



Transport
Roads & Traffic
Authority

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FOR
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Yamba 14km

SAFE T-CAM
WARNING
SPEED 80-100

Upgrading the Pacific Highway

Woolgoolga to Ballina

Refined concept design

October 2011

Woolgoolga to Ballina upgrade

Concept Design Update

October 2011



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Glossary

Alignment	The general route of a roadway in plan and elevation.
ARI	Annual recurrence interval. Used to describe the frequency or probability of floods occurring. (eg a 100 year ARI flood is a flood that occurs or is exceeded on average once every 100 years).
B-double	A combination road vehicle consisting of a prime mover towing two semi-trailers totalling 25m in length.
Class A	Divided road with at least two lanes in each direction with some direct accesses and able to converted to a Class M in the future and typically 100 km/h.
Class M	Divided road with at least two lanes in each direction with access controlled by interchanges and signposted at 110 km/h.
Concept design	Initial functional layout of a concept, such as a road or road system, to provide a level of understanding to later establish detailed design parameters.
Carriageway	The portion of a roadway devoted to vehicular traffic generally delineated by kerbs, a verge or a median.
Dual carriageway	Multi lane uni direction divided road.
Flyover	An overpass to enable separation of main road traffic and minor crossing traffic
Grade-separated	The separation of road traffic so that crossing movements, which would otherwise conflict, are at different levels.
Grade	The rate of longitudinal rise (or fall) of a carriageway with respect to the horizontal expressed as a percentage.
Horizontal alignment	Refers to the road geometry on a flat plane i.e left and right hand bends in a road and connecting straights.
Interchange	A grade separation of two or more roads with one or more interconnecting carriageways.
Pavement	The upper structural layer of a road.
Median	The central reservation which separates carriageways from traffic travelling in the opposite direction.
Seagull type intersection	A T-intersection on a divided road with deceleration and acceleration lanes in the median.
Service centre	A highway service centre is a place which provides services essential to long distance travellers on the highway.
Service road	A road that links a Class M road to local access roads or is an alternative route other than the motorway.
Shoulder	The portion of the carriageway beyond the traffic lanes adjacent to and flush with the surface of the pavement.
Topography	Terrain of the surrounding area.
Tie in	Connection to a part of the design and an existing feature.
T-intersection	Where one road meets another without crossing, forming the shape of a letter 'T'.
U-turn bay	Facility to enable one to turn and travel in the opposite direction.
Vertical alignment	Refers the changes in grade of a roadway, i.e vertical curves and connecting grades, up or down.

1. Executive summary

Introduction

The Woolgoolga to Ballina Pacific Highway upgrade project involves the proposed upgrade of approximately 155 km of highway between Woolgoolga and Ballina on the North Coast of NSW. The project starts approximately six kilometres north of Woolgoolga (30 kilometres north of Coffs Harbour) and ends approximately six kilometres south of Ballina at the start of the Ballina Bypass (which is under construction).

The Roads and Traffic Authority of NSW (RTA) is seeking to prepare the Pacific Highway between Woolgoolga and Ballina for construction. This involves finalising the concept design, preparing an environmental assessment on the concept design, seeking project approval, undertaking property acquisitions and undertaking necessary field investigations and preconstruction activities so this section of the Pacific Highway is ready when funding for construction becomes available.

The Woolgoolga to Ballina Pacific Highway upgrade project is an essential part of the Pacific Highway Upgrade Program, which has been ongoing since 1996 under joint funding by the Australian and NSW governments. The program involves upgrading the highway to a two-lane divided (dual carriageway) road between Hexham in NSW and the Queensland border and is delivering major road safety and travel efficiency benefits. Together, the Australian and NSW governments have spent \$3.9 billion to 2009 and have made available another \$4.84 billion to 2014 to continue upgrading the Pacific Highway as part of the Nation Building Program and Building Australia Fund.

Currently just over half of the 679 kilometres of Pacific Highway is a four lane divided road. The remaining sections are either under construction, approved for construction or have had a preferred route identified.

The project starts approximately six kilometres north of Woolgoolga (30 kilometres north of Coffs Harbour) and ends approximately six kilometres south of Ballina at the start of the Ballina Bypass (which is under construction).

The Woolgoolga to Ballina upgrade combines the four Pacific Highway upgrade planning projects previously developed:

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

The project excludes the upgrades currently occurring at Glenugie and Devils Pulpit.

Purpose of this report

This concept design update provides an overview of the project, the road design and the key engineering features along the route. The report describes the process of combining the designs previously developed and what refinements have been made to the design since they were previously exhibited. The purpose of the report is to allow a presentation of the technical design aspects of the proposed highway upgrade. It aims to provide further information to the community as part of the display of the concept design for the Woolgoolga to Ballina upgrade.

Project objectives

The projects that make up the Pacific Highway Upgrade Program are intended to achieve the core objectives of improved road safety and reduced travel times.

The aim of the Woolgoolga to Ballina upgrade is to upgrade the Pacific Highway to a higher motorway standard. This will be done through a combination of widening the existing road corridor and building new highway corridors away from the existing Pacific Highway alignment.

Key features

Key features of the Woolgoolga to Ballina upgrade include:

- A motorway standard highway with a four-lane dual carriageway (two lanes in each direction) that can be upgraded to three lanes each way if required.
- Ten grade-separated interchanges to provide access to and from the upgraded highway.
- Major bridges to cross the Clarence River and the Richmond River.
- Local access bridges and service roads to maintain connections to roads and properties.
- Structures designed to allow animals to cross over and under the upgraded highway where it crosses key fauna habitat or wildlife corridors.

Key benefits

Key benefits of the Woolgoolga to Ballina upgrade include:

- Improved road safety.
- Uninterrupted highway traffic flow.
- Access on and off the highway for local traffic.
- Forward planning for future population growth.
- Employment and business opportunities during construction.

Key changes

This concept design update describes:

- The preferred corridor and any refinements made to the highway boundaries.
- Details of changes made since display of the concept designs of the four previous projects.
- The highway function and form, including bridges and structures, flooding and drainage measures, earthworks and pavements.
- Property impacts and land acquisition needs.

Next steps

This concept design report is available at all public displays and can be downloaded from the RTA project website www.rta.nsw.gov.au/pacific (click on Woolgoolga to Ballina). Locations and dates of the public displays are listed on the RTA website. All community issues raised will be considered during the environmental impact assessment for the Woolgoolga to Ballina upgrade and ongoing refinement of the design.

A project application will be submitted to the Department of Planning and Infrastructure (DP&I). Under the new part of the Environment and Planning Act, DP&I will issue environmental assessment requirements and the environmental assessment will be undertaken in accordance with these. The DP&I will also seek public comment on the environmental assessment when the project is placed on exhibition. Further information on the assessment process is available on the DP&I website (www.planning.nsw.gov.au).

2. Introduction

The Pacific Highway is one of Australia's most important roads. Tens of millions of tonnes of freight, and millions of vehicles traverse its length every year. The Woolgoolga to Ballina upgrade (the project) is part of the Pacific Highway Upgrade Program, a joint undertaking by the Australian and NSW governments to improve the standard and safety of the Pacific Highway between Hexham and the Queensland border.

The Roads and Traffic Authority of NSW (RTA) is seeking approval for the Woolgoolga to Ballina upgrade, from the end of the Sapphire to Woolgoolga upgrade project at Arrawarra Beach through to the Ballina Bypass project, near the Bruxner Highway junction south of Ballina.

The RTA has formed the Woolgoolga to Ballina Planning Alliance with Sinclair Knight Merz and Aurecon to:

- Review, combine and refine the concept designs from the planning of the four previously developed projects.
- Confirm land acquisition needs and begin the acquisition process with landowners willing to initiate negotiations.
- Prepare an environmental assessment for planning approval of the project.

2.1. Project overview

The Woolgoolga to Ballina Pacific Highway upgrade project involves the proposed upgrade of approximately 155 km of highway between Woolgoolga and Ballina on the North Coast of NSW. The project starts approximately six kilometres north of Woolgoolga (30 kilometres north of Coffs Harbour) and ends approximately six kilometres south of Ballina at the start of the Ballina Bypass (which is under construction).

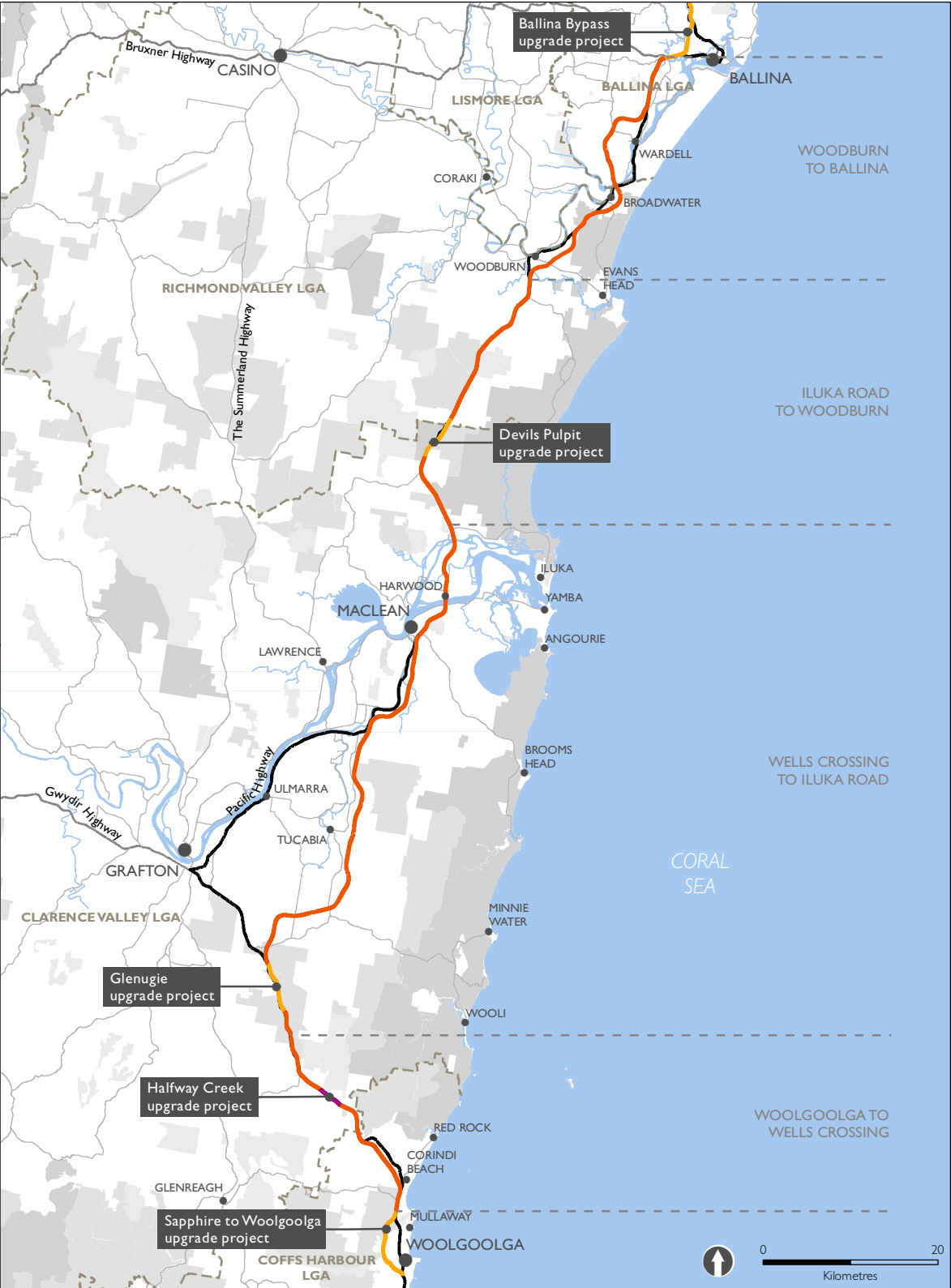
The Roads and Traffic Authority of NSW (RTA) is seeking to prepare the Pacific Highway between Woolgoolga and Ballina for construction. This involves finalising the concept design, preparing an environmental assessment on the concept design, seeking project approval, undertaking property acquisitions and undertaking necessary field investigations and preconstruction activities so this section of the Pacific Highway is ready when funding for construction becomes available.

An overview of the project location and alignment is shown in **Figure 1-1**.

The Woolgoolga to Ballina upgrade would connect to the Sapphire to Woolgoolga upgrade project in the south, extending the dual carriageway construction north from the Coffs Harbour region. It would connect to the Ballina Bypass upgrade project in the north which, together with other works north of Ballina, would complete the dual carriageway from Coffs Harbour to the Queensland border. This project represents the final phase of the planning for the Pacific Highway Upgrade Program.

