

Chapter 5 Options development and evaluation

This chapter describes the options considered for the Proposal and the evaluation process for selecting a preferred option. The main features of the preferred option are described together with location and design alternatives for certain sections of the preferred option.

5.1 Approach to route development and selection

Following the announcement of the Proposal in October 2000 by the Minister for Roads, a range of feasible upgrade options was developed, made available for public comment and subjected to a detailed comparative evaluation.

The approach to the identification and evaluation of highway upgrade options involved technical and environmental assessment together with community input in order to arrive at the preferred option for the Proposal. This approach is illustrated in Figure 5-1.

The feasible options identified for the Project were alternatives based on:

- the intention to use the existing Pacific Highway asset where possible to assist in achieving a 'value for money' Proposal and to minimise the potential for environmental impacts
- the context of the Proposal in the overall Pacific Highway network – there are well-developed plans to upgrade the section of highway immediately to the south of the Proposal area. To the north of the Proposal, the highway is already dual carriageway
- the overall objectives for the Pacific Highway Upgrading Program and the Proposal objectives
- identification and mapping of a range of environmental attributes that exert influences on the type and location of upgrade options.

5.2 Characteristics of the existing environment

In the study area, factors that influenced the development of the highway upgrade options are shown in Table 5-1. The four ESD Principles were also considered in the development of upgrade options (see Section 5.8).

5.3 Highway upgrade options considered

The outcome of the route suitability investigations was the identification of feasible upgrade options which were considered in four discrete sections within the study area (see Figure 5-2) - Johns River; Lake; Kew; and Herons Creek.

Options were developed for these sections, made available for public comment and then subjected to a detailed comparative evaluation. Community consultation was integral to the development of a preferred option for the Proposal.

