

Moorland to Herons Creek EIS

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**Working Paper No. 2**  
Concept Design



NSW Roads and Traffic Authority  
**Pacific Highway Upgrade - Moorland to Herons Creek**  
Concept Design Report

May 2005

This report takes into account the particular instructions and requirements of our client. It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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## 1. APPROACH TO DESIGN

The concept design of the Proposal as presented in this Working Paper was developed and refined as part of the design development process. The concept design is based on the road design standards that have been adopted for the Pacific Highway Upgrading Program and the accommodation of other influences including environmental issues, land management requirements, and service provision. The overall objective of the concept design is the development of a 'value for money' project from a broad community perspective.

Detailed design would be undertaken only if the proposal is approved. A requirement for the detailed design development process that follows project approval would be incorporation of the key principles established during the study and inherent in the concept design. The detailed design would also be required to meet the criteria on which the concept design was based and to take into account environmental constraints and mitigation measures identified in this EIS. Guidelines for the preparation of detailed designs are included in Section 5.16.

### 1.1 Urban design

The RTA's *Pacific Highway Urban Design Framework* contains the following urban design vision for the entire Pacific Highway upgrade project:

...a sweeping, vegetated highway, providing panoramic views to the Great Dividing Range and the rivers, forests, farmlands, and coastline of the Pacific Ocean. Sensitively designed to fit into the landscape and be unobtrusive. Characterised by simple, attractive road infrastructure.

Objectives have been developed to assist in delivery of this vision and these objectives formed the basis of the concept design development process. The objectives are further described in Section 5.14.

### 1.2 Road design criteria

The road design criteria applicable for the Proposal are those that are being used throughout the Pacific Highway Upgrading Program. These criteria were adopted for the concept design and would also apply for the detailed design should the Proposal proceed:

- four lane divided road with two 3.5 m lanes in each direction, and 2.5 m left-hand shoulders in each direction, consistent with the standard cross-sections developed for the Pacific Highway Upgrading Program, and including a 2.5 m left shoulder and a 0.5m median shoulder (widened to 1.0 m against traffic barriers) in each direction
- potential to reduce accidents to 15 crashes per 100 MVK over the upgrade length
- minimum design speed of 110 km/h on horizontal curves and 100 km/h on vertical curves
- median widths in accordance with design criteria dependant on type of barrier/fencing (i.e. normal depressed median width of 11 m, although this could vary in areas of deep cuttings, existing development, major structures and environmentally sensitive areas)
- meet or exceed B-Double vehicle requirements for travel along the highway as a through route but not generally for B-Doubles to make turns to or from the highway at intersections (exceptions are where B-Double usage of intersections already occurs or where catering for B-Doubles is considered desirable for existing or planned developments)
- intersections with the highway are to achieve Level of Service C or better for 100th Highest Hourly Volume after 30 years of operation

- desirable flood protection of 1 in 100 year Average Recurrence Interval (ARI) peak flood level and minimum flood protection from 1 in 20 year ARI peak flood level
- on-road provision for cyclists
- lighting where safety standards require such as at intersections and interchanges.
- consistent with the *Road Design Guide* (RTA 1996).

### 1.3 Other design influences

The concept design also incorporates responses to a range of other influences that are not necessarily reflected in specific design standards or criteria, including:

- input into design criteria from a multi-disciplinary approach involving DEC, DIPNR and DPI from the commencement of development of the Proposal
- continue provision of access for local landowners or managers, especially where landholdings are severed by the Proposal
- provide median openings (U-turn facilities) at regular intervals to provide for emergency service vehicles as well as for local residents with 'left in, left out' access to the highway
- provide for safe movement of terrestrial and arboreal fauna across the highway where fauna movement corridors exist
- avoid or reduce the direct impact on and thus permanent loss of, National Parks, State Forests and SEPP 14 wetlands
- reduce disruption to local and through traffic during construction
- maximise the use of the existing road reserves and existing road infrastructure where possible
- provide corridor consistent with biodiversity principles
- alignment consideration to mitigate effects on approved subdivisions, cultural heritage sites, visual impacts and property boundaries where possible
- geotechnical considerations
- soil erosion considerations.

## 2. OVERVIEW OF THE PROPOSAL

The Proposal extends 22.2 km from approximately 2.4 km south of Johns River to near Bobs Creek Road north of Herons Creek. The design features along the route are described below. The proposed highway upgrade is shown in Figures 2A to 2N in plan and longitudinal section. The following overview description refers to the four discrete sections for the Proposal as shown in the study area (Figure 1):

- Johns River section (Figures 2A to 2C)
- Lake section (Figures 2C to 2H)
- Kew section (Figures 2I to 2K)
- Herons Creek section (Figures 2L to 2N).

The proposed upgrade follows the alignment of the existing highway for a substantial portion of the total length. About 17 km or 75% involves duplicating the existing highway while 5.2 km or 25% of the length is on a bypass, as summarised below:

- Station 0.00-Station 1000 approx duplication on existing highway alignment
- Station 1000 –Station 3850 approx bypass to west of Johns River
- Station 3850 –Station 14300 approx duplication on existing highway alignment
- Station 14300 –Station 16700 approx bypass to east of Kew
- Station 16700 –Station 22200 duplication on existing highway alignment

The two proposed bypasses would be constructed on completely new alignments and would therefore not be constrained by the existing highway alignment through Johns River and Kew, some sections of which have substandard horizontal or vertical geometry.

In view of the reduction in traffic volumes, no improvement works are proposed on the existing section of highway that would be bypassed, but an allowance has been included in the cost estimates for minor works associated with converting the existing highway to suit its new function.

Specific features of the Proposal are described in the following sections. These features include provisions for fauna underpasses, drainage culverts, bridges, and modifications to the carriageway cross-section.

## 2.1 Johns River section

The Proposal would link with the proposed highway duplication between Coopernook and Moorland at the southern boundary of the property known as Camp Obadiah. At this point, the Coopernook to Moorland EIS (Connell Wagner 2000) shows the existing highway becoming the northbound carriageway, with the new southbound carriageway on the east side. North of the tie-in, the northbound carriageway would transition across to the western side of the existing highway while the existing highway would become the southbound carriageway.

The existing highway would then be duplicated on the western side for a distance of about 1 km until the point where the proposed western bypass of Johns River diverges from the existing highway.

The Johns River bypass would be about 2.5 km long. It would pass about 250 m west of the Johns River township traversing an approved but largely undeveloped rural residential subdivision north of Stewarts River Road.

A grade-separated half-diamond interchange is proposed at Stewarts River Road. Northbound off- and on-ramps would connect to a roundabout on Stewarts River Road that would pass above the bypass on a bridge. Southbound traffic would be catered for by southbound ramps formed by the existing highway at each end of the bypass. The existing highway would revert to a two-way local road between the southbound off-ramp and on-ramp. Further details of access to and from Johns River are provided in Section 5.6.1.

The bypass would merge with the existing highway near Bulleys Road and Wharf Road, just to the south of the Stewarts River. A median opening is proposed in the vicinity of Bulleys Road but there would be no direct connection between the upgraded highway and Bulleys Road. Instead, Bulleys Road would be diverted to the south and would be connected to the elevated roundabout on Stewarts River Road, eliminating the need for an at-grade intersection at Bulleys Road.

A second bridge would be constructed over the Stewarts River to the west of and parallel to the existing bridge, with a similar length and span configuration.

## 2.2 Lake section

Between the Stewarts River bridge and the Camden Haven River bridge, the highway would be upgraded through construction of a new carriageway which would generally be located on the western side of the existing highway within the existing road reserve.

Immediately north of the Stewarts River, the available width for the Proposal is restricted by a high rock cutting on the western side and the Main Northern Railway line on the eastern side. The median width would transition from 11 m to 4.5 m over the length of the Stewarts River bridge and the narrow median would extend for about 1.3 km to Station 5300. Split-level carriageways with a median barrier and median retaining wall up to 3 m high are also proposed throughout this restricted section. Other structural elements are required between the southbound carriageway and the railway line within this zone to protect the railway as follows:

- a second retaining wall up to 7 m high over a short length of about 100 m between Station 4450 and Station 4550
- an engineered 1H:1V slope up to 4 m high over a length of about 250 m between Station 4850 and 5100.

In the vicinity of Middle Brother Road, the median would widen again to 11 m with the new northbound carriageway on the western side of the existing highway alignment through to Passionfruit Gully. An at-grade T-intersection with median opening is proposed at Algona Road. The median is widened to accommodate turning semi-trailers at this intersection.

In order to avoid any requirement for land acquisition from Middle Brother National Park and to reduce the impact on vegetation, a narrow median (3 m wide) containing a wire rope barrier would be adopted for a 1 km section adjacent to the boundary of the National Park. A retaining wall up to 6 m high is also proposed between the southbound carriageway and the railway over a 150 m long section (Station 7400 to Station 7550) within this constrained zone.

North of Haydons Road, the median would widen again to 11 m and the new northbound carriageway would be located on the west side of the existing highway through to the Camden Haven River.

An at-grade T-intersection with median opening is proposed at Watson Taylor Road.

The existing bridge at Stony Creek would be replaced by a new bridge in a similar position, with a second new bridge constructed on the western side for the northbound carriageway.

Charles Yard Road at present runs parallel to the existing highway for a distance of about 800 m before connecting at Station 11000. It is proposed to relocate the intersection to Station 10200 where sight distance would be improved.

The road reserve containing the redundant section of Charles Yard Road would be utilised as a location for a new northbound rest area. The proposed rest area location is south of Ross Glen Road and within the remaining road reservation between Station 10500 and Station 11000. It would cater for both heavy vehicles and light vehicles. The existing southbound rest area on the east side of the existing highway just to the north would not be affected by the highway upgrade and would be retained.

Ross Glen Road would be relocated to the south where improved sight distance is available and an at-grade T-intersection with median opening is proposed. The intersection incorporates a widened median to accommodate turning semi-trailers. The intersection would also provide access to the property to the east on which the Camden Haven airfield is located.

A new bridge would be constructed on the western side of the existing bridge over the Main Northern Railway line, about 500 m south of the Camden Haven River.

At the Camden Haven River, a second bridge would be constructed to the western (upstream) side of and parallel to the existing structure. The new bridge would have length and span arrangements similar to the existing bridge. The new bridge would achieve the minimum clearance requirements specified by the NSW Waterways Authority (D R Meakin-Jones [Waterways Authority] 2001, pers. comm., 20 January), i.e. a clearance of at least 4.5 m between Mean High Water and the soffit of the new bridge.

The NSW Waterways Authority and DPI both advised that the two bridge piers from the previous bridge that remain in the Camden Haven River downstream of the existing bridge should be removed. Removal of these piers is proposed as part of the Proposal (see Section 5.15).

## 2.3 Kew section

North of the Camden Haven River, the new carriageway would remain on the western side of the existing carriageway for a distance of about 500 m before crossing to the eastern side.

About 1.5 km north of the Camden Haven River (1.5 km south of Kew) the proposed bypass of Kew would diverge eastwards from the existing highway. The Kew bypass would be about 2.5 km long and would pass about 250 m east of the Kew township, under Ocean Drive.

A grade-separated half-diamond interchange is proposed at Ocean Drive. Southbound off- and on-ramps would connect to a roundabout on Ocean Drive that would pass above the bypass on a bridge. Northbound traffic to and from the bypass would be catered for by use of the existing highway at each end of the bypass. The existing highway would revert to a two-way local road between the northbound off-ramp and on-ramp. Further details about access to and from Kew are provided in Section 5.6.

At the southern diverge area, Sunnyvale Road would be realigned away from the northbound off-ramp diverge and would connect to the existing highway at a roundabout 300 m further north. Bethesda Road would connect to the same roundabout. The proposed arrangement is shown in Figure 2J.

At the northern end of the bypass, Herons Creek Road would not connect to the upgraded highway but would be diverted south along a frontage road on the western side of the highway that would also connect to Weeroona Place. The frontage road would connect to the existing highway at a T-intersection at the start of the northbound on-ramp, about 500 m north of Kew (see Figure 2K).

The Kew bypass would be in cut for about two-thirds of the length in order to reduce the visual and noise impacts on Kew. The maximum depth of the major cutting near Bethesda Road would be about 17 m while in the long cutting under Ocean Drive and to the north of Kew the maximum depth would be about 13 m. Split-level carriageways have been proposed in this cutting to reduce earthworks. The southbound carriageway would be about 2 m higher than the northbound carriageway for most of the length of this cutting, with the level difference taken up by a one-way slope on the 11 m wide median.

The Kew bypass would rejoin the existing highway about 800 m north of Kew and the new carriageway would be located on the western side of the existing highway. The new carriageway would remain on the western side for the next 1 km through to the Kew/Kendall Sewage Treatment Plant (STP).

## 2.4 Herons Creek section

From the STP, the new carriageway would transition across to the eastern side of the existing carriageway and remain there through to just beyond the Boral Timber mill at Herons Creek.

An at-grade T-intersection allowing all vehicle movements including U-turns is proposed at the entrance to the Eggbert Egg property on the western side of the highway about 1 km north of the STP. The intersection incorporates a widened median to accommodate turning semi-trailers.

At-grade T-intersections are also proposed at Cluleys Road on the eastern side and Herons Creek Road on the western side. These two T-junctions would be separated by about 200 m. A wide median suitable for use by B-Doubles is proposed at the Herons Creek Road intersection to cater for B-Double traffic to and from the Boral Timber mill. The Cluleys Road intersection would accommodate turning semi-trailers.

There would be no direct impact on the Boral Timber mill landholding. North of the mill, the northbound carriageway would move to the western side of the existing highway and the new bridges across the Herons Creek floodway and Herons Creek would both be located on the western side.

The existing bridge at Herons Creek would be replaced by a new bridge in a similar position, with a second new bridge constructed on the western side for the northbound carriageway, parallel to the southbound bridge.

At the northern end the proposed upgrade connects to the existing dual carriageway at Bobs Creek Road. The existing intersection would be retained but deceleration lanes would be added to both sides of southbound carriageway approaches for improved safety.

## 3. DESIGN CRITERIA

### 3.1 Introduction

The primary criteria for the upgrading of the Pacific Highway from Moorland to Herons Creek are defined in the following documents:

- the Project Brief
- the RTA *Road Design Guide* 1996 (RDG) including various updates.

Key design criteria are summarised below.

### 3.2 Design Speed

The design speeds are specified in the Brief as follows:

**(a) Through Road in Rural/Semi-urban Situations**

- (i) Minimum 110 km/h Horizontal Alignment.
- (ii) Minimum 100 km/h Vertical Alignment.

**(b) Local/Service Roads in Urban Situations**

- (i) Minimum 60 km/h Horizontal Alignment.
- (ii) Minimum 60 km/h Vertical Alignment, desirable 80 km/h (where easy to achieve).

### 3.3 Design Vehicle

The design vehicle applicable for the design of the road and facilities varies according to the situation. This section of the Pacific Highway is now designated as a B-Double Route but the intersecting roadways are not. An exception has been made at the Herons Creek Road (north) intersection where B-Doubles are likely to require access to and from the Herons Creek timber mill:

Access to properties design single unit truck (12.5 m)

Note – design semi-trailer (19.0 m) has been adopted where semi-trailers are expected to use access to properties on a regular basis, such as farms or a right of way serving several properties.

Herons Creek Road (north) intersection B-Double (25 m)

Other Rural road intersections and interchanges design semi-trailer (19.0 m)

Note – Where right turns onto the highway are permitted the median should be widened so that the design vehicle making a turning right onto the highway can wait if necessary in the median without encroaching on the through lanes of the highway. An exception may be made at minor intersections with median openings where semi-trailers would not be expected to use the intersection on a regular basis. In these cases the standard median width should be retained.

Median cross-overs and U-turn facilities design semi-trailer (19.0 m)

Note: - Shoulder widening may be required at U-turn facilities, depending on the median width. Refer Figure 4.9.2 of RDG for details.

### 3.4 Cross-Section

The proposed typical cross-section of the upgrade is for divided carriageways with two lanes in each direction as shown in Figures 3A to 3D.

Traffic Lanes (in each direction) (pavement widening on curves not required)	2 x 3.5 m lanes
Normal Depressed Median Width for 110 km/h (reference RDG Figure 3.5.1, Feb 2000, Issue 1.0)	11.0 m
Minimum Median Width (with Type F Barrier) (reference RDG Table 6.8, with 1.0 m median shoulder as below)	2.6 m
Minimum Median Width (with Wire Rope Barrier) (reference RDG Table 6.8)	3.2 m
Paved Left Shoulder (without guardfence)	2.5 m
Paved Left Shoulder (with guardfence)	3.0 m
Paved Median Shoulder	0.5 m
Paved Median Shoulder against Type F Barrier	1.0 m
Paved Median Shoulder against kerb in unlit areas (median shoulder not required in lit urban areas where raised median provided)	0.5 m

Structures	Left shoulder	2.5 m
	Traffic Lanes (in each direction)	2 x 3.5 m lanes
	Median shoulder	1.0 m
	Total structure width between kerbs in each direction	10.5 m

(Note that the above requirements apply to new and replacements bridges only. Where existing structures to be retained have a width of less than 10.5 m, RTA has advised that generally the existing bridge should not be widened. Most existing bridges are about 9.2 m wide between kerbs but widening would be difficult and expensive.)

While a median width of 11.0 m has been adopted generally, the actual width may vary according to the circumstance:

- A reduced median width with a median barrier has been considered where there are significant advantages in reducing the road footprint, for example, in deep cuttings, on major structures (where new structures required on both carriageways), in environmentally sensitive areas, and adjacent to existing development.
- Wider medians have been considered where necessary to accommodate turning vehicles at intersections or where there are environmental considerations

The effective shoulder width as described above is 2.5 m paved plus 1.75 m verge in areas of low fill, or 3.0 m against a guardfence in higher fill areas. In areas of cut the shoulder width is 2.5 m plus a 1.0 m table drain (Type SO). This effectively provides a width of at least 3 m in most cases for vehicles to pull off the travelling lanes except on structures where the 2.5 m shoulder is provided.

Based on the results of geotechnical testing, typical fill slopes adopted are as follows:

- 4H:1V for fills < 3 m
- 2H:1V for fills > 3 m

In cuttings the slopes vary significantly depending on the existing material. Adopted slopes vary from 1H:1V in some rock cuttings to 3H:1V in some soil excavations. Further details are provided in Section 5.4.1 and in Working Paper No. 8 – Geotechnical Assessment.

### 3.5 Road Geometry

In rural areas the design speed is 110 km/h horizontally and 100 km/h vertically. The following key geometric design parameters are adopted for the design:

Absolute minimum radius of Horizontal Curves	600 m
Normal crossfall	3%
Superelevation for radii between 600 m and 749 m	5%
Superelevation for radii between 750 m and 949 m	4%
Superelevation for radii between 950 m and 3000 m	3%
For radii greater than 3000 m	super not required
Superelevation rollovers	As per RTA RDG
Plan Transition Spirals for radii 600 m or greater	not required
Horizontal Stopping Sight Distance	210 m

Note that, where significant cost savings would result, consideration may be given to adopting a Horizontal SSD of 175 m (corresponding to 100 km/h with 2.5s reaction time) provided that a manoeuvring area at least 3.0 m is available on the shoulder/verge adjacent to the lane with restricted horizontal sight distance.

Safe Intersection Sight distance (level grade)	295 m
Desirable Maximum Gradient	4.5%
K Value for Crest Curves with no intersections (Stopping Sight Distance)	66
Note: based on 175 m SSD 1.15 m to 0.2 m for 100 km/h and 2.5s reaction time	
K Value for Crest Curves containing a left-in/left-out intersection	98
Note: based on 150 m SSD 1.15 m to 0.0 m for 100 km/h and 1.5s reaction time (ASD)	
K Value for Crest Curves containing an intersection with median opening	133
Note: based on 175 m SSD 1.15 m to 0.0 m for 100 km/h and 2.5s reaction time (ASD)	
Desirable Minimum K Value for Sag Curves	66 (use >66 where possible)
Absolute Minimum K Value for Sag Curves	33

The centre of each carriageway is the horizontal and vertical control line, with superelevation developed by rotating about the centre of each carriageway.

### 3.6 Longitudinal Grades

The highway passes through rolling terrain and the desirable maximum grade for a 110 km/h design speed is 4%-6%.

Minimum grades are related to drainage requirements. A minimum grade of 0.5% should be applied in the following areas:

- in areas of cut where flat grades would create difficulties in grading the pavement subgrade and in grading surface water along the toe drain (flatter grades acceptable on crest curves)
- where superelevation rollovers will be required (flat transverse crossfall combined with flat longitudinal grading can result in excessive surface water flow depths).

Elsewhere, flatter grades have been considered where appropriate.

### 3.7 Intersection Capacity

The Brief calls for intersections to be designed to provide for LoS C or better for the 100<sup>th</sup> highest hourly volume (HHV) for 30 years after opening.

The 100<sup>th</sup> HHV for the highway and local roads at 30 years after been estimated from traffic counts and forecasts. Refer to Working Paper No. 1 for a full description of the intersection capacity analysis undertaken.

### 3.8 Pavements

Preliminary pavement designs should be prepared in accordance with the procedures and guidance described in the following:

- Austroads – Pavement Design, A Guide to Structural design of Road Pavements, 2004
- RTA- Concrete Pavement Manual, Design and Construction, 1998
- RTA Form 76 – Supplement to Austroads
- RTA – Technical Directions

The Design Life specified by RTA in the Project Brief are:

- carriageway and ramp pavements - 40 years
- Local Road pavements - 20 years

The preliminary pavement design including pavement thickness should also consider whole of life costs for pavement options such as rigid and flexible pavements. The whole of life costs should include road user delay costs during future routine maintenance or rehabilitation activities for each pavement option.

### 3.9 Structures

The Project Brief requires the structures to be designed for SM1600 loading in accordance with the Austroads and RTA design requirements. On 5 August 2003 the General Manager, Network Development approved a policy document *Pacific Highway Upgrading Program – Application of SM1600 to Projects* which outlines how SM1600 is to be applied on Pacific Highway projects in the development and implementation phases. The Policy identified three types on bridges on the Pacific Highway:

- Group a) highway bridges carrying highway traffic
- Group b) overpass structures at the interchanges
- Group c) bridges carrying local traffic over the highway

The Policy proposed that bridges in:

- Groups a) and b) should be designed to SM1600
- Group c) should be considered on a case-by-case basis.

The main criteria in the Policy for Group c) is the likelihood of the road being regularly used by heavy vehicles in the long term (say 40 to 60 years) future. If it involves regular use (e.g. more than 5 heavy vehicles per day 4 days per week) is assessed as being probable, then SM1600 should be adopted. Both Group c) bridges in the Proposal (Stewarts River Road overpass and Ocean Drive overpass) would be expected to have regular usage by heavy vehicles and therefore all new bridges should be designed for the SM1600 loading.

As stated in the code, and in the Brief, major structures are to be designed for a 100 year life.

New and replacement bridges that carry the Pacific Highway are required to have a minimum width of 10.5 m between the base of kerbs on each carriageway. As noted in 3.4 above, where existing structures to be retained have a width of less than 10.5 m, RTA has advised that generally the existing bridge should not be widened. Width of bridges carrying local roads should be in accordance with Table 3.11-2 of the RDG.

Local bridges across the Pacific Highway are to have a minimum clearance between the wearing surface and the soffit of the structure of 5.3 m. For pedestrian bridges above the highway the required clearance is 5.5 m.

Under bridges for off-highway traffic may have a minimum clearance between wearing surface and the soffit of 4.6 m. Where existing clearances are less than 4.6 m the existing clearance will generally be accepted, but should not be reduced.

Where cyclists may use bridges a barrier height of not less than 1200 mm is required.

Barrier screens are required on all overbridges that are accessible to pedestrians and cyclists

Where new bridges are required for adjacent carriageway, consideration shall be given to reducing the median width and combining the off-side guardrails.

### 3.10 Drainage

The proposed dual carriageway is required to have at least one carriageway trafficable for the 1 in 20 year Average Recurrence Interval (ARI) flood event south of Kew and for the 1 in 100 year ARI flood event north of Kew.

In addition the proposed upgrade should not cause any unacceptable increase in flood levels or velocities. Where unacceptable flood levels or velocities occur as a result of deficiencies in the existing highway design, it is anticipated that it may be necessary to consider improvements in existing drainage provisions.

For road surface drainage, allowance should be made for a system which would keep the travel lanes free of surface ponding in a 10 year ARI storm event. This drainage includes gutter flows, gully pits, median drainage and longitudinal pipe drainage etc. Allowance should be made for pits with grates only to be up to 80% blocked and for pits with grates and side entry inlets to be up to 50% blocked. All grates should be safe for cyclists.

To reduce the risk of aquaplaning the length of drainage flow paths on the road pavement must be restricted. The length of flow paths is most likely to be critical on superelevation rollovers on flat grades. The RTA's latest guideline is that in a rainfall intensity of 50 mm per hour no concentrated flows wider than 1 metre and deeper than 5 mm will be allowed on the through lanes. At intersections, and on the auxiliary lanes provided on the approach to an intersection, the maximum depth of water is not to exceed 7.5 mm during this storm. It is anticipated that these requirements will be included in the new Section 7 of the Road Design Guide when released

### 3.11 Access Provisions and intersections

At intersections where grade separation is not warranted and provision is made for right turns from the highway, sheltered right-turn deceleration lanes are to be provided in the highway median.

A 'left-in left-out' layout is the preferred arrangement for property access, with turning movements provided via the median cross-overs located at regular intervals along the highway. However, direct right turn access (or location of a median cross-over at the access point) should be considered where one or more of the following circumstances occur:

- traffic volumes to a property or business are relatively high
- several properties share the same access point
- the nearest median cross-over would otherwise be 3 km or more away
- articulated vehicles will use the access on a daily basis

Capacity requirements for intersections are described in Section 3.7.

For further details refer to Working Paper No. 1.

### 3.12 Layby Areas and Truck Stopping Bays

#### 3.12.1 Regular Laybys

Linemarking to designate formal layby areas is required on each side of the road at spacings of about 1 km and should be located where good sight distance is available. A layby for each direction will normally be incorporated with the widening required in any case at each median cross-over and then at intermediate points to suit the 1 km spacing required.

Layby areas should be a minimum of 4.5 m wide (measured from the edge line) and 20 m long (refer RDG Figure 3.4-1). A 0.5 m sealed shoulder is required where a guardfence is provided adjacent to the layby.

### 3.12.2 Truck Stopping Areas

In June 2003 RTA adopted a proposal to provide emergency stopping bays designed to suit B-Doubles (one vehicle only needed) on new works at 5 km spacing. The location of these stopping bays should consider:

- noise impacts on nearby residences
- location of other stopping opportunities for trucks (i.e. a nearby rest area or service centre removes the requirement for the bay)
- possibility of combining with another facility (e.g. telephone bay, widening at rural driveway)
- location of bays on adjacent sections of the highway
- the usual design criteria (sight distance, relationship to intersections etc)
- preference for the bays to be located on a crest

It has been assumed that allowance should be made for bays in both directions, even where one carriageway is basically retained, and that the truck stopping bay would replace every 5th regular layby.

The stopping area layout developed by RTA to allow use by a B-Double is shown in Figure 4 below.

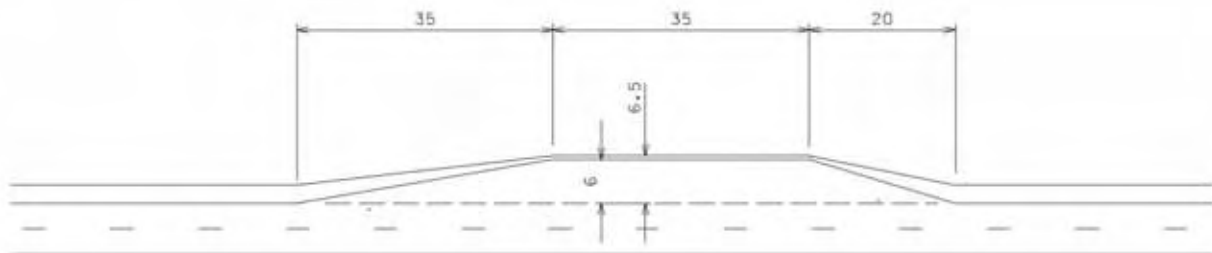


Figure 4 Truck stopping area layout

### 3.12.3 Other Layby Requirements

Layby areas suitable for use during bridge maintenance should also be provided adjacent to bridges where alternative access from local roads is not available.

## 3.13 Maintenance Access

Maintenance access shall be provided to all bridge structures, underpasses, scour protection and other drainage works including chemical traps and sedimentation basins.

## 3.14 Median Cross-overs and U-Turn Facilities

Median cross-overs which allow emergency vehicles to make a U-turn are required at spacings not greater than 5 km. RTA's other requirements are that median cross-overs should not be located within 3 km of an interchange and should be capable of handling B-Double movements. Minimum requirements are shown in Fig 4.9.1. of the RDG.

Desirable locations are on sags and straights where sight distance is the greatest, and preferably not on crests or horizontal curves. A driver should be able to recognise the cross-over from a distance of 300 m in either direction.

Median cross-overs should be combined with a property access on one side or T-intersections where possible. Typical details of a combined median cross-over/property access are shown in Fig 4.9.2 of the RDG.

Whether or not the cross-over is combined with local access, the widening of the outside shoulders to allow U-turns can also function as a layby area for both directions.

### 3.15 Rest Areas

The *Pacific Highway Upgrading Program - Strategic Assessment* assessed existing rest areas and identified where new rest areas should be provided. For the section of highway within the study area this document proposed a new northbound heavy vehicle rest area of approximately 0.7 ha in the vicinity of the Camden Haven River, and retention of an existing southbound heavy vehicle rest area located just south of the Camden Haven River.

Subsequently the report *Pacific Highway F3 (Freeway) Truck Rest Area Strategy* established that the new northbound rest area in the vicinity of the Camden Haven River should provide facilities for both heavy vehicle and light vehicle users. The report also included a requirement for parking areas for light and heavy vehicles to be separated, but the other facilities can be shared. Facilities to be provided included:

- parking for ten light vehicles
- parking for eight to ten B-Doubles
- deceleration lanes to RDG requirements
- acceleration lanes only in circumstances where they are necessary (i.e. poor sight distance to exit)
- toilets to the new 'Pacific Highway' design
- seating and shelter (usually 3 sets)
- shade for vehicles (using current trees if available).

In addition, existing rest areas along the existing highway in the study area would be retained where they are not affected by the Proposal and where safe access to and from the upgraded highway would be available.

