NSW Roads and Maritime Services

WOOLGOOLGA TO BALLINA | PACIFIC HIGHWAY UPGRADE

SUBMISSIONS / PREFERRED INFRASTRUCTURE REPORT

Appendix I Comparative assessment of alternative route options

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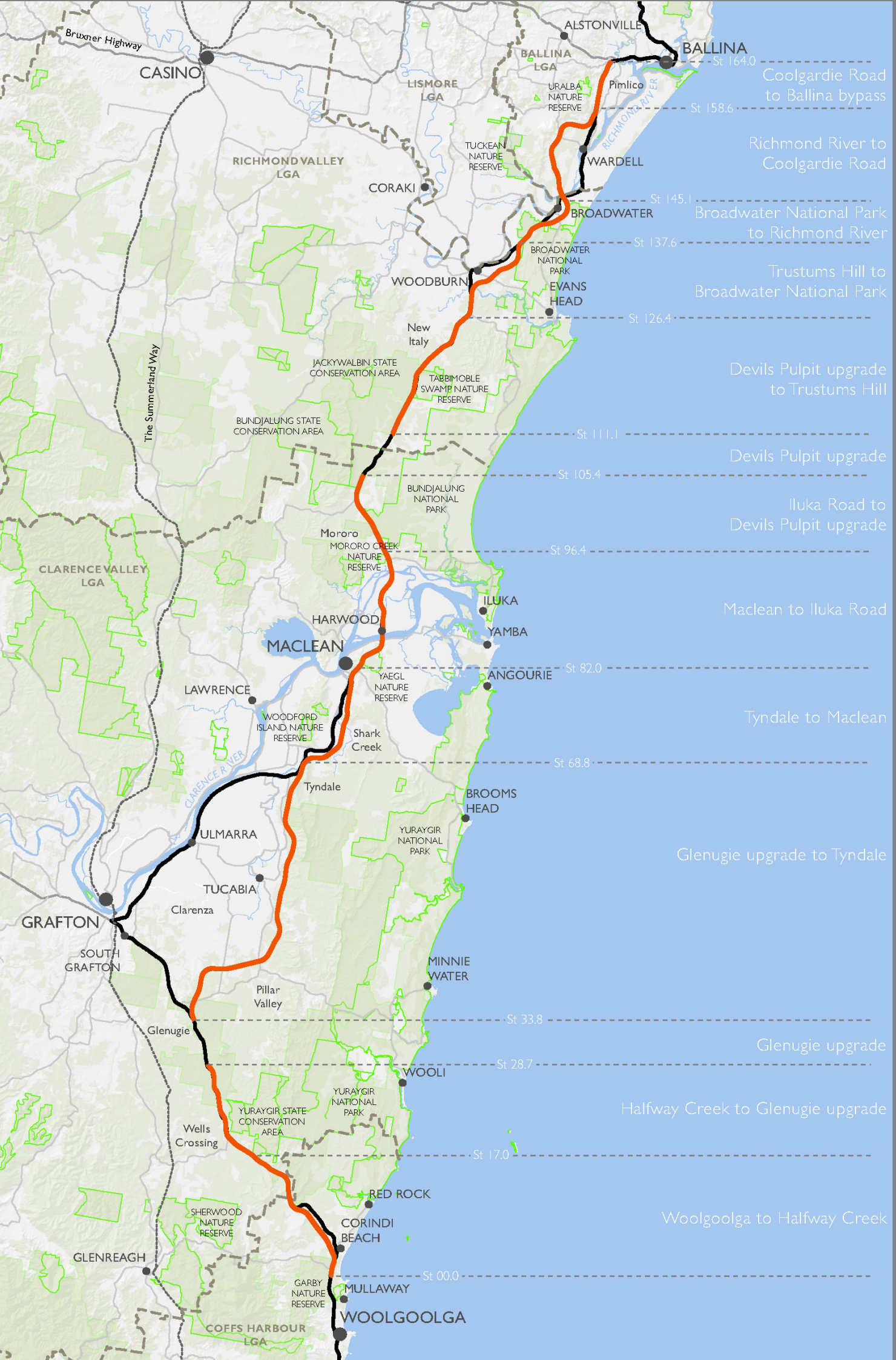
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LISMORE LGA
URALBA NATURE RESERVE
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RICHMOND RIVER
TUCKEAN NATURE RESERVE
WARDELL
RICHMOND VALLEY LGA
CORAKI
BROADWATER
BROADWATER NATIONAL PARK
WOODBURN
EVANS HEAD
New Italy
JACKYWALBIN STATE CONSERVATION AREA
TABBIMOBLE SWAMP NATURE RESERVE
The Summerland Way
BUNDJALUNG STATE CONSERVATION AREA
BUNDJALUNG NATIONAL PARK
Mororo
MORORO CREEK NATURE RESERVE
CLARENCE VALLEY LGA
ILUKA
HARWOOD
YAMBA
MACLEAN
ANGOURIE
YAEGL NATURE RESERVE
LAWRENCE
WOODFORD ISLAND NATURE RESERVE
Shark Creek
CLARENCE RIVER
Tyndale
BROOMS HEAD
YURAYGIR NATIONAL PARK
ULMARRA
TUCABIA
Clarenza
GRAFTON
SOUTH GRAFTON
MINNIE WATER
Pillar Valley
Glenugie
WOOLI
YURAYGIR NATIONAL PARK
YURAYGIR STATE CONSERVATION AREA
Wells Crossing
RED ROCK
SHERWOOD NATURE RESERVE
CORINDI BEACH
GLENREAGH
GARBY NATURE RESERVE
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11
Coolgardie Road to Ballina bypass
10
Richmond River to Coolgardie Road
9
Broadwater National Park to Richmond River
8
Trustums Hill to Broadwater National Park
7
Devils Pulpit upgrade to Trustums Hill
Devils Pulpit upgrade
6
Iluka Road to Devils Pulpit upgrade
5
Maclean to Iluka Road
4
Tyndale to Maclean
3
Glenugie upgrade to Tyndale
Glenugie upgrade
2
Halfway Creek to Glenugie upgrade
1
Woolgoolga to Halfway Creek

Appendix I Comparative assessment of alternative route options

The Environmental Impact Statement (chapter 4) provided details on the route option selection process for the project, as undertaken during the previous development phases. Community and stakeholder feedback on the EIS raised issues with the selection of the project alignment. In consideration of this feedback, RMS undertook a review of the route selection process and a comparison of the environmental issues considered at the time.

The process to select a preferred route included environmental and engineering investigations, and community and stakeholder feedback. A summary of the main issues considered for each route option considered during that process is provided.

A comparative assessment is provided to rank (high, medium, low) the issues according to the amount of potential community or environmental impact that may result or the degree that the issues may pose a substantial constraint to the development of the project.

The assessment is provided only for those previous development projects that considered route options:

- Woolgoolga to Wells Crossing
- Wells Crossing to Iluka Road
- Woodburn to Ballina.

The previous development project 'Iluka Road to Woodburn' is not addressed in this Appendix, as the existing highway corridor was identified to be the only feasible corridor due to the biodiversity constraints of the land surrounding the highway (including areas of national park and nature reserves). Therefore there was no route option process undertaken.

Detailed information on the route selection and concept design development processes for these projects is provided in the following reports:

- Woolgoolga to Wells Crossing Route Options Report (RTA, 2005)
- Woolgoolga to Wells Crossing Preferred Route Report (RTA, 2006)
- Woolgoolga to Wells Crossing Concept Design Report (RTA, 2008)
- Wells Crossing to Iluka Road Route Options Development Report (RTA, 2005)
- Wells Crossing to Iluka Road Preferred Route Report (RTA, 2006)
- Wells Crossing to Iluka Road Concept Design Report (RTA, 2009)
- Discussion paper on Tyndale to Maclean alternative route (RTA, 2010)
- Tyndale to Maclean Alternative Alignment Decision Report (RTA, 2011)
- Iluka Road to Woodburn Concept Design Report (RTA, 2006)
- Iluka Road to Woodburn Preferred Concept Design Report (RTA, 2008)
- Woodburn to Ballina Route Options Development Report (RTA, 2005)
- Woodburn to Ballina Upgrade Preferred Route Report (RTA, 2005)
- Woodburn to Ballina Upgrade Concept Design Report (RTA, 2008).

These reports and additional documents supporting the preferred route and concept design for the previous development projects, including methodology, working papers and outcomes of community and stakeholder involvement, are available on the RMS website:

http://www.rta.nsw.gov.au/roadprojects/projects/pac_hwy/index.html (click on Woolgoolga to Ballina).

In 2010, these four previous development projects were combined to form the Woolgoolga to Ballina upgrade for the purpose of seeking project approval for construction.

Woolgoolga to Wells Crossing project

THIS IS A SUMMARY OF THE ROUTE OPTIONS PROCESS, FOCUSING ON ENVIRONMENTAL IMPACTS. THE SUMMARY IS DERIVED FROM THE ROUTE OPTIONS WORKING PAPERS (RTA 2006) AND ROUTE OPTIONS DEVELOPMENT REPORT (RTA 2005).

THIS INFORMATION IS AS PER THE ROUTE OPTIONS ASSESSMENT UNDERTAKEN. THREATENED SPECIES AND POTENTIAL IMPACTS DISCUSSED ARE THOSE CONSIDERED DURING THAT PROCESS, AT THAT TIME.

TO AID UNDERSTANDING OF THE IMPACTS AND IDENTIFY THE BEST PERFORMING OPTION, THE ROUTE OPTION IMPACTS HAVE BEEN DISTILLED INTO A HIGH, MEDIUM AND LOW RANKING.

THE PROCESS OF RANKING IS THE ONLY ADDITIONAL/NEW WORK THAT HAS BEEN UNDERTAKEN.

Route selection process

A comprehensive route options and selection process was undertaken to identify the preferred route between Woolgoolga and Wells Crossing. Possible alignments were identified through preliminary studies, field investigations and consultation with the community and stakeholders. The assessment corridor (refer to Figure 1), was a narrow corridor centred around the existing highway.

Four feasible route options were short listed (known as the blue, green, purple and orange options) with some of the options sharing a common corridor through some of the project sections (refer to Figure 1). The project was divided into five sections:

- Section A: This section is from Arrawarra Creek to the Tasman Street (Corindi Beach) intersection. Key features within this section include connection to the Sapphire to Woolgoolga upgrade project, Wedding Bells State Forest and the village of Arrawarra
- Section B: This section is from the Tasman Street intersection to 500 metres south of Barcoongere Way, Dirty Creek. Key features within this section include the villages of Corindi Beach and Corindi, and the floodplains of Corindi River and associated tributaries
- Section C: This section is from 500 metres south of Barcoongere Way, Dirty Creek to 400 metres south of Falconers Lane. Key features within this section include Dirty Creek Range, extensive blueberry plantations and Newfoundland State Forest
- Section D: This section is from 400 metres south of Falconers Lane to, and inclusive of, the intersection with Lemon Tree Road, Halfway Creek. Key features within this section include Yuraygir State Conservation Area and the recently completed Halfway Creek duplication
- Section E: This section is from Lemon Tree Road to Bald Knob Tick Gate Road, Wells Crossing. Key features within this section include the locality of Halfway Creek, Yuraygir State Conservation Area, Newfoundland State Forest and Wells Crossing Flora Reserve, and the tie-in to the Wells Crossing to Iluka Road project.

The route option assessment considered community, environmental and engineering issues. This consideration included Matters of National Environmental Significance (under the EPBC Act) that had potential to occur within the study area.

The preferred route was a combination of the orange, refined orange and blue options.

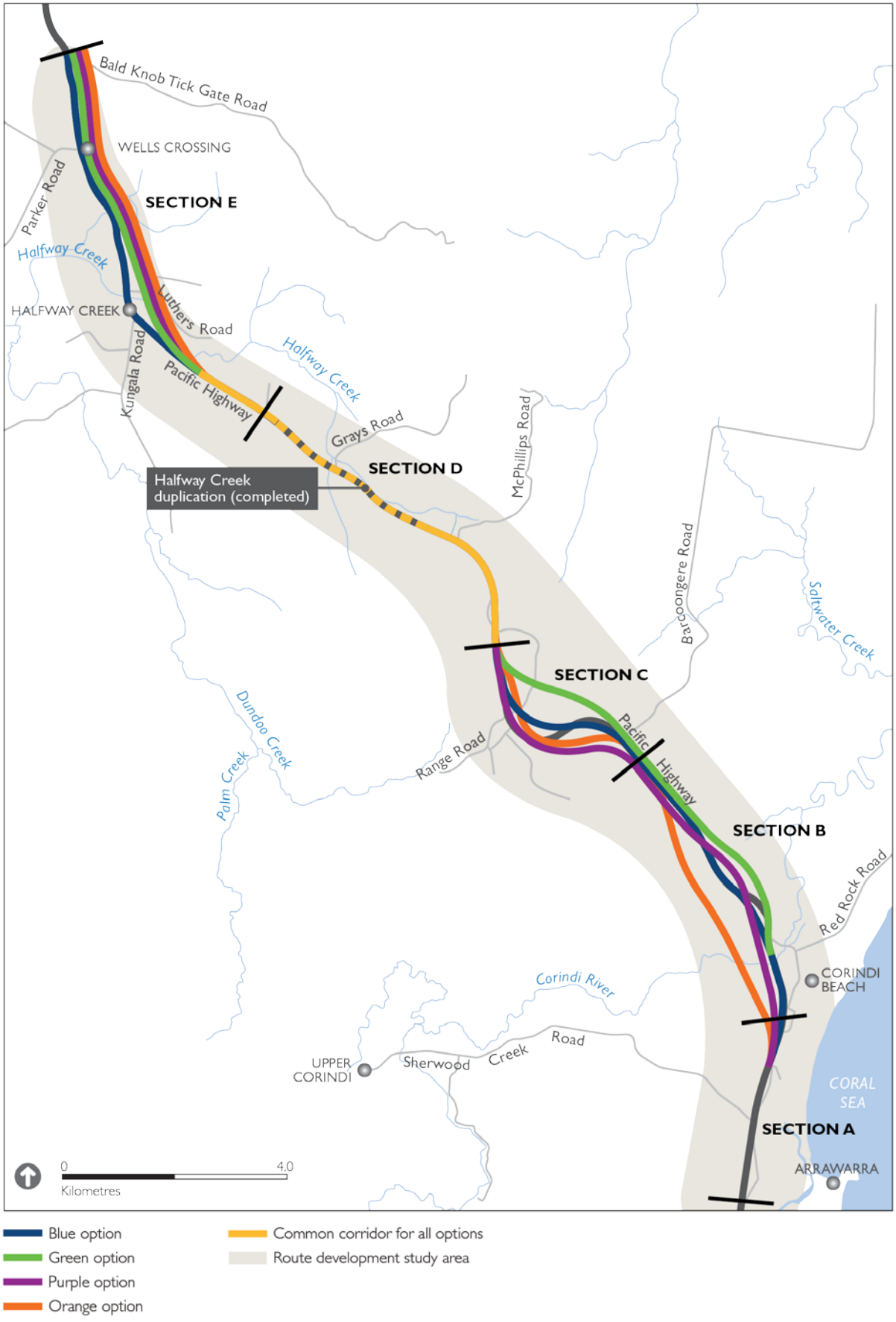

Figure 1: Shortlisted route options Woolgoolga to Wells Crossing

Biodiversity

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR BIODIVERSITY. THIS INFORMATION HAS BEEN SUMMARISED FROM THE PRELIMINARY TERRESTRIAL FLORA AND FAUNA ASSESSMENT WORKING PAPER. THE WORKING PAPER INCLUDED:

- **Woolgoolga to Wells Crossing Supplementary Preliminary Terrestrial Flora and Fauna Assessment Report – Advanced Investigations, Ecotone Ecological Consultants, June 2006c**
- **Woolgoolga to Wells Crossing Supplementary Preliminary Terrestrial Flora and Fauna Assessment Report – Refined Orange Option, Section E, Ecotone Ecological Consultants, June 2006b**
- **Woolgoolga to Wells Crossing Route Options Development – Preliminary Terrestrial Flora and Fauna Assessment Report, Ecotone Ecological Consultants, June 2006a**

How MNES were considered during the route options evaluation

The preliminary ecological assessment (Ecotone 2006a) assessed the constraints of each route option based on:

- A literature review, particularly of the schedules, provisional listings, preliminary and final determinations within the NSW *Threatened Species Conservation Act 1995* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999.*
- A review of relevant databases in order to generate a list of known or potential threatened species, endangered ecological communities and endangered populations for the study locality and study area.
- Mapping which indicated the likely location of any threatened species, endangered ecological communities and endangered populations within the study area.
- Preliminary field surveys of habitats and interpretation of aerial photograph.

Records of threatened species (from DEC and ForestsNSW databases) were reviewed in the biodiversity assessment. Threatened flora species recorded within the study area included:

- *Acronychia littoralis* scented acronychia – endangered
- *Allocasuarina defungens* – endangered
- *Allocasuarina simulans* – vulnerable.
- *Angophora robur* – vulnerable.
- *Boronia umbellata* – vulnerable.
- *Bothriochloa biloba* – vulnerable.
- *Corynocarpus rupestris subsp. rupestris* – vulnerable.
- *Cryptostylis hunteriana* leafless tongue-orchid – vulnerable.
- *Eucalyptus tetrapleura* square-fruited ironbark – vulnerable.
- *Leucopogon confertus* – endangered
- *Marsdenia longiloba* – vulnerable.
- *Melichrus hirsutus* – endangered
- *Parsonsia dorrigoensis* – endangered
- *Phaius australis* – endangered
- *Quassia sp. 'Moonee Creek'* – endangered
- *Thesium australe* austral toad-flax – vulnerable.
- *Zieria prostrata* – endangered

In addition to the EPBC Act listed flora species that have been recorded in the study area, the EPBC Act Protected Matters Search Tool identified another four flora species not been recorded in the locality but likely to occur in the area, as potential habitat is available in the study area. The species are:

- *Arthraxon hispidus* (hairy-joint grass) – vulnerable.
- *Cynanchum elegans* (white-flowered wax plant) – endangered.
- *Rutidosis heterogama* – vulnerable.
- *Tylophora woollsii* – endangered.

Threatened species (listed on the EPBC Act) recorded in the study area (and considered in the assessment):

- *Calidris tenuirostris* great knot – migratory.
- *Charadrius leschenaultii* greater sand plover – migratory.
- *Lathamus discolor* swift parrot – endangered.
- *Limosa limosa* black-tailed godwit – migratory.
- *Pandion haliaetus* osprey – migratory.
- *Sterna albifrons* little tern – migratory.
- *Xanthomyza phrygia* regent honeyeater – endangered.
- *Pteropus poliocephalus* grey-headed flying-fox – vulnerable.
- *Dasyurus maculatus maculatus* (SE population) spotted-tailed quoll – endangered.
- *Litoria aurea* green and golden bell frog – vulnerable.
- *Litoria olongburensis* olongburra frog – vulnerable.
- *Mixophyes iteratus* giant barred frog – endangered.

In addition to the EPBC Act listed fauna species that have been recorded in the study area, the EPBC Act Protected Matters Search Tool identified other fauna species that had not been recorded in the locality. The species are:

- Australian painted snipe (*Rostratula australis*) – vulnerable.
- Black-breasted button-quail (*Turnix melanogaster*) – vulnerable.
- Stuttering frog (*Mixophyes balbus*) – vulnerable.
- Large-eared pied bat (*Chalinolobus dwyeri*) – vulnerable.
- Brush-tailed rock-wallaby (*Petrogale penicillata*) – vulnerable.
- Long-nosed potoroo (*Potorous tridactylus tridactylus*) – vulnerable.
- Hastings River mouse (*Pseudomys oralis*) – endangered.
- Three-toed snake-tooth skink (*Coeranoscincus reticulatus*) – vulnerable.
- Bellinger River emydura (*Emydura signata*) – vulnerable.
- Border thick-tailed gecko (*Underwoodisaurus sphyrurus*) – vulnerable.
- A moth *Phyllodes imperialis* (southern subsp. – ANIC 3333) – endangered.
- White-bellied sea-eagle (*Haliaeetus leucogaster*) – migratory.
- White-throated needletail (*Hirundapus caudacutus*) – migratory.
- Black-faced monarch (*Monarcha melanopsis*) – migratory.
- Spectacled monarch (*Monarcha trivirgatus*) – migratory.
- Satin flycatcher (*Myiagra cyanoleuca*) – migratory.
- Rufous fantail (*Rhipidura rufifrons*) – migratory.
- Regent honeyeater (*Xanthomyza phrygia*) – migratory.

Other species considered most likely to occur that were TSC Act listed at the time of the route options evaluation, but have subsequently been listed under the EPBC Act, were:

- Koala (Phascolarctos cinereus).
- Australasian bittern (Botaurus poiciloptilus).

Endangered ecological communities (EEC) listed under the TSC Act 1995 that could occur in the study area and considered in the assessment included:

- Littoral rainforest in the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- Hunter lowland redgum forest in the Sydney Basin and NSW North Coast Bioregions.
- Lowland rainforest on floodplain in the NSW North Coast Bioregion.
- White box, yellow box, Blakely's red gum woodland.
- Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Subtropical coastal floodplain forest of the NSW North Coast bioregion.
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

Of these, only Coastal saltmarsh is known to occur in the vicinity of the study area.

The aquatic ecology assessment identified two EPBC Act listed species with a moderate to high likelihood of occurrence in the study area. These were:

- *Maccullochella ikei* Eastern Freshwater Cod E
- *Nannoperca oxleyana* Oxleyan Pygmy Perch E

All Commonwealth and State listed species identified through the above process were included in the route options evaluation process, including route selection and value management workshops.

The preliminary biodiversity assessment made a number of recommendations including the need to undertake detailed targeted field surveys and habitat assessment to determine which of the species previously recorded in the study locality are likely to occur within the study area. This is particularly in Section B and C where the route options diverge significantly from the existing highway and traverse different alignments. Based on this recommendation, a supplementary ecological assessment was undertaken. The habitat assessment for both flora and fauna focused on the differences in key features between the options, such as endangered or locally significant vegetation communities, potentially suitable habitat areas or features for threatened fauna. The investigation area mostly consisted of a strip of land 250 metres wide, extending 125 metres to either side of the centre line of each route option. The only EPBC Act listed threatened species confirmed during the habitat assessment surveys was the Osprey.

This assessment also noted that at the time of writing there was a preliminary determination for the listing of Lowland Rainforest on Coastal Floodplain Endangered ecological community on the TSC Act. This community was considered in the assessment.

Route options were compared against the following criteria:

- Designated wildlife corridors.
- Key habitats
- Department of Environment and Conservation (DEC) reservations under the *National Parks and Wildlife Act 1974.*
- State forests.
- Key vegetation types or habitat.
- Forest ecosystems (identified from "Forest Ecosystem Classification (FEC) project" mapping).
- Approximate total area of vegetation clearing.
- Approximate area of clearing of high conservation value forest ecosystems.
- Potential for threatened species.
- Aquatic habitats.

Designated wildlife corridors

Section	Route option	Dedicated wildlife corridors
A	ALL ROUTE OPTIONS	Does not traverse any dedicated wildlife corridor
B	Blue option	These options would result in the widening of the existing highway through the "Corindi River Subregional Corridor" and the "Dirty Creek Subregional Corridor".
	Green option	
	Purple option	
	Orange option	This option would result in the creation of a new cleared corridor within the "Corindi River Subregional Corridor" and widening of the existing clearing highway through the "Dirty Creek Subregional Corridor".
C	Blue option	These options would widen the existing cleared highway through the "Lazyman Creek Subregional Corridor" at the northern end of the section.
	Green option	This option would create a new cleared corridor through the "Lazyman Creek Subregional Corridor", which connects to Newfoundland State Forest.
	Purple option	This option would widen the existing cleared highway through the "Lazyman Creek Subregional Corridor" at the northern end of the section.
	Orange option	
D	Blue option	This option would widen the existing cleared highway through the "Newfoundland Sherwood Regional Corridor" and the "Yuraygir Sherwood Regional Corridor" and pass adjacent to the "Yuraygir CR Regional Corridor".
	Green option	
	Purple option	
	Orange option	
E	Blue option	This option would widen the existing cleared highway through the "Halfway Creek Regional Corridor," and along the western edge of the "Snake Creek Subregional Corridor".
	Green option	This option would widen the existing cleared highway through the "Halfway Creek Regional Corridor," and along the western edge of the "Snake Creek Subregional Corridor". There would be no clearing within the "Snake Creek Subregional Corridor".
	Purple option	
	Orange option	

Note colour code used to rank risk for issues or options:

Red - High

Yellow - Medium

Green - Low.