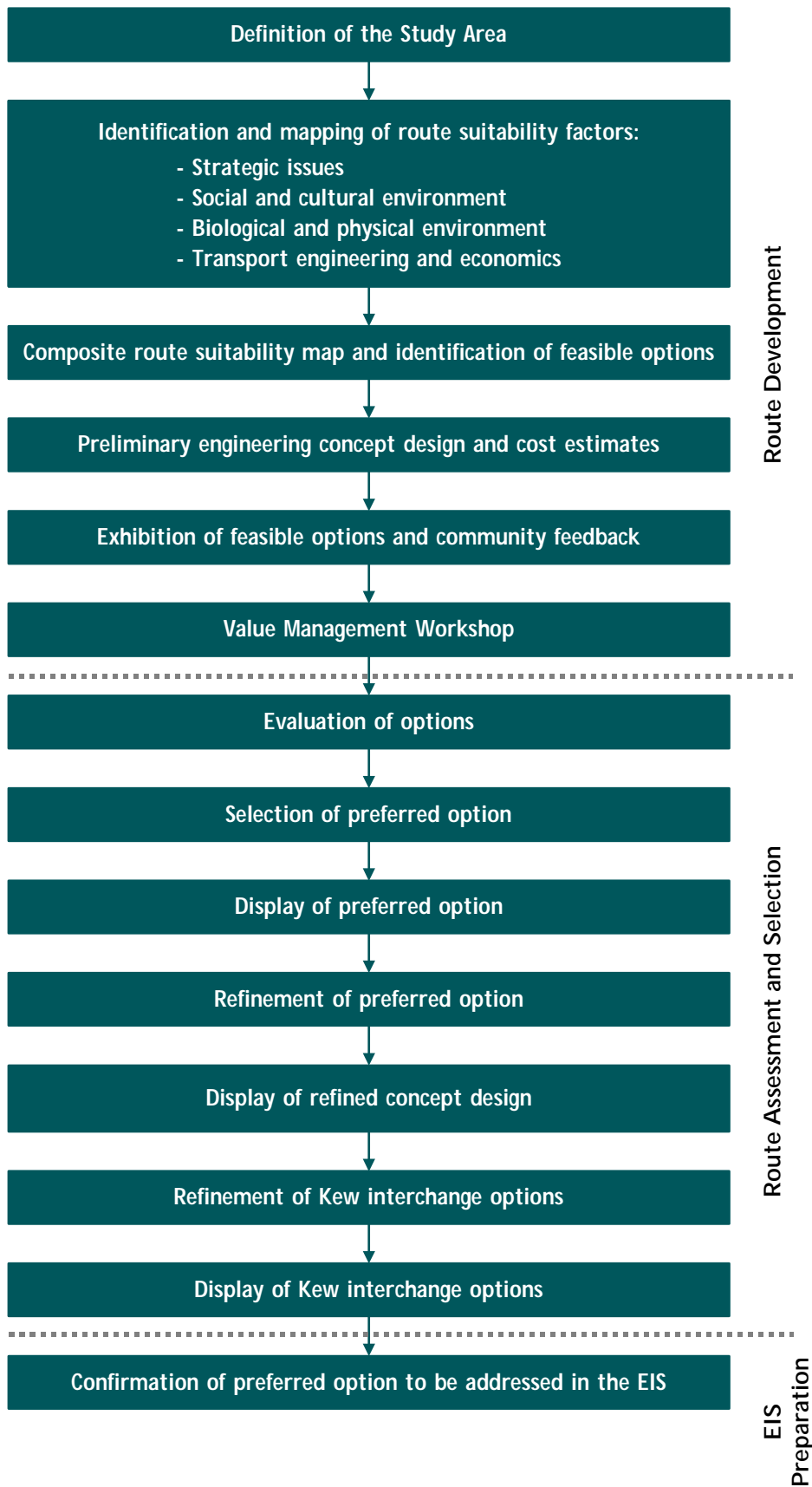


Figure 5-1 Route selection process

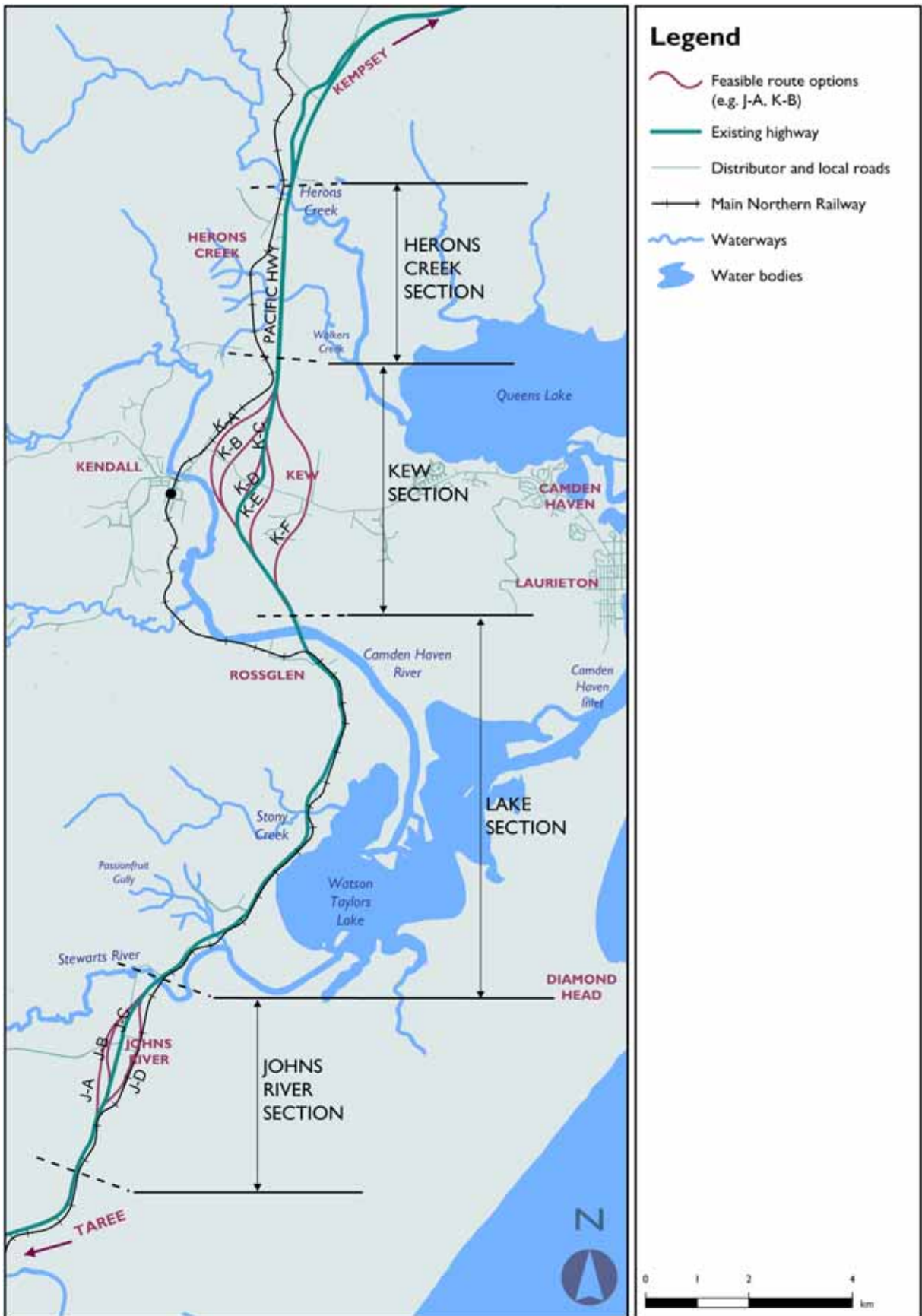


Figure 5-2 Route options considered for highway upgrading

Table 5-1 Factors influencing development of highway upgrade options

Category	Factors
Strategic issues	State and regional development issues Regional environmental management issues
Social and cultural environment	Urban and rural land use (terrestrial and aquatic) Economic and business impacts Aboriginal and European heritage Social impacts (including community structure and linkages) Land ownership Noise and vibration
Biological and physical environment	SEPP 14 wetlands National Parks and State Forests Ecological values (flora and fauna) Water quality Flood risk and damage Air quality Landscape and visual amenity Soils (including contamination and acid sulfate) Geotechnical issues
Transport engineering and economic	Route length Costing Road safety issues Local access provision

5.3.1 Johns River section options

Four feasible options were developed for the section of the highway from the Proposal commencement at 2.4 km south of Johns River to Stewarts River. These options were concurrent over the southern part of the section and involved duplication of the existing highway carriageway to the west within the existing road reserve. In the vicinity of Johns River township, the options were:

- Option J-A, which provided a western bypass of Johns River. Two sub-options, involving an at-grade staggered T-intersection and a half-diamond grade separation, were developed for the intersection of Stewarts River Road and the new highway.
- Option J-B also provided a western bypass of Johns River. It was shorter in length but located closer to the built-up area of the township than Option J-A. The two sub-options were developed as for Option J-A.
- Option J-C, which involved upgrading of the existing highway alignment with duplication occurring to the west of the existing carriageway. This option would be signposted through the township with a general speed limit of 80 km/h. Two sub-options were developed - a two-way service road to the east of the highway and an option with no service road.
- Option J-D, which involved an alignment on the eastern edge of the built-up area of the township adjacent to the western boundary of the railway reserve. No options were considered feasible to the east of the railway because of the need for two grade-separated crossings of the Main Northern Railway line to the north and south of Johns River.

Each of these four options included a new bridge across the Stewarts River immediately west of and parallel to the existing highway bridge. Figures 5-3A to 5-3D show the Johns River section proposed upgrade options.



Figure 5-3A Route option J-A - Johns River - Outer western bypass



Figure 5-3B Route option J-B - Johns River - Inner western bypass

This page left blank intentionally.



Figure 5-3C Route option J-C - Johns River - Existing highway upgrade



Figure 5-3D Route option J-D - Johns River - Inner eastern bypass

This page left blank intentionally.

5.3.2 Lake section options

Between Stewarts River and the Camden Haven River, opportunities for highway development were constrained because the existing road reserve is between the Main Northern Railway line and Watson Taylors Lake on the eastern side and Middle Brother National Park and State Forest to the west. As a result, no feasible options other than the duplication of the existing carriageway were developed. The upgrade would essentially follow the existing highway alignment.

Options for specific locations, designated L-A/L-B/L-C, were developed for this section that differed in regard to:

- the median width and the consequent potential impact on Middle Brother National Park
- the location of the second crossing of the Camden Haven River (upstream or downstream of the existing crossing).

5.3.3 Kew section options

Six options were developed for this Proposal segment - three to the west of Kew (Options K-A, K-B and K-C); one along the existing highway (Option K-D); and two to the east of Kew (Options K-E and K-F).

For the western options (K-A, K-B and K-C), southbound access to and from the highway upgrade would be provided by slip lanes at the southern and northern ends of the bypass whilst northbound access would be provided by a half-diamond, grade-separated intersection at Kendall Road. For the eastern options (K-E and K-F), northbound access to and from the highway upgrade would similarly be provided by slip lanes at the bypass ends with southbound access being provided by a half-diamond, grade-separated intersection at Ocean Drive.

Option K-C would pass immediately to the west of the Kew Visitors Information Centre and through the urban area of Kew just to the west of the existing highway in a cutting 750 m long and up to 8 m deep where it would pass under Kendall Road.

For Option K-D, which would run through the township area, two carriageways would be constructed within the existing road reserve. Traffic signals with left turn and right turn lanes would be provided at the intersection of the highway with Kendall Road/Ocean Drive. This option would be signposted through the township with a general speed limit of 60 km/h.

The eastern bypass options would each impact, to varying degrees, the existing Glen Haven residential estate and approved large-lot residential subdivisions to the north of Ocean Drive. Route Option K-F would pass in relatively close proximity to the new Camden Haven High School.

With the exception of Option K-D, the existing Pacific Highway through Kew would revert to a two lane, two-way local road when the new road was constructed.

Figures 5-4A to 5-4F show the proposed highway upgrade options considered in the Kew section.

5.3.4 Herons Creek section options

Two options were developed for the highway section between Herons Creek Road south near the sewage treatment plant and Bobs Creek Road at the northern end of the study area. These options involved the duplication of the existing highway carriageway largely to either the west (Option H-A) or the east (Option H-B).

5.4 Route options cost and road user economic performance

A summary of the estimated costs, road user Benefit-Cost Ratios (BCR), Internal Rate of Return (IRR) and Net Present Value (NPV) for each option is presented in Table 5–2. Note that these figures were those current and best available at the time of the evaluation and upon which it was based. The summary illustrates that considerable variation exists in the capital costs for the various options for particular sections, especially at Kew where the maximum cost difference is shown to be in the range of \$17 million to \$19 million. Upgrade options have positive BCRs ranging between 2.18 for Option J-D to 3.67 for Option L-B. Further details of the road user benefit-cost analysis methodology are given in Section 6.17.

