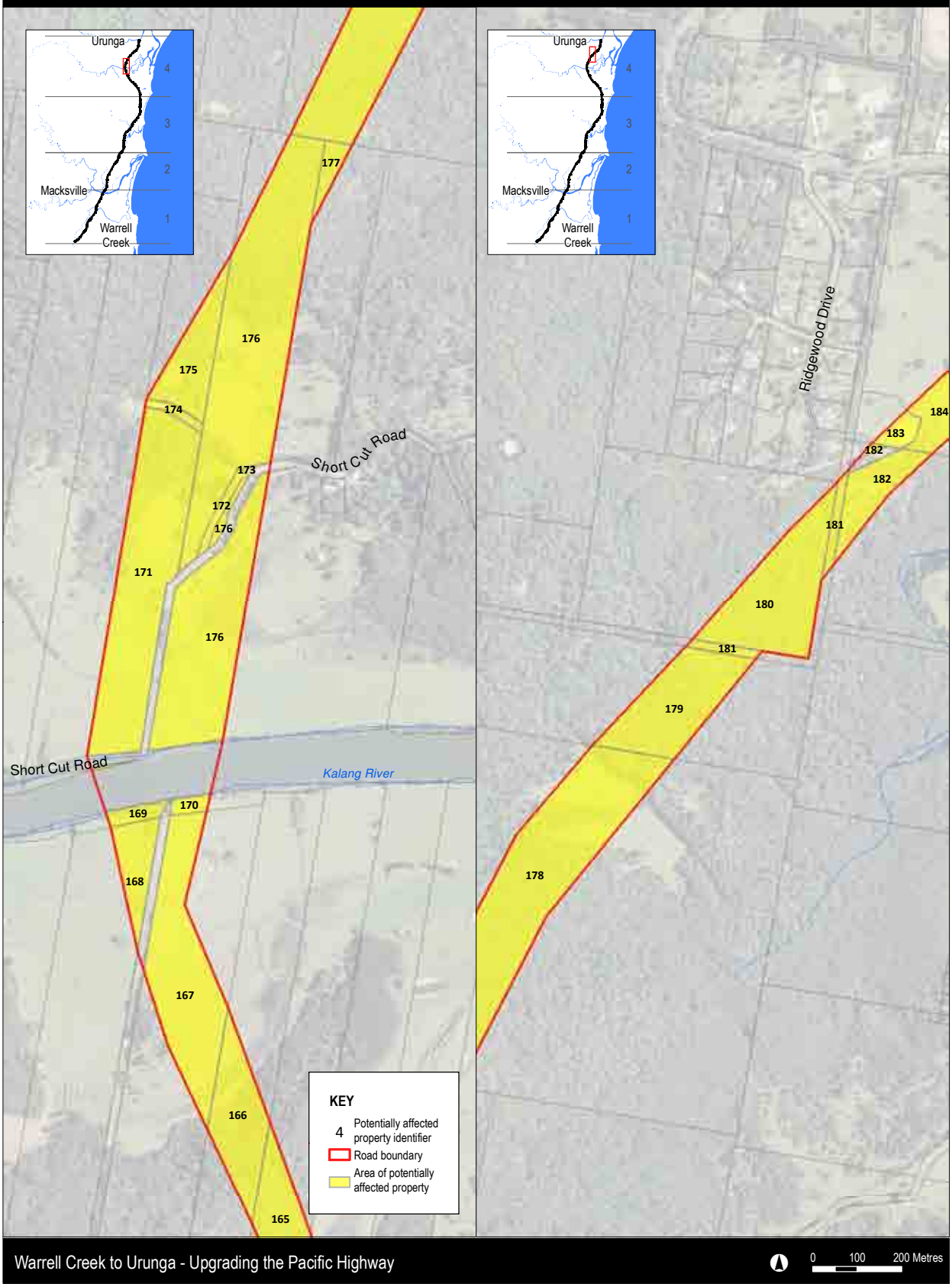
PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

FIGURE 11-5i | PROPERTY AFFECTED BY ACQUISITION



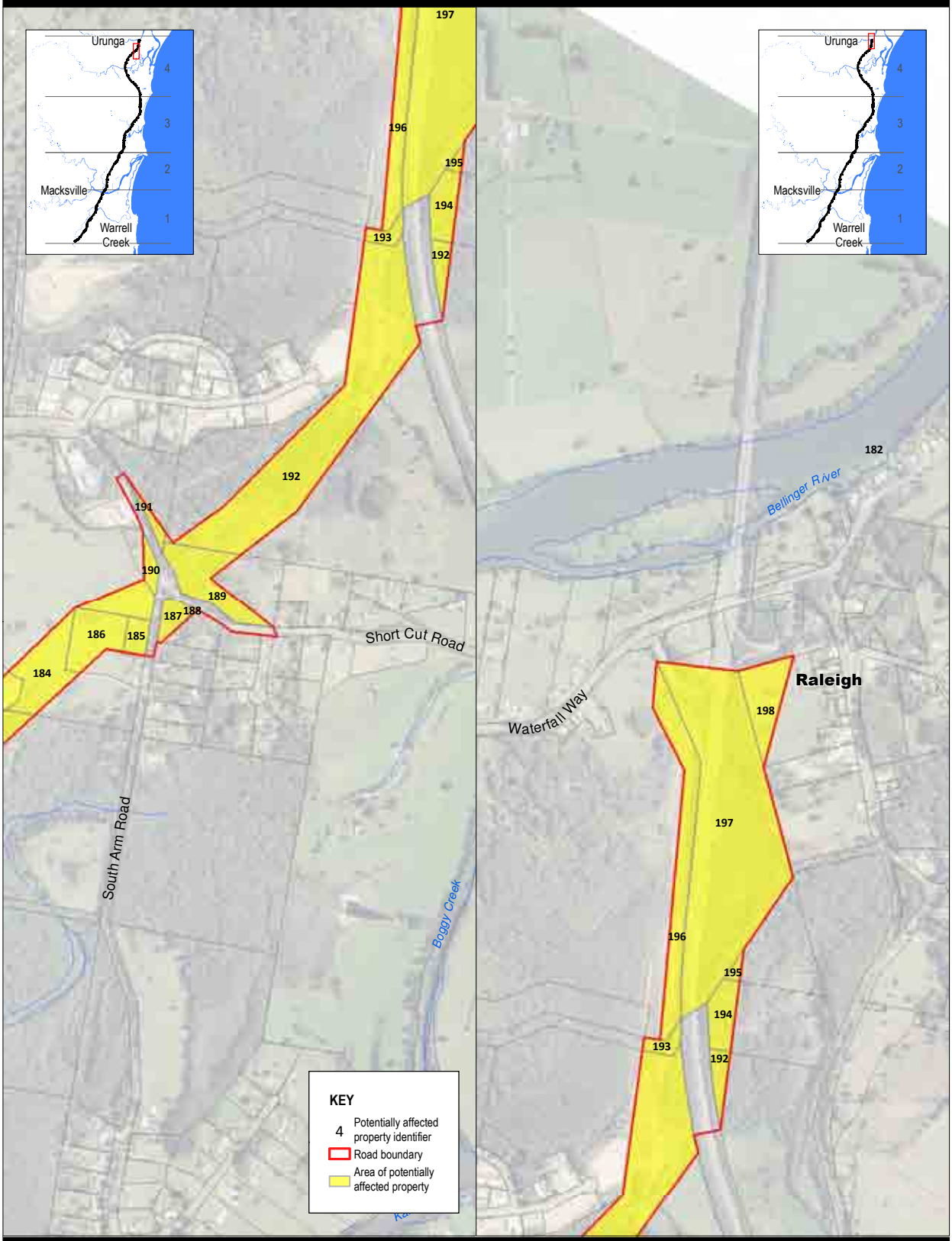
PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

FIGURE 11-5j | PROPERTY AFFECTED BY ACQUISITION



PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

FIGURE 11-5k | PROPERTY AFFECTED BY ACQUISITION



PROPERTY BOUNDARIES ARE APPROXIMATE AND ARE A COMBINATION OF GROUND SURVEY AND CADASTRAL OVERLAY, SUBJECT TO FURTHER REFINEMENT FOLLOWING DETAILED DESIGN.

Table 11-2 Properties and land uses directly affected by the Proposal[1]

Ref No	Current land use[1]	Total area (ha)	Area within corridor[1] (ha)	% of total property affected[2]		Ref No	Current land use[1]	Total area (ha)	Area within corridor[2] (ha)	% of total property affected[1]
1	Rural (Prime/Flooding)	0.09	0.00	1%		101	Rural	18.83	2.97	16%
2	Rural (Prime/Flooding)	0.04	0.01	36%		102	Rural	18.68	3.82	20%
3	Rural (Prime/Flooding)	5.85	0.08	1%		103	Rural	2.01	0.59	29%
4	Rural (Prime/Flooding)	10.47	4.31	41%		104	Rural	19.14	1.77	9%
5	Rural (Prime/Flooding)	13.88	0.16	1%		105	Rural	2.36	1.14	48%
6	Rural (Prime/Flooding)	1.72	0.41	24%		106	Rural	16.70	4.05	24%
7	Rural (Prime/Flooding)	40.49	1.15	3%		107	Rural	15.48	2.43	16%
8	Rural (Prime/Flooding)	78.19	4.22	5%		108	Rural	15.12	1.02	7%
9	Rural	16.12	3.47	22%		109	Rural	19.40	0.13	1%
10	Rural	49.69	7.28	15%		110	Rural (Future Urban)	15.95	8.86	56%
11	Rural	16.27	0.96	6%		111	Rural (Future Urban)	11.36	5.75	51%
12	Rural (Prime/Flooding)	0.62	0.32	51%		112	Rural (Future Urban)	51.00	4.70	9%
13	Rural (Prime/Flooding)	21.46	0.57	3%		113	Rural (Prime/Flooding)	10.71	1.34	12%
14	Rural (Prime/Flooding)	14.25	0.77	5%		114	Rural (Prime/Flooding)	3.23	1.27	39%
15	Rural (Prime/Flooding)	14.09	2.55	18%		115	Rural (Future Urban)	0.21	0.21	100%
16	Rural (Prime/Flooding)	6.59	1.98	30%		116	Rural (Future Urban)	0.59	0.59	100%
17	Rural (Prime/Flooding)	14.88	1.73	12%		117	Rural (Future Urban)	0.28	0.28	100%
18	Rural (Prime/Flooding)	66.04	5.94	9%		118	Rural (Future Urban)	2.39	0.47	20%
19	Rural (Prime/Flooding)	1.54	0.32	20%		119	Rural (Future Urban)	11.72	1.00	9%
20	Rural (Prime/Flooding)	45.02	7.03	16%		120	Rural (Future Urban)	1.90	0.37	20%
21	Rural (Prime/Flooding)	1.78	0.25	14%		121	Rural (Prime/Flooding)	32.33	0.45	1%

Ref No	Current land use[1]	Total area (ha)	Area within corridor[1] (ha)	% of total property affected[2]		Ref No	Current land use[1]	Total area (ha)	Area within corridor[2] (ha)	% of total property affected[1]
22	Rural (Prime/Flooding)	0.61	0.61	100%		122	Rural (Prime/Flooding)	18.06	4.16	23%
23	Rural (Prime/Flooding)	0.30	0.30	100%		123	Rural (Prime/Flooding)	10.54	1.93	18%
24	Rural (Prime/Flooding)	4.03	1.62	40%		124	Rural (Prime/Flooding)	0.06	0.01	23%
25	Residential (Village)	0.30	0.04	15%		125	Rural (Prime/Flooding)	8.15	0.28	3%
26	Residential (Village)	0.23	0.09	40%		126	Rural (Prime/Flooding)	10.16	0.06	1%
27	Rural (Prime/Flooding)	0.12	0.12	100%		127	Rural (Prime/Flooding)	0.41	0.19	46%
28	Residential (Village)	0.37	0.08	23%		128	Rural (Prime/Flooding)	0.24	0.24	100%
29	Rural (Prime/Flooding)	0.09	0.09	100%		129	Rural (Prime/Flooding)	0.02	0.02	100%
30	Rural (Prime/Flooding)	12.50	3.27	26%		130	Rural (Prime/Flooding)	12.26	2.56	21%
31	Rural (Prime/Flooding)	0.78	0.78	100%		131	Rural (Prime/Flooding)	0.04	0.04	100%
32	Rural (Prime/Flooding)	12.93	1.23	9%		132	Rural (Prime/Flooding)	0.01	0.01	100%
33	Rural (Prime/Flooding)	0.77	0.77	100%		133	Rural (Prime/Flooding)	9.30	0.96	10%
34	Residential (Village)	0.89	0.89	100%		134	Rural (Prime/Flooding)	2.03	1.21	60%
35	Residential (Village)	0.25	0.25	100%		135	Rural (Prime/Flooding)	2.43	0.34	14%
36	Rural	22.21	1.17	5%		136	Rural (Prime/Flooding)	2.02	2.02	100%
37	Rural (Prime/Flooding)	0.19	0.19	100%		137	Rural (Prime/Flooding)	4.28	0.07	2%
38	Rural (Prime/Flooding)	0.08	0.08	100%		138	Rural (Prime/Flooding)	3.78	3.78	100%
39	Rural	0.36	0.36	100%		139	Rural (Prime/Flooding)	1.64	1.64	100%
40	Rural	12.83	1.37	11%		140	Rural (Prime/Flooding)	2.79	2.72	98%
41	Rural (Prime/Flooding)	9.32	1.30	14%		141	Rural (Prime/Flooding)	8.38	1.17	14%
42	Rural (Prime/Flooding)	0.49	0.02	4%		142	Rural (Prime/Flooding)	0.60	0.60	100%
43	Rural (Prime/Flooding)	4.82	1.65	34%		143	Rural (Prime/Flooding)	11.71	1.00	9%

Ref No	Current land use[1]	Total area (ha)	Area within corridor[1] (ha)	% of total property affected[2]		Ref No	Current land use[1]	Total area (ha)	Area within corridor[2] (ha)	% of total property affected[1]
44	Rural (Prime/Flooding)	0.46	0.46	100%		144	Rural (Prime/Flooding)	1.91	0.33	17%
45	Rural (Prime/Flooding)	0.01	0.01	100%		145	Rural (Prime/Flooding)	2.20	0.72	33%
46	Rural (Prime/Flooding)	6.47	1.05	16%		146	Rural (Prime/Flooding)	6.97	4.25	61%
47	Rural (Prime/Flooding)	6.04	0.72	12%		147	Rural (Prime/Flooding)	1.34	1.34	100%
48	Rural	4.33	2.42	56%		148	Rural (Prime/Flooding)	48.65	4.55	9%
49	Rural	11.86	1.60	13%		149	Rural (Prime/Flooding)	7.99	7.98	100%
50	Rural	1.10	0.38	34%		150	NA	0.33	0.13	39%
51	Rural	4.20	4.20	100%		151	Rural - Secondary agriculture	188.03	15.05	8%
52	Rural	0.16	0.16	100%		152	Rural - Secondary agriculture	31.08	1.32	4%
53	Rural	16.33	5.46	33%		153	NA	1.62	1.62	100%
54	Rural	20.01	2.92	15%		154	Rural - Secondary agriculture	7.51	1.85	25%
55	Rural	13.29	2.35	18%		155	Rural - Forestry	0.53	0.53	100%
56	Rural	14.06	3.89	28%		156	Rural - Secondary agriculture	47.39	7.06	15%
57	Rural	13.03	0.11	1%		157	Rural - Forestry	12.82	3.90	30%
58	Rural (Prime/Flooding)	0.80	0.80	100%		158	Rural - Forestry	77.20	0.09	0%
59	Rural (Prime/Flooding)	55.96	0.75	1%		159	Rural - Forestry	1133.76	49.05	4%
60	Rural (Prime/Flooding)	21.19	6.93	33%		160	Rural - Forestry	8.18	0.06	1%
61	Rural (Prime/Flooding)	17.34	6.15	35%		161	Rural - Forestry	137.10	6.96	5%
62	Rural (Prime/Flooding)	0.53	0.20	38%		162	Rural - Secondary agriculture	13.74	3.87	28%
63	Rural (Prime/Flooding)	0.03	0.02	73%		163	Rural - Secondary agriculture	1.12	0.21	19%
64	Rural (Prime/Flooding)	0.03	0.03	100%		164	Rural - Secondary agriculture	16.37	0.85	5%
65	Rural (Prime/Flooding)	0.09	0.08	100%		165	Rural - Secondary agriculture	16.17	2.86	18%
66	Rural (Prime/Flooding)	0.22	0.22	100%		166	Rural - Secondary agriculture	16.57	3.44	21%

Ref No	Current land use[1]	Total area (ha)	Area within corridor[1] (ha)	% of total property affected[2]		Ref No	Current land use[1]	Total area (ha)	Area within corridor[2] (ha)	% of total property affected[1]
67	Rural (Prime/Flooding)	0.40	0.09	22%		167	Rural - Secondary agriculture	24.26	6.82	28%
68	Rural (Prime/Flooding)	0.08	0.08	100%		168	Rural - Secondary agriculture	23.47	1.63	7%
69	Rural (Prime/Flooding)	0.22	0.22	100%		169	Rural - Secondary agriculture	1.83	0.46	25%
70	Rural (Prime/Flooding)	0.17	0.04	22%		170	Rural - Secondary agriculture	0.79	0.31	40%
71	Rural (Prime/Flooding)	0.23	0.23	100%		171	Rural - Secondary agriculture	9.60	9.59	100%
72	Rural (Prime/Flooding)	1.92	0.32	16%		172	Rural - Small holdings	0.40	0.40	100%
73	Rural (Prime/Flooding)	19.75	4.40	22%		173	Rural - Small holdings	0.03	0.03	100%
74	Rural	10.24	3.80	37%		174	Rural - Small holdings	0.29	0.29	100%
75	Rural	2.10	0.20	10%		175	Rural - Small holdings	6.45	2.51	39%
76	Rural	0.99	0.17	17%		176	Rural - Small holdings	21.71	20.49	94%
77	Rural	1.03	0.91	88%		177	Rural - Small holdings	10.27	0.59	6%
78	Rural	1.06	1.06	100%		178	Rural - Small holdings	64.95	13.19	20%
79	Rural	0.40	0.40	100%		179	Rural - Small holdings	20.29	4.34	21%
80	Rural	2.47	2.09	84%		180	Rural - Small holdings	21.16	5.50	26%
81	Rural	11.90	1.59	13%		181	Rural - Small holdings	2.09	0.76	37%
82	Rural	2.13	1.66	78%		182	Rural - Small holdings	16.41	1.97	12%
83	Rural	2.06	1.48	72%		183	Rural - Residential	1.39	0.51	37%
84	Rural	10.46	1.24	12%		184	Rural - Residential	15.70	2.64	17%
85	Rural	10.11	1.70	17%		185	Rural - Residential	0.41	0.41	100%
86	Rural	10.11	2.04	20%		186	Rural - Residential	2.07	1.33	64%
87	Rural	10.61	1.19	11%		187	Rural - Residential	0.60	0.45	74%
88	Rural	1.56	0.86	55%		188	Rural - Residential	0.60	0.02	4%

Ref No	Current land use[1]	Total area (ha)	Area within corridor[1] (ha)	% of total property affected[2]		Ref No	Current land use[1]	Total area (ha)	Area within corridor[2] (ha)	% of total property affected[1]
89	Rural	2.07	0.89	43%		189	Rural - Residential	3.33	1.81	54%
90	Rural	2.00	2.00	100%		190	Rural - Residential	0.59	0.30	50%
91	Rural	2.00	0.11	6%		191	Industrial	2.06	0.23	11%
92	Rural	1.43	0.92	65%		192	Environmental protection - Special emphasis	40.77	9.82	24%
93	Rural	4.07	1.61	39%		193	Environmental protection - Special emphasis	3.68	0.32	9%
94	Rural	6.94	2.42	35%		194	Environmental protection - Special emphasis	4.39	0.87	20%
95	Rural	61.37	4.61	8%		195	Environmental protection - Special emphasis	2.89	0.13	5%
96	Rural	13.34	4.85	36%		196	Environmental protection - Special emphasis	47.81	3.10	6%
97		13.95	6.97	50%		197	Rural - Small holdings	13.20	12.32	93%
98		20.11	0.93	5%		198	Residential - Village Area	1.46	1.46	100%
99		39.89	5.84	15%						
100		16.08	2.48	15%		Total		3516.09	450.95	

[1]Information obtained from Nambucca and Bellingen Shire Councils' land use data.

[2] Area calculation and potential land requirements are indicative only and subject to further refinement following the detailed design

.

The maintenance of contiguity between existing and planned settlements and activity clusters, for example the Macksville central business district and its surrounds, has influenced the development and design of the Proposal. The existing Pacific Highway, which connects current townships and urban centres in the region, would be maintained to provide connectivity between existing settlements. Planned settlements in the area have been focused on the infill and expansion of existing activity clusters, which include development and services which are generally grouped in one geographical area. These future areas would be serviced by the existing Pacific Highway and, regionally, by the Proposal.

The location of interchanges along the Proposal have been planned to support local and regional contiguity between activity clusters. The proposed future growth areas to the south and south-west of Macksville would be serviced by the interchange at Bald Hill Road, which would link to the existing Pacific Highway to provide access to the main township and the Macksville and Congarinni future urban areas. The Nambucca Heads interchange would provide direct access to the proposed Boggy Creek future urban release area and employment lands to the north-west of Nambucca Heads. This interchange would also be important for ensuring that this area maintains its connection to the main township of Nambucca Heads. The interchange at Ballards Road and the upgraded existing Waterfall Way interchange would provide regional connectivity to and from the Urunga township and service the growing areas of Valla Beach, and south of Urunga.

11.3.3 Land sterilisation and severance

The Proposal has been designed to minimise the potential for sterilisation and severance of land as far as possible, by either closely following property boundaries or providing a means of access between separated portions of land. For example, at Warrell Creek the Proposal generally traverses along the boundaries of existing properties south of Rosewood Road to minimise severance and land sterilisation.

Farm access underpasses may be provided, where possible, to allow stock, machinery and farm vehicles to pass underneath the Proposal.

The extent of sterilisation and severance impacts would be confirmed during detailed design. The RTA would consult with all directly affected land holders on how to best minimise the impact on the function and amenity of their land use arising from any land sterilisation or severance. Consideration would be given to acquiring any sterilised or severed sections of land, in accordance with the RTA's Land Acquisition Policy Statement.

11.3.4 Access

11.3.4.1 Private property

The Proposal would result in both temporary and permanent changes to property access arrangements. If required, temporary access during construction or permanent alternative access to private properties would be provided in consultation with the affected land owners.

11.3.4.2 Local Access

The potential impact of the Proposal on the local road network has been an important consideration in the development of the concept design. The local access strategy for the Proposal is described in Chapter 6 – *Description of the Proposal*.

In addition, the existing Pacific Highway, which connects current townships and urban centres in the region, would be retained for local access. Where necessary, local access roads would be constructed next to the Proposal to accommodate local traffic and provide individual property access.

The reduced number of road and access connections to the Proposal may result in some instances in longer travel distances to and from some properties The Proposal is "controlled access" motorway standard. Access to the Proposal is generally only provided at the interchanges. The rationalisation of access points would result in improved safety conditions along the highway and safer east-west connections across the highway. Access across the Proposal would be provided at strategic locations via overpasses and underpasses. The locations of the overpasses and underpasses are described in Section 6.4.3.

11.3.4.3 Pedestrian and cycleway opportunities

The Proposal would allow for pedestrians and cyclists to use the existing highway under much lower traffic conditions than currently experienced, providing a safer walking or cycling environment.

The Proposal provides footpaths on the Mattick Road, Nambucca Heads interchange and East West Road overbridges. The provision of footpaths at these locations would allow pedestrians to safely walk over the new highway.

11.3.5 Planned development (including the *Mid North Coast Regional Strategy*)

Land use change in the vicinity of the Proposal is subject to strategic planning initiatives and statutory controls prepared by Bellingen and Nambucca Shire Councils, the Department of Planning and other agencies. The Proposal would provide vital transport infrastructure which supports local and regional economic development in the future and has been developed with consideration given to existing strategic planning documents.

Table 11-3 details the response of the Proposal to the aims of the Mid North Coast Regional Strategy. In addition, the following documents are considered further below:

- *Mid North Coast Regional Farmland Mapping Project 2009*.
- *Bellingen Shire Growth Management Strategy 2007*.
- *Nambucca Shire Draft 20-Year Structure Plan 2008*.

Table 11-3 Response of Proposal to the *Mid North Coast Regional Strategy*

Relevant Aims	Response
Protect high value environments including significant coastal lakes, aquifers, threatened species, vegetation communities and habitat corridors by ensuring the new urban development avoids these important areas and their catchments.	Considerable planning has been undertaken in the development of the Proposal to protect high value environments, as detailed in Chapter 10 – *Flora and Fauna.* While native vegetation, including a small percentage of wetland and mangroves would be lost as a result of the Proposal, the majority of vegetation to be removed is located within state forests and private properties within Section 4 of the Proposal. Habitat compensation and rehabilitation measures would mitigate anticipated habitat fragmentation and wildlife corridor impacts. As detailed in Chapter 13 – *Visual amenity and design*, the Proposal has been designed to enhance motorists experience of areas of high scenic quality, such as the bridge over the Nambucca River.
Protect the coast and the character of coastal villages by limiting growth to the agreed growth areas of towns and villages leaving greenbelts between settlements.	
Limit development in places constrained by coastal processes, flooding, wetlands, important primary industry land and landscapes of high scenic and conservation value.	
Encourage the growth and redevelopment of the Regions' four major regional centres and six major towns as a means of protecting sensitive coastal and natural environments and strengthening the economic and administrative functions of these centres as well as meeting increased housing density targets.	The main future growth areas identified by the Department of Planning, in consultation with Nambucca and Bellingen Shire Councils, are located around the current town centres of Macksville, Nambucca Heads, Scotts Head and Urunga, with minor proposed development to occur at Raleigh, Warrell Creek and Donnellyville. The Proposal would facilitate access to these growing communities and also between regional and major town centres. The Proposal facilitates access to existing and future planned industrial areas through the location of interchanges (e.g. Boggy Creek and the proposed Nambucca Heads Interchange).
Direct new rural residential development to areas close to existing settlements away from the coast.	
Cater for a minimum housing demand of 59,600 new dwellings by 2031 to accommodate the forecast population increase of 94,000 and any anticipated growth beyond this figure arising from increased development pressures in the Region.	
Ensure an adequate supply of land exists to support economic growth and the capacity for an additional 48,500 jobs in the Region by protecting existing commercial and employment areas and securing sufficient land to support new employment opportunities.	
Protect the cultural and Aboriginal heritage values and visual character of rural and coastal towns and villages and surrounding landscapes.	As detailed in Chapter 15 – *Aboriginal heritage*, subsurface testing of PAD sites has been undertaken providing substantial information regarding the sensitivity of the PADs identified and has provided opportunities to refine the route or develop suitable mitigation measures. As detailed in Chapter 13 – *Visual amenity and design*, the Proposal has been designed to generally be consistent with the existing landscape character areas and these would remain unchanged as a result of the Proposal.

The Bellingen Shire Growth Management Strategy recognises that much of the traffic through the area relies heavily on the Pacific Highway (and New England Highway to the west) and substantial road upgrading works will be required to achieve an acceptable road standard. Bellingen Shire Council has recognised that the Proposal would minimise the traffic constraint on the land to the south of the existing residential zone at Urunga.

Access to the two areas identified within the Nambucca Shire Council 20 Year Structure Plan as future urban areas (in the vicinity of Boggy Creek and Valla Beach and the Macksville and Congarinni Future Urban Areas) have been considered in the location of proposed interchanges.

The Bellingen Shire Growth Management Strategy also acknowledges the need for the future development of pedestrian and bicycle facilities. This goal would be supported by the Proposal as the existing Pacific Highway would be retained for local access. Overbridges and underpasses have also been incorporated into the Proposal at key locations to maintain access across the new highway. Bellingen Shire Council could have greater scope to provide these facilities on the existing highway with the expected diversion of the majority of through-traffic onto the Proposal.

11.3.6 Agriculture

The Mid North Coast Farmland Mapping Project (Department of Planning 2009) identifies 'regionally significant farmland' on the Mid North Coast. Regionally significant farmland refers to land that is capable of sustained use for agricultural production with a reasonable level of inputs and which has the potential to contribute substantially to the regional economy. The Mid North Coast Regional Strategy aims to ensure that high quality farmland or regionally significant farmland within the region are protected from settlement encroachment as these areas in the past have been lost to urban or rural residential development and future population growth is likely to create more pressure on farmland.

Based on the road boundary of the Proposal, it has been estimated that approximately 134 hectares of regionally significant farmland would be directly affected by the Proposal. This is based on clearing an area of up to 10 metres from the edge of the construction footprint. The regionally significant farmland affected by the Proposal is primarily located within the Nambucca River floodplain (see Figure 11-4).

Although several large agricultural operations and important areas of fertile land and high country would be affected by the Proposal, the viability and operational capacity of agricultural businesses would generally not be detrimentally affected as only 0.06 per cent of regionally significant farmland as mapped by the Mid North Coast Farmland Mapping Project would be affected by the Proposal.

Land use mapping obtained from the Nambucca Shire Council indicates that approximately 109 ha and 114 ha of land classified as 'rural' and 'rural (prime/flooding)' respectively would be directly impacted. Land use mapping obtained from the Bellingen Shire Council indicates that approximately 62 ha and 55 ha of land classified as 'rural-small holdings' and 'rural-secondary agriculture' respectively would be directly impacted. These areas include land mapped as regionally significant farmland. Other issues for agricultural land uses affected by the Proposal include:

- Maintaining good quality pasture for grazing (including retention of water supply).
- Access to high ground for stock refuge during flood events.
- Retention of shade trees for stock.

Consultation has occurred with affected property owners involved in agricultural activities to identify the above issues on a farm operation basis rather than on a property basis. The concept design has considered these issues and been refined in areas to retain critical water supply dams and livestock shade trees. Consultation with affected property owners would continue through detailed design.

11.3.7 Forestry

11.3.7.1 Operations (including potential for fragmentation and sterilisation of resources)

The Proposal would require the acquisition of approximately 145 hectares of state forest land. Table 11-4 and Table 11-5 respectively provide details of state forest land in Nambucca State Forest and the Newry/Little Newry state forests likely to be affected by the Proposal (10 metre buffer).

Table 11-4 Approximate area (and proportion) of the Nambucca State Forest affected by the Proposal

Forestry Management Zone	Total area (hectares)	Area affected[1] (hectares)	Proportion affected[1]
1 (dedicated reserve / special protection)	15.40	0	0%
2 (informal reserve (special management))	158.59	0	0%
3a (informal reserve (harvest exclusions))	220.25	0.56	0.25%
3b (special prescription)	21.35	4.32	20.22%
4 (general management native forest)	957.55	53.42	5.58%
5 (hardwood plantations)	174.13	4.81	2.76%
6 (softwood plantations)	0	0	0%
7 (non forestry use)	35.74	3.11	8.70%
8 (areas for further assessment)	147.34	5.34	3.62%
Total	1,730.34	71.55	4.13%

[1] - Area calculation and proportion are indicative only and subject to further refinement following the detailed design

Table 11-5 Approximate area (and proportion) of the Newry/Little Newry state forests affected by the Proposal

Forestry Management Zone	Total area (hectares)	Area affected[1] (hectares)	Proportion affected[1]
1 (dedicated reserve / special protection)	0	0	0%
2 (informal reserve (special management))	228.60	0	0%
3a (informal reserve (harvest exclusions))	294.28	0	0%
3b (special prescription)	13.19	0.03	0.21%
4 (general management native forest)	2,021.29	51.64	2.55%
5 (hardwood plantations)	1,095.33	4.88	0.45%
6 (softwood plantations)	0	0	0%
7 (non forestry use)	30.78	2.02	6.57%
8 (areas for further assessment)	448.64	115.40	3.43%
Total	4,132.10	73.97	1.79%

[1] - Area calculation and proportion are indicative only and subject to further refinement following the detailed design

The area of Nambucca State Forest affected by the Proposal is approximately 71.5 hectares, which equates to approximately 4.1 per cent of the total area of the forest. The area of Newry and Little Newry state forests affected by the Proposal is approximately 74 hectares, which equates to approximately 1.8 per cent of the total area of those forests.

Forestry Management Zones 3b, 4, 5 and in some cases, Zone 8 are considered to be forest harvesting zones (Managing our forests sustainably: Forest management Zoning in NSW State Forests Operational Circular 99/10 (State Forests 1999)). The total area of forest harvesting zones affected by the Proposal in the Nambucca State Forest and the Newry and Little Newry State Forests is 62.55 hectares (28.6 per cent) and 56.55 hectares (3.2 per cent) respectively.

Based on the proportion of the forest harvesting zones directly affected by the Proposal, it is not anticipated that there would be significant long term impact on timber production activities or the viability of forestry businesses nor would there be fragmentation or sterilisation of forestry resources.

The RTA would, in consultation with Forests NSW, ensure that access to state forest land is available for removal of any harvestable timber within the footprint of the Proposal prior to commencement of construction, or an arrangement could developed where harvest could occur pre-land transfer.

11.3.7.2 Access to State Forests

There has been ongoing development of the design for the Proposal to ensure retention of access arrangements and to minimise the separation and fragmentation of areas of state forest. The design development process resulted in the Proposal design described in Chapter 6 - *Description of the Proposal*. It includes the provision of connections to existing forestry access tracks off Old Coast Road into Nambucca State Forest.

The Proposal would maintain key access arrangements to the state forests for forest management purposes. Specifically, the Proposal provides for continued access at principal haulage routes that service the Nambucca State Forest, and also includes some adjustment to access tracks within the state forest to rationalise access and to improve road safety at the junctions with Old Coast Road and the highway.

Arrangements for future access into the state forests have been discussed with Forests NSW. The Department confirmed that the proposed access designed for the state forests would be suitable. The Proposal would not alter existing access arrangements into the Nambucca and Newry/Little Newry state forests. Access would be via Old Coast Road and off existing connections with the existing highway respectively. As appropriate access has been provided to the state forests, no sterilisation and fragmentation to resources would occur. Access to and within state forest land would also be retained for forestry operations, fire management activities and recreation purposes.

11.3.8 Industrial and commercial

No existing businesses on industrial zoned land would need to be acquired as a result of the Proposal. Based on the road boundary provided in Chapter 6 – *Description of the Proposal*, the Proposal would directly impact upon approximately 5.5 hectares of land which is zoned for industrial uses. This impact is within the Raleigh industrial

area, although this land is not currently used for industrial purposes. The existing Macksville sewage treatment plant, Nambucca Macadamia Nut Farm Pty Ltd (Nambucca Macadamia Nut Farm) and Cockburn's Saw Mill would not be directly impacted by the Proposal. The project team has consulted with the owners of the saw mill on a number of occasions, and has been advised that the forest through which the Proposal passes is not currently used for logging, although it may potentially be used for future logging.

Concern was raised in submissions for the preferred route about the effects on the Nambucca Macadamia Nut Farm. The Nambucca Macadamia Nut Farm is located off Upper Warrell Road to the west of the existing Pacific Highway. Since the Proposal is located to the east of the existing highway at Macksville, the nut farm would not be directly affected by the Proposal. An interchange would be located less than one kilometre from the Nambucca Macadamia Nut Farm property, providing access to a more efficient means of transport than the existing highway, improving access for the ongoing viability of this company, which exports its products internationally.

With the exception of businesses such as service stations, motels and caravan parks, most existing commercial land uses located in the region are not dependent upon highway through-traffic. Although existing motels and caravan parks in the region would most likely experience some decline in direct highway trade as a result of the Proposal, they could also benefit from the associated improvements in amenity, such as reduced traffic and noise impacts.

Potential local employment opportunities are expected to be established in the proposed employment lands identified in the Mid North Coast Regional Strategy at Raleigh, south-west of Macksville and at Boggy Creek. These areas would be adequately serviced through the proposed interchanges at Bald Hill Road, Nambucca Heads and Raleigh.

The Proposal would facilitate improved intra-regional travel to employment areas outside the study area, such as Coffs Harbour and Kempsey. Anecdotal evidence suggests that the opening of the Proposal would mean that areas north of and including Valla Beach and Nambucca Heads could provide attractive commuter suburbs for Coffs Harbour.

The resulting economic and residential development in the region could subsequently lead to the generation of growth in local job creation in sectors such as retail, health, education, housing construction and other services.

11.3.9 Extractive industries (including Nambucca Valley Quarry)

Extractive industries are reliant on access to major arterial roads to access markets and suppliers, and to avoid the need to use local roads and subsequent conflicts with local amenity. They require relatively direct, but controlled access to major arterial roads.

The Nambucca Valley Quarry is located adjacent to the existing highway, directly south of Warrell Creek. This is an operating hard rock quarry for unprocessed construction materials. The project team has held discussions with the quarry operators to determine the future development of the quarry and potential access arrangements to the Proposal that would enable the ongoing efficient operation of the quarry. As a direct result of this consultation, an underpass has been provided to enable quarry trucks to exit the quarry, travel under the Proposal and gain access

to Scotts Head Road. Trucks would then use the existing Scotts Head Road/existing highway intersection to travel north or south along the bypassed sections of highway, or to the Bald Hill Road or Warrell Creek interchanges to access the Proposal. Although the Proposal would bring the edge of the road boundary within 20 metres of the edge of the quarry, the future resources for the quarry would not be affected by the Proposal.

11.3.10 Construction stage impacts

The main land use impacts that may occur during the construction phase of the Proposal would relate to property and local access and the establishment of construction compounds. Some land would be acquired outside the operational road corridor for temporary construction access and ancillary facilities. Preliminary locations for major work sites and ancillary construction facilities are detailed in Chapter 6 – *Description of the Proposal*. It is unlikely that all sites would be used. However, it is necessary to provide flexibility in work site locations for the construction contractor(s). The establishment of these facilities would temporarily affect the land use of the chosen sites, although these impacts would be short term.

Access would be maintained to all private properties during construction. If temporary changes to access were required, these would be provided in consultation with the affected land owners.

11.3.11 Allgomera deviation to Nambucca River

The key areas of land use change in this section of the Proposal are:

- Change from rural and rural residential land use east of the Warrell Creek village area to a road transport corridor with rural and rural residential land uses either side.
- Potential change in the Warrell Creek village and Donnellyville from a village divided by a heavily trafficked two-lane road to a village with better amenity, improved access and the potential to enhance the diversity of business and residential development.
- Change from rural floodplain grazing south of the Nambucca River to a road transport corridor with rural use either side.
- Potential change in the Macksville town centre with the removal of much of the through-traffic and heavy vehicles.

While there would be changes in land use, the predominant land uses are expected to remain unchanged across this section.

Rural and rural residential uses would still continue east of the Warrell Creek village and south of the Nambucca River and the urban areas of Warrell Creek and Macksville would remain consistent, albeit with less through and heavy vehicle traffic.

11.3.12 Nambucca River to North Coast Railway Overbridge

The key areas of land use change in this section of the Proposal are:

- There would be some change in land use where state forest land would change to road corridor. The road corridor through the state forest is adjacent to an existing local road (Old Coast Road).
- Nambucca Shire Council has identified a future urban area in the vicinity of Boggy Creek, between Valla Beach and Nambucca Heads. The proposed interchange located at Boggy Creek Road has been located to provide access to this area.

11.3.13 Nambucca Heads to Ballards Road

The key areas of land use change in this section of the Proposal are:

- The Proposal runs adjacent to the existing highway for the majority of this section. As a result, the land use is not expected to change, apart from the wider road transport corridor.
- Impacts on the Little Newry State Forest would be minimal, as the route passes close to the existing transmission line and existing highway. Impacts on the viability of forestry operations would not be significant.
- North of Little Newry State Forest, the Proposal passes through regionally significant farmland currently used for grazing. There would be impacts on the productive capacity of this land, however this would not be significant at a regional level.
- The Ballards road interchange would have a positive land use impact on Valla Beach and through Urunga. Without it, northbound traffic would continue through Urunga and rejoin the new highway at the Waterfall Way interchange.

11.3.14 Ballards Road to Waterfall Way interchange

The key areas of land use change in this section of the proposal are:

- Change from state forest, rural and rural residential to a road transport corridor.
- Impacts would occur to land zoned for industrial purposes to the east of the existing Raleigh industrial area. However, as this land is already constrained by topography, impacts of the Proposal on industrial development and land use would be minimal.

11.3.15 Summary of potential land use and property impacts

While there would be changes in land use, the predominant land uses are expected to remain unchanged across the length of the Proposal.

The Proposal would result in the total or partial acquisition of 192 properties (approximately 365 ha), 145 hectares of state forest land (including 31.8 per cent of forest harvesting zones) and approximately 134 hectares (0.08 per cent) of regionally significant farmland.

Access arrangements have been designed to ensure that future land uses are not severed. The Proposal would not affect the development of the proposed future residential release areas, and may assist the establishment and ongoing viability of the proposed industrial and employment land areas through improved regional and inter-regional access. Interchange locations have been designed to facilitate access to key future development areas such as the proposed Boggy Creek industrial/commercial area and the residential land release area at Valla Beach. They have also been designed to facilitate access to tourist destinations such as Urunga, Valla Beach, Nambucca Heads and Scotts Head. The existing highway would be maintained as the local network, ensuring the continuation of local access to all areas in the study area.

At a regional level, the Proposal would service an increased number of travellers, workers and freight moving safely to, between and through the Warrell Creek to Urunga areas. This would assist in facilitating growth in the region through improved access to the region's growing communities and centres consistent with the aims of the Mid North Coast Regional Strategy.

11.4 Management of impacts

11.4.1 Proposed management measures

Potential impacts to property and land use have been avoided as far as potential throughout the route options development and refinement of the concept design. Where potential impacts were unable to be avoided, elements have been included in the concept design to minimise the impact. These include:

- Five grade-separated interchanges that have been strategically located along the route to complement the major existing and planned urban land use areas of the study area.
- A local access road network that extends the full length of the Proposal.
- Refinement to local roads where they are crossed by the Proposal so as to maintain the function of the local network in serving land use either side of the route.
- Adjustments to numerous internal property access arrangements where they are directly affected by the Proposal.
- Acquisition of the whole or part of properties affected by the Proposal in accordance with the RTA's *Land Acquisition Policy Statement*.
- Vehicular underpasses as described in Chapter 6 – *Description of the Proposal*.

These elements would be further refined during detailed design, in consultation with relevant property owners.

In addition, the RTA would adopt the following mitigation and management measures relating to land use and property impacts, which have been incorporated into the Appendix D – *Draft Statement of Commitments*:

- Forests NSW would have access to areas of state forest land identified for acquisition by the RTA to remove any harvestable timber within the footprint of the Proposal prior to commencement of construction.

- In consultation with Forests NSW, access to and within state forest land adjacent to the Proposal would be retained for forestry operations, fire management activities and recreation purposes.
- Property access would be maintained for the duration of construction. Temporary access requirements would be assessed in consultation with affected landholders.
- Advance notification would be given to property owners on proposed construction activities in the locality and any altered access arrangements.

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Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

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12. Social and economic

Social and economic issues are identified as key issues in the Director-General's requirements. A detailed social and economic assessment for the Proposal was undertaken and is presented in this chapter.

Director-General's requirements	Where addressed in the EA	
Social and Economic - including but not limited to: ▪ regional economic impacts to the agricultural sector taking into account impacts to regional and State significant farmland as identified in the *Mid North Coast Farmland Mapping Project* (Department of Planning et al. March 2009). ▪ local community socio-economic impacts associated with access, business exposure, land use, property and amenity related changes; ▪ land use viability, property infrastructure (i.e. sheds, water supplies etc), profitability, productivity, sustainability and natural resource values of businesses (including agricultural producers and Forests NSW). ▪ recreational and commercial fishing operations including oyster priority areas including consideration of the *NSW Oyster Industry Sustainable Aquaculture Strategy 2006*.	Section 11.3.6 Section 11.3.7 Section 12.3.1 Section 12.3.2 Section 12.3.2.7	Agriculture Forestry Regional agricultural and forestry impacts Local community social and economic impacts Impacts on recreational and commercial fishing operations including oyster priority areas
Land Use and Property	Chapter 11 Land use and property	
Visual Amenity and Design	Chapter 13 Visual amenity and design	
Noise and Vibration	Chapter 14 Noise and vibration	
Traffic and Transport	Chapter 17 Traffic and transport	

12.1 Assessment approach

An analysis of the social and economic impacts and changes likely to occur as a result of the Proposal has been undertaken in accordance with the methodology established by the then NSW Department of Urban Affairs and Planning's (now the Department of Planning) *Environmental Impact Statement Guidelines* (Department of Urban Affairs and Planning 1995).

A five step assessment process has been used as described below:

- Step 1: Community profiling, including demographic characteristics of the study area and identification of key stakeholders.
- Step 2: Scoping of issues and consultations both pre and post receipt of the Director-General's requirements. This included a structured business survey in the route options development phase.

- Step 3: Identifying the likely social and economic impacts of the Proposal and its alternatives.
- Step 4: Estimating and evaluating the significance of social and economic impacts according to:
  - Extent, significance and timeframe of potential impacts (including uncertainties).
  - Stakeholder group(s) affected (e.g. community, property owners, business, agriculture).
  - Feasibility of successful mitigation measures.
  - Equity implications.
- Step 5 – Considering identified social and economic impacts and opportunities to mitigate negative impacts.

12.2 Existing social and economic environment

12.2.1 Regional context

The Proposal is located in the Mid North Coast region of NSW, where the majority of the community lives in four major regional centres at Grafton, Coffs Harbour, Port Macquarie and Taree. In addition, there are six major towns, Maclean, Woolgoolga, Bellingen, Macksville, Kempsey and Forster-Tuncurry, and a variety of rural and coastal villages.

This region is expected to experience the most significant growth (through internal migration) of any region in NSW. Its population is set to grow from a current population of 333,400 to 424,400 by 2031, an increase of 27 per cent over 25 years (Department of Planning 2006). The average annual growth rate for the region during this period is estimated to be one per cent (Department of Planning 2006).

12.2.2 Local context

The Proposal is located within two local government areas, Nambucca Shire in the south and Bellingen Shire in the north. The townships and villages of Warrell Creek, Macksville, Nambucca Heads, Bellwood, Donnellyville and Valla Beach are located in the Nambucca Shire. The townships of Urunga and Raleigh are located in the Bellingen Shire.

12.2.2.1 Selected demographic characteristics

Nambucca Shire has a population of 17,897 according to the 2006 census (Australian Bureau of Statistics). This is an increase of one per cent from the 2001 census (Australian Bureau of Statistics 2006). More than half of the Shire's population resides in the eastern towns of Nambucca Heads and Macksville.

The median age of persons in Nambucca Shire is 46 and the average household size is 2.3 persons (Australian Bureau of Statistics 2006). The median age of the Nambucca Shire's population is relatively high compared to other Mid North Coast local government areas, the North Coast and NSW as a whole. This is likely to be due to the area being a popular retirement destination. The percentage of people of Indigenous origin is high compared to the State average (5.7 per cent of Nambucca Shire population compared to 2.1 per cent of NSW population in 2006), and the percentage of people from non-English speaking backgrounds is low compared to the rest of NSW.

Bellingen Shire has a population of 12,416 according to the 2006 census (Australian Bureau of Statistics 2006). This is an increase in the population of two per cent from the 2001 census. The median age of persons in Bellingen local government area is also relatively high at 44 and overall, the population is aging with a 2.8 per cent increase in the 55-64 year age group since 2001 (Australian Bureau of Statistics 2006). The average household size is slightly greater than that at Nambucca at 2.4 persons per household and there is also a relatively high indigenous population compared to the NSW average.

There is a trend for Bellingen Shire residents to move away from the Dorrigo plateau towards the valley (i.e. Bellingen) and the seaboard areas (i.e. Urunga), which has been linked to the deregulation of the milk industry and a decline in the timber industry. Forty per cent of the Bellingen Shire's population live in rural areas, with the Dorrigo Mountain forming a natural barrier across the Shire (Bellingen Shire Council 2008).

12.2.2.2 Business activity

Characteristics of the businesses within the study area include:

- Services sector including wholesale / retail trade, finance, business and professional services and health, community and cultural services.
- Primary sector comprising agriculture, aquaculture and fishing, forestry and extractive industries.
- Industry sectors including building, construction, extractive and manufacturing.

Services sector

Nambucca Shire has three major retail centres, Nambucca Heads, Macksville and Bowraville that offer retail space to service the local population and the many tourists that are attracted to the region. Macksville is an important administrative centre that has developed around the historically important primary production sectors of forestry and agriculture/grazing.

In Bellingen Shire, the main commercial areas in proximity to the Proposal are Urunga and Raleigh, including the Raleigh industrial area. Bellingen, to the north-west of the study area, also serves an administrative function for the Bellingen local government area.

The services sector, including retail trade, health and community services, accommodation and food services, and education and training, is the largest employer in the both Bellingen and Nambucca Shires (Bellingen Shire Council 2008 and Nambucca Shire Council 2004). Nambucca Heads and Urunga have expanded from small coastal villages to larger towns, largely as a result of the development of tourism as a significant component of the local economy, and more recently due to domestic migration (such as retirees).

A number of businesses have developed along the existing highway. These businesses comprise mainly accommodation services, motor vehicle services, other recreation services, cafes and restaurants and specialised food retailers.

Primary sector

Agricultural production is a significant feature of land use within the Nambucca Shire, even though the proportion of people employed in the agricultural, forestry, fishing and hunting industries has declined over the past decade. Agricultural pursuits focus around beef cattle, dairying, and a variety of horticulture. A more recent primary sector addition to the study area is macadamia farming which has been successfully developed as a commercial food crop (Nambucca Shire Council 2004).

While employment in the primary service sector is also declining in the Bellingen Shire, there is still a relatively high proportion of people employed in this sector, when compared with NSW. The primary industries in the Bellingen Shire include: dairying, forestry, beef cattle, oyster production, potato growing, organic foods and wine production (Bellingen Shire Council 2008).

Regionally significant farmland as identified in the Mid North Coast Farmland Mapping Project (Department of Planning 2009b) is present in the study area (Figure 11-4). This regionally significant farmland is defined as 'land capable of sustained use for agricultural production with a reasonable level of inputs and which has the potential to contribute substantially to the ongoing productivity and prosperity of a region'. That is, regionally significant farmland representing the best farmland on the Mid North Coast and does not specifically distinguish between 'regional' and 'State' significant farmland. The majority of regionally significant farmland is found to the south of the Nambucca River in Section 1 of the Proposal. There are smaller areas of regionally significant farmland in the vicinity of Deep Creek in Section 3 and the Kalang River in Section 4 of the Proposal.

The regionally significant farmland has been mapped to assist with the protection of the agricultural land resource for the future. It would better enable the region to balance the demand for residential land use and release with the economic need for land capable of food production. The protection of contiguous, rather than fragmented agricultural resources was the primary reason for the mapping, to support agricultural diversity, resilience, economies of scale and freedom from land use conflicts in rural areas.

Forestry has been a key industry in Bellingen Shire for many years and has been identified as one of the emerging industries in Nambucca Shire including on private land and within the Nambucca State Forest (Nambucca Shire Council 2008).

As stated in Chapter 11 – *Land use and property*, state forests have been divided into Forest Management Zones. The total area of forest harvesting zones affected by the Proposal in the Nambucca State Forest and the Newry and Little Newry state forests is 62.55 hectares (28.6 per cent) and 56.55 hectares (3.2 per cent) respectively.

The whole of the Bellinger River, Kalang River and Deep Creek were closed to commercial fishing in May 2002 after these river systems were declared Recreational Fishing Havens (NSW Fisheries 2008).

Finfish and crabs account for most of the commercial production of the Nambucca River. There are currently in excess of 80 commercial fishers who potentially fish the Nambucca River. Methods of commercial fishing permitted within Nambucca River are typical of methods used in other estuaries throughout NSW and include:

- Hauling (general purpose), fish and crab.
- Trapping, mesh netting, hand-lining, dip and scoop net, hand gathering and prawn netting.

Oyster farming of the Sydney Rock oyster (Crassostrea commercialis) occurs within the study area. The main oyster farming activity is centred in the middle and lower reaches of the Nambucca River. The June 2007 records showed there to be 40 leases, the majority of which are located along the main arm of Nambucca River, with priority lease areas clustered to the east of Goat Island, downstream of the Proposal. There are currently 51 oyster leases in the Bellinger and Kalang Rivers (pers comm. Relene Atkinson DPI 25 September 2008).

Industrial sector

Industrial zoned land is present around Nambucca Heads, Macksville and Raleigh as noted and illustrated in Chapter 11 – *Land use and property*. The major industries within the Bellingen and Nambucca Shires are niche manufacturing including vehicle body manufacturing, metal fabrication, lighting equipment manufacture, logistics, warehousing and distribution, food processing and light industry (Bellingen Shire Council 2008 and Nambucca Shire Council 2004). There is also an array of extractive industries and industrial operations located on rural lands that are outside the existing industrial zones including sand/gravel, granite, hard rock, marine pebble and break wall rock.

With the current development of the industrial lands in the south-west of Macksville and the future development of the Boggy Creek industrial area, the Nambucca Shire aims to become a key manufacturing and distribution hub of the Mid North Coast region (Nambucca Shire Council 2008).

12.2.2.3 Tourism

The main tourist attractions of the study area include the beaches, headlands, lakes, flora reserves and surrounding rural countryside. The 'coastal village' atmosphere of Nambucca Heads and other northern beaches settlements such as Valla Beach, Scotts Head and Urunga, combined with a good range of affordable and family accommodation, are also key attractors. Tourism on the Mid North Coast is a highly seasonal market with peaks during school and summer holidays, which results in tourist facilities being intensively used for short periods followed by prolonged periods of much reduced activity.

Tourism NSW (2008) has produced data for the North Coast tourism region, identifying that in the year ending September 2008, the Mid North Coast region had over 3.1 million domestic overnight visitors and another 162,800 international visitors. Domestic visitors spent almost 12.6 million nights in the region.

Regional data indicates that the majority of visitors to the North Coast region are from Sydney or elsewhere in NSW and by far the dominant mode of transport for visitors to the region is private vehicle (90 per cent), with the Pacific Highway being the primary route. A small but growing number of visitors to the region are using air travel, with rail and coach travel remaining relatively minor. The predominant tourist travel to the study area is via vehicular travel on the Pacific Highway.

Tourism is one of the main economic activities in the region and is considered to be one of the "emerging and developing industry sectors" (2005 Nambucca Economic Development Plan). Data from the 2006 Census showed that 8.6 per cent of total employment in the Bellingen Shire and 9.4 per cent in Nambucca Shire were in accommodation, cafes and restaurants.

12.2.3 Community services and facilities

The demographic characteristics of the North Coast indicate there is a relatively high demand for social and community services and facilities, particularly in the Nambucca area. Coffs Harbour, to the north of the investigation area, is one of the largest employment centres on the North Coast, reflecting its rapid growth and tourism focus. In Nambucca and Bellingen Shires, employment is concentrated in tourism, education, health and community services, manufacturing and construction, wholesale and retail trade (SKM 1998). Details of government community services and facilities available within the Nambucca and Bellingen local government areas are provided in council social and community plans. Key features include:

- District hospitals at Dorrigo, Bellingen and Macksville.
- TAFE / TAFE Annexe at Macksville and Bowraville respectively.
- NSW government access centres at Dorrigo and Nambucca Heads.
- Centrelink at Nambucca Heads.
- Roads and Traffic Authority at Nambucca Heads.
- Nambucca and Bellingen Shire Council owned halls, parks, reserves and sporting facilities.

Many more government services and facilities are available at the sub-regional centre of Coffs Harbour to the north. In addition, other community services such as sporting and leisure, educational and religious services are available (RTA 2005d).

12.2.4 Community access and mobility

12.2.4.1 Road access

Currently, the highway carries approximately 11,000 vehicles per day, with almost 20 per cent heavy vehicles. The existing Pacific Highway corridor serves a dual purpose of catering for through traffic, including freight, and providing local and regional access to the towns and villages along its length.

Over the past 25 years, traffic has grown at a rate of 2.3 per cent per year (2007 base year). Upgrades of other sections of highway to the north and south have increased the popularity of the Pacific Highway route between Sydney and Brisbane. Growth in traffic in the study area in the future would be derived from a combination of economic activity, population growth and continued growth in Sydney – Brisbane traffic.

Access to the existing Pacific Highway is currently gained from a series of local and regional roads in the area. Concerns were raised by members of the local communities during community consultation initiatives about road safety in accessing and travelling along the existing Pacific Highway. The key issues raised focused on a

perception that a high proportion of heavy vehicle drivers exhibited aggressive driving behaviour that created anxiety about using the highway. These perceptions have led to some drivers avoiding the use of the highway and taking more circuitous routes to reach their destinations.

12.2.4.2 Public transport

There are limited bus and rail services operating in the study area. These include:

- Three daily Countrylink rail services in each direction between Sydney and Brisbane, stopping at Macksville.
- Long distance coach services (Sydney to Brisbane and Brisbane to Sydney) operated by Greyhound/McCafferty's and Premier Motor Services. In total, there are seven Sydney to Brisbane services run each day via the Pacific Highway (there is also a service via the New England Highway). Each service stops at Macksville (Caltex service station, Pacific Highway), Nambucca Heads tourist information centre (Riverside Drive) and Urunga tourist information centre, Pacific Highway.

One bus company provides regular and school bus services through the study area, in addition to those which provide coach services along the highway. There are five routes servicing Macksville, Nambucca Heads, Urunga and their immediate surrounds.

Lack of adequate public transport remains one of the biggest issues for the Bellingen Shire, as it is for the rural Mid North Coast of NSW (Bellingen Shire Council 2008).

12.2.5 Future development

There are a number of proposed industrial and residential development sites within Nambucca and Bellingen Shire Council areas which would provide employment, housing and facilities for the local population.

Projections released by Nambucca Shire Council in their 20-Year Structure Plan estimate up to 4,000 new dwellings would be required in the Shire by 2026 (Nambucca Shire Council 2008) and accompanying this growth is the generation of 6,000-7,000 new jobs. The 20-Year Structure Plan aims to promote Macksville as the main administrative centre in the Shire and to promote Nambucca Heads as the main tourist town in the valley. The Structure Plan has identified the following areas for future residential and commercial development in close proximity to the Proposal:

- Macksville and Congarinni future urban area.
- Boggy Creek future urban area.
- Valla Beach future urban area.
- These areas are illustrated in Figure 11–1a to Figure 11-1c.

Within the Bellingen Shire, the Bellingen Shire Council Growth Management Strategy 2006-2026 identifies a 49 hectare area of land approximately two kilometres to the east of the Proposal known as the South Urunga investigation area for possible future development.

A number of the people entering the Nambucca and Bellingen Shire may be looking for a quieter, more affordable, coastal ('sea change') or rural ('tree change') lifestyle. A large portion of these 'sea' and 'tree' changers would be of retirement age. However, many more making the move are expected to be in their mid thirties to mid forties with families opting out of the cities to create a better quality of life. With the major employment centre on the Mid North Coast being Coffs Harbour, residential land in the study area has started to develop as feeder suburbs to Coffs Harbour employment areas.

According to Nambucca Shire Council in their 20-Year Structure Plan and the Bellingen Shire Council Growth Management Strategy 2006-2026, the decline in the number of productive small agricultural holdings over the last few decades is expected to continue into the future but forestry, tourism, macadamia nut farming and some extractive industries are expected to remain strong. There is also the possibility that aquaculture activities for prawns and estuary pond farms would expand in future.

12.3 Potential social and economic impacts

The following impact assessment draws on findings from a range of other studies (presented in Working papers 2 – *Visual amenity and design*, 3 – *Noise and vibration* and 6 – *Traffic and transport* (Volume 2) and Chapter 19 – *Other environmental issues*) as inputs into the overall assessment of the potential social and economic impacts of the Proposal. Cultural heritage impacts are described in Chapter 15 – *Aboriginal heritage*. Over six years of feedback obtained through community consultation undertaken by the project team has also been a key input into this social and economic assessment.

12.3.1 Regional agricultural and forestry impacts

12.3.1.1 Agricultural sector

Approximately 134 hectares of regionally significant farmland identified in the Mid North Coast Farmland Mapping Project (Department of Planning 2009b) would be directly affected by the Proposal. The regionally significant farmland affected by the Proposal is primarily located within the Nambucca River floodplain (see Figure 11-4).

Although several large agricultural operations and important areas of fertile land and high country would be affected by the Proposal, it is not expected that the viability and operational capacity of agricultural businesses would be detrimentally affected. Approximately 0.06 per cent of regionally significant farmland would be affected by the Proposal.

Details on how the concept design for the Proposal was developed to minimise agricultural impacts is found in Chapter 11 – *Land use and property*.

12.3.1.2 Forestry sector

As stated in Chapter 11 – *Land use and property*, the key forest resources in the study area are within the Nambucca, Newry and Little Newry State Forests. The Proposal is estimated to result in a reduction of

71.5 hectares (4.1 per cent) of total forest area from Nambucca State Forest and 74 hectares (1.8 per cent) of the total area of Little Newry and Newry State Forests.

Based on consultations with NSW Forests and the small proportion of the forest harvesting zones directly affected by the Proposal, it is not anticipated that there would be any substantial impact on timber production activities or the viability of forestry businesses, nor would there be fragmentation or sterilisation of forestry resources.

12.3.2 Local community socio-economic impacts

12.3.2.1 Access

The potential access issues have been addressed in Chapter 11 – *Land use and property* and Chapter 17 – *Traffic and transport* and a local access road strategy has been incorporated into the concept design for the Proposal, described in Chapter 6 – *Description of the Proposal*.

With any linear infrastructure project, there is the potential to create severance and impede the ability of residents to travel through an area, by the creation of a physical and /or psychological barrier. Connectivity and contiguity would be largely maintained throughout the study area through the various local access arrangements described in Chapter 6 – *Description of the Proposal*. Where access to the existing highway would be altered as a result of the proposed upgrade, new local access roads would provide a connection to the existing highway and then to the Proposal via interchanges.

12.3.2.2 Business exposure

Impacts of the Proposal on the viability, profitability, productivity and sustainability of affected non-agricultural businesses would reflect the change in the physical operating environment (accessibility, visibility and operating amenity) and disruption of patronage (be it from through-traffic on the existing highway, local patronage or whether the town or village is a 'destination' in its own right). These impacts would vary between the construction and operation stages as described below.

Construction stage

As the majority of the Proposal is located away from the existing Pacific Highway and the businesses along it, it is unlikely that construction activities would result in disruption. Access for rural business activities may suffer temporary disruption whilst specific sections are being constructed, particularly in areas of bypass. This may increase travel times to businesses during construction. For these areas, access and passage for farm vehicles and farm animals would be diverted.

A large construction workforce would be required for the duration of the construction period, expected to be around 300 workers and possibly their families which would result in a temporary increase in the population in the area. Accommodation services and goods would be required for these additional numbers which may result in economic benefits for a number of businesses as well as an increased demand on community services.

The material required for the construction of the Proposal would be sourced locally where possible, which would see an increase in demand for local materials. The construction activity would be expected to generate employment opportunities in the local area, especially through subcontractor and material supply.

The Nambucca Valley Quarry, located approximately 150 metres to the east of the existing highway in the Warrell Creek area, is an operating hard rock quarry for unprocessed construction materials, producing some 250,000 tonnes of hard rock per annum for the construction industry. It is the intention of the quarry manager to win material from the western area of the quarry, should the quarry be successful in supplying material for the construction of the Proposal (pers comm. Mid-Coast Quarries 26 November 2008). The intention is for that area to be utilised during the construction period and for blasting operations to then resume to the east of the existing blast area when road operations commence.

Operation stage

Economic impact of bypasses

The operation of a "bypass" would result in both positive and negative impacts depending on the nature and location of the businesses in the area. Those businesses along the existing highway, reliant on passing trade, would be negatively impacted if they are to be bypassed or where direct access to the businesses from the road is removed. Research into the economic impacts of bypasses similar to the Proposal (Garner and Parolin 1996) indicates that direct economic impact is restricted to businesses that are largely dependent on passing trade such as service stations, eateries and food stores. Indirect impacts are seen on other establishments in the retail rather than the wholesale sector. The businesses most affected are those providing inputs to restaurants, eateries and fast food outlets. The main impacts are reduced turnover and employment.

The Karuah Highway Bypass – Economic and Social Impacts – The 1 year report (Rowe and Phibbs 2005) supported the theory that businesses dependent on through-traffic would experience the greatest impact of the Pacific Highway bypassing a town. It concluded that Karuah was highly vulnerable to the economic impacts of the highway bypass because of its small population, the development of businesses focussed on highway traffic and a dispersed, poorly-defined town centre. The bypass of Karuah saw the closure of a number of highway dependent businesses. However, the economic impacts and employment losses were less than expected. The study also found that despite the economic impacts, the majority of Karuah's population viewed the bypass in a positive light due to the improved amenity in the town centre. It should be noted that the town profiles in the study area are very different to that of Karuah. They are larger with more diverse businesses and a latent demand from the local and regional population.

Impact to businesses within the study area

A survey of businesses in the study area was undertaken during the route development phase of the Proposal. Respondents indicated varying dependencies on through-traffic ranging from minimal to almost total dependency. Using employment as an indicator of economic significance, the number of persons directly dependent for employment on highway through-traffic represented only about three per cent of persons employed in the region. Through-traffic related business, therefore, does not represent a major component of the economic base of the

area. However, individual operations that are dependent on highway traffic are likely to experience potential losses to productivity and profitability.

Businesses which could potentially experience reduced patronage through removal of direct access from the highway or as a result of bypassing would be clustered in:

- Warrell Creek/Donnellyville – fruit stall and glass/windscreen repair business in Warrell Creek.
- Macksville – Two service stations on the existing highway in the town centre, food outlets and a hotel.
- Urunga – motels along the existing highway approaching the Urunga urban area, two service stations and a cafe/tourist attraction.
- Bellwood – shopping complex and motels on the existing highway.

Access to these businesses would be available through the existing Pacific Highway which would be retained for local access. The extent of adverse impact due to the change in access would be largely a function of the reliance on through traffic. However, these businesses may benefit from the improved connectivity with the local residences and villages which has the potential to increase patronage from the local community due to the improved amenity and safety of the existing highway.

The Macksville Chamber of Commerce has expressed concern about the potential loss of business and employment for the Caltex service station in Macksville. While it is considered that the service station is likely to continue to be a stopping point for tourist buses and potentially heavy vehicles, it is possible that some through-traffic may elect not to depart the new highway.

New access arrangements to an operational sawmill in Warrell Creek were developed in consultation with the owners to ensure the dimensions of logging trucks had been considered and incorporated into the concept design of the Proposal. Access for timber mill trucks from the mill to the Proposal would be via the Bald Hill road Interchange for northbound vehicles and the Warrell Creek Interchange for southbound trucks.

Valla in particular has a history of mining, since gold was originally discovered there in1878. The Proposal passes adjacent to a known mineral field for gold, antimony, arsenic, bismuth and other metals. However, the Proposal in this location is on the western side of the existing highway while the mining operations are on the eastern side. The Proposal passes through an existing mining exploration lease (No. 6702) owned by Norvale Pty Ltd. Consultation with that company confirmed that it is not considering utilising the location of the Proposal for any potential mining or extractive industry operations. The company's area of interest was further west of the Proposal.

The Nambucca Shire 20-Year Structure Plan indicates that the plan is for more people to be living in medium density housing, with shop-top / mixed use housing within all the commercial centres, where medium density residential development would be permitted around the core of each individual 'walkable neighbourhood'. The retention of the existing Pacific Highway for local access and removal of a large portion of the heavy vehicles from the towns, would assist with development of the walkable neighbourhood which would facilitate the use of these services by the local population rather than passing traffic.

Additional benefits to the local economy can also be expected through the general improvement to the road infrastructure, both within the study area and more broadly, the Pacific Highway Upgrade Program. The Proposal would provide economic growth for the area benefiting both the local and the regional areas through increased freight efficiency, travel times and Level of Service. These would provide flow-on benefits resulting in the reduction in transportation times and costs, providing better access for goods and services to markets as well as opening/strengthening access to inter-regional markets. The expected improvements in traffic flow would improve the fuel efficiency of vehicles and serve to reduce the overall vehicle derived greenhouse gas emissions.

The separation of through and local traffic would also provide greater opportunities for local businesses to adapt to a different environment along the existing highway that would not be dominated by the current levels of light and heavy vehicle traffic. The safer and quieter environment could provide opportunities for businesses that would not have been viable under the current conditions.

12.3.2.3 Community cohesion

Construction stage

It is expected that any adverse effects on community cohesion during construction would likely occur where construction of the Proposal is in close proximity to existing road infrastructure. For example the section of the Proposal between the Nambucca Heads and Ballards Road interchange. This impact would be temporary and transient as the focal point of impact would move as construction progresses along the corridor. It is not anticipated that there would be any long term community cohesion issues arising from the construction phase.

Operation stage

The existing Pacific Highway already forms a physical barrier between some of the community precincts within the study area. The presence of the existing highway, along with other physical and environmental factors, has fundamentally influenced the form and separation of the many urban and rural settlements within the study area. The Proposal would improve community cohesion and amenity in the towns of Macksville and Urunga as the existing highway in these areas would become a local access road and carry predominantly low speed local traffic with a reduced number of heavy vehicles.

Negative community cohesion impacts are closely linked to severance of properties by the Proposal. In these instances, access to neighbouring properties on the other side of the road would be less direct and it may become necessary to drive a greater distance, using the local access network.

Due to the size of some of the properties in the study area, there are a number of agricultural properties that would be severed as a result of the Proposal. The potential for impact on these properties has been considered during the concept design phase and through discussions with individual landowners. Where possible, the Proposal has been designed to traverse as close as possible to existing property boundaries to minimise property severance.

The separate local access road network would also enhance community cohesion in many localities due to the ability of residents to travel by road between these communities without having to engage with the high volume,

faster moving highway traffic. This would be of particular benefit in Urunga, Nambucca Heads and Macksville. Aside from the accessibility benefits of the proposed local access roads, all of the local communities in the study area would have the opportunity for access to the Proposal via the planned interchanges. Grade-separated interchanges are proposed at the following five locations: south of Warrell Creek, at Bald Hill Road south Macksville, at Boggy Creek north of Nambucca Heads, at Ballards Road (south of Urunga) and modifications to the existing Waterfall Way in Raleigh.

The Proposal has been designed in accordance with the Upgrading the Pacific Highway, Upgrading Program beyond 2006: Design Guidelines (RTA 2006), which aim to maintain connectivity. The existing Pacific Highway would thus be maintained for local access, which would include facilities for pedestrians, where necessary, and for use by cyclists. The proposed overbridges as part of the Proposal have also been designed with facilities for cyclists. Connectivity across and onto the Proposal would be maintained during the operation of the Proposal.

12.3.2.4 Amenity effects

Construction stage

Amenity can be regarded as what people hear, see and smell and how that affects their sense of well being. It is measured in terms of visual, noise and air quality impacts and changes in these aspects due to a change in proximity to (in this case) a new road structure and its associated traffic. Amenity effects during the construction stage would include changes to the visual environment, noise, vibration and dust from construction sites, blasting activities, construction compounds and batch plants. These impacts and the measures proposed to manage those impacts are described and addressed in Chapters 6 – *Description of the Proposal*, Chapter 14 – *Noise and vibration* and Chapter 19 – *Other environmental issues*.

Operation stage

The landscape design developed for the Proposal is consistent with the RTA's urban design vision for the Pacific Highway, as discussed in Chapter 13 – *Visual amenity and design*. However, the Proposal would result in permanent changes to the physical landscape and altered views for some residents. Of particular significance are the district views across the floodplains of the Kalang and Nambucca Rivers and significant forested views such as those around Raleigh. The concept design for the bridges in these areas and the interchanges has taken into consideration the potential for visual impacts and the disruption to existing rural or forestry views. Landscaping and planting would be used to minimise the impact of these views and cut batters and embankments would be revegetated to visually integrate the landscape colours and textures.

The predicted traffic noise impacts, including the proposed management measures, are discussed in Chapter 14 – *Noise and vibration*. In areas where the Proposal runs adjacent to the existing highway, the noise effects would not be appreciably different. Depending on the location, there may be a slight reduction in noise levels however, some properties would experience either no change or a slight increase. The Proposal incorporates a range of noise management measures such as low noise pavement and in some locations noise walls or property treatments to meet the appropriate noise level criteria.

The general amenity of the residential environments through Warrell Creek, Macksville, Bellwood and Urunga would improve as the Proposal would remove a majority of through-traffic, including heavy vehicles, from the existing highway. The decrease in traffic numbers would result in a reduction in traffic noise, vibration, air emissions and traffic conflicts as the existing highway reverts to a local road function.

There is potential for changes to business type and orientation in these areas as a result of the changes to amenity associated with the removal of much of the through-traffic. Service, retail and restaurant industries have spread away from the existing highway in Macksville as a result of the amenity impacts of the existing highway. Opportunities would arise to reactivate the area south of the existing Macksville Bridge and integrate with the riverside environments available directly east and west of the existing highway.

Accommodation businesses in Bellwood that have experienced noise impacts from the existing highway would have the opportunity to reactivate the river frontage area along the highway. This area has the potential to attract businesses that could take advantage of the riverside setting and views.

Accommodation businesses on the existing highway in Urunga would need to adapt to less business from through-traffic but changes to amenity and reductions in noise are likely to make these facilities more attractive as destination points rather than holiday and business "rest stops".

12.3.2.5 Land use and property impacts

Construction stage

The impacts of the Proposal on land use and property are addressed in Chapter 11 – *Land use and property.* Access is a significant impact for properties during construction. Whilst there would be changes to the property and road access arrangement during the construction phase of the Proposal, access to these facilities and to private properties would be maintained at all times during construction. The maintenance of land access during construction would be developed as part of the construction traffic management plan.

Operation stage

Potential social impacts of the Proposal associated with land use include implications for the operation of agricultural and rural residential properties, forestry impacts and altered access and mobility between private properties and local / regional community facilities.

In general, the Proposal would not result in a change to the predominant agricultural and rural-residential land uses between Warrell Creek and Urunga (refer Chapter 11 – *Land use and property*). It is expected that potential negative impacts on access to forestry areas for logging would be minimal due to the reinstatement of severed logging tracks.

The alignment of the Proposal was designed with consideration given to existing and planned development, particularly in relation to the *Mid North Coast Regional Strategy*, *Mid North Coast Regional Farmland Mapping Project* and the strategic planning documents of the local Councils. The planned developments in close proximity to the road alignment of the Proposal are the proposed future urban area at Boggy Creek and residential land release

area at Valla Beach. Interchanges have been included in these locations to ensure that access is possible to these areas when they are developed in the future.

The Proposal would assist with achievement of the aims of the *Mid North Coast Regional Strategy* through delivery of a route which has been aligned to avoid high value environments and areas of cultural heritage values. The concept design and mitigation measures proposed have taken into consideration the significance of the surrounding landscapes. Further, the route makes use of existing infrastructure where feasible and has been aligned to minimise impacts and maintain continuity between existing development and the areas which have been identified for potential future urban development.

Consultation has been undertaken by the project team with all directly affected landowners whose land is anticipated to be acquired for the purpose of the Proposal, and landowners living nearby the Proposal. The acquisition negotiation process and determination of compensation is governed by the RTA's *Land Acquisition Policy Statement* and the *Land Acquisition (Just Terms Compensation) Act* 1991 respectively. As a result of these discussions, the project team has developed an understanding of the typical concerns of landowners directly affected by the proposed upgrade in relation to property acquisitions. The socio-economic impacts of property acquisitions expressed by the community are listed as follows with a commentary on the likely impact.

Limited number of properties to choose from in the area

Owing to the low density form of residential accommodation, there are limited numbers of properties within the study area. The expected decline in housing stock would affect the ability of some residents to find a suitable (and similar) alternate property in the area.

Loss of local connections and community cohesion

Loss of connections and community cohesion would be a particular issue for those who relocate outside of the area. It is presently unknown what proportion of those who would have their dwellings acquired would stay within the locale or relocate elsewhere.

Impacts on health and wellbeing owing to the possible upheaval

For many residents within the study area, impacts on health and well-being were associated with the uncertainty of which route would become the preferred option and the potential for it to result in the acquisition of their property. Negative impacts on health and wellbeing could potentially be experienced by those landowners facing property acquisition. The RTA has taken steps to keep land owners informed of the status of the Proposal in order to allay and minimise some of the health and well being impacts of residents fearing property acquisitions and those residents of properties which would actually be acquired. Consultation is further described in Chapter 5 – *Community consultation*.

12.3.2.6 Tourism impacts

Construction stage

No properties associated with tourist operations would be acquired for the Proposal. As such potential effects on tourist activity would be confined to changes in access, reduction in through-traffic patronage, and effects on amenity that may make tourist areas and operations more or less attractive for visitors.

Impacts on tourism during the construction stage could arise due to changed access arrangements to tourist attractions, facilities and services in the study area. Tourist facilities and destinations could also be potentially affected by an increase in dust, construction noise, traffic conflicts and visual impacts associated with construction.

There are significant tracts of natural vegetation and opportunities for bushwalking and ecotourism activities in a number of areas along the Proposal. As such, the disturbance typical of construction activities may disrupt activities such as hiking and bird watching, particularly through vegetated areas within Nambucca, Newry and Little Newry state forests. However, all such construction related impacts would be transient and short term and measures would be implemented as part of the Proposal to avoid or mitigate such effects.

Operation stage

The upgrading of the Pacific Highway is an important infrastructure initiative that also benefits the tourism sector. Businesses along the existing Pacific Highway could also benefit from tourism as this road would be retained for local and tourist traffic. The Proposal would further improve highway safety and travel times and make the region (including the coastal villages and hinterland of the study area) more readily accessible. The importance of car transport for tourists visiting the area is vital for access to and within the study area. The Proposal would improve travel times and road safety between urban areas to the north (such as Coffs Harbour) and to the south (such as Kempsey) and to the scenic coastal areas in between. The Proposal would have the potential to enhance the attractiveness of these areas for day trips to and from local urban centres.

Access to businesses with current direct highway access between Nambucca Heads and Ballards Road would be altered as a result of the Proposal. Access to these businesses and tourist destinations would ultimately be from the local access road network and interchanges. However, it is anticipated that only minor increases in travel time to these locations may occur as a result of the expected lower speed environment of the local access roads. While there may not be a heavy reliance on passing trade from the Pacific Highway, there could still be some loss of business to highway-related business such as motels as a result of traffic bypassing the town. However, as a result of the bypass towns like Nambucca Heads, Macksville and Valla Beach may see an increase in tourism (as a tourist destination) associated with approved amenity (less noise and traffic) that may entice tourists to the towns. Signage would be utilised to promote tourist activities through the area by identifying villages to passing traffic as a place for "stoppers" to get fuel, supplies etc. and for "stayers" for short term accommodation and other services. Signage would also be used to identify tourist locations, facilities and services for visitors visiting the area

12.3.2.7 Impacts on recreational and commercial fishing operations including oyster priority areas

Impacts of the Proposal on recreational and commercial fisheries, including oyster farming, are discussed in Working paper 1 – *Flora and fauna*.

Construction stage

Water quality degradation as a result of the construction process is the biggest threat from the Proposal to the fisheries in the area, either through sediment disturbance within the waterway during construction of in-stream structures, release of sediment into the water from construction works, stockpiles or compounds, or through accidental spillage. The construction environmental management plan would aim to minimise impacts on water quality during the construction period, through the implementation and maintenance of sedimentation basins that capture sediment laden stormwater from exposed construction areas and prevent it from entering water courses as well as temporary erosion and sediment controls. Construction compounds would also be located a safe distance from waterways and appropriate spill mitigation measures would be implemented to prevent possible accidental spillage from entering groundwater.

Access to the fisheries from existing marinas and launch ramps used for recreational purposes would be maintained and no significant impacts are anticipated to fishing operations during the construction period.

The NSW Oyster Industry Sustainable Aquaculture Strategy (DPI 2006) identifies the 'healthy growth' water quality parameters for oysters most likely to be affected by human activity as: suspended solids, pH and toxic elements and substances. Priority oyster aquaculture areas are located in the Nambucca River on and to the east of Goat Island, over one kilometre downstream of the Proposal, and within the Kalang River to the east of the Proposal in the vicinity of Newry Island. The soil and water management sub plan to be implemented during construction would contain specific measures to minimise release of sediment and toxic elements into the water course and to protect the oyster leases particularly during construction of in-stream structures, within the Kalang and Nambucca Rivers. The RTA has worked with the oyster industry on a number of projects. The acid sulphate soil management sub plan would include measures for appropriate management of potential acid sulphate soils to ensure the pH of waters is not adversely affected.

Operation stage

The key rivers to be bridged under the Proposal include Warrell Creek, Nambucca River, Deep Creek and the Kalang River. Consultation has been undertaken with Maritime NSW which identified the necessary vertical and horizontal clearances required on the bridges to ensure that passage of commercial and recreational fishing vessels is not impeded. Existing launch facilities would be retained and local road access would be provided to ensure continued access to the fisheries and oyster leases along the Nambucca River and for recreational and commercial fishing within the rivers and creeks.

Oyster aquaculture ideally requires a stable mean water level that varies with each tide cycle. Salinity also affects the growth of oysters and larval distribution. The design of bridges and drainage structures would retain the pre-construction hydrological conditions and spill control equipment incorporated into the design would be regularly

maintained. As a result, the operation of the Proposal would not adversely affect water flow or salinity and subsequent oyster growth.

Spill control equipment would be incorporated into the design of the Proposal. Surface water drainage may be directed to local waterways, however, rainwater would be passed through water pollution ponds to minimise potential contamination from the Proposal from entering the water. The Proposal would be subject to the RTA's schedule of regular maintenance to reduce the potential for release of contaminated water from the Proposal into the neighbouring watercourses. Under normal operation, no significant impacts on water quality and thus fisheries and oyster priority areas are expected.

12.4 Management of impacts

The sections below do not provide the entire list of management measures that would mitigate socio-economic impacts. Measures indicated below should be read in conjunction with measures including noise wall locations, access arrangements during construction and operation phases and the urban design and landscape strategy, as well as Chapter 7 - *Construction of the Proposal* and Appendix D– *Draft Statement of Commitments*. These management measures would also assist in mitigating socio-economic impacts.

12.4.1 Construction stage

The key measures for the management of potential social and economic impacts of the Proposal during the construction stage are outlined in Table 12-1. This table summarises the relevant social or economic issue, applicable management measures and includes references to other chapters in this environmental assessment which further discuss the measures (where applicable).

Table 12-1 Construction stage management measures

Issue	Management measures
Local business impacts	Retain access to businesses along the existing highway. See also Chapter 6 – *Description of the Proposal.*
Agriculture and forestry	Incorporation of fencing around construction activities to prevent livestock from adjacent properties entering the construction areas. Retention of access to forestry and agricultural areas. See also Chapter 11 – *Land use and property*.
Aquaculture	Inclusion of water quality protection measures, particularly during installation of in-stream structures, as part of the soil and water management sub plan to protect priority aquaculture areas downstream in the Nambucca and Kalang Rivers. See also Chapter 10 – *Flora and fauna* and Chapter 16 – *Water quality and hydrology*.
Regional economy	No specific measures proposed.
Community cohesion	The preparation and implementation of a construction environmental management plan and sub-plans, during the construction phase. See also Chapter 11 – *Land use and property*.

Issue	Management measures
Amenity	Construction batching plants and other ancillary facilities located to minimise impacts on sensitive land uses such as residences and community facilities. Appropriate environmental controls to be implemented to maintain the environmental amenity (e.g. water quality, detention basins, dust mitigation measures, blasting and noise control measures). See also Chapter 6 – *Description of the Proposal.*
Minimise noise and dust impacts	Implementation of appropriate noise and dust management measures during construction. See also Chapter 14 – *Noise and vibration* and Chapter 19 – *Other environmental issues*.
Land use and property	Selection of construction compounds and batching plants located to minimise impacts on sensitive properties. Maintain access to private properties and implement community involvement plan. See also Chapter 5 – *Community Consultation*, Chapter 6 – *Description of the Proposal* and Chapter 7 – *Construction of the Proposal*.
Traffic and access	Implementation of traffic management procedures to manage access during construction to businesses and private properties. See also Chapter 17 – *Traffic and transport.*
Tourism impacts	Implementation of a construction environmental management plan and sub plans including a traffic management plan, the latter to address matters such as temporary access changes and impacts on local businesses and tourism. See also Chapter 17 – *Traffic and transport.*

12.4.2 Operational phase management measures

The impact mitigation and management measures identified in Table 12-2 for the operational phase should be interpreted in conjunction with measures proposed for closely related issues (e.g. land use, traffic, noise / air quality, visual / landscape) as detailed within this environmental assessment. Table 12-2 provides a range of management measures, indicating the issue it would assist in managing as well as (where applicable) relevant chapters in this environmental assessment where additional information on the specific issue is provided.

Table 12-2 Operational stage management measures

Issue	Management measures
Business activity	Provide appropriate signage to make users of the new highway aware of services in villages and townships including Warrell Creek, Macksville, Nambucca Heads and Urunga. Inclusion of interchanges as discussed in Chapter 6 – *Description of the Proposal*.
Aquaculture	Undertake periodic maintenance of surface water drainage systems and permanent sediment basins as part of the RTA's maintenance program. See also Chapter 10 – *Flora and fauna* and *Chapter 16 – Water quality and hydrology*.
Community cohesion and property access	Installation of interchanges and overpasses / underpasses for local roads in order to allow property access. Provision of local access routes across the new highway and to maintain connectivity between severed agricultural properties. See also Chapter 6 –*Description of the Proposal* and *Chapter 11 – Land use and property*.
Amenity effects, including noise impacts on communities	Provision of appropriate noise mitigation measures during the operational phase and the use of low noise pavement, noise barriers and property treatments as required. See also Chapter 14 – *Noise and vibration*.

Issue	Management measures
Visual impacts	Urban design and scenic management of the Proposal to comply with the RTA Pacific Highway Urban Design Framework (to improve the visual sensitivity and scenic quality of the upgrade). See also Chapter 13 – *Visual amenity and design*.
Land use and property impacts	Reinstate land used temporarily for construction compounds or storage sites. Maintain biodiversity offset plantations. See also Chapter 10 – *Flora and fauna*.
Promote villages/towns to tourists	Signage to be used to identify tourist locations, facilities and services for visitors in the area. A further measure to promote villages/town appeal for tourists is to implement planting along the Proposal corridor and local access roads.