The alignment would follow the existing highway alignment in some locations and deviate from this alignment in others. The project would require the bypass of Grafton, South Grafton, Ulmarra, Tyndale, Maclean, Woodburn, Broadwater and Wardell. The project crosses two major river systems, namely the Clarence and Richmond Rivers. These are some of the largest rivers on the east coast of Australia with substantial floodplains.

Figure 1.1 Project overview



- Woolgoolga to Ballina upgrade project
- Upgrade completed to dual carriageway
- Upgrade under construction or soon to commence
- Existing Pacific Highway
- State Forest
- National Park
- Nature Reserve / State Conservation Area

2.2. Project background

Planning for the Woolgoolga to Ballina upgrade started in 2004 and has involved ongoing community consultation and environmental investigation. Route selection and concept design development was completed in four separate projects developed by the RTA between 2004 and 2010. The extents of the previous projects were:

- From north of Woolgoolga at Arrawarra to Wells Crossing south of Glenugie.
- From Wells Crossing to Iluka Road north of the Clarence River at Maclean.
- From Iluka Road to Woodburn.
- From Woodburn to the Bruxner Highway intersection near Ballina.

As part of detailed planning for the completion of the Pacific Highway Upgrade program, these sections have been amalgamated to form one project – the Woolgoolga to Ballina upgrade - for the purposes of planning approval, concept design development and construction planning.

The primary role of the Woolgoolga to Ballina Planning Alliance is to consolidate the work undertaken to date, build on the knowledge gained from previous investigations, review and refine the concept design where appropriate and to prepare an environmental assessment of the Woolgoolga to Ballina upgrade.

2.3. Project objectives

The Woolgoolga to Ballina upgrade has been designed to meet a set of key project objectives that are consistent with the objectives of the wider Pacific Highway Upgrade Program.

The projects that make up the Pacific Highway Upgrade Program are intended to achieve the core objectives of improved road safety and reduced travel times. The overall program objectives and main Woolgoolga to Ballina upgrade objectives are provided in Table 1-1.

■ **Table 1-1 Key project objectives**

Overall program objectives	Woolgoolga to Ballina upgrade objectives
Significantly reduce road accidents and injuries	• Reduce crash rates to 15 crashes or less per 100 million vehicle kilometres travelled. • Provide a dual carriageway highway with limited or controlled access points and improved overtaking opportunities. • Provide appropriate emergency access routes and facilities. • Retain existing or provide appropriate driver rest areas. • Separate local traffic from through traffic.
Reduce travel times	• Increase the capacity of the highway. • Provide a route and design that improves traffic flow and allows for consistent travelling speeds. • Provide a level of flood immunity that minimises the risk of delays due to flooding.

Overall program objectives	Woolgoolga to Ballina upgrade objectives
	• Provide facilities for managing and maintaining traffic flow in the event of incidents.
Reduce freight transport costs	• Provide a route and design that increases travel efficiency through reductions in length, improvements in alignment and consistency in posted speed limits. • Provide a design standard that meets or exceeds B-double truck requirements.
Develop a route that involves the community and considers their interests	• Continue to consult with community stakeholders during each stage of project planning. • Cater for the access and transport needs of existing communities and properties along the existing highway. • Minimise adverse impacts on existing industries, businesses, towns, properties, residents and lifestyles.
Provide a route that supports economic development	• Provide a route that maintains or improves access to regional and interstate markets. • Provide a route that maintains or improves access to existing towns, tourist centres, business and industries.
Manage the upgrading of the route in accordance with Ecologically Sustainable Development principles	• Integrate environmental, social and economic considerations into all stages of project planning and assessment. • Provide the best outcomes, on balance, taking into account key environmental, social and economic factors.
Provide the best value for money	• Provide a route and design that uses existing highway infrastructure where feasible and consistent with other project objectives. • Provide a strategy for staging the delivery of the project in accordance with upgrade need and availability of funding.

2.4. Key features of the project

Key features of the Woolgoolga to Ballina upgrade include:

- A motorway standard highway with a four-lane dual carriageway (two lanes in each direction) that can be upgraded to three lanes each way if required.
- Ten grade-separated interchanges to provide access to and from the upgraded highway.
- Major bridges to cross the Clarence River and Richmond River.
- Local access overbridges or underpasses and service roads to maintain connections to existing local roads and properties.
- Structures designed to allow animals to cross over and under the upgraded highway where it crosses key fauna habitat or wildlife corridors.

The Woolgoolga to Ballina upgrade may not be built in one phase and may be staged, depending on the need for upgrades and the availability of funding. This would mean some sections of the highway would be upgraded ahead of others. In addition, some sections may not be immediately constructed as motorway standard. The concept design provides flexibility to allow a motorway standard upgrade throughout the alignment should it be required in the future.

The planning approval being sought for the project excludes the six kilometre Glenugie upgrade, which is currently under construction and the 5.4 kilometre Devils Pulpit upgrade which is due to commence construction. These projects were subject to separate approval processes.

2.5. Purpose and scope of this report

This concept design update provides an overview of the project, the road design and the key engineering features along the route. The purpose of the report is to allow a presentation of the technical design aspects of the proposed highway upgrade. It aims to provide further information to the community as part of the display of the concept design for the Woolgoolga to Ballina upgrade.

This concept report is intended to provide a basis for further refinement and assessment of the design during the environmental assessment through to project approval. Approval of the project and the concept design would secure the project corridor and provide certainty for land use planners, developers and the community about the future delivery of the Woolgoolga to Ballina upgrade.

This report describes:

- The preferred corridor and any refinements made to the previous concept designs and highway boundaries.
- Details of the changes made since display of the concept designs of the four previous projects.
- The highway function and form, including bridges and structures, flooding and drainage measures, earthworks and pavements.
- Property impacts and land acquisition needs.

The concept design is based on current standards applicable to the Pacific Highway Upgrade Program. It has incorporated the designs from the previous four development projects, with an emphasis on providing an update on relevant standards, improvements or refinements where appropriate and uniformity of design documentation to allow for future construction planning. Investigations during the detailed design stage of the project may result in further refinements to this design.

2.6. Next steps

Further development of the Woolgoolga to Ballina upgrade is likely to include:

- Further specialist investigations for both the environmental impact assessment and detailed design phases.
- Preparation of the environmental impact assessment.
- Property acquisition.
- Detailed design.
- Preparation of construction tender documentation.
- Construction of the project.

A project application has been submitted to the Department of Planning and Infrastructure (DP&I). DP&I will issue environmental assessment requirements and the environmental assessment will be undertaken in accordance with these. The DP&I will also seek public comment on the environmental assessment when the project is placed on exhibition. Further information on the assessment process is available on the DP&I website (www.planning.nsw.gov.au).

This concept design update is available at all public displays and can be downloaded from the RTA project website www.rta.nsw.gov.au/pacific (click on Woolgoolga to Ballina). Locations and dates of the public displays are listed on the RTA website. All community issues raised will be considered during the environmental impact assessment for the Woolgoolga to Ballina upgrade and ongoing refinement of the design.

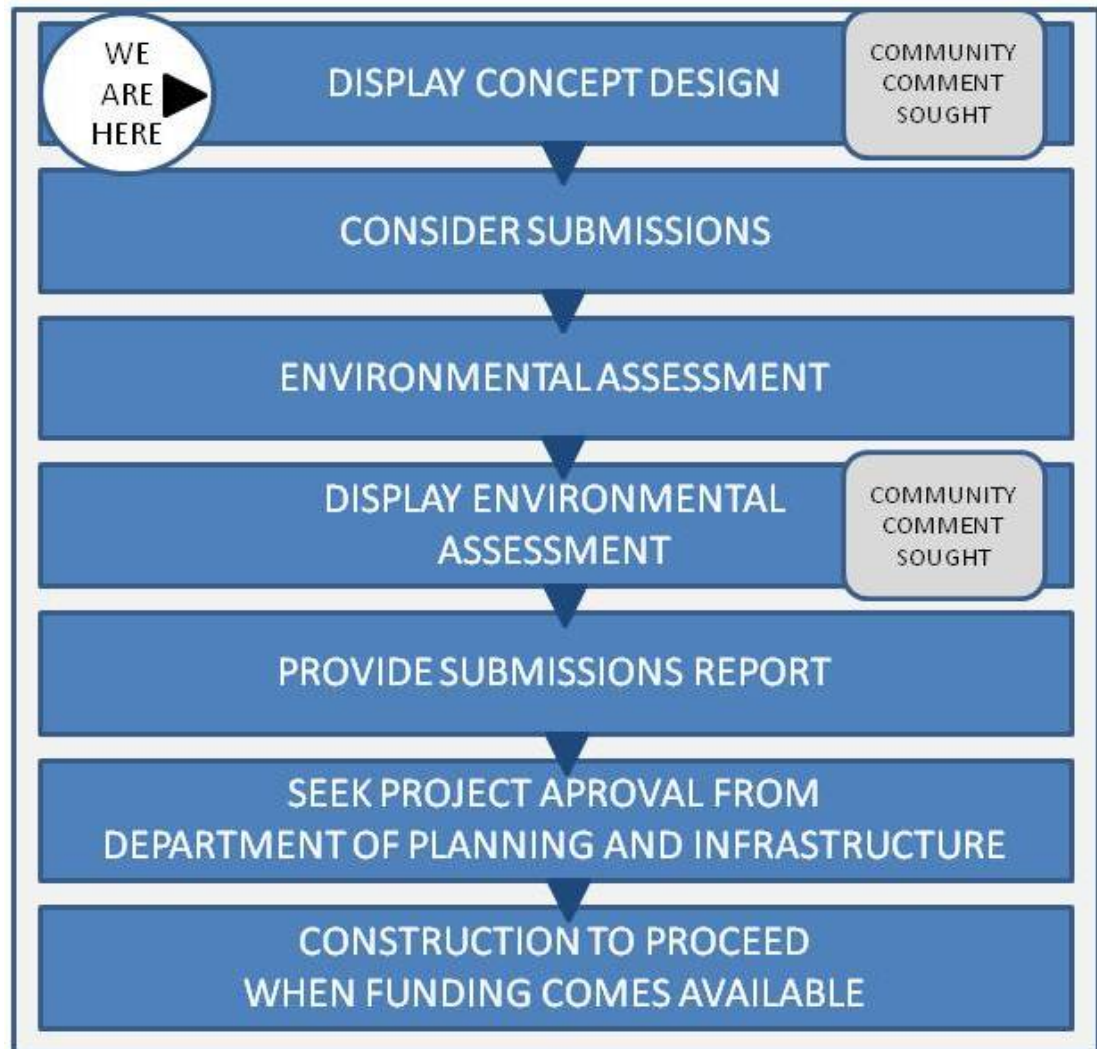
Community input on the concept designs of the four previous projects has been considered in the further development of this concept design and will also be addressed during the environmental assessment.

The RTA project team will continue to consult with landowners and the community about the Woolgoolga to Ballina upgrade to:

- Help the residents and stakeholders become aware of the project and the need for the upgrade.
- Discover and understand any issues, values and concerns residents and stakeholders have about the project.
- Include residents and stakeholders issues in each continued investigations.
- Communicate the outcomes of the investigations.
- Inform residents and stakeholders about the next steps.

The steps in the assessment approval process for the project are summarised in **Figure 1-2 below**.

Figure 1-2 Next steps following display of the concept design update



3. Previous design development and consultation

The Woolgoolga to Ballina upgrade incorporates the four previous projects developed by the RTA between Woolgoolga and Ballina. These previous projects considered a range of highway upgrades and / or alternative routes for the Pacific Highway. The projects are commonly referred to as:

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

As part of detailed planning for the completion of the Pacific Highway Upgrade Program, these previous projects have been combined to form one project – the Woolgoolga to Ballina upgrade – for the purposes of planning approval, concept design development and construction planning. The extents of these previous planning projects are shown on **Figure 1-1**.

Details of the preferred route and concept designs are available in the following reports:

- *Woolgoolga to Wells Crossing Concept Design Report* (RTA, 2008a).
- *Iluka Road to Woodburn Preferred Concept Design Report* (RTA, 2008b).
- *Woodburn to Ballina Concept Design Report* (RTA, 2008c).
- *Wells Crossing to Iluka Road Concept Design Report* (RTA, 2009).

Tyndale to Maclean Alternative Alignment Decision Report (RTA, 2011). Since the completion of these reports, this concept design has been further developed and refined to account for new environmental and technical input. The following sections provide a summary of each of these reports and the consultation conducted for each.

3.1. Woolgoolga to Wells Crossing

The project between Woolgoolga and Wells Crossing features a 27 kilometre dual carriageway (two lanes in each direction) upgrade of the Pacific Highway.

The design included duplicating the existing highway with a major realignment of the existing Pacific Highway between Kangaroo Trail Road and Range Road to improve safety. Direct property access to the highway would be rationalised and a service road would provide access to the highway for properties at McPhillips Road, Lemon Tree Road, Luthers Road and Eggins Drive. The upgrade would result in an improved alignment at Dirty Creek Range and safer access for local residents.