In order to provide a uniform basis for comparison, the following assumptions and points are relevant:

- All options start and finish at common points on the existing highway. The starting points (from the south) for each section are:
 - Johns River section - southern extremity of the study area
 - Lake section - north abutment of Stewarts River Bridge
 - Kew section - 650 m north of north abutment of bridge over Camden Haven River
 - Herons Creek section - 100 m north of existing access to the Kew/Kendall sewerage treatment plant (STP).
- All options provide for a dual carriageway. Where appropriate, options provided for construction of an additional carriageway beside the existing pavement, as well as for upgrading the existing carriageway to provide a 20 year design life.
- Opening year was assumed to be 2011, with construction beginning in 2006. The evaluation period was over 35 years, with a 30 year operating period following a 5 year construction period.
- AADT is assumed to be 11,570 (1998) for the whole route, with a growth rate of 4.3% per annum until 2006 and 2.7% per annum from 2006 onwards. An average growth rate of 2.7% was assumed from 2006 onwards for the 35 year period. This equates to an AADT of 19,705 in 2011.
- Annual maintenance costs were assumed to be \$60,000 per km per year in the base case, and \$30,000 per km per year for each proposal case. A \$6,000 annual maintenance cost has been assumed for the traffic lights in Kew.
- A one-off cost of \$8 million was assumed for the re-construction of the existing road (in the base case). This was apportioned across the route by length.

The total cost for each option is an all-inclusive cost which includes provision for the following key items:

- investigation costs for geotechnics and survey
- design costs
- utility diversion/protection costs
- land acquisition costs
- allowance for RTA design and construction management costs
- construction supervision
- construction
- compensatory habitat.



Figure 5-4A Route option K-A - Kew - Far western bypass



Figure 5-4B Route option K-B - Kew - Central western bypass

This page left blank intentionally.



Figure 5-4C Route option K-C - Kew - Inner western bypass



Figure 5-4D Route option K-D - Kew - Existing highway upgrade

This page left blank intentionally.



Figure 5-4E Route option K-E - Kew - Inner eastern bypass



Figure 5-4F Route option K-F - Kew - Outer eastern bypass

This page left blank intentionally.

Table 5-2 Summary of options and economic evaluation

Option	Code	Route length km	Capital cost range* \$million	BCR	IRR (%)	NPV (at 7%) \$million
Johns River section						
'Do nothing' base case		4.16	-	-	-	-
Outer western bypass Johns River	J-A	4.25	41-45	2.40	13.2	34.9
As above with half-diamond	J-A1	4.25	43-47	2.29	12.9	34.1
Inner western bypass	J-B	4.25	40-44	2.45	13.4	35.4
As above with half-diamond	J-B1	4.25	43-47	2.29	12.9	34.1
Existing highway upgrade	J-C	4.15	41-45	2.35	13.0	33.7
As above without service road	J-C1	4.15	38-42	2.55	13.7	35.7
Inner eastern bypass	J-D	4.20	45-50	2.18	12.5	32.8
Lake section						
'Do nothing' base case		9.22	-	-	-	-
Existing highway upgrade	L-A	9.22	65-72	3.61	17.0	100.8
Existing highway upgrade	L-B	9.22	64-70	3.67	17.1	101.1
Existing highway upgrade	L-C	9.22	66-73	3.55	16.8	100.1
Kew section						
'Do nothing' base case		4.82	-	-	-	-
Far western bypass	K-A	5.30	55-61	2.20	12.6	41.4
Central western bypass	K-B	5.05	56-62	2.45	13.6	46.5
Inner western bypass	K-C	4.75	48-53	3.32	16.7	67.5
Existing highway upgrade	K-D	4.80	39-43	2.85	14.7	43.4
Inner eastern bypass	K-E	4.70	46-51	3.53	17.4	70.8
Outer eastern bypass	K-F	4.80	47-52	3.34	16.7	66.9
Herons Creek section						
'Do nothing' base case		4.0	-	-	-	-
Existing highway upgrade	H-A	4.0	31-35	3.17	15.7	31.5
Existing highway upgrade	H-B	4.0	28-31	3.60	16.9	43.2

*Note: The capital cost range accounts for the inherent uncertainty of estimating in the early stages of proposal development. All costs based on February 2001 dollars.

5.5 Evaluation of alternatives

5.5.1 Evaluation approach

The Moorland to Herons Creek section of the Pacific Highway is situated in an area of high natural significance which includes substantial areas of National Park, State Forests, Nature Reserves and SEPP 14 wetlands, together with areas of high cultural significance. The waterways within and surrounding the study area provide significant quantities of finfish and oysters to NSW markets, and are popular for recreational activities. Native bushland in the area provides an abundance of natural resources for uses ranging from logging and beekeeping to recreational and conservation purposes. These factors, together with the significant reliance of many town businesses on highway-related trade, mean that strong tensions exist between the natural, social and economic environmental factors in route development and selection. Consequently, the evaluation approach adopted was to:

- raise issues under the key impact categories for each of the options, including those raised in community comments on the options
- identify the extent and nature of impacts
- identify the extent to which adverse impacts can be mitigated

then to

- assess which option or options have the least overall impact.

Ultimately, a preferred option was recommended on the basis of least overall adverse impact and greatest ability for mitigation of such impacts. To assist in the assessment, summary tables based on the key evaluation categories were abstracted to facilitate the evaluation process and these are documented in the following sections.

5.5.2 Evaluation criteria

The criteria for evaluation of the feasible upgrade options relate directly to the overall objectives set by the NSW Government for the Pacific Highway Upgrading Program. These are described in Table 5–3. Detailed comparative evaluations were derived for each section of the Proposal based on the criteria.

The comparison of the options generally reveals relatively small differences in performance between those options on new alignments and greater difference in performance (generally worse) by upgrade options along the existing highway alignment through the townships of Johns River and Kew. The relatively small differences in performance are to be expected because all these upgrade options meet relevant engineering design criteria so differences are related to such factors as:

- road user economic analysis
- constructability issues
- extent and nature of impacts on local access patterns
- estimated earthworks quantities and balances
- potential loss of native vegetation
- number of houses lost
- number of residences potentially affected by noise levels in excess of EPA guidelines
- potential impacts on noise sensitive locations
- visual impact.

Table 5–3 Evaluation criteria

Relevant Pacific Highway Upgrading Program and Proposal objectives	Relevant evaluation criteria (and units of measurement)
Traffic and transportation and criteria	
<i>Program objectives</i>	
To significantly reduce road accidents and injuries	<ul style="list-style-type: none"> - extent of increased length of dual carriageway achieved (kilometres) - reduction in number of locations where turning movements to and from the existing highway are permitted (number) - extent of increased safe overtaking opportunities (metres and number) - narrow bridges eliminated (number)
To reduce travel times	<ul style="list-style-type: none"> - Levels of Service achievable relative to forecast traffic volumes (level of service) - total route length (kilometres) - road user delay during construction, operation, and maintenance (minutes)
To reduce freight transport costs	<ul style="list-style-type: none"> - extent of travel time savings (minutes) - extent of vehicle operating cost savings (\$)
<i>Proposal specific objectives</i>	
Develop a dual carriageway with potential to reduce crash rates to 15 crashes per 100MVK over the Proposal length	<ul style="list-style-type: none"> - comparison with crash rates of other sections of highway built to a similar standard
Maximise the use of the existing road reserve, where possible	<ul style="list-style-type: none"> - area of additional land to be acquired (beyond existing road reserve boundaries) (hectares)
Satisfy the technical and procedural requirements of the RTA with respect to design of the Proposal	<ul style="list-style-type: none"> - consistency of design with nominated design requirements – see below (extent and nature of inconsistencies)
Provide intersections designed to provide at least Level of Service C thirty (30) years after opening for the 100th Highest Hourly Volume	<ul style="list-style-type: none"> - type of local vehicular and pedestrian movements catered for by each intersections (level of service)
Develop a solution for the intersection of the Pacific Highway with Ocean Drive/Kendall Road at Kew that meets community expectations	<ul style="list-style-type: none"> - safety and traffic performance of intersection alternatives (qualitative)
Retain or replace existing rest areas within the study area	<ul style="list-style-type: none"> - consistency with draft <i>Pacific Highway Upgrading Program – Strategic Assessment</i> (SKM 2000) recommendations - existing rest areas retained (number) - provision of new rest areas provided that meet needs of the current and future travelling public (number and size in hectares)
Develop a Preliminary Engineering Design generally meeting the criteria for a 100 km/h design speed for the vertical alignment and a 110 km/h design speed for the horizontal alignment. Adoption of a lower design speed of 80 km/h may be acceptable in specific urban locations, depending on the alignment of the Preferred Route.	<ul style="list-style-type: none"> - length of option providing 100 km/h design speed for vertical alignment (kilometres) - length of option providing 110 km/h design speed for horizontal alignment (kilometres) - length of option providing 80 km/h design speed for horizontal alignment (kilometres)