12.5 Residual impacts

The construction phase has the potential for significant impacts on transport, access and amenity unless appropriately managed. These impacts would be temporary in nature and managed through the construction environmental management plan. Once constructed, the Proposal would result in both positive and negative socio economic impacts. The local and regional residual benefits and impacts as a result of undertaking the Proposal include:

- Benefits to local businesses which could gain from reduced traffic and improved local access and potential negative impacts for businesses reliant on passing trade.
- Removal of current severance effects of the existing highway through the townships of Warrell Creek, Macksville, Nambucca Heads/Bellwood and Urunga, as a result of removing a portion of traffic from the existing Pacific Highway.
- Potential severance of communities distanced from the existing highway which would be traversed by the Proposal.
- Generally enhanced community interaction and cohesion resulting from a local access road network that facilitates improved access between settlements along and on both sides of the existing highway corridor.
- Improvements in amenity for residences along the existing highway. Adverse amenity impacts for rural residences currently distanced from the existing highway which would be exposed to new transport infrastructure which would introduce noise impacts, changes to access and alterations to the visual environment.
- Improvement in road safety through the provision of a high-standard highway with controlled access points, and the construction of a local access road network to reduce local and through-traffic conflicts.
- Compatibility with future land use and development plans in the study area and provision of high standard traffic infrastructure to support both local and regional road traffic needs well into the future.
- Potential for increased tourism activity due to the improved accessibility and safety for road travel to and within the study area by visitors as well as improved access to destinations to the north and south of the study area.

- Potential negative impact on tourism activity and tourist related businesses as a result of reduced patronage from through-traffic.
- Potential for improved local economic activity due to a combination of the above changes.

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Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

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14. Noise and vibration

Noise and vibration is identified as a key issue in the Director-General's requirements. A detailed noise and vibration assessment for the Proposal was undertaken and is presented in this chapter. This assessment is supported by Working paper 3 – Noise and vibration.

Director-General's requirements	Where addressed in the EA	
Noise and vibration – including but not limited to: ▪ construction noise and vibration including construction traffic noise and blasting impacts;	Section 14.3.4 Section 14.3.4.5 Section 14.5 Section 14.5.1 Section 14.5.3 Section 14.5.4 Section 14.5.5 Section 14.5.6	Construction noise and vibration Blasting Construction assessment Typical construction activities Construction noise from mobile activities Noise and vibration from batch plants, construction compounds and deliveries Construction vibration Blasting
▪ operational road traffic noise impacts including consideration of local meteorological conditions (as relevant) and any secondary noise impacts from proposed noise mitigation measures; and	Section 14.4 Section 14.4.4 Section 14.4.5	Operational noise assessment Meteorological impact assessment Secondary noise impacts
▪ consideration of the following guidelines as relevant: *Environmental Criteria for Road Traffic Noise* (EPA 1999), *Environmental Noise Management Manual* (RTA 2001), *Environmental Noise Control Manual* (EPA 1994) and *Assessing Vibration: A Technical Guideline* (DEC, 2006).	Section 14.1 Section 14.3 Section 14.4 Section 14.6	Assessment approach Assessment criteria Operational noise assessment Identification of appropriate noise mitigation

14.1 Assessment approach

The assessment of noise and vibration has been undertaken in accordance with the following guidelines and standards:

- *Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA 1999).
- *NSW Industrial Noise Policy* (EPA 2000).
- *RTA Environmental Noise Management Manual* (ENMM) (RTA 2001a).
- *Interim Construction Noise Guideline* (ICNG) (DECCW 2009).

- *Assessing Vibration: A Technical Guideline* (DEC 2006).
- *British Standard 7385: Part 2 ""Evaluation and measurement of vibration in buildings"*.
- *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (1990) Australian and New Zealand Environment and Conservation Council (ANZECC).
- *Australian Standard AS2187.2-2006: "Explosives – Storage, Transport and Use"*.

The descriptors used to assess road traffic noise and vibration are those defined by the above guidelines. Definitions of these descriptors can be seen in the above text box. Figure 14-1 provides a schematic of the approach to the noise and vibration assessment.

The noise assessment identified and assessed potential noise impacts for each individual dwelling in the study area, which enabled a more detailed presentation of potential noise impacts. While all the identified receivers within the study area were included in the initial modelling runs, only those receivers that were predicted to exceed the relevant noise criteria were identified for additional assessment of potential noise impacts. From the 2,863 residences in the study area, approximately 1,600 were predicted to require further noise assessment.

Noise descriptor definitions

L_{A10} – the noise level exceeded for 10 per cent of the measurement interval, this is commonly referred to as the average-maximum level;

L_{A90} – the noise level exceeded for 90 per cent of the measurement interval. This is commonly referred to as the background noise level.

L_{Aeq} – the noise level having the same energy as the time varying noise level over the 15 minute interval. For traffic noise this descriptor is classified as LAeq 15 Hr and LAeq 9 Hr for the day and night-time noise levels respectively. This is commonly referred to as the ambient noise level.

L_{Amax} – the maximum noise level measured at a given location over the measurement interval.

RBL – The Rating Background Level (RBL) is the overall single-figure background level, which is the 10th percentile of the LA90 values for each of the day, evening and night-time periods over the whole monitoring period.

14.2 Existing noise environment

Noise monitoring was conducted at eight key representative locations along the existing highway to provide background noise levels, to set appropriate criteria for the noise assessment, and to allow validation of the noise model used to determine existing traffic noise levels at receivers. The monitoring locations were selected to be representative of receivers that would experience a noise impact from the existing highway or from the Proposal. The noise monitoring locations are illustrated in Figure 14-2 and Figure 2-1 in Working paper 3 - *Noise and vibration*.

The noise levels in terms of long term ambient traffic noise are provided in Table 14-1. The time periods are as defined in the NSW ECRTN.

Figure 14-1 Assessment approach of noise and vibration

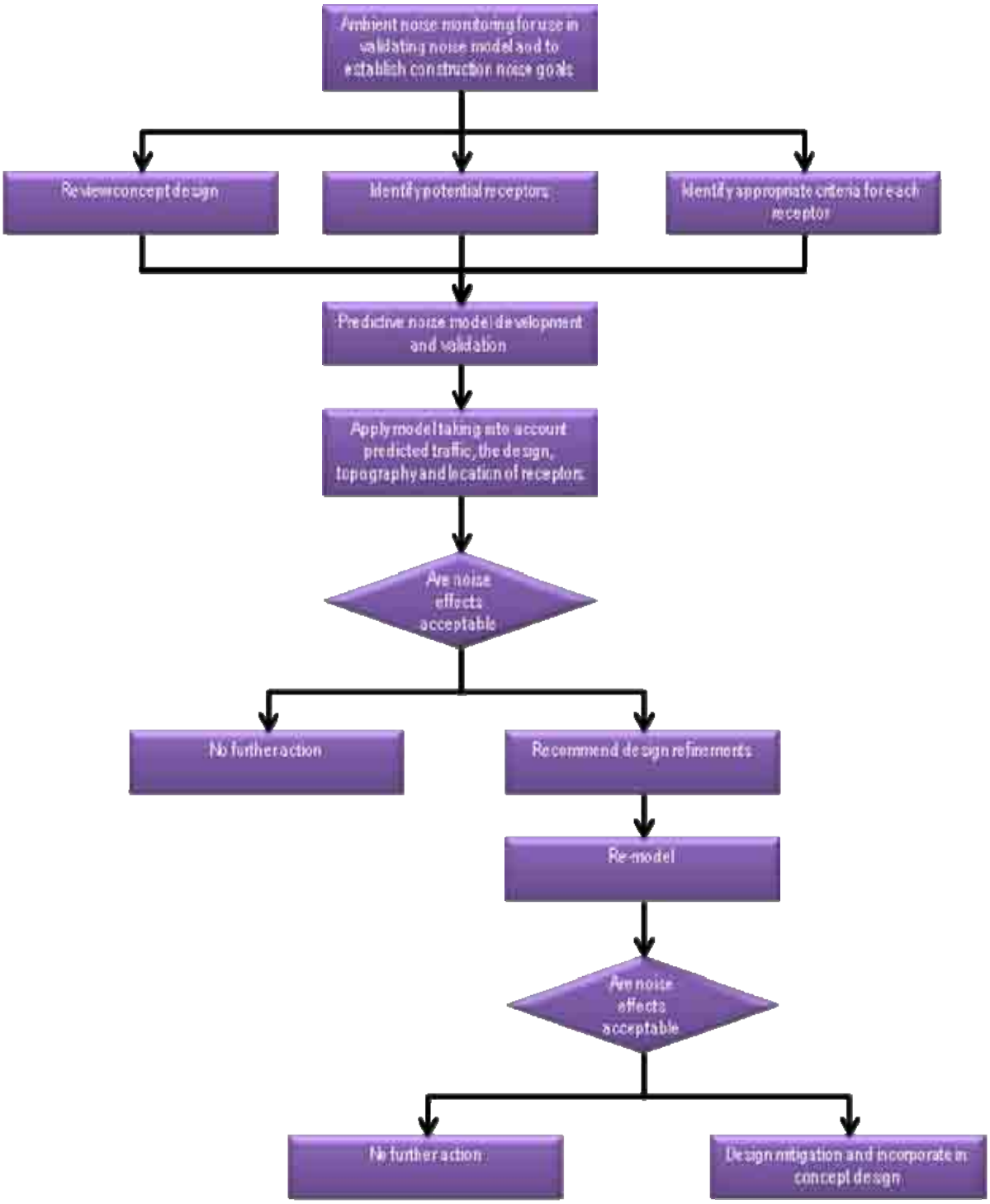


Table 14-1 Ambient noise monitoring results – traffic descriptors (dB(A))

Location	L_{Aeq} 15 hour	L_{Aeq} 9 hour	L_{Amax} Day	L_{Amax} Night
Location1	55	48	66	61
Location 2	59	51	68	62
Location 3	58	56	68	69
Location 4	53	53	65	65
Location 5	52	53	65	65
Location 6	55	57	68	70
Location 7	53	54	69	68
Location 8	46	46	59	54

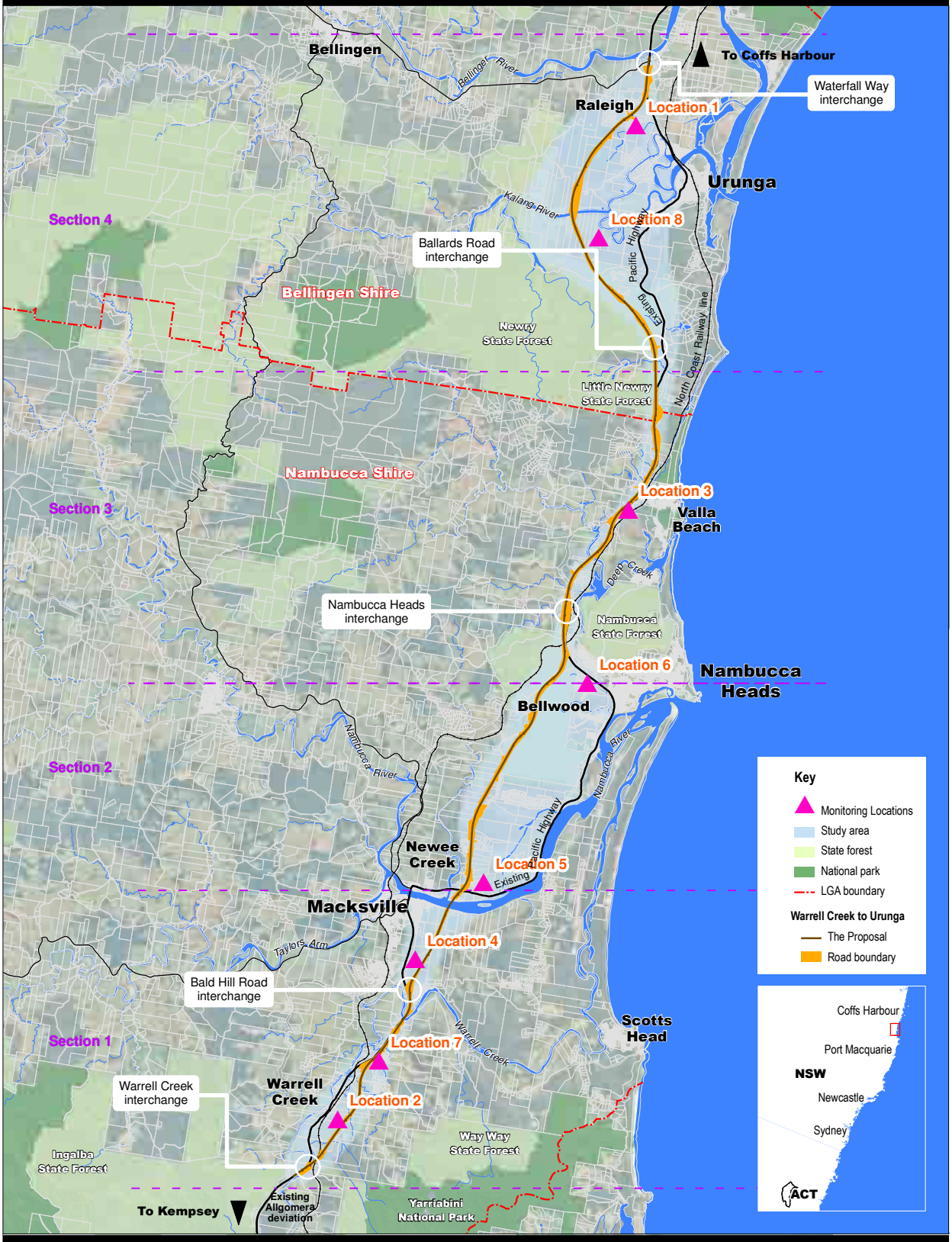
Observations during the site surveys at locations 2, 3, 4, 5, 6 and 7 confirmed that the monitored noise levels were dominated by road traffic noise on the Pacific Highway during the day time periods. It follows that these locations are also likely to have an ambient noise environment dominated by traffic noise during the night-time when other non-traffic noise sources are not present. At locations 1 and 8, the day time traffic noise was audible but did not provide a significant contribution to the noise environment. At these locations, traffic noise levels would tend to become more dominant during the evening and night-time as other non-traffic noise sources diminished in level.

Selected environmental noise parameters for each monitoring location are presented in Table 14-2. These are used for developing appropriate construction noise level criteria as discussed in Section 14.3.4. The maximum noise levels recorded at each site are noted as the L_{Amax} as well as the ambient L_{Aeq} noise level and the rating background level (RBL).

Table 14-2 Ambient noise monitoring results – environmental descriptors (dB(A))

Location	Day			Evening			Night		
	L_{Amax}	L_{Aeq}	RBL	L_{Amax}	L_{Aeq}	RBL	L_{Amax}	L_{Aeq}	RBL
Location 1	67	52	39	65	49	42	57	46	41
Location 2	69	58	42	65	52	41	61	51	40
Location 3	68	58	49	69	58	47	69	56	44
Location 4	64	53	48	65	54	45	65	53	40
Location 5	65	51	41	65	53	38	65	52	34
Location 6	68	53	43	67	56	39	71	56	32
Location 7	70	51	39	68	54	41	68	54	37
Location 8	61	44	37	55	44	41	54	44	40

FIGURE 14-2 | NOISE MONITORING LOCATIONS



14.3 Assessment criteria

14.3.1 Operational noise

Criteria for the assessment of road traffic noise are set out in the NSW Government's Environmental Criteria for Road Traffic Noise (EPA 1999) (ECRTN). The RTA has also published the Environmental Noise Management Manual (RTA 2001a) (ENMM) to assist in implementing the criteria.

Under the ECRTN, road projects are classified as either 'new road' or 'redevelopment of an existing road' (see Table 14-3). The ENMM Practice Note (i) assists in identifying which noise level criteria should apply for new roads and road upgrades. Further details regarding the application of the ENMM can be found in Section 3 of the Working paper 3 - *Noise and vibration*.

Table 14-3: Criteria for operational traffic noise for residents – ECRTN

Road category	Noise level criterion		Where criteria are already exceeded
	Day (7am-10pm)	Night (10pm-7am)	
New freeway or arterial road	55dbA (L_{Aeq}, 15 hr)	50dbA (L_{Aeq}, 9 hr)	The new road should be designed so as not to increase existing noise levels by more than 0.5dB.
Redevelopment of an existing freeway or arterial road	60dbA (L_{Aeq}, 15 hr)	55dbA (L_{Aeq}, 9 hr)	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2dB. Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies.

14.3.2 Nambucca Heads rest area

The character of noise from rest areas differs from general traffic noise and requires a different approach to assessment and management. Noise levels generated within the rest area have been assessed in accordance with the Industrial Noise Policy (EPA 2000) (INP). This policy requires that the L_{Aeq} noise level associated with the proposed operation (over a typical 15 minute period at any time) should not exceed the background L_{A90} noise level by more than 5 dB(A). Noise levels measured at Location 3 (see Table 14-2) are representative of the nearest sensitive receiver to the proposed rest area and are estimated to have a similar daily noise profile based on the distance from the road and the location in Section 3 of the Proposal. The background noise during the quietest period (night) at Location 3 is 49 dB(A). Based on the definition of a non intrusive noise impact, the noise goal for the operation of the rest area at the nearest receiver would be an $L_{Aeq\ 15\ min}$ of 54 dB(A).

14.3.3 Maximum noise level assessment – sleep disturbance

The ECRTN provides guidance in assessing the likelihood of sleep disturbance due to traffic noise impacts. The cause of sleep disturbance varies between studies. However, it is largely recognised that the maximum noise level of an event (i.e. vehicle pass-by), the number of occurrences, the duration of the event, and the noticeable

difference in noise between the maximum noise level and the background or ambient noise levels, are key factors. Not all people are affected to the same degree or by the same noise exposure and findings from studies of sleep disturbance measured by an awakening, change in sleep state or after-effects, and reflect the considerable variation in the population's response to noise. For assessment purposes, at locations where the traffic noise is continuous rather than intermittent, the RTA ENMM employs a methodology to assess these impacts based on the emergence of the L_{Amax} over the $L_{Aeq\ (1hr)}$ noise level. Any vehicle pass-bys where the L_{Amax} noise level is 15 dB(A) or more above the $L_{Aeq\ (1hr)}$ noise level is considered to be a maximum noise event.

14.3.4 Construction noise and vibration

The noise and / or vibration impacts which may be encountered by sensitive receivers during the construction stage of the Proposal include the operation of heavy plant and machinery during the road works; bridge works and piling during construction. These activities have the potential to generate both airborne noise impacts and vibration impacts during construction.

14.3.4.1 Construction noise guidelines

The DECCW (2009) has established an Interim Construction Noise Guideline (ICNG) that supersedes any previous guidance on management of construction noise impacts. This Proposal has been assessed in accordance with the ICNG and management of noise impacts has been recommended when guideline noise levels are expected to be exceeded.

This risk of adverse impact of construction noise within a community is determined by the extent of its emergence above the existing background noise level, the duration of the event, and the characteristics of the noise. In view of this, the DECCW has identified two forms of assessment based on the expected duration of the works. For new public infrastructure or major developments, a quantitative assessment is required. For shorter duration works such as maintenance and repair, a qualitative assessment may be satisfactory.

The ICNG recommends standard hours for construction work as summarised in Table 14-4. Although these hours may be varied where necessary to undertake work for safety or accessibility reasons, which may include:

- Delivery of oversized plant or structures;
- Emergency work; and
- Work where the proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Table 14-4 Recommended standard hours for construction work

Work type	Recommended standard hours of work
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

Recommended noise levels for airborne noise at sensitive receivers and advice on how they should be applied are provided in Table 14-5. The RBL described in the table is the overall single-figure background noise level measured in each relevant assessment period (during or outside the approved construction hours).

Table 14-5 Recommended noise management levels (DECCW 2009)

Recommended Standard hours: Monday to Friday 7 am to 6 pm	Noise affected RBL + 10 dB	■ The noise affected level represents the point above which there may be some community reaction to noise. ■ Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. ■ The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
Saturday 8 am to 1 pm No work on Sundays or public holidays	Highly noise affected 75 dB(A)	■ The highly noise affected level represents the point above which there may be strong community reaction to noise. ■ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: ■ 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. ■ 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	■ A strong justification would typically be required for works outside the recommended standard hours. ■ The proponent should apply all feasible and reasonable work practices to meet the noise affected level. ■ Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. ■ For guidance on negotiating agreements see section 7.2.2, ICNG.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence.

-Noise levels may be higher at upper floors of the noise affected residence.

The ICNG states that the noise management level applies at any property boundary that is most exposed to the construction noise, at a height of 1.5 m above ground level. In cases where the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within

30 m of the residence. It is also noted that noise levels may be higher at upper floors of the noise affected residence and therefore should be considered where necessary in an impact assessment.

In addition to the management level provided in Table 14-5, management levels for noise at other sensitive land uses are presented in Table 14-6. These levels are applicable only when the property is being used. Levels indicated as internal are measured in the centre of the occupied room, whilst those marked as external are to be measured inside the affected property, within 50 m of the boundary.

Table 14-6 Construction noise goals – other sensitive land uses

Land use	Management level, LAeq (15 min) – when land is utilised
Class rooms at schools and other educational institutions	Internal noise level – 50 dB(A)
Hospital wards and operating theatres	Internal noise level – 40 dB(A)
Places of worship	Internal noise level –45 dB(A)
Active recreation areas (such as parks and sports grounds or playgrounds)	External noise level – 65 dB(A)
Passive recreation areas (such as outdoor grounds used for teaching, outdoor cafes or restaurants)	External noise level – 60 dB(A)

For the Proposal there are no non-residential sensitive land uses (listed in Table 14-6) currently identified that may be impacted by construction noise. These management levels should however be referred to during the detail design and construction phase to ensure any future changes of land use would be accounted for.

For other land uses such as commercial and industrial premises, there are three categories of noise management levels, measured externally at the most affected occupied point of the premises:

- Industrial premises: external $L_{Aeq(15min)}$ 75 dB(A).
- Offices, retail outlets: external $L_{Aeq(15min)}$ 70 dB(A).
- Other business that may be sensitive to noise: project specific.
  (Internal noise levels from AS2107 *Acoustics – Recommended design sound levels and reverberation times for building interiors* (Standards Australia 2000) may assist.)

The noise goals for residential, other sensitive land uses and industrial/commercial premises would be adopted as project specific criteria for the proposed upgrade.

14.3.4.2 Construction hours

Construction would normally be limited to the following hours:

- Between 6am and 6pm Monday to Friday.
- Between 7am and 4pm Saturday.

There would be no works outside these hours or on Sundays or public holidays except:

a) Works that do not cause construction noise to be audible at any sensitive receivers.

b) For the delivery of materials required outside these hours by the Police or other authorities for safety reasons.

c) Where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.

d) Any other work as agreed through negotiations between the RTA and potentially affected sensitive receivers. Any such agreement must be recorded in writing and a copy kept on site for the duration of the works.

e) Where the work is identified in the CNVMP and approved as part of the CEMP.

f) As agreed by the DECCW.

Local residents and the DECCW must be informed of the timing and duration of work approved under items (d) and (e) at least 48 hours before that work commences.

Construction hours would be addressed in the CNVMP for the Proposal. The CNVMP would be finalised in consultation with the Department of Planning and DECCW.

14.3.4.3 Project-specific construction noise criteria

Based on measured noise levels described in Section 14.2, the project-specific construction noise objectives for each representative monitoring location have been determined and are presented in Table 14-7. Considering the possibility that works would be undertaken outside standard construction hours additional management levels for these times are also included in the construction noise objectives.

Table 14-7 Project-specific construction noise objectives

Location	Setback from existing highway (m)	Standard hours 7am – 6pm M-F 8am – 1pm Sat		Extended hours 6am – 7am M-F 7am – 8am Sat		Extended hours 6pm – 7pm M-F 1pm – 4pm Sat	
		RBL dB(A)	Noise objective	RBL dB(A)	Noise objective	RBL dB(A)	Noise objective
1	620	39	49	42	47	41	46
2	400	42	52	41	46	40	45
3	80	49	59	47	52	44	49
4	250	48	58	45	50	40	45
5	380	41	51	38	43	34	39
6	200	43	53	39	44	32	37
7	160	39	49	41	46	37	42
8	1300	37	47	41	46	40	45

14.3.4.4 Vibration

Assessing Vibration: A Technical Guideline (DECC 2006) was used to assess potential vibration impacts associated with the Proposal. It considers impacts from vibration in terms of effects on building occupants (human comfort).

The Australian Standard AS2187.2-2006 *Explosives – Storage, Transport and Use* (Appendix J) provides guidance for the assessment of structural damage to buildings caused by vibration. This section of the standard is based on the British Standard 7385: Part 2 "*Evaluation and measurement of vibration in buildings*". The Australian Standard should be used as a guide to assess the likelihood of building damage from ground vibration including piling, compaction, construction equipment and road and rail traffic.

For the purpose of this report, vibration can be defined as follows (DECC 2006):

- Continuous – where vibration occurs uninterrupted for a defined period (usually throughout the day-time and/or night-time) and can include sources such as machinery and steady road traffic.
- Impulsive – where vibration occurs as a rapid build up of the vibration energy to a peak followed by a decay that may or may not involve several cycles of vibration (depending on the frequency of the system). It can also consist of a sudden application of several cycles at approximately the same amplitude, provided that the duration is short, typically less than 2 seconds. This may include activities such as occasional dropping of heavy equipment or loading / unloading activities.
- Intermittent – where continuous vibration activities are regularly interrupted, or where impulsive activities recur. This may include activities such as rock hammering, drilling, pile driving and passing heavy vehicles or trains.

The criteria for continuous and impulsive vibration, intermittent vibration impacts and structural damage criteria are provided in Table 14-5, Table 14-6 and Table 14-7 respectively.

Table 14-8 Continuous and impulsive vibration acceleration criteria (m/s^2) 1-80Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous Vibration					
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or Night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or Night-time	0.04	0.029	0.080	0.058
Impulsive Vibration					
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous Vibration					
Offices, schools, educational institutions and places of worship	Day or Night-time	0.64	0.46	1.28	0.92
Workshops	Day or Night-time	0.64	0.46	1.28	0.92

Table 14-9 Intermittent vibration impacts criteria (m/s^2) 1-80Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Critical areas	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Table 14-10 Structural damage criteria

Group	Type of Structure	Peak Component Particle Velocity, mm/s		
		4Hz to 15Hz	15Hz to 40Hz	40Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50		
2	Un-reinforced or light framed structures Residential or light commercial type buildings	15 to 20	20 to 50	50

14.3.4.5 Blasting

Blasting activities produce ground-borne vibration and air blast overpressure, both of which can cause discomfort and, at higher vibration levels, potential damage to property.

The ANZECC Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration have been adopted by the DECCW and establish ground vibration and airblast over-pressure criteria for potentially effected locations.

The blast charge configuration should be selected to ensure that the DECCW goals are not exceeded. Before blasting can commence at a site, critical locations should be identified and appropriate measures taken to limit over

pressure and vibration to acceptable levels. Blasts should be monitored initially at these locations to ensure that predicted over-pressure and vibration levels are not exceeded.

The recommended goals for blasting during the Project are based on the ANZECC guidelines, Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration. These state that: "Blasting should generally only be permitted during the hours of 9:00am to 5:00pm Mondays to Saturday" and that "Blasting should not take place on Sundays or Public Holidays".

Table 14-11 shows the limiting blast over-pressure and ground vibration for the control of blasting impact on residential premises.

Table 14-11 Limiting criteria for the control of blasting impact at residences

Day	Time of Blasting	Blast Over Pressure Level, dB (linear)	Ground Vibration, Peak Particle Velocity, (mm/sec)
Monday to Saturday	9am-5pm	115	5
Sunday, Public Holiday	Anytime	0	0

In addition, any exceedance above an over pressure of 115dB (linear) should be limited to not more than 5% of the total number of blasts. On these infrequent occasions a maximum limit of 120dB (linear) should not be exceeded at any time. Ground vibrations above 5 mm/sec should also be limited to not more than 5% of the total number of blasts. On these infrequent occasions a maximum limit of 10 mm/sec should not be exceeded at any time.

14.4 Operational noise assessment

14.4.1 Modelling results

In consideration of the potential for traffic noise to impact residential dwellings, noise modelling was undertaken to predict the noise level for key milestones. The following scenarios were modelled in accordance with the ENMM:

- Existing conditions. Existing noise levels were calculated and used to test the integrity of the noise models by comparing the predicted levels with measured levels.
- Year 2013 "Future existing". In this scenario, noise levels were calculated for traffic on the existing road network immediately prior to the nominal date of opening for the Proposal.
- Year 2023. Noise levels were calculated for the Proposal 10 years after the anticipated opening date.

Assessment of the year 2023 traffic data provides the expected future noise levels so that mitigation measures designed for this scenario are still valid for at least 10 years after the opening of the Proposal. The initial predictions were made without the inclusion of any noise mitigation measures and were based on the parameters for the modelling inputs in Table 14-12 and the traffic data in Working paper 6 - *Traffic and transport*.

Table 14-12 Summary of modelling inputs

Input variable	Modelled Data
Traffic numbers and mix	Traffic numbers forecast for the years 2013 and 2023. See Section 6 of Working paper 6 - *Traffic and transport*.
Ground topography	Obtained from aerial photogrammetry, two metre increments
Gradient of roadway	Taken from a 3D model of the design alignment
Air and ground absorption	Ground absorption as per SoundPLAN implementation of the CoRTN Algorithm
Height of receivers	1.5 metres above ground terrain
The acoustic properties of the road pavement surfaces	Tyned asphaltic concrete assumed for the whole alignment
Traffic speed	110 km/h throughout the Proposal
Attenuation due to building structures	Building structures have not been included in the noise model due to the rural residential nature of the study area
Facade reflection	+2.5 dB (A)
LA_{10} to LA_{eq} conversion	Generally a reduction of 3 dB (A) from LA_{10} to LA_{eq} but can be site specific.

Of the 2,863 potential receivers modelled, 374 are predicted to experience an exceedance of the noise criterion for the Proposal in the absence of mitigation and management measures (specific details are provided in Tables 4-8 and 4–9 of Working paper 3 - *Noise and vibration*). These receivers, therefore, required further assessment for mitigation and management measures in accordance with ECRTN and ENMM guidelines.

The noise mitigation and management measures which have been included in the design of the Proposal to address these exceedances are described in Sections 14.6 and 14.7.1.

It is important to recognise that the Proposal would have a positive noise effect in some sections of the study area. The benefit to existing receivers would result primarily from the reduction in traffic currently using the existing highway. The reduction in traffic noise expected for the residents adjacent to the existing highway has been based on the change in the amount of traffic numbers. This reduction is estimated to be approximately 7 dB(A) for both the daytime and night-time periods. A reduction of this magnitude is considered to be significant and would, therefore, provide a noticeable change in noise levels at residential locations near the existing highway.

14.4.2 Nambucca Heads rest area

An assessment of the rest area was undertaken to determine the potential for the use to cause an adverse noise impact at a nearby receiver. Where the closest receiver is predicted to be lower than the most stringent of the operational noise criteria, the activities within the rest area would comply with the INP noise guidelines at all locations. Receiver number 801 from the assessment table of Working paper 3 - *Noise and vibration* is the closest residence located approximately 170 metres away from the rest area, on the eastern side of the existing highway. The noise monitoring has been used to identify a Rating Background Level (RBL) for this receiver. The RBL for the

most stringent of the assessment periods, being night-time, is 49 dB(A), which forms the basis of the intrusive noise goals.

The assessment of the rest area has been undertaken against the guideline noise levels from the INP intrusiveness noise goals, which requires that the $L_{Aeq\ 15\ min}$ noise emissions from the Proposal are no more than 5 dB(A) above the RBL. In accordance with the INP, the noise goal for the nearest sensitive receiver would be 54 dB(A) between 10pm and 7am each day, representing the quietest assessment period. The noise levels used to assess the potential for impacts have been identified based on typical activities and their duration and listed in Table 4-12 of Working paper 3 - *Noise and vibration*. The typical $L_{Aeq\ 15\ minute}$ noise level at the nearest receiver is estimated to be 49 dB(A) and, therefore, below the INP noise goals of 54 dB(A) for this location.

During the night-time, when background levels are low and noise emissions from the rest area may be the most noticeable, it is possible for maximum noise levels from the rest area to create sleep disturbance impacts. To assess this potential, the maximum noise level emissions from rest area activities have also been predicted at the nearest receiver. The maximum estimated noise level would likely be associated with the use of exhaust brakes and at the most affected location would be approximately L_{Amax} 57 dB(A). This level is estimated to be below the definition level of a L_{Amax} noise event and would generally result in noise levels inside a dwelling of less than 50 dB(A) for this location.

14.4.3 Maximum noise level assessment

The assessment of maximum noise impacts for the Proposal was undertaken by sampling night-time traffic noise at a representative site along the Pacific Highway (on the existing highway at Waterfall Way). The measurements made at the Waterfall Way interchange, north of Urunga, are expected to be representative of the Proposal having the same traffic profile, pavement surface, a dual lane carriageway in each direction, and flat terrain with no hills or bends.

The predictions of the noise model for maximum noise levels at all locations have been included in the analysis summarised in Section 4.10 of Working paper 3 - *Noise and vibration*. Predicted noise levels inside a dwelling with the windows open for ventilation have been assumed to be 10 dB(A) lower than the external noise level. Where windows are closed, a greater degree of attenuation would be expected. The ECRTN guidelines state that maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions. One or two noise events per night with maximum internal noise levels of 65-70 dB(A) are not likely to significantly affect health and well being. As such, where the predicted maximum levels modelled are greater than or equal to 65 dB(A) (the lower end of the guideline figure has been used) additional acoustic investigations for these properties would be considered during the detailed design phase.

14.4.4 Meteorological impact assessment

The Director General's requirements include consideration of local meteorological conditions (as relevant). It is important to note that when undertaking an assessment of traffic noise impacts, that the incorporation of meteorological data into the CoRTN modelling algorithm is not possible. Furthermore, the results of modelling (if

possible) cannot be compared to any valid criteria, as the assessment of adverse weather conditions are not supported the DECCW ECRTN.

To respond to the Director General's requirements, the assessment team endeavoured to establish the significance of temperature inversions and wind patterns for the study area, in order to quantify the potential for noise impacts from these effects. An investigation of local meteorology was undertaken, however, meteorological stations in the area could not provide the appropriate data for this form of assessment. Nearby weather stations were also reviewed, but either could not supply appropriate data or were not representative of the area being investigated.

Without the relevant historical meteorological data for an area, it is impossible to ascertain the frequency and strength of temperature inversions. In general, inversions may increase noise levels by between 3-5 dB(A) depending on conditions. Although an estimate of impacts may be made to account for potential increases in noise levels, these estimates have no valid basis and may ultimately be an under or over estimate of noise impacts from these weather conditions.

Temperature inversions (increase in temperature with height) arise from the cooling of the land surface which, in turn, cools the near surface air faster than the layers aloft. Temperature inversions can occur any time of the year, but usually at night when the sky is clear and winds are light. Since sound waves travel faster through warmer air, the sound "rays" from a ground based noise source can effectively be reflected back towards the ground thereby adding to the noise levels received directly from the source.

It is expected that where temperature inversions are experienced in an area it would affect residences at distances greater than approximately 100 metres from the road. Due to the nature of the weather conditions during an inversion, it is likely that residences would have windows and doors closed to assist in heat retention during the cooler months, and therefore the effects of the increase in noise levels from an inversion would be negated by the additional attenuation provided to the building by the closed windows and doors.

14.4.5 Secondary noise impacts

Noise mitigation measures including the provision of noise barriers (including mounds or walls) is discussed in Section 14.6. The noise impacts from reflections off noise barriers can have the potential to increase local noise levels in some instances. These increases occur when traffic noise reflects off one noise barrier onto a parallel barrier reinforcing noise levels and thereby reducing the benefit from noise walls. For the Proposal, the proposed locations of noise walls do not have walls on the opposite carriageway. The instances of noise walls on only one side of the carriageway are, therefore, not expected to cause any secondary noise impacts at residential locations.

14.5 Construction assessment

14.5.1 Construction traffic

14.5.1.1 Construction programming and temporary roadworks

The proposed construction works would be programmed to minimise the interaction between the construction works and the local and regional road network. This would minimise disruption to local and through traffic. Construction of the northern and southern interchanges would enable traffic to be switched between the existing highway and the Proposal to facilitate the continual flow of traffic through around the Proposal corridor.

Spoil haulage

As outlined in Section 7.3.4, the proposal is not likely to generate excess spoil as the design seeks to achieve balanced earthworks. If spoil haulage is required, vehicles would use the proposed construction haul roads and the existing road network. Vehicle movements would be relatively small and difficult to detect above normal daily fluctuations in traffic.

Access impacts

Ancillary facilities

Section 7.3.7 details the possible locations of ancillary facilities and environmental and social criteria for selection of preferred sites. The location of ancillary facilities would be near transport facilities for delivery and access reasons and therefore the additional vehicle movements are not likely to present a significant noise or vibration impact on sensitive receivers.

Construction access

Access points at the northern and southern tie-ins would be required to facilitate construction activities. Right-turn lanes and widened shoulders would be provided at the site compound entry, and where construction turning volumes are likely to be high or where adverse geometry exists. All access points would:

- Have safe intersection sight distances.
- Accommodated the turning movements of the largest heavy vehicles.

Local Roads

During construction, some temporary changes to access arrangements may be needed for local roads in and around the Proposal. Temporary changes to access arrangements would consider the turning requirements of school buses and would be finalised during the detailed design.

Properties

Property access would be maintained for the duration of the construction. If required temporary or alternative access would be provided in consultation with the affected landowner(s).

14.5.2 Typical construction activities

This construction noise and vibration assessment has been undertaken based on the assumption that the equipment used to construct the Proposal would be similar to that used on other highway projects. An assessment of the actual construction noise and vibration impacts would require information on the specific equipment used, detailed construction methodology and final locations of construction compounds. At this time, these details have not been determined for the Proposal. Accordingly, an assessment has been undertaken based on typical construction equipment for previous road construction projects.

14.5.3 Construction noise from mobile activities

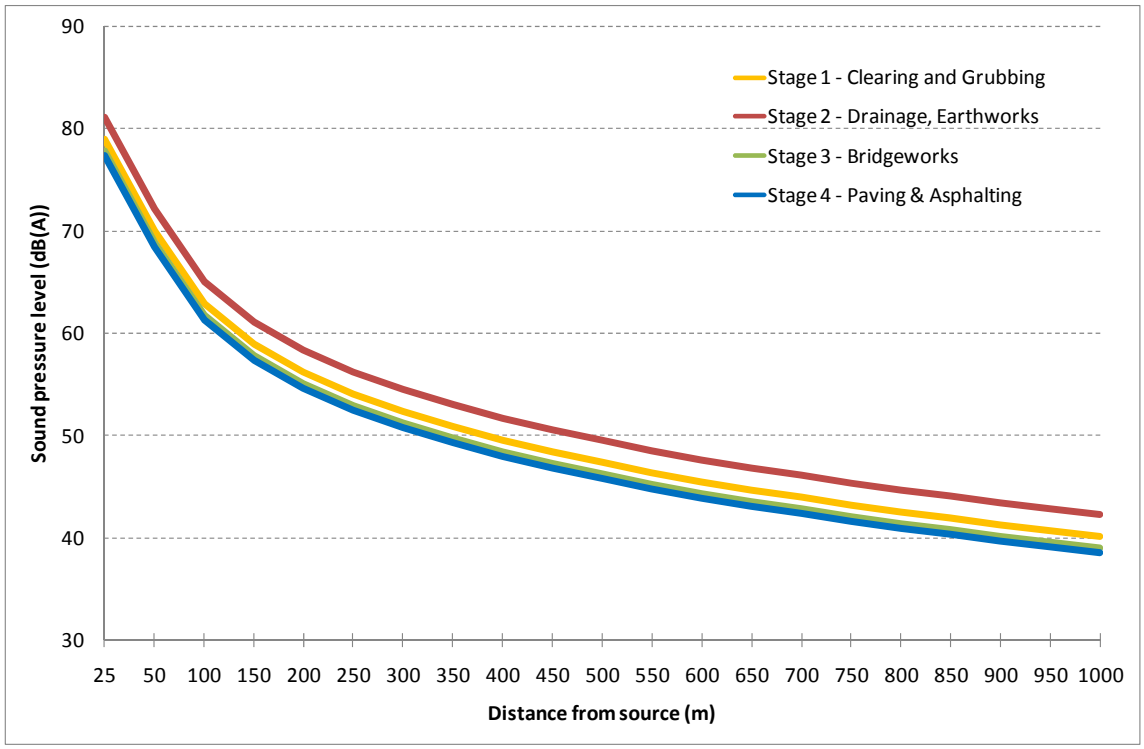
Total sound power levels for various mobile construction activities have been predicted based on the typical construction equipment required for each identified road construction activity and are noted in Table 14-10.

Based on the noise emissions outlined in Table 14-13, a graph of expected noise levels has been generated in Figure 14-3. The graph estimates the resultant sound pressure level for given distances from the construction works. These are indicative levels only, which provide information on the level of noise to be expected where no mitigation is present. Specific noise levels at a noise sensitive receiver would be determined as part of the CNVMP. The CNVMP would include monitoring, noise mitigation and community consultation as a minimum as well as measures to address unforseen significant noise sources.

Table 14-13 Summary of predicted noise levels for typical road construction activities and associated works

Activity	Description	L_{Aeq} Sound Power Level range (dB(A))
Clearing and grubbing	Felling of trees and shrubs as well as removal of man-made structures; removing stumps, roots and general vegetation.	103-114
Earthworks (including drainage)	Bulk earthworks including rock hammering, topsoil stripping, cut and fill (which may include blasting), excavation of culverts and basins, construction of batters and landscaping. Culvert construction, drainage installation, diversion drains to sedimentation basins.	107-114
Bridgeworks	Casting and formwork, piling, concrete pouring, pre-cast element installation and demolition as required.	105-121
Paving and asphalting	Application of road surface pavement to road base slab including batch plants, pouring of concrete base and sub-base, supplication of sprayed bitumen seals; laying of asphalt, saw cutting, finishing open drains and installation of road furniture and medians.	104-111

Figure 14-3 Estimated reduction of construction noise with distance from the source



14.5.4 Noise and vibration from batching plants, construction compounds and deliveries

Noise emissions from batching plants are typically dominated by associated vehicle movements and use of plant and equipment. Predicted noise contours for the batching plants are provided in Section 6.3 of Working paper 3 – Noise and vibration. The modelling indicates that within 250 m of the plant, the L_{Aeq} noise levels noise levels are likely to be approximately 55 dB(A), whilst at 500 m, the noise levels is expected to be approximately 48 dB(A); and at 1000 m, the predicted noise level is 41 dB(A). Specific consideration of noise effects and management measures would be completed during the development of the CNVMP when specific compound sites and activities have been determined by the appointed construction contractor.

The impact of noise and vibration from the establishment and operation of site compounds on nearby sensitive receivers is unlikely to be significant. However, noise and vibration would be considered during siting and commissioning of the compound(s).

During establishment of the site, anticipated activities include clearing and grading and the installation of pre-fabricated portable site offices and a maintenance workshop area. Sources of noise during this time, although typically relatively noisy, are anticipated to be of limited duration. They include mobile machinery (e.g. scrapers, graders compactors and mobile cranes) and stationary plant (e.g. generators, compressors). Vibration sources are not likely to be significant and would be rapidly attenuated with distance.

Operation of the site compounds would be required to support construction activities for the Proposal and the predominant noise source would likely be vehicle movements (e.g. staff transport and delivery of construction materials and consumables). However, these vehicle movements are not likely to present a significant noise or vibration impact on sensitive receivers. The use of hand tools during vehicle maintenance may result in audible noise at sensitive receivers. However, their use would reflect the existing rural land use and would not be a continual noise source. Any noise and vibration generated during the operation of the site compound would be managed under the CNVMP.

14.5.5 Construction vibration

This section provides guidance on the vibration impacts that may be expected from the construction activities associated with the Proposal. Table 14-14 summarises the anticipated level of vibration for the various construction activities. It can be assumed that activities such as compaction and rolling, as well as ripping would be the dominant sources of vibration during the construction of the Proposal.

Table 14-14 Summary of anticipated vibration levels for various construction activities.

Activity	Description	Vibration guidance
Clearing and grubbing	Clearing of vegetation, trunk and root removal, processing of timber waste	In general, the activities carried out during this stage of works generate low levels of vibration and areas close to residences are generally already cleared. Vibration impact is considered unlikely.
Earthworks	Bulldozers ripping	1mm/s to 2mm/s at distances of approximately 5 metres. At distances greater than 20 metres, vibration is usually below 0.2mm/s.
	Compactors	20mm/s at distances of approximately 5 metres, 2mm/s at distances of 15 metres. At distances greater than 30 metres, vibration is usually below 0.3mm/s.
	Vibratory rollers	Up to 1.5mm/s at distances of 25 metres. Higher levels could occur at closer distances, however, no damage would be expected for any building at distances greater than approximately 12 metres (for a medium to heavy roller).
	Truck traffic (on normal smooth road)	0.01mm/s to 0.2mm/s at the footings of buildings located 10m-20 metres from a roadway (note that very large surface irregularities can cause levels up to five to ten times higher).
Bridgeworks	Impact piling	The typical levels of ground vibration from pile driving range from 1 mm/s to 3 mm/s at distances of 25 metres to 50 metres, depending on ground conditions and the energy of the pile driving hammer.
Paving and asphalting	Paver, concrete cutter	None of the construction plant used during paving and asphalting would be major sources of ground vibration.

There is a possibility that annoyance as a result of earthworks or bridgeworks activity may occur for residents within 20 metres and up to 100 metres from road works although only during ripping or use of vibratory rollers or during bridge piling. Beyond 100 metres there is a low probability of annoyance for all activities. Property damage to

nearby residences as a result of these works is unlikely. With respect to annoyance from ramp/bridge construction, there is a possibility of complaints from residents but structural damage is unlikely.

Vibration monitoring would be undertaken during works within 50 metres of residences where vibration may be generated by equipment.

14.5.6 Blasting

Blasting activities produce ground-borne vibration and air blast overpressure, both of which can cause discomfort and at higher vibration levels, potential damage to property. At this stage of the development of the Proposal, data are not available to quantify specific blasting information and seismic details of the study area. Table 14-15 provides general guidance for estimating the likely minimum distance from blasting that may be required to meet over-pressure and vibration criteria described in Section 14.3.5.2 for a range of Maximum Instantaneous Charge (MIC) values.

Table 14-15 Minimum distances to comply with blasting vibration and over-pressure limits for various MIC values

Maximum instantaneous charge (MIC)	Minimum distance Limits (metres)	
	Vibration	Over pressure
5	70	290
10	100	350
20	140	430
50	220	560
100	300	670
200	430	750

The above distances are estimates and should only be referred to for guidance. However, it is evident that the degree of impact is strongly dependent on the size of the blast and that a greater separation distance is required to comply with the over-pressure limit than the vibration limit. In terms of buffer distances, the over-pressure limit is more stringent than the vibration limit and, therefore, would become the limiting blast criterion for the Proposal. As there are a number of cuttings on the Proposal, it is expected that blasting may be required during the earthworks phase. Where blasting is necessary within the minimum buffer distances, additional management strategies would be required and would be detailed within the CNVMP.

14.6 Identification of appropriate noise mitigation

Before including noise barriers/mounds into the Proposal, an assessment was undertaken of the effective use of low noise pavements along the Proposal. The incorporation of low noise pavements was assessed at locations where clusters (groups) of residents would benefit having regard to the predicted noise criterion exceedances outlined in Section 14.4.1. The proposed sections of low noise pavement for the Proposal are shown in Table 14-16, Figure 14-4 a-d and illustrated in Working paper 3 – *Noise and vibration*.

The inclusion of low noise pavements at the locations in Error! Reference source not found. was included in the noise model and the predictions re-assessed for the design year (2022) operational scenario. The results of the remodelled impacts are shown in Table 14-17 along with the reduction of noise level impacts in each range.

After the implementation of low noise pavements, the total number of exceedances is reduced by 53 receivers. However, 220 noise sensitive receivers still remained above the ECRTN criterion for night-time noise levels.

The inclusion of additional mitigation measures as part of the Proposal such as noise walls/mounds and architectural treatments were, therefore, assessed in accordance with Practice note IV of the ENMM. Other considerations include the general cost/benefit guide in Practice note (IV) of the ECRTN.

Modelling of noise barriers concluded that many of the locations along the Proposal precluded the effective use of noise barriers due to topographic effects or large distances between receivers. Topographic constraints occur when a residential receiver is located higher than the road carriageway and therefore looks down on the traffic stream over the top of the barrier. In these instances, noise barriers do not block the line of sight of traffic and the minimum noise reduction of 5 dB(A) required in the design of a noise barrier cannot be achieved.

Table 14-16 Proposed sections of low noise pavement

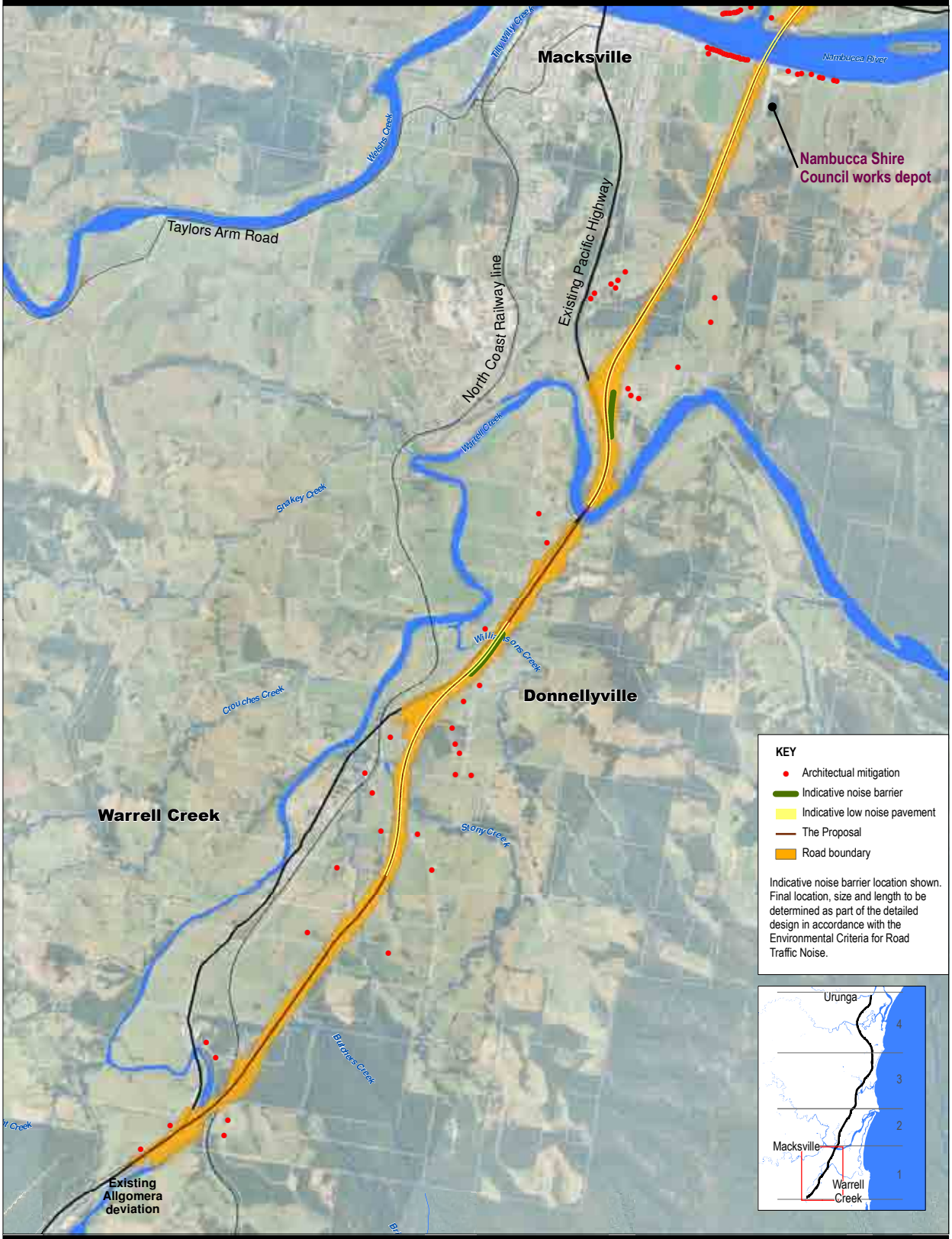
General location	Chainage[1]	Length
Warrell Creek	Ch. 3,100 to Ch. 5,400	2,300 metres
Northern abutment Bridge over Warrell Creek to Old Coast Road	Ch. 6,600 to Ch. 11,750	5,150 metres
North and south of East West Road at Valla Beach	Ch. 25,100 to Ch. 26,800	1,700 metres
Northern end of Proposal – Ridgewood Drive to end of Proposal	Ch. 38,800 to Ch. 41,000	2,200 metres

[1] To be refined during detailed design

Table 14-17 Number of exceedances – low noise pavement

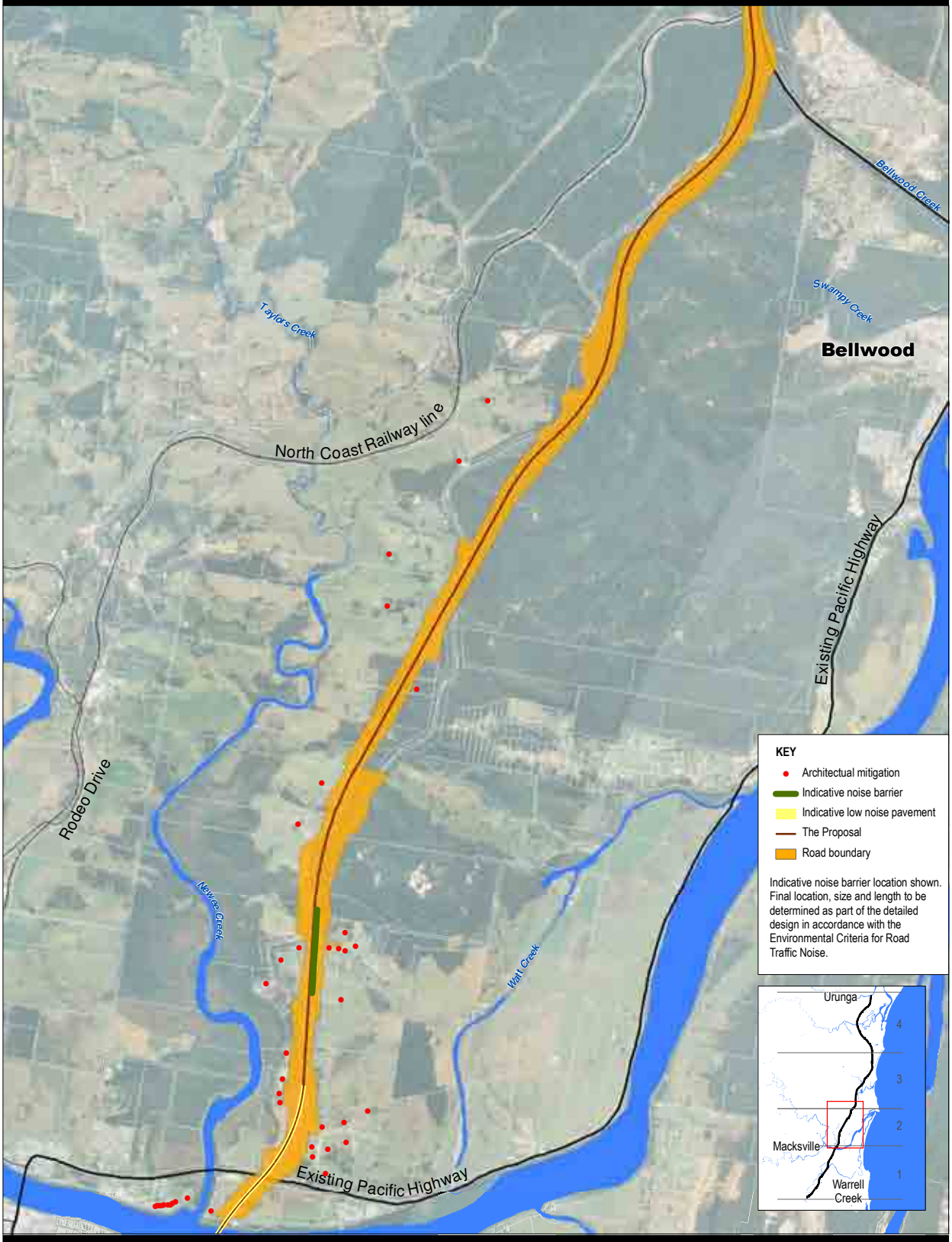
Range of exceedance (dB(A))	Number of receivers exceeding without low noise pavement	Number of receivers exceeding with low noise pavement	Difference after mitigation
1-2	170	65	101
3-5	100	79	18
6-10	89	68	21
>10	15	8	7
Total	273	220	53

FIGURE 14-4a | LOW NOISE PAVEMENT AND NOISE BARRIER LOCATIONS **SECTION 1 OF 4**



Warrell Creek to Urunga - Upgrading the Pacific Highway

FIGURE 14-4b | LOW NOISE PAVEMENT AND NOISE BARRIER LOCATIONS **SECTION 2 OF 4**

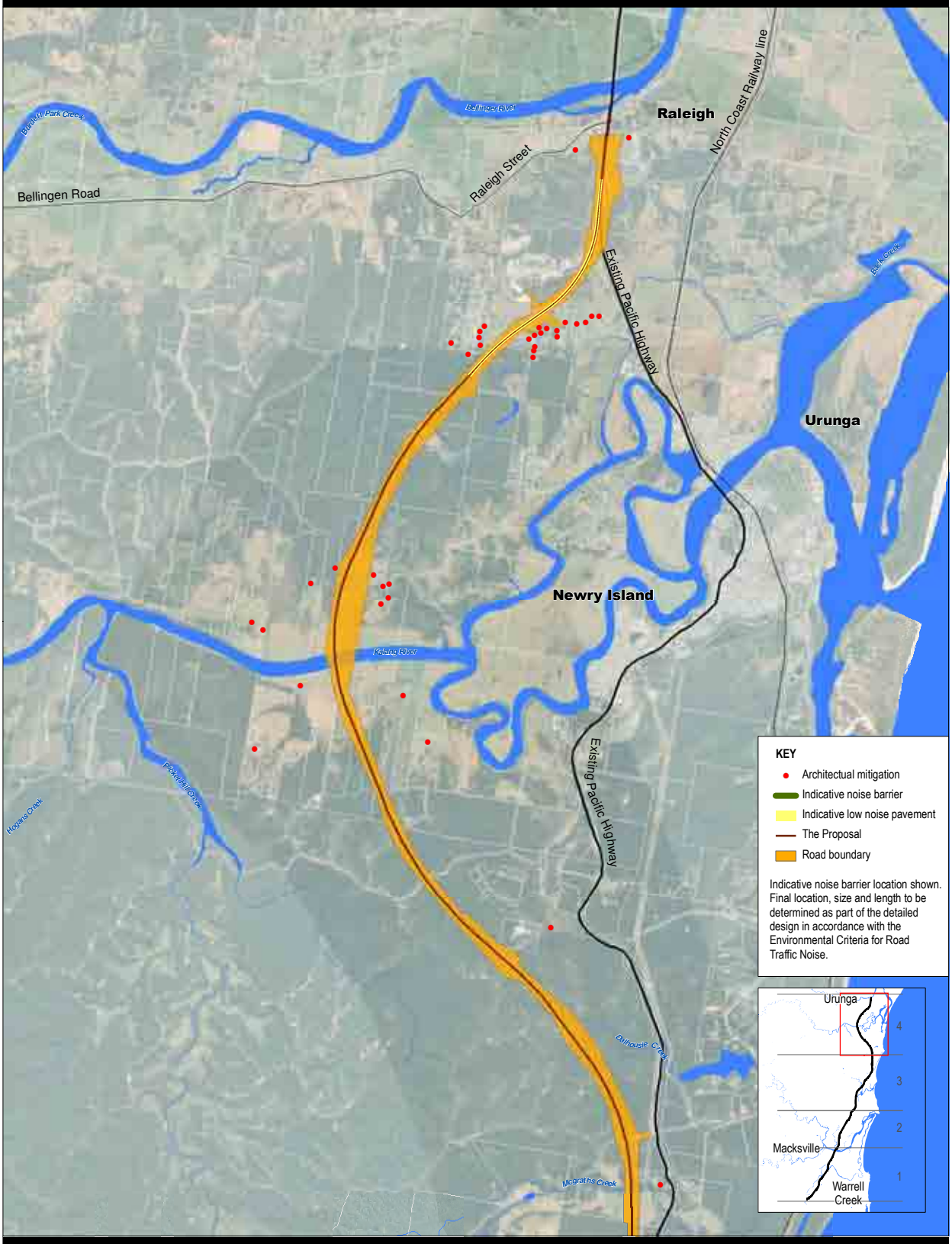


Warrell Creek to Urunga - Upgrading the Pacific Highway

FIGURE 14-4c | LOW NOISE PAVEMENT AND NOISE BARRIER LOCATIONS SECTION 3 OF 4

Warrell Creek to Urunga - Upgrading the Pacific Highway

FIGURE 14-4d | LOW NOISE PAVEMENT AND NOISE BARRIER LOCATIONS **SECTION 4 OF 4**



Where barriers can be successfully implemented, an assessment of their effectiveness versus the cost to build and the number of residences that would benefit was undertaken. The locations where barriers were considered to provide a noise benefit and were cost-effective can be seen in Table 14-18. These were also illustrated in Working paper 3 – *Noise and vibration*.

Table 14-18 Noise barrier locations

Location	Type	Chainages[1]	Height above pavement
Albert Drive to Donnellyville	Wall	4500 – 5000 eastern side	4.5 metres
Donnellyville, adjacent to south bound lane	Wall	5000 – 5300 eastern side	4 metres
Bald Hill interchange, adjacent to South bound on ramp	Wall	7100 – 7450 eastern side	4 metres
Mattick Road	Wall	12325 – 12900 eastern side	4.5 metres

[1] To be refined during detailed design; it is noted that earth mounds may be constructed on land acquired for the Proposal should surplus spoil be available.

Table 5-4 and Table 5-5 of Working paper 3 - *Noise and vibration* show which properties are to be considered for architectural treatment to mitigate noise impacts from the Proposal. The number of properties to be considered for treatments has been summarised in Table 14-19 for each section of the Proposal.

Architectural treatments can include treatment of the building or local noise mounds or barriers, where residents prefer this option. However, the use of local noise barriers would be subject to a cost/benefit analysis to determine their appropriate application. The recommendations for noise mitigation are based on the current road alignment and road surface type, and should be flexible in their application to allow alternatives that may provide additional benefits to noise affected locations in the future.

Table 14-19 Proposed architectural (on property) noise treatments

Location	Number of residences at which treatment is proposed[1]
Allgomera deviation to Nambucca River	65
Nambucca River to Nambucca Heads	39
Nambucca Heads to Ballards Road	40
Ballards Road to Waterfall Way interchange	37

[1] To be refined during detailed design (data sourced from GIS information).

14.7 Proposed management measures

14.7.1 Operational noise

In order to manage the predicted operational noise impacts of the Proposal, assessment of the eligibility for noise treatments at sensitive receiver locations was completed, in accordance with the ENMM. Consideration of other reasonable and feasible actions to reduce predicted noise levels was also undertaken in accordance with the ECRTN. The range of operational noise mitigation and management measures proposed includes:

- Low- noise pavement is proposed at the locations identified in this environmental assessment (see Figure 14-4 a-d).
- Noise barriers are proposed at the locations and to the specifications identified in this environmental assessment, subject to detailed design, noise modelling and assessment against the criteria (see Figure 14-4 a-d).
- Architectural treatments would be considered at properties identified in this environmental assessment, where reasonable and feasible (see Figure 14-4 a-d).
- A reasonable and feasible approach has been adopted and would continue to limit operational noise impacts in accordance with the ECRTN. The approach to the mitigation of operational noise impacts would be developed further during detailed design and in consultation with relevant property owners.
- Monitoring of operational noise would be undertaken within one year after opening along the Proposal. Should the monitoring indicate that traffic noise levels exceed the relevant noise level criteria in the ECRTN, the RTA would investigate and implement further reasonable and feasible mitigation measures. The selection of these measures would be undertaken in consultation with affected property owners. The proposed operation phase noise management measures are also included in Appendix D - *Draft Statement of Commitments*.

14.7.2 Construction noise and vibration

In order to appropriately manage construction noise and vibration impacts of the Proposal the following mitigation and management measures would be implemented:

- Construction activities would generally be restricted to the following hours
  - Between 6am and 6pm Monday to Friday.
  - Between 7am and 4pm Saturday.
- Works outside the proposed construction hours would be limited to:
  - Works that do not cause construction noise to be audible at any sensitive receivers.
  - For the delivery of materials required outside these hours by the Police or other authorities for safety reasons.
  - Where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.
  - Any other work as agreed through negotiations between the RTA and potentially affected sensitive receivers. Any such agreement must be recorded in writing and a copy kept on site for the duration of the works.
  - Where the work is identified in the CNVMP and approved as part of the CEMP.
  - As agreed by the DECCW.
- Rock breaking, rock hammering, sheet piling, pile driving and any similar activity would be scheduled only between the hours of 9am to 12pm and 2pm to 5pm, Monday to Friday; and 9am to 12pm, Saturday except where works are to be undertaken outside proposed construction hours as outlined above. All plant and

equipment would be well maintained and fitted with adequately maintained silencers which meet the vehicle design specifications.

- Prior consultation and notification would be undertaken with nearby residents that may be affected by noise or vibration generating activities that exceed the relevant criteria.
- Public address systems used at any construction site would not be used outside normal construction hours as indicated above, except where prior consultation has been undertaken with affected residents as outlined above. Public address systems would be designed to limit noise spillage off-site.
- Blasting trials would be undertaken if blasting is to be used, with results from the trials used to determine site-specific blast designs to satisfy relevant performance criteria.
- All reasonable attempts would be made to contact sensitive receivers located within 500 metres of a blast location. The contact would be made at least 48 hours before a blast and advice given to the receiver would include a schedule of blast time(s) and a telephone number and contact name.
- Noise and vibration monitoring would be undertaken during construction to determine the effectiveness of mitigation strategies.

The proposed pre-construction and construction phase noise and vibration management measures are outlined in the Appendix D - *Draft Statement of Commitments*.

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Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

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15. Aboriginal heritage

This chapter describes the process undertaken in assessing the presence and likely significance of Aboriginal cultural areas and archaeological items or sites of Aboriginal significance within the study area. An Aboriginal heritage working paper was prepared in consultation with the Aboriginal community. This working paper contains information sensitive to the Aboriginal community. The recommendations included in the working paper have been incorporated into this chapter. A copy of Working paper 4 – Aboriginal heritage was provided to the Department of Planning, DECCW and Aboriginal Focus Group.

Director-General's requirements	Where addressed in the EA
Aboriginal cultural heritage values of the route, specifically on artefact, potential archaeological deposits and landscape cultural values (such as watercourses, spur lines and raised areas in floodplains) where relevant.	Section 15.2.2 Cultural heritage Section 15.2.3 Archaeological Heritage
Regional scale cumulative impacts and the significance of the impacts of the project in the context of the Pacific Highway Upgrade Program.	Section 15.3.3 Regional scale cumulative impacts Section 15.3.4 Significance of impacts in the context of the Pacific Highway Upgrade Program

15.1 Assessment approach

The assessment of the Aboriginal heritage impacts of the Proposal presented in this chapter includes consideration of both the cultural and archaeological values of the assessment area. The assessment approach was undertaken in two parts: the cultural assessment, which addressed Aboriginal cultural and social aspects of the assessment area; and the archaeological assessment which identified known and potential Aboriginal archaeological sites. Senior SKM archaeologist, Vanessa Edmonds, undertook both assessments, which built upon earlier work undertaken by Robyn Mills during the route development phase (details of which are outlined in Sections 15.1.2 and 15.1.3).

Both assessments have been undertaken in conjunction with the local Aboriginal community and in accordance with the RTA Procedure for Aboriginal Cultural Heritage Consultation and Investigation (RTA 2008b), Interim Community Consultation Requirements for Applicants (DEC 2004) and Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation: Part 3A, Environmental Planning and Assessment Act (DoP 2005).

Community consultation is also outlined in Chapter 5 – *Community consultation*.

15.1.1 The study area

The study area for the Aboriginal cultural and archaeological assessment included areas within the proposed road boundary that had the potential to be impacted during construction as shown in Figure 6-1 to Figure 6-4. A wider area was also considered to incorporate links with the wider landscape for archaeological predictive modelling

purposes and to understand the wider cultural landscape. This allows for more robust site identification predictions to be made for the proposed impact zone.

15.1.2 Archaeological assessment

The purpose of the archaeological assessment was to identify the impacts of the Proposal on any Aboriginal objects, places and/or any potential archaeological deposits (PADs), and to develop corresponding impact mitigation strategies. The scope of the archaeological assessment included:

- A search and review of relevant heritage registers, including the DECCW Aboriginal Heritage Information Management System (AHIMS).
- Background literature research which built on the Aboriginal heritage report prepared as part of the route options assessment (RTA 2004a).
- Production of a desktop landform sensitivity model, which identified areas of Potential Archaeological Sensitivity (PAS) across the assessment area.
- A comprehensive archaeological site survey, including participation of nominated Aboriginal community stakeholders, to identify Aboriginal objects, places, PADs and cultural values.
- Archaeological test-excavation program, based on the results of the archaeological site survey, in consultation with Aboriginal stakeholders.
- An assessment of significance of the archaeological resource within the assessment area.
- Aboriginal consultation and participation, including Aboriginal focus group meetings (see Section 15.1.4).
- Development of appropriate archaeological management and mitigation measures for the assessment area.

15.1.3 Cultural assessment

The purpose of the cultural assessment was to identify the cultural significance to the Aboriginal community of any objects and/or places within the assessment area and to develop strategies to mitigate impacts. This involved substantial input from the local Aboriginal community and included the following:

- Background desktop literature research.
- Consultation with the Gumbaynggirr people including Nambucca Heads Local Aboriginal Land Council (LALC), Unkya LALC, Bowraville LALC and Coffs Harbour LALC, Elders groups and other knowledge holders.
- Identification of cultural knowledge holders within the community.
- Discussions and field visits with cultural knowledge holders.
- Identification of culturally significant sites, areas, elements and features along the Proposal.
- An assessment of significance of the cultural values of the assessment area.
- Development of appropriate cultural management and mitigation measures for the assessment area.

15.1.4 Aboriginal community consultation

Aboriginal stakeholder involvement has been critical to the successful identification of the cultural significance of the study area and the impacts of the Proposal on Aboriginal cultural and archaeological heritage. Prior to the commencement of the environmental assessment process, five Aboriginal community stakeholder sub-committee meetings, were held to allow the study team to better establish an understanding of the relevant Aboriginal cultural and archaeological heritage issues, for members of the Aboriginal community to understand the Proposal scope and to provide input into the assessment process.

In accordance with the Interim Community Consultation Requirements for Applicants (DEC 2005) the following formal consultation activities were undertaken for the environmental assessment to ensure Aboriginal communities have the opportunity to improve assessment outcomes:

- Advertisement in print media requesting Aboriginal people and/or groups who wanted to be consulted on cultural heritage issues for this Proposal, was published in the following print media on 30 August 2007:
  - The *Koori Mail*, The *National Indigenous Times*, *Deadly Vibe* magazine, *In Vibe* magazine; *Nambucca Guardian*, *Bellingen Shire Courier Sun*, *Coffs Coast Advocate*, *Mid Coast Observer* and *The Land*.
- Written notification was provided to the following agencies and stakeholders regarding the proposal:
  - Relevant Local Aboriginal Land Councils (Unkya, Bowraville, Coffs Harbour, Nambucca Heads LALCs), Bellingen and Nambucca Shire Councils, NSW Native Title Service, Registrar of the National Native Title Tribunal, Heritage Branch, Department of Planning, NSW Aboriginal Land Council, Department of Aboriginal Affairs and the DECCW.
- Registration of Aboriginal stakeholders resulted in 18 individuals being identified for consultation:
  - Registered individuals came from the following organisations: Unkya LALC, Bowraville LALC, Coffs Harbour LALC, Nambucca Heads LALC and Muurrabuy Language Centre.
- Aboriginal Focus Group (AFG) meetings were held at key stages during the assessment process. The purpose of the AFGs was to disseminate information, develop and endorse cultural and archaeological assessment methodologies, identify cultural knowledge holders and to gain feedback from the Aboriginal community:
  - Four AFGs in total were held on the following dates: 17 September 2007, 18 March 2008, 20 August 2008 and 27 April 2009.
- Stakeholder involvement in the development and delivery of field assessments was ongoing throughout the assessment. The outcomes of this consultation are briefly outlined here:
  - Site inspection of geotechnical locations was carried out in consultation with registered stakeholders, after requests for assessment of geotechnical-test sites. Written reports outlining the findings were sent to the Aboriginal site officers in attendance during site inspection for confirmation and endorsement prior to geotechnical works taking place.

- Comprehensive field survey methodology was developed in collaboration with registered stakeholders and undertaken with stakeholder participation.
- Survey results and methodologies for archaeological test excavation were circulated to registered stakeholders for review and comment and were subsequently endorsed. This methodology was also endorsed by the DECCW.
- Archaeological test excavations for the Proposal were conducted with the participation and input of stakeholder representatives.
- All concerns from registered stakeholders regarding Proposal impacts to both significant cultural and archaeological sites were heard, recorded and incorporated into the management recommendations for the Proposal. The following concerns resulted in Proposal reconsideration:
  - To avoid direct impacts to Rosewood Creek Aboriginal scarred tree, the Proposal was realigned and a qualified arborist engaged to assess construction and operational indirect impacts to the long term health of the tree.
  - To avoid direct impacts to the boundary of Cow Creek Aboriginal Reserve the Proposal was realigned and test excavations and interviews conducted in the vicinity of the reserve to investigate the potential presence of Aboriginal burials. No significant findings were reported from this process, the likely location of an Aboriginal burial was located well outside the Proposal corridor.
  - To avoid run-off from an old tip site impacting upon Bellwood Swamp, a highly significant cultural site, historic aerial photos were inspected and discussions were held to delineate the boundary of the old tip site. The Proposal was subsequently realigned to the west to avoid disturbing the tip-site and avoid any indirect impacts to Bellwood Swamp.
- After the archaeological and cultural assessments were undertaken, registered Aboriginal stakeholders reviewed the draft technical paper over a 21 day period. Feedback was sought and comments received were incorporated into the final version of the technical report.
- Stakeholders advised that there were no substantial objections to the Proposal providing the management measures outlined in the technical paper were undertaken.
- Consultation at the final AFG meeting discussed how the assessment findings would be represented within the public version of the technical paper. Public and restricted access versions of the technical report were then produced to reflect stakeholder concerns regarding sensitive information included in the report and copies and were circulated to all registered stakeholders for their records. However, as noted previously, due to the sensitive nature of the information, the Working paper has not been publically released.

Table 15-1 summarises how the DECCW Interim Community Consultation Requirements for Applicants 2005 have been considered in the assessment and consultation process.

Table 15-1 Accordance with the DECCW Interim Community Consultation Requirements for Applicants 2005 and Part 3A Draft assessment and consultation guidelines

Part 3A Draft Part 3A Guidelines for Aboriginal Cultural Heritage impact assessment and community consultation	Where this is addressed in the Environmental Assessment	DECC Guideline Stage	Where this is addressed in the Environmental Assessment
Step 1 – Preliminary assessment	Working paper 4 – Aboriginal heritage: sections 4.1, 4.3, 6.1 and 6.3. Sections 15.1.2, 15.1.3 and 15.1.4 of environmental assessment, volume 1.	Stage 1 – Notification and registration of interests	Working paper 4 – Aboriginal heritage: section 3.4 and Appendix J
Step 2 – Information requirements	Working paper 4 – Aboriginal heritage: sections 1.2, 1.3 and 6.1. Sections 15.1.1, 15.1.2 and 15.1.3 of the environmental assessment volume 1	Stage 2 – Preparation for the assessment (design)	Working paper 4 – Aboriginal heritage: sections 3.2, 3.4, and 3.5.1, and Appendix G
Step 3 – Integration of information and identification of heritage values	Working paper 4 – Aboriginal heritage: sections 3, 4, 6, 7, 8, 9 and 10. Sections 15.1, 15.2, 15.3 and 14.4 of the environmental assessment, volume 1.	Stage 3 - Drafting, review and finalisation of the Cultural Heritage Assessment Report	Working paper 4 – Aboriginal heritage: section 3.5 and Appendix G
Step 4 – Information regarding the proposed development	Working paper 4 – Aboriginal heritage: sections 6.3, 6.4, 6.9, 6.10, 6.11, 9.1, 9.2, 9.3 and 10.1. Section 15.3 and 15.4 of the environmental assessment, volume 1		

15.2 Existing environment

15.2.1 Aboriginal history

The study area was originally occupied by groups of Kumbainggiri (Gumbainggirr or Gumbaynggirr) and Jaiku (Ngaku) speaking people. The Kumbainggiri (Gumbaynggirr) people reportedly occupied the area from the lower course of the Nymboida River east across the range to Urunga, Coffs Harbour and Bellingen and south from One Tree Point to Nambucca Heads. The Jaiku (Ngaku) speaking people reportedly occupied land to the south. Much of the connection to the land for the present Aboriginal community relates to their understanding of food sources and resource gathering places within the landscape. Hence there is significance associated with gullies, rivers and creek and coastal areas throughout the region.

The first recorded visual contact between Aboriginal people and Europeans along the north-east coast of NSW occurred in 1770 during the voyage of Captain Cook. Settlement of the land by Europeans within the region began around the 1820s. Conflict between early European settlers and Aboriginal people appears to have been

commonplace, with serious confrontation occurring between the Aborigines and the cedar cutters. There are historical records of massacres at a number of locations (Nambucca River, Yarrahapinni) and it is likely that other massacres occurred but went unrecorded.

Between 1883 and 1908, 16 Aboriginal reserves were established in the Macleay and Bellinger River valleys. In the early 20th-century, many of the reserves were sold off into private ownership, and Aboriginal people were moved around to different locations, such as missions. Some Gumbaynggirr people still occupy former missions, such as at Bowraville, and Bellwood. Over this time of great social volatility, many traditional practices, such as initiation ceremonies, began to die out with the last one in the Nambucca region being held in the 1920s or 1930s.

15.2.2 Cultural assessment

The former National Parks and Wildlife Service (now within the DECCW) initiated three important surveys in the area which include a major survey and ethnographic study of sacred/ceremonial sites and places on the Mid North Coast, a management study for Aboriginal Historic Sites in the North Coast region, and a Cultural Heritage Pilot Proposal of the NPWS Coffs Coast Area. The ethnographic survey recorded Dreamtime stories and the location of ceremonial and mythological sites significant to both the Gumbaynggirr and Dungatti people. Reporting of these areas and stories was by Tribal Elders Harry Buchanan and Mr Terry Donovan. Sites were identified at Mount Sullivan, Mount England, Pickett Hill, Scotts Head, Yarrahapinni Mountain and Bald Mountain.

The information provided by the Aboriginal community during the consultation process has provided information on the cultural heritage landscape values of the assessment area. Some of the specific cultural heritage values of the landscape identified through consultation are identified in Table 15-2.

Table 15-2 Aboriginal cultural heritage landscape values

Value	Description and cultural significance
Resource gathering locations and techniques	The Gumbaynggirr people still fish and collect wild food throughout the region. Knowledge of the techniques and prime resource gathering locations is passed on through generations. Many important cultural sites are associated with 'increasing' of a particular key resource, such as yam or kangaroo.
Scarred trees	Many stakeholders identified scarred trees as being of sacred and ceremonial significance. This was due in part to scarred trees being some of the few 'markers' remaining in the landscape. In many areas, scarred trees provide an indication of past ceremonial practices or burial sites, of which detailed understanding may have been lost.
Pathways through the landscape	During field surveys, LALC representatives identified the importance of spurlines and ridgelines as a route for travel through the landscape. These pathways are particularly significant when they lead to permanent water bodies.
Water courses, water holes or springs	Permanent water bodies are culturally significant as a central location for gathering of people, resource collection and camping. All accessible sites adjacent to water courses or natural water bodies have been surveyed.
Indigenous plants and animals	Indigenous plants and animals are significant to the Gumbaynggirr people. During the consultation process, animals and plants were often mentioned in the context of resource collection and spiritual importance.
Burial sites	Burial sites are of great importance and generally engender a high level of concern to the Gumbaynggirr people because the locations of burials have rarely been documented. Any anecdotal evidence of burials was considered as highly significant.

Value	Description and cultural significance
Areas of spiritual significance	The strong attachment the Gumbaynggirr people have to the Proposal corridor landscape (and outside it) as evidenced through their Dreamings and social connections can lead to the identification of areas that have a high spiritual connection for certain Gumbaynggirr who may have witnessed or experienced an event or where oral history of such an event has been passed on.

Much of the connection and relation to the land for the Gumbaynggirr people relates to their understanding of food sources and resource gathering places within the landscape. Consequently, there is significance associated with rivers and creek and coastal areas throughout the region.

As part of the research for the cultural assessment the following registered cultural sites were identified near the assessment area (see Table 15-3).

Table 15-3 – Registered Aboriginal cultural sites near the Proposal Corridor (from South to North)

Site name	Description
Deleted text (AHIMS # 21-6-36)	Undisclosed area, information removed to preserve the sensitive information on the location.
Undisclosed area	Undisclosed area, information removed to preserve the sensitive information on the location.
Bora ground (Deadmans Gully and Browns Crossing)(AHIMS 21-6-0287)	This site is highly sensitive and culturally significant. The area is referred to as Deadmans Gully and was named as such based on a story regarding tribal conflict between the Gumbaynggirr and Thungatti tribes.
Scotts Head Headlands, mythological place (AHIMS # 21-6-0016)	Important for the Dreaming about the Making of the Sea. Scotts Head is well outside the Proposal Corridor to the south east and would not be impacted.
South Beach (AHIMS # 21-6-0163)	Along the shoreline of Scotts Head is Forrester's Beach known to the local Gumbaynggirr people as South Beach (Biddi Farm) where an old Gumbaynggirr lady was left there to die. No one goes to this place after dark because a big wave will rise up and drown people.
Bald Mountain (AHIMS # 21-6-0039)	This area is of high cultural significance to Gumbaynggirr people and is the location of a Bora Ring and 'Diamond Tree' known as the Kaperra Ground. No details on location of these were provided but Bald Hill also forms part of the Mount Yarrahapinni Koala Dreaming. Bald Hill lies approximately two km south-east of the Proposal Corridor.
Bellwood Swamp (AHIMS # 21-6-0090; 21-6-0102; 21-6-0141; 21-6-0164)	This swamp was identified as being an area of high significance to the Gumbaynggirr people during consultation. There are a number of sensitive sites around the periphery of the swamp, whilst swamp itself and the resources contained within would have provided a significant food and materials resource of the Gumbaynggirr. The route has been realigned to avoid indirect impacts upon the swamp.
Pickett Hill (AHIMS # 21-6-0064)	This is a kangaroo increase site. Senior 'clever men' from the tribe would visit Pickett Hill to perform ceremonies to ensure that the time was right to hunt kangaroo in the tribal area. The Proposal is aligned very closely to the existing Pacific Highway alignment, therefore impacts to Pickett Hill and its cultural significance are unlikely.
Mount England (AHIMS # 21-6-0044)	This is located to the west of Nambucca Heads and is a significant natural mythological place associated with yam increase ceremonies.
South Arm bora ground (AHIMS # N/A)	The site is located on the northern side of the Kalang River approximately 1.1 km to the east of the Proposal. Although this site has been impacted by the construction of a house, the place retains its cultural significance.

During the field and consultation components for the cultural assessment a further six cultural were identified by the registered Aboriginal community and cultural knowledge holders (see Table 15-4).

Table 15-4 –Aboriginal cultural areas near the Proposal Corridor identified through consultation activities

Site Name	Description
Boggy Creek spiritual area	This site of an 'old Aboriginal woman' down at Boggy Creek near the alignment, known to be the great great grandmother Buchanan who lived around Cow Creek. While this area is unlikely to retain physical evidence of this manifestation, it provides a link to the Buchanan family of their recent past and beloved ancestor.
Cow Creek Aboriginal Reserve (AHIMS 21-6-0228)	Established in the mid 1800s and located approximately 100 metres from the western edge of the existing Pacific Highway. The reserve was established in 1880 and Aboriginal people were living at the reserve until the 1920s. Two houses were built at the reserve but not lived in; the Aboriginal people preferring to cook outside on an open fire. Immediately west of the reserve near the base of Mount England was a tribal conflict site marked with trees which were destroyed by fire in 1917.
Buchanan conflict site at Cow Creek (AHIMS 21-6-0286)	Site of a tribal punishment. The exact location of the site is unknown and could be on either side of the existing Pacific Highway. This site has been registered on the AHIMS register by the Buchanan family (Site 21-6-0286: Buchanan Conflict Site). A young couple ran off together from the Reserve without approval from their Elders. The couple were not suitable for each other, according to custom, and were pursed along Cow Creek and killed and buried in a hollow log in the creek. The killings were witnessed by two young Aboriginal boys in the early 1900's. The Proposal alignment was modified to avoid this place.
Burial site	Undisclosed site, information removed to preserve the sensitive information on the location.
Cabbage tree palm resource site	This site occurs within the Nambucca State Forest and is registered as occurring in several gullies running east-west from the Old Coast Road. Cabbage tree palms are a recognised resource for the Aboriginal people of the region and the intact cabbage tree palm areas in gullies provide a representation of the attachment to a relationship with the land and its resources.
Aboriginal mirrah (Initiation site) (AHIMS 21-3-0034)	Communication with individuals responsible for recording the site indicates indicated that this site is a stingray 'increase' site and is located outside the proposed impact zone. The locations of many culturally sensitive items have previously been recorded inaccurately on-purpose to protect the sites from damage.