Key issues that have been investigated within this section of the upgrade include:

- Crossing of the Corindi floodplain in a manner that considers the hydrological regime in addition to wetland habitats.
- Traversing Dirty Creek Range with an optimal alignment in terms of safety and functionality, whilst minimising impacts (eg noise, visual, ecological).
- Impacts to property and commercial horticultural activities in the area.
- Minimising impacts to state forest areas and other lands with threatened ecological communities (eg Wells Crossing Flora Reserve).
- Impacts to Aboriginal sites and Aboriginal vested lands in the area.
- Maximising the use of the existing highway infrastructure, particularly the section of highway upgraded at Halfway Creek.

A brief history of the Woolgoolga to Wells Crossing project includes:

- November 2004: Investigations begin and include community consultation to identify a study area and route options.
- October 2005: Route options announced and displayed for community comment.
- August 2006: Preferred route announced and displayed for community comment.
- May 2007: Preferred routes identified for the Barcoongere Way and Luthers Road areas following further community, agricultural and environmental investigations.
- April 2008: Concept design announced and on display for community comment.

Community consultation for Woolgoolga and Wells Crossing also included:

- Six community liaison group meetings – 15 Dec 2004, 2 March 2005, 20 July 2005, 2 November 2005, 11 May 2006 and 5 September 2006.
- Two community information sessions - November 2004 and February 2007.
- Four community update newsletters – November 2004 (Introduction to the project), October 2005 (Route Options Display), August 2006 (Preferred Route Display), April 2008 (Concept Design).
- Four focus group meetings with ecological and Aboriginal groups.
- Seven static displays and three staffed displays to discuss route options, as well as six static displays and one staffed display to discuss the concept design.

3.2. Wells Crossing to Iluka Road

The project between Wells Crossing to Iluka Road features a 70 kilometre dual carriageway.

The design for this section of highway is a combination of an arterial and a motorway standard highway. Interchanges with a local overpass or underpass access and access ramps to the upgraded highway would be provided at Glenugie, Tyndale, Maclean, Yamba, Harwood and Iluka Road.

Key issues that have been investigated within this section of the upgrade include:

- Towns and villages that were in the study area that would be either affected by a widened highway, or by the preferred route bypassing the town.
- The Clarence River floodplain and river crossing, with a substantial catchment area and threatened SEPP 14 wetland habitats.
- Amenity of areas that may be affected by a new highway alignment.
- Reducing the amounts of fill required for structures to cross floodplain areas.
- Improving the function and safety of the highway, whilst ensuring connectivity to the local road network to obtain maximum utility of the new highway.
- Prime agricultural land (eg high value cane farming) and access for farm operators.
- Threatened species directly or indirectly affected by the upgraded highway route.
- Residential areas and property acquisitions.
- Maximising the use of the existing highway corridor at the southern and northern end of this upgrade section.
- Crossing of the Clarence River in terms of location and design form of the crossing.

A brief history of the Wells Crossing to Iluka Road project includes:

- November 2004: Investigations begin and include community consultation to identify a study area and route options.
- October 2005: Route options announced and displayed for community comment.
- May 2006: Outcomes of value management workshop announced.
- September 2006: Preferred route announced and displayed for community comment.
- January 2009: Concept design announced and displayed for community comment.

- May 2009: Alternative alignment between Tyndale and Maclean investigated.
- October 2010: Alternative alignment between Tyndale and Maclean is displayed for community comment.
- August 2011: Alternative alignment between Tyndale and Maclean is announced and will now be included in the Woolgoolga to Ballina environmental assessment.

Community consultation for Wells Crossing to Iluka Road also included:

- Five community liaison group meetings.
- Nine community updates - November 2004 (Introduction to the project), October 2005 (Route options), May 2006 (Value management), September 2006 (Preferred route), January 2009 (Concept design), May 2009 (Alternative route), June 2009 (Glenugie upgrade), August 2009 (Glenugie upgrade Environmental Assessment), October 2010 (Alternative route).
- Three flyers (progress update, preferred route display and route options display).
- Eight static displays and six information sessions to discuss the preferred route as well as seven static and three staffed displays to discuss route options.

3.3. Iluka Road to Woodburn

The Pacific Highway upgrade between Iluka Road and Woodburn involves a 33 kilometre dual carriageway upgrade of the Pacific Highway between the Iluka Road and Trustums Hill Road, just south of Woodburn.

The majority of the new highway will be built within the existing corridor. The use of the existing highway has construction, economic and environmental benefits. The upgrade includes a safer road alignment with better intersections, curves and gradients.

Intersections ('seagull' type design) will provide safe access onto the highway for northbound and southbound traffic at Jacky Bulbin Road, Serendipity Road, Swan Bay and New Italy Road.

Key issues that have been investigated within this section of the upgrade include:

- Maximising the use of the existing highway, whilst making improvements to the alignment for safety e.g. at Devils Pulpit State Forest.
- Providing fauna connectivity and appropriate number and type of crossing structures.
- Avoiding the areas of state forest, nature reserve and national parks within the project corridor.
- Avoiding direct impacts to State heritage listed New Italy Museum site.
- Threatened species directly or indirectly affected by the upgraded highway route.

A brief history of the Iluka Road to Woodburn project includes:

- November 2004: Investigations begin and include community consultation to identify a study area and route options.
- March 2006: Concept design announced on display for community comment.
- July 2008: Preferred concept design on display for community comment. This was a refinement of the concept design following community consultation.

Community consultation for Iluka Road and Woodburn also included:

- Six community update newsletters.
- Five community information sessions.
- Ten static displays and one staffed display.

3.4. Woodburn to Ballina

The Pacific Highway upgrade between Woodburn and Ballina involves a 32 kilometre dual carriageway upgrade of the Pacific Highway.

It includes grade-separated interchanges at Woodburn, Broadwater (Evans Head Road) and Coolgardie Road (Wardell). The existing highway would be retained as a local service road for residents. The upgrade bypasses the towns of Woodburn, Broadwater and Wardell.

Northbound and southbound rest areas for trucks and cars would be provided south of Old Bagotville Road.

Key issues that have been investigated within this section of the upgrade include:

- Affects of the upgrade on the towns of Woodburn, Broadwater and Wardell.
- Maximising the use of the existing corridor, particularly to reduce impacts through Broadwater National Park.
- The Richmond River floodplain and river crossing, with a substantial catchment area and threatened SEPP 14 wetland habitats.
- Lands of high ecological values and Aboriginal significance e.g. in vicinity of Wardell Heath.
- Affects on agricultural properties (grazing and cane farming) and areas important for regional productive industries.
- Reducing the amounts of fill required for structures to cross floodplain areas.

- Providing fauna connectivity and appropriate number and type of crossing structures.
- Sites of high Aboriginal significance with the project study area and lands owned by Aboriginal land council.
- Deep soft soils in floodplain areas traversed e.g. Richmond River floodplain.

A brief history of the Woodburn to Ballina project includes:

- November 2004: Investigations begin and include community consultation to identify a study area and route options.
- May 2005: Route options announced and displayed for community comment.
- November 2005: Preferred route announced and displayed for community comment.
- October 2006: Ongoing consultation with the community regarding interchange locations and access arrangements.
- March 2008: Concept design announced and displayed for community comment including a number of refinements to the preferred route.

Community consultation for Woodburn to Ballina also included:

- Ten community liaison group meetings.
- Five community update newsletters (covering concept design, interchanges, preferred route and route options).
- Twenty two focus group meetings regarding flooding, the sugar industry, ecology and indigenous issues.
- Three community information sessions.
- Eighteen static displays and four staffed displays.

4. Concept design review

4.1. Concept design features

The main concept design task was to combine the four previous concept designs into a consolidated and consistent road design for the entire route between Woolgoolga and Ballina.

Two highway options are being considered for various sections of the Pacific Highway Upgrade Program:

- Arterial style highway (referred to as Class A).
- Motorway style highway (referred to as Class M).

The concept design for the proposed upgrade from Woolgoolga to Ballina has been developed as a Class M highway. The project would not be built in one phase but would be staged, depending on the availability of funding. This would mean some sections of the highway would be upgraded ahead of others.

Some future stages would involve an initial upgrade to an arterial road (Class A). Many safety and travel efficiency benefits (separated north and southbound carriageways) would be realised through the upgrade to an interim Class A highway alignment.

The key features of the highway design include:

- A divided road with two lanes in each direction and a median wide enough to allow a further upgrade to three lanes in each direction, if required.
- A speed limit of 110 kilometres per hour.
- Controlled access, with highway access limited to grade-separated interchanges.
- A continuous alternative route to highway (in most locations this would be the existing highway).

4.2. Review process

The Woolgoolga to Ballina Planning Alliance has undertaken a comprehensive review of the consolidated concept design. The design approach adopted was to make changes only where they represented a substantial improvement or opportunity in relation to social, environmental, functional and/or cost outcomes.

The range of design review activities included:

- Confirming the alignment for the length of the entire project and linking it to the completed section at Halfway Creek and the detailed designs for the Glenugie and Devils Pulpit upgrades.
- Ensuring conformity with RTA's Road Design Guide and associated check lists.

- Confirming a Class M highway design including overall footprint and acquisition requirements where the proposed upgrade is next to the existing highway (particularly in the Woolgoolga to Wells Crossing and the Iluka Road to Woodburn projects).
- Reviewing private property access needs, service road layouts and overpass/underpass for local roads.
- Reviewing interchange designs to:
 - maximise road safety and local traffic accessibility
 - review functionality
 - reduce soft soil impacts and improve constructability.
- Designing practical safe and economic temporary connections to the existing highway.
- Designing appropriate connections to sections of the alignment that are undergoing construction eg Glenugie upgrade, Devils Pulpit and the Ballina Bypass.
- Refining the flood modelling across the whole alignment as to refine the design of waterway and floodplain crossings.
- Refining the alternative alignment between Tyndale and Maclean including the interchange at Maclean.

A structured process for the identification and assessment of the options emerging from the concept design review has been undertaken.

4.3. Key concept design refinements

The concept design review identified improvements at the following locations:

- New overbridge to be provided over highway alignment for Sherwood Creek Road just south of Corindi. This change was necessary to connect Sherwood Creek Road (west of the highway) with the local road network (Eggins Road east of highway) following the redesign of the interchange south of this location at Arrawarra as part of the Sapphire to Woolgoolga upgrade.
- Interchange at Range Road, Corindi: two roundabouts have been provided and the intersection shifted to improve performance and safety, as well as enabling construction to be carried out away from the existing Pacific Highway.
- Interchange at Eight Mile Lane shifted to reduce the number of bridge structures, lengthen one bridge structure and avoid a major realignment of Picaninny Creek and Pheasants Creek.
- Interchange at Tyndale: the southbound off ramp needed changes to improve the safety of the steep and sharp exit for traffic going to Grafton. This change, together with the need to reduce fill requirements and reduce impact on vegetation, led to an overall reduction in the size of the interchange in both footprint and in height of the cutting.

- The local access road at Goodwood Street will now pass over the proposed highway at the Maclean interchange. This reduces the height of the main alignment, with potential beneficial effects on amenity and also reduced fill requirements for the project. A roundabout at Jubilee Street has also been added to provide improved traffic flow and safety.
- An alternative arrangement at the Harwood and Yamba interchange has been considered as part of the concept design refinement. This arrangement will mean better local traffic flow.
- Two roundabouts are to be provided to improve performance and safety at the Iluka Road interchange.
- Two roundabouts will be provided at the interchange at Broadwater Evans Head Road, to improve performance and safety.
- At the interchange at Wardell (Coolgardie Road), two roundabouts will be provided at the interchange to improve performance and safety.
- The highway alignment was moved 50 metres east near Pillar Valley, which allowed the number of bridge structures to be reduced, in accordance with revised flooding modelling undertaken.

There will be changes to a number of bridges along the route following more comprehensive flood modelling across the project area. Staged temporary connection roads between the proposed dual carriageway upgrade and the existing Pacific Highway have been identified at Tyndale and at the Richmond River at Broadwater to enable vehicular connection during staged openings of the upgrade.

4.4. Other concept design refinements

There have been a number of smaller design refinements that have occurred since previous consultation. These are listed in Table 3-1.

■ **Table 3-1 Further design changes**

Location	Design element	Benefit
Eggins Drive, Corindi Beach	Road widening to 7m plus shoulders	In line with design guidance for service roads
Between Range Road and Wells Crossing	Land acquisition for future Class M	Increased strip acquisition to ensure greater separation between the service roads and the main alignment.
Between Iluka Road and Woodburn	Land acquisition for future Class M	Increased strip acquisition to ensure greater separation between the service roads and the main alignment.
Mororo	Southbound rest area within sensitive vegetation	Relocated 1 km north to lesser quality vegetation and reshaped in line with other rest areas on the project.
Tabbimobil Swamp Nature Reserve	New fauna over pass bridge added and rope crossings	Improve interconnectivity between two forested areas and major fauna corridor.