NPWS designated key habitats

Section	Route option	NPWS designated key habitats
A	ALL ROUTE OPTIONS	None affected
B	ALL ROUTE OPTIONS	None affected
C	ALL ROUTE OPTIONS	None affected
D	Blue option	Small areas of key habitat are identified in the study area. Some are adjacent to the existing highway and may be affected by all these options.
	Green option	
	Purple option	
	Orange option	
E	Blue option	This option is likely to require clearing within, and possibly fragmentation of some of small areas of key habitat.
	Green option	
	Purple option	
	Orange option	

DEC reservations under *National Parks and Wildlife Act 1974*

Section	Route option	DEC reserves
A	ALL ROUTE OPTIONS	None affected
B	ALL ROUTE OPTIONS	None present in this section
C	ALL ROUTE OPTIONS	None affected
D	Blue option	Yuraygir State Conservation Area to the east, although clearing at Halfway Creek would not impact on this reserve.
	Green option	
	Purple option	
	Orange option	
E	ALL ROUTE OPTIONS	None affected

State forests

Section	Route option	State forest
A	Blue option	This option would widen the existing highway corridor through the Wedding Bells State Forest.
	Green option	
	Purple option	
	Orange option	
B	ALL ROUTE OPTIONS	None present in this section
C	Blue option	This option would clear vegetation within the southern extent of Newfoundland State

Section	Route option	State forest
		Forest within Dirty Creek Range.
	Green option	This option would clear a new corridor through Newfoundland State Forest to the east of the existing highway.
	Purple option	None affected
	Orange option	None affected
D	Blue option	These options would widen the existing highway alignment along this section, including clearing of some vegetation within Newfoundland State Forest.
	Green option	
	Purple option	
	Orange option	
E	Blue option	This option would widen the existing highway alignment along this section, including clearing of some vegetation within the Wells Crossing Flora Reserve and Glenugie State Forest.
	Green option	These option would clear a new corridor through the western edge of Wells Crossing Flora Reserve. It would also widen the existing cleared corridor along the eastern edge of Glenugie State Forest including minor clearing within the state forest.
	Purple option	
	Orange option	

Key vegetation types or habitats

Section	Route option	Vegetation types
A	Blue option	These options pass through vegetation communities that would likely qualify for one or more endangered ecological communities listed under the NSW TSC Act: • Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. • River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. • Subtropical coastal floodplain forest of the NSW North Coast bioregion. • Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner • Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.
	Green option	
	Purple option	
	Orange option	
B	Blue option	Habitat within this option includes the remnant vegetation in the floodplains of Corindi River and Redbank Creek, and within cleared farmland (containing scattered large, isolated habitat trees that could provide potential roost sites for threatened bats). This option could remove some of this habitat. Option crosses a band of rainforest vegetation east of the Dirty Creek Range. This rainforest is likely to qualify as the endangered ecological community (EEC) Lowland rainforest on coastal floodplain. The option would also cross a band of swamp vegetation by a creekline at the northern end of the section, likely to qualify as Swamp sclerophyll forest on coastal floodplains.
	Green option	Habitat within this option includes the remnant vegetation in the floodplains of Corindi River and Redbank Creek and within cleared farmland (containing scattered large, isolated habitat trees that could provide potential roost sites for threatened bats). This option could remove some of this habitat. The three small areas of swamp vegetation are likely to constitute the EEC Swamp sclerophyll forest on coastal floodplains.
	Purple option	Habitat within this option includes the remnant vegetation in the floodplains of Corindi River and Redbank Creek and within cleared farmland (containing scattered large, isolated habitat trees that could provide potential roost sites for threatened bats). This option could remove some of this habitat.

Section	Route option	Vegetation types
		Only the narrow area of swamp vegetation at the far northern end of Section C could constitute the EEC Swamp sclerophyll forest on coastal floodplains.
	Orange option	Habitat within this option includes the remnant vegetation in the floodplains of Corindi River and Redbank Creek and within cleared farmland (containing scattered large, isolated habitat trees that could provide potential roost sites for threatened bats). Redbank Creek appears to have very little, if any riparian vegetation at the point that the option would cross. Habitat trees could require clearing. Only the narrow area of swamp vegetation at the far northern end of Section C could constitute the EEC Swamp sclerophyll forest on coastal floodplains.
C	Blue option	These options pass mostly through an area of transitional vegetation types including moist forest with rainforest elements (variously tallowwood, blue gum, spotted gum and ironbark). Parts of these vegetation types would have moderate conservation significance and habitat value for fauna.
	Green option	
	Purple option	The options would pass through common vegetation types of no particular conservation significance, such as turpentine/ blackbutt dry forest.
	Orange option	
D	Blue option	A tall moist forest community dominated by blackbutt/ stringybark and red ash with a rainforest understorey or drier black sheoak understorey occurs along the Halfway Creek duplication. This community would have moderate conservation significance, but is not listed.
	Green option	
	Purple option	
	Orange option	
E	Blue option	These options pass through a mature Scribbly Gum community. Many trees in this community immediately adjacent to the existing highway are mature and contain good hollows for fauna. This option would likely clear mature trees at the edge of the existing highway. Further north, towards the northern end of the study area, this option passes through a Rough-barked Angophora Scrub community. This option also passes through some riparian vegetation at the Halfway Creek crossing.
	Green option	
	Purple option	
	Orange option	

Forest ecosystems

Section	Route option	Forest ecosystems
A	Blue option	Swamp Oak forest ecosystems may be impacted.
	Green option	Swamp Oak forest ecosystems may be impacted.
	Purple option	Swamp Oak and Wet Flooded Gum-Tallowwood forest ecosystems may be impacted.
	Orange option	Swamp Oak and Wet Flooded Gum-Tallowwood forest ecosystems may be impacted.
B	Blue option	Wet Flooded Gum-Tallowwood forest ecosystems may be impacted.
	Green option	Swamp Oak and Wet Flooded Gum-Tallowwood forest ecosystems may be impacted.
	Purple option	Wet Flooded Gum-Tallowwood forest ecosystems may be impacted.
	Orange option	Swamp Oak and Wet Flooded Gum-Tallowwood forest ecosystems may be impacted.
C	Blue option	Wet Flooded Gum-Tallowwood forest ecosystems may be impacted.
	Green option	
	Purple option	
	Orange option	

Section	Route option	Forest ecosystems
D	Blue option	Wet Flooded Gum-Tallowwood forest ecosystems may be impacted.
	Green option	
	Purple option	
	Orange option	
E	Blue option	There are no mapped forest ecosystems with an assigned high conservation value that would be impacted within this section.
	Green option	
	Purple option	
	Orange option	

Vegetation clearing

Section	Route option	Vegetation clearing (hectares)	EEC clearing (hectares)
A	Blue option	22	22 (potential)
	Green option	22	22 (potential)
	Purple option	27	27 (potential)
	Orange option	30	30 (potential)
B	Blue option	19	13
	Green option	27	20
	Purple option	21	15
	Orange option	26	21
C	Blue option	30	3
	Green option	30	5
	Purple option	29	1
	Orange option	29	1
D	Blue option	20	Not confirmed
	Green option	22	Not confirmed
	Purple option	22	Not confirmed
	Orange option	22	Not confirmed
E	Blue option	73	Not confirmed
	Green option	92	Not confirmed
	Purple option	92	Not confirmed
	Orange option	92	Not confirmed

Potential threatened species

Section	Route option	Threatened species potentially occurring
A	Blue option Green option Purple option Orange option	Flora: the swamp orchid *Phaius australis*. Fauna: known or potential habitat occurs for the glossy black cockatoo, black-necked stork, osprey, square-tailed kite, powerful owl, grass owl, koala, squirrel glider, spotted-tailed quoll, grey-headed flying-fox, eastern chestnut mouse, little bent-wing bat, hoary wattled bat, common blossom bat and wallum froglet. Species most likely to occur are the wallum froglet, koala, squirrel glider, eastern chestnut mouse, common blossom bat and a variety of insectivorous bats.
B	Blue option Green option Purple option Orange option	Fauna: Potential habitat occurs for threatened fauna species in remnant riparian vegetation along the creeks and on the floodplains, including black-necked stork, brolga, osprey, square- tailed kite, grey-headed flying-fox, little bent-wing bat, hoary wattled bat, southern myotis, east-coast freetail-bat and yellow-bellied sheathtail-bat.
C	Blue option Green option	Flora: *Eucalyptus tetrapleura* could occur. Fauna: Potential habitat occurs for the koala and yellow-bellied glider. No other threatened species were recorded for this section, however, the following species could occur; the glossy black cockatoo, sooty owl, powerful owl, spotted-tailed quoll, grey-headed flying-fox, little bent-wing bat, greater broad-nosed bat, golden-tipped bat, Stephens banded snake and stuttering frog.
	Purple option Orange option	Flora: *Eucalyptus tetrapleura* could occur. Fauna: Potential habitat occurs for the koala and yellow-bellied glider. No other threatened species records could be found for this section of the highway, however, the following species could occur; the glossy black cockatoo, powerful owl, squirrel glider, grey-headed flying-fox, little bent-wing bat, greater broad-nosed bat and hoary wattled bat.
D	Blue option Green option Purple option Orange option	Flora: The following species have been recorded within 2 kilometres of the existing highway and have the most potential to occur: *Eucalyptus tetrapleura* (square-fruited ironbark), *Olearia stilwelliae, Plectranthus suaveolens* and *Leucopogon confertus*. Fauna: Potential habitat may occur for the koala. Species previously recorded near the existing highway in this section include the glossy black cockatoo, powerful owl, yellow-bellied glider, squirrel glider, common planigale, brush-tailed phascogale, spotted-tailed quoll, grey-headed flying-fox and little bent-wing bat. Other species recorded further away from the existing highway that could occur are the rufous bettong, sooty owl, masked owl, wompoo fruit-dove and giant barred frog. Several other species may occur, including the greater broad-nosed bat, hoary wattled bat, golden-tipped bat, Stephens banded snake and stuttering frog.
E	Blue option Green option Purple option Orange option	Flora: The following threatened or locally rare flora species have been recorded within close proximity to the existing highway and therefore have a high potential to occur; *Eucalyptus tetrapleura, Botrychium australe, Lindsaea incisa* and *Brasenia schreberi*. Fauna: Potential habitat may occur for the koala. Species previously recorded near the existing highway include the rufous bettong, yellow-bellied glider, brush-tailed phascogale, powerful owl and square-tailed kite. Other species recorded further away from the existing highway that could occur are the glossy black cockatoo, bush stone-curlew, grey-crowned babbler and squirrel glider. Several other species may occur, including the common planigale, spotted-tailed quoll, grey-headed flying-fox, little bent-wing bat, greater broad-nosed bat, hoary wattled bat, yellow-bellied sheathtail-bat, east-coast freetail-bat and masked owl.

Aquatic habitat

Section	Route option	Aquatic habitat
A	Blue option	These options would avoid impacts to wetlands, including SEPP 14 wetlands, that occur on the eastern side of the highway. The low-lying land in this area supports forest dominated by Melaleuca species, which would likely fit criteria for endangered ecological community listing.
	Green option	
	Purple option	This option would result in clearing of around 27 hectares of potential endangered ecological communities.
	Orange option	This option would result in clearing of around 30 hectares of potential endangered ecological communities.
B	Blue option	This section crosses the Corindi River / Cassons Creek floodplain which is likely to support small patches of floodplain wetlands and floodplain forests, which could include endangered ecological communities. Several creeks will also need to be crossed, but no major wetlands occur.
	Green option	
	Purple option	
	Orange option	
C	Blue option	The only aquatic habitats within the section are several creeks that need to be crossed. There are no known significant aquatic ecological issues associated with these creeks. This option crosses several creeks but does not impact on known significant aquatic ecological habitats.
	Green option	
	Purple option	
	Orange option	
D	Blue option	The main aquatic habitat feature is Halfway Creek. This creek supports small wetlands and floodplain forests which could be endangered ecological communities. No wetland impacts are likely. There is also the possibility that the endangered fish species (listed under the FM Act), Oxleyan Pygmy Perch and Eastern Freshwater Cod could occur.
	Green option	
	Purple option	
	Orange option	
E	Blue option	Duplication of existing and new creek crossings would be necessary but no wetland impacts are likely.
	Green option	
	Purple option	
	Orange option	

Table 1. Contemporary comparative assessment of the biodiversity impacts across all the route options.

Section	Route option	Designated wildlife corridors	Key habitats	DEC reservations	State Forests	Key vegetation types or habitat	Forest ecosystems	Vegetation clearing	TEC clearing	Threatened species.	Aquatic habitats
A	Blue option	Low	Low	Low	Medium	Medium	Medium	Low	Medium	Medium	Low
	Green option	Low	Low	Low	Medium	Medium	Medium	Low	Medium	Medium	Low
	Purple option	Low	Low	Low	Medium	Medium	Medium	Medium	High	Medium	Low
	Orange option	Low	Low	Low	Medium	Medium	Medium	Medium	High	Medium	Low
B	Blue option	Medium	Low	Low	Low	Medium	Medium	Low	Low	Medium	Medium
	Green option	Medium	Low	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium
	Purple option	Medium	Low	Low	Low	Medium	Medium	Low	Low	Medium	Medium
	Orange option	High	Low	Low	Low	Medium	Medium	Medium	Medium	Medium	Medium
C	Blue option	Medium	Low	Low	Medium	Medium	Medium	Medium	Low	Medium	Medium
	Green option	High	Low	Low	High	Medium	Medium	Medium	Low	Medium	Medium
	Purple option	Medium	Low	Low	Low	Medium	Medium	Medium	Low	Medium	Medium
	Orange option	Medium	Low	Low	Low	Medium	Medium	Medium	Low	Medium	Medium
D	Blue option	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium[1]	Medium	High
	Green option	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium[1]	Medium	High
	Purple option	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium[1]	Medium	High
	Orange option	Medium	Medium	Medium	Medium	Medium	Medium	Low	Medium[1]	Medium	High
E	Blue option	Medium	Medium	Low	Medium	High	Low	High	Medium[1]	High	Medium
	Green option	High	Medium	Low	High	High	Low	High	Medium[1]	High	Medium
	Purple option	High	Medium	Low	High	High	Low	High	Medium[1]	High	Medium
	Orange option	High	Medium	Low	High	High	Low	High	Medium[1]	High	Medium

[1] A ranking of medium has been provided for these route options due to the uncertainty of TEC presence and clearing requirements.

In reviewing the contemporary comparative assessment, the best performing option for each of the sections were:

For section A: the blue and green options.
For section B: the blue and purple options.
For section C: the purple and orange option.
For section D: all options were comparable.
For section E: the blue option.

As a result of the analysis, further modifications and refinements were made to the route options to avoid the ecological constraints and to minimise impacts. As noted previously, the preferred route was a combination of the orange, refined orange and blue options.

However, route options were evaluated against other community, environmental and engineering issues. These issues are detailed below.

Hydrology

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR HYDROLOGY. THIS INFORMATION HAS BEEN SUMMARISED FROM THE WOOLGOOLGA TO WELLS CROSSING ROUTE OPTIONS DEVELOPMENT REPORT (OCTOBER 2005) AND WOOLGOOLGA TO WELLS CROSSING PREFERRED ROUTE REPORT (AUGUST 2006).

Hydrology issues

Section	Route option	Length in floodplain	Bridges required	Flood immunity
A	Blue option	N/A	No major bridges required	Major flooding does not occur in section A. Alignment crosses Arrawarra Creek at start of section.
	Green option	N/A		
	Purple option	N/A		
	Orange option	N/A		
B	Blue option	2.7 km	New bridges or major drainage culverts required at Corindi River, Blackadder Gully and Cassons Creek.	One carriageway on existing alignment needs to be raised by 1.5 metres to achieve 20% flood immunity. A new waterway structure would be required at Corindi floodplain to mitigate the impact of the raised alignment.
	Green option	3.0 km	New bridges or major drainage culverts required at Corindi River, Blackadder Gully and Cassons Creek.	The new alignment would be located further downstream across the Corindi floodplain than the existing highway. This is expected to reduce the upstream impact of raising the road and hence be a smaller impact than the raising of the road along the existing alignment.
	Purple option	2.9 km		
	Orange option	2.3 km	No major bridges required	This option is located further upstream, hence reduced flooding impact and less bridging or raising required.
C	Blue option	N/A	No major bridges required	New waterway structures would be required at Dirty Creek and at several minor watercourses.
	Green option	N/A		
	Purple option	N/A		
	Orange option	N/A		
D	Blue option	N/A	No major bridges required	No major flooding issues
	Green option	N/A		
	Purple option	N/A		
	Orange option	N/A		

Section	Route option	Length in floodplain	Bridges required	Flood immunity
E	Blue option	N/A	Two existing bridges at Halfway Creek and Wells Crossing would require replacement to meet design standards. Larger bridges or culverts required across the Halfway Creek floodplain.	No major flooding issues
	Green option	N/A	Larger bridges or culverts required across the Halfway Creek floodplain.	No major flooding issues
	Purple option	N/A		
	Orange option	N/A		

Table 2. Contemporary comparative assessment of the hydrology impacts across all the route options.

Section	Route option	Length in floodplain	Bridges required	Flood immunity
A	Blue option	Low	Low	Low
	Green option	Low	Low	Low
	Purple option	Low	Low	Low
	Orange option	Low	Low	Low
B	Blue option	High	High	High
	Green option	High	High	Medium
	Purple option	High	High	Medium
	Orange option	Medium	Low	Low
C	Blue option	Low	Low	Low
	Green option	Low	Low	Low
	Purple option	Low	Low	Low
	Orange option	Low	Low	Low
D	Blue option	Low	Low	Low
	Green	Low	Low	Low

Section	Route option	Length in floodplain	Bridges required	Flood immunity
	option			
	Purple option	Low	Low	Low
	Orange option	Low	Low	Low
E	Blue option	Low	Medium	Low
	Green option	Low	Medium	Low
	Purple option	Low	Medium	Low
	Orange option	Low	Medium	Low

Noise and vibration

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR NOISE AND VIBRATION. THIS INFORMATION HAS BEEN SUMMARISED FROM THE WOOLGOOLGA TO WELLS CROSSING PRELIMINARY NOISE ASSESSMENT REPORT OCTOBER 2005.

Noise and vibration issues

Section	Route option	Receivers in 500 metres	Weighted noise impact ranking (without mitigation/ with mitigation1)
A	Blue option	136	137.2/137.2
	Green option	136	137.2/137.2
	Purple option	129	128.7/128.7
	Orange option	129	128.7/ 128.7
B	Blue option	147	141.8/ 107
	Green option	144	135.6/ 109
	Purple option	131	140.4/ 123
	Orange option	42	68.5/68.5
C	Blue option	14	17.8/17.8
	Green option	14	16.4/16.4
	Purple option	6	6.4/6.4
	Orange option	6	6.4/6.4
D	Blue option	27	27.1/27.1
	Green option	27	27.9/27.9
	Purple option	27	27.9/27.9
	Orange option	27	27.9/27.9

Section	Route option	Receivers in 500 metres	Weighted noise impact ranking (without mitigation/ with mitigation1)
E	Blue option	40	41.6/41.6
	Green option	35	38.1/38.1
	Purple option	35	38.1/38.1
	Orange option	35	38.1/38.1

[1] Mitigation scenario considered: barrier or low noise pavement at Corindi Beach and barrier at Corindi.

Table 3. Contemporary comparative assessment of the noise and vibration impacts across all the route options.

Section	Route option	Receivers in 500 metres	Weighted noise impact ranking (without mitigation/ with mitigation)
A	Blue option	High	High
	Green option	High	High
	Purple option	Low	Low
	Orange option	Low	Low
B	Blue option	High	High
	Green option	High	Medium
	Purple option	Medium	High
	Orange option	Low	Low
C	Blue option	High	High
	Green option	High	High
	Purple option	Low	Low
	Orange option	Low	Low
D	Blue option	Medium	Low
	Green option	Medium	Medium
	Purple option	Medium	Medium
	Orange option	Medium	Medium
E	Blue option	High	High
	Green option	Medium	Medium
	Purple option	Medium	Medium
	Orange option	Medium	Medium

Social effects

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR SOCIAL & ECONOMIC ISSUES. THIS INFORMATION HAS BEEN SUMMARISED FROM THE WOOLGOOLGA TO WELLS CROSSING ROUTE OPTIONS DEVELOPMENT REPORT (OCTOBER 2005) AND WOOLGOOLGA TO WELLS CROSSING SOCIAL EFFECTS REPORT JUNE 2006.

NB: REFERENCES TO BUSINESSES HAVE NOT BEEN UPDATED AND AS SUCH, THIS ASSESSMENT MAY REFERENCE CLOSED OR RELOCATED BUSINESSES.

Property impacts

Section	Route option	Dwellings in road footprint	Area of properties to be acquired
A	Blue option	8	1.0
	Green option	8	1.0
	Purple option	16	7.8
	Orange option	18	16.1
B	Blue option	41	23.4
	Green option	33	28.5
	Purple option	38	27.7
	Orange option	21	52.5
C	Blue option	31	28.1
	Green option	15	29.3
	Purple option	33	35.1
	Orange option	33	34.8
D	Blue option	61	31.9
	Green option	51	35.8
	Purple option	51	35.8
	Orange option	51	35.8
E	Blue option	28	46.7
	Green option	18	66.8
	Purple option	18	66.8
	Orange option	18	66.8

Changes to accessibility

Section	Route option	Local and highway access
A	Blue option	There are 11 accesses along Section A. Interchange options in this area includes the partial interchange proposed as part of the Sapphire to Woolgoolga project at the start of this section. Likely accessibility impacts to Wedding Bells State Forest, Upper Corindi Road, Darlington Beach Resort, Lorikeet Tourist Park and Home Village and Arrawarra Beach Holiday Park during construction.
	Green option	
	Purple option	
	Orange option	
B	Blue option	There are 25 accesses along Section B. Improved access to Corindi Beach provided by possible grade separated interchange. Interchange options include the extension of Coral Street and Kangaroo Trail Road at Corindi Beach. Improved safety of access provided at all intersections with the upgraded highway. Initially, the crossroad intersection at Corindi may need to be converted to left in / left out on both sides of the highway to maintain safety. Likely changed general access arrangements during construction and operation. Accessibility impacts at Blackadder Gully during construction.
	Green option	There are 25 accesses along Section B. Improved access to Corindi Beach provided by possible grade separated interchange. Interchange options include the extension of Coral Street and Kangaroo Trail Road at Corindi Beach, as the existing cutting on the highway is a suitable location for such an interchange. Initially, the crossroad intersection at Corindi may need to be converted to left in / left out on both sides of the highway to maintain safety. Likely changed general access arrangements during construction and operation. Accessibility impacts at Blackadder Gully and generally for those properties east of the existing highway around Corindi during construction. Potential use of parts of the existing highway as a local access road, allowing some private accesses and intersections to be retained, including possible connection directly to Coral Street. This may involve local traffic being directed through Corindi Beach to access the upgraded highway. The new cross-drainage bridge (essentially relocated Blackadder Gully bridge) on the Corindi floodplain could be utilised as an underpass for the local access road.
	Purple option	There are 25 accesses along Section B. Improved access to Corindi Beach provided by possible grade separated interchange. Interchange options in Section B include the extension of Coral Street and Kangaroo Trail Road at Corindi Beach, as the existing cutting on the highway is a suitable location for such an interchange. The Purple option allows for the rationalisation of intersections and private accesses south of Corindi. Initially, the crossroad intersection at Corindi may need to be converted to left in / left out on both sides of the highway to maintain safety.

Section	Route option	Local and highway access
		Accessibility impacts at Blackadder Gully and generally for those properties east of the existing highway around Corindi during construction. Potential use of parts of the existing highway as a local access road, allowing some private accesses and intersections to be retained, including possible connection directly to Coral Street. This may involve local traffic being directed through Corindi Beach to access the upgraded highway.
	Orange option	All existing accesses would be retained in the Orange option with the existing highway retained as a local access road. Improved access to Corindi Beach provided by possible grade separated interchange. The Orange option also provides the possibility for a consolidated Sapphire to Woolgoolga / Corindi Beach interchange to be located between Upper Corindi Road and Kangaroo Trail Road. Accessibility impacts for properties generally to the west of this option during construction. The existing highway is used in full as a local access road, allowing private accesses and intersections to be retained, and avoids any redirection of local traffic through Corindi Beach.
C	Blue option	There are 11 accesses along Section C. Initially, the four public road intersections and private roads and driveways may be converted to left in / left out only. Initially, an option for access rationalisation at the base of Dirty Creek Range is to combine Dirty Creek Road and Barcoongere Way intersections with a new 600 metre local access road. Ultimately all access to the highway would be via a grade separated interchange. The likely location for an interchange is at the bottom of Dirty Creek Range. This is a suitable location for heavy vehicles from Barcoongere Way and the adjacent quarry to access the highway and for Yuraygir National Park users. Accessibility impacts for isolated rural dwellings both at the base and top of Dirty Creek Range and for logging operations and recreational users at Barcoongere Way during construction. Likely improved safety of access for vehicles, including logging trucks, using Barcoongere Way during operation.
	Green option	Most of the 11 accesses will remain as the existing highway will be retained as a local access road between the vicinity of Barcoongere Way and Falconers Lane. However, ultimately all access to the highway would be via a grade separated interchange. The likely location for an interchange is at the bottom of Dirty Creek Range. This is a suitable location for heavy vehicles from Barcoongere Way and the adjacent quarry to access the highway and for Yuraygir National Park users. Likely changed general access arrangements during construction and operation. Improved safety of access provided at all intersections with upgraded highway. Possible retention of sections of existing highway as a local access road would improve safety for local traffic. Accessibility impacts for isolated rural dwellings both at the base and top of Dirty Creek Range during construction. Possible accessibility impacts for logging operations and recreational users at Barcoongere Way during construction. Severance of portion of Newfoundland State Forest likely to result in access issues for forestry management activities and emergency response operations.

