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

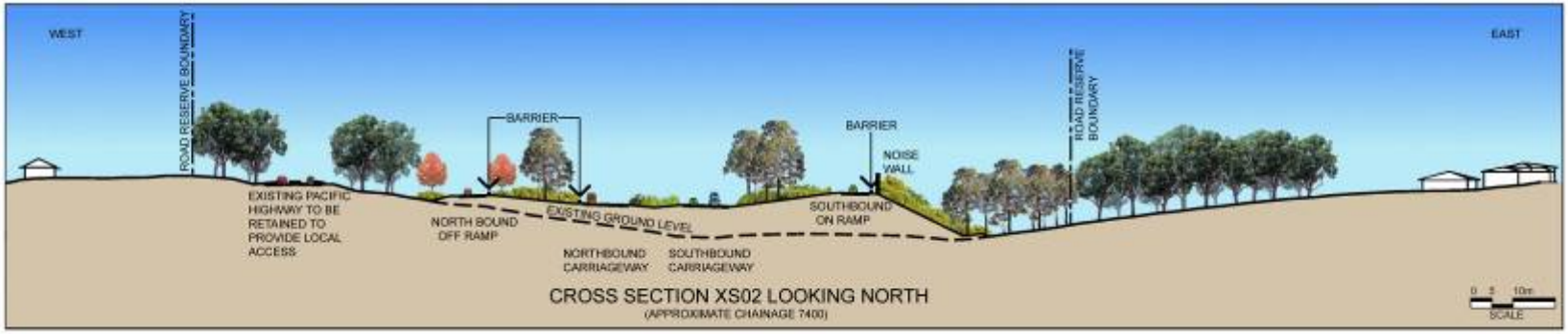


Figure 6-11 C/S XS03 Typical cross section east of Macksville looking north (approximate chainage 9500 m)

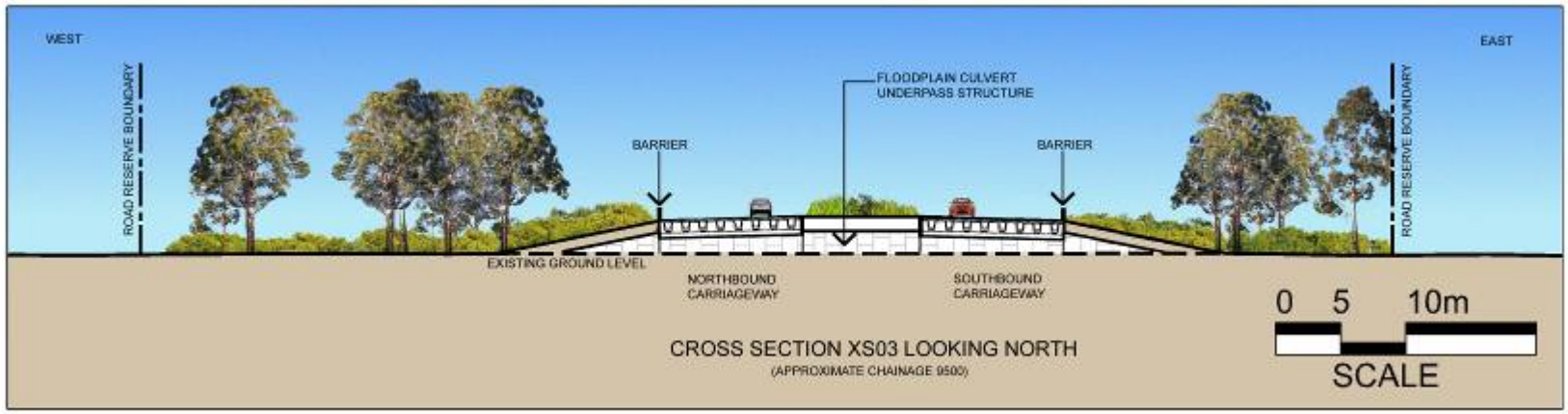


Figure 6-12 C/S XS04 Typical cross section south of Nambucca River looking north (approximate chainage 10200 m)