Based on the above guidelines the Proposal incorporates the following measures in respect of rest areas:

- retention of:
  - existing southbound heavy vehicle rest area 0.75 km south of the Rossglen turnoff, Station 11200 to Station 11500. This is a developed off-highway rest area with access ramps to and from the existing highway. Access to the rest area would continue to be available following the highway upgrade. This rest area is a designated rest area in the Strategic Assessment and a landscape upgrade of the rest area is proposed as part of the highway upgrade. Refer to Working Paper No. 9 for further details
- closure of:
  - existing heavy vehicle rest area 100 m north of Rossglen turnoff, Station 12100. The new northbound carriageway passes through the middle of this rest area and retention would not be possible. It would be replaced by the new northbound rest area proposed at Station 10700 to 11000 as described below. The existing toilets would be relocated to the new northbound rest area.

- an existing southbound heavy vehicle rest area about 0.3 km south of Haydons Road at Station 7600. This rest area comprises a widened shoulder over a length of about 100m. According to the Strategic Assessment this rest area should be retained, however this would not be possible due to the width restrictions imposed by the Middle Brother National Park and the adjacent railway.
- construction of:
  - new northbound heavy vehicle rest area located to the south of Ross Glen Road, Station 10700 to Station 11000. The proposed location of the new northbound rest area is about 1.2 km south of the bridge over the railway line. The rest area would be accommodated within the existing road reserve and would be facilitated by relocating the Charles Yard Road connection to the highway by about 800 m further to the south. Layouts for the proposed rest area would be developed during the detailed design stage and would incorporate the parking and other facilities listed above. The area available is in excess of the 0.7 ha suggested in the Strategic Assessment. Adequate sight distance is available at the exit from the rest area and an acceleration lane would not be required.

The detailed design of rest areas would follow the *Road Environment Safety Update 23 Rest Area Best Practice Design Guide*.

### 3.16 Lighting

The proposed criteria for the provision of lighting are as follows:

- All grade-separated intersections are to be lit to the Standard recommended in Part 12 - Roadway Lighting Guide - of the AUSTRROADS *Guide to Engineering Practice* and the Australian Standard for Road Lighting AS 1158. The needs at each site should be assessed individually).
- All intersections using raised islands are to be fully lit to the Australian Standard.
- All intersections that carry relatively high side road volumes (>1000 vpd) are to be fully lit to the Australian Standard.
- There are 'special cases' that may require other intersections to be lit to the full intersection lighting standard:
  - where the number of heavy vehicles making right turns to and from the side road usually exceeds 50 movements in total during night-time hours
  - where there is a relatively high proportion of aged drivers in the local population and there are movements over 300 vpd.
- Intersections that carry moderately high side road volumes (between 300 and 1000 vpd) should be lit to 'flag' the intersection in accordance with Section 3.5.2(b) of AS 1158.1.1:1997. This would not achieve the lighting levels proposed at interchanges but is primarily aimed at identifying in advance the existence of the intersections for motorists travelling at night. Due to the width of the road, two or three street light fittings may be required at each intersection.

Apart from the interchanges and intersections as noted above, lighting of the upgrade is not required.

The most energy efficient lighting technology would be used wherever technically and economically feasible.

### 3.17 Pedestrians and Cyclists

The designs of land acquisition requirements, intersections, interchanges, bridges and underpasses are required to incorporate all works necessary to allow pedestrians to safely use the local road network.

Specific requirements applicable to pedestrians include:

- barrier screens are required on all overbridges that are accessible to pedestrians and cyclists
- safe egress is required for pedestrians from any tunnels and underpasses in the event of an incident in the tunnel or underpass.

For cyclists, the Brief requires on-road provision for cyclists on the highway and provision for safe movement of cyclists at intersections. No separate off-road provision for pedestrians or cyclists would be provided. Long distance cyclists would be able to use the sealed 2.5 m wide left shoulder that would generally be provided on both carriageways. This sealed shoulder width is consistent with RTA guidelines for road shoulder usage by cyclists where the 85<sup>th</sup> percentile vehicle speed is 100 km/h (refer Section 3.3.8 of the RTA *Road Design Guide*). The shoulder width would be increased by 0.5 m to 3.0 m where guard fencing or a barrier is located at the edge of shoulder. The only exception would be the left shoulder of new bridges, where the shoulder would not be widened from 2.5 m. The shoulder would also be available to vehicles stopping because of a breakdown or other reason.

Where bridges would be used by cyclists, a 1.2 m minimum height railing is required. Provisions as necessary are also required to allow cyclists to continue to use the local road network. Hastings Council has recently upgraded Ocean Drive by providing 2 x 3.5 m lanes plus a 1.5 m wide sealed shoulder/cycleway on each side of the road. It has been agreed with Hastings Council that any modifications to Ocean Drive should incorporate the widened shoulder.

For local roads crossing over or under the highway provision should be made for the safe passage of pedestrians and cyclists. For the Ocean Drive overbridge, Hastings Council has requested that the widened shoulder should be continued across the bridge above the bypass and that a separate footway should be provided on the south side of the bridge.

Pedestrian and cyclists would also use the Stewarts River Road overpass and provision should be made for a separate footway/cycleway.

Barrier screens should be provided at the edges of all overbridges that are accessible to pedestrians and cyclists.

### 3.18 Linemarking and Signs

Linemarking and sign proposals are required and should be in accordance with the AS 1742, the RTA Model Drawings and the Austroads Guide to Traffic Engineering Practice, Part 8: Traffic Control Devices.

Signage should include provision of tourist signposting for by-passed towns such as Johns River and Kew if appropriate. These requirements are defined in RTA's Traffic Engineering Manual, Part 12, Tourist Signposting.

### 3.19 Emergency Telephones

RTA policy for emergency telephones on the Pacific Highway is not finalised, however allowance should be made for the provision of emergency telephones at 3 km to 4.5 km intervals. Where possible the emergency telephones should be located at layby areas or truck stopping areas.

## 4. EXISTING HIGHWAY

### 4.1 Existing Road

The existing highway is single carriageway roadway, generally with one lane in each direction. The current speed limit on this section of the highway is 100 km/h except at the townships of Johns River (80 km/h speed limit) and Kew (60 km/h speed limit).

There is only one major intersection between Moorland and Herons Creek – the crossroads in Kew where MR538 (Kendall Road and Ocean Drive) intersects with the highway. Previously the side roads at this intersection were controlled by stop signs. The northbound and southbound Pacific Highway approaches each consisted of a single through lane, a right turn storage bay and a separate left turn lane. Traffic control signals have been installed at this location and were commissioned on 30 November 2001. With the commissioning of the traffic control signals the configuration of the intersection was altered. The northbound and southbound highway approaches each now provide a single through-only lane, a joint through and left turn lane and a right turn storage bay.

All other minor intersections are simple priority controlled junctions. Locations where turning lanes are provided are summarised in Table 1.

**Table 1 Existing intersections where turning lanes are provided**

Location	Form of Intersection	Northbound Approach	Southbound Approach
Camp Obadiah	T-Intersection on RHS	Right turn lane	-
Stewarts River Road	T-Intersection on LHS	Left turn lane	Right turn lane
Bulleys Road (south)/ Wharf Road	Cross junction	Right turn lane Left turn lane	
Middle Brother Road	T-Intersection on LHS	Left turn lane	-
Algona Road	T-Intersection on LHS	-	Right turn lane
Ross Glen Road	T-Intersection on LHS		Right turn lane
Sunnyvale Road (north)	T-Intersection on LHS	-	Right turn lane
Tathra Road/Visitors Information Centre	Cross junction	Right turn lane	Right turn lane Left turn lane
Kew – Kendall Road/Ocean Drive	Cross junction	Right turn lane Left turn lane	Right turn lane Left turn lane
Herons Creek Road (north)	T-Intersection on LHS	Left turn lane	Right turn lane
Bobs Creek Road	T-Intersection on RHS		-

The existing highway has been widened at a number of locations to provide an overtaking lane for one direction. Table 2 details the overtaking lanes between Moorland and Herons Creek. Overtaking lanes are present for three sections of the northbound carriageway and total 4.9 km in length (including tapers). They are present for four sections of the southbound carriageway and total 5.6 km in length (including tapers).

**Table 2 Existing overtaking lanes (distances from Taree in km)**

Overtaking Lane No.	Roadloc Link	Start Taper	End Taper	Start Taper	End Taper	Length (km) (excluding taper)	Length (km) (including taper)
<b>Northbound direction</b>							
NB 1	2130	40.5	40.5	41.9	42.0	1.35	1.5
NB 2	2130	45.95	46.06	47.7	47.8	1.64	1.85
NB 3	2150	53.56	53.69	55.18	55.3	1.49	1.74
Subtotal – northbound						4.5	4.9
<b>Southbound direction</b>							
SB 1	2120	37.0	37.1	38.2	38.3	1.05	1.3
SB 2	2130	43	43.26	44.6	44.7	1.34	1.7
SB 3	2145	50.87	51.63	51.92	52.01	0.89	1.14
SB 4	2150	56.29	56.48	57.52	57.64	1.04	1.35
Subtotal southbound						4.3	5.6
<b>Total both directions</b>						<b>8.8</b>	<b>10.5</b>

In total, northbound overtaking lanes are available for about 22% of the total length and southbound overtaking lanes are available for about 25% of the total length. The northbound and southbound overtaking lanes are generally at separate locations, so just under 50% of the existing highway is three lanes wide.

Opportunities for overtaking are very limited at other locations along the highway. Where there is no overtaking lane, barrier lines restrict overtaking opportunities except over the following lengths where normal separation lines exist:

- 1600 m north from the bridge over the Camden Haven River
- 230 m near Herons Creek Road (south)
- 500 m near Eggbert egg farm property.

The horizontal and vertical geometry of the existing highway has been reviewed in comparison to the 110 km/h design standard (100 km/h vertical geometry) required for the upgraded highway.

In terms of the horizontal geometry, curves are generally at or above the minimum 600 metre radius (R600) required for 110 km/h. The only existing curves with radii below R600 are located as follows:

- 600 m north of Algonia Road (R550 right hand bend)
- at Watson Taylor Road (R500 left hand bend)
- 150 m north of Kendall Road/Ocean Drive intersection (R250 left hand bend).

The R250 curve is located within the urban area of Kew where an existing speed limit of 60 km/h applies.

In terms of the vertical geometry, there are a significant number of crest vertical curves which are below minimum requirements for the 100 km/h design speed specified for vertical geometry. Sections with sub-standard vertical curvature are located as follows:

- near the Camp Obadiah entry (90-100 km/h crest)
- about 1 km south of Stewarts River Road (90-100 km/h crest)
- about 350 m south of Stewarts River Road (90-100 km/h crest)
- about 100 m south of Stewarts River Road (70-80 km/h sag)
- about 400 m to 1200 m north of Stewarts River (70-100 crest/sag/crest)
- about 150 m south of Algona road (80-90 km/h crest)
- about 700 m to 250 m south of Haydons Road (60-80 km/h crests)
- about 200 m south of Charles Yard Road (90-100 km/h crest)
- adjacent to Bethesda Nursery (60-70 km/h crest)
- about 100 m north of Bethesda Nursery (60-70 km/h sag)
- about 200 m south of Sewage Treatment Plant (STP) access (90-100 km/h crest)
- from STP to 1 km north of STP (90-100 km/h crest x 3)
- about 300 m north of Walkers Creek (90-100 km/h crest)
- adjacent to Herons Creek Timber Mill (90-100 km/h crest).

Where the horizontal and vertical geometry is adequate and the pavement is in good condition efforts have been made in the design of the upgrade to allow the pavement of the existing highway to be retained as one carriageway of the upgraded highway.

## 4.2 Existing Bridges

There are six existing bridges within the section of highway under consideration, as follows:

- Stewarts River Bridge
- Stony Creek Bridge
- Rossglen Rail Bridge
- Camden Haven River Bridge
- Herons Creek Flood Channel Bridge
- Herons Creek Bridge.

Information was obtained from available bridge drawings, in particular the span lengths, deck widths and foundation information. Visual inspections of the six bridges were undertaken in December 2000 and a preliminary assessment has been made to identify existing deficiencies requiring repair or maintenance and also to identify existing structures which are nearing the end of their useful life and for which allowances should be made for replacement.

The RTA Brief requires that new structures in the duplicated highway are to be designed to carry SM1600 loading but it is not a requirement for existing structures to be able to carry the SM1600 load. This reflects the purpose of the revised Bridge Code which is to ensure that new bridges are designed to cater for future vehicles that are reasonably expected to be using the Australian road network in about 40 years time. Current vehicle loading on Australian roads is typically covered by T44 loading. Hence it is reasonable that there should be no requirement to strengthen existing structures to carry loading above T44 at this time.

The ability of existing structures to carry abnormal vehicles or heavy load platforms is a separate issue as these vehicles travel under escort and their location within the carriageway can be controlled and possibly directed onto the opposite carriageway when only one new bridge would be provided.

Similarly, road authorities generally do not replace all bridge barriers with each code revision. However, comments are provided on the existing barriers of each bridge to assist in planning future barrier upgrades.

#### 4.2.1 Stewarts River Bridge

This 289 m long bridge has six internal spans of 38 m and a 30.5 m span at each end. It is on a 2000 m horizontal radius and a 1.3% longitudinal fall. The deck provides 9.2 m between kerbs, with service ducts in the kerbs and an asphaltic concrete wearing surface. The scuppers drain directly to the ground below or into the waterway with no provision for containment or treatment. The vehicle barriers have modified New Jersey profile lower section with steel post and double box beam upper section. The deck is continuous with a large finger expansion joint at the northern end and a fixed joint at the southern abutment. The superstructure comprises a single box post tensioned segmental construction with 110 mm wide concreted joints between the segments. The bridge design was completed in 1981 and construction completed in 1984. Design is to the NAASRA 1976 Bridge Design Code for T44 vehicle loading and probably the standard abnormal vehicle loading.

The RC piers are founded on 0.9 m diameter bored piles that extend to between 13 m and 20 m below Mean Sea Level (MSL). The piles found on rock. Each blade pier has a pair of pot bearings that appear to have been designed for removal for maintenance purposes. Most of the area below the bridge is pasture with the waterway confined to the second span from the northern end. The waterway has a tidal range of less than 0.5 m and appears to be shallow. Typical ground level in the floodplain below the bridge is 2 m above MSL. The southern abutment has access into a service/maintenance chamber within the abutment. Slope protection at the southern abutment is by grout filled fabric mattress.

Both abutment joints require repairs and it could be appropriate to repaint the barrier. It would also be possible to modify the deck drainage locally above the permanent waterway so that the runoff could be treated prior to discharge into the water. The pier bearings appear to be rusting and should be carefully inspected and replaced or repaired as appropriate. Provided that a more detailed assessment shows that repairs can be deferred until the construction of the new highway, it is likely that the highway traffic can be diverted onto the duplication bridge during the construction contract and the repairs to joints, barriers and bearings completed without traffic on the deck.

#### 4.2.2 Stony Creek Bridge

The single 15 m span bridge was designed in 1936, constructed in 1938 and widened in 1980. It comprises three reinforced concrete (RC) girders, the outside girders of which were widened 1980 with RC cantilever ribs added. The original design and widening details are similar to those at the Herons Creek Bridge described below.

The original bridge drawings do not state the design vehicle loading but it would have been less than T44. The lower "Class A" bridge loading which was in use between 1923 and 1954 is about 63% of T44, though this percentage varies with span and force effect under consideration. The bridge widening drawings do not state the design vehicle load.

The vehicle barriers comprise a single steel rail with a W guardrail below the rail. Supporting Steel posts are mounted onto a concrete kerb at 2 m centres. These barriers would not comply with current code requirements. The distance between the face of the barrier rails in the widened bridge is 9.5 m with 9.2 m between kerbs. Scuppers drain stormwater directly to the waterway below. There are no movement joints in the deck and the road surface is asphaltic concrete for the length of the bridge and run-on slabs. There is a service duct in the western kerb.

The drawings show abutment foundations approximately 3 m below NGL while the wingwalls are founded closer to the surface. There was standing water below the bridge while the drawings suggest that the channel is typically dry. This local scour may suggest that the waterway area through the bridge is too small or that flood velocities are relatively high. The creek banks are overgrown locally but open out to pasture not far away on the upstream or western side. There is a steel girder railway bridge a little downstream of the road bridge.

There appears to be settlement at both run on slabs and movement at the joint between the abutment wall and wing wall on the northwest corner. However the most noticeable feature is the extensive cracking to the beams and deck soffit of the original construction. These cracks have been treated by what appears to be a surface coating of mortar. It is probable that the extra load from the widening work and increases in vehicle loads have contributed to this cracking.

The assessment is that this bridge should be replaced as part of the highway upgrade contract. The 60-year-old concrete elements are showing signs of distress and are probably inadequate for the current vehicle loads.

While replacement is recommended, the investigation suggests that the replacement is not urgent and can wait until Proposal implementation. Further, the order of construction of the various sections of the upgrade need not be influenced by the timing of replacement of this bridge.

#### **4.2.3 Rossglen Rail Bridge**

The road over rail bridge was designed in 1982 to the NAASRA Bridge Code for T44 and standard abnormal vehicle loading. The vehicle barriers were designed for a 45 kN load. Construction was completed in 1983. The three span I girder deck has 12.5 m side spans and a 17.5 m central span over the Main Northern Railway line. The deck is on a large skew of approximately 50 degrees and the road on a tight horizontal curve. The deck comprises five NAASRA Type 3 girders with a 175 mm thick insitu deck and diaphragms at the support lines. The wearing surface is asphaltic concrete and the bridge width is 9.2 m between the face of the barrier kerbs. The vehicle barriers have a modified New Jersey concrete lower section with a post and double box rail upper section. There are no scuppers or other deck drainage system.

The piers are RC blade walls on high level footings and with elastomeric bearings below each girder. The railway cutting is very steep to the outside of each pier. The cutting exposes the granite rock foundation material and footings of the previous bridge can be seen to the west of the existing bridge. The single track railway is on a horizontal curve and is not electrified.

There are cracks at the interface between the diaphragms and girders but these are probably shrinkage cracks and not of concern. The guardrails require painting and the expansion joints should be repaired especially at the north abutment. The pier joints have been filled with bitumen. The run on slab at the north abutment appears to have settled.

#### **4.2.4 Camden Haven River Bridge**

The bridge was designed in 1983 to NAASRA 1976 Bridge Design Code, including the T44 vehicle loading and probably the standard abnormal vehicle loading given in that code. Construction was completed in 1986. The continuous 6 span bridge has four central 29 m spans and two 23.5 m end spans for a total 165 m length. It is straight in plan. The deck is a post-tensioned voided slab with a curved soffit line. There are expansion joints at each abutment and the wearing surface is asphaltic concrete. The width between kerb faces is 9.2 m and the vehicle barriers comprise a modified New Jersey lower section with a steel post and double box rail above. The distance between face of barrier rails is 9.55 m. Service ducts are located in each barrier. Scuppers drain directly to the waterway below.

There is a designated navigation channel 20 m wide and 4.5 m above MHSW in the span to the north of the central pier. The tidal range at the site is less than 0.5 m and the bed level approximately 2 m below MSL. Reinforced concrete piers extend down to pilecaps at the water line. The foundations are 560 mm octagonal pretensioned piles extending to 25 m below mean sea level where they found on siltstone. There are 8 raked piles per pile cap. Vehicle access is possible below the bridge at both abutments although the track at the south abutment

is private. There is a small private boat ramp close to the bridge at the south abutment. An Optus services post for an optic fibre cable is located at the southwest corner of the bridge.

There appears to have been some repair work to the pile cap concrete at two piers and the expansion joints require repair. The paint on the barriers is 15 years old. In other respects the bridge appeared in good condition.

Remains of an earlier bridge at the site are visible just downstream of the existing bridge. This structure was designed in 1938 and had 11 spans. The two central piers are still visible in the river to the east of the existing bridge. The southern abutments of the existing and previous bridges were close together while the alignments diverge to the north.

Both NSW Waterways and DPI (Fisheries) have advised that the remaining pylons of the former bridge should be removed. RTA has agreed that this EIS should assess removal of the former piers as well as the other underwater debris that remains.

Methods of removing the disused piers and pier rubble have been investigated including an assessment of the disturbance the operation would cause and methods to mitigate these impacts. The proposed construction methodology and likely impacts are described in Section 5.15

#### **4.2.5 Herons Creek Flood Channel Bridge**

This simply supported span type bridge was designed in 1963 with three spans each 10.5 m long. The overall deck width is 10.4 m with an 8.5 m width between kerbs. The kerb face is set in from the barrier face by approximately 0.5 m leaving an overall width between barriers of approximately 9.5 m. Post and rail vehicle barriers are of reinforced concrete construction. The deck comprises pretensioned concrete units with an insitu structural topping which also forms the road surface. Scuppers drain directly to the grassed floodplain below and then into the waterway. The 400 mm square precast pier piles had a contract toe level 14 m below the road level. Scour protection to the spill through abutment slopes is concrete filled sand bags. There is a timber footbridge over the floodplain "channel" approximately 30 m upstream of the bridge. The channel passes below the northern span of the bridge. There are small scour holes adjacent to the southern pier piles.

The vehicle barriers probably do not comply with current code requirements while the bridge may have been designed for less than T44 loading. The Bridge "H20-S16" loading which was in use between 1954 and 1976 is equivalent to approximately 75% of T44 loading. The drawings do not note the design loading.

The pier deck joints are fitted with narrow compression type seals approximately 5 mm wide while the abutment joints are filled with bitumen. Concrete edges next to the joint are spalled in places and have been repaired in others. The vehicle barrier end block and connection to the approach W barrier are damaged at the northeast corner. The deck units, structural topping, piers, abutments and revetments appeared in adequate condition. The run on slabs show no sign of settlement.

Despite the probable lower design loading the appearance and condition of this structure suggests that it can be retained for one carriageway when the highway is upgraded, subject to checking in the detail design phase against calculations or other records held by the RTA, particularly for abnormal vehicles. Restrictions on abnormal vehicle usage should be applied. If necessary, abnormal vehicles would travel under escort and could use the new bridge on the adjacent carriageway.

Minor repairs at the deck joints will be required and the kerb line could be moved closer to the barrier face.

#### 4.2.6 Herons Creek Bridge

The original design and widening details are similar to those at the Stony Creek bridge described in Section 4.2.2. The two span Herons Creek bridge was constructed in about 1940 and was widened in 1977 to provide 9.2 m between kerbs. Each span is 12.2 m long. The Work as Executed (WAE) drawings for the 1940 bridge indicate that there was a second single span bridge on the floodplain. This second bridge was probably removed in 1964 when the current bridge over the floodplain was constructed. The original bridge drawings do not state the design vehicle loading but it would have been less than T44. The lower Bridge "Class A" loading was in use between 1923 and 1954 and is about 63% of T44, though this percentage varies with span and force effect under consideration. The bridge widening drawings do not state the design vehicle load.

The vehicle barriers comprise a single steel rail with a W guardrail below the rail. Steel posts mounted onto a concrete kerb are at 2 m centres. These barriers would not comply with current code requirements. The distance between the face of the barrier rails in the widened bridge is 9.5 m with 9.2 m between kerbs. Scuppers drain stormwater directly to the waterway below. There are no movement joints in the deck and the road surface is concrete for the length of the bridge and run-on slabs. The drawings show foundations a little below the normal creek water level. The low water channel is under the northern span and the creek banks are heavily wooded. There is a timber pedestrian bridge to the west of the vehicle bridge and an AC pipe and overhead cables west of the timber bridge.

The concrete deck surface is in a reasonable condition although there are cracks at the ends of the run on slabs and the surface is worn to an exposed aggregate texture. There has been some concrete patching and exposed steel angles at the interface between the deck and run on slabs. Movement at the ends of the run on slabs is not unexpected given the jointless deck. The movement should not compromise the deck structure but may require periodic maintenance of the riding surface.

There is cracking to the beams below the deck. Several cracks are clearly visible from ground level and are estimated to be 0.5 mm wide. Cracking appears worse on the outer beams especially on the western (or upstream) side. The bridge widening would have increased the dead load on the outer beams and could have contributed to this cracking. In addition it is likely that current road loading exceeds the load for which the structure was designed.

The abutment wingwalls have moved relative to the abutment wall as indicated by the open joints. This is worst at the southeast corner.

The assessment is that this bridge should be replaced as part of the highway upgrade contract. The bridge is probably inadequate for current vehicle loading and is showing signs of distress. The bridge is 60 years old and can be expected to require increasing maintenance in the coming years. It also does not have appropriate deck drainage or other measures to ensure protection of water quality in Herons Creek from polluted run off from the road surface.

While replacement is recommended, the investigation suggests that the replacement is not urgent and can wait until Proposal implementation. Further, the order of construction of the various sections of the upgrade need not be influenced by the timing of replacement of this bridge.

#### 4.2.7 Summary

The Stewarts River Bridge, Rossglen Rail Bridge, Camden Haven River Bridge and the Herons Creek Flood Channel Bridge all appeared to be in good condition. They require minor maintenance to joint seals, barriers, scuppers, deck surfacing and the like, but no obvious signs were found to suggest that the major structural elements were in distress or that the durable life of the major structural elements was in question. All these bridges with the possible exception of the Herons Creek Flood Channel Bridge were designed for at least

NAASRA 1976 T44 vehicle loading. It would appear that they could be retained for one carriageway when the highway is upgraded, subject to the following:

- checking the structural adequacy of the Herons Creek Flood Channel Bridge, particularly for abnormal vehicles, and applying restrictions if necessary (abnormal vehicles would travel under escort and could use the new bridge on the adjacent carriageway). Further investigation of this bridge should be carried out in the detail design phase of the project;
- The Herons Creek Flood Channel Bridge is only 8.5 m wide and the bridge barriers would not comply with current design standards. Widening of the bridge and upgrading of the barriers would be desirable on safety grounds.
- minor maintenance and repair work on all four bridges;
- check of corrosion to the bearings at the Stewarts River Bridge – this may be the most expensive element to repair on these structures if the corrosion is found to be more than surface rust.

Repairs and maintenance of existing structures would normally be funded by separate RTA funding and no specific allowances have been made in the Proposal cost estimates.

The Stony Creek Bridge and Herons Creek Bridge are both 60 years old and of a similar design. They were both widened but not strengthened in the late 1970s. They would have been designed for less than T44 loading. Both structures have cracks especially at the outer beams and slabs probably due to the extra load from the widening. Some of these cracks have been patched in the past. The width of both structures is only 9.2 m between kerbs (10.5 m required for new bridges) and the barriers would not comply with current design standards. Assessment of these structures suggests that they should be replaced as part of the proposed highway upgrade due to their inadequate load capacity, suspect durability and narrow width.

Allowance will be made for replacement of the Stony Creek and Herons Creek bridges as part of the highway upgrade.

The results of the assessment of existing bridge structures are summarised in Table 3.

### 4.3 Existing culverts

There are eleven existing box culverts plus about fifty smaller pipe culverts under the existing highway. The box culverts and headwalls are all of concrete construction and generally appear to be in good condition with a few exceptions:

- The culvert structure between the Rossglen rail bridge and the bridge over the Camden Haven River. The culvert appears to have settled in the centre of the embankment by about 100 mm. Further investigation is required to determine if repair or replacement of this 4 cell 1.8 m x 1.8 m box culvert is required.
- A culvert about 300 m north of the north abutment of the bridge over the Camden Haven River. Although identified as a cattle crossing, it appears to also double as a drainage structure. It is likely that this structure has settled as it is now partially silted-up, has standing water on both sides and appears rather small for a cattle crossing.

It appears that the majority of the culverts could be re-used in the upgraded highway where the existing highway is to be reused provided they have adequate waterway area and the road level does not change significantly. Culverts may require lengthening and new end details if the carriageway width is greater than that currently in place. Water from the existing road surface typically drains directly into the waterways at the culverts, with no existing sediment basins or other water quality control measures.

**Table 3 Summary of existing bridges**

Bridge	Total bridge (span layout)	Existing width between kerbs	Construction date and type	Design Loading	Works Required
Stewarts River	289 (8 spans: 6@38.0, 2@30 end spans)	9.2 m	1985 - Precast segmental box girder	NAASRA 1976, T44 & probably Abnormal Vehicle	Repairs
Stony Creek	16 (single span)	9.2 m	1938 - Slab over 3 No RC girders (widened 1979 with RC cantilever ribs added)	Probably DMR 1927 Standard UDL + Pt. Loads	Replace with 10.5 m wide bridge
Railway at Rossglen	42 (3 spans: 12.4, 17.5, 12.4)	9.2 m	1982 - Precast, prestressed concrete I girders	NAASRA 1976, T44 & Abnormal Vehicle	Repairs
Camden Haven River	164 (6 spans: 4@29.0, 2@23.5 end spans)	9.2 m	1984 Prestressed concrete voided slab	NAASRA 1976, T44 & Abnormal Vehicle	Repairs
Herons Creek Floodway	32 (3 spans x 10.7)	8.5 m	1963 - Inverted T beams with insitu deck and infill	DMR 1948 Standard Truck	Repairs. Check structural adequacy, especially for abnormal loads  Widen and replace barriers if bridge structure retained.
Herons Creek	24.5 (2 spans x 12.25)	9.2 m	1938 (Slab over 3 No RC girders) Widened 1979 - RC cantilever ribs added)	Probably 1927 Standard UDL + Pt. Loads	Replace with 36 m long x 10.5 m wide bridge

#### 4.4 Existing rest areas

There are seven existing rest areas of varying standard within the project area (see Table 4). Of these, the only two that would approach current rest area standards would be the northbound rest area 100 m north of the Rossglen turnoff and the southbound rest area 0.75 km south of the Rossglen turnoff.

The latter site also fits in with the site identified in RTA's Strategic Assessment for the Pacific Highway. Proposed improvements to this rest area are described in Section 5.12. The other existing rest areas which are not part of the current strategy would be retained where access is safe and can be incorporated at low cost into the proposed upgrade.

**Table 4 Location of existing vehicle rest areas**

Roadloc (distance from Taree in km)	Location	Access Arrangement	Description
43.6	0.5 km south of Haydons Road turnoff	Entry/exit from northbound carriageway	Minor shoulder widening only
43.8	0.3 km south of Haydons Road turnoff	Entry/exit from southbound carriageway	Shoulder widening only
44.5	Just south of Watson Taylor Road	Entry/exit from southbound carriageway	Shoulder widening only
45.6	0.5 km north of Stony Creek	Entry/exit from southbound carriageway	Heavy vehicle rest area/ stockpile area
47.5	0.75 km south of Rossglen turnoff	Entry/exit from southbound carriageway	Heavy vehicle rest area
48.3	100 m north of Rossglen turnoff	Entry/exit from northbound carriageway	Heavy vehicle rest area
50.0	1 km north of Camden Haven River	Entry/exit from southbound carriageway	Heavy vehicle rest area

#### 4.5 Existing pavement

The existing highway comprises a sealed flexible pavement with sealed shoulders for the full length. As noted in Section 4.1, just under 50% of the existing highway is three lanes wide with an overtaking lane and the remainder has one lane in each direction. Pavement width in the two lane sections is a minimum of about 11 m, comprising two 3.5 m lanes and two 2 m minimum sealed shoulders.