Further concept design refinements made to the entire alignment include:

- Changes to the number, alignment and length of a number of bridges along the route following more comprehensive flood modelling across the project area, as detailed further in Section 5.1 of this report.
- Land acquisition or location of water quality basins to ensure adequate space for their construction.
- Minor changes in vertical alignment i.e. removal of vertical curves from bridges where possible to reduce cost and to ease construction.

5. Key features of concept design

The concept design is intended to provide a sound and clear basis for future phases of project planning and development. The design for the project follows the RTA's Road Design Guide and Austroads *Guide to Road Design* (Austroads, 2010). The Woolgoolga the Ballina upgrade has been divided into 11 sections as one possible delivery scenario and described below.

The project alignment would follow the existing highway alignment in some locations and deviate from this alignment in others.

In general, where the alignment follows the existing highway alignment, the carriageway of the existing highway would be incorporated into the upgrade, becoming either the northbound or southbound carriageway of the new class M road. Only one new carriageway would need to be constructed in these locations, although works may also be carried out on the existing highway carriageway to improve its gradient or alignment in accordance with design standards.

Where the existing highway alignment is to be retained as one carriageway of the upgrade the pavement would also be rehabilitated. In places this pavement may be removed entirely and a new pavement formation constructed using materials reprocessed from the original pavement. Investigations into the condition of the existing highway pavement would determine the final arrangements.

Where the proposed alignment deviates from the existing highway alignment, two new carriageways would be constructed, either on a completely new alignment or closely following the existing alignment.

5.1. Project description

5.1.1. Section 1 – Woolgoolga to Halfway Creek

Woolgoolga to Halfway Creek is about 17 kilometres long, extending from Arrawarra Beach Road, Arrawarra (about six kilometres north of Woolgoolga) to the northern end of the completed Halfway Creek upgrade at Lemon Tree Road, Halfway Creek. The proposed alignment for this section of the upgrade is as follows:

- Between Arrawarra Beach Road and Eggins Close, the proposed alignment would follow the existing highway alignment. A northbound carriageway would be constructed on the western side of the existing highway, and the existing highway would become the new southbound carriageway.
- Between Eggins Close and Range Road, the proposed alignment would deviate to the west of the existing highway, bypassing the village of Corindi.
- The proposed alignment would re-join the existing highway alignment just before Range Road.

- Between Range Road and Halfway Creek, the proposed alignment would follow the existing highway alignment. A northbound carriageway would be constructed on the western side of the existing highway, and the existing highway would become the new southbound carriageway.

5.1.2. Section 2 - Halfway Creek to the Glenugie upgrade

Halfway Creek to the Glenugie upgrade is about 12 kilometres long, extending from the northern end of the Halfway Creek upgrade at Lemontree Road to the southern end of the Glenugie upgrade at Franklins Road. The alignment for this section of the upgrade is as follows:

- From Lemontree Road to Kungala Road, the upgrade would follow the existing highway alignment. A new northbound carriageway would be constructed on the western side of the existing highway, and the existing highway would become the new southbound carriageway.
- From Kungala Road to Newfoundland State Forest, northbound and southbound carriageways would be constructed, with the new carriageways closely following the existing highway alignment.
- From Newfoundland State Forest to Franklins Road, the upgrade would deviate to the east of the existing alignment.

5.1.3. Section 3 - Glenugie upgrade to Tyndale

Glenugie upgrade to Tyndale is about 35 kilometres long, extending from the northern end of the current Glenugie upgrade (located just south of Eight Mile Lane) to Tyndale. The proposed upgrade involves constructing a new alignment to the east of the existing highway, passing through a mix of open grazing land and remnant bushland on the eastern side of the Coldstream River.

5.1.4. Section 4 - Tyndale to Maclean

Tyndale to Maclean is about 13 kilometres long. The alignment for this section is a dual carriageway deviating to the east of the existing highway and re-joining the existing highway alignment at Maclean. An alternative route was considered between 2009 and 2011 following community feedback received about the previous preferred route.

The original route ran along the eastern edge of the south arm of the Clarence River for its entire length, except where it crossed Shark Creek, where the alignment was further east from the mouth of the river.

The alternative route deviates from the original route immediately north of the proposed interchange at Tyndale. It runs parallel to the south arm of Shark Creek, but is between 600 and 1,200 metres to the east of the eastern bank. It runs almost directly north-south for most of its length, cutting through Green Hill just after crossing Shark Creek. The road will then return to the previously announced preferred route near the proposed interchange at Maclean.

Planning and consultation has shown the new route will minimise the impact of the road on higher quality sugar cane land and will also be easier to build because it avoids stability issues associated with the original route's location next to the river.

The new route will be included in the environmental assessment for the Woolgoolga to Ballina upgrade.

5.1.5. Section 5 - Maclean to Iluka Road, Mororo

Maclean to Iluka Road is about 14 kilometres long, extending from Maclean to Iluka Road, Mororo. The upgrade would involve constructing either new northbound or new southbound carriageways that would generally follow the existing highway alignment. The proposed alignment would cross the Clarence River via the Harwood Bridge. An additional bridge would be required to provide the dual carriageway arrangement (this is called the Harwood Bridge duplication).

5.1.6. Section 6 - Iluka Road to Devils Pulpit upgrade

Iluka Road to the Devils Pulpit upgrade is about nine kilometres long, extending from Iluka Road, Mororo to the southern end of the Devils Pulpit upgrade. The upgrade would involve constructing either new northbound or new southbound carriageways closely following the existing highway alignment, with minor deviations to meet design standards for road gradient and curvature. A bridge would be built where the upgrade crosses the Clarence River North Arm at Mororo to provide the dual carriageway arrangement for the crossing (this is called the Mororo Bridge duplication).

5.1.7. Section 7 - Devils Pulpit upgrade to Trustums Hill

Devils Pulpit upgrade to Trustums Hill is about 15 kilometres long, extending from the northern end of the Devils Pulpit upgrade to just south of Gap Road, Trustums Hill. The proposed alignment would generally follow the existing highway alignment with minor deviations to the west where northbound and southbound carriageways would be constructed. For the remainder of the section, a carriageway would be constructed next to the existing highway to form the northbound lanes, and the existing highway would be used for the southbound lanes.

5.1.8. Section 8 - Trustums Hill to Broadwater National Park

Trustums Hill to the Broadwater National Park is about 11 kilometres long, extending from just south of Gap Road to the Broadwater National Park. It would initially follow the existing highway alignment before deviating to the west at Woodburn interchange between Gap Road and Trustums Hill Road. North of the interchange, the proposed alignment would cross back over the existing highway alignment and follow a new alignment to the east, re-joining the existing alignment at the end of the section. The upgrade of this section would involve constructing northbound and southbound carriageways.

5.1.9. Section 9 - Broadwater National Park to the Richmond River

Broadwater National Park to the Richmond River is about eight kilometres long. The first three kilometres of this section would follow the existing highway alignment through Broadwater National Park. In this location, the upgrade would involve construction of northbound and southbound carriageways using the existing road reserve where possible. This part of the upgrade would require acquisition of land from Broadwater National Park on both the east and the west side of the highway.

Between the northern boundary of Broadwater National Park and the Richmond River, the upgrade would deviate to the east of the existing highway, bypassing the town of Broadwater.

5.1.10. Section 10 - Richmond River to Coolgardie Road

Richmond River to Coolgardie is about 14 kilometres long, extending from the southern side of the Richmond River just east of Broadwater, to Coolgardie Road, Coolgardie. The proposed alignment would cross the Richmond River and follow a new alignment to the west of the existing highway, bypassing the town of Wardell, before re-joining the existing alignment at Coolgardie Road. The crossing of the Richmond River would require construction of a major bridge.

5.1.11. Section 11 - Coolgardie Road to Ballina

Coolgardie Road to Ballina is about eight kilometres long. The proposed alignment for this section of the upgrade is as follows:

- Between Coolgardie Road and about 150 metres north of Whytes Lane, northbound and southbound carriageways would be constructed immediately west of the existing highway. The southbound lanes of the existing highway would become a local service road and the single northbound lane would be decommissioned.
- About 150 metres north of Whytes Lane, the proposed alignment would re-join the existing highway alignment. The existing highway would be incorporated into the southbound carriageway of the upgrade and a northbound carriageway would be constructed to the west.
- Local access north of Whytes lane would be provided via Pimlico Road.

5.2. Road alignment and geometry

The highway cross-section would comprise a dual carriageway with:

- Two lanes per carriageway, each lane 3.5 metres wide.
- A typical median width of 12 metres, to allow for future widening of the highway within the median to three lanes per carriageway, if required.
- A left shoulder, generally 2.5 metres wide and three metres wide next to barriers.
- A right shoulder 0.5 metres wide.

The design criteria for the new carriageways are summarised in **Table 4-1**. The cross-section of a typical motorway standard (class M) highway road is shown in **Figure 4-1**.

■ **Table 4-1 Upgrade design criteria**

Design element	Design criteria
Design speed ¹	110 km/h horizontal 100 km/h vertical
Number of lanes	Two lanes per carriageway ²
Traffic lane width	3.5 m
Outside shoulder widths	2.5 m (with no safety barrier) or 3 m (with safety barrier)
Inside shoulder widths	0.5 m
Median width	12 m
Clear zone	11 m
Formation, drainage and road reserve widths	In accordance with the RTA's Road Design Guide and standard RTA model drawings.
Minimum horizontal radius	1200 m desirable 750 m minimum
Maximum super elevation	3 %
Maximum vertical grade	4.5 % desirable 6.0 % maximum ³
Vertical clearance bridges to overhead	5.5 m desirable 5.3 m minimum
Design vehicle	19.5 m semi-trailer 25 m B-double
Flood immunity	Carriageways flood-free for the 1-in-20 year flood event on major floodplains and the 1-in-100 year flood event elsewhere. ⁴

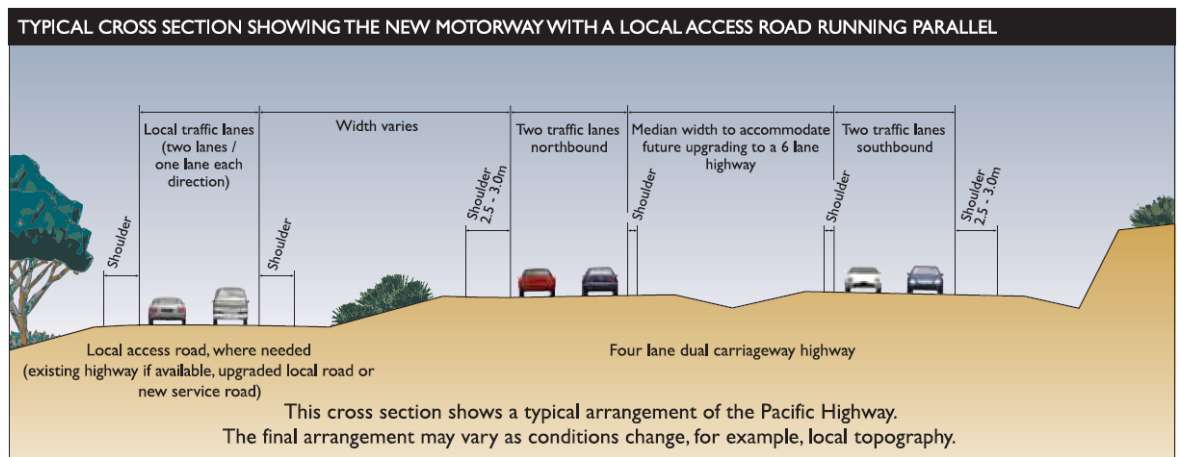
1. This refers to the full Class M upgrade. The posted speed limit for initial upgrades involving a combination of Class M and Class A road is likely to be 100 km/h. A decision on speed limits would be made at a time closer to construction.

2. Allowance has been made (mostly in the median) for future widening to three lanes in each direction, if required.

3. Desirable maximum length for a six percent grade is 500 metres.

4. Staging in some location may result in one carriageway being flood immune to work under a traffic control contra-flow arrangement.

■ **Figure 4-1 Typical cross section of a motorway standard (Class M) road**



A new carriageway is to be constructed along side the existing highway for much of this project. Which side of the existing highway the new carriageway will be built on may vary from location to location depending on environmental, engineering or other constraints.

5.2.1. Service road standards

Service roads would generally be two defined lanes, each 3.5 metres wide, with:

- Sealed shoulders two metres wide where the road is deemed to be a cycle route for a design speed of 80 kilometres per hour).
- Sealed shoulders one metre wide where the road is not deemed to be a cycle route.
- No kerb or gutter.

Where service roads are parallel to the upgrade, a separation distance of 25 metres (edge line to edge line) would generally be adopted. This separation is based on the required clear zones for both the upgrade and the service road and provision of a five metre planting (screening) zone between the clear zones. Reduced separation could be used if barriers or alternative screening methods were adopted.