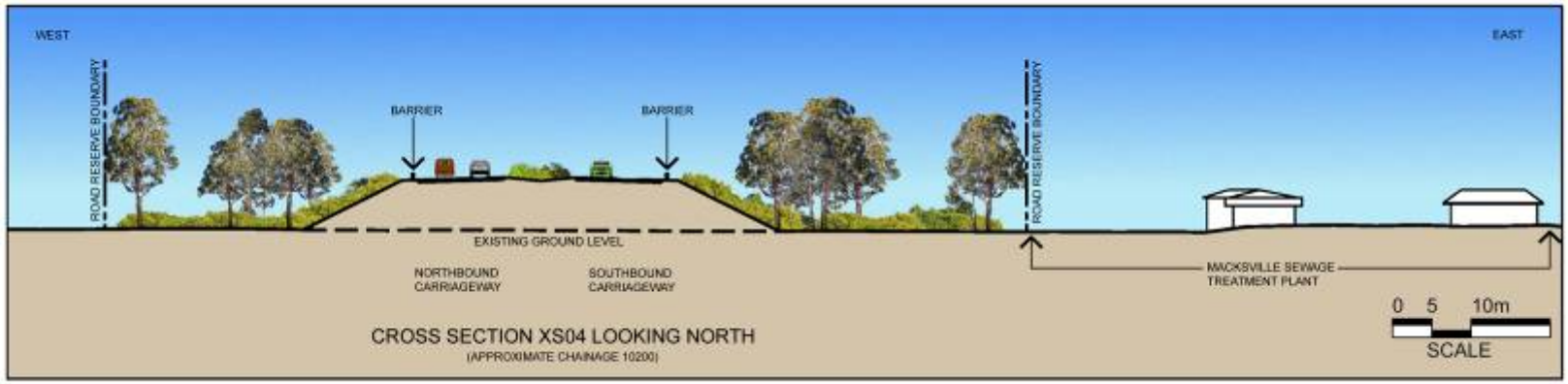


Figure 6-13 C/S XS05 Typical cross section at Old Coast Road near Letitia Close looking north (approximate chainage 11550 m)

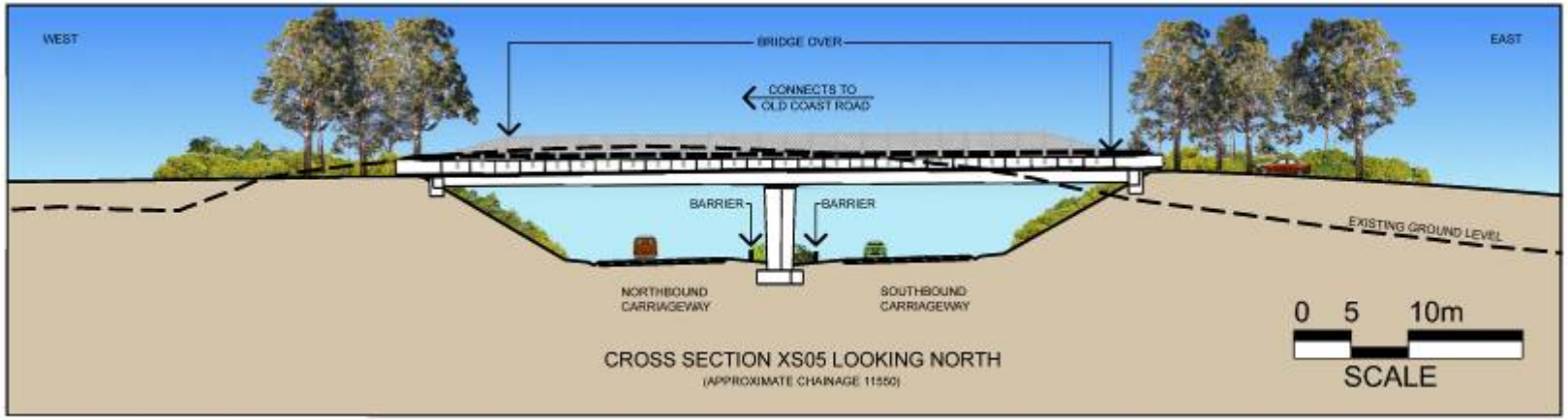


Figure 6-14 C/S XS06 Typical cross section at Mattick Road looking north (approximate chainage 12600 m)