Section	Route option	Local and highway access
	Purple option	Most of the 11 accesses would remain as the existing highway will be retained as a local access road between the start of Section C and around 300 metres south of Range Road. Possible retention of sections of existing highway as a local access road would improve safety for local traffic. Range Road would cross above the new highway and connect to the existing highway which would become a local access road. Ultimately all access to the highway would be via a grade separated interchange. The likely location for an interchange is at the bottom of Dirty Creek Range. This is a suitable location for heavy vehicles from Barcoongere Way and the adjacent quarry to access the highway and for Yuraygir National Park users. Accessibility impacts for rural properties and large blueberry farm along Range Road during construction.
	Orange option	Most of the 11 accesses would remain as the existing highway will be retained as a local access road between the start of Section C and around 300 metres south of Range Road. Range Road would cross above the new highway and connect to the existing highway which would become a local access road. Ultimately all access to the highway would be via a grade separated interchange. The likely location for an interchange is at the bottom of Dirty Creek Range. This is a suitable location for heavy vehicles from Barcoongere Way and the adjacent quarry to access the highway and for Yuraygir National Park users. Likely changed general access arrangements during construction and operation. Improved safety of access provided at all intersections with upgraded highway. Possible retention of sections of existing highway as a local access road would improve safety for local traffic. Accessibility impacts for rural properties and large blueberry farm along Range Road during construction.
D	Blue option	There are 12 accesses along Section D. In a Class M upgrade the proximity of Halfway Creek and Yuraygir State Conservation area would require the local access road to cross the highway to the southern side of the alignment. Possible accessibility impacts for all existing properties and intersections during construction and operation including the Halfway Creek truck stop and motel and rural fire brigade at Lemon Tree Road. The proximity of Halfway Creek and Yuraygir State Conservation Area limit the opportunity for local access roads on the eastern side of the highway. In the Class M scenario a local access road would need to switch sides, requiring a bridge / underpass at or near Grays Road.
	Green option	There are 12 accesses along Section D. In a Class A upgrade the number of access onto the highway will be reduced with the provision of a local access road (using the southbound carriageway of the Halfway Creek duplication and the existing highway) on the northern side of the alignment. Possible accessibility impacts for all existing properties and intersections during construction and operation including the Halfway Creek truck stop and motel and rural fire brigade at Lemon Tree Road. Likely changed general access arrangements during construction and operation. These options would involve the retention of the existing southbound carriageway at the Halfway Creek duplication as a local access road, resulting in many accesses and roads (eg Grays Road and McPhillips Road) remaining unaltered.

Section	Route option	Local and highway access
	Purple option	There are 12 accesses along Section D. In a Class A upgrade the number of access onto the highway will be reduced with the provision of a local access road (using the southbound carriageway of the Halfway Creek duplication and the existing highway) on the northern side of the alignment. Possible accessibility impacts for all existing properties and intersections during construction and operation including the Halfway Creek truck stop and motel and rural fire brigade at Lemon Tree Road. This option would involve the retention of the existing southbound carriageway at the Halfway Creek duplication as a local access road, resulting in many accesses and roads (eg Grays Road and McPhillips Road) remaining unaltered.
	Orange option	There are 12 accesses along Section D. In a Class A upgrade the number of access onto the highway will be reduced with the provision of a local access road (using the southbound carriageway of the Halfway Creek duplication and the existing highway) on the northern side of the alignment. Possible accessibility impacts for all existing properties and intersections during construction and operation including the Halfway Creek truck stop and motel and rural fire brigade at Lemon Tree Road. These options would involve the retention of the existing southbound carriageway at the Halfway Creek duplication as a local access road, resulting in many accesses and roads (eg Grays Road and McPhillips Road) remaining unaltered.
E	Blue option	There are 21 accesses along Section E. Ultimately, local access roads may be required on both sides of the alignment for part of Section E. New bridges would be required for these local access roads to cross Halfway Creek and Wells Crossing. An overpass would be required at Kungala Road connecting new local access roads and Kungala Road to possible grade separated interchanges in Section C or in the Wells Crossing to Iluka Road project. Possible accessibility impacts to highway businesses including Benefield's Rose Farm and general store service station (Kungala Road), and Big Garden Furniture during construction and operation.
	Green option	There are 21 accesses along Section E. Ultimately, local access roads may be required on both sides of the alignment for part of Section E. The existing highway will be used as a local access road from Lemon Tree Road for two kilometres and from Kungala Road to Bald Knob Tick Gate Road. A grade separated interchange may be provided at Luthers Road in the Class M scenario. Likely changed general access arrangements during construction and operation. Potential accessibility impacts, mainly during construction, for those scattered rural properties that would be located to the east of these options. This option involves the construction of new carriageways and the reverting of the existing highway to local access road status. As a result existing access situation for many properties would be unaltered along the existing highway. Acquisition of a portion of Wells Crossing Flora Reserve may result in access issues for forestry management activities and emergency response operations.
	Purple option	
	Orange option	

Community and amenity impacts

Section	Route option	Community severance/ cohesion	Amenity
A	Blue option	A possible local access road between Arrawarra and Corindi Beach may improve community cohesion. Potential community stress impacts caused by changed access, reduced environmental amenity and property acquisition.	Potential for reduced environmental amenity for Darlington Beach Resort and Lorikeet Tourist Park and Home Village due to noise, air quality and visual impacts during construction and operation. For these options, the old Pacific Highway would be re-used as a local access road and would therefore potentially increase traffic volumes in proximity to these developments. The potential visual impact in this area would result from the vegetation clearance required for the widening of the highway to the west.
	Green option		
	Purple option	Provision of a possible local access road between Arrawarra and Corindi Beach may improve community cohesion. Potential stress impacts on members of the community caused by changed access, reduced environmental amenity and property acquisition.	Potential for reduced environmental amenity for Darlington Beach Resort and Lorikeet Tourist Park and Home Village due to noise, air quality and visual impacts during construction and operation. These impacts would be fewer than the Blue and Green options. The potential visual impact would be from vegetation clearing in woodland and state forest to widen the corridor to the west of the existing highway.
	Orange option		The potential visual impact would be from the clearance to the woodland and state forest vegetation to widen the corridor for two new carriageways to the west of the existing highway. Towards the end of this section where this option deviates to the west, a new cleared corridor would be created, introducing a new visual disturbance in the landscape.
B	Blue option	Possible grade separated interchange would improve connection between Kangaroo Trail Road residents and Corindi Beach. Likely increased severance of residences within and immediately surrounding Corindi.	A Corindi Beach grade separated interchange would be a prominent feature. The potential change to the landscape would depend on the interchange location, design and associated landscape treatments. The upgraded highway would be a prominent visual feature at Corindi, where this option continues the existing highway configuration, bisecting this village.
	Green option	Possible grade separated interchange would improve connection between Kangaroo Trail Road residents and Corindi Beach. Likely improved community cohesion within and between Corindi, Blackadder Gully and Corindi Beach.	A Corindi Beach grade separated interchange would be a prominent feature. The potential change to the landscape would depend on the interchange location, design and associated landscape treatments. These options would result in landscape impacts by creating a new cleared corridor through the forested area immediately north east of Corindi, and widening of the existing cleared corridor on the eastern

Section	Route option	Community severance/ cohesion	Amenity
			side towards the end of the section. Overall visual impact likely to be reduced by achieving separation from Corindi.
	Purple option	Possible grade separated interchange would improve connection between Kangaroo Trail Road residents and Corindi Beach. Likely improved community cohesion within and between Corindi, Blackadder Gully and Corindi Beach. Potential perceived isolation of properties located east of these options from Corindi, particularly for those in Blackadder Road.	A Corindi Beach grade separated interchange would be a prominent feature. The potential change to the landscape would depend on the interchange location, design and associated landscape treatments. These options would result in landscape impacts by creating a new cleared corridor through the forested area immediately north east of Corindi, and widening of the existing cleared corridor on the eastern side towards the end of the section. Overall visual impact likely to be reduced by achieving separation from Corindi.
	Orange option	Possible grade separated interchange would improve connection between Kangaroo Trail Road residents and Corindi Beach. Likely improved community cohesion within and between Corindi, Blackadder Gully and Corindi Beach. Potential perceived isolation of properties located east of these options from Corindi, particularly for those in Blackadder Road.	A Corindi Beach grade separated interchange would be a prominent feature. The potential change to the landscape would depend on the interchange location, design and associated landscape treatments. Vegetation clearing would be required, most noticeably in the woodland area west and southwest of Corindi. As this option deviates substantially from the existing highway alignment, it has potential to result in new visual disturbance in the landscape through which it passes.
C	Blue option	No substantial community severance impacts are considered likely. This option may result in minor separation of isolated rural properties along Dirty Creek Road.	This option passes through the relatively steep forested landscape of the Dirty Creek Range. The clearing would vary, with a newly cleared corridor required where the alignment deviates from the existing highway. Embankments in excess of 10 metres high and a cut in excess of 20 metres deep are proposed. These cuts and fills would be prominent features on the landscape. It would also widen the width of clearing required.
	Green option	No substantial community severance impacts are considered likely. This option may create a barrier to movement between rural properties along Dirty Creek Road and Range Road East at the top of Dirty Creek Range.	The majority of this option is located within the steep forested landscape that characterises the Dirty Creek Range, and a new cleared corridor would be created through this landscape for most of this section where the alignment deviates from the existing highway. Fill embankments in excess of 10 metres high are followed by a major cut potentially 40 metres in height around the summit. A series of cut

Section	Route option	Community severance/ cohesion	Amenity
			and fill embankments then occur for the remainder of the section.
	Purple option	No substantial community severance impacts are considered likely.	These options traverse the characteristic forested landscape of the Dirty Creek Range, but also runs along the eastern edge of the extensive blueberry farms along Range Road. Large amounts of cut (around 20 metres) and fill would be required in the crossing of Dirty Creek Range, creating a series of prominent visual features that would be primarily viewed by road users, and possibly from a small number of rural residences.
	Orange option		
D	Blue option	No substantial community severance impacts are considered likely.	No substantial change in environmental amenity for all properties currently fronting the existing highway during operation, and minor impacts during construction. All options would traverse an undulating forested landscape in this section. There are some significant cleared areas for agricultural uses however the only significant cleared areas adjacent to the highway is at Halfway Creek where there is a service station, motel and rural fire brigade shed. Clearing is generally limited to widening of the existing corridor until the existing Halfway Creek duplication. A small amount of cut and fill is required for the majority of the section and would result in a negligible change to the landscape. The number of potential viewers, other than highway users, is relatively low.
	Green option		
	Purple option		
	Orange option		
E	Blue option	No substantial community severance impacts are considered likely. Access across the highway would be restricted and may make it more difficult for properties on the eastern side of the existing highway to access local facilities such as the community hall or service station and general store at Kungala Road.	No likely significant change in environmental amenity for all properties currently fronting the existing highway during operation, and minor impacts during construction. The existing cleared corridor through flat to undulating forested landscape would need to be widened for the majority of this section. Potential viewers in this section are limited to road users and a small number of rural residents.
	Green option	Potential separation of scattered rural properties that would be located to the east of these options. Likely improved consolidation within Halfway Creek locality.	No likely significant change in environmental amenity for properties currently fronting the existing highway generally between Lemon Tree Road and Kungala Road, during operation, and minor impacts during construction. Likely improved environmental amenity for those residences fronting, and on the western side of, the existing highway generally between

Section	Route option	Community severance/ cohesion	Amenity
	Purple option	Potential separation of scattered rural properties that would be located to the east of these options. Likely improved consolidation within Halfway Creek locality.	Halfway Creek and Wells Crossing. Likely reduced environmental amenity for rural residences located to the east of the existing highway generally between Halfway Creek and Wells Crossing - some of which were not previously exposed to the highway. These options would mostly pass through flat to undulating forested landscape. Where these options are located along the existing highway alignment, it would require clearing of vegetation to the west. Parts of the eastern side of the existing highway in this area are already cleared, which would reduce the cleared corridor effect. The proximity of the existing highway to the west may lead to a wider cleared corridor in some locations. Potential viewers in this section are limited to road users and a small number of rural residents.
	Orange option	Potential separation of scattered rural properties that would be located to the east of these options.	

Economic impacts

Section	Route option	Economic infrastructure
A	Blue option	Potential economic benefits to tourist resources including Darlington Beach Resort and Lorikeet Tourist Park and Home Village through improved access safety, although there is potential for some loss of environmental amenity for those located close to the upgraded highway and for minor impacts during construction. No expected impacts on the sewage treatment plant operated by Coffs Harbour City Council in Kangaroo Trail Road.
	Green option	
	Purple option	Potential economic benefits to tourist resources including Darlington Beach Resort and Lorikeet Tourist Park and Home Village through provision of improved safety of access. No expected impacts on the sewage treatment plant operated by Coffs Harbour City Council in Kangaroo Trail Road. Possible economic impacts through loss of forestry lands within Wedding Bells State Forest.
	Orange option	Possible minor impacts to the sewage treatment plant operated by Coffs Harbour City Council in Kangaroo Trail Road due to acquisition of land. Potential economic benefits to tourist resources including Darlington Beach Resort and Lorikeet Tourist Park and Home Village through provision of improved safety of access. Possible economic impacts through loss of forestry lands within Wedding Bells State Forest.

Section	Route option	Economic infrastructure
B	Blue option	Potential to increase road user awareness of Corindi Beach and Red Rock through improved signage where appropriate and access provided by possible grade separated interchange. Possible loss of potential agricultural productivity of rural properties due to land acquisition, in particular at Blackadder Gully. No expected economic impacts to Amble Inn Tavern subject to concept design and location of the possible grade separated interchange for Corindi Beach and possible local access road to Arrawarra. No expected economic impacts to any of the orchards.
	Green option	Potential to increase road user awareness of Corindi Beach and Red Rock through improved signage where appropriate and access provided by possible grade separated interchange. No expected economic impacts to Amble Inn Tavern subject to concept design and location of the possible grade separated interchange for Corindi Beach and possible local access road to Arrawarra. Likely loss of potential agricultural productivity of rural properties including the orchards in Blackadder Road and small blueberry farm north of Corindi.
	Purple option	Potential to increase road user awareness of Corindi Beach and Red Rock through improved signage where appropriate and access provided by possible grade separated interchange. No expected economic impacts to Amble Inn Tavern subject to concept design and location of the possible grade separated interchange for Corindi Beach and possible local access road to Arrawarra. Likely loss of potential agricultural productivity of rural properties. Likely loss of potential agricultural productivity of rural properties located to the east of Corindi and the existing highway generally, including the orchards in Blackadder Road and small blueberry farm north of Corindi.
	Orange option	Potential to increase road user awareness of Corindi Beach and Red Rock through improved signage where appropriate and access provided by possible grade separated interchange. No expected economic impacts to Amble Inn Tavern subject to concept design and location of the possible grade separated interchange for Corindi Beach and possible local access road to Arrawarra. Likely loss of potential agricultural productivity of rural properties located to the west of Corindi and the existing highway generally. Likely economic impacts on the banana plantation, west of existing highway to the north of Corindi.
C	Blue option	Possible minor economic impacts to Newfoundland State Forest (due to acquisition of forestry land) and possibly Barcoongere State Forest (due to accessibility changes during construction). Possible minor tourism impacts for Yuraygir National Park as a result of accessibility changes at Barcoongere Way during construction. Possible minor loss of potentially productive agricultural lands.
	Green option	
	Purple option	Possible economic impacts to blueberry farm through loss of non-productive land and possible restrictions on accessibility during construction.

Section	Route option	Economic infrastructure
	Orange option	Possible minor loss of potentially productive agricultural lands.
D	Blue option	Possible economic impacts for Halfway Creek Truck Stop due to changed access, mainly during construction. Possible minor loss of land within Newfoundland State Forest. Potential minor economic impacts caused by changed access arrangements during construction, and possibly during operation for Rainbow's End Holiday Farm / Mirriyindi Bed and Breakfast (Grays Road) and Bowtech Distributors Australia (McPhillips Road).
	Green option	
	Purple option	
	Orange option	
E	Blue option	Potential economic impacts to highway businesses through changed access arrangements during both construction and operation. Possible minor loss of higher quality agricultural land on the eastern side of the existing highway where this option crosses Halfway Creek, although the majority of this land is heavily vegetated. Subject to concept design, likely economic impacts to the service station and general store (Kungala Road) due to property acquisition and changed access, and indirectly to Benefields Rose Farm (orchard) (Kungala Road), which uses the service station site as a shop front for passing and other trade. Economic impacts due to possible relocation or closure of Bananacoast 24hr Heavy Float and Tow Truck Service. Possible minor economic impacts to Big Garden Furniture due to changed access arrangements. Possible minor economic impacts to operations within Glenugie State Forest as a result of acquisition of productive lands.
	Green option	Likely business impacts for highway businesses (Benefields Rose Farm, service station and general store (Kungala Road), Big Garden Furniture and Bananacoast 24hr Heavy Float and Tow Truck Service) by separation from highway through traffic. Possible minor loss of higher quality agricultural land on the eastern side of the existing highway where this option crosses Halfway Creek, although the majority of this land is heavily vegetated. Possible minor impacts to Big Garden Furniture as a result of property acquisition. Possible minor economic impacts to operations within Glenugie State Forest as a result of acquisition of productive lands.
	Purple option	
	Orange option	

Table 4. Contemporary comparative assessment of the socio and economic impacts across all the route options.

Section	Route option	Property impacts	Changes to accessibility	Community and amenity issues	Economic impacts
A	Blue option	Low	Low	Medium	Low
	Green option	Low	Low	Medium	Low
	Purple option	Medium	Low	Low	Medium
	Orange option	High	Low	High	High
B	Blue option	Low	Low	High	Medium
	Green option	Medium	Low	Medium	Medium
	Purple option	Medium	Medium	High	High
	Orange option	High	Medium	High	High
C	Blue option	Low	Medium	Medium	High
	Green option	Medium	High	High	High
	Purple option	High	Medium	Medium	Medium
	Orange option	High	Medium	Medium	Medium
D	Blue option	Medium	High	Low	High
	Green option	High	High	Low	High
	Purple option	High	High	Low	High
	Orange option	High	High	Low	High
E	Blue option	Medium	High	Medium	High
	Green option	High	Low	Medium	High
	Purple option	High	Low	Medium	High
	Orange option	High	Low	High	High

Cultural heritage

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR ABORIGINAL HERITAGE ISSUES. THIS INFORMATION HAS BEEN SUMMARISED FROM THE WOOLGOOLGA TO WELLS CROSSING ROUTE OPTIONS DEVELOPMENT REPORT (OCTOBER 2005).

Heritage impacts

Section	Route option	Aboriginal heritage sites and cultural places
A	Blue option	No known heritage items within or in immediate proximity of this section. The entire coastal zone is an area of high heritage potential, particularly in undisturbed areas, around watercourses and swamps. Midden sites have potential to occur in association with present or remnant water sources in the coastal zone. Much of the land in the southern part of this section contains areas of cultural sensitivity to the local Aboriginal community. All options would traverse corridors of movement along the existing highway alignment, but are not expected to affect a historical campsites or men's ceremonial place.
	Green option	
	Purple option	
	Orange option	
B	Blue option	There are no known heritage items within or in the immediate proximity of these options. Artefacts have been recorded adjacent to these options on a hill-slope bordered by Corindi River and Coral Street, which are not listed on the AHIMS register. The entire coastal zone is an area of high heritage potential, particularly in undisturbed areas, around watercourses and swamps. Midden sites have potential to occur in association with present or remnant water sources in the coastal zone. The potential also exists for sites within older sediment deposits of the Corindi River floodplain. The entire area generally encompassed by the study area boundaries, Corindi and Corindi Beach, is an area of high cultural sensitivity to the local Aboriginal community. Sensitive sites within this area include a massacre site, burials, corridors of movement, campsites, and sacred men's and women's sites and story places. This option would traverse or pass along the edge of a number of these sensitive sites, generally in the vicinity of the existing highway alignment.
	Green option	
	Purple option	
	Orange option	There are no known heritage items within this option. However, artefacts from site #22-1-0076 may extend to within close proximity of this option. The entire coastal zone is an area of high heritage potential, particularly in undisturbed areas, around watercourses and swamps. Midden sites have potential to occur in association with present or remnant water sources in the coastal zone. The potential also exists for sites within older sediment deposits of the Corindi River floodplain. The entire area generally encompassed by the study area boundaries, Corindi and Corindi Beach, is an area of high cultural sensitivity to the local Aboriginal community. The area traversed by this option north of Kangaroo Trail Road to the Corindi River contains an area of known burials.
C	Blue option	There are no known heritage items within or in the immediate proximity of the options. High potential for stone artefacts to occur, particularly in undisturbed ground and around watercourses. Generally low potential for other types of Aboriginal objects.
	Green option	
	Purple option	
	Orange option	

Section	Route option	Aboriginal heritage sites and cultural places
D	Blue option	One indigenous heritage item listed on the AHIMS register, an isolated artefact (DEC site #13-4-0092) occurs within or in close proximity to these options in the vicinity of the existing Halfway Creek duplication. There is a high potential for stone artefacts to occur in a widespread distribution, particularly in undisturbed areas and around watercourses. An area of this section generally bounded by the start of the section, Grays Road and the study area boundaries, contains sites of cultural sensitivity to the local Aboriginal community including a number of historical campsites. All options traverse this area generally along the existing highway alignment.
	Green option	
	Purple option	
	Orange option	
E	Blue option	There are no known heritage items within or in the immediate proximity of this option. There is a high potential for stone artefacts to occur in a widespread distribution, particularly in undisturbed areas and around watercourses. Within this section areas of cultural sensitivity to the local Aboriginal community include two travel routes (that traverse the study area) and associated campsites, and a ceremonial site. This option would traverse the two travel routes. Within this section there are two parcels of land vested in Grafton-Ngerrie LALC under the Aboriginal Land Rights Act 1983, both of which are located adjacent to the eastern edge of the existing highway. This option may involve acquisition of one parcel of land located immediately south of Luthers Road.
	Green option	There are no known heritage items within or in the immediate proximity of this option. There is a high potential for stone artefacts to occur in a widespread distribution, particularly in undisturbed areas and around watercourses. Within this section areas of cultural sensitivity to the local Aboriginal community include two travel routes (that traverse the study area) and associated campsites, and a ceremonial site. This option would traverse the two travel routes. This option would pass in the vicinity of the ceremonial site in the vicinity of Halfway Creek. Within this section there are two parcels of land vested in Grafton-Ngerrie LALC under the Aboriginal Land Rights Act 1983, both of which are located adjacent to the eastern edge of the existing highway. This option may involve acquisition of one parcel of land located around 200 metres north of Luthers Road.
	Purple option	
	Orange option	

Table 5. Contemporary comparative assessment of the heritage impacts across all the route options.

Section	Route option	Aboriginal heritage impacts
A	Blue option	Medium
	Green option	Medium
	Purple option	Medium
	Orange option	Medium
B	Blue option	Medium
	Green option	Medium
	Purple option	Medium
	Orange option	High
C	Blue option	Medium
	Green option	Medium
	Purple option	Medium
	Orange option	Medium
D	Blue option	High
	Green option	High
	Purple option	High
	Orange option	High
E	Blue option	Medium
	Green option	High
	Purple option	High
	Orange option	High

Functional and design characteristics

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR FUNCTIONAL ISSUES. THIS INFORMATION HAS BEEN SUMMARISED FROM THE WOOLGOOLGA TO WELLS CROSSING ROUTE OPTIONS DEVELOPMENT REPORT (OCTOBER 2005) AND WOOLGOOLGA TO WELLS CROSSING PREFERRED ROUTE REPORT (AUGUST 2006).

Functional issues

Section	Route option	Length	Ability to stage construction	Constructability	Cost ($M) (class A / class M)
A	Blue option	3.5 km	Section A can be constructed independently from the remaining other sections. Staged construction between Class A and Class M may be possible within Section A.	Poor due to the significant portions of reconstruction on the existing alignment. High potential for impact on public utilities.	30/35
	Green option	3.5 km		Good as a large proportion of the new construction would be separate to the existing highway.	30/35
	Purple option	3.5 km			40/50
	Orange option	3.5 km		Good as constructed separate to the existing highway. Minimal impact on public utilities.	35/40
B	Blue option	5.6 km	Section B can be built entirely independent of the other sections. The realignment between Coral Street and Corindi can be constructed independently to the duplication of the remainder of Section B.	Poor due to the significant portions of reconstruction on the existing alignment. High potential for impact on public utilities.	105/120
	Green option	5.7 km	Section B can be constructed independently to the other sections. The duplication to Coral Street can also be constructed independently to the new alignment north of Corindi that in turn can be constructed independently to the realignment for the remainder of Section B.	Reasonable as a large proportion of the new construction would be separate to the existing highway. Moderate potential for impact on public utilities. New alignment across Corindi floodplain may require preload embankments for soft soil conditions. Given this is away from the existing highway there will be minimal impact on through traffic during construction.	100/105
	Purple option	5.6 km	Section B can be constructed independently from the other sections. Construction of the highway within Section B cannot be staged.	Reasonable as a large proportion of the new construction would be separate to the existing highway. Moderate potential for impact on public utility plant. To the north of Corindi, this	95/115

Section	Route option	Length	Ability to stage construction	Constructability	Cost ($M) (class A / class M)
				option presents traffic management issues, as the existing highway is reconstructed. Skew on Blackadder Gully bridge may present a less than optimum construction solution.	
	Orange option	5.3 km		Good as constructed separate to the existing highway. Minimal impact on public utilities plant, apart from fibre optic cable crossings.	85/90
C	Blue option	4.4 km	Section C can be built independently to the other sections. Staging of construction activities within Section C may not be possible.	Constructability of this option is poor due to the lengths requiring reconstruction and traffic switches at three locations. Up to 20 metres cuts and fills on Dirty Creek Range. Potential impact on public utility plant.	45/55
	Green option	4.1 km		Constructability of this option is reasonable as a large proportion of the new construction is separate to the existing highway carriageway. This alignment requires cuts of up to 40 metres depth through the range, which will require consideration of cutting instability.	55/60
	Purple option	4.6 km		Constructability is poor at top of Dirty Creek Range due to portions of existing highway requiring reconstruction. Up to 22 metre cuts and shallower fills.	55/65
	Orange option	4.6 km			
D	Blue option	5.8 km	Section D can be built independently to the other sections. Staging of the duplication within Section D is possible. An initial upgrade to Class A may be possible.	Constructability is good because a large proportion of the new construction is separate to the existing highway carriageway and does not require reconstruction of southern carriageway of the Halfway Creek duplication tie-in.	30/40
	Green option	5.8 km			55/80
	Purple option	5.8 km			55/80
	Orange option	5.8 km			55/80
E	Blue option	7.8 km	Section E can be constructed independently from the other sections. Construction within Section E may be suitable for staging.	Constructability of this option is poor due to the significant portions of reconstruction on the existing alignment. High potential for impact on public utility plant. Swamp area to the east of the	75/100

Section	Route option	Length	Ability to stage construction	Constructability	Cost ($M) (class A / class M)
				highway opposite Kungala Road and across Halfway Creek likely to be poor foundation conditions.	
	Green option	7.8 km		Constructability of these options is reasonable as most of the new construction is separate to the existing highway carriageway. Swamp area to the east of the highway opposite Kungala Road and across Halfway Creek likely to be poor foundation conditions.	75/85
	Purple option	7.8 km			
	Orange option	7.8 km			

Table 6. Contemporary comparative assessment of the functional issues across all the route options.