A preliminary assessment of the condition of existing pavements has been made using RTA Pavement Investigation Reports, deflectograph surveys and a visual assessment to evaluate conditions and estimate the remaining pavement life. Details of the assessment are provided in Appendix A. The preliminary findings were that major rehabilitation is required for 14.7 km, or about 65% of the 22.3 km of existing highway. This assessment adopted a conservative approach since it would be at least ten years before the upgraded highway would be opened to traffic. Allowance should also be made for minor rehabilitation of the remaining 7.4 km of existing carriageway where re-use is intended. Existing pavement condition is shown graphically on Figure 5.

#### 4.6 Conclusions about use of existing highway assets

Existing bridges represent a significant asset and all are at locations where they could potentially be used as a one way bridge carrying a single carriageway. All bridges are located where horizontal and vertical geometry is adequate for the upgraded highway and all but two are expected to be in a structural condition suitable for continued usage.

Compared to the bridges, pavements are in worse condition and two-thirds of the existing pavement is assessed as requiring full reconstruction. The remaining 7.4 km of pavement is in reasonable condition but of this length, about 1.7 km is in areas where the existing horizontal or geometry is substandard. This effectively reduces the length of pavement suitable for re-use to 15-20% of the existing pavement after allowing for reconstruction of pavements at either end of the substandard sections.

The majority of the existing culverts should be suitable for re-use in the upgraded highway subject to capacity checks and provided that the road level does not change significantly.

Of the seven existing rest areas, only the southbound rest area located 0.75 km south of the Rossglen turnoff (47.5 km north of Taree) fits in with the rest area sites identified in RTA's Strategic Assessment for the Pacific Highway. Proposed improvements are described in Section 5.12. The other existing rest areas will be retained where access is safe and where they can be incorporated at low cost into the proposed upgrade.

## 5. CONCEPT DESIGN

### 5.1 Highway design

The concept design has been prepared and refined as part of the design development process. It is based on the design criteria defined in Section 3 above and accommodates other influences including environmental issues, land management requirements, and service provision. The overall objective of the concept design is the development of a 'value for money' project from a broad community perspective.

Detailed design would be undertaken only if the proposal is approved. A requirement for the detailed design development process that follows project approval would be incorporation of the key principles established during the study and inherent in the concept design. The detailed design would also be required to meet the criteria on which the concept design was based and to take into account environmental constraints and mitigation measures identified in this EIS. Guidelines for the preparation of detailed designs are included in Section 5.17.

Typical cross sections are shown in Figures 3A to 3D. The Proposal cross section consists of two carriageways, each with two 3.5 m wide traffic lanes and a 2.5 m wide left shoulder and 0.5 m right shoulder, generally separated by an 11 m wide median without a central barrier. Shoulder widths would be increased by 0.5 m where guard fencing or a barrier is located at the edge of shoulder. The only exception would be the left shoulder on bridges, where the 2.5 m shoulder would not be widened. The 11 m wide median would generally be depressed for drainage reasons and landscaped to assist in reducing headlight glare.

As noted in Section 2.2 above, there are two sections of the Proposal where the median width would be reduced and a median barrier would be provided. The first is immediately north of the Stewarts River where the median width would be reduced from 11 m to 4.5 m over the length of the bridges and the narrow median would extend for about 1.3 km to Station 5300. Split-level carriageways with a retaining wall up to 3 m high would be developed in the narrow median. A Type F concrete barrier is proposed at the median edge of the northbound carriageway. A retaining wall up to 7 m high would also be required between the southbound carriageway and the Main Northern Railway line over a 100 m length within this section, between Station 4450 and Station 4550. An engineered 1H:1V slope up to 4 m high would also be required between the southbound carriageway and the Main Northern Railway line.

The second location is in the vicinity of the Middle Brother National Park where the available width for the Proposal is restricted by the National Park on the western side and the Main Northern Railway line on the eastern side. In order to eliminate the requirement for land acquisition from Middle Brother National Park and to reduce the impact on vegetation, the median width would be reduced from the standard 11 m to 3 m width barrier for a 1 km section adjacent to the boundary of the National Park. A retaining wall up to 6 m high is also proposed between the eastern side of the southbound carriageway and the railway over a 150 m long section within this constrained zone (Station 7400 to Station 7550).

No dedicated facilities for arboreal fauna crossings are deemed necessary although a number of drainage culverts would be augmented to integrate fauna crossings into the carriageway design. Details are provided in Section 5.13 and in Working Paper No. 7.

The Proposal design is generally in accordance with the criteria established in Section 3 of this Paper. The only locations where the design criteria have not been achieved are described in Section 5.2 below.

## 5.2 Non-compliance with design parameters

The only location where the design criteria nominated in Section 3 have not been achieved is on the southbound carriageway from Station 4500 to Station 4950. At this location the design is constrained by an existing high (15 m maximum) and steep rock cutting on the west side and the existing Main Northern Railway line immediately adjacent and up to 10 m lower on the east side. In order to avoid the difficulty and expense of disturbing the existing rock cutting or the railway, the proposed upgrade incorporates split level carriageways with a retaining wall up to 3 m high in the median and an additional retaining wall up to 7 m high between the southbound carriageway and the railway.

The southbound carriageway is on an 850 m radius curve at this location, and the median retaining wall restricts visibility to some extent for southbound traffic using the fast lane. In order to provide Stopping Sight Distance (SSD) for a design speed of 110 km/h (i.e. 210 m), a median shoulder/verge area about 4.7 m wide would be required. This assumes that the driver's eye position is 2.0 m to the right of the lane line in the centre of the southbound carriageway. Provision of the full 110 km/h SSD with a 4.7 m wide shoulder/verge would add significantly to the width and cost, and would also make it very difficult to accommodate the highway upgrade between the existing constraints.

Following discussions with RTA it was agreed that it was reasonable in these circumstances to accept a minor reduction in the horizontal sight distance at this location. A combined median shoulder/verge width of 3.0 m has been provided between the edge of the median lane and the toe of the median retaining wall. This corresponds to a SSD of 190 m, equivalent to a 2.5 second reaction time from about 105 km/h or a 1.5 second reaction time from just over 110 km/h. The reduction is considered acceptable in this instance for the following reasons:

- A significant cost savings can be made
- It is consistent with lower speed environment of 100 km/h adopted for the vertical geometry on this and other Pacific Highway projects.
- At night the maximum headlight sight distance is only about 150 m, less than the 190 m SSD proposed,
- RTA acknowledges that the 210 m SSD guideline is desirable where practical and cost effective rather than an absolute requirement.
- Reducing the SSD to 190 m would still provide manoeuvre sight distance allowing a vehicle to move into the widened shoulder/verge area (3.0 m available) if necessary to avoid a hazard in the roadway. Austroads, Queensland Main Roads and VicRoads all allow the use of manoeuvre sight distance in lieu of full SSD where sight distance is restricted, although VicRoads is the only one of the three allowing use of manoeuvre sight distance at speeds above 100 km/h (only where significant savings are possible).
- The sight distance reduction is being applied on a R850 m radius curve, i.e. appreciably above the minimum radius curve

## 5.3 Pavements

### 5.3.1 Pavement Design

Full strength pavement would be provided for the highway travel lanes and the inner and outer shoulders. Preliminary pavement designs have been prepared using the pavement design criteria described in Section 3.8. Flexible pavements have been designed using CIRCLY Version 5a.

### 5.3.2 Subgrade

The soil types along the route of the road are generally cohesive and variable in subgrade support strength, with soaked CBRs ranging from 2.5% to 45%. Plasticity Index (PI) values indicate that moderately expansive soils are present along the majority of the route of the road. Tests carried out have shown that CBR values greater than 3% can generally be achieved in soils with PI values up to 35.

It has been assumed that existing soils with a PI less than 35 will be reused in general fills, and existing soils with higher PI values, if reused, will be stabilized to provide a CBR value of at least 3%. For the purposes of the preliminary pavement design a subgrade CBR value of 3% has been adopted.

RTA practice recommends that where plastic, expansive soils are used within 1 m of finished surface level, a zone of better quality material, preferably at least 300 mm thick and minimum CBR10 should be provided above the more plastic material. Accordingly, a 300 mm thick selected material zone (SMZ) of minimum CBR10 material has been included in all sealed flexible pavement designs. If the in-situ material in the floor of the cuttings meets the requirements for the select material zone (SMZ) then the in-situ material may be used as the SMZ.

### 5.3.3 Traffic Volumes

Traffic volumes adopted for pavement designs are based on the volumes contained in Working Paper No. 1 as noted in Table 5.

### 5.3.4 Pavement Design Assumptions

The design of the various pavements have been based on the following assumptions:

#### 5.3.4.1 General assumptions for pavements

- Open graded asphalt wearing course not treated as a structural layer in the design
- Design modulus of dense graded asphalt – 2,800 MPa
- Design modulus of lean mix concrete – 10,000 MPa (no post cracking fatigue life allowed for in the design)
- Tyre pressure - 750kPa
- The mechanistic design relationships for the fatigue of asphalt and cemented materials were determined in accordance with Austroads 2004. A Reliability Factor of 1 was used to determine the allowable number of load repetitions for a project reliability level of 95%.

**Table 5 Traffic Volumes for Pavement Design**

	Design Life	2002 AADV	2011 AADV	2031 AADV	2051 AADV	Percentage Heavy Vehicles
N/B	40 years	5,521	7,627		22,139	19%
S/B	40 years	5,521	7,627		22,139	19%
Ocean Drive (both ways)	20 years		6,123	10,432		10% assumed
Kew Interchange ramps	40 years		1,667		4,838	15% assumed
Stewarts River Road, Johns River	20 years	402 (year 2000)	458	581	738	10% assumed
Johns River Interchange ramps	40 years	242 (year 2000)	276		445	15% assumed
Sealed Local Road (Herons Creek Road is representative)	20 years	322 (year 2000)	343	1120		10% assumed
Unsealed Local Road (Cluleys Road is representative)	20 years	62 (year 2000)	71	90		10% assumed

Source: Working Paper No. 1 – Traffic assessment

#### 5.3.4.2 Pacific Highway

- Design life: 40 years
- AADV (north bound) 7,627 vehicles commencing in 2011, same for south bound
- Annual growth rate 2.7%
- 100% heavy vehicles travelling in the design lane (While this could be slightly conservative, Austroads 2004 suggests 100% be used for two lane carriageways in rural area unless lane specific data is available.)
- 19% of total traffic is heavy vehicles
- The proportion of each axle group is based on the Vehicle Class traffic data:
- SAST: 0.379, SADT: 0.051, TAST: 0.003, TADT: 0.342, TRDT: 0.225
- The axle group loading distribution is in accordance with Table A7.4.2 Austroads 2004.
- Safety Factor of 3 used for design traffic for bound flexible pavement option in accordance with RTA Form 76, Table 7.9a
- Load Safety Factor (LSF) of 1.3 for PCP rigid pavement option
- Calculation of traffic for flexible and rigid pavement design in accordance with Austroads 2004.
- Design Standard Axle Repetitions (SARs) for flexible pavement design:
  - For fatigue of asphalt =  $4.8 \times 10^8$
  - For rutting and shape loss =  $3.3 \times 10^8$
  - For fatigue of cemented materials =  $3.85 \times 10^9$
- Design traffic for rigid pavement design =  $11.3 \times 10^7$  HVAG

- Effective Subgrade Strength of CBR 75 for rigid pavement design (based on a composite insitu subgrade strength of CBR5.5 and 150 mm LMC subbase)
- Concrete 28 day flexural strength used in rigid pavement design = 4.25 MPa (in accordance with RTA preferred practice to account for possible lack of strength gain between 28 and 90days in nominal 4.5 MPa concrete).

#### 5.3.4.3 Ocean Drive

- Design life: 20 years
- AADV (both ways) 6,123 vehicles commencing in 2011
- Annual growth rate 2.7%
- 100% heavy vehicles travelling in the design lane (i.e. 50% of the two-way HVs)
- 10% of total traffic is heavy vehicles
- The proportion of each axle group and the axle group loading distribution is based on Table A7.4.2:
- Safety Factor of 2 used for design traffic for flexible pavement in accordance with RTA Form 76, Table 7.9a
- Calculation of traffic for flexible pavement design in accordance with Austroads 2004. Axle groups per HV = 2.8.
- Design Standard Axle Repetitions (SARs) for flexible pavement design:
  - For fatigue of asphalt =  $1.6 \times 10^7$
  - For rutting and shape loss =  $2.3 \times 10^7$
  - For fatigue of cemented materials =  $1.8 \times 10^8$

#### 5.3.4.4 Kew Interchange Ramps

- Design life: 40 years
- AADV 1,667 (one way) vehicles commencing in 2011
- Annual growth rate 2.7%
- 100% heavy vehicles travelling in the design lane
- 15% of total traffic is heavy vehicles
- The proportion of each axle group and the axle group loading distribution is based on Table A7.4.2:
- Safety Factor of 2 used for design traffic for flexible pavement in accordance with RTA Form 76, Table 7.9a
- Calculation of traffic for flexible pavement design in accordance with Austroads 2004. Axle groups per HV = 2.8.
- Design Standard Axle Repetitions (SARs) for flexible pavement design:
  - For fatigue of asphalt =  $3.7 \times 10^7$
  - For rutting and shape loss =  $5.4 \times 10^7$
  - For fatigue of cemented materials =  $4 \times 10^8$

**5.3.4.5 Stewarts River Road – Johns River**

- Design life: 20 years
- AADV 458 vehicles (both ways) commencing in 2011
- Annual growth rate 2.7%
- 100% heavy vehicles travelling in the design lane (i.e. 50% of two-way HVs)
- 10% of total traffic is heavy vehicles
- The proportion of each axle group and the axle group loading distribution is based on Table A7.4.2:
- Safety Factor of 2 used for design traffic for flexible pavement in accordance with RTA Form 76, Table 7.9a
- Calculation of traffic for flexible pavement design in accordance with Austroads 2004. Axle groups per HV = 2.8, ESA/HV = 2.5.
- Design Standard Axle Repetitions (SARs) for flexible pavement design:
  - For fatigue of asphalt =  $1.3 \times 10^6$
  - For rutting and shape loss =  $1.9 \times 10^6$
  - For fatigue of cemented materials =  $1.4 \times 10^7$

**5.3.4.6 Johns River Interchange Ramps**

- Design life: 40 years
- AADV 276 vehicles (one way) commencing in 2011
- Annual growth rate 2.7%
- 100% heavy vehicles travelling in the design lane
- 15% of total traffic is heavy vehicles
- The proportion of each axle group and the axle group loading distribution is based on Table A7.4.2:
- Safety Factor of 2 used for design traffic for flexible pavement in accordance with RTA Form 76, Table 7.9a
- Calculation of traffic for flexible pavement design in accordance with Austroads 2004. Axle groups per HV = 2.8, ESA/HV = 2.5.
- Design Standard Axle Repetitions (SARs) for flexible pavement design:
  - For fatigue of asphalt =  $4.5 \times 10^6$
  - For rutting and shape loss =  $3 \times 10^6$
  - For fatigue of cemented materials =  $3.4 \times 10^7$

**5.3.4.7 Sealed Local Roads**

- Design life: 20 years
- AADV 343 vehicles (both ways) commencing in 2011
- Annual growth rate 2.7%
- 100% heavy vehicles travelling in the design lane (i.e. 50% of two-way HVs)
- 10% of total traffic is heavy vehicles

- The proportion of each axle group and the axle group loading distribution is based on Table A7.4.2:
- Safety Factor of 2 used for design traffic for flexible pavement in accordance with RTA Form 76, Table 7.9a
- Calculation of traffic for flexible pavement design in accordance with Austroads 2004. Axle groups per HV = 2.8, ESA/HV = 2.5.
- Design Standard Axle Repetitions (SARs) for flexible pavement design
  - For granular pavements (empirical design) =  $9 \times 10^5$

#### 5.3.4.8 Unsealed Local Roads

- Design life: 20 years
- AADV 71 vehicles (both ways) commencing in 2011
- Annual growth rate 2.7%
- 100% heavy vehicles travelling in the design lane (i.e. 50% of two-way HVs)
- 10% of total traffic is heavy vehicles
- The proportion of each axle group and the axle group loading distribution is based on Table A7.4.2:
- Safety Factor of 2 used for design traffic for flexible pavement in accordance with RTA Form 76, Table 7.9a
- Calculation of traffic for flexible pavement design in accordance with Austroads 2004. Axle groups per HV = 2.8, ESA/HV = 2.5.
- Design Standard Axle Repetitions (SARs) for flexible pavement design:
  - For granular pavements (empirical design) =  $1.8 \times 10^5$

#### 5.3.5 Pavement Structures

Preliminary pavement designs have been prepared for each major pavement type.

##### 5.3.5.1 Pacific Highway

Two options were considered for the pavement structure, namely a bound flexible pavement and a PCP rigid pavement.

The bound flexible pavement has the following structure:

- 30 mm open graded wearing course (Only where low noise pavement is required i.e. Station 1400-3950, Station 15000-16600, and Station 20340-21450)
- 175 mm dense graded asphalt
- Bitumen emulsion curing coat
- 250 mm lean mix concrete (critical layer, the nominal thickness shown is 20 mm greater than the design thickness)
- 7 mm bituminous sprayed seal
- 150 mm CBR30 min upper selected material zone
- 150 mm CBR10 min lower selected material zone
- subgrade CBR3

- For cuttings in rock or where free water (spring) is present in the cutting, include a 500 mm drainage layer covered with geotextile under the lower selected material zone
- For cuttings with expansive clay subgrades, replace the lower selected material layer with a 450 mm low permeability capping layer of dense graded gravel with  $PI > 4$

The PCP rigid pavement has the following structure:

- 30 mm open graded wearing course (Only where low noise pavement is required i.e. Station 1400-3950, Station 15000-16600, and Station 20340-21450)
- 25 mm dense graded asphalt (only where low noise pavement is required i.e. Station 1400-3950, Station 15000-16600, and Station 20340-21450)
- 255 mm plain concrete base, undowelled, with structural concrete shoulders (critical layer, the nominal thickness shown is 20 mm greater than design thickness)
- Two coats wax emulsion curing compound
- 150 mm lean mix concrete subbase
- 7 mm bituminous sprayed seal
- 150 mm CBR30 min upper selected material zone
- 150 mm CBR10 min lower selected material zone
- subgrade CBR3
- For cuttings in rock or where free water (spring) is present in the cutting, include a 500 mm drainage layer covered with geotextile under the lower selected material zone
- For cuttings with expansive clay subgrades, replace the lower selected material layer with a 450 mm low permeability capping layer of dense graded gravel with  $PI > 4$

#### ***Settlement issues - Consolidation settlement and pavement selection***

The route of the upgraded highway crosses flood plains of the Stewarts River and Camden Haven River on fill embankments ranging in height from 4 m to 11.5 m. Long term post-construction settlements in the order of 100 mm to 300 mm are predicted under the embankments. Given the relatively poor foundation conditions, it is likely that there will be differential settlements at bridge abutments and lateral drainage structures together with the risk of general shape loss to pavement surfaces on the embankment sections. The severity of pavement shape loss (ride quality) will depend on the rate of change of localized settlements and uniformity of subgrade support.

Given the potential for problems, flexible pavement may be preferable within these zones to facilitate ease of shape correction and minimize repair downtime. If rigid pavements are constructed on embankments, it is recommended that the PCP pavement be dowelled to assist with joint integrity and load transfer as slab reorientation occurs over time under the likely action of differential settlement.

#### **5.3.5.2 Ocean Drive**

Bound flexible pavement:

- 175 mm dense graded asphalt
- Bitumen emulsion curing coat
- 190 mm lean mix concrete (critical layer, the nominal thickness shown is 20 mm greater than design thickness)

- 7 mm bituminous sprayed seal
- 150 mm CBR30 min upper selected material zone
- 150 mm CBR10 min lower selected material zone
- subgrade CBR3

#### **5.3.5.3 Kew Interchange Ramps**

Bound flexible pavement:

- 175 mm dense graded asphalt
- Bitumen emulsion curing coat
- 205 mm lean mix concrete (critical layer, the nominal thickness shown is 20 mm greater than design thickness)
- 7 mm bituminous sprayed seal
- 150 mm CBR30 min upper selected material zone
- 150 mm CBR10 min lower selected material zone
- subgrade CBR3

#### **5.3.5.4 Stewarts River Road – Johns River**

Bound flexible pavement:

- 175 mm dense graded asphalt
- Bitumen emulsion curing coat
- 150 mm lean mix concrete (critical layer, the nominal thickness shown is 20 mm greater than design thickness)
- 7 mm bituminous sprayed seal
- 150 mm CBR30 min upper selected material zone
- 150 mm CBR10 min lower selected material zone
- subgrade CBR3

#### **5.3.5.5 Johns River Interchange Ramps**

Bound flexible pavement:

- 175 mm dense graded asphalt
- Bituminous emulsion curing coat
- 165 mm lean mix concrete (critical layer, the nominal thickness shown is 20 mm greater than design thickness)
- 7 mm bituminous sprayed seal
- 150 mm CBR30 min upper selected material zone
- 150 mm CBR10 min lower selected material zone
- subgrade CBR3

#### **5.3.5.6 Sealed Local Road**

Unbound flexible pavement:

- 40 mm dense graded asphalt wearing course
- 150 mm unbound base CBR80
- 150 mm unbound subbase CBR45
- 300 mm CBR10 min selected material zone
- subgrade CBR3

#### **5.3.5.7 Unsealed Local Road**

Unbound flexible pavement:

- 200 mm unbound base CBR45
- 250 mm CBR10 min selected material zone
- subgrade CBR3

### **5.3.6 Whole of Life Pavement Analysis**

A Whole of Life (WoL) costing comparison was undertaken for the two alternative pavement types considered for the main carriageways of the Pacific Highway upgrade, i.e. bound flexible pavement and PCP rigid pavement. For each of these pavement types, a WoL costing was undertaken with and without the non-structural, open graded (OG) asphalt wearing course required for noise reduction through Johns River and Kew.

The Present Worth or Present Value method has been used for economic comparison of the alternative pavement types and includes initial construction cost, routine and periodic maintenance costs, road user delay costs and salvage value.

#### **5.3.6.1 Initial Construction, Maintenance Costs and Salvage Value**

Initial construction, maintenance costs and salvage values used in the WoL analysis have been derived directly from the respective unit rates data supplied by RTA. The rates for new construction and maintenance items supplied by RTA were based on year 2003 contract prices.

#### **5.3.6.2 Road User Delay Costs**

Delay costs used in the WoL analysis have been derived from relevant Weighted Average value of Travel Time per vehicle-hour included in RTA's Economic Analysis Manual, Version 2 (RTA 1999). Parameters used were according to the RTA's April 2004 update.

#### **5.3.6.3 Delays during routine and periodic maintenance**

Delay costs are based on the general assumptions shown in Table 6.

#### **5.3.6.4 Analysis Period**

An analysis period of 40 years was used consistent with the pavement design life and typical routine and periodic maintenance requirements for each alternative pavement type over this period are based on the respective RTA future maintenance regime models.

#### **5.3.6.5 WoL Cost Comparison Summary**

A discount rate of 7% was used in the analysis. Table 7 details the Present Value for each pavement type analysed.

**Table 6 Delay assumptions for routine and periodic maintenance**

Item description	Value adopted
Weighted average value of travel time per vehicle-hour	\$27.59
All work undertaken between the hours of:	7:00am to 5:00pm
All work undertaken on week days:	Monday to Friday
Percentage of traffic flow between 7:00am to 5:00pm:	65 %
Annual traffic growth rate:	2.7 %
Normal traffic speed:	100 km/h
Temporary speed restriction during maintenance:	40 km/h
Working length in each direction with speed restrictions on any one day for periodic maintenance:	1.0 km
Working length in each direction with speed restrictions on any one day for routine maintenance:	0.5 km
Percentage of vehicles delayed by flagman for periodic maintenance:	5 %
Average delay per vehicle due to flagman for periodic maintenance:	5 mins
Percentage of vehicles delayed by flagman for routine maintenance:	2 %
Average delay per vehicle due to flagman for routine maintenance:	3 mins
Duration of work in a 5 km section for periodic maintenance:	
- Flexible pavement option (no OG wearing course)	30 days
- Flexible pavement option (with OG wearing course)	30 days
- Rigid pavement option (no OG wearing course)	15 days
- Rigid pavement option (with OG wearing course)	40 days
Duration of work in a 5 km section for routine maintenance per year:	
- Flexible pavement option (no OG wearing course):	5 days
- Flexible pavement option (with OG wearing course):	5 days
- Rigid pavement option (no OG wearing course):	5 days
- Rigid pavement option (with OG wearing course):	5 days

**Table 7 Results of WoL Pavement Type Comparison**

Pavement Type	Initial Construction Cost	Present Value at 7% discount rate			
		Capital Cost <sup>(1)</sup>	Maintenance Costs <sup>(2)</sup>	Road User Delay Costs	Present Value
1. Flexible Pavement Option (no OG wearing course)	\$115	\$107	\$19	\$4	\$130
2. Flexible Pavement Option (with OG wearing course)	\$127	\$119	\$25	\$4	\$148
3. Rigid Pavement Option (no OG wearing course)	\$92	\$86	\$7	\$5	\$97
4. Rigid Pavement Option (with OG wearing course)	\$114	\$106	\$25	\$9	\$140

Note: 1. Construction cost assumed to occur at end of first year  
2. Includes allowance for salvage value

#### 5.3.6.6 Sensitivity Testing

Sensitivity testing for discount rates at 4% and 10% were undertaken and show that Present Value comparison relativities between the pavement types 1 and 3 and pavement types 2 and 4, are generally maintained. Testing for  $\pm 20\%$  changes in capital costs, maintenance costs and delay costs also show that Present Value relativities between pavement types 1 and 3, and pavement types 2 and 4 are generally maintained.

#### 5.3.6.7 Conclusion

The analysis of the pavement options suggests that rigid pavement would have a lower PV cost. However, the decision would depend on relative costs at the time of construction, and this EIS is not predicated on adopting either rigid or flexible pavement.

## 5.4 Cut and fill requirements

### 5.4.1 Cut and fill (including batter slopes)

Cut slopes would need to be formed in both soil and rock and an assessment has been made of suitable batter angles for each new cutting along the preferred option. This assessment has been based upon information from the ground investigation, geological mapping and kinematic analysis and observation of the performance of existing cut slopes in the area.

While cut slopes in soils of 3H:1V would be preferable due to the potential erodibility of the soil in the study area, cut slopes in soil of 2H:1V would be acceptable from stability considerations. In the interests of reducing the extent and volume of cuttings, cut slopes in soil of 2H:1V have generally been adopted on the understanding that topsoiling and stabilisation would be required during construction. Benches are proposed at approximately 7 m to 10 m intervals in the deeper cuts and at the rock/soil interface. The benches are proposed in accordance with standard RTA practice to improve stability and reduce long term maintenance.

Rock cut batters have been assessed based on slope stability and erodibility criteria and are generally relatively flat (flatter than 1H:1V) due in many instances to the fractured nature and adverse jointing present in the rock mass. The base of the rock slopes would have dish drains and verge widths related to the materials within the slope. It is anticipated that spot bolting would be required in rock cuttings to stabilise isolated wedges. The location of these seams of rock would be confirmed during excavation.

A number of new fill embankments would need to be constructed along the preferred option. An assessment has been made of suitable batter angles for these new slopes, based upon information from the ground investigation. From stability considerations alone, maximum fill slopes should not exceed 2H:1V. In order to reduce the extent of earthworks, a 2H:1V fill slope has generally been adopted on the proviso that all fill batters would be topsoiled and grassed for stability. Flatter batters of 3H:1V have, however, been adopted on low fills and also on the approach embankments to the Stewarts River and the Camden Haven River where the flatter batter improves embankment stability on the soft soils.

The only location where steeper fill batters are proposed is between Station 4840 and Station 5100 where a section of 1H:1V fill has been provided between the highway and the railway so that fill from the highway embankment would not extend onto the railway. The steeper slope in this section would be up to 4 m high and would be achieved by an engineered slope using selected crushed rock materials and surface stabilisation.

Table 8 presents an outline of the approximate volumes of cut and fill required for bulk earthworks in each section of the Proposal.

There is a considerable excess of material from the Kew section but it is intended that this would be utilised on the other three sections where there is a shortfall. This situation has implications in terms of the order of construction of the sections (i.e. construction staging) as well as in the requirements for stockpile areas.

In addition to the bulk fill volume in Table 8, approximately 150,000 m<sup>3</sup> of select fill would be required for construction of pavements. The excess material available from bulk earthworks would be suitable for use as select fill for pavements, resulting in an approximate overall balance of cut and fill for the Proposal.

**Table 8 Indicative earthworks volumes**

Section	Cut (m <sup>3</sup> )	Fill (m <sup>3</sup> )	Estimated Balance* (m <sup>3</sup> )
Johns River	210,000	200,000	Approx balance
Lake	290,000	250,000	30,000 excess
Kew	520,000	295,000	230,000 excess
Herons Creek	90,000	220,000	130,000 shortfall
Total	1,100,000	960,000	130,000 excess

Quantities would be subject to refinement during detailed design

\* Estimated balances not equal to the difference between cut and fill volumes due to influence of allowances for unsuitable material and bulking.

It is noted that there are no major excavations in acid sulphate soils (ASS) or potential acid sulphate soils (PASS) in any sections and therefore this has not restricted the use of excess fill in other sections of the route. The only excavations in ASS or PASS would be minor excavations for sediment basins, drainage ditches and pile caps in the floodplain south of Stewarts River and in the Camden Haven River floodplain. Further details of the location of ASS and PASS as well as measures for construction management and treatment are described in Section 8.5.

#### 5.4.2 Sources of fill material

Material from excavations would be variable in quality but it is anticipated that, provided suitable methods of excavation are used, sufficient quantities of material won from excavations would be available and suitable for use in embankments as general fill and also as select fill for the top 0.3 m of embankments. Lower quality material could be used for landscape fill/noise mounds and in the lower layers of embankments. Minor adjustments could be made to the longitudinal grading of the highway upgrade if necessary during the detailed design stage to suit the results of further geotechnical investigations carried out at that time.