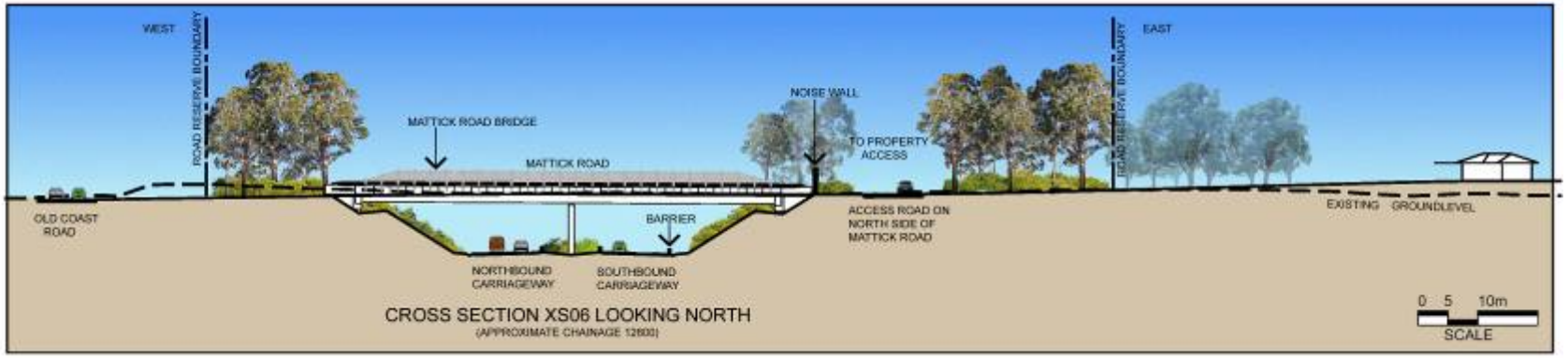


Figure 6-15 C/S XS07 Typical cross section at Valla Road looking north (approximate chainage 22400 m)

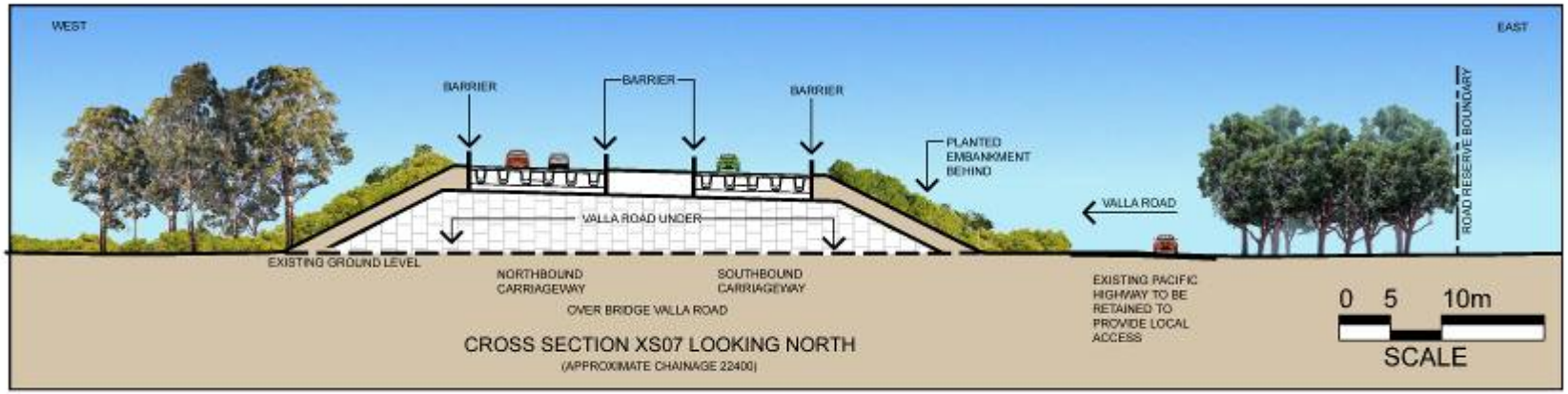


Figure 6-16 C/S XS08 Typical cross section near Valla Beach looking north (approximate chainage 25600 m)