15.2.3 Archaeological assessment

Searches of the DECCW AHIMS register were undertaken in November 2007 and September 2009 across the assessment area including 5 kilometres on either side of the corridor. The 2007 AHIMS search resulted in 117 registered sites being located within the vicinity of the Proposal. None of these registered sites are located within the Proposal impact area. As a result of the assessment reported in this chapter, the AHIMS search of 2009 resulted in 119 registered sites being recorded in the same search area.

From the desktop search of AHIMS prior to site survey, the following site types were recorded:

- Natural mythological or ritual sites (22 per cent of total sites).
- Open camp sites as represented by scatters of stone artefacts (15 per cent of total sites).
- Midden sites (13 per cent of total sites).

- Scarred trees (10 per cent of total sites).
- Bora or ceremonial sites, with or without archaeological evidence (nine per cent of total sites).
- Isolated artefacts (nine per cent of total sites).
- Post-colonisation camping sites (nine per cent of total sites).
- Aboriginal reserve sites (five per cent of total sites).

Site types with less than three occurrences throughout the Proposal region included waterholes, stone arrangements, walking tracks, resource gathering sites, burial sites and conflict sites.

Of the above sites, six in the vicinity of the Proposal area are of particular Aboriginal cultural significance. These sites are Boggy Creek spiritual area[1], Cow Creek Aboriginal Reserve, Buchanan conflict site at Cow Creek Aboriginal Reserve, an undisclosed burial site, Cabbage tree palm resource site[1] and Aboriginal mirrah (an initiation site).

No declared Aboriginal Places exist within the assessment area.

15.2.4 Sensitivity modelling

As part of previous Aboriginal archaeological and cultural heritage studies undertaken for route options and further assessment for the environment assessment, a total of 40 areas of potential archaeological sensitivity (PAS) were identified as being within the Proposal corridor. These areas were identified using predictive models, landforms, consultation with the Gumbaynggirr people and previous investigations in the region. Details of existing sensitive landscapes within the assessment area are outlined in Table 15-5.

Table 15-5 – Predicted archaeological and cultural heritage sensitive landscapes within the assessment area

Broad archaeological landscape units	Specific landscape characteristics within the broad landscape units	Sensitivity rating	Issues relating to assigning sensitivity ratings.
Floodplain / swamps	Low lying areas.	Low	Previous flooding, damp soils.
	Raised areas within floodplain, such as terraces.	High	Many known sites are recorded within this landform unit.
Low ridgelines and gentle spurlines with a gradient less than 10°	Level to gently sloping crests of spurlines particularly those between 10-30m AHD and adjacent to swamps.	High	Many known sites are recorded within this landform unit, however many of these areas have been highly disturbed by farming practices and housing development. Additionally, sites are likely to be of shallow nature.
	Upper slopes of spurlines greater than 100m from water.	Low	Known sites of low significance located in these areas.

[1] Identified during this assessment.

Broad archaeological landscape units	Specific landscape characteristics within the broad landscape units	Sensitivity rating	Issues relating to assigning sensitivity ratings.
	Natural landscape features identified by LALC as mythological places.	High	Rarely associated with material evidence.
Steep ridges with a gradient greater than 10°	Ridge crests associated with Aboriginal walking trails to and from ceremonial events.	Moderate	Sites not usually found in steep terrain, however Aboriginal use of areas as a walking path indicates that sites may be found in this landscape.
	Exposed stone areas, potential source of lithic material.	Moderate	Site specific area (i.e. visited for the specific purpose of obtaining stone for manufacture of stone tools).
	Flat, crests of ranges.	Moderate	Some possibility of small campsites located in these areas on transport routes; potential for scarred trees on old growth timber.

These 40 PAS areas have been subject to the comprehensive field survey in conjunction with the registered stakeholders.

15.2.5 Archaeological resource within the assessment area

As a result of comprehensive field survey of the PAS areas, eight new surface sites were identified (five with associated PAD) and 29 isolated PADs (34 PAD areas in total). These eight newly recorded sites are detailed in Table 15-6.

Table 15-6 – Sites identified during survey program

Site name	Information	Test excavation conducted
Rosewood Creek scarred tree and associated PAD (#22)	Scarred white mahogany recorded on top of a spurline overlooking Rosewood Creek, trending north towards Warrell Creek. The tree is on private property. The scar had significant regrowth, and consequently appeared quite small, though was probably originally the size of a large shield or Coolamon. Test excavations across the associated PAD resulted in no subsurface artefacts being recovered.	Yes
Bald Hill Road 1 and associated PAD (#7)	Artefact collection previously recorded by Navin (1991). The site was reported by the landowner who had collected a number of artefacts including two ground-edge axes, broken pebbles and flaked pebbles. The artefacts were collected across different parts of the property off Bald Hill Road in Section 2, across the range of landforms. The property includes a spur, slopes and low-lying swampy floodplain. A single isolated surface stone artefact was recorded at that time and collected. These were re-inspected, recorded and photographed during the detailed subsurface testing. The collection had been previously fire-damaged when the building they were being stored in was burnt. A single flake of fine-grained sandstone was also discovered during detailed subsurface testing on this property. This was located on the crest of the spur. A diffuse spread of artefacts is likely across the associated PAD.	Yes

Site name	Information	Test excavation conducted
Plantation trail artefact 1 and resource gathering site	This artefact was located on an access track in the Nambucca State Forest. The artefact consists of a large sandstone artefact possibly a broken axe or a grinding stone. The location of the artefact represents a larger resource exploitation and gathering area focused on the gullies and lower parts of the forested areas. The resource gathering component is recorded as Cabbage Tree Palm Resource Gathering Site.	No
Boggy Creek artefact 1 and associated PAD (#16) Resource gathering site	This site was recorded on private property on the bank of Boggy Creek. One ground sandstone artefact was found during survey and an area of cabbage tree palms and cycads was located nearby. These have been registered as one site on the AHIMS Register. Test excavations across the associated PAD resulted in no subsurface artefacts being recovered.	Yes
Deep Creek scarred tree 1	This Bloodwood tree is located west of the existing Pacific Highway. The tree is located on RTA owned land in an area with few old-growth trees. The scar on the tree is irregular and may not be culturally significant. The LALC and Elders present on-site during recording of this site requested that the site be recorded. Since then, re-inspection by Nambucca LALC and a DECCW Sites Officer has confirmed that the site is not of cultural significance, the scar more consistent with a tear; the tree has since been de-registered as an Aboriginal Site on AHIMS.	No
Kalang Spur artefact scatter and associated PAD (#12)	Originally recorded as two disparate sites, further survey found that the site extended across at least 730 metres x 35 metres. This large site consisted of 76 surface artefacts located on the crest of north-east to south-west trending spur. The spur led towards the Kalang River in the north-east. The artefacts consist of fine, medium and coarse grained sandstone flaked artefacts, with a small amount of other materials such as chert. The artefacts were scattered along an access track in a forested area on private property. During subsurface testing, a further 19 artefacts were discovered on the crest and upper slope of the spur, this included some ochre and artefacts with ochre residue.	Yes
South Arm Road 1	This site consisted of an isolated artefact (flake). The artefact was found during survey of the area. The artefact was found on the crest of an east-west trending spur. The artefact was exposed at surface and may have been imported to site during road construction. The area around the site was not considered to be a PAD due to the heavy disturbance of surface material through road construction. It is possible the artefact may have been imported in road fill and was not considered to be in situ due to road construction and maintenance activities. The site and its surrounds may be impacted during construction.	No
Tysons Flat Ridge artefact scatter and associated PAD (#29)	This site consisted of one possible hammerstone and one weathered flake lying on a track on the crest of a sloping ridgeline on private property and shallow subsurface deposits of further stone artefacts (12 recorded).	Yes

The 34 PADs that were identified as a result of field survey are detailed in Table 15-7. Of these 34 PADs, 25 were subject to subsurface archaeological test excavation. Twenty of these PADs had no associated surface archaeological material (i.e. isolated PADs), however five PADs were associated with five of the above previously identified surface sites; these were Bald Hill Road 1, Boggy Creek Artefact 1, Kalang Spur Artefact Scatter, Rosewood Creek Scarred Tree and Tysons Flat Ridge Artefact Scatter.

Table 15-7 – PAD areas identified during survey program

PAD number	PAD sensitivity	Landform	Test excavation conducted	New site resulting from testing
PAD 1	Low	Floodplain adjacent to swamp	No	-
PAD 2	Moderate	Upper slope and crest of spur	Yes	Old Coast Road Stone Artefact
PAD 3	Moderate	Upper slope and crest of spur	Yes	No
PAD 4	Moderate	Crest of spur north of Kalang River	No	-
PAD 5	Moderate	Crest of spur	Yes	No
PAD 6	Moderate	Crest of spur	Yes	No
Bald Hill Road and PAD 7	Moderate	Crest of spur	Yes	See Table 15-6 for description
PAD 8	High	Terraces adjacent to Cow Creek.	Yes	Cow Creek Artefact Scatter (Cow Creek Aboriginal Reserve)
PAD 9	Moderate	Floodplain and terraces south of Kalang River	Yes	No
PAD 10	Low	Ridge north of Deep Creek	Yes	No
PAD 11	Low	Low spur north of Deep Creek	Yes	No
Kalang Spur artefact scatter and PAD 12	High	Spur trending north of Kalang River	Yes	See Table 15-6 for description
PAD 13	Low-Moderate	Ridge north of Warrell Creek	Yes	No
PAD 14	Low-Moderate	Crest of spur in road reserve	Yes	No
PAD 15	Low	Floodplain and terraces	No	-
Boggy Creek artefact 1 and PAD 16	Moderate	Forested and cultivated land on either side of Boggy creek	Yes	See Table 15-6 for description
PAD 17	Moderate	Low-lying terrace/floodplain of Warrell Creek	Yes	No
PAD 18	Moderate-High	Steep terraces of Butcher's Creek	Yes	No
PAD 19	Low-Moderate	High crest and ridge in grazed farmland	Yes	Butcher's Creek 1
PAD 20	Moderate	High crest and ridge in grazed farmland	Yes	No
PAD 21	Low	Cultivated land on ridge above gully	No	-
Rosewood Creek scarred tree and PAD 22	Moderate	High crest and ridge in grazed farmland	Yes	See Table 15-6 for description
PAD 23	Low-Moderate	Crest of spur in grazed farmland	Yes	No
PAD 24	Moderate	Defined terrace to Stony Creek	Yes	Stony Creek 1
PAD 25	Moderate	Rise. Survey yet to be undertaken	No	-
PAD 26	Low	Rise. Survey yet to be undertaken	Yes	No

PAD number	PAD sensitivity	Landform	Test excavation conducted	New site resulting from testing
PAD 27	Moderate	Steeply defined south-east trending ridgeline above Tysons Flat	Yes	Tysons Flat 2
PAD 28	Moderate	Raised flat terrace feature – part of Tysons Flat	Yes	Tysons Flat 1
Tysons Flat Ridge artefact scatter and PAD 29	Low	Sloping spurline trending towards Tysons Flat	Yes	See Table 15-6 for description
PAD 30	Low-moderate	Small, flat rise above Newee Creek in residential front yard	Yes	No
PAD 31	Moderate	Small rise adjacent to floodplain of Warrell Creek	No	-
PAD 32	Low	Low floodplain of Oyster Creek	No	-
PAD 33	Moderate	Floodplain/terraces on northern bank of Warrell Creek	No	-
PAD 34	Moderate	Floodplain/terraces on southern bank of Warrell Creek	No	-

All PADs, including those subjected to previous test excavation, will be re-evaluated and further targeted testing undertaken prior to the determination of the environmental assessment. PADs considered to have potential to contain Aboriginal objects will be tested where:

- PAD adjoins an identified site and the further extent of the site requires confirmation [PADs 7, 8, 16, 19, 24, 27, 29 all adjoin a confirmed site].
- The initial testing sample was insufficient to provide a reliable determination of the presence of Aboriginal objects or cultural information [PADs 3, 6, 9].
- The PAD has not been previously tested [PADs 21, 25, 31, 32, 33, 34].

Subsurface testing program across the twenty isolated PADs resulted in the identification and recording of six new Aboriginal archaeological sites. Details of these new subsurface sites are detailed in Table 15-8.

Table 15-8 Newly identified subsurface archaeological sites recorded as a result of test excavation

Site name	Information
Old Coast Road stone artefact (AHIMS 24-6-0288) (Previously PAD #2)	This site consisted of an isolated stone artefact buried at five centimetres below ground surface in an excavation on private property. The artefact was found on the crest of an east-west trending spur. The topsoil at this location was very shallow and hard as a result of the compaction of the soil by stock. This site represents a low density artefact scatter with high level of soil disturbance.
Cow Creek artefact scatter (Previously PAD #8)	A total of 42 artefacts were discovered during the excavation of 100 test pits within the Cow Creek Aboriginal Reserve. The artefacts were concentrated on a low rise adjacent Cow Creek, with the concentration grading towards the creek bank in one area. Additionally, a small concentration of artefacts occurs on a flat area next to a driveway. These are considered as outliers and occur in a disturbed context. The site extent is approximately 35 metres x 50 metres. Artefacts found so far have been made predominantly (83 per cent) from sandstone, with small amounts made from glass, quartz and other materials.

Site name	Information
Butchers Creek 1 (Previously PAD #19)	Site comprised a subsurface deposit of stone artefacts (three recorded) on the upper slopes and crest of a rise adjacent to Butcher's Creek. Only the eastern edge of the site, on the upper slopes, is within the Proposal corridor, and an unknown portion likely exists to the west on the crest of the rise. The location of the site would have provided good vantage of the surrounding area as well as access to Butcher's Creek to the south and the resources associated with it. The site may be part of a walking trail connected to Mount Yarrahappini, as the rise it is on forms part of the Mount Yarrahappini footslopes.
Stony Creek 1 (Previously PAD #24)	Site comprises a subsurface deposit of stone artefacts (eight recorded) on the flat top of a defined terrace of Stony Creek. The location of the site would have provided immediate access to the freshwater resources of Stony Creek. Due to the relatively sparse nature of deposits, it is likely that it represents an ephemeral activity area (e.g. campsite). The site may be part of a walking trail connected to Mount Yarrahappini, as Stony Creek runs down from the Mount Yarrahappini footslopes.
Tysons Flat 2 (Previously PAD #27)	This site consisted of 21 stone artefacts of both fine and coarse grained materials in subsurface deposits on a ridge/spurline above a swampy area called 'Tyson's Flat'. This site appeared to be of a similar nature to Kalang Spur Artefact Scatter (above) and likely represents a pathway activity area.
Tysons Flat 1 (Previously PAD #28)	This site consisted of a very discrete subsurface deposit of stone artefacts (four recorded), located below the surface on a distinct flat raised terrace feature. It is located in close proximity to the site of an historic house associated with the early logging of the area and may have been disturbed from logging activities. The area may have been flood prone, as it is located on a low-lying area adjacent to a swampy drainage line. However, recent inhibitors to surface water drainage downstream from here may have added or created the swampy nature of the area today.

15.3 Impacts on Aboriginal cultural heritage

15.3.1 Assessment of significance

In total, 14 sites resulted from archaeological investigations (survey and excavation) across the assessment area. These have been assessed for heritage significance (see Table 15-9). This included both cultural (traditional, cultural and educational) and scientific significance values (site integrity, site structure, site contents and representativeness).

Table 15-9 Significance of and potential impacts to archaeological sites and potential archaeological deposits (south to north)

Site Number	Site Name	Scientific Significance	Aboriginal Significance	Investigation	Impacted by Proposal	Management
NA	PAD 31	Moderate	Moderate	Not tested – not to be impacted	No impact	N/A
NA	Previously PAD 18	Moderate - High	Moderate	Survey and sub-surface testing	Direct Impact	None – not required, as no longer PAD
NA	Butchers Creek 1 (previously PAD 19)	Moderate	High	Survey and sub-surface testing	Direct impact	Salvage
NA	Previously PAD 20	Moderate	Moderate	Survey and sub-surface testing	Direct Impact	None – not required, as no longer PAD
NA	Previously PAD 21	Low	Low - Moderate	Survey	Direct Impact	None – not required, as no longer PAD
NA	Rosewood Creek Scarred Tree (and previously PAD 22)	Moderate	High	Survey and sub-surface testing	No impact	Protection
NA	Previously PAD 23	Low-Moderate	Moderate	Survey and sub-surface testing	Direct Impact	None – not required, as no longer PAD
NA	Stony Creek 1 (previously PAD 24)	Low	High	Survey and sub-surface testing	Direct impact	Salvage
NA	PAD 25	Moderate	Moderate	None	Direct Impact	TBA pending further investigation
NA	Previously PAD 26	Low	Low	Survey and sub-surface testing	Direct Impact	None – not required, as no longer PAD
NA	PAD 34	Moderate	Moderate	Survey	Direct Impact	TBA pending further investigation
NA	PAD 33	Moderate	Moderate	Survey	Direct Impact	TBA pending further investigation
NA	Previously PAD 13	Low-Moderate	Moderate	Survey and sub-surface testing	Direct Impact	None – not required, as no longer PAD
21-6-0141	Bald Hill Road 1 (previously PAD 7)	Low	High	Survey and sub-surface testing	Direct Impact	Salvage
NA	Previously PAD 1	Low	Moderate	Survey	Direct Impact	None – not required, as no longer PAD
NA	Previously PAD 15	Low	Moderate	Survey	Direct Impact	None – not required, as no longer PAD
21-6-0288	Old Coast Road Stone Artefact (previously PAD 2)	Low	Moderate	Survey and sub-surface testing	Direct impact	Collection
NA	Plantation Trail Artefact 1 and Cabbage Tree Palm Resource Site	Low	Moderate	Survey and recording of resources	Partial (resource only)	Recording of resources

Site Number	Site Name	Scientific Significance	Aboriginal Significance	Investigation	Impacted by Proposal	Management
NA	Boggy Creek Artefact 1 & Resource Gathering area (previously Pad 16)	Low	Moderate	Survey, sub-surface testing and recording of resources	Partial (resource only)	Recording of resources
NA	Cow Creek Artefact Scatter (previously PAD 8)	Moderate	High	Survey, sub-surface testing, and interviews	Direct impact	Salvage
NA	Deep Creek Scarred Tree 1 (not a site)	None	None	Survey	No impact	N/A
NA	Previously PAD 11	Low	Low-Moderate	Survey and sub-surface testing	Direct Impact	None – not required, as no longer PAD
NA	Previously PAD 10	Low	Low	Survey and sub-surface testing	Direct Impact	None – not required, as no longer PAD
NA	PAD 32	Low	Moderate	Survey	Direct impact	TBA pending further investigation
NA	Previously PAD 14	Low-Moderate	Low	Survey and sub-surface testing	Direct Impact	None – not required, as no longer PAD
NA	Kalang Spur Artefact Scatter (and PAD 12)	Moderate	High	Survey and sub-surface testing	Direct impact	Salvage
NA	PAD 9	Moderate	Moderate	Survey and sub-surface testing	Direct impact	TBA pending further investigation
NA	South Arm Road 1	Low	Moderate	Survey	Direct impact	Collection
NA	Previously PAD 3	Moderate	Low Moderate	Survey and sub-surface testing	Direct Impact	None – not required, as no longer PAD
NA	Previously PAD 4	Moderate	Low Moderate	Survey	Direct impact	None – not required
NA	Previously PAD 5	Moderate	Low Moderate	Survey and sub-surface testing	Direct impact	None – not required
NA	Tysons Flat Ridge Artefact Scatter (previously PAD 29)	Moderate	Moderate-High	Survey and sub-surface testing	Direct impact	Salvage
NA	Tysons Flat 1 (previously PAD 28)	Low	Low-Moderate	Survey and sub-surface testing	Direct impact	Collection
NA	Tysons Flat 2 (and PAD 27)	Moderate	Moderate-High	Survey and sub-surface testing	Direct impact	Salvage
NA	PAD 6	Moderate	Moderate	Survey and sub-surface testing	Direct impact	TBA pending further investigation

Table 15-10 outlines the significance of the six cultural areas that were identified within the assessment area through the cultural assessment process.

Table 15-10 Significance of cultural sites

Site name	Aboriginal significance	Scientific significance	Proposal impact
Boggy Creek spiritual area	High	Low	Direct impact
Cow Creek Aboriginal reserve (AHIMS 21-6-0228)	High	Moderate	Partial impact
Buchanan conflict site at Cow Creek (AHIMS 21-6-0286)	High	Low	No impact
Undisclosed site	High	Moderate	No impact
Cabbage tree palm resource site	High	Low	Partial impact
Aboriginal mirrah (Initiation site) (AHIMS 21-3-0034)	High	Low	No impact

15.3.2 Summary of impacts

Based on the design in Chapter 6 – *Description of the Proposal*, the Proposal would have direct, indirect and potential impact on the 14 identified archaeological sites as indicated in Table 15-9. Of these nine archaeological sites would be directly impacted by the Proposal. Eight of these are identified as being of moderate or high cultural significance to the local Aboriginal community, and one has been identified as having low-moderate Aboriginal significance with the scientific value of these nine sites ranging from low to moderate significance. Two sites would be partially impacted by the Proposal. These sites would have the resources gathering site element impacted but not the artefact scatter of the site. Additionally, one archaeological site would be potentially impacted while the final two archaeological sites would not be impacted by the Proposal.

Of the six cultural sites identified in Table 15-10, one would be directly impacted, two would be partially impacted and three would not be impacted by the Proposal. All of these sites are considered to be of high significance to the Aboriginal community.

15.3.3 Regional scale cumulative impacts

The cultural heritage places identified during consultation and field surveys are of high significance to the Gumbaynggirr people. The Cow Creek Reserve and the cultural places associated with it provide an insight into Aboriginal life before and during contact with Europeans. The Cow Creek Reserve also represents a symbol of the treatment of the Gumbaynggirr people by Europeans in the region. The people living at Cow Creek showed a resilience to continue their traditional way of life regardless of the confines within which they were placed. Regionally these places are highly significant to the remaining Gumbaynggirr people.

The scientific significance of each of the archaeological sites individually is generally considered to be low to moderate. However, the cultural significance is generally considered to be high. It is important to consider the

archaeological sites in a regional context; individually they may not be as important, but regionally they provide a reasonable distribution of artefacts across important landforms. The regional Aboriginal cultural heritage values and knowledge for the Gumbaynggirr people of the Nambucca valley would be impacted by the destruction of these sites.

On a regional scale, loss of archaeological (scientific) resources due to the Proposal would be considered low-moderate. This is due to the fact that, although not particularly numerous, some of the sites which are impacted are significant within the region (i.e. Cow Creek Artefact Scatter, Kalang Spur Artefact Scatter and Tysons Flat 2) provide a reasonable distribution across a range of important landforms, are generally relatively intact and provide important information on a range of important Aboriginal activities across the region. However, the majority of the sites are common within the region (e.g. small flaked artefact scatters), with no exceptional raw materials. Many of these site types still exist unimpacted (and likely unrecorded) within the region and therefore the regional archaeological resource would not be impacted to a significant level as a result of this Proposal. Additionally, significant efforts were made by the RTA to avoid impact to significant Aboriginal cultural places, thus leading to little impact to the Aboriginal cultural values of the region. The information gathered during this investigation is considered sufficient to mitigate and off-set the cumulative regional impacts.

15.3.4 Significance of impacts in the context of the Pacific Highway Upgrade Program

Aboriginal communities have historically occupied the areas along the entire length of the Pacific Highway Upgrade Program. As such, construction activities along the upgrade have the potential to impact upon Aboriginal heritage items and values. The RTA's Procedures for Aboriginal Cultural Heritage Consultation and Investigation (RTA 2008b) provides a system for obtaining information on culturally significant areas and archaeological sites to provide the greatest opportunity to ensure potential impacts are avoided, mitigated or managed as part of the route development and planning stages. Extensive consultation with the Aboriginal communities also assisted with the development of mitigation and management measures, and the outstanding impacts are generally perceived by the local Aboriginal community to be acceptable.

As previously outlined, subsurface testing of PAD sites has been undertaken as part of the environmental assessment for the Proposal. This has allowed more substantial information to be obtained regarding the sensitivity of the PADs identified and has provided opportunities to refine the route or develop suitable mitigation measures. This ensures greater certainty of the impacts associated with the construction and operation of the Proposal and the effectiveness of the mitigation measures to be implemented to manage those impacts. The Pacific Highway Upgrade Program as a whole aims to minimise the impacts on Aboriginal heritage. As such, the management hierarchy of avoid where possible, if not manage or mitigate, would be implemented.

15.4 Management of impacts

Proposed management measures are discussed in Table 15-11 and included in Appendix D - *Draft Statement of Commitments.*

Table 15-11 Proposed management measures for archaeological and cultural sites

Site name	Proposal impact	Mitigation
Archaeological sites		
Rosewood Creek scarred tree	No impact	■ Realignment of the Proposal has been undertaken to ensure that the edge of the alignment does not fall within 16 metres of the tree trunk. ■ An arborist has also assessed the health of the tree, which has informed these management recommendations. ■ Erect protective fencing pre construction phase. ■ Additional protective plantings should be undertaken post construction surround this tree to obscure the scar. ■ Monitoring of the tree health is to be undertaken annually for two years after construction.
Deep Creek scarred tree 1	No impact	■ No mitigation required. ■ Not Aboriginal scarred tree, de-listed from AHIMS.
South Arm Road 1	Potential impact	■ Artefact should be collected prior to construction and placed in the care and control of Coffs LALC with information on its context.
Plantation Trail artefact 1 and resource gathering site	Partial impact	■ Recording of resource site completed. ■ No further mitigation required.
Boggy Creek artefact 1 and resource gathering site	Partial impact	■ Recording of resource site completed. No further cultural mitigation required. ■ Where avoidance is not possible to the archaeological material, archaeological salvage excavation is required prior to construction in consultation with the Aboriginal stakeholders.
Bald Hill Road 1	Direct impact	■ Archaeological salvage excavation required prior to construction in consultation with the Aboriginal stakeholders.
Kalang Spur artefact scatter	Direct impact	■ All attempts to be made during detailed design to avoid site, including protective fencing during construction. ■ Where avoidance is not possible, archaeological salvage excavation is required prior to construction in consultation with the Aboriginal stakeholders.
Tysons Flat Ridge artefact scatter	Direct impact	■ All attempts to be made during detailed design to avoid site, including protective fencing during construction. ■ Where avoidance is not possible, archaeological salvage excavation is required prior to construction in consultation with the Aboriginal stakeholders.
Old Coast Road stone artefact	Direct impact	■ Single artefact should be collected prior to construction and placed in the care and control of Unkya LALC with information on its context.
Cow Creek artefact scatter	Direct impact	■ Archaeological salvage excavation is required prior to construction in consultation with the Aboriginal stakeholders.
Butchers Creek 1	Direct impact	■ All attempts to be made during detailed design to avoid site, including protective fencing during construction. ■ Where avoidance is not possible, archaeological salvage excavation is required prior to construction in consultation with the Aboriginal stakeholders.

Site name	Proposal impact	Mitigation
Stony Creek 1	Direct impact	■ All attempts to be made during detailed design to avoid site, including protective fencing during construction. ■ Where avoidance is not possible, archaeological salvage excavation is required prior to construction in consultation with the Aboriginal stakeholders.
Tysons Flat 1	Direct impact	■ Artefact should be collected prior to construction and placed in the care and control of Coffs LALC with information on its context.
Tysons Flat 2	Direct impact	■ All attempts to be made during detailed design to avoid site, including protective fencing during construction. ■ Where avoidance is not possible, archaeological salvage excavation is required prior to construction in consultation with the Aboriginal stakeholders.
Cultural sites		
Boggy Creek spiritual area	Direct impact	■ Recording of cultural area completed. ■ No further mitigation required.
Cow Creek Aboriginal reserve (AHIMS 21-6-0228)	No impact	■ No mitigation required.
Buchanan conflict site at Cow Creek (AHIMS 21-6-0286)	No impact	■ No mitigation required.
Burial site(s)	No impact	■ No mitigation required.
Cabbage tree palm resource site	Partial impact	■ Recording of cultural area completed. ■ No further mitigation is required.
Aboriginal mirrah (Initiation site) (AHIMS 21-3-0034)	No impact	■ No mitigation required.

Known and potential impacts associated with the construction of the Proposal would be managed through an Aboriginal heritage management sub-plan. This sub-plan would be developed in consultation with the Department of Planning, the DECCW and the relevant Aboriginal community stakeholders. This document would contain specific measures with appropriate controls are in place to avoid or minimise impacts identified Aboriginal cultural heritage sites and values. Specifically this sub-plan would detail, but not be limited to, the following:

- Physical protection of all Aboriginal cultural heritage sites not directly impacted by the Proposal to avoid any accidental disturbance.
- Clear mapping, outlining all Aboriginal cultural heritage sites within and adjacent to the Proposal impact zone.
- Aboriginal cultural heritage awareness training for all construction workers and contractors, including information on site locations, conservation management requirements and construction mitigation.
- Procedures for unexpected finds uncovered during works, including human remains. This would include details of an on-call archaeologist, protocols for notifying the DECCW under s91 of the *National Parks and Wildlife Act* and care and control of any unexpected objects.

- Salvage excavation mitigation field methodology for the known sites identified above in Table 15-11 to be developed, including care and control of all salvaged material, site registration protocols and excavation reporting requirements.
- Appropriate interpretation and cultural offsets for impacts to cultural heritage such as plain English publications and artefact display units for community.
- Procedures for on-going Aboriginal community consultation.

The results of PAD testing to date will be reviewed and further targeted investigation of PADs undertaken. This will include previously untested PADs, those where sampling was insufficient to resolve the presence of Aboriginal objects and to clarify the extent of identified sites. This additional archaeological investigation would be completed prior the determination of the Environmental Assessment. Further mitigation measures may result from these investigations, which would be included in the Aboriginal heritage management sub-plan.

15.5 Residual impacts

Provided the mitigation and management measures documented through this chapter are implemented effectively, no significant long term impacts are predicted for Aboriginal heritage.

Finding opportunities for training, employment and active Aboriginal participation during construction is a subject that has been raised through the Aboriginal consultation process. Employment and training opportunities would be discussed further with Aboriginal stakeholders prior to construction in accordance with the NSW Government's *Aboriginal Participation in Construction Guidelines*. Where feasible, members of the Aboriginal community employed under the Guidelines will be provided with opportunities to undertake tasks during the construction program for the Proposal.

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Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

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16. Water quality and hydrology

Water is included as a key issue in the Director-Generals requirements. This chapter provides an assessment of the potential impacts on water way and wetland water quality, groundwater and changes to existing flood regimes. This assessment is supported in Working paper 5 – Water (Flooding and water quality).

Director-General's requirements	Where addressed in the EA
Water way and wetland water quality taking into account impacts from both accidents and runoff and considering relevant environmental water quality criteria specific in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* 2000.	Section 16.1.1 Water quality Section 16.2.2 Surface water quality Section 16.3.1 Construction stage (water quality Section 16.3.2 Operational stage (water quality)
Groundwater contamination risk, groundwater use and groundwater users.	Section 1.1.1 Groundwater Section 16.3.1 Construction stage (groundwater and contamination risk) Section 16.3.2 Operational stage (groundwater and contamination risk)
Changes to existing flood regimes, in accordance with the *Floodplain Development Manual* (former Department of Natural Resources, 2005), including impacts to existing property and infrastructure and the future development potential of affected land.	Section 16.1.2 Flooding Section 16.2.4 Flooding (existing conditions) Section 16.3.1 Construction stage (flooding) Section 16.3.2 Operational stage (flooding)

16.1 Assessment Approach

16.1.1 Water quality

To assess the existing water quality conditions within potentially impacted waterways, existing and collected water quality data were compared against the guideline values for protection of aquatic ecosystems set out in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ 2000). The specific ANZECC and ARMCANZ (2000) water quality guideline values used were the default trigger values for chemical and physical stressors applicable to slightly disturbed estuarine and lowland river ecosystems in south-eastern Australia. Wetland health was also assessed using the ANZECC and ARMCANZ (2000) guidelines.

Existing surface water quality data used for the assessment included data collected by Nambucca Shire Council from two sites on the Nambucca River between 1991 and 2007 and data obtained during field investigations conducted for the environmental assessment and route options assessment phases.

What is ANZECC and ARMCANZ?

The Australian and New Zealand Environment Conservation Council (ANZECC) and the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) published the revised Australian and New Zealand guidelines for fresh and marine water quality in 2000. These guidelines provide government, the community, catchment and water managers with a framework for conserving ambient water quality in rivers, lakes, estuaries and marine waters. The ANZECC guidelines use a risk based approach based on the common issues or pressures that are put on different waterways and acknowledges that different levels of protection may be appropriate for different water bodies.

For each water quality objective, a set of indicator values are prescribed. The objectives include:

- Protection of aquatic ecosystems.
- Protection of primary contact recreation (swimming, surfing).
- Protection of secondary contact recreation (boating fishing).

The environmental objective 'protecting aquatic ecosystems' has been used to review the quality of water for the creeks and rivers in this study area. The key issues for which are: nuisance aquatic weeds and lack of dissolved oxygen, the indicators being total phosphorus, total nitrogen, chlorophyll a and dissolved oxygen.
A set of trigger values have been prescribed for these indicators. Exceedance of these indicates water quality is considered unacceptable for this purpose.

Geotechnical investigations undertaken to inform the concept design and environmental assessment and a search of the DECCW (formerly the Department of Water and Energy (DWE)) licence borehole user's database formed the basis of the groundwater assessment.

16.1.2 Flooding and climate change

A study of the flooding impacts of the Proposal that considered the Floodplain Development Manual (DIPNR 2005) was undertaken for the Proposal. The study involved flood modelling to assess the changes to the existing flood regimes and assessed the flooding characteristics of 1 in 10, 100 and 2,000 Average Recurrence Interval (ARI) flood events. The modelling was used to describe the existing environment and assess the impacts of flooding on the Proposal for each major waterway crossing.

The flooding impact assessment has been undertaken in terms of:

- Impacts of the Proposal in the current climate.
- Impacts of the Proposal under a changed climate (i.e. increased rainfall depth and intensity and sea level rise).
- Impacts of climate change on the Proposal.

The climate change scenarios were developed based on the *Practical Consideration for Climate Change* (DECC 2007) and advice from the DECCW.

16.2 Existing conditions

16.2.1 Surface water sources

The Proposal crosses 13 waterways along its length. These include freshwater systems, estuarine systems, intermittently closed and open lakes and lagoons (in which salinity levels vary between freshwater and saline conditions) and wetlands with the larger wetlands in the locality often within or associated with wetlands listed under SEPP 14. These are shown in Table 16-1.

The four catchments in the study area are the Nambucca River, Warrell Creek, Deep Creek and Kalang River catchments. The Nambucca River is a large river with a catchment of approximately 1,000 km^2 upstream of the town of Macksville. Warrell Creek has a catchment of approximately 300 km^2 upstream of the town of Nambucca Heads. Deep Creek has a catchment of approximately 70 km^2 upstream of the where the Proposal crosses it. It is a minor tidal creek at the proposed crossing with a well defined bank and little floodplain. The Kalang River is a large river with a catchment of approximately 340 km^2 upstream of Urunga. The Kalang River divides into two channels approximately 3.5 kilometres upstream of the existing railway bridge.

Table 16-1 Watercourses and wetlands within the study area

Section	Location	Waterways crossed
1	Allgomera deviation to Nambucca River extends from the northern end of the existing Allgomera deviation to the northern bank of the Nambucca River at Macksville (detailed description in Chapter 6).	Freshwater systems - Upper Warrell Creek, Butchers Creek, Stony Creek, Rosewood Creek and Williamson Creek. Estuarine systems - Warrell Creek and Nambucca River. Passes approximately 180 metres from SEPP 14 Wetland No 388 (Gumma Creek).
2	Nambucca River to Nambucca Heads extends from the northern bank of the Nambucca River at Macksville to the North Coast Railway crossing at Nambucca Heads (detailed description in Chapter 6).	No waterways crossed, however passes approximately 40 metres from SEPP 14 Wetland No 383 and approximately 900 metres from Wetland No 386.
3	Nambucca Heads to Ballards Road extends from the crossing of the North Coast Railway at Nambucca Heads to Ballards Road (detailed description in Chapter 6).	Freshwater systems - unnamed tributary of Oyster Creek. Estuarine systems - Deep Creek and McGraths Creek. Intermittently closed and open lakes or lagoons - Boggy Creek and Cow Creek.
4	Ballards Road to Waterfall Way interchange extends from Ballards Road to the start of the existing Waterfall Way interchange just south of Bellinger River (detailed description in Chapter 6).	Estuarine systems - Kalang River and Bellinger River is just to the north. Passes approximately 70 metres from SEPP 14 Wetland No 351 and Wetland No 353.

16.2.2 Surface water quality

A qualitative summary of the water quality data obtained for the environmental assessment is shown in Table 16-2. A quantitative assessment of this data has been included in Working paper 5 – *Water (Water quality)* and expressed in terms of turbidity, conductivity, salinity, temperature, pH and dissolved oxygen. The DII classifies major waterways in terms of their ability to support fish habitat. Classifications include Class 4 – unlikely fish habitat;

3 – minimal fish habitat; 2 – moderate fish habitat and 1 – major fish habitat as described in the publication 'Why to Fish Need to Cross the Road' (Fairfull and Witheridge 2003). These classifications have been applied to the waterways within the study area. The waterways crossed within the four sections of the Proposal and the proposed Fishways Classifications are provided in Table 16-2

16.2.3 Groundwater

Two main types of groundwater regimes are likely to be found along the Proposal based on geological types and groundwater levels observed in standpipe piezometers. These include:

- Undulating hills (underlain by typically weathered phyllite).
- Alluvial floodplains.

The phyllite in the hilly areas exhibits low permeability with the main transport route for groundwater being defects in the rock, particularly along veins and foliation partings. Groundwater level measurements indicated that water levels were generally greater than 10 metres depth in these areas. The second groundwater regime was beneath the alluvial floodplains either side of the major waterways. Groundwater levels were high (less than five metres depth) and typically reflected their proximity to the major watercourses. Groundwater levels across the floodplains are likely to fluctuate due to tidal influences by up to 0.5 metres. There are a number of groundwater dependent communities the Proposal. These include swamp forests and communities generally associated with low lying land, wetlands and water courses. Further details on these communities and their location are provided in Chapter 10 – *Flora and fauna*.

The most likely locations where groundwater is close to the ground surface and therefore more at risk of contamination, is in streams, as base flow, around the rivers and in the wetlands. Agricultural practices also represent the greatest risk in terms of groundwater contamination where fertilisers or pesticides are or have historically been applied to the land. Soil samples were taken in areas of both potential point source and diffuse pollution sources and tested for a range of contaminants including heavy metals and organic herbicides and pesticides. The soil samples returned results below laboratory reporting limits indicating very low to negligible levels of contaminants when compared to the adopted assessment criteria or laboratory reporting limits. Therefore the risk to groundwater in these locations is considered to be low.

16.2.3.1 Groundwater use and users

The DII database identified 19 licensed bores within the study area. The bores located around Macksville intersected shale and slates and the bores north of Nambucca Heads generally intersected clay, shales and slate. The depths of the bores varied between four metres and 58 metres. However, depths generally ranged between 30-40m. The groundwater levels of these bores at the time of sampling (where available) range from five to 30 metres, salinity was good and bore yields up to 8.84 litres per second. The majority of bores are used for domestic supply with or without stock. Other bore uses include waste disposal, industrial and recreational purposes.

Table 16-2 Qualitative water quality summary

Section	Watercourse/body	Summary of findings	Fishways classification
1	Freshwater systems - Upper Warrell Creek, Butchers Creek, Stony Creek, Rosewood Creek and Williamson Creek	■ Water quality in the freshwater creeks (Upper Warrell, Butchers, Rosewood, Stony and Williamson Creeks) was generally good, with the exception of dissolved oxygen levels. The dissolved oxygen levels were below the minimum saturation requirement for aquatic ecosystems. This is potentially due to the very low flow conditions at the time of sampling and volume of macrophyte growth. Acid sulphate soils are likely to be present at Butchers Creek. ■ Low dissolved oxygen concentrations were found in Williamson Creek (a freshwater tributary of Warrell Creek) on all sampling occasions. This creek has the poorest water quality in this section. ■ All of the freshwater creeks sampled in Section 1 are currently impacted by runoff from the existing Pacific Highway and/or other roads, as well as runoff from farmland. The freshwater creeks have degraded banks and limited riparian vegetation.	Warrell Creek(upstream and downstream): 1 Butchers Creek: 2 Rosewood Creek: 2 Williamson Creek: 2 Nambucca River: 1
	Estuarine systems - Warrell Creek and Nambucca River	■ The estuarine waterways (Warrell Creek and Nambucca River) were found to have high turbidity and low dissolved oxygen concentrations. Water quality appeared to deteriorate in wet weather as a result of stormwater runoff. ■ Sampling conducted in Nambucca River by Nambucca Shire Council 1991-2007 (upstream and downstream of the Proposal) indicated that ANZECC and ARMCANZ guideline values for aquatic ecosystems were exceeded on 80% of occasions for oxidised nitrogen and 50% for total phosphorous. Wastewater effluent from wastewater treatment plant at Gumma Road, Macksville is likely to have contributed to high nutrient concentrations.	
	SEPP 14 Wetland No 388 (Gumma Creek) located close to the Proposal.	■ Wetland No 388 was found to have elevated turbidity and low dissolved oxygen. Water quality appeared to deteriorate in wet weather as a result of increased sediment in the runoff from Gumma Road.	
2	SEPP 14 Wetland No 383 (approximately 260m west of Proposal) and Wetland No 386 (approximately 15km east of Proposal).	■ Wetland No 383 and No 386 did not contain any water at the time of the Proposal sampling events. ■ Wetland No 386 is impacted by runoff from the existing Pacific Highway. The water quality at Wetland No 383 may potentially be impacted by local roads and Newee Creek which flows through the wetland. ■ Both wetlands are surrounded by disturbed and high risk acid sulphate soils.	

Section	Watercourse/body	Summary of findings	Fishways classification
3	*Freshwater systems - unnamed tributary of Oyster Creek* *Estuarine systems - Deep Creek and McGraths Creek* Intermittently closed and open lakes or lagoons - Boggy Creek and Cow Creek	■ High turbidity and low dissolved oxygen in the tributary to Oyster Creek were indicative of poor water quality probably due to the low flow and macrophyte growth. Oyster Creek itself was found to be acidic on one sampling occasion and is impacted by Pacific Highway runoff. ■ pH levels during the first dry weather sampling event were below the recommended minimum levels for aquatic ecosystems at the majority of sites but improved on subsequent sampling occasions. ■ Turbidity levels were high, failing aquatic ecosystem protection guidelines at the majority of sites. High turbidity levels coincided with low dissolved oxygen concentrations. ■ In Deep Creek, turbidity levels generally met the ANZECC and ARMCANZ (2000) guidelines during dry weather conditions but increased following rainfall, with levels exceeding ecosystem protection guidelines during wet weather conditions. pH was slightly acidic on one sampling occasion and the creek is located in a high risk acid sulphate soil area. Deep Creek is affected by runoff from the existing Pacific Highway. ■ McGraths Creek was inaccessible and could not be sampled. ■ The poorest water quality conditions were found in Boggy Creek and the tributary of Oyster Creek. ■ Boggy Creek water quality conditions are poor probably due to low flow conditions and large volumes of floating debris. This creek is impacted by Pacific Highway and agricultural runoff. ■ Cow Creek water quality conditions are poor with turbidity and dissolved oxygen failing to meet guidelines for the protection of aquatic ecosystems on the majority of sampling occasions, probably due to low flow conditions and large volumes of floating debris. This creek is impacted by Pacific Highway and agricultural runoff.	Boggy Creek: 2 Cow Creek: 2 Deep Creek: 1 Oyster Creek tributary: 2 McGraths Creek: 3
4	Estuarine systems - Kalang River and Bellinger River is just to the north SEPP 14 Wetland No 351 and Wetland No 353	■ Turbidity and dissolved oxygen levels in the Kalang and Bellinger rivers indicated poor water quality during dry weather, with a further deterioration in water quality during wet weather. ■ Wetland No 353 did not contain any water at the time of the Proposal sampling events. Wetland No 351 was found to have poor water quality, with high turbidity and low dissolved oxygen concentrations attributed to very low water flows and influx of sediment and organic matter during wet weather. The wetland currently receives runoff from an adjacent road and from a stormwater pipe that discharges into the wetland. ■ Both Wetland No 351 and the Kalang River at the Proposal crossing point are located within areas containing high risk acid sulphate soils.	Kalang River: 1

16.2.4 Flooding

The flood behaviour in the study area is complex, necessitating significant investigation to understand flooding behaviour and the effects of the Proposal on that flooding behaviour.

Two hydrologic models, RAFTS and RORB, were used to model the flows within the five key waterways listed below, based on rainfall data and catchment characteristics:

- Upper Warrell Creek.
- Warrell Creek.
- Nambucca River.
- Deep Creek.
- Kalang River.

The MIKE 21, MIKEFLOOD and HEC-RAS hydraulic models were then used to model the flood levels within these five waterways. The models identified that the existing flooding regime for Warrell Creek and Upper Warrell Creek as a well defined channel with a narrow floodplain.

The results of the existing 100 year ARI flood impact for the Kalang River, Nambucca River and Warrell Creek are shown in Figure 16–1, Figure 16–3 and Figure 16–5 respectively.

The existing flooding regime of the Kalang River is characterised by a narrow floodplain in the upper reaches of the study area. The Kalang River splits into two arms which surround Newry Island, creating an extensive floodplain. The flow patterns across Newry Island are complex.

The flooding regime predicted by the model for Nambucca River was widespread flooding in the low lying areas of Macksville and the surrounds particularly in Gumma Swamp.

The existing flooding regime for the Nambucca River is characterised by widespread flooding in the low lying areas of Macksville and surrounds, particularly in Gumma Swamp. Flooding of these areas occurs as a result of a lack of conveyance of the river, and flood water backing up into the low-lying Gumma Swamp.

The lower reaches of Warrell Creek are tidally influenced. However, flooding around the Proposal is primarily influenced by the conveyance of the waterway. Changes to the existing flooding regime have been assessed considering the Floodplain Development Manual (DIPNR 2005). Impacts to existing property and infrastructure and the future potential of affected land are provided in Section 16.3.

The Warrell Creek, Upper Warrell Creek and Deep Creek existing flooding regime was characterised by a well defined channel and confined floodplain in the study area. Once the existing flood regimes were defined, developed conditions hydraulic models were built to assess the potential impacts of the Proposal including the proposed road alignment and associated infrastructure.

16.3 Potential impacts

16.3.1 Construction stage

16.3.1.1 Water quality

Construction of the Proposal, as with all road construction projects, presents a potential risk to water quality. The main water quality risks associated with construction of the Proposal are:

- Exposure of soils during earthworks, which creates the potential for off-site transport of eroded sediments and pollutants.
- Disturbance of acid sulphate soils, which creates the potential for oxidation of these soils and subsequent generation of acidic run-off. The waterways with the highest probability of acid sulphate soils are Warrell Creek, Nambucca River, Deep Creek, Kalang River, Bellinger River, all five SEPP wetlands (No.383, 386, 388, 353 and 351) and other low-lying areas, creeks and wetlands.
- Alteration of surface and subsurface flows which could cause disturbances to hydrology and hydraulics.
- Cuttings may intercept perched water tables or layers of relatively low permeability soil/rock. There are a series of cuttings with the greatest potential risk of impacting surrounding ecosystems and groundwater sensitive areas including four in Section 1, two deep cuttings in Section 2, one in Section 3 and two in Section 4.
- Dewatering impacts such as reduction in groundwater levels and reduced flow, and off-site discharges of sediment laden water, particularly at locations where cuttings are proposed.
- Intersection and interference with an aquifer which could obstruct groundwater flow and limit groundwater availability. Accidental spills or leaks of oil, grease or fuel from work machinery and vehicles or from construction sites or compounds, and accidental spills of other chemicals that may be used during the course of construction.

The construction of the Proposal involves the realignment of one intermittent creek between Rosewood Road and O'Dells Road. The creek would be realigned along the west side of the upgrade towards a culvert and then into Warrell Creek. As the subject creek is intermittent in nature, the impacts on water quality would be minor.

The main risks to creeks and rivers crossed by the Proposal are associated with an increase in sedimentation and the corresponding reduction in dissolved oxygen. The risk of water quality impacts within the creeks is exacerbated by existing poor water quality and the shallow degraded creek banks.

The waterways with the potential to be affected due to a high probability of acid sulphate soils include Warrell Creek, Nambucca River, Deep Creek, Kalang River, Bellinger River and SEPP 14 wetlands No. 383. Further details of acid sulphate soil risks are provided in Chapter 18 – *Soils characteristics and erosion controls*. Exposure of these soils would result in a decrease in pH levels. Well vegetated creeks such as Deep Creek, (an estuarine system), are better protected from potential water quality impacts associated with spillage as well as sedimentation due to the density of the riparian vegetation and also the level of vegetation within the catchment which acts as a filter.

The Proposal passes in close proximity to five SEPP 14 wetlands. There would be no direct impact on Wetland No 388 near Gumma Creek in Section 1, Wetlands No 383 or 386 in Section 2 or Wetlands No 351 and 353 in Section 4. Potential impacts to these wetlands include increased sediment in runoff from the roads in close proximity to the wetlands. These wetlands are surrounded by disturbed and high risk acid sulphate soils, which would need to be managed appropriately if disturbed during construction.

In-stream structures would be required for the major water crossings, including the Nambucca River, Kalang River and Warrell Creek. The installation of these structures would create the potential for surface water quality impacts through the removal of in-stream and stream bank vegetation, disturbance of in-stream sediments, possible localised turbidity, ground disturbance near drainage lines and hydrocarbon/chemical leaks from small scale spills from construction vehicles. Specific management and mitigation measures would need to be implemented during construction of these structures. The estuarine water quality of Bellinger River is not expected to be impacted by the Proposal as the northern most point of the proposed highway upgrade works cease just south of this waterway.

16.3.1.2 Groundwater and contamination risk

The construction of cuttings below the groundwater table has the potential to impact on the existing groundwater regime, and locally draw the groundwater table down. As a consequence, there is the potential for the drawdown to impact on springs, surface water systems, nearby structures and the potential for negative impacts on groundwater dependent ecosystems and communities. This issue is discussed further in Chapter 10 – *Flora and fauna*. The largest cuttings in Sections 1 and 4 pose the highest risk of impact to surrounding ecosystems and groundwater sensitive areas. All cuts which penetrate the watertable have the potential to impact downstream groundwater patterns and ecosystems. The groundwater drawdown is expected to be greatest in and surrounding cuts where the current groundwater level is greater than three metres above the cut of the base. This occurs in two cuts in Section 4 and 4 cuttings in Section 1 and one in Section 3.

Where the groundwater level is less than about two metres above the proposed cutting base level, the cutting is not expected to have significant impact on the deeper groundwater regime.

The geotechnical investigations undertaken to date have not identified any springs in the immediate vicinity of the cuttings. The impacts to more distant springs (regional bedrock aquifer springs) are likely to be minor or negligible, since the recharge feeding these springs is drawn from a considerably larger area of catchment.

In addition to the cutting, the disturbance and ground clearing associated with construction of access roads, tracks and general vegetation clearing can alter groundwater recharge and introduce pollutants. The compaction of soils and cutting and filling associated with construction reduce groundwater recharge. This reduction in the depth of groundwater allows surface contaminants a shorter pathway to the water table making the groundwater table more vulnerable to pollution. Accidental spills, particularly in locations of highly permeable strata have the potential to contaminate groundwater.

16.3.1.3 Flooding

There is the potential for flows to be impeded during construction if materials or compounds are placed in or near overland flowpaths. During wet weather events surface water may enter cuts and sediment basins rather than following natural drainage channels. These rainfall events may contribute to increased erosion of the exposed areas causing runoff into nearby waterways. Construction of in-stream structures in the Nambucca River and the Kalang River has the potential to introduce temporary impediments to flow. Flooding may occur during construction, however flooding events are considered to be more significant during the operation of the Proposal. Mitigation measures for flooding during operation are addressed in Section 16.4.2.

16.3.2 Operational stage

16.3.2.1 Water quality

Once the Proposal is operational, the main risk to water quality is an increase in surface runoff due to an increase in impervious surfaces. The most important pollutants of concern relating to road runoff are:

- Suspended sediment from the paved surface.
- Heavy metals attached to particles washed off the paved surface.
- Oil and grease and other hydrocarbon products.
- Anthropogenic litter.

In addition, nutrients such as nitrogen and phosphorus are also found in road runoff due to atmospheric deposition of fine soil particle. The export of suspended solids and associated contaminants, namely heavy metals, nutrients and organic compounds, is a key consideration for stormwater quality management (Austroads 2001). Trapping suspended soils is the primary focus of the water quality management strategy for the operational stages of the road upgrade as pollutants such as nutrients, heavy metals and hydrocarbons are usually attached to fine sediments (RTA, June 2003b).

Additional potential risks to water quality that may result from operation of the Proposal include:

- Impacts associated with accidental spills of fuels or chemicals during transport of dangerous goods and other hazardous substances.
- Traffic accidents leading to spills of fuels and oils.
- Impacts associated with the maintenance of the roadway, which may include herbicide use, mowing, road-surface cleaning and repair.
- Decreased dissolved oxygen levels from some hydrocarbons and decay of organic matter.
- Increased nutrient levels (nitrogen and phosphorus).
- Increased sediment loads which would reduce light penetration through the water column and silting of the waterways.

- Acidic pH levels, low dissolved oxygen, excess sulphate and iron stains from the exposure of acid sulphate soils.
- Increased heavy metals (including aluminium and iron) from vehicle wear, accidental spills and acid sulphate soils.
- Silting of waterways and associated smothering of aquatic flora and fauna.
- Accidental spills of chemicals and potential to cause impacts to the aquatic (and terrestrial) ecosystems.
- Litter polluting waterways. Oil and grease are unsightly and can cause water quality problems.
- Accidental spillage of hazardous materials either as a result of a collision or otherwise

These water quality impacts would potentially impact aquatic biota (by stimulating the growth of algae and aquatic plants) through increased nutrients. Chemical spills, acid sulphate soils and heavy metals may be toxic to aquatic biota and fish. The majority of the waterways that are potentially impacted by the operation of the Proposal are already impacted by stormwater runoff from existing roadways and road maintenance activities. Impact mitigation measures are available and would be implemented as part of the Proposal design and operation so that adverse impacts are minimised as far as practical.

The location and size of the sediment basins are provided in the Working paper 5 - *Water (Water quality)*. Sedimentation basin locations are also identified in Figures 6–1 to Figure 6–4. The potential for a spill of hazardous substances from a vehicle transporting dangerous goods along the upgraded section of the Pacific Highway is considered to be low, due to the following factors:

- Dangerous goods vehicle movements along the upgraded section of highway are expected to account for only 0.2 per cent of total daily traffic movements, hence the likelihood of an accident involving a truck containing dangerous goods is very low.
- The high road design standards proposed, which would reduce the potential for road accidents relative to the existing situation.
- The stringent legislative controls on the transport of dangerous goods.

With the implementation of the proposed impact mitigation and management measures, the impacts of the operation of the Proposal on water quality are not expected to be significant.

16.3.2.2 Groundwater

There is the potential for long term impacts on groundwater, creeks and waterways during operation of the Proposal where cuttings have intersected the watertable which is more likely along the larger cuttings in Sections 1 and 4.

The impacts could include contaminated road runoff entering the groundwater system, cuttings of the Proposal diverting groundwater from the existing groundwater regime and potentially limiting base flow to these water bodies. The geotechnical investigations undertaken during preparation of this environmental assessment infer that base flows to these creeks are provided largely by the relatively shallow local and intermediate groundwater flow

systems. Any cutting that significantly diverts potential rainfall recharge away from the local shallow groundwater system, or intersects the watertable significantly, is likely to locally diminish water discharges to the creeks and water bodies, and would have secondary impacts on groundwater dependent ecosystems reliant on this recharge.

The 19 licensed groundwater wells identified from the DII database along the Proposal are predominantly used for domestic and stock purposes. The construction of cuttings below the groundwater table may impact on the existing groundwater regime and locally lower the water table. As a consequence, there is a potential for the drawdown to impact on springs and surface water systems. The groundwater drawdown is expected to be greatest in and surrounding cuts where the current groundwater level is greater than three metres above the base of the cut. Current groundwater shows that this is the case for two cuts in Section 4.

Existing property and infrastructure along the Proposal, such as houses, farm buildings and businesses, may also be affected by the road cuttings. The lowering of the water table could potentially affect the stability of such structures. Therefore, their proximity to the proposed alignment is also considered within the assessment. Structures at distances within 200 metres of a cutting could potentially be impacted. Details of the nearest structure or infrastructure to the cuttings are provided in Table 16-3.

Table 16-3 Proximity of cuttings to property and infrastructure

Cutting	Proximity to Property and Infrastructure
2.2	40 metres
2.3	25 metres
2.5	40 metres
2.6	75 metres
2.9	175 metres
2.10	25 metres
3.5	35 metres (groundwater bore)
4.10	45 metres
4.14	100 metres
4.15	10 metres
4.16	40 metres

Road cuttings were identified based on the proposed depth, horizontal planar area, distance from an environmental features (endangered ecological community or creek) to the proposed cutting and distance from an anthropogenic feature (structure or groundwater bore) to the proposed cutting and these results are presented in Table 16-4.

Table 16-4 Groundwater impact results

Classification	Numbers of Cuttings within Category	Cutting Numbers
Type A – Proposed cuttings have a significant depth of excavation into the topography, a large length and area of extent, and/or there are known EECs, creeks, bores or structures in the immediate vicinity of the cutting.	Section 1: four Section 2: two Section 3: one Section 4: two	Section 1: 1.3, 1.5,1.10 and 1.11 Section 2: 2.5 and 2.14 Section 3: 3.5 Section 4: 4.2 and 4.10
Type B – Proposed cuttings have a moderate depth of excavation into the topography, a small to moderate length and area of extent, and/or there are known EECs, creeks, bores or structures in the vicinity of the cut.	Section 1:eight Section 2: eight Section 3: nine Section 4: ten	Section 1: 1.1, 1.2,1.4,1.6,1.7,1.8 and 1.9 Section 2: 2.2, 2.3, 2.6, 2.10, 2.12, 2.13, 2.15 and 2.22 Section 3: 3.1, 3.4, 3.8, 3.9, 3.10, 3.12, 3.14, 3.15 and 3.16 Section 4: 4.1, 4.3, 4.5, 4.7, 4.9, 4.11, 4.14, 4.15, 4.16 and 4.17
Type C – Proposed cutting is not expected to impact the groundwater regime, is of insignificant depth, small length and area of extent, and/or there are no EECs, creeks, bores or structures in the immediate vicinity of the cutting.	Section 1: zero Section 2: ten Section 3: two Section 4: three	 Section 2: 2.7, 2.8, 2.9, 2.11, 2.16, 2.17, 2.18, 2.19, 2.21 and 2.23 Section 3: 3.11 and 3.13 Section 4: 4.3, 4.6 and 4.8

16.3.2.3 Flooding

The Proposal crosses perpendicular to the natural flood flow paths, which flow predominantly east towards the coast. In this regard the Proposal has the potential to impede flood flows in the watercourses and their floodplains.

The Proposal could affect the flooding regime by:

- Reducing flood storage due to road embankment being constructed in floodplain areas.
- Affecting flood conveyance due to bridges over primary waterways.

Affecting flood behaviour through interfering with existing flow patterns through embankments and cuttings altering local terrain and natural drainage patterns.

These impacts have the potential to then impact on surrounding properties. The design criteria for the Proposal were to ensure that no existing dwellings were adversely affected for events up to the 1 in 100 year ARI flood event. Hydrologic and hydraulic assessment has been undertaken to determine design flood conditions and hydrological models of the contributing catchments were developed to derive design flows for culvert capacity assessment and design. A hydraulic analysis of each of the five major waterway crossings has been undertaken to determine design flood characteristics and design constraints related to flood immunity for the bridge structure. Peak flow and water level estimates for the bridge locations were provided for the one in 10, 100 year and 2000 year average recurrence interval (ARI) flood events (details are provided in Working paper 5 – *Water (Flooding).* The results of the developed 100 year ARI flood impact for the Kalang River, Nambucca River and Warrell Creek are shown in Figure 16–2, Figure 16–4 and Figure 16–6 respectively. The red shades indicate an increase in flood level and

the blue shades indicate a reduction in flood level. Average recurrence interval is the long-term average number of years between the occurrence of a flood as big as or larger than the selected event. For example, floods with a discharge as great as or greater than the 10 year ARI flood event would occur on average once every 10 years. ARI is another way of expressing the likelihood of occurrence of a flood event. Two scenarios were modelled for the Nambucca River as two options are being considered for crossings on the northern side of the Nambucca River comprising an embankment with culverts (option1) or built structure/viaduct across the northern floodplain (option 2).

The hydraulic modelling results showed that the Proposal at Warrell Creek, Upper Warrell Creek, Nambucca River, Deep Creek and the Kalang River would have a limited impact on flood levels. Table 16-5 provides details of the predicted increase in flood levels on the upstream side of the road for the key watercourses. It also provides information on the potential area to be impacted.

Table 16-5 Flood modelling results, developed conditions (existing climate)

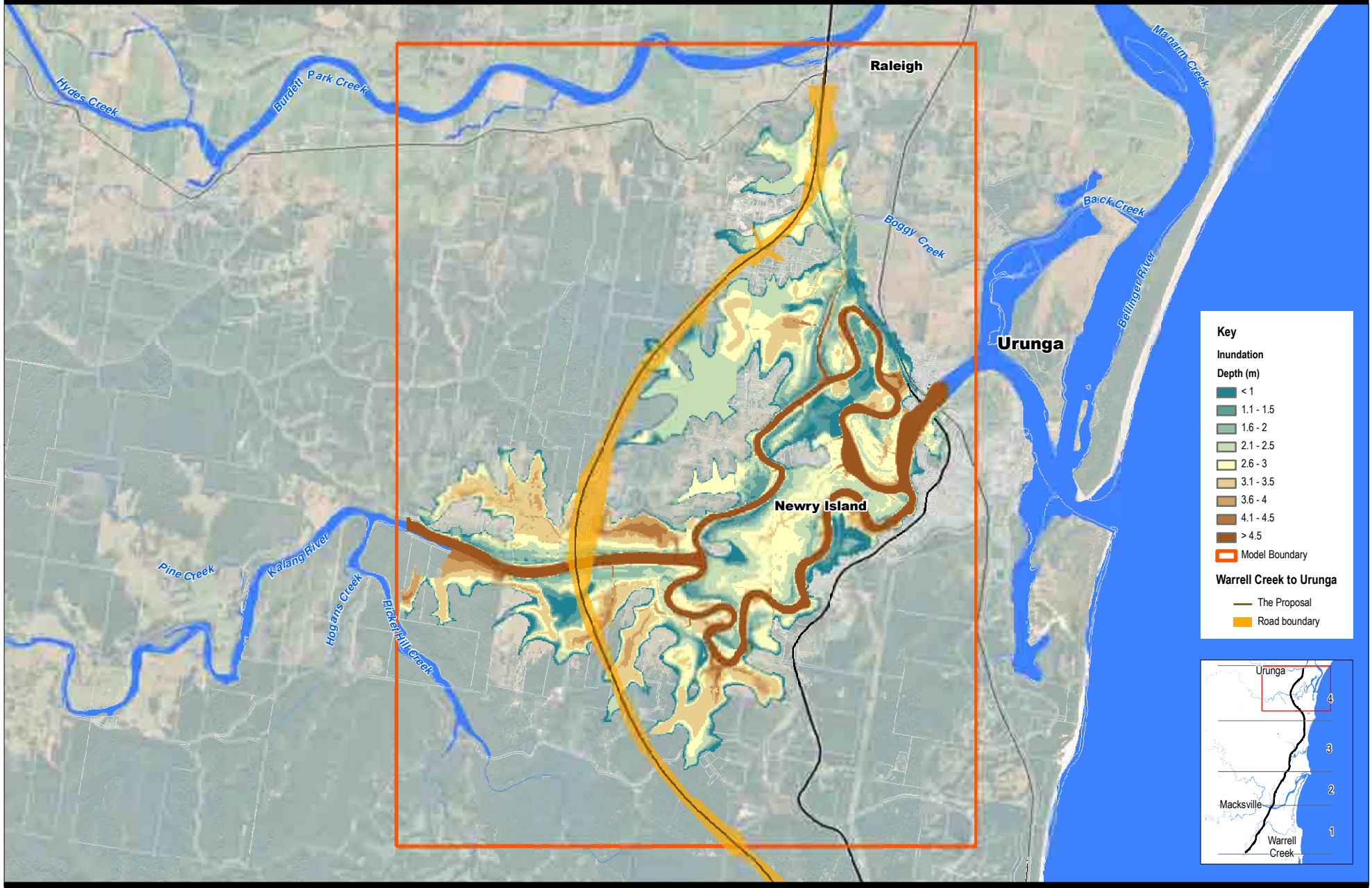
Waterway	Predicted upstream increase (100 yr ARI)	Predicted increase at nearest residence	A description of area affected
Kalang River	60mm	50mm	Dense vegetation, agricultural land and one dwelling
Deep Creek	10mm	None affected	Dense vegetation an agricultural land
Nambucca River (option 1)	Less than 20mm	20mm	Land identified by Council for future development
Nambucca River (option 2)	15mm	15mm	Land identified by Council for future development
Upper Warrell Creek	30mm	None affected	Dense vegetation and agricultural land
Warrell Creek	10mm	None affected	Agricultural land

The affected areas alongside most of the waterways and within the floodplain include urban areas, agricultural land and dense vegetation. The affected area along the Kalang River currently supports dense vegetation, agricultural land and one dwelling. The one affected dwelling is located on the floodplain and on land which is highly vulnerable to flooding. The Proposal would increase flooding by approximately 50mm in a flood that is over 1000mm deep and thus make a small incremental increase in the damages experienced at the dwelling.

The information from the flood modelling exercise has been used to assist with the design of bridge deck levels which would be significantly above the 1 in 100 year ARI flood levels on major waterway crossings.

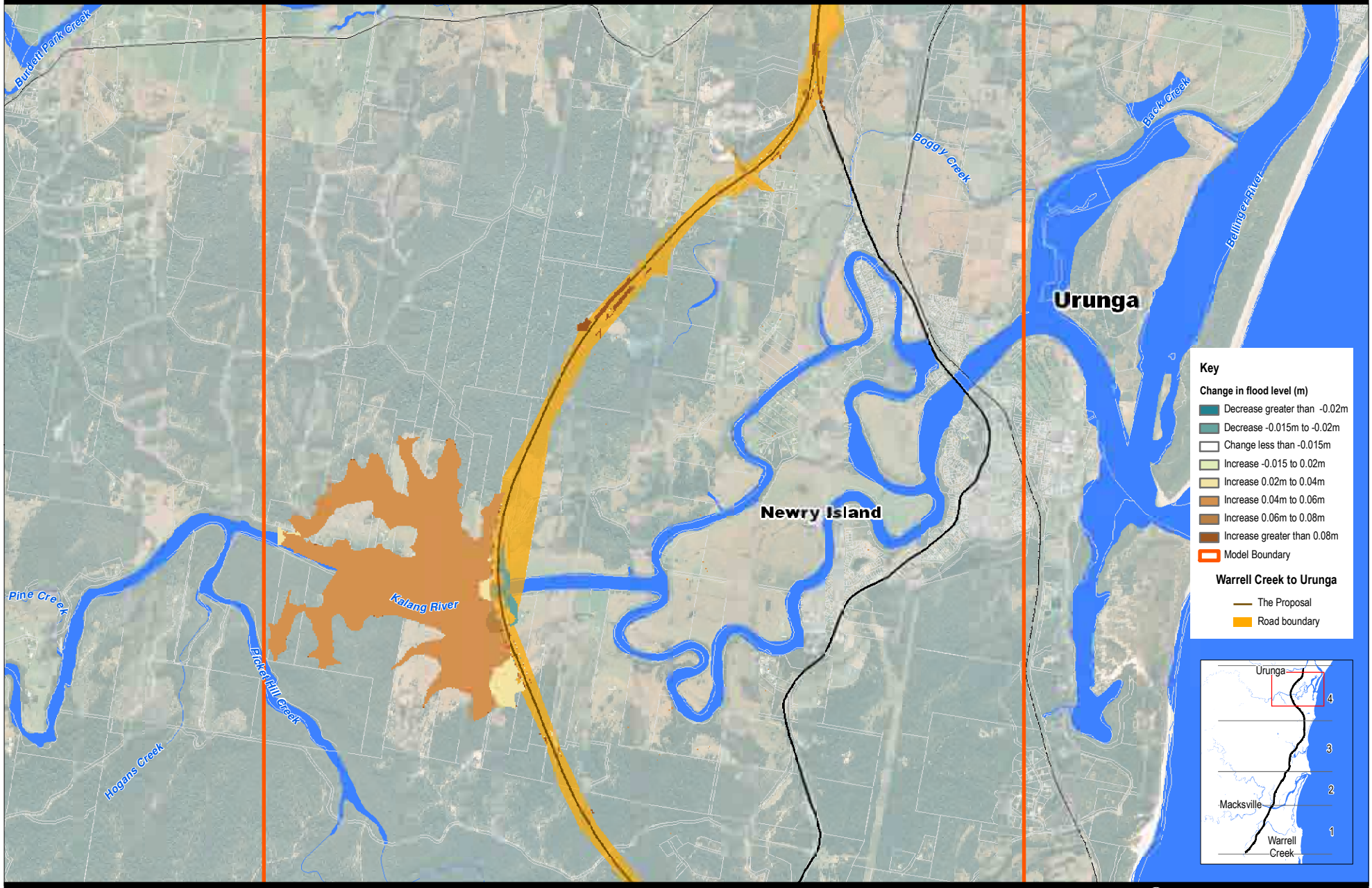
Future residential and industrial development proposed by Nambucca Shire Council in the flood risk area between Taylors Arm and Tilly Willy Creek has led to concerns from the community regarding possible downstream flooding impacts. The hydraulic assessment identified that the development would not impact the flood levels for the Proposal and the Proposal would not impact flood levels at the proposed development site.

FIGURE 16-1 | KALANG RIVER - EXISTING CONDITIONS 100 YEAR ARI FLOODING



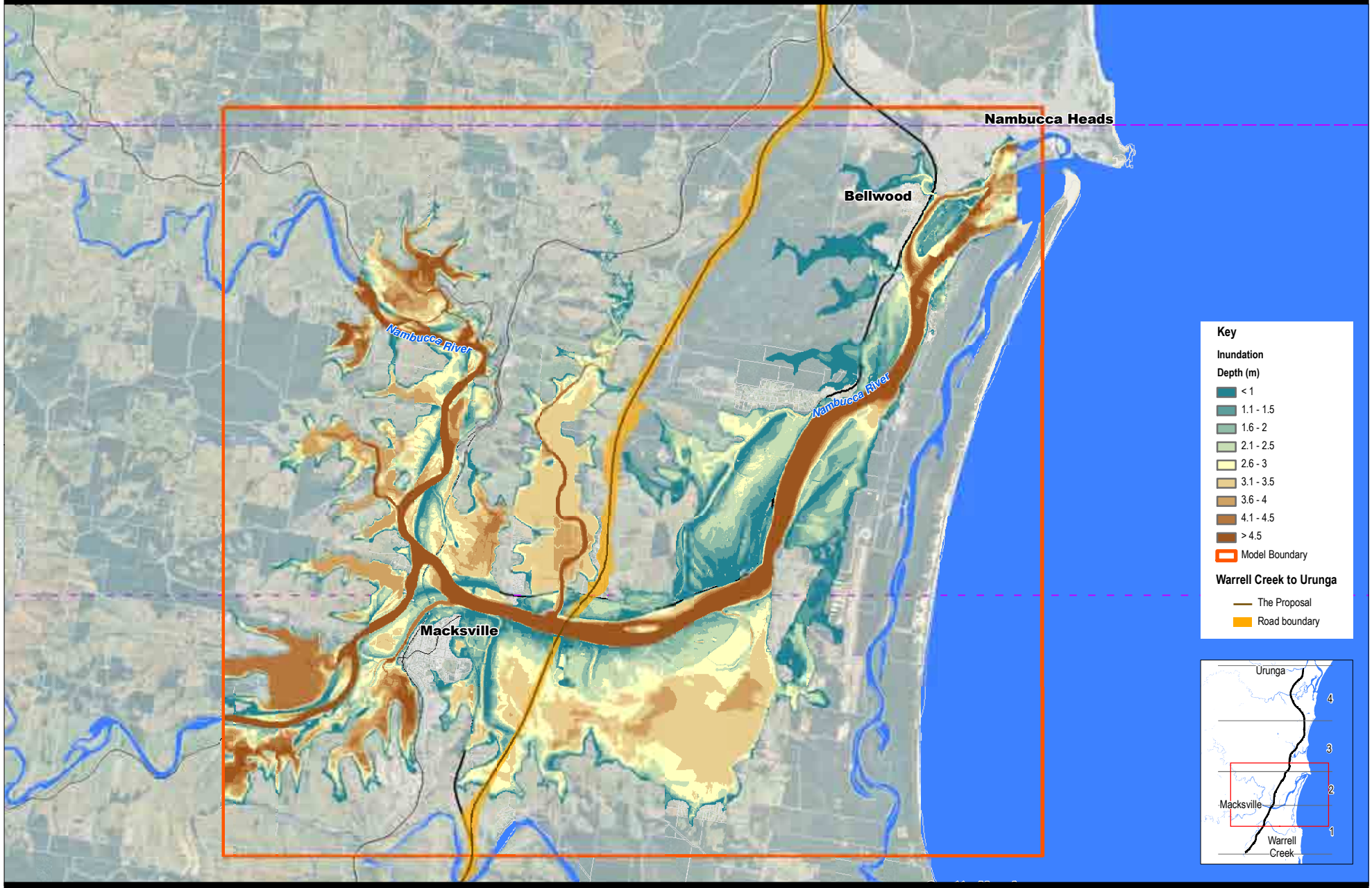
Warrell Creek to Urunga - Upgrading the Pacific Highway

FIGURE 16-2 | KALANG RIVER - DEVELOPED CONDITIONS 100 YEAR ARI FLOODING



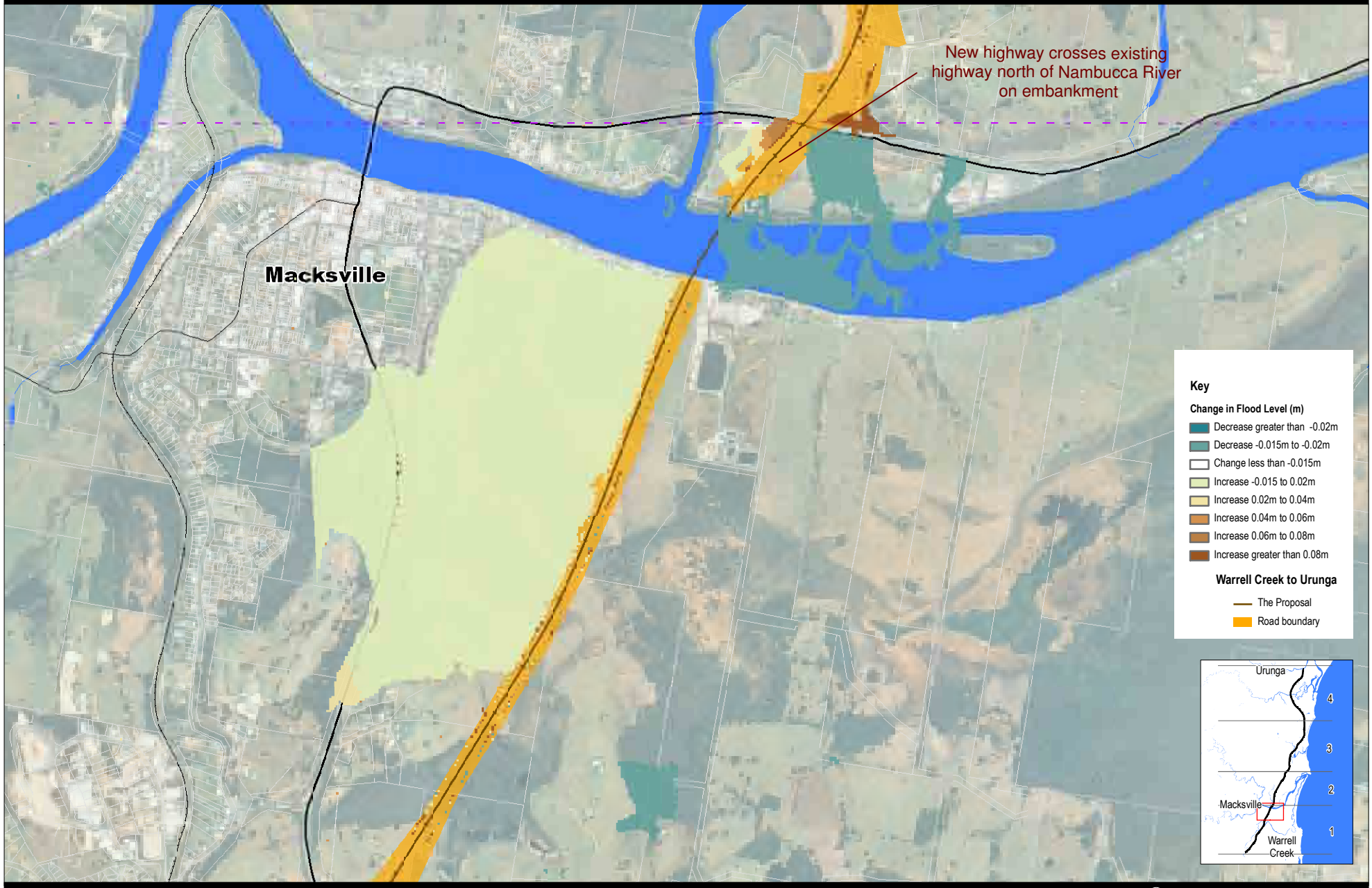
Warrell Creek to Urunga - Upgrading the Pacific Highway

FIGURE 16-3 | NAMBUCCA RIVER - EXISTING CONDITIONS 100 YEAR ARI FLOODING



Warrell Creek to Urunga - Upgrading the Pacific Highway

FIGURE 16-4a | NAMBUCCA RIVER - DEVELOPED CONDITIONS 100 YEAR ARI CHANGE IN FLOOD LEVEL (EMBANKMENT OPTION)

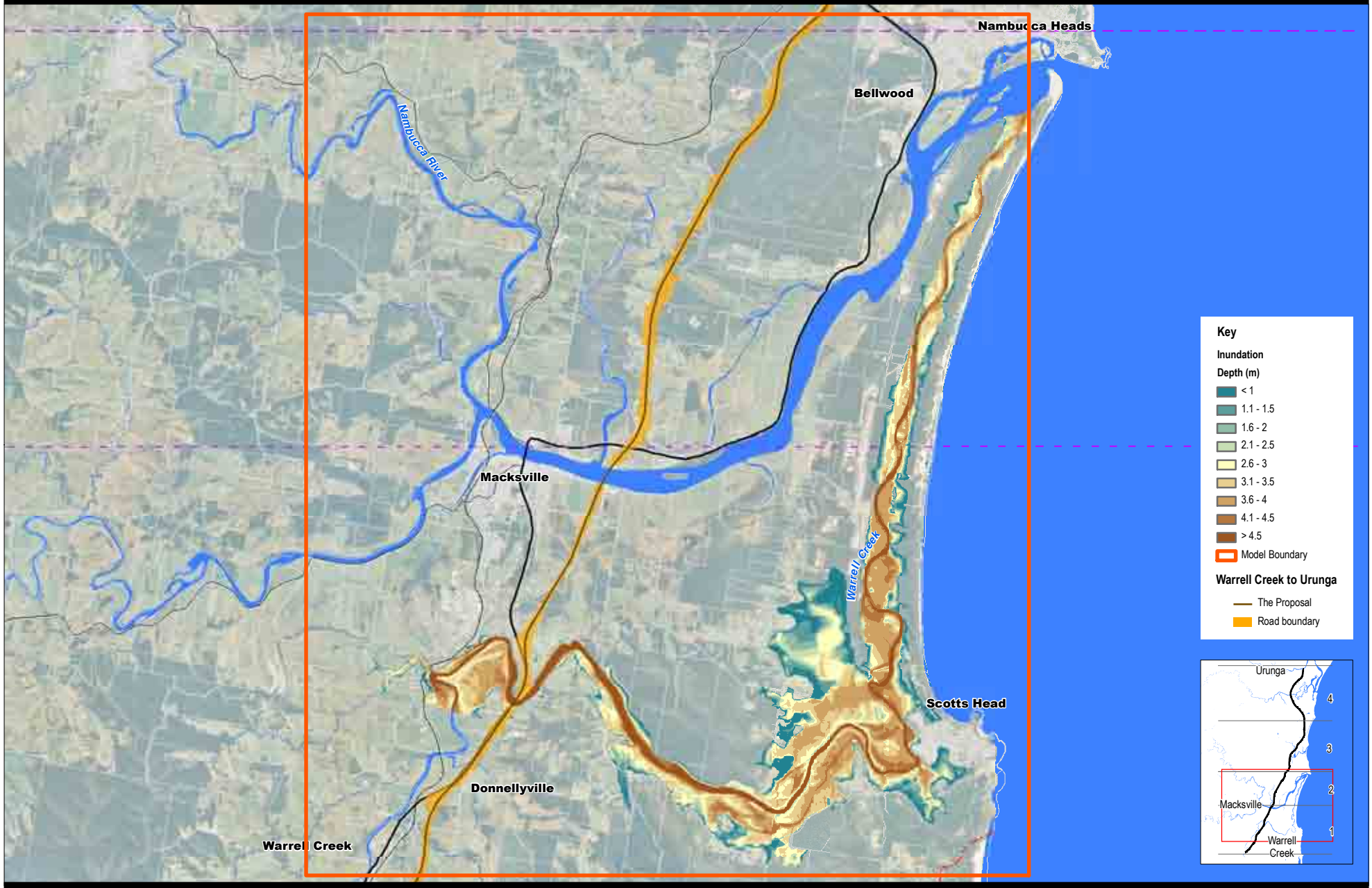


Warrell Creek to Urunga - Upgrading the Pacific Highway

FIGURE 16-4b | NAMBUCCA RIVER - DEVELOPED CONDITIONS 100 YEAR ARI CHANGE IN FLOOD LEVEL (BRIDGE OPTION)

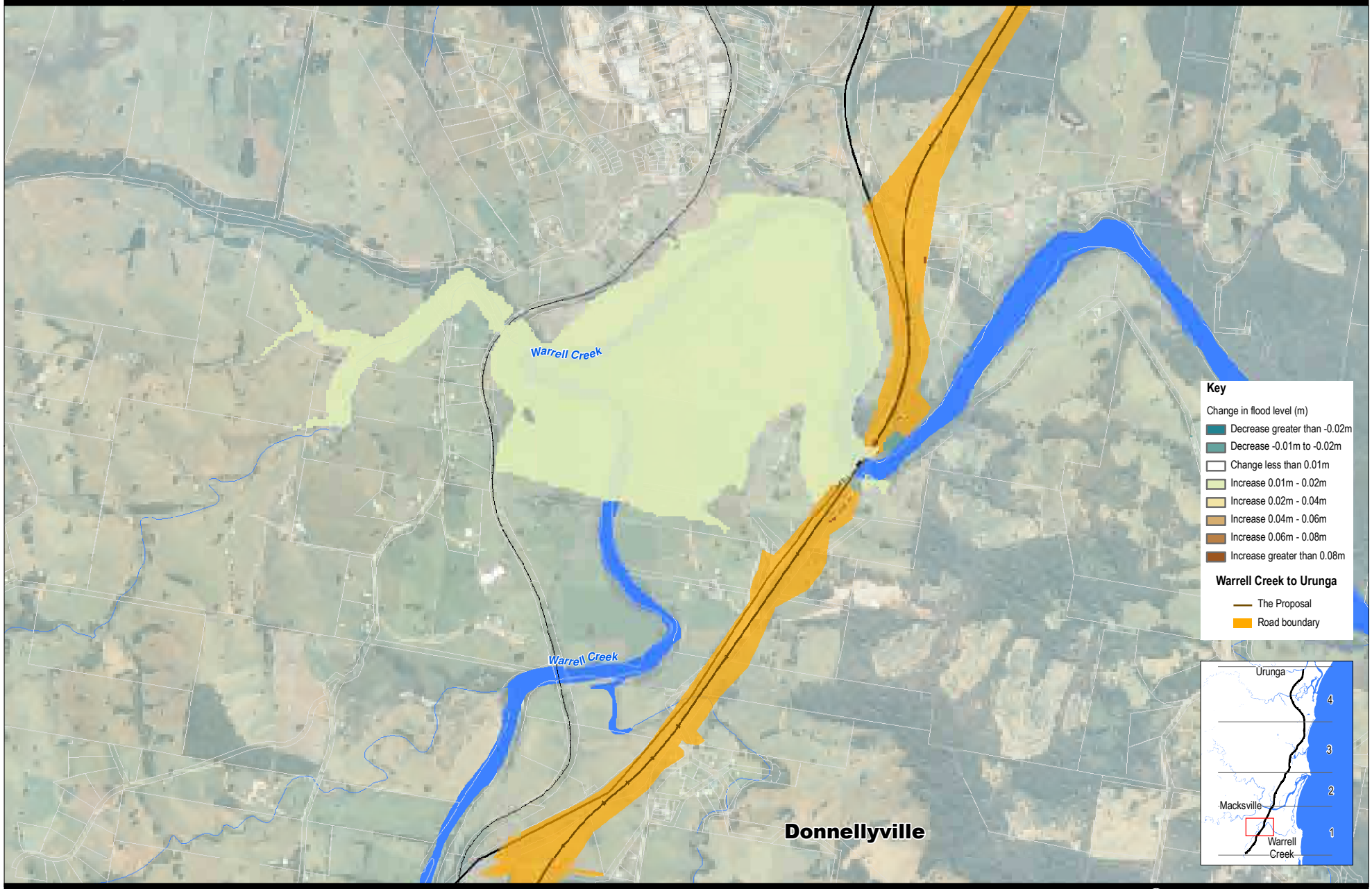
Warrell Creek to Urunga - Upgrading the Pacific Highway

FIGURE 16-5 | WARRELL CREEK - EXISTING CONDITIONS 100 YEAR ARI FLOODING



Warrell Creek to Urunga - Upgrading the Pacific Highway

FIGURE 16-6 | WARRELL CREEK - DEVELOPED CONDITIONS 100 YEAR ARI CHANGE IN FLOOD LEVEL



Warrell Creek to Urunga - Upgrading the Pacific Highway

The capacity of existing culverts to achieve 100 year ARI design standard was evaluated. The new crossings and culverts to be included along the Proposal have been sized based on the peak discharges derived from the hydrologic/hydraulic analysis outlined in Working paper 5 – *Water (Flooding).* The sizing of all underpasses would be confirmed at the detailed design stage.

