7 The preferred route

7.1 Description of the preferred route

The preferred route (as illustrated in **Figure 7-1**) commences at the existing Pacific Highway alignment approximately 3.0 km south of Woodburn and extends generally in a north-east direction away from the current highway. An approximately 350 m long bridge crossing would be required at the Tuckombil Canal (Evans River).

Between Woodburn and Broadwater the route continues in a north-easterly direction through agricultural land, skirting the edge of an endangered ecological community and Broadwater National Park. This section of the route consists of embankments and bridges to provide immunity from floodwaters. North of Lang Hill the route follows the western edge of Broadwater National Park before joining the existing highway alignment which bisects the Park. Through the Park, the route would follow the existing highway road reserve, avoiding any direct impact on the National Park.

In the vicinity of Broadwater, the route would be located to the east of Cooks Hill and west of the National Park boundary.

North of Cooks Hill the route would swing north-west and approximately 2.0 km north of Broadwater crosses the Richmond River on a bridge approximately 850 m long with a navigational clearance of 15 m. The route would proceed to the west of Laws Hill on the northern side of the river. North of the river, the highway would head north-west towards the Blackwall Range.

The route would skirt around Jali land and areas of Wardell Heath containing endangered ecological communities before returning east to join the existing highway approximately 4.0 km north of Wardell. For the remaining 6.5 km the route would follow the existing highway corridor, and would be raised up on embankments to be above the floodwaters. The route would connect with the approved Ballina Bypass.

The total length of the preferred route is 36 km.

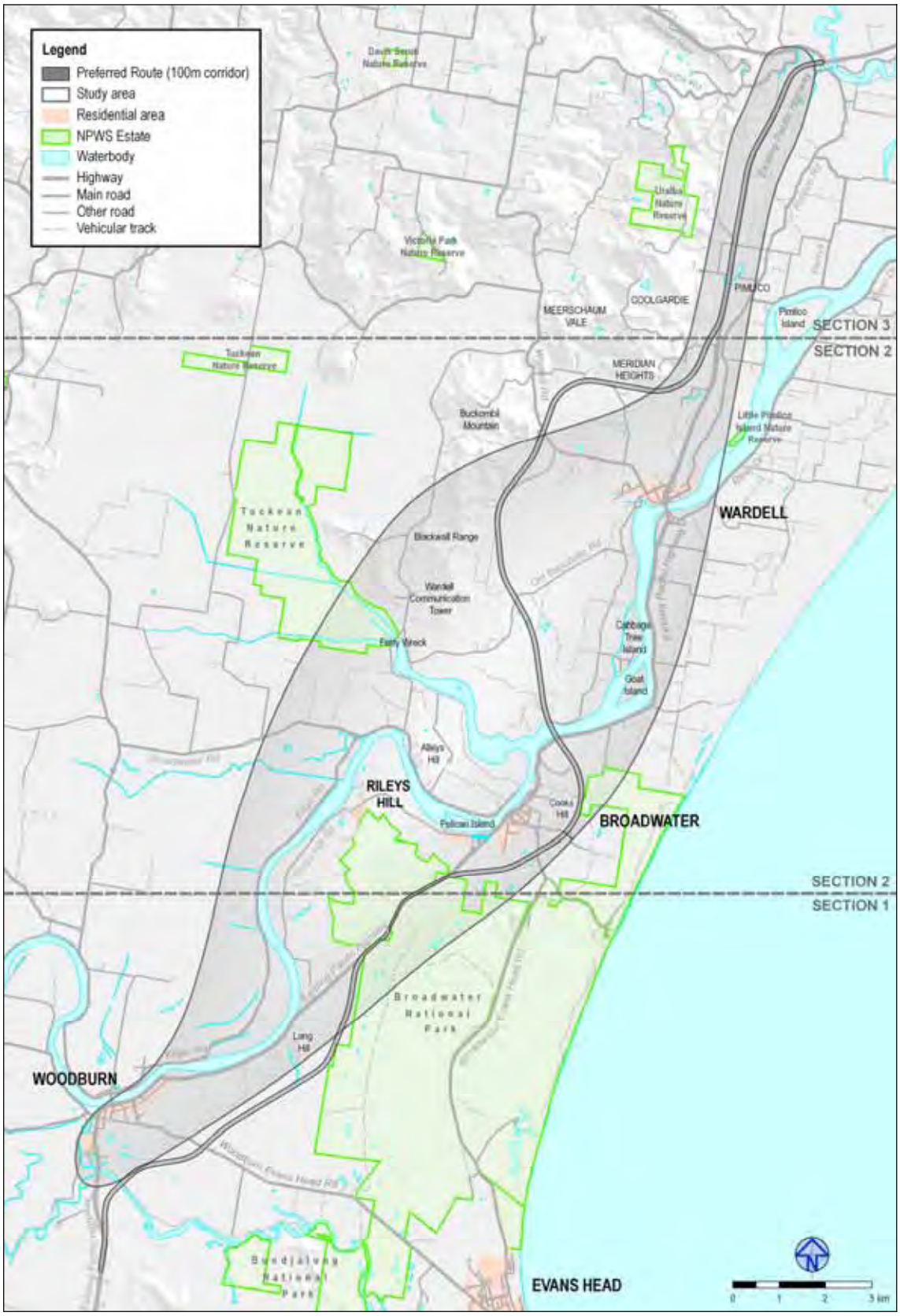

Figure 7-1 Preferred route

Table 7-1 Summary characteristics of the preferred route

Preferred route characteristics[5]		
Total length (m)	36,155	
Length of bridges* (m)	1,196	
Length of flood alleviation structures* (m)	880	
Speed limit (km/h)	110	
Interchanges	Two alternative options for a possible interchange near Woodburn. Possible interchange at Broadwater	
Preliminary cost estimate* ($2005)	$590m - $645m	
Potential social and landuse impacts		
Approximate number of land parcels within road footprint	106	
Impacts on land use (hectares)	Grazing	100.6
	Quarry	3.4
	Rural Residential	1.8
	Sugar Cane	31.0
	Sugar Cane Stockpile	3.0
	Timber	32.8
	Urban	25.2
	Watercourse	2.6
Approximate number of dwellings within road footprint	5	
Approximate number of other buildings within road footprint	10	
Community Noise Burden – Steady State 2035 **(predicted % population 'bothered' by traffic noise)**	Section 1 – 0.3 Section 2 – 1.8 Section 3 – 0.6	

[5] Characteristics related to area are based upon the upgrade 'footprint', which is less than the corridor width. The footprint assessed excludes interchanges, local road crossings and rest areas.

Preferred route characteristics[5]	
Community Noise Burden – Noise Change 2015 **(predicted number of dwellings to experience a traffic noise increase)**	Section 1 - 10 Section 2 - 114 Section 3 - 34
Impact on towns	Woodburn – increased amenity, decreased access Broadwater – increased amenity Wardell – increased amenity
Flooding* (current design assumption)	Target of less than 50 mm afflux for the 1 in 100 year design flood
Flood immunity	1 in 20 year flood within floodplain 1 in 100 year flood elsewhere
Potential environmental impacts	
Number of known threatened species known or likely to occur in route corridor	85
Extent of Endangered Ecological Communities impacted (hectares)	51.97
Extent of National Park Estate impacted (hectares)	0
Impacts on Aboriginal heritage	4 known sites and potential for sites in the vicinity of Cooks Hill
Impacts on non-Aboriginal heritage	2 known sites and potential for additional sites from farming and early pioneering activities
Water quality	4 waterway crossings

* Subject to refinement of concept design and further studies.

7.2 Potential impacts of the preferred route

7.2.1 Traffic and transport

The preferred route would result in traffic and transport benefits across the study area for both through and local traffic. This would occur as through traffic is removed from the existing Pacific Highway which currently passes through the towns of Woodburn, Broadwater and Wardell. This would result in improved local amenity and traffic safety.

Based on a number of travel speed surveys, the existing time taken from the southern end of the route south of Woodburn to the Bruxner Highway is on average 26 minutes at an average speed of 85 km/h. Forecast travel

times for through traffic on the preferred route is approximately 20 minutes at an average travel speed of 110 km/h. Therefore, the upgrade is expected to reduce travel times from south of Woodburn to the Bruxner Highway.

The upgraded Pacific Highway would result in a high standard road alignment in accordance with the Pacific Highway Upgrade Program objectives. The current accident rate on the existing Pacific Highway between Woodburn and Ballina is 48 crashes per 100 million vehicle kilometres travelled. For the preferred route the target accident rate is 15 crashes per 100 million vehicle kilometres travelled.

The total estimated crashes on the existing Pacific Highway and new highway upgrade have been assessed. The figures suggest a potential to reduce the total number of crashes by up to 65 per cent from the current situation.

The proposed location of grade separated interchanges has not been finalised, and would be developed during the next phase of concept design. Options being considered for development are:

- Woodburn: A possible north facing half diamond interchange on the Woodburn to Evans Head Road with a possible south facing half diamond interchange at the tie-in south of Woodburn, or a full diamond interchange on the Woodburn to Evans Head Road.
- Broadwater: A possible full diamond interchange on the Broadwater to Evans Head Road.
- Wardell: A possible north facing half diamond interchange near Coolgardie Road, with local traffic either utilising a service road adjacent to the highway, or an upgraded Pimlico Road.
- Interchanges at the Bruxner Highway and Teven Road as part of the approved Ballina Bypass project.

Local roads would generally pass over or under the Pacific Highway upgrade dependent on terrain, existing road alignment, geotechnical conditions and urban design principles. These arrangements would be developed during the concept design phase.

Rest areas have not yet been determined for this section of the Pacific Highway upgrade, however it is anticipated there would be one major rest area within the project. Possible sites and layouts would be investigated during the concept design phase.

Truck breakdown bays suitable for B-doubles combined with cross-over facilities would be located approximately every 5 km. Locations for these would be determined during the concept design phase.

7.2.2 Urban design, landscape and visual assessment

The urban design, visual and landscape constraints and opportunities for the preferred route have been assessed in relation to the existing scenic character of the area. It is acknowledged that no project of this nature

occurs without urban design, visual and landscape impacts. The preferred route option either minimises these impacts or is able to mitigate them to an acceptable level. Artistic impressions of the preferred route are shown in **Figure 7-2** to **Figure 7-8**.

Within the southern portion of section 1 of the study area, south of Broadwater National Park, the preferred route is predominantly located through open pastureland / floodplain / sugar cane fields with some pockets of woodland around Tuckombil Canal and other pockets associated with the Broadwater National Park edge. While the proposed route requires large embankment heights, the route is distant from the township of Woodburn and skirts the eastern edge of Lang Hill rather than the edge of the Richmond River, thereby reducing severance of the river from the locality and visual impacts in views from the river. The northern portion of section 1 is located on the existing Pacific Highway alignment through Broadwater National Park.

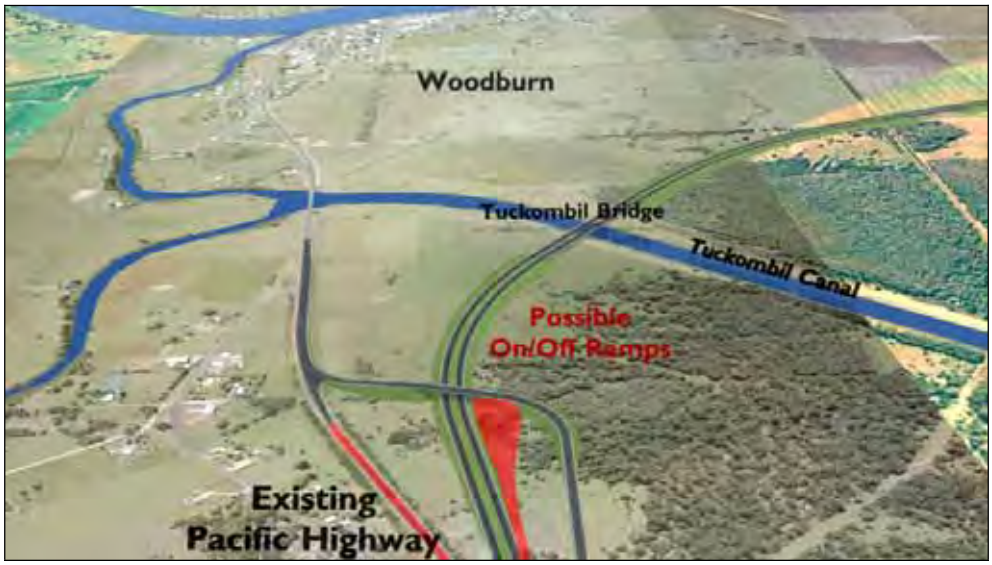

Figure 7-2 Artist impression from south of Tuckombil Canal towards Woodburn

For the portion of the study area in section 2, south of the Richmond River/Broadwater, the preferred route is predominantly located through pasturelands along the northern edge of Broadwater National Park. The route skirts the edge of Broadwater township, east of a small unnamed hill at Montis Gully and east of Cooks Hill. The eastern slopes of Cooks Hill are currently being quarried.