Relevant Pacific Highway Upgrading Program and Proposal objectives	Relevant evaluation criteria (and units of measurement)
Economic objectives and criteria	
<i>Program objectives</i>	
To provide a route that supports economic development	<ul style="list-style-type: none"> - assessment of LoS on highway compared with 'do minimum' base case - assessment of changes in local access provisions (qualitative) - travel time savings compared to 'do minimum' base case (minutes)
To provide the best value for money	<ul style="list-style-type: none"> - level of road user economic performance (NPV, BCR, IRR, FYRR and NPV/CC) - extent of use of the existing road formation (kilometres)
ESD objectives and criteria	
<i>Program objectives</i>	
To manage the upgrading of the route in accordance with Ecologically Sustainable Development (ESD) principles	<ul style="list-style-type: none"> - area of native vegetation loss (hectares) - extent and nature of areas of conservation significance affected – terrestrial and aquatic (hectares and qualitative assessment) - Threatened Species affected – terrestrial and aquatic (number and category) - extent and nature of sites of cultural heritage significance affected – indigenous and non-indigenous (number and category/qualitative assessment) - extent of direct impact on waterways and potential for water quality impacts (length of bridges and qualitative assessment) - compliance with applicable air quality criteria (qualitative assessment)
<i>Proposal specific outcomes</i>	
Provide flood immunity on at least one carriageway for a 1:100 year flood event north of Kew and for at least a 1:20 year flood event south of Kew	<ul style="list-style-type: none"> - extent and nature of flooding impacts beyond road reserve (changes in afflux levels in millimetres).
Land use and strategic planning	
<i>Proposal specific outcomes</i>	
Provide transport developments which are complementary with land use	<ul style="list-style-type: none"> - nature of zoning of land required for the proposal (hectares) - extent of various land uses affected (hectares) - extent and nature of impacts on highway-related businesses and other businesses (number of businesses and other data if available) - extent and nature of impacts on agricultural activities (hectares and production data if available)
Community cohesion	
<i>Program objectives</i>	
To develop a route that involves the community and considers their interests	<ul style="list-style-type: none"> - residences required to be acquired (number) - extent and nature of severance impacts on individual properties (number and size of properties [hectares] and size of residual lots) - residences affected by noise levels in excess of relevant guidelines (number) - extent and nature of change to the existing landscape quality (qualitative assessment) - extent and nature of changes to local access patterns (roads closed)
<i>Proposal specific outcomes</i>	
Integrate input from the local communities into development of the Proposal through the implementation of a comprehensive program of community consultation	<ul style="list-style-type: none"> - community support for or opposition to particular alternatives (quantitative and qualitative feedback from Community Focus Group meetings and the Options Display)

5.6 Selection of the preferred option

5.6.1 Options summary

Table 5–4 summarises the feasible options considered and highlights those which cumulatively became the Proposal preferred option.

Table 5–4 Options summary

Section	Feasible options	
Johns River	J-A	Outer western bypass
	J-B	Inner western bypass
	J-C	Upgrade along the existing highway
	J-D	Inner eastern bypass
Lake	L-A	New bridge over the Camden Haven River to the east
	L-B	New bridge over the Camden Haven River to the west
	L-C	New bridge over the Camden Haven River to the east and narrow median in section adjacent to Middle Brother NP
	L-B	Modified (L-B/L-C) - New bridge over the Camden Haven River to the west and narrow median in section adjacent to Middle Brother NP
Kew	K-A	Far western bypass
	K-B	Mid western bypass
	K-C	Inner western bypass
	K-D	Upgrade along the existing highway
	K-E	Inner eastern bypass
	K-F	Far eastern bypass
Herons Creek	H-A	Duplication largely to the west of the existing highway
	H-B	Duplication largely to the east of the existing highway

Segments that make up the Preferred Option

5.6.2 Johns River section

General comments

The summary evaluation of the Johns River upgrade options is shown in Table 5–5. The detailed comparative evaluation indicated that the additional cost (\$3 million) required for a grade-separated intersection at Stewarts River Road (Options J-A1 and J-B1) could not be justified. In addition, these options would cause larger fill shortages. For these reasons, Options J-A1 and J-B1 were not considered further in the evaluation. Option J-C1 (no service road) would not meet a number of the key Pacific Highway Upgrading Program and Proposal objectives, specifically those related to safety. Consequently, Option J-C1 was not considered further in the evaluation.

Table 5-5 Summary evaluation of Johns River section options

Evaluation categories	J-A (staggered T junction)	J-B (staggered T junction)	J-C (with service road)	J-D
Traffic and transportation	σσσ	σσσ	σ	σσσσ
Engineering	σσσσ	σσσ	σ	σσ
Economic	σσσσ	σσσσ	σσσσ	σσσσ
ESD/environmental	σσ	σσσ	σσσσ	σσ
Land use and strategic planning	σσ	σσ	σσσ	σσσ
Community cohesion	σσσσ	σσσ	σ	σσ

Note More symbols = better performing option
Fewer symbols = worse performing option

Overall conclusion for the Johns River section

Option J-A is considered to be the best performing of the Johns River options by a relatively narrow margin compared with Option J-B. Options J-C and J-D have a similar level of performance but at a noticeably lower level than Options J-A and J-B.

Reasons for recommending Option J-A as the preferred option

Option J-A is considered to be the best performing of the Johns River options because:

- It has an estimated capital cost at the lower end of the range.
- There would be no major constructability issues with it (although 40% of its length would have to be constructed under traffic, i.e. duplication adjacent to the existing highway carriageway).
- No houses would be lost.
- The concept design for this option indicates that there would be a manageable fill shortage that could be addressed as part of design refinement.
- It would result in the lowest number of houses potentially being affected by noise levels in excess of EPA guidelines.
- It would have the lowest visual impact.
- Although it would potentially impact a greater area of native vegetation than other options, this vegetation is not considered to be of high conservation significance. Appropriate mitigation measures, both on this section and on other sections of the proposal, would ensure that impacts on native vegetation would be minimised and that wider habitat values would be maintained.
- It would be farther away from the tavern in Johns River, which has become a popular local facility.
- In the future, should traffic volumes increase sufficiently, it would be easier to integrate a grade-separated intersection at Stewarts River Road on Option J-A than on Option J-B primarily because of the access and visual issues associated with the latter option's proximity to the tavern.
- This option would have impacts on highway-related business similar to the other bypass options.