In summary, cross drainage along the length of the Proposal would be facilitated at bridges and at culvert locations that are designed to allow the passage of water associated with a 1 in 100 year flood event. As per the objectives of the Pacific Highway Upgrade Program, the Proposal provides flood immunity for at least one highway carriageway for a one in 100 year flood event.

16.3.2.4 Flooding under climate change scenarios

A climate change sensitivity analysis was undertaken to assess the potential changes to the flooding regime and potential impacts to the proposed infrastructure resulting from climate change. The sensitivity analysis for climate change was undertaken for two potential effects comprising a rise in sea level and increase in rainfall intensity and depth. The modelling exercise identified that development of the Proposal has potential impacts on the flooding regimes of the five major waterways being traversed, the main impacts being an increase in flood levels upstream of the Proposal and an increase in the area of inundation.

The increase in flood levels resulting from climate change for a 1 in 100 year ARI flood compared with the flood levels for the current climate for selected locations along four of the major waterways is shown in Table 16-6. Further detail is provided in Section 3 of Working paper 5 – *Water (Flooding)*.

Table 16-6 Flood modelling results, developed conditions (climate change)

Waterway and location	Proposal in place – current climate	Proposal in place – changed climate	Impact of climate change on Proposal
	100 year ARI	100 year ARI	
Kalang River upstream side of bridge	60 mm	60 mm	Minimal impact on flood immunity or structural integrity of bridge
Deep Creek 20 m upstream of proposed bridge	10 mm	10 mm	Minimal impact on flood immunity or structural integrity of bridge
Nambucca River (option 1 - new highway crosses existing highway north of Nambucca River on embankment) upstream side of new highway	20 mm	40 mm	Minimal impact on flood immunity or structural integrity of bridge
Nambucca River (option 2 - new highway crosses existing highway north of Nambucca River on bridge structure) upstream side of new highway	15 mm	30 mm	Minimal impact on flood immunity or structural integrity of bridge
Upper Warrell Creek 25 m upstream of proposed bridge	30 mm	30 mm	Minimal impact on flood immunity or structural integrity of bridge

The increase in flood levels resulting from climate change for a 1 in 100 year ARI flood for the Kalang River, Nambucca River and Warrell Creek are shown in Figure 16–7, Figure 16–8 and Figure 16–9 respectively. The modelling demonstrates that while the extent of flood inundation is likely to increase under the climate change scenarios, the Proposal is unlikely to contribute to this increase.

The results of the changed climate modelling exercise showed that the Proposal at Kalang River would have limited impact on flood levels similar to the impacts under the existing climate. The impacts due to climate change would have minimal impact on the flood immunity or structural integrity of the proposed bridge over the Kalang River as the road deck is 5.7 m higher than the 100 year ARI flood event level.

The modelling showed that the impacts from increased rainfall rather than increased sea level are predicted to be more significant at the Nambucca River crossing. The climate change impacts would have minimal impact on the flood immunity or structural integrity of the proposed bridge as the deck level is higher than the 100 year ARI flood event level with climate change. The road over the Gumma Swamp floodplain, south of Nambucca River, is predicted to be overtopped by approximately 170mm under the increased rainfall climate scenario. The road over the floodplain north of the Nambucca River would be 7.5-8m above the flood levels under this same climate change scenario.

The climate change impacts would have minimal impact on the flood immunity or structural integrity of the proposed bridges over Warrell Creek and Upper Warrell Creek. The area of impact under the climate change scenario would not impact on any existing dwellings.

16.4 Management measures

This section describes the water quality and hydrology management measures that have been incorporated into the design of the Proposal.

16.4.1 Construction stage

16.4.1.1 Water quality

Sediment basins are designed to intercept run-off containing sediments and retain the sediment and attached pollutants thereby protecting the downstream waterways. Temporary water quality basins during construction have been designed for the Proposal in accordance with Soils and Construction, Volume 1, 2004, and Volumes 2C and 2D, 2008 manuals (known as 'the Blue Book'). All creeks and waterways along the Proposal have been considered in this assessment. Runoff from the construction areas would receive treatment at proposed sediment basins for all creeks and waterways except at less critical locations where the annual average soil losses were estimated to be less than 150m^3/annum, as recommended in the 'Blue Book'. Waterways with the DII classification of Class 1, 2 or 3 (major, moderate to minimal fish habitat) were provided with sediment basins regardless of the 150m^3/annum. The temporary sediment basins have been indicatively positioned at numerous locations along the Proposal as shown in Figures 6–1 to Figure 6–4. Following completion of the construction, a number of the sediment basins would be converted to permanent sediment basins depending on their suitability for operation.

FIGURE 16-7 | KALANG RIVER - DEVELOPED CONDITIONS WITH CLIMATE CHANGE IMPACTS 100 YEAR ARI FLOODING

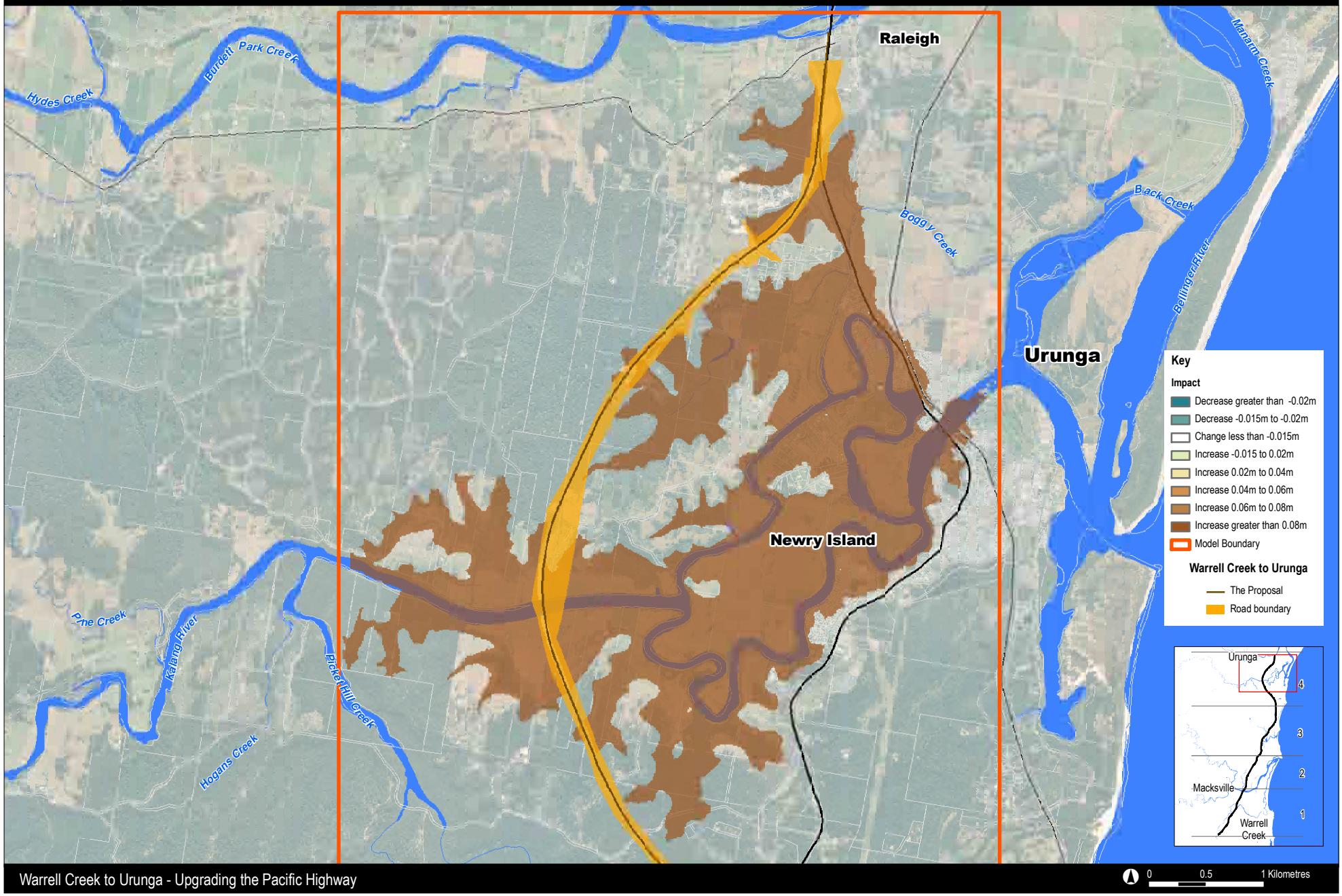
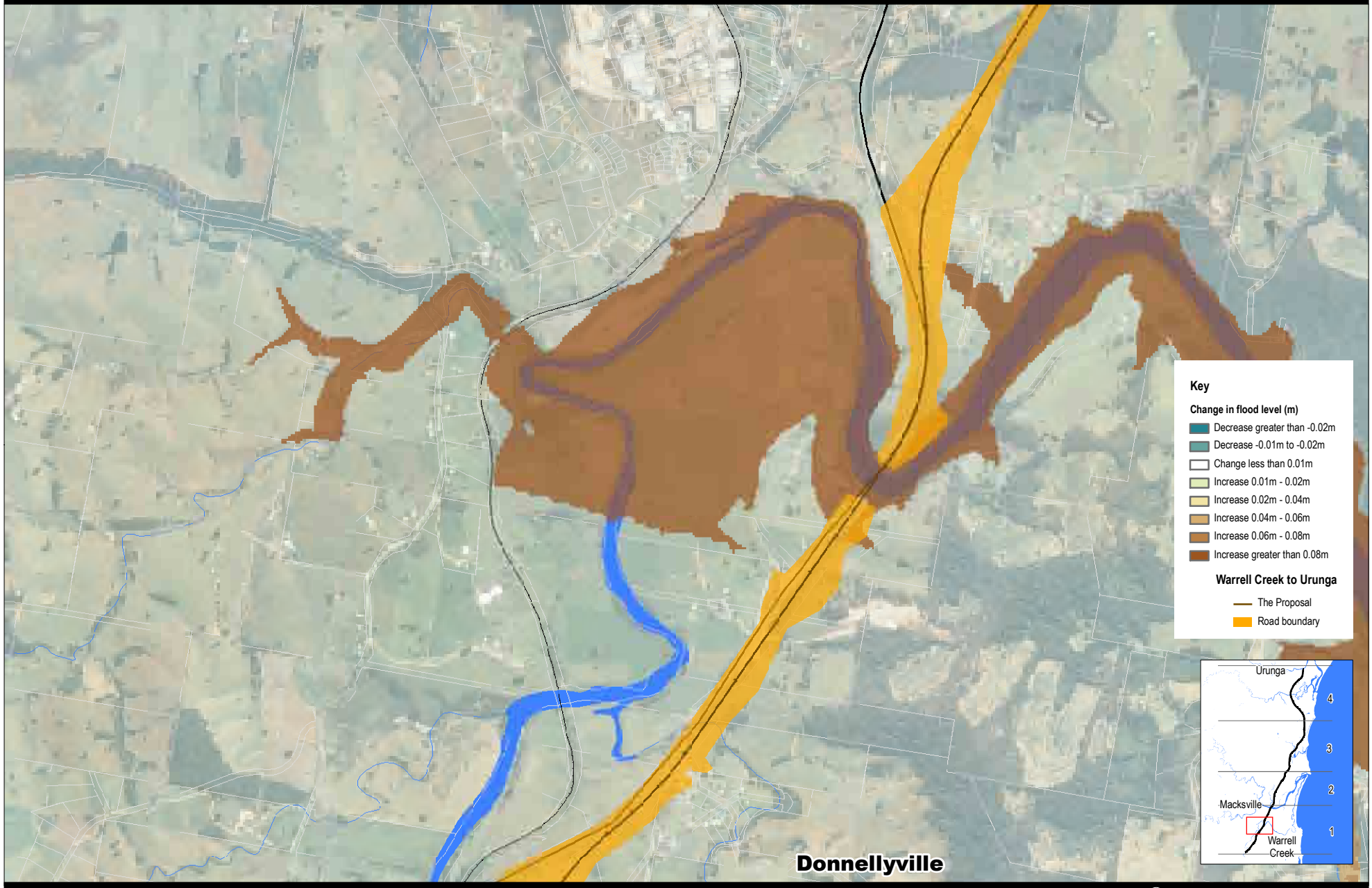


FIGURE 16-8a | NAMBUCCA RIVER - DEVELOPED CONDITIONS WITH CLIMATE CHANGE IMPACTS 100 YEAR ARI FLOODING (OPTION 1)

FIGURE 16-8b | NAMBUCCA RIVER - DEVELOPED CONDITIONS WITH CLIMATE CHANGE IMPACTS 100 YEAR ARI FLOODING (OPTION 2)

FIGURE 16-9 | WARRELL CREEK - DEVELOPED CONDITIONS WITH CLIMATE CHANGE IMPACTS 100 YEAR ARI FLOODING



Warrell Creek to Urunga - Upgrading the Pacific Highway

Details of the additional erosion and sediment controls on site, to minimise the potential for adverse water quality impacts and associated risk to aquatic habitats during construction, would be provided at the detailed design stage as part of a comprehensive soil and water management plan. The plan would include:

- Diversion of external 'clean' runoff around the construction area to reduce mixing of 'clean' and 'dirty' runoff and to consequently reduce the size of the required sediment basin.
- Diversion of all "dirty" runoff to the proposed sediment basin.
- Installation of sediment fences and straw bales to trap sediments.
- Installation of barrier fences to delineate the extent of site that can be disturbed.
- Installation of sediment traps and check dams, where required, especially in smaller catchments where a sediment basin has not been proposed.
- Stockpiling and reuse of all topsoil.
- Rehabilitation of disturbed area as quickly as possible.
- Water quality monitoring at the outlet of the sediment basins.

16.4.1.2 Acid sulphate soils

The management of acid sulphate soils is addressed in Chapter 18 - *Soils characteristics and erosion controls*. The Proposal would avoid or minimise excavation and lowering of the water table in areas known to contain acid sulphate soils. The use of sediment basins has not been adopted on floodplains due to acid sulphate soils that are expected to be encountered should any excavations be undertaken. Swale drains (elongated basins) or other appropriate controls would be used instead of basins in areas of acid sulphate soils. Monitoring of water quality downstream of acid sulphate soil risk areas would also allow early identification of potential risks from acid sulphate soils and would ensure that mitigation measures are implemented in a timely manner.

16.4.1.3 Groundwater

To quantitatively assess possible groundwater impacts and management requirements or mitigation measures, it is recommended that baseline monitoring, of both groundwater levels and chemical quality, be completed at selected cutting sites at the detail design stage to resolve the uncertainty of the predication of groundwater behaviour, particularly at those cuttings which are most likely to impact environmental features such as springs, creeks and endangered ecological communities (typically Type A cuttings in Table 16-4). Monitoring of selected cutting sites should commence in advance of construction and should comprise the following:

- Installation and monitoring of groundwater wells (potentially nested or multi-level) prior to road construction.
- Hydraulic tests (falling head) to estimate hydraulic conductivities of the shallow and possible deep aquifer systems that the cuts may intersect (prior to road construction).

- Groundwater sampling and analysis for at least total dissolved solids, pH, and heavy metals and hydrocarbon compounds prior to, during and following road construction to identify whether baseflow to creeks is provided by the groundwater systems.
- Monitoring of cuttings to determine whether these are having an adverse impact on water quality.
- Visual observations and quantitative measurements of surface water flows at creeks.
- An assessment of the condition of endangered ecological communities.
- Where there is the potential for adverse impacts on groundwater, measures including the use of groundwater diversion systems would be included in the detailed design.

16.4.1.4 Flooding

To minimise the potential for adverse flooding impacts and associated risk to aquatic habitats, property and other assets during construction, a soil and water management sub-plan would be prepared by the RTA as outlined above. Measures specific to flooding impacts to be included are:

- Avoidance of flood prone land during selection of construction compounds where possible, and inclusion of possible flow diversion to divert flows and ensure adequate drainage of the construction works with provision for large rainfall events.
- Provision of adequate waterway areas through embankments constructed on the floodplains, with consideration given to impacts of large flood events that would pass over the top of the final formation but be restricted by preloaded embankments.
- Provision of culverts and bridges along the length of the Proposal to allow passage of water for a 1 in 100 year flood event.

16.4.2 Operational stage

16.4.2.1 Water quality

The water quality objective for the road upgrade during the construction and operational phases is to protect sensitive waterways through the installation of devices which treat stormwater as close to its source as possible, to ensure that the existing water regime is altered to the smallest amount practicable from the road upgrade. To achieve this objective, measures have been incorporated into the drainage design to ensure pavement runoff passes though a water quality control measure before entering the receiving water, where possible. General pavement drainage would also incorporate methods for the retention of a minimum 20,000 litres of oil or chemical polluted run-off for the more sensitive water crossings.

The proposed water quality measures incorporated into the drainage design of the Proposal would include permanent water quality basins, vegetated swales and permanent spill containment basins. These water quality control devices would mainly target suspended solids and their associated pollutants and would also provide a function for the required containment of accidental spills.

Permanent water quality basins would be used to trap the finer sediments and associated contaminants before stormwater is discharged into the receiving waterways. The basins would treat road pavement and batter runoff collected by the pavement drainage network. Permanent sediment basins have been indicatively positioned at numerous locations along the Proposal as shown in Figures 6–1 to Figure 6–4. The location and design of the water quality basins are described in Working paper 5 - *Water (Water quality).*

Vegetated swales/table drains could be used in some circumstances where sediment basins used during the construction phase are decommissioned and vegetated swales are used to replace them as a water quality treatment measure. Treatment of stormwater is provided through the removal of suspended solids and their associated pollutants. The locations where vegetated swales can be used would be identified at the design stage of the Proposal.

Permanent spill containment basins would also be used and would be designed to capture liquid spills of a maximum 20,000 litres. The water quality strategy for permanent spill containment basins is based on an assessment of the sensitivity of the water crossings and waterways along the road upgrade. The sensitivity of the creeks and waterways has been determined by using the DII classification. Following containment, the pollutant would be pumped out and the spill disposed of in an appropriate manner. The location of sensitive waterways and provision of spill containment basins are provided in Working paper 5 - *Water (Water quality).*

A practical water quality monitoring program to assess potential impacts on downstream water quality would also be implemented, until revegetation becomes established. These mitigation and management measures, along with the proposed design features are considered appropriate to manage the potential water quality issues identified as being associated with the construction and / or operation of the Proposal. With the implementation of the proposed impact mitigation and management measures there would be little, if any, residual impacts on water quality. The occurrence of any residual impacts would be identified through the proposed water quality monitoring program, with action taken to address any residual impacts as required.

16.4.2.2 Groundwater

Groundwater monitoring would be initiated prior to construction to collect background data, and during the early years of operations, at frequency to be determined (potentially quarterly during the early years of operations) and documented in the soil and water management sub-plan.

The objective of monitoring would be to verify the validity of groundwater levels, and to flag adverse trends. At cuttings where mitigation measures are implemented, monitoring may permit an early assessment of groundwater behaviour in response to the mitigation measures and verify the effective functioning of those measures.

The transfer of seepage or extracted water downstream to maintain local groundwater levels may be required. Transfer could include the collection of seepage from the cut face in the drainage system which would be diverted to absorption trenches or to water quality ponds to be tested and possibly treated before being released back to the creek or natural drainage system at some point downstream.

16.4.2.3 Flooding

The potential impacts associated with the Proposal on the five major waterways have been mitigated or minimised with the following measures:

- Route selection that minimised the number of crossings of major waterways, and avoided sensitive areas.
- Vertical and horizontal alignment of the Proposal took local conditions including inundation risks into consideration.
- Provision of floodplain structures to maintain existing flood regimes including culverts and bridges. These have been sized for a 1 in 100 year flood event.
- 1 in 100 year flood immunity for the upgrade across floodplains.
- Sufficient clearances below major waterway bridges to enable the free passage of river traffic.

16.4.2.4 Climate Change

According to current knowledge of climate change science, the future climate that the Proposal will operate in will be one different from the current. According to the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the future climate is likely to be characterised by an increased temperature and more intense storm events that occur less frequently. Although the storms will be more intense, the spells between large rainfall events are expected to be longer and this will coincide with increasing sea levels over time.

More intense storms have ramifications to the proposal in terms of higher winds and more intense rainfall. They are also expected to create larger storm surge that will build over a base of higher sea levels. The flooding regime for the Proposal is therefore expected to change with time.

Current knowledge suggests that rainfall events that would cause the current 1 in 100 year ARI flood may occur more frequently in the future. The 1 in 100 year flood will therefore be redefined over time to be a larger and more damaging event.

The science behind climate change predictions is currently in a period of rapid development. The predictions of rainfall intensity increases over the coming years are published on the CSIRO climate change website (http://www.climatechangeinaustralia.gov.au/index.php) and relate the change in rainfall intensity to the range of probable increases in carbon dioxide emissions.

Development of the Proposal must therefore be planned with an awareness of the potential for climate change impacts on the Proposal and the range of the potential impacts. For the Proposal, the RTA considers that an adaptive approach provides the most appropriate methodology for the management of the impact of future climate change on flood behaviour and the performance of the highway drainage structures. This approach would involve:

- Designing and constructing the proposal to achieve the Proposal objective of providing flood immunity on at least one carriageway for a 1 in 100 year flood event.
- Monitoring the performance of the installed drainage structures.

- Periodic reviews of published rainfall and ocean level data and advices / guidelines issued by appropriate organisations.
- Determine, based on the above data, the actual and/or predicted performance of the highway drainage structures and compare this performance against the Proposal objective of providing flood immunity on at least one carriageway for a 1 in 100 year flood event.
- Identify any location(s) where the performance of the highway drainage structures does not satisfy the Proposal objective and identify and assess measures to manage these areas. Potential management measures could include:
  - Augmentation of the drainage structures and/or undertaking other works to provide flood immunity on at least one carriageway for a 1 in 100 year flood event.
  - Accept a reduced level of flood immunity at these locations and implement appropriate measures to any impacts of the reduced flood immunity.
  - A combination of the above.
- Implement the adopted management measures.

Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

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17. Traffic and transport

Traffic and Transport is identified as a key issue in the Director-General's requirements. A detailed traffic and transport assessment was undertaken and is presented in this chapter. This assessment is supported by Working paper 6 – Traffic and Transport.

Director-General's requirements	Where addressed in the EA	
Traffic and transport – including but not limited to the following: Operational traffic and transport impacts to the local, regional and fire trail networks (existing and planned) including impacts from traffic rerouting and modified access to the upgraded highway. Public transport impacts (including on bus services). Interactions with rail infrastructure and the viability of a shared road and rail corridor. Construction traffic impacts (including spoil haulage).	Section 17.2.1	Existing road network
	Section 17.2.2	Planned road network
	Section 17.3	Impact of future traffic growth on the existing road network
	Section 17.4	Traffic and transport impacts
	Section 17.4.1	Changes to the road network with the proposed upgrade (impacts from traffic rerouting)
	Section 17.4.5	Impacts on local roads and modified access to the upgraded highway
	Section 17.4.6	Impacts on fire trail network
	Section 17.4.8	Impacts on public transport including bus services
	Section 17.2.11	Interaction with rail infrastructure
	Section 17.4.9	Construction traffic impacts

17.1 Assessment approach

To undertake the traffic and transport assessment, background data were gathered from a number of sources including:

- Historical and current traffic count data.
- Heavy vehicle facilities and usage.
- Reported accident history.
- Previous relevant traffic studies in the area.
- Existing and proposed pedestrian and bicycle facilities.
- Public transport facilities and operation.

The data collected for the traffic assessment were used to evaluate the overall effect of the Proposal on traffic volumes and patterns on the proposed upgrade and on local roads.

Objectives related to the Pacific Highway Upgrade Program were used to guide the development of the Proposal. The Proposal objectives relevant to traffic and transport issues are shown in Table 3-1.

17.2 Existing traffic and transport characteristics

17.2.1 Existing road network

The roads in the study area provide both regional and local access. Regional roads are usually sealed and provide access between urban areas in the study area, and connections to other centres outside the study area. Local roads can be sealed or unsealed provide access to local residences, community facilities and services within the confines of the study area. Other roads within the study area which have been considered during the environmental assessment are fire trails. These exist within the state forests and provide access to emergency vehicles and some isolated rural properties. Fire trails are unsealed and except for recreational pursuits, are not suitable for use as public thoroughfares.

The road network within the study area is made up of a hierarchy of roads ranging from local unsealed and sealed roads to the existing Pacific Highway's local, regional and interstate connection role. The existing Pacific Highway provides the main north-south access within the study area. Through the study area, the existing Pacific Highway is predominantly a two-lane single carriageway with a general speed limit of 100 kilometres per hour, although this is reduced when the highway passes through the built-up areas of Warrell Creek, Macksville, Nambucca Heads/Bellwood and Urunga, and where road conditions, adjacent conditions or local access arrangements dictate that a lower speed limit is necessary.

A key traffic constraint on the existing highway is the Macksville Bridge. Numerous accidents, many of which have blocked the highway, have occurred on the bridge and its approaches. Occasionally, these accidents have damaged the bridge structure resulting in closure of the bridge for extended periods while repairs were made. Signalised intersections on the southern side of the Nambucca River also result in significant traffic queuing during holiday periods.

Regional roads

In addition to the Pacific Highway, other significant roads providing strategic intra-regional connections in the study area are shown in Figure 17-1a and b and include:

- Scotts Head Road – provides access between the Pacific Highway and coastal communities including Scotts Head.
- Taylors Arm Road / Wallace Street - provides access between Macksville and small communities to the west.

- Ferry Road/Bellingen Road - provides access between the Pacific Highway at Macksville and communities to the north-west.
- Rodeo Drive - provides access between Macksville and Bowraville to the west.
- Riverside Drive / Mann Street / Old Coast Road - provides access between the Pacific Highway and Nambucca Heads/Bellwood.
- Shortcut Road - provides alternate access between Pacific Highway and Bellingen through Urunga.
- Waterfall Way - provides access between the Highway and coastal strip and towns such as Bellingen, Dorrigo to the west.
- Waterfall Way is also an inter-regional connection, providing access beyond the Mid North Coast Region to the New England Region.

Local roads

The existing key roads in the study area are illustrated in Figure 17-1a and b. As can be seen, the road network primarily comprises urban collector and local roads that provide local access to the Pacific Highway and other arterial roads (shown in blue) as well as to residences and services through the study area.

The local roads act to provide access to local residences, serve local facilities and communities and are used predominantly by local traffic, which is defined as having its origin and destination between the northern and southern extents of the study area (including Bellingen and Waterfall Way). Local traffic includes visitors, trips related to business within the area, as well as to these trips made by local people living and working in the study area.

Fire trails

Fire trails exist through the Nambucca, Newry and Little Newry State Forests. These are managed and maintained by Forests NSW to allow for timber harvesting and haulage, for recreational use, research and to allow access for fire fighting and hazard reduction burning. The fire trails are not strictly 'public roads' and under the *Forestry Act* 1916, Forests NSW retains the right to close these roads as required. The fire trails in the study area are predominantly accessed from tracks off the existing Pacific Highway. Fire trails within privately owned forest areas are not available for general public use.

17.2.2 Planned road network

Potential future urban areas and other proposed development as identified by Nambucca and Bellingen Shire Councils is discussed in Chapter 11 – *Land use and property.* This chapter also outlines proposed changes to the road network to support proposed development within the study area, or to accommodate access as a result of the Proposal.

FIGURE 17-1a | EXISTING ROAD NETWORK IN STUDY AREA — SECTION 1 OF 2

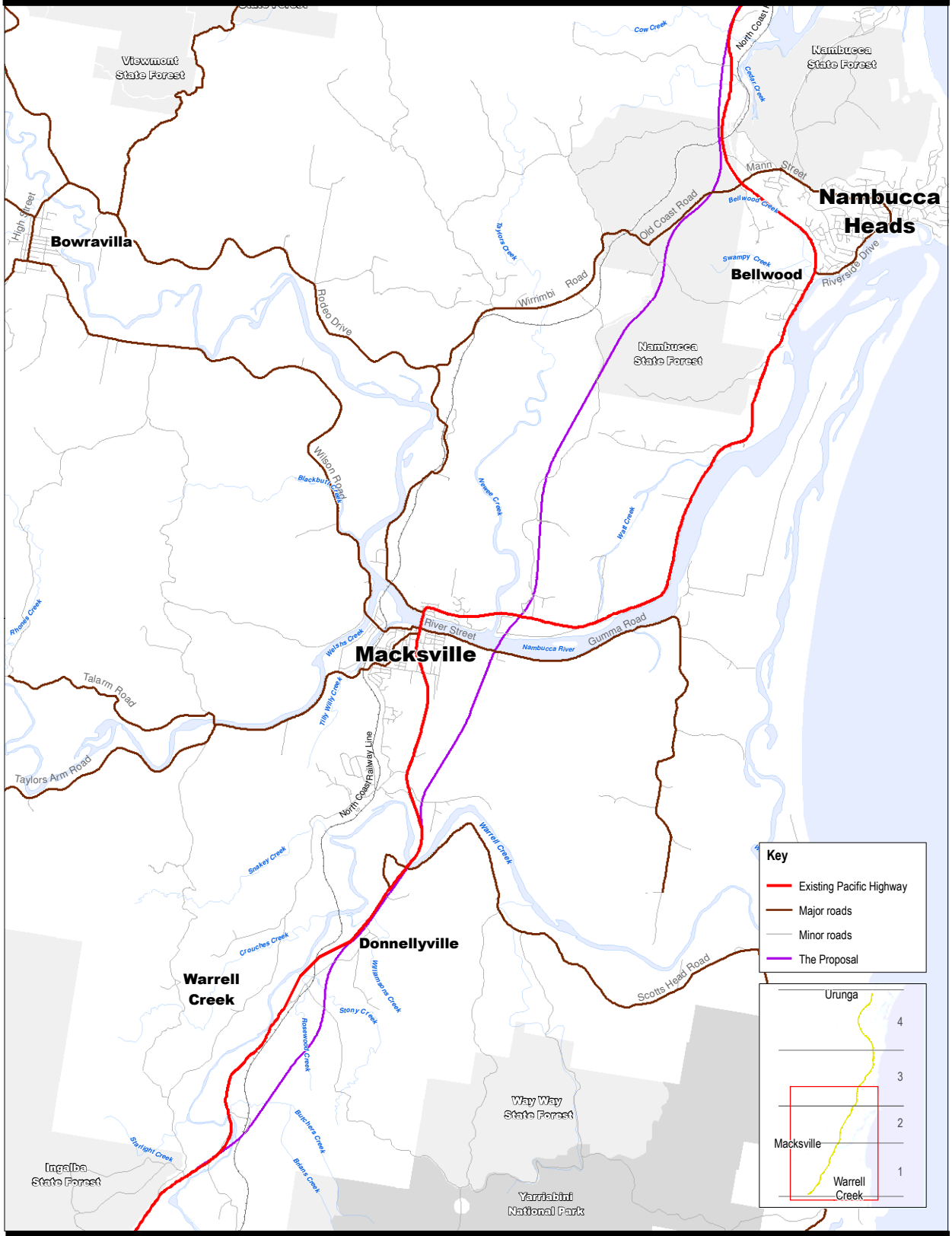
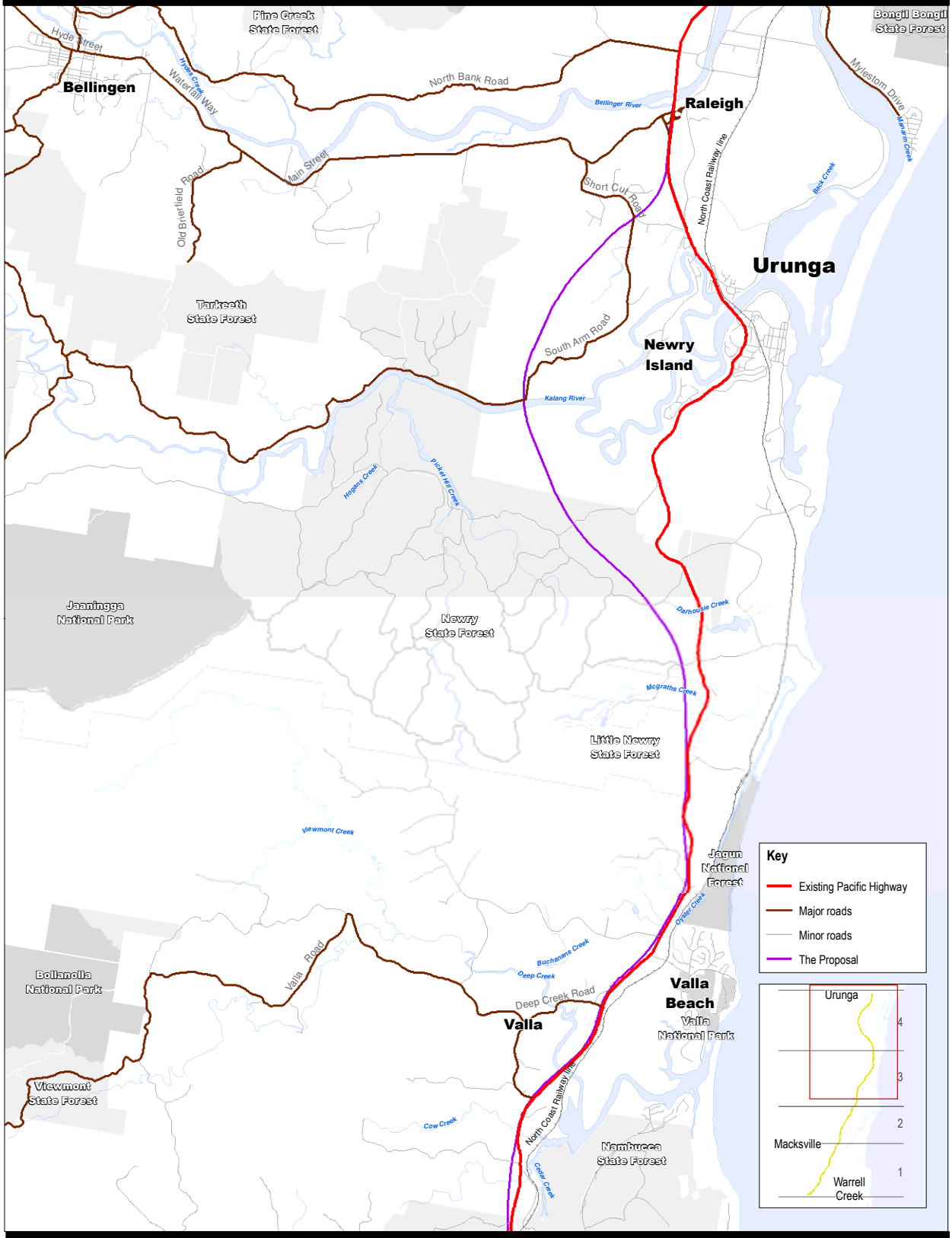


FIGURE 17-1b | EXISTING ROAD NETWORK IN STUDY AREA — SECTION 2 OF 2



Regional roads

There are no current plans for significant upgrades to the regional road network in the study area, aside from the Pacific Highway upgrade (the Proposal).

Local roads

Future development of the Nambucca Shire is likely to increase the strategic importance of currently lower-order roads such as Cow Creek Road, Boggy Creek Road and Burkes Lane, north of Nambucca Heads. The development of the Pacific Highway upgrade has been undertaken in consultation with the councils to ensure that the Proposal could be integrated with the future development plans.

Fire trails

There are no significant changes proposed to the fire trails within the study area. Those that are present would continue to be maintained by Forest NSW. As noted in Chapter 5 – *Community consultation*, design refinements have been included in the Proposal to maintain access to forestry areas for both resource and fire management.

17.2.3 Existing traffic volumes

Table 17-1 provides an estimate of the annual average daily traffic (AADT) volumes in 2007 along the existing Pacific Highway and Waterfall Way in the study area. The AADT was estimated from seasonally adjusted survey counts conducted at various locations in the study area in November 2007. Traffic is highest between the urban centres of Macksville and Nambucca Heads, and north of the Raleigh interchange where traffic from Waterfall Way joins the highway to access Coffs Harbour.

Table 17-1 2007 annual average daily traffic estimate

Location	2007 AADT estimate (vehicles)
Pacific Highway, end of dual carriageway, south of Warrell Creek (north of Upper Warrell Creek Road)	9,000
Pacific Highway, south of Bald Hill Road	10,400
Pacific Highway, south of Florence Wilmont Drive (near Watts Creek Bridge)	12,400
Pacific Highway, south of Valla Beach Road	11,000
Pacific Highway, at Bellingen / Nambucca local government area boundary	10,550
Pacific Highway, at Bellinger River (north of Waterfall Way interchange)	13,550
Waterfall Way, between Raleigh and Bellingen	6,750

As shown in Figure 17-2, heavy vehicles (trucks and buses) constitute a much higher proportion of traffic during early morning and late at night than during the day, due to the lower volume of light vehicles during those times. Heavy vehicles make up around 19 per cent of total daily traffic.

Figure 17-2 Traffic composition

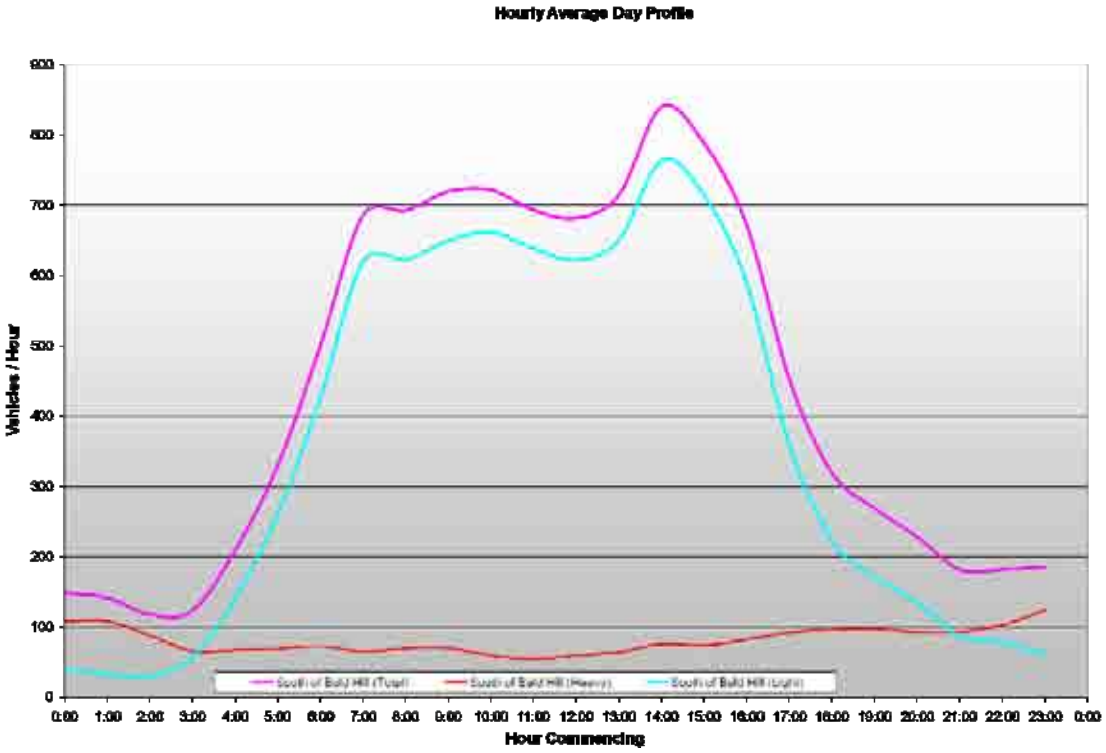
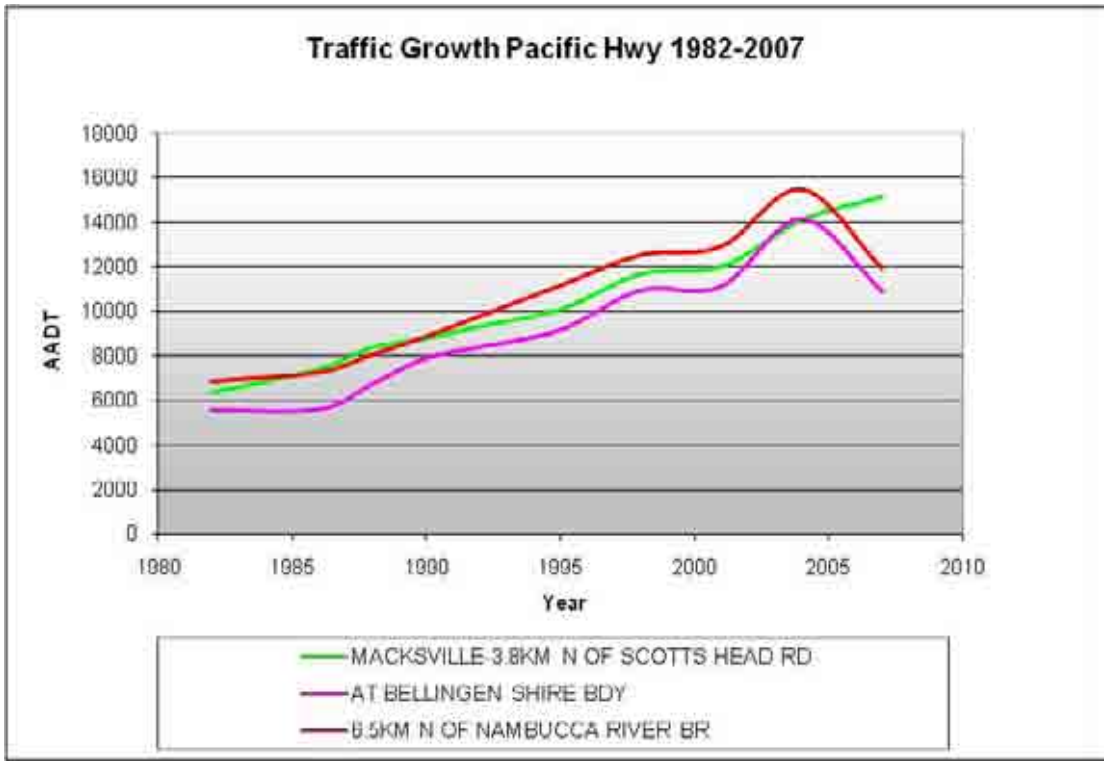


Figure 17-3 illustrates the traffic growth between 1982 and 2007 at three Pacific Highway locations in the study area. The graph shows a steady increase in traffic between 1982 and 2007, with the highest volume of traffic at Macksville. The estimated average long-term growth rate for traffic within the study area from 1982 to 2007 is 2.1 per cent per annum (linear, with base year 2007). A change in the RTA's reporting methods is evident on the graph as a dip in the traffic levels at two of the sites from around 2002.

Figure 17-3 Traffic growth along the Pacific Highway in the study area, 1982-2007



17.2.4 Current network capacity

The Pacific Highway within the study area varies in its capacity between one lane and two lanes in each direction. The nominal capacity of the single-lane sections is approximately 2,800 vehicles per hour (two-way) or 1,400 vehicles per hour (in each direction) , but this is reduced when taking into account such factors as the terrain, road shoulder provision and the proportion of heavy vehicles in the traffic stream.

The performance of a road during a particular hour can be measured by the Level of Service (LoS), which is estimated from the capacity of the road and the volume using the road. The LoS of a section of road varies from A (free flow, travel at posted speed limits) to F (forced flow, travel speeds well below the posted limit), and describes the ease with which drivers are free to select their desired speed and manoeuvre within the traffic stream[2]. The design peak hour Level of Service at all Pacific Highway sites surveyed for this Proposal (detailed in Working paper 6 – *Traffic and transport*) is currently at E (congestion and intolerable delays).

[2] A roadway with Level of Service D is operating close to its limit of stable flow, with all drivers being severely restricted in their freedom to select their desired speed and to manoeuvre in the traffic stream. At Level of Service E traffic volumes are close to or at capacity and there is virtually no freedom to select desired speeds or manoeuvre in the traffic stream.

Other roads in the study area are generally free of congestion, with traffic volumes much less than those experienced on the existing highway.

17.2.5 Traffic patterns

An origin-destination survey was undertaken to examine the traffic patterns and composition of traffic within the study area. This categorises the traffic into through-traffic (heavy and light vehicles where both the origin and destination lie outside the study area), regional traffic (where one of either the origin or destination are outside the study area) and local traffic (where both the origin and destination are within the study area). The results of the survey are summarised as follows and shown in Figure 17-4 and Figure 17-5.

- Approximately 60 per cent of northbound light vehicles entering the study area from the south were classified as through-traffic, with both their origin and destination outside the study area.
- Approximately 75 per cent of northbound heavy vehicles entering the study area and almost 58 per cent of heavy vehicles entering the study area from the north and heading south were classified as through-traffic. The southbound percentage is lower due to the higher volume of traffic entering the study area from the north.
- Approximately 50 per cent of all recorded trips are classified as local traffic, particularly between Macksville, Nambucca Heads, Urunga and Bellingen.
- Approximately 40 per cent of traffic was classified as regional traffic.

Figure 17-4 Total versus through traffic 2007

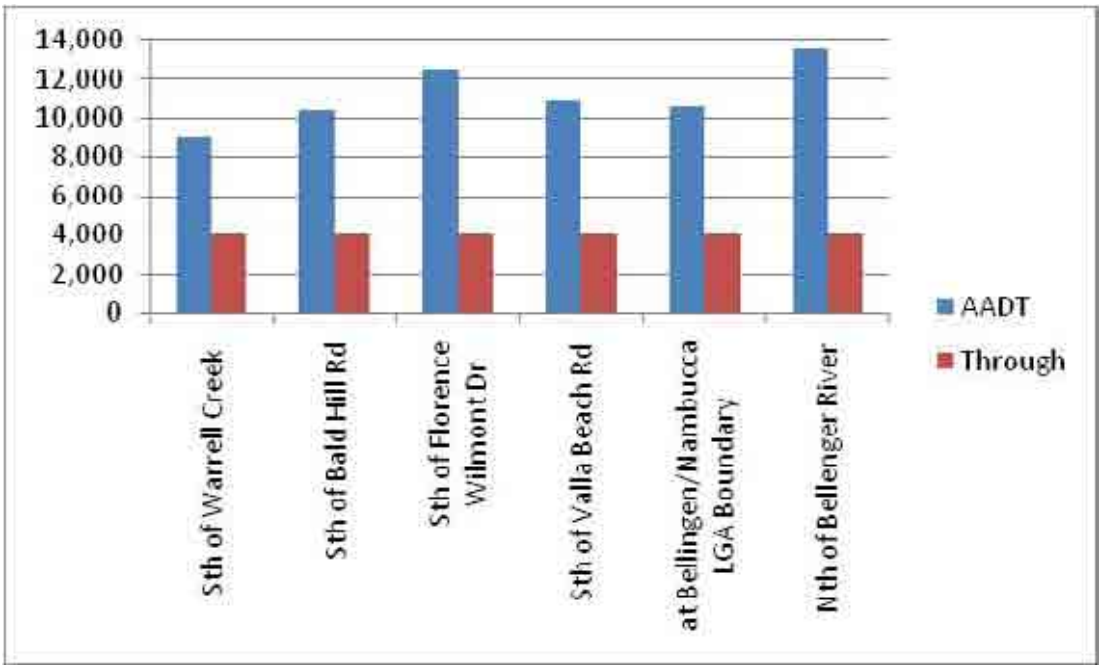
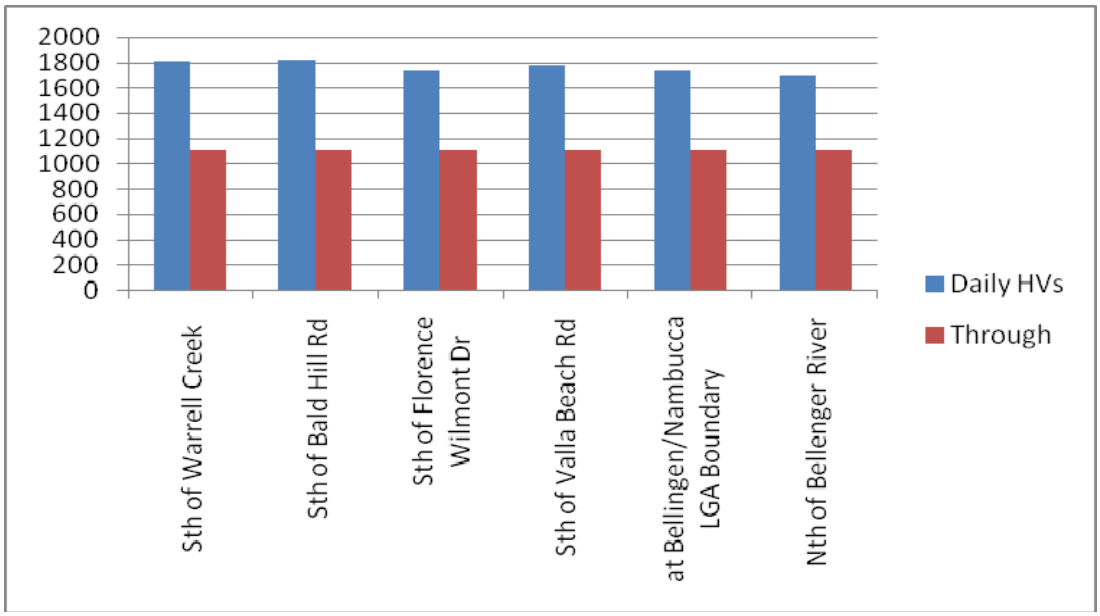


Figure 17-5 Daily heavy vehicle traffic versus through heavy vehicles 2007



17.2.6 Travel time

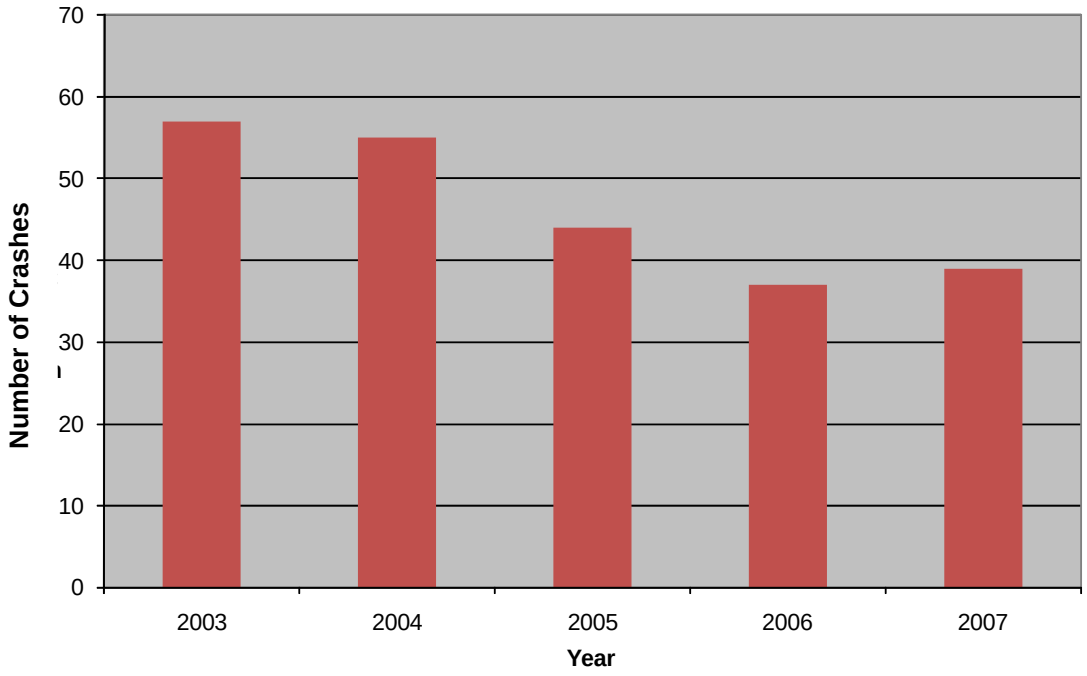
At the current signposted speed limits, travel time for the investigation area is approximately 32 minutes for the 45 kilometre length of the existing highway (around 84 kilometres per hour). This travel time can vary significantly, especially in holiday periods when heavy congestion north and south of Macksville Bridge is commonplace, often resulting in delays of approximately 30 minutes.

17.2.7 Road safety

An historical crash analysis was carried out over a five year period for the years 2003 to 2007 (inclusive), based on the RTA Traffic Accident Database. Crashes have been spread fairly evenly along the highway in the study area, although a number of locations have experienced multiple crashes. The number of crashes from 2003 to 2007 inclusive is shown in Figure 17-6.

A target of 15 crashes per 100 million vehicle kilometres travelled (MVKT) was set for the Pacific Highway Upgrade Program. A total of 229 accidents (with a crash rate of 25 crashes per 100 MVKT) were recorded along the Pacific Highway between Warrell Creek and Urunga during this period.

Figure 17-6 Number of crashes 2003-2007



The results of the analysis is summarised as follows:

- A total of 229 crashes occurred during this 2003-2007 period, including 10 fatal crashes, in which there were 13 fatalities, and 100 injury crashes.
- In 64 (28 per cent) of the crashes, speed was indicated as a contributing factor, and 40 (17 per cent) crashes were reported as fatigue-related crashes.
- 56 of the crashes (approximately 24 per cent of the total crashes) involved heavy vehicles, including 17 crashes that were reported as speed-related and 12 reported as fatigue-related.
- Approximately 50 per cent of crashes were reported as run-off road crashes.
- Approximately 20 per cent of crashes were reported as rear-end crashes.
- Approximately 13 per cent of crashes were reported as occurring at intersections.
- Approximately 10 per cent of crashes were reported as head-on crashes.
- Approximately one per cent of crashes were reported as pedestrian-related crashes.

The accident analysis concluded that the number of crashes varied from year to year, with a decreasing trend over the surveyed five years. There was a correlation between crash severity and vehicle speed, with the proportion of fatal accidents increasing at higher vehicle speeds. Almost half of the accidents which the vehicle speed was described as “excessive” resulted in an injury. With a crash rate of 25 crashes per 100 MVKT, this section of the Pacific Highway has almost twice the target rate of 15 crashes per 100 MVKT for the upgraded dual carriageway highway, although is consistent with other single-carriageway sections of the highway.

17.2.8 Pedestrian and cyclist network

An extensive pedestrian network is present throughout the townships of the study area. The network connects the major roads with the main pedestrian generators such as shopping areas, schools and other facilities within the town. Bellingen Shire Council resolved to adopt its Pedestrian Accessibility and Mobility Plan in October 2006 which guides the development of pedestrian infrastructure in the shire (Bellingen Shire Council 2006). Nambucca Shire does not have a similar plan, although pedestrian issues are raised in the Nambucca Shire Strategic Transport Plan (2006).

The NSW Coastline Cycleway project is a joint project between the Department of Planning, RTA and local councils. The cycleway route aims to link the communities along the NSW coast, and also follow the coastline and avoid main roads where possible. The Coastline Cycleway would comprise a combination of shared off-road walking/cycling paths, back roads and fire trails and would be constructed, as a separate project to this Proposal.

17.2.9 Public transport network

Public transport operating in the area includes Countrylink rail services and local and long-distance bus and coach services. Long-distance bus and coach services in the study area are summarised in Table 17-2.

Table 17-2 Long distance bus and coach services

Route	Operation	Major stops
Sydney to Brisbane (Greyhound/McCafferty's)	■ Four return services per day.	■ Macksville (Caltex service station) ■ Nambucca Heads tourist information centre (Riverside Drive) ■ Urunga tourist information centre
Sydney to Brisbane (Premier Motor Service)	■ Two return services per day.	
Sydney to Byron Bay (Premier Motor Service)	■ One return service per day.	

Busways provides public transport and school bus services stopping at various locations along the existing Pacific Highway in the study area and include the following routes.

- 360 Bowraville, Macksville, Nambucca Heads, Urunga and Coffs Harbour.
- 361 Bellingen, Urunga and Coffs Harbour.
- 359 Nambucca Heads, Urunga and Bellingen.
- 358 Macksville, Nambucca Heads and Valla Beach.
- 353 Macksville and Scotts Head.

CountryLink operates three daily rail services in each direction within the study area. They run between Sydney and Macksville, Casino and Brisbane respectively. Travel time via CountryLink between Nambucca Heads and Sydney is approximately eight hours, and between Nambucca Heads and Brisbane it is about six hours.

The existing highway crosses the North Coast Railway Line at two locations in the study area. At both, the highway passes over the top of the railway.

17.2.10 Rest areas

There are several rest areas for vehicles along this length of the existing Pacific Highway, and Driver Reviver sites at Warrell Creek and Urunga. The Proposal includes the provision of a rest area for both light and heavy vehicles at the Nambucca Heads interchange. The proposed rest area is described in Chapter 6 – *Description of the Proposal*.

17.2.11 Interaction with rail infrastructure

The Proposal crosses the North Coast Railway Line at two locations: approximately 700 metres east of Browns Crossing Road, Warrell Creek, and approximately 200 metres south of Gordons Knob Road, Nambucca Heads. The Proposal would not obstruct the functioning of the railway during the construction or operation of the Proposal at these two locations. Consultation has and would take place between the RTA and the Australian Rail Track Corporation (ARTC) regarding the construction method at these crossing points.

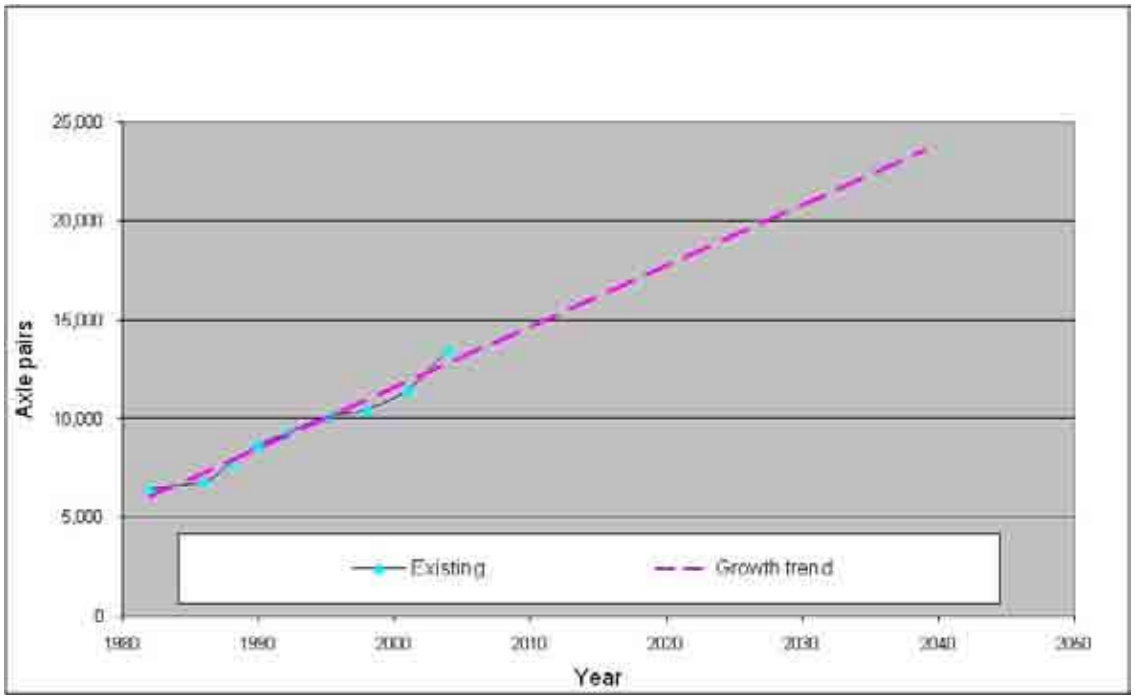
The North Coast Railway Line runs north south through the study area in close proximity to the existing Pacific Highway in some locations. To reduce land use impacts and to maximise the use of this existing transport corridor, the opportunity to insert the Proposal within or alongside the railway corridor was reviewed during the early route selection stages. Discussions with ARTC were held, and the geology and the potential alignment geometry for a highway in this location were investigated. It was found that a suitable alignment that would meet RTA design guidelines could not be achieved by sharing the rail corridor. Furthermore, significant fill or piling would be required to render the soft soils suitable for road construction.

17.3 Impact of future traffic growth on the existing network

The predicted future traffic volumes along the highway within the study area were derived from the historical annual average daily traffic (AADT) data from several representative locations. Figure 17-7 provides an indication of the overall future traffic profile throughout the study area. The predicted growth rate is 2.2 per cent per year (2007 base year).

New industrial land will be released at Macksville, Nambucca Heads and Urunga which is expected to increase the amounts of traffic accessing these towns. A population growth rate of one per cent per annum is estimated for the study area, and the local and regional traffic growth has been forecasted to correspond to this population growth. Growth in traffic on the highway will result in congestion occurring on a more regular basis, with greater pressure on infrastructure maintenance programs.

Figure 17-7 Forecast traffic volumes



17.4 Traffic and transport impacts

17.4.1 Changes to the road network with the proposed upgrade

The Proposal would provide two lanes of travel in each direction on a divided carriageway suitable for a 110 kilometres per hour speed limit. Provisions have been made in the design for an additional lane per direction in the median, if required in the future.

The existing Pacific Highway would no longer remain the main carrier of traffic with the construction of the Proposal, but would function as a local traffic access route. Local roads would continue to intersect with the existing Pacific Highway and would cross the Proposal via overbridges or underpasses as described in Chapter 6 – *Description of the Proposal*.

Table 17-3 provides the traffic forecasts for 2013 (assumed opening of the Proposal), 2023 (ten years after opening) and 2033 (20 years after the opening) along the Proposal. This forecast is based on expected growth in the area considering population projections, planned growth centres and new released industrial land. Traffic which would use the Proposal would be predominantly through-traffic and vehicles travelling from one end of the study area to the other, with some of the longer local trips.

Table 17-3 Forecast daily traffic volumes along the Proposal at 2013, 2023 and 2033 (AADT vehicles / day)

Section	2013			2023			2033		
	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total
Warrell Creek interchange to Bald Hill Road interchange	6,500	1,600	8,100	7,550	2,100	9,650	8,500	2,300	10,850
Bald Hill Road interchange to Nambucca interchange	6,500	1,800	8,300	7,500	2,300	9,800	8,550	2,550	11,100
Nambucca interchange to Ballards Road interchange	7,900	1,950	9,850	9,050	2,500	11,550	10,200	2,750	12,950
Ballards Road interchange to Waterfall Way interchange	7,400	1,800	9,200	8,500	2,350	10,850	9,600	2,550	12,150

Impacts from traffic rerouting

Positive impacts would be experienced by local traffic using the existing Pacific Highway, which would operate as a local access road with the Proposal in place. Local traffic would be able to travel along the existing highway for its entirety between the existing Allgomera Deviation and the Waterfall Way interchange at Raleigh. Table 17-4 provides the traffic forecasts for 2013 (assumed opening of the Proposal), 2023 (ten years after opening) and 2033 (20 years after the opening) along the existing Pacific Highway with the Proposal in place. Note that these volumes include traffic accessing the Proposal from within the study area, as well as local traffic.

The volume of heavy vehicles remaining on the existing Pacific Highway during operation of the Proposal would be significantly reduced as most heavy vehicles would transfer to the upgraded road. The heavy vehicles remaining on the existing highway would be rigid trucks and buses servicing the towns and villages in the study area. The existing highway would also provide access between towns within the study area and the interchanges to be constructed on the Proposal.

The Level of service (LoS) of a section of road varies from A (good) to F (poor), depending on the number of lanes, traffic volumes and the frequency of intersection and junctions. The LoS on the Pacific Highway in the study area is currently operating at a LoS of E (at capacity). In 2033 the Pacific Highway without the proposed upgrade between Warrell Creek and Urunga would operate at a LoS of F (poor), unless highway upgrades are implemented. The Proposal would operate at a LoS of A (good) in 2013 and beyond to 2033 calculated using the Austroads Guide to Traffic Engineering Practice Part 2: Roadway Capacity (Austroads 1999).

Table 17-4 Forecast daily traffic volumes along the existing Pacific Highway at 2013, 2023 and 2033 with Proposal (AADT vehicles / day)

Section	2013			2023			2033		
	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total
South of Bald Hill Road	2,850	550	3,400	3,100	600	3,700	3,350	700	4,050
Bald Hill Road to Macksville	3,750	600	4,350	4,100	650	4,750	4,450	700	5,200
Macksville to Nambucca Heads	4,800	250	5,000	5,250	300	5,500	5,700	350	6,000
Nambucca Heads to Nambucca interchange	4,950	550	5,500	5,450	650	6,100	5,900	850	6,800
Nambucca interchange to Valla Beach	2,600	300	2,900	2,850	350	3,200	3,100	400	3,500
Valla Beach to Ballards Road	2,200	250	2,450	2,400	300	2,700	2,600	350	2,900
Ballards Road to Urunga	3,350	450	3,850	3,650	450	4,150	4,000	550	4,500

17.4.2 Impacts on road safety

The Proposal would result in a positive impact on road safety, with a target rate of 15 crashes per 100 million vehicle kilometres travelled for the upgraded dual carriageway highway, when compared with the existing crash rate of 25 crashes per 100 million vehicle kilometres travelled for this section of the highway.

The signage to be included along the Proposal would comply with current RTA practices and standards. This would apply to emergency access points, highway crossovers, u-turn facilities and speed zones. Signage would also be provided directing motorists to various towns, service locations and tourist attractions in the study area.

17.4.3 Impacts on freight efficiency

The inter-capital freight volume on the existing Pacific Highway in the study area was estimated to be approximately 2.9 million tonnes in the study area in 2004 (BRTE 2006). Road-based freight transport represents 76 per cent of the Sydney-Brisbane inter-capital freight, rail represents 11 per cent, coastal shipping 12 per cent and air 1 per cent (Ernst and Young 2006).

Any increase in the freight task is most likely to be absorbed predominantly by road. For the rail mode share to increase, significant investment in rail track and signalling infrastructure to improve travel times and access to the Sydney ports is required, and the freight industry needs to respond to such improvements by diverting freight from road to rail. This is considered an unlikely scenario in the short-medium term.

The continued upgrade of the Pacific Highway would improve travel times relative to the New England Highway, and provide a high-quality and safer route for road freight between Sydney and Brisbane.

The freight forecasts for the Sydney-Brisbane corridor indicate that road freight tonnages along the Pacific Highway will increase at an average annual rate of between 3.7 and 4.2 per cent per annum to 2029. From the freight movement forecasts, road will continue to be the dominant mode with the freight tonnes expected to be carried along the Pacific Highway in 2029 to range between 62 and 75 per cent. It is considered that the higher end of this range is the more likely outcome. Without the Proposal this growth would be constrained with the current and predicted LoS experienced on the existing highway throughout the study area.

The Proposal would improve road travel times, reliability, safety and fuel efficiency for heavy vehicles. The contribution of the Proposal to total travel time saving is approximately 9.5 minutes for commercial vehicles during normal operation. Further benefits for heavy vehicle transport would also be experienced through similar upgrades in the region such as Kempsey to Eungai to the south and the proposed Sapphire to Woolgoolga upgrade to the north. The Proposal is unlikely to have any significant negative impacts on the movement of freight to or from the study area, but would contribute to a general improvement in conditions on the Pacific Highway between Sydney and Brisbane.

17.4.4 Impacts on regional roads

The Proposal forms part of the upgrade program for the whole Pacific Highway between Hexham and the Queensland border. The whole program would improve road travel times, reliability and safety for all road users between Sydney and Brisbane. Access would be maintained between the Proposal and regional centres in the study area through the provision of strategically placed interchanges. Interchanges would be provided at Warrell Creek, Bald Hill Road, south of Macksville, Nambucca Heads, Ballards Road, south of Urunga and upgrades to Waterfall Way at Raleigh. The existing highway would act as a local access road, resulting in important efficiency and safety advantages in separating local and through-traffic.

There would be no significant rerouting of regional roads.

17.4.5 Impacts on local roads and modified access to the upgraded highway

Local access onto and off the Proposal would be provided through five grade-separated interchanges listed below. Further details are provided in Chapter 6 – *Description of the Proposal*.

- Warrell Creek interchange, south of Warrell Creek village.
- Bald Hill Road interchange, south of Macksville.
- Nambucca Heads interchange near Boggy Creek.
- Ballards Road interchange, south of Urunga.
- Upgrades to the existing Waterfall Way interchange at Raleigh.

These proposed interchanges would provide access to the local road network and community destinations including Warrell Creek, Macksville, Nambucca Heads, Urunga and Raleigh. Local road crossings of the Proposal have been consolidated through the provision of adjacent local access roads that feed local traffic to the crossing points incorporated into the design. Local access roads are shown in Figure 17-1a and b. The existing Pacific Highway would be retained for local access purposes. Interchange locations were determines considering current and proposed future urban development in the study area.

The local road network strategy aims to maintain a continuous alternative route (the existing highway) to the upgrade, as a local access, with rationalised, safer connections across the upgrade. It is expected that local road connections with the existing highway would be safer and more efficient with the separation of local and through-traffic and the resultant reductions in vehicle numbers on the existing highway. The local road network strategy is included in Chapter 6 – *Description of the Proposal*.

Some minor rerouting of existing roads would be required to enable access to particular local roads such as Old Coast Road north of Mattick Road and Deep Creek Road. Access would be maintained to all properties along the local roads, which may require modification to the driveways of individual properties.

There is not expected to be any significant change in local travel times on existing roads in the study area as a result of the Proposal.

17.4.6 Impacts on fire trail network

Construction

The Proposal severs numerous fire trails as indicated below, however access to the fire trail network during construction would be maintained in consultation with Forests NSW.

Operation

Numerous fire trails are present throughout the Nambucca State Forest, the Newry State Forest and the Little Newry State Forest. The Proposal would bisect several existing fire trails in Nambucca State Forest and Newry State Forest in particular. The fire trails impacted by the Proposal include:

- Poplar Trail
- Gossips Road
- CPT 319/2
- CPT 296/8
- CPT 296/1
- CPT 294/2
- Tower Road
- CPT 284/5
- Jacksons Road
- Mines Road
- Allans Trail
- Jacks Ridge Road
- Plantation Trail
- CPT 298/1
- CPT 319/3
- CPT 296/2
- CPT 284/1
- CPT 318/3
- Fairbrothers Road
- CPT 293/1
- CPT 296/6
- CPT 298/4
- CPT 294/4
- CPT 284/3

Consultation has been undertaken with Forests NSW to ensure that provision for access to the fire trail network has been incorporated in to the Proposal. Access has been maintained to the fire trail network through new connections alongside the Proposal. Further consultation Forests NSW would be required to ensure the needs of fire trails are further considered at the detailed design stage.

17.4.7 Impacts on cyclists and pedestrians

Construction

Cyclists and pedestrian may experience short term impacts where the Proposal impacts local access roads and private accesses (e.g. driveways).

Operation

The existing highway and local roads, with their associated pedestrian and cycle facilities where provided, would continue to be available once the Proposal is constructed. The significant difference would be the reduction in the number of heavy vehicles using the existing highway. This has the potential to create a more attractive, and safe, cycle route through the study area than is currently available. Where existing pedestrian and cycle links are severed by the Proposal, new facilities have been incorporated into the design of overbridges as appropriate. Cyclists wishing to ride on the Proposal would be accommodated on the 2.5 metre left shoulder. Linemarking and signposting would be provided on ramps at interchanges so as cyclists are guided where to cross them.

17.4.8 Impacts on public transport including on bus services

Construction

There would be minimal disruption to the existing school bus routes during construction as the existing highway would be retained for local access and would be available throughout the construction period.

Operation

Individual bus operators may modify services, including changing routes or adding services to utilise the upgraded highway. However, it is expected that local bus routes would continue to run along the existing Pacific Highway, as this would service the greatest number of potential passengers. Similarly some of the current long-distance coaches are expected to continue to make stops within the study area. However, should operators utilise the upgraded highway, travel time would be improved.

17.4.9 Construction traffic impacts

The majority of the Proposal would be constructed away from the existing Pacific Highway and therefore minimal traffic would be affected on the existing highway. In locations where the Proposal crosses the existing Highway and local roads, there are likely to be short-term, temporary traffic delays. Potential traffic impacts during construction would also be due to increases in traffic volumes from construction work vehicles and haulage of materials to and from the construction site(s). Haulage of materials between areas of cut and fill would take place off-road where feasible, either along the carriageway under construction or in bypass areas within the proposed corridor. Appropriate traffic management measures would be implemented to minimise any traffic related impacts and

incorporated as part of the traffic management sub-plan to be developed as part of the construction environmental management plan.

The construction traffic management sub-plan would address the management of traffic around worksites at the following locations where the Proposal intersects with existing roads.

For properties where access would be temporarily affected by the construction of the Proposal, alternative access would be provided, where feasible and reasonable, in consultation with property owner.

17.4.9.1 Spoil haulage within construction corridor

The key routes for spoil haulage would depend on exact nature of the cut and fill produced by the Proposal and the quarries used by the construction contractor. It is anticipated that the Proposal would result in a surplus of spoil. Where possible, excess spoil generated by the Proposal would be used to construct visual screening and noise mounds. Spoil haulage would generally be limited to within the construction corridor. Some haulage of spoil material may also be required along the existing local road network. It is expected that vehicle movements along existing roads, if required, would be difficult to detect above normal daily fluctuations in traffic.

17.4.9.2 Quarry material haulage

As identified in Section 7.3.2.1, it may be necessary to source some material from nearby quarries. Quarries within 100 kilometres of the Proposal are identified in Table 7-4. Haulage of quarry material has the potential to damage local roads, disrupt traffic, and create adverse noise and amenity impacts for those living alongside haulage routes. Quarries used to supply material for the construction of the Proposal would be selected by the construction contractor. As for spoil haulage, it is expected that vehicle movements along existing roads would be difficult to detect above normal daily fluctuations in traffic. Additionally, any impacts associated with the haulage of quarry material would be managed in accordance with mitigation measures outlined in the following section.

17.5 Management of impacts

17.5.1 Regional and local roads (including property access)

17.5.1.1 Construction

The following measures would be implemented during construction of the Proposal:

- Identification of local roads to be utilised by construction traffic and implement measures to ensure that construction traffic utilise the identified roads.
- Identification of local roads that may be partially or completely closed during the construction phase and provide affected stakeholders information regarding expected timings and duration of closures.
- Implement temporary traffic diversions (including property access) in accordance with RTA requirements. Property access to be maintained during construction in consultation with affected landowners.

The following measures have also been included in the *Draft Statement of Commitments* (Appendix D):

- Pre-construction road condition reports would be prepared for all non-arterial (local) roads likely to be used by construction traffic.
- Post-construction road condition reports would be prepared for the roads assessed prior to construction. Copies of the reports would be provided to the relevant roads authority. Any damage resulting from construction (not normal wear and tear) would be repaired at the RTA's cost, unless an alternative arrangement for road damage is agreed with the relevant roads authority.
- Construction vehicle movement arrangements would be developed to limit impacts on other road users (including pedestrians, vehicles and cyclists) and with specific regard to other road works in the area, local traffic movement requirements and peak traffic volumes, including long weekends and holiday periods.

17.5.1.2 Operation

The following measures would be implemented during operation of the Proposal:

- Confirm feasible property access with affected landowner at detailed design stage.
- Safe access to the upgraded highway would be provided at strategically located grade separated interchanges.
- Local roads would pass over or under the upgraded highway.

17.5.2 Fire trail networks

17.5.2.1 Construction

The following measures would be implemented during construction of the Proposal:

- Access to the fire trail network would be maintained during construction in consultation with Forests NSW.

17.5.2.2 Operation

The following measures would be implemented during operation of the Proposal:

- Suitability of proposed access into state forests included in the Proposal would be re-confirmed with the Forests NSW at the detail design stage.

17.5.3 Cyclists, pedestrians and public transport (including bus services)

17.5.3.1 Construction

The following measures would be implemented during construction of the Proposal:

- Access to local roads (including for pedestrians, cyclists and bus services) would be maintained during construction. Any temporary access changes during construction would be undertaken in accordance with RTA requirements.

17.5.3.2 Operation

The following measures would be implemented during operation of the Proposal:

- Provision for cyclist and pedestrian movement over the upgrade has been made at the local road bridges identified in Chapter 6. It is expected that cyclists would use the existing Pacific highway for cycling activities as a result of lower traffic volumes and reduced number of heavy vehicles.

17.5.4 Spoil haulage and quarry material

17.5.4.1 Construction

The following measures would be implemented during construction of the Proposal:

- Noise and amenity impacts for quarry material haulage would be managed by the Quarry operational license
- Spoil haulage would generally be confined to access tracks within the worksite. Should local roads be required for spoil haulage, RTA would comply with the statements of commitment outlined above
- Timing of construction activities to avoid spoil and quarry material haulage along local roads at peak traffic times, such as holidays and long weekends.

Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

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18. Soil characteristics and erosion control

Soil characteristics and erosion is identified as a key issue in the Director-General's requirements. An assessment was undertaken and is presented in this chapter. This chapter is supported by Working paper – 5 Water (Flooding and water quality).

Director-General's requirements	Where addressed in the EA	
Surface, geological and soil characteristics and the potential for soil contamination, soft soils and acid sulphate soils.	Section 16.3.2	Operational stage (potential water quality impacts)
	Section 18.2.1	Topographical and terrain characteristics
	Section 18.2.2	Geographical and soil characteristics
	Section 18.2.3	Soft soils
	Section 18.2.4	Contamination
	Section 18.2.5	Acid sulphate soils
	Section 18.2.6	Gumma Flat tidal wetland area
	Section 18.3	Impact of changes to surface and subsurface conditions
Erosion and sedimentation control measures such as retention pond siting, with particular reference to the Gumma Flat tidal and wetland areas.	Section 18.2.6	Gumma Flat tidal wetland area (existing environment)
	Section 18.3.5	Erosion and sedimentation (potential impacts)
	Section 18.3.6	Gumma Flat tidal wetland area (potential impacts)
	Section 18.4.1.2	Erosion and sedimentation (management of construction impacts)
	Section 18.4.2.1	Erosion and sedimentation (management of operational impacts)

18.1 Assessment approach

Geotechnical investigations have been undertaken to identify potential geotechnical, soil and fill issues for the Proposal and to identify effective management and mitigation measures to be implemented during construction and operation.

Geotechnical investigations for this environmental assessment were undertaken between 2007 and 2009. The findings of preliminary geotechnical investigations from the initial route options development and preferred route selection phase between 2004 and 2007 were also used as an input into this assessment.

The investigations enabled the surface, geological and soil characteristics to be recorded and comprised geotechnical, contaminated land and acid sulphate soil investigations along the full length of the Proposal between Warrell Creek and Urunga. Geotechnical investigations included core drilling, installation and monitoring of standpipe piezometers, cone penetrometer and dissipation testing, test pits, seismic refraction surveys (over both land and water), shear vane testing and borehole optical imaging.

Australian Height Datum (AHD)

Since 1971 Australian heights have been referred to as the Australian Height Datum (AHD) that is based on a limited mean sea level determination at thirty tide gauges around the Australian continent. The Australian Height Datum was adopted by the National Mapping Council as the datum to which all vertical control for mapping (and other surveying functions) is to be referred.

Contaminated soils investigations included a desktop study, visual assessment and testing of soil samples.

The acid sulphate soil investigation component included visual assessment, pH tests for field screening and suspended peroxide oxidation combined acidity and sulphate (SPOCAS) laboratory analyses.

18.2 Existing geology and soils

18.2.1 Topographical and terrain characteristics

The study area comprises two major geological terrain types: the alluvial floodplains at major waterway crossings, and the foothills of the coastal ranges. The characteristics of these terrain types are summarised in Table 18-1.

Table 18-1 Terrain units of the Proposal

Terrain Unit	Topography	Geology	Soils
Floodplains	Flat to gently sloping coastal plains and river terraces, with estuarine mud flats.	Quaternary alluvial and estuarine soils up to about 15 to 35 metres thick.	Alluvial/ estuarine: sands, silts, clays, organic clays, possible gravels, expected to be potential acid sulphate soils.
Foothills	Gently to moderately undulating hills, with wide river valleys and creeks.	Nambucca Beds (schists and phyllites), with some granite intrusions and local granodiorite dykes.	Residual clay of high plasticity to less than 5m depth. Small creeks: Alluvial sediments.

The topography of the foothills is characterised by spurs and ridgelines positioned predominantly in a west to east direction. The Proposal would traverse the spurs and ridges in an approximate north-south direction. The

topography traversed by the Proposal comprises a series of ridges and valleys, typically between 10 metres and 30 metres Australian Height Datum (AHD), with the highest point being approximately 60 metres AHD, south of the Kalang River.

The topography adjacent to the major river crossings typically consists of extensive areas of alluvial floodplains less than five metres AHD. Swamp areas in shallow topographic lows are sometimes present on the larger extensive alluvial floodplains including Nambucca River and Kalang River. These swamp areas are usually the product of billabongs (river meanders cut off from the main waterway) or scouring during flood events. These low topographic areas contain alluvial soils and are located away from the major waterways.

18.2.2 Geological and soil characteristics

The 1:250,000 Geological Series Sheet SH/ 56-10 and 11 for Dorrigo–Coffs Harbour (Leitch et al 1971) indicated that the Proposal would be predominantly located on low-grade regional metamorphic rocks of the Lower Permian age known as the Nambucca Beds, comprising phyllites, slates and schists. The Proposal is also located adjacent to igneous intrusive rocks, and would traverse the margins of some of these intrusions.

The geology of the floodplains is characterised by Quaternary alluvial and estuary soils (commonly referred to as soft soils) 15 to 35 metres thick, with sands, silts, clays, organic clays and possible gravels. The soils that underlie the floodplains are of low strength and are highly compressible, given that they are of alluvial and estuarine origin. Further information on the soft soils is provided in Section 18.2.3.

The geology of the hills is characterised by Nambucca Beds of schists and phyllites, with some granite intrusions and local granodiorite dykes. The associated soils comprise residual clay of high plasticity to less than five metres deep. Small creeks contain alluvial sediments and hillslope colluvium is likely to comprise sandy clay.

The floodplain south of the Nambucca River within the Proposal corridor has moderately to highly compressible soils to depths over 20 metres.

Nambucca Beds

The Proposal traverses hilly areas which are predominantly underlain by Nambucca Beds, which may be three to four kilometres thick. These rocks mainly consist of phyllite, with some slate and schist formed from low grade metamorphism of fine-grained sedimentary rocks.

Phyllite is a fine-grained rock formed from low grade metamorphism of claystones. Regional metamorphism causes weakness in the phyllite, known as foliation. This regional metamorphism occurs during tectonic movements which generate pressure and heat, and can also cause folding. The phyllite has been folded, and the dip of foliation is linked to the folding. Small scale faulting was present in some areas, and increases with the intensity of folding. No major faults were observed during the geotechnical investigations. This is consistent with published geological data which shows the absence of faults in the area.

Phyllite varies from extremely low strength and weathered material to high strength and fresh material. The boreholes, up to 26 metres in depth, encountered moderately to highly weathered phyllite. The strength of the phyllite is highly dependent on foliation, with phyllite generally being strongest when it is loaded perpendicular to the foliation. There is a gradual transition from residual clay soil to weathered rock, and the strength of the material does not suddenly increase with depth. Residual soil is found at a depth less than five metres, generally on ridges.

Boreholes encountered extensive quartz veining in the phyllite, in many spots along the Proposal. It is likely that the veining is linked to igneous intrusions, although this has not been proven. The phyllite predominantly displays signs of increase weathering in the vicinity of the quartz veining, which is likely due to water flow through the veining. Pyritic mineralisation was found in some slightly weathered and fresh phyllite rocks. This mineralisation predominantly occurs along the joint faces and where quartz veining is present. The rock adjacent to the quarry appeared to comprise some pyritic mineralisation.

Rock below alluvial flats exhibited less weathered rock than those located in the ridgelines. Investigations undertaken in the base of creek valleys without extensive alluvial material, comprised test pits with a maximum depth of about four metres. The depth of weathering in the creek valleys compared to ridgelines is therefore difficult to deduce.

Igneous intrusives

Igneous intrusions consist of acidic granitic rocks (adamellite) which intruded into the Nambucca Beds during the Upper Permian age. These igneous intrusions occur adjacent to the Proposal, notably to its east near Warrell Creek (consisting of Yarrahapinni Adamellite) and to its west near Valla Beach (Valla Adamellite). The Proposal crosses the edge of each intrusion.

The geotechnical investigations found that the igneous rock, in the southern section of the Proposal, near Warrell Creek, did not exhibit any layering structure and some pyrite was present in the defects. Cutting observations imply that igneous rocks are widespread in the immediate area. The rock encountered near Valla Beach, where the Proposal crosses a dyke, was similar to the rock near Warrell Creek. The quarry (Nambucca Valley Quarry) located in this area showed that igneous rock forms a near-vertical dyke structure through the surrounding phyllite, and is understood to be linked to the Valla Adamellite located to the south-west of the Proposal.

During the investigations, slightly weathered or fresh intrusive rocks usually were encountered within the first two metres in depth, which is characteristic of a shallow weathering profile. These rocks were generally either high or very high in strength.

Contact metamorphic rocks

Contact metamorphism of rocks occurs when the rocks undergo thermal alteration. Large scale intrusions have resulted in contact metamorphism of the Nambucca Beds, where the phyllites and schists have been altered to hornfels.

The Proposal passes through an area of hornfels, adjacent to the Yarrahapinni Adamellite near Warrell Creek. Hornfels also display shallow weathering profiles, and are usually high to extremely high strength when unweathered. In some circumstances, thermal alteration has occurred along former joints or faults, which form into hornfels with characteristics similar to igneous dykes.