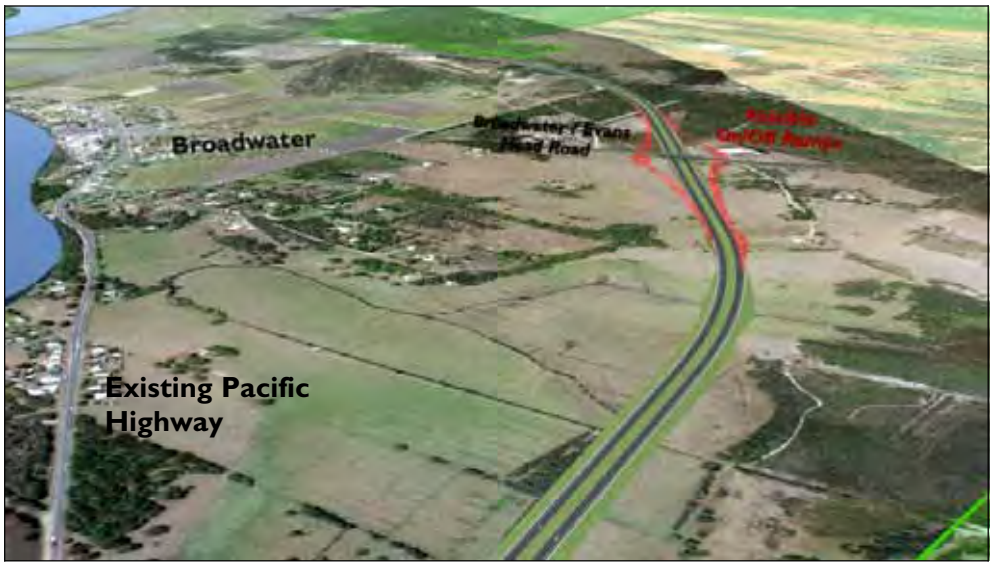

Figure 7-3 Artist impression looking north-east from south of Broadwater

Figure 7-4 Artist impression looking north-west from east of Broadwater

Heading north-west, the route crosses the Richmond River and skirts the western edge of Laws Hill, passing through a degraded quarry landscape area and the visually sensitive Wardell heath and woodland area. The route then mostly traverses pasturelands at the foothills of the Blackwall Range. Some rural residences located along these foothills, particularly around the Wardell Road/Hillside Lane area below Buckombil Mountain, would be visually impacted. There is likely to be an impact on the historic 'Stonehenge' property in particular on the land surrounding the buildings.

Figure 7-5 Artist impression looking north-west from crossing of Old Bagotville Road

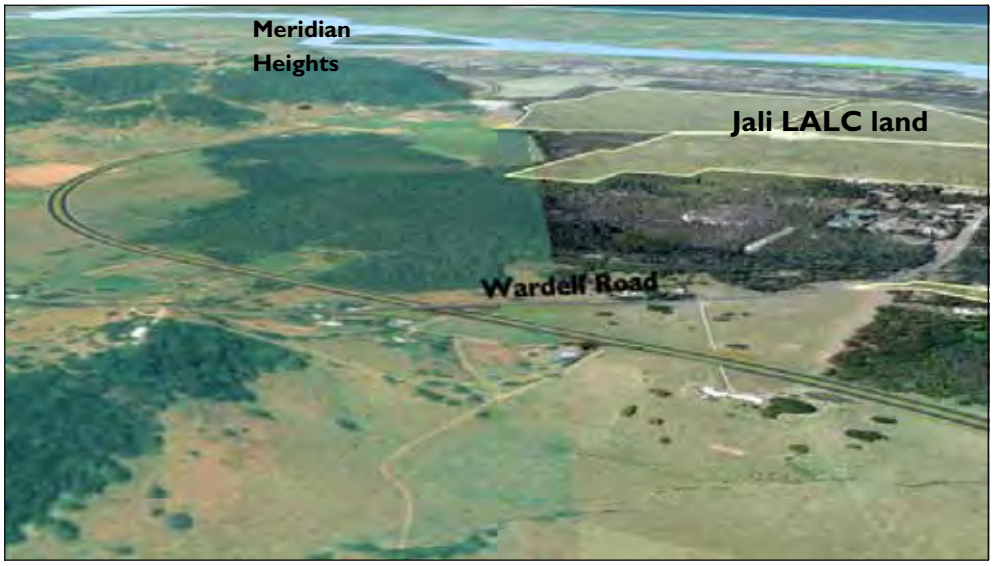

Figure 7-6 Artist impression looking north-east from crossing of Wardell Road

As the route heads north-east it skirts the Blackwall Range with the Meridian Heights settlement located on a hilltop above. The visual impact has been assessed as medium low: it avoids Broadwater township, avoids the sensitive landscape of the Wardell heath and woodland, but has some impacts visually due to the bridge crossing of the Richmond River and some cuttings and embankments along the foothills of the Blackwall Range.

Figure 7-7 Artist impression looking north-east towards Pimlico

Section 3 predominantly uses the existing Pacific Highway corridor. The route passes through the middle of the floodplain valley with sugar cane fields on either side. The visual impact is low. The embankments are relatively low and the route re-uses the existing corridor through a medium visual sensitivity landscape.

Figure 7-8 Artist impression looking north from Whytes Lane

Further investigation of measures required to mitigate the visual impacts of the preferred route would be required as part of the concept design and environmental assessment.

7.2.3 Geotechnical considerations

Geotechnical conditions within the preferred route vary from low lying areas located on deep soft Holocene sediments associated with the Richmond River floodplain, to slightly more elevated 'heathland' areas underlain by Pleistocene-age sands, and to more elevated areas underlain by metasedimentary rocks of the Neranleigh-Fernvale Beds (refer **Figure 7-9**).

Given that construction of approximately 5 km of road embankment would be required over areas underlain by deep soft sediments, minimising the time for embankment settlement and optimising construction timing/costing presents the greatest geotechnical challenge for the project.

Opportunities to reduce the fill requirement for the preferred route would be developed during the refinement of the concept design. However, it is still likely that a substantial amount of material would be required for the project. Options currently under consideration for the source of fill material include obtaining material locally from the vicinity of the route, obtaining material from local quarries, or obtaining material from quarries further a field.

Investigations indicate that at Tuckombil Canal the depth to material assessed as adequate for piled foundations is approximately 13 m. For the crossing of the Richmond River piling depths ranging from 25 m (on weathered sandstone) for the northern abutment, to 35 m (on medium to dense sand) for the southern abutment are indicated. As these bridge sites are in areas underlain by soft clays, particular attention would need to be given to the assessment of settlement and strength characteristics during the concept design.

7.2.4 Socio-economic issues

A preliminary assessment of the social impacts of the preferred route has been undertaken incorporating business impacts; access to opportunities; amenity; social character (of the towns in particular); and the likely level of disruption related to the direct property impacts of the options.

The likely impact on sites of Aboriginal cultural significance and the social impacts of flooding have also been considered.

The preferred route avoids the townships of Woodburn, Broadwater and Wardell, in effect bypassing these towns. Immediately after towns are bypassed, some businesses more reliant on passing trade from motorists, sometimes experience short term impacts on business activity and incomes. In some cases businesses face closure. In the medium to long-term, there are likely to be beneficial outcomes including improved residential amenity, increased tourist trade and convenience of local shopping. The provision of suitable signposting on a new road or upgraded highway attracts the attention of motorists and encourages them to make a detour to visit and enjoy towns no longer on a busy road.

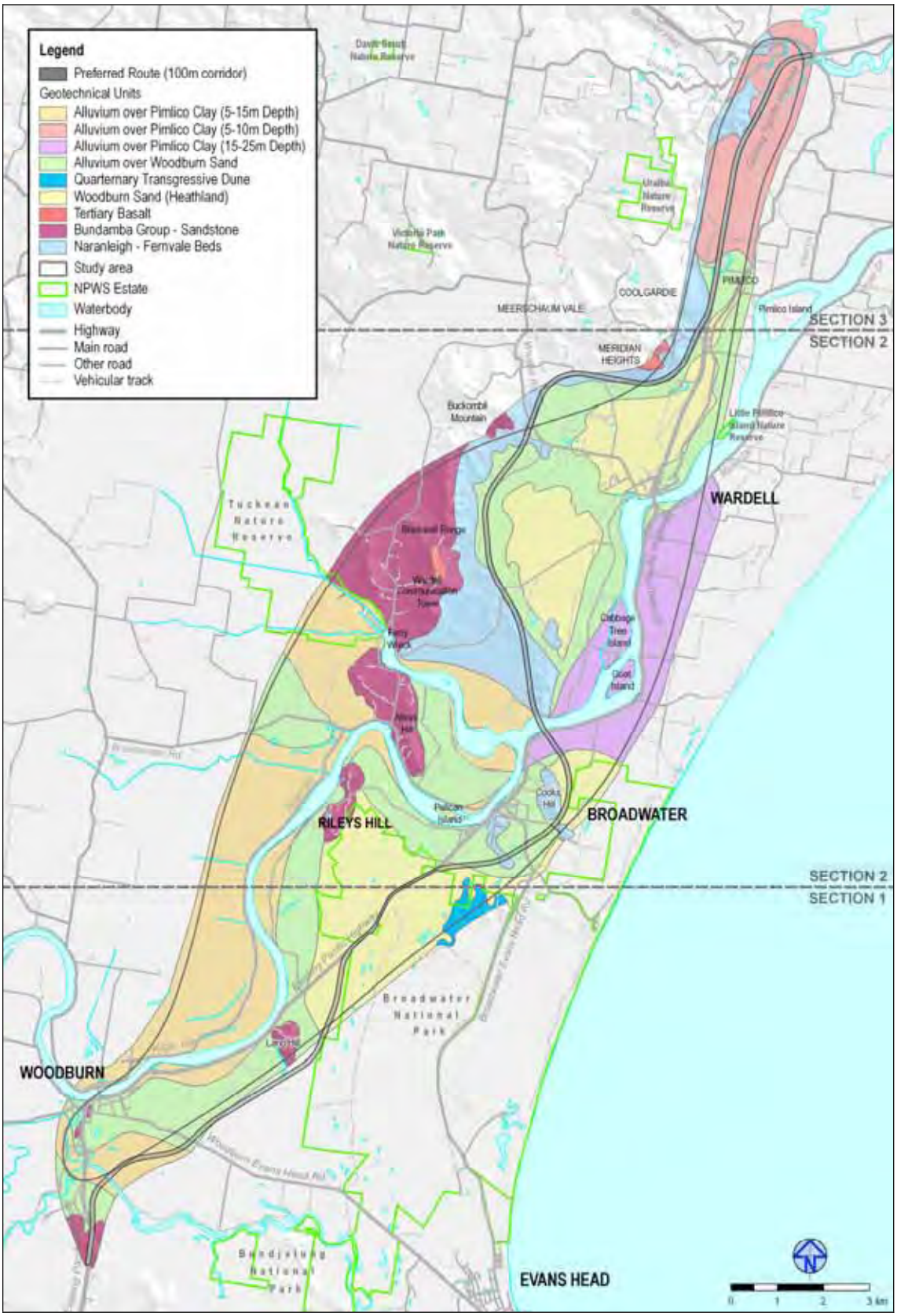

Figure 7-9 Preferred route – geology

Business impacts

Accessibility is one key element in estimating the overall effects, however, the more important factor in determining the overall impact is the ability of the township to adapt and attract motorists from the Highway. The distance from the Highway or accessibility is not as important as creating a town where motorists want to stop, be it as a destination or a stopover.

Access to opportunities

Access to opportunities is considered a function of both physical accessibility to opportunities and the likely future distribution of the opportunities themselves. Opportunities in this context is understood to include employment opportunities, recreation opportunities, access to shopping and, the opportunity to access social and community services, i.e. those opportunities that are primarily located in urban centres.

The preferred route improves access to opportunities throughout the study area.

The preferred route would also improve regional and local accessibility throughout the sub-region. It would largely separate regional from local traffic, freeing up the local road network for more local movements. The preferred route would not cut off access across the route, since local roads would generally continue over or under the new highway. Overall therefore, access to opportunities would be improved as a result of the preferred route.

The extent and distribution of opportunities in the sub-region is likely to be improved by the preferred route. This would be primarily a result of the improved amenity likely to be experienced in the towns through which the Pacific Highway currently passes (Woodburn, Broadwater and Wardell). Improved amenity in the towns is likely to result in them becoming more attractive locations for residential and commercial activities. Although there are limits to the potential expansion of the towns due to flood prone lands and other constraints, there is potential for some residential development growth. Increases in population are expected to result in an increase in the range of goods and services offered in the towns. The population increase may also in some cases provide the required thresholds to provide additional community services and activities (or even to maintain existing services and facilities). Such services, generally provided by Councils, may include, branch libraries and neighbourhood/community centres.

Potential adverse social outcomes of the preferred route are that as a result of the amenity of the towns being improved, there is likely to be an increase in the price of property, leading to increased rents. The price of goods and services in the towns is also likely to increase. For those on fixed incomes and for tenants rather than property owners, this would be a disadvantage. This would however, be a common outcome for all of the route options.

Amenity

As noted above, the amenity of the towns is likely to improve as a result of the preferred route. This is likely to result from the removal of existing

through traffic from the towns, and an associated improvement in the noise environment in particular, but also in the visual environment and in localised air quality. The improvement in traffic related safety conditions in the towns, especially for older people and children, is also a significant expected benefit.

Outside the towns, the effect of the preferred route would vary, depending in particular on the visual effects of the preferred route and on its effect on the noise environment. There are some locations where potentially adverse visual and noise effects would require mitigation, but even with mitigation, the overall effect on amenity would be adverse, compared with the current situation. Where adverse visual and noise effects are found in the same location, the overall effect on amenity would be worse.