5.2.2. Access road standards

Access roads would generally be a two-lane (each three metres wide) formation with 0.5 metre unsealed shoulders and no kerb and gutter. Design criteria for service and access roads are presented in **Table 4-2**.

■ **Table 4-2 Service road and access road design criteria¹**

Design element	Service road design criteria	Access road design criteria
Horizontal alignment	80 km/h	70 km/ h (desirable)
Vertical alignment	80 km/h	70 km/h (desirable)
Lane width	3.5 m	3.0 m
Flood immunity	1-in-20 year event	1-in-10 year event

¹Criteria listed in table describes desirable road speeds only, to be confirmed during detailed design.

The proposed alignment would follow the existing highway alignment in some locations and deviate from this alignment in others. The proposed alignment is shown in **Figures 4-2(a-d)**.

In general, where the proposed alignment follows the existing highway alignment, the carriageway of the existing highway would be incorporated into the upgrade, becoming either the northbound or southbound carriageway of the new motorway standard (Class M) road. Only one new carriageway would need to be constructed in these locations although work may also be done on the existing highway carriageway to improve its gradient or alignment.

Where the proposed alignment deviates from the existing highway alignment, two new carriageways would be constructed, either on a completely new alignment or closely following the existing alignment.

Figure 4.2a The concept design alignment (Woolgoolga to Glenugie)

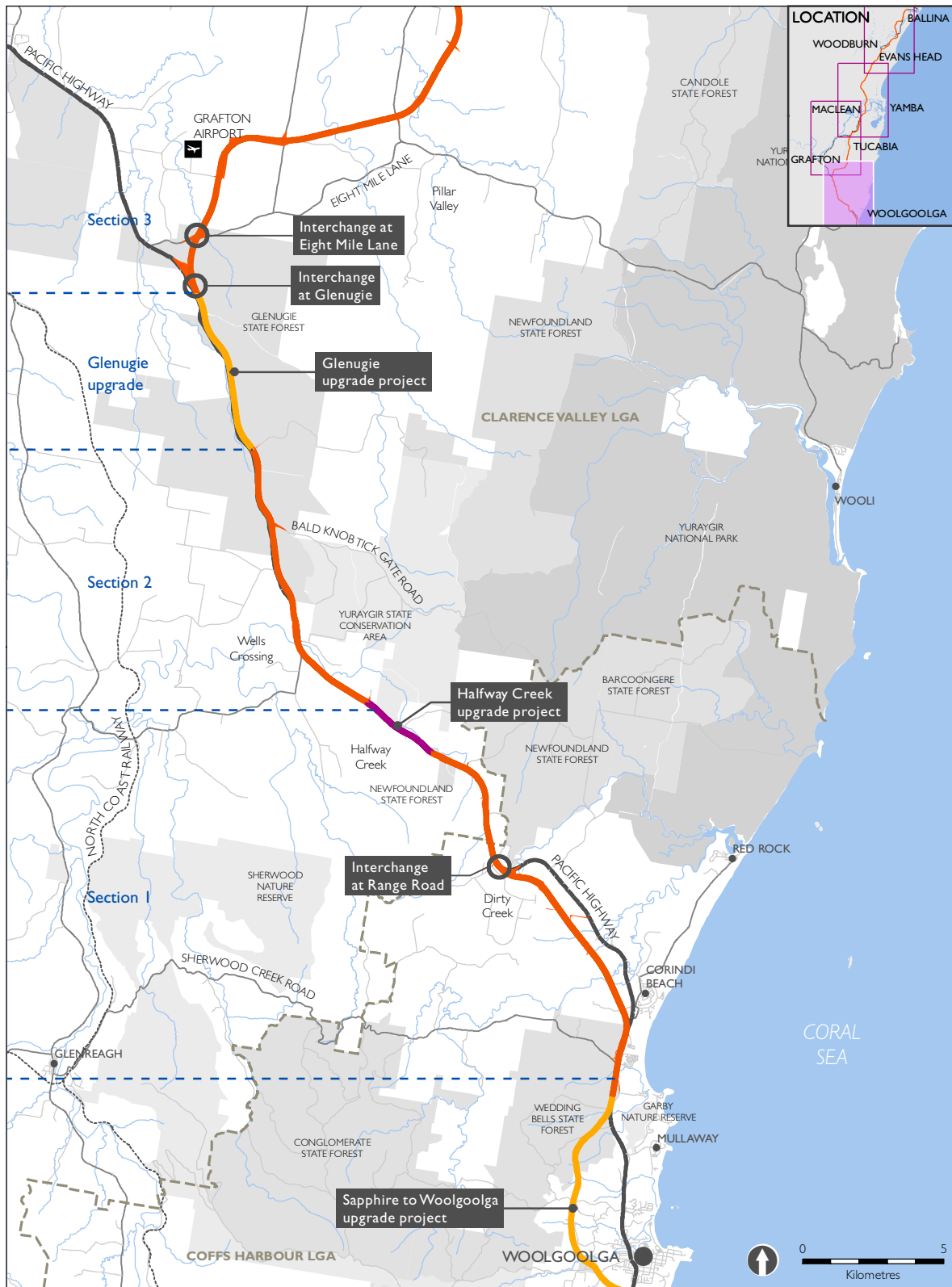


Figure 4.2b The concept design alignment (Glenugie to Maclean)

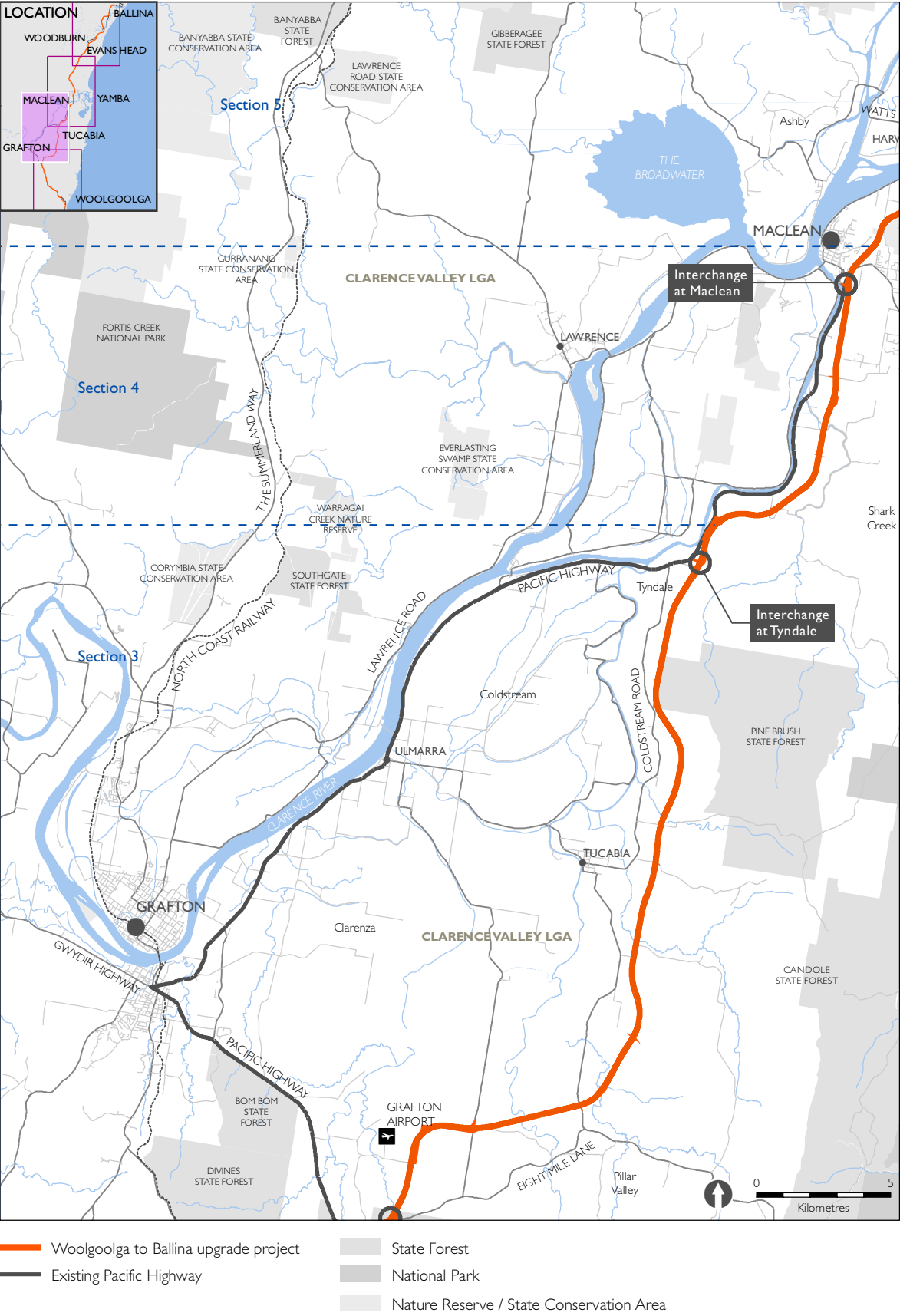


Figure 4.2c The concept design alignment (Maclean to Devils Pulpit)