Sources of other construction materials such as pavement materials and aggregates for concrete and asphaltic concrete are discussed in Section 6.3.

## 5.5 Structures

### 5.5.1 Bridges

Several new bridges are proposed in addition to the retention of some existing bridges for the Proposal. On all new bridge structures carrying the upgraded highway the proposed pavement width is 10.5 m comprising a left shoulder width of 2.5 m, two 3.5 m traffic lanes and a 1.0 m median shoulder. The proposed bridges are summarised in Table 9 and further described in the text below.

Note that the bridge span arrangements defined below are based on initial functional layouts of the concept design as developed to allow the assessment of likely impacts. Minor adjustments may be made during the detailed design stage as described in Section 5.17.

**Table 9 Summary of Proposed Bridge Structures**

Bridge Location	Approx. Station	Existing bridge length (m)	No. of new bridges	Roadway width (m)	Footway/cycleway width (m)	Abutment type	Spans	Overall bridge length (m)
Stewarts River Road (crosses highway)	2530	-	1	9.0	1.5	1H:1V spill-through	2 x 25.5	51.0
Stewarts River (crosses river)	3950-4250	289.0	1	10.5		1.5H:1V spill-through	8 x 38	304.0
Stony Creek (crosses creek)	8770	15.2	2	10.5		vertical	1 x 15.5	15.5
Rossglen Railway (crosses railway)	12250	42.3	1	10.5		1H:1V spill-through	12.5, 17.5, 12.5	42.5
Camden Haven River (crosses river)	12610-12790	164.0	1	10.5		1.5H:1V spill-through	6 x 29	174.0
Ocean Drive (crosses highway)	15800	-	1	11.0	2.0	2H:1V spill-through	10.5, 17.5, 17.5, 10.5	56.0
Herons Creek Floodway (crosses floodway)	21480	32.0	1	10.5	2.0	1H:1V spill-through	3 x 10.7	32.0
Herons Creek (crosses creek)	21560	24.4	2	10.5	2.0	vertical	1 x 24.5	24.5

#### 5.5.1.1 Stewarts River Road Bridge

- A new 51 m long two-span bridge would be constructed for the Stewarts River Road overpass above the Johns River bypass section of the upgraded highway. The new bridge would have piled foundations and the superstructure would comprise 1200 mm deep Super-T beams with a concrete slab over. The road width on the structure would consist of 2 x 3.5 m lanes with a 1 m shoulder each side.
- For improved pedestrian and cyclist safety a 1.5 m wide raised pedestrian/cycle footway would be provided on the south side of the Stewarts River Road overbridge, in addition to the shoulder. Throw screens would be provided on both sides of the bridge.

#### 5.5.1.2 Stewarts River Bridge

- The existing eight-span 9.2 m wide by 289 m long bridge (spans of 30.5 m, 6 x 38.0 m and 30.5 m) would be converted to one-way, two lane operation for the southbound carriageway. While the existing bridge is not as wide as the 10.5 m proposed for a single carriageway on new bridges, it would provide adequately for two lanes of traffic with a reduced left shoulder width (1.2 m rather than 2.5 m for new bridges). Widening of the existing bridge is not proposed.
- A new eight-span 304 m bridge (eight spans of 38.0 m) would be constructed for the northbound carriageway on the western side, adopting a similar span layout to that of the existing bridge except that the end spans would be slightly longer to avoid disturbing the existing abutments of the adjacent bridge. While the span configuration for the new bridge

would match the existing bridge, the superstructure would not necessarily match the shape and form of the existing bridge (refer Working Paper No. 9).

- While the piled foundations are reasonably deep, most of the bridge length can be constructed over dry land.

#### **5.5.1.3 Stony Creek Bridge**

- As noted in Section 4.2.2 above, the existing single span bridge is narrow and in poor condition. It would be replaced with a new single span 15.5 m long bridge. A similar new parallel bridge would be constructed on the west side for the northbound carriageway.

#### **5.5.1.4 Railway Bridge at Rossglen**

- The existing three-span 9.2 m wide by 42.3 m long bridge (spans of 12.4 m, 17.5 m and 12.4 m) would be converted to one-way, two lane operation in the southbound carriageway with a 1.2 m left shoulder (as for the Stewarts River bridge).
- A new three span 42.5 m long bridge with a similar span layout (spans of 12.5 m, 17.5 m and 12.5 m) would be constructed on the west side for the northbound carriageway.

#### **5.5.1.5 Camden Haven River Bridge**

- The existing six-span 9.2 m wide by 164 m long bridge (spans of 23.5 m, 4 x 29.0 m and 23.5 m) would be converted to a one-way, two lane operation for the southbound carriageway with a 1.2 m left shoulder as above.
- A second six-span 174 m long bridge (6 spans of 29.0 m) would be constructed across the river on the western side for the northbound carriageway, adopting the same span layout to that of the existing bridge except that the end spans would be slightly longer to avoid disturbing the existing abutments of the adjacent bridge. The span configuration for the new bridge would match the existing bridge, and the superstructure would be required to be similar in shape and form to the existing bridge (refer Working Paper No. 9).

#### **5.5.1.6 Ocean Drive Bridge**

- A new four-span 56 m bridge (spans of 10.5 m, 2 x 17.5 m and 10.5 m) would be constructed for the Ocean Drive overpass above the highway. The most likely form of the superstructure would be Super-T beams with a concrete slab over. The roadway width on the structure would comprise 2 x 3.5 m lanes plus 2 m wide shoulders on each side. The widened shoulders are proposed in accordance with RTA guidelines (refer RDG Table 3.11-2) for the relatively high forecast traffic volumes on Ocean Drive (AADT 10,400 after 20 years).
- For improved pedestrian and cyclist safety a 2 m wide raised pedestrian/cycle footway would be provided on the south side of the overbridge in addition to the road shoulder. Throw screens would be provided on both sides of the bridge.

#### **5.5.1.7 Herons Creek Floodplain Bridge**

- The existing three-span 8.5 m wide by 32 m long bridge (3 spans of 10.7 m) over this floodway would be converted to a single direction, two-lane bridge for the southbound carriageway. Because of the narrow width of the existing bridge, allowance has been made for widening this bridge to the 10.5 m proposed for new bridges. As noted in Section 4.2.5, further checks of the Herons Creek flood channel bridge would be carried out in the detailed design stage to confirm the structural adequacy of this bridge and that it can be retained with widening.

- A new three-span 32 m long bridge (3 x 10.7 m spans) would be constructed on the western side for the northbound carriageway across the floodway. While the span configuration for the new bridge would match the existing bridge, the superstructure would not necessarily match the shape of the existing bridge (refer Working Paper No. 9).

#### **5.5.1.8 Herons Creek Bridge**

- As noted in Section 4.2.6 above, the existing two-span 24 m long bridge across Herons Creek is narrow and in poor condition, and would be replaced with a new single span 24.5 m long bridge for the southbound carriageway and a similar new parallel bridge for the northbound carriageway.

#### **5.5.2 Culverts**

Apart from the bridge structures there are 52 culverts required under the upgraded highway as described in Section 5.7. Of these, 17 would be reinforced concrete box culverts (RCBC) and the remainder pipe culverts. Culverts would be standard culverts in accordance with RTA standard details apart from two culverts to be constructed within the Camden Haven floodplain. These would require special detailing during the final design phase to ensure that allowance is made for the expected settlements:

- south of the Camden Haven River at Station 12390 where the existing culverts would be extended under the new northbound carriageway with four 1200 mm diameter reinforced concrete pipes
- north of the Camden Haven River at Station 13060 where the existing sunken culverts would be replaced with one 3.3 m x 2.1 m RCBC and one 3.3 m x 2.4 m RCBC.

#### **5.5.3 Removal of pylons of former bridge over Camden Haven River**

Both NSW Waterways and DPI (Fisheries) advised that the remaining pylons of the former bridge across the Camden Haven River, just downstream of the existing bridge, should be removed. Removal of the old piers and the underwater debris on the riverbed is proposed and is assessed as part of this EIS.

A reconnaissance dive around the old bridge piles reported on the condition of the two partially demolished piers located in the river immediately downstream of the current bridge and mounds of debris remaining after the removal of the seven other trestle piers.

The two piers now each consist of four approximately equal segments, with the pile cap located at 0.7 m below bed level for the northernmost pier (pier 6) and at 1 m below bed level for pier 5. Reinforced concrete rubble surrounds the two piers and the remaining seven pile trestle piers of the old bridge. The debris mounds peak at 1 m above the riverbed and taper into the surrounding silt riverbed over areas typically 4 m x 2 m. Beyond the debris piles, the riverbed is comprised of river gravel overlain by soft silt.

Methods of removing the disused piers and pier rubble have been investigated including an assessment of the disturbance the operation would cause and methods to mitigate these impacts. A methodology reflecting the best practice for removal of these piers and related underwater debris is described in Section 6.2.6.

#### **5.5.4 Other structures**

The only other structures required are earth-retaining structures within the Lake section where the Middle Brother National Park and/or the existing railway limit the possible extent of earthworks and necessitate the use of narrow medians and retaining structures. Four structures are required:

- A median retaining wall is required to separate the split-level carriageways just north of Stewarts River between Station 4300 and Station 5000. The maximum height of the retaining wall is 3 m. This wall would probably be constructed as a piled wall because of the limited room available for construction under traffic.
- A second retaining wall is required between the southbound carriageway and the railway from Station 4450 to Station 4550. The wall would be up to 7 m high and would be founded in part on the existing batter between the highway and the railway. The form of the wall would be decided in the detail design phase but would probably be a piled wall to avoid excessive removal and replacement of the existing fill material. Preferably the piles would be socketed into rock at the base. Anchors could be added to reduce the number and diameter of piles.
- Over a length of about 250 m between Station 4850 and Station 5100, an engineered 1H:1V slope up to 4 m high is required. The slope would be constructed using rock material from excavations. For reasons of stability and to avoid erosion this slope would be faced with grouted stones/ rock rip-rap or similar.
- In order to avoid any requirement for land acquisition from Middle Brother National Park and to reduce the impact on vegetation, a narrow median (3 m) containing a wire rope barrier would be adopted for a 1 km section adjacent to the boundary of the National Park. A retaining wall up to 6 m high is also proposed between the southbound carriageway and the railway over a 150 m long section (Station 7400 to Station 7550) opposite the Middle Brother National Park. The form of the wall would be as for the retaining wall between Station 4450 and Station 4550, described above.

## 5.6 Interchanges and local access arrangements

### 5.6.1 Interchanges

Interchanges with grade separation are proposed at Stewarts River Road in Johns River and at Ocean Drive in Kew.

#### 5.6.1.1 Johns River

A grade-separated half-diamond interchange is proposed at Stewarts River Road approximately 300 m to the west of Johns River. The proposed interchange incorporates a bridge on Stewarts River Road above the bypass. A northbound off-ramp and northbound on-ramp would connect to Stewarts River Road at an elevated roundabout and provide access to and from Johns River and areas to the west for northbound traffic. Bulleys Road would be diverted to the south and would also be connected to the elevated roundabout. Stewarts River Road would continue to connect with the former highway at the existing T-intersection in Johns River.

Southbound traffic would be catered for by a southbound off-ramp from the existing highway just south of the Stewarts River where the bypass rejoins the existing highway alignment. A southbound on-ramp is proposed at the south end of the bypass to allow local traffic to rejoin the upgraded highway. The existing highway would revert to a two-way local road between the southbound off-ramp and on-ramp.

#### 5.6.1.2 Kew

A grade-separated half-diamond interchange is proposed at Ocean Drive approximately 250 m to the east of Kew. The proposed interchange would provide for southbound traffic movements to and from the upgraded highway. Key features of the interchange are:

- Ocean Drive would pass above the bypass on a bridge.

- A southbound off-ramp and southbound on-ramp would connect to Ocean Drive at an elevated roundabout on Ocean Drive just to the east of the bypass.

Northbound local traffic is catered for by northbound ramps to and from the existing highway:

- Access to Kew and the local region for northbound traffic is provided by a northbound off-ramp near Sunnyvale Road where the bypass diverges away from the existing highway. The single lane exit ramp would meet the existing highway, the Sunnyvale Road (north) diversion, and Bethesda Road at a roundabout about 300 m north of the diverge.
- A northbound on-ramp from the existing highway is proposed at the north end of the bypass to allow local traffic to rejoin the upgraded highway. At the northern end of the bypass, Herons Creek Road would be diverted along a frontage road to the south which would also connect to Weeroona Place. The frontage road would join the existing highway at a T-intersection at the start of the northbound on-ramp, about 500 m north of Kew.

The existing highway would revert to a two-way local road between the northbound off-ramp and on-ramp.

#### **5.6.2 At-grade intersections, median openings and local access provisions**

RTA policy where highways are being upgraded to dual carriageway standard is to restrict the frequency of median openings so that the safety benefits of the upgrade can be improved. The *Road Design Guide* (RTA 1996) suggests that median openings should be provided at 3 km to 5 km intervals, however, for the Proposal the minimum spacing has been reduced to 2 km or less in some instances for the convenience of local residents. Where possible, the median openings have been combined with at-grade intersections to reduce additional travel distances.

Access to all existing properties would be maintained or reinstated as part of the proposed works but the result of the limited number of median openings is that some local residents who currently have direct access to and from both directions of the highway would be provided with left-in/left-out connections to one carriageway only. Median openings, at-grade intersections or interchanges where U-turns would be possible are proposed at eleven locations along the highway within the Proposal area as summarised in Table 10.

While the proposed highway upgrade is not a controlled access road, it is also RTA policy to limit the number of left-in/left-out connections as well as the number of median openings. This can be achieved by the construction of frontage roads on one or both sides of the upgraded highway which direct traffic from several properties to one access point with the highway. Local access roads have been considered where:

- there are several properties close together and a short frontage road would allow their access to be combined to one point
- direct access to the upgraded highway would be difficult as a result of changes in the level of the upgraded highway
- sight distance is substandard and a frontage road is required to shift the access connection to a point where adequate sight distance is available
- a relatively short section of frontage road would allow property access or minor local access roads to be diverted through the proposed interchanges at Johns River and Kew, thus eliminating at-grade intersections and increasing the safety benefits of the interchanges.

Based on this approach, frontage roads have been proposed at the locations identified in Table 11. In addition, allowance has been made in the proposed land acquisition boundaries for frontage roads in the future at the locations shown in Table 11, but these frontage roads are not proposed as part of the EIS.

**Table 10 At-grade intersections, median openings and local access provisions**

Station	Facility
About 600 m south of Proposal limits	Proposed median opening for adjoining Cooperook to Moorland Proposal
Station 2500	Johns River interchange
Station 3600	Median opening/U-turn facility
Station 6400	Median opening/U-turn facility combined with Algona Road intersection
Station 8550	Median opening/U-turn facility combined with Watson Taylor Road intersection
Station 11650	Median opening/U-turn facility combined with Ross Glen Road intersection
Station 13650	Median opening/U-turn facility combined with local access connection near Glen Haven
Station 15800	Kew interchange
Station 17150	Median opening/U-turn facility
Station 19000	Median opening/U-turn facility combined with local access connection at Eggbert property
Station 20900/ Station 21100	Median opening/U-turn facility combined with Cluleys Road/Herons Creek Road intersections. The Herons Creek Road intersection would allow B-Double vehicles to make turns to and from the upgraded highway.
Station 22150	Existing median opening/U-turn facility combined with Bobs Creek Road intersection to be retained. Deceleration lanes to be added to both sides of southbound carriageway approaches for improved safety.
About 1.4 km north of Proposal limits	Existing median opening at Bago Road intersection about 1.5 km north of the Bobs Creek Road intersection.

**Table 11 Frontage road locations**

Station	Frontage road description
<b>Included in the Proposal</b>	
2500 – 3500	Frontage road on west side of bypass diverts Bulleys Road to Johns River interchange
4900 – 5200	Frontage road on west side of upgraded highway. Shifts access point to the cut/fill line where good sight distance is available
5700 – 6100	Frontage road on west side of upgraded highway provides access connection for 3 properties
13600 – 14600	Frontage road on east side of upgraded highway provides access connection for 3 properties
14400 – 14700	Sunnyvale Road diverted on west side away from exit ramp diverge and connected to roundabout approx 300 m north
16400 – 17200	Frontage road on west side of highway diverts Herons Creek Road south and Weeroona Place back to the Kew interchange.
21800 – 22150	Frontage road on west side of highway diverts school access to the Bobs Creek Road intersection
<b>Provision for future frontage roads</b>	
50 – 200	Frontage road on west side to combine access for 4 properties
400 – 1150	Frontage road on west side to combine access for 4 properties
19000 – 19450	Frontage road on west side to combine access for 3 properties
19700 – 20400	Frontage road on west side to combine access for 4 properties

Based on these proposals for interchanges, intersections, median openings and frontage roads, the following impacts on local access would occur:

- Johns River section
  - Stewarts River Road would have connectivity to Johns River maintained
  - access to the highway would be enhanced from the west
  - Johns River residents would have marginally increased travel distances to access the upgraded highway.
- Lake section
  - additional travel distances of up to 3 km are expected for those residents who could not access the upgraded highway at Algona Road, Watson Taylor Road or Ross Glen Road.
- Kew section
  - all turning movements required for access to Kew would be catered for
  - minimal inconvenience is expected for traffic using Ocean Drive or Kendall Road as travel distances would be reduced or only slightly increased
  - additional travel distances of up to 1.5 km would occur for those residents who would use the existing highway to access the Kew interchange.
- Herons Creek section
  - up to 2 km additional travel distances would be experienced by residents as there would be a limited number of median openings
  - direct access to the Herons Creek Public School would be provided from the Bobs Creek Road intersection.

The existing highway through the Johns River and Kew townships would serve as a local road after the opening of the Proposal and it is anticipated that the bypassed sections would revert to local road status under the care and control of the Greater Taree City Council (for the existing highway at Johns River) and Hastings Council (existing highway at Kew). Preliminary discussions have been held with both councils regarding works on the existing highway prior to handover. Further discussions are required with both councils during the detailed design phase to agree on the scope and extent of works on the bypassed sections of the highway prior to handover.

### 5.6.3 Rail Access

The Main Northern Railway line extends for the full length of the Proposal. While relocation of the railway would not be required and all existing railway crossings would be maintained, there are several locations within the Lake section where acquisition of part of the existing rail reservation would be required and/or works would be required in close proximity to the existing railway line. At some locations the proposed works would affect existing rail access for repairs and maintenance and alternative access arrangements have been developed. The proposed access arrangements are shown on Figure 2C to 2H and are further described below:

- Station 1000 – 1200

At this location the existing highway would be retained as the southbound on-ramp allowing southbound traffic from Johns River to rejoin the upgraded highway. The proposed works would be only marginally closer to the existing railway and acquisition of rail land would not be required. Access to the railway for repairs and maintenance would not be affected.

- Station 4350 – 4650

Acquisition of part of the rail reservation would be required over a length of about 300 m on the north side of the Stewarts River. Within this section a retaining wall

would be required between the southbound carriageway and the railway from Station 4450 to Station 4550.

The Proposal would affect access to the railway and a new rail access track has been proposed on the east side of the existing railway. It would extend about 1 km south from the existing timber bridge (Salvation Bridge) at Station 5200.

- Station 4850 – 5150

Acquisition of part of the rail reservation would be required over a length of about 300 m immediately to the south of Salvation Bridge. The acquisition would accommodate the highway fill batter as well as a proposed sedimentation basin.

Access to the railway would be affected by the Proposal and a new access track would be provided on the east side of the railway line as described above.

- Station 6400 – 6650

Minor acquisition of part of the rail reservation would be required over a length of about 250 m opposite Algona Road to accommodate earthworks.

Access to the railway between Stations 6400 and 8100 would be affected by the Proposal. Construction of a new rail access track on the east side of the railway is therefore proposed between the existing railway level crossing at Station 5950 and Watson Taylor Road at Station 8400.

- Station 7000 – 7600

Minor acquisition of part of the rail reservation would be required over a length of about 600 m opposite Middle Brother National Park. The acquisition is necessary because of the constraint presented by the National Park, and would be required to accommodate the earthworks as well as construction of the proposed retaining wall between the southbound carriageway and the railway over a 150 m long section from Stations 7400 to 7550.

Access to the railway in this section would be provided by the new rail access track on the east side of the railway as described above.

- Station 7900 – 8100

Minor acquisition of part of the rail reservation would be required to accommodate earthworks over a length of about 200 m opposite Haydons Road. Access to the railway in this section would be provided by the new rail access track on the east side of the railway as previously described.

- Station 8400 – 8850

Acquisition of a triangle of railway land on the north side of the existing Watson Taylor Road would be required to accommodate the realignment of Watson Taylor Road as well as sedimentation basins on either side of Stony Creek.

Access to the railway in this section would be available from the realigned Watson Taylor Road.

- Station 10100 – 10600

Minor acquisition of part of the rail reservation would be required over a length of about 500 m opposite the realigned Charles Yard Road intersection to accommodate sedimentation basins.

Existing access to the railway for repairs and maintenance in this section would not be affected.

- Station 10950 - 11300

Minor acquisition of part of the rail reservation would be required over a length of about 350 m opposite the proposed northbound rest area.

Existing access to the railway in this section would not be affected.

## 5.7 Drainage and water quality treatment

### 5.7.1 Major catchments

The major catchments at the Stewarts River, Camden Haven River and Herons Creek were assessed in relation to design requirements to accommodate key drainage/hydrological characteristics (see Working Paper No. 4). The key design implications are as follows:

- Stewarts River – Duplication of existing 289 m long bridge opening. The 1 in 100 year afflux resulting from the duplication with a second bridge of approximately the same length would be minimal, estimated at 10-12 mm.
- Camden Haven River – Raise highway slightly to achieve protection from the 1 in 100 year flood level. Duplication of existing 163 m long bridge opening with an equal or greater opening would be required. The 1 in 100 year afflux resulting from the duplication with a second bridge of approximately the same length would be minimal, estimated at 12-15 mm.
- At Herons Creek the Proposal would incorporate the following:
  - existing highway would be raised to provide protection from the 1 in 100 year ARI flood level
  - duplication of existing Herons Creek 32 m long floodway bridge opening
  - replacement of existing 24 m long Herons Creek bridge with new single span 24 m long bridge and a duplicate 24 m span bridge on the west side
  - to reduce the afflux resulting from raising the level of the existing highway, upgrade culvert at Station 21280 from 0.45 m diameter pipe to three 3.0 m x 2.1 m box culverts.

By adopting these measures the afflux in a 100 year ARI event would generally be less than 100 mm and would not affect any existing residences. However, there would be a maximum afflux of 180 mm in a localised undeveloped area immediately to the southwest of the Herons Creek Road intersection (Station 20950). Refer to Section 2.4 of Working Paper No. 4 for further details.

As a result of the review of the key drainage/hydrological characteristics it has been possible to achieve at least one carriageway trafficable for the 1 in 100 year Average Recurrence Interval (ARI) flood event for the full length of the project. This includes the section south of Kew where a 1 in 20 year ARI was the minimum requirement specified by the RTA in the Brief.

### 5.7.2 Minor catchments

Minor catchments have been assessed and proposals are presented in Table 12. Further details are included in Working Paper No. 4. A total of 52 culverts are proposed along the highway upgrade to ensure that permanent and temporary water flows are appropriately conveyed under both carriageways in a 100 year flood event. In some cases, adjustments to culvert sizes have been made as noted to better accommodate fauna crossing requirements.

It should be noted that three existing culverts under the railway line immediately downstream of the upgraded highway in the Lake section appear to be undersized. It is recommended that

these rail culverts, at Station 6010, Station 10710 and Station 11370 should be upgraded as noted in Table 10. The deficiency in the size of these existing rail culverts is independent of the highway upgrade and no specific allowance for these works has been included in the cost estimates.

**Table 12 Culverts for minor catchments**

Culvert No.	Station	Feature	Culvert size for drainage	Note
1	140	Watercourse	One 1.35 m diameter RCP	
2	600	Watercourse	Two 0.75 diameter RCPs	
3	850	Watercourse	One 2.4 m x 1.2 m RCBC	
4	1018	Minor watercourse	One 0.525 m diameter RCP	
5	1325	Watercourse	One 2.4 m x 1.2 m RCBC	Include raised ledge to provide a dry passage for fauna
6	2100	Washtub Creek tributary	One 1.5 m diameter RCP	
7	2450	Washtub Creek	Two 2.4 m x 1.2 m RCBCs	
8	2690	Washtub Creek tributary	One 1.5 m diameter RCP	
9	3300	Watercourse	One 2.4 m x 1.2 m RCBC	
10	3500	from Bulleys Road	One 0.60 m diameter RCP	
11	4500	Minor watercourse	One 0.45 m diameter RCP	
12	4950	Yaralin Creek	Two 1.2 m diameter RCPs	
13	5060		Two 1.2 m diameter RCPs	
14	5660	Passionfruit Gully	Three 3.0 m x 3.0 m RCBCs	Raise invert of one cell to provide a dry passage for fauna
15	5770		One 0.9 m diameter RCP	
16	6010	Minor watercourse	One 1.05 m diameter RCP	In addition, one 0.6 m diameter pipe downstream under railway at Station 6100 should be upgraded to one 1.35 m minimum diameter RCP
17	6460	Minor watercourse	One 0.9 m diameter RCP	
18	6810	Minor watercourse	One 0.75 m diameter RCP	
19	7180	Small creek	Two 2.4 m x 1.2 m RCBCs	
20	7460	Minor watercourse	One 0.60 m diameter RCP	
21	7720	Small creek	Two 1.8 m x 1.2 m RCBCs	Increase size of one cell to 1.8 m x 1.8 m and raise invert slightly to provide a dry passage for fauna
22	7940	Minor watercourse	One 0.75 m diameter RCP	
23	9160	Minor watercourse	One 0.90 m diameter RCP	
24	9360	Watercourse	One 0.75 m diameter RCP	
25	9800	Minor watercourse	Two 1.8 m x 1.2 m RCBCs	
26	9950	Watercourse	One 2.4 m x 1.2 m RCBC	
27	10240	Minor watercourse	One 0.90 m diameter RCP	
27a	10505	Minor watercourse	One 0.45 m diameter RCP	
28	10710	Small creek	Two 2.4 m x 1.2 m RCBCs	1.5 m diameter RCP culvert under rail downstream should be replaced with two 2.4 m x 1.2 m RCBCs
29	11040	Minor watercourse	One 0.75 m diameter RCP	
30	11370	Small creek	Two 1.8 m x 1.2 m RCBCs	Downstream culvert under rail should be replaced with two 1.8 m x 1.2 m RCBCs
31	11600	Minor watercourse	One 0.90 m diameter RCP	

Culvert No.	Station	Feature	Culvert size for drainage	Note
32	11950	Minor watercourse	One 0.90 m diameter RCP	
33	12390	Watercourse	Extend culverts under new northbound carriageway using a buried connection chamber and four 1.2 m diameter RCPs	
34	13060		One 3.3 m x 2.1 m RCBC and one 3.3 m x 2.4 m RCBC	Proposed fauna crossing - one cell raised for dry passage The additional height in one cell allows it to function as a stock crossing as well
35	13770	Minor watercourse	One 1.05 m diameter RCP	
36	14290	Watercourse	Two 1.5 m diameter RCPs	
37	14550	Minor watercourse	One 0.90 m diameter RCP	
38	15170	Watercourse	One 0.75 m diameter RCP	Provide a dedicated 1.5 m x 1.5 m RCBC fauna crossing with invert raised to provide dry passage, in addition to the 0.75 m diameter RCP provided for drainage
39	15450	Watercourse	One 1.5 m diameter RCP	
40	16000	Minor watercourse	One 0.75 m diameter RCP with drop inlet	
41	16200		One 0.75 m diameter RCP with drop inlet	
42	16790	Minor watercourse	One 0.90 m diameter RCP	
43	17210		One 0.90 m diameter RCP	Increase size to 2.0 m x 2.0 m RCBC for fauna crossing
44	17830	Watercourse	One 0.90 m diameter RCP	
45	18210	Watercourse	One 1.2 m diameter RCP	
46	18560	Watercourse	One 0.75 m diameter RCP	
47	19010	Minor watercourse	One 0.75 m diameter RCP	
48	19510	Walkers Creek	Two 4.0 m x 3.2 m RCBCs	Provide a raised shelf for dry passage of fauna
49	20010	Minor watercourse	One 0.90 m diameter RCP	
50	21060	Small creek	One 1.8 m x 1.2 m RCBC	
51	21280	Minor watercourse	Three 3.0 m x 2.1 m RCBCs	

Note: RCBC - Reinforced Concrete Box Culvert  
RCP - Reinforced Concrete Pipe  
Culvert sizes and locations would be subject to refinement during detailed design.

### 5.7.3 Water quality control

As the Proposal crosses the Stewarts River, Camden Haven River, Herons Creek and other waterways, and traverses or passes close to several National Parks and SEPP 14 wetlands, particular attention has been given in the concept design to environmental measures that would be implemented to meet DEC guidelines for runoff discharge.

The most sensitive points for control of runoff are:

- the major bridges over the Stewarts River, Camden Haven River and Herons Creek
- Passionfruit Gully and other drainage lines that flow into National Parks such as Watson Taylors Lake (Crowdy Bay National Park) and SEPP 14 wetlands on the eastern, downstream side of the Proposal

- areas where the Proposal lies close to SEPP 14 wetlands No. 544a and No. 544c.

Where the above areas were identified as being most vulnerable to runoff from the highway or disturbed areas and where the terrain suited installation of basins, surface runoff from the road would undergo sufficient treatment using a system of water quality control ponds incorporating chemical traps to contain spills of hazardous materials and ensure that runoff meets relevant guidelines for discharge into wetlands or watercourses. The locations of sedimentation basins were selected taking into account geotechnical, hydrologic, hydraulic, soil conservation and other environmental issues such as avoiding mature trees wherever possible (see Figures 2A to 2N). Basins have been located as close as possible to the waterway, maximising the capture of site run-off and minimising the area of cleared land.

As shown in Table 13, a total of 42 basins are proposed. These basins would all be used during the construction phase but on completion of construction and establishment of vegetation, 19 of the basins would be removed while the remaining 23 basins would be retained during the operation phase of the upgraded highway.

Basins have been defined as either standard basins or as longitudinal basins. Standard sediment basins generally have a length three to four times greater than their width. In flatter areas such as the Camden Haven River flood plain, longitudinal basins (long narrow basins) would be more suitable than the standard basins as they reduce the requirement to acquire additional land and involve less disturbance to existing vegetation. Proposed locations of the various basin types are shown in shown in Table 13.