In section 1 the overall effect on amenity is likely to depend on the approach to the mitigation of traffic noise from the new route. The preferred route would have a visual impact. This impact may be exacerbated by measures required for noise mitigation. If, however, noise mitigation alongside the route itself was not required, those dwellings that might require noise to be mitigated by treatment to the dwellings themselves may be considered to be adversely affected in terms of overall amenity.

In section 2 some rural residences located along these foothills, particularly around the Wardell Road/Hillside Lane area below Buckombil Mountain, would be affected by the preferred route including the historic 'Stonehenge' property. While the heritage buildings at Stonehenge would not be affected, the surrounding land and access to the property would be affected. Any impact on 'Stonehenge' would be managed during finalisation of the concept design in order to maintain the heritage amenity of the property as far as possible. As the route heads north-east it skirts the Blackwall Range with the Meridian Heights settlement located on a hilltop above. It is likely that residents currently not affected by road traffic noise would be affected by the preferred route and their overall amenity would be reduced.

In section 3, the preferred route is likely to have a low visual impact overall. Residents currently with views looking down on or over the existing highway would view a wider roadway footprint which would have some amenity impact. The impact of the preferred route could be reduced with suitable landscape treatments. Also, it is possible that traffic noise mitigation measures, such as architectural treatments or noise barriers, may be required in this section. Depending on the type of noise mitigation measures adopted for the new road, there would be potential for some reduction in visual amenity.

Social character

The preferred route would change the social character of the towns. This would occur primarily as a result of the changes in amenity and the consequent effect on the provision of local opportunities described above. Associated with this, there is likely to be a change in the demographic character of the towns. Because of improved amenity and changes in the

range of goods and services offered, the towns are likely to become more attractive residential locations for relatively higher income groups.

Until now, the towns of Woodburn and Broadwater, and to a lesser extent Wardell, have largely avoided the pressure of becoming "targeted" as residential locations as has occurred in many North Coast towns. This is likely to change as a result of removing Pacific Highway through traffic from the towns. The social character of the towns is likely to become more "upmarket".

Apart from the demographic changes, there are likely to be changes to the physical fabric of the towns that would not be possible without removing through traffic from the towns. Some of these changes may be by way of improvements to the public domain, such as streetscape improvements, including local traffic management in the interests of pedestrian safety and landscaping. Changes such as this would also contribute to the changed social character of the towns.

Outside the towns, the character of some rural areas is likely to change as a result of changes in amenity in particular. These are described above under "Amenity".

Disruption related to property impacts

The preferred route would result in adverse property impacts by directly affecting some properties and dwellings.

Some property impacts would be compensable. The issues considered in determining compensation include:

- The market value of the land on the date of its acquisition.
- Value of structures including houses and other property structures such as sheds and outbuildings affected by the preferred route.
- Property adjustments - fencing, drainage and access directly affected by the preferred route.
- Allowances for the reimbursement of reasonable legal & valuations fees incurred.
- Any special value of the land on the date of its acquisition.
- Any loss attributable to severance.
- Any loss attributable to disturbance.
- Solatium - compensation to a person for non-financial disadvantage resulting from the necessity to relocate their principal place of residence.
- Any increase or decrease in the value of adjoining or severed land.

The most adverse impacts would arise from those impacts that may be mitigated to some extent but which are not compensable, such as dwellings that are adversely affected in terms of amenity (noise, views) but are not directly affected by the preferred route.

Aboriginal cultural significance

Consultation with the local Aboriginal communities has indicated a strong attachment to the land and identified areas within the study area which are important as the last vestiges of Aboriginal land.

The alignment of the preferred route has attempted to respect Aboriginal culture and needs by avoiding these lands where possible.

Consultation has indicated there is potential to affect sites of Aboriginal significance in the vicinity of Cooks Hill. The preferred route passes around the eastern side of Cooks Hill and further investigations of the area would be necessary prior to completing the concept design and environmental assessment of the upgrade.

Social impacts of flooding

There would be changes to the flooding characteristics as a result of the preferred route. However, measures would be taken to ensure that the maximum increase in flood depth is low, thereby minimising the potential impact.

Any change in the flooding regime has the potential to affect an additional number of houses as discussed in Section 7.2.9.

There is potential for an interchange on the preferred route that could provide the Evans Head community with a 'flood free' access to the Pacific Highway, via the Broadwater - Evans Head Road.

7.2.5 Statutory planning and land use considerations

Statutory and strategic planning considerations are discussed in Section 2.6.1. Local planning and land use considerations are discussed below.

Local planning schemes

The preferred route passes through Ballina Council and Richmond Valley LGAs. The route does not go through the Lismore City Council area. Each Council has a Local Environment Plan as described in Section 2.6.1.

Table 7-2 and **Table 7-3** outline the zonings applicable to the preferred route and the permissibility of the route within each zoning. **Figure 7-10**, **Figure 7-11** and **Figure 7-12** show the preferred route overlaid on Council zonings.