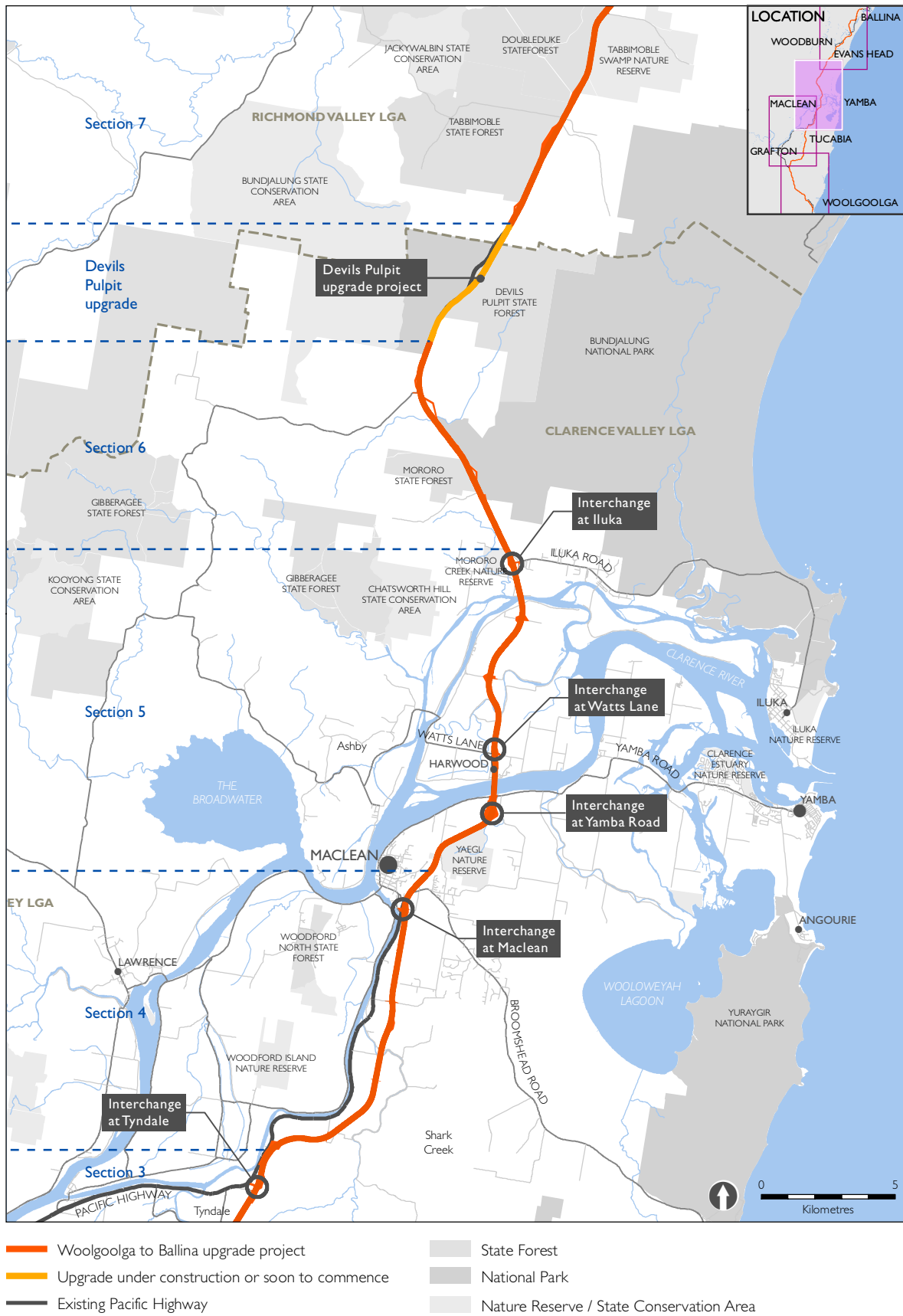
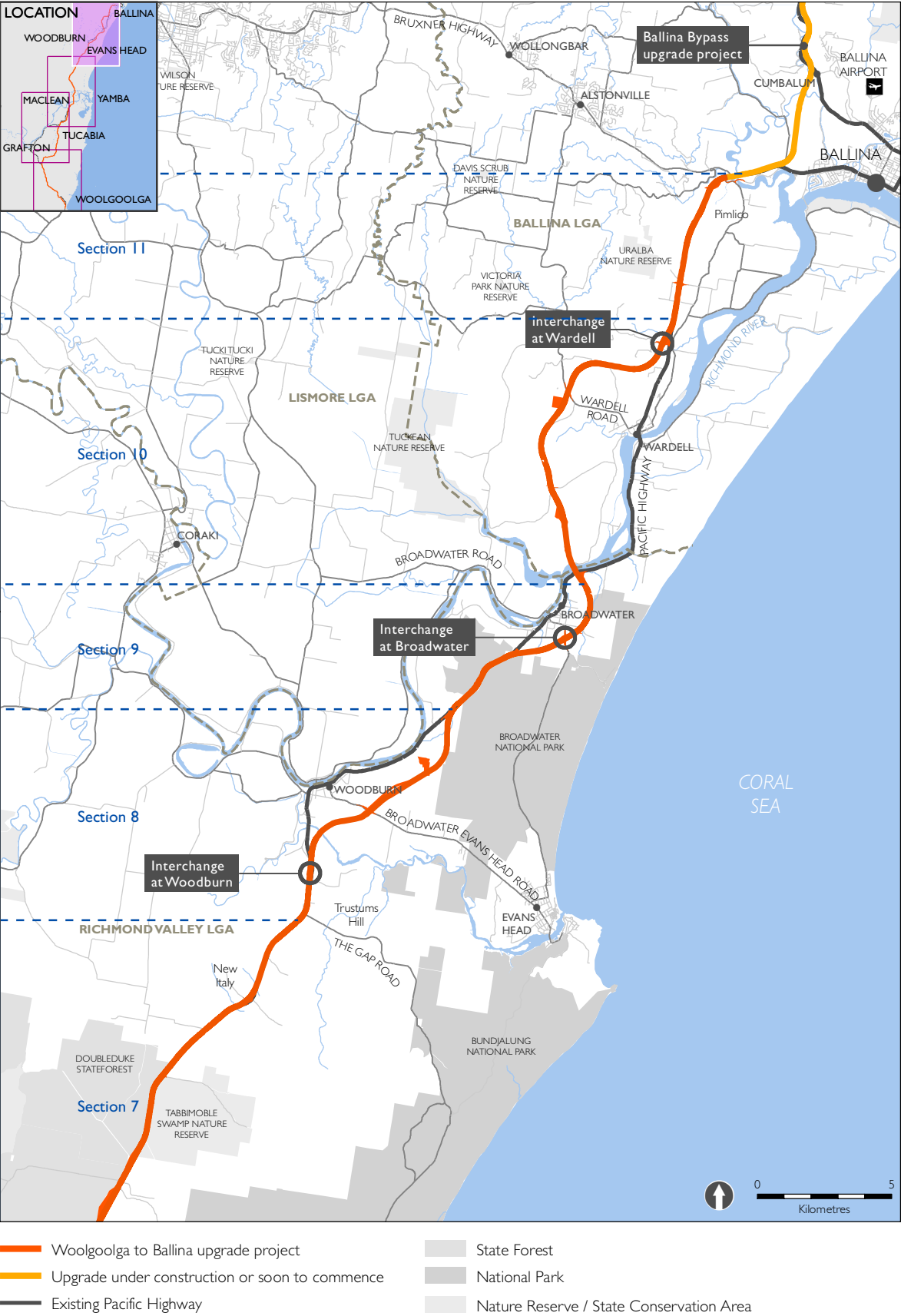


Figure 4.2d The concept design alignment (Devils Pulpit to Ballina)



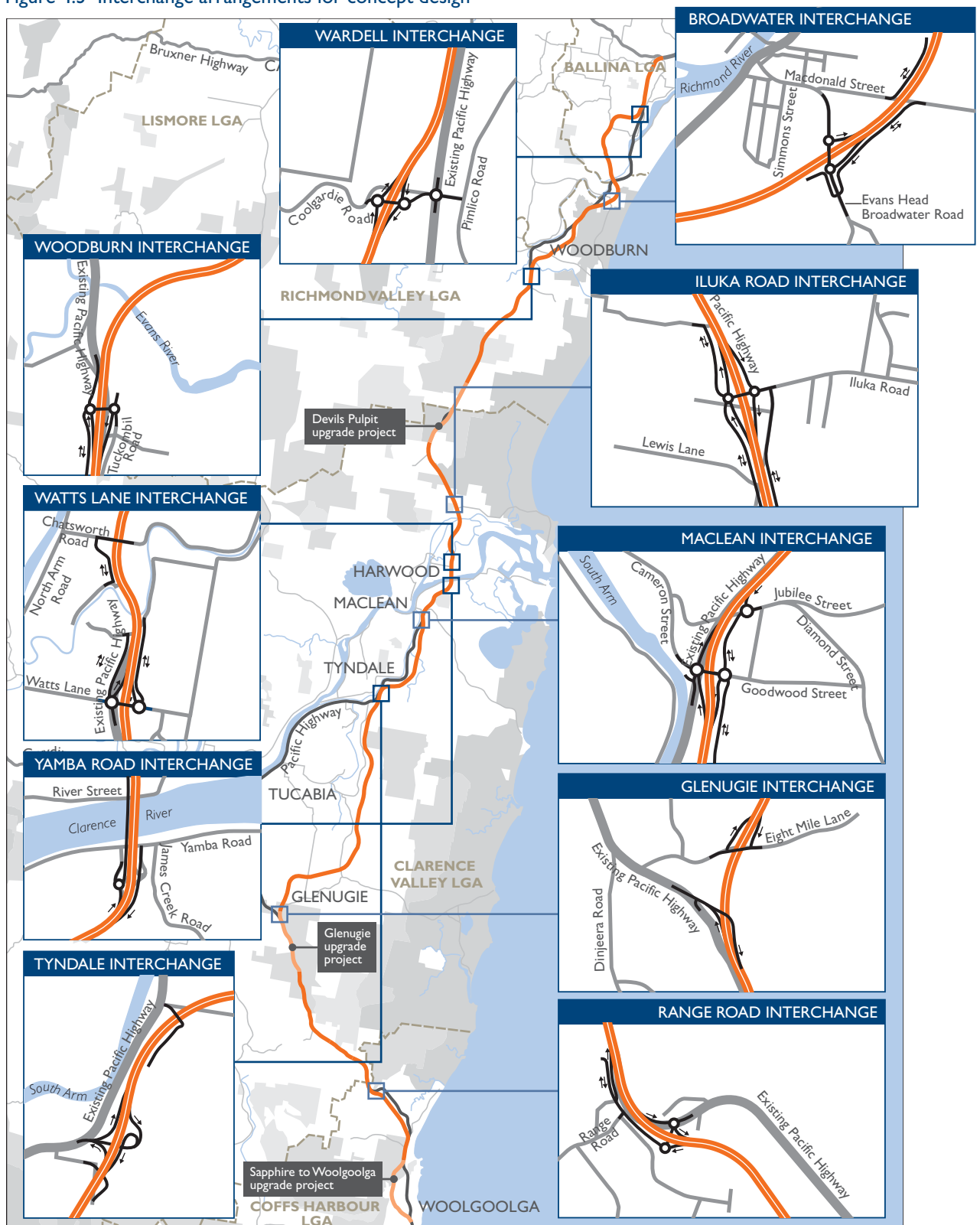
5.3. Access arrangements and interchanges

The project includes 10 interchanges as listed in **Table 4-3**. The locations of the interchanges are shown in **Figure 4-3**. Details of each interchange are provided in the following sections.

■ **Table 4-3 Summary of proposed interchanges**

Project section	Interchange location	Description
1	South of Range Road, Corindi	Dumbbell design interchange comprising two roundabouts located each side of the upgraded highway and connected by a bridge. On-load/ off-load ramps from the upgraded highway would connect either to the roundabouts or to a service road.
3	Glenugie and Eight Mile Lane	Full interchange including a northbound on-load ramp and southbound off-load ramp to enable access to/ from the north via a bridge passing over the upgraded highway at Eight Mile Lane. Ramps to the south at Glenugie to provide full access to/ from Grafton.
3	Tyndale, North of Sheey's Lane	Full interchange including ramps to enable full access to the upgraded highway via connection roads from the existing Pacific Highway. The ramps would provide a transfer between the highway and Grafton.
4	Goodwood Street, Maclean (south)	Dumbbell design interchange comprising two roundabouts located each side of the upgraded highway and connected by a bridge. On-load/ off-load ramps from the upgraded highway would connect either to the roundabouts or a service road.
5	South of Yamba Road, Maclean	Full interchange with ramps connecting the upgraded highway to Yamba Road via two service roads. Ramps to south only
5	Watts Lane at Harwood	Dumbbell design interchange comprising two roundabouts located each side of the upgraded highway and connected by a bridge. On-load/ off-load ramps from the upgraded highway would connect to the roundabouts, which would also connect to Watts Lane and a service road. Ramps from north only
5	Iluka Road, to the south of Jubilee Street	Dumbbell design interchange comprising two roundabouts located each side of the upgraded highway and connected by a bridge. On-load/ off-load ramps from the upgraded highway would connect to the roundabouts to provide unrestricted access to/ from Iluka Road.
8	Trustums Hill Road, south of Woodburn	Dumbbell design interchange comprising two roundabouts located each side of the upgraded highway and connected by a bridge. On-load/off-load ramps from the upgraded highway would connect to the roundabouts from the south only.
9	Evans Head Road at Broadwater	Dumbbell design interchange comprising two roundabouts located each side of the upgraded highway and connected by a bridge. On-load/off-load ramps from the upgraded highway would connect to the roundabouts from the north only.
10	Coolgardie Road, north of Wardell	Dumbbell design interchange comprising two roundabouts located each side of the upgraded highway and connected by a bridge. On-load/ off-load ramps from the upgraded highway would connect to the roundabouts to provide unrestricted access for Coolgardie Road and Wardell.

Figure 4.3 Interchange arrangements for concept design



5.3.1. Service roads

To comply with the design standards for a motorway (Class M) highway, the concept design would include continuous alternative routes to the upgraded highway for non-motorway traffic. These continuous alternative routes are termed ‘service roads’. These would be sealed roads suitable for all classes of vehicles except oversized vehicles and B-doubles.

Where the project involves constructing new northbound and southbound carriageways ‘offline’ from the existing Pacific Highway alignment, the existing highway would be retained as a local service road and provide the continuous alternative route to the upgraded highway. In other sections, where the carriageways of the existing highway are to be incorporated into the upgrade, new service roads would be constructed. All service roads would connect back to the upgraded highway via the grade-separated interchanges described in the previous section.

New service roads constructed as part of the project would be designed to local council and Austroads standards and would generally have a posted speed limit of 80 kilometres per hour. Where the existing Pacific Highway is to become a service road, the posted speed limit may be up to 100 kilometres per hour. The service roads proposed for each section of the project are listed in **Table 4-4**.

■ **Table 4-4 Summary of proposed service roads**

Project section	Service road description	Location
1	Upgrade of Eggins Drive	Between Arrawarra Beach Road and Eggins Close, Arrawarra
1	Parallel to west side of existing highway	Between Range Road, Dirty Creek and Halfway Creek
2	Parallel to west side of existing highway	Between Halfway Creek and Wells Crossing
5	Parallel to west side of existing highway	Between Watts Lane, Harwood and Iluka Road, Iluka
6	Parallel to west side of existing highway	Between Iluka Road, Iluka and New Italy
6	Parallel to east side of existing highway	Between New Italy and The Gap Road, Trustums Hill
7	Parallel to east side of existing highway	Between Gap Road, Trustums Hill and Trustums Hill
9	Parallel to west side of existing highway	Through Broadwater National Park
10	Parallel to east side of existing highway	Between Coolgardie Road, Coolgardie and Whytes Lane, Pimlico
11	Use of existing road (Pimlico Road) to east of existing highway	Between Whytes Lane, Pimlico and the new connection to Smiths Drive over Emigrant Creek

5.3.2. New local access roads

Access roads would be constructed where appropriate to maintain access to local roads and properties that currently have direct access to the highway. These access roads would connect to a service road or local road, not directly to the upgraded highway. They would generally be ‘no through roads’ and would be signposted at either 50 or 60 kilometres per hour. The access roads proposed for each section of the project are listed in **Table 4-5**.