Reasons for not recommending other options

The main reasons for not recommending Option J-B as the preferred option are:

- It would be closer to existing development, especially the tavern.
- The concept design for this option indicates that it would have a marginally larger shortage of fill than would Option J-A.
- Although there are no major constructability issues with this option, it has a marginally greater length to be built under traffic than Option J-A, i.e. duplication adjacent to the existing highway carriageway.
- It would result in a larger number of houses potentially being affected by noise levels in excess of EPA guidelines compared with Option J-A.
- It would have marginally greater visual impact than Option J-A.

The main reasons for not recommending Option J-C (without a service road) as the preferred option are:

- It is not the lowest estimated capital cost option.
- It would not meet a key design criterion in relation to achievement of a 110 km/h design speed along the full length of the option.
- It would have major constructability issues because the whole length would have to be constructed under traffic.
- It would have a major land use and community impact on the township of Johns River through the loss of six houses, all located on the west side of the existing highway north of Stewarts River Road.
- It would result in an increased traffic noise impact on houses and noise sensitive land uses (Johns River Public School and Johns River Community Hall) adjacent to the highway.

The main reasons for not recommending Option J-D as the preferred option are:

- It has the highest estimated capital cost.
- It would have more complex constructability issues than the other options because of its proximity to the Main Northern Railway line.
- It would result in the largest number of houses potentially being affected by noise levels in excess of EPA guidelines.
- It would have a moderate visual impact but it would be more difficult to resolve in urban and regional design terms and integrate the upgrade into the township context.
- It would result in the loss of one identified European cultural heritage item – the wooden bridge over the Main Northern Railway line.

5.6.3 Lake section

General comments

As indicated on Table 5–6, the performance of the options for the Lake section is generally fairly similar. This is because of the significant constraints (the Main Northern Railway line and Watson Taylors Lake to the east of the existing highway and the dissected terrain of Middle Brother Mountain and the associated Middle Brother National Park and Middle Brother State Forest on the west of the existing highway) which largely restrict upgrading options to duplication within or adjacent to the existing road reserve. The key differences between the options relate to:

- the potential impact on land within the Middle Brother National Park
- the location of the new bridge over the Camden Haven River – to the east or west of the existing highway bridge
- the resultant marginal differences in estimated capital cost, constructability, and cut and fill balances.

Table 5–6 Summary evaluation of the Lake section options

Evaluation category	L-A (new bridge over Camden Haven River to east)	L-B (new bridge over Camden Haven River to west)	L-C (new bridge over Camden Haven River to east and narrow median in section adjacent to National Park)
Traffic and transportation	σσσσ	σσσσ	σσσ
Engineering	σσ	σσσ	σσσ
Economic	σσσσ	σσσσ	σσσσ
ESD/environmental	σσ	σσ	σσσ
Land use and strategic planning	σσσ	σσσ	σσσ
Community cohesion	σσσ	σσσ	σσσ

Note More symbols = better performing option,
Fewer symbols = worse performing option

Overall conclusion for the Lake section

Option L-B performs marginally better than Option L-A mainly in relation to aspects associated with the location of the Camden Haven River bridge to the west and constructability issues. Option L-C would have a better environmental performance than either Option L-A or L-B, mainly because of the section of narrow median adjacent to the Middle Brother National Park.

Inclusion in the otherwise better-performing Option L-B of a narrow median along the 700 m section which abuts Middle Brother National Park would add approximately \$1 million to the cost of Option L-B. This cost increment is considered justified because of the conservation importance of the National Park and also because the road user benefit cost ratio (BCR) for this combined option would not be significantly different to that for Option L-B without the narrow median.

Reasons for recommending Option L-B with a narrow median adjacent to Middle Brother National Park as the preferred option

Option L-B with a narrow median adjacent to Middle Brother National Park is the best performing option of the Lake options because:

- It would have no direct impact on Middle Brother National Park.
- The location of the new bridge over the Camden Haven River to the west has a number of advantages relative to a location to the east of the existing bridge, namely:
 - there would be no need for land acquisition on the south or north sides of the river (except for sedimentation basins and truck rest area)
 - the highway geometry of northbound lanes would be better than for Option L-A
 - it would leave more room on the east side for the railway upgrade in the long term
 - it would save about \$0.9 million (compared with placing the new Camden Haven River bridge to the east of the existing bridge)

- although it would be closer to Rossglen, there would be no measurable increase in traffic noise levels at houses in Rossglen.
- Both Options L-A and L-B would have constructability issues, but Option L-B would not have the added difficulty that would be associated with Option L-A of switching carriageways between the bridges over the Main Northern Railway line and the Camden Haven River which would complicate traffic staging.

The inclusion of a 700 m section of narrow median adjacent to the boundary of Middle Brother National Park would add an extra \$1 million to the cost of Option L-B and require an additional 400 m of retaining wall with a maximum height of 5 m between the southbound carriageway road and the railway. Keeping the Proposal out of the National Park would be consistent with the management objectives for this Park and the maintenance of its conservation significance and with retaining the high cultural significance attributed to Middle Brother Mountain by Local Aboriginal Land Councils. It would also avoid the need for legislative amendment to the National Park's boundaries. The use of a narrow median over this distance would have some safety implications in terms of potentially slightly higher accident rates but the resulting rates would still be expected to be within the target crash rate of 15 crashes per 100 MVK.

5.6.4 Kew section options

General comments

The options evaluated in Table 5–7 are those that were placed on public display in May 2001. In response to matters raised in community submissions after this display and matters raised at the Value Management Workshop for the proposal, the addition of grade-separated interchanges at both the northern and southern ends of the five bypass options for Kew were examined. The additional capital costs of around \$4 million were found to be unwarranted because of the design and constructability difficulties involved (at the northern end in particular) and a reduction in safety performance.

Table 5–7 Summary evaluation of Kew section options

Evaluation category	K-A	K-B	K-C	K-D	K-E	K-F
Traffic and transportation	σσσ	σσσ	σσσσ	σ	σσσ	σσσ
Engineering	σσ	σσ	σ	σ	σσσ	σσ
Economic	σσσ	σσσ	σσσσ	σσσ	σσσσ	σσσσ
ESD/environmental	σσ	σσσ	σσσ	σσσσ	σ	σ
Land use and strategic planning	σσ	σσ	σσ	σ	σσσ	σσσ
Community cohesion	σσ	σσσ	σ	σσ	σσσ	σσ

Note More symbols = better performing option
Fewer symbols = worse performing option

Overall conclusion for the Kew section

Option K-E is considered to be the best performing option of the Kew options. Options K-F, K-A, K-B and K-C all have a similar and slightly lower overall level of performance but with specific lower levels of performance relative to some criteria. Option K-D (upgrade along the existing highway alignment) has the lowest level of overall performance.

Reasons for recommending Option K-E as the preferred option

Option K-E is the best performing option of the Kew options because:

- It has the lowest estimated capital cost of the Kew bypass options.
- It has the highest estimated road user BCR (3.53) of the Kew options.