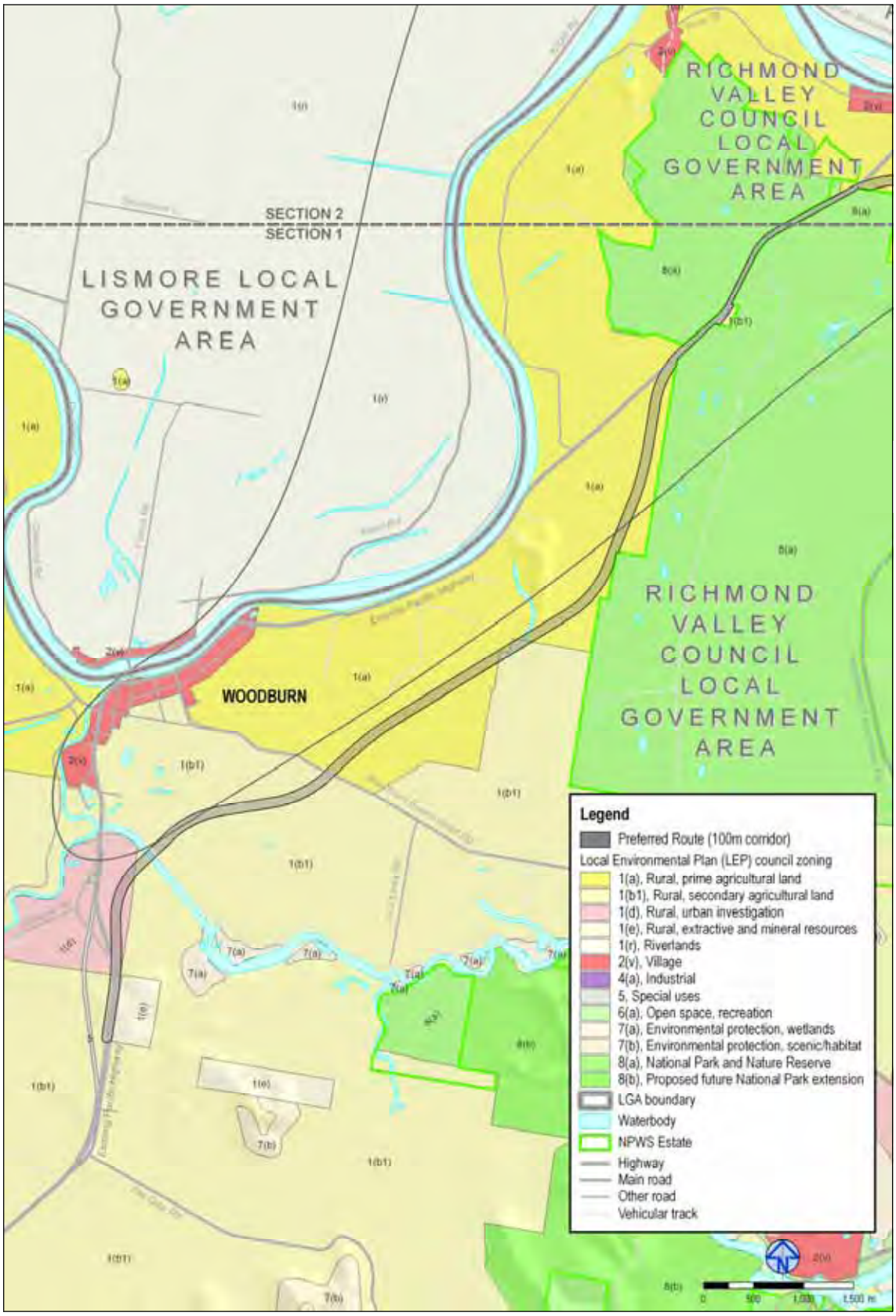

Figure 7-10 Preferred route – land zoning – section 1

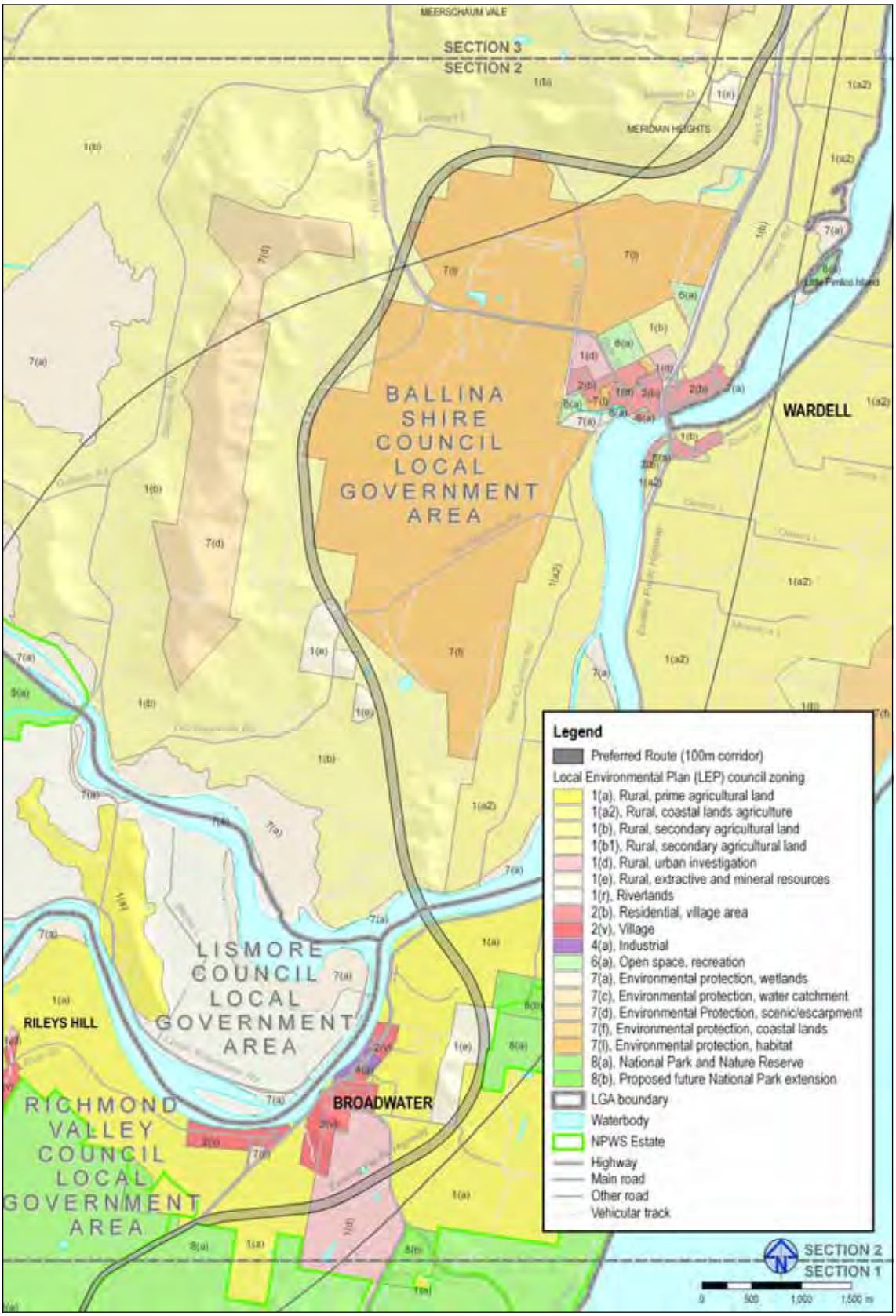

Figure 7-11 Preferred route – land zoning – section 2

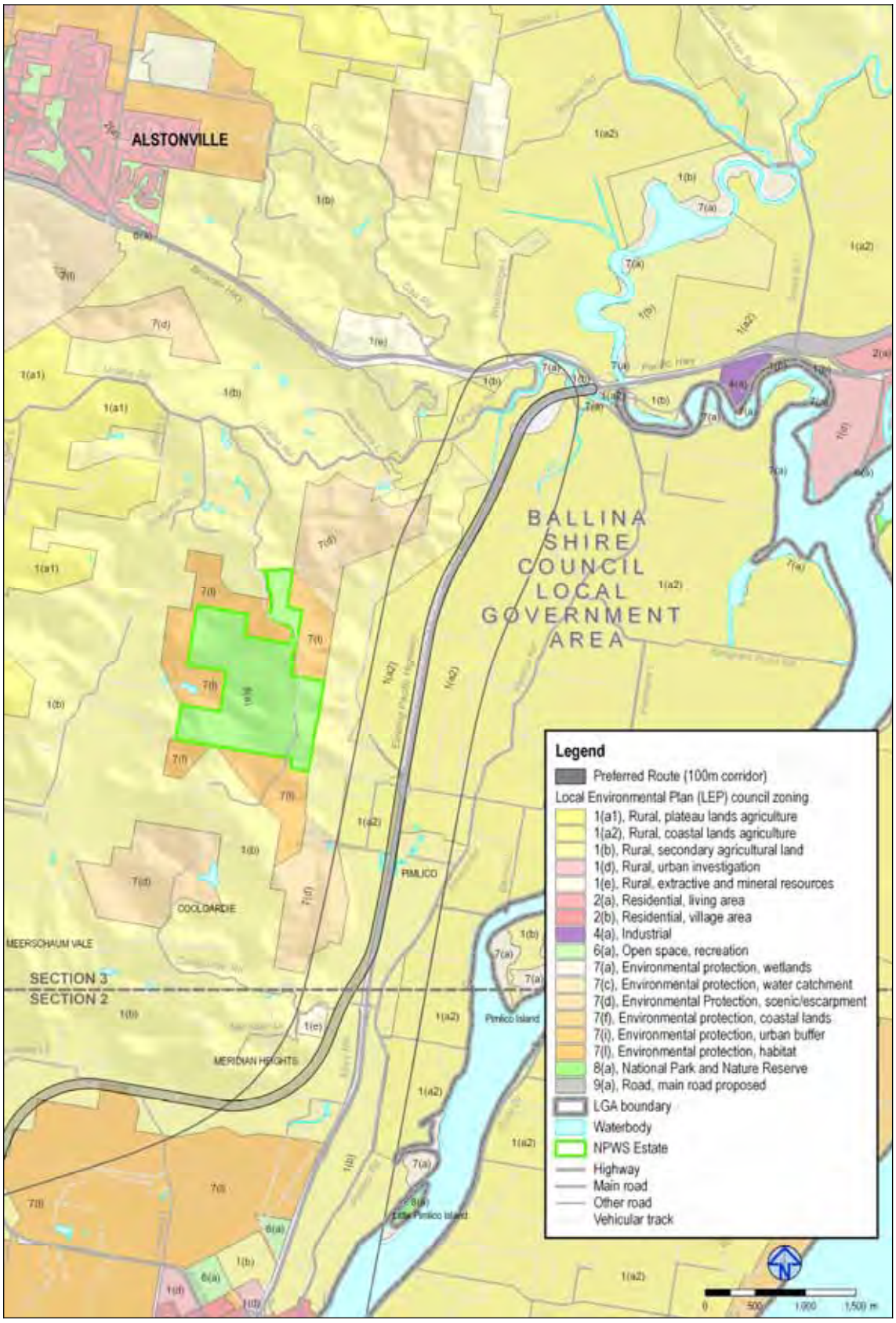

Figure 7-12 Preferred route – land zoning – section 3

Table 7-2 Ballina LEP 1987 - Land use zoning of the preferred route

Zoning	Application	Comment	% of route in each LEP zoning
1a(2) Rural (Coastal Lands Agriculture)	Adjacent to the Richmond River north of Wardell.	Roads are not prohibited and are permissible with Council consent.	2.3
1(b) Rural (Secondary Agricultural Land)	West and north of Wardell Heath	Roads are not prohibited and are permissible with Council consent.	29.6
1(e) Rural extractive and mineral resources)	Near Old Bagotville Road	Roads are not prohibited and are permissible with Council consent.	1.2
7 (l) Environmental Protection (habitat)	Wardell Heath	Roads are not prohibited and are permissible with Council consent.	1.2
General – Existing Main and Arterial Roads	Pacific Highway	Roads are not prohibited and do not require Council consent.	17.3

Roads are permissible within all the zones in the preferred route, with development consent from Council. Any roadworks within existing road reservations, zoned General – Existing Main and Arterial Roads,would be permissible and would not require Council consent.

Table 7-3 Richmond River LEP 1992 - Land use zoning of the preferred route

Zoning	Application	Comment	% of route in each LEP zoning
1(a) Rural (Prime Agricultural Land)	Adjacent to Richmond River	Roads are not prohibited and are permissible with Council consent.	29.6
1(b1) Rural (Secondary Agricultural Land)	South of Woodburn	Roads are not prohibited and are permissible with Council consent.	11.7
1(d) Rural (Urban Investigation)	Near Broadwater	Roads are not prohibited and are permissible with Council consent.	5.3

Zoning	Application	Comment	% of route in each LEP zoning
1(e) Rural (extractive and mineral resources)	Vicinity of Cooks Hill	Roads prohibited, although Model Provisions apply (refer below).	1.8

Under Clause 9(3) of the Richmond River LEP, roads would appear to be prohibited in the 1(e) Rural (extractive and mineral resources) zone. They are not included in the purposes permissible without consent or the purposes permissible with consent. As prohibited development includes all purposes other than those permitted without consent or those permitted only with consent, the prima facie position is that roads are prohibited in this zone.

However, Clause 6 of the Richmond River LEP adopts Clause 35 of the *Environmental Planning and Assessment Model Provisions 1980* (Model Provisions), with a limited exclusion relating to items 2 and 11 of Schedule 1. Accordingly, item 8 of Schedule 1 to Clause 35 of the Model Provisions applies.

Hence, in the terms of the Model Provisions, nothing in the LEP "shall be construed as restricting or prohibiting or enabling the consent authority to restrict or prohibit" the "carrying out of any development required in connection with the construction, reconstruction, improvement, maintenance or repair of any road, except the widening, realignment or relocation of such road."

The Woodburn to Ballina upgrade is a new road and therefore is not characterised as widening, realignment or relocation. The Model Provisions therefore override the prohibition.

Land use impacts

Direct impacts of the preferred route by land use type are summarised in **Table 7-4** and shown on **Figure 7-13**, **Figure 7-14**, and **Figure 7-15**. There are a number of agricultural activities and some drainage infrastructure that may be affected by the preferred route. Replacement of lost infrastructure, assurance of drainage on sugar cane farms; maintenance of access to loading pads for sugar harvest; and access for operations to continue between land parcels may be required.