Further details of the design methodology and selection process for proposed sedimentation basins during construction and water quality control ponds during the operation phase are provided in Appendix B.

**Table 13 Sedimentation basins**

Station	Feature	Location <sup>(1)</sup>	Type of basin <sup>(2)</sup>	Adopted basin	
				Total capacity (m <sup>3</sup> )	Type <sup>(3)</sup>
Station 140	Watercourse	NW	Longitudinal	110	C
		SW	Longitudinal	40	C
Station 600	Watercourse	NW	Standard	262	C
Station 850	Watercourse	NW	Standard	49	C
Station 2100	Washtub Creek Tributary	SW	Longitudinal	962	C
Station 2450	Washtub Creek	SW	Longitudinal	413	C+O
Station 2690	Washtub Creek Tributary	SW	Standard	116	C
Station 3260	Watercourse	NW	Longitudinal	34	C
		SW	Longitudinal	419	C
Station 4200	Stewarts River	N	Standard	104	C+O
Station 4000	Stewarts River	S	Standard	844	C+O
Station 4960	Yaralin Watercourse	SW	Standard	352	C
Station 5060	Watercourse	NE	Longitudinal	507	C+O
Station 5660	Passionfruit Gully	SW	Standard	419	C+O
Station 6010	Minor watercourse	NW	Standard	406	C+O
Station 7945	Minor watercourse	NW	Standard	565	C
Station 8770	Stony Creek	NW	Longitudinal	202	C+O
		NE	Standard	186	C+O
		SW	Standard	520	C+O
		SE	Longitudinal	605	C+O
Station 9970	Watercourse	SW	Standard	56	C+O
Station 10250	Minor watercourse	NE	Longitudinal	140	C+O
		SE	Longitudinal	329	C
Station 11600	Minor watercourse	NW	Standard	93	C+O
		SW	Standard	62	C
Station 12800	Camden Haven River	NW	Longitudinal	256	C+O
Station 12550	Camden Haven River	SW	Longitudinal	151	C+O
Station 13060	Old Cattle Crossing	NW	Longitudinal	481	C+O
		NE	Longitudinal	319	C+O
Station 13790	Minor watercourse	NW	Longitudinal	165	C+O
		NE	Longitudinal	112	C
Station 14300	Watercourse	NE	Standard	198	C
Station 15470	Watercourse	NW	Standard	2153	C+O
		NE	Standard	134	C+O
Station 17850	Watercourse	SW	Standard	221	C
Station 19510	Walkers Creek	SW	Standard	51	C+O
Station 20010	Minor watercourse	NW	Standard	144	C
		NE	Standard	269	C
Station 21070	Small Creek	SW	Longitudinal	312	C
		SE	Standard	312	C
Station 21465	Herons Creek Flood Channel	SW	Standard	177	C+O
Station 21550	Herons Creek	NW	Standard	77	C+O

(1) Location with respect to culvert/waterway: NW = north-west side of highway etc

(2) Type of basin: Standard = standard basin with length three to four times width  
Longitudinal = Longitudinal basin = long narrow basin suitable for flat areas

(3) C = Construction phase only, C+O = Construction and Operation phases

## 5.8 Utilities

Utility services (in particular fibre optic and coaxial cables and water and effluent mains) would be affected by the Proposal in numerous locations and would require relocation or protection. An estimate of the adjustment and protection costs has been made and is included in the project cost estimate (see Chapter 7). The most significant impacts on utility services are shown in Table 14.

**Table 14 Impacts on utilities**

Station	Impact
<b>Telstra</b>	
Station 14500 to Station 15000	Optic fibre crossing in proposed deep highway cutting would require 'live' relocation.
Station 15230	Optic fibre crossing in proposed shallow fill would require lowering and protection.
Station 16350 to Station 16600	Optic fibre crossing in proposed deep cutting would require 'live' relocation.
	Alternatively, to avoid the above 'live' relocations, the Sydney-Brisbane optic fibre route may be cut over and relocated to the eastern boundary from Station 12800 to Station 18500.
Station 15800	Optic fibre along Ocean Drive to be raised into new Ocean Drive fill embankment and into Ocean Drive overbridge crossing of highway.
Station 16400 to Station 22200	Coaxial cable route occurs in a number of cuttings and fills and may require relocation over this full length.
Station 0 to Station 1400	Coaxial cable along proposed highway may require relocation.
<b>Optus</b>	
Station 12800	Optic fibre crossing in front of new northern Camden Haven bridge abutment and may require protection.
Station 17050	Optic fibre crossing in fill under Herons Creek Road to be protected.
Station 18500	Optic fibre crossing in fill to be protected.
<b>NextGen</b>	
Station 18500	Optic fibre crossing in shallow fill to be protected.
<b>Sewerage</b>	
Station 16550 to Station 17100	0.2 m diameter rising main and effluent main under proposed highway in fill to be relocated.
<b>Water</b>	
Station 15800	0.375 m diameter and 0.225 m diameter water mains along Ocean Drive to be raised into new Ocean Drive fill embankment and into Ocean Drive overbridge crossing of highway.
Station 16600 to Station 17000	0.15 m diameter and 0.10 m diameter water mains under proposed highway in fill to be relocated.
Station 18800 to Station 19400	0.15 m diameter water main under proposed highway and side road to be relocated.

Impacts and proposals would be subject to refinement during detailed design.

As part of its small township sewage scheme, Hastings Council proposes to provide a sewage system for Herons Creek township. Hastings Council has engaged a consultant to carry out the design development works associated with collection of sewage from the township and transfer, via pump and rising main, to the Kew-Kendall sewage treatment plant on the east side of the highway just to the north of Kew. While Council does not have an agreed construction schedule for the rising main, it may be constructed prior to construction of the Proposal. Information on the Proposal has been provided to Council and its consultant to ensure that the rising main is located where it would be clear of the Proposal and associated works, and would not require later relocation or protection.

## 5.9 Lighting, fencing and signposting

For safety and consistency with other Pacific Highway Upgrades, roadway lighting would be provided at the grade-separated junctions at Johns River and Kew. Lighting would be in accordance with Part 12 - Roadway Lighting Guide - of the *Guide to Engineering Practice* (AUSTROADS 1988) and the Australian Standard for Road Lighting (AS 1158). The most energy efficient lighting technology would be used wherever technically and economically feasible.

Interchange areas to be lit in accordance with these standards would include:

- merge and diverge areas (eight in total)
- ramps
- roundabouts at Johns River and Kew.

In addition, flag lighting is proposed at all T-intersections incorporating median openings. The flag or guidance lighting would be as described in AS 1158.1.1 (Isolated intersections and junctions). It would not achieve the lighting levels proposed at interchanges but is primarily aimed at identifying in advance the existence of the intersections for motorists travelling at night. Due to the width of the road, two or three street light fittings may be required at each intersection.

A summary of proposed lighting is shown in Table 15.

**Table 15 At-grade intersections with flag lighting**

Station	Facility
Station 6400	Median opening/U-turn facility combined with Algona Road intersection
Station 8550	Median opening/U-turn facility combined with Watson Taylor Road intersection
Station 11650	Median opening/U-turn facility combined with Ross Glen Road intersection
Station 13650	Median opening/U-turn facility combined with local access connection near Glen Haven
Station 19000	Median opening/U-turn facility combined with local access connection at Eggbert property
Station 20900/ Station 21100	Median opening/U-turn facility combined with Cluleys Road/Herons Creek Road intersections.
Station 22150	Median opening/U-turn facility combined with Bobs Creek Road intersection

The road reserve would be fenced on both sides in a manner consistent with adjoining land uses to prevent unauthorised pedestrian access and inadvertent intrusion by wildlife or stock. Where fauna activity is unlikely, post and wire fencing would generally be provided. Where boundaries are unchanged, post and wire boundary fences already exist in most cases and would be retained. Where new fencing is required, in areas requiring land acquisition for example, a new standard 5-wire fence would generally be provided at the acquisition boundary.

In some areas, this fencing would be of the fauna exclusion ('floppy top') variety to ensure that Koalas and other native fauna are not able to wander onto the roadway but are directed to the crossings provided. The proposed locations of fauna-proof fencing are as developed in Working Paper No. 7. The proposed fauna fencing locations are summarised in Table 16. These locations take into consideration fauna movements associated with:

- the regional continuity of habitat in the area
- the size and location of habitat present on either side of the highway
- the locations of structures facilitating fauna movements, such as RCBC and bridge openings (refer Section 6.13) and the species likely to need or use the fauna movement facilities
- the current and possible future land uses on either side of the highway
- the feasibility of construction with respect to engineering constraints.

The fencing should be located on both sides of the highway (as close as practicable) to guide animals to and through the movement structures and to prevent access onto the highway. In most areas the fauna-proof fencing would be supplemented by an existing post and wire boundary fence or, where new acquisition is required, by a new standard 5-wire fence located at the new acquisition boundary.

Where the vegetation strip between the acquisition boundary and the extent of earthworks decreases to less than about 15 m, consideration should be given to relocating the floppy topped fencing to the property boundary.

On private land the post and wire boundary fences would generally extend across fauna crossing locations. While the wire fence would act as a partial barrier to some species, particularly larger animals, some form of fencing would be necessary in most cases for boundary delineation and control of any stock.

Fence locations shown in Table 16 are indicative only. Final fence types and locations would be subject to negotiations with adjacent landowners during the detailed design stage of the Proposal but would generally be in accordance with the principles described above.

Further details of fauna provisions are provided in EIS Chapter 10 and in Section 5.13 as well as in Working Paper No. 7.

Road signage would be determined during the detailed design stage and would conform to prevailing RTA practice. Discussions would be held with Greater Taree and Hastings Councils during the detailed design stage of the Proposal in relation to any particular signage requirements prior to the exits to Johns River and Kew. An objective of any such signage would be to alert motorists to the facilities and attractions available in both townships and the Camden Haven region (see also EIS Chapter 17).

**Table 16 Proposed fauna fencing locations**

Section	Station of proposed fauna crossing	Station of southern limit of fencing	Station of northern limit of fencing	Length of highway requiring fencing (metres each side of highway)
Johns River	1325	1200	1570	370
Lake	5660	5600	5700	100
	7750	7000	7900	900
	8770	8600	9100	500
Kew	12780	no fauna fencing proposed since road elevated with steep embankments		
	13070	no fauna fencing proposed since road elevated with steep embankments		
	15170	15000	15300	300
Herons Creek	17200	17050	17500	450
	19510	19450	19700	250
	21465	21300	21600	300

Proposals would be subject to refinement during detailed design.

## 5.10 Noise attenuation measures

Design development of the Johns River bypass and the Kew bypass in particular have incorporated a number of design modifications aimed at reducing the need for specific noise mitigation measures. Noise mitigation has been considered and integrated as part of the design development of the Proposal as noted:

- Lowering the Johns River bypass consistent with flood requirements and taking Stewarts River Road over the top of the bypass
- Lowering the Kew bypass at the south end of the long cutting east of Kew, under Ocean Drive
- Lowering the height of the Kew bypass fill across the creek 300 m south of Ocean Drive from about 6 m to 4 m
- Lowering the Kew bypass where it crosses at the rear of the Glen Haven subdivision properties and incorporating a mound to reduce the visual impact of the bypass on this subdivision. The mound would also provide some noise attenuation benefits
- Lowering the new northbound carriageway outside the Herons Creek public school.

The predicted impact of road traffic noise from the Proposal is described in Working Paper No. 3 – Noise and Vibration Assessment. In order to meet the relevant criteria for road traffic noise for residential and other sensitive land uses, noise attenuation measures would need to be implemented along certain sections of the Proposal to assist in reducing traffic noise levels. In particular, the following noise mitigation measures are proposed:

### 5.10.1 Johns River

A 3.5 m high mound with a 1 m high noise wall on the top is proposed on the east side of the bypass to the north of Stewarts River Road. The mound would have 2H:1V slopes on each side and would be 1.5 m wide at the top. The mound and wall would extend from the overpass embankment at Station 2550 for a length of about 400 m to Station 2960. From Station 2960 to Station 3300 there would be no wall and the mound would taper from 3.5 m down to zero height.

Low noise pavement is also proposed on both carriageways through Johns River, from Station 2400 (Stewarts River Road), through to Station 3950; a total length through Johns River of approximately 1.55 km.

#### **5.10.2 Kew**

A 3 m high noise wall is proposed on the west side to the south of Ocean Drive. The wall would extend from the cutting at Station 15370 to the Ocean Drive embankment at Station 15800, a total length about 430 m.

North of Ocean Drive on the west side a 3 m high mound is proposed. The mound would start at the north side of Ocean Drive at Station 15820 and would extend through to Station 16000 at 3 m height. It would taper from 3 m high to zero between Station 16000 and Station 16150.

Low noise pavement is also proposed on both carriageways through Kew, extending from Station 15000 to Station 16600, a length of 1.6 km.

In addition, a 3 m high mound is proposed on east side to south of Ocean Drive. This mound is provided in response to both urban design and noise issues since it could not be justified on noise criteria alone. It would start at the end of the cutting at Station 15060 and end at the start of the long cutting at Station 15520.

#### **5.10.3 Herons Creek**

A 3 m high noise wall is proposed on the west side of the upgraded highway past the school, although it would not reduce noise levels to the EPA target levels. The wall would extend from Station 21650 to Station 21980.

Low noise pavement would be adopted past the Herons Creek village, but not outside the school. The low noise pavement would extend from Station 20340 to Station 21450 m on both carriageways.

These attenuation measures are also discussed in Working Paper No. 3 – Noise and Vibration Assessment.

### **5.11 Pedestrian and cyclist facilities**

Provision for pedestrian and cyclist movements across the highway is incorporated with the provision for local vehicle access. This includes improved pedestrian and cyclist safety via raised pedestrian/cycle footways incorporated in the Ocean Drive and Stewarts River Road overbridges. Separate raised footways are also proposed beside the western shoulder of the Herons Creek and Herons Creek floodway bridges to replace the existing timber footbridges used by Herons Creek Public School students.

No separate off-road provision for pedestrians or cyclists would be provided within the road reserve along this section of the Pacific Highway. Long distance cyclists would be able to use the sealed 2.5 m wide left shoulder that would generally be provided on both carriageways. This sealed shoulder width is consistent with RTA guidelines for road shoulder usage by cyclists where the 85<sup>th</sup> percentile vehicle speed is 100 km/h (refer Section 3.3.8 of the RTA *Road Design Guide*). The shoulder width would be increased by 0.5 m to 3.0 m where guard fencing or a barrier is located at the edge of shoulder. The only exception would be the left shoulder of new bridges, where the shoulder would not be widened from 2.5 m. The shoulder would also be available to vehicles stopping because of a breakdown or other reason.

The 2.5 m wide shoulder would be continuous across new bridge structures. The only locations where the 2.5 m wide left shoulder would not be available would be across the existing bridges at the Stewarts River (289 m long) and at the Camden Haven River (163 m long), both of which are retained for the southbound carriageway. There is no footway on either bridge and the available carriageway width between barriers is 9.2 m. Maintaining the

1.0 m wide median shoulder and two by 3.5 m lanes would allow a 1.2 m wide left shoulder for cyclists or emergency stopping. Over these bridges the shoulder width would be below desirable standards for uses by cyclists. The cost of widening these existing bridges to provide the full 2.5 m left shoulder would be prohibitive and is not proposed, however, further consideration will be given during the detailed design phase to the positioning of lane and shoulder markings within the available 9.2 m width. Reducing the median shoulder width and/or the lane widths would provide some scope to increase the left shoulder width without the cost of bridge widening.

Southbound cyclists would have an alternative route along the existing Pacific Highway through Johns River and northbound cyclists would have an alternative route along the existing highway through Kew. The pavement width on the existing highway at both Johns River and Kew is wide enough to allow re-linemarking with adequate shoulder widths for southbound and northbound cyclists respectively given the reduced traffic volumes on these sections of road.

## 5.12 Rest areas

The *Pacific Highway Upgrading Program - Strategic Assessment* (SKM 2000) assessed existing rest areas and identified where new rest areas should be provided. For the section of highway within the study area this document proposed a new northbound heavy vehicle rest area of approximately 0.7 ha in the vicinity of the Camden Haven River, and retention of an existing southbound heavy vehicle rest area located just south of the Camden Haven River.

Subsequently the report *Pacific Highway F3 (Freeway) Truck Rest Area Strategy* established that the new northbound rest area in the vicinity of the Camden Haven River should provide facilities for both heavy vehicle and light vehicle users. The report also included a requirement for parking areas for light and heavy vehicles to be separated, but the other facilities can be shared. Facilities to be provided included:

- parking for ten light vehicles
- parking for eight to ten B-Doubles
- deceleration lanes to RDG requirements
- acceleration lanes only in circumstances where they are necessary (i.e. poor sight distance to exit)
- toilets to the new 'Pacific Highway' design
- seating and shelter (usually 3 sets)
- shade for vehicles (using current trees if available).

In addition, existing rest areas along the existing highway in the study area would be retained where they are not affected by the Proposal and where safe access to and from the upgraded highway would be available.

Based on the above guidelines the Proposal incorporates the following measures in respect of rest areas:

- retention of:
  - existing southbound heavy vehicle rest area 0.75 km south of the Rossglen turnoff, Station 11200 to Station 11500. This is a developed off-highway rest area with access ramps to and from the existing highway. Access to the rest area would continue to be available following the highway upgrade. This rest area is a designated rest area in the Strategic Assessment and a landscape upgrade of the rest area is proposed as part of the highway upgrade. Refer to Working Paper No. 9 for further details

- closure of:
  - existing heavy vehicle rest area 100 m north of Rossglen turnoff, Station 12100. The new northbound carriageway passes through the middle of this rest area and retention would not be possible. It would be replaced by the new northbound rest area proposed at Station 10700 to 11000 as described below. The existing toilets would be relocated to the new northbound rest area.
  - an existing southbound heavy vehicle rest area about 0.3 km south of Haydons Road at Station 7600. This rest area comprises a widened shoulder over a length of about 100m. According to the Strategic Assessment this rest area should be retained, however this would not be possible due to the width restrictions imposed by the Middle Brother National Park and the adjacent railway.
- construction of:
  - new northbound heavy vehicle rest area located to the south of Ross Glen Road, Station 10700 to Station 11000. The proposed location of the new northbound rest area is about 1.2 km south of the bridge over the railway line. The rest area would be accommodated within the existing road reserve and would be facilitated by relocating the Charles Yard Road connection to the highway by about 800 m further to the south. Layouts for the proposed rest area would be developed during the detailed design stage and would incorporate the parking and other facilities listed above. The area available is in excess of the 0.7 ha suggested in the Strategic Assessment. Adequate sight distance is available at the exit from the rest area and an acceleration lane would not be required.

The detailed design of rest areas would follow the RTA's *Road Environment Safety Update 23 Rest Area Best Practice Design Guide*.

### 5.13 Provision for fauna movement

A summary of the provisions that have been made in the concept design to allow for the safe movement of fauna across the highway corridor, together with the rationale for each measure, is presented in Table 17. Provision for fauna movement is proposed only through use of bridges and other drainage structures such as culverts. Based on ecological and regional connectivity issues (see Working Paper No. 7), there are no 'purpose specific' fauna underpasses or overpasses proposed, although some culverts have been augmented or enlarged based on fauna connectivity requirements.

As noted in Section 6.9, the proposed highway reservation would be fenced on both sides with fauna exclusion fencing and/or stock-proof fencing in all relevant locations. The fauna-exclusion fencing would assist in directing fauna to the crossings provided and the proposed extent of this fencing is summarised in Table 16.

The crossings should also aim to provide dry passage for fauna either through the inclusion of a raised walkway within existing culverts or through the positioning of new cells. Proposals are described generally in Table 17 and would be further developed in the detailed design stage of the proposed highway upgrade.

Further consideration of the need for design features to facilitate safe fauna movement across the bypass is given in Chapter 10.

Additionally, a number of other bridges and drainage structures included in the Proposal but not mentioned above may also function as fauna movement facilities, especially for smaller fauna. These additional locations are not listed above due to the lack of suitable habitat on at least one side of the preferred route, or because they do not provide connectivity within a wider regional context (see Working Paper No. 7).

**Table 17 Location and type of fauna crossings**

Approx. Station	Proposed culvert size for drainage	Proposed adjustment to suit fauna
1325	One 2.4 m x 1.2 m RCBC	Raised ledge for dry passage of fauna
5660	Three 3.0 m x 3.0 m RCBCs to be lengthened	Invert of one cell raised for dry passage of fauna
7720	Two 1.8 m x 1.2 m RCBCs	Size of one cell increased to 1.8 m x 1.8 m RCBC
8790	Duplicate existing 15.2 m span bridge	Single span bridge, no special adjustment required
12630	174 m long bridge over Camden Haven River	Northern span of bridges allows fauna to cross under the highway - no special adjustment required
13060	Replace existing sunken culvert with one 3.3 m x 2.1 m RCBC and one 3.3 m x 2.4 m RCBC	Invert of one cell raised for dry passage of fauna
15170	0.75 m diameter pipe	Additional 1.5 m x 1.5 m RCBC fauna crossing with invert raised to provide dry passage for fauna
17210	0.9 m diameter pipe	Culvert size increased to 2 m x 2 m RCBC
19510	2 x 4.0 m x 3.2 m RCBC	Raised shelf provided for dry passage of fauna
21465	32 m span bridge over Herons Creek floodway	Bridge structure allows fauna to cross under the highway - no special adjustment required

Proposals would be subject to refinement during detailed design.

## 5.14 Landscape and urban design concept plan

The *Pacific Highway Urban Design Framework* contains six urban design objectives to assist in delivery of the urban design vision presented in Section 1.1. These objectives are:

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

These objectives have underpinned the development of the urban design and landscape concept presented in Working Paper No. 9 and summarised in EIS Chapter 13. The landscape and urban design concept is illustrated in EIS Figures 6-4A to 6-4N which represent the proposed urban and landscape concept for the Proposal. Figures 6-4O and 6-4P show the proposed layouts at the Johns River and Kew interchanges respectively.

Particular ways in which the urban design objectives have been incorporated in the development of the concept design of the Proposal include:

- The townships of Johns River and Kew are proposed to be bypassed, to achieve key road design requirements, and safety and amenity improvements for these communities.
- The existing road formation would be retained as one carriageway for most of the remaining length, while the second carriageway would be constructed alongside. This would limit the amount of disturbance of vegetation and contribute to a well-vegetated, natural road reserve
- The noise mound that would separate the Johns River bypass from the township would also contribute as a visual mitigation measure.

- A narrow median with split-level carriageways would be implemented over the section to the north of the Stewarts River bridge. As well as adding an interesting design element, this allows the existing high rock cutting (300 m long and up to 15 m high) to be retained undisturbed, and also allows the retaining wall between the upgraded highway and the railway to be reduced in height.
- The vertical alignment of the proposed Kew bypass has been lowered to reduce the visual impact of the bypass on the township of Kew to the west and the Glen Haven subdivision to the east of the bypass. The lower profile is supplemented by the addition of earthen mounds and noise walls on both sides of the bypass to further reduce the visual impact on these communities.
- Split-level carriageways are also proposed on the Kew bypass to the north of Ocean Drive to better integrate the design with the topography and to reduce the footprint of the disturbed area.

## 5.15 Layby Areas and Truck Stopping Bays

In accordance with the criteria in Section 3.12, layby areas have been proposed in both directions at intervals of about 1 km, with every fifth layby in each direction designated as a truck stopping bay.

Actual spacings have been adjusted to suit access locations, sight distance requirements, and to reduce additional cut and fill requirements. Proposed locations are shown in Table 18.

## 5.16 Guidelines for detailed design

### 5.16.1 General guidelines

The concept design on which this EIS is based is an initial functional layout developed as part of the design development process. It addresses and responds to all constraints and principles identified and established as part of this study. The concept design is intended to define a robust and buildable concept that provides:

- a definition of property acquisition requirements sufficient to allow acquisition to proceed
- a clear description of the design principles, extent of impacts and impact mitigation requirements
- a sound and clear basis for the later development of detailed designs to the standard required to support the construction contract.

Detailed design would be undertaken only if the proposal is approved and would take into account environmental constraints and mitigation measures identified in this EIS. Matters raised in representations would be considered and could result in adjustments to the design as a condition of the proposal proceeding. In addition, alternative approaches derived from the greater knowledge of detailed design or the passage of time may be suggested in relation to elements of the concept design. Consequently, it is possible that the detailed design may vary from the concept design description provided in this Working Paper.

**Table 18 Layby Areas and Truck Stopping Bays**

Station	Type	Comment
<b>Northbound</b>		
530	Car	combined with access
1250	Car	
2500	-	Johns River interchange
3200	Car	
4300	Truck	
6000	Car	combined with access
7400	Car	
8980	Car	
10400-11000	-	rest area
11880	Car	
13700	Car	combined with access
15260	Car	
16100	Car	
17150	Truck	dedicated U-turn facility
18500	Car	
19700	Car	combined with access
20465	Car	
<b>Southbound</b>		
400	Car	combined with access
1420	Car	
2500	-	Johns River interchange
2970	Car	
4370	Car	
5950	Truck	
6860	Car	
8330	Car	at an intersection with median opening
9700	Car	combined with access
11000-11600	-	rest area
13300	Car	combined with access
14410	Car	
15800	-	Kew Interchange
17150	Truck	dedicated U-turn facility
18100	Car	
19340	Car	combined with access
20600	Car	
21620	Car	combined with access

Proposals would be subject to refinement during detailed design.

### 5.16.2 Key issues for detailed design

The objective of these guidelines for detailed design is to ensure that the design development process that follows project approval adequately incorporates the key principles established during the study and inherent in the concept design.

The development of detailed design would be required to:

- be consistent with the design criteria and design principles on which the concept design was based as described in the EIS and any subsequent Representations Report
- address any unresolved issues associated with the development of the concept design as proposed in the EIS and any subsequent Representations Report
- meet any Conditions of Approval arising from the EIS approval process, unless changes to the Conditions of Approval are subsequently agreed
- incorporate community and Agency requirements by the implementation of a consultation plan aimed at identifying and resolving issues of concern to Agencies, the community and other groups
- avoid identified environmentally sensitive areas and significant species wherever possible
- develop and refine mitigation measures
- appropriately develop and incorporate the urban design strategy and landscape concept developed in Working Paper No. 9 into the detailed design
- establish detailed proposals for construction delivery method and construction staging addressing buildability, traffic capacity and safety during construction, geotechnical issues, all relevant RTA specifications and design requirements, current guidelines, and policies and practicality/cost effectiveness
- incorporate the construction concepts and environmental management requirements presented in this EIS and any subsequent Representations Report
- address risk management during construction and operation
- provide a level of definition sufficient to support a construction contract that will meet all RTA's requirements for the completed highway upgrade
- ensure that the detailed design allows for safe and cost effective maintenance of the highway upgrade during operation in accordance with Occupational Health and Safety requirements and relevant RTA specifications.

## 6. CONSTRUCTION ISSUES

### 6.1 Delivery methods

The options under consideration for delivery of the project include:

- design by RTA or a consultant followed by competitive tendering by contractors for a construction only contract
- design and construction (D&C) contract awarded after competitive tendering to a contractor with design team
- design, construct and maintain (DCM) contract with maintenance for a nominated period.

The Concept Design and the EIS are not predicated on any particular contract packaging, delivery or construction method. If the Proposal proceeds, and closer to the time of construction, the RTA will consider the options for project delivery, and select and implement the preferred method in compliance with this EIS and the conditions of approval.

### 6.2 Construction methods

The construction staging and construction methods outlined in this Working Paper are intended to present a feasible and realistic staging and methodology in sufficient detail to allow an assessment of the likely nature and extent of environmental impacts during construction. Requirements for construction methods would be developed in more detail in the tender specification and would subsequently be developed and finalised by the successful construction contractor(s) in consultation with the RTA.

The detailed construction methodology prepared by the construction contractor(s) would be in the form of Construction Method Statements based on the commitments and obligations contained in this EIS. The construction contractor(s) may adopt alternative construction methods provided that the level of adverse impact during construction is not substantially different from the impact of the methodology presented below. It is also expected that the construction method developed by the contractor(s) would vary from that described in this chapter as a result of detailed design changes, community and stakeholder representations, the conditions of approval by the Minister for Infrastructure and Planning, and the chosen delivery method.

#### 6.2.1 Typical construction sequence

The detailed method of construction for the Proposal would depend on the staging and the specific approach of the construction contractor(s) in meeting contractual obligations. However, it could be expected to be along the following lines for each section of the proposed works:

- acquisition of land
- adjustment of existing public utilities
- pre-clearing investigations to confirm locations of flora and fauna of conservation significance
- site establishment including survey setout, safety fencing of site, and establishment of site compounds, and access points and access routes
- installation of traffic management measures to control highway and construction traffic during construction
- installation of temporary erosion, sediment and water quality controls including diversion drainage, sedimentation basins and cross-flow culverts

- establishment of stockpile areas
- clearing of vegetation and mulching of plant material for reuse
- stripping, stockpiling and management of topsoil
- treatment of any soft soil areas under embankments
- earthworks
- installation of drainage lines, fauna underpasses and local access
- establishment of asphalt and concrete batch plants
- bridge construction
- subgrade preparation and pavement construction
- topsoil rehabilitation and revegetation of batters and berms
- landscaping
- installation of on-site noise mitigation measures
- installation of noise mitigation measures (note that, where possible, noise mitigation measures would be installed earlier in the construction process where not dependent on completion of earthworks and where they would be of benefit in reducing construction noise)
- line marking and signposting
- interchange lighting
- finishing works (including general site clean up and removal of site compounds).

As the delivery method and construction staging for this project have not yet been determined, there may be some variation to this sequence and the preferred method of undertaking particular works. However, the construction method would have to comply with the construction concepts and environmental management requirements presented in this EIS and the Construction Environmental Management Plan (CEMP) prepared by an independently appointed contractor.

## **6.2.2 Construction staging**

### **6.2.2.1 General Issues**

The assessment of options for staging of construction requires a consideration of both the size of construction packages and the order of construction of the various sections of the Proposal.

Appropriate staging of construction both within and between construction stages would be required to ensure continuity of access along the highway and to and from adjacent properties and intersecting roadways. Staging of construction should also consider the land acquisition process, availability of fill material (earthworks balance of each section), areas where pre-consolidation of embankments will be required, funding availability, and the remaining life of existing bridges designated for replacement.