Small igneous dykes are also present and are likely to have formed from magma, associated with the larger igneous intrusions. These were observed in cuttings along the existing Pacific Highway. Alterations of the Nambucca Beds into hornfels were observed in close proximity to a number of these dykes. These intrusions were generally of medium to very high strength, although some were observed that had weathered to a residual soil. The widths of the dykes varied from less than one metre to 15 metres.

Slope instability

The geotechnical investigations found no occurrence of major natural slope instability. This is likely to be due to the relatively shallow residual soils on the hillsides and the relatively gentle undulating topography of the Proposal. Colluvial soil slopes may be present near the base of slopes and are likely to be at marginal stability. This is due to the continual slope formation process of mass weathering and erosion. The geotechnical investigations found no colluvial slope which could cause instability during slope modifications in the Proposal area, although their possible existence should not be precluded.

Geotechnical Soil and Rock Units

The detailed geotechnical investigations undertaken along the route has placed the soil and rock types into three different categories:

- Fill/topsoil.
- Floodplain soils.
- Rock derived soils.

These are further divided into sub-units as described in Table 18-2.

Table 18-2 Generalised geotechnical soil and rock units along the Proposal

Unit	Sub-Unit		
	Compressibility / weathering profile	Geological unit	Description
Fill/topsoil	Variable compressibility	F1	Variable mixtures of silty clay, clayey material.
Floodplain soils	Highly compressible	S1	Clays and clayey silts – very soft and soft.
	Moderate to high compressible	S2	Silts or mixed soils – loose/soft or poorer.
	Moderately compressible	S3	Sands – very loose and loose.
	Low compressible	S4	Gravels and sands – medium dense or dense.

Unit	Sub-Unit		
	Compressibility / weathering profile	Geological unit	Description
	Low compressible	S5	Clays or clayey silts – firm or stiffer.
Rock-derived units	Residual	R1	Residual soil and extremely weathered phyllite. Generally extremely low to very low strength.
	Highly to moderate weathered	R2	Highly and moderately weathered phyllite. Generally low strength to medium strength.
	Slightly weathered to fresh	R3	Slightly weathered and fresh phyllite. Generally medium strength to high strength.
	Igneous	R4	Intrusive igneous rocks and contact metamorphic rocks. Generally high to very high strength.

The composition of fill and topsoil varies, but generally contains mixtures of silty clay and clayey material. Floodplain soils contain gravel, sand, silt and clay in varying proportions, and are also variably compressible. The rock derived units have varying strength depending on the level of weathering which reduces the strength of the unit. Unit R1 comprises residual soil and extremely weathered phyllite. Soils are generally medium to high plasticity silty clays or low to high liquid limit silts, weathered in-situ from the underlying phyllite. Residual soil generally has a depth of less than five metres, especially on ridges, with a gradual change to weathered rock. Extremely weathered phylllite is generally extremely low strength. Quartz veins generally present within the parent phyllite rocks have typically decomposed to sands and gravels, which often appear scattered throughout the soil profile and across the ground surface. Unit R2 comprises highly and moderately weathered phyllite and are generally very low to medium strength. The weathering profile of the phyllite generally exhibits a transitional profile. At places where quartz veining is present, localised areas of material with a higher degree of weathering than the surrounding rock may be present. This is likely due to the presence of groundwater flowing through the discontinuities associated with the veins.

Unit R3 comprises slightly weathered and fresh phyllite and soils are generally medium to high strength. This unit was generally encountered at levels below the base of the planned cuts. At the Deep Creek and Kalang River floodplains, Unit R3 was encountered within four and seven metres of the top of the bedrock profile respectively, which indicates that the weathering profile of the rock beneath the floodplain alluvium is relatively shallow. Similar to Unit R2, where quartz veining is present, localised areas of material with a higher degree of weathering than the surrounding rock may be present.

Unit R4 comprises igneous intrusive features and associated contact metamorphic rocks that are occasionally encountered along the Proposal. The intrusive rocks encountered along the Proposal exhibit a shallow weathering profile with slightly weathered or fresh rock encountered within five metres of the existing ground surface. The strength of the intrusive rocks is generally either high or very high strength.

A granodiorite intrusive was encountered at 12.8 metres depth in Section 2 and is not typical of the igneous features found throughout the rest of the Proposal. This granodiorite was moderately weathered and typically medium strength. The Valla Adamellite located to the west of Valla Beach is located in the vicinity of the Proposal.

18.2.3 Soft soils

Soft soils are soils that under load continue to settle over a very long time span. These soils are widespread in the coastal region of eastern Australia and are generally associated with soils that have a high water content on floodplains, waterways or wetlands.

Soft soils are present in a number of locations along the Proposal, typically associated with low lying land and generally occur beneath the floodplains which surround the major waterways. The Proposal would cross these areas at Warrell Creek, Nambucca River, Deep Creek, Kalang River and other areas of smaller and shallower alluvial deposits.

The geotechnical investigations found that the alluvial soils are up to approximately 12 metres depth at Warrell Creek, 25 metres depth at the Nambucca River, 13 metres depth at Deep Creek and 21 metres depth at the Kalang River. Sample locations can be seen in Figure 18-1a and Figure 18-1b.

In areas where the Proposal crosses minor sections of alluvial soils away from major waterways, the thickness of the soils are expected to be significantly thinner. These soft alluvial soils generally comprise fine grained soils such as silty clays and sandy clays. Some gravel fractions were present in some layers, and generally occur towards the base of the soil sequence.

The floodplain soils underlying the Proposal are distinctly different from the typical floodplain soils along the NSW North Coast such as in the Ballina area. The Ballina soils are in an area of extrusive volcanic rocks, which have resulted in the formation of high plasticity clays due to weathering and erosion of the volcanic rocks. The floodplain soils underlying the Proposal are in the Kalang and Nambucca river catchments where most volcanic rocks have been removed. The rivers traverse bedrock comprising relatively low strength phyllites and schists, which have resulted in the weathering and erosion of these rocks, which were subsequently affected by marine transgressions, and hence the formation of low plasticity clayey and sandy silts.

18.2.4 Contamination

A preliminary contamination assessment was undertaken and included a desktop review to identify potential or known sites, visual observations of potential and known contaminated sites, sampling of potential contaminated sites and analytical testing and interpretation of the soil samples. The desktop study comprised the use of historical aerial photographs to identify potentially contaminating land uses and contaminant point sources. The contaminants of concern included heavy metals, pesticides, insecticides and herbicides associated with the primary land uses including grazing and agricultural land.

Six soil samples were analysed from five different locations at depths between ground level and 0.6 metres in depth. These samples included diffuse source contamination at agriculture/woodland and woodland/forestry areas, and point source contamination at railway land, adjacent piggery/cattle shed (two samples) and the southern bank of the Kalang River. The samples chosen are reasonably typical of the majority of the Proposal and consequently, the type of potential contamination is unlikely to significantly differ from the conditions reported.

All samples tested were below the adopted assessment criteria or laboratory reporting limits. Based on the sampling, diffuse source contamination is unlikely to impact the Proposal.

An old municipal tip is located in the Nambucca State Forest to the south of the intersection of Old Coast Road and Bellwood Road. The tip was closed approximately 20 years ago. However, the site has not been remediated. The Proposal was realigned in response to the environmental assessment to maximise the distance between the tip and the Proposal which is now around 40 metres. No obvious evidence of surface contamination was noted at the tip site during the inspection.

Other potential land uses that have a potential risk of soil contamination which lie within or adjacent to the construction footprint include:

- Sheep dips (no historical sheep dips have been recorded along the alignment).
- Sawmills.
- Nambucca waste management facility and landfill.
- Raleigh waste management centre.
- Gravel quarry.
- Raleigh Industrial Estate.
- Macksville sewage treatment plant.

Sections 18.3.3, 18.4.1.3 and 18.4.3 discuss likely impacts and management measures.

A search of the DECCW database of licensed facilities indicated that the Proposal does not traverse any licensed facilities. There remains a possibility that other historically filled sites, the locations which are currently unknown, remain in the study area.

Groundwater contamination and risk to groundwater quality were addressed in Chapter 16 – *Water quality and hydrology* (see Section 16.2.3) and Working paper 5 - *Water (Flooding and water quality)*.

18.2.5 Acid sulphate soils

Acid sulphate soils are commonly associated with low-lying estuarine areas at elevations less than five metres above sea level, particularly near major rivers, drainage depressions or creeks. Assessment for the presence of

acid sulphate soils was conducted at 29 boreholes and test pits located in these areas that were most likely to contain these soils. The soil types at these locations typically comprised grey clayey and silty soils with varying amounts of organic material, shells and sand and are characteristic of the estuarine depositional conditions in which acid sulphate soils occur. The presence of jarosite, shell and root matter was logged as part of the assessment for the presence of acid sulphate soils.

The areas of the Proposal which are less than five metres above height datum (AHD) have been assessed based on the available contour maps. An initial visual assessment of the soils was carried out to determine the presence of actual acid sulphate soils and potential acid sulphate soils. A total of 87 soil samples were collected and were initially screened using field pH (phf) for actual acid sulphate soils and field pH following treatment with 30 per cent hydrogen peroxide (pHfox) for potential acid sulphate soils.

The results of the field screening found that the soils were generally acidic with pHf values less than five and suggest that actual acid sulphate soils are likely to be present at the majority of the tested locations, although not necessarily at high concentrations of acidity. The locations at which jarosite was present generally had pHf values greater than 5, indicating that soluble acidity that formed during oxidation of these soils is minimal or has already been flushed from the soils during previous rain events. The locations which had the lowest pHf values included:

- Adjacent to Warrell Creek (TP1315 and BH1109).
- In the low lying area of the Nambucca River floodplain (TP1325, TP1326 and BH1113 to BH1115).
- Adjacent to the Nambucca River (BH1116).
- North of Warrell Creek (BH1118).
- In the low lying area of the Kalang River floodplain (TP4314).
- Adjacent to the Kalang River (BH4108 and BH4109).
- North of the Kalang River (BH4111 and TP4325).
- From the field screening results, slightly less than half of the tested samples were considered likely to contain potential acid sulphate soils. These locations included:
- Adjacent to Warrell Creek.
- Adjacent to Nambucca River.
- North of Nambucca River.
- Near Cow Creek.
- Adjacent to Deep Creek.
- In the low lying area of the Kalang River floodplain.
- North of Kalang River.

Seven of the 11 locations at which jarosite was noted to be present, were in soils considered likely to contain potential acid sulphate soils and indicates that the soils may have already partially oxidised. Based on the results from the field screening, selected samples were analysed for suspended peroxide oxidation combined acidity and sulphate (SPOCAS) testing. From the SPOCAS analyses, the samples which had the highest concentrations of total actual acidity (assessment for actual acid sulphate soils) are listed in Table 18-3.

Table 18-3 Highest concentrations of total actual acidity

Borehole	Depth
BH1108 (adjacent to Warrell Creek)	0.8 to 1.0 metres depth
BH1108	1.4 to 1.9 metres depth
BH1118	2.9 to 3.0 metres depth
TP4302 (just south of Ballards Road interchange)	0.5 to 0.6 metres depth
TP4314 (in the low lying area of the Kalang River floodplain)	0.1 to 0.2 metres depth
TP4314	1.0 to 1.1 metres depth
TP4314	2.0 to 2.1 metres depth

The SPOCAS analyses also tested for potential acid sulphate soils where total sulphidic acidity represents the store of acidity present in the soils as unoxidised sulphides. The results indicated that potential acid sulphate soils underlie the majority of the investigation area, and the highest concentrations of total sulphidic acidity were reported in Table 18-4. The SPOCAS analytical results also indicated that the inherent acid neutralising capacity of the soils appears to be limited.

Table 18-4 Highest concentrations of total sulphidic acidity

Borehole	Depth
BH1117 (adjacent to Nambucca River)	2.5 to 2.95 metres depth
TP4314 (low lying area of the Kalang River)	0.1 to 0.2 metres depth
TP4314	2.0 to 2.1 metres depth
TP4315 (low lying area of the Kalang River)	2.3 to 2.4 metres depth
TP4326 (north of Kalang River)	1.8 to 1.9 metres depth
BH1108 (adjacent to Warrell Creek)	1.4 to 1.9 metres depth
BH1108	11.5 to 11.95 metres depth
BH3105 (adjacent to Deep Creek)	7.4 to 7.5 metres depth
BH3106 (adjacent to Deep Creek)	1.0 to 1.25 metres depth
BH3106	4.0 to 4.5 metres depth

Figure 18-1a and Figure 18-1b show the extent and risk of acid sulphate soils in the study area, and the locations of the boreholes for the acid sulphate soil assessment.

18.2.6 Gumma Flat tidal and wetland area

Nambucca River is tidally influenced and is augmented by Gumma Swamp, a broad southern floodplain downstream of Macksville, shown in Figure 16-1a. The floodplain is primarily fed and drained by Gumma Gumma Creek. Gumma wetland stretches four kilometres from the mouth of Gumma Gumma Creek. A main feature of the Gumma wetland area is the backswamp which contains organic soils. These soils are characterised by low wet-bearing strength, high erodibility, low permeability, strong acidity, sodicity, high aluminium toxicity and salinity, and contain potential acid sulphate soils (WetlandCare Australia 2004). As detailed in the Working paper 5 – *Water (flooding and water quality)*, the Gumma wetland area (SEPP 14 wetland No. 388) receives runoff from Gumma Road which may contribute to poorer water quality following wet weather events. Chapter 16 – *Water quality and hydrology* (see Section 16.2.4) describes the existing flooding regime for the Nambucca River which includes flooding in Gumma Swamp. The flooding was due to a lack of conveyance of the river in this area as the river drops into coastal flat lands and flood water backing up into the low-lying Gumma Swamp.

18.3 Impact of changes to surface and subsurface conditions

The impacts of the Proposal on surface and subsurface conditions are described below. Erosion and sedimentation into nearby waterways and the specific management measures proposed to manage these impacts have been addressed in Chapter 16 – *Water quality and hydrology*.

18.3.1 Soft soils

Soft soils would be encountered during the construction of the Proposal. The construction of embankments on soft soils would result in stability or settlement issues. Various methods would be used to treat soft-soil conditions which are described in Section 18.4. The locations of soft alluvial soils are shown in Table 18-5.

Table 18-5 Locations of soft soils along the Proposal

Section	Location of soft soils	Depth
Section 1 - Allgomera deviation to Nambucca River	Floodplains of Nambucca River – between chainage 8,400 and 11,000 Floodplains of Warrell Creek – between chainage 6,150 and 6,750and between chainage 500 and 900	Up to 25 metres deep Up to 12m deep
Section 2 - Nambucca River to Nambucca Heads	Not encountered.	N/A
Section 3 - Nambucca Heads to Ballards Road	Floodplains of Deep Creek – between chainage 22,800 and 23,750 metres.	Up to 13 metres deep.
Section 4 - Ballards Road to existing Waterfall Way interchange	Floodplains of Kalang River – between chainage 35,000 and 36,500 metres.	Up to 20 metres deep.

FIGURE 18-1a | ACID SULPHATE SOIL RISK MAP SECTION 1 OF 2

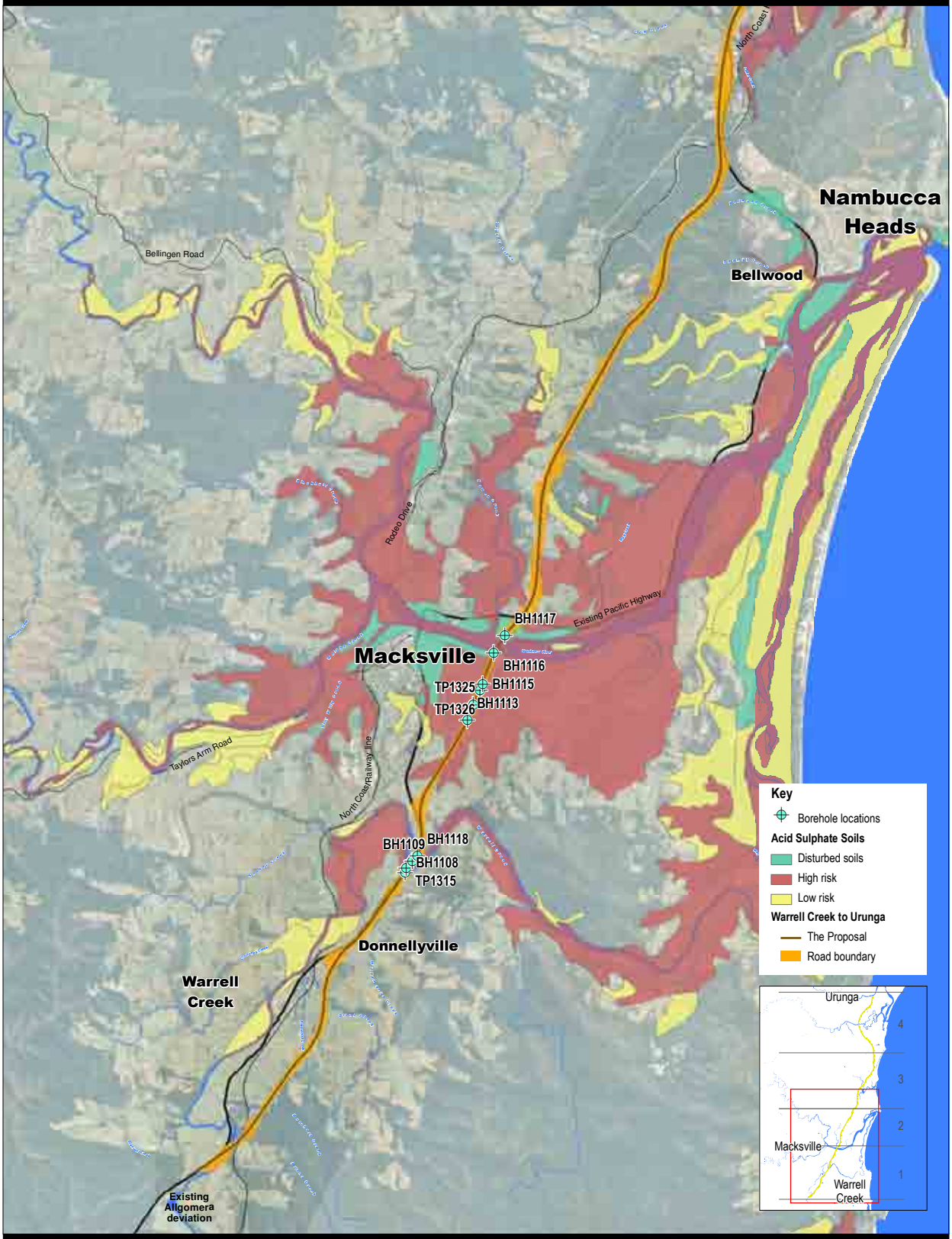
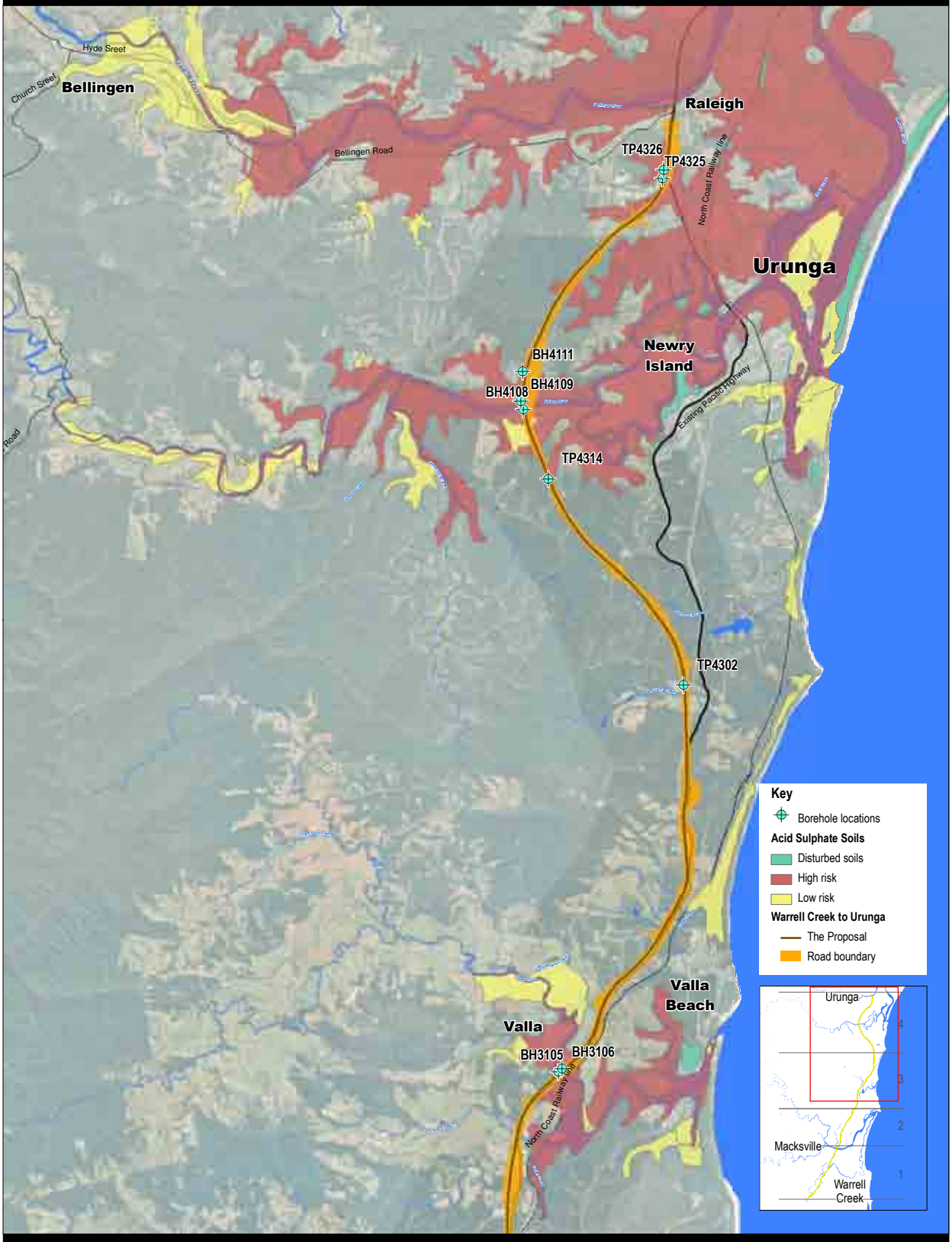


FIGURE 18-1b | ACID SULPHATE SOIL RISK MAP — SECTION 2 OF 2



Significant volumes of alluvial soils were not encountered within Section 2 of the Proposal. It is not expected that floodplain soils would have any significant impact on timing or settlement constraints for this section of the Proposal.

The alluvial floodplain associated with Deep Creek is typically underlain by soft clayey silts and very loose granular materials. North of Deep Creek, the compressible alluvial soils overlay medium dense sandy gravels. In general, the alluvial soils across the Deep Creek floodplain indicate variable strength with depth.

The alluvial floodplain associated with the Kalang River is typically underlain by soft to firm clayey silts with sandy layers and lenses. These alluvial soils typically overlie medium dense and dense sandy and clayey gravels above the weathered phyllite bedrocks. Stiffer clays and silts were also encountered within the alluvial soils indicating that Kalang River has likely meandered across the floodplain at various stages, resulting in soils of varying strength and composition being deposited during different periods of time; that is, there is not a consistent increase in strength with increasing depth of these floodplain soils.

Floodplain alluvial soils types that are likely to experience settlement and instability under embankment loads include very loose to loose silts and sands and very soft to soft silts and clayey silts. The alluvial and estuarine soils that underlie the floodplains are of low strength and highly compressible. If used as a foundation layer beneath structures such as culverts, bridges and embankments, settlement is likely to occur. However, the bearing capacity (strength) of the soils would improve as settlement occurs. The presence of these soils would impact the design of the Proposal, the time needed to construct the Proposal, the construction costs and the management of the embankment fill materials during construction.

The structures to be constructed on soft soils along the Proposal include:

- Bridges over Upper Warrell Creek and Warrell Creek.
- Bridges / culverts on the Nambucca River floodplain.
- Bridge over Nambucca River.
- Bridge over existing highway north of Nambucca River.
- Bridge over Deep Creek.
- Bridges / culverts on the Kalang River floodplain.
- Bridge over Kalang
- River.

18.3.2 Cut batters

Cuts are required to achieve the current highway design standards due to the undulating and hilly nature of the terrain along the Proposal. These comprise of side cuts where the highway traverses hillslopes and deep cuts through the ridges. Permanent cut batter slopes would be designed to ensure long-term stability without the need

for structural support. Drainage and slope protection measures would be required to reduce erosion and the risk of local instability. Batter stabilisation would be required, as the bare earth surfaces at the completion of construction would rapidly erode if no erosion controls are implemented. Protection of the cut batters would be required and these measures are detailed in Section 18.4.1. Fill batters would be grassed and revegetated (seeding and/or planting) in accordance with the landscaping plan that would be determined as part of the detail design. Typical shallow and deep cuttings are provided in Figure 18-2 and Figure 18-3.

18.3.3 Contaminated land

Based on the preliminary contamination assessment, the results indicated that the soils did not present a significant contamination hazard for the Proposal and are unlikely to pose a risk to the environment and human health. The area considered to be of most concern from the preliminary study is the site of a former municipal tip within Nambucca State Forest. This site is likely to contain contaminated material as the site has not been remediated since its closure.

There is also the potential for contamination as a result of spillage or mishandling of potentially contaminating materials such as asphalt, cement, fuels, hydraulic fluids or other chemicals. Should any contamination be present, appropriate mitigation and management measures would be implemented to ensure that the soils do not pose a risk to future road users or the public.

Figure 18-2 Typical shallow cutting

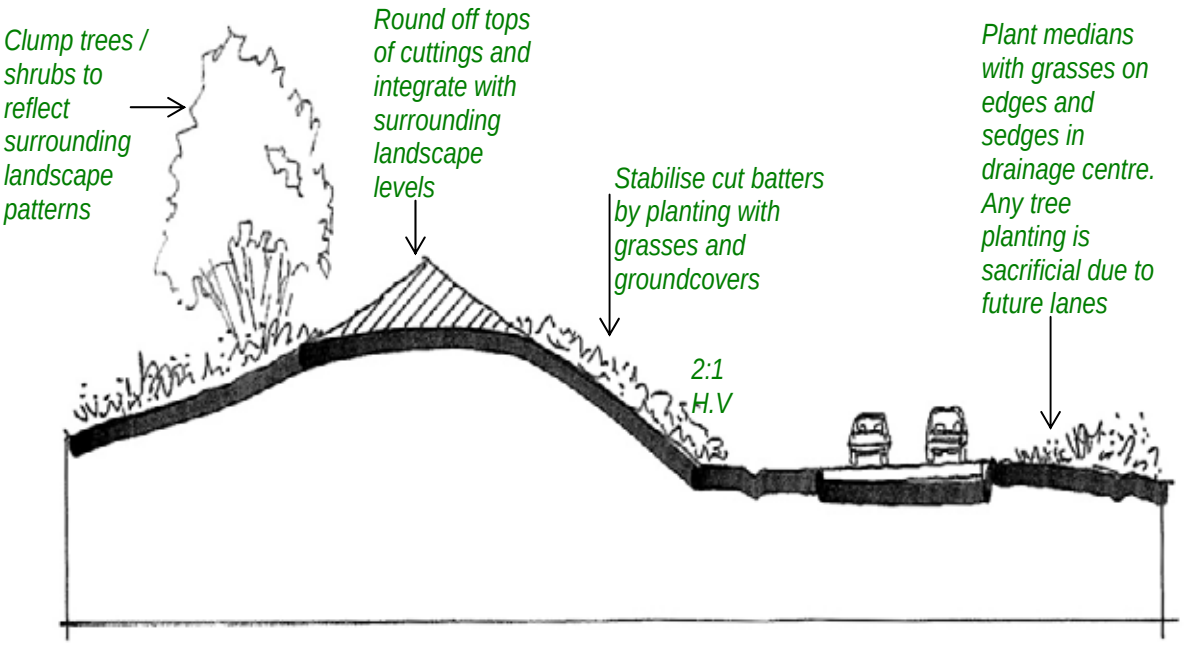
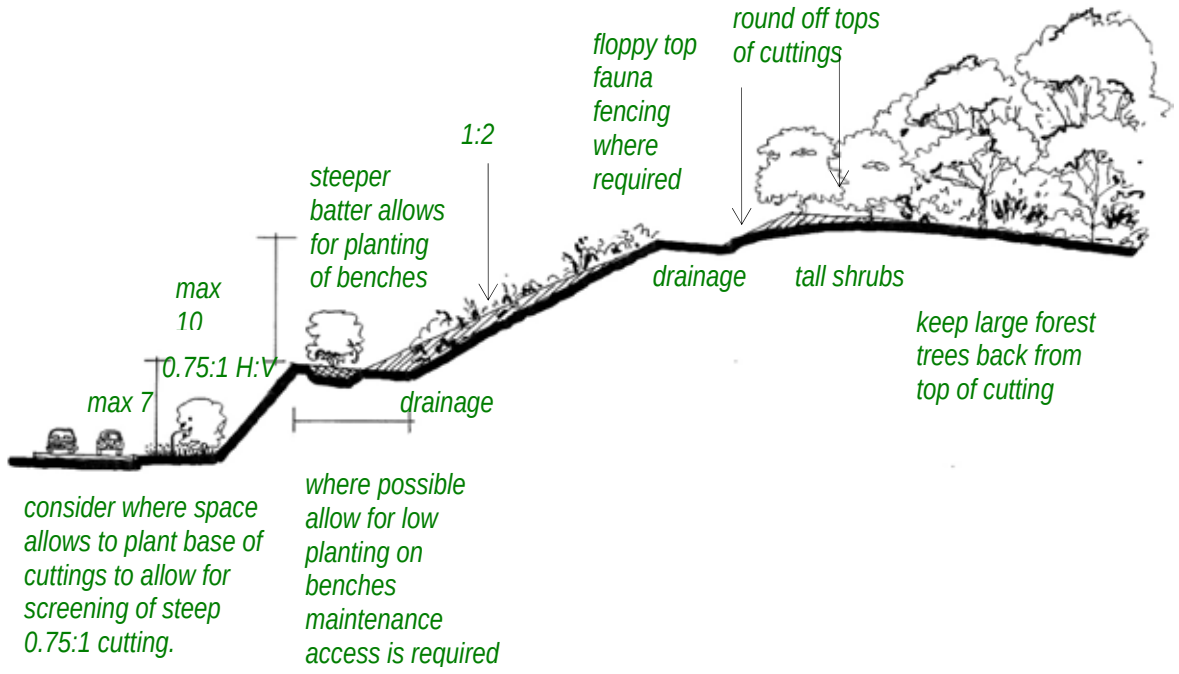


Figure 18-3 Typical deep cutting



18.3.4 Acid sulphate soils

Potential acid sulphate soils contain iron sulphides (pyrites), which may oxidise when exposed to air, resulting in the soil acidification and dissolved acid and metal discharge into nearby surface water bodies via surface water runoff and groundwater flows (see Section 16.3.1).

The acid sulphate soil analyses indicated that both actual and potential acid sulphate soils are present at concentrations greater than the action criteria at the majority of the sampled investigation locations. Very high concentrations of total potential acidity were measured in the samples as noted in Table 18-4.

Since the acid neutralising capacity of the soils is insufficient to neutralise the total potential acidity present in the soils, appropriate acid sulphate soil management would be required for the Proposal. Furthermore, even where disturbance of the soils is not expected to occur, the effects of these soils on the infrastructure should be considered including acid and sulphate attack of concrete and metal structures and differential ground settlement due to natural fluctuations in rainfall, water levels, upstream discharges and loading of soils.

18.3.5 Erosion and sedimentation

The Proposal would require removal of vegetation, construction of subgrade and embankments, translocation of soils, and construction of bridges and culverts. These construction activities have the potential to result in impact on soils through exposure, therefore leaving them vulnerable to erosion by wind and water. Sheet, gully and

streambank erosion could occur from bridge and culvert works, excavation and floodplain works, and road construction.

The erosion of soils could lead to transport of sediment into nearby waterways without effective management. Scour issues could arise during construction as scour occurs when the size of a channel is reduced or where a channel is steepened. This could occur at the point where the natural waterway channel changes to culvert inlet when the water flows at a sufficient velocity to erode and carry soil particles which cause turbidity and sedimentation. Waterways which do not have vegetation to stabilise soils are more likely to be susceptible to erosion and scour. Further details on the effects of sedimentation on water quality are provided in Chapter 16 – *Water quality and hydrology* (see Section 16.3.1).

18.3.6 Gumma Flat tidal and wetland area

The Proposal is located approximately 180 metres from the Gumma Flat wetland area (SEPP 14 wetland No. 388). A number of floodplain culverts and/or bridges would be required across Gumma Swamp to address flooding issues. Soft soils associated with the floodplain would need to be considered during the construction, as described above. Construction activities have the potential to lead to transport of eroded sediments into the Gumma Flat tidal and wetland area. The proposed management measures to mitigate the erosion and sedimentation of the floodplain areas, including Gumma Flat tidal and wetland area, consist of collection of flows in swale drains (elongated basins) that would provide treatment and spill containment adjacent to the earthworks embankments. These measures would be developed during the detailed design and construction phase of the Proposal. The use of retention basins has not been adopted on the floodplains due to the acid sulphate soils that are expected to be encountered should excavation be undertaken in these locations.

18.3.7 Operational stage impacts

There is the potential for contamination of soils or groundwater as a result of accidental spillage of hydrocarbons or other liquids following a vehicle accident or as a result of failure of spill containment devices.

18.4 Management of impacts

18.4.1 Construction

The impacts associated with construction of the Proposal would be managed through adherence to the construction environmental management plan prepared by the construction contractor.

18.4.1.1 Soft soils

The various construction techniques used to treat soft soils would be dependent upon the availability of suitable construction materials, construction scheduling and the local ground conditions. The construction techniques would be assessed and selected by the construction contractor. Construction techniques which may be used include:

- Surcharging (placing additional temporary fill of greater height than required) on top of fill embankments to reduce the amount of residual settlement following construction works and expedite the rate of consolidation.
- Foundation treatments and the use of wick drains could be applied beneath some sections of the embankment to accelerate and control settlement conditions to manage long-term embankment settlements.
- Transitional structural reinforcement measure such as piles, stone columns and soil mixing have been considered to limit the risks associated with differential settlement at bridge abutments.
- Toe berms or staged embankment construction would be necessary to reduce instability risks during construction of the embankments.
- Other measures such as vacuum consolidation (used for construction on soft soils) as determined as feasible during the detailed design phase.
- Management strategies for the construction of the Proposal on soft soils would be further developed during detailed design. The specific properties and extent of soft soils would be further investigated during detailed geotechnical studies, which would be undertaken during detailed design. The removal of soft soils is not considered to be appropriate given that large areas would need to be excavated and that corresponding disturbance of acid sulphate soils would therefore be likely to result.

Embankment construction would likely require staging due to the presence of soft soils. Construction of the pavement on top of the embankment would commence only when the risk of settlement is low. Additional time would also be required during the construction on soft soils for drainage, preloading, surcharging, and relocation of some materials. Construction activities and staging are described in Chapter 7 – *Design and construction of the Proposal*.

Bridges on soft soils would need to be supported on piles driven into rock as deep compressible alluvial and estuarine soils are expected at most waterway crossings. Piles would likely be approximately 20 to 25 metres long at Warrell Creek, approximately 20 to 40 metres long at the Nambucca River east of Macksville and approximately 20 to 25 metres long at the Kalang River. The length of piling would be confirmed during the detailed design of the Proposal. Bridge approach treatment would be needed to provide a smooth transition between the bridges and embankments on floodplains as fill embankments on the soft soils settle.

18.4.1.2 Cut batters

Measures would be required to improve the stability of batter slopes and local protection measures, including but not limited to rock bolts and mesh. The need for and locations for such measures would be determined during detailed design or during construction, after cuttings have been established and in-situ batter material has been assessed.

During the initial construction stages, all batters would be subject to engineering inspections and additional regular inspections would be undertaken during excavation by a suitably qualified engineering geologist to identify any potentially de-stabilising seams or steeply inclined joints. Other above-mentioned stabilising methods (such as rock bolts) would be applied if unfavourable jointing is encountered.

Care would be taken to avoid over-excavation and to maintain batter stability throughout construction. Appropriate surface draining systems would be provided around the crest and benches of all cut batters to assist in the management of erosion and sedimentation (see Section 16.4.1). Cut batter designs have been based on the RTA's *Batter Management Strategy*.

Drainage and slope protection measures would be required to reduce erosion and the risk of local instability. The cut batter slopes should be revegetated (seeded and/or planted) immediately following placement of topsoil to limit potential for rutting and scouring of cut batter surfaces in soil and weathered rock. This is shown in Figure 18-4.

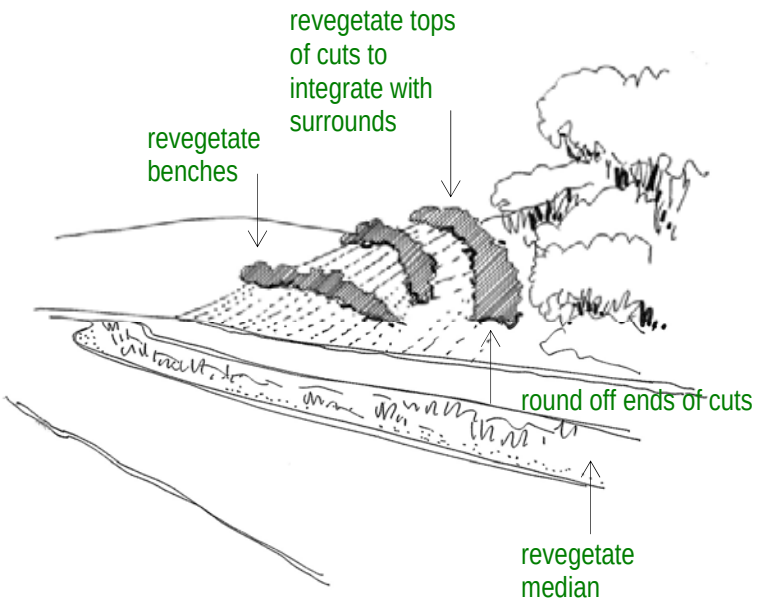
18.4.1.3 Contaminated land

Based on the preliminary contamination investigations, contamination is not anticipated to impact on the construction of the Proposal. While the Proposal has been sited to avoid the tip site, care would need to be taken in the vicinity of the tip when clearing and grubbing for construction.

Specific measures for managing any unforseen occurrences of contaminated land include:

- Potentially contaminated areas of land to be impacted by the Proposal would be identified and further investigated in accordance with the *RTA's Contaminated Land Management Guideline* (RTA 2005e).
- In the event that contamination investigations indicate that the concentrations of contaminants on or adjacent to the Proposal are above the intended land use criteria, an appropriate risk-based management plan approach would be developed in accordance with the *RTA's Contaminated Land Management Guideline* (RTA 2005e).
- A remedial action plan would be developed if the contamination is found to pose unacceptable risks to the environment or human health, and remediation works would be undertaken in consultation with the DECCW.

Figure 18-4 Treatment of cuttings and embankments



18.4.1.4 Acid sulphate soils

Disturbance of acid sulphate soils may occur during the preparation of the subgrade and large volumes of soil may therefore require treatment and disposal. As there is a high risk of acid sulphate soil occurrence along sections of the Proposal, alternative subgrade preparation measures would need to be applied to minimise the disturbance of foundation materials. Specific measures to mitigate impacts on acid sulphate soils include:

- Avoiding or minimising excavation and lowering of the water table in areas known to contain acid sulphate soils.
- If acid sulphate soils are disturbed, acid generation potential would be minimised, any acid produced would be neutralised, and acid waste leaving the site would be prevented using appropriate measures in accordance with the Acid Sulphate Soil Manual (ASSMAC 1998).
- Monitoring of water quality downstream of acid sulphate soil risk areas to allow early identification of potential risks from acid sulphate leachate to ensure that mitigation measures are implemented in a timely manner (see Section 16.4.1).
- Acid resistant construction materials would be used where possible in areas known to contain high risk acid sulphate soils.
- The acid sulphate soils would be covered with clean fill to prevent further disturbance.

As a result, an acid sulphate soils management sub-plan would be developed and implemented prior to the commencement of construction works. The sub-plan would be prepared in consultation with relevant government departments as part of the construction environmental management plan. The sub-plan would be consistent with the *Acid Sulphate Soils Manual* (ASSMAC 1998) and would include a contingency plan to deal with the unexpected discovery of actual or potential acid sulphate soils, a water quality monitoring program and measures to manage acid sulphate soil impacts.

During construction the RTA would:

- Ensure that the soil and water management sub-plan and acid sulphate soil management sub-plan are implemented in an appropriate manner in accordance with any approval or licence conditions.
- Ensure that all impact control measures specified in the soil and water management sub-plan and acid sulphate soil management sub-plan are maintained in effective working order for as long as they are required.
- Identify surface water quality and groundwater quality criteria in accordance with relevant guidelines.
- Undertake water quality and groundwater monitoring and reporting as required by any approval conditions or licences.
- Implement and maintain a water quality monitoring program to assess the effects of Proposal construction until all affected areas have been fully stabilised and revegetation work has resulted in the establishment of sustainable vegetation cover.

- Install culverts and bridge structures in the location described in Chapter 6 – *Description of the Proposal* and comply with design specifications.

18.4.1.5 Erosion and sedimentation

The construction of the Proposal has the potential to result in erosion and sedimentation impacts. A soil and water management sub-plan would be prepared and implemented in consultation with relevant government departments and councils as part of the construction environmental management plan. Erosion and sediment controls as detailed in Chapter 16 - *Water quality and hydrology* (see Section 16.4.1), would be put into place prior to the commencement of construction works. Regular inspections and if necessary, maintenance would be undertaken to restore damaged erosion and sediment controls. Sedimentation basins have been sited and sized in the concept design to effectively protect receiving waters. These have been included in the design described in Chapter 6 - *Description of the Proposal*. Temporary water quality basins during construction have been designed for the Proposal in accordance with *Soils & Construction, Volume 1, 2004, and Volumes 2C and 2D, 2008* manuals (known as 'the Blue Book') and the method for sizing and locating the sediment basis detailed in Chapter 16 – *Water quality and hydrology* and Working paper 5 – *Water* (*Flooding and water quality*).

Following completion of the construction, a number of the sediment basins would be converted to permanent sediment basins depending on their suitability for operation.

An appropriately qualified soil conservationist would be consulted according to the schedule identified in the soil and water management sub-plan to:

- Assist in the preparation of progressive erosion and sediment control plans.
- Undertake inspections of temporary and permanent erosion and sedimentation control devices.
- Ensure that the most appropriate controls are being implemented.
- Check that controls are being maintained in an efficient condition.
- Check that controls meet any relevant approval requirements and / or licence conditions.

18.4.2 Operational stage

18.4.2.1 Erosion and sedimentation

Conventional mitigation and management measures would be applied to control erosion and operation impacts during the operational phase of the Proposal. During operation, a number of the sediment basins provided during construction would be converted to permanent sediment basins. Other measures incorporated into the drainage design of the road upgrade to reduce the impact of erosion and sedimentation includes permanent water quality basins, vegetated swales and permanent spill containment basins. These are detailed in Chapter 16 – *Water quality and hydrology* and Working paper 5 – *Water (Flooding and water quality).*

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Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

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19. Other environmental issues

This chapter considers a number of other issues that have not been identified in the environmental assessment requirements issued by the Director-General. The environmental risk assessment in Chapter 9 – Environmental risk analysis has concluded that these issues did not pose substantial environmental risk.

19.1 Hazards and risk

This section examines the hazards and corresponding risks to human health and the environment that could arise as a result of incidents during construction or operation of the Proposal. The main potential incident of concern for the Proposal is the accidental release of toxic, flammable or explosive material during storage, use or transport of hazardous substances.

The risks associated with hazardous substances were assessed on a qualitative basis, in consideration of the likelihood of an incident occurring and the potential severity of consequences. It is important to note, that the hazards and risks associated with road traffic were only assessed in relation to the transport of hazardous substances. The general hazards and risks associated with road traffic accidents are beyond the scope of this environmental assessment.

19.1.1 Construction stage hazards and risks

Hazards and risks associated with construction of the Proposal would include:

- Environmental and occupational health and safety hazards - including environmental and social impacts if spills of hazardous materials were to occur, and dangers to construction workers and the public.
- Transport of hazardous materials.
- Handling and storage of hazardous materials.

Sensitive environmental receivers such as watercourses and water bodies, threatened species and endangered ecological communities may be impacted by hazardous materials during construction of the Proposal if appropriate environmental management measures are not implemented.

Dangerous goods and hazardous materials that may be used during construction include, but may not be limited to, diesel fuels, oils, greases and lubricants, petrol, gases (oxy-Acetylene), bitumen, paints and epoxies, curing compounds, herbicides and hydrated lime. Some of these hazardous materials would be stored at the construction work sites. The storage, handling and use of the materials would be undertaken in accordance with the *Occupational Health and Safety Act* 2000 and the *WorkCover guideline Storage and Handling of Dangerous Goods 2005*. The quantities required are not expected to pose a significant off-site risk. Potential risks would be further mitigated by placing restrictions on storage of hazardous materials.

Occupational health and safety hazards have the potential to occur between the construction workforce and members of the public. The standard mitigation measures identified in Section 19.1.2 would reduce the risks to members of the public during construction. Additionally, batching plants are to be positioned at least 15 metres from sensitive receptors to ensure activity is not potentially hazardous.

19.1.1.1 Operational stage hazards and risks

During operation there is the potential for contaminants arising from normal operation of the highway (tyre and brake wear, engine oil leaks, litter), or chemicals from accidental spillages to adversely affect the quality of the local environment. The main route for these contaminants to the environment would be via run-off from both paved and unpaved surfaces. The installation of permanent water quality controls would reduce the risk to the environment.

Risks to members of the public during operation would relate to incidents involving the release of dangerous goods. The Pacific Highway is a designated dangerous goods route. Dangerous goods that might be transported in significant quantities on the Pacific Highway include flammable and combustible petroleum products (petrol and diesel); liquefied petroleum gas and toxic gases (e.g. ammonia and chlorine); corrosive materials (acids and alkalis); other toxic materials (e.g. pesticides); and nitrogen-based fertilisers or bulk explosives.

Crashes involving vehicles transporting chemicals and/or other dangerous goods would generally affect only a small area, with hazards relating to toxic effects, fire and explosions. The Proposal is located within a sparsely populated area such that most incidents would have limited potential to affect those not directly involved in a crash or incident. The Proposal has been designed to meet relevant design guidelines for highways and would contribute to an overall improvement in driving conditions. The proposed bypass would reduce the likelihood of hazardous goods incidents and serious head-on collisions through separation of the carriageways.

19.1.2 Management measures

19.1.2.1 Construction

The risks associated with transport of hazardous substances to and from construction sites would be minimised as the goods would be transported in compliance with the Australian Code for the Transport of Dangerous Goods by Road and Rail.

During construction, potential hazards and risks would be identified and managed using standard management measures such as:

- Securing bunded areas for storage of oils and other hazardous liquids, and for activities with the potential for spillage and contamination.
- Temporary sediment basins for the duration of construction.
- Regular maintenance and inspection for construction controls.

- Prepare and implement a site-specific safety management plan and safe work methods statements for the Proposal. Identify hazards associated with work on the site and hazard control measures to ensure that people are adequately protected from risk of injury or illness.

19.1.2.2 Operational

During operation, management measures would include:

- Installing permanent water quality basins, vegetated swales and permanent spill containment basins to provide containment of accidental spills.
- Permanent spill containment basins would be designed to capture spills of a maximum of 20,000 litres and would be located near sensitive environments (see Section 16.4.2).

19.2 Air quality

19.2.1 Existing air quality

There is limited information about air quality in the vicinity of the Proposal. Long-term monitoring is not usually undertaken outside metropolitan and/or industrial areas, because pollutants typically do not exist in concentrations that would cause adverse environmental or health impacts.

There has, however, been short-term air quality monitoring adjacent to a dual carriageway section of the Pacific Highway at Korora, which is located in an urban area approximately 30 kilometres north of the Urunga. A monitoring station was established at Korora to monitor the ambient air quality from October 2005 to January 2007. The speed limit at the monitoring point is signposted at 100km/hr and the gradient of the road is approximately 5.2 per cent. The monitoring site is adjacent to one of the most trafficked sections of the Pacific Highway. Monitoring was conducted over the peak traffic period that coincides with the Christmas holidays from November to January. Due to the proximity of the monitoring site to the existing highway, the concentrations of air quality parameters measured are inclusive of vehicle emissions. Therefore, the concentrations detected are likely to be substantially higher than the ground level exposure for the local area, and provide a worst case scenario of ambient air quality in the area.

The air quality station was equipped to monitor the following air quality and meteorological parameters:

- Carbon monoxide (CO).
- Oxides of nitrogen (NO_x).
- Nitrogen dioxide (NO_2).
- Nitrogen monoxide (NO).
- Particulate matter less than 10 microns in diameter (PM_{10}).
- Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$).
- Wind speed.

- Wind direction.
- Air temperature.
- Relative humidity.

The AADT at Korora was approximately 19,700 over the monitoring period, which is nearly double the current (average) AADT for the Pacific Highway between Warrell Creek and Urunga.

In setting air quality goals for NSW, the DECCW has adopted the National Environment Protection Council of Australia's air quality standards, which are part of the National Environment Protection Measures (NEPM). While goals have been established for carbon monoxide, nitrogen dioxide and PM10, advisory reporting goals only have been identified for PM2.5. Table 19-1 identifies the maximum concentrations detected during the monitoring period and compares the readings with the maximum NEPM recommendations. Pollutant concentrations in Table 19-1 have been provided in parts per million (ppm), milligrams per cubic metre (mg/m3), or micrograms per cubic metre (µg/m3).

Table 19-1 Korora air quality monitoring results

Pollutant	Averaging period	NEPM goals		Korora monitoring results	
		Maximum concentration	10-year goal (max allowable exceedence)	Maximum recorded concentration	Average recorded concentration
National standards and goals for ambient air quality					
Carbon monoxide	8 hrs	9.0 ppm (10 mg/m^3)	1 day a year	0.2 ppm (0.3 mg/m^3)	0.03 ppm (0.04 mg/m^3)
Nitrogen dioxide	1 hr	0.12 ppm (246 µg/m^3)	1 day a year	0.036 ppm (73.8 µg/m^3)	0.004 ppm (9.2 µg/m^3)
Particles as PM_{10}	1 day	50 µg/m^3	5 days a year	37.8 µg/m^3	20.3 µg/m^3
Advisory reporting goals					
Particles as $PM_{2.5}$	1 day	25 µg/m^3	Gather data to facilitate review of goal	15.4 µg/m^3	7.7 µg/m^3

Results obtained from the Korora monitoring station were:

- The maximum 8-hour average carbon monoxide concentration was 0.3 milligrams per cubic metre, compared with the goal of 10 milligrams per cubic metre.
- The maximum 1-hour average nitrogen dioxide concentration was 73.8 micrograms per cubic metre compared with the goal of 246 micrograms per cubic metre.

- The maximum 24-hour average PM_{10} concentration was 37.8 micrograms per cubic metre compared with the goal of 50 micrograms per cubic metre.

The non-regulated $PM_{2.5}$ was also measured and levels peaked at 15.4 micro grams per cubic metre, compared to the advisory NEPM reporting goal of 25 micro grams per cubic metre.

The NEPM goals are ambient air quality goals that are intended to be applied at locations away from the influence of significant emission sources. Dispersion would reduce the pollutant levels significantly as the distance from the road increases. For example, compared with the above levels measured at 20 metres from the highway (Table 19-1), levels 100 metres from the highway would be closer to ambient levels and would be approximately one tenth of the levels provided in Table 19-1.

19.2.2 Potential impacts of the Proposal on air quality

19.2.2.1 Construction stage

Air emissions during the construction of the Proposal would generally comprise dust and vehicular emissions. Dust would be generated as a result of various construction phase activities including:

- Clearing of vegetation and moving topsoil.
- Earthworks including embankments and cuttings.
- Wind erosion of stockpiles and unsealed haul roads and light vehicle access tracks.

Typically, large particulate matter emitted into the air would return to the surface closer to the emission source than smaller particulates. The dust levels (total suspended particulates) experienced on any given construction day would relate to the extent of earthmoving activities (including blasting) being undertaken and the area of soil exposed at any one time. Any construction dust plumes are not expected to be visible, and would not impact houses closest to the Proposal. Vehicle and equipment emissions during construction are expected to be minor. Overall construction air quality impacts are expected to be minor.

19.2.2.2 Operational

Predicted annual average daily operational traffic volumes, including heavy vehicle traffic and the proposed local access road network were presented in Section 17.4. The predictions indicate that 10 years after the estimated opening of the Proposal (2013), the total annual average daily traffic volume would be about 11,500.

The effect of projected increase in vehicle traffic volumes on air quality would be offset to a point by the continual improvement in average emission performance of vehicles, with newer more efficient vehicles replacing older less efficient vehicles. Emissions would also be reduced due to more efficient traffic movement and slightly reduced travel times.

Vehicle emission controls were introduced in the early 1970s and emission limits have been progressively tightened over the past 30 years. These controls have resulted, particularly over the last 10 years, in improvements in a

number of air quality indicators and it is accepted that vehicles meeting tighter emission standards have played a major part in the improvement.

It is considered that, given the comparatively low traffic volume on the Proposal, air quality could be expected to meet the DECCW guidelines. Pollutants would further diminish with distance from the proposal, resulting in negligible operational impacts.

19.2.3 Management measures

19.2.3.1 Construction and operation

Apart from dust control measures during construction, no other mitigation measures are required.

19.3 Non-Aboriginal heritage

19.3.1 Assessment approach

The European heritage assessment presented in this report has been based upon:

- The results of a heritage assessment of the study area in 2004 undertaken for the route options study for the Pacific Highway upgrade.
- Additional searches of all relevant heritage registers to identify any items or places within the study area that may have been listed since the completion of the investigations in 2004.
- Further consultation with representatives from Nambucca and Bellingen Shire Councils and relevant heritage groups to identify any additional heritage issues.
- An assessment of heritage significance of heritage items within the study area.
- Statement of Heritage Impacts compiled for specific items.

The additional heritage register searches undertaken for this environmental assessment included the Australian Heritage Commission Database, State Heritage Register, State Heritage Inventory, register of the National Trust, the RTA's Section 170 register and the heritage schedules of the Nambucca and Bellingen local environmental plans.

To adequately identify all places that have the potential to be impacted by the Proposal, the study area for non-Aboriginal heritage extended approximately 60 metres either side of the proposed road upgrade corridor. The assessment of significance was undertaken in accordance with the principles outlined in the *Australia ICOMOS Charter for Places of Cultural Significance* (Burra Charter 1999) and the guidelines issued by the NSW Heritage Branch.

19.3.2 Existing environment

19.3.2.1 Settlement and landuse history

Forestry

Cedar was harvested along all the major NSW coastal rivers and was abundant in the Bellinger River Valley, especially on the alluvial flats of the lower section (Dunne 1990). Cutters were on the Bellinger River in 1839 and the Nambucca River in 1841. Cedar cutting rapidly expanded throughout the region and as cedar resources were depleted, attention was diverted to other stands of hardwoods. Mills were established at Raleigh, Nambucca and Urunga to exploit the timber resources required for the building industry and railway sleepers and girders. Waves of permanent settlers moved into the areas opened up by the cedar industry. Between 1864 and 1884 a total of 563 conditional purchases of land were made in the Kempsey/Nambucca area. A similar pattern of settlement occurred in the Bellinger River Valley from the 1860s.

Agriculture

Cattle were brought into the region, with cattle numbers between 1895 and 1905 increasing from 1,636 to 5,186 (Townsend 1993). After the turn of the century the dairy industry expanded following population increases and butter factories were set up at Raleigh, Gleniffer and Bellingen to process the milk (Pearson 1994). Farmers established piggeries due to the large amounts of unused skimmed milk resulting from cream production; bacon and ham became by-products of the dairying industry.

The changes in technology following World War I meant that the dairy industry was no longer dependent upon the local processing of raw milk into butter and many local butter factories closed. With the decline of the dairy industry some farmers diversified into growing other crops including bananas, avocadoes and potatoes. Some farmers were bought out by Australian Paper manufacturers and the land was turned over to timber plantations which were in recent years taken over by Forests NSW.

Transport

The opening of roads in the district enabled easier movement away from the coastal fringe and the waterways. The road from Bellingen to Dorrigo enabled timber from Dorrigo and large quantities of maize from the Bellingen Valley to be shipped to Sydney via the Bellinger River. The coming of the railway in 1906 created a demand for sleepers and the fast growing city of Sydney was in constant need of ever increasing supplies of hardwood for construction purposes (Townsend 1993).

Light rail or tramways were often set up to transport logs from the forest to the larger mills. By the 1920s the bullock teams were being replaced by traction engines. The advent of the railway and the construction of main roads and bridges removed the need to move timber and produce to Sydney by ship. After World War II, improved access roads and advances in logging and saw milling technology resulted in the majority of saw mills moving out of the forests and into nearby towns.

Industry and mining

Ship building became and important business as entrepreneurs took advantage of the local timber-getting industry. The local shipbuilding industry was dominated by two men, John Stuart and Edward Davis. Ships were built at several sites along the Nambucca River.

Many local residents were employed in fishing in Macksville, Nambucca and Scotts Head (Dunne n.d.). The shipbuilding family, the Davis', were the first to take up an oyster lease on the river employing Indigenous labourers. The industry serviced both the local and Sydney markets and catches was transported to the city via train. Fishing has drawn holiday makers to the area since the early twentieth century.

Gold was discovered at Valla in 1878 by an Aboriginal named Dick Marshall. A gold rush saw many claims staked in the area, with miners and their families living in tents and a small settlement with a post office, two shops and a hotel was soon constructed. The Valla Mine began operations in 1891 and continued operation with several interruptions. In 1919 it became clear that gold mining was no longer viable and mining activity was redirected to working the rich arsenic content. Mechanical roasters and refiners were constructed and the mine entered a new period of prosperity, growing to employ over 90 men in 1929. The mine closed in 1933 (Thurtell and Smith 1997).

Towns and villages

Two cattle stations were established in Warrell Creek by pastoralists in the 1840's (Townsend 1993). While pastoral activities opened up vast tracts of country around the Warrel Creek area, the main activity was cedar getting which established Warrell Creek as a centre for the forestry industry. The railway passed through the settlement in 1919 and greatly influenced the development of the area. Warrell Creek became a base for railway maintenance gangs and produce transportation.

The growth of Macksville occurred simply because local settlers there were keen to subdivide their holdings and accelerated when land which was initially taken as free selection was converted to freehold and subdivided in 1886/87. Macksville, which was officially referred to as Nambucca, but locally as Nambucca Central, expanded as the preferred growth centre despite the government's choice of Wilson because of its flood free situation. The new road north from Kempsey, which was surveyed in 1868 passed through Macksville.

The establishment of a ferry crossing east of Macksville centre in 1883 was associated with the "Nambucca" Hotel, which Thomas Boulton opened in 1882, and led to the development of Macksville as the major township in the area. A subdivision by Angus Mackay in 1887 in central Macksville represented the first recorded use of the name, "Macksville". Numerous businesses followed and this was sufficient to sustain the continued growth of the village of Macksville. This impetus was also strengthened by the relocation of the ferry to a site at the end of Princess Street, just to the west of the existing road bridge. The early and continued growth of Macksville resulted in many substantial commercial buildings, some of which remain today (Townsend 1993).

Early growth at Nambucca Heads was associated with its function as a port for the Nambucca Valley, servicing the local timber industry, with the local economy severely hampered by slumps in the demand for timber and by the fire which destroyed the Buckman Mill in 1883. The continued growth of Nambucca Heads relied much more on

passing trade than Macksville and Bowraville, both of which had a broader range of businesses servicing growing local populations and the surrounding hinterlands. This reliance on passing trade inhibited the growth of Nambucca Heads which only recorded 64 households in the 1891 census (Townsend 1993).

Urunga's early history was linked with agriculture (dairying and maize growing), the timber industry and the need for a pilot station to assist shipping from the mouth of the Bellinger River. The shipping activity at Bellinger Heads, the early name for Urunga, transported maize and cedar to Sydney. The sandbar was considered dangerous and construction of training walls to channel the river and make navigation safer increased local employment opportunities with quarrying and transporting of the stone, as well as the actual building of the training walls. The pilot station was established in 1876, only ceasing operations in 1927.

By the 1900's, several timber mills were established as well as schools and businesses to serve the growing population at Bellinger Heads. The nearby ferry crossing of the Kalang River gave the town access to an increasing passing trade. The ferry service continued until it was replaced by a timber bridge in 1928. The expansion of the northern rail line further consolidated its advantage. These two transport developments were significant in cushioning the economic downturn associated with the declining river trade. It was in the first decade of the twentieth century that the name Urunga came into use, being firmly established by 1912 (Urunga Public School, 1882-1982).

19.3.2.2 Heritage items

There were no listed heritage items (items or places currently listed on statutory heritage registers) located within the study area. There were, however, thirteen items located within the study area that were considered to be of potential heritage significance. These are listed in Table 19–1 and shown in Figure 19-1. For items where the potential for adverse impacts has been identified, a Statement of Heritage Impact (SOHI) has been prepared to determine the heritage significance and to assist with development of management and mitigation measures outlined.

Table 19-2 Non Aboriginal heritage items within the study area

No	Item name	Address	Description	Statutory listing	Heritage significance
1	Boulton Hotel	75 River Road, Macksville	Macksville's first hotel established in the early 1880s. The building is now a private house but retains some of its original features. The hotel is a weatherboard, single storey colonial house with a bull nosed veranda on three sides, hipped roof and picket fence.	Nil	Local significance.

No	Item name	Address	Description	Statutory listing	Heritage significance
2	Ferry/punt crossing at Boulton Hotel	Opposite Boulton Hotel, Macksville	First crossing of the Nambucca River in Macksville. Important for its early association with the development of the local area. The site includes remnant wooden piles and timber beams on the southern side of the river. The northern launch point is also still visible.	Nil	Local significance. Should be recommended for listing on the heritage schedule of the Nambucca Shire LEP. SOHI prepared.
3	Farm house, North Macksville	Junction of Pacific Highway and Old Coast Road	Large weatherboard and fibro farm house with corrugated iron roof, thought to be more than 50 years old. The building appears to have been renovated.	Nil	Low potential significance. SOHI prepared.
4	Old municipal tip site	Eastern side of Old Coast Road, north of Macksville	None available.	Nil	Local significance.
5	Valla gold mine	Pacific Highway south of Mines Road	Operation of the gold mine dates back to 1878. The mine closed during World War 1 and reopened again in 1919 when the ores were mined for arsenic and sulphur. The mine site is recorded approximately 30 m to the east of the present Pacific Highway alignment and 50 m east of the proposed route.	Nil	Local significance.
6	Cow Creek Aboriginal Reserve	Pacific Highway, north of Nambucca Heads	The Cow Creek Aboriginal Reserve was gazetted in 1894 over an area of 40 acres. In addition to burials on the land, the Cow Creek site is considered to have a high likelihood for living deposits such as food remains, camp sites and historical rubbish and debris.	Nil	High local significance.
7	Former stock route	Pacific Highway, north of Cow Creek Aboriginal Reserve	The former travelling stock route runs along the northeast corner of the Cow Creek Aboriginal Reserve. Many travelling stock routes have associated features including watering facilities, bores, dams and windmills, yards. This section of travelling stock route does not retain any notable features beyond the actual route reserve.	Nil	No heritage significance (determined from preparation of SOHI).
8	Tramway and quarry, Martells Road	Martells Road, Urunga	The stone quarried from this location was used in the construction of training walls and docks at Urunga. Some physical evidence of cuttings and creek crossing construction remains.	Nil	Local significance.
9	South West Arm Road scenic road landscape	South West Arm Road	Scenic road and landscape along the Kalang River. Provides important views to the surrounding cultural landscape, which includes small dairy farms with timber houses and cultural plantings.	Nil	High local significance. Identified as a Conservation Area by Bellingen Shire Council.

No	Item name	Address	Description	Statutory listing	Heritage significance
10	Farm house, Kalang River	South Arm Road	The farmhouse is thought to date back to the late nineteenth or early twentieth century. It was previously located on the northern bank of the Kalang River, approximately 30m north of South West Arm Road but was relocated some time after the 1950s. Since then, it has been relocated to its current position. The house is representative of the land use patterns and tenure of the local area and region.	Nil	Low local significance.
11	Fire trail and right of carriageway	Off South Arm Road, near Kalang River	One of the earliest carriageways in the area. Dates back to the late 1800s.	Nil	No heritage significance (determined from preparation of SOHI).
12	Possible house site	North of Kalang River, north and west of South Arm Road	Anecdotal evidence of possible house site. The site includes cleared land with footings, abandoned farm machinery and introduced plantings.	Nil	High local significance as identified by the SOHI.
13	Tangye pump	Between Warrell Creek and the North Coast Railway Line	The Tangye pump is located within a derelict tin shed adjacent to Warrell Creek. The pump is a relic facility from the period in which steam locomotives were used on NSW railways.	Nil	High local significance as identified by the SOHI.

The items listed in Table 19–1 were considered to be of local heritage significance. Three items have been identified as conservation areas in the *Bellingen Shire Council Local Environmental Plan 2003*. The remaining sites were not listed on any statutory heritage registers or any draft amendments to any statutory heritage registers or schedules.

19.3.3 Potential impacts

19.3.3.1 Construction

There is the potential for removal of or damage to heritage items, which may include vibration impacts or changes to the views, or damage to an element of the heritage item during the construction process. Of the fifteen items listed in Table 19–1, nine have the potential to be impacted by construction of the Proposal. The remaining six items within the study area are unlikely to be impacted by the Proposal because they either lie outside the zone of potential construction impact or the route alignment has been adjusted to avoid impacts on these heritage items.

The potential impacts of construction on non-Aboriginal heritage are summarised in Table 19-3.

19.3.3.2 Operational

There would be no impacts to non-Aboriginal heritage during the operation of the Proposal.

FIGURE 19-1 | NON-ABORIGINAL HERITAGE SITES

Table 19-3 Summary of construction impacts on non Aboriginal heritage within the study area

No	Item name	Address	Heritage significance	Construction impacts
1	Boulton Hotel	75 River Road, Macksville	Local significance	Nil. Located outside zone of potential impact.
2	Ferry/punt crossing at Boulton Hotel	Opposite Boulton Hotel, Macksville	Local significance. Should be recommended for listing on the heritage schedule of the Nambucca Shire LEP. SOHI prepared.	Indirect (within 50m of centreline) impacts.
3	Farm house, North Macksville	Junction of Pacific Highway and Old Coast Road	Low potential significance. SOHI prepared.	Direct impacts. Demolished and removed.
4	Old municipal tip site	Eastern side of Old Coast Road, north of Macksville	Local significance.	Nil. Located outside zone of potential impact.
5	Valla gold mine	Pacific Highway south of Mines Road	Local significance.	Nil. Route alignment adjusted to avoid impact on mine.
6	Cow Creek Aboriginal Reserve	Pacific Highway, north of Nambucca Heads	High local significance.	Indirect impacts. Adjacent to existing Pacific Highway on western side. Route adjusted to minimise impact on the reserve.
7	Former stock route	Pacific Highway, north of Cow Creek Aboriginal Reserve	No heritage significance (determined from preparation of SOHI).	Potential for indirect impacts (including impacts to southern end of former stock route). Close proximity to existing highway. Route alignment adjusted to minimise impact.
8	Tramway and quarry, Martells Road	Martells Road, Urunga	Local significance.	Nil. Located outside zone of potential impact.
9	South West Arm Road scenic road landscape	South West Arm Road	High local significance. Identified as a Conservation Area by Bellingen Shire Council.	Direct impacts. Visual impacts and impacts where Proposal intersects South Arm Road.
10	Farm house, Kalang River	South Arm Road	Low local significance.	Direct impacts. Likely to be demolished and removed.
11	Fire trail and right of carriageway	Off South Arm Road, near Kalang River	No heritage significance (determined from preparation of SOHI).	Direct impacts. Small section removed for Proposal.
12	Possible house site	North of Kalang River, north and west of South Arm Road	High local significance as identified by the SOHI.	Direct impacts. Likely to remove all archaeological remains.
13	Native swamp	AMG 499275/6627500	Local significance. Identified as a Conservation Area by Bellingen Shire Council.	Nil. Located approximately 30 metres east of proposed road alignment.
14	Vegetation group remnant forest	AMG 500300/669200	Local significance. Identified as a Conservation Area by Bellingen Shire Council.	Nil. Located approximately 40 metres southeast of proposed road alignment

No	Item name	Address	Heritage significance	Construction impacts
15	Tangye pump	Between Warrell Creek and the North Coast Railway Line	High local significance as identified by the SOHI	Direct impacts, likely to remove all archaeological remains.

19.3.4 Management measures

19.3.4.1 Construction

For items of heritage significance in Table 19-3 which have been identified as being directly or indirectly impacted, a series of mitigation measures are proposed. These are detailed in Table 19-4. These mitigation measures would be developed into a non-Aboriginal heritage management sub-plan as part of the construction environmental management plan. This document would be prepared in consultation with the NSW Department of Planning Heritage Branch, Nambucca and Bellingen Shire Councils. In addition to the specific mitigation measures detailed in Table 19-4 the plan would include:

- Procedures to be implemented if previously unidentified non-Aboriginal relics are discovered during construction.
- An education program for construction personnel on their obligations for non-Aboriginal relics.
- Procedures for stopping work in the event that additional heritage items are uncovered during works.

With regard to potential impacts to archaeological deposits, relics or other items of potential heritage value, established procedures would be followed with the guidance of RTA heritage specialists. These specialists would provide advice on whether consultation with Department of Planning Heritage Branch is necessary. Consultation with Bellingen Shire Council would be undertaken during detailed design of the Proposal so that appropriate impact mitigation measures can be developed for the potentially impacted Conservation Area, namely the South West Arm Road scenic road landscape.

Table 19-4 Proposed construction mitigation measures

Item name	Proposed construction impact mitigation and management measures
Ferry/punt crossing at Boulton Hotel	■ The location of the remains on the south and north banks would be plotted on all construction plans as a heritage area. The area would be designated a 'no impact zone'. ■ Information about this item and its heritage significance, including the need to avoid damaging this item would be provided to all RTA staff, contractors and subcontractors during their induction. ■ The boundaries of the item would be marked on the site prior to construction and would be maintained during construction. ■ Weekly inspections would be conducted to determine possible impacts on the item. ■ Photographic records would be taken from established locations at each weekly inspection to monitor the impacts on the item over time. ■ If impacts to the heritage item occur, details including the effect on the item should be provided to the RTA in accordance with Non-Indigenous heritage management plan procedures.

Item name	Proposed construction impact mitigation and management measures
Farm house, North Macksville	■ An archaeological analysis of the structure's evolution would be undertaken to document the original and evolving fabric of the building. This would be undertaken in tandem with an archival recording and dismantling of the building to expose areas for investigation and recording before its demolition. ■ An archival recording of the house and farm outbuildings would be undertaken and would follow the NSW Heritage Branch guidelines 'How to Prepare Archival Recording of Heritage Items' (1998) and 'Photographic Recording of Heritage Items Using Film or Digital Capture' (2006). ■ Copies of completed archival records would be lodged with relevant local historical archives such as Local Studies collection in the Clarence Regional Library and the Bowraville Folk Museum as well as with the NSW Heritage Branch library.
Cow Creek Aboriginal Reserve	■ Activities extended outside the official boundary of the reserve onto the area adjacent to the Proposal. No structural remnants were found during detailed subsurface investigations of the area.
Former stock route	■ Minimal indirect impacts to the item during construction. No construction impact mitigation measures required.
South West Arm Road scenic road landscape	■ A detailed landscape design and treatment would be developed and implemented in consultation with relevant professionals with experience in heritage landscapes to minimise the impact of the road. The design would be reviewed by the NSW Heritage Branch to ensure the goal of minimising the impact of the road on the views of the River Farm Landscape. ■ Selective plantings would be used to partially screen the road. ■ The Kalang River crossing would be designed to avoid impact or closing of South West Arm Road. This would allow the road to maintain its historic function of linking properties along the north bank of the Kalang River.
Farmhouse, Kalang River	■ An archival record of the original fabric of the farmhouse would be prepared in accordance with the NSW Heritage Branch Guidelines: 'How to Prepare an Archival Recording of Heritage Items' (1998) and 'Photographic Recording of Heritage Items Using Film or Digital Capture'. ■ Copies of completed archival record would be lodged with local historical archives such as Local Studies collection in the Clarence Regional Library, Urunga Museum and the Heritage Branch Library.
Fire trail and right of carriageway	■ Minimal impacts to the item during construction. No construction impact mitigation measures required.
Possible house site	■ A two staged approach for further historical and archaeological investigations is required to further identify possible remains and its significance. ■ Stage One, undertake: - Historical research to further establish the history of the land including land ownership, council rate records, issued saw mill licenses and oral history. - Clear and record any archaeological remains on the site; prepare an archaeological assessment in accordance with Heritage Branch guidelines. ■ Stage Two, undertake: - If significant archaeological remains are to be impacted then undertake archaeological work that would recover and mitigate the loss of significant information in accordance with the assessment and an archaeological research design. - The archaeological research design would be reviewed by Heritage Branch specialists. All archaeological work would be performed at a standard consistent with the provisions of s.139 permits issued under the Heritage Act.
Tangye pump	■ The Tangye pump is within the construction footprint of the road and requires relocation. It should remain within the local community and be suitably interpreted and curated in its new location. ■ Prepare an archival record of the pump in accordance with the NSW Heritage Branch Guidelines: 'How to Prepare an Archival Recording of Heritage Items' (1998) and 'Photographic Recording of Heritage

Item name	Proposed construction impact mitigation and management measures
	Items Using Film or Digital Capture'. ■ Copies of completed archival record would be lodged with local historical archives such as Local Studies collection in the Clarence Regional Library, and the Bowraville Folk Museum as well as the Heritage Branch Library. ■ It is understood that the local museum is interested in obtaining the pump and its driving engine or exhibition. Liaison with the local museums and collections is recommended to establish the level of interest (which often changes over time) and the best location for the Tangye pump to be relocated. ■ Suitable local museums and other bodies would be approached to become permanent custodians of the Tangye Pump upon completion of its archival recording.

19.3.4.2 Operational

As operation of the Proposal would not impact non-Aboriginal heritage, no specific impact mitigation or management measures are required for the operational stage.

19.3.5 Summary of management measures

The following list is a summary of the impact mitigation and management measures that would be implemented for the Proposal:

- Preparation of a non-Aboriginal heritage management sub-plan containing specific mitigation measures for the heritage items identified to date.
- If there is any potential for additional impact on an item of heritage significance after detailed design, further archaeological investigation, including archival and photographic recording of the site would be undertaken prior to construction.
- If any archaeological deposits, relics or other items of potential heritage significance are uncovered or are likely to be destroyed or impacted by the construction of the Proposal then the NAHMS-P would identify specific mitigation requirements, including when referral is required to the Heritage Branch.
- Consultation with Bellingen Shire Council would be undertaken during detailed design of the Proposal so that appropriate impact mitigation measures can be developed for the potentially impacted Conservation Area, namely the South West Arm Road scenic road landscape.
- A detailed landscape design and treatment would be implemented to mitigate visual impacts of the road on views of the South West Arm Road scenic road landscape.
- Consultation would be undertaken with local museums and collections to identify opportunities or relocation of the Tangye pump.
- Assessment of the possible house site to determine whether it has archaeological significance.

Opportunities to avoid and minimise impacts on items of heritage significance would be investigated during detailed design and implemented where practical.

19.4 Waste management

Various waste streams would be generated during the construction of the Proposal, including construction and demolition waste, vegetation waste, packaging materials and liquid wastes.

19.4.1 Waste streams

Waste products would be generated during the construction of the Proposal and would include the following waste streams:

- Demolition wastes from existing structures that require demolition, pipe work, pavements and concrete pathways.
- Excavation wastes, although the Proposal has been designed with the aim of achieving a cut/fill balance, there is the potential that some excavation material may be produced which would be unsuitable for reuse.
- Vegetation from removal of shrubs and trees, however, where possible this would be mulched for use in landscaping.
- Packaging materials associated with items delivered to site such as pallets, crates, cartons, plastics and wrapping materials, all of which need to be disposed of once the product has been used. Minimisation of packaging of raw materials would be strongly encouraged. Components of this waste stream could be recycled or reused.
- Wastes produced from the maintenance of various heavy construction equipment including liquid hazardous wastes from cleaning, repairing and maintenance. Likewise leakage or spillage of fuels/oils during construction would need to be managed and disposed of appropriately.
- Non-hazardous wastes would be generated through the use of worker's facilities such as toilets.
- General wastes including office wastes, scrap materials and biodegradable wastes.

19.4.2 Management measures

19.4.2.1 Construction

All wastes would be managed and disposed of in accordance with relevant state legislation and government policies including the *Waste Avoidance and Resource Recovery Act* 2001 (WARR Act), the *Waste Avoidance and Resource Recovery Strategy 2007* and the *RTA's Waste Reduction and Purchasing Policy* (WRAPP). The *DECCW's Waste Classification Guidelines* (DECC 2008b) would be used to classify the different types of waste, and the management, treatment and disposal of the wastes.

Site wastes would generally be managed using the following principles (moving from most desirable to least desirable):

- Avoiding unnecessary resource consumption.
- Recovering resources for reuse.

- Recovering resources for recycling or reprocessing.
- Disposing of residual waste (as a last resort).

Avoidance of waste can be accomplished for the Proposal by providing realistic predictions on the quantities of resources such as construction materials. The potential to re-use waste materials either on-site or off-site including re-use of topsoil and fill material would be identified during detailed design. Trees and plant material could be mulched or chipped on-site and used for landscaping. Where possible, waste would be segregated and recycled and recycling facilities would be provided for paper, plastic, glass, aluminium cans and other recyclable materials. Waste disposal would only occur where there are no other options for waste avoidance, reuse and recycling. All waste disposal would occur in accordance with the *DECCW's Waste Classification Guidelines* (DECC 2008b).

RTA's contractors are required to propose recycled content construction materials where they are cost competitive and performance competitive. The cost competitiveness of materials is assessed on a project life-cycle basis considering issues such as impacts on construction practices and disposal requirements. RTA's contractors are also required to report waste minimisation quantities, initiatives and barriers. In addition, the RTA has allowed for recycled and recovered materials procurement for road construction and maintenance works. The use of these products with recycled content and products that produce low waste quantities would reduce demand on resources. Opportunities to reduce the demand on resources, where reasonable and feasible, include using secondary waste materials such as fly ash, slag and silica within concrete mixes.

Standard site specific waste management measures would therefore include requirements for:

- The application of the waste minimisation hierarchy principles of avoid/reduce /re-use/recycle/dispose.
- Waste handling, storage and disposal.
- Any waste material that is unable to be re-used, re-processed or recycled would be disposed at a facility approved to receive that type of waste.
- Secondary waste materials, such as fly ash and steel slags would be used in construction materials where reasonable and feasible.
- Waste management impacts during construction are expected to be low, given the management and disposal activities outlined above.

19.4.2.2 Operational

There are no specific waste management measures proposed for the operational stage.

19.5 Energy

19.5.1 Energy use

As with any infrastructure and development project, all construction activities associated with the Proposal would consume energy. Construction activities that consume energy include:

- Procurement and delivery of materials to site.
- Site establishment, including compound set up.
- Relocation and protection of services.
- Earthworks including earth and rock cuttings and retaining walls.
- Removal, relocation and compaction of excavated material in fill embankments.
- Vegetation removal.
- Construction of pavements, bridges and culverts.
- Demolition of structures and pavements.
- Operation of batching plants, site compounds and lighting.
- Construction plant including cranes, rollers, excavators, bulldozers, graders and water trucks.
- Removal of waste from the site.

Equipment and vehicles on the construction site would consume a large quantity of fuel. It is estimated that 1.5 litres of fuel are required for each cubic metre of earthworks and on this basis, it is estimated that 8.7 million litres of fuel would be used for earthworks operations.

Other activities such as the delivery of raw materials to batching plants and the construction of bridges would also utilise a large amount of fuel. It is estimated that up to 15 million litres of fuel would be required for such activities.

The main sources of electricity consumption during construction include the supply of electricity to site compounds to provide electricity for air conditioning, operation of office equipment and external lighting during occasional night-time work. It is likely that the site compounds would be connected to the local power grid as electricity requirements would be minor. Some generators may be necessary for emergency power supply. Construction plant and equipment would be selected by the appointed contractor. The duration of use of the plant and equipment would depend on the specific conditions encountered. It is estimated that construction would be completed over an active period of approximately 36 months.

Some energy would be consumed during the operation of the Proposal and these activities include road repairs, minor landscaping including grass cutting and operation of the road lighting and traffic control devices.

19.5.2 Management measures

With the objective of minimising any imported materials and conserving resources, opportunities to achieve cut/fill balance would be assessed during the detailed design phase. Specific considerations to reduce energy consumption during construction would include:

- Awareness programs would be conducted for all site personnel regarding energy conservation measures and energy audits would be undertaken to identify and address energy waste.
- Office based equipment (including lights and computers), would be operated in an efficient manner and regularly maintained. If economically viable, electrical energy derived from renewable energy source accredited by the National Green Power Accreditation Steering Group (or equivalent) would be used for the supply of at least 50 per cent of the on-site electrical energy required during construction.
- The energy saving measures implemented would be monitored to determine their effectiveness.

19.6 Greenhouse gases

19.6.1 Overview

The aim for managing greenhouse gas (GHG) emissions is to minimise the impact the proposal has on climate change by reducing emissions from both the road construction process and also as a result of the operation of the upgrade.

In terms of construction phase GHG emissions, a balance needs to be reached between minimising construction emissions and the consequence this may have on operational emissions. For example, the increased use of cut and fill may have the effect of increasing construction GHG emissions, but may also provide for a straighter and flatter highway route, thereby decreasing the operational emissions of vehicles using the upgrade and consequently lower operational GHG emissions.

19.6.2 Greenhouse gases and climate change

Greenhouse gases absorb outgoing heat energy that is reflected from the earth. The absorption of this heat warms the air, enabling life to survive, and is known as the Greenhouse Effect. The primary, human produced greenhouse gas is carbon dioxide (CO_2).

Human activities, such as the combustion of carbon-based fuels, increase the amount of GHGs in the atmosphere. This leads to greater absorption of heat and increases in atmospheric temperature, known as the Enhanced Greenhouse Effect.

Different GHGs have different heat absorbing capacities, or global warming potentials. In order to achieve a basic unit of measurement, each GHG is compared to the absorptive capacity of CO_2, and measurements and estimates of GHG levels are reported in terms of CO_2 equivalent emissions (CO_2-e). The primary GHG that would be generated by the operation of the proposal is CO_2, which is generated by the use of liquid fuel in private vehicles and construction machinery.

19.6.3 Australian government response to climate change

The Australian government is implementing a comprehensive strategy for tackling climate change. The strategy is built on three pillars: reducing Australia's carbon pollution; adapting to unavoidable climate change; and helping to shape a global solution. The *White Paper – Carbon Pollution Reduction Scheme* (CPRS) was released on 15 December 2008. The Paper set out the Government's policy in relation to two major elements of its mitigation strategy - a medium-term target range for national emissions, and the final design of the CPRS.

Commencement of the CPRS was targeted for 1 July 2010 but this has recently been postponed by 12 months to 1 July 2011. If passed by government, the CPRS will be Australia's primary policy tool to drive reductions in emissions of greenhouse gases. The economic cost of GHG emissions is not currently reflected in the costs of business or the price of goods and services as firms currently face no cost from increasing emissions. The CPRS is designed to redress this market failure through a cap-and-trade system to reduce carbon pollution.

The CPRS will cover the major GHG emitters - approximately 1,000 entities that together account for around 75 per cent of Australia's emissions from the stationary energy, transport, fugitive, industrial processes, waste and forestry sectors. The CPRS will cover all six greenhouse gases covered under the Kyoto Protocol (CO_2, methane (CH_4), nitrous oxide (N_2O), sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs)).

The Proposal's exposure to a future CPRS will depend on timing of its approval and implementation, and may result in increased costs of construction fuel and materials, in particular for materials such as steel and concrete which have high levels of embodied energy. This will result in increases in prices for these commodities as producers look to offset their increase in energy costs to manufacture these products.

The *National Greenhouse and Energy Reporting Act* 2007 (the NGER Act) introduced a single national framework for the reporting and dissemination of information about the GHG emissions, GHG projects, and energy use and production of corporations. The NGER Act will underpin the CPRS, providing the emissions data on which obligations under the CPRS will be based. Not all corporations that report under existing NGER legislation will be subject to CPRS liabilities. The RTA is not required to report GHG emissions under the NGERs legislation, however for consistency this assessment has used NGERs emissions estimation methods for the calculation of project related GHG emissions.

19.6.4 Assessment methodology

As relevant to infrastructure projects, emissions are categorised into three broad scopes (see Figure 19-2):

- Scope 1: All direct GHG emissions (including fuel).
- Scope 2: Indirect GHG emissions (typically from the consumption of purchased electricity).
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the project, electricity-related activities (e.g. transmission and distribution (T&D) losses) not covered in Scope 2, outsourced activities, waste disposal, etc.

Table 19-5 sets out the methodology adopted for the assessment of GHG emissions associated with the Proposal.