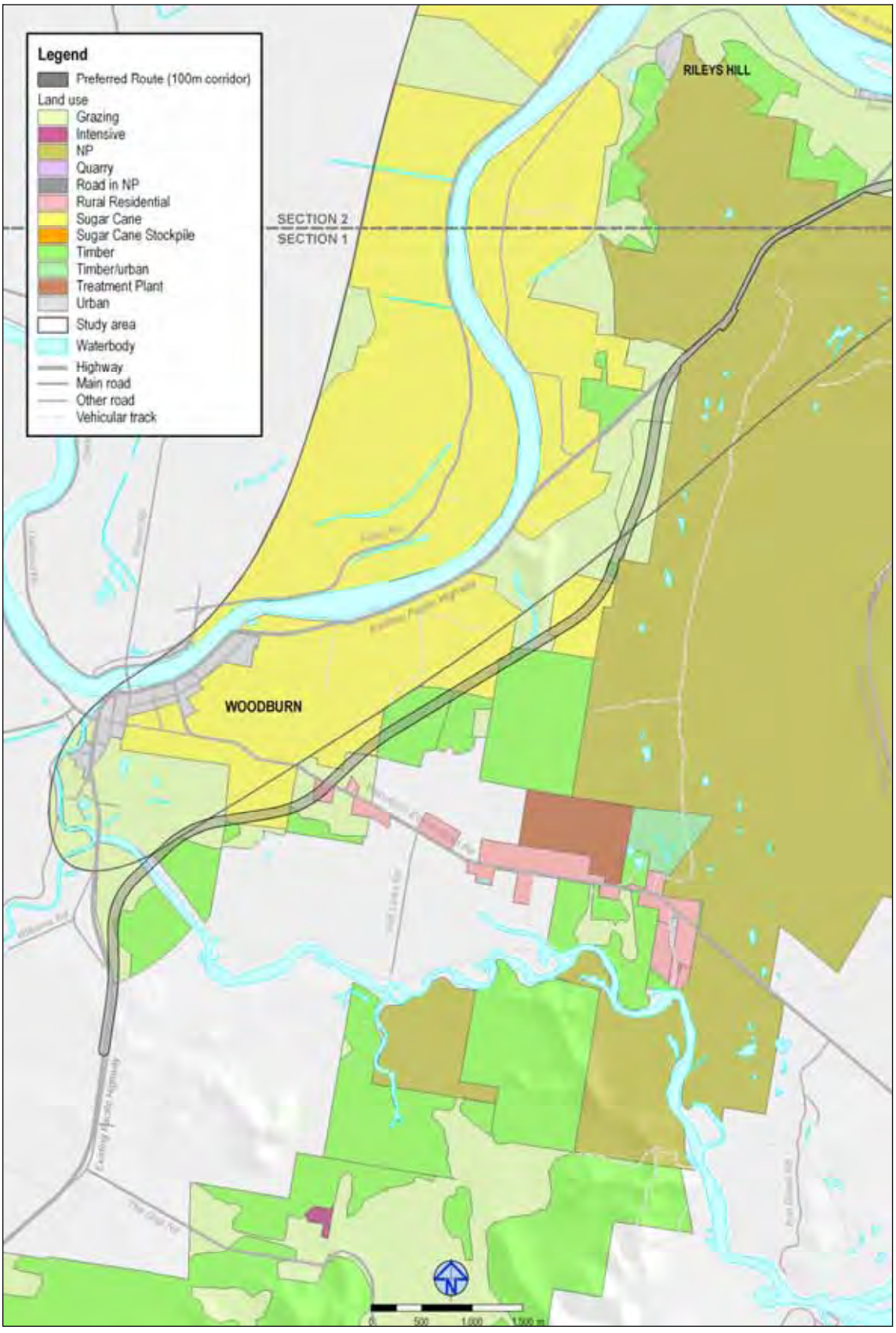

Figure 7-13 Preferred route - land use - section 1

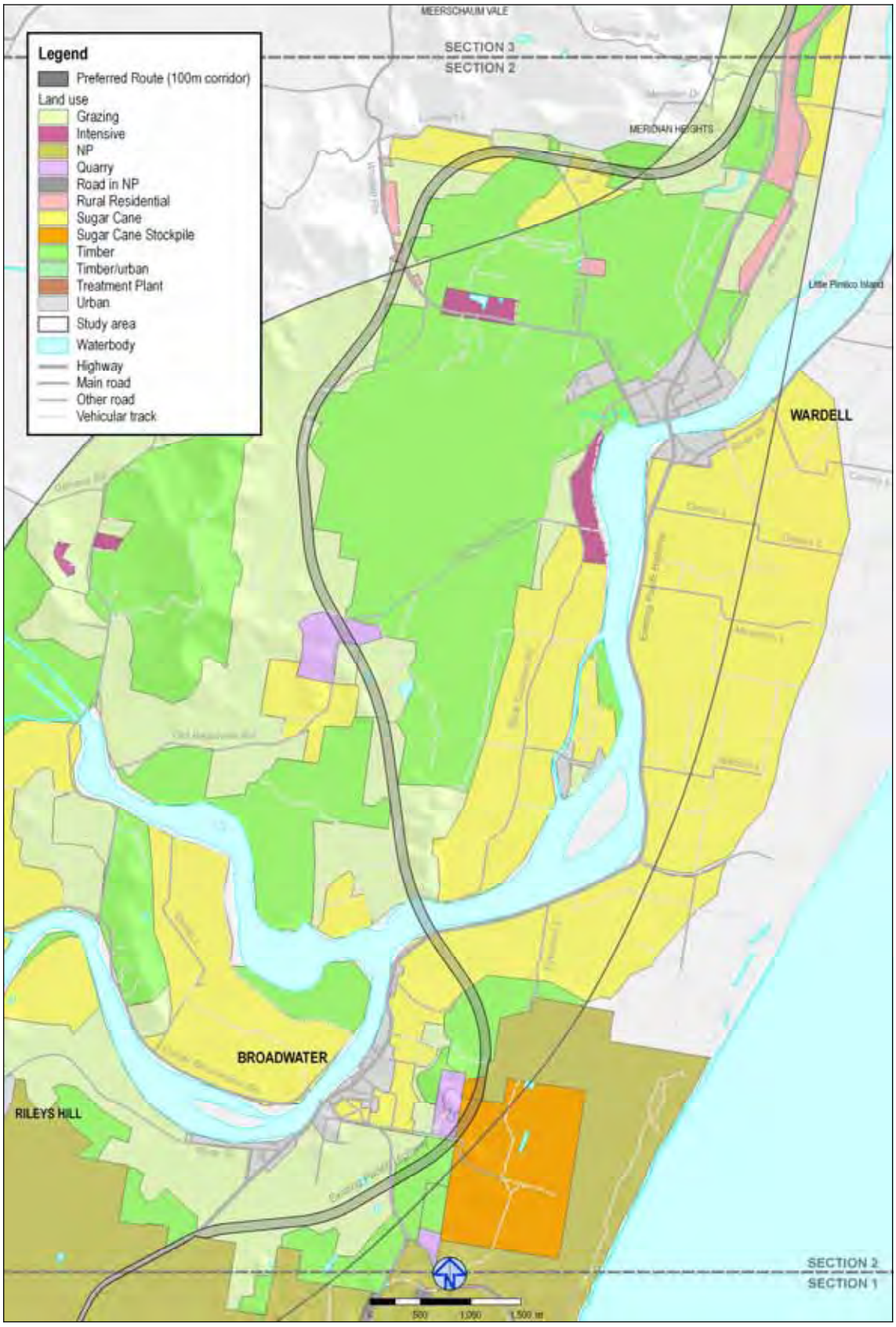

Figure 7-14 Preferred route - land use - section 2

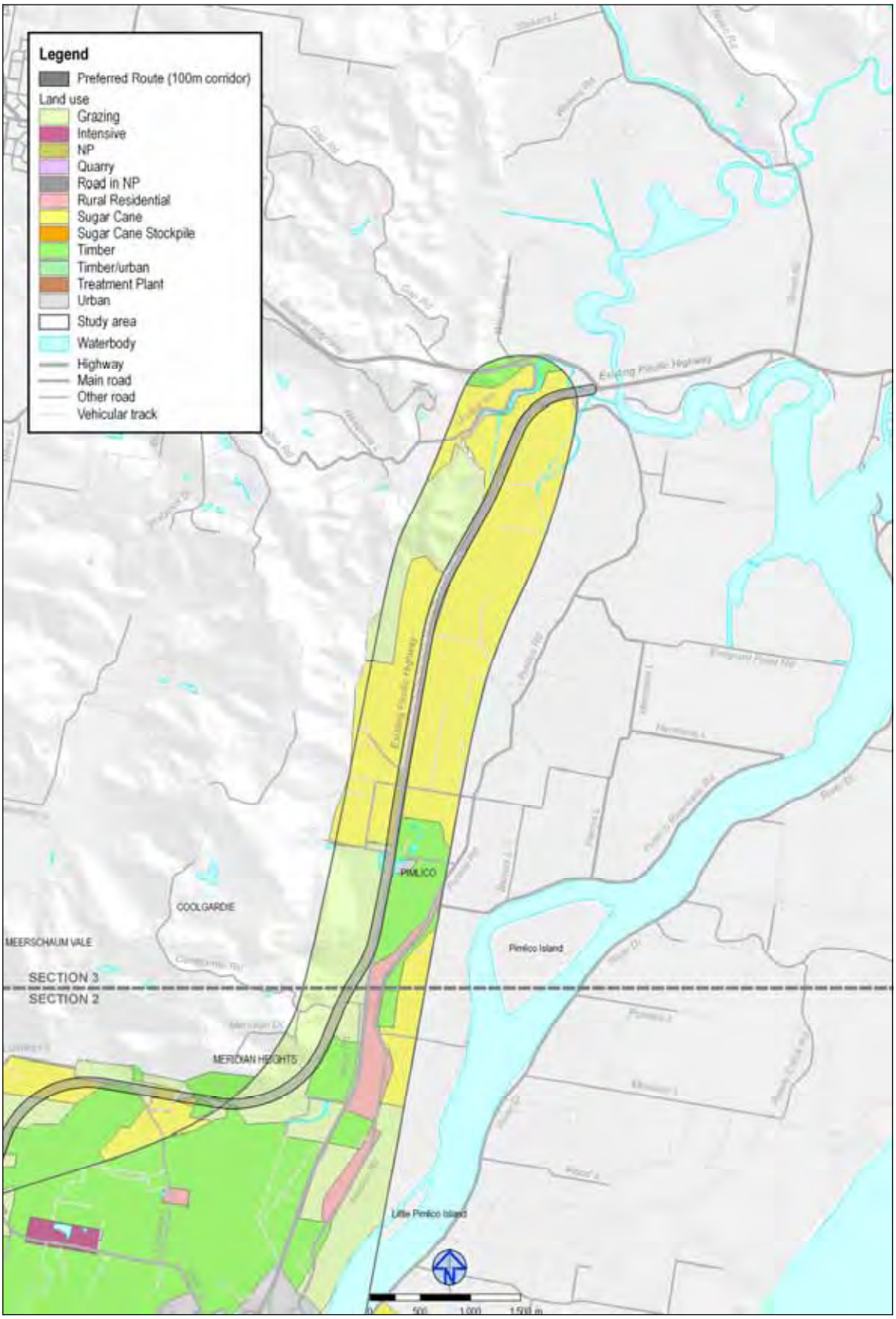

Figure 7-15 Preferred route - land use - section 3

Table 7-4 Land use impacts based upon preferred route footprint

Land use type	Hectares	% of footprint
Grazing	100.6	47
Road reserve through National Park	13.8	6
Quarry	3.4	2
Rural Residential	1.8	1
Sugar Cane	31.0	15
Sugar Cane Stockpile	3.0	1
Timber	32.8	15
Urban	25.2	12
Watercourse	2.6	1

7.2.6 Noise

A preliminary noise impact assessment has been undertaken on the basis of steady-state Community Noise Burden (CNB) for the preferred route. This analysis provides an indication of the likely reaction of residents to traffic noise after a period of adjustment to changes in the noise. The findings for predicted noise impacts extrapolated to 2035 (20 years after road opening) in terms of CNB are shown in **Table 7-5**.

The 'do-nothing' CNB has been calculated for the length of the existing highway through each section based on predicted traffic flows in 2035.

Table 7-5 Community Noise Burden (CNB) in 2035

Section	CNB (% population bothered by traffic noise)	Do-nothing (% population bothered by traffic noise)
Section 1 Woodburn to Broadwater National Park	0.3	6.43
Section 2 Broadwater National Park to Wardell	1.8	8.33
Section 3 Wardell to Bruxner Highway	0.6	0.24

The assessments show that the noise impact associated with the preferred route would be significantly lower, i.e. better, than that of the 'do nothing' scenario, except in section 3.

The noise impact north of Wardell is expected to be worse than the 'do nothing' scenario. This length of the preferred route generally follows the route of the existing highway, such that the same dwellings would be affected by traffic noise from the 'do nothing' scenario and the upgraded highway. The unmitigated adverse noise impact identified is predominantly due to the change to a noisier concrete pavement.

Predictions of the number of dwellings exposed to various range of traffic noise without mitigation in 2035 (20 years after opening) are shown in **Table 7-6**.

Table 7-6 Predicted number of dwellings exposed to a range of traffic noise levels without mitigation (2035)

Preferred Route	Predicted number of dwellings with noise level (without mitigation):		
	55-60 dB(A)	61-65 dB(A)	>65 dB(A)
Section 1	19	2	5
Section 2	63	46	40
Section 3	20	28	9

Some residents might experience changes in traffic noise level due to the upgrade on opening of the road in 2015. Predicted numbers of affected dwellings are shown in **Table 7-7**.

Table 7-7 Predicted numbers of noise affected dwellings

Preferred Route	Predicted number of dwellings to experience a noise increase
Section 1	10
Section 2	114
Section 3	34

Detailed noise and vibration assessments would be undertaken as part of the concept design and the environmental assessment. The detailed assessment would take into consideration any refinements made to the preferred route during concept design, and the impact of interchanges, service roads and local road changes on the surrounding environment.

Where road traffic noise impacts exceed the noise guidelines for the project, possible mitigation measures would be investigated by the RTA. The cost effectiveness and practicality of providing mitigation measures would also be taken into consideration at this time.

7.2.7 Heritage

Aboriginal heritage

No Aboriginal sites on or near the preferred route are listed on the Commonwealth or National Heritage Lists, Register of the National Estate, NSW Heritage Register, heritage schedule of the Richmond Valley Local Environmental Plan or the Department of Environment and Conservation's Aboriginal Heritage Information Management System.

Archaeological surveys undertaken during the route development process have identified a number of Aboriginal heritage sites that are not identified on any registers. **Table 7-8** and **Figure 7-16**, **Figure 7-17** and **Figure 7-18** outline the identified sites occurring on or near the preferred route.

Table 7-8 Aboriginal heritage sites

Location	Site	Significance
Woodburn to Broadwater National Park	Isolated stone artefact	This artefact was found on the level crest of an undulating ridge just west of the Pacific Highway Reserve and has been disturbed by track construction and underground telephone cable installation. The bulk of the crest has been excavated to make way for the existing highway and slopes away to the immediate west of the artefact location. It was concluded that the site has little further archaeological potential and it was recommended that the artefact be collected ahead of any construction disturbance.
	Isolated stone artefact and PAD	This artefact was located on the northern upper slope of an undulating ridge just west of the Pacific Highway road reserve and has been disturbed by track construction and underground telecommunications installation. No additional artefacts were apparent on the two metre wide track. The ridge crest west of the track levels out to form a broad low peninsula fringed by swamp. This crest supports grassy open woodland with negligible surface visibility, and although probably disturbed to some degree by past vegetation clearance, is considered to have substantial potential to contain subsurface archaeological deposits (PAD).
Broadwater National Park to Wardell	Cooks Hill massacre site	Despite an absence of surface evidence, the potential remains for subsurface archaeological deposits on the sand rise bordering the western bank of Eversons Creek.

Location	Site	Significance
	Midden/open campsite/s	Field inspections confirmed the existence of archaeological material across the McGeary's Quarry property traversed by the preferred route. This material occurs with greatest density on and around the northern margin of the existing extraction pit, where stone artefacts and pipi (*Donax deltoides*) shells are deflating down the pit cutting. Immediately north of the cutting, the grassed surface layer has been removed, creating an eroding sand exposure approximately 200 square metres in extent. The site is estimated to contain upwards of 1,000 surface artefacts, none of which would be in a primary depositional context. The exposure also contains a number of dense pipi shell accumulations set within a low level background pipi scatter. Most of the shell is in a highly fragmented condition. A number of overburden heaps occur on the margins of the extraction pit. Given that they comprise topsoil stripped from the extraction area, these heaps can be expected to contain artefacts and midden shell.
	Scarred trees	A group of four scarred trees are located at the base of a ridge north of Back Channel Road at Bagotville. These trees are assessed to have a high local level of scientific and cultural significance and may be affected depending upon the final alignment of the preferred route.
Wardell to Bruxner Highway	No sites identified	Due to extensive disturbance by sugar cane cultivation, cattle grazing, house construction and development of the existing Pacific Highway this section of the preferred route would not have any substantial archaeological potential.

Additional investigations are required. A number of appropriate management strategies would be implemented to minimise any impacts on all identified sites.

Non-Aboriginal heritage

The preferred route traverses riverine, agricultural and bushland areas and incorporates corridors of land adjacent to the existing Pacific Highway.

Heritage register searches have shown that the preferred route does not contain any items identified as having either local or State heritage significance. However there are known heritage items that could be affected by the preferred route. These are listed in **Table 7-9** and shown in **Figure 7-16**, **Figure 7-17** and **Figure 7-18**.