Section	Route option	Length	Ability to stage construction	Constructability	Cost estimate ($M) (class A / class M)
A	Blue option	Low	Low	High	Low
	Green option	Low	Low	Low	Low
	Purple option	Low	Low	Low	High
	Orange option	Low	Low	Low	Medium
B	Blue option	Medium	Low	High	High
	Green option	Medium	Low	Medium	Medium
	Purple option	Medium	Low	Medium	Medium
	Orange option	Low	Low	Low	Low
C	Blue option	Medium	Low	High	Low
	Green option	Low	Low	Medium	Medium
	Purple option	High	Low	High	High
	Orange option	High	Low	High	high
D	Blue option	Low	Low	Low	Low
	Green option	Low	Low	Low	High
	Purple option	Low	Low	Low	High
	Orange option	Low	Low	Low	High
E	Blue option	Low	Low	High	High
	Green option	Low	Low	Medium	Medium
	Purple option	Low	Low	Medium	Medium
	Orange option	Low	Low	Medium	Medium

Summary conclusion

A summary of the comparative assessments across all environmental issues is detailed below.

This shows that overall, the orange option had high impacts across most environmental considerations while the green and red options had mostly low impacts. While the purple option consistently had medium impacts across the entire range of environmental issues.

Section	Issue	Blue option	Green option	Purple option	Orange option
A	Biodiversity	Medium	Medium	High	High
	Hydrology	Low	Low	Low	Low
	Noise	High	High	Low	Low
	Social effects	Low	Low	Medium	High
	Cultural heritage	Medium	Medium	Medium	Medium
	Functional and design	High	Low	High	Medium
B	Biodiversity	Medium	Medium	High	High
	Hydrology	High	High	High	Medium
	Noise	High	Medium	Medium	Low
	Social effects	Medium	Low	High	High
	Cultural heritage	Medium	Medium	Medium	High
	Functional and design	High	Medium	Medium	Low
C	Biodiversity	Medium	High	Medium	Medium
	Hydrology	Low	Low	Low	Low
	Noise	High	High	Low	Low
	Social effects	Low	High	Medium	Medium
	Cultural heritage	Medium	Medium	Medium	Medium
	Functional and design	Medium	Low	High	High
D	Biodiversity	Medium	Medium	Medium	Medium
	Hydrology	Low	Low	Low	Low
	Noise	Low	Medium	Medium	Medium
	Social effects	Medium	High	High	High
	Cultural heritage	High	High	High	High
	Functional and design	Low	Medium	Medium	Medium
E	Biodiversity	Medium	High	High	High
	Hydrology	Medium	Medium	Medium	Medium
	Noise	High	Medium	Medium	Medium
	Social effects	High	Medium	Medium	High
	Cultural heritage	Medium	High	High	High
	Functional and design	High	Medium	Medium	Medium

Development of the route options

A Value Management workshop was held in March 2006 which reviewed the outcomes of the investigations and community feedback, and considered the options against the agreed criteria:

- Functional
- Social and economic
- Natural and cultural environment.

The participants to the Value Management workshop included Roads and Maritime Services (then RTA), the project team and representatives of Council, government agencies, local Aboriginal Land Councils and Community Liaison Groups.

The workshop recommended that the orange option required further investigation of a number of issues (including impacts on Aboriginal heritage and ecology) and should be pursued with the following refinements:

- Between Corindi River and Range Road: Straighten the option on a new alignment, rather than connecting back to the existing highway
- Near Kungala Road and Luthers Road: Locate the option closer to the existing highway to minimise vegetation loss.

The project team developed a 'refined orange option' based on these refinements, and further engineering, ecological and heritage investigations were undertaken.

The project team then undertook a route selection workshop that analysed the four original short listed route options and the refined orange option to select a preferred route. The route options were analysed against functional, community and environment criteria to satisfy the Pacific Highway Upgrade Program objectives. The route options were then considered in conjunction with a construction cost estimate to determine which option would provide the best value.

The preferred route was selected based on a balance of community feedback, outcomes of the value management workshop and Roads and Maritime Services' own technical investigations and review. The preferred route option for each section is identified in the following sections (and shown in Figure 2).

Section A

The orange option was selected for section A. It was considered to be better to the other options because it would:

- Re-use the existing highway as a southbound carriageway in a class A upgrade scenario
- Make maximum use of the existing road reserve
- Allow for the staged construction of the highway upgrade over time to better suit traffic growth and demand
- Result in similar potential noise impact relative to the existing highway for those residential receivers located within a 500-metre radius of the existing highway
- Represent the best value for money overall.
- However, this option would potentially impact potential habitat for the Commonwealth listed threatened species Koala and Oxleyan Pygmy Perch.

Sections B and C

In sections B and C, the refined orange and orange options were chosen for further investigation to minimise the impacts on biodiversity, agricultural land and rural residential properties. This combination of options resulted in the identification of a localised wider corridor across the Corindi River floodplain. This combination of options was considered to be superior to the other options in section B because it would:

- Provide the opportunity to select a preferred road alignment with the shortest travel time for both light and heavy vehicles up the ascent of Dirty Creek Range

- Present the lowest engineering risk as it would involve the shortest crossing of the Corindi floodplain and areas of soft soils. This would result in the shortest length of bridging for floodwater mitigation and areas requiring soft soil treatment
- Have some ecological impacts, for which mitigation can be provided
- Have the lowest overall noise impact on communities
- Have the least impact in terms of severance through the townships of Corindi and Corindi Beach (ie would have the greatest separation between the proposed road corridor and these residential areas)
- Avoid key areas of known cultural sensitivity
- Potentially better satisfy overall community expectations
- Allow the existing highway to be used as a local access road and minimise the need to build new local roads
- Represent the best value for money overall.
- Similarly, this combination of options was considered to be superior to the other options in section C because it would:
- Provide the opportunity to select a preferred road alignment with the shortest travel time for both light and heavy vehicles up the ascent of Dirty Creek Range
- Present the lowest engineering risk as it would minimise the extent of areas involving the widening of existing cuttings under traffic
- Have the lowest overall noise impact
- Not impact on Newfoundland State Forest
- Result in the lowest overall capital cost when combined with the preferred route in section B
- Represent the best value for money overall.

Section D

In section D, the blue option was selected as the preferred route because it would:

- Maximise the use of existing assets (particularly the Halfway Creek duplication) and those sections of the existing highway that comply with the design standards for the Pacific Highway Upgrade
- Represent the best value for money overall.

Section E

A combination of blue, refined orange and orange options was selected for further investigation in section E, due to a number of identified constraints.

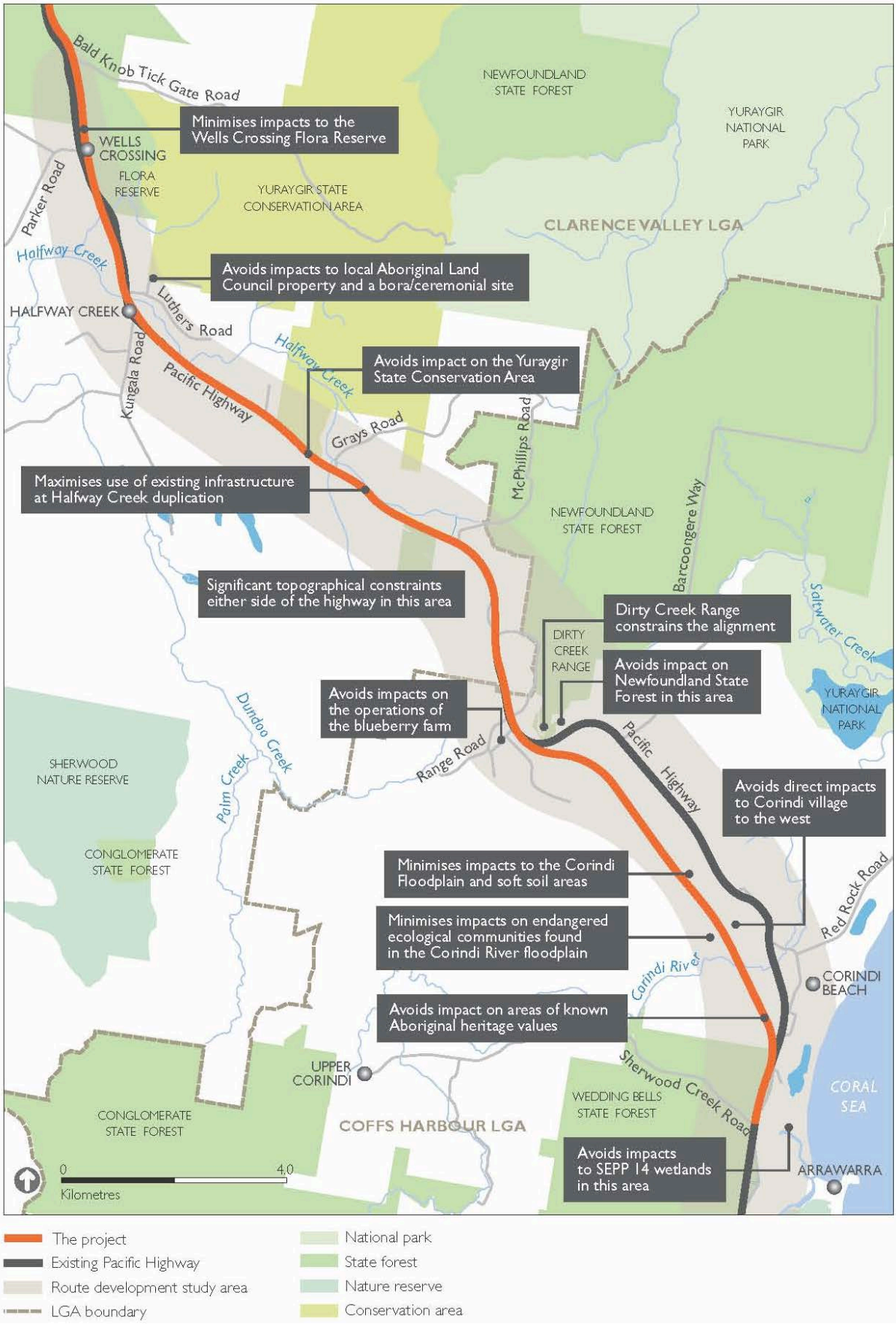

Figure 2: Preferred route for Woolgoolga to Wells Crossing

Wells Crossing to Iluka Road project

THIS IS A SUMMARY OF THE ROUTE OPTIONS PROCESS, FOCUSING ON ENVIRONMENTAL IMPACTS. THIS INFORMATION HAS BEEN SUMMARISED FROM THAT CONTAINED IN THE ROUTE OPTIONS WORKING PAPERS (SEPTEMBER 2006).

THIS INFORMATION IS AS PER THE ROUTE OPTIONS ASSESSMENT UNDERTAKEN. THREATENED SPECIES AND POTENTIAL IMPACTS DISCUSSED ARE THOSE CONSIDERED DURING THAT PROCESS, AT THAT TIME.

TO AID UNDERSTANDING OF THE IMPACTS AND IDENTIFY THE BEST PERFORMING OPTION, THE ROUTE OPTION IMPACTS HAVE BEEN DISTILLED INTO A HIGH, MEDIUM AND LOW RANKING.

THE PROCESS OF RANKING IS THE ONLY ADDITIONAL/NEW WORK THAT HAS BEEN UNDERTAKEN.

Route selection process

A comprehensive route options and selection process was undertaken to identify the preferred route between Wells Crossing to Iluka Road. Possible alignments were identified through preliminary investigations within the study area, mapping of constraints and through the application of the Pacific Highway upgrade program design standards. Between Wells Crossing and Harwood Bridge, four short listed route options were identified from the long list of possible route corridors. These were known as the orange (A), purple (B), green (C) and red (D) options (refer to Figure 3). These alignments were reviewed in performance against social, environmental and design criteria. Options suggested by the community were also considered.

The route option assessment considered community, environmental and engineering issues. This consideration included Matters of National Environmental Significance (under the EPBC Act) that had potential to occur within the study area.

The route option which performed best overall was the purple option, which was progressed through to the preferred route stage.

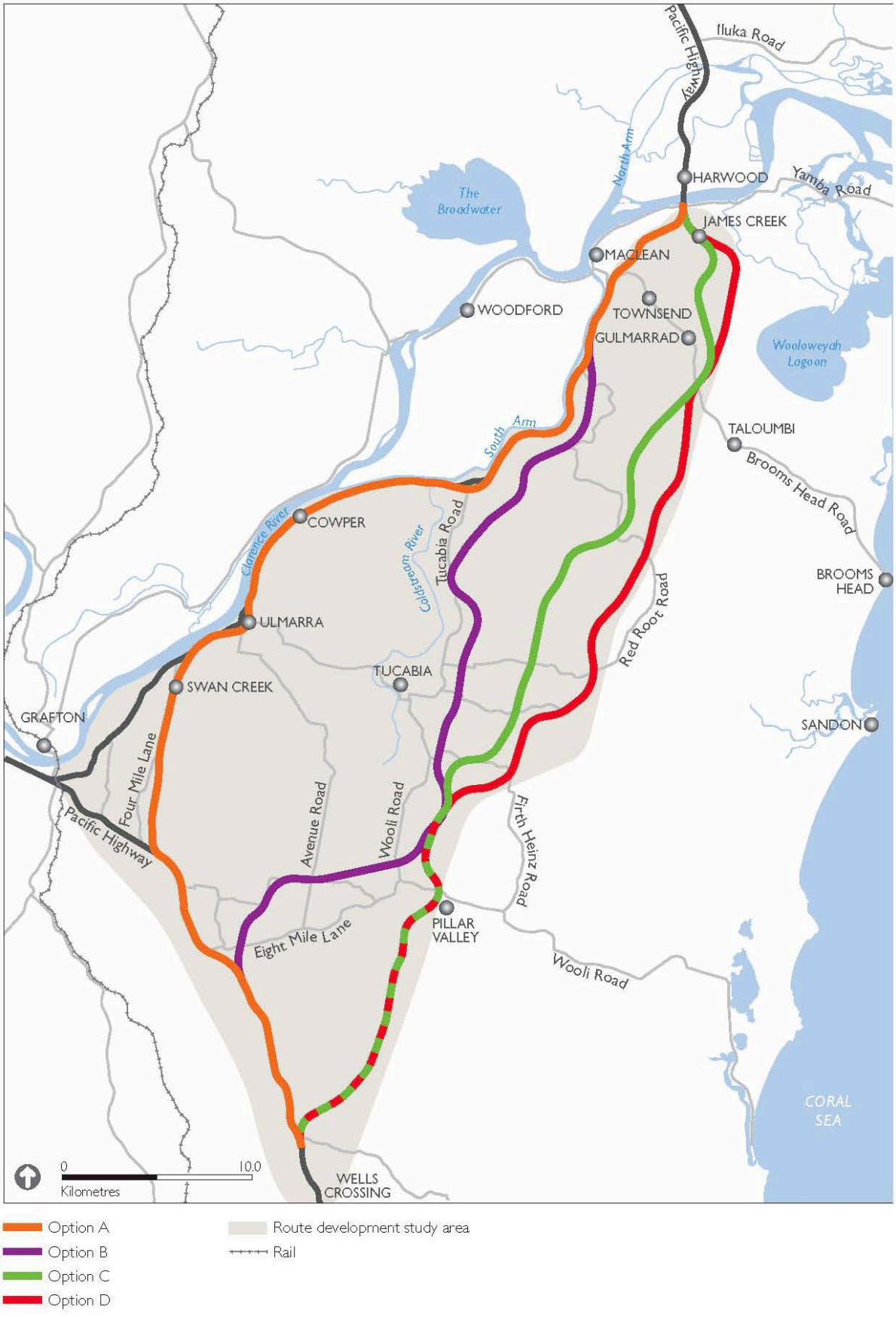

Figure 3: Shortlisted route options Wells Crossing to Iluka Road

Biodiversity

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION AGAINST BIODIVERSITY ISSUES. THIS INFORMATION HAS BEEN SUMMARISED FROM THAT CONTAINED IN THE WELLS CROSSING TO ILUKA ROAD BIODIVERSITY WORKING PAPER SEPTEMBER 2006.

How MNES were considered during the route options evaluation

The ecological investigations targeted and sought to identify vegetation and habitat representing the following criteria:

- Vegetation characteristics of an Endangered Ecological Community as listed under the NSW TSC Act or Commonwealth EPBC Act.
- Vegetation of regional and local rarity and conservation significance.
- Habitat for threatened and significant flora species.
- Terrestrial fauna habitat of regional conservation value and considered locally important for threatened fauna species.
- Locations of known and potential wildlife corridor and fauna movement avenues.

The list of threatened EPBC Act terrestrial flora and fauna species considered as part of the route options were:

- *Rutidosis heterogama* V
- *Eucalyptus tetrapleura* V
- *Grevillea quadricauda* V
- *Melichrus hirsutus* E
- *Quassia sp. 'Moonee Creek'* E
- *Lindsaea incisa* E
- *Lindsaea fraseri* E
- *Petrogale penicillata* Brush tailed Rock Wallaby E
- *Burhinus grallarius* Bush Stone Curlew V
- *Cyclopsitta diophthalma coxeni* Double- eyed Fig-Parrot E
- *Mixophyes iterates* Giant Barred Frog E
- *Litoria aurea* Green and Golden Bell Frog E
- *Pteropus poliocephalus* Grey-headed Flying-fox V
- *Sterna albifrons* Little Tern E
- *Xanthomyza phyrygia* Regent honeyeater E
- *Erythrotriorchis radiates* Red Goshawk E
- *Mixophyes balbus* Stuttering Frog V
- *Lathamus discolour* Swift Parrot E

In addition, there were a number of other species considered that were only TSC Act listed at the time of the route options, but have subsequently been listed under the EPBC Act. These include:

- *Prostanthera palustris*.
- *Botaurus poiciloptilus* Australian Bittern.
- *Phascolarctos cinereus* Koala.
- *Chalinolobus dwyeri* Large-eared Pied Bat.
- *Potorous tridactylus* Long-nosed Potoroo.
- *Litoria olongburensis* Olongburra Frog.

These species were identified through database searches and previous reports undertaken in the area. Field investigations were undertaken across the entire project study area through priority areas. Over 200 sites were sampled to identify the conservation values at each site. Conservation values included vegetation structure and plant species diversity, naturalness, age structure, patch size and connectivity, representativeness, disturbance condition, potential or known threatened species habitat and flora and fauna habitat values. Only one threatened EPBC Act listed flora species was identified through field investigations (*Eucalyptus tetrapleura*).

All NSW listed aquatic species were considered and assessed for their likelihood of occurrence. This assessment that there were only two EPBC Act listed species with a moderate to high likelihood of occurrence in the study area. These were:

- *Maccullochella ikei* Eastern Freshwater Cod E
- *Nannoperca oxleyana* Oxleyan Pygmy Perch E

Flora and fauna habitat across the study area was also assessed. This included habitat for EPBC Act listed species and Wetlands of National Importance. Habitats identified across the study area were:

- Open forest and woodland
- Riparian habitats
- Swamp forests
- Wetland, lagoons and estuarine habitat
- Aquatic habitats
- Estuarine mangrove forest and
- Modified grasslands and pastures.

The EPBC Act listed species were considered as well as NSW listed species throughout the route options evaluation process including as part of the Value Management and Route selection workshop. As a result of these identified impacts, further modifications and refinements were made to the route options to better understand the ecological constraints and to minimise impacts.

The comparison of route options was based on the assessment of impacts of each option on:

- SEPP 14 wetlands.
- Conservation reserves (Nature Reserves and State Conservation Areas).
- Conservation zones within state forests (flora reserves and land within special management zones).
- Endangered ecological communities.
- High quality flora and fauna habitats and wildlife corridors.
- High quality stream habitats.

Conservation reserves

Route option	Total area of impact	Comment
Orange/A option	1.4 ha	Impacts would be on the edge of Yaegl Nature Reserve associated with widening of the existing road reserve
Purple/B option	1.4 ha	Impacts would be on the edge of Yaegl Nature Reserve associated with widening of the existing road reserve
Green/C option	Nil	N/A
Red/D option	Nil	N/A

Conservation zones within state forests

Route option	Total area of impact	Comment
Orange/A option	14 ha	Primarily edge effects associated with widening of the existing highway road reserve, which would result in encroachment into the Glenugie State Forest.
Purple/B option	12 ha	Primarily edge effects associated with widening of the existing highway road reserve, which would result in encroachment into the Glenugie State Forest.
Green/C option	5 ha	Severance of conservation zones within both Glenugie and Pine Brush state forest
Red/D option	3 ha	Severance of conservation zones within Glenugie State Forest

SEPP 14 wetlands

Route option	Total area of impact	Comment
Orange/A option	0.6 ha	Minor edge effect on the SEPP 14 wetland at Yaegl Nature Reserve- avoidable by minor re-alignment of this option
Purple/B option	0.6 ha	Minor edge effect on the SEPP 14 wetland at Yaegl Nature Reserve- avoidable by minor re-alignment of this option
Green/C option	3.6 ha	Direct impact through the Shark Creek SEPP 14 wetland- potential to minimise impacts is limited to narrowing of the road footprint.
Red/D option	nil	Nil

Endangered ecological communities

Route option	Total area of impact (ha)						Total area impact (ha)
	Swamp sclerophyll	Swamp oak floodplain	Subtropical coastal floodplain	Freshwater wetlands on coastal floodplain	Lowland rainforest on floodplain	Coastal saltmarsh	
Orange/ A option	21	12	32	N/A	N/A	N/A	66
Purple/B option	97	15	141	N/A	N/A	N/A	253
Green/C option	30	13	91	10	N/A	N/A	144
Red/D option	54	38	144	8	N/A	N/A	244

High quality flora and fauna habitat and fauna corridors

Route option	Around area of vegetation impact (ha)	Comment	Comparative assessment
Orange/A option	10	Potential for removal of *Eucalyptus tetrapleura* Impact, but not a significant impact to known population of *Macadamia tetrapleura* Potential for *Phaius australis* Black necked stork recorded to west of existing highway during periods of flood No significant impacts to wildlife corridors Wildlife 'black spot' on existing highway between Yaegl Nature Reserve and habitat to the north of Maclean.	Low
Purple/B option	100	Potential for removal of *Eucalyptus tetrapleura* Passes through habitat suitable for *Melaleuca irbyana* Potential for *Phaius australis* and *Olax angulata* Potential to impact on a known population of *Macadamia tetraphylla* Passes along western foothills of the Coastal Range that exhibit high quality key fauna habitats. Significant aquatic habitats are present along parts of Chaffin Creek. Several threatened fauna species expected to occur. In particular: Brush-tailed Phascogale, Rufous bettong, squirrel glider, Powerful owl, masked owl and microchiropteran bats. There are numerous records of the coastal emu The area between Pillar Valley and Tucabia represent a significant movement avenue for emus from the Yuraygir National Park to the wetlands. The Coldstream wetlands are a significant nesting area for the black necked stork- not directly impacted by this option, but passes in proximity. North south regional wildlife corridor connecting Pine Brush State Forest to the Glenugie State Forest. This option follows a portion of this corridor	Medium
Green/C option	255	Passes through large areas of remnant and regrowth native vegetation across the majority of its length Impacts to known populations of *Eucalyptus tetrapleura* Potential for suitable habitat for *Hibbertia marginata* and *Rutidosis heterogama* and *Melichrus hirsutus*. Passes through rainforest pockets including areas of Subtropical Coastal Floodplain forest, with the potential for *Quassia Moonee Creek*, *Austromyrtus fragrantissima* and *Endiandra hayesii* Potential also for *Phaius australis* and *Olax angulata* Passes through small sections of moist forest types with the potential for threatened rainforest species. Regionally significant flora and fauna habitat for several threatened flora species that could occur. Including Brush-tailed	High

Route option	Around area of vegetation impact (ha)	Comment	Comparative assessment
		Phascogale, forest owls, Koala, Rufous bettong and squirrel glider Forest are contiguous and in good quality providing significant opportunities for wildlife movement north and south along the ranges and to Tyndale Swamp and Coldstream River habitat. Significant regional corridor linking Yamba to Tyndale Swamp and Pine Brush State Forest and down to Coldstream River would be intersected in three locations, which is important for the coastal emu. The option dissects at least five regional wildlife corridors. Directly impacts on a large portion of the habitat of the emu population and would result in the reduction, fragmentation and isolation of habitat. Direct impacts to significant floodplain swamps and wet meadows that provide habitat for frog species, including the Wallum froglet. These could also provide important refuge areas for fauna during drought and fire and provide potential breeding habitat for the Black-necked stork and Brolga.	
Red/D option	220	Passes through large areas of remnant and regrowth native vegetation across the majority of its length, with the overall potential impact to threatened species being similar to the green option. Impacts to known populations of *Eucalyptus tetrapleura* Potential for suitable habitat for *Hibbertia marginata* and *Rutidosis heterogama* and *Melichrus hirsutus*. Passes through rainforest pockets including areas of Subtropical Coastal Floodplain forest, with the potential for *Quassia Moonee Creek*, *Austromyrtus fragrantissima* and *Endiandra hayesii* Potential also for *Phaius australis* and *Olax angulata* Passes through small sections of moist forest types with the potential for threatened rainforest species. Regionally significant flora and fauna habitat for several threatened flora species that could occur. Including Brush-tailed Phascogale, forest owls, Koala, Rufous bettong and squirrel glider Forest are contiguous and in good quality providing significant opportunities for wildlife movement north and south along the ranges and to Tyndale Swamp and Coldstream River habitat. Significant regional corridor linking Yamba to Tyndale Swamp and Pine Brush State Forest and down to Coldstream River would be intersected in three locations, which is important for the coastal emu. The options dissects at least five regional wildlife corridors. Directly impacts on a large portion of the habitat of the emu population and would result in the reduction, fragmentation and isolation of habitat. Direct impacts to significant floodplain swamps and wet meadows that provide habitat for frog species, including the Wallum froglet. These could also provide important refuge areas for fauna during drought and fire and provide potential breeding habitat for the Black-necked stork and Brolga.	High

Aquatic habitats

Route option	Waterway type	No. of crossings	Comment
Orange/A option	Class 1	6	Most of the waterways were assessed to exhibit poor environmental condition as a result of poor riparian zones While the floodplain holds a complex of wetlands and waterways Option has a low potential of impact on aquatic ecology provided appropriate pollution control mechanisms are maintained during construction. The risk of major impacts to broader aquatic ecological systems is considered to be minimal.
	Class 2	8	
	Class 3	5	
	Class 4	32	
Purple/B option	Class 1	5	Waterways were assessed to exhibit mixed environmental conditions from good to poor Large significant pools within Coldstream River and Chaffin Creek that could have habitat for Eastern Cod however, is considered unlikely. As the option crosses the middle reaches of most streams, impacts have the potential to extend well downstream to streams in good conditions.
	Class 2	7	
	Class 3	7	
	Class 4	42	
Green/C option	Class 1	6	The option crosses the upper reaches of streams, which as a rule exhibit better stream conditions due to the retention of the riparian zone and instream habitat. While it is unlikely that threatened fish species are present, there might be a likelihood that the endangered butterfly *Petalura gigantea* and the OPP may exist along the corridor.
	Class 2	9	
	Class 3	16	
	Class 4	58	
Red/D option	Class 1	4	The option crosses the upper reaches of streams, which as a rule exhibit better stream conditions due to the retention of the riparian zone and instream habitat. While it is unlikely that threatened fish species are present, there might be a likelihood that the endangered butterfly *Petalura gigantea* and the OPP may existing along the corridor.
	Class 2	14	
	Class 3	33	
	Class 4	39	

Table 7. Contemporary comparative assessment of the biodiversity impacts across all the route options.