Figure 19-2 Scope 1, 2, and 3 GHG emissions

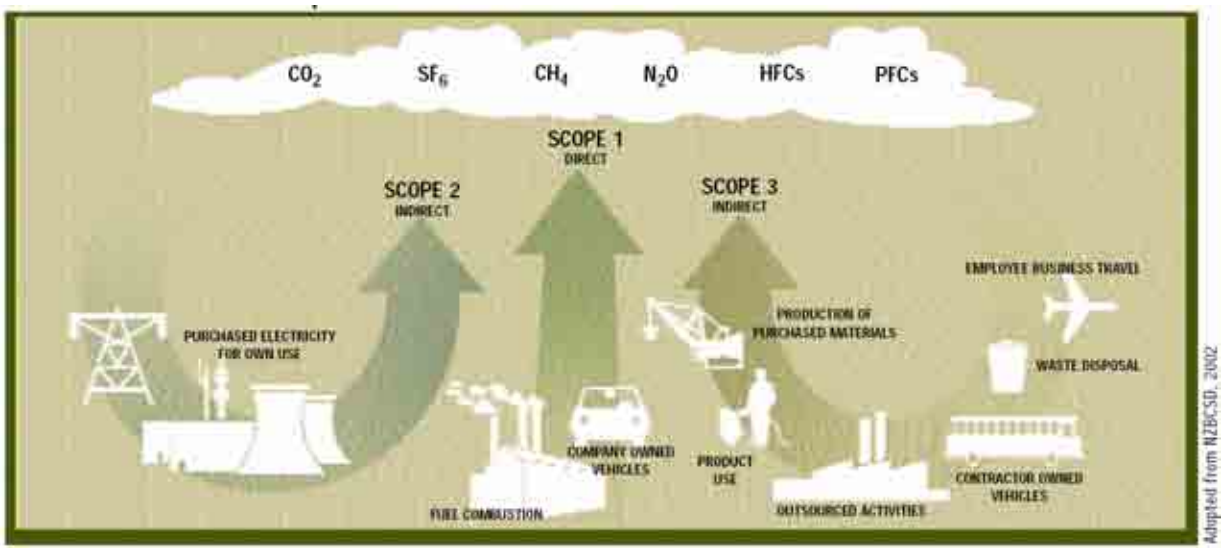

Table 19-5 GHG assessment methodology

Element	Description
Project boundaries	■ The project boundary includes both the existing and upgraded highway asset. ■ For the upgraded highway the project boundary includes construction and operational phase emissions. ■ Direct emissions from combustion of fuel (Scope 1), indirect emissions from consumption of electricity (Scope 2) and as relevant to construction other upstream and downstream indirect emissions (Scope 3) are included in the assessment. ■ In terms of Scope 3 emissions associated with construction, these emissions are from upstream and downstream processes and include: - Embodied energy of construction materials. - Transport of materials and waste to and from construction sites. - Disposal of waste to landfill.
Assessment methodology	■ The assessment methodology is based on estimates of activity data and material quantities for the baseline and upgrade scenarios. ■ GHG emission factors are those provided by the Australian Department of Climate Change (DCC) – *National Greenhouse Accounts (NGA) Factors* (June 2009). ■ In terms of assessing the range of GHG emission sources to be considered and quantified for the assessment a test of significance has been applied. Where emissions from some sources are small (estimated at less than 1 % of total) no quantification has been undertaken. ■ In terms of GHG emissions from operational traffic these are assessed for both the existing highway (do-nothing) and upgraded highway considering traffic flows in the year of road opening and 10 years after opening.

Element	Description
Baseline GHG emissions sources	■ Fuel use from vehicles using the existing Pacific Highway. ■ Electricity consumption from: - Street lighting. - Traffic signals.
Calculating Upgrade GHG Emissions	■ Operational Phase: - As above for baseline GHG emission sources. ■ Construction Phase: - Vegetation clearance (both direct emissions from equipment fuel consumption, loss of carbon sink and emissions from disposed vegetation). - Fuel consumption in site vehicles, plant and equipment. - Electricity consumption. - Use of explosives. - Embodied energy of construction materials. - Transport of materials and waste to and from construction sites. - Disposal of waste to landfill.

19.6.5 Construction phase GHG emissions

19.6.5.1 Energy use

As with any infrastructure and development project, all construction activities carried out on-site would consume energy. Construction activities that consume energy include:

- Site establishment, including compound set up.
- Relocation and protection of services.
- Earthworks including earth and rock cuttings and retaining walls.
- Removal, relocation and compaction of excavated material, both on and off-site.
- Vegetation removal.
- Lighting during night-time activities.
- Demolition of structures and pavements.
- Laying of concrete curbing and pavement.
- Construction of infrastructure such as culverts, drainage and rest areas.
- Operation of batching plants and site compounds, including lighting.
- Construction plant including trucks, cranes, rollers, excavators, bulldozers, graders and track laying machines.

Based on the initial estimates of fuel use for energy intensive construction activities, an estimation of full fuel cycle emissions of greenhouse gas emissions are summarised in Table 19-6 and Table 19-7. The quantification of GHG emissions is indicative only and where applicable has been based on a construction period of three years. A more accurate appreciation of GHG emissions from the construction of the Proposal would be possible following the development of a detailed construction schedule.

Table 19-6 Estimated construction fuel greenhouse gas emissions

Activity	Estimated fuel usage (kL)	Scope 1 emission factor (t CO_2-e/kL)	Scope 3 emission factor (t CO_2-e/kL)	Full fuel cycle emission factor (t CO_2-e/kL)	Total emissions (tonnes CO_2-e)
Fuel Use[1]					
Earthworks	8,700	2.695	0.205	2.9	25,230
Concrete Batching	15,000	2.695	0.205	2.9	43,500
Total					68,730

[1] - Calculations assume all fuel for construction is diesel.

Table 19-7 Estimated construction electricity greenhouse gas emissions

Activity	Estimated fuel usage (kWh)	Scope 2 emission factor (t CO_2-e/kWh)	Scope 3 emission factor (t CO_2-e/kWh)	Full fuel cycle emission factor (t CO_2-e/kWh)	Total emissions (tonnes CO_2-e)
Electricity Use					
Lighting[1 + 2]	65,043	8.9×10^{-4}	1.8×10^{-4}	1.07×10^{-3}	69.6
Office Activities[1+ 3]	375	8.9×10^{-4}	1.8×10^{-4}	1.07×10^{-3}	0.4
Total					70

1 – For the purposes of this calculation, a 3 year construction period has been assumed.

2 – Calculations assume that work site lighting will be powered by diesel generators. This figure estimates electricity use for external areas at site offices / construction compounds (12x450W for 11hrs per day).

3 – This calculation is based on data contained in the Department of Infrastructure, Transport, Regional Development and Local Government Annual Report 2008 of 9MJ for a typical office worker, and an estimated on-site office based staff of 50 people.

The largest source of energy related GHG emissions during construction are expected to be generated through the consumption of fuel, in particular from concrete batching plants. Emissions from the use of electricity are not expected to contribute extensively to overall construction emissions.

19.6.5.2 Embodied energy GHG emissions

A further important consideration is the embodied energy in construction materials. Construction projects are indirectly responsible for energy consumption and greenhouse gas emissions from the extraction of raw materials and production of manufactured materials, for example concrete and asphalt required for paving and curbing, in addition to steel required for re enforcing and drainage. In a carbon constrained future (e.g. following the

introduction of a CPRS), the cost of construction materials with high embedded energy levels will increase, and this should be taken into account during the design phase when the selection of materials is being considered.

Other activities such as the delivery of raw materials and removal of waste from the construction area would also utilise a large amount of fuel. With the objective of minimising the need for imported materials and conserving resources, opportunities to achieve cut/fill balance would be assessed during the detailed design phase.

An estimation of construction GHG emissions for sources other than energy is provided in Table 19-8.

Table 19-8 Estimation of construction greenhouse gas emissions (other than energy)

Source	Estimated usage	Emission factor	Total emissions (tonnes CO_2-e)
Steel - recycled	15,000 t	0.717 t CO_2e/t[6]	10,755
Steel - other	5,000 t	2.65 t CO_2e/t[6]	13,250
Sand[1]	150,000 m^3	0.017 t CO_2e/t[6]	6,944
Pavement quality materials[1]	400,000 m^3	0.017 t CO_2e/t[6]	18,516
Concrete aggregates[1]	300,000 m^3	0.017 t CO_2e/t[6]	13,887
Cement	200,000 t	0.804 t CO_2e/t[6]	160,800
Blasting[4]	600t	180 kg/t[6]	108
Waste disposal – office[5]	30 t	1.1 t CO_2e/t[6]	33
Transport of materials (quarry)[2]	5 895 kL	2.695 t CO_2e/kL	15,881
Transport of materials (steel)[3]	344 kL	2.695 t CO_2e/kL	928
Transport of materials (cement)[3]	3 442 kL	2.695 t CO_2e/kL	9,275
Transport of waste (office)[2 + 5]	8.7 kL	2.695 t CO_2e/kL	0.07
Total			250,377

1 – Assumes a density of 2.723 t/m^3

2 – Assumes 25T truck and 60km one way trip (Nambucca area)

3 – Assumes 25T truck and 50% of material sourced from Newcastle, 25% from Brisbane and 25% from Sydney

4 - Volume and type of explosive is given as an example of potential explosive use. The actual type and volume of explosive will be determined during detailed construction planning.

5 – Estimate of 200kr per office worker per annum, and 50 office staff (Picken, Macguire, Waste Management and Environment, Taking a Closer Look at Office Waste, April 2002 - http://www.wme.com.au/categories/waste_managemt/april2_02.php).

6 – Emission Factors taken from RTA Greenhouse Gas Inventory for Road Construction Projectsv1.3 (May 2009).

19.6.5.3 Vegetation removal – loss of carbon sink

GHG emissions due to land clearing were calculated using the DCC FullCAM Modelling tool. FullCAM is a fully integrated carbon accounting model for estimating and predicting all biomass, litter and soil carbon pools in forest and agricultural systems. Carbon masses per hectare were calculated for Blackbutt forest (being the dominant vegetation association directly impacted), agricultural land and typical local species along the proposal length. An estimate of construction GHG emissions from the clearing of vegetation is provided in Table 19-9.

Table 19-9 Estimation of construction greenhouse gas emissionsfrom the clearing of vegetation

Source	Usage	Average tonnes carbon per ha (FullCAM)[4]	Emission factor	Total emissions (tonnes CO_2-e)
Land clearing – Blackbutt forest	225.9 ha	240[2 + 3]	3.67	192,474
Land clearing – local native species[1]	141.3 ha	130[2 + 3]	3.67	68,977
Land clearing – agricultural / rural land	134.1 ha	1.85[2 + 3]	3.67	910
Total				262,361

1. All native vegetation types other than Blackbutt have been included as 'local native species' in FullCAM.
2. Carbon contained in soil and existing debris has not been included.
3. With reference to the flora and fauna assessment and in discussion with project ecologists, average tree age has been estimated as 80 years.

19.6.5.4 Waste disposal

Waste may be generated where demolition of structures such as fences, buildings or existing roads is required. In addition packaging and damaged equipment may also be deposited to landfill. All wastes would be managed and disposed of in accordance with relevant state legislation and government policies, including the DECCW's *Waste Classification Guidelines* (DECC 2008b). Proposed waste management plans are outlined in Section 19.4, and detail the intention to reuse suitable wastes on-site wherever possible and to reduce waste volumes from the sorting and recycling of eligible waste. It is therefore expected that GHG emissions generated by construction waste would be well below one percent of total construction emissions, and as such this source has not been quantified in this report.

19.6.5.5 Summary of potential construction impacts

Construction of the Proposal is expected to generate approximately 581,538 t CO_2e (refer to Table 19-6 - Table 19-9). It should be noted that all fuel and material volumes, electricity usages and transport distances are approximate only, and have been estimated using typical and/or expected usage data for these activities.

The GHG emission calculations contained in Table 19-6 to Table 19-9 show that the largest emissions are expected to be generated through clearing of native vegetation, followed by concrete production. These two sources alone are expected to generate almost 75 per cent of construction related GHG emissions.

19.6.6 Operational phase GHG emissions

19.6.6.1 Electricity use

During the operation of Proposal, electricity usage would primarily occur as a result of lighting. It is not anticipated that electricity use would change substantially over the life of the project. The estimated annual operational energy use is provided in Table 19-10.

Table 19-10 Estimation of annual operational energy use

Activity	Fuel usage (kWh/yr)	Scope 2 emission factor (t CO_2-e/kWh)	Scope 3 emission factor (t CO_2-e/kWh)	Full fuel cycle emission factor (t CO_2-e/kWh)	Total emissions (tonnes CO_2-e)
Street lighting[1]	682,550	8.9×10^{-4}	1.8×10^{-4}	1.07×10^{-3}	730

1 – Assumes 400W High Pressure Sodium lighting installed at each interchange at 50m spacing for 11hrs each day.

19.6.6.2 Vehicle emissions

Reductions in emissions as a result of the Proposal would be expected through efficiency gains made by vehicles using the upgraded route. Improvements in grade and surface condition would be expected to result in an overall reduction per vehicle in GHG emissions.

The RTA has provided an estimation of fuel savings as a result of the Proposal over for a 30 year period. This was calculated using the NSW RTA REVs tool. Note that the proportion of heavy vehicles (i.e. diesel fuel) is forecast to increase over time. This is due to the growth rate applied to heavy vehicles being higher than the rate applied to other vehicles. The fuel savings over the entire 30 year period are expected to be in the order of:

- Diesel 103.4 million L.
- Unleaded petrol (ULP) 50.8 million L.

Annual emission savings were calculated using anticipated traffic growth rates (as given in Section 7, Traffic and Transport) to calculate fuel savings in the year of opening and in ten years time. Table 19-11 contains an estimate of annual GHG emission savings from vehicle exhausts as a result of the Proposal.

Table 19-11 Estimation of emission savings during operation

	Estimated fuel saving (kL)	Scope 1 emission factor (t CO_2e/kL)	Scope 3 emission factor (t CO_2e/kL)	Full fuel cycle emission factor (t CO_2e/kL)	Total emissions (tonnes CO_2-e)
2013 only					
Petrol	1,232	2.289	0.181	2.47	3,043
Diesel	2,509	2.695	0.205	2.9	7,276
Total					10,319
2023 only					
Petrol	1,486	2.289	0.181	2.47	3,670
Diesel	3,025	2.695	0.205	2.9	8,773
Total					12,443
Total 30 Year					
Petrol	50,800	2.289	0.181	2.47	125,476
Diesel	103,400	2.695	0.205	2.9	299,860
Total					425,336

1 – Based on estimated 30 year fuel savings data provided by the RTA and calculated using REVs tool.

19.6.6.3 Other operational emission sources

GHG emissions generated through maintenance activities will occur throughout the life of the project, however these will be comparatively small and are expected to be well below one percent of the total operational emissions; as such these emission sources have not been quantified.

19.6.7 Proposal GHG emissions – summary

For the Warrell Creek to Urunga section of the highway, the following operational GHG emission benefits are anticipated when compared to the existing highway:

- A shorter route would decrease fuel use from vehicles travelling along the new route.
- The elimination of traffic signals would decrease braking and acceleration, thereby reducing fuel demands from traffic.
- Cut and fill balance would result in a flatter route, thereby reducing fuel use from vehicular traffic.

While the RTA is not responsible for GHG emissions from road traffic once the Proposal is operational, decisions made regarding road design and construction would influence operational emissions. Overall, it is anticipated that the operation of the Warrell Creek to Urunga Pacific Highway Upgrade would result in reductions in overall transport emissions through increased operational efficiencies gained through alignment and flow improvements for vehicle traffic using the route.

A summary of total project GHG emissions over a thirty year period are contained in Table 19-12.

Table 19-12 Proposal greenhouse gas emissions summary

Emission Source	GHG emissions (tonnes CO_2-e)
Construction Emissions	
Fuel Use	68,730
Electricity Use	70
Sources other than energy (not including vegetation removal)	250,377
Vegetation Removal	262,361
Total Construction Emissions	581,538
Operational Emissions	
Street Lighting	730
Petrol Savings	- 125,476
Diesel Savings	- 299,860
Total Operational Emissions (30 year)	- 424,606
Net 30 year GHG emissions	156,932

This summary shows that at the end of the nominated thirty year period, GHG emissions associated with the construction of the project would exceed operational GHG emission savings by approximately 156,932t CO2e. If it is assumed that operational fuel savings continue to be made at the same rate beyond 30 years, it is anticipated that emission savings would equal those generated at some time around 40 years of operation.

19.6.8 Greenhouse gas management measures

Greenhouse gas emissions can be reduced at both the construction and operational states of the proposed upgrade. Management measures to be considered during the construction and operation of the upgrade have been provided in Table 19-13.

The extent to which these measures will be adopted has not been determined at this stage of the Proposal, and as such the impact of the adoption of these measures has not been quantified in this report. Where this information becomes available in the future, the GHG calculations contained in this report may be updated to account for these reductions.

Table 19-13 Proposed greenhouse gas management measures

Proposal stage	Proposed mitigation measure
Construction	■ Fuel efficiency would be considered during the selection of construction machinery and vehicles. ■ Where feasible, use biofuels (biodiesel, ethanol, or blends such as E10 or B80), to reduce greenhouse gas emissions from construction plant and equipment. ■ Plant and equipment would be maintained in order to ensure equipment operates at maximum fuel efficiencies. ■ Strategies for minimising the volume of concrete and steel required for the project would be considered. ■ Where suitable, concrete containing high a proportion of recycled material would be considered for use. ■ The embodied energy of construction materials would be considered when choosing suppliers, in particular for materials such as cement, aggregate, concrete and steel in line with the RTA's specifications, particularly 'design, construct, maintain' requirements. ■ Options for maximising the use of recycled steel in concrete reinforcement would be investigated in line with the RTA's specifications, particularly 'design, construct, maintain' requirements. ■ Where feasible, options for the reuse of spoil material on-site would be considered. ■ Where off-site disposal of waste material is necessary, disposal sites would be selected to be as close as possible to the excavation area to minimise the fuel consumption associated with transport. ■ Energy-efficient site lighting would be used. ■ In the selection of material suppliers, consideration would be given to their proximity to the work area. ■ The use of prefabricated construction materials would be considered where feasible in line with the RTA's specifications, particularly 'design, construct, maintain' requirements. ■ Site offices would consider energy efficient building design in the construction and fit-out. ■ Minimise vegetation clearance as far as possible and replant removed vegetation where feasible. ■ Where feasible, mulch cleared vegetation for re-use on-site. ■ Use local staff wherever possible, to reduce transport-related emissions. ■ Revegetate cleared areas to the extent feasible.

Proposal stage	Proposed mitigation measure
	■ Use recycled materials, for example, replacing cement with fly ash, using recycled aggregate and recycled content in steel, to minimise the lifespan impact of greenhouse gas emissions in production. This would be undertaken where feasible and reasonable
Operation	■ Fuel efficiency would be considered during the selection of maintenance machinery and vehicles. ■ The use of energy-efficient street lighting would be considered. In addition, an energy audit for the street lighting system would be conducted in accordance with AS/NZS 1158:1.1.2005 - Lighting for roads and public spaces - Vehicular traffic (Category V) lighting - Performance and design requirements. The purpose of the audit would be to demonstrate that the design of the lighting scheme has minimised the life cycle energy of the scheme, commensurate with reliability and cost. ■ Use local staff wherever possible, to reduce transport-related emissions. ■ The establishment of RTA programs that encourage better vehicle maintenance and, therefore improve fuel economy. ■ The establishment of RTA programs that reduce fuel use, such as clear signage, provision of facilities that encourage public transport use, solar powered telephones and lighting and maintenance of a quality road surface.

Warrell Creek to Urunga
Upgrading the Pacific Highway

ENVIRONMENTAL ASSESSMENT

VOLUME 1 ENVIRONMENTAL ASSESSMENT

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20. Justification and conclusion

This chapter addresses the strategic need for the proposed upgrade, including how the proposed upgrade would meet the identified Proposal needs and that of the Pacific Highway Upgrade Program. This chapter also outlines the cumulative and synergistic impacts of the Pacific Highway Upgrade Program, and the contribution of the proposed upgrade to these impacts. The table below identifies the key issues for the assessment in the environmental assessment requirements. Note that some of these issues are addressed in earlier chapters.

Director-General's requirements	Where addressed in the EA	
Strategic Justification Outline the strategic outcomes for the Pacific Highway Upgrade Program, including with respect to strategic need and justification:	Chapter 3	Strategic justification and project need
■ The aims and objectives of relevant State planning policies	Chapter 3	Strategic justification and project need
■ The principles of ecologically sustainable development	Section 20.2	Integration of the program and Proposal with principles of ecologically sustainable development
■ Cumulative and synergistic impacts associated with the program as a whole	Section 20.1	Integration of the program and Proposal with principles of ecologically sustainable development
Identify how the project fits within these strategic outcomes and how impacts associated with the project would be considered and managed to achieve acceptable environmental outcomes across the Pacific Highway Upgrade Program. Describe:		
■ The need for and objectives of the project	Chapter 3	Strategic justification and project need
■ Alternatives considered (including an assessment of the environmental costs and benefits of the project relative to alternatives)	Chapter 3	Strategic justification and project need
■ Provide justification for the preferred project taking into consideration the objects of the *Environmental Planning and Assessment Act 1979*	Section 20.1 Section 20.3	Cumulative and synergistic impacts Relationship between the proposed upgrade and the objectives of the EP&A Act

20.1 Cumulative and synergistic impacts

The upgrade of the Pacific Highway is integral to meeting the needs of local, regional and state transportation demands as growth pressures along the NSW coastal strip increase. Important transport, economic, social and environmental outcomes would be achieved through the overall Pacific Highway Upgrade Program and the Proposal as described in Table 20-1.

Table 20-1 Potential cumulative and synergistic impacts of the program and the Proposal

Desired outcome	Pacific Highway Upgrade Program	Proposal
Transport: *improved safety and travel times*	Improved travel times would result in a potentially significant transfer of freight from rail to road due to reduced road transport costs, leading to an increase in heavy vehicles on the road (and associated safety and amenity implications).	■ Travel time improvement expected. However, minimal rail to road transfer expected as result of Proposal itself, relative to overall program. ■ Provision of efficient alternative to Macksville Bridge would avoid significant delays in peak holiday periods and when accidents on the bridge have blocked overall highway traffic. ■ Significantly improved safety through study area would contribute to the overall reductions in traffic accidents and associated injury and loss of life with the flow-on social, emotional and economic effects.
	Congestion and slower travel times during roadworks for the various upgrade projects.	■ Minor disruption with Proposal largely offline to the existing highway allowing existing road network to be maintained for most of the construction period. Some temporary access changes during construction of tie-ins. However, relatively small impact in context of overall Pacific Highway Upgrade Program.
Economic: *improved opportunities for regional economic development*	Some specific economic activities may be affected in towns that are bypassed. These could be positive or negative effects, depending on the nature of the activities within the context of the town.	■ Main effects would be felt in Warrell Creek and Macksville with a small number of highway traffic dependent businesses affected on the existing highway in Bellwood and Urunga. ■ A number of businesses would also experience positive effects of the preferred route with existing unmitigated traffic noise be removed from proximity to accommodation related businesses. ■ Removal of through-traffic (especially heavy vehicle traffic) from the centres of Warrell Creek and Macksville and along the existing highway at Bellwood and Urunga would change the amenity of these areas, enabling opportunities for different commercial operations to develop.
	Lack of availability of road materials for other projects.	■ Relatively large material quantities needed for the Proposal. Earthworks have been designed to be in balance and the resource need for select material

Desired outcome	Pacific Highway Upgrade Program	Proposal
		has been assessed as being able to be catered for by surrounding quarries. ■ Potential for impact on availability of the same resources for other construction efforts in the study area. The extent of impacts on resource availability and price would be dependent on the construction program and timing, but is not expected to be significant.
Social*:* *improved access to employment and community services*	The primary beneficiaries would be road users. Others in the community, including disadvantaged groups, would benefit to the extent that cost reductions and other flow-on effects are passed onto public transport users and consumers.	■ Minor impact relative to overall program as interchange improvements and local road connections would benefit many in the community. Proposal would improve local road network by removing through-traffic and by provision of safer east/west connections across the north/south spine.
	Increased severance and amenity impacts on farms or towns not bypassed or areas not upgraded.	■ The current highway creates a barrier due to the perceived safety risks in east/west crossings. ■ The Proposal is expected to result in improved amenity in the town centres of Warrell Creek and Macksville. It is also expected to improve amenity on the existing highway in the areas of Bellwood and the outskirts of Urunga. ■ Some individual farms may experience some severance impacts. This would be in areas predominantly south of the Nambucca River and directly south of the Kalang River. ■ The preferred route was located to largely follow farm operations boundaries to minimise impacts on farm operations and severance.
	Changes in the character and lifestyle of communities from induced development.	■ The Proposal traverses rural and urban area where development controls and local environmental plans within the local government areas shape the level and type of development. The Proposal is considered to have a positive role in supporting future land use development proposed by Nambucca and Bellingen shire councils. ■ The Proposal is expected to improve access to Coffs Harbour and Kempsey creating some opportunities for residential areas in the study area to become more attractive to commuters to these regional centres. This may create some induced housing demand which could have an upward effect on property prices.
	Impacts on Aboriginal culture due to interference	■ The study area is rich in Aboriginal culture. The

Desired outcome	Pacific Highway Upgrade Program	Proposal
	or disturbance to cultural sites of heritage.	Aboriginal cultural heritage assessment and the associated consultation have assisted in shaping and refining the route to minimise impacts on areas of high cultural value.
Environmental: *protection and enhancement of the natural and built environment*	Loss of habitat and severing of wildlife corridors where new route alignments are constructed. Compensatory programs would offset impacts to some extent.	■ The study area has extensive biodiversity value in areas that haven't been cleared for agriculture and commercial/industrial use. ■ Maintenance of habitat has been an integral component in the route selection and concept design process. Refinements to the design have been made to avoid and minimise impacts on threatened species and to provide habitat for species that need to cross the Proposal. ■ Compensatory arrangements have commenced with the potential to provide compensatory habitat in key zones within the study area. ■ Minor impact relative to overall program due to land already cleared for agriculture, small area of vegetation removal, replanting of riparian vegetation and disturbed nature of existing vegetation.
	Increases in fuel use and greenhouse emissions from growth in vehicle use and population levels in the region associated with increased accessibility arising from the program.	■ No noticeable impact expected (benefits for fuel use and greenhouse gas emissions expected to be positive compared to the existing situation).
	Impacts on landscape by the construction of new roads.	■ Substantial element in a scenic landscape. High impact in some areas due to large structures proposed and location on floodplains. Urban and landscape design measures have shaped the design and would continue to be a high priority.
	Some loss of agricultural land to the highway and to new introduced development.	■ No land expected to be lost to new introduced development however loss of agricultural land due to location in a rural area.
	Potential reduction in water quality and impacts on flooding managed through best practice methods.	■ Some potential benefits for water quality in the Nambucca and Kalang Rivers during operation. ■ Some localised minor negative impacts. These would be controlled by standard water quality control measures and would have special focus on protecting the aquaculture industry in the study area. ■ Bridge structures and culverts designed for major flooding events.

Desired outcome	Pacific Highway Upgrade Program	Proposal
	General improvement in townscape and heritage values (with the exception of isolated locations) due primarily to highway bypasses.	■ Minimal impact on townscapes. ■ Significant heritage items have been avoided. Minor impact in context of overall program.
Financial: *effective and efficient way of investing financial resources*	Net economic benefit from the Pacific Highway Upgrade Program.	■ A range of immediate local economic benefits through the general improvement to the road infrastructure which would have flow-on benefits of providing better access for goods and services to markets and opening/strengthening access to inter-regional markets. ■ Some isolated small negative impacts anticipated where businesses along the existing highway are dependent on through-traffic are bypassed by the Proposal.

20.1.1 Transport desired outcome - improved safety and travel times

The Pacific Highway Upgrade Program, including the Proposal, is expected to have significant benefits for transport and public safety, including a significant reduction in the number of total vehicle accidents. The target for the Proposal is a reduction in accident rates from 28 accidents per million vehicle kilometres travelled (MVKT) to 15 per MVKT.

The contribution of the Proposal to total travel time saving is approximately nine minutes for cars and 9.5 minutes for commercial vehicles during normal operation. This time saving would be greater in busy periods, especially during peak holiday seasons. The Proposal would also result in the bypass of the existing Macksville Bridge which, along with the associated traffic lights in the Macksville town centre, can result in significant delays during peak holiday periods. Economic desired outcome - improved opportunities for regional economic development.

This Proposal would assist in generating regional economic development benefits in terms of the additional economic activity and employment induced by construction expenditure and the anticipated reduction in road transport costs. As described in Section 12.3.2.2, it is estimated that the Proposal would create about 300 jobs during construction. Additional monetary benefits for road users would be associated with increases in travel efficiency and reduced travel times (which would reduce vehicle operating costs, including freight transport costs) and a decrease in the road accident rate.

The proposed upgrade would also ensure that the transport and economic benefits achieved by the other projects in the overall in the Pacific Highway Upgrade Program are able to be capitalised on by the residents and businesses within the region. More specifically the tourism industry would experience growth from improved accessibility to the region. Freight transport costs would also be expected to reduce due to reduced travel time and improved fuel efficiency. Importantly, the proposed upgrade would also support the targeted future levels of population and housing growth on the Mid North Coast as identified in the *Mid North Coast Strategy*.

The Pacific Highway Upgrade Program is estimated to have positive cumulative and synergistic benefits in terms of improved road safety and travel times from Hexham to the Queensland border. The Proposal would contribute to the achievement of these benefits.

20.1.2 Social desired outcome - improved access to employment and community services

Substantial direct benefits of the program would accrue to road users, through improved safety, reduced crashes and reductions in the costs of travel. Reduced travel times would also improve access to employment opportunities and community services and facilities for resident populations. The flow-on effects would produce further social benefits in the form of reductions in costs for public transport users and increased economic activity and employment. Public transport users would, however, need to rely on possible cost reductions and beneficial flow-on effects for public transport availability to gain accessibility benefits.

The key social benefits gained from the Proposal would relate to accessibility and public safety, including the separation of local and through traffic.

The Pacific Highway Upgrade Program is estimated to have positive cumulative and synergistic benefits in terms of economic and social impacts and is likely to contribute to the growth in the tourism industry as a result of improved accessibility to the region. The Proposal would contribute to the achievement of these benefits.

20.1.3 Environmental desired outcome - protection and enhancement of the natural and built environment

There are a range of cumulative environmental impacts associated with the Pacific Highway Upgrade Program. Some of the cumulative impacts are discussed earlier in the environmental assessment (Chapter 10 - *Flora and fauna* and Chapter 15 - *Aboriginal heritage*). There are also a range of amenity and other social impacts on some residents and communities that would occur as a result of the Pacific Highway Upgrade Program including impacts relating to visual amenity, noise and community severance. As an important part of the Pacific Highway Upgrade Program these impacts have been minimised through route selection and Proposal design, and would continue to be minimised in the procedures associated with construction.

There are also a number of cumulative environmental benefits of the Pacific Highway Upgrade Program. These include (in general terms) improved lower resource use and reduced greenhouse gas emissions (on a per vehicle basis). The Proposal is predicted to slightly reduce carbon dioxide emissions as a result of decreased travel times and congestion, and improved road curvature and gradient.

The proposed upgrade would have some environmental impacts which are discussed in detail in this environmental assessment, along with management measures to minimise these impacts. Residents on the existing Pacific Highway, where it would become a local access road, would experience some amenity benefits. These would be greatest in the Warrell Creek and Macksville town centres, along the existing highway at Bellwood and in Urunga.

The Pacific Highway Upgrade Program is estimated to have positive cumulative and synergistic benefits in terms of the natural and built environments. The Proposal would contribute to the achievement of these benefits.

20.1.4 Financial desired outcome - effective and efficient way of investment financial resources

Quantifiable monetary benefits of the Pacific Highway Upgrade Program, such as savings in vehicle operating costs, travel time and avoided crashes, would be substantial as indicated earlier in Section 17.4.2 and 17.4.3. The Proposal would contribute to the totals above in a way that is generally proportional to its length. Economic and 'value-for-money' considerations have been integrated into the development of alternative routes for the proposed upgrade, the selection process for the preferred route and also in the concept design.

The Proposal would contribute to the extension of positive cumulative and synergistic transport and economic benefits of the other projects in the Pacific Highway Upgrade Program through the Mid North Coast region.

20.2 Ecologically sustainable development

Ecologically sustainable development aims to sustain and conserve natural resources through 'using, conserving and enhancing the communities' resources so that the ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased (Commonwealth Government of Australia, 1990).

The principles of ecologically sustainable development have been an integral consideration throughout the process of developing the proposed upgrade and assessing its benefits and impacts. In addition, the preparation and exhibition of the environmental assessment in itself contributes to the consideration of the principles of ecologically sustainable development. It makes detailed information about the proposed upgrade publicly available and assists in the decision on whether the proposed upgrade should proceed.

Definitions of the four principles of ecologically sustainable development quoted below are from the *Protection of the Environment Administration Act* 1991. The definitions from this act are cross referenced in the *Environmental Planning and Assessment Act* 1979.

Precautionary principle

If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

In the application of the precautionary principle, public and private decisions should be guided by:

- careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment, and;
- an assessment of the risk-weighted consequences of various options.

Intergenerational equity

The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

Conservation of biological diversity

Conservation of biological diversity and ecological integrity should be a fundamental consideration.

Improved valuation, pricing and incentive mechanisms

Environmental factors should be included in the valuation of assets and services, such as:

- Polluter pays - that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement.
- The users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.
- Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms that enable those best placed to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

The ways in which the Pacific Highway Upgrade Program as a whole and the proposed upgrade respond to the principles of ecologically sustainable development are summarised in Table 20-2. It should be noted that ecologically sustainable development should be seen as a goal that shapes decision making processes. It is not a concept that a particular project can be judged definitively against as to whether sustainable development has or has not been achieved.

Table 20-2 Application of ecologically sustainable development principles to the PHUP and Proposal

Relevant ecologically sustainable development principles	Pacific Highway Upgrade Program Approach	Warrell Creek to Urunga Proposal approach
Precautionary principle.	Early strategic assessment. Use of best available technical information and adoption of best practice environmental standards, goals and measures to minimise environmental risks.	Environmental risk analysis prepared at project application phase and updated in this environmental assessment. Conservative, "worst case" scenarios addressed in impact assessment. Best practice measures are included in the management measures proposed throughout this environmental assessment and incorporated into Appendix D - *Draft Statement of Commitments*.
Inter-generational equity.	The decision to upgrade the Pacific Highway has integrated long and short-term economic, environmental, land use and social (including social equity) considerations, so that any foreseeable impacts are not left to be addressed by further generations.	Issues that have potential long-term implications, such as consumption of non-renewable resources, waste disposal, greenhouse emissions, removal of vegetation and impacts on visual amenity and water quality, have been avoided and minimised as much as possible through route selection/ concept design and application of management measures as described in

Relevant ecologically sustainable development principles	Pacific Highway Upgrade Program Approach	Warrell Creek to Urunga Proposal approach
		Appendix D - *Draft Statement of Commitments*. Positive measures have been taken in the assessment of this Proposal to provide more comprehensive documentation of cultural heritage in the vicinity of the Proposal and to avoid key ecological species and habitats to conserve and protect threatened species for their own intrinsic value and to enable future generations to observe and enjoy the ecology.
Conservation of biological diversity.	Recognition in the program of the rich biological environment of the North Coast of NSW and the need to avoid and control potential impacts throughout the length of the upgrade (e.g. through selection of which sections to upgrade).	The route selection /concept design development have sought to avoid and minimise biodiversity impacts as much as possible. SEPP 14 wetland areas have been avoided and impacts on endangered ecological communities have been minimised. Measures have been implemented in the concept design to avoid stands of *Marsdenia longiloba* and to provide for fauna movement both under the Proposal and through the retention of widened and forested medians to enable safer crossing over the Proposal by species of squirrel gliders.
Improved valuation, pricing and incentive mechanisms.	Environmental and social costs/ benefits considered alongside economic and financial costs/benefits in the decision to upgrade the Pacific Highway and in the selection of the highway sections to upgrade.	Environmental and social issues were considered in the strategic planning and establishment of the need for the project, and in the consideration of options. The value placed on these resources is evident in the extent of the planning, environmental investigations and design of management measures.

20.3 Objects of the Environmental Planning and Assessment Act 1979

The ways that the Proposal would meet the objects of the *Environmental Planning and Assessment Act* 1979 are outlined in Table 20-3.

Table 20-3 Performance of the proposed upgrade against the objects of the *Environmental Planning and Assessment Act* 1979

Objectives of the *Environmental Planning and Assessment Act* 1979	Performance of proposed upgrade
(a) To encourage	
(i) the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, water, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	The Proposal and associated mitigation and management measures detailed in the environmental assessment allow for the proper management of these issues. For discussion of: • Agricultural land, see Chapters 11 and 12. • Natural areas, see Chapter 11. • Forests, see Chapter 11 and 12. • Minerals see Chapters 11 and 12. • Water, see Chapters 6 and 16. • Cities, towns and villages, see Chapters 11 and 12.
(ii) the promotion and co-ordination of the orderly and economic use and development of land.	The development of the Proposal is anticipated to have economic benefits for the region, and for the movement of freight. No substantial adverse impacts on the local business community are expected, although there may be some specific impacts on businesses dependent on through-traffic (see Chapter 12).
(iii) the protection, provision and co-ordination of communication and utility services.	Utilities affected by the Proposal would be relocated and/or protected as described in Chapter 6.
(iv) the provision of land for public purposes.	The Proposal is proposed for a public purpose. No land reserved for public recreation would be affected.
(v) the provision and co-ordination of community services and facilities.	No community facilities occur within the proposed road reserve. Access to community facilities would be maintained, but altered in certain cases.
(vi) the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	Protection of threatened species, populations and ecological communities, and their habitats is described in Chapters 6 and 10.
(vii) ecologically sustainable development.	Achievement of the principles of ESD was a key design principle for the Proposal. This is described in Table 20-2.
(viii) the provision and maintenance of affordable housing.	The Proposal is unlikely to significantly influence the provision and maintenance of affordable housing in the area. There is the potential for some upward pressure on housing prices if the area is seen by investors as a commuter area for employees in Coffs Harbour and Kempsey.
(b) To promote the sharing of the responsibility for environmental planning between the different levels of government in the State.	This is a high level objective that does not apply specifically to individual projects. While the Minister for Planning would determine the project application under Part 3A, Nambucca and Bellingen shires have been consulted extensively throughout the route selection and environmental assessment process. Additionally referral has been made to the Commonwealth under the provisions of the *Environment Protection Biodiversity Conservation Act* 1999.
(c) To provide increased opportunity for public involvement and participation in environmental planning and assessment.	Community involvement in the planning and assessment of the Proposal has been extensive and is described in Chapter 5.

20.4 Conclusion

This environmental assessment has addressed the key issues identified in the environmental assessment requirements under Part 3A of the *Environmental Planning and Assessment Act* 1979. A checklist of these requirements and where they are addressed in this report is provided in Appendix B.

The project fulfils the strategic objectives of the Pacific Highway Upgrade Program while identifying impacts and avoiding or minimising these impacts through design, where possible, or through the incorporation of impact mitigation and management measures into Proposal construction and operation. The Proposal is consistent with Federal and State government planning strategies and policies, particularly in terms of identifying transport deficiencies along the corridor, including safety and congestion issues, while also providing infrastructure in response to significant future economic and population growth expectations for the Mid North Coast of NSW. In meeting the objectives of Federal and State planning strategies and policies, the Proposal is expected to have significant functional, environmental, social and economic benefits on a local and regional scale. The most notable benefits would be:

- Improvements to road safety conditions for all road users in the study area attributed to the high standard design that is based on dual carriageways with controlled access conditions (i.e. highway access limited to proposed interchanges) and the related separation of local and through-traffic.
- Improved travel times and transport efficiency for local road users as well as inter-regional vehicles, the latter including freight transport along the NSW coast between regional and capital centres.
- Increased traffic capacity and level of service along the route that reduces congestion effects and especially during peak holiday periods (which currently have impacts on tourist destinations like the Coffs Harbour).
- A new highway bridge across the Nambucca River at Macksville The new highway bridge also provides a second crossing of the Nambucca River should traffic incidents close the existing bridge.
- Compatibility with existing and planned urban development in the study area mainly through provision of interchanges at strategic locations and inclusion of a local access road network, both of which correspond to established land use development plans.
- Significantly improved accessibility between local communities between Warrell Creek and Urunga including cross highway mobility (due to the proposed local access road network), resulting in improved use of community facilities and services and increased social cohesion.
- Improved noise environment for most residences along the existing highway.
- Removal of through-traffic from Warrell Creek, Macksville, Bellwood and the area directly west of the Urunga town centre resulting in generally improved amenity of the town (e.g. traffic noise, traffic conflict, visual) and enhanced community linkages between the large population areas east and west of the current highway.
- Opportunities for enhanced local business activity and growth in the Warrell Creek, Macksville and Bellwood town areas associated with the above benefits arising from removal of through-traffic.

- Significant local and regional economic benefits are expected to flow to the Nambucca and Bellingen shire areas and particularly in the important tourism sector, noting that private car use will remain by far the dominant travel mode for visitors.
- Good road user economic outcomes with benefits in excess of costs and indicating a sound expenditure by governments on this transport infrastructure.
- Better protection from hazardous spills and road runoff than currently available for aquaculture operations (especially oyster leases) in the Kalang and Nambucca rivers.
- Positive long term noise impacts, water quality improvements in the long term and a longer term net reduction in greenhouse gas emissions.

However, as with any major highway proposal there are inevitably adverse impacts that would occur during the construction and or operational phases on the Proposal. The major adverse impacts are related primarily to:

- Impacts on Aboriginal heritage.
- Impacts on private property.
- Potential for noise impacts on some residences.
- Loss of forestry land.
- Loss of native vegetation and threatened species and impacts to endangered ecological communities.
- Potential for indirect impacts on native vegetation and habitat.
- Minor disruption during construction.

Mindful of the nature and magnitude of these effects and the inability to avoid or eliminate the identified impacts through further planning and design, substantial effort has focussed on the development of comprehensive environmental management and mitigation measures. These measures aim to minimise, as far as practical, the identified impacts and represent best practice environmental management for large infrastructure development. As the largest capital works organisation in NSW, the RTA has a very substantial track record in successfully devising and implementing environmental management plans for highway projects, often in very sensitive locations. The measures for the Warrell Creek to Urunga upgrade have been incorporated formally into the Proposal in the form of a *Draft Statement of Commitments* (refer to Appendix D), noting that these commitments have been updated, strengthened and tailored from the preliminary commitments initially presented in the project application report.

Other potential and adverse impacts relate to matters such as construction noise and vibration, construction air quality, construction traffic disruption, effects on water quality, land use planning, non-farm business effects, forestry operations, Aboriginal heritage sites and non-Aboriginal heritage sites. The assessment has concluded that these environmental impacts are of a low risk because the risk has been largely avoided through planning, the small scale of impact and / or the capacity for the risk to be readily managed. Nonetheless, the *Draft Statement of Commitments* includes measures to be applied during construction and or operation of the Proposal to ensure these aspects are also effectively managed.

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Appendix A Director-General's requirements

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NSW GOVERNMENT | Planning

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Our ref: S02/01634-2

Mr Bob Higgins
General Manager, Pacific Highway
NSW Roads and Traffic Authority
PO Box 576
GRAFTON NSW 2460

Attention: Adam Cameron

Dear Mr Higgins

Director General's Requirements for the Environmental Assessment of the Proposed Pacific Highway Upgrade - Warrell Creek to Urunga Project (Major Project 07_0112)

I refer to the above Project and the Director-General's requirements (DGRs) for the environmental assessment of the project, which were issued on 23 September 2007, and the RTA's letter of 23 September 2009 requesting their reissue.

I wish to advise you that in accordance with section 75F(3) of the *Environmental Planning and Assessment Act 1979*, the Director-General has reissued and modified his requirements for the proposed Pacific Highway Upgrade between Warrell Creek to Urunga (Major Project 07_0112). I have attached a copy of the Director-General's requirements (DGRs) for the environmental assessment of the Project. These requirements have been prepared following consultation with the relevant government agencies.

It should be noted that the Director-General's requirements have been prepared based on the information provided to date. Under section 75F(3) of the Act, the Director-General may alter or supplement these requirements if necessary and in light of any additional information that may be provided prior to the proponent seeking approval for the Project.

I would appreciate it if you could contact the Department at least two weeks before you propose to submit the Environmental Assessment for the Project to determine:

- the fees applicable to the application;
- relevant land owner notification requirements;
- consultation and public exhibition arrangements that will apply;
- options available in publishing the Environmental Assessment via the Internet; and
- number and format (hard-copy or CD-ROM) of the Environmental Assessment that will be required.

Prior to exhibiting the Environmental Assessment, the Department will review the document to determine if it adequately addresses the DGRs. The Department may consult with other relevant government agencies in making this decision. If the Director-General considers that the Environmental Assessment does not adequately address the DGRs, the Director-General may require the proponent to revise the Environmental Assessment to address the matters notified to the proponent. Following this review period the Environmental Assessment will be made publicly available for a minimum period of 30 days.

If your proposal includes any actions that could have a significant impact on matters of National Environmental Significance, it will require an additional approval under the Commonwealth

Environment Protection Biodiversity Conservation Act 1999 (EPBC Act). This approval would be in addition to any approvals required under NSW legislation and it is your responsibility to contact the Department of the Environment, Water, Heritage and the Arts to determine if an approval under the EPBC Act is required for your proposal. Please note that the Commonwealth Government has accredited the NSW environmental assessment process for assessing impacts on matters of National Environmental Significance. As a result, if it is determined that an approval is required under the EPBC Act, please contact the Department immediately as supplementary Director-General's requirements will need to be issued.

If you have any enquiries about the modified requirements, please contact Kylie Seretis on (02) 9228 6510 or via email (kylie.seretis@planning.nsw.gov.au).

Yours sincerely

13/10/09

Scott Jeffries
A/Executive Director
As delegate for the Director-General

Director-General's Requirements

Section 75F of the *Environmental Planning and Assessment Act 1979*

Application number	07_0112
Project	Pacific Highway Upgrade – Warrell Creek to Urunga
Location	An approximately 45 kilometre length of dual carriageway from the existing Allgomera deviation south of Warrell Creek extending for approximately 45 kilometres to the Waterfall Way interchange at Raleigh within the Bellingen Shire and Nambucca Shire Local Government Areas.
Proponent	NSW Roads and Traffic Authority (RTA)
Date issued	13 October 2009
Expiry Date	13 October 2011
General requirements	The Environmental Assessment (EA) must include the following: 1. an **executive summary**. 2. a **detailed description** of the Project including: ▪ route alignment and corridor width; ▪ design elements (e.g. requirements for LOS, pedestrian and cyclists, rest areas and service centres etc); ▪ differentiate the limits of the Project with respect to the existing Pacific Highway, including operational/ maintenance responsibilities; ▪ potential staging; ▪ ancillary facilities (e.g. compound site, batching plants etc); and ▪ resourcing (e.g. construction material needs, spoil disposal, natural resource consumption including water). 3. an **assessment of the key issues**, with the following aspects addressed for each key issue (where relevant): ▪ describe the existing environment; ▪ assess the potential impacts of the proposal at both construction and operation stages, in accordance with relevant policies and guidelines. Both direct and indirect impacts must be considered including potential interactions with the existing Pacific Highway (as relevant); ▪ identify how relevant planning, land use and development matters, (including relevant strategic and statutory matters), have been considered in the impact assessment and/ or in developing management/ mitigation measures; and ▪ describe measures to be implemented to avoid, minimise, manage, mitigate, offset and/or monitor the impacts of the Project (such as staging to facilitate migratory fish and fish passage) and the residual impacts. 4. a **draft Statement of Commitments (SoC)**. The SoC must incorporate or otherwise capture all measures to avoid, minimise, manage, mitigate, offset and/or monitor impacts identified in the impact assessment sections of the EA and ensure that the wording of the SoC clearly articulates the desired environmental outcome of the commitment. The SoC must be achievable, measurable (with respect to compliance), and time specific, where relevant. 5. **certification** by the author of the Environment Assessment that the information contained in the Assessment is neither false nor misleading.
Key issues	▪ **Strategic Justification** – outline the strategic outcomes for the Pacific Highway Upgrade Program (PHUP), including with respect to strategic need and justification, the aims and objectives of relevant State planning policies, the principles of Ecologically Sustainable Development, and cumulative and synergistic impacts associated with the Program as a whole. Identify how the project fits within these strategic outcomes and how impacts associated with the project will be considered and managed to achieve acceptable environmental planning outcomes across the PHUP.

- **Project Justification** – describe the need for and objectives of the project; alternatives considered (including an assessment of the environmental costs and benefits of the project relative to alternatives), and provide justification for the preferred project (including interchange locations) taking into consideration the objects of the *Environmental Planning and Assessment Act 1979*.
- **Flora and Fauna** - including but not limited to:
  - threatened terrestrial and aquatic species, populations, ecological communities and/or critical habitat including erosion of genetic stock; and
  - targeted surveys of threatened flora and fauna species including *Marsdenia longiloba* (Slender Marsdenia), *Amorphospermum whitei* (Rusty Plumb), *Acacia chrysotricha* (Newry Golden Wattle), *Acronychia littoralis* (Scented Acronychia) and *Parsonsia dorrigoensis* (Milky Silkpod).
  - terrestrial habitat and biodiversity including native vegetation loss, habitat fragmentation, weed infestation, wildlife and riparian corridors, riparian habitat, and groundwater-dependent communities;
  - aquatic habitat and biodiversity including wetlands, mangroves, and seagrass;
  - regional scale cumulative impacts and the significance of the impacts of the project in the context of the PHUP; and
  - including consideration of draft *Guidelines for Threatened Species Assessment* (DECC/DPI, July 2005) and *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation* (Section 6.4 and 6.5 specifically) (NSW Fisheries, 1999)
- **Land Use and Property** - including but not limited to:
  - directly-affected properties and land uses adjacent to the project, including property access, property allotment, land sterilisation and severance;
  - the connectivity (including pedestrian and cycleway opportunities) and contiguity of existing and planned settlements and activity clusters;
  - the operation of Nambucca Valley Quarry south of Warrell Creek;
  - the operation the Forests NSW estate including potential for fragmentation and sterilisation of resources; and
  - the attainment of the objectives of *the Mid North Coast Strategy* (Department of Planning, March 2009)..
- **Social and Economic** - including but not limited to:
  - regional economic impacts to the agricultural sector taking into account impacts to regional and State Significant farmland as identified in the *Mid-North Coast Farmland Mapping Project* (Department of Planning et al. March 2009).
  - local community socio-economic impacts associated with access, business exposure, land use, property and amenity related changes;
  - land use viability, property infrastructure (ie. sheds, water supplies etc), profitability, productivity, sustainability and natural resource values of businesses (including agricultural producers and Forests NSW); and
  - recreational and commercial fishing operations including oyster priority areas including consideration of the *NSW Oyster Industry Sustainable Aquaculture Strategy 2006*.
- **Visual Amenity and Design** - including but not limited to:
  - Design and landscaping consistent with overall design of the PHUP and the existing (and desired) character of affected localities;
  - identification of impacts to local view sheds and source of impact including bridges, embankments, interchanges and alterations to natural landscape features; and
  - visual significance of the crossings at the Nambucca and Kalang Rivers (including district views across associated floodplains).
- **Noise and Vibration** - including but not limited to:
  - construction noise and vibration including construction traffic noise and blasting impacts;
  - operational road traffic noise impacts on sensitive receivers, including consideration of local meteorological conditions (as relevant) and any secondary noise impacts from proposed noise mitigation measures; and
  - consideration of the following guidelines as relevant: *Environmental Criteria*

	for Road Traffic Noise (EPA 1999), *Environmental Noise Management Manual* (RTA, 2001), *Interim Construction Noise Guideline* (DECC, 2009), *Assessing Vibration: A Technical Guideline* (DEC, 2006). ▪ **Aboriginal heritage** – including but not limited to: ▪ Aboriginal cultural heritage values of the route, specifically on artefacts, potential archaeological deposits and landscape cultural values (such as watercourses, spur lines and raised areas in floodplains) where relevant; ▪ regional scale cumulative impacts and the significance of the impacts of the project in the context of the PHUP; and ▪ consideration of the draft *Guidelines For Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (DEC, 2005). ▪ **Water** - including but not limited to: ▪ water way and wetland water quality taking into account impacts from both accidents and runoff and considering relevant environmental water quality criteria specified in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000*; ▪ groundwater contamination risk, groundwater use and groundwater users; ▪ demonstrating consideration of the effects of sea level rise, changes to rainfall frequency and/or intensity as a result of climate change on the project; and ▪ changes to existing flood regimes, in accordance with the *Floodplain Development Manual* (former Department of Natural Resources, 2005), including impacts to existing property and infrastructure and the future development potential of affected land. ▪ **Traffic and Transport** - including but not limited to: ▪ operational traffic and transport impacts to the local, regional and fire trail networks (existing and planned), including impacts from traffic rerouting and modified access to the upgraded highway; ▪ construction traffic impacts (including spoil haulage); ▪ public transport impacts (including on bus services); and ▪ interactions with rail infrastructure and the viability of a shared road and rail corridor. ▪ **Soil and Fill** – including but not limited to: ▪ surface, geological and soil characteristics and the potential for soil contamination, soft soils and acid sulfate soils; and ▪ erosion and sedimentation control measures such as retention pond siting, with particular reference to the Gumma Flat tidal and wetland area. **Environmental Risk Analysis** – notwithstanding the above key assessment requirements, the EA must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the EA.
Consultation	You should undertake an appropriate and justified level of consultation with relevant parties during the preparation of the EA, including but not limited to: ▪ local, State or Commonwealth government authorities and service providers, including the Department of Environment, Climate Change and Water, the Industry and Investment NSW, , Australian Rail Track Corporation, Bellingen Shire Council and Nambucca Shire Council; ▪ Specialist Interest Groups including Local Aboriginal Land Councils, commercial aquatic enterprises such as oyster growers, mineral exploration licence holders, chambers of commerce; and ▪ the public, including affected landowners. The EA must describe the consultation process, document all community consultation undertaken to date and identify the issues raised (including where these have been addressed in the EA).

Appendix B Director-General's requirements checklist

Director-General's requirement	Where addressed in EA
An executive summary	Executive Summary
A **detailed description** of the project including:	
▪ route alignment and corridor width;	Sections 6.4
▪ design elements (e.g. requirements for LOS, pedestrian and cyclists , rest areas and service centres etc);	Sections 6.2.4, 6.5, 6.5.7, 6.5.10
▪ differentiate the limits of the Project with respect to the existing Pacific Highway, including operational/maintenance responsibilities;	Section 6.4
▪ potential staging;	Section 7.2
▪ ancillary facilities (e.g. compound sites, batching plants etc); and	Section 7.3.7
▪ resourcing (e.g. construction material needs, spoil disposal, natural resource consumption including water).	Section 7.3, 19.4.2
An **assessment of the key issues**, with the following aspects addressed for each key issue (where relevant): ▪ describe the existing environment; ▪ assess the potential impacts of the proposal at both construction and operation stages, in accordance with relevant policies and guidelines. Both direct and indirect impacts must be considered including potential interactions with the existing Pacific Highway (as relevant); ▪ identify how relevant planning, land use and development matters (including relevant strategic and statutory matters), have been considered in the impact assessment and/or in developing management and mitigation measures; ▪ describe measure to be implemented to avoid, minimise, manage, mitigate, offset and/or monitor the impacts of the Project (such as staging to facilitate migratory fish and fish passage) and the residual impacts.	Chapters 10-18 are dedicated to assessment of key issues. The required aspects are assessed within each key issue chapter (i.e. Chapters 10-18).
A Draft Statement of Commitments (SoC) The SoC must incorporate or otherwise capture all measures to avoid, minimise, manage, mitigate, offset or monitor impacts identified in the impact assessment sections of the EA and	Appendix D

Director-General's requirement	Where addressed in EA
ensure that the wording of the SoC clearly articulates the desired environmental outcome of the commitment. The SoC must be achievable, measurable (with respect to compliance), and time specific where relevant.	
certification by the author of the Environmental Assessment that the information contained in the assessment is neither false, or misleading.	Statement of Validity
Strategic Justification – outline the strategic outcomes for the Pacific Highway Upgrade Program (PHUP), including the respect to strategic need and justification, the aims and objectives of relevant State planning policies, the principles of Ecologically Sustainable Development, and cumulative and synergistic impacts associated with the Program as a whole. Identify how the project fits within these strategic outcomes and how impacts associated with the project will be considered and managed to achieve acceptable environmental planning outcomes across the PHUP. Project Justification – describe the need for and objectives of the project; alternatives considered (including the assessment of the environmental costs and benefits of the project relative to alternatives), and provide justification for the preferred project (including interchange locations) taking into consideration the objects of the *Environmental Planning and Assessment Act* 1979.	Section 3.1.1 Relationship of the Proposal to the Pacific Highway Upgrade Program Section 3.1.2 NSW and Australian Strategic Planning Policy and Framework Section 3.5 Statement of strategic need Section 20.2 Integration of the Program and Proposal with Principles of Ecologically Sustainable Development Section 20.4 Relationship between the proposed upgrade and the Objectives of the EP&A Act Section 3.2 Need for the Project Section 3.3 The "do nothing" option Section 3.4 Proposal objectives Section 3.5 Statement of strategic need Section 4.1 Route planning and development process Section 4.3 Macksville to Urunga Section 4.4 Warrell Creek options Section 4.5 Interchanges Section 4.6 Alternatives considered Section 4.7 Conformation of the Proposal as the preferred option Section 20.1 Cumulative and synergistic impacts Section 20.3 Relationship between the proposed upgrade and the

Director-General's requirement	Where addressed in EA	
		Objectives of the EP&A Act
	Section 20.4	Conclusion
Flora and fauna – including but not limited to: ■ threatened terrestrial and aquatic species, populations, ecological communities and/or critical habitat including erosion of genetic stock; and ■ targeted surveys of threatened flora and fauna species including *Marsdenia longiloba* (Slender Marsdenia), *Amorphospermum whitei* (Rusty Plumb), *Acacia chyrsotricha* (Newry Golden Wattle), *Acronychia littoralis* (Scented Acronychia) and *Parsonsia dorrigoensis* (Milky Silkpod); ■ terrestrial habitat and biodiversity including native vegetation loss, habitat fragmentation, weed infestation, wildlife and riparian corridors, riparian habitat, and groundwater-dependant communities; ■ aquatic habitat and biodiversity including wetlands, mangroves, and seagrass; ■ regional scale cumulative impacts and the significance of the impacts of the project in the context of the PHUP; and ■ including consideration of draft *Guidelines for Threatened Species* Assessment (DECC/DPI July 2005) and *Policy and Guidelines for Aquatic Habitat Management and Fish Conservation 1999* (Section 6.4 and 6.5 specifically) (NSW Fisheries, 1999).	Section 10.3 Section 10.3.2 Section 10.3.3 Section 10.3.4 Section 10.4.2 Section 10.4.3 Section 10.4.4 Section 10.4.5 Section 10.5 Section 10.5.6	Existing environment Terrestrial vegetation Terrestrial fauna Aquatic fauna Potential flora impacts Potential fauna impacts Potential impacts to aquatic habitats and biodiversity Cumulative impacts Management of impacts Compensatory habitat
Land Use and Property – including but not limited to: ■ directly-affected properties and land uses adjacent to the project, including property access, property allotment, land sterilisation and severance; ■ the connectivity (including pedestrian and cycleway opportunities) and contiguity of existing and planned settlements and activity clusters; ■ the operation of Nambucca Valley Quarry south of Warrell Creek; ■ the operation of Forests NSW estate including potential for fragmentation and sterilisation of resources; and ■ the attainment of the objectives of the *Mid North Coast*	Section 11.3.1 Section 11.3.2 Section 11.3.3 Section 11.3.4 Section 11.3.5 Section 11.3.7 Section 11.3.9	Property acquisition Land connectivity and contiguity Land sterilisation and severance Access Planned development (including the *Mid North Coast Regional Strategy*) Forestry operations (including potential for fragmentation and sterilisation of resources) Extractive industries (Nambucca Valley Quarry)

Director-General's requirement	Where addressed in EA
Strategy (Department of Planning, March 2009).	
Social and Economic - including but not limited to: ▪ regional economic impacts to the agricultural sector taking into account impacts to regional and State significant farmland as identified in the *Mid North Coast Farmland Mapping Project* (Department of Planning et al. March 2009). ▪ local community socio-economic impacts associated with access, business exposure, land use, property and amenity related changes; ▪ land use viability, property infrastructure (i.e. sheds, water supplies etc), profitability, productivity, sustainability and natural resource values of businesses (including agricultural producers and Forests NSW). ▪ recreational and commercial fishing operations including oyster priority areas including consideration of the *NSW Oyster Industry Sustainable Aquaculture Strategy 2006*.	Section 11.3.6 Agriculture Section 11.3.7 Forestry Section 12.3.1 Regional agricultural and forestry impacts Section 12.3.2 Local community social and economic impacts Section 12.3.2.7 Impacts on recreational and commercial fishing operations including oyster priority areas
Visual amenity and design – including but not limited to: ▪ Design and landscaping consistent with overall design of the PHUP and the existing (and desired) character of affected localities; ▪ identification of impacts to local view sheds and source of impact including bridges, embankments, interchange and alterations to natural landscape features; and. ▪ visual significance of the crossings at the Nambucca and Kalang Rivers (including district views across associated floodplains).	Section 13.3 Impacts of landscapes and views Section 13.3.4 Impacts on local view sheds Section13.3.6 Crossings of Nambucca and Kalang Rivers Section13.4.1 Consistency with Pacific Highway Upgrade Program guidelines
Noise and vibration – including but not limited to: ▪ construction noise and vibration including construction traffic noise and blasting impacts;	Section 14.3.4 Construction noise and vibration Section 14.3.4.5 Blasting Section 14.5 Construction assessment Section 14.5.1 Typical construction activities Section 14.5.3 Construction noise from mobile activities Section 14.5.4 Noise and vibration from batch plants, construction compounds and deliveries Section 14.5.5 Construction vibration

Director-General's requirement	Where addressed in EA
▪ operational road traffic noise impacts including consideration of local meteorological conditions (as relevant) and any secondary noise impacts from proposed noise mitigation measures; and ▪ consideration of the following guidelines as relevant: *Environmental Criteria for Road Traffic Noise* (EPA 1999), *Environmental Noise Management Manual* (RTA 2001), *Environmental Noise Control Manual* (EPA 1994) and *Assessing Vibration: A Technical Guideline* (DEC, 2006).	Section 14.5.6 Blasting Section 14.4 Operational noise assessment Section 14.4.4 Meteorological impact assessment Section 14.4.5 Secondary noise impacts Section 14.1 Assessment approach Section 14.3 Assessment criteria Section 14.4 Operational noise assessment Section 14.6 Identification of appropriate noise mitigation
Aboriginal heritage – including but not limited to: Aboriginal cultural heritage values of the route, specifically on artefact, potential archaeological deposits and landscape cultural values (such as watercourses, spur lines and raised areas in floodplains) where relevant.	Section 15.2.2 Cultural heritage Section 15.2.3 Archaeological Heritage
Regional scale cumulative impacts and the significance of the impacts of the project in the context of the Pacific Highway Upgrade Program.	Section 15.3.3 Regional scale cumulative impacts Section 15.3.4 Significance of impacts in the context of the Pacific Highway Upgrade Program
consideration of the draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (DEC, 2005).	
Water – including but not limited to: Water way and wetland water quality taking into account impacts from both accidents and runoff and considering relevant environmental water quality criteria specific in the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* 2000.	Section 16.1.1 Water quality Section 16.2.2 Surface water quality Section 16.3.1 Construction stage (water quality Section 16.3.2 Operational stage (water quality)
Groundwater contamination risk, groundwater use and groundwater users.	Section 1.1.1 Groundwater Section 16.3.1 Construction stage (groundwater and contamination risk) Section 16.3.2 Operational stage (groundwater and contamination risk)
Changes to existing flood regimes, in accordance with the *Floodplain Development Manual* (former Department of Natural Resources, 2005), including impacts to existing property and infrastructure and the future development potential of affected land.	Section 16.1.2 Flooding Section 16.2.4 Flooding (existing conditions) Section 16.3.1 Construction stage (flooding) Section 16.3.2 Operational stage (flooding)
Traffic and transport – including but not limited to the following: Operational traffic and transport impacts to the local, regional and fire trail networks (existing and planned) including impacts from traffic rerouting and modified access to the upgraded highway.	Section 17.2.1 Existing road network Section 17.2.2 Planned road network Section 17.3 Impact of future traffic growth

Director-General's requirement	Where addressed in EA	
Public transport impacts (including on bus services). Interactions with rail infrastructure and the viability of a shared road and rail corridor. Construction traffic impacts (including spoil haulage).		on the existing road network
	Section 17.4	Traffic and transport impacts
	Section 17.4.1	Changes to the road network with the proposed upgrade (impacts from traffic rerouting)
	Section 17.4.5	Impacts on local roads and modified access to the upgraded highway
	Section 17.4.6	Impacts on fire trail network
	Section 17.4.8	Impacts on public transport including bus services
	Section 17.2.11	Interaction with rail infrastructure
	Section 17.4.9	Construction traffic impacts
Soil and Fill – including but not limited to: Surface, geological and soil characteristics and the potential for soil contamination, soft soils and acid sulphate soils.	Section 16.3.2	Operational stage (potential water quality impacts)
	Section 18.2.1	Topographical and terrain characteristics
	Section 18.2.2	Geographical and soil characteristics
	Section 18.2.3	Soft soils
	Section 18.2.4	Contamination
	Section 18.2.5	Acid sulphate soils
	Section 18.2.6	Gumma Flat tidal wetland area
	Section 18.3	Impact of changes to surface and subsurface conditions
Erosion and sedimentation control measures such as retention pond siting, with particular reference to the Gumma Flat tidal and wetland areas.	Section 18.2.6	Gumma Flat tidal wetland area (existing environment)
	Section 18.3.5	Erosion and sedimentation (potential impacts)
	Section 18.3.6	Gumma Flat tidal wetland area (potential impacts)
	Section 18.4.1.2	Erosion and sedimentation (management of construction impacts)

Director-General's requirement	Where addressed in EA
	Section 18.4.2.1 Erosion and sedimentation (management of operational impacts)
Environmental Risk Analysis – notwithstanding the above key assessment requirements, the EA must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the EA.	Section 9.2. Results of the environmental risk analysis No additional key impacts identified.
Consultation You should undertake an appropriate and justified level of consultation with relevant parties during the preparation of the EA, including but not limited to: ■ Local, State or Commonwealth government authorities and service providers, including the Department of Environment, Climate Change and Water, the Department of Industry and Investment NSW, Australian Rail Track Corporation, Bellingen Shire Council and Nambucca Shire Council; ■ Specialist Interest Groups including Local Aboriginal Councils, commercial aquatic enterprises such as oyster growers, mineral exploitation licence holders, chambers of commerce; and ■ The public, including affected landowners. The EA must describe the consultation process, document all community consultation undertaken to date and identify the issues raise (including where these have been addressed in the EA)	Section 5.1 Community consultation objectives Section 5.2.1 Government agencies and service providers Section 1.1.1 Public consultation Section 5.2.3 Affected landowners Section 5.2.4 Special Interest groups Section 5.3 Consultation activities undertaken to date Section 5.4 Key issues raised Section 5.5 How consultation has influenced the development of the proposal Section 5.6 Future consultation

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Appendix C Other issues raised checklist

Issues Raised	Environmental assessment reference
Department of Planning	
■ Negative impacts of bypasses on town business.	Chapter 12
■ Impacts on noise and water quality. ■ Impacts on threatened species and their habitat.	Chapters 14 & 16 Chapter 10
■ Impact on Aboriginal cultural heritage values.	Chapter 15
■ Avoidance and mitigation of impacts, or compensation for unavoidable impacts upon threatened species and Aboriginal cultural heritage.	Chapters 10 & 15
■ Impacts on biological, ecological and physical characteristics of estuarine and salt marshes.	Chapter 10
■ Protection, rehabilitation and ongoing management of estuarine river banks, including mitigation of impacts on waterway stability to control erosion and sedimentation.	Chapters 10 & 18
■ Flooding impacts on land, infrastructure and assets during and post development.	Chapter 16
■ Methods used to address acid sulphate soils when found.	Chapter 18
■ Consultation with others undertaking natural resource management projects in the area.	Chapter 5
Department of Environment and Climate Change (now part of the Department of Environment, Climate Change and Water)	
■ Existing acoustic environment should be assessed and reported with reference to the relevant sections of the DECC Guidelines 'Environmental Criteria for Road Traffic Noise' (ECRTN) and the NSW Industrial Noise Policy.	Chapter 14
■ Assessment of predicted operational noise impacts of Proposal in accordance with ECRTN and RTA's Environmental Noise Management Manual (ENMM).	Chapter 14
■ The Proposal will result in significant noise impacts for rural residential areas including those located in the vicinity of Donnellyville, Bald Hill Road, Letitia Close/Mattick Road, Old Coast Road, Florence Wilmont Drive, East West Road, South Arm Road, Short Cut Road and Ridgewood Drive. The environmental assessment should place particular emphasis on these locations with the aim of incorporating operational noise mitigation measures into the design of the highway.	Chapter 14
■ Location of sensitive receivers (such as schools, residences or hospitals for example) should be clearly identified on any diagrams provided by the NAR.	Chapter 14
■ Criteria used to develop the proposed mitigation measures to control noise, vibration and blasting impacts caused by construction activities and associated traffic should be included in the NAR. The NAR should provide details of measures proposed to mitigate noise and vibration in relation to construction and blasting activities.	Chapter 14
■ Assess the requirement for, and feasibility of, implementing operation stage noise mitigation	Chapter 14

Issues Raised	Environmental assessment reference
measures prior to commencement of construction to provide a construction stage benefit, particularly for those rural residential areas listed above, and for those residences on Gumma Road, adjacent to the Nambucca River Bridge.	
■ Impacts of the Proposal on watercourses along the road corridor should be assessed.	Chapters 10 & 16
■ Ambient water quality conditions and the impact of the Proposal on SEPP 14 wetlands (#388, 353 and 351) should be assessed with reference to the National Water Quality Management Strategy (ANZECC, 2000) and River Flow and Water Quality Objectives.	Chapter 16
■ Identification of the number and types of bridges and culverts for the Proposal. Should consider whether structures are to be placed in the watercourse and demonstrate how construction and operation stage impacts will be mitigated.	Chapters 6 & 10
■ Description of any potential changes to flooding and drainage patterns arising from the Proposal.	Chapter 16
■ Assessment of the presence of ASS on the site and determine the likelihood of the Proposal's construction processes disturbing ASS and appropriate measure that will be implemented to mitigate these impacts. This assessment should be conducted in accordance with the Acid Sulphate Soils Manual (ASSMAC, 1998).	Chapter 18
■ Details of stormwater management with particular regard to soil dispersability (including imported fill), operational spill containment measure and approximate locations of temporary sediment basins.	Chapters 6 & 16
■ Water usage requirements and potential supply sources of the construction stage of the Proposal and wastewater re-use opportunities should be considered.	Chapter 7
■ Threatened biodiversity field surveys and assessments following steps listed in NSW Threatened Species Survey and Assessment Guidelines: June 2006, should be carried under seasonal and climatic conditions, specifically within the preferred route corridor. ■ Detailed analysis of up-to-date biodiversity study data for the study area.	Chapter 10
■ Describe, quantify and address likely direct and indirect impacts associated with the project to threatened biodiversity, their habitats and native vegetation distribution, including cumulative impacts and a qualitative and quantitative landscape impact assessment.	Chapter 10
■ Where biodiversity impacts and unable to be demonstrably mitigated or avoided, these should be described and quantified to determine the extent to which compensatory habitat or other offsets will be required. Consideration should be given to applying the DECC Biobanking Credit Calculator.	Chapter 10
■ Identify whether the Proposal constitute Key Threatening Processes (KTPs) listed under the TSC Act. Where KTPs are identified, relevant threat abatement measures proposed to be implemented are required.	Chapter 10
■ Describe objectives and assess the feasibility of implementing appropriate flora and fauna mitigation measures during construction and operation, including nature and extent of expected	Chapter 10

Issues Raised	Environmental assessment reference
impacts. ■ Where appropriate and feasible mitigation measures are identified, environmental assessment should define and commit to measure to ensure impacts to threatened species and biodiversity are managed in accordance with current environmental best practice. Where fauna crossing structures are proposed, the environmental assessment must consider the suitability of such structures by gaining a thorough understanding of pre-development threatened fauna population dynamics including a habitat assessment of the adjacent landscape. Any proposed mitigation measures should be evaluated against a clearly defined and measurable goal.	Chapters 6 & 10
■ Flora survey work needs to target *Marsdenia longiloba* (Slender Marsdenia), *Amorphospermum whitei* (Rusty Plumb), *Aciacia chrysotricha* (Newry Golden Wattle), *Achronychia littoralis* (Scented Acronychia), *Parsonia dorrigoensis* (Milky Silkpod) and any additional threatened flora species known or predicted to occur along the Proposal.	Chapters 6 & 10
■ Evaluate direct and indirect impacts to EECs including Swamp Sclerophyll Forest on Coastal Floodplains, Freshwater Wetlands on Coastal Floodplains, River-Flat Eucalypt Forest on Coastal Floodplains, Subtropical Coastal Floodplain Forest, and Swamp Oak Floodplain Forest. These contain indigenous plant and animal assemblages that are generally poorly conserved in the region and are subject to further fragmentation and erosion of genetic stock. Must evaluate and proposed mitigation measures for EECs.	Chapter 10
■ Determine direct and indirect impacts and mitigation measures for SEPP 14 wetlands through alteration of hydrological regimes, particularly near Gumma Swamp south of Nambucca River, Newee Creek, Deep Creek complex near Boggy and Cow Creeks, and wetlands west of Urunga and Newry Island. Evaluate impacts of altered hydrological regimes on EECs associated with SEPP 14 wetlands.	Chapter 16
■ Address how the RTA has met the information, survey and consultation requirements as set out in the draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation.	Chapter 15
■ Identify nature and extent of impacts on Aboriginal cultural heritage values across Proposal. Direct and indirect impacts on the Proposal and document the number, nature and significance of Aboriginal site to be impacted including consideration of impacts resulting from ancillary activities and infrastructure.	Chapter 15
■ Aboriginal cultural values should be assessed in consultation with the Aboriginal community and determine appropriate mitigation measures to offset or avoid these impacts for incorporation in concept designs and future environmental management plans.	Chapter 15
■ Describe actions that will be (or have been) taken to avoid or mitigate impacts on Aboriginal cultural heritage values during construction and operation of the Proposal. Describe activities and actions which will be undertaken and any agreements made with the Aboriginal community and DECC, which will attempt to compensate for unavoidable impacts of the Proposal on Aboriginal cultural values. This should include an assessment of likely effectiveness and reliability of the	Chapter 15

Issues Raised	Environmental assessment reference
measures proposed and any residual impacts after these measures are implemented.	
■ Demonstrate that effective Aboriginal community consultation has been undertaken in determining and assessing impacts, developing options, determining Aboriginal site management and salvage requirements and making final recommendations.	Chapters 5 & 15
Bellingen Shire Council	
■ Improved access to the south of Urunga to avoid isolation of the Urunga township.	Chapters 4 & 6
■ Consider threatened species habitat located north of the Kalang River and south of the Short Cut Road.	Chapter 10
■ Noise mitigation measures to land adjacent to and either side of Short Cut Road, zoned Rural 1 (c1) Rural Residential.	Chapter 14
■ Minimisation of environmental and visual impact of highway between Raleigh and Raleigh Industrial estate, within 7(s) Special emphasis zone, on surrounding forest.	Chapter 13
■ Design for dual carriageway at South Arm Road will need to ensure that there is no change to flood effects for this section of road.	Chapter 16
■ Provision will need to be made to enable convenient pavement rehabilitation of the section of road under the dual carriageway at South Arm Road.	Chapter 6
■ Extensive sections of the existing highway will be used as local access roads (such as bridge over Kalang River). Consideration of options required as ongoing maintenance will impose significant additional cost burden on Council.	Chapter 6
■ Assessment of south bound exit at the Raleigh deviation to ensure that traffic does not back up the south bound carriageway.	Chapter 4 & 6
■ The Proposal should be referred to the Rural Fire Service to assess whether there are any adverse impacts on fire trails.	Chapter 5 & 6
■ Provision of new Rest Area / Visitor Information Centre at Waterfall Way Interchange to replace existing facility.	Chapter 4 & 6
Nambucca Shire Council	
■ Impact on local infrastructure and access to local towns ■ Access to Valla, Boggy Creek and Cow Creek urban release areas.	Chapters 4 & 12
State Emergency Services (now part of the Department of Police and Emergency Services)	
■ Access for emergency vehicles on to and off the highway.	Chapters 6 & 12

Issues Raised	Environmental assessment reference
Department of Primary Industries (Forests NSW) (now part of the Department of Industry and Investment)	
■ Loss of productive land for timber production and impact on local forest agreements.	Chapter 12
■ Impact on productive native forests, plantation estates, and conservation areas (as Special Management Areas established under s21A Forestry Act).	Chapter 12
■ Impacts on State Forest access, including the effect upon local road and forest roads during and post construction.	Chapter 12
■ Severance of roads and fire trails, therefore alternate road and fire management needs to be addressed.	Chapter 12
■ Parts of the areas have a high wildfire frequency and the assessment should consider the impact of the proposed upgrade on fire management in bush fire prone areas, particularly in relation to access.	Chapter 12
Department of Primary Industries (Fishing and Aquaculture) (now part of the Department of Industry and Investment)	
■ Potential impacts on SEPP14 wetlands.	Chapters 4 & 10
■ Impacts on aquacultures.	Chapters 5 & 12
■ Number of waterways and the ability to construct structures over these waterways.	Chapter 6
■ Impact on marine vegetation including mangroves, sea grass and salt marsh. Any impact on marine vegetation will need to be address through compensatory habitat.	Chapter 10
■ Proposed width of the alignment including predicted temporary crossings and haulage routes to identify footprint over waterways and their impacts on aquatic vegetation.	Chapters 6 & 10
■ Potential staging or timing of works (to consider migratory fish movements).	Chapter 7
■ Provide description of temporary or permanent sediment retention ponds adjacent to waterways.	Chapter 6
■ The environmental assessment should capture the area known as Gumma Flat where low lying tidal flats and wet lands are identified as potential acid sulphate soils conducive to the production of iron sulphides. This may result in acid run off during earth moving works and a poor outcome for water quality.	Chapter 16
■ The environmental assessment should include that the impact of acid water is directly linked to red spot disease in fish and high mortality in oysters. Water-flows from the proposed alignment form a direct link to Gumma Creek which confluences with Nambucca River just upstream of commercial oyster growing leases.	Chapter 10
■ Detailed risk assessment of all potential impacts to fish habitat during and after works. Include consideration of impacts on the oyster industry, commercial fisheries, and any recreational fishery issues.	Chapter 9
■ Description of measures and initiatives to avoid, minimise, manage and mitigate impacts of the	Chapters 8 & 10

Issues Raised	Environmental assessment reference
project to waterways and fish habitat.	
Department of Primary Industries (Minerals) (now part of the Department of Industry and Investment)	
■ Consultation with operators of the Nambucca Valley Quarry and assessment of risks associated with blasting is recommended.	Chapter 5
Department of Primary Industries (Agriculture) (now part of the Department of Industry and Investment)	
■ Property dislocation and machinery access.	Chapters 6 & 12
Department of Primary Industries (North Coast Region) (now part of the Department of Industry and Investment)	
■ The Draft Mid North Coast Regional Strategy should be addressed in the environmental assessment.	Chapter 3
Department of Water and Energy (now part of the Department of Environmental, Climate Change and Water)	
■ If extraction of water from a surface water source or the course of a river is changed, a permit or licence is required under Part 2 of the *Water Act* 1912.	Chapter 2
■ If the Proposal is in a gazetted Water Sharing Plan (under provisions of the *Water Management Act* 2000), approval requirements may be satisfied under the Act.	Chapter 2
■ Address the decommissioning of bores in accordance with Chapter 18 of Minimum Construction Requirements for Water Bores in Australia, Edition 2 Revised September, 2003.	Chapter 16
■ Details of any proposed works likely to intercept groundwater.	Chapter 16
■ Details of any proposed groundwater extraction and use.	Chapter 16
■ Details of proposed method of disposal of any water extracted and approval from the relevant approval authority.	Chapter 16
■ Details of any existing bores on the development site and in the immediate vicinity.	Chapter 16
■ Details of the existing groundwater users (including the natural environment) within the area of the proposed development and any potential impacts on these users.	Chapter 16
■ Management strategy to deal with potential impact on groundwater with the disturbance of acid sulphate soils.	Chapter 16
■ Details on protective measures for groundwater dependent ecosystems.	Chapter 10
■ Details to prevent groundwater pollution, so that future remediation is not required.	Chapter 16
■ Monitoring program for assessment on groundwater.	Chapter 16
■ Contingency plans linked to the groundwater monitoring program.	Chapter 16

Issues Raised	Environmental assessment reference
Australian Rail and Track Corporation	
■ Alternatives to road transport.	Chapter 3
■ Construction method for railway crossings.	Chapter 17
Heritage Council	
■ Assessment of heritage significance of identified sites and any impacts upon heritage sites, including those of Aboriginal, historic or archaeological significance. Also consideration of wider heritage impacts in areas surrounding the Proposal.	Chapters 15 & 19
■ Lists maintained by the National Trust under the EPBC Act and the local council should be reviewed to determine areas of historical significance which may be affected by Proposal.	Chapter 19
■ Non-Aboriginal heritage items within the study area affected by the Proposal should be identified by field survey. A statement of significance and an assessment of the impact of the Proposal on the heritage significance of these items should be undertaken. Measures to conserve their heritage significance should be identified.	Chapter 19
■ The field survey and assessment should be undertaken by a qualified practitioner/consultant with historic sites experience.	Chapters 15 & 19
■ Where it is likely that the project will impact on Aboriginal heritage, adequate community consultation should take place regarding the assessment of significance, likely impacts and management/mitigation measures.	Chapter 15
Ministry of Transport (now part of the Department of Transport and Infrastructure)	
■ Potential for disruption of existing school bus services during construction.	Chapters 6 & 12
■ Opportunity for provision of cycle way connections along the highway and to adjoining communities.	Chapter 6
Maritime NSW	
■ Identified the necessary vertical and horizontal clearances required on the Nambucca and Bellingen River bridges to ensure adequate clearances for river vessels.	Chapter 12
Coffs Harbour Local Aboriginal Land Council	
■ Management of Aboriginal artefacts.	Chapter 15
Nambucca Head Local Aboriginal Land Council	
■ Methodology for investigation of Cow Creek Aboriginal Reserve.	Chapter 15

Appendix D Draft Statement of Commitments

This appendix outlines the Draft Statement of Commitments proposed by the RTA to avoid, minimise, manage, mitigate or offset and/or monitor impacts identified in the environmental assessment.

Director-General's requirements	Where addressed
A Draft Statement of Commitments (SoC) The SoC must incorporate or otherwise capture all measures to avoid, minimise, manage, mitigate, offset or monitor impacts identified in the impact assessment sections of the EA and ensure that the wording of the SoC clearly articulates the desired environmental outcome of the commitment. The SoC must be achievable, measurable (with respect to compliance), and time specific where relevant.	Appendix D

The *Draft Statement of Commitments* includes:

- The desired environmental outcomes for the Proposal.
- Key actions to be undertaken to achieve the outcomes.
- Reference to the timing of the actions.
- Reference documents influencing the outcomes and implementation of the commitment.

The *Draft Statement of Commitments* specifies certain environmental outcomes to be achieved. Greater detail as to how those outcomes would be achieved is provided in the mitigation and management measures in Chapters 10 to 19. The *Draft Statement of Commitments* is presented in a format that is readily auditable and transparent.

The Director-General of the Department of Planning may require the *Draft Statement of Commitments* to be revised in response to submissions to the environmental assessment and/or for changes to the Proposal to minimise environmental impacts. The revised Statement of Commitments would be included in the submissions report prepared to respond to issues raised in submissions.