Key factors influencing the order of construction of the Proposal are:

- An excess of material available from the Kew section is required for construction of the remaining of the remaining length of the Kew section as well as for the other sections. Early construction of just the Kew section would result in the need to stockpile and double-handle about 200,000 m<sup>3</sup> of material.
- An approximate earthworks balance has been achieved for the Johns River section and for the Lake section.
- There is a shortage of general fill of about 130,000 m<sup>3</sup> for the Herons Creek section.
- The embankments across the Camden Haven floodplain and the southern approach embankment to the Stewarts River bridge will require a significant period for settlement prior to construction of pavements. It has been estimated that the embankments for the Camden Haven River bridge will settle by up to 0.6 m during consolidation due to the nature of the soft or loose alluvial deposits. Depending on the method of construction adopted and time constraints, it could take up to 4½ years to achieve 90% consolidation for the embankment on the south side of the Camden Haven River. For this reason, construction of the embankments would need to be carried out with sufficient lead-time to allow for consolidation prior to bridge and pavement construction. Early construction of these embankments would maximise the settlement time available.
- Settlement of the embankments at Stewarts River is not expected to be as significant (0.3 m consolidation), and would have a lesser impact on construction staging.
- In terms of safety and amenity, the sections which would benefit most from earlier construction are the Kew and Johns River bypasses and associated interchanges.
- Where possible, dual carriageway sections should be provided in continuous lengths, avoiding short sections of single carriageway between completed dual carriageway sections. The duplication at the northern end of the project is already in place and it is anticipated that the Coopernook to Moorland section will be complete prior to commencement of construction of the Proposal.
- It is assumed that land acquisition would proceed following approval of the project and that the acquisition process would not influence the order of construction.
- It has been assumed that the availability of funding would not be a constraint and that a relatively short construction period, estimated at 3 to 3½ years minimum, could therefore be achieved.
- While there are two existing bridges which are identified for replacement, structural assessment indicates that replacement is not urgent and therefore does not influence construction staging.
- Haulage would also have an impact on local roads. It would include the transfer of fill material between sections as well as the delivery of construction materials such as pavement materials, asphalt, and concrete. Where significant volumes of fill material need to be transferred between sections, this transfer should not coincide with peaks in delivery of construction materials. Haulage should also take into account peak travel hours and times, particularly during school and public holiday periods, to minimise the potential for delays on the highway to the travelling public.

- In order to maximise the return on the investment it is preferable that completed sections be opened to traffic as soon as possible. This means that any individual construction stage should begin and end at locations where connection back into the highway network existing at the time could be safely achieved and with a minimum of temporary works required. Generally the tie-in would require a transition between the new dual carriageway highway and the existing single carriageway. The safety of the horizontal and vertical alignment of the temporary connections is particularly important in this case because the connections may be required to operate for a period of two years or more. Other issues that should be considered in determining preferable section limits for the transitions are:
  - one carriageway of the newly completed works should approximately match to the existing carriageway both horizontally and vertically
  - there should be no intersections or local access points in the vicinity of the tie-in
  - tie-ins on sharp horizontal or vertical curves should be avoided.

#### 6.2.2.2 Proposed Staging

The construction staging of the Proposal has been reviewed based on the above criteria and one option for construction would be to adopt two stages as described below. It should be noted, however, that the way in which the Proposal might be staged would depend on the availability of funding, emerging accident history and other issues that at the time may demonstrate a need to develop staging to satisfy specific requirements.

- **Stage 1 – Johns River, Kew, and Herons Creek sections**

This stage would include the Kew bypass, the Herons Creek section and Johns River bypass. It would include construction of the embankments across the Camden Haven floodplain and the southern approach embankment to the Stewarts River bridge, but would not include pavement construction on these embankments. There would be an approximate overall balance of earthworks for Stage 1, with the excess of material in the Kew section balancing shortages in the other sections, primarily the Herons Creek section. This stage would include the Herons Creek bridges, the Ocean Drive bridge, and the Stewarts River Road bridge. It would exclude the major bridges across the Stewarts River and the Camden Haven River, since these should be constructed after the approach embankments have settled. The length of construction in Stage 1 would be about 12 km of completed pavement plus about 1 km of embankment in soft soil areas.
- **Stage 2 - Lake section**

This stage would cover the remaining section between Johns River and Kew, including construction of the Stewarts River bridge, Stony Creek bridges, Rossglen railway bridge and the Camden Haven bridge. It would also include construction of pavements on the embankments across the Camden Haven floodplain and the southern approach embankment to the Stewarts River bridge. There would be an approximate overall balance of earthworks for Stage 2. The length of construction in Stage 2 would be about 10 km including the major bridges and construction of pavements on embankments in soft soil areas.

#### 6.2.2.3 Order of works within each stage of construction

Within each stage it would be preferable to concentrate resources on convenient sub-sections which could be completed and opened to traffic separately. This process would also help ensure that disruption to traffic at any one time would be restricted in extent. Suggested sub-sections within each stage are defined below, in the proposed order of construction:

- **Stage 1 – Johns River, Kew, and Herons Creek sections**
  - Embankments across the Camden Haven floodplain (Station 12300-12600 and Station 12800-13500) using fill material sourced from cuttings in Kew.
  - Johns River section, which has an approximate earthworks balance. It would include the bridge and interchange at Stewarts River Road. At the southern end the duplication would match to the Coopernook to Moorland section which should be completed before the Moorland to Herons Creek upgrade commences. At the north end, the new southbound carriageway of the bypass would be connected to the existing highway at Station 3800. A temporary dual to single carriageway transition would be constructed between Station 3400 to 3700. The northbound embankment earthworks would be constructed through to the proposed abutment at Station 3940 but northbound pavement would be constructed to Station 3700 only.
  - Herons Creek section using fill material sourced from cuttings in Kew. It would include the three bridges at Herons Creek. At the northern end the duplication would match to the existing dual carriageway north of Bobs Creek Road. At the southern end a temporary connection would be made to the existing carriageway at about Station 17100. A temporary single to dual carriageway transition could be constructed between Station 17100 and Station 17400 so that the Herons Creek section could be opened to traffic prior to construction of the Kew bypass.
  - Completion of Kew bypass, including the bridge and interchange at Ocean Drive and the access roads at Weeroona Place, Sunnyvale Road and Glenhaven. At the southern end a temporary single carriageway to dual carriageway transition would be constructed between Station 13300 and 13600. At the northern end the bypass would be connected to the completed Herons Creek section at Station 17100.
- **Stage 2 - Lake section**
  - Lake section south. It is proposed to construct the southern section first because the settlement period required for the soft soils at the Stewarts River is shorter than at the Camden Haven River. This section would include construction of the Stewarts River bridge and completion of the pavements on the south approach embankment. It also includes construction of retaining walls in the section just to the north of the Stewarts River and opposite the Middle Brother National Park. At the southern end the duplication would match to the completed section of the Johns River bypass at Station 3700. At the northern end, the upgraded southbound carriageway of the bypass would be connected to the existing highway at about Station 9800. A temporary dual to single carriageway transition would be constructed between Station 9800 and 10100.
  - Lake section north. This would be the last section constructed in order to provide as long a period as possible for settlement of soft soils under the Camden Haven floodplain embankments. This section would include construction of the railway bridge at Rossglen and the Camden Haven River bridge, as well as completion of the pavements on the approach embankments to this bridge. At the southern end the duplication would match to the completed Lake south section at Station 9800. At the northern end, the section would include pavement construction through to the completed Kew section pavement at Station 13600.

### 6.2.3 Construction packaging

Adoption of a single construction contract for Stage 1 and another single contract for Stage 2 would result in two large contracts but their size is not excessive considering recent practice. Each stage would require two to three years to construct. The advantage of single contracts is that efficiencies in construction can be achieved and that earthmoving process can be optimised with a minimum of stockpiling and double-handling. It would also be easier to ensure that disruption to traffic at any one time would be restricted in extent.

Should circumstances at the time require, however, it would be possible to split Stage 1 and/or Stage 2 into sub-sections. The sub-sections could correspond to the four Stage 1 sub-sections and the two Stage 2 sub-sections listed above. Careful documentation would be required if smaller contract packages are adopted since it would be necessary to ensure that disruption to through traffic at any one time is controlled and that possible conflicts arising from having different contractors on site at the same time are addressed. While it would be feasible to sub-divide Stage 1 and Stage 2 into smaller contracts, the basic order of works as described in Section 6.2.2 should be retained. The construction staging methodology has been developed based on the two major packages shown. The same methodology would work if the packages were sub-divided, the only real difference being that various sub-sections would be carried out consecutively by different contractors rather than under the one contract.

The exact construction packaging, as with the construction staging described in Section 6.2.2, would depend on other issues such as the availability of funding and the concurrent workload in the construction industry.

### 6.2.4 Traffic impacts during construction

There are no appropriate alternate temporary routes to the existing highway that could be used during construction. Provision for highway traffic therefore needs to be considered in the construction staging and construction methodology for all sections of the Proposal.

Construction of the Johns River bypass and Kew bypass could generally proceed free of traffic but a significant part of the proposed highway upgrade would involve duplication alongside the existing highway. Generally the horizontal alignment of the existing highway has been adopted as the approximate alignment of one carriageway of the upgraded highway and the proposed median width is 11 m. In this situation the new carriageway could be constructed with little impact on existing traffic. Once the new carriageway is complete, traffic would be transferred to the new carriageway while the existing carriageway was upgraded.

However, there are a number of locations where one carriageway would not be clearly separate from the existing highway and construction activities would be required in close proximity to existing highway traffic.

Locations where work would necessarily be carried out in close proximity to the existing highway are:

- at the tie-ins at either end of the Johns River and Kew bypasses
- along the Lake section just north of the Stewarts River bridge (Station 4300 to Station 5000) where split level carriageways, narrow median and retaining walls are proposed
- along the Lake section through Middle Brother National Park where a narrow median and retaining wall are proposed
- where the Johns River and Kew bypasses connect to the existing highway
- at the connections to the existing dual carriageways north of Herons Creek and south of Johns River where the Cooperbrook to Moorland duplication is expected to be complete

- at locations where the new carriageway switches from one side of the existing carriageway to the other side:
  - around Station 200 where the new carriageway would shift from the eastern side to the western side of the existing carriageway
  - around Station 13200 where the new carriageway would shift from the western side to the eastern side of the existing carriageway
  - between Station 17000 and Station 18500 where the new carriageways straddle the existing highway in order to avoid existing fibre optic cables on both sides of the existing highway
  - around Station 21000 where the new carriageway would shift from the eastern side to the western side of the existing carriageway.

In addition to speed restrictions and traffic controls, night work could be required for short periods at the above locations where the proposed new carriageway conflicts with the existing highway. Night work may be necessary to allow smooth transitions to be constructed and traffic diversions to be installed while minimising traffic impacts. Detailed arrangements for works in these areas would be developed during detail design. Refer to Section 5.16 for further description of requirements during detailed design.

#### **6.2.5 Construction of the major bridges**

Major bridges are required across the Stewarts River (new bridge 304 m long) and across the Camden Haven River (174 m). The northern span of the Stewarts River bridge crosses the river itself, but the piers are all located within the floodplain rather than in the river. The Camden Haven River bridge would have five piers, all of which would be located within the river.

Construction of new bridge structures may result in adverse impacts on local waterways traversed by the Proposal, particularly in terms of water quality and degradation of aquatic biota. Potential impacts may include:

- increased sediment and contaminant loadings to waterways, resulting from disturbance of stream beds
- physical alteration or removal of aquatic habitat
- impediment to fish passage
- afflux and constriction of flood waters due to physical obstruction.

These impacts are addressed in EIS Chapters 8, 9 and 11. Other construction issues are described in the following sections.

#### **General mitigation measures**

- Erosion and sedimentation control measures would be used during construction including the use of silt fences/curtains and sedimentation basins designed in accordance with Landcom's *Managing Urban Stormwater: Soils and Construction 'Blue Book'*, and RTA's *Road Design Guide* to achieve best practice erosion control and mitigation.
- As part of the CEMP for the project, an Acid Sulfate Soils Management Plan (ASSMP) would be prepared in acid sulfate soil risk areas, with further sampling and testing to be carried out on the sediments at risk areas prior to any disturbance. The ASSMP would provide guidance on the appropriate management and control measures to be implemented in the event that any excavations unearth acid sulfate material.

- If riparian vegetation needs to be removed during site preparation, the DPI prefers the 'cut stump' method of removal to maintain natural scour protection.
- Current practice is for sediment basins to be set as close as possible to the waterway, maximising the capture of site run-off and minimising the area of cleared land. For works done in waterways, basic RTA practice is to surround the works with silt fences. Details of proposals for erosion and sediment control are provided in Appendix B.
- Where work in watercourses is required (e.g. culvert installation), these works should be carried out under the shortest possible timeframe and in as dry a condition as possible.
- The DPI's Policy and Guidelines for Aquatic Habitat Management and Fish Conservation recognises that snags in waterways form one of the most important habitat components for fish within a river or creek and advises that they should be retained to the greatest extent possible. Snags consist of whole trees, limbs and root masses that are partly or wholly submerged. Where the removal of snags is necessary, DPI suggests they should be relocated to areas of the river or creek either upstream or downstream of the proposed construction works. These snags should remain in this position on completion to reduce handling and further habitat dislocation.

### **Approach to assessment of bridge construction impacts**

Construction of the 304 m bridge over the Stewarts River and 175 m bridge over the Camden Haven River requires methods that would reduce the extent and potential for adverse impacts and incorporate appropriate mitigation measures and design treatments.

A feasible method of construction has been developed for these bridges (as described below) but detailed construction methods would be the prerogative of the contractor. The method of construction described is not intended to be prescriptive but is presented to allow a realistic assessment of the likely nature and extent of impacts during construction. The contractor may adopt alternative construction methods provided that the level of impact during construction is not greater than the impact of the method presented below. This requirement will be reflected in the CEMP and contract conditions for the project.

### **Construction of the bridge over the Stewarts River**

There will be no pier construction in the Stewarts River waterway itself as the bridge has been designed to span the river. Appropriate erosion and sediment control measures would be required to prevent sediment-laden runoff from entering the river, but the riverbed should not be disturbed by construction activities.

It is proposed that the piers and abutments for the new bridge would be supported on driven steel or concrete piles and founded on rock at about 15 m below AHD. Excavation for pile caps may expose ASS. An ASSMP would be prepared in advance of the construction works to provide the construction contractor(s) with an appropriate range of measures and strategies on how to excavate in ASS areas, handle and dispose of, if necessary, ASS material won from any excavation works. Further details of requirements for management of ASS and PASS materials are provided in EIS Chapter 8.5.

### **Construction of the bridge over the Camden Haven River**

It is anticipated that construction of the foundations in the waterway of this river would be carried out using a barge-mounted pile-driving rig. For the piers adjacent to the banks, other methods such as the construction of rock support pads would be considered subject to demonstration of acceptable environmental management and mitigation measures. Driven hollow steel tubes or driven concrete piles are suggested for the piling as disturbance to PASS and the riverbed during construction is less than for other pile systems involving bored cast in-situ concrete piles. The rig would install the steel tube or precast concrete pile by vibrating the piles through the marine silts and sediments.

Following the vibration, the steel tubes or concrete piles would be driven, using a piling rig to the required load capacity. The piles would be founded on bedrock at approximately 25 m below AHD. Inclined piles would be installed to transfer horizontal forces to the substrates. For steel tubes, the top 7 m of the piles would be concrete filled after all of the piles in the pile groups are installed.

The pile cap would be formed up around the piles using the piles to support the formwork. The bottom of each pile cap would be just below the low tide water level - the pile cap would extend out of the water for approximately 1.25 m to match the existing pile caps.

Concrete for the construction of the pile caps, piers and headstocks to support the bridge beams could be provided by barge using skips. Erection of the precast beams for spans above water could also take place using barges. A barge-mounted crane would lift the precast beams from a storage area (probably on the north bank of the Camden Haven River), transport them to the appropriate span, and lift them into position.

Clearing of riparian vegetation communities along the riverbank for construction access would be restricted to the extent reasonably possible for construction of the bridge. This vegetation helps to consolidate the riverbank habitat and provide scour protection. Some removal of riparian vegetation would be required during construction for vehicle/boat access and the preparation of the bridge abutments. Sediment fences would be deployed around areas of excavated or stripped land and sediment curtains would be installed in the vicinity of any minor works disturbing the river banks. A revegetation program would be initiated at each new bridge crossing once all construction is complete to help maintain natural scour protection.

In adopting driven steel tube piles, it is anticipated that there would be minimal disturbance to the riverbed during construction of the piles, pile caps and piers for the Camden Haven River bridge. The use of a sediment curtain or similar containment device agreed by the DPI and DIPNR would be suitable because of the silty sand particle size of the riverbed deposits. The construction contractor would be required to ensure that relevant water quality levels were maintained during bridge pile construction.

The construction contractor would also be required to ensure that there was no spillage into the river of concrete during transport or pouring into the pile tube or pile cap. This could be achieved by extending the formwork above the top of the pour to reduce the risk of spillage.

#### **6.2.6 Removal of old bridge piers in Camden Haven River**

Both NSW Waterways and DPI (Fisheries) advised that the remaining pylons of the former bridge across the Camden Haven River, just downstream of the existing bridge, should be removed. Accordingly, this EIS assesses removal of the former piers, including the other underwater debris that remains. Further details of the debris are provided in Section 5.5.3.

Methods of removing the disused piers and rubble have been investigated considering the disturbance the operation could cause and potential methods to mitigate these impacts.

Based on these investigations, a methodology reflecting best practice has been developed and described below, aimed at reducing disturbance of river sediments while removing the bulk of the non-natural structures in the riverbed. The methodology described is not intended as prescriptive, rather to evaluate the extent of impacts that removal might cause and methods of mitigating those impacts.

The main potential environmental effect would be the increase in turbidity caused by disturbing the layer of silt that overlies the debris piles and surrounds the remains of the pier structures. A second potential impact would be the further disturbance to the riverbed caused by dropping cut sections of the pier columns on the riverbed. A possible method of removal of disused piers and rubble is summarised below.

- In order to reduce the disturbance of fine sediments, the required machinery (12.2 m steel pontoon barges with machinery such as grab, saw cutter, crane) would be positioned near the rubble pile or pier. A silt curtain would then be positioned surrounding the perimeter of the working area and then anchored to the riverbed. In all locations, operations to remove pier columns or clear rubble would take place entirely within the area isolated by the silt curtain. Rubble would be removed to the level of the riverbed using a crane mounted on the barge. The barge would transport the rubble to a ramp on the southern riverbank. From there the rubble would be off-loaded for appropriate land disposal. To the extent possible, increases in turbidity would be contained within the small area of the silt curtain. Suspended sediments would be allowed to settle to the riverbed before removal of the silt curtain following completion of works at that location.
- Following removal of existing rubble in the vicinity of the disused lift span piers, the pier and diaphragm visible above the waterline would be secured in a vertical position by a braced frame supported between two barges. The pier section would then be saw cut below the diaphragm but above water level. The cutting would be done during low tide. The minimum depth of cutting would be to that required to cut the reinforcing cage; the tension caused by the barges lifting with the tide should be sufficient to sever the remaining unreinforced concrete. The detached pier columns would then be transported to the ramp on the southern bank where they would be off-loaded for demolition and appropriate disposal on land. This methodology avoids the additional disturbance of allowing the cut section to drop into the riverbed, then causing further disturbance in retrieving it.
- The second stage of the demolition would be aimed at removing the remaining sections of the lift span pier stubs to below the level of the riverbed. The top of the remaining structure (pier column stubs) would be at the low tide level. A barge would be used to place an open steel caisson over the stub of the pier column, forming a seal on top of the 3.58 m diameter pilecap and extending to 0.3 m above the high tide level. The diameter of the steel caisson would be about 3.4 m, providing sufficient workspace between it and the pier. The silt would be removed from the base of the caisson, which would then be sealed and the work area within it would be dewatered. Slurry water from the dewatering procedure would be contained on the barge and disposed of on land after treatment. The pier column stub would be cut approximately 0.5 m above the base of the pilecap, or about 0.5 m below bed level. The column stub would be removed using a crane on the barge and transported to the southern bank for appropriate disposal on land. No silt curtain would be required for this stage of the works, as the disturbance due to cutting would be confined within the steel caisson, and silty water would be contained on the barge prior to land disposal after treatment.

The methodology described above has been developed to demonstrate a feasible method for removal of the old bridge piers and most of the underwater debris while largely containing any disturbed sediment and controlling turbidity increases in the river within acceptable limits. Alternative methods of removal of the bridge piers and debris would not be precluded subject to similar control of disturbed sediment and turbidity being achieved.

## 6.2.7 Construction adjacent to Main Northern Railway line

### 6.2.7.1 Description of works required

The Main Northern Railway line extends for the full length of the Proposal. However, the proposed highway upgrade is close to the existing railway only through the Lake section and at one isolated location south of Johns River township. While relocation of the railway would not be required, there are several locations where acquisition of part of the existing rail reservation would be required and/or works would be required in close proximity to the existing railway line. These locations are shown on Figures 2A and 2C to 2H and include the following:

- Station 1000–1200: At this location the existing highway would be retained as the southbound on-ramp allowing southbound traffic from Johns River to rejoin the upgraded highway. The proposed works would be only marginally closer to the existing railway and acquisition of rail land would not be required.
- Station 4350–4650: Acquisition of part of the rail reservation would be required over a length of about 300 m on the north side of the Stewarts River and construction of a retaining wall would be required between the southbound carriageway and the railway from Station 4450 to Station 4550.
- Station 4850–5150: Acquisition of part of the rail reservation would be required over a length of about 300 m immediately to the south of Salvation Bridge to accommodate the construction of a highway fill batter as well as a proposed sedimentation basin.
- Station 6400–6650: Minor acquisition of part of the rail reservation would be required over a length of about 250 m opposite Algona Road to accommodate earthworks adjacent to the railway.
- Station 7000–7600: Minor acquisition of part of the rail reservation would be required over a length of about 600 m opposite Middle Brother National Park to accommodate earthworks as well as construction of a proposed retaining wall between the southbound carriageway and the railway over a 150 m long section from Stations 7400 to 7550.
- Station 7900–8100: Minor acquisition of part of the rail reservation would be required to accommodate earthworks over a length of about 200 m opposite Haydons Road.
- Station 8400–8850: Acquisition of a triangle of railway land on the north side of the existing Watson Taylor Road would be required to accommodate the realignment of Watson Taylor Road as well as construction of sedimentation basins on either side of Stony Creek.
- Station 10100–10600: Minor acquisition of part of the rail reservation would be required over a length of about 500 m opposite the realigned Charles Yard Road intersection for construction of sedimentation basins.
- Station 10950–11300: Minor acquisition of part of the rail reservation would be required over a length of about 350 m opposite the proposed northbound rest area near Ross Glen Road, although the proposed works would be only marginally closer to the existing railway.
- Culverts under rail at Stations 6010, 10710 and 11370: There are three existing culverts under the railway line immediately downstream of the upgraded highway in the Lake section that appear to be undersized. Upgrading of rail culverts at Stations 6010, 10710 and 11370 would be required as noted in Table 6-4, although the deficiency is independent of the highway upgrade and no specific allowance for these works has been included in the cost estimates.

- Construction of bridge above railway at Ross Glen: The existing three-span 9.2 m wide by 42.3 m long bridge (spans of 12.4 m, 17.5 m and 12.4 m) above the railway at Ross Glen would be retained and converted to one-way, two lane operation for the southbound carriageway. A new three span 42.5 m bridge with a similar span layout would be constructed above the railway on the west side of the existing bridge for the northbound carriageway.
- Fencing: RailCorp has previously noted that there is no existing fence between the road and rail in some parts of the Lake section. Installation of fencing is proposed as part of the highway upgrade. Allowance would be made for gates where necessary.

#### **6.2.7.2 Construction methods**

The works described above could be carried out without significant disruption to existing rail services. Detailed proposals for working adjacent to and within the rail corridor would be developed in consultation with Railcorp during the detail design phase of the project.

All works within the rail corridor would be required to comply with Railcorp requirements. Any short-term track possessions would require development and approval of a track possession plan in accordance with Railcorp's requirements.

### **6.3 Construction resources**

#### **6.3.1 General fill and select fill materials**

Material from excavations would be variable in quality but it is anticipated that, provided suitable methods of excavation are used, sufficient quantities of material won from excavations would be available and suitable for use in embankments as general fill and also as select fill for the top 0.3 m of embankments. Lower quality material could be used for landscape fill and noise mounds and in the lower layers of embankments.

#### **6.3.2 Other materials**

Sand and aggregates would be required for the highway pavement sub-base course and, depending on the choice between rigid or flexible pavement in the detailed design stage, for the overlying pavement asphalt layers or concrete base. Sand, aggregates, and gravel would also be required for other pavements including local roads and ramps, as well as for drainage layers, bedding sand, erosion protection, gabions, and select fill if sufficient material is not available from excavations.

Requirements for materials will also depend on the final design and the extent of use of pre-cast components for bridges and structures but indicative quantities for major items (excluding precast concrete components) are given in Table 19.

Cement quantities are substantial but would be readily available from industry sources.

Information provided by the DPI indicates that there are five industrial mineral borrow areas or quarries within or near the project that would be potential sources of pavement materials and coarse aggregates. Table 20 summarises the details and locations of these quarries. Further information is provided in Section 2.6 of Working Paper No. 8. Currently, the Boral Quarry at Johns River is the only one in operation. The approved extraction limit of this quarry is 180,000 tonnes per year but annual tonnage varies from 180,000 to 280,000 tonnes with special approval.

Outside the study area, Pacific Blue Metal operates a quarry at Possum Brush, about 40 km south of Moorland, producing about 220,000 tonnes per year. There is also a Readymix quarry at Jandra in the same vicinity, producing about 200,000 tonnes per year.

**Table 19 Aggregate and cement requirements**

Purpose	Type	Tonnes required (t)
Major bridges	Coarse aggregate	5,000
	Fine aggregate	2,500
	Cement	1,800
Minor structures	Coarse aggregate	2,800
	Fine aggregate	1,400
	Cement	1,000
Highway pavement - rigid pavement option	Coarse aggregate	250,000
	Fine aggregate	125,000
	Cement	80,000
Highway pavement - flexible pavement option	Asphaltic concrete	200,000
	Base course (lean mix)	280,000
	Cement (for lean mix)	12,000
Other pavement	Asphaltic concrete	30,000
	Base course (lean mix)	25,000
	Cement (for lean mix)	2,000

**Table 20 Existing aggregate borrow pits**

Name and location	Operator and operational status	Product/material
Taylor's Pit, Ocean Drive, Kew	Hurd Haulage Pty Ltd - not operated. Hastings Council proposes to develop this site as a waste transfer station	Road materials/conglomerate
Bethesda Quarry, off Bethesda Road, Kew	NSW Roads and Traffic Authority - not operated	Road materials/shale
Rossglen	State Rail Authority of NSW - not operated	Railway ballast/granite
Stony Creek Road, Middle Brother State Forest	State Forests of NSW - not operated	Road materials/granite
Johns River	Boral Resources Pty Ltd - in operation	Hard rock aggregate/granite

The total tonnage of coarse aggregates for on-site batched concrete, asphaltic concrete and pavements required for the full length of the Proposal could be up to 350,000 tonnes depending on the type of pavement adopted. Pavement and bridge construction would be spread over three years or more, so requirements could be up to 150,000 tonnes per year. There is the potential, therefore, for much of the pavement materials and coarse aggregates required for the Proposal to be sourced from the Johns River quarry, although it may need to be supplemented from quarries further to the south.

Depending again on the pavement type and extent of usage of precast concrete, sand (fine aggregates) required for on-site batched concrete, lean mix and asphaltic concrete could total up to 180,000 tonnes of clean, durable sand with a low alkali/silica reaction. No sand deposits sufficient for use have been identified in the vicinity of the Proposal and, as a result, sand would have to be imported.

## 6.4 Ancillary construction facilities

### 6.4.1 Range of facilities and activities

In addition to the physical footprint of the permanent works for the Proposal as shown on Figures 2A to 2N, the construction contractor would require temporary access to land to accommodate a range of construction-related facilities and activities. These would include some or all of the following:

- site compounds for offices and storage of plant and equipment
- batch plants - potentially both concrete and asphalt, depending on the type of pavement adopted
- crushing plants
- stockpile areas
- spoil disposal areas.

Actual requirements for these facilities and activities would depend on the construction contractor, the final design, and the staging and work methods adopted for the construction. To ensure a comprehensive appreciation of the overall impacts of the construction of the Proposal, investigations have been undertaken:

- to identify sufficient suitable areas for each possible ancillary construction facility or activity
- to assess likely environmental impacts of siting these facilities and activities in nominated locations within the project area and whether these impacts could be avoided or reduced
- to present appropriate mitigation measures for any residual impacts.

At the time of construction, the contractor would be able to select available sites for ancillary facilities from those identified for each type of activity according to the final design, staging and proposed work methods.

### 6.4.2 Identification of suitable sites for construction facilities and activities

Identification of suitable areas for ancillary facilities and activities has been based on typical area requirements for projects on a similar scale, combined with appreciation of the study area and the environmental issues identified during project development and the preparation of this EIS. Environmental and construction related criteria for each type of construction related facility have been developed and are identified in Table 20.

A further description of each type of construction-related facility and activity is provided in Sections 6.4.4 to 6.4.9.

Using these criteria, a number of potentially suitable sites for ancillary construction facilities and activities have been identified. The potential sites identified are shown in Figures 6A and 6B while descriptions of the characteristics of each site are summarised in Table 21.

At the time of construction, the contractor would be able to select available sites for ancillary facilities from those identified in Figures 6A and 6B, and Table 21 for each type of activity according to the final design, staging and proposed work methods.

It should be noted that some of the sites identified in Figures 6A and 6B and Table 21 are on private land. Any use by the construction contractor(s) of the sites identified would be subject to prior negotiation and agreement between the parties. Usage would also be subject to suitable access arrangements and appropriate environmental controls as described in Section 6.4.3.