Route option	Conservation Reserves	Conservation zones within state forests	SEPP 14 wetlands	Endangered Ecological Communities	High quality habitat and fauna corridors*	Aquatic habitats
Orange/A option	High	High	Medium	Low	Low	Low
Purple/B option	High	Medium	Medium	High	Medium	Medium
Green/C option	Low	Low	High	Medium	High	High
Red/D option	Low	Low	Low	High	High	High

*Rankings taken from the Biological Working Paper, September 2006

The biodiversity assessment identified that only considering biodiversity impacts, the best performing option is the Orange/ A option.

However, route options were evaluated against other community, environmental and engineering issues. These issues are detailed below.

Hydrology

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Required waterway areas

Route option	Major floodplain crossings			Minor floodplain crossings	
	Total waterway area	Total bridge span length	Number of crossing	Total waterway area	Number of crossings
Orange/A option	5641	5500	66	901	39
Purple/B option	1962	2180	58	1370	44
Green/C option	1258	1166	36	659	34
Red/D option	1209	1100	36	1084	61

Hydrology assessment

Route option	Comment
Orange/A option	Requires the most number of crossings 105 Has the greatest potential to change flooding patterns and behaviour on the Clarence River floodplain. Crosses 38 km of floodplain Would require substantial amounts of fill to ensure the highway has the required level of flood immunity, having the potential to result in increased flood levels and redistribution of flood waters. The Swan Creek area would be difficult to achieve a design with acceptable flood impacts as they have the potential to propagate upstream to Grafton. Due to the overtopping of the Grafton levee in floods greater than 50 year ARI event, any minor increases in flood level in the river adjacent to Grafton has the potential to result in much higher increases inside the levee system.
Purple/B option	Has the second largest requirement for waterway area as it passes across the large local catchments more downstream of the catchments. Crosses 13 km of floodplain within the Clarence floodplain. Highest number of minor waterway crossings, reflecting the large number of minor watercourses crossed on the east of the Coldstream Basin.
Green/C option	Least waterway crossings and required waterway area (for both major and minor waterways). Option passes through more high land the other options and only traverses a short length across the Clarence River floodplain. Crosses 5 km of floodplain, around Shark Creek and north of Brooms Head Road. This option has the least potential of the options to impact on flooding behaviour of the study area.
Red/D option	Would require larger waterways area in the northern part of the alignment as it passes over lower land east of any other option. Option passes through areas of high land, minimising potential impacts on flooding behaviour. Crosses 9 km of floodplain around Red Root Road and north of Brooms Head Road.

Table 8. Contemporary comparative assessment of the hydrology impacts across all the route options.

Route option	Length in floodplain	No of waterway crossings	Potential for downstream flood impacts
Orange/A option	High	High	High
Purple/B option	Medium	High	Medium
Green/C option	Low	Low	Low
Red/D option	Medium	Medium	Low

Noise and vibration

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION AGAINST NOISE AND VIBRATION ISSUES. THIS INFORMATION HAS BEEN SUMMARISED FROM THAT CONTAINED IN THE WELLS CROSSING TO ILUKA ROAD NOISE AND VIBRATION WORKING PAPER SEPTEMBER 2006.

Qualitative description of route options

Route option	Comment
Orange/A option	825 receivers in proximity to the option Sensitive receivers in the east of Ulmarra would experience increased road traffic noise exposures as a result of the deviation around the township. Residences and other sensitive receivers (eg Ulmarra Public School) fronting the current highway within Ulmarra would have a reduced noise exposure. Some sensitive receivers in Tyndale would experience a new noise exposure. However an increase in the separation distance of highway traffic from some receivers would reduce noise impacts The section from Tyndale to Harwood bridge would be adjacent to the existing highway and therefore only minor changes to existing noise impacts would result in this section.
	Sensitive receivers in the swan creek area east of the existing highway would be subject to new road traffic noise exposure No significant change to noise exposure would result for sensitive receivers on the highway where the option would involve upgrading of the existing highway.
Purple/B option	803 receivers in proximity to the option. Between Tyndale and shark creek, noise impacts are expected to be minimal. This option rejoins the existing highway west of the Shark creek community where new noise exposure may occur for some sensitive receivers. From Shark creek to Tyndale the option would be adjacent to the existing highway and therefore only minor changes to existing noise impacts would result in this section.
	The options passes to the north of the Pillar Valley community, being in close proximity to some sensitive receivers and providing a new exposure to several houses. Provides a good offset to the sensitive receivers of Tucabia but comes with a several hundred metres of some receivers in the outskirts of the community.
Green/C option	129 receivers in proximity to the option.
	Due to the sparsely populated area, the option provides minimal noise impacts until the Pillar

Route option	Comment
	Valley Community where the road comes within about 300 metres of several sensitive receivers. Provides a good noise buffer where it crosses Bostock Road, passing within about 200 metres to the west of several sensitive receivers in the area. The options provides a good noise buffer to the sensitive receivers south of Taloumbi but come within 200 metres of others to the north. The option passes within 100-200 metres to the east of sensitive receives in Gulmarrad and would provide a new noise exposure to sensitive receivers at James Creek.
Red/D option	77 receivers in proximity to the option.
	Due to the sparsely populated area, the option provides minimal noise impacts until the Pillar Valley Community where the road comes within about 300 metres of several sensitive receivers. Provides a good noise buffer where it crosses Bostock Road. The option provides a good noise buffer to the sensitive receivers south of Taloumbi but come within 300 metres of others to the north. The option provides a good noise buffer to the sensitive receivers to the east of the Gulmarrad community but would provide a new noise exposure to sensitive receivers to the east of Townsend and James Creek.

Affected receivers

Noise level range LAeq dB(A)	Number of receivers per option							
	Orange/A option		Purple/B option		Green/C option		Red/D option	
	Day	Night	Day	Night	Day	Night	Day	Night
>45 and ≤ 50	362	388	85	120	86	95	52	48
>50 and ≤ 55	317	231	56	59	18	25	17	23
>55 and ≤ 60	154	125	9	13	5	5	3	1
>60 and ≤ 65	66	55	6	7	1	4	2	4
>65	55	26	4	4	0	0	1	1
TOTAL	**954**	**825**	**160**	**203**	**110**	**129**	**75**	**77**
Total above criteria	**121**	**206**	**19**	**83**	**6**	**34**	**6**	**29**
Total above criteria minus acquisitions	**46**	**131**	**9**	**73**	**6**	**34**	**5**	**28**

Option A, using the existing highway for a large proportion of the route has the potential to impact on the greatest number of residences. Newly affected residences would result where the options option deviates away from the highway.

The purple/B option would have the potential to impact on the greatest number of sensitive receivers of the three options that pass on a new alignment.

Green and Red options have similar numbers of sensitive receivers potentially affected by an increase in noise levels in the noise range above 50dB(A).

Table 9. Contemporary comparative assessment of the noise and vibration impacts across all the route options.

Route option	Number of receivers in proximity of the route	No of receivers exceeding the night time noise criteria	Impacts to areas not currently affected by highway noise
Orange/A option	High	High	Low
Purple/B option	High	Medium	Medium
Green/C option	Low	Low	High
Red/D option	Low	Low	Medium

Social-economic factors

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION AGAINST SOCIAL ECONOMIC ISSUES. THIS INFORMATION HAS BEEN SUMMARISED FROM THAT CONTAINED IN THE WELLS CROSSING TO ILUKA ROAD SOCIO-ECONOMIC WORKING PAPER SEPTEMBER 2006.

Property impacts

Route option	Dwelling directly acquired (within a 100 m wide road reserve)	Dwellings within 50 m of the road reserve.
Orange/A option	75	93
Purple/B option	10	11
Green/C option	0	0
Red/D option	1	2

Travel time and accessibility impacts

Route option	Travel savings from Wells Crossing to Harwood Bridge	Subregional and local accessibility improvements	Effects on traffic movements within and between towns	Access to and from the upgraded highway
Orange/A option	12 minutes for through traffic	Accessibility between sub-regional and district centres and to tourism areas would improve, as route would attract 90% of existing Highway traffic and potential interchange locations are closer to major centres. Local traffic using the option would also benefit from travel time savings	Would bypass and reduce traffic volumes in South Grafton, Swan Creek, Ulmarra and Tyndale. There would be changes to local roads but access would be maintained. Diversion of through traffic would improve pedestrian circulation and reduce conflicts between vehicles thus improving safety. Local access between towns would be preserved.	Opportunities for interchanges close to Grafton provide opportunities for local traffic to access upgraded highway and for through traffic to access Grafton.
Purple/B option	14 minutes for through traffic	Accessibility to centres of employment, services and tourism would not improve for local residents and only 30% of existing traffic would use the route. Possible improved access to Yamba and Maclean.	Would bypass and reduce traffic volumes in South Grafton, Swan Creek, Ulmarra and Tyndale. There would be changes to some local roads, but access would be maintained. Safety benefits to pedestrians and road users on existing highway with removal of 30% traffic and 50% of heavy vehicles.	No interchanges close to Grafton are proposed, although access along existing highway would be maintained.
Green/C option	17 minutes for through traffic	Accessibility to centres of employment, services and tourism would not improve for local residents and only 30% of existing traffic would use the route. Possible improved access to Yamba and Maclean.	Would bypass and reduce traffic volumes in South Grafton, Swan Creek, Ulmarra and Tyndale. There would be changes to some local roads, but access would be maintained. Safety benefits to pedestrians and road users on existing highway with removal of 30% traffic and 50% of heavy vehicles.	No interchanges close to Grafton are proposed, although access along existing highway would be maintained.
Red/D option	17 minutes for through traffic	Accessibility to centres of employment, services and tourism would not improve for local residents and only 30% of existing traffic would use the route. Possible improved access to Yamba and Maclean.	Would bypass and reduce traffic volumes in South Grafton, Swan Creek, Ulmarra and Tyndale. There would be changes to some local roads, but access would be maintained. Safety benefits to pedestrians and road users on existing highway with removal of 30% traffic and 50% of heavy vehicles.	No interchanges close to Grafton are proposed, although access along existing highway would be maintained.

Community and amenity impacts

Route option	Noise impacts	Effect on residential character, amenity and lifestyle	Visual impacts
Orange/A option	131 residences would be affected by night-time noise levels exceeding DEC criteria for redeveloped roads (assuming no mitigation). Opportunities to reduce noise levels to through South Grafton, Ulmarra and Tyndale	Bypass of South Grafton, Ulmarra and Tyndale would improve amenity in these areas. Route in close proximity to existing highway, so improvements in other sections would be lesser. Impacts through Townsend associated with widening of existing alignment. Lifestyle and severance impacts for previously unaffected properties along Four Mile Lane, Amenity impacts for residents along new sections of route. Approximately 75 houses would be acquired and this would impacts on the structure and cohesion of communities along the highway.	Potential interchange near Swan Creek could impact on visual amenity within the relatively densely populated area south of Ulmarra. Harwood Bridge interchange would impact on residences along Clarence River but is common to all options. Route would be highly visible to many people and of a large scale.
Purple/B option	73 residences would be affected by night time noise levels exceeding DEC criteria for new roads assuming no mitigation. Opportunities to reduce noise levels to residents along the existing highway between Eight Mile Lane and Shark Creek	Substantial adverse impacts on residents previously not affected by highway or other major roads, including Pillar Valley and along Tucabia Road. Impacts through Townsend associated with widening of existing alignment. Many residents have stated they strongly value the environmental qualities and sense of community of living in this area. Acquisition of approximately 10 houses, mainly along the existing highway, and this would impact on the structure and cohesion of communities along the highway.	Harwood Bridge interchange would impact on residences along Clarence River but is common to all options. Increased visual impacts in areas currently unaffected by a major road, although route generally follows edges of land use units, thereby integrating with surroundings. Relatively high visual impacts through bushland and rural areas with large visually prominent cuts and fills, albeit through areas with low population density.
Green/C option	34 residences would be affected by night time noise levels, exceeding DEC criteria for new roads assuming no mitigation. Opportunities to reduce noise levels to residents along the existing highway between Wells Crossing and Harwood.	Substantial adverse impacts on residents previously not affected by highway or other major roads, including Pillar Valley, Gulmarrad and James Creek. Many residents have stated they strongly value the environmental qualities and sense of community of living in this area.	Harwood Bridge interchange would impact on residences along Clarence River but is common to all options. Relatively high visual impacts through bushland and rural areas with large visually prominent cuts and fills, albeit through areas with low population density.

Route option	Noise impacts	Effect on residential character, amenity and lifestyle	Visual impacts
		Minimal direct acquisition of houses, so minimal changes to the structure of communities.	Moderate to high visual impacts near Gulmarrad and James Creek
Red/D option	28 residences would be affected by night time noise levels exceeding DEC criteria for new roads, assuming no mitigation. Opportunities to reduce noise levels to residents along the existing highway between Wells Crossing and Harwood.	Substantial adverse impacts on residents previously not affected by highway or other major roads, including Pillar Valley and James Creek. Many residents have stated they strongly value the environmental qualities and sense of community of living in this area. Minimal direct acquisition of houses, so minimal changes to the structure of communities.	Harwood Bridge interchange would impact on residences along Clarence River but is common to all options. Low visual impact through forested areas. Visual fragmentation of strong visual unit through cane farms and grazing areas south of Clarence River. Relatively high visual impacts through bushland and rural areas with large visually prominent cuts and fills, albeit through areas with low population density.

Economic impacts

Route option	Effects on productivity of land and viability of properties	Effects on highway related businesses	Effects on regional and sub-regional businesses
Orange/A option	Approximately 465 ha of prime agricultural land impacted. Would take higher flood free farmland close to existing highway, with substantial impacts on viability of properties. Would also sever access within properties. High potential for impacts on soy bean industry, but low potential airborne risks to organic farms.	Interchanges near Swan Creek and Four Mile Lane provide opportunities to limit the impacts of traffic diversions on local business. Businesses that currently benefit from direct access to the highway would lose trade as a result of restricted access to and from the highway. However, lost trade may be replaced by new business opportunities along the upgraded highway.	Interchange locations would facilitate access to Grafton and support its role as a sub-regional centre. Economic impacts expected to be short term, recovering in medium to long term.
Purple/B option	Approximately 265 ha of prime agricultural land impacted, including grazing land and sugar cane farms. Would take higher flood free farmland close to existing highway north of Shark Creek and adjacent to Tucabia Road.	Through traffic likely to be diverted from existing highway related businesses with potential to impact substantially on viability of businesses that rely heavily on highway for turnover. However, lost trade may be replaced by new business opportunities along the upgraded	Interchanges at Glenugie and Yamba Road offer access to Grafton, Maclean and Yamba, but it is expected most through traffic would stay on the upgraded highway. As highway related businesses are a small proportion of local economy, overall impacts are

Route option	Effects on productivity of land and viability of properties	Effects on highway related businesses	Effects on regional and sub-regional businesses
	Edge effects through Glenugie State Forest and Bom Bom State Forest. Highway potential for impacts on soy bean industry, but low potential for airborne risks to organic farms.	highway. 70% of traffic would continue to use the existing highway and projected incremental growth in traffic volumes means that over time, impacts from passing trade would be minimal.	expected to be minimal.
Green/C option	Potential impacts on 115 ha of prime agricultural land, mainly north of Brooms Head Road, on productive areas of Pine Brush State Forest. Potential impacts on rural communities around Pillar Valley, Bostock Road, Gulmarrad and James Creek Road. Minor impacts on Glenugie State Forest, on grazing land and on farming activities important to local economy. Greater potential for impacts on organic producers in east of the study area.	Through traffic likely to be diverted from existing highway related businesses with potential to impact substantially on viability of businesses that rely heavily on highway for turnover. However, lost trade may be replaced by new business opportunities along the upgraded highway. 70% of traffic would continue to use the existing highway and projected incremental growth in traffic volumes means that over time, impacts from passing trade would be minimal.	Interchanges at Wells Crossing and Harwood Bridge offer access to Grafton, but it is expected most through traffic would stay on the upgraded highway. As highway related businesses are a small proportion of local economy, overall impacts are expected to be minimal.
Red/D option	Potential impacts on 220 ha of prime agricultural land, mainly north of Brooms Head Road and around Red Root Road. Potential impacts to communities around Pillar Valley, Bostock Road and Red Root Road. Minor impacts on Glenugie State Forest, on grazing land and on farming activities important to the local economy. Greater potential for impacts on organic producers in east of study area.	Through traffic likely to be diverted from existing highway related businesses with potential to impact substantially on viability of businesses that rely heavily on highway for turnover. However, lost trade may be replaced by new business opportunities along the upgraded highway. 70% of traffic would continue to use the existing highway and projected incremental growth in traffic volumes means that over time, impacts from passing trade would be minimal.	Interchanges at Wells Crossing and Harwood Bridge offer access to Grafton, but it is expected most through traffic would stay on the upgraded highway. As highway related businesses are a small proportion of local economy, overall impacts are expected to be minimal.

Equity impacts

Route option	Equity impacts
Orange/A option	Traffic relief benefits for large numbers of residents of South Grafton, Ulmarra and Tyndale. Small numbers of previously unaffected people would be impacted by traffic and noise at Four Mile Lane and at Ulmarra and Tyndale bypasses. Greater impact on businesses along the existing highway because 90% of traffic will be diverted to the new road. Less potential impact on businesses in Grafton because of more direct access to and from the new road. Does not share the effects of the project
Purple/B option	Major new impacts on amenity and lifestyle of relatively small numbers of residents in rural residential areas and rural localities distant from the existing highway. Noise, visual, severance impacts and changes to the environmental quality and character of the areas. Less impact that the Orange/A option on businesses along the highway, because 70% of traffic would continue to use the existing highway. Greater potential effects on businesses in Grafton because of diversion of through traffic away from the town. Shares the effects of the project.
Green/C option	Major new impacts on amenity and lifestyle of relatively small numbers of residents in rural residential areas and rural localities distant from the existing highway. Noise, visual, severance impacts and changes to the environmental quality and character of the areas. Less impact that the Orange/A option on businesses along the highway, because 70% of traffic would continue to use the existing highway. Greater potential effects on businesses in Grafton because of diversion of through traffic away from the town. Shares the effects of the project.
Red/D option	Major new impacts on amenity and lifestyle of relatively small numbers of residents in rural residential areas and rural localities distant from the existing highway. Noise, visual, severance impacts and changes to the environmental quality and character of the areas. Less impact that the Orange/A option on businesses along the highway, because 70% of traffic would continue to use the existing highway. Greater potential effects on businesses in Grafton because of diversion of through traffic away from the town. Shares the effects of the project.

Table 10. Contemporary comparative assessment of the socio and economic impacts across all the route options.

Route option	Property impacts	Travel time	Access issues	Community and amenity issues	Agricultural impacts	Business impacts	Equity impacts
Orange/A option	High	High	Low	High	High	Low	Low
Purple/B option	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Green/C option	Low	Low	High	Low	Low	High	High
Red/D option	Low	Low	High	Low	Medium	High	High

Cultural heritage

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Impacts on heritage sites

Route option	Impacts		Indeterminate impacts	Impact rating
	Sites directly impacted	Sites indirectly impacted		
Orange/A option	2 Aboriginal heritage sites (high significance) 2 PAD sites (low significance) 4 Historical heritage sites (high significance)	1 Historical heritage site (high significance) 1 Historical heritage site (low significance)	Bom Bom, Ulmarra Camp	High
Purple/B option	No sites directly impacted	1 Aboriginal heritage site (moderate significance) 1 Historical heritage site (low significance) 1 Historical heritage site (low significance)	Coldstream River valley	Low
Green/C option	1 Historical heritage site (high significance) 2 Aboriginal heritage sites (low significance)	3 Aboriginal heritage sites (low significance) 2 Historical heritage sites (low significance)	Coldstream River valley, access routes through Gulmarrad.	Moderate-high
Red/D option	1 Historical heritage site (high significance) 3 Aboriginal heritage sites (low significance)	1 Historical heritage site (moderate significance) 2 Historical heritage site (low significance)	Coldstream River valley, access routes through Gulmarrad.	Moderate

Proportion of route within predicted Aboriginal archaeological sensitivity

Route option	Proportion of route length within predicted Aboriginal archaeological sensitivity		
	Low to negligible (%)	Moderate to low (%)	High to moderate (%)
Orange/A option	0.7	39	60
Purple/B option	0.6	49	50
Green/C option		70	30
Red/D option		61	39

Table 11. Contemporary comparative assessment of the heritage impacts across all the route options.

Route option	Impact on heritage sites	Archaeological sensitivity
Orange/A option	High	High
Purple/B option	Low	High
Green/C option	High	High
Red/D option	Medium	High

Functional and design characteristics

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Functional issues

	Orange/A option	Purple/B option	Green/C option	Red/D option
Length	69 km	66 km	60 km	60 km
Maximum gradient	4.2%	4.5%	5%	5%
Design speed and speed limit	All options would meet required design standards including 110km/h vertical and horizontal design speed.			
Potential to stage construction	Construction could be staged	Potential to stage southern and northern sections	There is no opportunities to stage construction of these options	
Earthworks	Large volumes of fill material would need to be imported to achieve flood immunity	Areas of large earthworks volumes would be limited to Bondi Hill, around Tyndale.	Earthworks volumes would be high, but cut and fill volumes would be balanced.	
Soils	High potential to encounter acid sulphate soils	Moderate potential to encounter acid sulphate soils, mainly north of Bondi Hill	Some potential to encounter soft soils and acid sulphate soils.	
Costing ($2004)	$1,300-$1,400	$950-$1,050	$700-$800	$700-$800

Table 12. Contemporary comparative assessment of the functional issues across all the route options.

Route option	Length	Need to construct as one project	Earthworks	Soils	Cost
Orange/A option	High	Low	High	High	High
Purple/B option	Medium	Medium	Low	Medium	Medium
Green/C option	Low	High	Medium	Low	Low
Red/D option	Low	High	Medium	Low	Low

Summary conclusion

A SUMMARY OF THE COMPARATIVE ASSESSMENTS ACROSS ALL ENVIRONMENTAL ISSUES IS DETAILED BELOW.

This shows that overall, the orange option had high impacts across most environmental considerations while the green and red options had mostly low impacts. While the purple option consistently had medium impacts across the entire range of environmental issues.