- There would be no major constructability issues with it, except that blasting is expected to be required near Ocean Drive, but management of such blasting would not present any significant problems.
- Two houses would be lost (both south of Ocean Drive – one at the western end of Bellbird Close and one on Bethesda Road) - this is the second lowest number of houses lost of the Kew options.
- The concept design for this option indicates that there would be a manageable fill excess (70,000 m³) which could probably be utilized for the Lake section, subject to works scheduling.
- It would not be close to Camden Haven High School – the perception of adverse noise impacts on the school arising from the proximity of Option K-F to the school would not apply to Option K-E.
- It would have a high visual impact, similar to all the other Kew options - there are urban design measures that would be integrated into the concept design which would mitigate this impact and ensure that the upgraded highway would make a positive contribution to the physical fabric of Kew.
- Although it would potentially impact a greater area of native vegetation than other options, this vegetation is not considered to be of high conservation significance. Appropriate mitigation measures, both on this section and on other sections of the proposal, would ensure that impacts on native vegetation would be minimised and that wider habitat values would be maintained.
- It is only one of two options that would not affect the Camden Haven Golf Course – a major local and regional community facility.
- It would be relatively close to the centre of Kew and the use of the existing highway as the northbound off ramp would mean that all northbound traffic with a destination eastwards towards Laurieton and west towards Kendall would still pass through the centre of Kew.
- The location of Option K-E to the east of Kew would place the upgraded highway and its southbound access ramps closer to the major growth areas along the coast to the east of Kew than the bypass options to the west of the existing highway.

Reasons for not recommending other options

The main reasons for not recommending Option K-A as the preferred option are:

- It has the second highest estimated capital cost.
- It requires the greatest length of new bridges.
- South of Kendall Road, there are two locations where it would not be above the 100 year flood event but it would be above the 20 year flood event. While the bypass to the north of Kendall Road would be above the 100 year flood level, access from Kew to the north would not be possible via the Kendall Road half diamond interchange because Kendall Road at the interchange is, and would remain, also below the 100 year flood level.
- This option would potentially reduce the flood storage volumes of the Camden Haven floodplain south of Kew.
- It would cross a tributary creek of the Camden Haven River close to the confluence of these two waterways which has implications for water quality.
- It has the lowest estimated road user BCR (2.20) of any of the Kew options.

- It would result in the third largest loss (9 hectares) of native vegetation of the options for this section.
- It would affect four holes on the western end of the Camden Haven Golf Course. The additional cost to adjust the course is approximately \$1.5 million.
- It would have a major impact on highway-related businesses in Kew.
- Five houses would be lost – the second highest number of any Kew option.
- It would require the acquisition of approximately 42 hectares of land – the second largest requirement of any of the Kew options.
- Of the 10 houses potentially affected by noise levels in excess of EPA guidelines, many of these would be in Kendall township to the west of Option K-A.
- As with the other Kew options, it would have a high visual impact, including an impact on the views from some residences in Kendall.

The main reasons for not recommending Option K-B as the preferred option are:

- It has the highest estimated capital cost.
- It would require a greater length of new bridges than several other options for this section.
- It has a relatively low estimated road user BCR (2.45) compared to other Kew options.
- It would affect all 18 holes of the Camden Haven Golf Course. To implement this option, additional land and a complete rebuilding of the golf course would be required. The additional cost is approximately \$6.8 million.
- It would have a major impact on highway-related businesses in Kew.
- Three houses would be lost – the third highest number of any Kew option.
- It would require the acquisition of approximately 39 hectares of land – the third largest requirement of any of the Kew options.
- Ten houses would potentially be affected by noise levels in excess of EPA guidelines.
- As with the other Kew options, it would have a high visual impact particularly where it crosses the Camden Haven Golf Course.

The main reasons for not recommending Option K-C as the preferred option are:

- It has a higher estimated capital cost than several of the other options.
- It requires 620 m of retaining wall with a maximum height of 7.5 m to form the cutting under Kendall Road – the greatest requirement of any of the Kew options.
- It would affect four centrally located holes of the Camden Haven Golf Course. To implement this option, an additional 10 hectares of land would be required to the north of the eastern portion of the golf course and 5 new or partially new holes, a new driving range, and the relocation of the golf cart storage building would be required at a total cost of \$1.3 million.
- It would have a major impact on highway-related businesses in Kew.
- Ten houses would be lost in a concentrated location on both sides of Kendall Road in the centre of Kew (the highest number of any Kew option) and this would have a major social impact on the township.
- Thirty-two houses would potentially be affected by noise levels in excess of EPA guidelines, the highest number of any of the Kew options.

- As with the other Kew options, it would have a high visual impact, in this case, related to the proposed cutting under Kendall Road and crossing of the eastern end of the golf course.

The main reasons for not recommending Option K-D as the preferred option are:

- It would increase local travel distances because of the introduction of a median barrier in the central part of Kew.
- Although it would meet intersection criteria for safety and functionality, safety would be reduced relative to other options because of the at-grade intersection at Kendall Road/Ocean Drive which would continue to be controlled by signals.
- Pedestrian safety would be reduced relative to other options because of the retention of highway traffic through the centre of Kew where there would be the highest local concentration of pedestrian movements.
- The total length of this option would have to be constructed under traffic.
- It has a relatively low estimated road user BCR (2.85) compared to other Kew options.
- It would affect three holes on the eastern end of the Camden Haven Golf Course and would require purchase of some additional land. The additional cost is approximately \$1.6 million.
- While through traffic would be retained through the centre of Kew, this option would have an impact on highway-related trade for existing businesses because changes to the availability of parking and turning movements would restrict ease of access to businesses for both through and local traffic.
- As with the other Kew options, it would have a high visual impact, particularly on the centre of Kew with the highway and its related infrastructure and continuously moving traffic becoming the dominant visual element in centre of the township.

The main reasons for not recommending Option K-F as the preferred option are:

- Although there would be no major constructability issues with the proximity of this option to the Camden Haven High School, particular controls on construction activities in the vicinity of the school in relation to dust, noise, safety and other impacts would be required.
- It would potentially impact the second largest area of native vegetation.
- It would affect a recently approved, but as yet only partially constructed, large lot subdivision north of Ocean Drive.
- It would be the option located closest to the SEPP 14 wetland to the south-east of Kew for the greatest distance – a total of 2.5 km – 1.5 km greater length than the other Kew options.
- Two houses would be lost (one to the north and one to the south of Ocean Drive).
- It would have a major impact on highway-related businesses in Kew.
- Seventeen houses would potentially be affected by noise levels in excess of EPA guidelines.
- The Camden Haven High School, as a noise sensitive land use, would potentially be affected.
- As with the other Kew options, it would have a high visual impact – in this case, because of its visual exposure on lower lying land to the south of Ocean Drive.

5.6.5 Herons Creek section

General comments

The options evaluated in Table 5–8 are those that were placed on public display in May 2001. The performance of the two options for the Herons Creek section is generally fairly similar because the relatively recent upgrading of the highway along this section dictates that upgrading is best achieved through the duplication on either the western or eastern side of the existing carriageway. At the southern end of this section where it would link with the Kew section, the upgrading is to commence on the western side because of the presence of fibre optic cables. As a result, the key differences between the two options relate to:

- the potential impact on future development options for the Boral Timber mill at Herons Creek – a major value-adding facility for the regional timber industry and the major local employer
- the restriction on the location of the new bridges over Herons Creek and its floodway to the western side of the existing bridges for hydrologic and environmental reasons
- the resultant differences in capital cost, constructability, and cut and fill balances.

Table 5–8 Summary evaluation of Herons Creek section options

Evaluation category	H-A (to the west of the highway)	H-B (to the east of the highway)
Traffic and transportation	σσσσ	σσσσ
Engineering	σσ	σσσ
Economic	σσσ	σσσ
ESD/environmental	σσσ	σσ
Land use and strategic planning	σσ	σσσ
Community cohesion	σσσ	σσσ

Note More symbols = better performing option
Fewer symbols = worse performing option

Overall conclusion for the Herons Creek section

Option H-B is considered to be the better performing option of the two Herons Creek options. Option H-A has a marginally lower level of performance. Note that the options are concurrent where they cross Herons Creek to the west of the existing highway.