Figure 7-16 Preferred route - heritage - section 1

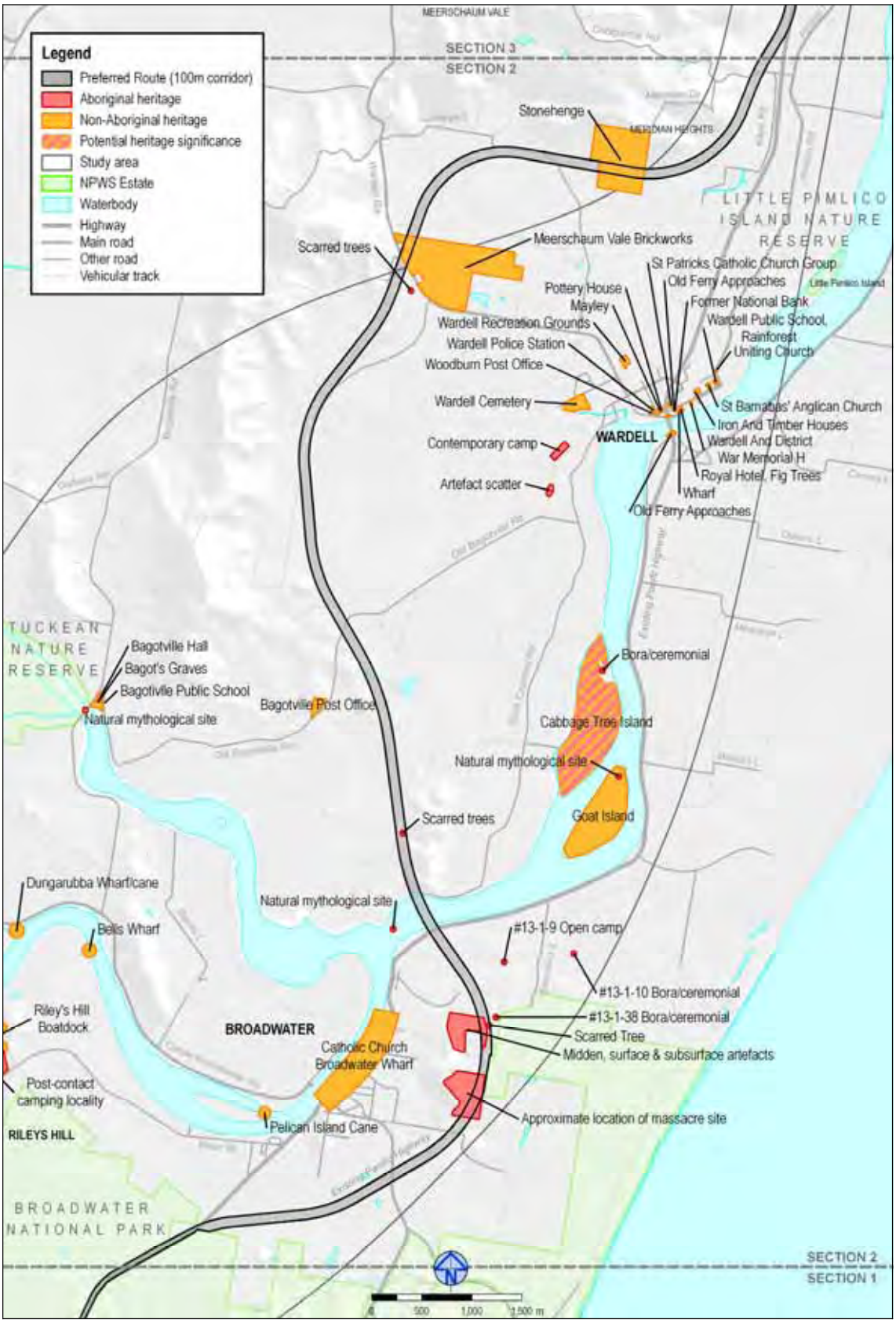

Figure 7-17 Preferred route - heritage - section 2

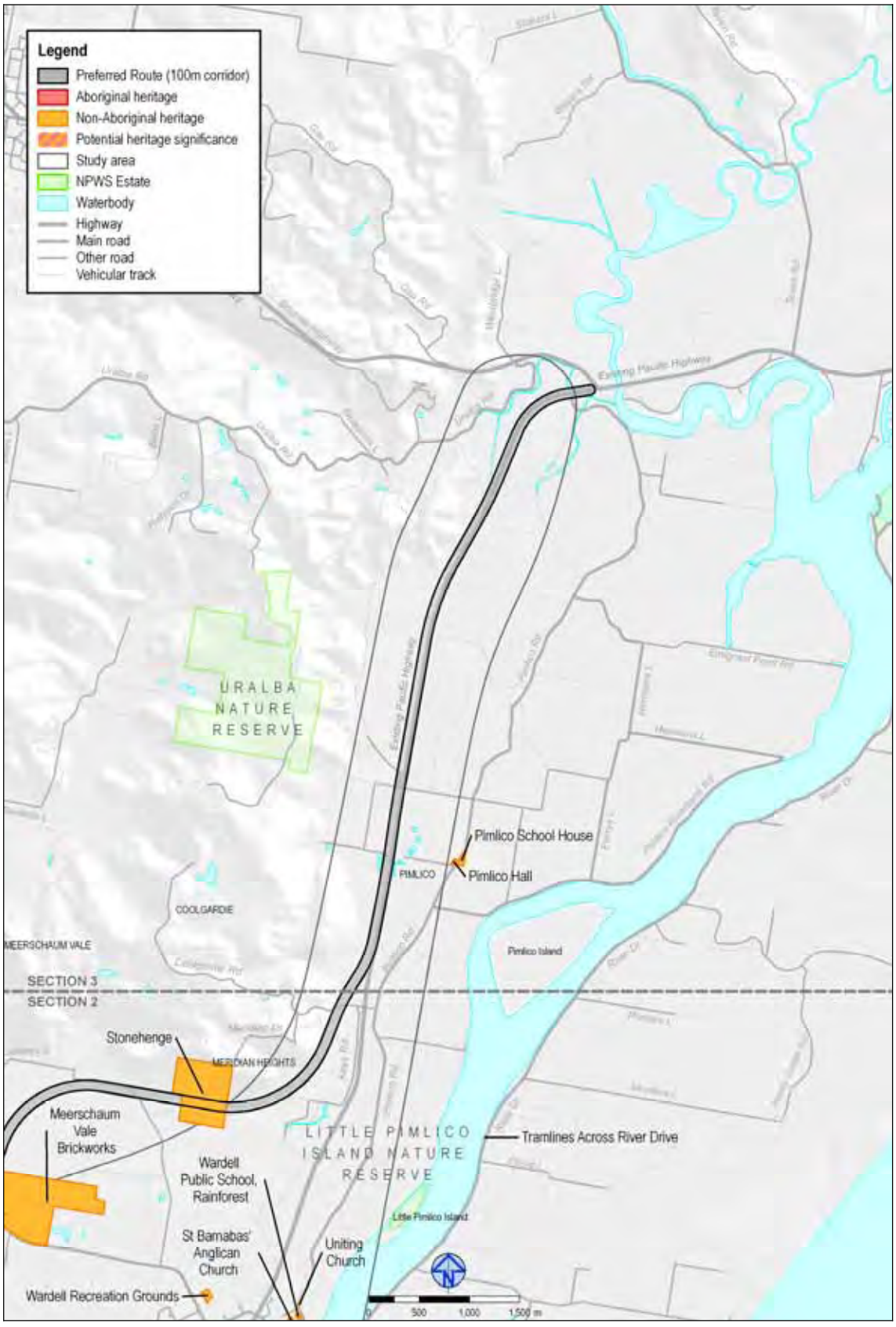

Figure 7-18 Preferred route - heritage - section 3

Table 7-9 Non-Aboriginal heritage sites

Location	Site	Description
Woodburn to Broadwater National Park	Stock route	Connects North Woodburn and Woodburn abattoir. Remains of the construction and any modifications of the stock route could be affected. Remains relating to its usage could also be affected.
	Tuckombil Canal	Remains could be affected on either side of the canal relating to the construction and later modification of the canal. Moorings and punts may also be found along the canal bank. Remains relating to early use of the canal could be affected adjacent to its banks
	Extant buildings	Original dwellings and agricultural buildings are scattered throughout the area. The preferred route could impact on these and evidence of past occupation.
	Lang Hill Quarry	The preferred route is close to Lang Brick Quarry which was recently listed in a draft heritage report for Richmond Valley Council as an industrial site of local significance.
	Drainage channels	Topographic and anecdotal evidence indicate that a number of drainage channels may be located within the preferred route. Many of these canals were constructed in the late 19th / early 20th century.
Broadwater National Park to Wardell	Three quarry sites	Road construction works in these areas are likely to impact on remains of quarrying / industrial activity.
	Meerschaum Vale brickworks	Anecdotal evidence indicates that brickworks may have been present. The landowner advises that there are no remnant brickworks on the land and has not given permission for further investigations to occur. If the brickworks do occur and are affected by the preferred route, evidence of early industrial activity is likely to be disturbed.
	Extant buildings	Original dwellings and agricultural buildings are scattered throughout the area. The preferred route could impact on these and evidence of past occupation.

Location	Site	Description
	'Stonehenge'	Potential adverse impact on the land surrounding the buildings but not the buildings themselves. Access to 'Stonehenge' would also be affected.
	'Oakvale'	Oral evidence of a heritage building in Meerschaum Vale area. Exact location is not known, but this building and associated remains of agricultural activities could be affected by the preferred route.
Wardell to Bruxner Highway	No sites identified	The land beside the existing highway is predominantly used for rural purposes, commercial activities and contains pockets of bushland.

Additional investigations are required. A number of appropriate management strategies would be implemented to minimise any impacts on all identified sites.

7.2.8 Biodiversity

As discussed in Section 2.7.1, the study area for the Woodburn to Ballina upgrade contains large areas of important high quality habitat. The preferred route has been selected to minimise the impact on these areas.

The potential ecological impacts of the preferred route are summarised in **Table 7-10** in terms of the sum of areas impacted compared with the total area contained within the preferred route corridor.

Table 7-10 Potential ecological impacts based upon preferred route footprint

Type		
Endangered Ecological Communities	51.97	hectares
Native vegetation	65.77	hectares
Regional and subregional fauna corridors	6.00	number

Flora

Figure 7-19, **Figure 7-20**, and **Figure 7-21** illustrate the potential ecological impacts (vegetation communities) of the preferred route.

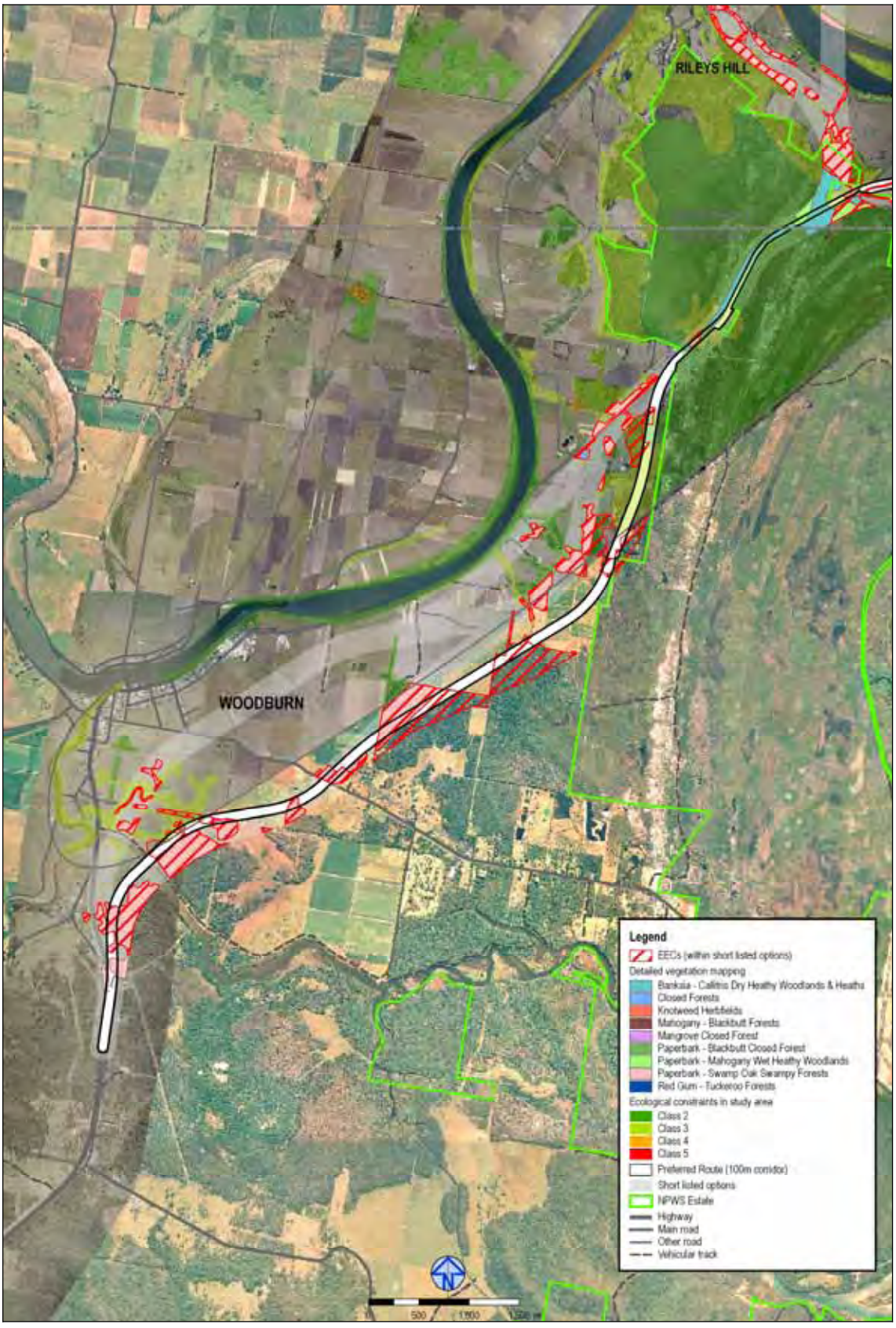

Figure 7-19 Preferred route - ecological impacts (vegetation communities) - section 1

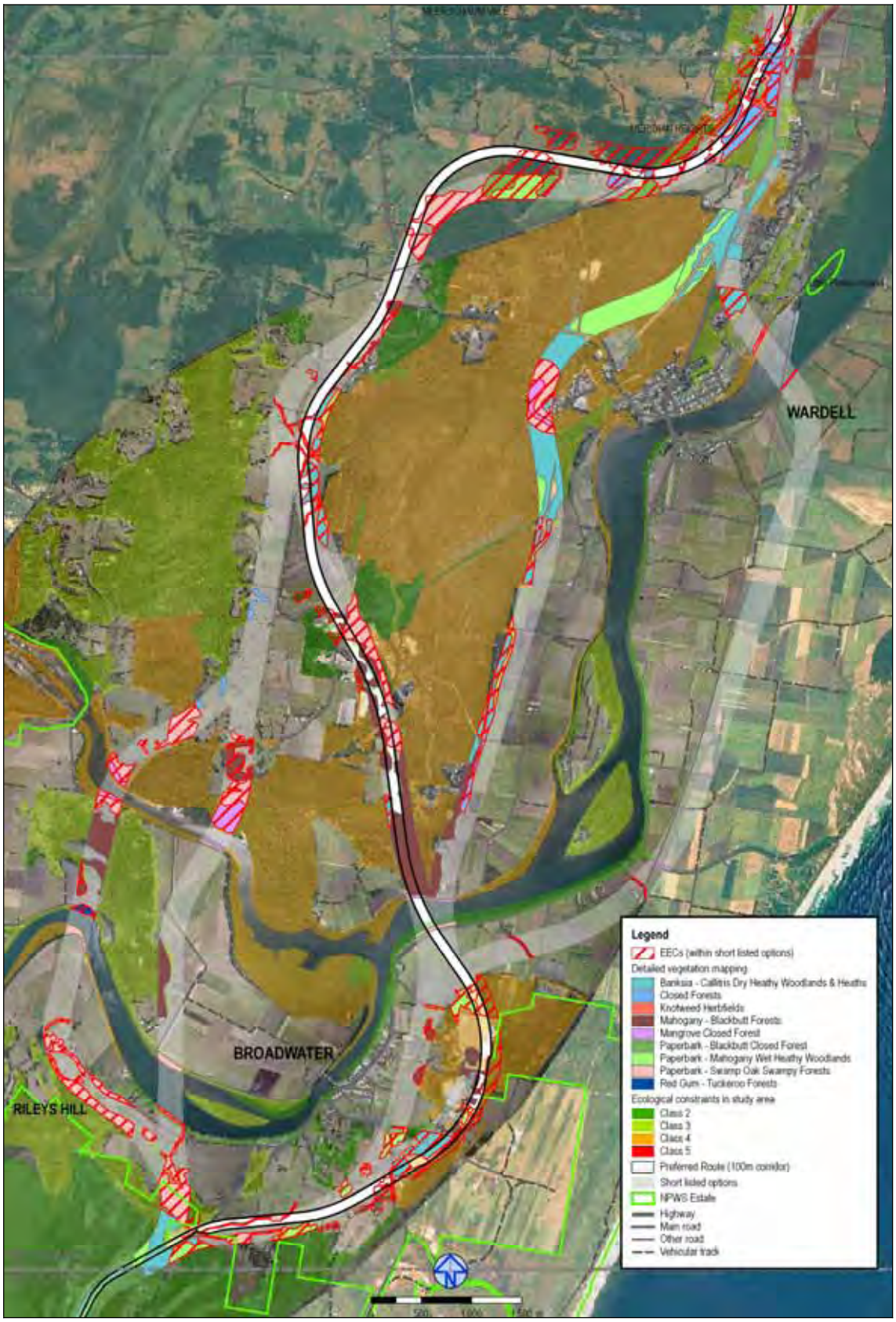

Figure 7-20 Preferred route - ecological impacts (vegetation communities) - section 2