**Table 20 Locational criteria for ancillary construction facilities**

Locational criteria	Site compound	Batching plant	Crushing plant	Stockpile area	Spoil disposal area
<b>Environmental criteria</b>					
100 m or more from waterways and SEPP 14 wetlands	✓	✓	✓	✓	✓
Not in protected conservation areas, e.g. Middle Brother National Park	✓✓	✓✓	✓✓	✓✓	✓✓
Low conservation significance for flora, fauna and cultural heritage	✓	✓	✓	✓	✓
No substantial clearing of native vegetation required, or is located where future clearing is required for permanent project works	✓✓	✓✓	✓✓	✓✓	✓✓
Around 200m or more from dwellings or other uses that may be adversely affected by operational noise or other impacts of the plant	✓✓	✓✓	✓✓	✓	✓
<b>Construction requirements</b>					
Easy and safe access to the main road network	✓✓	✓✓	✓✓	✓	✓
Directly adjacent to the upgrade route	✓✓	✓✓	✓✓	✓✓	✓✓
Relatively level ground but elevated or sloped to assist drainage and allow containment and treatment of runoff	✓	✓	✓	✓	✓
Minimum area preferred (indicative)	2-3 ha	1 ha	3 ha	3 ha	Variable
Electricity and phone services available or can be provided without adverse environmental impacts	✓	✓	✓	Not relevant	Not relevant
Preferably within existing road reservation or within areas to be acquired by the RTA	✓✓	✓✓	✓	✓	✓
At least one site within each likely major construction stage/package	✓✓	✓✓	✓✓	As required	As required
Easily accessible supply of water of appropriate quality	✓	✓✓	✓✓	Not relevant	Not relevant
Adjacent/close to concrete batching plant and/or asphalt batching plant	Not relevant	Not relevant	✓✓	Not relevant	Not relevant

✓✓ Site compliance highly desirable or essential

✓ Site compliance desirable – some flexibility possible depending on particular location and design response

While a number of suitable sites have been nominated in Figures 6A and 6B and Table 21, the contractor would have the option of using other areas within or outside the footprint of the permanent works for the Proposal, subject to satisfying the relevant locational criteria and implementing appropriate environmental mitigation measures such as those described in Table 21. For example:

- depending on the staging of works, land which is within the footprint of the permanent works, and which would ultimately be cleared in accordance with the project design, may offer opportunities for construction related activities
- there may also be other areas within or outside the road corridor that would be suitable as sites for ancillary facilities.

If the contractor identifies a potential ancillary construction site in addition to those assessed in this EIS, a separate environmental impact assessment process may need to be undertaken for that additional site.

Appropriate mitigation measures would be required at all sites used for ancillary construction activities. Further details of potential environmental and appropriate mitigation measures are provided Section 6.4.3 below.

### **6.4.3 Potential environmental impacts and mitigation measures**

For each type of ancillary construction activity the potential environmental impacts and related mitigation measures have been identified and are summarised in Table 23.

The construction contractor would be required to address the potential environmental impacts and develop appropriate mitigation measures for each ancillary construction facility in the Construction Environmental Management Plan (CEMP). This would be prepared by the selected construction contractor for implementation throughout construction. Further details are provided in Section 6.7.

Further descriptions of each type of construction-related facility/activity and appropriate mitigation measures are provided in Sections 6.4.4 to 6.4.9.

### **6.4.4 Site compounds**

The construction contractor would require site compounds for offices, workforce facilities, and storage areas for plant and construction materials. Given that the Proposal may be constructed in several stages (see Section 6.2.2), the construction contractor may require one or more site compounds for each construction stage/package. If the compounds are located close to the new bridge structures required for the Stewarts and Camden Haven Rivers, they could also function as compounds for construction of these bridges. Otherwise, separate compounds would be required near the site of each bridge.

The construction compounds would require about 2 to 3 ha of land and would be fenced for security and safety purposes. Initial site works for the compounds would involve site clearing and installation of appropriate environmental controls. Hard-standing areas would be provided for parking, storage, access roads, and site sheds.

Potential impacts of site compounds would include lighting, noise, visual, traffic, waste, odours and contamination. Potential environmental impacts and related mitigation measures for construction compounds are summarised in Table 22. Environmental management of ancillary construction facilities should be included in the CEMPs.

### **6.4.5 Concrete batching plants**

Construction of the new bridge structures over the Stewarts and Camden Haven Rivers together with the minor bridges and structures would require about 5,500 m<sup>3</sup> of site-batched concrete to be placed in-situ over a period of up to two years. If a rigid pavement were adopted for the full length of the Proposal, an additional 190,000 m<sup>3</sup> of concrete (assuming 250 mm thick un-reinforced base over a 150 mm lean mix sub-base) would be required over a period of around three years. Even if an asphaltic concrete type pavement is adopted, the concrete requirements for the bridges alone are such that establishment of one or more concrete batching plants is likely to be cost-effective. The size of the two major structures as well as the other new bridges in the Lake section (i.e. Passionfruit Gully and Stony Creek) and at Herons Creek suggests that two or three concrete batching plants would be required. Potential sites for concrete batching plants have been identified at the southern end (adjacent to the Stewarts River), in the middle (adjacent to or north of the Camden Haven River) and at the north end (north of Herons Creek Road on the west side of the highway).

**Table 21 Potential sites for ancillary construction activities**

Site location (Station)	Prop. Ref No.	Potential area	Comments	Suitability* potential				
				1	2	3	4	5
<b>Johns River section</b>								
150-350	4	Western side of highway Up to 3 ha	Cleared, private land, 2 nearby houses. Power and phone available.	✓	x	x	x	x
1600-1900	12	Southern area of property 4 ha	Semi-treed private land, has been used for agricultural activities, 1 house 150 m+ to the north.	✓	✓	✓	✓	✓
2340-2550	16	East of bypass 1.6 ha	Flat and cleared private land (includes house). Close to tavern and occupied house (Property 17). Potential for site compound for bridge works.	✓	x	x	x	x
2600-3300	21/24	West of highway, north of Stewarts River Road junction 4 ha	Generally cleared private land, subdivision approved on Property 21, no houses very close, north of drainage line (Washtub Creek tributary).	✓	x	x	✓	x
3400-3600	28	South of Bulleys Road, west of bypass 3 ha	Private land, flat and cleared, access from Bulleys Road, 1 house north of Bulleys Road.	✓	x	x	✓	x
4000-4125	-	Within road reserve south of Stewarts River on western side of upgrade Up to 1.6 ha in road reserve including eastwards under existing bridge (could expand onto private property westwards)	Cleared but subject to flooding. Actively farmed land adjacent on north and south (Farming activities also use road reserve). Includes PAD 2 (subject to further investigation at time of construction). May be useful for bridge construction.	✓	x	x	x	x
4200-4230	-	Road and rail reserves under and adjacent to north side of Stewarts River bridge Up to 1 ha	Accessible from old highway on northern side of the river. May be useful for bridge construction.	✓	x	x	x	x
<b>Lake section</b>								
Adjacent to project area between old highway and Stewarts River	34	Quarry and land adjacent to quarry, owned by Boral 1 ha	Operating quarry – potential to use crushing plant and locate batching plant. Access from Bulleys Road to highway and southern side of bridge. Access to northern side of bridge along former highway route. May assist with construction of wall north of Stewarts River.	x	✓	✓	✓	x
4700-5100	35	East of highway and railway, within rail reservation 1+ ha	Access over wooden bridge (load restrictions), cleared land, close to Stewarts River and 1 house.	✓	x	x	x	x
5500-5600	40	West of highway Up to 2 ha	Private land. Access off Middle Brother Road. 1 house within 100 m. South of Passionfruit Gully.	✓	x	x	✓	x
5900-6900	-	East side of highway and railway 5+ ha	Private land, cleared, access by rail level crossing, flat land near railway, low-lying to the east. Drains to Watson Taylor Lake, no houses nearby.	✓	x	x	✓	x
8200 – 8550	53/57	Immediately north and south of Watson Taylor Road on east side of existing highway to railway line 1 ha	Within rail reservation. Northern side of Watson Taylors Road is cleared, previously used for stockpile site.	✓	x	x	✓	x

Site location (Station)	Prop. Ref No.	Potential area	Comments	Suitability* potential				
				1	2	3	4	5
8600-8750	59	South of Stony Creek, west side of road reserve 1.5 ha	Private land, cleared, visible from residence on Property 59. Useful for bridge construction.	✓	x	x	✓	x
8800-8900	61	Near site of new bridge over Stony Creek, western side of road reserve 1.5 ha	Private land, cleared, visible from residence on Property 59. Possible site compound for bridge construction.	✓	x	x	✓	x
8900-9400	-	Road reserve area to east of existing highway and west of railway line 1.5 ha cleared (3.0 ha total)	Some land cleared, previously used as an RTA stockpile site. North of Stony Creek (8770- 8790).	✓	✓	✓	✓	✓
10500-10900	-	Road reserve and adjacent land to the east of railway 5 ha	Private land, cleared, level crossing 400 m to the north. House to the south.	✓	x	x	✓	x
10700-11000	-	Road reserve area of proposed northbound rest area (not big enough for construction facilities)	Possible staging issue depending on timing requirements for new rest area, some clearing required in any case for roadworks and rest area.					
11000-11600	-	East of highway and railway 5+ ha	Private airfield land to south of house, access by level crossing, low-lying.	✓	x	x	✓	x
12450-12600	67/68	Southern side of Camden Haven River adjacent to area of proposed fill 2.5 ha	Private land on both sides of highway. Possible construction area for bridge on southern side of river. Road reserve itself not cleared and not wide enough for bridge works.	✓	x	x	✓	✓
12800-12900	71	Area within road reserve immediately north of Camden Haven River bounded by Sunnyvale Road on eastern side of existing highway 0.5 ha	Close to SEPP 14 wetland and Camden Haven River. Close to new bridge but on wrong side of highway and vertical clearance under existing bridge is restricted. Within existing road reserve. Not cleared but existing vegetation of limited value. Telstra fibre optic cable crosses area.	✓	x	x	✓	x
12800-12900	74	Land to east of highway Up to 1 ha	Private land (was old highway reserve). Close to SEPP 14 wetland. Flat and cleared but flood prone.	✓	x	x	✓	x
<b>Kew section</b>								
13500-13800	75	Western side of highway 4 ha	Part road reserve and adjacent private land. Flat and cleared. Heritage site A14 at Station 13950. PAD3 at Station 13500 (subject to further investigation during construction).	✓	✓	✓	✓	✓
13600-13900	76	East side of highway in front paddock 1.5 ha	Private land under transmission line. Flat and generally cleared.	✓	✓	✓	✓	✓
14400-14500	79	Eastern side of highway	Private land. Flat and generally cleared. North of sedimentation basin.	✓	x	x	✓	x
14900	85	Bunyah Aboriginal Land Council land on eastern side of bypass 1 ha	Previously used as a quarry. Regrowth vegetation. Adjacent residences in Glen Haven Drive. Fairly flat. Restricted access to alignment once cutting constructed.	✓	x	x	✓	x
15300	91	Property and house west of bypass 0.5 ha	Close to residential development in Glen Haven Drive and Kew township, access via former highway near Police Station.	✓	x	x	✓	x

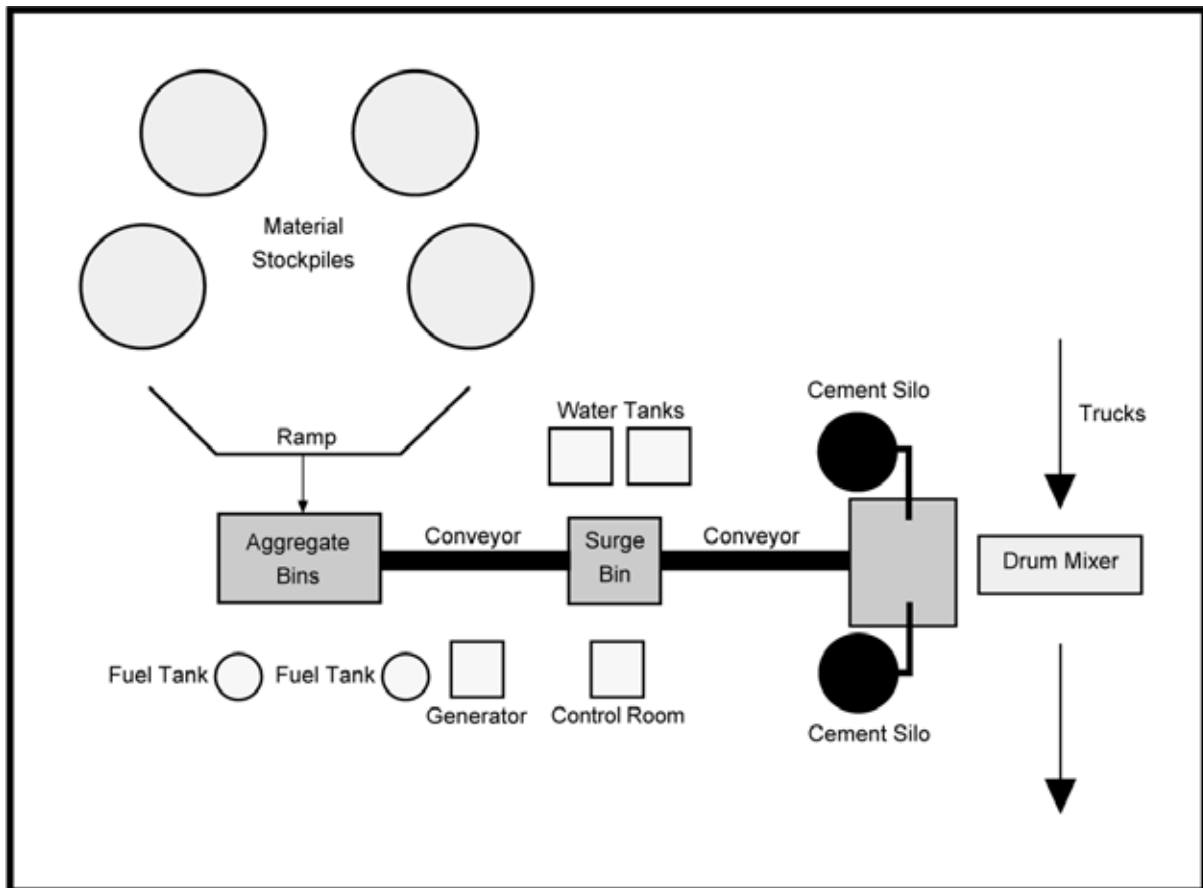
Site location (Station)	Prop. Ref No.	Potential area	Comments	Suitability* potential				
				1	2	3	4	5
15800-900	99	Northeast of Ocean Drive 2.5 ha	Hastings Council land, former quarry site, availability may depend on timing of Council's plans for Waste Transfer Station on the site, suitable for batching plant and/or crushing plant.	✓	✓	✓	✓	✓
16350-16650	101	Western side of upgrade south of Weeroona Place 5+ ha	Some area within road reserve, most on private property. Mostly cleared land, except northern end. Drains into Golf Course.	✓	x	x	✓	✓
16800-17000	105	Western side of upgrade north of Weeroona Place 2 ha	Private land adjacent to project area. Cleared. Close to 1 house.	✓	x	x	✓	x
17400-17600	-	Former tip site on Herons Creek Road 1.5 ha	Hastings Council-owned land. Regrowth, access via Herons Creek Road. No houses close. Potential contamination issues arising from prior use of the site as a rubbish tip would require investigation.	✓	✓	✓	✓	✓
<b>Herons Creek section</b>								
18800-19000	111/112	Eggbert Egg Farm front paddock and on eastern side of existing highway 2 ha	Private land adjacent to project area. Cleared area south of houses and hatcheries.	✓	x	x	✓	x
19550-19650	117	West of highway, north of Walkers Creek 3 ha	Private land. Cleared and flat. Adjacent to Walkers Creek.	✓	✓	✓	✓	✓
20300-20450	123	Land to east of highway 1.5 ha	Semi-cleared land (RTA to acquire property including house).	✓	x	x	✓	x
20950-21100	129	West of highway 1.5 ha	Boral Mill land in area used for timber storage, generally cleared, access from Herons Creek Road.	✓	✓	✓	✓	✓
21150-21450	131	Western side near Herons Creek and floodway – site of new bridges 1.5 ha	Property to be acquired by RTA. Access from Herons Creek Road and the highway. Close to new bridges. House area in PAD5 (subject to further investigation during construction).	✓	✓	✓	✓	✓
* 1	Site compound			✓	Suitable			
2	Batching plant – concrete or asphalt			x	Unsuitable			
3	Crushing plant							
4	Stockpile area							
5	Spoil disposal area							

**Table 22 Ancillary construction facilities - potential environmental impacts and mitigation measures**

Likely environmental impacts	Mitigation measures	Ancillary facility*				
		1	2	3	4	5
Soil erosion and sedimentation of water bodies	Reduce area of disturbance to vegetation and topsoil.	✓	✓	✓	✓	✓
Contaminated runoff adversely affecting water quality	Divert clean runoff around the site.	✓	✓	✓	✓	✓
	Install environmental controls downstream of disturbed areas and before discharge into watercourses.	✓	✓	✓	✓	✓
	Provide properly drained hardstand or similar to reduce infiltration to and contamination of soil and groundwater.	✓	✓	✓	x	x
	Contain and monitor run-off from batch plants (including pH)	x	✓	✓	x	x
	Bund fuel and chemical storage areas in accordance with DEC requirements, e.g. 100% storage capacity	✓	✓	✓	x	x
	Treat runoff from fuel storage and vehicle wash down areas prior to discharge from site.	✓	✓	✓	x	x
	Prompt removal or clean-up of spillages of materials.	✓	✓	✓	x	x
Fumes from batch plants or crushing plants	Regularly maintain and service all operational plant and equipment to ensure optimum performance and reduce the potential for emissions.	x	✓	✓	x	x
Dust generation or vehicle emissions adversely affecting air quality	Water unsealed areas such as haul roads during weather conditions conducive to dust generation.	✓	✓	✓	✓	✓
	Undertake regular maintenance of vehicles and machinery to ensure efficient operation.	✓	✓	✓	✓	✓
Traffic impacts	Set haul routes to reduce disturbance	✓	✓	✓	✓	✓
Vehicle and equipment noise	Ensure safe access and egress for construction vehicles	✓	✓	✓	✓	✓
	Comply with relevant DEC noise requirements.	✓	✓	✓	x	x
	Regularly monitor noise levels.	✓	✓	✓	x	x
	Undertake regular maintenance of vehicles and machinery to ensure efficient operation.	✓	✓	✓	x	x
Waste	If required, installation of temporary noise mitigation measures at nearby residences.	✓	✓	✓	x	x
	Good site housekeeping to prevent littering.	✓	✓	✓	x	x
	Reduce amount of waste generated	✓	✓	✓	x	x
	Segregate waste streams for recycling or disposal at an approved facility.	✓	✓	✓	x	x
	Remove liquid and solid waste by tanker or truck for disposal at an approved facility.	✓	✓	✓	x	x
Impacts on visual quality	Consider installation of colour coordinated shade cloth on perimeter fencing to reduce visual impact.	✓	✓	✓	x	x
	If site is particularly visible from key viewing points, consider supplementary planting (indigenous species) external to perimeter fence.	✓	✓	✓	✓	✓
Impacts on flora and fauna	Reduce area to be cleared.	✓	✓	✓	✓	✓
	Prior to clearing, inspect areas to be cleared for presence of native fauna.	✓	✓	✓	✓	✓
	Install fauna provisions as soon as possible	✓	✓	✓	x	x
	Revegetate sites on completion of construction.	✓	✓	✓	✓	✓
* 1	Site compound		✓		Required	
2	Batching plant – concrete or asphaltic concrete		x		Not required	
3	Crushing plant					
4	Stockpile area					
5	Spoil disposal area					

Concrete batching plants could have a schematic configuration similar to that shown in Figure 7. Concrete aggregates and sand would be stockpiled on site and transferred by front-end loaders to aggregate bins. A conveyor would transfer aggregates to a surge bin and then to a mixer where water, cement and admixtures would be added. Trucks would be loaded directly from the drum mixer. Temporary buildings for staff amenities, offices and quality assurance control would also be required.

Potential environmental impacts and related mitigation measures for concrete batching plants are summarised in Table 22.



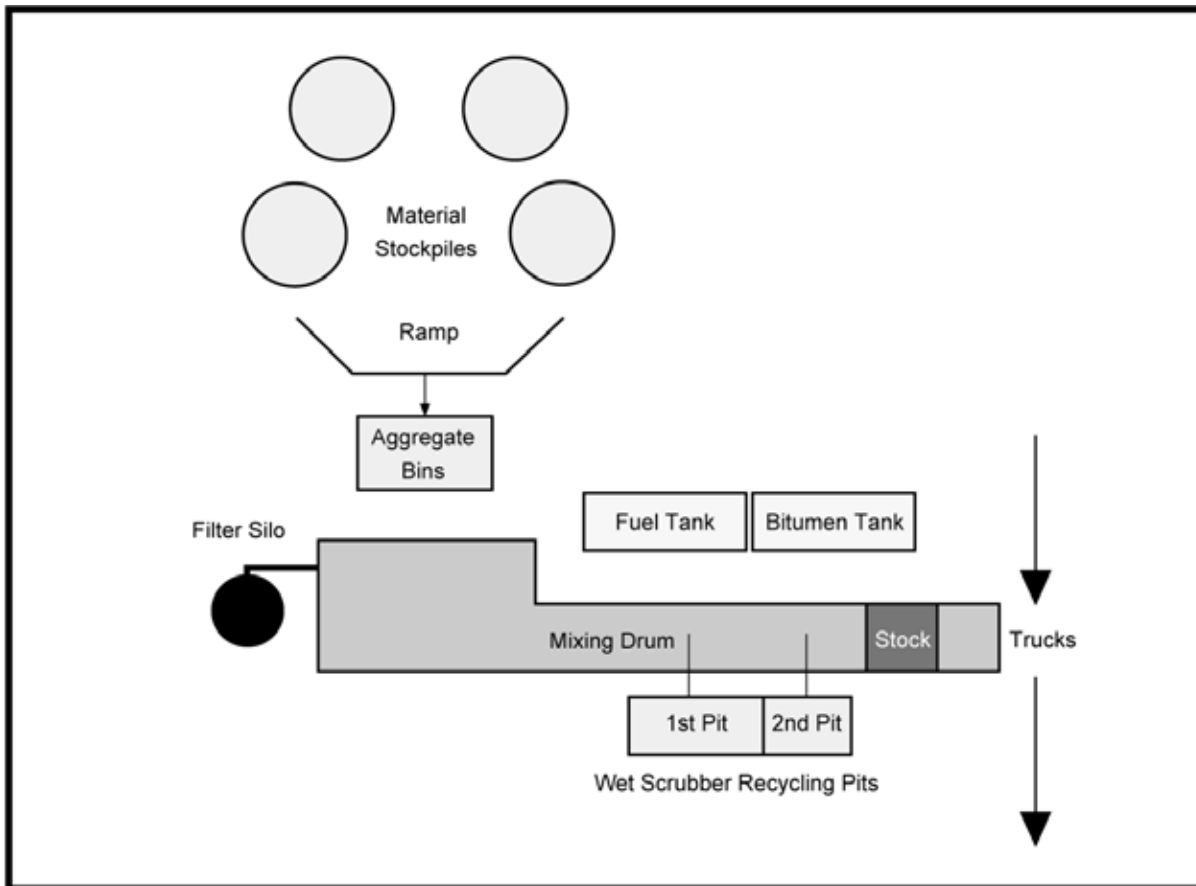
**Figure 7 Concrete batching plant**

#### 6.4.6 Asphalt batching plants

Adoption of a flexible pavement for the Proposal would require about 230,000 tonnes of asphaltic concrete (assuming 175 mm thickness and including local roads) to be placed over a period of two to three years. In the interests of allowing greater flexibility in the design and construction process, suitable sites for such plants have been identified in each of the four major sections of the Proposal.

Asphalt batching plants could have a schematic configuration similar to that shown in Figure 8. Aggregates would be stockpiled on site and transferred by front-end loaders to aggregate bins. Filler would be stored in silos and bitumen in a large capacity tank. A conveyor would transfer aggregates to a mixing drum where filler and bitumen would be added. Fuel tanks would supply fuel to the plant, generators and burners. Asphaltic concrete would be loaded onto trucks from the mixing drum. Temporary buildings for staff amenities, offices and quality assurance control would also be required.

Potential environmental impacts and related mitigation measures for asphalt batching plants are summarised in Table 22.



**Figure 8 Asphalt batching plant**

#### 6.4.7 Crushing plants

The major cuttings in the vicinity of Ocean Drive in the Kew section of the Proposal would generally require excavations in medium to high strength rock. According to the geotechnical investigations carried out in 2001, blasting is likely to be required, followed by crushing to reduce the rock to sizes suitable for placement in fill embankments (see Working Paper No. 8).

The excavations in the Kew section would require removal of about 520,000 m<sup>3</sup> of material, of which about 350,000 would be rock. Given the significant volumes of material to be excavated and reused elsewhere on the project, it is likely that the contractor would want to establish a crushing plant in the vicinity for efficiency of operations and to reduce the amount of haulage. The former quarry on the north side of Ocean Drive would be a potential site subject to Council plans for a waste transfer facility on the site. Table 21 includes a number of other potential crushing plant sites within the Kew section.

Substantial excavation volumes would also be required in the Johns River section (about 200,000 m<sup>3</sup>) and in the Lake section (about 290,000 m<sup>3</sup>), including some low to medium strength rock. It is therefore likely that at least one crushing plant site would be required in the southern half of the project. There is the possibility that the construction contractor(s) could negotiate with Boral Quarry to use its existing crushing plant, otherwise a number of other potential sites for crushing plants have been identified in Table 21.

The crushing plant area should also include areas for stockpiling of material. The stockpiling requirements would again depend on the construction staging and contractors work methods but assuming conservatively that all rock would be crushed and that storage would be required for 30% of the rock cut volume on each side of the river, the crushing plant sites should each contain sufficient area for stockpiling of about 100,000 m<sup>3</sup> north of the Camden Haven River and about 50,000 m<sup>3</sup> within the southern half of the project. This would require a stockpile area of about 3.5 ha (total site area of 4 ha) north of the Camden Haven River and about half that for the southern half of the project.

The assessment in Table 21 has identified suitable crushing plant sites with sufficient area to accommodate these requirements.

The crushing plant could potentially produce aggregates for concrete and/or asphalt as well. To facilitate this option, the crushing plants should preferably be located adjacent to concrete or asphalt batch plants to reduce truck traffic on public roads.

Potential environmental impacts and related mitigation measures for crushing plants are summarised in Table 22.

#### **6.4.8 Stockpile sites**

The profile of the Proposal has been adjusted to achieve an approximate balance of material overall but there would be a surplus of material from the Kew section and a shortage for the Herons Creek section. The construction packaging and staging proposed in Section 6.2 has been arranged to the extent possible to reduce haulage of material and allow material to be moved directly from cut areas and placed in fill areas or spoil disposal areas without the need for stockpiling and the resultant double-handling.

It is likely however that there would be a requirement for stockpiling of general fill material outside of the crushing plant areas, and for temporary storage of select material, rock material or other imported materials consistent with construction requirements on other sections of the project. It is estimated that there could be a requirement to stockpile up to about 150,000 m<sup>3</sup> of excavated material during the project. As a result of this possible requirement and assuming a maximum height of 3 m stockpile areas of up to 5 ha in total may be required for stockpiling of general fill within the study area.

In addition, areas would be required for the stockpiling of topsoil materials from cut and fill areas prior to placement on medians, embankment slopes, and flatter cut batters. It is estimated that about 200,000 m<sup>3</sup> of topsoil would be stripped and stockpiled over the full length of the project. Assuming a maximum stockpile height of about 3 m, up to about 2 ha would be required within each of the four major sections.

Hence the total area required for stockpiling could be up to 12 ha. The analysis in Table 21 has identified suitable stockpile sites with a total area of 14 ha and therefore adequate for anticipated stockpile requirements.

The nominated stockpile areas would also be suitable for the temporary storage of other materials such as unsuitable material, topsoil, and cleared vegetation to be used for sediment control as described in EIS Section 9.3.2.

The construction contractor(s) would be required to protect stockpiles of erodible material such as topsoil against erosion by mulching or other means. Potential environmental impacts and related mitigation measures for stockpile sites are summarised in Table 22.

#### 6.4.9 Spoil disposal areas

It is proposed that most of the excess of fill material from the Kew section would be utilised on the remaining sections of the Proposal but it is likely that there would be relatively small volume of excess material which would require spoil disposal areas. It is also possible that, depending on construction staging, excess fill material used to surcharge the embankments in soft soil areas would also require later removal to spoil disposal areas. In addition, disposal of material from cuttings classed as unsuitable for use in embankments and ASS would be required.

Based on the concept design and the preliminary geotechnical investigations, the volume of excess material would be about 60,000 m<sup>3</sup>, mainly comprising unsuitable material. During the detail design stage when additional geotechnical testing would be carried out, the volume of excess material could be further reduced. Design refinements could include minor adjustments to the highway profile and utilising material unsuitable for the highway embankment for non-critical areas such as the earthen noise mounds or as surcharge material on embankments above soft soils.

However, depending on the staging of construction, methods of construction of embankments in soft soil areas and the resulting consolidation periods required, it is possible even after design refinement that up to about 50,000 m<sup>3</sup> of surcharge material may need to be disposed of in spoil disposal areas. Placement of spoil would be subject to meeting the landscape and urban design objectives in Section 5.14. Table 21 identifies potential spoil disposal areas totalling about 30 ha. Working Paper No. 9 also identifies several areas where batter slopes could be flattened within the road reserve to better integrate the upgrade with the surrounding terrain (see also EIS Chapter 13).

PASS would generally not be removed as part of any bulk excavations. However, small volumes may be excavated in isolated areas for drainage works, construction of sedimentation basins, and construction of bridge abutments. Any excavated PASS would be buried below the water table or treated and tested prior to placement in landscaped fill (see Working Paper No. 8 – Geotechnical Assessment).

Potential environmental impacts and related mitigation measures for spoil disposal areas are summarised in Table 22.

### 6.5 Waste management

#### 6.5.1 Waste management and minimisation

Waste management would have a high priority during construction of the Proposal, consistent with the objectives of the *Waste Avoidance and Resource Recovery Act 2001* and the DEC's *Waste Avoidance and Resource Recovery Strategy 2003*. The current strategy for this Act sets the following targets:

- to maintain the level of total waste generated for the next five years
- to increase the recovery and utilisation of materials from construction and demolition from 65% to 76%
- to reduce the total volume and tonnage of litter reported annually.

The selected construction contractor would be required to include in the CEMP a Waste Management Plan that would set out objectives for minimising and managing waste during construction, and provide guidelines for managing waste, implementing re-use and recycling programs, and disposing appropriately of other non-reusable waste.