Reasons for recommending Option H-B as the preferred option

Option H-B is the better performing option of the two Herons Creek options because:

- It has an appreciably lower estimated capital cost.
- It has a marginally higher estimated road user BCR (3.59) than Option H-A (3.16).
- The concept design for this option indicates that it would have a substantially lower earthworks shortage (35,000 m³) than would Option H-A (65,000 m³).
- It would not affect the future development options for the Boral Timber mill.
- Although it would affect a larger area of native vegetation (11 hectares) than Option H-A (4 hectares), this vegetation is not considered to be of high conservation significance. Appropriate mitigation measures, both on this section and on other sections of the proposal overall, would ensure that impacts on native vegetation would be minimised and that wider habitat values are maintained.

Reasons for not recommending Option H-A

The main reasons for not recommending Option H-A as the preferred option are:

- It has an appreciably higher estimated capital cost.
- It has a marginally lower estimated BCR (3.16) than Option H-A (3.59).
- The concept design for this option indicates that it would have a substantially higher earthworks shortage (65,000 m³) than would Option H-A (35,000 m³).
- It would significantly adversely affect the current operations of and future development options for the Boral Timber mill.

5.6.6 Conclusion

Based on this comparative assessment, the Preferred Option for the Proposal was comprised of the following elements:

- Johns River section – Option J-A with staggered T-intersection at Stewarts River Road
- Lake section – Option L-B, modified with a narrow median adjacent to Middle Brother National Park
- Kew section – Option K-E – the inner east route
- Herons Creek section – Option H-B, with development primarily to the east of the highway.

The Preferred Option for the Proposal was announced on 12 March 2002.

5.7 Refinement of the preferred option

After announcement of the preferred option, detailed cadastral surveying and other investigations were undertaken along the route to assist in developing the engineering concept design. Refinement of the preferred option principally comprised detailed reviews of:

- intersection/interchange arrangements at Johns River
- interchange arrangements at Kew
- land acquisition requirements (based on discussions with potentially affected landowners)
- the horizontal and vertical alignments to optimise the design
- locations and layouts of at-grade intersections
- provisions for local access including options for the addition of frontage roads.

In some cases the reviews resulted in changes to the preferred option. Key elements considered during the refinement process are detailed below, including those cases where it was decided not to proceed with the refinement.

5.7.1 Johns River section

Johns River interchange

The preferred option at Johns River incorporated staggered T-junctions at the Stewarts River Road and bypass intersection. In response to safety issues raised by the community in relation to the at-grade junctions, a more detailed comparison than that previously undertaken was carried out between the proposed staggered T-junctions and an alternative grade separated interchange at Stewarts River Road. The consequence of the further investigation was that the preferred option was refined to provide a grade-separated interchange in lieu of the staggered T-junction arrangement on the basis of economic benefits derived largely from accident cost savings.

Bulleys Road/Wharf Road

Several variations of the intersection of Wharf Road and Bulleys Road with the highway were considered with the aim of improving safety where there would be several different traffic movements interacting because of the proximity of the southbound off-ramp. The presence of heavy vehicles from the Boral Quarry is a compounding factor. Further investigation showed that the safest option was to eliminate traffic movements through an at-grade intersection by providing a frontage road on the west side of the highway and connecting to the elevated roundabout at Stewarts River Road. The median opening would be retained but would be used for U-turns only.

Frontage roads

On the west side of the highway between the start of the Proposal at Station 0 and the start of the Johns River bypass at Station 1200, there are six existing local access connections to the existing highway. As part of the design refinement process two options for providing access to these properties were considered, based on safety, ease of access and the longer-term access needs:

- Option 1 provided separate left-in/left out connections to the northbound carriageway for each property at Stations 20, 220, 530, 980 and 1120.
- Option 2 provided two frontage roads which could be accommodated within the existing road reservation on the west side as follows:
 - Station 20 to Station 200: frontage road on west side to combine access for three properties into one connection at Station 200
 - Station 400 to Station 1150: frontage road on west side to combine access for four properties into one connection at Station 980.

Following a review of these options once developed, however, the construction of the additional 950 m of frontage road could not be justified at this stage because of cost and low traffic volumes. Consequently, while the frontage roads do not form part of the EIS proposal, it has been determined that the road reservation and highway upgrade proposal would allow future installation of both frontage roads if considered desirable in the future. If this were to occur, a separate environmental impact assessment would be undertaken at that time.

5.7.2 Lake section

Frontage road at Passionfruit Gully

There are three properties on the western side just to the north of Passionfruit Gully. The Refined Concept Display had a separate left-in/left-out access for each property. In the interests of improved safety the proposal has been modified to include a short frontage road between Station 5700 and Station 6000 linking the three properties. The frontage road would connect to the upgraded highway at Station 5980 at a single left-in/left-out connection. Minor additional land acquisition would be required.

Watson Taylor Road intersection

The Watson Taylor Road intersection arrangement shown in the preferred option was reviewed during the concept design stage. The intersection location has been moved to the north by about 150 m and access for the two properties on the western side has been connected to the back of the intersection. The revised layout improves safety by locating the intersection where better sight distance would be available and it is also more convenient for the two properties to the west.

No provision has been made for median widening to accommodate right-turn movements for semi-trailers on the expectation that few semi-trailers would use either Watson Taylor Road or the properties to the west.

Northbound rest area and Charles Yard Road

The arrangements for the new northbound rest area have been slightly modified as the concept design has been developed. In order to improve safety, the relocated Charles Yard Road intersection has been moved further to the south so that it can function quite separately from the entrance to the proposed rest area. The relocated intersection would be about 800 m south of the existing Charles Yard Road intersection.

The nose for the exit lane into the rest area would be located about 300 m north of and beyond the relocated Charles Yard Road intersection, allowing sufficient distance for a deceleration lane prior to the rest area diverge.

The area of land available for the rest area within the remaining area of the road reservation is about 300 m long and 50 m wide. While detailed layouts of the rest area have not been prepared, the 1.5 ha available would be quite sufficient for the facilities proposed and would allow flexibility during detail design to retain as much as possible of the existing vegetation.

Ross Glen Road intersection and airport access

The Ross Glen Road intersection and airport access arrangement shown in the preferred option was modified during the concept design stage to improve safety and convenience. The revised proposal shifted the Ross Glen Road intersection about 150 m further to the south (or about 300 m south of the current junction location). The new location has improved sight distance for southbound highway traffic. It also allows the airfield access to be connected to the back of the intersection, improving emergency access. The intersection incorporates median widening to allow semi-trailers to safely make right turns from either Ross Glen Road or the airfield.

5.7.3 Kew section

Kew interchange options

The Preferred Option for the Kew bypass (Option 1) as announced included a single interchange on Ocean Drive, with southbound ramps to and from a roundabout on Ocean Drive and northbound ramps utilising the existing highway.

Options involving separate interchanges to the north and south of Kew to replace the central interchange were investigated during the route selection phase but were not adopted as part of the preferred option, essentially because the significant increased cost could not be justified.

Following the preferred option announcement, further discussions were held with some members of the business community, the outcome of which was that a more detailed investigation of an alternative with separate interchanges to the north and south would be undertaken. No changes to arrangements for northbound traffic were proposed for the investigation.

The alternative investigated was to provide grade-separated interchanges at both the southern and northern departure points from the highway for the Kew bypass to ensure that all traffic to and from Kew, Kendall, Lorne and areas to the west as well as to and from Laurieton and coastal areas to the east would be directed through Kew. The half-diamond interchange and roundabout proposed at Ocean Drive would be omitted. It was considered by the interested community members that this Option 2 with separate interchanges to the north and south of Kew would, in comparison to the preferred option:

- facilitate continuation of Kew's role in servicing highway traffic
- assist the continued viability of businesses in Kew by virtue of the higher volume of traffic passing through the Kew business area
- facilitate the continued role of the Kew Visitors Information Centre and assist in the growth of tourism in the Camden Haven area.