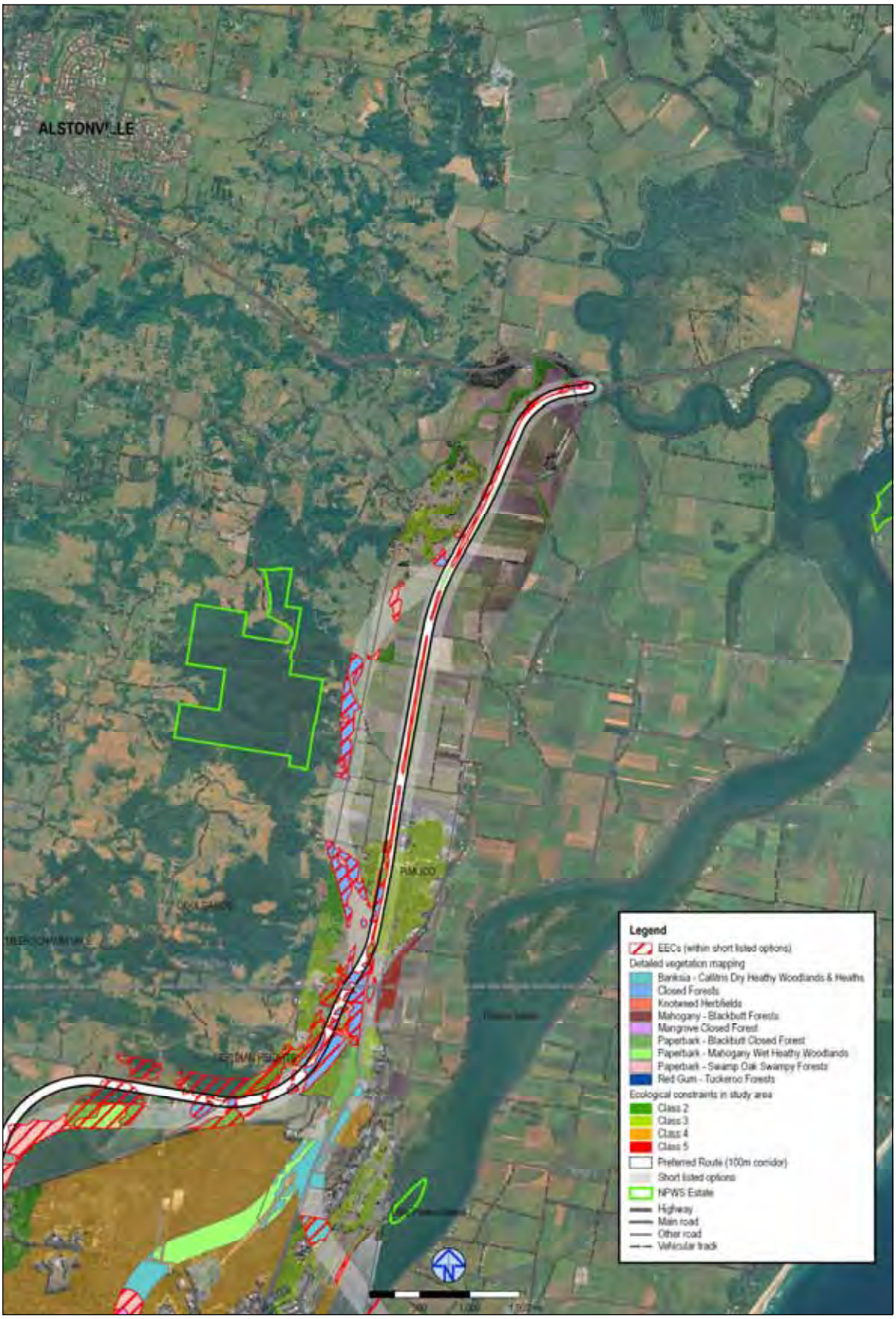

Figure 7-21 Preferred route - ecological impacts (vegetation communities) - section 3

The preferred route would impact on the following broad vegetation communities:

- Banksia – Callitris Dry Heathy Woodlands.
- Paperbark – Mahogany Wet Heathy Woodlands.
- Paperbark – Blackbutt emergent Closed Forest.
- Mahogany – Blackbutt Forests.
- Paperbark – Swamp Oak Swampy Forests.
- Knotweed Riparian Herbfields.
- Closed Forests.
- Mangrove Closed Forests.

The desktop assessment and field surveys undertaken to date have identified several known and potential threatened plant species that would be affected by the preferred route, including but not limited to, those described in **Table 7-11**.

Table 7-11 Potential threatened plant species

Common Name	Species Name
Thorny Pea	*Desmodium acanthocladum*
White Lace Flower	*Archidendron hendersonii*
Rough-shelled Bush Nut	*Macadamia tetraphylla*
No Common Name	*Geijera paniculata*
No Common Name	*Isoglossa eranthemoides*
No Common Name	*Marsdenia longiloba*
Red Lilly Pilly	*Syzigium hodgkinsoniae*
Rusty Rose Walnut	*Endiandra hayesii*
Scale Myrtle	*Austromyrtus fragrantissima*
Lesser Swamp Orchid	*Phaius australis*

Fauna

The desktop assessment and field surveys undertaken to date have identified several known and potential threatened species that could be affected by the preferred route including, but not limited to those described in **Table 7-12**.

Table 7-12 Potential threatened fauna species

Common Name	Species Name
Birds	
Grass Owl	*Tyto capensis*
Powerful Owl	*Ninox strenua*
Masked Owl	*Tyto novaehollandiae*
Black Bittern	*Ixobrychus flavicollis*
Bush-stone Curlew	*Burhinus grallarius*
Rose-crowned Fruit-Dove	*Ptilinopus regina*
Wompoo Fruit Dove	*Ptilinopus magnificus*
Superb Fruit-Dove	*Ptilinopus superbus*
Black-necked Stork	*Ephippiorhynchus asiaticus*
Brolga	*Grus rubicunda*
Osprey	*Pandion haliaetus*
Square-tailed Kite	*Lophoictinia isura*
Alberts Lyrebird	*Menura alberti*
Grey-crowned Babbler	*Pomatostomus temporalis*
Mangrove Honeyeater	*Lichenostomus fasciogularis*
Mammals	
Koala	*Phascolarctos cinereus*
Long-nosed Potoroo	*Potorous tridactylus tridactylus*
Squirrel Glider	*Petaurus norfolcensis*
Common Blossom-bat	*Syconycteris australis*
Eastern Long-eared Bat	*Nyctophilus bifax*
Little Bentwing-bat	*Miniopteris australis*
Common Bentwing-bat	*Miniopteris schribersii*
Eastern Freetail-bat	*Mormopterus norfolkensis*
Hoary Wattled Bat	*Chalinolobus nigrogriseus*
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*
Greater Broad-nosed bat	*Scoteanax rueppellii*
Grey-headed Flying –fox	*Pteropus poliocephalus*
Black Flying-fox	*Pteropus alecto*
Common Planigale	*Planigale maculata*
Brush-tailed Phascogale	*Phascogale tapoatafa*
Amphibians	
Wallum Froglet	*Crinia tinnula*
Olongburra Frog	*Litoria olongburensis*
Common Eastern Froglet	*Pseudechis porphyriacus*

Common Name	Species Name
Molluscs	
Mitchell's Rainforest Snail	*Thersites mitchellae*

Additional threatened flora and fauna species and/or communities may be listed under the TSC Act or the EPBC Act during the further development of the preferred route. Listings under these Acts would need to be monitored and the potential impact of the preferred route on additional listed species and/or communities would need to be assessed.

More detailed ecological assessments would be undertaken during concept design and for inclusion in the environmental assessment. Over this time it is possible that, depending on the findings of detailed surveys, the final alignment of the preferred route could be moved to avoid areas of significance within the preferred route corridor. Mitigation measures would be identified during these detailed ecological assessments.

7.2.9 Flooding and drainage

The route option development process for the Woodburn to Ballina Pacific Highway upgrade has modelled the flooding impacts and identified the capital works required to mitigate flooding impacts within the Richmond River floodplain. The hydrological and hydraulic modelling undertaken for the route options assessment has formed the basis for the flooding impact assessment for the preferred route.

The flood model used for the hydraulic modelling was an integrated 1D/2D model (SOBEK). The 1D river cross sections were taken from the WBM (1999) Mike 11 model, and the 2D terrain model was developed from photogrammetry supplemented with ground survey. A two-dimensional model was considered necessary to adequately describe flooding impacts of the route.

The preferred route crosses two major rivers, the Evans River (Tuckombil Canal) near Woodburn and the Richmond River at Broadwater. Each bridge crossing needs as a minimum to span the river channel and to allow for a sufficient floodway to minimise afflux. The preferred route also passes across a flood conveyance/storage area south-east of Woodburn towards the National Park near Broadwater (refer **Figure 7-22**). This area drains to the Evans River, providing an important connection from the Pacific Ocean at Evans Head to the Richmond River at times of flood. Within this area, bridges would be required to allow flood flows to 'balance' by allowing flows from the Richmond River to discharge to the Evans River.

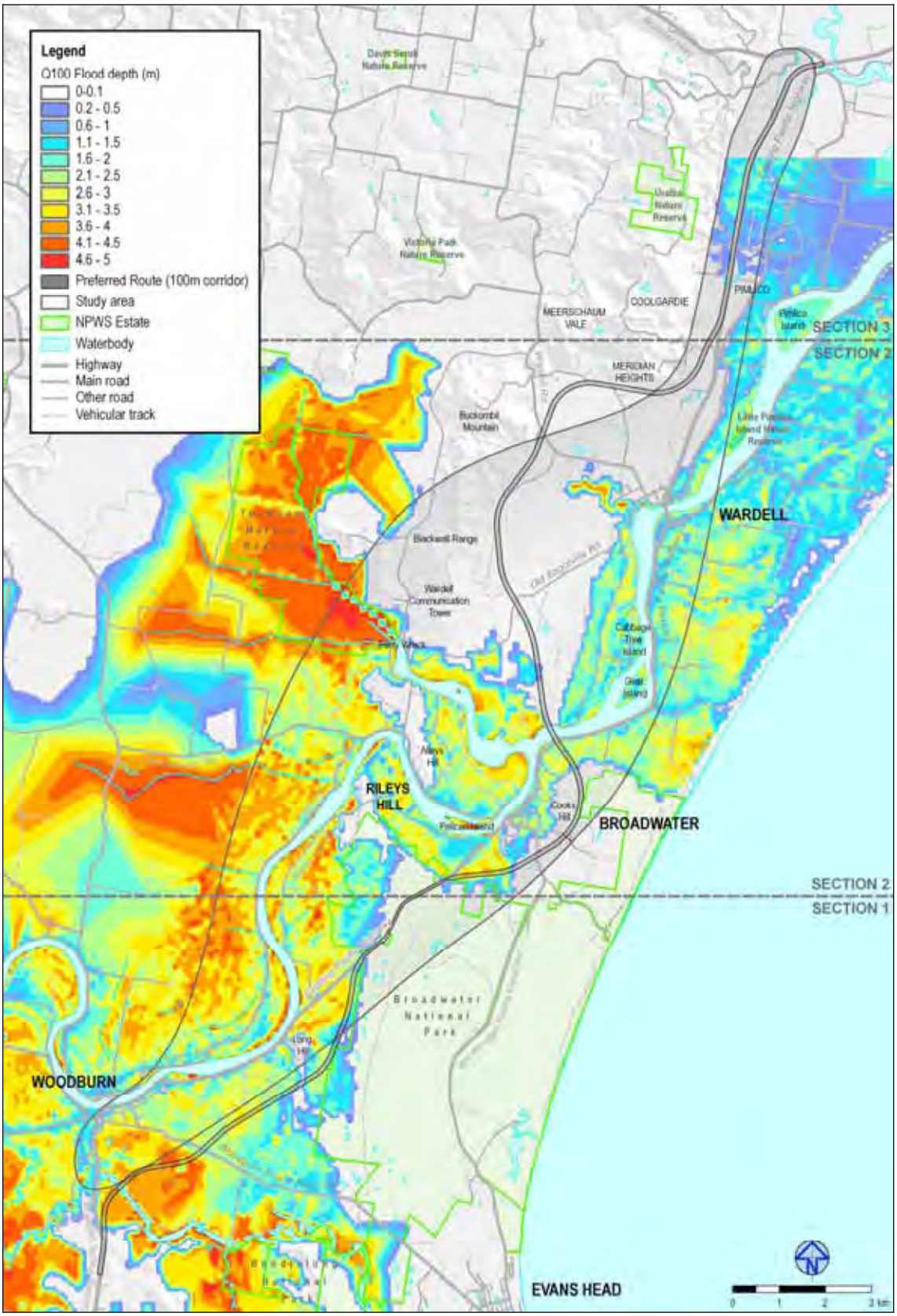

Figure 7-22 Preferred route – Q100 flood depth

Preliminary design has indicated, based upon preliminary concept design assumptions, that the structures shown in **Table 7-13** would be required to limit flood impacts to a target maximum afflux of 50 mm in the 100 year ARI flood. The project would be provided with a flood immunity to the 20 year ARI within floodplain areas and the 100 ARI elsewhere.