### 6.5.2 Recycling of materials during construction

There are four houses and two small span reinforced concrete bridges to be demolished along the Proposal route. Where possible and consistent with other environmental or occupational health and safety requirements, waste materials would be recycled either on-site or through approved off-site recycling programs. Examples of potential opportunities for recycling of materials during construction include:

- tree and plant material generated during initial site clearing - with the exception of certain weeds and invasive plant species, this material would be mulched and used on-site during construction and landscaping
- existing houses to be demolished prior to highway construction in such a way that recycling of the building materials is optimised
- reuse of existing highway - depending on agreements reached with the Hastings and Greater Taree Councils, pavement materials from excess pavement widths on the old highway at Johns River and Kew could be taken up for recycling or reused on site
- rock and soil material found to be unsuitable for construction purposes would be recycled within the project area in batter extensions or other spoil disposal areas as described in Section 6.4.8, subject to meeting the landscape and urban design objectives in Section 5.14
- on-site facilities for sorting of paper, plastic, glass and other waste from site compounds - this waste could be recycled through Local Council recycling programs
- bridges to be demolished including the Stony Creek bridge, Herons Creek bridge and the Camden Haven bridge piers would be assessed for the potential for reuse and recycling of materials. The concrete from the bridges and piers could be recycled using the site crushing plant for use as road base for temporary or construction access roads. Other demolition materials from the bridges, such as steel reinforcement, could also be recycled off site.

### 6.5.3 Post construction waste management

Once the proposed highway upgrade is operational, there would be two waste streams, one from maintenance activities and the other from highway users. Maintenance waste such as vegetation pruning would be collected and recycled for mulch within the road reserve or through Local Council programs. Other maintenance waste such as oils and greases would be disposed of in an approved manner.

Litter from highway users would be collected by the maintenance organisation. Materials such as glass and aluminium cans would be recycled and other material that cannot be readily recycled would be disposed of to appropriately licensed landfills. Rubbish bins would be installed at all rest area locations along the route of the Proposal with the bins emptied on an appropriate regular basis.

## 6.6 Energy statement

An energy statement for the Proposal considers the energy required during the construction of the Proposal as well as the energy (fuel) that would be saved by vehicles travelling along the highway once it becomes operational.

### 6.6.1 Energy required for road construction

Most of the construction work for the Proposal would be undertaken by diesel-powered machinery. However, the construction equipment actually used would be dependent on the contractor selected and the actual conditions encountered during construction. The range of construction equipment is likely to include, but would not be limited to:

- light transport vehicles
- graders and scrapers
- bulldozers
- front-end loaders and backhoes
- excavators
- drilling rigs
- compactors and compressors
- water trucks
- materials trucks (highway and off-highway)
- backhoes, paving machines and other heavy weight vehicles
- pile driving rigs - barge-mounted and land-based
- cranes - barge-mounted and land-based
- concrete pumps and air compressors
- concrete and/or asphalt batching plants
- crushing plants.

Given the extent and nature of the Proposal, a large quantity of fuel is likely to be used. Fuel consumption would depend on factors including the age and condition of equipment, the speed of operation, and the site conditions encountered. The volume of fuel used would be generally proportional to the earthworks involved. A conservative estimate of fuel usage is 15 million litres of diesel.

### 6.6.2 Energy considerations during operation

Energy consumption once the Proposal is completed would be by vehicles using the highway and by vehicles and equipment involved in maintenance of the highway. Aggregate energy use would gradually increase in proportion to the overall growth in traffic volumes on the highway but, compared to the do-nothing case, the Proposal has the potential to reduce energy usage through improved vehicle operating conditions and reduced congestion, especially in peak holiday periods. The Proposal length is about 50 m shorter than the existing highway and this would also contribute to a small but positive energy saving.

As part of the analysis of greenhouse emissions in Chapter 12, fuel usage has been estimated for the Proposal and the do-nothing case for a 30-year operation life. Based on Level of Service and travel speed estimations applied to every hour in the 30-year analysis period, fuel usage over the 30-year operating period has been estimated to reduce from 1067 million litres in the do-nothing case to 1039 million litres for the Proposal. This represents an overall fuel saving of about 28 million litres. The rate of improvement increases over time and by the thirtieth year the estimated fuel usage reduces from 57 million litres per year without the upgrade to 46 million litres per year with the upgrade.

Routine maintenance of the proposed highway upgrade would involve several medium sized vehicles and equipment such as tractors and slashers for grass cutting. Maintenance vehicles would also be required for the permanent water quality control ponds. Energy usage by these vehicles and equipment would be insignificant compared to the fuel usage estimated above, although perhaps slightly above the energy consumption required by the existing highway because of the greater area of roadway requiring maintenance.

### 6.7 Environmental management measures

In addition to the Project Environmental Management Plan (PEMP) prepared by the RTA, a CEMP would be prepared by the selected construction contractor for implementation throughout construction. An outline of the matters to be addressed in the CEMP is provided in EIS Chapter 21.

### 6.8 Construction staging, programming and workforce

A possible program for project implementation is shown in Figure 9. It assumes that design and construction would immediately follow on from an early project approval. The decision on the actual program for project implementation will be made following the receipt of project approval and will be dependent on funding and program priorities.

It is currently anticipated that determination of the EIS would be achieved by early 2006. After all project approvals are obtained, it is estimated that a period of about two years would be required for land acquisition concurrent with adjustments being made to public utilities completion of detail design and investigations, and tendering procedures prior to commencement of construction.

It is likely that a construction period of about three to five years would be required depending on the method of project delivery, funding availability and the contractor’s work methods. On the assumption that there would be two main construction packages as identified in Section 6.2.2 and that the project delivery method would be by conventional detail design followed by tendering for construction, an indicative construction schedule has been prepared. Adoption of alternative delivery methods, such as D&C or DCM (refer Section 6.1) would allow an earlier commencement of construction and would also allow a shorter construction period than the five years shown, subject to the availability of appropriate funding levels.

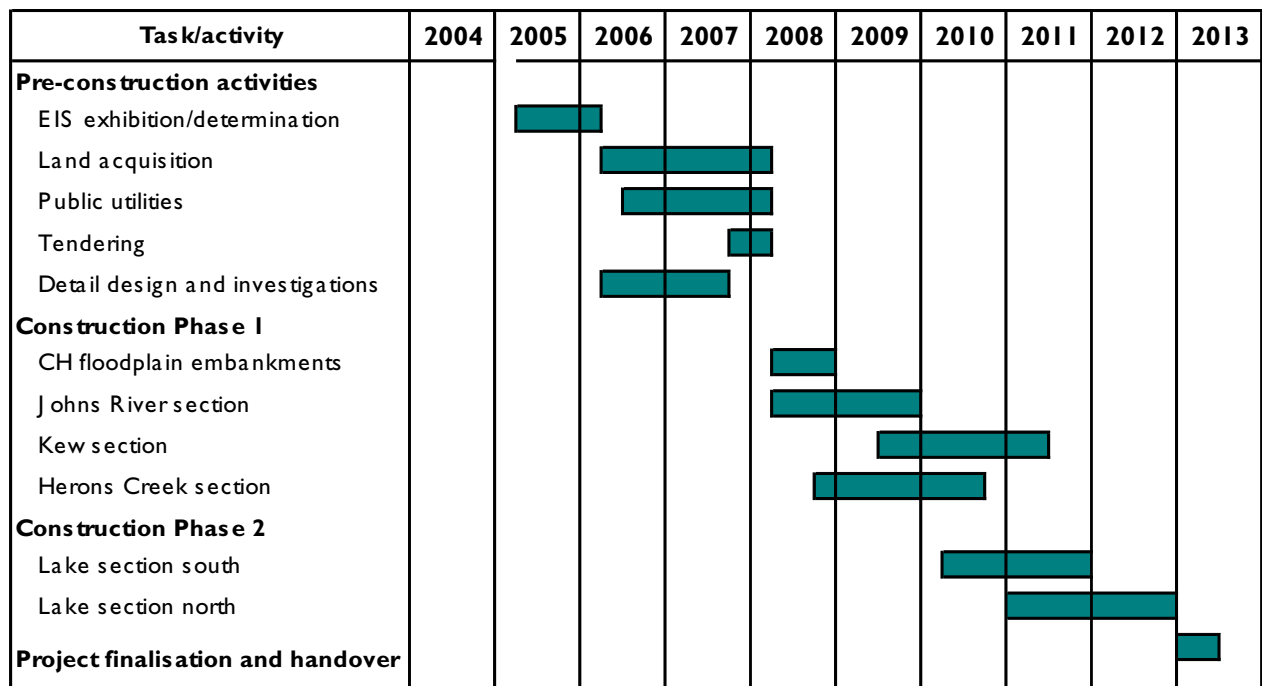


Figure 9 Indicative implementation schedule

For a total project cost estimated at approximately \$223 million (in February 2001 dollars), a peak construction workforce of about 200 to 250 people would be anticipated. The average size of the construction workforce on site would be approximately 100 people including management staff and subcontractors. It is expected that a large proportion of this workforce would be from the Greater Taree and Hastings regions.

## 7. PROPOSAL COST ESTIMATE

Based on the design described in this EIS, the total cost of the project on completion has been estimated at \$223 million (see Table 23). This figure is based on February 2001 dollar costs for easier comparison with the RTA's initial strategic cost estimates. The estimate of total project cost includes all costs associated with the design, construction and handover of the project.

The estimates have been prepared in accordance with the *RTA Project Management Guidelines for Estimating, Scope and Cost Control for Development Projects* (RTA, Version 3, February 2000), and are based on rates and quantities for upwards of 180 separate items. The estimate is based on average construction contract rates and on quantities derived from the concept design.

Estimates have been prepared in the form of a base component plus a contingency component for each item. The base component represents the bare cost of the works as set out in the concept design for each option. The contingency component includes allowance for normal contingency (covering any inadequacies in the concept design layouts or estimating methods) and risk contingency (covering major unknowns). The contingency allowance varies from 20% up to 60%, averaging about 29% overall. The contingency allowances have been set in consultation with RTA based on the risks identified in the risk management study and experience from previous projects.

**Table 23 Proposal estimate summary**

RTA Job Cost Item	Description	Estimated Cost (including contingencies)
Job 1	Project Development	\$7.1 million
Job 2	Investigation and Design	\$4.8 million
Job 3	Property Acquisition	\$19.8 million
Job 4	Public Utility Adjustments	\$8.6 million
Job 5	Construction	\$181.1 million
Job 6	Project Handover	\$1.9 million
Total		\$223.1 million say \$223 million

Note: Estimate revised March 2005 but based on February 2001 dollar costs.

The total project cost (including contingencies) corresponds to about \$10 million per km including structure costs or about \$8.5 million per km if structure costs are excluded.

## 8. ROAD USER ECONOMIC EVALUATION

### 8.1 Types of road user benefits

A road user cost benefit analysis was undertaken for the Proposal based on a total estimated project cost of \$223 million (including RTA management costs and land acquisition). There are three particular ways in which road user benefits accrue in major road projects. These, in fact, are estimates of future costs that would have accrued if the Proposal did not proceed, and thus become cost savings which accrue as a result of implementing the Proposal. These three areas are:

- **Value of time (VOT)** savings that represent the value of travel time of the road users. Benefits can arise if, as a result of the Proposal, the average speed of vehicles is increased and/or the trip length is reduced. In both cases, there is a resultant decrease in trip time that can be valued in dollar terms. This represents a major source of benefit for many road upgrading projects.
- **Vehicle operating cost (VOC)** savings are estimates of the change in operating costs for different vehicles based on the changed road conditions resulting from the Proposal. The future VOC is estimated for the existing and changed road conditions based on VOC curves for normal and heavy vehicles operating at different speeds on average grades. Where the new road conditions permit significantly higher speeds (for example, due to improved alignment), the VOC may be higher.
- **Accident cost** savings are estimated based on the historical record of accidents in the road corridor and projected into the future based on forecast traffic growth. Changes in the future accident profile are estimated based on experience with similar projects implemented in the past where post implementation studies have been carried out.

Maintenance saving benefits may also occur if major maintenance or upgrading an existing road can be avoided or delayed by the construction of a new road. In the case of Moorland to Herons Creek, if an upgrade of the highway were not provided, the following maintenance and upgrading of the existing alignment would be required in the short to medium term (five to ten years):

- major pavement rehabilitation of the highway along the length of the route
- on-going maintenance of the roadway
- improvements to intersections, including channelisation and turning lanes, to increase safety and efficiency of the road
- improvements to and/or introduction of environmental controls especially in areas adjacent to SEPP 14 wetlands and National Parks
- maintenance and possible upgrade of the bridges across waterways.

The Base Case option of retaining the existing highway includes allowances for the cost of rehabilitating the existing pavement and for on-going maintenance of the existing highway.

Note that this section represents a road user economic evaluation only. Broader economic impacts are considered in EIS Chapter 17.

## 8.2 Approach to analysis

Generally the approach to estimating the benefits of the Proposal has been conservative such that benefits would be underestimated where uncertainty existed.

A discounted cash flow (DCF) analysis has been undertaken to estimate the costs and benefits associated with the Proposal in comparison to retaining the existing Pacific Highway as a Base Case option.

Results are quantified in terms of the following criteria:

- Net Present Value (NPV) is the present value of costs less the present value of benefits over the life of a project using a discount rate of 7%. Projects are worthwhile where the present value of benefits exceeds the present value of costs, i.e. NPV is positive.
- Benefit Cost Ratio (BCR) is the present value of costs divided by the present value of benefits using a discount rate of 7%. A BCR greater than 1 indicates a project is worthwhile. Economic worth as measured by BCR generally follows that measured by NPV.
- Internal Rate of Return (IRR) is the discount rate at which the present value of project benefits equals the present value of project costs. A low IRR indicates that project benefits (which usually occur throughout the life of a project) only match project costs (which usually occur largely at the start of a project) if the discount rate is small; a high IRR indicates that project benefits exceed project costs at ordinary discount rates. Accordingly, economically attractive projects have high IRRs.
- First Year Rate of Return (FYRR) is a measure of the present value of the benefits achieved in the first full year of a project's operation divided by the present value of the capital costs incurred to achieve this. It is expressed as a percentage and is typically used to determine the best start date for a project. If a project has a FYRR below the discount rate (e.g. 7%) then the implementation of the project might be better deferred until the FYRR either equals or exceeds the discount rate.
- NPV/CC is the NPV divided by the capital costs of a project. It is a convenient measure of economic performance (as measured by NPV) that differentiates between projects with different capital costs. In dividing NPV by capital cost, the result provides a measure of the efficiency of benefit production, in terms of capital expenditure. Unless the capital cost of a project involves delayed expenditure then  $NPV/CC = BCR - 1$ .

Analysis was conducted for a 35 year time period (2006 to 2040) using a real discount rate of 7%. A 30-year operation period has been taken with construction taking place over the five years 2006-2011.

The analysis of road user benefits was conducted in accordance with standard RTA procedure as outlined in *Economic Analysis Manual, Version 2* (RTA 1999d). Parameters used incorporated the RTA's updates up to and including October 2004 and are discussed in Working Paper No. 2.

## 8.3 Results of road user economic analysis

### 8.3.1 Economic evaluation

The analysis revealed that, at a discount rate of 7%, the Proposal would return a Benefit Cost Ratio in the order of 3.5, with a net present value of \$355 million (see Table 24). This indicates that the Proposal would be economically viable.

**Table 24 Results of the economic evaluation for the Proposal**

Economic parameter	Result
Benefit-cost ratio	3.5
Net present value	\$355 million
Discount rate	7%
Internal rate of return	17.0%
First year rate of return	13.1%

### 8.3.2 Road user benefits

A summary of the road user benefits is presented in Table 25. The primary source of road user benefits over a 5-year construction period and a 30-year operational period from 2005 to 2039 is in travel time cost savings.

**Table 25 Summary of total road user benefits, 2005 to 2039 (Present Value @ 7%)**

Project case	Capital costs	Maintenance costs	Vehicle operating costs	Travel time costs	Accident costs	Net cost
Base case (existing highway)	-	\$15.1 million	\$568 million	\$883 million	\$26.9 million	\$1493 million
Highway upgrade proposal	\$153 million	\$4.8 million	\$526 million	\$440 million	\$14.6 million	\$1138 million
Difference	-\$153 million	\$10.3 million	\$42 million	\$443 million	\$12.3 million	\$355 million

## 9. PROPERTY ACQUISITION AND COMPENSATION

### 9.1 Property details

The locations of all properties in the immediate vicinity of the proposed upgrade are shown in the Property Reference Maps, Figures 10A and 10B. Details of each property referenced on these figures are summarised in Table 26.

Existing and proposed property boundaries in the vicinity of the alignment are shown in Figures 2A to 2N. Properties from which acquisition would be required are also shown in Table 26.

Land acquisition totalling almost 70 ha would be required from 69 private landowners and 8 government departments or agencies including Department of Lands (Crown Land), RTA, Rail Corporation New South Wales (RailCorp), Department of Infrastructure, Planning and Natural Resources (incorporating the department previously known as Land and Water Conservation), NSW Department of Primary Industries (Forests NSW), Bunyah Local Aboriginal Land Council, Hastings Council and the NSW Department of Education.

### 9.2 Land acquisition process

Land required for the Proposal would be acquired in accordance with the provisions of the *Land Acquisition (Just Terms Compensation) Act 1991*. The RTA acquires property required for road works in accordance with its Land Acquisition Policy, a copy of which is included in Appendix B of the EIS. This policy sets out the procedures for acquisition and the conditions that apply to acquisition, compulsory acquisition and hardship acquisition.

**Table 26 Summary of land acquisition requirements**

Property Ref. No.	Property address or description	DP and Lot No.	Approx. total area of lot (ha)	Approx. area to be acquired (ha)
<b>Johns River section</b>				
1	Pacific Highway Moorland	DP 703878 Lot 8	1.4	
2	Pacific Highway Moorland	DP 703878 Lot 8	0.6	
3	Pacific Highway Moorland	DP 778395 Lot 9	4.5	
4	Pacific Highway Moorland	DP 778395 Lot 10	28.2	
5	Pacific Highway Moorland	DP 614983 Lot 5	0.4	
6	Railway	-	-	
7	Pacific Highway Johns River	DP 845868 Lot 28	2.1	
8	Pacific Highway Johns River	DP 819425 Lot 2	25.2	
9	Pacific Highway Johns River	DP 819425 Lot 1	4.7	
10	Pacific Highway Johns River	DP 754448 Lot 233	49.5	2.00
11	Purfleet Taree Local Aboriginal Land Council, Pacific Highway Johns River	DP 754448 Lot 212	2.4	
12	65 Stewarts River Road Johns River	DP 801893 Lot 2	8.1	1.57
13	Crown Land, Pacific Highway Johns River	-	-	2.83
14	63 Stewarts River Road Johns River	DP 801893 Lot 1	6.3	2.07
15	43 Stewarts River Road Johns River	DP 739704 Lot 1	2.0	0.32
16	23 Stewarts River Road Johns River	DP 739704 Lot 2	3.4	1.85
17	21 Stewarts River Road Johns River	DP 308795 Lot 1	0.1	
18	15 Stewarts River Road Johns River	DP 879623 Lot 283	2.7	
19	7 Stewarts River Road Johns River	DP 879623 Lot 284	0.5	
20	50 Stewarts River Road Johns River	DP 1000354 Lot 3	2.3	
21	38 Stewarts River Road Johns River	DP 1027117 Lot 4	1.4	0.04
21	22 Stewarts River Road Johns River	DP 1027117 Lot 6	22.1	6.59
22	12 Stewarts River Road Johns River (RTA-owned)	DP 1000354 Lot 2	1.4	0.56
23	8 Stewarts River Road Johns River	DP 1000354 Lot 1	1.6	0.06
24	24 Stewarts River Road Johns River	DP 1027117 Lot 5	28.2	0.49
25	DIPNR, Pacific Highway Johns River	DP 754448 Lot 125	2.8	1.12
26	Pacific Highway Johns River	DP 122836 Lot 1	6.6	
27	Pacific Highway Johns River	DP 391437 Lot 0	0.1	
28	27 Bulleys Road Johns River	DP 787622 Lot 5	28.4	0.32
29	9 Wharf Road Johns River	DP 589513 Lot 3	4.7	
30	26 Bulleys Road Johns River	DP 706429 Lot 42	1.8	0.34
31	75 Bulleys Road Johns River	DP 816026 Lot 43	10.8	0.03
32	Pacific Highway Johns River	DP 260424 Lot 4	1.4	
33	Pacific Highway Johns River	DP 260424 Lot 5	0.1	
Sub-total Johns River section				20.18
<b>Lake section</b>				
34	Bulleys Road Johns River	DP 816026 Lot 45	2.5	0.03
35	Railway	-	-	0.56
36	Bulleys Road Johns River	-	11.7	
37	20 Yaralin Close Johns River	DP 716380 Lot 1	2.2	0.05
38	99 Middle Brother Road Johns River	DP 716380 Lot 2	40.5	
39	14 Middle Brother Road Johns River	DP 260425 Lot 2	12.6	
40	14 Middle Brother Road Johns River	DP 260425 Lot 2	4.0	0.04
41	Opposite Middle Brother Road	-	3.0	
42	Pacific Highway Passionfruit Gully	DP 615876 Lot 1	1.0	
43	Pacific Highway Passionfruit Gully	DP 260425 Lot 4	28.3	0.46
44	Pacific Highway Passionfruit Gully	DP 588647 Lot 2	4.1	0.33
45	Pacific Highway Passionfruit Gully	DP 588647 Lot 1	4.1	0.40

Property Ref. No.	Property address or description	DP and Lot No.	Approx. total area of lot (ha)	Approx. area to be acquired (ha)
46	17 Algona Road Middle Brother	DP 249033 Lot 1	4.3	0.17
47	10 Algona Road Middle Brother	DP 249033 Lot 2	2.1	
48	24 Caringal Drive Middle Brother	DP 249033 Lot 3	2.0	0.21
49	26 Caringal Drive Middle Brother	DP 249033 Lot 4	2.0	0.07
50	31 Caringal Drive Middle Brother	DP 249033 Lot 5	10.1	
51	Middle Brother National Park	-	-	
52	Railway, south of Algona Road	-	-	
53	Railway, south of Watson Taylor Road	-	-	0.76
54	4149 Pacific Highway Middle Brother	DP 809818 Lot 20	6.9	1.47
55	100 Pacific Highway Middle Brother	DP 609955 Lot 1	6.6	
56	4151 Pacific Highway Middle Brother	DP 552057 Lot 2	20.0	
57	Railway, north of Watson Taylor Road	-	-	0.89
58	110 Pacific Highway Middle Brother	DP 754418 Pt Lot 20	15.3	
59	Pacific Highway Middle Brother	DP 754418 Pt Lot 146	1.1	
60	Pacific Highway Middle Brother	DP 754418 Pt Lot 33	6.5	
61	Pacific Highway Middle Brother	DP 754418 Pt Lot 146	2.3	
62	Middle Brother State Forest, opposite stockpile	-	-	0.71
63	Railway, opposite Middle Brother State Forest	-	-	0.33
64	Middle Brother State Forest	-	-	0.06
65	Middle Brother State Forest	-	-	
66	Middle Brother State Forest, Ross Glen Road diversion	-	-	1.47
67	Pacific Highway Rossglen	DP 264366 Lot 11	5.5	0.67
68	Pacific Highway Rossglen	DP 264366 Lot 11	7.1	
Sub-total Lake section				8.68
<b>Kew section</b>				
69	10 Pacific Highway Kew	DP 706258 Lot 28	5.3	
70	Road Reserve (RTA-owned)		0.7	
71	Road Reserve (RTA-owend)		0.4	
72	Pacific Highway Kew	DP 706258 Lot 29	0.3	0.09
73	Pacific Highway Kew	DP 706258 Lot 30	1.2	0.16
74	Pacific Highway Kew	DP 706258 Lot 24	38.0	0.08
75	20 Pacific Highway Kew	DP 706258 Lot 27	37.4	0.02
76	4738 Pacific Highway Kew	DP 706258 Lot 23	18.6	0.81
77	Pacific Highway Kew	DP 706258 Lot 26	0.1	0.02
78	Pacific Highway Kew	DP 706258 Lot 25	0.0	
79	4740 Pacific Highway Kew	DP 733145 Lot 2	32.8	0.91
80	Pacific Highway Kew	DP 712854 Lot 1	3.7	0.15
81	Bethesda Road Kew	DP 733145 Lot 1	6.6	1.61
82	550 Pacific Highway Kew	DP 587919 Lot 3	0.2	0.21
83	550 Pacific Highway Kew	DP 587919 Lot 3	0.5	0.03
84	560 Pacific Highway Kew	DP 754405 Lot 148	0.9	0.02
85	Bunyah Local Aboriginal Land Council, Bethesda Road Kew	DP 823801 Lot 327	3.2	0.52
86	570 Pacific Highway Kew	DP 564615 Lot 2	12.0	0.94
87	9 Bellbird Close Kew	DP 855169 Lot 41	1.5	0.03
88	11 Bellbird Close Kew	DP 855169 Lot 40	1.5	0.08
89	13 Bellbird Close Kew	DP 855169 Lot 39	1.4	0.18
90	10 Bellbird Close Kew	DP 855169 Lot 38	1.5	0.49
91	8 Bellbird Close Kew (RTA owned)	DP 855169 Lot 37	2.6	0.90
92	NSW Police, 20 Tathra Road Kew	DP 754405 Pt Lot 62	1.0	
93	12 Tathra Road Kew	DP 710749 Lot 6	5.9	2.00

Property Ref. No.	Property address or description	DP and Lot No.	Approx. total area of lot (ha)	Approx. area to be acquired (ha)
94	20 Ocean Drive Kew	DP 557965 Lot 2	6.1	2.27
95	40 Ocean Drive Kew	DP 569595 Lot 1	4.2	
96	640 Pacific Highway Kew	DP 557965 Lot 1	2.0	0.21
97	53 Ocean Drive Kew	DP 602511 Lot 5	2.0	
98	Pacific Highway Kew	DP 578792 Lot 4	0.2	
99	4928 Pacific Highway Kew	DP 775532 Lot 7	37.0	6.74
100	4928 Pacific Highway Kew	DP 729726 Lot 1	0.3	
101	Pacific Highway Kew	DP 578792 Lot 4	9.1	0.72
102	Pacific Highway Kew	DP 1047707 Lot 35	53.3	1.05
103	22 Weeroona Place Kew	DP 570233 Lot 2	1.5	0.19
104	22 Weeroona Place Kew	DP 570233 Lot 2	15.8	
105	300 Pacific Highway Kew	DP 567240 Lot 1	4.0	0.85
106	300 Pacific Highway Kew	DP 567240 Lot 1	19.8	0.01
107	Hastings Council (south part of STP), Pacific Highway Herons Creek	DP 879080 Lot 100	103.4	1.45
108	Pacific Highway Kew	DP 883598 Lot 73	5.3	2.26
Sub-total Kew section				25.01
<b>Herons Creek section</b>				
109	Pacific Highway Herons Creek	DP 883598 Lot 74	22.0	1.99
110	Hastings Council (north part of STP), Pacific Highway Herons Creek	DP 879080 Lot 100	17.5	1.27
111	Pacific Highway Herons Creek	DP 248577 Lot 5	10.9	0.39
112	5220 Pacific Highway Herons Creek	DP 1046693 Lot 5	71.9	0.53
113	5233 Pacific Highway Herons Creek	DP 248577 Lot 4	11.0	0.45
114	5220 Pacific Highway Herons Creek	DP 1046693 Lot 4	15.6	0.50
115	5275 Pacific Highway Herons Creek	DP 248577 Lot 3	10.9	0.21
116	Pacific Highway Herons Creek	DP 573043 Lot 1	96.6	1.32
117	5277 Pacific Highway Herons Creek	DP 248577 Lot 2	10.9	0.11
118	5301 Pacific Highway Herons Creek	DP 754405 Lot 298	10.4	0.14
119	Pacific Highway Herons Creek	DP 517560 Lot 1	0.0	0.01
120	830 Pacific Highway Herons Creek	DP 617135 Lot 4	44.4	1.45
121	5329 Pacific Highway Herons Creek	DP 569272 Lot 3	10.1	0.37
122	5353 Pacific Highway Herons Creek	DP 608795 Lot 2	10.1	0.33
123	5376 Pacific Highway Herons Creek	DP 571398 Lot 1	3.4	0.60
124	5377 Pacific Highway Herons Creek	DP 608795 Lot 1	5.9	0.23
125	DIPNR, Cluleys Road Herons Creek	DP 1024922 Lot 7001	5.6	1.33
126	5403 Pacific Highway Herons Creek	DP 754405 Lot 286	6.1	
127	5409 Pacific Highway Herons Creek	DP 754405 Lot 269	0.2	
128	Pacific Highway Herons Creek	DP 754405 Lot 263	2.1	0.11
129	851 Pacific Highway Herons Creek	DP 883538 Lot 1	15.4	1.67
130	Pacific Highway Herons Creek	DP 611102 Lot 1	2.6	0.63
131	420 Pacific Highway Herons Creek	DP 619562 Lot 2	2.6	1.05
132	5494 Pacific Highway Herons Creek	DP 754444 Lot 7	15.9	
133	Pacific Highway Herons Creek	DP 754403 Lot 47	1.2	
134	DIPNR, Pacific Highway Herons Creek	DP 48119 Lot 58	0.3	
135	Pacific Highway Herons Creek (RTA-owned)	DP 754403 Lot 26	0.1	0.04
136	Pacific Highway Herons Creek (RTA-owned)	DP 754403 Lot 26	0.8	0.27
137	Pacific Highway Herons Creek (RTA-owned)	DP 754403 Lot 33	0.6	0.06
138	Pacific Highway Herons Creek (RTA-owned)	DP 754403 Lot 41	0.2	0.11
139	Bunyah Local Aboriginal Land Council, Pacific Highway Herons Creek	DP 48119 Lot 57	2.8	
140	NSW Dept of Ed. & Training, Herons Creek	DP 754403 Lot 36	0.7	

<b>Property Ref. No.</b>	<b>Property address or description</b>	<b>DP and Lot No.</b>	<b>Approx. total area of lot (ha)</b>	<b>Approx. area to be acquired (ha)</b>
141	NSW Dept of Ed. & Training, Herons Creek	DP 821631 Lot 54	0.7	0.37
142	NSW Dept of Ed. & Training, Herons Creek	DP 821631 Lot 55	0.1	0.05
143	NSW Dept of Ed. & Training, Herons Creek	DP 821631 Lot 52	0.4	
144	NSW Dept of Ed. & Training, Herons Creek	DP 821631 Lot 51	1.7	0.03
145	Burrawan State Forest	-	-	0.02
146	Bunyah Local Aboriginal Land Council, Pacific Highway Herons Creek	DP 47928 Lot 56	9.3	0.43
147	Burrawan State Forest	-	-	
Sub-total Herons Creek section				16.05
<b>Total all sections</b>				<b>69.92</b>

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