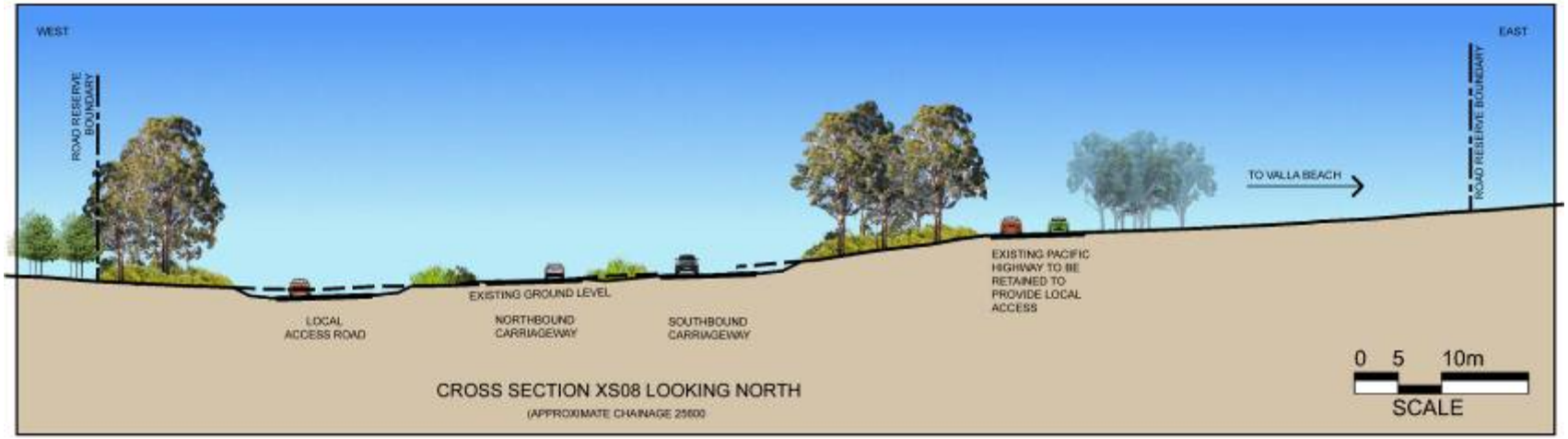


Figure 6-17 C/S XS09 Typical cross section at East West Road looking north (approximate chainage 26000 m)