Outcome	Ref No.	Key action	Timing	Reference document
Environmental management				
Compliance and continuous improvement in environmental management.	M1	The head contractor for the project will have an environmental management system.	Pre-construction and construction	*ISO14001:2004.* *RTA QA Specification G36 – Environmental Protection.*
	M2	Suitably qualified and experienced personnel will develop and implement project specific environmental management plans and procedures, incorporating as a minimum the mitigation and management measures in the environmental assessment.	Pre-construction and construction	*RTA QA Specification G36 – Environmental Protection.* *All relevant RTA policies, specifications, guidance notes and environmental directions.*
	M3	RTA and the contractor will implement a performance and compliance program.	Pre-construction and construction	
Community consultation				
Informed community.	CC1	Keeping the community informed will include: ▪ regular project updates. ▪ prior notice of project activities. ▪ changes to traffic and access and works outside standard working hours. ▪ contact details for enquiries. Targeted consultation with affected individuals or groups will occur as necessary (e.g. waterway users, farmers, noise affected residents, etc.).	Pre-construction and construction	*RTA Community Involvement and Communications Manual (RTA 2008).* *AS 4269 Complaints Handling.*
	CC2	Complaint management will include: ▪ A published 24 hour toll free complaints number.	Pre-construction and construction	*RTA Community Involvement and Communications Manual (RTA 2008).*

Outcome	Ref No.	Key action	Timing	Reference document
		▪ Directions on how to register a complaint. ▪ Acknowledgment of complaints within eight working hours. ▪ Complaint recording. ▪ Tracking of complaints until resolution.		*AS 4269 Complaints Handling.*
Traffic and transport				
Minimise impacts on traffic.	T1	Construction vehicle movements and work programs will incorporate traffic control measures to minimise traffic and transport impacts on local roads and the existing Pacific Highway.	Pre-construction and construction	*RTA Traffic Control at Work Sites (RTA 2003).* *RTA QA Specification G10 Control of Traffic.* *RTA Community Involvement and Communications Manual (RTA 2008).*
	T2	Any use of non-arterial roads by construction traffic will require the preparation of pre-construction and post-construction dilapidation reports, with copies to go to the relevant roads authority. Repair of any damage resulting from construction (normal wear and tear), will occur, unless there are alternative arrangements with the relevant roads authority.	Pre-construction and operation	*RTA QA Specification G10* *Control of Traffic*.
Minimise impacts on local traffic movement, pedestrians and public transport.	T3	Construction vehicle movement arrangements will limit impacts on other road users (including pedestrians, vehicles, cyclists and disabled persons), having regard to other road works in the area, local traffic movement requirements, and peak traffic volumes, including those during long weekends and holiday periods.	Pre-construction and Construction	*RTA Traffic Control at Work Sites.* *RTA QA Specification G10 Control of Traffic.*
Maintaining access to private properties and state forest resources.	T4	Where the Proposal temporarily or permanently affects any legal property access, the provision of feasible and reasonable alternative access to an equivalent standard will be necessary, unless a property owner agrees to alternative arrangements.	Pre-construction, construction and operation	*RTA Traffic Control at Work Sites.* *RTA QA Specification G10 Control of Traffic.* *Land Acquisition (Just Terms Compensation) Act* 1991. *RTA Land Acquisition Policy.*

Outcome	Ref No.	Key action	Timing	Reference document
	T5	Construction vehicle movements and work programs will incorporate traffic control measures to maintain access to state forests.	Construction	Chapter 5 and Chapter 11 of the environmental assessment (EA). *RTA Traffic Control at Work* *Sites* (RTA 2003). *RTA QA Specification G10* *Control of Traffic*.
Noise and vibration				
Minimise construction noise and vibration impacts.	N1	Further investigation of all feasible and reasonable mitigation and management measures to minimise construction noise at sensitive receivers will occur as part of detailed design (including consideration of early implementation of operational noise mitigation measures). Noise and vibration monitoring will measure against predicted levels and assess effectiveness. Implementation of further feasible and reasonable mitigation measures will occur where necessary.	Pre-construction and construction	RTA *Environmental Noise Management Manual (2001).* *Practice Note VII.* *Interim Construction Noise Guideline* (DECCW) *NSW Industrial Noise Policy (EPA 1999).* *Chapter 14 of the EA.*
	N2	Consultation with affected education institutions during construction works in their vicinity will attempt to limit audible construction works during important events, such as examination periods.	Pre-construction	
	N3	Construction would normally be limited to the following hours: ▪ Between 6am and 6pm Monday to Friday. ▪ Between 7am and 4pm Saturday. There would be no works outside these hours or on	Construction	RTA *Environmental Noise Management Manual (2001)*. *Interim Construction Noise Guideline* (DECCW Chapter 14 of the EA. AS 2436-1981 *Guide to Noise Control on*

Outcome	Ref No.	Key action	Timing	Reference document
		Sundays or public holidays except: a) Works that do not cause construction noise to be audible at any sensitive receivers. b) For the delivery of materials required outside these hours by the Police or other authorities for safety reasons. c) Where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm. d) Any other work as agreed through negotiations between the RTA and potentially affected sensitive receivers. Any such agreement must be recorded in writing and a copy kept on site for the duration of the works. e) Where the work is identified in the CNVMP and approved as part of the Construction Environmental Management Plan. f) As agreed by DoP and the DECCW. Local residents and the DECCW must be informed of the timing and duration of work approved under items (d) and (e) at least 48 hours before that work commences.		*Construction, Maintenance and Demolition Sites.*

Outcome	Ref No.	Key action	Timing	Reference document
	N4	All reasonable attempts will be made to contact sensitive receivers located within 500 metres of a blast location. The contact will be at least 48 hours before a blast and will include a schedule of blast time(s), and a telephone contact name and number.	Construction	*Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (ANZECC). German Standard *DIN 4150 Part 3 Structural Vibration in Buildings (Effects on Structures).* *Assessing Vibration: A Technical Guideline* NSW DECC (2006). RTA *Community Involvement and Communications Manual (RTA 2008)*.
Management of operational noise and vibration.	N5	Confirmation of all feasible and reasonable mitigation and management measures to minimise operational noise at sensitive receivers will occur as part of detailed design. Implementation of the measures would occur as construction proceeds.	Pre-construction and construction	Section 14.6 of the EA. NSW Government's *Environmental Criteria for Road Traffic Noise*. RTA's *Environmental Noise Management Manual*.
	N6	Monitoring of operational noise will continue for one year after completion of construction. If monitoring indicates a clear trend that traffic noise levels exceed those predicted, investigation of all further feasible and reasonable management measures will occur. Consultation with a suitably qualified and experienced acoustic specialist and the affected property owner will be necessary during the development of any additional mitigation measures.	Operation	NSW Government's *Environmental Criteria for Road Traffic Noise.* RTA's *Environmental Noise Management Manual*.
Flora and fauna				
Minimise impacts on flora and fauna.	F1	Clearing of native vegetation (including endangered ecological communities (EECs)) will be restricted to the minimum area necessary for construction.	Pre-construction and construction	Chapter 10 of the EA.

Outcome	Ref No.	Key action	Timing	Reference document
	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.	Pre-construction and construction	Chapter 10 of the EA. *DECC (2004) Threatened species survey and assessment: Guidelines for developments and activities (working draft).* *Australian Network for Plant Conservation 2004 guidelines*.
	F3	Site induction of construction workers will inform and instruct them of vegetation to be retained.	Pre-construction and construction	*DECC (2004) Threatened species survey and assessment: Guidelines for developments and activities (working draft).*
	F4	Plantings of rusty plum (*Amorphospermum whitei*) in areas of suitable habitat adjacent to the Proposal will follow from seed collection and propagation.	Pre-construction	Australian Network for Plant Conservation 2004 guidelines.
Maintain fauna habitat and connectivity.	F5	A suitably qualified ecologist will undertake pre-clearance surveys. 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.	Pre construction and construction	*National Parks and Wildlife Act* 1979. *RTA QA Specification G36 Environmental Protection.*
	F6	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.	Pre construction and construction	Section 10.5 of the EA. *Australian Network for Plant Conservation 2004 guidelines*.
	F7	Retention of mature trees in the median at locations identified in the EA 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.	Pre-construction and construction	Table 10-12 of the EA.

Outcome	Ref No.	Key action	Timing	Reference document
	F8	Provision of fauna crossings will be as identified in the environmental assessment	Pre-construction	Table 10-11 of the EA.
Minimise adverse impacts on aquatic habitat and fish species.	F9	Design and construction of waterway crossings will be in accordance with the fish habitat classification of each waterway and in consultation with the Department of Industry and Investment.	Pre-construction	*Fishnote: Policy and Guidelines for Fish Friendly Waterway Crossings* (NSW Fisheries). *Policy and Guidelines for Design and Construction of Bridges, Roads, Causeways, Culverts and Similar Structures* (NSW Fisheries 1999). *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge 2003).
Minimise fauna road injuries and mortalities during operation.	F10	Erection of fauna exclusion fencing (e.g. floppy-top fencing) along the Proposal at appropriate locations will direct fauna movement towards fauna-crossing structures.	Construction and Operation	Figure 10-6 to 10-9 of the environmental assessment.
Offset residual impacts of the Proposal on key habitat.	F11	Development of an offset agreement will occur in consultation with the Department of Environment, Climate Change and Water.	Pre-construction and construction	RTA *Compensatory Habitat Policy and Guideline* (draft).
Effective flora and fauna management and mitigation measures.	F12	Monitoring and assessment of the effectiveness of fauna and flora mitigation measures will be for a minimum period of 12 months after completion of construction. This would include the use of any required additional feasible and reasonable mitigation and management measures.	Operation	Section 10.5.11 of the EA.
	F13	The RTA will set bed levels for culverts and ledges for combined fauna passage in consultation with the Department of Environment, Climate Change and Water.	Pre-construction and construction	Section 10.4.3 of the EA

Outcome	Ref No.	Key action	Timing	Reference document
Aboriginal heritage				
Minimise impacts on Aboriginal heritage.	AH1	The protection of items and areas of archaeological significance not directly affected by construction will occur.	Pre-construction and construction	*RTA Procedure for Aboriginal cultural heritage consultation and investigation.* *Aboriginal cultural heritage: Standards and Guidelines Kit (DECCW).* *Protecting Aboriginal objects and places - Interim guidelines for community consultation.* *National Parks and Wildlife Act* 1974. *Chapter 15 of the EA.*
	AH2	There will be protocols will be established and implemented to manage any previously unidentified Aboriginal objects or skeletal remains encountered during construction. All works in the vicinity of the find will cease to obtain Aboriginal heritage specialist advice and inform the Department of Environment, Climate Change and Water.	Pre-construction and construction	*RTA Procedure for Aboriginal cultural heritage consultation and investigation.* *Protecting Aboriginal objects and places - Interim guidelines for community consultation.* *National Parks and Wildlife Act* 1974. *Chapter 15 of the EA.*
	AH3	The management of any Aboriginal heritage items directly affected will be in consultation with Aboriginal stakeholders and the DECCW.	Pre-construction and construction	*RTA Procedure for Aboriginal cultural heritage consultation and investigation.* *Protecting Aboriginal objects and places - Interim guidelines for community consultation.* *National Parks and Wildlife Act* 1974. *Chapter 15 of the EA.*
	AH4	All construction personnel will receive training on their obligations for protection of Aboriginal cultural materials, including information on site locations, conservation management and legal obligations in regard to Aboriginal cultural materials.	Pre-construction	*RTA Procedure for Aboriginal cultural heritage consultation and investigation.* *National Parks and Wildlife Act* 1974.

Outcome	Ref No.	Key action	Timing	Reference document
Aboriginal participation will be on-going.	AH5	The RTA will comply with the NSW Government's *Aboriginal Participation in Construction Guidelines.*	Pre-construction and construction	*RTA Procedure for Aboriginal cultural heritage consultation and investigation.* *NSW Government's Aboriginal Participation in Construction Guidelines (2007).*
Non-Aboriginal heritage				
Minimise impacts on non-Aboriginal heritage.	NH1	The detailed design will minimise impacts to identified non-Aboriginal heritage items where feasible and reasonable.	Pre-construction	*Heritage Act* 1977. *Section 19.3 of the EA.*
	NH2	If any material of potential archaeological significance is unearthed, work will cease to obtain specialist heritage advice.	Pre-construction and construction	*Heritage Act* 1977. *Section 19.3 of the EA.*
	NH3	Preparation of archival and photographic records for impacted heritage items would be in accordance with relevant guidelines.	Pre-construction	NSW Heritage Branch Guidelines: *How to Prepare Archival Recording of Heritage Items (1998).* *Photographic Recording of Heritage Items Using Film or Digital Capture (2006).* *Heritage Act* 1977. *Section 19.3 of the EA.*
Water quality and hydrology				
Erosion and sediment controls are effective.	W1	Minimisation of the area of soil exposure during construction.	Construction	*RTA QA Specification G40 Clearing and Grubbing.*
	W2	Detailed design will further investigate any additional feasible and reasonable mitigation and management measures to minimise construction erosion and sedimentation.	Pre- construction	*Managing Urban Stormwater – Soils and Construction*", the RTA's "*Guidelines for the Control of Erosion and Sedimentation in Roadworks*" and the Department of Planning's "*Constructed Wetlands Manual*".

Outcome	Ref No.	Key action	Timing	Reference document
				Temporary sediment basins to be installed at locations identified in Figures 6-1-6.21 of the EA.
	W3	Monitoring of water quality upstream and downstream of the site during construction will determine the effectiveness of mitigation strategies. Implementation of additional feasible and reasonable management measures will occur if necessary.	Pre-construction and construction	Draft DECC "*Managing Urban Stormwater: Soils and Construction, Volume 2, Book 4, Main Road Construction* (2006)". *Managing Urban Stormwater: soils and construction* (Landcom 2006). The RTA's *Code of Practice for Water Management – Road Development and Management*. RTA *QA Specification G38 Soil and Water Management*. RTA *QA Specification G39 Soil and Water Management (Erosion and Sediment Control Plan).*
	W4	Development and implementation of specific construction measures for in-stream works to limit water quality impacts will occur in consultation with relevant government agencies.	Pre-construction and construction	*Managing urban stormwater: soils and construction* (Landcom 2006). The RTA's *Code of Practice for Water Management – Road Development and Management*. RTA *QA Specification G38 Soil and Water Management*. Chapter 16 of the EA.
	W5	Managing operational water quality will occur by applying *RTA's Code of Practice for Water Management – Road Development and Management (1999)*.	Operation	*RTA's Code of Practice for Water Management – Road Development and Management (1999).*
Minimise groundwater related impacts.	W6	Investigation of the potential for changes in the groundwater table will take place before starting any major earthworks. Where a potential for change is	Pre-construction and construction	Section 16.4 and Table 16-4 of the EA. *RTA's Code of Practice for Water Management – Road Development and Management (1999).*

Outcome	Ref No.	Key action	Timing	Reference document
		identified, the significance of the change and any resultant impacts will be determined and measures to manage the changes will be designed and implemented as necessary.		RTA *QA Specification G38 Soil and Water Management*.
Soils and fill				
Minimise impact of exposing acid sulphate soil.	S1	Identification and management of Acid Sulphate Soils will be in accordance with the *Guidelines for the Management of Acid Sulphate materials: Acid Sulphate Soils, Acid Sulphate Rock and Monosulphidic Black Ooze* (RTA 2005).	Pre-construction and construction	*Guidelines for the Management of Acid Sulphate materials: Acid Sulphate Soils, Acid Sulphate Rock and Monosulphidic Black Ooze* (RTA 2005). *Acid Sulphate Soils Manual"* (Acid Sulphate Soil Management Advisory Committee 1998).
Protection of the environment, workers and the public.	S2	There will be identification, investigation and appropriate management of areas of potential soil contamination (including works in the vicinity of the old municipal tip site in Nambucca State Forest).	Pre-construction and construction	DECC (1999) *Environmental Guidelines – Assessment, Classification and Management of Liquid and non-liquid Waste*. *Contaminated Land Management Guideline* (RTA 2005). DECC Guidelines for NSW Site Auditor Scheme. *Contaminated Land Management Act,* 1997. SEPP 55 – Remediation of *Land*.
Air quality				
Minimise dust generation and impact to sensitive receivers.	AQ1	To minimise windblown, traffic generated or equipment generated dust emissions, there will be feasible and reasonable mitigation and management measures.	Construction	DECC guideline "*Approved Methods for Sampling and Analysis of Air Pollutants in New South Wales*".

Outcome	Ref No.	Key action	Timing	Reference document
	AQ2	Dust generating activities will stop where visible dust is being emitted outside the construction corridor and dust suppression measures are ineffective.	Construction	Section 19.2 of the EA.
Greenhouse gases and energy				
Minimise greenhouse gas and energy consumption.	G1	Wherever feasible and reasonable detailed design will consider whole of life reductions in greenhouse gas emissions and energy consumption.	Pre-construction and construction	AS/NZS 1158:1.1.2005.
	G2	Energy efficient work practices will be adopted to limit energy use. Where reasonable and feasible, equipment and management measures will be adopted to minimise energy use and greenhouse gas production.	Preconstruction and construction	
Visual amenity and design				
Urban and landscape character of the study area will be maintained and enhanced.	UD1	The preparation of detailed urban and landscape design will be in consultation with Nambucca and Bellingen Shire councils and the community. The detailed design and implementation of built elements and landscapes and the mitigation of residual impacts will be in accordance with the visual and urban design objectives and principles of the project.	Pre-construction	*Beyond the Pavement – RTA Urban and Regional Design Practice Notes* (RTA 2004). *Pacific Highway Urban Design Framework* (RTA 2005). Chapter 13 of the environmental assessment. Working paper 2 – *Visual amenity and design.* Landscape Guidelines (RTA 2008).
Minimise visual impacts.	UD2	The species to be used in the landscaping treatments will include native and locally indigenous plants.	Pre-construction and construction	Working paper 2 - *Visual Amenity and Design* and Working paper 1 – *Flora and fauna.*
Monitoring and management of landscaping to ensure its effectiveness.	UD3	Landscape and rehabilitation works will be subject to monitoring and maintenance where necessary for a minimum of two years after construction.	Construction and operation	Chapter 10 and 13 of the EA.
Hazards and risk				
Minimise the risk of hazard on the environment and community.	HR1	Hazardous materials used during construction will be stored in bunded areas within construction sites. Hazardous materials will not be stored on the floodplain below the 20 year ARI flood level. Use of	Construction	*AS 1940 The Storage and Handling of Flammable and Combustible Liquids.* *RTA QA Specification G38 Soil and Water*

Outcome	Ref No.	Key action	Timing	Reference document
		hazardous materials in floodplain areas will be limited to a daily or weekly threshold. Containers, workshops, plant, material stores and storage tanks will not be sited on the floodplain of watercourses where avoidable.		*Management.* *DEC Bunding and Spill Management Guidelines (in DEC Environmental Protection manual for Authorised Officers).* *RTA Code of Practice for Water management (RTA 1999).* *RTA QA Specification G36 Environmental Protection.*
	HR2	Potentially hazardous and contaminating activities (such as washing construction plant and handling hazardous chemicals) and activities with the potential for spillage such as refuelling, maintenance of equipment, mixing of cutting oil and bitumen will be in bunded areas or in other areas where suitable containment measures are in place to prevent discharge into watercourses.	Construction	*AS 1940 The Storage and Handling of Flammable and Combustible Liquids.*
Waste and resource management				
Minimise waste production.	WR1	The waste minimisation hierarchy principles of avoid / reduce / re-use / recycle / dispose will apply to all aspects of the proposal, including work programs, purchase strategies and site inductions. Quarterly assessments will identify opportunities for improvement.	Pre-construction and construction	*Waste Avoidance and Resource Recovery Act* 2001. NSW Government's *Waste Reduction and Purchasing Policy*. *Waste Avoidance and Resource Recovery Strategy (DECC 2006).* DECC (1999) *Environmental Guidelines – Assessment, Classification and Management of Liquid and non-liquid Waste.*

Outcome	Ref No.	Key action	Timing	Reference document
				RTA Stockpile management procedures 2001.
Minimise waste produced and dispose appropriately.	WR2	Where reuse or recycling of water is not possible, it will be sent to an appropriately licensed facility.	Construction	*Protection of the Environment Operations Act* 1997. *Waste Classification Guidelines (DECC 2008).* *RTA Guidelines for Management of Acid Sulphate Materials (RTA 2005).* *RTA QA SpecificationsG36 Environmental Protection.*
Landuse and property				
Appropriate compensation will be paid in relation to property acquisitions.	P1	Negotiation of all property acquisitions will be in accordance with the RTA *Land Acquisition Policy Statement.* Compensation assessment will be in accordance with the *Land Acquisition (Just Terms Compensation) Act* 1991.	Pre-construction	RTA *Land Acquisition Policy Statement.* *Land Acquisition (Just Terms Compensation) Act* 1991.
Minimise impacts on forestry operations.	P2	The Department of Industry and Investment will have access to state forest land identified for acquisition by RTA to remove any harvestable timber within the footprint of the proposal prior to commencement of construction. Access to state forest land adjacent to the proposal will provide for forestry operations, fire management activities and recreation purposes.	Pre-construction, construction and operation	*Community involvement a Communications. Draft: A resource manual for staff* (RTA June 2008).
Maintenance of water supply to properties.	P3	Where the proposal adversely affects a licensed bore, dam or other property water supply, RTA will investigate an alternate source or negotiate compensation for the loss with the landowner.	Construction and operation	
Socio economic impacts				
Minimise impacts on businesses, agriculture and aquaculture.	S1	There will be ongoing consultation with affected businesses, agricultural and aquaculture landowners.	Pre-construction and construction	*Community Involvement and Communications. Draft: A resource manual for staff* (RTA June 2008).

Outcome	Ref No.	Key action	Timing	Reference document
Minimise disruption to utilities and services.	S2	The identification of utilities and services potentially affected by construction, including requirements for diversion, protection and / or support will occur prior to the start of construction. Consultation with the service providers will determine alterations to services, the limitation of disruptions and requirements for advice to customers.	Pre-construction and construction	
Minimise environmental and social impacts from the construction of temporary ancillary facilities.	S3	Sites chosen for ancillary facilities will satisfy criteria outlined in Chapter 7 of the EA. Occupation and use of compound and work sites will seek to minimise disturbance to adjacent residents.	Pre-construction and construction	Section 7.3.7 of the environmental assessment.

Appendix E Study team

Sinclair Knight Merz – Key project team members	
Jo Moss	Project Director
Ross Jones	Project Manager
Kim Collings	Assistant Project Manager
Jo North	Environment Team Leader
Katie Bagnall	
Richard Davies	Design Team Leader
Prudence Burke	Consultation Team Leader
Denise Lo	Environmental Scientist
Chris Thomson	Flora and Fauna
Andrew Carty	
Scott Hughes	Noise and Vibration
Tony Church	Water Quality
Kate Byrnes	
Emma Collins	
Vanessa Edmonds	Heritage
Joseph Brookes	
Rose Reid	
Tim Bickerstaff	Traffic and Transport
David Lowe	
Matt Davies	Air Quality and Greenhouse
Yvette Sheedy	Land Use Planning
David Cotterill	Economics
Ajay Arcot	GIS
Jonathan Chen	
Adrian Howard	Flooding and Hydrology
Sarah Gosling	

Sub-consultants– Environmental assessment preparation	
DEM	Visual and Urban Design
Golder Associates	Geotechnical
Au Fait Design	Graphics

RTA	
Bob Higgins	General Manager, Pacific Highway Office
Chris Clark	Project Development Manager
Adam Cameron	
John O'Donnell	Environmental Services Manager
Michelle Forwood	Senior Environmental Specialist
Peter Keane	

Appendix F Minister's Orders and Letter of confirmation from the Director-General

Department of Planning

ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

ORDER

I, the Minister for Planning, order, under section 75B (1) of the Environmental Planning and Assessment Act 1979, that the development described in the Schedule is a project to which Part 3A of the Environmental Planning and Assessment Act 1979 applies.

FRANK SARTOR, M.P.,
Minister for Planning

Sydney, 5 December 2006.

SCHEDULE

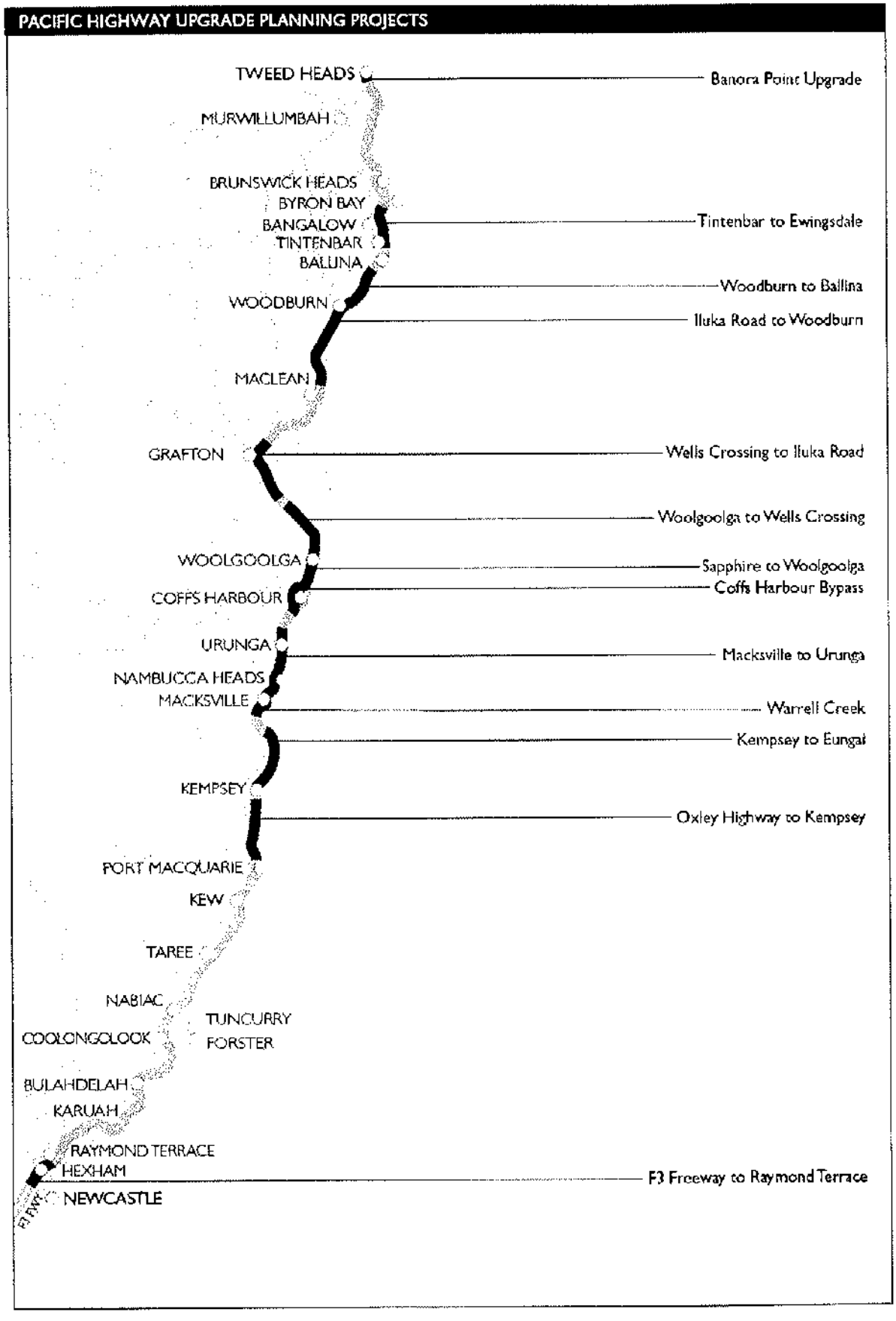
Development for the purposes of upgrading the following segments of the Pacific Highway, located within the Tweed, Byron, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Port Macquarie-Hastings, Port Stephens and Newcastle Local Government Areas and at the locations shown on the map marked 'Pacific Highway Upgrade Planning Projects', to achieve at least four lanes of dual carriageway ('the Project'):

1. Banora Point, from the northern extent of the completed Chinderah bypass extending approximately 2.5 kilometres to the southern extent of the Tweed Heads bypass north of Minjungbal Drive.
2. Tintenbar to Ewingsdale, from Ross Lane approximately 13 kilometres north of Ballina extending for approximately 17 kilometres to the existing Ewingsdale interchange approximately 32 kilometres north of Ballina.
3. Woodburn to Ballina, from approximately 3 kilometres south of Woodburn extending for approximately 36 kilometres to the Ballina bypass approximately 6 kilometres south of Ballina.
4. Iluka Road to Woodburn, from the Iluka Road intersection extending for approximately 35 kilometres to a point approximately 3 kilometres of south Woodburn.
5. Wells Crossing to Iluka Road, from approximately 23 kilometres south of Grafton extending for approximately 71 kilometres to the Iluka Road intersection approximately 56 kilometres north of Grafton.
6. Woolgoolga to Wells Crossing, from Arrawarra Creek, approximately 5 kilometres north of Woolgoolga extending for approximately 28 kilometres to the intersection of the Pacific Highway and Bald Knob Tick Gate Road.
7. Sapphire to Woolgoolga, from Campbell Close approximately 8 kilometres north of Coffs Harbour extending for approximately 25 kilometres to the intersection with Arrawarra Beach Road approximately 31 kilometres north of Coffs Harbour.
8. Coffs Harbour Bypass, from approximately 700 metres south of the Englands Road intersection extending for approximately 12 kilometres to approximately 500 metres south of Old Coast Road.
9. Macksville to Urunga, from Crouchs Creek approximately 47 kilometres north of Kempsey extending for approximately 37 kilometres to Waterfall Way Bridge approximately 88 kilometres north of Kempsey.
10. Warrell Creek, from south of Warrell Creek approximately 42 kilometres north of Kempsey extending for approximately 6 kilometres to Crouchs Creek approximately 47 kilometres north of Kempsey.
11. Kempsey to Eungai, from approximately 7 kilometres south of Kempsey extending for approximately 41 kilometres to approximately 34 kilometres north of Kempsey.
12. Oxley Highway to Kempsey, from the intersection of the Pacific Highway and the Oxley Highway extending for approximately 37 kilometres to the Maria River south of Kempsey.
13. F3 Freeway to Raymond Terrace, from the F3 Freeway approximately 1 kilometre south of the John Renshaw Drive Roundabout extending for approximately 15 kilometres to approximately 1.5 kilometres of Masonite Road, Raymond Terrace.

Development for all associated or ancillary works, activities, uses, structures or facilities for the purposes of the Project, and includes (but is not limited to) works, activities, uses, structures or facilities for the following:

a) construction (including demolition works) and operation (excluding maintenance) of the Project;
b) access for construction and operation of the Project including access for pedestrians, public transport and vehicles;
c) environmental management and pollution control for the Project;
d) associated interchanges, intersections, bridges, overpasses, ramps, service roads and road modifications for the Project;
e) any changes to the route of the existing carriageway or road for the Project;
f) any re-alignment, modification, demolition or replacement of the existing carriageway or road for the Project; and
g) any winning or obtaining extractive material as part of the construction work for the Project.

Development does not include activities comprising of surveys, test drilling, test excavations, preliminary geotechnical investigations or the like associated with the design and environmental assessments required for the Project prior to the commencement of construction.


PACIFIC HIGHWAY UPGRADE PLANNING PROJECTS
TWEED HEADS
Banora Point Upgrade
MURWILLUMBAH
BRUNSWICK HEADS
BYRON BAY
BANGALOW
TINTENBAR
Tintenbar to Ewingsdale
BALLINA
Woodburn to Ballina
WOODBURN
Iluka Road to Woodburn
MACLEAN
GRAFTON
Wells Crossing to Iluka Road
Woolgoolga to Wells Crossing
WOOLGOOLGA
Sapphire to Woolgoolga
COFFS HARBOUR
Coffs Harbour Bypass
URUNGA
Macksville to Urunga
NAMBUCCA HEADS
MACKSVILLE
Warrell Creek
Kempsey to Eungai
KEMPSEY
Oxley Highway to Kempsey
PORT MACQUARIE
KEW
TAREE
NABIAC
TUNCURRY
COOLONGOLOOK
FORSTER
BULAHDELAH
KARUAH
RAYMOND TERRACE
HEXHAM
F3 Freeway to Raymond Terrace
NEWCASTLE

ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

Declaration of Critical Infrastructure Project

I, the Minister for Planning, declare under section 75C of the *Environmental Planning and Assessment Act* 1979, that the project referred to in the Schedule is a critical infrastructure project, having formed the opinion that the project is essential for the State for economic and social reasons.

FRANK SARTOR, M.P.,
Minister for Planning

Sydney, 5 December 2006.

SCHEDULE

Development for the purposes of upgrading the following segments of the Pacific Highway, located within the Tweed, Byron, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Port Macquarie-Hastings, Port Stephens and Newcastle Local Government Areas and at the locations shown on the map marked 'Pacific Highway Upgrade Planning Projects', to achieve at least four lanes of dual carriageway ('the Project'):

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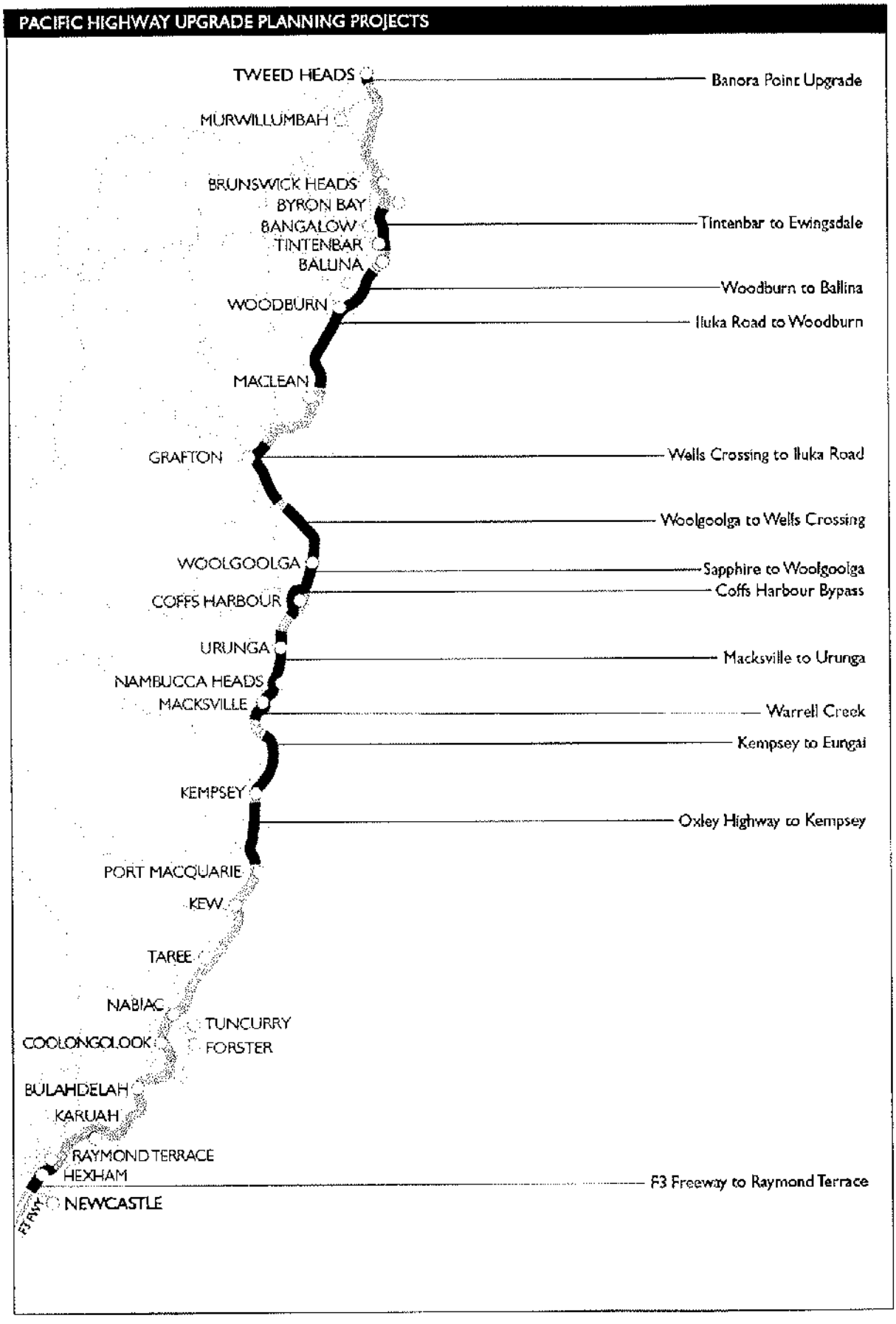
Development does not include activities comprising of surveys, test drilling, test excavations, preliminary geotechnical investigations or the like associated with the design and environmental assessments required for the Project prior to the commencement of construction.


PACIFIC HIGHWAY UPGRADE PLANNING PROJECTS
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COFFS HARBOUR
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MACKSVILLE
KEMPSEY
PORT MACQUARIE
KEW
TAREE
NABIAC
TUNCURRY
COOLONGOLOOK
FORSTER
BULAHDELAH
KARUAH
RAYMOND TERRACE
HEXHAM
NEWCASTLE
F3 FWY
Banora Point Upgrade
Tintenbar to Ewingsdale
Woodburn to Ballina
Iluka Road to Woodburn
Wells Crossing to Iluka Road
Woolgoolga to Wells Crossing
Sapphire to Woolgoolga
Coffs Harbour Bypass
Macksville to Urunga
Warrell Creek
Kempsey to Eungai
Oxley Highway to Kempsey
F3 Freeway to Raymond Terrace

10/317.1626 ACL:JW
Mr Robert (Bob) Higgins
(02) 6640 1378
Bob_Higgins@rta.nsw.gov.au

The Director General
Department of Planning
GPO Box 39
Sydney NSW 2000

Attention: Lisa Mitchell

HIGHWAY NO. 10 PACIFIC HIGHWAY. WARRELL CREEK TO URUNGA UPGRADE ENVIRONMENTAL ASSESSMENT.

Dear Lisa

I refer to the NSW Roads and Traffic Authority's (RTA) Project Application (Application Number: 07_0112) to the NSW Department of Planning dated 23 August 2008 for the proposed Warrell Creek to Urunga Pacific Highway upgrade. Reference is also made to the Department's Director General's Requirements for the proposed environmental assessment of the Warrell Creek to Urunga upgrade dated 23 September 2007(DGR's).

A preferred route has now been selected for the Warrell Creek section of the upgrade. Following the announcement of the preferred route for the Warrell Creek section, the RTA will publicly release the Warrell Creek Review Report which describes the preferred route and how it was selected. The report also responds to public submissions received in response to the announcement of the route options for the Warrell Creek section in September 2007.

In view of the selection of the preferred route for the Warrell Creek section, the RTA seeks confirmation from the Director General that the DGR's are still appropriate and do not require amendment. If this is not the case and the Director General considers the DGR's should be amended, we would be pleased if you could advise the RTA as soon as possible.

The RTA also wishes to confirm its understanding that the proposed environmental assessment of the Warrell Creek section will be undertaken in respect of the preferred route only (for both the Warrell Creek section and Macksville to Urunga section) and that any other route options previously investigated will not be assessed in any detail.

Should you require further information regarding this project please do not hesitate to contact the Project Development Manager, Mr Adam Cameron on 6640 1063 or by email Adam_Cameron@rta.nsw.gov.au.

Yours faithfully

B J Watters 2/7/08

Brian Watters
Director, Major Infrastructure

NSW GOVERNMENT
Department of Planning

Contact: Lisa Mitchell
Phone: (02) 9228 6354
Fax: (02) 9228 6355
Email: lisa.mitchell@planning.nsw.gov.au

BOZ

Mr Brian Watters
Director, Major Infrastructure
NSW Roads and Traffic Authority
PO Box K198
HAYMARKET NSW 1238

Our ref: S02/01634
Your ref: 10/317.1626 AC:LJW

Attention : Mr Bob Higgins

Dear Mr Watters

Proposed Pacific Highway Upgrade – Warrell Creek to Uranga (07_0112)

I refer to your letter dated 2 July 2008 regarding the Director General's Requirements (DGRs) and Environmental Assessment for the subject project.

The Department of Planning notes that the Roads and Traffic Authority (RTA) considered several options prior to the finalisation of the preferred route. The DGRs were written in consideration of the broad project scope and are still considered appropriate for the RTA's preferred route.

The Department of Planning can also confirm that the Environmental Assessment should consider the preferred route in detail, however justification for the preferred route (including an assessment of the environmental costs and benefits of the project relative to alternatives) should be considered as stated in the DGRs.

Please do not hesitate to contact Lisa Mitchell on (02) 9228 6510 or via email at lisa.mitchell@planning.nsw.gov.au should you have any queries or require clarification.

Yours sincerely

14.7.08

Chris Wilson
Executive Director
Major Project Assessments
As delegate for the Director General

GM, PH

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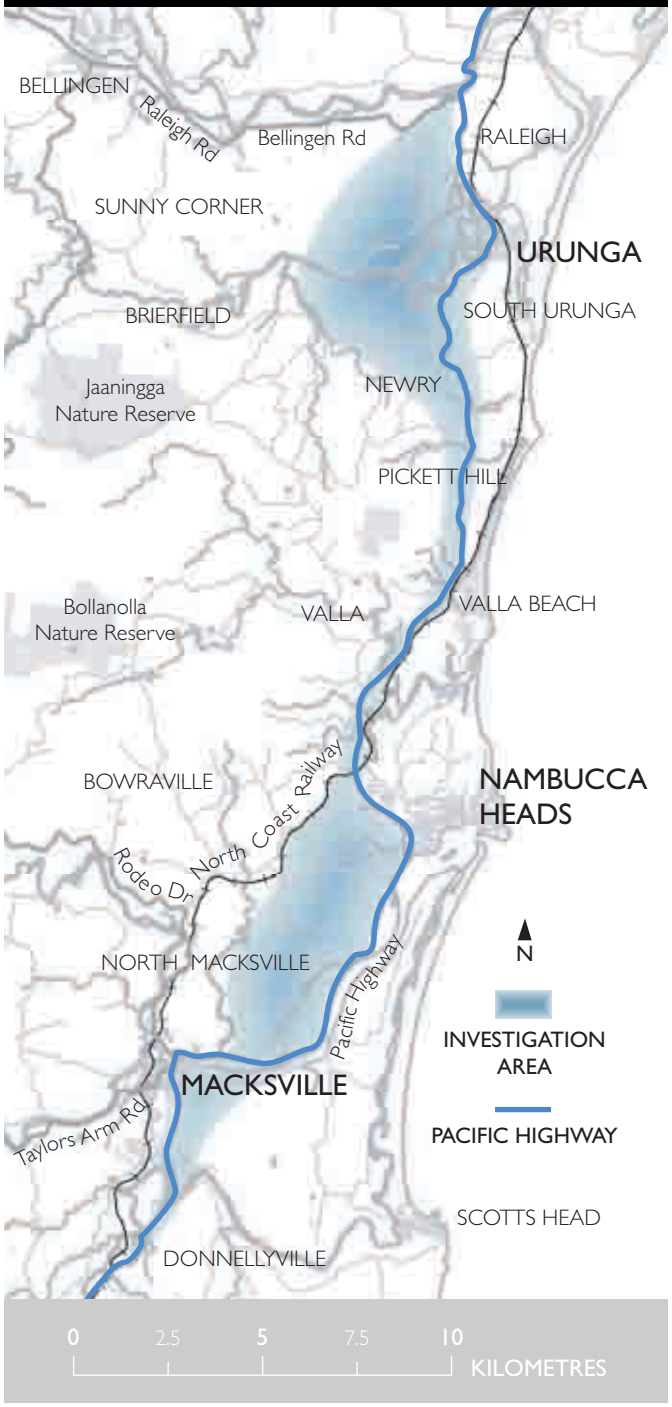
Appendix G Community updates

INVESTIGATION AREA



Have your say

To find out more about the proposed Macksville to Urunga Upgrade and provide comment:

- Call the Project information line (freecall) on **1800 800 612**. If you call out of hours, please clearly leave your contact details and we will return your call.
- Ask to be placed on the project mailing list to receive future community updates.
- Attend information days / displays as advertised in local and regional newspapers.
- Nominate to represent a sector of your community on a Community Liaison Group.
- Visit the project web site (*includes a feedback facility*) at **www.rta.nsw.gov.au/pacific.htm**
- Fill in and return the attached survey.
- **Write to:** Pacific Highway Upgrade
  Macksville to Urunga
  C/- Ross Jones
  Sinclair Knight Merz
  PO Box 164
  ST LEONARDS NSW 1590
  Fax: 02 9928 2502
  email: macks2urunga@skm.com.au

RTA Project Manager:
Ray Dallen
Phone: 02 6640 1376
Facsimile: 02 6640 1001
email: ray_dallen@rta.nsw.gov.au

Project information line (FREECALL)
1800 800 612

Upgrading the Pacific Highway

RTA/Pub.03.084

All information included in correspondence is collected for the sole purpose of assisting in the assessment of this proposal. The information received including names and addresses of respondents, may be published in subsequent assessment documents unless clear indication is given in the correspondence that all or part of that information is not to be published.

NEW SOUTH WALES GOVERNMENT INITIATIVE

RTA

Macksville to Urunga

Upgrading the Pacific Highway

JUNE 2003

Macksville to Urunga

The Roads and Traffic Authority (RTA) has begun investigating options to upgrade the Pacific Highway between Macksville and Urunga on the mid north coast (a distance of approximately 40 kilometres). The project will link the proposed Warrell Creek Realignment in the south to the completed Raleigh Deviation in the north. Initial planning for this project is fully funded by the NSW Government as part of its $1.6 billion commitment to the Pacific Highway Upgrading Program.

The proposed upgrade would benefit both road users and local residents by:

- Improving road safety.
- Improving traffic flows.
- Reducing travel times.

This is the first in a series of community updates for the route options development and assessment process. It explains what will take place and how you can be involved. Community input will play an important part in the project planning.

Upgrading options

There is currently no preferred route for the project. However, an investigation area has been defined (see map). The study area will allow the development of a range of feasible route options. Potential routes both east and west of the existing Pacific Highway, as well as along the existing highway corridor would be considered. Bypasses of Macksville, Urunga and Bellwood will be investigated, as well as the possibility of upgrading the existing route through these towns.

Options development and assessment process

Sinclair Knight Merz (SKM) has been engaged by the RTA to assist in the development and assessment of route options. Project planning is aimed at achieving a balance between environmental, community, social, engineering and economic considerations.

Given the significant local knowledge that exists on a range of issues relevant to the study area, it is important that members of the local communities participate fully throughout the process.

A number of technical, environmental and social studies will commence shortly. As some of these will involve field investigations, permission to enter private properties for the studies will be arranged through individual property owners.

Following these initial studies, concept designs for possible route options will be developed for a more detailed assessment. These options will be publicly displayed for community comment.

A broad outline of the planning process and opportunities for community involvement are shown on the next page.

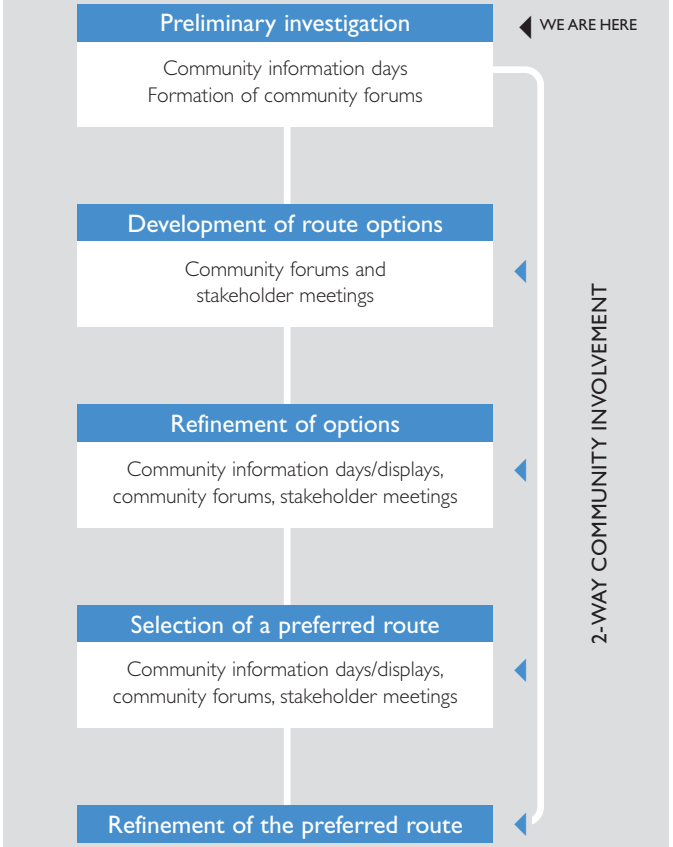
Pacific Highway Upgrading Program

This is the single largest construction program in NSW for the past 40 years. Twenty-one major projects and 19 smaller projects have been opened to traffic. Four major construction projects are underway, including the Karuah Bypass, Halfway Creek Realignment, Coopernook Bypass and Taree to Coopernook Upgrade. A further 15 projects are at various stages of planning and development, including the Kempsey to Eungai and Moorland to Herons Creek Upgrades.

The program has brought major improvements to the road conditions and travel times. Notorious blackspots have been removed with the completion of the Bulahdelah to Coolongolook and Yelgun to Chinderah Freeways, Raleigh Deviation and Ewingsdale Interchange.

As well as boosting tourism and transport efficiency and providing safer and more consistent overtaking opportunities, the Pacific Highway Upgrading Program has saved lives and reduced serious injury accidents.

PLANNING PROCESS



Macksville to Urunga

Upgrading the Pacific Highway

COMMUNITY UPDATE – ROUTE OPTIONS

NOVEMBER 2004

Macksville to Urunga Upgrade

The Roads and Traffic Authority (RTA) has been investigating options to upgrade the Pacific Highway between Macksville and Urunga on the mid north coast (a distance of approximately 40 kilometres). This Community Update describes the route options that have been shortlisted for further consideration and the key issues associated with each of the options. The options are on public display for comment from Tuesday 30 November 2004 to Wednesday 2 February 2005.

Planning for the project is fully funded by the NSW Government as part of the 10 year Pacific Highway Upgrading Program. The project will link the existing highway at Warrell Creek in the south to the completed Raleigh Deviation in the north.

Study team investigations

Since the start of planning for the project and the announcement of the investigation area in June 2003, the study team has been developing and assessing possible route options. Investigation of environmental, traffic, engineering, land use and social issues and community input have helped identify feasible route options. These investigations included:

- The development of maps showing environmental, engineering and social information.
- Consideration of community input provided through the community information displays held in 2003 and the three Community Liaison Groups (CLGs).
- Assessment of different land uses and property information.
- A review of the plants and animals, and their habitats.
- Identification of indigenous and non-indigenous heritage issues.
- Assessment of geotechnical and flooding conditions.
- Prediction of future traffic volumes and pedestrian needs.
- Examination of existing and future road traffic noise.
- Assessment of potential effects on businesses for the various options.
- Consideration of social and economic issues relating to the current location of the Pacific Highway.

In response to requests from sections of the Macksville community, the study team has also investigated the feasibility of route options to the west of Macksville. These options are located outside the June 2003 investigation area.

What are the options?

There is currently no preferred option for the project. The selection of a preferred option will be based on the consideration of community, environmental, engineering, economic and functional issues.

The June 2003 investigation area has been divided into four sections to enable a detailed review of the options and to better understand local issues. The sections are:

- Section 1: From the northern end of the proposed Warrell Creek Deviation to the northern bank of the Nambucca River (see pages 6 and 7).
- Section 2: From the northern bank of the Nambucca River to where the existing highway crosses the North Coast Railway Line west of Nambucca Heads (see pages 8 and 9).
- Section 3: From where the highway crosses the railway west of Nambucca Heads to Little Newry State Forest in the vicinity of Mines Road, south of Urunga (see pages 10 and 11).
- Section 4: From Mines Road to the southern end of the Raleigh Deviation (see pages 12 and 13).

A wide range of options were considered. These were refined into a smaller number of viable options in Sections 1, 2 and 4 as shown on the following maps. Due to constraints to the east and west of the existing highway, one option is proposed in Section 3 (see page 10 for details).

Options to the west of Macksville are shown on pages 14 and 15. These options leave the existing highway south of Warrell Creek and rejoin the highway west of Nambucca Heads near the southern end of Section 3. The proposed Warrell Creek Deviation is currently on hold, pending the selection of the preferred option for the Macksville to Urunga project.

Overview of route options

The upgrading of the Pacific Highway in the Macksville to Urunga area is a significant component of the overall Pacific Highway Upgrading Program. This section provides an overview of the shortlisted upgrade options between Warrell Creek and the Raleigh Deviation. The following pages then describe, in more detail, the proposed route options and the constraints that exist throughout the study area.

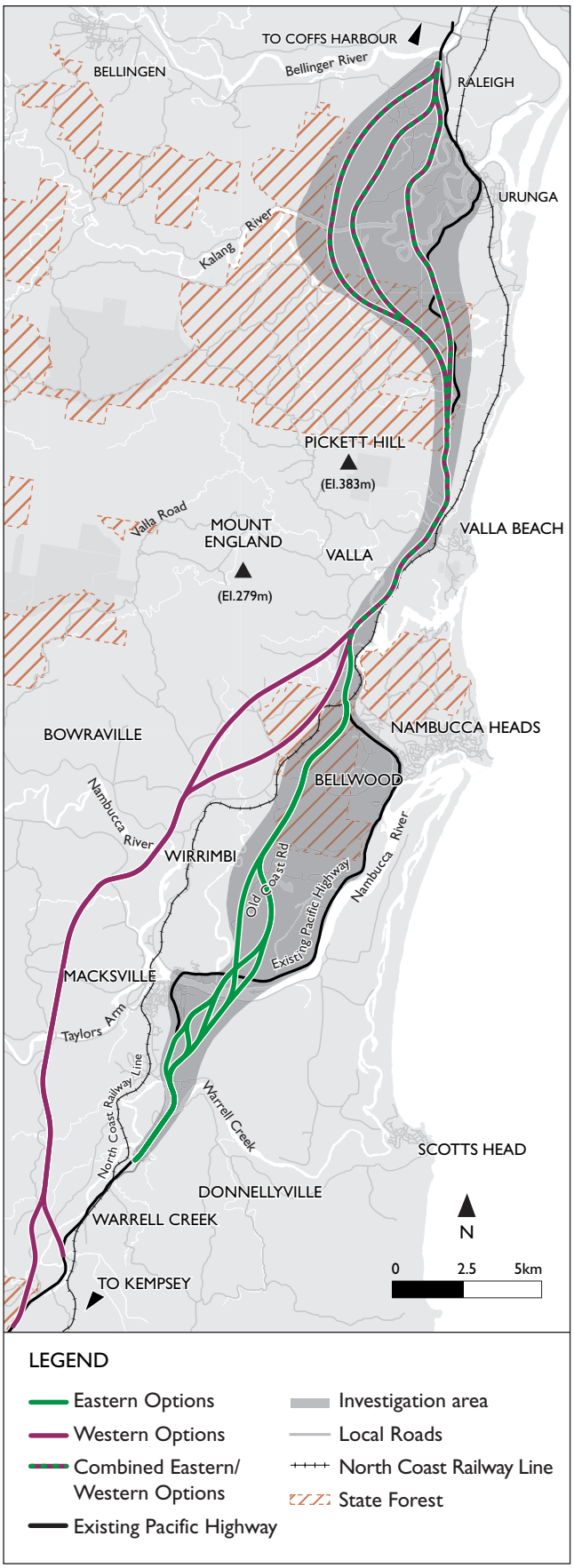
Given the size of the proposed upgrade there are opportunities to stage construction of the project. Staging would provide the community with benefits in key areas as early as practicable, and the RTA could allocate the available funding for the Pacific Highway Upgrading Program to those areas that can provide the most community benefit.

Figure 1 and the table below provide a broad comparison of the options being considered between Warrell Creek and Raleigh. For all options, a four-lane, divided highway is proposed with provision for additional lanes in the median in the future if required (see Figure 3 on the following page).

	WESTERN OPTIONS	EASTERN OPTIONS
LENGTH	41.0-45.1km	40.8-43.4km[a]
PRELIMINARY COST ESTIMATED IN $2003	$530-558 million	$520-555[b] million
ECONOMIC VIABILITY	(BCR[c] 1.2-1.4)	(BCR 1.5-1.8)
ABILITY TO STAGE	Limited opportunities	Greater opportunities to stage
ENVIRONMENTAL ISSUES	Large amount of vegetation clearing	Large amount o vegetation clearing
	Potential archaeological issues	
COMMUNITY ISSUES	Longer access to Macksville	Shorter access to Macksville
	Potential impacts on existing and future rural residential development	Potential impacts on existing and future rural residential development
		Potential noise impacts on Macksville
		Potential flood impacts near Macksville
	Potential impact on rural properties	
NUMBER OF MAJOR BRIDGES	6 to 9	7 to 8

a Includes Warrell Creek Deviation.
b Includes $50 million for the proposed Warrell Creek Deviation.
c Benefit Cost Ratio (BCR) – present value of road user benefits divided by the present value of costs.
d BCR for the West of Macksville options between Warrell Creek and Nambucca Heads is approximately 1.0.

Figure 1: Overview



Strategic context

What should the upgrade achieve?

The Macksville to Urunga upgrade forms part of the Pacific Highway Upgrading Program. The objectives of this program are to:

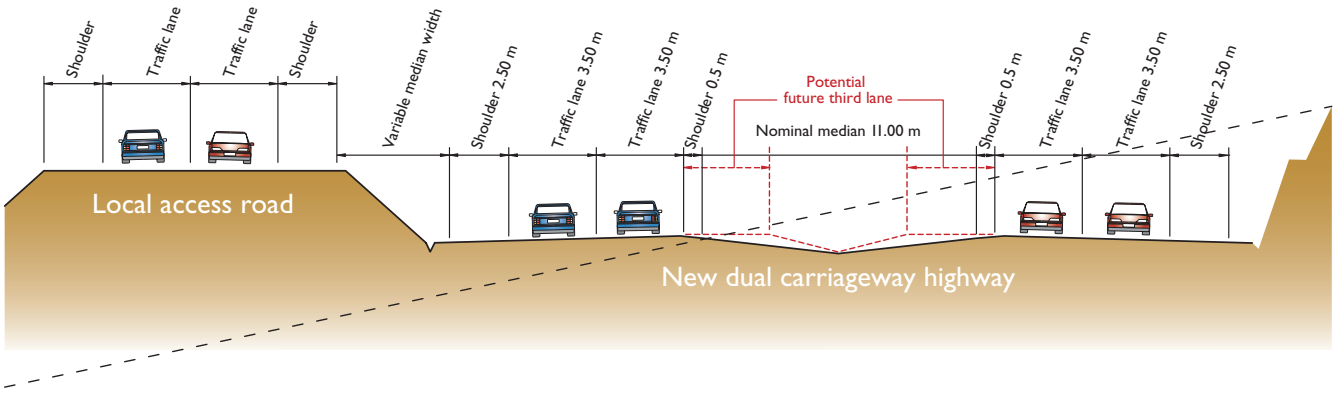
- Significantly reduce road accidents and injuries.
- Reduce travel times.
- Reduce freight transport costs.
- Have a community satisfied with the physical development of the route.
- Provide a route that supports economic development.
- Manage the upgrading of the route in accordance with Ecologically Sustainable Development (ESD) principles.
- Maximise the effectiveness of expenditure.

The specific objectives of the Macksville to Urunga upgrade are to:

- Achieve safe driving conditions on the highway for travel speeds of 110 kilometres per hour in rural areas and 80 kilometres per hour in urban areas.
- Integrate input from local communities into the development of the project.
- Provide connections from the upgraded highway to the key centres of Macksville, Nambucca Heads and Urunga.
- Have acceptable roadway capacity for traffic volumes at least 30 years after opening.
- Develop a dual carriageway road that accommodates all vehicles up to and including B-Double trucks.
- Maintain highway access during flood conditions.
- Provide acceptable access to properties.
- Develop delay management strategies to minimise disruption to local and through traffic and maintain access to affected properties and land during construction.
- Develop solutions that facilitate the staged construction of the project.
- Develop solutions for the ultimate grade separation of the Pacific Highway and local road intersections including consolidation of accesses by the use of service roads.
- Provide rest areas within the investigation area.
- Provide transport infrastructure that is complementary with surrounding land use.
- Ensure the project achieves value for money.

Figure 2: Dual carriageway highway with service road

Figure 3: Typical cross section of proposal



Selecting a preferred route

Upgrading the existing highway

The option of upgrading the existing Pacific Highway through the townships of Macksville, Bellwood and Urunga has been considered. The road corridor through Macksville is narrow and widening it would have a significant impact on a large number of residential and commercial properties.

The existing highway through Bellwood is constrained by the Nambucca River to the east and the residential and commercial properties to the west. Because the existing highway winds through Urunga, widening it to dual carriageway, even with an 80km/h travel speed, would have a significant impact on adjacent residential and commercial properties.

The option of upgrading the existing highway through Macksville, Bellwood and Urunga is not acceptable due to the impacts on these townships. No further consideration will therefore be given to this option.

The process to select a preferred route for the project that includes community issues is shown in the planning process diagram on the right.

No preferred option has been selected at this stage. Community comment on these shortlisted options will be considered as part of the process of selecting the preferred option.

A Value Management Study will be held to help select a preferred option. The Value Management Study will involve a workshop with representatives from a range of government, council and community interests. The recommendations arising from the study, together with the technical reports and community input, will be part of the evaluation of the options.

When selected, the preferred option will be placed on display.

Please review the information on the route options in the following sections of this Community Update and provide your comments to the study team using the contact details on the back cover.

Figure 4: Planning process

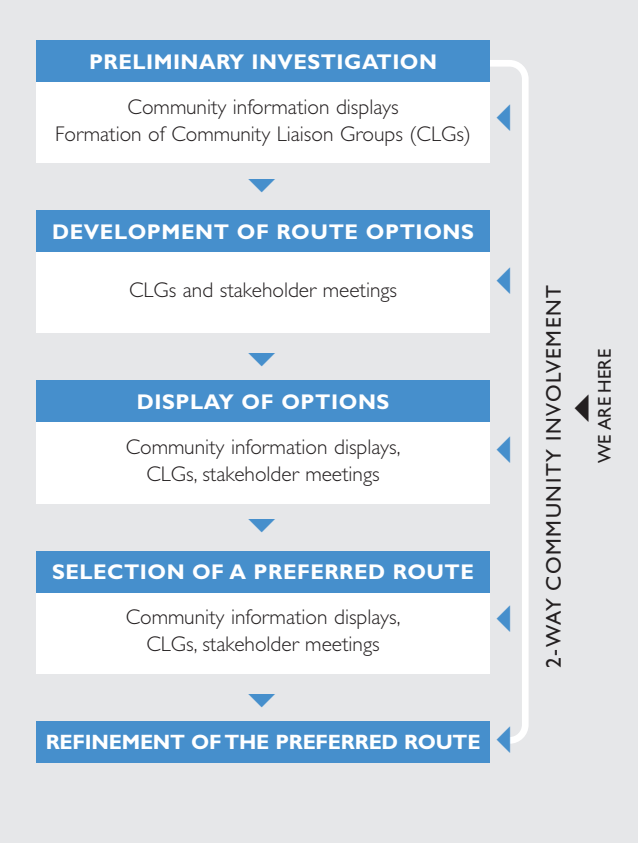
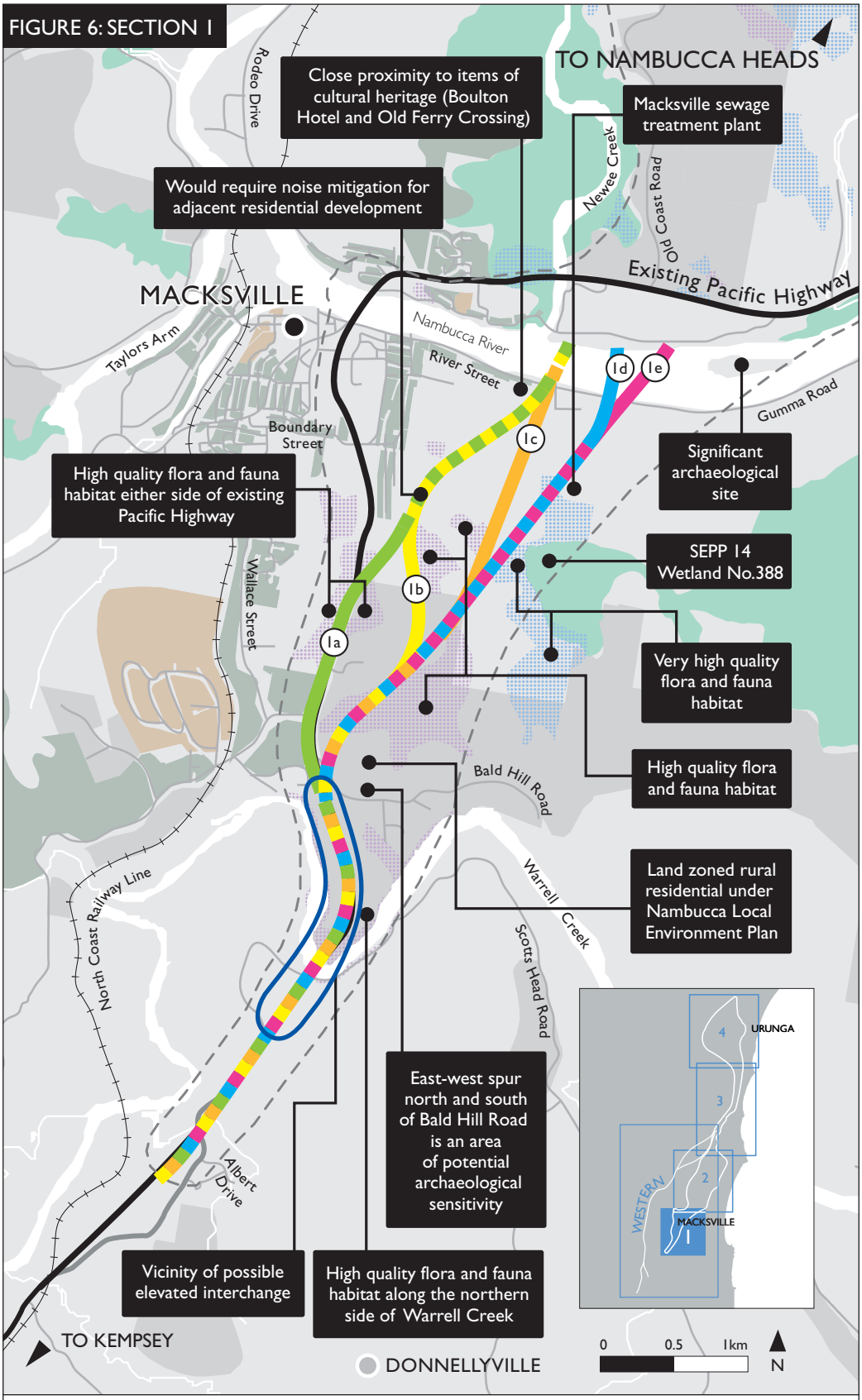


Figure 5: Grade separated interchange – Waterfall Way Interchange at Raleigh

SECTION 1 OPTIONS

From northern end of proposed Warrell Creek deviation to the northern bank of the Nambucca River.

FIGURE 6: SECTION 1



LEGEND

- Option 1a
- Option 1b
- Option 1c
- Option 1d
- Option 1e
- Very high quality habitat
- High quality habitat
- SEPP# 14 Wetland
- Residential area
- Rural residential area
- Industrial Area
- Investigation area
- Existing Pacific Highway
- North Coast Railway Line
- Local Roads

SEPP – State Environmental Planning Policy.

DESIGN ISSUES
TOTAL LENGTH – INCLUDING BRIDGE OVER NAMBUCCA RIVER
BRIDGES REQUIRED
BRIDGE OVER NAMBUCCA RIVER
MAXIMUM GRADIENT
MAXIMUM ELEVATION
SIGNPOSTED SPEED
CONNECTIONS TO TOWNS
CONNECTION TO OPTIONS IN SECTION 2
PRELIMINARY COST ESTIMATED IN $ 2003
ABILITY TO STAGE CONSTRUCTION
PROPERTY IMPACTS
APPROXIMATE NUMBER OF AFFECTED PROPERTIES
IMPACT ON RURAL PROPERTIES
IMPACT ON MACKSVILLE SEWAGE TREATMENT PLANT
COMMUNITY IMPACTS
POTENTIAL NOISE IMPACTS
FLOOD IMPACTS
BIOPHYSICAL IMPACTS
POTENTIAL IMPACT ON – FLORA AND FAUNA HABITAT
– THREATENED SPECIES
– RIVERINE/AQUATIC VEGETATION
HERITAGE IMPACTS

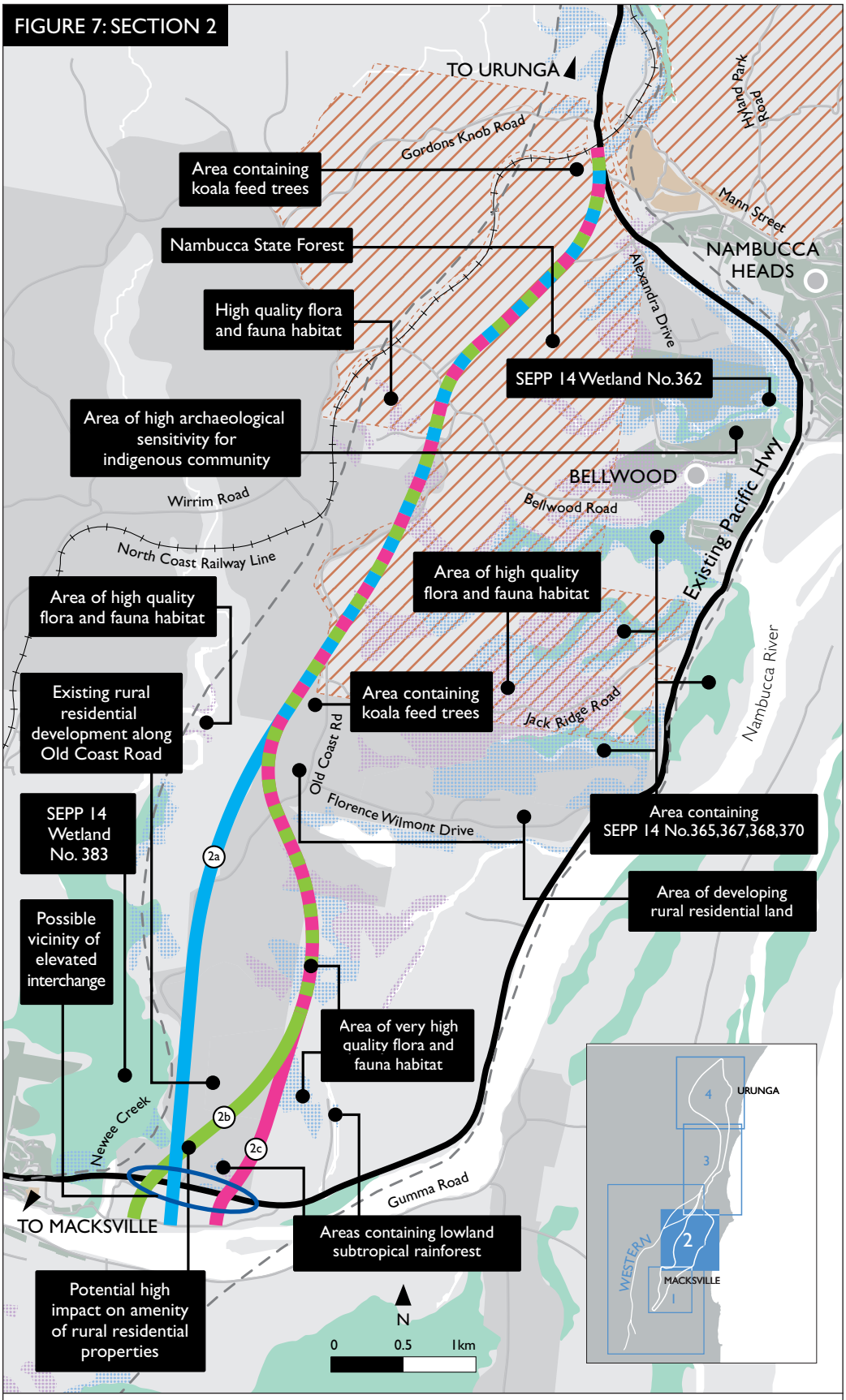
Five shortlisted options have been developed in this section. They are all located east of Macksville. Figure 6 and the table below provide a comparison of the shortlisted options for Section 1.

OPTION 1a (GREEN)	OPTION 1b (YELLOW)	OPTION 1c (ORANGE)	OPTION 1d (BLUE)	OPTION 1e (PINK)
All options share a common route for a distance of 2.5 km from the southern end of the investigation area to approximately where Bald Hill Road crosses the existing Pacific Highway. The upgrade for this length could be accommodated within the existing road reserve.				
6.1 km including 2.4 km of new dual carriageway.	6.1 km including 3.5 km of new dual carriageway.	6 km including 3.6 km of new dual carriageway.	6.1 km including 3.6 km of new dual carriageway.	6.3 km including 3.8 km of new dual carriageway.
All options in Section 1 would require duplication of the existing bridge over Warrell Creek and a new 4 lane bridge over the Nambucca River.				
Approx. 360 m in length.	Approx. 360 m in length.	Approx. 340 m in length.	Approx. 380 m in length.	Approx. 450 m in length.
All options have a maximum gradient of 4%.				
24 m above sea level for all options.				
All options have been developed for an ultimate signposted speed limit of 110km/h. With staged construction, initial speed limit may be 100km/h.				
All options include a possible interchange with the existing highway south of Macksville.				
Connects with Option 2b and, with modifications, Option 2a.			Connects with Option 2a and, with modifications, Option 2b.	Connects with Option 2c.
$124 million ($20.4 M/km).	$116 million ($19 M/km).	$114 million ($19 M/km).	$117 million ($19.2 M/km).	$124 million ($19.7 M/km).
Cost for all options includes a bridge over the Nambucca River.				
A 6 to 6.3 km bypass of Macksville could be constructed as a stand alone project.				
59 parcels of land.	49 parcels of land.	48 parcels of land.	52 parcels of land.	52 parcels of land.
All options have the potential to divide some rural properties and may require measures to provide connectivity between severed properties.				
In close proximity to the Macksville sewage treatment plant.			Encroaches on the property on which the Macksville sewage treatment plant is located.	
267 residences potentially affected without noise mitigation.	277 residences potentially affected without noise mitigation.	122 residences potentially affected without noise mitigation.	105 residences potentially affected without noise mitigation.	103 residences potentially affected without noise mitigation.
For all options, the crossing of the Nambucca River and floodplain would result in a maximum predicted increase in flood level of less than 50 mm for the 1 in 100 year flood.				
• 2.5 ha of very high quality. • 1.5 ha of high quality.	• 2.5 ha of very high quality. • 4ha of high quality.	• 3.5 ha of very high quality. • 2.5 ha of high quality.	• 4 ha of very high quality. • 2.5 ha of high quality.	• 4 ha of very high quality. • 2.5 ha of high quality.
All options could have a moderate impact on potential threatened species habitat requiring mitigation measures.				
Moderate potential to cross a wildlife corridor adjacent to the existing highway.	Low potential to cross existing wildlife corridors.			
All options have the potential for impact on riverine and aquatic vegetation at the Warrell Creek and Nambucca River crossings.				
All options impact on 2 areas of potential archaeological sensitivity				
No direct impact to any known sites of non-indigenous heritage significance.				

SECTION 2 OPTIONS

From the northern bank of the Nambucca River to where the existing highway crosses the North Coast Railway Line west of Nambucca Heads.

FIGURE 7: SECTION 2



LEGEND

- Option 2a
- Option 2b
- Option 2c
- Very high quality habitat
- High quality habitat
- SEPP# 14 Wetland
- Residential area
- Rural residential area
- Industrial Area
- Investigation area
- Existing Pacific Highway
- North Coast Railway Line
- Local Roads
- State Forest

SEPP – State Environmental Planning Policy.

DESIGN ISSUES
TOTAL LENGTH
BRIDGES REQUIRED
MAXIMUM GRADIENT
MAXIMUM ELEVATION
SIGNPOSTED SPEED
CONNECTIONS TO TOWNS
CONNECTION TO OPTIONS IN SECTION 1
CONNECTION TO OPTIONS IN SECTION 3
PRELIMINARY COST ESTIMATED IN $ 2003
ABILITY TO STAGE CONSTRUCTION
PROPERTY IMPACTS
APPROXIMATE NUMBER OF AFFECTED PROPERTIES
COMMUNITY IMPACTS
POTENTIAL NOISE IMPACTS
FLOOD IMPACTS
BIOPHYSICAL IMPACTS
POTENTIAL IMPACT ON – FLORA AND FAUNA HABITAT
– THREATENED SPECIES
– STATE FOREST
– RIVERINE/AQUATIC VEGETATION
HERITAGE IMPACTS

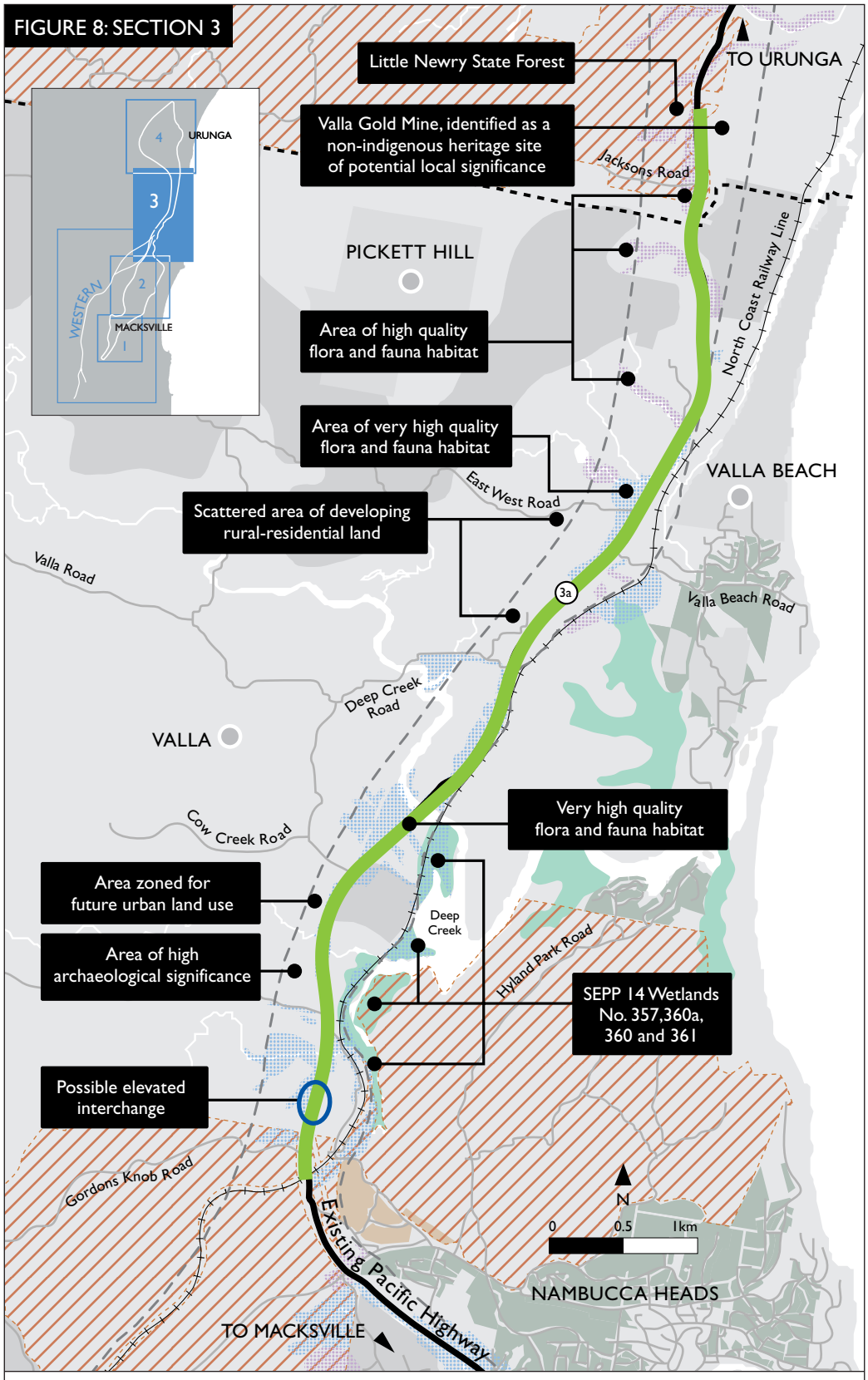
Section 2 provides a bypass of Bellwood. Three shortlisted options have been developed in this section. The northern part of the three options share a common route generally along Old Coast Road, from Newee Creek to the existing highway at the North Coast Railway Line. Figure 7 and the table below provide a comparison of the shortlisted options for Section 2.

OPTION 2a (BLUE)	OPTION 2b (GREEN)	OPTION 2c (PINK)
9.3 km.	9.7 km.	9.3 km.
All options would require bridges at local crossings (including Old Coast Road), major streams and the North Coast Railway Line.		
All options have a maximum gradient of 3%.		
38 m above sea level for all options.		
All options have been developed for an ultimate signposted speed limit of 110km/h. With staged construction, initial speed limit may be 100km/h.		
All options include a possible interchange with the existing highway north of Macksville (east of Newee Creek).		
Connects with Option 1d and, with modifications, Options 1a, 1b or 1c.	Connects with Options 1a, 1b, or 1c and, with modifications, Option 1d.	Connects with Option 1e.
All options continue north as option 3a.		
$87 million ($9.3 M/km).	$88 million ($9 M/km).	$83 million ($9 M/km).
Cost for all options includes a possible interchange with the existing highway north of the Nambucca River.		
The 9.3 to 9.7 km bypass of Bellwood could be constructed as a stand alone project.		
54 parcels of land.	45 parcels of land.	36 parcels of land.
All options have the potential to divide some rural properties and may require measures to provide connectivity between severed properties.		
127 residences potentially affected without noise mitigation.	104 residences potentially affected without noise mitigation.	124 residences potentially affected without noise mitigation.
None of the options would have major flooding impacts.		
• No impact on very high quality. • 4 ha of high quality. • 22 ha of medium quality.	• 2.5 ha of very high quality. • 4ha of high quality. • 19 ha of medium quality.	• 4.5 ha of very high quality. • 4.5 ha of high quality. • 21 ha of medium quality.
All options in Section 2 have a high potential to cross wildlife corridors.		
Low potential impact to threatened species habitat.	Moderate potential impact to threatened species habitat.	High potential impact to threatened species habitat. Impacts on small area of Lowland Subtropical Rainforest which is an endangered ecological community.
All options would impact on Nambucca State Forest.		
None of the options would have the potential for significant impacts on riverine or aquatic vegetation at river crossings.		
Impact on 7 areas of potential archaeological sensitivity.	Impact on 5 areas of potential archaeological sensitivity.	Impact on 2 areas of potential archaeological sensitivity.
Impact on 2 items of low potential significance for non-indigenous heritage.	Impact on 1 item of low potential significance for non-indigenous heritage.	

SECTION 3 OPTION

From the crossing the North Coast Railway west of Nambucca Heads to Little Newry State Forest in the vicinity of Mines Road south of Urunga.

FIGURE 8: SECTION 3



LEGEND

- Option 3a
- Very high quality habitat
- High quality habitat
- SEPP# 14 Wetland
- Residential area
- Rural residential area
- Industrial Area
- Investigation area
- Existing Pacific Highway
- North Coast Railway Line
- Local Government Area boundary
- Local Roads
- State Forest

SEPP – State Environmental Planning Policy.

- DESIGN ISSUES
- TOTAL LENGTH
- BRIDGES REQUIRED
- MAXIMUM GRADIENT
- MAXIMUM ELEVATION
- SIGNPOSTED SPEED
- CONNECTIONS TO TOWNS
- CONNECTIONS SECTION 2 AND WEST OF MACKSVILLE OPTIONS
- CONNECTIONS TO SECTION 4
- PRELIMINARY COST ESTIMATED IN $2003
- ABILITY TO STAGE CONSTRUCTION
- PROPERTY IMPACTS
- APPROXIMATE NUMBER OF AFFECTED PROPERTIES
- IMPACT ON RURAL PROPERTIES
- COMMUNITY IMPACTS
- POTENTIAL NOISE IMPACTS
- FLOOD IMPACTS
- BIOPHYSICAL IMPACTS
- POTENTIAL IMPACT ON
  – FLORA AND FAUNA HABITAT
- – THREATENED SPECIES
- – STATE FOREST
- – RIVERINE/AQUATIC VEGETATION
- HERITAGE IMPACTS

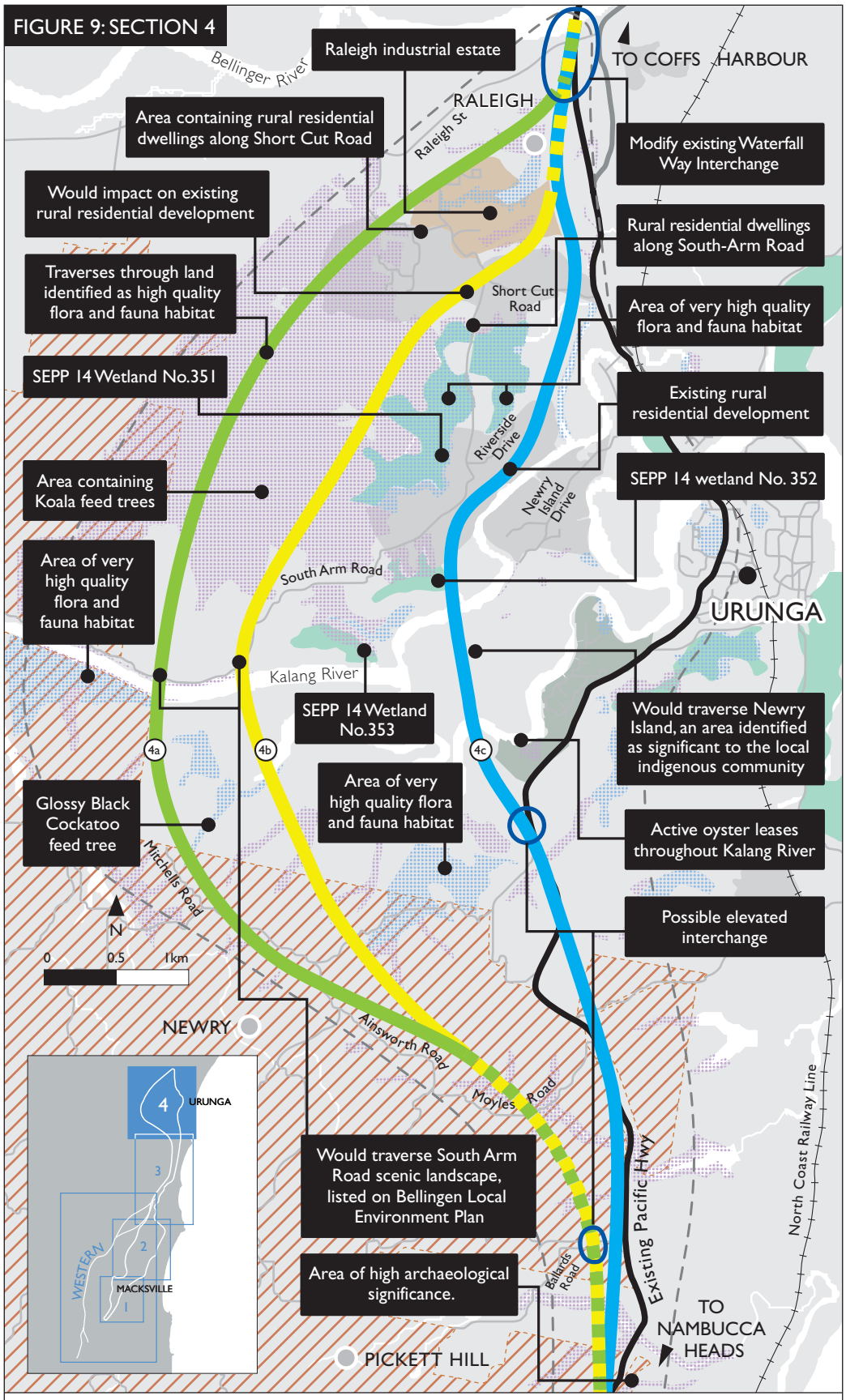
Section 3 is a narrow section of the investigation area and for much of its length the existing Pacific Highway is suitable for duplication. Only one option has been developed in this section. Details of the option for this section are shown in Figure 8 and the table below.