Route option	Biodiversity	Hydrology	Noise and vibration	Socio economic factors	Cultural heritage	Functional and design
Orange/A option	Low-medium	High	Medium	High	High	High
Purple/B option	Medium to high	Medium to high	Medium	Medium	Medium	Medium
Green/C option	High	Low	Low	Low	High	Low-medium
Red/D option	High	Low to medium	Low	Low	Medium	Low-medium

Development of the route options

A Value Management workshop was held in March 2006 which reviewed the outcomes of the investigations and community feedback, and considered the options against agreed performance criteria developed as part of the workshop. The participants to the Value Management workshop included RMS (then RTA), the project team and representatives of Council, government agencies, local Aboriginal Land Councils and Community Liaison Groups. The performance criteria were selected by consensus at the workshop based on what factors all participants felt were important in selecting a route. Other than the orange route, the alignments of the other routes were modified at the workshop.

Upon assessment of the route options, modified versions of the Purple, Green and Red options were identified. However, no clear option was identified from this workshop, but the need for further work was recognised before a decision on the preferred route could be made. The workshop did note that modified green option appeared to perform best including strategic cost, on balance with the other options but further work was required to confirm the most appropriate alignment between Glenugie

and Pillar Valley. If costs were excluded from the assessment, the modified green and orange options were closely ranked.

Further studies to be undertaken included:

- Further work to determine which alignment was the better option for the southern section.
- Confirmation of the assumptions, decisions, and recommendations made during the workshop.
- Consideration of environmental mitigation and compensation costs associated with each route and the feasibility of mitigation (including Emu impact mitigation, dedicated fauna crossings and fauna exclusion fencing). Also consider the social and economic impact mitigation measures for each route.
- Investigation and consideration of the quarry issues raised (particularly with respect to the Modified Green Option).
- Consideration of the impact of the project on the long term supply of quarry products in the region.
- Exploration of existing highway improvement needs and their associated cost if an eastern option is moved forward as the preferred option.
- Consideration of a potential interchange at/near Tyndale on a Modified Purple Option as an alternative.
- Undertaking a thorough study of impacts on the coastal Emu of the proposed new highway and potential mitigation measures should an eastern option move forward as the preferred option.

Further assessment was undertaken based on the Value Management workshop recommendations. In addition to the list above, these further specialist studies included ecological studies (EEC condition assessment, habitat values and movement corridors, coastal emu habitat impacts, provision for environmental mitigation measures (including a land bridge, dedicated fauna crossings and fauna exclusion fencing) in cost estimates), heritage studies, geotechnical studies, flooding, noise and development of cost estimates.

A two-day route selection workshop was then held later in March 2006 between the project team. The workshop considered a range of factors to recommend a preferred option. The two day route selection workshop developed refined route options (refined purple and refined red options) which were then assessed against the orange option.

The modified green option and the modified red option (from the value management workshop) were very similar, however the refined green option developed at the route selection workshop closely followed the red option. As such, the refined red option was developed and progressed forward, rather than the refined green option.

The refined purple option was developed with an interchange at Tyndale, following the existing highway between Tyndale and Maclean. As with the value management workshop, the orange option was not refined as it could not be further improved.

The two day route selection workshop found that:

- The orange option performed best in natural environment, but ranked poorly in social and local economics. The cost estimates prepared identified the cost as $1,713 million (in 2006 dollars).
- The refined purple option performed the best in the functional criteria and ranked second for both social and local economics and natural environment. The cost estimate for the option was $1288 million (in 2006 dollars). This cost estimate included $17 million for environmental mitigation.
- The refined red option performed the best in social and local economics, but ranked last in natural environment criteria. The cost estimate for this option was $1130 million (in 2006 dollars). This included $24 million for environmental mitigation.

The results of this workshop were used along with other investigations to assist RMS in determining the preferred route.

The preferred route was identified as the refined purple option (refer to Figure 4) combined with a package of measures to improve the safety of the existing highway. This option was selected as it would avoid the key risk areas of ecology and flooding, and meet a balance of functional, social and local economic and environmental criteria.

The advantages of the refined purple option are that it would:

- Achieve the best balance across a range of issues in relation to the objectives of the Pacific Highway Upgrade Program and the Wells Crossing to Iluka Road project
- Avoid direct impacts on prime agricultural land between Four Mile Lane and Cowper
- Avoid high-flood-risk areas in Swan Creek, Ulmarra and Cowper and the majority of the Coldstream Basin floodplain
- Avoid areas of soft soils and acid sulfate soils on the Coldstream floodplain
- Avoid areas important to local farmers as flood refuge for livestock
- Minimise the impact on threatened ecological communities and to the Yaegl Nature Reserve
- Avoid impacts on important wildlife corridors linking to the wetland areas in the north of the study area
- Avoid wetlands protected under SEPP 14, and maintain conditions that are important to aquatic species, and other plant and animal species
- Avoid areas of known Aboriginal and non-Aboriginal heritage significance.

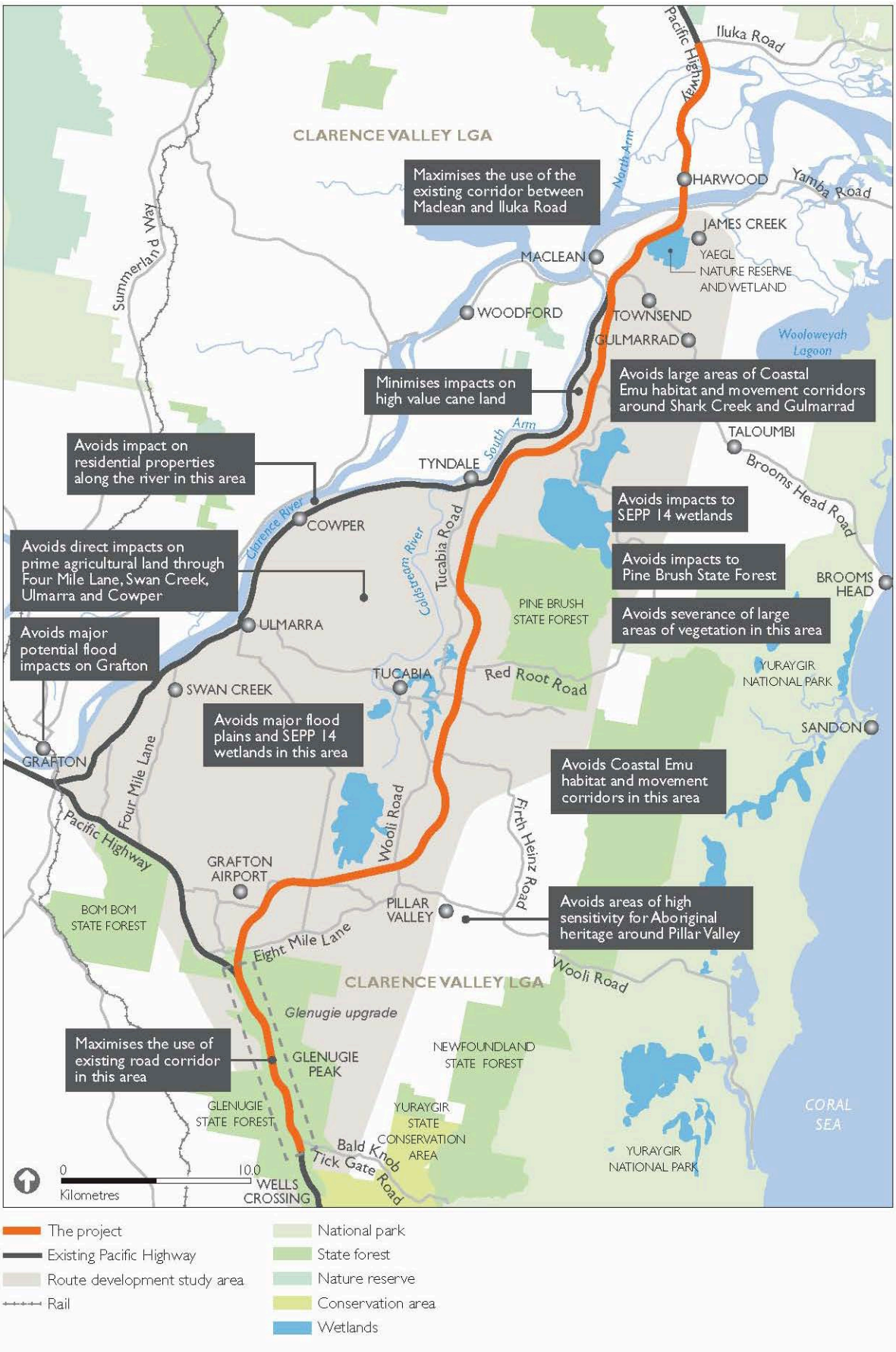

Figure 4 Wells Crossing to Iluka Road preferred route.

Woodburn to Ballina project

THIS IS A SUMMARY OF THE ROUTE OPTIONS PROCESS, FOCUSING ON ENVIRONMENTAL IMPACTS. THE SUMMARY IS DERIVED FROM THE ROUTE OPTIONS WORKING PAPERS AND ROUTE OPTIONS DEVELOPMENT REPORT (RTA 2005).

THIS INFORMATION IS AS PER THE ROUTE OPTIONS ASSESSMENT UNDERTAKEN. THREATENED SPECIES AND POTENTIAL IMPACTS DISCUSSED ARE THOSE CONSIDERED DURING THAT PROCESS, AT THAT TIME.

TO AID UNDERSTANDING OF THE IMPACTS AND IDENTIFY THE BEST PERFORMING OPTION, THE ROUTE OPTION IMPACTS HAVE BEEN DISTILLED INTO A HIGH, MEDIUM AND LOW RANKING.

THE PROCESS OF RANKING IS THE ONLY ADDITIONAL/NEW WORK THAT HAS BEEN UNDERTAKEN.

Route selection process

The development of the preferred route for the Woodburn to Ballina project commenced in 2004. The short listed route options were announced and placed on display for community comment. The preferred route was announced in November 2005, and placed on display for community comment. The concept design was displayed in March 2008 (refer to Chapter 4 of the EIS for further details).

The investigation corridor for the Woodburn to Ballina project extended from the southern side of Tuckombil Canal to the intersection of the Pacific Highway with the Bruxner Highway. From Woodburn, north towards Wardell, the eastern extent of the investigation corridor comprised land between the existing highway corridor and the coast. To the west, it extended into the Tuckean Nature Reserve, about 1.5 kilometres northwest of Bagotville Road. From Wardell, north to the Bruxner Highway intersection, the study area was constrained by the Blackwall Range to the west and the need to link to the existing Pacific Highway corridor at the Ballina bypass.

A comprehensive route options and selection process was undertaken to identify the preferred route between Woodburn and Ballina. Possible alignments were identified through preliminary studies, field investigations and consultation with the community and stakeholders.

The project was divided into three sections (refer to Figure 5), from south to north:

- Section 1: Between Tuckombil Canal and south of Broadwater
- Section 2: Between a point south of Broadwater to north of Wardell, and crossing the Richmond River
- Section 3: Between the Pacific Highway north of Wardell and the Pacific Highway intersection with Bruxner Highway joining the Ballina bypass.

A range of short listed route options was then identified based on these sections. There were three short listed options in section 1 (known as options 1A, 1B and 1C), six short listed options in section 2 (known as options 2A, 2B, 2C, 2D, 2E and 2F) and two options in section 3 (known as options 3A and 3B). These options are shown in Figure 5). The route options all pass through the Broadwater National Park on the existing highway alignment to minimise impacts on the national park.

The options assessment considered community, environmental and engineering issues, including consideration to Matters of National Environmental Significance listed under the EPBC Act that could occur within the study area.

The preferred route was a combination of Options 1C, 2C, 2E and 3B.

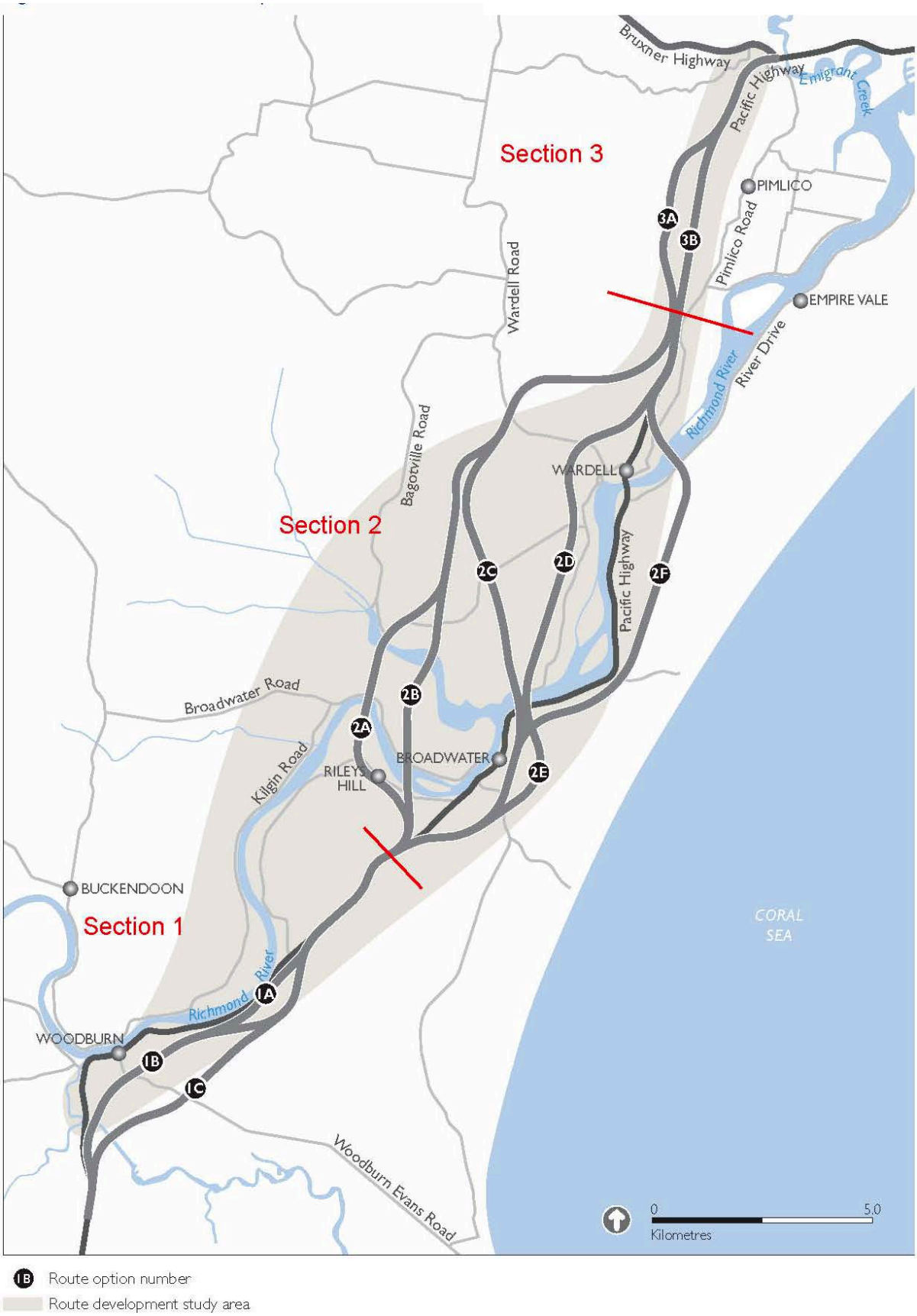

Figure 5: Shortlisted route options Woodburn to Ballina

Biodiversity

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR BIODIVERSITY. THIS INFORMATION HAS BEEN SUMMARISED FROM THE FLORA AND FAUNA ASSESSMENT REPORT. THE REPORT INCLUDED THE FOLLOWING REPORTS:

- **Flora and Fauna Assessment of Options: Phase 1 and Phase 2 investigations. Proposed Woodburn to Ballina Pacific Highway Upgrade (Geolyse, September 2005).**
- **Flora and Fauna Assessment of Options: Addendum Report. Proposed Woodburn to Ballina Pacific Highway Upgrade (Geolyse, October 2005).**

How MNES were considered during the route option evaluation

The ecological characteristics investigated included, but were not limited to:

- The suitability of the habitats traversed by the options for terrestrial flora and fauna including threatened species, endangered populations, RoTAP species and regionally significant flora species;
- The extent of endangered ecological communities within the options listed under the provisions of the NSW *Threatened Species Conservation Act 1995* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999*;
- The extent of regionally significant vegetation communities traversed by the identified options;
- The occurrence or potential habitat of migratory species listed under the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* within the identified options;
- The occurrence or potential habitat of threatened aquatic species within the identified options; and
- The potential impact of the options on regional, sub-regional and local fauna corridors within and adjoining the study area.

The list of threatened species listed under the EPBC Act known or potentially occurring within the study area in 2005 included:

Birds

- Coxen's Fig-Parrot *Cyclopsitta diophthalma coxeni*
- Tristan Albatross *Diomedea dabbenena*
- Swift Parrot *Lathamus discolor*
- Southern Giant-Petrel *Macronectes giganteus*
- Northern Giant-Petrel *Macronectes halli*
- Black-throated Finch (southern) *Poephila cincta cincta*
- Kermadec Petrel (western) *Pterodroma neglecta neglecta*
- Australian Painted Snipe *Rostratula australis*
- Campbell Albatross *Thalassarche impavida*
- Black-breasted Button-quail *Turnix melanogaster*
- Regent Honeyeater *Xanthomyza phrygia*

Fishes

- Oxleyan Pygmy Perch *Nannoperca oxleyana*

Frogs

- Green and Golden Bell Frog *Litoria aurea*
- Olongburra Frog *Litoria olongburensis*
- Giant Barred Frog *Mixophyes iteratus*

Mammals

- Blue Whale *Balaenoptera musculus*

- Large-eared Pied Bat *Chalinolobus dwyeri*
- Spotted-tailed Quoll *Dasyurus maculatus maculatus* (SE mainland population)
- Southern Right Whale *Eubalaena australis*
- Humpback Whale *Megaptera novaeangliae*
- Long-nosed Potoroo (SE mainland) * *Potorous tridactylus tridactylus*
- Grey-headed Flying-fox *Pteropus poliocephalus*

Reptiles

- Loggerhead Turtle *Caretta caretta*
- Green Turtle *Chelonia mydas*
- Three-toed Snake-tooth Skink *Coeranoscincus reticulatus*
- Leathery Turtle *Dermochelys coriacea*

Sharks

- Grey Nurse Shark (east coast population) *Carcharias taurus* (east coast population)
- Great White Shark *Carcharodon carcharias*
- Whale Shark *Rhincodon typus*

Invertebrates

- Mitchell's Rainforest Snail *Thersites mitchellae*

Plants

- Scented Acronychia *Acronychia littoralis*
- Scale Myrtle *Austromyrtus fragrantissima*
- Marbled Balogia *Baloghia marmorata*
- Stinking Cryptocarya *Cryptocarya foetida*
- Leafless Tongue-orchid *Cryptostylis hunteriana*
- *Davidsonia sp. Mullumbimby-Currumbin Ck* (A.G. Floyd 1595)
- Thorny Pea *Desmodium acanthocladum*
- Small-leaved Tamarind *Diploglottis campbellii*
- Rusty Rose Walnut *Endiandra hayesii*
- Ball Nut *Floydia praealta*
- Coastal *Fontainea Fontainea oraria*
- Monkey Nut *Hicksbeachia pinnatifolia*
- *Isoglossa eranthemoides*
- Rough-shelled Bush Nut *Macadamia tetraphylla*
- Southern Ochrosia *Ochrosia moorei*
- Onionwood *Owenia cepiodora*
- Lesser Swamp-orchid *Phaius australis*
- Spiny Gardenia *Randia moorei*
- *Rutidosis heterogama*
- Smooth-bark Rose Apple *Syzygium hodgkinsoniae*
- Rose Apple *Syzygium moorei*
- Arrow-head Vine *Tinospora tinosporoides*

These species were considered in the assessment to determine the likelihood of presence in the study area.

Terrestrial fauna surveys undertaken within the study area confirmed a range of threatened fauna species. Those that are listed under the EPBC Act were:

- Olongburra Frog *Litoria olongburensis*
- Grey-headed Flying-fox *Pteropus poliocephalus*

- Long-nosed Potoroo *Potorous tridactylus tridactylus*
- Osprey *Pandion haliaetus*

A number of bird species were also identified during the fauna surveys, which are listed as migratory species. These included:

- White-bellied Sea-Eagle *Haliaeetus leucogaster*
- White-throated Needletail *Hirundapus caudacutus*
- Cattle Egret *Ardea ibis*
- Great Egret *Ardea alba*
- Rainbow Bee-eater *Merops ornatus*
- Glossy Ibis *Plegadis falcinellus*

In addition, koalas (*Phascolarctos cinereus*) were identified in the field. This species was only listed on the TSC Act at the route option phase, but has subsequently been listed on the EPBC Act.

The following threatened flora species listed on the EPBC Act were identified during flora surveys in the study area:

- *Geijera paniculata* endangered
- *Isoglossa eranthemoides* endangered
- *Macadamia tetraphylla* vulnerable
- *Marsdenia longiloba* endangered
- *Syzygium moorei* vulnerable.

Although no threatened aquatic species were identified during the surveys, previous studies and literature identified records of the threatened species Oxleyan Pygmy Perch (*Nannoperca oxleyana*) within the study area.

The assessment of the route options also assessed the potential impact to other threatened species listed on the EPBC Act (or TSC Act but subsequently listed on the EPBC Act). These included:

- Red Goshawk *Erythrotriorchis radiates*
- Painted Snipe *Rostratula benghalensis*
- Double-eyed Fig-Parrot *Cyclopsitta diophthalma coxeni*
- Hastings River Mouse *Pseudomys oralis*

A total of 7 endangered ecological communities (listed under the TSC Act) were also considered as occurring within the route options and included:

- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions; (Small areas may be defined as this EEC however the vegetation community is floristically analgous with the Subtropical Coastal Floodplain Forest EEC).
- Subtropical Coastal Floodplain Forest of the NSW North Coast Bioregion.
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions.
- Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion.[1]
- Coastal saltmarsh in the NSW North Coast, Sydney Basin and South East Corner Bioregions.

[1] NB: Lowland Rainforest of Subtropical Australia was only listed on the EPBC Act in 2011.

All Commonwealth and State listed species identified through the above review were included in the route options evaluation process, including route selection and value management workshops.

Route options were compared against the following criteria:

- Approximate total area of vegetation clearing.
- Regional and subregional corridors.
- Aquatic habitats.
- SEPP 14 coastal wetlands.
- Threatened species and EEC occurrences.
- Potential biodiversity impacts of options.
- Identification of potential significant impact.

Vegetation clearing

Section	Route option	Vegetation clearing (hectares)	EEC clearing (hectares)
1	1A	7.57	5.4
	1B	9.97	8.2
	1C	22.37	19.6
2	2A	29.91	23.7
	2B	27.17	22.6
	2C	34.44	24.7
	2D	28.51	9.2
	2E	31.92	11.0
	2F	13.22	6.7
3	3A	12.67	12.7
	3B	13.16	13.2

Regional or sub-regional corridors

Section	Route option	No of corridors crossed	Corridors
1	1A	1	All routes in Section 1 impact on the corridor linkage through Broadwater National Park
	1B	1	All routes in Section 1 impact on the corridor linkage through Broadwater National Park
	1C	1	All routes in Section 1 impact on the corridor linkage through Broadwater National Park
2	2A	6	Numerous crossings/ fragmentation of thin corridors in the west of the study area
	2B	4	Numerous crossings/ fragmentation of thin corridors in the west of the study area
	2C	4	Fragments numerous corridors and the widest corridor identified in the study area
	2D	1	Impacts on the edge of corridor on the western edge of the Wardell heathlands, reducing corridor width

Section	Route option	No of corridors crossed	Corridors
	2E	1	Similar impacts as 2D, no additional impacts on regional corridor in route variation
	2F	1	Only fragments the corridor in the vicinity of Broadwater
3	3A	2	Fragments the corridor on the western edge of the Blackwall range north of Coolgardie
	3B	1	Crosses one corridor in the north of Section 3 and reduces the width of the corridor adjoining the existing Pacific Highway

Aquatic habitat

The assessment of habitats within waterways in each of the options is shown below. This assessment identified the waterways which are likely to be:

1. crossed by route option (perpendicular to option);
2. adjacent waterways (not crossed, but parallel with alignment, within 250m); and
3. within corridor on the edge of option or ending near the edge of the 250m corridor option (again, not crossed by option).

The assessment considered the class of waterway based on fisheries habitat classification system.