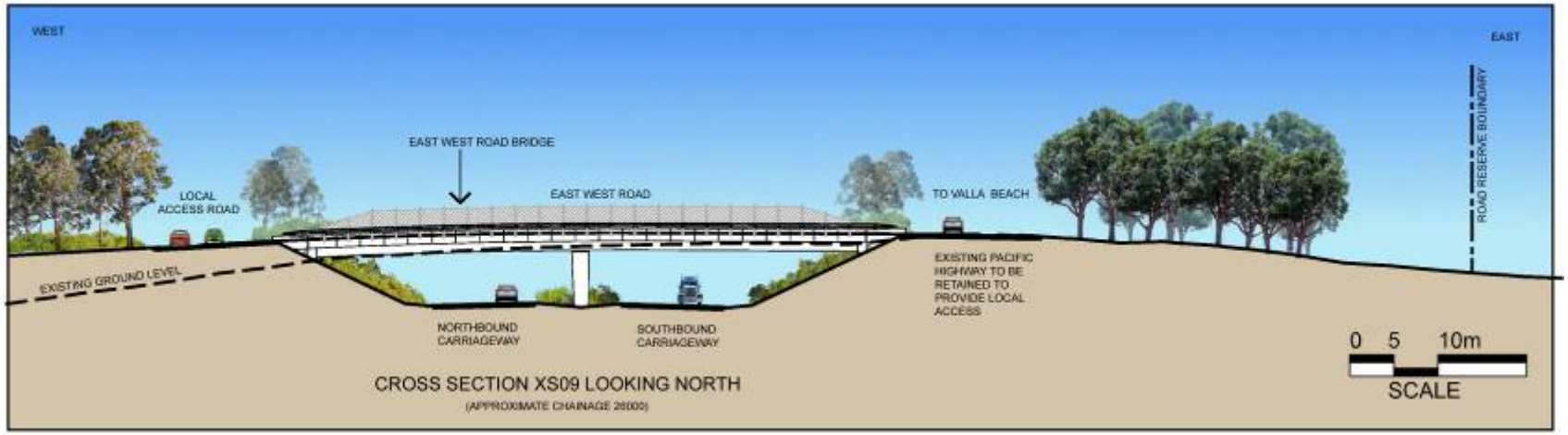


Figure 6-18 C/S XS0A Typical cross section through the forest north of Kalang River looking north (approximate chainage 37500 m)

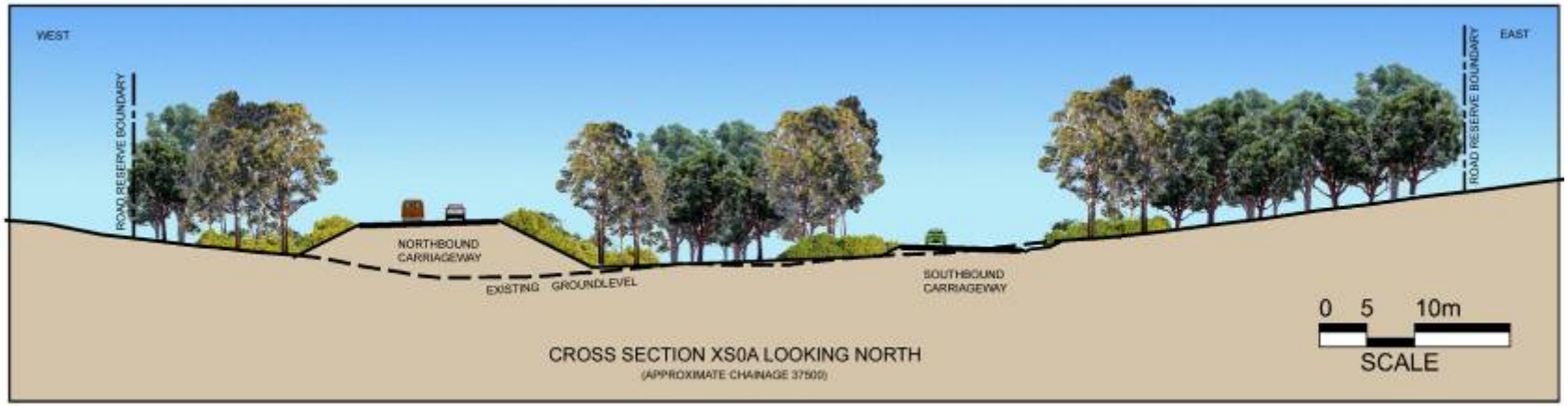
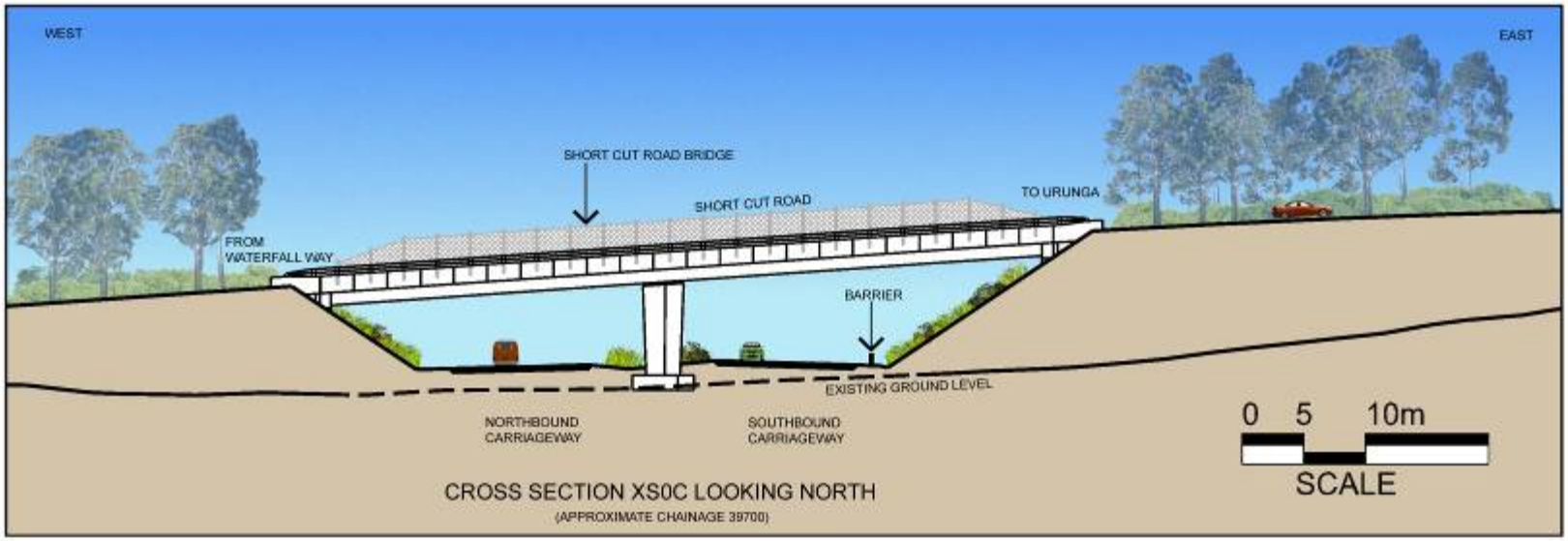