■ **Table 4-5 Summary of proposed new local access roads**

Project section	Access road name/ description	Location
1	No name – provides access between western properties and existing Pacific Highway north of Corindi	North-west of Corindi, either side of upgraded highway
1	McPhillips Road - provides access between eastern properties and proposed service road	South-east of Halfway Creek, east of upgraded highway
2	Lemon Tree Road - provides access between eastern properties and proposed service road	South of Halfway Creek, east of upgraded highway
2	Luthers Road - provides access between eastern properties and proposed service road	South of Halfway Creek, east of upgraded highway
3	Six Mile Lane – deviation for 2 km	East of Grafton Airport, Glenugie
3	Off Avenue Road – 1 km property access	Near Wants Lane, Glenugie
3	No name - access road over upgraded highway	Off Tallowood Lane north of Champions Creek
3	Fire trail - access road over upgraded highway	Within Pine Brush State Forest
3	No name - access road over upgraded highway	South of Pine Brush State Forest, Pillar Valley near Jade Crescent
3	No name - access road over upgraded highway from Coldstream Road	One km south of Tyndale
4	Connection to Byrons Lane, Tyndale – provides access to properties on southern side of upgraded highway	South of upgraded highway, Tyndale
4	Connection from Gallaghers Lane, Tyndale to Norleys Lane, Shark Creek	East of upgraded highway, Shark Creek
4	Connection from MacLean to McIntyres Lane, Gulmarrad	East of upgraded highway south of MacLean
5	Serpentine Channel Road South, Chatsworth – connection to service road	At new connection to Harwood interchange
5	Fischers Road, Chatsworth – new connection to Carrolls Lane	East of existing Pacific Highway, Chatsworth
5	Garretts Lane East, Woombah - new connection on eastern side of upgraded highway to new interchange at Iluka Road.	East of existing Pacific Highway, Woombah
6	Tabbimoble Flats Access Road – connection to properties on eastern side of upgraded highway to service road	Eastern side of main alignment between Jacky Bulbin Road and Devils Pulpit State Forest
7	Eastern access road south of New Italy – new access road	From New Italy to Minyumai Road, Tabbimoble
7	Whites Road – new access road	Western side of upgraded highway from New Italy to Whites Road, New Italy
7	Western access road located south of The Gap – new access road	Western side of upgraded highway connecting western properties from Nortons Gully to the Woodburn interchange
9	No name – access to properties east of upgraded highway	Off Broadwater-Evans Head Road, Broadwater (west)
9	No name – access to properties east of upgraded highway	Off Broadwater-Evans Head Road, Broadwater (east)
9	Broadwater Quarry Road – deviation of access road to Broadwater Quarry	Western side of upgraded highway to the north of Broadwater Quarry Road, Broadwater
10	Thurgates Road – new access road to west of upgraded highway	Western side of upgraded highway connecting to Old Bagotville Road
10	Lumleys Lane – new access road to the west and north of the upgraded highway	Western and northern side of upgraded highway from Wardell Road to Lumleys Lane

Project section	Access road name/ description	Location
10	Lumleys Lane – new access road to the west and north of the upgraded highway	Off Wardell Road, west of Wardell
11	Whytes Lane West, Pimlico - new connection to McAndrews Lane, Pimlico	West of upgraded highway at Pimlico
11	Smith Drive and Pimlico Road connection - new bridge over Emigrant Creek	Southern side of upgraded highway at Emigrant Creek

5.3.3. Alterations to existing local roads

The Woolgoolga to Ballina upgrade would include alterations to a number of local roads to maintain existing traffic routes and access. These alterations would include realignment and provision of crossings of the upgraded Pacific Highway via overbridges and underpasses. The road alterations proposed for each section of the project are listed in **Table 4-6**.

■ **Table 4-6 Summary of proposed alterations to existing local roads**

Project section	Road and location	Alteration required
1	Sherwood Creek Road, Arrawarra	Deviation to north and over upgraded highway to proposed service road
1	Kangaroo Trail Road, Corindi Beach	Local road over upgraded highway
1	Dundoo Reach Road, Dirty Creek	Tie in to proposed service road
1	Falconers Lane, Milleara	Tie in to proposed service road
1	The Siding, Millera	Tie in to proposed service road
1	McPhillips Road, Milleara	Deviation to north and over upgraded highway to proposed service road
1	Dunmar Lane, Milleara	New tie in to proposed service road
1	Rediger Close, Milleara	New tie in to proposed service road
2	Grays Road, Milleara	Deviation to south and over upgraded highway to proposed service road
2	Lemon Tree Road, Halfway Creek	Deviation to north and over upgraded highway to proposed service road
2	Kungala Road, Halfway Creek	Tie in to proposed service road
2	Luthers Road, Halfway Creek	Deviation to north and over upgraded highway to proposed service road
2	Bald Knob Tick Gate Road, Wells Crossing	Deviation to south and over alignment to proposed service road
2	Franklins Road, Glenugie	Deviation to south and over upgraded highway to proposed service road
3	Eight Mile Lane, Glenugie	Local realignment to south over upgraded highway
3	Chevalley Lane – East of Grafton Airport, Lavadia	New connection to Six Mile Lane
3	Six Mile Lane, Lavadia	Local realignment to south over main alignment
3	Avenue Road, Lavadia	Local road over main alignment
3	Wants Lane, Lavadia	Local realignment to south connecting to Avenue Road
3	Wooli Road, Pillar Valley	Local road over main alignment
3	Mitchell Road, Pillar Valley	Local road over main alignment
3	Firth Heinz Road, Tucabia	Local realignment to east and over main alignment

Project section	Road and location	Alteration required
3	Bostock Road, Tucabia	Local road over main alignment
3	Somervale Road, Tucabia	Local road over main alignment
3	Bensons Lane – deviation under main alignment to the east	At Tyndale
4	No name - Access road over main alignment	2 km north of Tyndale
4	Byrons Lane - Access road over main alignment	At Tyndale
4	Cameron Lane	Connection to new interchange
4	Goodwood Street, Maclean	Connection to new interchange
4	Jubilee Street, Maclean	Stopped up on western side. Diverted to new interchange on eastern side
5	Yamba Road, Maclean	New connection to new interchange and interconnection via existing bridge to Watt Lane, Harwood
5	Watt Lane, Harwood	Local road over main alignment and connection to new interchange
5	Chatsworth Road, Chatsworth	Local road over main alignment
5	Carrolls Lane, Chatsworth	Local road over main alignment
7	Serendipity Road, Tabbimoble	Local road over main alignment
8	Tuckombil Road, The Gap	Minor horizontal shift
8	Pacific Highway, Trustums Hill	New connection to Woodburn Interchange
8	Woodburn - Evans Head road, Woodburn	Deviation to south and over main alignment
9	Broadwater - Evans Head road, Broadwater	Deviation over main alignment and interchange
10	Back Channel Road, Wardell	Deviation to south and under main alignment
10	Old Bagotville Road	Deviation to north and over main alignment
10	Lumley Lane (from Wardell)	Deviation to south and stopping up
10	Coolgardie Road, Wardell	Local Road over main alignment and interchange
11	McAndrews Lane, Pimlico	Local road over main alignment
11	Whytes Lane, Pimlico	Deviation to south

5.3.4. Emergency facilities, maintenance crossovers and stopping bays

Combined emergency u-turn bays, maintenance crossovers and stopping bays (in addition to the shoulder) would typically be provided every three kilometres enabling:

- Emergency vehicles to conduct u-turns.
- Contra-flow arrangements to be implemented.
- Vehicles to pull-over clear of the running lane edge in the event of an emergency stop.

5.3.5. Rest areas

Rest areas would be provided at approximately 50 kilometre intervals for both northbound and southbound traffic. There would be six rest areas located along the project corridor (three for each direction) and these would be consistent with rest area spacing elsewhere along the Pacific Highway. There are also rest areas immediately adjacent to the tie ins i.e. at Arrawarra Beach Road and a service centre north of the tie in to the Ballina bypass. Additionally, the Mid-North Coast Regional Strategy allows highway service centres to be developed in the vicinity of the Maclean interchange, in addition to those at Ballina and at Arrawarra. The list of rest areas proposed on the Woolgoolga to Ballina upgrade are:

- Halfway Creek
- Tucabia (north and southbound).
- Maclean service Centre
- North of Mororo Road (southbound only).
- Devils Pulpit (northbound only).
- South of Old Bagotville Road (north and southbound).

In addition, at either end of the upgrade (although not forming part of the Woolgoolga to Ballina upgrade) service centres would be located at:

- Arrawarra Beach Road (rest area with capacity for future development as a service centre)
- Ballina bypass.

Rest areas would generally be located on or near the crest of hills to enable easier and safer access, avoiding locations where traffic would be accelerating (i.e. downhill sections).

Typical amenities provided at rest areas would include toilets and areas suitable for recreation and picnicking. Rest areas would be divided into separate sections for commercial and domestic use. Parking provision would be made for B-doubles, semi-trailers, light commercial vehicles, cars and trailers.

Actual delivery of the rest areas may be staged depending on the timing of development of service centres as if these are developed first, then the need for a rest area may be deferred. Staging may also apply to the actual development of the rest area. Initial development would see spaces for 10 B-Doubles provided, with the capacity to expand to up to 20 truck spaces as required in future, while using the same entry and exit facilities.

5.4. Additional infrastructure

Road furniture and fencing would be provided along the upgraded highway. This would include road barriers, signage, boundary demarcation, and fauna and stock fencing. Lighting would typically be provided at interchanges, including at the merge points of on-load and off-load ramps and roundabouts. Details of road furniture, fencing and lighting would be further developed during future project approval and/or detailed design phases.

5.5. Width of the project corridor

The project corridor would include:

- The carriageways and road reserve for the motorway standard road, including the 10 grade-separated interchanges.
- Areas for construction including temporary construction facilities and sediment basins.
- Areas for permanent sediment basins to protect water quality during highway operation.

The project corridor would vary in width, depending on cut-and-fill heights and the locations of interchanges, sediment basins and construction facilities. In locations where the scope of the project is limited to new northbound and southbound carriageways, the corridor would typically be about 150 metres wide. Where grade-separated interchanges are proposed, the corridor would be substantially wider.

The actual footprint would be defined in greater detail during future planning phases of the project in conjunction with future project approval applications and/or detailed design.

5.6. Bridges and structures

The project would incorporate various types of bridge and a range of other structures including:

- Bridges over rivers, creeks and major flood ways.
- Bridges over local roads or underpasses to allow local roads or service roads (including the existing highway) to pass underneath the upgraded highway.
- Overbridges to carry local traffic over the upgraded highway.
- Retaining walls where required.
- Fauna crossing structures.
- Drainage structures including box and pipe culverts.

The estimated total length of bridge structures required for the project would be about 11 kilometres. These include:

- Major bridges structures for the following waterway crossings:
 - Clarence River crossing at Harwood.
 - Richmond River crossing at Broadwater.
- Additional long or multiple span bridges for the following waterways and floodplains:
 - Corindi Creek.
 - Coldstream River.
 - Pillar Valley.
 - Shark Creek.
 - Clarence River (North Arm).
 - Tabbimobil Creek and Overflow.
 - Tuckombil Canal.
 - Duck Creek.
 - Emigrant Creek.
- Bridges over local roads or highway underpass structures.
- Overpass structures at local roads or interchanges.

5.7. Earthworks and materials management

The supply of earthworks materials would be predominantly from the road cuttings to be constructed on the project. However, the long sections of flood plain and generally flat terrain elsewhere on the northern sections of the project result in a lack of suitable cuttings to generate all of the earth required.

As such, a number of potential additional cut material sites (on hilly terrain) have been identified away from the edge of the proposed dual carriageway, generally on adjoining property owned by the RTA.

Alternatives for sourcing additional material as part of the project may include:

- Changing the vertical alignment to increase cut and reduce fill in areas.
- Flatten cut batters to provide more excavated material and gentler slopes for landscaping.
- Provide additional width at the base of cut batters to provide wider verges and clear areas adjacent the carriageway.
- Lower some sections of the new local access road to reduce cut to fill discrepancies in some sections.

Alternatively, the use of materials from nearby quarries would be considered.

The preliminary earthworks assessment identified that the project would generate approximately 13.3 million m³ of cut material and would require 12.4 million m³ of fill material, giving an overall excess of approximately 900,000 m³. However, the excess is generally not in proximity to the areas that is needed. This means there would be an excess of material in the southern end of the project and a deficit of material in the northern end (north from Harwood).

As there may be further changes to the concept design during the final design phase, a full review of the earthworks and material quantities balance would be undertaken at that time. There would be many opportunities to achieve a more detailed earthworks balance.

5.8. Pavements

A number of different pavement designs would be applied to various sections of the proposed Woolgoolga to Ballina upgrade in the detailed design phase. For the purpose of this report, and for concept design cost estimating, a number of assumptions have been made with respect to pavement types in various locations and circumstances.