Section	Route option	Waterways	Comment
1	1A	One class 1 waterway within corridor	Known threatened aquatic species habitat - known Oxleyan Pygmy Perch present in Wallum Heath Wetland
		One class 2 waterway crossing	Perennial/Tidal flow, commercial and/or recreational fish habitat - Tuckombil Canal with defined banks
	1B	One class 1 waterway within corridor	Known threatened aquatic species habitat - known Oxleyan Pygmy Perch present in Wallum Heath Wetland
		One crossing across a class 2 waterway	Perennial/Tidal flow, commercial and/or recreational fish habitat - Tuckombil Canal with defined banks
	1C	One class 1 waterway within corridor	Known threatened aquatic species habitat - known Oxleyan Pygmy Perch present in Wallum Heath Wetland
		One crossing across a class 2 waterway	Perennial/Tidal flow, commercial and/or recreational fish habitat - Tuckombil Canal with defined banks
2	2A	One class 1 waterway crossing.	Known protected aquatic species habitat - Richmond River with small mangrove area and defined bank and known Estuary Cod habitat
		One class 2 waterway with one crossing	One waterway consists of Perennial/Tidal flow, commercial and/or recreational fish habitat - Tuckean Broadwater with defined banks and Wallum Heath Wetland or pools
		One class 2 waterway within corridor.	None
	2B	Two class 2 waterway crossings	Perennial/Tidal flow, commercial and/or recreational fish habitat - Richmond River with small mangrove area and defined bank, Tuckean Broadwater with large and small mangrove areas on banks and Wallum Heath Wetland or pools
		One class 2 waterway within the corridor and/or	None

Section	Route option	Waterways	Comment
		adjacent	
	2C	One class 2 waterway crossing	Perennial/Tidal flow, commercial and/or recreational fish habitat - Richmond River with small mangrove area and defined bank and Wallum Heath Wetland or pools
		One class 2 waterway adjacent to option and/ or within the corridor	None
	2D	Four class 2 waterway crossings	Perennial/Tidal flow, commercial and/or recreational fish habitat - Richmond River with small mangrove area and defined bank and Bingil Creek with defined banks, mangroves and connected Wallum Heath Wetland
		One class 2 waterway within the corridor	None
		Two class 2 waterways adjacent to option and/ or within the corridor	None
	2E	Nine class 2 waterway crossings	Perennial/Tidal flow, commercial and/or recreational fish habitat - Richmond River with small mangrove area and defined bank and Bingil Creek with defined banks, mangroves and connected Wallum Heath Wetland
		Three class 2 waterways within the corridor	None
		Two class 2 waterways adjacent to option and/ or within the corridor	None
	2F	Eight class 2 waterway crossings	Perennial/Tidal flow, commercial and/or recreational fish habitat - Richmond River with small mangrove area and defined bank and Wallum Heath Wetland or pools
		Two class 2 waterway within corridor	None
		One class 2 waterways adjacent to option and/ or within the corridor	None
3	3A	One class 2 waterway crossing	Perennial/Tidal flow, commercial and/or recreational fish habitat, named or unnamed waterway - Duck Creek
		One class 2 waterway en route	None
	3B	One class 2 waterway crossing	Perennial/Tidal flow, commercial and/or recreational fish habitat, named or unnamed waterway - Duck Creek and Swamp Sclerophyll forest

SEPP 14 coastal wetlands

Section	Route option	Area of SEPP 14 coastal wetland impacted (ha)
1	1A	0
	1B	0
	1C	0
2	2A	1.29

Section	Route option	Area of SEPP 14 coastal wetland impacted (ha)
	2B	1.23
	2C	0
	2D	0
	2E	0
	2F	0
3	3A	0.99
	3B	0.99

Threatened species and EEC occurrence

Section	Route option	Threatened species and EEC
1	1A	Likely occurrence of threatened Microchiropteran and Megachiropteran bat species, Koalas and threatened birds. Within the section of Broadwater National Park: Known habitat for threatened Megachiropteran and Microchiropteran bats, Wallum Froglet, Koalas and Brolga. Potential habitat for Grass Owl, Common Planigale, threatened fruit doves, Oxleyan Pygmy Perch, Brush-tailed Phascogale, Mitchell's Rainforest Snail, and Barred Cuckoo-shrike. Known occurrence of Lowland Rainforest, Swamp Sclerophyll Forest and Wetland EEC's.
	1B	Likely occurrence of threatened Microchiropteran and Megachiropteran bat species, Koalas, and threatened birds. Within the section of Broadwater National Park: Known habitat for threatened Megachiropteran and Microchiropteran bats, Wallum Froglet, Koalas, and Brolga. Potential habitat for Grass Owl, Common Planigale, threatened fruit doves, Oxleyan Pygmy Perch, Brush-tailed Phascogale, Mitchell's Rainforest Snail, and Barred Cuckoo-shrike.
	1C	Known habitat for Little Bentwing-bat and Eastern Long-eared Bat, Grass Owl, Thorny Pea, and Long-nosed Potoroo. Potential occurrence of other threatened bat species, threatened Birds including the Black-necked Stork and Square-tailed Kite, Koala, Squirrel Glider, Common Planigale, Phaius australis, and Austromyrtus frangrantissima. Known occurrence of Swamp Sclerophyll Forest EEC. Within the section of Broadwater National Park: Known habitat for threatened Megachiropteran and Microchiropteran bats, Wallum Froglet Koalas and Brolga. Potential habitat for Grass Owl, Common Planigale, threatened Fruit doves, Oxleyan Pygmy Perch, Brush-tailed Phascogale, Mitchell's Rainforest Sna,l Barred Cuckoo-shrike, and threatened plant species. Known occurrence of Lowland Rainforest, Swamp Sclerophyll Forest, and Wetland EEC's.
2	2A	Known and potential habitat for numerous threatened species including but not limited to; Grey-headed Flying-fox, Microchiropteran bats, threatened frogs, Black Bittern, Common Planigale, Koala, Bush Hen, Bush-stone Curlew, Brush-tailed Phascogale, Squirrel Glider, Brolga, Masked Owl, Grass Owl, Powerful Owl, Bush Hen, Osprey, Mangrove Honeyeater, Brush-tailed Phascogale, threatened Fruit-doves, Long-nosed Potoroo, Ground Parrot, Endiandra hayesii, *Archidendron hendersonii, Isoglossa eranthemoides, Syzygium hodgkinsonii, Macadamia tetraphylla*, and Oxleyan Pygmy Perch. Known breeding habitat of Grey-crowned Babbler and known roosting habitat of Common Blossom-bat and Eastern Long-eared Bat. Known occurrence of Swamp Sclerophyll Forest and Wetland EEC's. Grey-headed and Black Flying Fox colony within 250m of option.
	2B	Known and potential habitat for numerous threatened species including but not limited to;

Section	Route option	Threatened species and EEC
		Grey-headed Flying-fox, Microchiropteran bats, threatened frogs, Black Bittern, Common Planigale, Koala, Bush Hen, Bush-stone Curlew, Brush-tailed Phascogale, Squirrel Glider, Brolga, Masked Owl, Grass Owl, Powerful Owl, Bush Hen, Osprey, Mangrove Honeyeater, Brush-tailed Phascogale, threatened Fruit-doves, Long-nosed Potoroo, Ground Parrot, *Endiandra hayesii, Archidendron hendersonii, Isoglossa eranthemoides, Syzygium hodgkinsonii,* and Oxleyan Pygmy Perch, *Macadamia tetraphylla, Syzygium moorei, Desmodium acanthocladum*, and numerous other threatened rainforest flora species recorded from the immediate vicinity. Known breeding habitat of Grey-crowned Babbler and known roosting habitat of Common Blossom-bat and Eastern Long-eared Bat. Known occurrence of Swamp Sclerophyll Forest, Rainforest, Casuarina, and Wetland EEC's.
	2C	
	2D	Known and potential habitat for numerous threatened species including but not limited to; Megachiropteran and Microchiropteran bats, Grass Owl, Long-nosed Potoroo, Ground Parrot, Common Planigale, threatened frogs, Koalas, Black Bittern, Squirrel Glider Bush Stone Curlew, Bush Hen, threatened Fruit-doves, Brolga, Grey Crowned Babbler, Osprey, Barred Cuckoo-shrike, Glossy Black Cockatoo, Powerful Owl, Masked Owl, Mangrove Honeyeater, Brush-tailed Phascogale and Oxleyan Pygmy Perch. *Macadamia tetraphylla, Archidendron hendersoni, Syzygium moorei, Desmodium acanthocladum*, and numerous other threatened rainforest flora species recorded from the immediate vicinity. Known occurrence of Swamp Sclerophyll Forest, Rainforest, Casuarina, and Wetland EEC's.
	2E	
	2F	Known or potential habitat for threatened species including but not limited to Megachiropteran and Microchiropteran bats, threatened fruit -doves, Long-nosed Potoroo, Grey-crowned Babbler, Ground Parrot, threatened Frogs, Koalas, Brolga, Osprey, Mangrove Honeyeater, Squirrel Glider, and small areas of EEC's.
3	3A	Known or potential habitat for threatened species including but not limited to Megachiropteran and Microchiropteran bats, Alberts Lyrebird, Rose-crowned Fruit Dove, Superb Fruit Dove, Wompoo Fruit Dove, White-eared Monarch, Masked Owl, Grass Owl, Koala, Barred Cuckoo Shrike, and White- eared Monarch. Presence of rainforest EEC's. Known occurrence of threatened plant species and Rainforest, Swamp Forest, and Casuarina Woodland EEC.
	3B	Known or potential habitat for threatened species including but not limited to Megachiropteran and Microchiropteran bats, Alberts Lyrebird, Rose-crowned Fruit Dove, Superb Fruit Dove, Wompoo Fruit Dove, White-eared Monarch, Masked Owl, Grass Owl, Koala, Barred Cuckoo Shrike, and White- eared Monarch. Known occurrence of threatened plant species and Rainforest, Swamp Forest, and Casuarina Woodland EEC.

Potential biodiversity impacts

Section	Route option	Potential impacts of option
1	1A	Loss of foraging and roosting habitat for threatened species. Within the section of Broadwater National Park: Increased isolation/ fragmentation of threatened species habitat. Loss of habitat area for numerous threatened fauna species. Potential for increased road strike Potential for clearing of EEC's. Potential hydrological alteration and associated impacts on threatened amphibians, EEC's and Oxleyan Pygmy Perch.
	1B	Loss of foraging and roosting habitat for threatened species. Within the section of Broadwater National Park: Increased isolation/ fragmentation of threatened species habitat. Loss of significant habitat area for numerous threatened fauna species. Potential for increased road strike. Potential for clearing of EEC's.
	1C	Loss of foraging habitat for threatened species. Increased isolation/ fragmentation of known threatened species habitat. Potential for increased road strike. Loss of area of EEC. Potential hydrological alteration. Within the section of Broadwater National Park: Increased isolation/ fragmentation of threatened species habitat. Loss of habitat area for numerous threatened fauna species. Potential for increased road strike. Potential for clearing of EEC's. Potential hydrological alteration on Amphibians, EEC's and Oxleyan Pygmy Perch.
2	2A	Loss of significant foraging, roosting, denning and breeding habitat for numerous threatened species. Potential for increased road strike. Potential impacts on fisheries breeding habitats. Isolation/Fragmentation of threatened species habitat roosting and feeding habitats. Potential for loss of EEC's. Weed and Feral animal intrusion. Potential hydrological alteration and associated impacts on amphibians, EEC's and Oxleyan Pygmy Perch.
	2B	Loss of foraging, roosting, denning and breeding habitat for threatened species. High potential for increased road strike. Potential impacts on fisheries breeding habitats. Isolation/Fragmentation of threatened species habitat roosting and feeding habitats, particularly the Common Blossom Bat. Weed and Feral animal intrusion. Loss of substantial areas of EEC's. Potential hydrological alteration and associated impacts on amphibians, EEC's and Oxleyan Pygmy Perch.
	2C	Loss of foraging, roosting, denning and breeding habitat for threatened species. High potential for increased road strike. Potential impacts on fisheries breeding habitats.

Section	Route option	Potential impacts of option
		Isolation/Fragmentation of threatened species habitat roosting and feeding habitats, particularly the Common Blossom Bat. Weed and Feral animal intrusion. Loss of substantial areas of EEC's. Potential hydrological alteration and associated impacts on Amphibians, EEC's and Oxleyan Pygmy Perch.
	2D	
	2E	Loss of foraging, roosting and denning habitat for threatened species. Potential for increased road strike. Isolation/Fragmentation of threatened species habitat roosting and feeding habitats. Potential for loss of EEC's. Potential hydrological alteration and associated impacts on amphibians, and EEC's. Weed and Feral animal intrusion.
	2F	Negligible impacts throughout the majority of the option route. In the vicinity of Wardell; Some small fragmentation of threatened species habitat. Low potential for increased road strike. Low potential for impacts on fisheries breeding habitats. Loss of small areas of EEC.
3	3A	Some additional isolation/Fragmentation of threatened species habitat. Loss of small habitat area for threatened fauna species. Potential for increased road strike. Loss of areas of EEC's.
	3B	Some additional isolation/Fragmentation of threatened species habitat. Loss of small habitat area for threatened fauna species. Potential for increased road strike. Damage to EECs.

Identification of potential significant impact

Section	Route option	Potential for significant impact
1	1A	Medium
	1B	Medium
	1C	Medium to High
2	2A	High
	2B	High
	2C	High
	2D	High
	2E	High
	2F	Low
3	3A	Medium
	3B	Low

Table 13: Contemporary comparative assessment of the biodiversity impacts across all the route options.

Section	Route option	Vegetation clearing	EEC clearing	Regional and sub-regional corridors	Aquatic habitats	SEPP 14 Wetlands	Threatened species and EEC	Potential impacts	Potential significant impact#
1	1A	Low	Low	Low	Low	Low	Low	Low	Medium
	1B	Medium	Medium	Low	Low	Low	Medium	Medium	Medium
	1C	High	High	Low	Low	Low	High	High	High*
2	2A	Medium	High	High	High	High	High	High	High
	2B	Medium	High	High	Medium	High	High	Medium	High
	2C	High	High	High	Medium	Low	High	High	High
	2D	Medium	Low	Medium	Medium	Low	Medium	High	High
	2E	High	Medium	Medium	High	Low	Medium	Medium	High
	2F	Low	Low	Low	High	Low	Low	Medium	Low
3	3A	Low	Low	Medium	Medium	Medium	High	Medium	Medium
	3B	High	High	Medium	Medium	Medium	Low	Medium	Low

This has been taken from the Flora and Fauna Assessment of Options: Phase 1 and Phase 2 investigations (Geolyse 2005).

* This ranking has been altered to match the format of this comparative assessment.

The biodiversity assessment identified that only considering biodiversity impacts, the best performing option for each of the options are:

- For section 1: Option 1A.
- For section 2: Option 2F
- For section 3: Option 3A.

(Note: The preferred route was a combination of the 1C, 2C, 2E and 3B options). However, route options were evaluated against other issues. These issues are detailed below.

Hydrology

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR HYDROLOGY. THIS INFORMATION HAS BEEN SUMMARISED FROM THE WOODBURN TO BALLINA ROUTE OPTIONS DEVELOPMENT REPORT (JUNE 2005).

Hydrology issues

Section	Route option	Bridge structures	Flood alleviation structures
1	1A	Tuckombil Canal bridge - a low level multi-span 350 metre long (minimum drainage requirement) viaduct.	Flood plain bridges north of Woodburn - 1,380 metres of viaduct (several multi-span viaducts ranging in total length from 90 to 210 metres) (minimum drainage requirement).
	1B		
	1C	Tuckombil Canal - a low level multi-span 350 metres long (minimum drainage requirement) viaduct.	Flood plain bridges north of Woodburn and parallel to Richmond River - 880 metres of viaduct (several multi-span viaducts ranging in total length from 160 to 200 metres) (minimum drainage requirement).
2	2A	Richmond River – this bridge would be 720 metres long. Tuckean Broadwater – this bridge would be 450 metres long to satisfy the minimum drainage requirement.	No major structures
	2B	Richmond River – this bridge would be a 810 metre long bridge. The Richmond River bridge structure would incorporate approach viaducts of around 100 metres. Tuckean Broadwater - minimum drainage requirement govern this 650 metre long bridge.	No major structures
	2C	Richmond River - the bridge would be a 780 metre bridge which exceeds the drainage requirement of 750 metres. The Richmond River bridge structure would incorporate a short southern approach viaduct.	No major structures
	2D	Richmond River - The bridge would be a 1180 metre long bridge and exceeds the drainage requirement of 750 metres. The Richmond River bridge structure would incorporate approach viaducts	No major structures
	2E		
	2F	Richmond River - the bridge would be a 1,110 metre long bridge and exceeds the minimum drainage requirement of 800 metres.	Flood plain north of Broadwater and parallel to Richmond River - a 4,000 metre viaduct of several multi-span viaducts ranging in total length (minimum drainage requirement).
3	3A	No main bridge structures	No major structures
	3B	No main bridge structures	No major structures

THIS COMPARATIVE ASSESSMENT BELOW OF THE ABOVE INFORMATION HAS BEEN UNDERTAKEN NOW TO PROVIDE A CLEAR COMPARISION OF THE HYDROLOGY IMPACTS ACROSS ALL THE ROUTE OPTIONS.

Table 14: Contemporary comparative assessment of the hydrology impacts across all the route options.

Section	Route option	Bridge structure	Flood alleviation structures
1	1A	Medium	Medium
	1B	Medium	Medium
	1C	Medium	Medium
2	2A	High	Low
	2B	High	Low
	2C	Low	Low
	2D	Medium	Low
	2E	Medium	Low
	2F	Medium	High
3	3A	Low	Low
	3B	Low	Low

Noise

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR NOISE AND VIBRATION ISSUES. THIS INFORMATION HAS BEEN SUMMARISED FROM THE WOODBURN TO BALLINA REVIEW OF ACOUSTIC INVESTIGATIONS JUNE 2005.

Noise issues

A preliminary noise assessment was undertaken to assess the noise impact and reaction for each of the route options. The Community Noise Burden analyses were adopted. The weightings used were based on the guidelines "Design Manual for Roads and Bridges". This guidance is based on research carried out in communities living close to the road. The change in community noise burden impact incorporates the reaction of affected populations that are newly affected by highway noise.

Section	Route option	Community noise burden (% study area population bothered by traffic noise)		Change in community noise burden
		Do-nothing	Upgrade	
1	1A	4.86	0.60	0.49
	1B		0.56	0.42
	1C		0.08	0.12
2	2A	6.32	0.87	2.73
	2B		0.78	2.60
	2C		1.46	2.31
	2D		1.96	4.05

Section	Route option	Community noise burden (% study area population bothered by traffic noise)		Change in community noise burden
		Do-nothing	Upgrade	
	2E		1.34	3.89
	2F		1.71	2.93
3	3A	0.18	0.10	0.16
	3B		0.22	0.53

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Table 15. Contemporary comparative assessment of the noise impacts across all the route options.

Section	Route option	Relative impact of upgrade
1	1A	Medium
	1B	Medium
	1C	Low
2	2A	Medium
	2B	Low
	2C	Low
	2D	High
	2E	High
	2F	Medium
3	3A	Low
	3B	Medium

Social effects

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR SOCIAL ECONOMIC ISSUES. THIS INFORMATION HAS BEEN SUMMARISED FROM THE WOODBURN TO BALLINA ROUTE OPTIONS DEVELOPMENT REPORT (JUNE 2005).

Property impacts

Section	Route option	Land parcel within road footprint	No of residences in road footprint
1	1A	53	1
	1B	57	1
	1C	36	1
2	2A	70	12
	2B	59	4
	2C	68	8

Section	Route option	Land parcel within road footprint	No of residences in road footprint
	2D	57	7
	2E	54	21
	2F	73	7
3	3A	22	6
	3B	20	0

Agricultural impacts

Section	Route option	Land use impacts
1	1A	Grazing 13.7ha Sugar Cane 25.8ha
	1B	Grazing 22.3ha Sugar Cane 20.5ha
	1C	Grazing 13.5ha Sugar Cane 25.8ha
2	2A	Grazing 73.5ha Sugar Cane 5.6ha
	2B	Grazing 58.5ha Sugar Cane 15.5ha
	2C	Grazing 62.3ha Sugar Cane 11.2ha
	2D	Grazing 15.3ha Sugar Cane 33.5ha
	2E	Grazing 13.5ha Sugar Cane 31.8ha
	2F	Grazing 16.9ha Sugar Cane 45ha
3	3A	Grazing 12.4ha Sugar Cane 17.8ha
	3B	Grazing 0.3ha Sugar Cane 3ha

Community and amenity impacts

Section	Route option	Amenity
1	1A	Visual Impact = High The high visual impact is due to its close proximity to Woodburn and the Richmond River and the typical overall height of the embankments/cuttings and bridges of 4 to 6 metres. Close proximity to Woodburn creates potential for highway noise, light and visual impacts and interruption of views east from the town to adjacent farmland. Should vegetation screening and or noise walls be required there could be associated negative impacts in terms of limiting visual connection opportunities between the highway and the town. The alignment between Lang Hill and the Richmond River may require treatment of the river bank and mitigation works to reduce the visual impact of the Highway from the river. The route uses the alignment of the existing Highway corridor through Broadwater National Park, thereby reducing potential adverse visual impacts on the park environment. For the town of Woodburn, Options 1B and 1C have a better overall outcome for amenity than Option 1A. While the traffic noise effects of Option 1A could be satisfactorily mitigated by means of noise walls, Options 1B and 1C are sufficiently far away from Woodburn not to require noise mitigation and have a less adverse visual impact, from the perspective of the population centre of Woodburn, than Option 1A. Options 1B and 1C would be worse for traffic noise, they would be better from a visual perspective than Option 1A. This is because Option 1A is more disruptive of the visual quality of the river environment. This is one of a number of localities, therefore, where what would be better for noise would be worse from a visual point of view, and vice versa. Hence the interpretation of amenity would differ, depending on whether greater value was ascribed to the noise effects or the visual effects. From the point of view of the dwellings, Option 1A may be preferable, although this might not necessitate adjustments being made to individual dwellings, despite their being affected by noise to some extent. The traffic noise effects of Options 1B and 1C would be greater, but mitigation would be available for individual properties. North of McDonalds Creek the amenity effects of the options are equal, as all options follow the same alignment.
	1B	Visual impact = Medium High The medium high visual impact of this option is due to its close proximity to Woodburn and typical overall embankment/cutting and bridge heights of 4 to 6 metres. Compared to Option 1A, the visual impact of the route is lessened where its alignment is east of Lang Hill, away from the Richmond River. Close proximity to Woodburn creates potential for highway noise, light and visual impacts and interruption of views east from the town to adjacent farmland. Should vegetation screening and or noise walls be required there could be associated negative impacts in terms of limiting visual connection opportunities between the highway and the town. This option passes east of Lang Hill, avoiding the risk of impact on the Richmond River banks and the potential requirement for mitigation of views from the river. The route uses the alignment of the existing Highway corridor through the Broadwater National Park, thereby reducing potential adverse visual impacts on the park environment.

Section	Route option	Amenity
	1C	Visual impact = Medium High Although typical overall embankment/cutting and bridge heights in this option exceed 6 metres its visual impact is medium high because the visual impact of the route is lessened where its alignment is east of Lang Hill (away from the Richmond River) and further east of Woodburn. The location of the route away from Woodburn, reduces potential noise, light and visual impacts on the town. There may still be a visual connection from the Highway to the town, at a distance. In addition, this option is elevated on significant embankments, resulting in visual impacts which may require mitigation. This option passes east of Lang Hill, avoiding the risk of impact on the Richmond River banks and the potential requirement for mitigation of views from the river. The route uses the alignment of the existing Highway corridor through the Broadwater National Park, thereby reducing potential adverse visual impacts on the park environment.
2	2A	Visual impact = Medium High This option passes through visually sensitive landscapes of hilly and densely wooded terrain in the vicinity of Alleys Hill and Wardell Mountain, plus the two river crossings at the Richmond River and the Tuckean Broadwater. In addition, the route traverses the rolling terrain at the foothills of the Blackwall Mountain Range. This option would require significant earthworks and visual mitigation. The Option would use the alignment of the existing highway corridor through the Broadwater National Park, thereby reducing adverse visual impacts in that location. North of Broadwater National Park, this Option swings west through farm land following the Richmond River, turns north to the east of Rileys Hill, crosses the Richmond River, passes to the west of Alleys Hill and then crosses the Tuckean Broadwater before heading in to the foot hills of the Blackwall Mountain Range. Potential views of the Tuckean Broadwater, the Richmond River and Cooks Hill may be possible from the high points of the two bridges at the Richmond River and Tuckean Broadwater. However, significant mitigation would likely be required where the bridges pass through existing mangroves at the river edges and adjoining dense woodlands. Major earthworks and numerous culverts for natural drainage would require mitigation where the highway traverses the rolling terrain of the Blackwall Mountain Range foothills. The highway alignment along the edge of the wooded foothills between Wardell Mountain and Meridian Drive may offer elevated views east over the Wardell Heath to Broadwater, the sugar mill stack and Cooks Hill in the background, with possible views to the Richmond River. Views of Wardell Mountain and Buckombil Mountain and the Blackwall Mountain Range may also be possible. The amenity of Riley's Hill would be adversely affected by noise under Option 2A and to a lesser extent by Option 2B. Depending on the design quality of any bridges over the Richmond River, the residents of Riley's Hill may also consider that there would be adverse visual impacts associated with Options 2A and 2B. Whatever the particular mix of effects, it is likely that Riley's Hill would be adversely affected, in terms of amenity, by Options 2A and 2B. For Riley's Hill all other options would be better, from the point of view of amenity. Clearly, the amenity of Broadwater would benefit more from Options 2A and 2B than any of the other options. However, for the other options, Option 2E would be better from a visual point of view, for the residents of Broadwater, than any of the other options. Option 2E may also be acceptable from a traffic noise point of view as, although there would be some noise for Broadwater residents from a road along this alignment, it would not be sufficiently bad for it to require mitigation with noise walls. The alignment of Options 2C, 2D and 2F would be better from a noise point of view as noise walls would be required. Broadwater is, therefore, an instance of

Section	Route option	Amenity
		one option (2E) being better from a visual point of view, but not from a noise point of view. People's preferences may depend on whether they value reduced noise more than the visual quality of the environment or the opposite. Between Broadwater and Wardell, all route options west of the river would have an adverse effect on the noise environment of individual dwellings located in the vicinity. Options 2B and Option 2C, where it swings to the west, perform poorly in visual terms. Option 2D, while having a similar traffic noise impact to Options 2B and 2C, would have a less adverse visual impact. Option 2F, east of the river, would have a worse visual impact, similar in degree to the visual impact of the most westerly route options. From a noise point of view, however, Option 2F would have the least adverse impact, compared with Options 2B, 2C and 2D, as it affects a fewer number of dwellings. A further conflict, therefore, exists here between the visual and the noise effects; Option 2D is better on visual grounds, but Option 2F is preferable on noise grounds. Options 2B and 2C would have the best overall amenity effects for Wardell. Options 2D and 2F would both require noise mitigation by means of a noise wall. In the case of Option 2D the north westerly part of Wardell would still be more affected by noise from the highway than it is at present. In the case of Option 2F dwellings on or near Pimlico Road would be better off as a result of a noise wall having to be provided. The visual impacts of Option 2D would depend on the design quality of the road and noise walls in this location. Overall, therefore, from an amenity point of view, Option 2F would be more acceptable than Option 2D.
	2B	Visual impact = Medium The medium visual impact of this option is primarily due to its passing through visually sensitive landscapes of hilly and densely wooded terrain in the vicinity of Alleys Hill and Wardell Mountain, plus the river crossings at the Richmond River and the Tuckean Broadwater. Compared to Option 2A, the alignment of this route parallels the edge of the steep slopes and dense woodland of Alleys Hill without cutting through the woodland. Like Option 2A this route traverses the rolling terrain at the foothills of the Blackwall Mountain Range. This option would require significant earthworks and visual mitigation. The Option would use the alignment of the existing highway corridor through the Broadwater National Park, thereby reducing adverse visual impacts on it. At the south western edge of Broadwater this option swings away from town, crosses the Richmond River before the eastern slopes of Alleys Hill, crosses the Tuckean Broadwater and then heads in to the foot hills of the Blackwall Mountain Range. This route avoids all towns and settlements. Potential views of the Tuckean Broadwater, the Richmond River and Cooks Hill may be possible from the high points of the two bridges at the Richmond River and Tuckean Broadwater. However, significant mitigation would likely be required where the bridges pass through existing mangroves at the river edges and adjoining dense woodlands. Major earthworks and numerous culverts for natural drainage would require mitigation where the Option traverses the rolling terrain of the Blackwall Mountain Range foothills. The highway alignment along the edge of the wooded foothills between Wardell Mountain and Meridian Drive may offer elevated views east over the Wardell Heath to Broadwater, the sugar mill stack and Cooks Hill in the background, with possible views to the Richmond River. Views of Wardell Mountain and Buckombil Mountain and the Blackwall Mountain Range may also be possible.
	2C	Visual impact = Medium The medium visual impact of this option is primarily due it being on an overall average embankment height of 4 to 6 metres and in close proximity to Broadwater. The bridge height would be considerably high where it crosses the Richmond River. Between Broadwater and Buckombil Mountain the Option would pass through moderately sensitive landscape (a mixture of grazing and sugar cane farming, quarries and remnant woodland) west of the Wardell Heath before skirting the foothills of the Blackwall Mountain Range and then utilising the route alignments of Option 2A and 2B north of Wardell Road.