Table 7-13 Hydraulic structures required for flood mitigation

Structure	Description	Clear Opening*	Bridge Length*
Bridge	Tuckombil Canal Crossing		350 m
Bridge	Richmond River Crossing		840 m
Floodwater bridging	Floodplain balancing and provision of local drainage south of Broadwater	880 m	

* Bridge lengths and openings listed are minimum openings to maintain a 50 mm afflux. Bridge lengths may be larger to accommodate geotechnical and structural constraints, and are subject to refinement of concept design and further studies.

Data has been obtained for the floor levels of 836 properties (residences and businesses) in Coraki, Woodburn, Broadwater and Wardell to estimate the number of properties affected by an increase in the 100 year ARI afflux. The number of properties affected by various afflux ranging from existing conditions (0 mm afflux) to 100 mm afflux is shown in **Table 7-14**.

The increase in afflux is generally estimated to occur upstream of Broadwater, past Woodburn to Swan Bay, and extend into the Tuckean Swamp.

Table 7-14 Estimate of properties potentially flood affected in Coraki, Woodburn, Broadwater and Wardell

Afflux (mm)	Number of floor levels potentially flooded	Additional floor levels potentially flooded	Max depth of inundation (m)	Mean depth of inundation (m)
No change	449	-	3.24	0.76
50	471	22	3.29	0.77
75	481	32	3.31	0.78
100	490	41	3.34	0.79

The route option assessment modelling has indicated that the preferred route can achieve flood immunity for the 20 year ARI within the floodplain, and for the 100 year ARI elsewhere, where appropriate cross drainage through the floodplain is provided. The section of the preferred route north of the Richmond River crossing at Broadwater is dominated by localised flooding that would be managed by providing cross drainage under the highway.

Hydraulic modelling of the preferred route during the concept design would refine the assessment of floodplain conveyance and structures deemed necessary to mitigate flood impacts.

7.2.10 Economic evaluation

The economic analysis evaluated the preferred route in accordance with NSW Treasury guidelines and is consistent with the NSW RTA *Economic Analysis Manual*.

The project analysis starts in 2005, with construction commencing in 2012 and a projected opening time of 2015. The analysis timeframe is over a 30 year period ending in 2035.

Project development costs include inputs such as investigations, traffic demand analysis, construction and project management. Economic benefits were assessed for impacts on vehicle operating costs, travel time savings, vehicle accidents, recreation and tourism, business and agriculture.

The results, shown below in **Table 7-15**, represent the analysis of the preferred route, relative to the 'Do Nothing' or base case that is the Pacific Highway as it currently stands.

Table 7-15 Economic analysis summary

Preferred route	Low project cost	High project cost
Length (km)	36.1	36.1
Project Cost ($'000)	589,970	646,712
Development Cost per km ($'000)	16.321	17,891
PROJECT COSTS (Present Value $'000)		
Development & Construction Costs	376,071	412,241
SUB TOTAL COSTS	376,071	412,241
PROJECT BENEFITS (Present Value $'000)		
Vehicle Operating Costs*	(29,223)	(29,223)
Travel Time*	19,458	19,458
Accident Costs*	42,926	42,926
Residual Value	18,628	24,211
Tourism and Recreation	4,050	4,050
Amenity Impacts	33,448	33,448
Ecological Impacts	112	112
Business Impacts	28,069	28,069
SUB TOTAL BENEFITS	117,468	117,468
RESULTS		
Net Present Value ($'000)	(258,603)	(289,190)
Benefit Cost Ratio	0.3	0.3

* VOCs, travel time and accident costs are expected to overestimate the benefits, since the traffic (kms travelled, travel time) have not been adjusted to reflect the increase in length of the updated route.

The preferred route result indicates a negative Net Present Value (NPV) and Benefit Cost Ratio (BCR) less than 1. However, there are a number of non-quantifiable factors that should be considered in the evaluation decision that have not been accounted for in the economic analysis.

Economic Analysis of Pacific Highway Program

It has been estimated that, following the ten year upgrading program in June 2006, there remains $6.1 billion of works to complete upgrading the Pacific Highway to a good dual carriageway standard (mixture of highway standard and freeway standard dual carriageway road). A further $1.9 billion would be required to upgrade the Pacific Highway to a full limited access, freeway standard road with alternative route suitable for local traffic use. This latter work would include retro-fitting interchanges and service roads on lengths of dual carriageway completed before July 2006.

The projects included in the post-2006 $6.1 billion program are shown in **Table 7-16**. The $8.0 billion program requires building projects indicated as being highway standard in that table to the freeway standard instead. As well as retro-fitting works on the lengths listed in **Table 7-17**.

Table 7-16 Lengths to be upgraded in $6.1 billion program

Karuah to Bulahdelah - sections 2&3	Wells Crossing to Harwood
Bulahdelah upgrade	Harwood to Iluka Road *
Coopernook to Moorland *	Iluka Road to Woodburn *
Moorland to Herons Creek *	Woodburn to Ballina
Oxley Highway to Kempsey *	Ballina bypass
Kempsey to Eungai	Tintenbar to Ewingsdale
Warrell Creek realignment *	F3 to Raymond Terrace
Macksville to Urunga	Failford Road to Tritton Road *
Bonville upgrade	Herons Creek to Stills Road *
Sapphire to Woolgoolga *	Coffs Harbour bypass
Woolgoolga to Wells Crossing *	Banora Point upgrade

* Indicates to be constructed to highway standard in this program

Table 7-17 Lengths that require retro-fitting work in $8.0Billion program

Raymond Terrace to Karuah	Coopernook bypass
Karuah to Bulahdelah - section 1	Herons Creek Deviation – remainder
Bulahdelah to Coolongolook	Eungai & Allgomera duplication
Coolongolook to Wang Wauk	Raleigh Deviation
Wang Wauk to Bundacree Creek	Lyons Road to Englands Road
Bundacree Creek to Possum Brush	Korora Hill to Sapphire
Rainbow Flat Deviation – remainder	Ewingsdale to Tyagarah
Taree bypass	Chinderah bypass
Taree to Coopernook	

The net present value and benefit cost ratios for the remaining works have been calculated assuming that the works are all completed by 2016. The benefits considered are travel time savings, vehicle operating cost savings and crash cost savings. A breakdown of the costs and benefits as well as the economic return measures are shown in **Table 7-18**.

Table 7-18 Costs, benefits and economic return measures

	Mix of highway and freeway upgrade	**Full freeway standard upgrade**
Capital Cost (undiscounted)	6,107	8,063
Present Value		
Costs		
Capital	4,085	5,285
Incremental O&M	133	147
Total Costs	4,218	5,432
Benefits		
Road user cost savings		
- Vehicle operating costs		
Light vehicles	985	945
Heavy vehicles	932	931
- Travel time costs		
Light vehicles	2,165	2,514
Heavy vehicles	472	481
- Crash costs	590	654
Sub-total	5,144	5,524
New trips	413	448
Total Benefits	5,557	5,972

	Mix of highway and freeway upgrade	Full freeway standard upgrade
Economic Return Measures		
Net present value	1,339	540
Benefit-cost ratio	1.3	1.1

In addition, there are other benefits that are not included in the traditional road user benefit-cost calculations. These are new or expanded business and employment opportunities arising from the road construction sector expenditures associated with the Program. These expenditures would have output, employment and household income consequences, both directly and indirectly as industries supplying the road construction sector respond to the increased demand for their products and households respond to the additional income earned.

Table 7-19 provides estimates of the generation of employment and induced economic activity from the construction expenditure associated with the upgrade program beyond 2006. These estimates are based on applying multiplier outputs from existing models which incorporate estimation of the economic effects of changes in the output of the road construction industry.

Table 7-19 Estimated Regional Economic Impacts During Construction Period(1)

	Hunter SD	Mid-North Coast SD	Richmond Tweed SD	Total
Total employment created (2)	9,100-16,000	53,000-68,000	23,000-26,000	85,000-110,000
Increase in output(3)	$540m-960m	$2,100m-2,700m	$930m-1,100m	$3,600m-4,800m
Total household income generated(4)	$310m-550m	$1,500m-2,000m	$670m-750m	$2,500m-3,300m

Notes:

(1) Lower end of range is for $6.1 billion program, higher end is for $8.0 billion program.

(2) In road construction sector and in all sectors after allowing for multiplier effects. Jobs are measured in persons years, where a person year is equivalent to one full-time job for one person for one year.

(3) In sectors other than road construction (in $million).

(4) In all sectors (in $ million).

Sensitivity analysis

It should be noted that the following factors would significantly affect the actual project BCR:

- capital cost estimates assume a 28% contingency;

- variances in assumed traffic growth rates;
- variances in assumed accident rates;
- variance in the assumed discount rate; and
- scope changes during the development of the concept design.

7.3 Bruxner Highway interchange section of the Ballina Bypass upgrade

Immediately north of the Woodburn to Ballina section of the Pacific Highway upgrade is the Ballina Bypass upgrade. An environmental impact statement (EIS) and concept design was completed for the Ballina Bypass in February 1998. Environmental studies for the project are complete and the project has been approved.

The current design for the Ballina Bypass incorporates a partially grade separated interchange at the Bruxner Highway, refer to **Figure 7-23** and **Figure 7-24**.

Current Pacific Highway design standards require that interchanges be grade separated, therefore a review of this section of the Ballina Bypass upgrade will be undertaken to improve highway safety and short trips between interchanges.

Figure 7-23 Bruxner Highway intersection artist impression (EIS ultimate scheme)

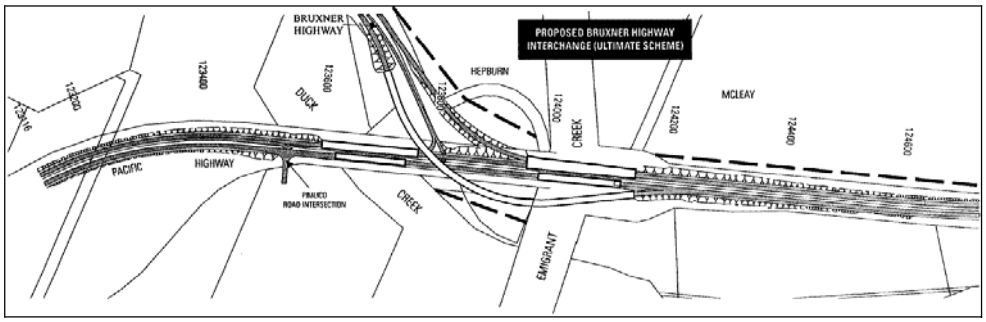

Figure 7-24 Bruxner Highway intersection schematic (EIS ultimate scheme)

8 The next steps

8.1 Woodburn to Ballina upgrade

Following the announcement of the preferred route for the Woodburn to Ballina project the RTA proposes to submit the Woodburn to Ballina project to the Department of Planning for approval under Part 3A of the EP&A Act.

Further survey, geotechnical, ecological and other investigations would also be undertaken to provide input into the refinement of the design and environmental assessment.

The level of environmental assessment (EA) required for a proposal under Part 3A would be determined by the Director-General of Planning, who issues EA requirements after consultation with the relevant public authorities and local Councils. The EA may include a statement of commitments in respect of environmental management and mitigation measures proposed to be undertaken if the project is approved.

When completed, the EA would be publicly exhibited and submissions would be sought. The RTA may be asked to prepare a report on the submissions and revise its statement of commitments. It would also consider modifications to the project to minimise environmental impacts. The Department of Planning (DoP) may request the RTA to display, for public information, a Preferred Project Report which identifies the proposed modifications.

The DoP would consider the EA, the public submissions and any report requested from the RTA in recommending to the Minister for Planning whether the project should be approved.

8.2 Bruxner Highway interchange section of the Ballina Bypass

The current design of the Bruxner Highway interchange section of the Ballina Bypass will be reviewed to assess possible improvements in functionality and safety by reconfiguring the interchange at the Bruxner Highway.

This would be undertaken without amending the Pacific Highway upgrade alignment presented in the Ballina Bypass EIS.

The review will reassess existing information available on a range of engineering, planning, environmental and cost factors in relation to alternative configurations.

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