The new dual carriageways would generally consist of a heavy duty pavement with a nominal design life of 40 years.

In some areas a low noise pavement may be provided and this is proposed as a typical heavy duty pavement with asphalt surfacing to reduce road traffic noise.

Where the existing highway is to be incorporated into the new dual carriageway or would become the local access road, various treatments are proposed. The final design of these would be dependent on the future use of the existing road and the residual life of the existing pavement layers.

5.9. Road pavement drainage

The drainage system for the road pavement and road formation has been designed for a 1 in 10 year storm event. The drainage comprises of:

- Pits and pipe systems designed to remove water from the travel lanes as quickly as possible. Additional drainage pits have been provided in areas of flat longitudinal grades to prevent ponding of water and to reduce the possibility of vehicle aquaplaning in very flat areas.
- All pipes discharge from a headwall to overland flow before being treated by sedimentation/detention basins prior to discharging into any natural watercourse.
- Longitudinal gutters with minimal pits and pipes through cuttings.
- Kerbs and pits at interchanges.
- Median pits throughout most of the length.

5.10. Traffic barriers and roadside furniture

Typically medians will not have barriers as they are 12 metres wide, however on significant curves and where medians are narrower than 11 metres, wire rope barriers will be installed.

Other locations where barrier protection on the road formation will be required include:

- Adjacent to high fills (2.5 metres or higher).
- At approaches to overbridges and culverts.
- On bridge supports.
- At waterway crossings.
- In vicinity of other structures eg fauna crossings.

Although roadside signage will also be required the design has not included it at this stage. Fencing will typically be a combination of stock fencing and native fauna fencing at strategic locations along the route.

5.11. Public utilities

A utilities investigation has been undertaken to identify the existing utility assets and determine the likely impacts along the corridor. The process of investigation included undertaking a Dial-Before-You-Dig enquiry followed by direct communication with various authorities. The following utility services have been identified along the proposed alignment from Woolgoolga to Ballina:

- Electricity - Country Energy (low voltage and high voltage).
- Telecommunications – Telstra Cable and Telstra Optic Fibre.
- Sewer and Water – Coffs Harbour City Council, Clarence Valley Council, Richmond Valley Council and Ballina Shire Council.

5.12. Project staging and tie-in connections

Project staging

As described in section 4.1, the project has been divided into 11 indicative sections, numbered sequentially from south to north, to facilitate potential future staging of delivery. Each delivery stage would involve upgrading a combination of one or more project sections based on the availability of funding and need for the upgrade (eg the priority for increased safety and travel efficiency in that section).

In addition to the staging of highway sections, in some instances there may be interim staging of the upgrade at discreet locations within the identified sections. These may include for example the

upgrade of a waterway crossing, the establishment of an interchange arrangement or the upgrade of an at-grade intersection. This would provide greater flexibility and best use of available funding, and enable response to a critical need, such as intersection safety. The likely staging scenario will require further development as the planning of the project continues.

Section tie-ins

Section tie-ins are required to smoothly transition from an upgraded section of highway to the existing highway. The section tie-ins for the project would comprise the following types:

- Connection to existing single carriageway.
 - This type of tie-in occurs where an upgraded section is tying into a part of the Pacific Highway that has not been upgraded. The tie-in involves reducing the new two lane carriageways to a single lane before the end of the dual carriageway section to enable a two-lane two-way connection with the existing road.
- Connection to existing dual carriageway.
 - This type of tie-in occurs where an upgraded section is tying into a previously upgraded part of the Pacific Highway. No specific connection is required for this scenario. Instead, the dual carriageways of the upgraded section are constructed seamlessly to the existing dual carriageways.
- Temporary tie-ins.
 - Temporary tie-ins may be required at two locations along the concept plan corridor where the ends of project sections are off-line from (ie do not connect to) the existing Pacific Highway. These temporary tie-ins would connect the upgraded section of highway to the existing Pacific Highway. Once the adjoining sections of the project are completed, the temporary tie-ins would be removed and the upgraded sections connected. The locations where temporary tie-ins may be required are at Tyndale and east of the proposed Richmond River Bridge.

6. Environmental considerations

The work undertaken for the four previous development projects identified the main environmental issues to take into consideration. The Woolgoolga to Ballina concept design review considered these issues to further minimise impacts where possible. The following sections summarises the key environmental issues that were considered in the overall Woolgoolga to Ballina design review.

6.1. Flooding and drainage

The project corridor crosses two of the largest river systems in Australia – the Clarence and Richmond rivers – as well as many smaller river and wetland systems including Coldstream Basin and Corindi Creek. As such, key features of the project design include significant bridging and drainage structures across these waterways.

Considerable hydrological design and assessment work has been undertaken including comprehensive flood modelling across the entire alignment to define the flooding behaviour and inform where design refinements were needed. The improved flood modelling informed a number of bridge and culvert design refinements. These included rationalisation of many bridges located in close proximity to each other (e.g. Coldstream River and its floodplain).

All sections of the project, apart from those crossing the Richmond and Clarence River floodplains, are designed to be above the 100 year ARI¹ flood levels. The crossings of the Richmond and Clarence River floodplains are designed to be above the 20 year ARI flood levels. By way of comparison, it should be noted that the level of the existing highway across these floodplains is generally well below these proposed immunity levels in many places. Hence, the project would result in a substantial decrease in the frequency of the highway being cut by floodwaters.

Across Chatsworth Island from Serpentine Channel to Carrolls Lane, only the new northbound carriageway will be constructed with a 20 ARI immunity. Under flood events where-by the southbound carriageway becomes inundated, a contra-flow traffic arrangement with restricted speed will be in place on the northbound carriageway via the use of cross-over's and fixed signage. There are relatively low traffic volumes on this section so this contra-flow solution has enabled the existing formation to be used for the project. The specific approach taken at this locality will be decided following further consideration of the risks and costs of such a contra-flow traffic arrangement.

Due to the relatively flat flood gradients on the Clarence River and Richmond River floodplains and the substantial agricultural areas on these floodplains, these areas include the highest risk for the project in terms of changes to the flooding regime.

The main aims of the flooding assessments on these floodplains are to:

- Minimise the potential changes to the hydrological regime of the Clarence River and Richmond River floodplains.

¹ Annual recurrence interval. Used to describe the frequency or probability of floods occurring. (eg a 100 year ARI flood is a flood that occurs or is exceeded on average once every 100 years).

- Minimise the potential for increased impacts on properties, dwellings and existing road.
- Minimise the potential for impact on the existing drainage systems and smaller, more frequent flood events.

While bridges and culverts would be provided within the length of floodplain crossings to minimise the changes to existing flood patterns (eg. flood height, flood durations, flood flows and velocities), it is not possible to achieve nil impact in all areas of the floodplains. Localised changes to flood patterns would occur where the project crosses the floodplains.

The bridges and culverts proposed in the concept design on the Richmond River floodplain (between Woodburn and the Richmond River) are different to those proposed in the previous development stage of the project. This is due to the refined flood modelling that has now been used in this concept design assessment. The terrain, calibration and representation of flow were all improved for reviewing and refining the concept design. The bridge over the Richmond River is unchanged from the concept design of the Woodburn to Ballina project. The bridge over the Tuckombil Canal and the floodplain and the main structures between Tuckombil Canal and the Richmond River has been changed from the previous concept design. The other structures remain unchanged.

The primary reason for these changes is due to an improved understanding of the floodplain behaviour and quantification of the flow rates crossing the route at these locations. This improved understanding is based on better terrain data, flood models and road design. The concept design utilised the latest flood modelling available from Richmond Valley Council which provided flood models calibrated against more flood events (including the January 2008 and May 2009 flood events) and more flood records than previous flood models used for design.

However, it is recognised that flood modelling is only a tool for road and bridge design. The models are only as good as the data used in the development of the models and the understanding of flooding behaviour of the road designers and hydrologists. The on-going process of refining the road design, including the management of flooding and bridge / culvert sizings on the major floodplains, would need to include the experiences of those that have lived and worked on these floodplains through previous flood events.

Therefore, the RTA may need to establish flooding interests groups for each of the two major floodplains to assist in further development of design solutions and mitigation measures. As well, RTA will provide an independent review of the flood management measures which would provide an additional level of integrity aimed at achieving a robust and sustainable flood management design for this project.

6.2. Water quality

The Woolgoolga to Ballina concept design review included consideration of how stormwater and road runoff water would be captured and released into the environment. The system for capturing

and treatment of stormwater required a combination of hard structures (gross pollutant traps, water quality ponds/ basins) and soft treatment methods (grassed swales and constructed wetlands), depending on the sensitivity of the receiving waterways.

The identification of locations, required volumes and space requirements for the water quality control design provided greater certainty in identifying the road boundaries for the project. Where possible, construction stage sediment basins were located and sized so that they can be retained as water quality basins for the operational phase of the project.

For water quality treatment in floodplains and other locations with minor changes in gradient, modelling undertaken showed that grassed swales would sufficiently treat runoff to meet the guideline criteria. This significantly reduced the number of permanent basins throughout the project, particularly at areas within the Clarence and Richmond river floodplains.

6.3. Property impacts

The Woolgoolga to Ballina upgrade requires enough land to accommodate:

- A road corridor wide enough to allow the construction of the highway carriageway for the ultimate (class M) motorway upgrade.
- Sufficient area for access roads and service roads for the both the arterial and motorway class upgrades.
- Sufficient area for water quality control, rest areas, drainage structures, noise structures and fauna crossings.

The route alignment would affect properties in private and public ownership. The alignment was selected to maximise the use of the existing highway corridor, where possible, with deviations required to address environmental, functional, social and economic constraints and requirements.

The project design seeks to minimise private and public property impacts where possible. As such, the review considered the following issues:

- Maximising the use of the existing road corridor.
- Minimising or avoiding impacts to state forest, national park or nature reserves including at Bundjalung National Park, Tabbimoble Swamp Nature Reserve and Yuraygir National Park.
- Making allowance in the project corridor to accommodate a future Class M design. This resulted in an increase in the strip acquisitions of properties required along those stretches of highway.
- Rationalisation of property impacts to reduce property severance and reduce incidence of small residual parcels of land that would not form a viable use of land.

Overall, the Woolgoolga to Ballina upgrade would require acquisition of a total of 560 land parcels or 1629 hectares of land, either wholly or in part.

While the majority of affected properties would be subject to partial acquisition, some would need to be totally acquired. In the event that a property is subject to total acquisition but not all of the land is required for the project, the excess land would be either:

- Sold after completion of construction.
- Kept by the RTA for future use.
- Transferred to council or another government agency.

All land acquisitions would be conducted in accordance with the RTA's *Land Acquisition Policy* and the *Land Acquisition (Just Terms) Compensation Act 1991*. Negotiations for property acquisition would include consultation on property adjustments where required to maintain farm management practices and access to roads.

The property acquisition boundary does not include provisions for temporary structures eg batch plants. These sites would be leased or purchased from adjacent property owners prior to construction, if required and would not form part of the proposed road corridor.

6.4. Urban design and landscaping

The concept design for the Woolgoolga to Ballina upgrade has been developed using the RTA's *Pacific Highway Urban Design Framework* (RTA, 2005e), which sets the following urban design objectives:

- Provide a flowing road alignment that is responsive and integrated with the landscape.
- Provide a well vegetated, natural road reserve.
- Provide an enjoyable, interesting highway.
- Value the communities and towns along the road.
- Provide consistency-with-variety in road elements.
- Provide a simplified and unobtrusive road design.

An urban design and landscape framework has been developed with the following objectives:

- Achieve an aesthetically pleasing road alignment by following the edges of landscape units and responding to the local topography.
- Integrate road embankments into the adjacent landscape through use of variable batter slopes.

- Integrate the road reserve and median with the surrounding landscape through the use of appropriate plantings.
- Provide for local and regional access needs, including local access to the highway and intra- and inter-regional traffic movements.
- Avoid or minimise adverse visual impacts on towns and communities, where possible, and provide measures to reduce adverse impacts.
- Incorporate bridge designs and road furniture and features that are aesthetically pleasing and compatible with surrounding natural and developed landscapes.

Further work in this area will include the identification of opportunities for optimising integration with existing landscape through refinement of earthworks profiles, identification of key viewpoints to assess the visibility of the project.

Computer visualisation designs will also be developed to demonstrating function and layout of the road design and road operation. These visualisations will target sites that typically include interchanges, major bridges and major cuttings along the alignment.

6.5. Ecology

The consideration of impacts to animals and plants within the project study area was a key input into the design and refinement of the design. Main areas of focus included:

- Wildlife crossing structures for different species to maintain existing connections.
- Specific consideration and measures to facilitate *Coastal Emu* passage.
- Design refinements to reduce the concept design footprint in areas where threatened vegetation communities were present or in vicinity of sensitive waterways.
- Consideration of threatened species found within the project corridor and refining the design to minimise impacts (eg changes to bridge structures or a reduction in footprint).

7. References

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