OPTION 3a (GREEN)
9.1km generally parallel to the existing highway.
Deep Creek and other streams.
5%.
26 m above sea level.
Ultimate travel speed of 110km/h. With staged construction, initial speed may be 100km/h.
Possible interchange with the existing highway west of Nambucca Heads.
Connects to the northern end of Section 2 and west of Macksville options.
Connects to the southern end of Section 4 options.
$113 million, including bridge over North Coast Railway Line ($12.5 M/km).
Could be constructed in small increments.
105 parcels of land (approx.).
Impact minimised as it closely follows the existing highway.
This option closely follows the existing highway alignment and makes provision for the use of the existing highway as a service road in the long term.
Would not directly impact on future Cow Creek urban land release area.
128 residences potentially affected without noise mitigation adjacent to the existing highway.
Potential impacts for stream crossings.
• 5 ha very high quality. • 1 ha of high quality. • 10 ha of medium quality.
Would have a moderate impact on potential threatened species habitat.
Impacts on Little Newry State Forest.
Potential impact on riverine and aquatic vegetation at stream crossings.
Located immediately adjacent to a site considered significant for indigenous heritage. Potential impact on six areas of potential archaeological sensitivity, of low to moderate significance.
In close proximity to Valla Gold Mine, which is of potential local non-indigenous heritage significance.

SECTION 4 OPTIONS

From Little Newry State Forest in the vicinity of Mines Road to the southern end of the Raleigh Deviation.

FIGURE 9: SECTION 4



LEGEND

- Option 4a
- Option 4b
- Option 4c
- Very high quality habitat
- High quality habitat
- SEPP# 14 Wetland
- Residential area
- Rural residential area
- Industrial Area
- Investigation area
- Existing Pacific Highway
- North Coast Railway Line
- Local Roads
- State Forest

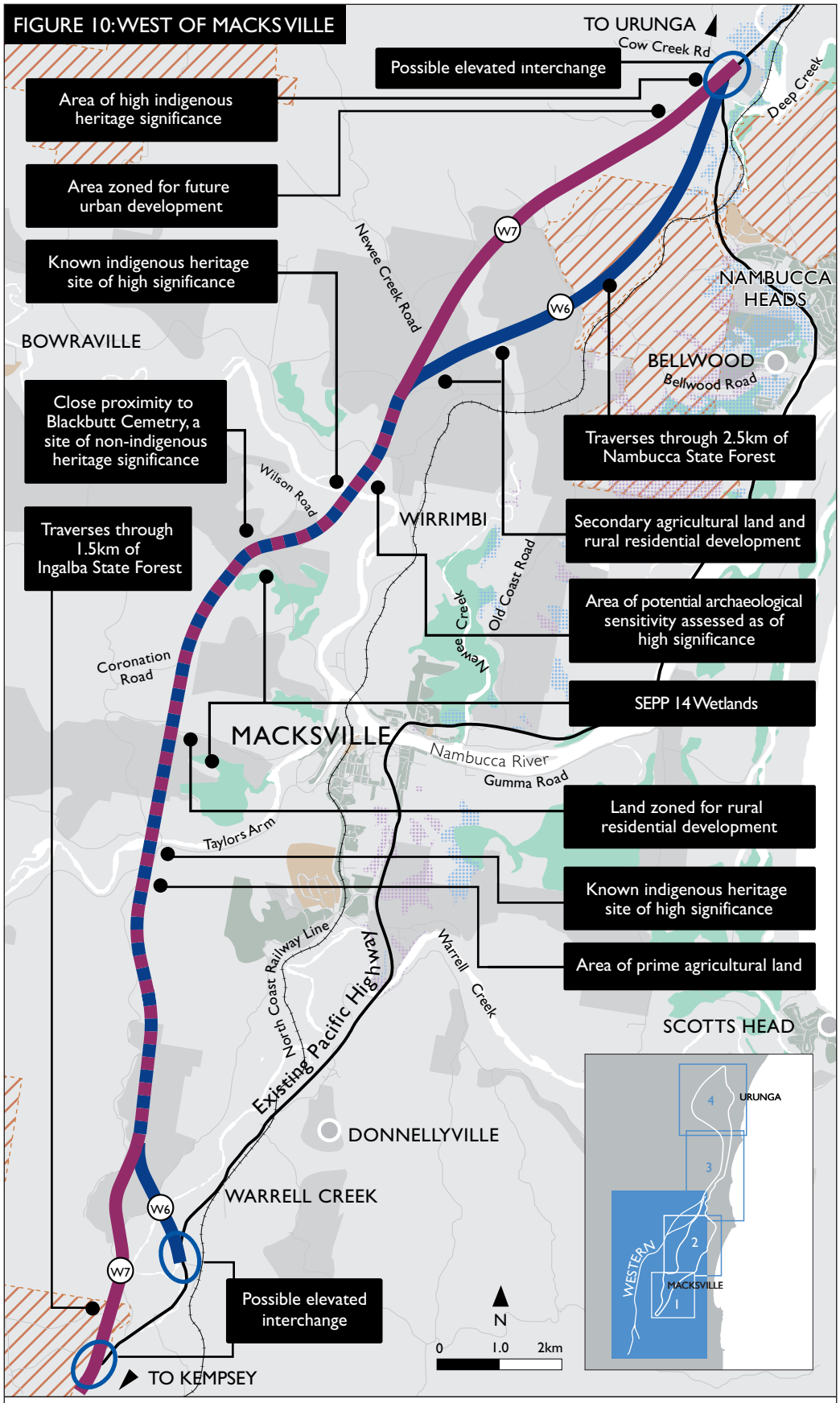
SEPP – State Environmental Planning Policy.

DESIGN ISSUES
TOTAL LENGTH
BRIDGES OVER KALANG RIVER
MAXIMUM GRADIENT
MAXIMUM ELEVATION
SIGNPOSTED SPEED
CONNECTIONS TO TOWNS
CONNECTIONS TO SECTION 3
PRELIMINARY COST ESTIMATED IN $2003
ABILITY TO STAGE CONSTRUCTION
PROPERTY IMPACTS
APPROXIMATE NUMBER OF AFFECTED PROPERTIES
IMPACT ON RURAL PROPERTIES
COMMUNITY IMPACTS
POTENTIAL NOISE IMPACTS
FLOOD IMPACTS
BIOPHYSICAL IMPACTS
POTENTIAL IMPACT ON – FLORA AND FAUNA HABITAT
– THREATENED SPECIES
– STATE FOREST
– RIVERINE/AQUATIC VEGETATION
HERITAGE IMPACTS

Section 4 provides a bypass of Urunga. Three shortlisted options have been developed in this section. Figure 9 and the table below provide a comparison of the shortlisted options for Section 4.

OPTION 4a (GREEN)	OPTION 4b (YELLOW)	OPTION 4c (BLUE)
13.5 km.	12.4 km.	11.3 km.
Single crossing approximately 170 metres in length.	Single crossing approximately 155 metres in length.	Bridges over both arms of the Kalang River approximately 355 metres in total length.
Would have a maximum gradient of 5%.	Would have a maximum gradient of 6%.	Would have a maximum gradient of 5%.
43 m above sea level.	36 m above sea level.	41 m above sea level.
All options have been developed for an ultimate signposted speed of 110km/h. With staged construction, initial speed limit may be 100km/h.		
All options include a possible interchange with the existing highway south of Urunga and a modification to the existing Raleigh Interchange.		
All options connect with the northern end of Section 3.		
$166 million ($12.3 M/km).	$156 million ($12.5 M/km).	$180 million ($15.9 M/km).
The 11.3 to 13.5km bypass of Urunga could be constructed as a stand alone project.		
47 parcels of land.	58 parcels of land.	62 parcels of land.
All options have the potential to divide some rural properties and may require measures to reconnect severed properties.		
86 residences potentially affected without noise mitigation.	85 residences potentially affected without noise mitigation.	284 residences potentially affected without noise mitigation.
Both options have potential to impact on the South Arm Road scenic landscape, which is of cultural heritage significance.		In close proximity to the South Arm Road scenic landscape.
For all options, the crossing of the Kalang River and floodplain would result in a maximum increase in flood level of less than 50 mm for the 1 in 100 year flood.		
• 1.5 ha very high quality. • 20 ha of high quality. • 28 ha of medium quality.	• 1 ha very high quality. • 12 ha of high quality. • 20 ha of medium quality.	• No impact on very high quality. • 4 ha of high quality. • 20 ha of medium quality.
Would have a high impact on potential threatened species habitat.	Would have a moderate impact on potential threatened species habitat.	Would have a low impact on potential threatened species habitat.
All options would impact on Little Newry State Forest and Newry State Forest.		
All options have the potential for impact on riverine and aquatic vegetation at the Kalang River and other waterway crossings.		
Impact on 2 areas of potential archaeological sensitivity (1 of high significance). Impact on 1 site of low significance.	Impact on 9 areas of potential archaeological sensitivity, of low to moderate significance. Impact on 1 site of low significance.	Impact on 4 areas of potential archaeological sensitivity, of low to moderate significance and Newry Island, an area of high archaeological significance. Impact on 1 site of low significance. Is in close proximity to another site of high cultural significance.
These options are in the vicinity of an area of significance for indigenous heritage on the eastern side of the existing highway.		In the vicinity of two areas of significance for indigenous heritage.

OPTIONS TO THE WEST OF MACKSVILLE (Alternatives to the options identified for Section 1 and 2) From the existing highway south of Warrell Creek to the existing highway west of Nambucca Heads.



The west of Macksville options provide a western bypass of both Warrell Creek and Macksville. Two shortlisted options have been developed for this section. Figure 10 and the table below provides a comparison of the shortlisted options for west of Macksville.

DESIGN ISSUES
TOTAL LENGTH
BRIDGES REQUIRED
MAXIMUM GRADIENT
MAXIMUM ELEVATION
SIGNPOSTED SPEED
CONNECTIONS TO TOWNS
CONNECTIONS TO SECTION 3
PRELIMINARY COST ESTIMATED IN $2003
ABILITY TO STAGE
PROPERTY IMPACTS
APPROXIMATE NUMBER OF DIRECTLY AFFECTED PROPERTIES
IMPACT ON RURAL PROPERTIES
COMMUNITY IMPACTS
BIOPHYSICAL IMPACTS
POTENTIAL IMPACT ON – WILDLIFE
– FLORA AND FAUNA HABITAT
– STATE FOREST
– RIVERINE/AQUATIC VEGETATION
HERITAGE IMPACTS

The investigation of options west of Macksville involved:

- Review of the option proposed by the Macksville community and further refinement to develop a route that was feasible in engineering terms and considered the project's objectives.
- Development of alternatives and variations to the concept proposed by the community.
- Preparation of strategic cost estimates and cost benefit analyses.
- Broad identification of property impacts.
- Review of available information to identify zoning, land use, ecological, transport and cultural heritage constraints associated with a route west of Macksville.

Two feasible options were identified from south of Warrell Creek to the northern end of Section 2 of the study area, west of Nambucca Heads. The western options are longer than the equivalent options to the east of Macksville.

The location of the options to the west of Macksville and the distance from the existing highway means they could not be constructed in stages.

The investigations to date have indicated that more detailed studies (eg noise, heritage, flora and fauna) would need to be carried out to enable these options to be considered further. The options west of Macksville, which are outside the study area announced in June 2003, were investigated in response to requests from sections of the Macksville community. Comment from the broader community on the merits of these options will help determine the way forward with these additional options.

OPTION W6 (DARK BLUE)	OPTION W7 (DARK MAROON)
22.6km.	25km.
Warrell Creek, Taylors Arm and Nambucca River – total of 5 bridges.	Taylors Arm and Nambucca River – total of 3 bridges.
Both options have maximum gradients of less than 4%.	
41 m above sea level.	37 m above sea level.
Signposted speed limit of 110km/h.	
Possible interchanges with the existing highway south of Warrell Creek and west of Nambucca Heads.	
Connects to the southern end of Section 3.	
$286 million ($12.7 M/km).	$296 million($11.8 M/km).
The full length of either option would need to be constructed.	
111 parcels of land (approx.).	129 parcels of land (approx.).
Both options would divide some rural properties.	
Would remove through traffic from the Macksville town centre. Options would be located away from built up areas.	
Both options cross wildlife corridors.	
Approximately 42 hectares of vegetation to be cleared.	Approximately 50 hectares of vegetation to be cleared.
Impacts on Nambucca State Forest.	Impacts on Ingalba State Forest.
Both options have the potential to impact on riverine and aquatic vegetation at river crossings.	
Potential impact on 3 sites of high archaeological significance. Impact on 17 areas of potential archaeological sensitivity, one of which is of high significance.	
Both options would pass close to Blackbutt Cemetery, a site of high non-indigenous heritage significance.	

Have your say

The shortlisted options are on display from Tuesday 30 November 2004 to Wednesday 2 February 2005 at the locations shown below.

The displays provide maps showing greater detail of the key constraints that guided development of the options.

Display locations

- Nambucca Shire Council, Princess Street, Macksville (Mon-Fri 9am -4pm)
- Bellingen Shire Council, Hyde Street, Bellingen (Mon-Fri 8.30am -4.30pm)
- Nambucca Heads, RTA Motor Registry, Shops 11&13 Seascape Shopping Centre, Ridge Street (Mon-Fri 9am -4pm)
- Nambucca Heads, Nambucca Plaza, Pacific Highway (Mon-Wed 8am-7pm, Thur-Fri 8am -7.30pm, Sat-Sun 8am -6pm)
- Urunga Post Office, Bonville Street (Mon-Fri 9am-5pm)
- Bowraville Technology Centre, 39 High Street (Mon-Fri 9am-5pm)
- Warrell Creek, Fire Brigade, Cnr Sonny's Rd and Albert Drive (Mon-Sun 9am-5pm)
- RTA Pacific Highway Office, Prince Street, Grafton (Mon-Fri 8.30am-4.30pm)

Staffed displays

Project staff will be available to discuss the route options in more detail at:

- Urunga Post Office, Bonville Street, Urunga
  Tuesday 7 December 2004, 9am-5pm
- Macksville Senior Citizens' Hall, Princess Street, Macksville
  Wednesday 8 December 2004, 9am-5pm
- Nambucca Plaza, Pacific Highway, Bellwood
  Thursday 9 December 2004, 11am -7.30pm

How to comment

Comments and submissions are welcome and should be sent by Wednesday 2 February 2005 to the postal address on this page. Please refer to sections 1,2,3,4 or the options West of Macksville in your submission.

Detailed reports available

The following detailed reports have been prepared:

- Macksville to Urunga, Draft Route Options Development Report.
- Macksville to Urunga, Draft Assessment of West of Macksville Route Options.

The reports outline how the options were identified, the major planning constraints and the potential impacts of each option. The reports are available on the project website or by phoning the project information line (see details below). Copies of the reports can be viewed at the display locations.

For further enquiries:

www.rta.nsw.gov.au/pacific
(click on 'Macksville to Urunga Upgrade')

1800 800 612 (freecall)

FOR SUBMISSIONS OR
FURTHER INFORMATION WRITE TO:
Pacific Highway Upgrade – Macksville to Urunga
C/- Ross Jones
Sinclair Knight Merz
PO Box 164
St Leonards NSW 1590
Facsimile: 02 9928 2502
Email: macks2urunga@skm.com.au

RTA PROJECT MANAGER:
Chris Clark
Phone: 02 6640 1043
Facsimile: 02 6640 1001
Email: chris_clark@rta.nsw.gov.au

All information in representations received, including the name and address of the respondent, may be published in subsequent assessment documents unless clear indication is given in the representation that all or any part of that information is not to be published.

The Pacific Highway Upgrading Program

The Pacific Highway Upgrading Program is the single largest construction program in NSW for the last 40 years.

Already twenty-three major projects and 19 smaller projects have been opened to traffic. Three major construction projects are underway – including Bundacree Creek to Possum Brush, Coopernook Bypass and Taree to Coopernook Upgrade. Further projects are at various stages of planning and development, including the Bulahdelah, Kempsey to Eungai and Moorland to Herons Creek upgrades.

The program has brought major improvements to road conditions and travel times. From 1997 to 2002, travel times between Hexham and the Queensland border have been reduced by about 55 minutes for passenger vehicles and just over an hour for heavy vehicles. Notorious black spots have been removed with the completion of the Bulahdelah to Coolongolook and Yelgun to Chinderah Freeways, Raleigh Deviation and Ewingsdale Interchange.

As well as boosting tourism and transport efficiency, providing safer and more consistent overtaking opportunities has saved lives and reduced the incidence of serious injury accidents.

Macksville to Urunga

Upgrading the Pacific Highway

PREFERRED ROUTE
NOVEMBER 2005









Completing the upgrade of the Pacific Highway

Identification of a preferred route to upgrade the Pacific Highway between Macksville and Urunga is a key step towards upgrading the highway.

With the $2.2 billion Pacific Highway Upgrade Program in place since 1996, almost 230 kilometres of the highway are now double-lane divided road. A further 225 kilometres of new highway are under construction, or have been approved for construction or had a preferred upgrade route identified.

The Macksville to Urunga Upgrade is one of five projects proceeding to either preferred route or concept design in November 2005. An additional group of five projects also proceeded to the route selection phase in October 2005. These ten projects will provide preferred routes or upgraded alignments for the final 270 kilometres of the highway. This will provide planning certainty for local communities and pave the way for a construction program to complete the upgrade of the Pacific Highway.

The Pacific Highway is a road of national importance. Its upgrading is funded by State and Federal governments.

For the 10 years to June 2006 the NSW Government will have contributed $1.66 billion and the Federal Government will have contributed $660 million.

This community update

This community update describes the preferred route for the upgrade and the key reasons why the preferred route was chosen. The preferred route is on display for comment until **Tuesday 31 January 2006.**

The preferred route

The preferred route involves options 1c and 2a to the east of Macksville, an upgrade of the existing highway between Nambucca Heads and Mines Road south of Urunga and the option 4b bypass of Urunga.

Warrell Creek upgrade

The preferred route for the upgrade would also require the construction of the Warrell Creek upgrade. This was designed in the late 1990's to an earlier standard than that proposed for the Macksville to Urunga upgrade. The preferred route and design for the Warrell Creek upgrade will be reviewed to ensure that it provides an appropriate connection between the existing Allgomera Deviation and the Macksville to Urunga upgrade, as well as meeting current design and environmental standards.

PREFERRED ROUTE

How was the preferred route chosen?

Possible constraints to building a highway were mapped. From this, route options were identified and the most feasible options were placed on public display from November 2004 to February 2005.

Field investigations, public submissions, comments received from other government agencies and the outcomes of a value management workshop held in April 2005 were considered during the selection of the preferred route.

Why was the preferred route chosen?

The preferred route provides the best overall balance between functional, ecological, social and economic considerations.

When compared to options to the west of Macksville, options located in the original study area to the east of Macksville were found to:

- Provide better road safety, transport efficiency, highway access and ability to stage construction.
- Have less impact on urban businesses, future growth, native flora and fauna and cultural heritage.

Of the options located to the east of Macksville options 1c and 2a were selected as they:

- Provide good road safety and transport efficiency.
- Have the lowest impact (including potential noise impact) on existing and future residential areas, communities and rural activities.
- Have moderate flooding, ecological and Aboriginal heritage impacts.

In the north of the study area, option 4b was selected as it would:

- Provide the best outcome both overall and in the vicinity of the Raleigh Industrial Area.
- Provide good road safety and transport efficiency.
- Have the least impact on future growth and rural activities.
- Have moderate impacts on residential areas, communities, businesses and cultural heritage.

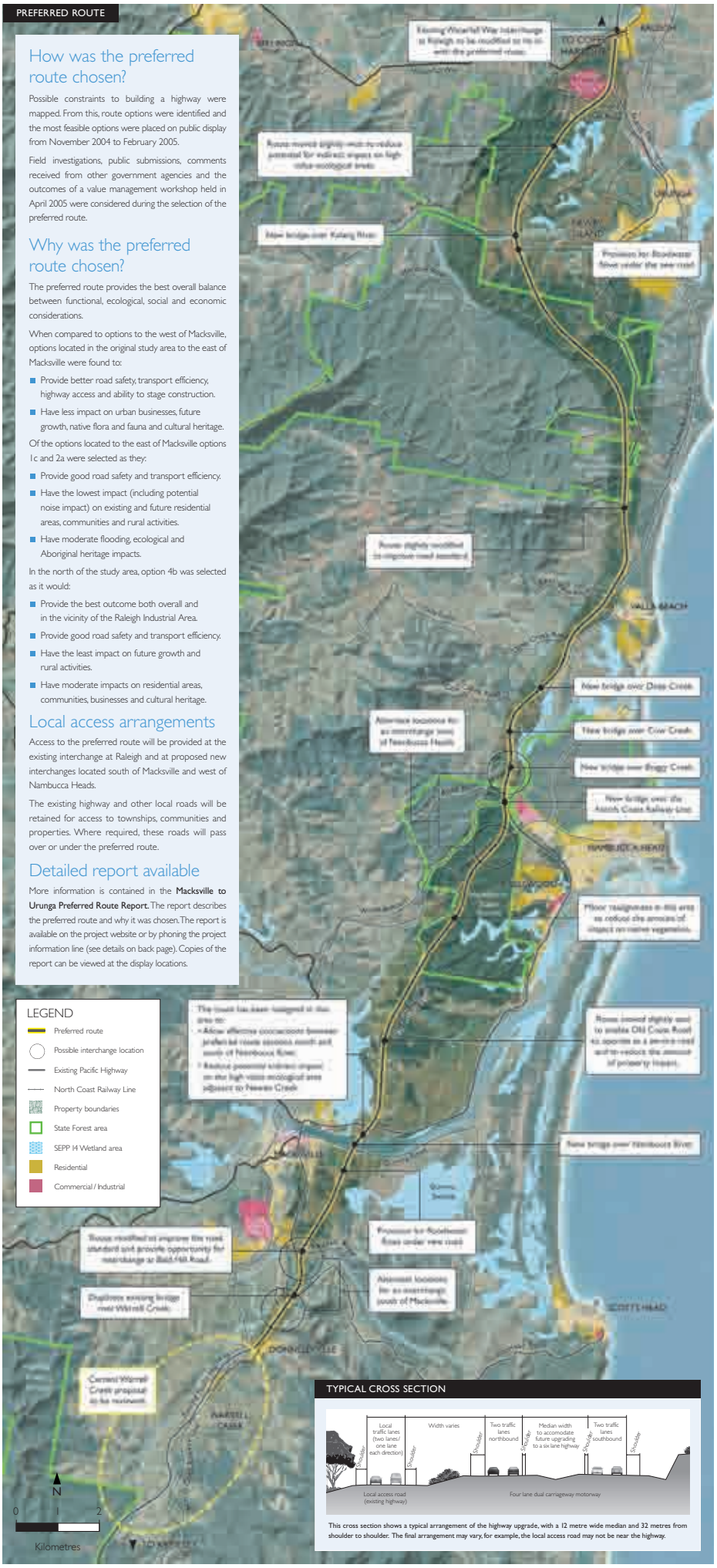
Local access arrangements

Access to the preferred route will be provided at the existing interchange at Raleigh and at proposed new interchanges located south of Macksville and west of Nambucca Heads.

The existing highway and other local roads will be retained for access to townships, communities and properties. Where required, these roads will pass over or under the preferred route.

Detailed report available

More information is contained in the **Macksville to Urunga Preferred Route Report.** The report describes the preferred route and why it was chosen. The report is available on the project website or by phoning the project information line (see details on back page). Copies of the report can be viewed at the display locations.



TYPICAL CROSS SECTION

This cross section shows a typical arrangement of the highway upgrade, with a 12 metre wide median and 32 metres from shoulder to shoulder. The final arrangement may vary, for example, the local access road may not be near the highway.

Stay involved

The RTA will continue to consult with landowners and the community about the preferred route. There are many aspects of the design that will need local community input, including access arrangements, reducing impact on the immediate environment, drainage infrastructure, noise management and others.

Your submission on the preferred route should be sent to the address shown in the contact information box. All community issues for the preferred route will be considered during the assessment studies.

Display locations

The preferred route is on display until **Tuesday 31 January 2006** at the locations shown below. These displays include maps that show more detail about the issues in this area, and how they relate to the preferred route.

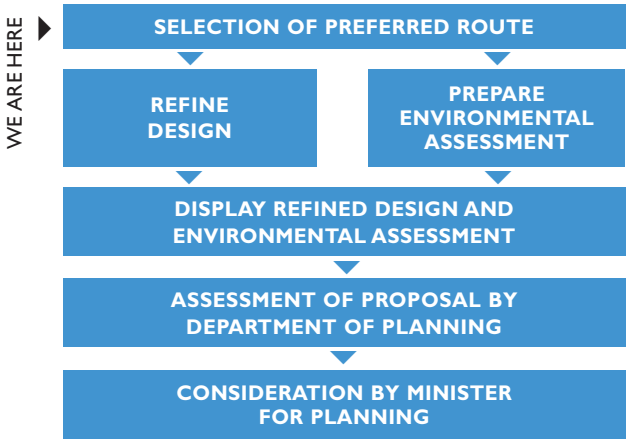
- Nambucca Shire Council, Princess Street, Macksville (Mon-Fri 9am-4pm)
- Bellingen Shire Council, Hyde Street, Bellingen (Mon-Fri 8.30am-4.30pm)
- Nambucca Heads, RTA Motor Registry, Shops 11 & 13 Seascape Shopping Centre, Ridge Street (Mon-Fri 9am-4pm)
- Nambucca Heads, Nambucca Plaza, Pacific Highway (Mon-Wed 8am-7pm, Thur-Fri 8am-7.30pm, Sat-Sun 8am-6pm)
- Urunga Post Office, Bonville Street Urunga (Mon-Fri 9am-5pm)
- Bowraville Technology Centre, 39 High Street Bowraville (Mon-Fri 9am-5pm)
- Warrell Creek, Fire Brigade, Cnr Sonny's Road and Albert Drive (Mon-Sun 9am-5pm)
- RTA Pacific Highway Office, Prince Street Grafton (Mon-Fri 8.30am-4.30pm)

Staffed displays

Project staff will be available to discuss the preferred route in more detail at:

- Urunga Senior Citizens' Hall, Urunga Tuesday 6 December 2005, 9am-5pm
- Nambucca Shire Council, Princess Street Macksville, Wednesday 7 December 2005, 9am-5pm
- Shop 2A Nambucca Plaza, Pacific Highway, Bellwood Thursday 8 December 2005, 10am-7pm

What happens next



Further survey, geotechnical and ecological investigations will commence shortly and the design for the preferred route will be refined.

Approval of the proposal will be requested under the recently introduced Part 3A of the *EP&A Act*. The proposal will be the subject of an environmental assessment which will examine the potential impacts of the preferred route. The refined design and assessment will be displayed for community comment prior to assessment of the proposal by the Department of Planning and consideration by the Minister for Planning.

To contact the study team, write to:
Ross Jones, Sinclair Knight Merz
PO Box 164, St LEONARDS NSW 1590

macks2urunga@skm.com.au

1800 800 612 (toll free)
Project Information Line

To contact the RTA's Project Manager write to:
Chris Clark, RTA
PO Box 546, GRAFTON NSW 2460

www.rta.nsw.gov.au/pacific
(Click on Macksville to Urunga project)

T 02 6640 1000 **F** 02 6640 1001

RTA/Pub. 05.274

A New South Wales Government Initiative

Warrell Creek to Urunga upgrade

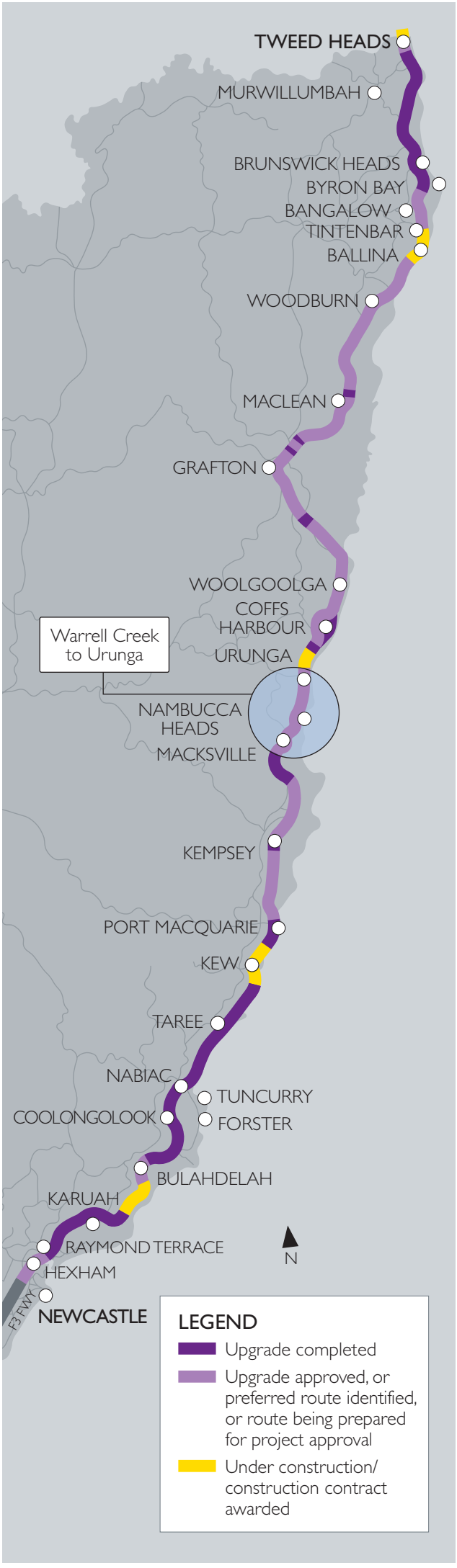
(Incorporating Warrell Creek and Macksville to Urunga upgrading projects)
Upgrading the Pacific Highway

COMMUNITY UPDATE
SEPTEMBER 2007







In June 2003, the NSW Roads and Traffic Authority (RTA) began planning a dual carriageway upgrade of the Pacific Highway from Macksville to Urunga. In November 2005, the NSW Minister for Roads announced the preferred route for the upgrade and a review of the previously approved preferred route for the adjacent Warrell Creek upgrade.

This community update provides information on the current status of the upgrade of the highway between Warrell Creek and Urunga.

Completing the upgrade of the Pacific Highway

Upgrading the Pacific Highway between Warrell Creek and Urunga is a key step in progressing the completion of the upgrade of the highway.

As of August 2007, a total of 263 kilometres are four lane divided road. A further 78 kilometres are under construction or have had a construction contract awarded, with the remaining either approved for construction or with a preferred route identified.

The Pacific Highway is part of the Auslink National Network. The NSW and Australian governments have committed $1.3 billion for the next three years to upgrade the highway. This is in addition to the $2.31 billion committed since 1996 to upgrade the Pacific Highway, of which the NSW Government contributed $1.66 billion.

Warrell Creek to Urunga upgrade

The combined Warrell Creek and Macksville to Urunga projects would involve an upgrade of the existing highway to four lane divided road (dual carriageway) between the northern end of the existing dual carriageway Allgomera deviation, south of Warrell Creek, and the Waterfall Way at Raleigh, north of Urunga. The upgrade would improve road safety and relieve traffic congestion.

Preferred route submissions

The submissions received following the announcement of the preferred route, for the Macksville to Urunga section of the highway, have been considered by the RTA. Key issues raised in the submissions include property, access, noise, flooding, Aboriginal heritage and social impacts.

The submissions included proposals for alternative routes to the east of Macksville. These proposals were assessed against the preferred route. The assessment found that although the alternative route options had lower property and residential (including noise) impacts than the preferred route, they also:

- Provided poorer road safety and transport efficiency.
- Had greater impacts on rural activities and flora and fauna.
- Had greater constructability issues and potential flooding impacts due to the longer crossings of the Nambucca River floodplain downstream of Macksville.
- Cost more and provide less value for money.

The assessment concluded that the preferred route announced in November 2005 provides the best overall balance between functional, economic, ecological and social considerations.

More information is contained in the **Macksville to Urunga Preferred Route Submissions Report.** The report is available on the project website or by phoning the project information line. Copies of the report can be viewed at a number of display locations. (See back page for details.)

Access arrangements (Macksville to Urunga section)

Access to the preferred route for the Macksville to Urunga section of the upgrade will be provided at the existing interchange at Raleigh and at proposed new interchanges located south of Macksville and west of Nambucca Heads.

Preferred locations and layouts of the new interchanges were identified at a workshop attended by the project team and representatives of Bellingen and Nambucca shire councils and after consideration of the submissions received following the announcement of the preferred route. They are described below and shown on the map on the following page.

Interchange south of Macksville

The preferred location for the south Macksville interchange is at Bald Hill Road. This option was seen to perform better than the option located in the vicinity of the Scotts Head Road and Pacific Highway junction as it:

- Is closer to Macksville.
- Provides improved access to Scotts Head, Warrell Creek and Donnellyville from both the highway and Macksville.
- Has less impacts on adjacent properties.

Interchange west of Nambucca Heads

The preferred location for the Nambucca interchange is near Boggy Creek. This option was seen to perform better than the option located south of the North Coast Railway Line on Old Coast Road as it provides improved access to:

- Nambucca Heads, Valla/Valla Beach and adjacent areas and South Urunga.
- The Boggy Creek future urban area west of Nambucca Heads.

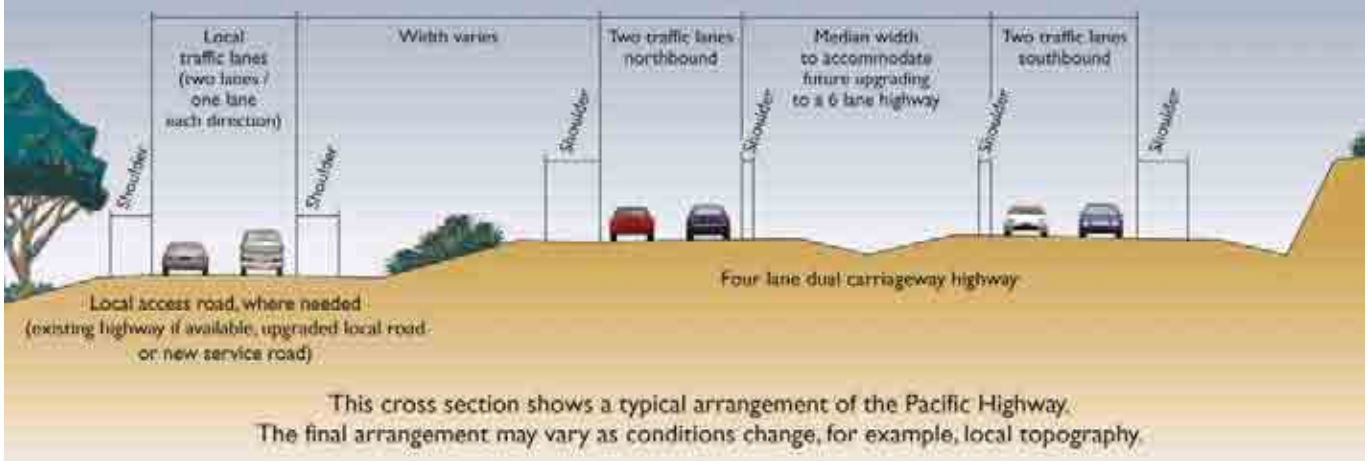
Raleigh interchange

The existing Waterfall Way interchange at Raleigh will be modified to tie in with the preferred route.

Local access arrangements

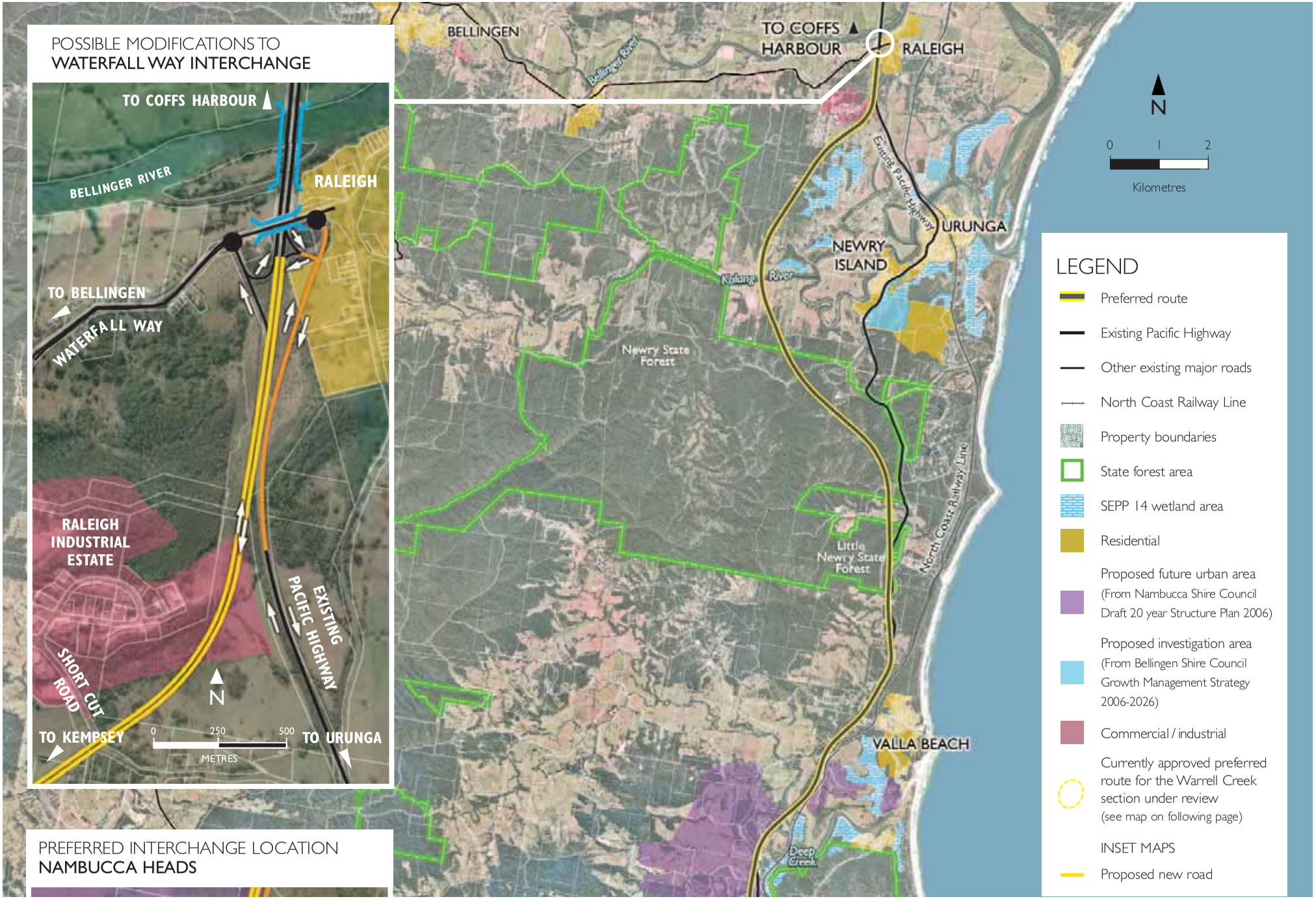
The existing highway and other local roads will be retained for access to townships, communities and properties. Where required, these roads will pass over or under the preferred route.

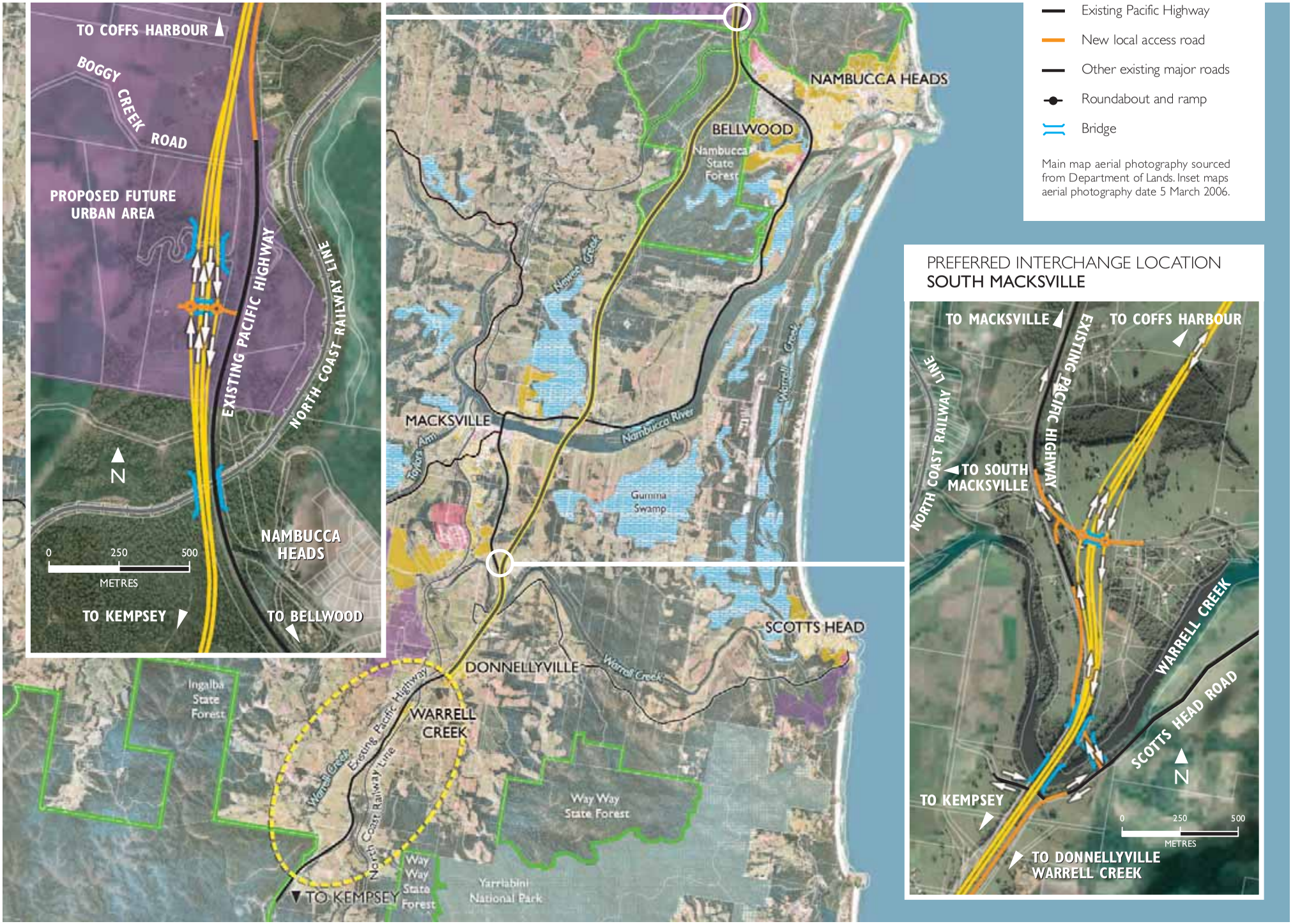
TYPICAL CROSS SECTION



This cross section shows a typical arrangement of the Pacific Highway. The final arrangement may vary as conditions change, for example, local topography.

MACKSVILLE TO URUNGA PREFERRED ROUTE




TO COFFS HARBOUR
BOGGY CREEK ROAD
PROPOSED FUTURE URBAN AREA
EXISTING PACIFIC HIGHWAY
NORTH COAST RAILWAY LINE
N
0
250
500
METRES
NAMBUCCA HEADS
TO KEMPSEY
TO BELLWOOD
NAMBUCCA HEADS
BELLWOOD
Nambucca State Forest
Nambucca River
MACKSVILLE
Taylors Arm
Gumma Swamp
Warrell Creek
SCOTTS HEAD
DONNELLYVILLE
WARRELL CREEK
Ingalba State Forest
Existing Pacific Highway
North Coast Railway Line
Way Way State Forest
Yarriabini National Park
TO KEMPSEY
Existing Pacific Highway
New local access road
Other existing major roads
Roundabout and ramp
Bridge
Main map aerial photography sourced from Department of Lands. Inset maps aerial photography date 5 March 2006.
PREFERRED INTERCHANGE LOCATION
SOUTH MACKSVILLE
TO MACKSVILLE
TO COFFS HARBOUR
NORTH COAST RAILWAY LINE
EXISTING PACIFIC HIGHWAY
TO SOUTH MACKSVILLE
WARRELL CREEK
SCOTTS HEAD ROAD
N
TO KEMPSEY
0
250
500
METRES
TO DONNELLYVILLE
WARRELL CREEK

Warrell Creek upgrade review

Outcomes of review

Planning approval for the preferred route for the Warrell Creek upgrade was granted in the 1990s to an earlier standard than that proposed for current upgrades of the Pacific Highway.

A review of the upgrade found that the currently approved preferred route and design would need to be modified to meet current design standards for the Pacific Highway and provide an appropriate connection between the existing Allgomera deviation and the Macksville to Urunga upgrade. The review also found that the design would have significant noise impacts on the village of Warrell Creek and would need to be substantially modified to meet current noise guidelines.

In response to the outcomes of the review, a number of options for the Warrell Creek upgrade have been developed.

How were the options developed?

The new route options were assessed against a range of functional, environmental, social, economic and cost considerations. Comments received from government agencies, Nambucca Shire Council and the community were considered during the identification of the options.

The assessment identified a shortlist of the four most feasible routes. The currently approved preferred route and the four new shortlisted route options are shown in the figure on the following page.

Key findings

The key findings of the assessment of the shortlisted options (shown overleaf) were that:

- As the study area is primarily used for residential and farming purposes, the extent of very high and high quality ecological habitat is limited. Most of the native flora and fauna is located on the eastern side of Warrell Creek in the south of the study area.
- While the western (Red and Blue) options would have less impact on farming properties than the eastern (Orange and Purple) options, they would provide little change to existing noise levels at Warrell Creek village; would require new arrangements to provide access to properties east of the upgrade and would have more construction difficulties than the eastern options.
- Of the two eastern options, the Purple option was assessed as performing better than the Orange option as it would result in the least change to existing access arrangements and have fewer construction difficulties and slightly lower noise impacts than the Orange option.
- With preliminary costs of $88 million to $91 million ($2006), the eastern options are less expensive than the western options at $102 million to $122 million ($2006).

The Purple option was assessed to be one of the best performing options overall and provided the best value for money. On balance, it was considered to have more merit than the other options.

Local access arrangements

For all the route options, local access would be provided by an at-grade T-intersection at the southern end of the project and by a local road connection from Donnellyville to the proposed interchange south of Macksville. Access across the highway upgrade would be provided by a western extension of Albert Drive, north of the railway line.

Stay involved

The RTA is seeking your comments on the new route options before making a decision on the outcomes of the review of the Warrell Creek upgrade.

Written submissions are welcome and should be sent by close of business on **Friday 5 October 2007**. You can use the enclosed feedback form or send a response to the address shown in the contact information box (back page). All community submissions will be considered before a decision on the outcomes of the review of the Warrell Creek upgrade is made.

The outcomes of the review will be included in the environmental assessment of the upgrade of the highway between Warrell Creek and Urunga.

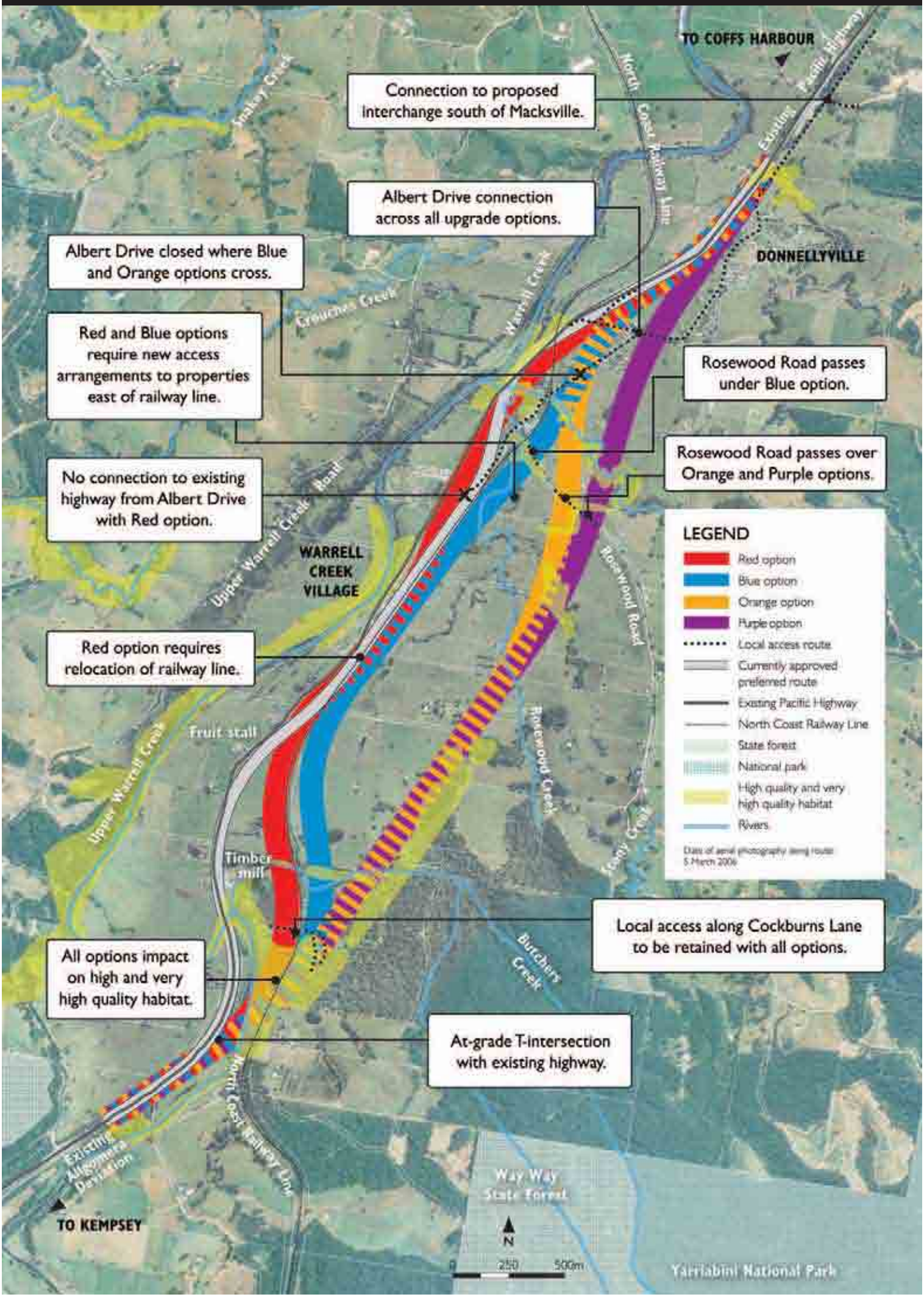
Detailed report available

More information is contained in the **Draft Warrell Creek Review Report.** The report describes the review of the currently approved preferred route and the development and assessment of new route options. The report is available on the project website or by phoning the project information line (see back page for details). Copies of the report can be viewed at the display locations.

Staffed display

Project staff will be available to discuss the **Warrell Creek upgrade review** at the Warrell Creek Community Hall, Tuesday 11 September 2007, 2pm-8pm.

WARRELL CREEK UPGRADE OPTIONS



Environmental assessment process

Project application

The RTA has lodged an application for project approval under Part 3A of the *EP&A Act, 1979* with the Director-General of the Department of Planning for the upgrade of the highway between Warrell Creek and Urunga. The application, which includes a preliminary environmental assessment, has been advertised and posted on the Department of Planning and RTA websites.

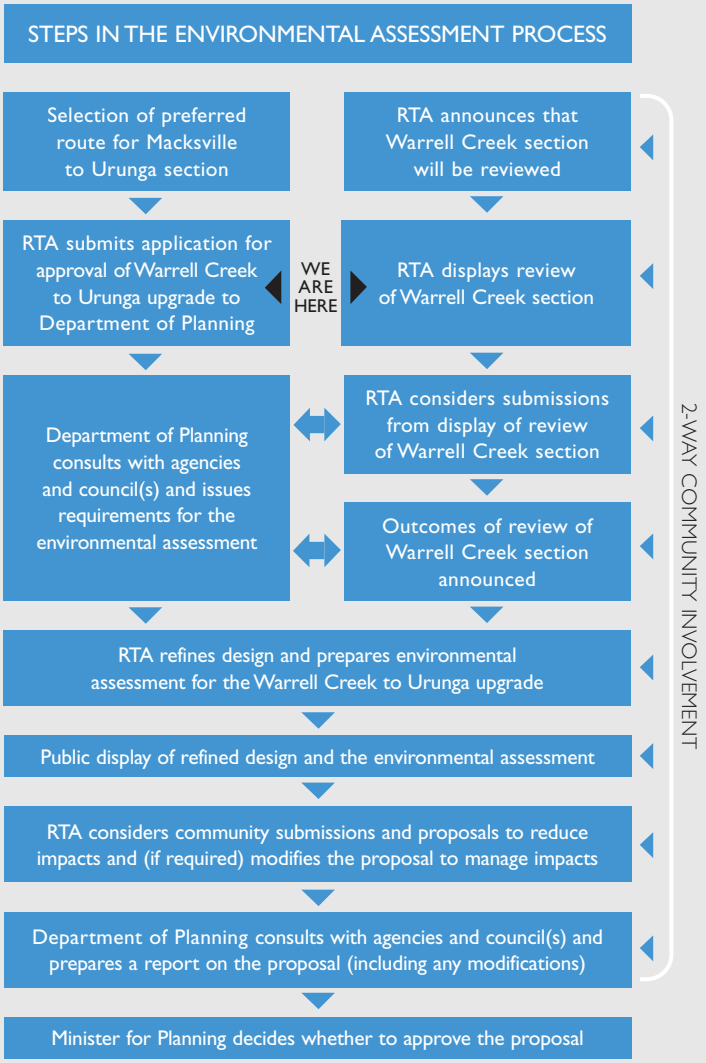
The Department of Planning will consult various agencies before providing the RTA with a list of requirements for the assessment of the proposal.

Environmental assessment

When completed, the environmental assessment and refined design will be placed on display for public comment for at least 30 days. The assessment will contain a draft Statement of Commitments indicating the measures proposed by the RTA to minimise the potential impact of the proposal on the environment.

At the end of the display, the RTA will be asked to respond to the issues raised in community submissions. The RTA may modify the proposal further to manage impacts on the environment.

The Department of Planning provides an assessment report for consideration by the Minister for Planning. The Minister then decides whether to approve the proposal.



Display locations

The documents discussed in this community update are on display until **Friday 5 October 2007** at the locations shown below. These displays include maps that show more detail about the proposed upgrade.

- Nambucca Shire Council,
  Princess Street, Macksville
  (Mon-Fri 9am-4pm).
- RTA Pacific Highway Office,
  Prince Street, Grafton
  (Mon-Fri 8.30am-4.30pm).
- Bellingen Shire Council,
  Hyde Street, Bellingen
  (Mon-Fri 8.30am-4.30pm).
- Urunga Post Office,
  Bonville Street, Urunga
  (Mon-Fri 9am-5pm).
- Nambucca Heads, RTA Motor Registry,
  Shops 11 &13 Seascape Shopping Centre,
  Ridge Street (Mon-Fri 9am-4pm).

To contact the study team, write to:
Ross Jones, Sinclair Knight Merz
PO Box 164, ST LEONARDS NSW 1590

macks2urunga@skm.com.au

1800 800 612 (toll free)
Project information line

To contact the RTA's Project Manager write to: Chris Clark, RTA
PO Box 546, GRAFTON NSW 2460

www.rta.nsw.gov.au/pacific
(click on Warrell Creek to Urunga)

T 02 6640 1000 F 02 6640 1001

RTA/Pub. 07.256

Australian Government

New South Wales Government

RTA

Warrell Creek to Urunga upgrade

(Incorporating Warrell Creek and Macksville to Urunga projects)
Upgrading the Pacific Highway

QUESTION AND ANSWER SHEET
JUNE 2008

The preferred route

The preferred route for the Warrell Creek section is the Purple option. In response to community issues raised, the design was further refined at the northern end to reduce potential noise and visual impacts on residences. The preferred route is shown in the diagram below.

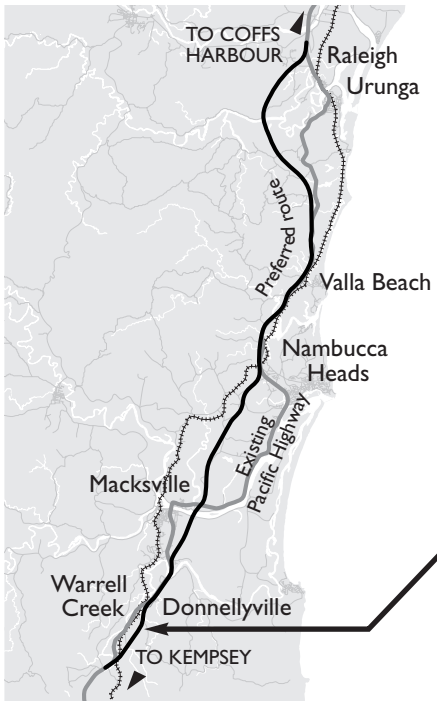
The RTA has a program to upgrade the whole Pacific Highway. It is important for drivers to have a consistent standard on the Pacific Highway. The previously approved route was designed to an earlier standard than that proposed for the current upgrade of the Pacific Highway.

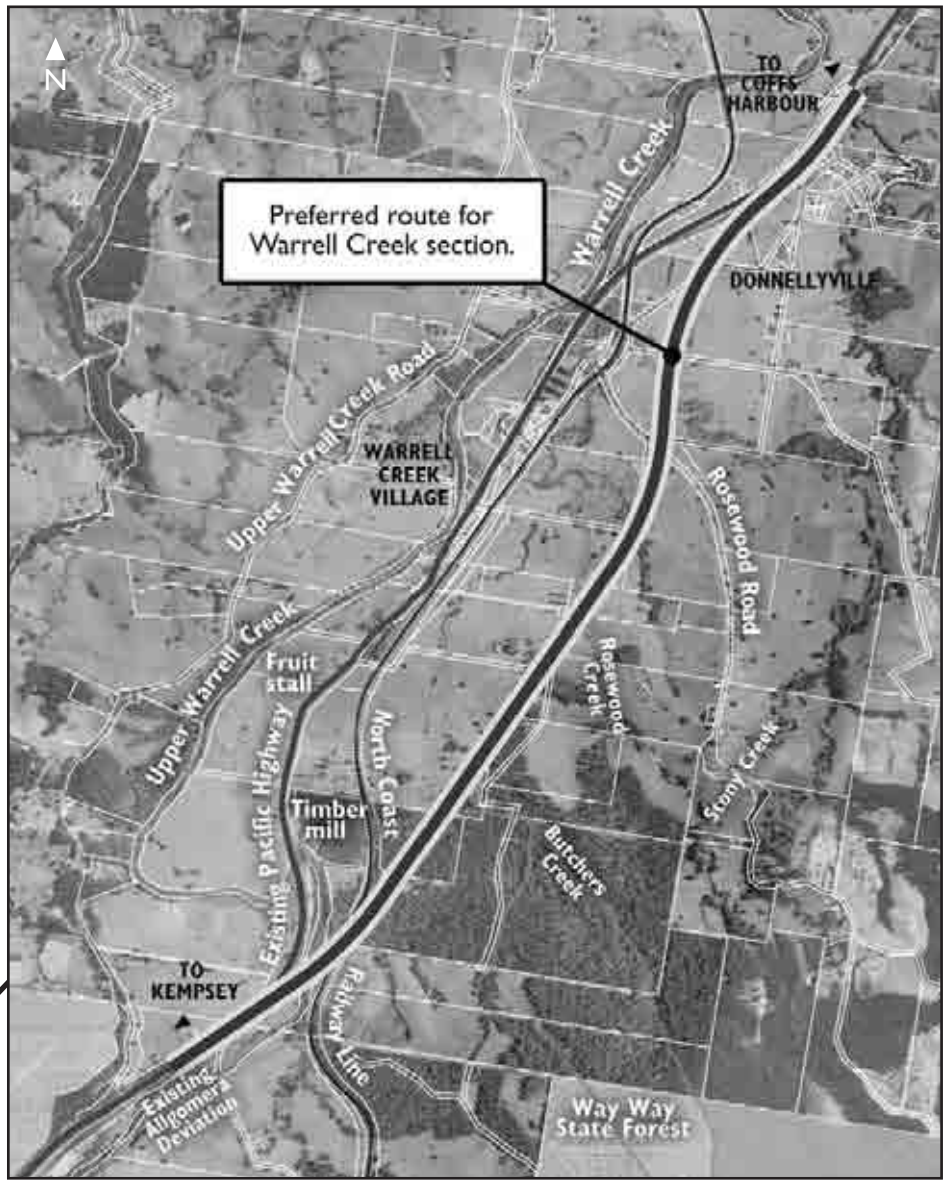
Detailed report available

More information is contained in the *Warrell Creek Review Report.* The report describes the review of the Warrell Creek section, the development of route options and the selection of the preferred route. The report identifies and responds to the issues raised in community submissions.

The report is available on the project website or by phoning the project information line (see back page for details).

Locality sketch





Aerial photography sourced from Department of Lands September 2000. Area surrounding preferred route November 2007.

Some questions and answers

1. Why was the 1998 previously approved route not continued with?

The previously approved route for the Warrell Creek upgrade mostly comprised an upgrade of the existing highway.

The previously approved route was designed to an earlier standard than that proposed for the current upgrade of the Pacific Highway. The previously approved route had:

- Horizontal geometry for 100km/h.
- Tighter curves (that had a 600 metre radius).
- A median width of nine metres.
- Direct property access to the upgraded highway.
- No provision for ultimate grade separation and provision of local access via service roads.

The current design guidelines for the upgraded sections of the Pacific Highway include:

- Horizontal geometry for 110 km/h.
- Improved curves of 750 metres (1200 metres desirable).
- A median width of 12 metres.
- Provision for ultimate grade separation and provision of local access via service roads.
- Split-level intersections and controlled access points.

2. What noise mitigation measures would have been necessary with the previously approved route?

A barrier of some form, over 11 metres high would have been needed to protect the residents in the Warrell Creek village. This would visually sever one side of the village from the other.

3. Why is a new preferred route important to the NSW Roads and Traffic Authority?

The RTA has a program to upgrade the whole Pacific Highway. It is important for drivers to have:

- An alignment that is consistent with adjoining highway sections.
- Improved safety by separating lower speed local traffic and high speed through traffic.
- A reduced number of at-grade intersections along the upgraded highway.

4. What issues were raised in the 2007 display of route options?

Four route options for the Warrell Creek section were displayed for community comment from 4 September to 30 November 2007. On balance, the Purple option was considered to have more merit than the other options.

A staffed display, public meetings at the Warrell Creek Community Hall and meetings with potentially directly affected landowners and residents living adjacent to the route options were held.

The key issues raised during the display and through 39 submissions received included:

- Concerns with the overall review/consultation process – including issues with the currency and accuracy of the data used for the assessment of the route options.
- Concern about access to properties and along local roads.
- Social effects of severance of communities and perceptions of inequity between residents in different parts of the study area.
- Noise and visual impacts.
- Property impacts, both direct and indirect.
- Concern regarding emissions from heavy vehicles contaminating tank water quality.

5. How does the RTA acquire land?

The *Roads Act,* 1993 provides the basis for the RTA to acquire land. It only provides for the RTA to acquire land required for road purposes (called 'directly affected' land).

The RTA generally acquires property:

- After a project has been approved.
- When funds are available for acquisition.

The announcement of a preferred route or concept design does not mean that a 'programmed acquisition' process starts. A preferred route may still be subject to change.

In some circumstances, the RTA may consider acquiring property before a project is approved if:

- Hardship is demonstrated by the owner in writing to the RTA.
- Funds have been allocated to the project.

Where acquisition is not required for properties that will be close to an upgraded highway, the RTA undertakes mitigation measures. These measures are described in an environmental assessment which will be placed on display for community comment.

For more information or to obtain a copy of the *Warrell Creek Review Report* please contact the RTA:

www.rta.nsw.gov.au/pacific (click on Warrell Creek to Urunga) | 1800 800 612 (toll free) Project information line

RTA/Pub.08.172

Australian Government

New South Wales Government

RTA

Warrell Creek to Urunga upgrade

(Incorporating Warrell Creek and Macksville to Urunga upgrade projects)
Upgrading the Pacific Highway

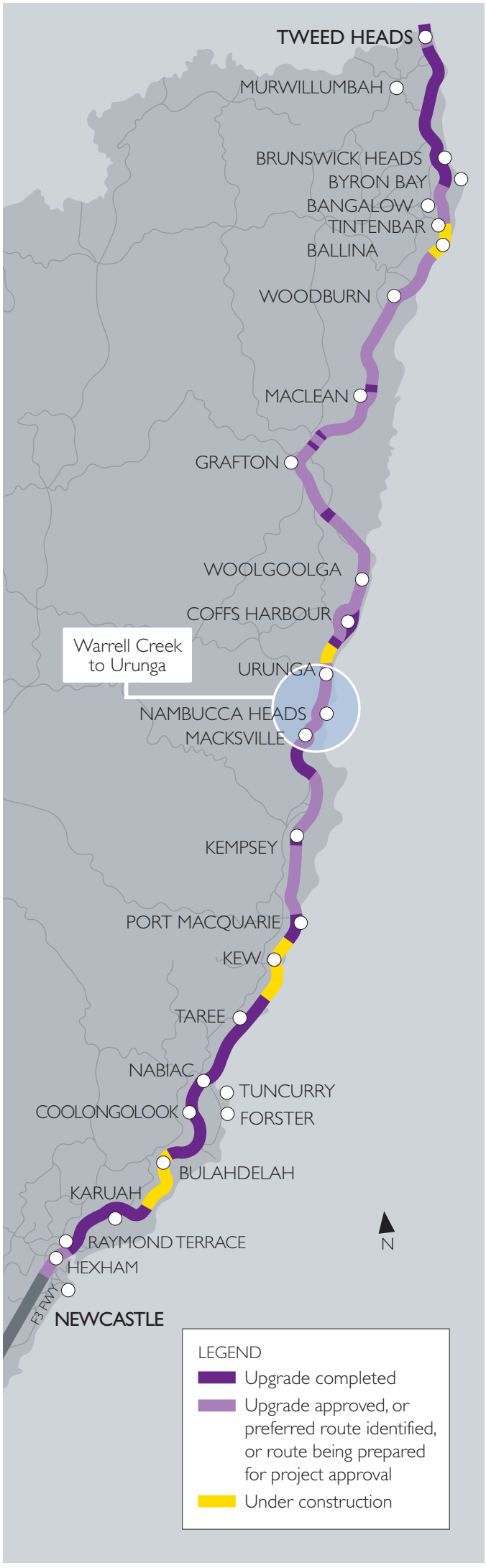
COMMUNITY UPDATE

JUNE 2008







This community update provides information on the upgrade of the Pacific Highway between Warrell Creek and Urunga. It identifies:

- The preferred route for the Warrell Creek section.
- The concept design for the Warrell Creek to Urunga upgrade, including the location and layout of modified interchanges and areas where the design has been modified to reduce impact.

Completing the upgrade of the Pacific Highway

Currently, 267 of a total of 679 kilometres are double lane divided road. A further 87 kilometres are under construction. The remaining kilometres are either approved for construction or have had a preferred route identified.

The Pacific Highway is part of the AusLink National Network. By mid 2009, the NSW Government will have spent $2.3 billion and the Australian Government $1.3 billion towards the upgrade of the Pacific Highway.

Warrell Creek to Urunga upgrade

The existing highway would be upgraded to a four lane divided road (dual carriageway) between the northern end of the completed Allgomera deviation, south of Warrell Creek and the Waterfall Way at Raleigh, north of Urunga.

The preferred route for Macksville to Urunga was announced in November 2005. The preferred route was selected after community consultation and field investigations. As part of those investigations, a range of options were considered, including options to the west of Macksville and options suggested by the community. Information on these investigations is contained in a series of project reports, which are available on the project website (see back page for details).

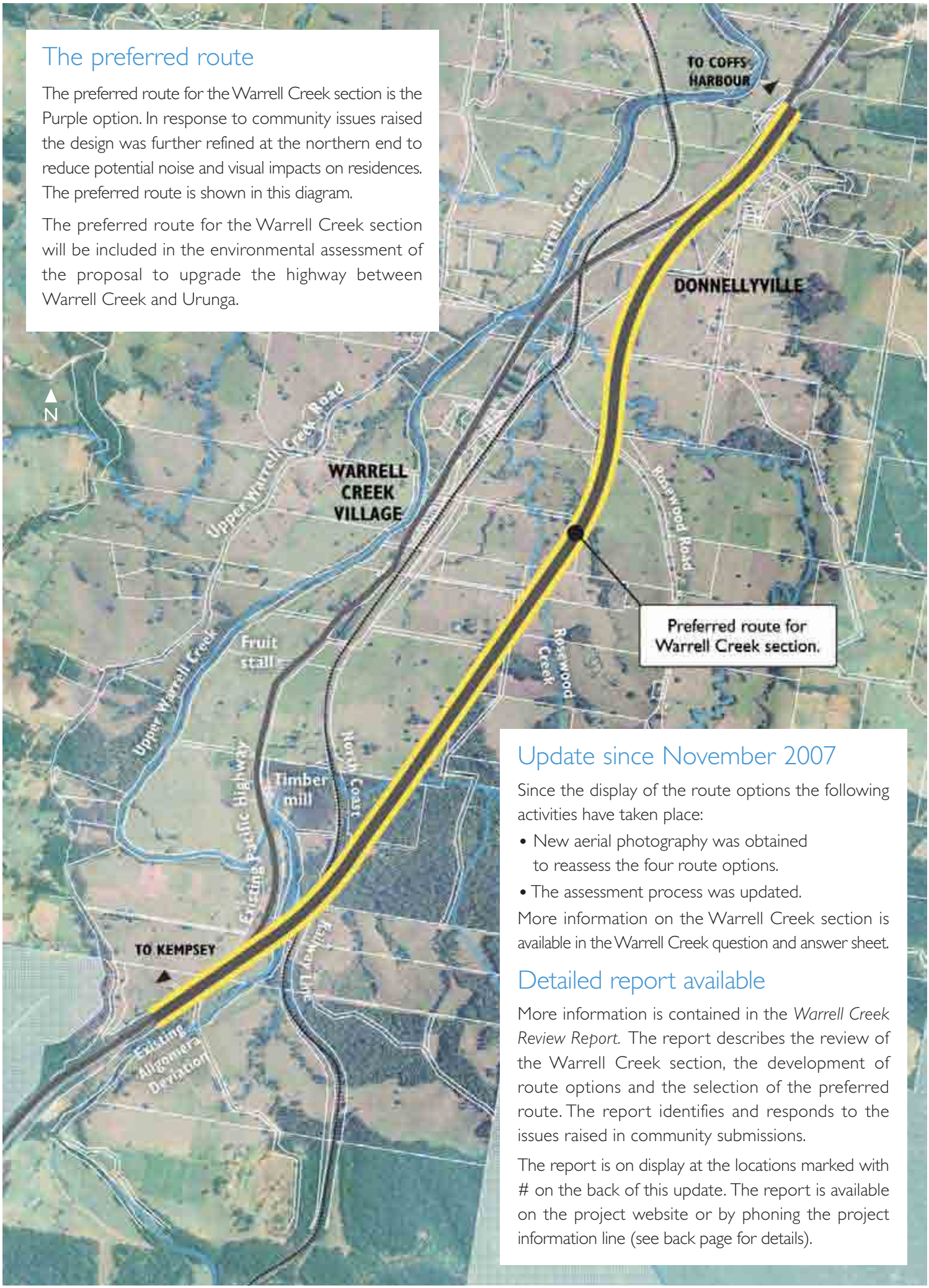
Preferred route for Warrell Creek

The preferred route for the Warrell Creek section is the Purple option displayed in September 2007 (see next page).

The preferred route

The preferred route for the Warrell Creek section is the Purple option. In response to community issues raised the design was further refined at the northern end to reduce potential noise and visual impacts on residences. The preferred route is shown in this diagram.

The preferred route for the Warrell Creek section will be included in the environmental assessment of the proposal to upgrade the highway between Warrell Creek and Urunga.



Update since November 2007

Since the display of the route options the following activities have taken place:

- New aerial photography was obtained to reassess the four route options.
- The assessment process was updated.

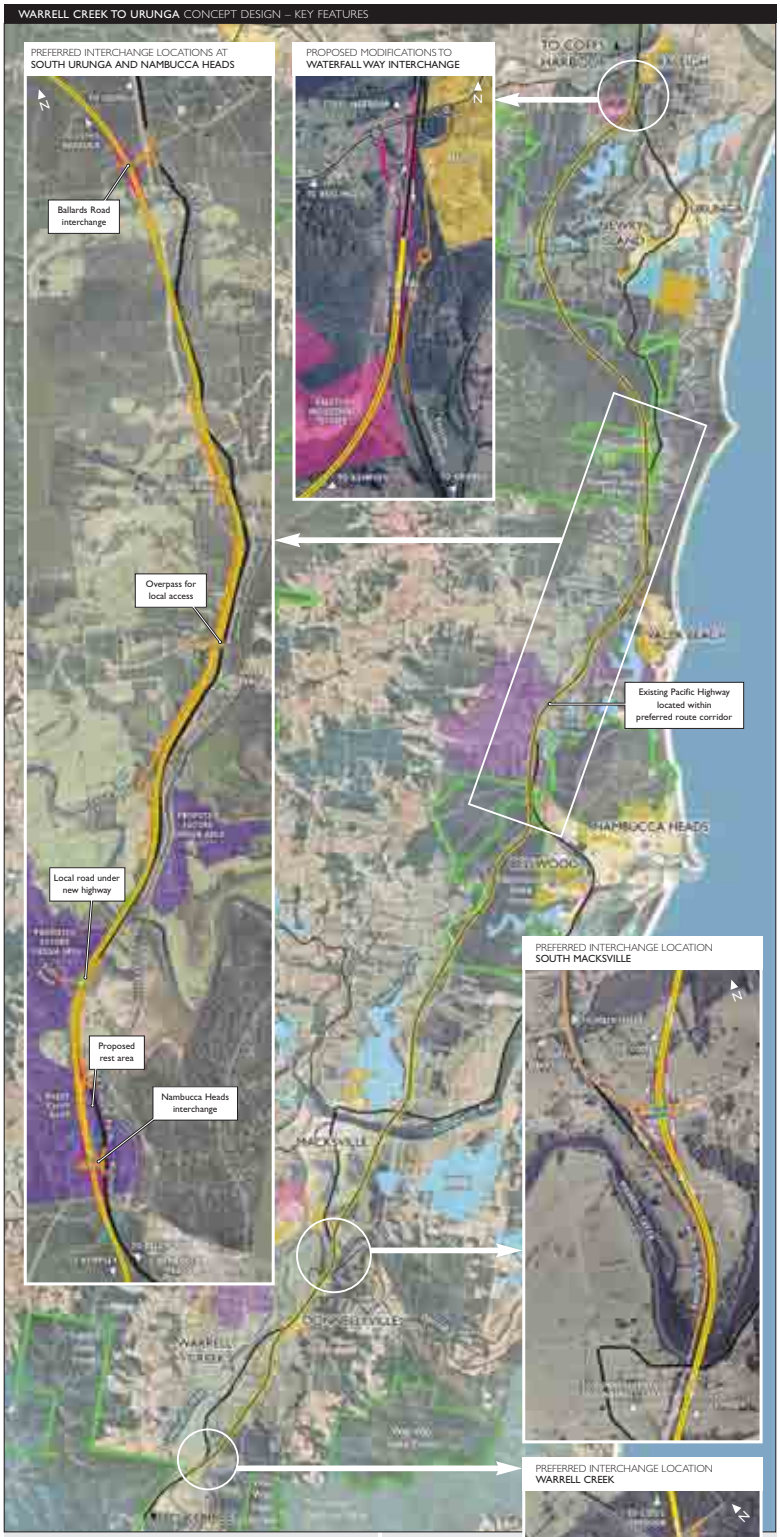
More information on the Warrell Creek section is available in the Warrell Creek question and answer sheet.

Detailed report available

More information is contained in the *Warrell Creek Review Report.* The report describes the review of the Warrell Creek section, the development of route options and the selection of the preferred route. The report identifies and responds to the issues raised in community submissions.

The report is on display at the locations marked with # on the back of this update. The report is available on the project website or by phoning the project information line (see back page for details).

Aerial photography sourced from Department of Lands September 2000. Area surrounding preferred route November 2007.



Main map aerial photography sourced from Department of Lands September 2000. Area surrounding preferred route November 2007.

Aerial images in inset maps November 2007

Concept design

The concept design for the upgrade of the Pacific Highway from Warrell Creek to Urunga is shown on the map above. Further refinements to the concept design may occur during the environmental assessment of the project and in response to further community comments.

It is proposed to build a new four lane dual carriageway highway between Warrell Creek and the existing Waterfall Way interchange at Raleigh. The existing highway would become a local road connecting existing and future communities to each other and to the new highway.

Highway access arrangements

The location and layout of access points on the highway have been refined based on community comments and further investigations. Access would be provided via five grade-separated interchanges at the following locations:

- Existing Waterfall Way interchange at Raleigh.
- Ballards Road, south of Urunga.
- Near Boggy Creek, west of Nambucca Heads.
- Bald Hill Road, south of Macksville.
- South of Warrell Creek village.

Changes to the highway access arrangements since the September 2007 community update include:

- New interchanges at Ballards Road and south of Warrell Creek.
- Refinement of the Bald Hill Road interchange to retain the existing highway south of the interchange as part of the local road network.
- Upgrading the access ramps at the existing Raleigh interchange, to improve road safety.

Local roads and property accesses

The existing Pacific Highway would connect to the new highway at five interchanges. This would:

- Provide safer access to properties that currently have direct highway access.
- Enable residents to take road trips to local shops and facilities without having to use the upgraded section of highway.
- Provide a continuous alternative local road link between Warrell Creek and Raleigh for school buses and motorists who do not wish to use the upgraded highway.

Existing local roads would be retained and new local roads constructed to provide access to townships, communities and properties. Where required, these roads would pass over or under the new highway. There would be no direct access from properties to the new highway.

Alignment changes

Changes to the alignment of the new highway since the September 2007 community update include:

- A shift in the alignment of the upgrade to the east, south of Bald Hill Road, to retain the existing highway as a local road connecting Scotts Head Road and the Warrell Creek/Donnellyville area to the interchange at Macksville.
- Minor shifts in the alignment through the Nambucca State Forest to minimise impacts on native flora and to avoid the disused tip site adjacent to Old Coast Road.
- Minor shifts in the alignment north of Valla Beach and through the Newry State Forest to reduce impacts on the existing highway and to minimise impacts on native flora.
- A minor shift in the alignment west of Newry Island to minimise impacts on native flora and to further distance the upgrade from the SEPP 14 wetlands to the east.

New rest area

The area between the new and existing highways north of the Boggy Creek interchange is a potential location for a rest area for light and heavy vehicles.

Opportunities to stage construction

Opportunities to stage construction of the upgrade include constructing one or more of the sections of highway to bypass Warrell Creek village, Macksville, Bellwood (Nambucca Heads) and Mines Road, south of Urunga.

No decision has been made in regard to staging the construction of the project.

Display locations

The concept design for the Warrell Creek to Urunga upgrade and the *Warrell Creek Review Report* are on display until **Friday 8 August 2008** at the locations shown below:

- Nambucca Shire Council, Princess Street, Macksville (Mon-Fri 9am-4pm).#
- Bellingen Shire Council, Hyde Street, Bellingen (Mon-Fri 8.30am-4.30pm).#
- Urunga Post Office, Bonville Street, Urunga (Mon-Fri 9am-5pm).#
- Nambucca Heads, RTA Motor Registry, Shops 11 &13 Seascape Shopping Centre, Ridge Street (Mon-Fri 9am-4pm).#
- Warrell Creek Community Hall, Albert Drive, Warrell Creek.
- RTA Pacific Highway Office, 21 Prince Street, Grafton (Mon-Fri 8.30am-4.30pm).#

Staffed displays

Project staff will be available to discuss the concept design for the Warrell Creek to Urunga upgrade and the preferred route for the Warrell Creek section in more detail at the following locations:

- Warrell Creek Community Hall, Monday 30 June 2008, 4pm-8pm.
- Nambucca Shire Council, Tuesday 1 July 2008, 9am-4pm.
- Urunga Senior Citizens Hall, Urunga, Wednesday 2 July 2008, 10am-4pm.
- Nambucca Plaza, Pacific Highway, Bellwood, Thursday 3 July 2008, 10am-8pm.

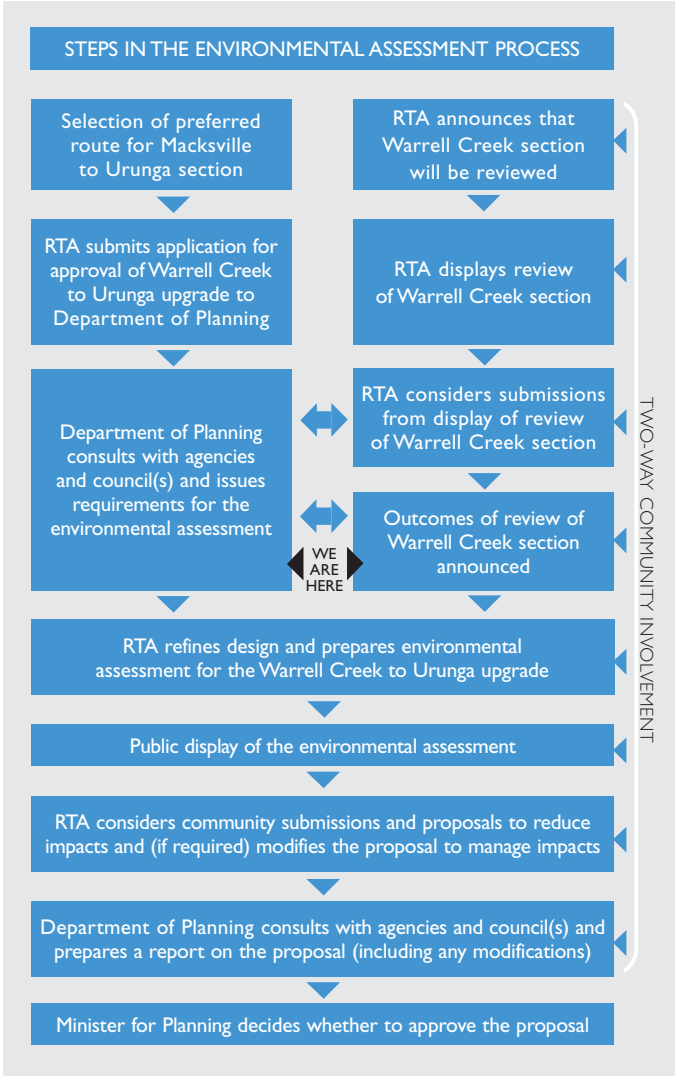
It should be noted that you can drop in at any time during the staffed displays.

What happens next?

The Department of Planning has provided the RTA with a list of requirements for the environmental assessment of the proposal to upgrade the highway between Warrell Creek and Urunga.

When completed, the environmental assessment will be placed on display for public comment for at least 30 days. At the end of the display, the RTA will be asked to respond to the issues raised in the community submissions. The RTA may modify the proposal further to manage impacts on the environment.

The Department of Planning provides an assessment report for consideration by the NSW Minister for Planning. The Minister then decides whether to approve the proposal.



To contact the study team, write to:
Ross Jones, Sinclair Knight Merz
PO Box 164, St Leonards NSW 1590

macks2urunga@skm.com.au

1800 800 612 (toll free)
Project information line

To contact the RTA's Project Manager write to: Chris Clark, RTA
PO Box 546, GRAFTON NSW 2460

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(click on Warrell Creek to Urunga)

www.auslink.gov.au

T 02 6640 1000 F 02 6640 1001

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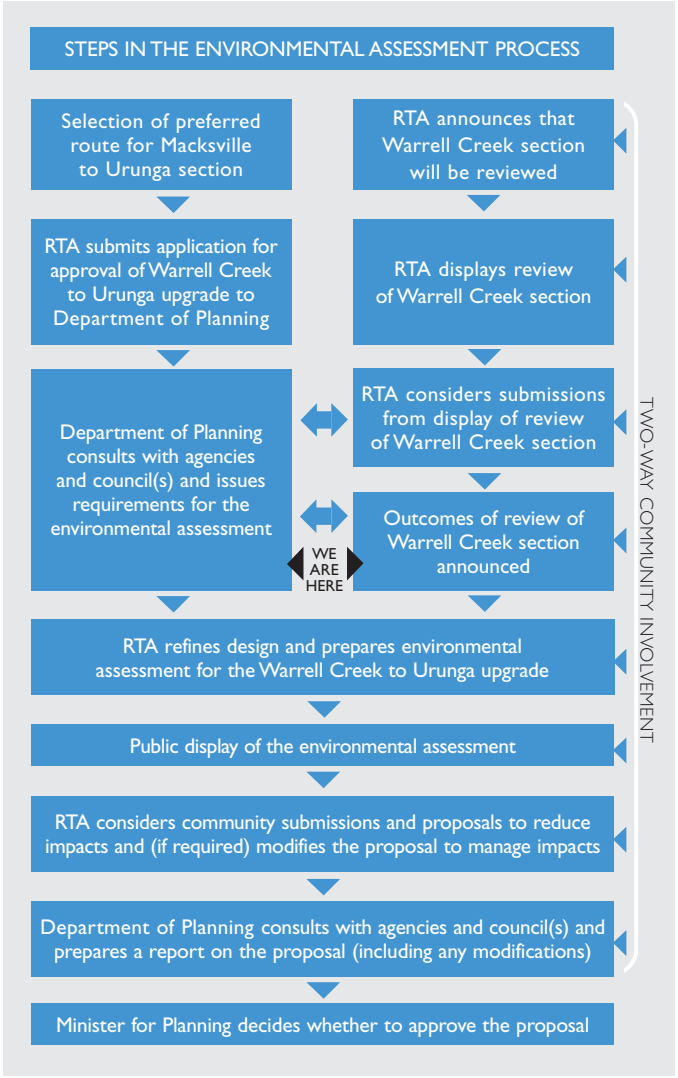

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