Section	Route option	Amenity
		The route uses the alignment of the existing highway corridor through the Broadwater National Park, thereby reducing adverse visual impacts on it. The narrow space between Broadwater and Cooks Hill means that the Option passes in close proximity to the town. This would most likely require noise barriers to avoid major impacts on residential amenity from noise and vehicle lights, potentially reducing the scenic quality of the town. Should vegetation screening and/or noise walls be required there is the potential to impair visual connection opportunities between the highway and the town. The single river crossing of the Richmond River north of Broadwater would pass through established mangroves, which would require mitigation. The northern bridge landing would be on elevated terrain, reducing the need for high approach embankments, however, the southern approach would be considerably elevated. At this location, major mitigation and visual screening may be required. Potential views north and south over Broadwater to Cooks Hill and the Richmond River and the floodplains beyond may be possible from the high point of the bridge. The Option aligns with Buckombil Mountain to the north and Cooks Hill to the south, potentially offering distinctive views to these important natural features. At the western edge of the Wardell Heath mitigation opportunities exist to extend the heath and woodland across the road corridor to reduce the visual impacts of the highway alignment. Some earthworks and culverts for natural drainage would likely require mitigation where the Option would traverse the rolling terrain leading up to and along the Blackwall Mountain Range foothills To the west and north of Wardell the highway corridor traverses existing woodland. However, if a significant amount of the existing vegetation could be retained within the highway corridor this could be used to reduce visual impacts when seen from the elevated vantage points of Wardell Road and Meridian Drive.
	2D	Visual impact = Medium This Option has the same alignment as Option 2E north of the Richmond River. It differs from Option 2E in that it passes west of Cooks Hill. The medium visual impact of this Option is primarily due its close proximity to Broadwater on embankments with an overall height of 4 to 6 metres, plus the crossing at the Richmond River. Between Broadwater and Wardell the route passes along the junction of a homogenous landscape of sugar cane fields and the Wardell Heath. The narrow space between Broadwater and Cooks Hill means that the route passes in close proximity to the town. This would most likely require noise barriers to avoid major impacts on residential amenity from noise and vehicle lights, potentially reducing the scenic quality of the town. Should vegetation screening and/or noise walls be required there is the potential to impair visual connection opportunities between the highway and the town. The single river crossing of the Richmond River north of Broadwater would pass through established mangroves, requiring mitigation. The northern bridge landing would be on elevated terrain, reducing the need for high approach embankments, however, the southern approach would be significantly elevated. At this location, major mitigation and visual screening may be required. Potential views north and south over Broadwater to Cooks Hill and the Richmond River and the floodplains beyond may be possible from the high point of the bridge. Approximately half of this Option's alignment would be along the eastern edge of the Wardell Heath. It may offer views east to the Richmond River. The other half would be within the Wardell Heath and woodland and would require substantial removal of existing vegetation. However, if a significant amount of existing vegetation could be retained within the highway corridor this could be used to reduce visual impacts when seen from the elevated vantage points of Wardell Road and Meridian Drive. The Option uses the alignment of the existing highway corridor north of Wardell, potentially reducing impacts on the surrounding landscape and therefore the need for mitigation.

Section	Route option	Amenity
	2E	Visual impact = Medium Low This Option has the same alignment as Option 2D north of the Richmond River. South of the river, however, it would pass east of Cooks Hill. While this Option shares many aspects of Option 2D, its medium low visual impact is due to the section of the route passing to the east of Cooks Hill which would thus avoid Broadwater. Between Broadwater and Buckombil Mountain the route would pass through a homogenous landscape of sugar cane fields east of the Wardell Heath. The alignment of the new highway to the east of Cooks Hill would avoid Broadwater and would reduce the need for mitigation of noise, vehicle lights and visual impacts on the town. The single river crossing of the Richmond River north of Broadwater would pass through established mangroves, requiring mitigation. The northern bridge landing would be on elevated terrain, reducing the need for high approach embankments, however the southern approach would be considerably elevated. At this location, major mitigation and visual screening maybe required. Potential views north and south over Broadwater to Cooks Hill and the Richmond River and the floodplains beyond may be possible from the high point of the bridge. Approximately half of this Option's alignment would be along the eastern edge of the Wardell Heath. It may offer views east to the Richmond River. The other half would be within the Wardell Heath and woodland and would require substantial removal of existing vegetation. However, if a significant amount of existing vegetation could be retained within the highway corridor this could be used to reduce visual impacts when seen from the elevated vantage points of Wardell Road and Meridian Drive. The Option would use the alignment of the existing highway corridor north of Wardell, potentially reducing impacts on the surrounding landscape and therefore the need for mitigation.
	2F	Visual impact = High The high visual impact of this Option is primarily due it's alignment in close proximity to Broadwater and the need for very high embankments. The visual impact would be further exacerbated by the use of the 4 to 6 metre high embankments and bridges cutting through the flat and homogenous landscape of the sugar cane fields east of the Richmond River. The Option would use the alignment of the existing highway corridor through the Broadwater National Park, thereby reducing adverse visual impacts at that location. The narrow space between Broadwater and Cooks Hill means that the Option would pass in close proximity to the town. This may require barriers to avoid major impacts on residential amenity from noise and vehicle lights, potentially reducing the scenic quality of the town. Should vegetation screening and/or noise walls be required there is the potential to impair visual connection opportunities between the highway and the town. The single river crossing of the Richmond River north of Broadwater would pass through established mangroves, requiring mitigation. The northern bridge landing would be on elevated terrain, reducing the need for high approach embankments, however the southern approach would be considerably elevated. At this location, major mitigation and visual screening maybe required. Potential views north and south over Broadwater to Cooks Hill and the Richmond River and the floodplains beyond may be possible from the high point of the bridge. North of Broadwater, the alignment of the new highway would be east of the Richmond River and would be elevated above the floodplain. The significant embankment heights may require mitigation to reduce the visual impact of the highway passing through this uniform and single landscape type. The single yet significantly high and long bridge crossing of the Richmond River north-east of Wardell would require significant mitigation of the bridge approach ramps at the river edges. Panoramic views in all directions of the Richmond River, the Blackwall Range and the coast may be possible from the

Section	Route option	Amenity
		high point of the bridge. The Option uses the alignment of the existing highway corridor north of Wardell, potentially reducing impacts on the surrounding landscape and therefore the need for mitigation.
3	3A	Visual impact = Low A portion of this option traverses the foothills of the Blackwall Mountain Range and may require mitigation of the earthworks and densely vegetated steep slopes and natural drain lines. Never the less, this option would have an overall low visual impact, in part because it avoids increasing the existing highway's severing of the flat and homogenous cane fields landscape. North of Meridian Heights, west of the current alignment, individual dwellings that are currently affected by Pacific Highway noise would continue to be adversely affected by Option 3A and in some cases noise levels would be higher. The visual impact of Option 3A is also more adverse than the visual impact of Option 3B. There is no change to the noise environment for Option 3B, but there is a change for the worse under Option 3A. Overall, therefore, the performance of Option 3A is worse than Option 3B in terms of amenity.
	3B	Visual impact = Low The low visual impact of this option is primarily due to the route alignment utilising the existing highway corridor and sitting on relatively low embankments less than 2 metres high. It is assumed that the new highway corridor would require the removal of a significant amount of the existing roadside vegetation. Therefore, the future road user experience may change from the existing sense of partial enclosure to a more open experience of sugar cane fields.

Table 16. Contemporary comparative assessment of the social effects across all the route options.

Section	Route option	Property impacts	Agricultural impacts	Community and amenity issues
1	1A	Medium	Medium	High
	1B	Medium	High	Medium
	1C	Low	Medium	Medium
2	2A	High	High	High
	2B	Low	High	Medium
	2C	Medium	High	Medium
	2D	Low	Medium	Medium
	2E	High	Medium	Low
	2F	Medium	Medium	High
3	3A	Medium	High	Low
	3B	Low	Low	Low

Cultural heritage

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR ABORIGINAL HERITAGE ISSUES. THIS INFORMATION HAS BEEN SUMMARISED FROM THE WOODBURN TO BALLINA ROUTE OPTIONS DEVELOPMENT REPORT (JUNE 2005).

Heritage impacts

Section	Route option	Aboriginal heritage sites and cultural places
1	1A	Given the generally low-lying topography and poor drainage conditions of section 1, these options are assessed to have a low overall level of archaeological sensitivity. Identified places of cultural value are confined to a reported massacre site (involving the killing of two individuals) on or near Options 1A and 1B at Woodburn. No physical evidence of the massacre is expected to be present.
	1B	
	1C	Given the generally low-lying topography and poor drainage conditions of section 1, these options are assessed to have a low overall level of archaeological sensitivity.
2	2A	Known sites on Options 2A and 2B are restricted to a group of three possible scarred trees on a valley flat of the coastal ramp. Both of these options have been extensively disturbed by clearing and agricultural activities and any significant undetected archaeological evidence is likely to be primarily restricted to uncultivated footslopes and creek lines between the Old Bagotville Road and the Wardell-Alstonville Road and between Lumleys Lane and Coolgardie Road further north. However, a sample survey on the coastal ramp revealed no microtopographic features that might have attracted Aboriginal occupation in their own right and it is concluded that the archaeological resource is unlikely to be substantial.
	2B	
	2C	The primary Aboriginal heritage constraint identified on Option 2C is a group of four scarred trees located at the base of a ridge north of Back Channel Road at Bagotville. These trees are assessed to have a high local level of scientific and cultural significance and would be destroyed. North of Broadwater, the option crosses the Richmond River close to a culturally significant natural mythological/sacred site situated in the riverbed. This site poses no permanent constraint to development of the option provided it is not disturbed. On the basis of the survey results, in tandem with its topographic character and high

Section	Route option	Aboriginal heritage sites and cultural places
		overall level of disturbance, it is concluded that any significant undetected archaeological evidence on Option 2C is likely to be primarily restricted in its distribution to the few uncultivated spur crests, footslopes and creek lines between Back Channel Road and the Old Bagotville Road and between Lumleys Lane and Coolgardie Road.
	2D	Options 2D and 2E traverse culturally sensitive coastal barrier landscapes with substantial potential to contain intact archaeological deposits. Known sites include one artefact scatter and an historic/contemporary camp, a reported massacre site and an extensive open camp/midden. There is a high likelihood of archaeologically significant subsurface occupation evidence occurring in association with all of these sites. There is also a good probability of subsurface occupation evidence in places along the elevated rim of the sand barrier between the Richmond River and the Old Bagotville Road.
	2E	Although its exact whereabouts is unknown, a site containing multiple Aboriginal burials has been reported on the sand plain near Wardell. This sand plain supports often impenetrable heath vegetation with no surface disturbances sufficient to determine the presence or absence of subsurface features like burials. Due to their usually scattered distribution and the limited area that burials themselves occupy, it may also be the case that this site would not be detected during a subsurface archaeological investigation. Without exception, Aboriginal people have a strong emotional attachment to the graves of their forebears and any Aboriginal burials can thus be expected to have a very high level of cultural significance.
	2F	No permanent Aboriginal heritage constraints have been identified with respect to Option 2F. DEC references to two previously registered sites are extremely suspect and the sites are considered more likely to be situated on sand-based ground well south of the option. However, in the unlikely event that the references are correct, both sites will have been significantly impacted by sugar cane cultivation. Option 2F is assessed to have a low overall level of archaeological sensitivity.
3	3A	Options 3A and 3B have been variously disturbed by sugar cane cultivation, cattle grazing, house construction and development of the existing Pacific Highway. Undisturbed land is primarily confined to paperbark swamps that would not have been conducive to Aboriginal occupation. Neither option is considered to have any substantial further archaeological potential.
	3B	

Table 17. Contemporary comparative assessment of Aboriginal heritage impacts across all the route options.

Section	Route option	Aboriginal heritage impacts
1	1A	High
	1B	High
	1C	Low
2	2A	Low
	2B	Low
	2C	High
	2D	Medium
	2E	Medium
	2F	Low
3	3A	Low
	3B	Low

Functional and design characteristics

THIS IS A SUMMARY OF THE ROUTE OPTIONS EVALUATION FOR FUNCTIONAL ISSUES. THIS INFORMATION HAS BEEN SUMMARISED FROM THE WOODBURN TO BALLINA ROUTE OPTIONS DEVELOPMENT REPORT (JUNE 2005).

Functional issues

Section	Route option	Length	Construction issues	Costing (units)
1	1A	11.4	Option would be constructed over potential acid sulphate soils (PASS) that may exist down to 1 m depth. The option traverses PASS over a length of 346 metres.	100
	1B	11.8	Option would be constructed over potential acid sulphate soils (PASS) that may exist down to 1 m depth. The option traverses PASS over a length of 396 metres.	88
	1C	11.3	Option would be constructed over potential acid sulphate soils (PASS) that may exist down to 1 m depth. The option traverses PASS over a length of 1700 metres.	86
2	2A	16.5	Option would be constructed over potential acid sulphate soils (PASS) that may exist down to 1 m depth. The option traverses PASS over a length of 2504 metres.	100
	2B	15.6	Option would be constructed over potential acid sulphate soils (PASS) that may exist down to 1 m depth. The option traverses PASS over a length of 1790 metres. This option passes through six to twelve metres of Pimlico Clays (soft soils). It would experience settlements and therefore pre-loading or ground improvements may be required at • Richmond River. • McDonalds Creek. • Tuckean Broadwater	109
	2C	17.0	Option would be constructed over potential acid sulphate soils (PASS) that may exist down to 1 m depth. The option traverses PASS over a length of 4461 metres.	93
	2D	15.1	Option would be constructed over potential acid sulphate soils (PASS) that may exist down to 1 m depth. The option traverses PASS over a length of 5034 metres.	88
	2E	15.5	Option would be constructed over potential acid sulphate soils (PASS) that may exist down to 1 m depth. The option traverses PASS over a length of 3107 metres.	84
	2F	15.8	Option would be constructed over potential acid sulphate soils (PASS) that may exist down to 1 m depth. The option traverses PASS over a length of 11749 metres.	160
3	3A	7.1	The option does not traverse high risk PASS areas.	100
	3B	6.7	The option does not traverse high risk PASS areas.	98

Table 18. Contemporary comparative assessment of the functional issues across all the route options.

Section	Route option	Length	Construction	Costing (units)
1	1A	Low	Low	High
	1B	Medium	Low	Medium
	1C	Low	High	Low
2	2A	High	Low	Medium
	2B	Medium	High	High
	2C	High	Medium	Low
	2D	Low	Medium	Low
	2E	Low	Medium	Low
	2F	Medium	High	High
3	3A	Medium	Low	Medium
	3B	Low	Low	Low

Summary conclusion

Table 19. Contemporary comparative assessment of all the route options.

Section	Route option	Biodiversity	Hydrology	Noise	Social effects	Cultural heritage	Functional and design
1	1A	Low	Medium	Medium	High	High	High
	1B	Medium	Medium	Medium	High	High	Medium
	1C	High	Medium	Low	Medium	Low	High
2	2A	High	High	Medium	High	Low	Medium
	2B	High	High	Low	Medium	Low	High
	2C	High	Low	Low	Medium	High	Medium
	2D	Medium	Medium	High	Low	Medium	Low
	2E	Medium	Medium	High	Medium	Medium	Low
	2F	Low	High	Medium	Medium	Low	High
3	3A	Low	Low	Low	High	Low	Medium
	3B	Medium	Low	Medium	Low	Low	Low

Based on the above comparative assessment, Option 1C is better performing option for section 1. For section 2, the best performing option is Option 2D, with Option 2E also a good performing option. For section 3, while the two options are closely ranked, Option 3B is the better performing option.

Following the value management workshop, further investigations were undertaken to attempt to minimise potential environmental, agricultural and Aboriginal heritage impacts.

Development of the route options

A value management workshop was held in July 2005, to analyse the route options against the following five key criteria: environment, heritage, functional, social and noise, and business and economic. The route options were analysed and a number of key issues raised that would need to be addressed in further phases of the project. The key recommendations from the workshop were:

- Support for option 1C as the preferred route for section 1 (subject to further investigations to minimise biodiversity impacts)
- Support for option 3B as the preferred route for section 3 (subject to confirming road, the footprint and impact on sugarcane land)
- For section 2, options 2A and 2B not to be considered further due to their environmental impacts. Options 2C, 2D, 2E and 2F considered to be possibly preferred options, subject to further reduction of impacts on biodiversity and Aboriginal heritage
- Support for the community alternative route to be further analysed.

Following the value management workshop, further investigations were undertaken to attempt to minimise potential environmental, agricultural and Aboriginal heritage impacts.

The study team then re-evaluated the route options against the analysis criteria and selected the preferred route, as outlined below (and shown in Figure 6).

Section 1

Option 1C (refined to avoid land subject to a Native Title claim and to reduce agricultural impacts) was selected as the preferred route for Section 1. There would be no changes to impacts to Commonwealth listed matters. Option 1C was selected because it would:

- Have less noise and visual impact on existing and potential future residential areas of Woodburn
- Provide a good visual and landscape design outcome
- Have the lowest impact on agricultural lands
- Have acceptable ecological impacts, for which mitigation can be provided
- Have the lowest known and potential Aboriginal heritage impact
- Be the cheapest option to construct, while providing the greatest road user benefits
- Have the shortest length in flood-affected areas and require the shortest length of bridging for floodwater mitigation.

Section 2

A combination of options 2C and 2E (refined to avoid Jali Local Aboriginal Land Council land and reduce ecological impacts) was selected as the preferred route in section 2. Reduction in ecological impacts included avoiding the Wardell Heath, habitat for Commonwealth listed threatened species including the Olongburra Frog, Koala and Grey-headed Flying-fox.

Options 2C and 2E were selected because they would:

- Have fewer significant impacts than the other options
- Have less noise and visual impact on Broadwater and Wardell than options 2D and 2F, resulting in better overall amenity
- Avoid impact on SEPP 14 wetlands, and have less impact on high quality vegetation than options 2A, 2B and 2D
- Have less ecological impacts than the displayed option 2C
- Have less impact on agricultural land (particularly regionally significant agricultural land) than option 2F
- Not require the acquisition of Jali land
- Have the shortest length in flood-affected areas
- Provide good road user benefits for a reasonable construction cost
- Provide the opportunity for a flood-free route connecting Evans Head to the highway.

However, this preferred route would still impact on Commonwealth listed threatened species Oxleyan Pygmy Perch and Hairy Joint-grass.

Section 3

Option 3B (unrefined) was selected as the preferred route for section 3. It was preferred to option 3A because it would:

- Have less noise and visual impacts on communities, resulting in better overall amenity (eg at Whytes Lane West)
- Be the cheaper option to construct, while providing the greatest road user benefits
- Retain the highway on its existing route (using the existing asset which is suitable for upgrading).

The options selected for the preferred route were broadly consistent with those options recommended during the value management workshop.

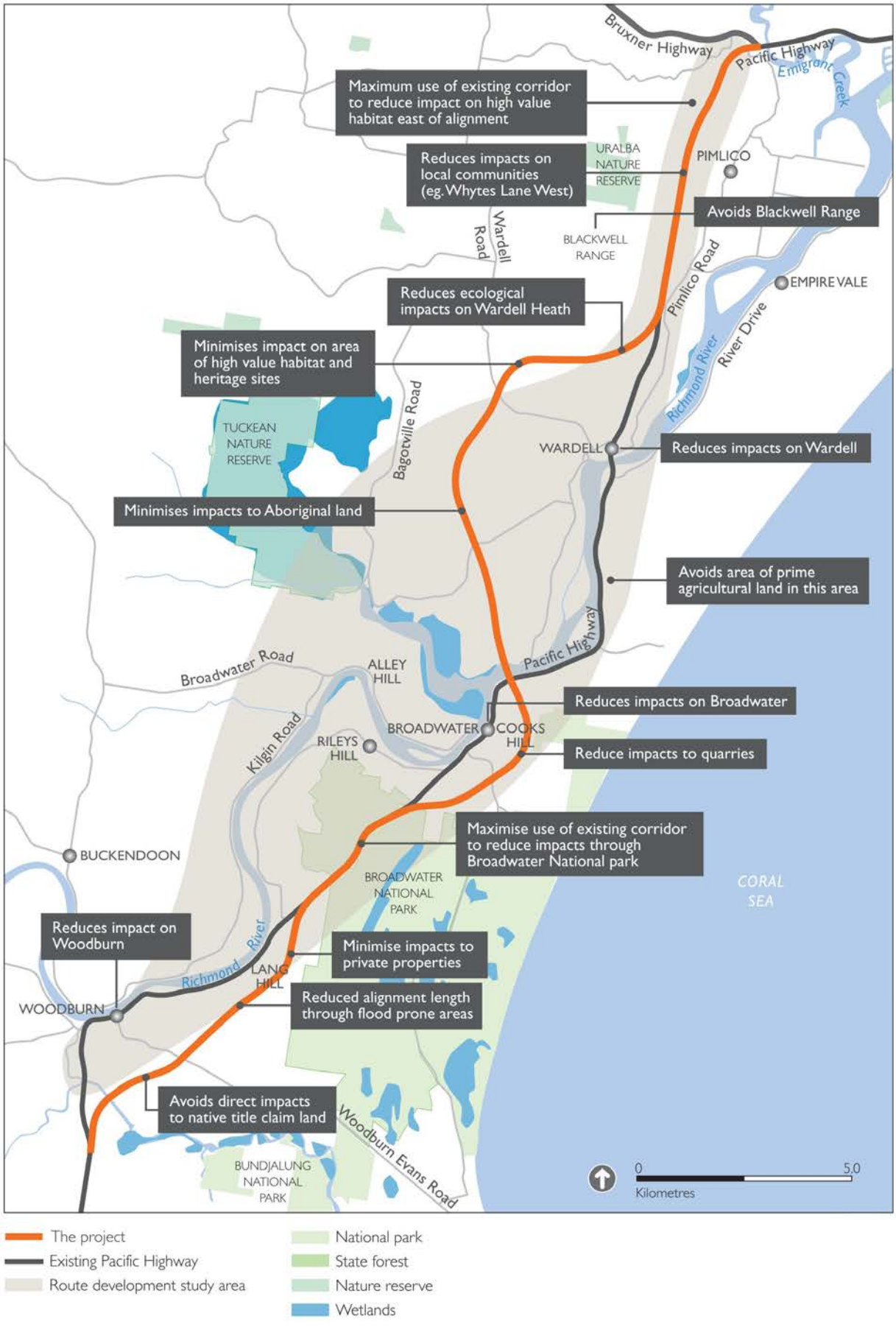

Figure 6 Woodburn to Ballina preferred route