Figure 6-19 C/S XS0C Typical cross section at Short Cut Road looking north (approximate chainage 39700 m)



6.5.2 Earthworks

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

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

Table 6-2 Typical Cutting Depths and Fill Heights

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

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

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

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

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

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

6.5.3 Bridges

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

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

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

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

Table 6-3 Proposed bridge locations and descriptions

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

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

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

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

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

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

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

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

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

6.5.4 Drainage and water quality treatments

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

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

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

6.5.4.1 Cross drainage

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

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

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

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

6.5.4.2 Proposed pavement drainage (longitudinal drainage)

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

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

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

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

6.5.4.3 Open channels

Open channels would be used to:

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

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

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

Table 6-5 Indicative proposed cross-drainage structures

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

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

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

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

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

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

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

6.5.5 Provision for fauna movement

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

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

Plate 1 Example fauna movement structure

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

Plate 2 Example combined fauna / drainage structure

Combined fauna / drainage structures may include the following features:

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

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

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

6.5.6 Pavements

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

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

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

6.5.7 Pedestrians and cyclists

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

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

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

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

6.5.8 Local bus stop arrangements

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

6.5.9 Road furniture and fencing

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

6.5.9.1 Street lighting

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

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

6.5.9.2 Safety barriers

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

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

6.5.9.3 Line marking and signposting

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

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

6.5.9.4 Headlight screens

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

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

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

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

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

6.5.9.5 Fencing

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

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

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

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

6.5.10 Rest areas and service centres

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

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

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

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

6.5.11 Noise attenuation

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

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

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

6.5.11.1 Low noise pavements

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

Table 6-6 Indicative location of low noise pavements

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

[1] - To be refined during detailed design.

6.5.11.2 Noise barriers

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

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

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

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

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

[1] – To be refined during detailed design.

6.5.11.3 Architectural noise reduction treatments

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

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

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

[1] – To be refined during detailed design.

6.5.12 Arrangements for emergency access

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

Additional traffic management facilities included in the Proposal comprise:

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

6.5.13 Utility services

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

Table 6-9 Potential utilities and services adjustments

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

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

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

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

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