Designs were developed for an option with separate interchanges to the north and south of Kew (Option 2). These interchange arrangements, together with Option 1 with an Ocean Drive interchange (which was as included in previous displays of the Preferred Option), were exhibited for public comment in December 2003 and January 2004. Submissions made in response to this exhibition as well as feedback from the staffed display periods were incorporated into the review and assessment of the two options. It should be noted, however, that few people visited the display while it was staffed, and there was a small number of submissions (14).

Without the Proposal, the AADT passing through Kew in 2011 is projected to be 24,500, including traffic on Kendall Road and Ocean Drive. Implementation of Option 1 would see this figure reduce to 7,000 (71% reduction) and for Option 2 the figure would be 9,300 (62% reduction).

There would be additional costs involved in the implementation of Option 2, comprised of initial capital cost, costs to road users, and accident costs. The additional capital cost amounts to \$3.5 million (reduced from the \$4 million figure of Section 5.6.4 through design refinement) and arises principally from the need for an extra bridge.

An analysis of the differences in the distances that would be travelled by vehicles under each of the options has been undertaken. Overall, Option 2 involves a net additional annual travel distance of 219,000 km by 2011, at a road user cost of around \$160,000. The potential for accidents is also increased under Option 2. This arises from the fact that the total number of vehicles passing through the Kew intersection has increased and with it the potential for accidents. The accident rate would also increase because the geometry of the southbound off-ramp in Option 2 is steeper and tighter than in Option 1 and because all traffic is diverted through the one intersection in Kew rather than split between the intersection and the Ocean Drive roundabout.

Regardless of the option adopted, construction of the highway bypass would result in a significant drop in traffic passing through Kew with an associated and inevitable effect on existing highway-related businesses with a high dependency on this trade. Consequentially, consideration of the merits of the two interchange options became one of whether the possible additional highway-related trade in Kew (over and above what would occur with Option 1) warranted the additional capital expenditure and the ongoing costs to road users arising from the higher travel distances and accident rates projected.

The issue to be resolved was not the attraction of an additional 2300 vpd through Kew in 2011 by investing the additional capital, road user and accident costs, but rather how many of the drivers would stop and make a Kew purchase which they would not otherwise have made under Option 1. There does not appear to be directly applicable data or a precedent situation available to assist with this analysis, but having regard to the nature of the 2300 vehicles (local or tourist) and the travel patterns prescribed by the road layout, it is considered that any attracted spend by these additional motorists would have no substantial impact on the viability of those Kew businesses with a high dependence on highway-related trade in the context of a 64% reduction in traffic through Kew.

The potential for Option 2 to attract greater volumes of southbound traffic to stop in Kew was also considered. The variables affecting the attraction include prior visual cues, the distance of off-highway travel and the additional travel distance involved. An assessment of these variables for Kew suggests that signage rather than the choice of option would have a greater affect on the attraction of southbound vehicles into the township. There is an allowance for advance signage in the proposal estimate.

With respect to the matter of assistance to tourism in the Camden Haven area, no evidence could be identified which would support this possibility arising from the adoption of Option 2. Further, no rationale could be established which would suggest a means by which Option 2 would provide quantifiable tourism benefits over Option 1.

On this basis, Option 1 involving a single central interchange was retained as an element of the preferred option.

Sunnyvale Road

Local access arrangements in the vicinity of Sunnyvale Road and the northbound exit ramp into Kew have been modified during the concept design stage to improve safety and convenience. The preferred option layout had the Sunnyvale Road intersection connecting to the exit ramp but it was considered that safety could be further improved during the concept design development.

In order to separate the Sunnyvale Road connection completely from the northbound diverge, Sunnyvale Road would be diverted to the north using a link road about 300 m long. It is located at a higher level above the existing highway and largely within the existing road reservation, although some additional acquisition would be required to accommodate the link road. A roundabout would be installed where the link road and Bethesda Road connect to the old highway. The one-way northbound off-ramp from the highway would connect to the same roundabout.

The roundabout would effectively provide a transition between the high-speed upgraded highway and the local road network providing access to Kew and surrounding areas.

Glenhaven frontage road

The preferred option layout included a median opening and property access opposite the start of the northbound deceleration lane into Kew. This arrangement was modified during the concept design stage to improve safety by separating the median opening and the northbound diverge.

The revised proposal moves the median opening about 600 m to the south, or about 550 m south of the start of the northbound deceleration lane. A frontage road linking back to the median opening would be provided on the east side to provide access to three existing properties. The frontage road is about 1 km long. It is designed for use by semi-trailers to suit the needs of three businesses currently fronting the highway.

Herons Creek Road (south) and Weeroona Place

The preferred option layout included an at-grade intersection at Herons Creek Road south with a short frontage road connecting Weeroona Place back to the existing highway.

In order to eliminate one at-grade intersection, an additional frontage road has been proposed on the western side to link Herons Creek Road south back to the Kew interchange. The link road has been positioned against the fill batter of the highway to reduce acquisition requirements. The extra length of frontage road is about 350 m, bringing the total length of this frontage road to about 700 m.

5.7.4 Herons Creek section

Frontage road south of Walkers Creek

On the western side of the highway to the south of Walkers Creek, there are three properties with highway access. As part of the design refinement process an option for providing a frontage road linking these properties was developed.

The frontage road would extend north from the Eggbert property for a distance of about 400 m to connect to the existing access points for the two properties to the north. The intersection with median opening at the Eggbert property would remain. Additional acquisition would be required from the southern two of the three properties to accommodate the frontage road.

Following a review of this frontage road option, its construction could not be justified at this stage for the reasons outlined in Section 5.7.1.

For the purposes of the EIS the Proposal incorporates access for the Egbert property at the at-grade intersection with median opening while access to the other two properties to the north is provided by a combined left-in/left-out access point just south of Walkers Creek.

While the frontage road does not form part of the EIS proposal, the land acquisition necessary to allow construction of the frontage road is included in the EIS proposal. This acquisition would allow future installation of the frontage road where warranted in the future. If this were to occur, a separate environmental impact assessment would be undertaken at that time.

Frontage road north of Walkers Creek

On the western side of the highway to the north of Walkers Creek, there are four properties with access off the existing highway. As part of the design refinement process an option for providing a frontage road linking these properties was developed.

The frontage road would extend for a distance of about 700 m from Station 19700 to Station 20400 to connect access to the four properties on the western side of the highway to the north of Walkers Creek. The connection to the highway would be a single left-in/left-out access point at Station 20060. Some additional acquisition would be required to allow construction of the frontage road.

Following a review of this frontage road option, its construction could not be justified at this stage for the reasons outlined in Section 5.7.1.

For the purposes of the EIS the proposal incorporates individual left-in/left-out access points for each of the four properties.

While the frontage road does not form part of the EIS proposal, the land acquisition necessary to allow construction of the frontage road is included in the EIS proposal. This acquisition would allow future installation of the frontage road where warranted in the future. If this were to occur, a separate environmental impact assessment would be undertaken at that time.

Access to Herons Creek Public School

The existing access arrangements to Herons Creek Public School include a driveway from the highway to the south of the school at about Station 21700 as well as a track from the north which connects to the existing highway opposite Bobs Creek Road.

This arrangement has been modified during the concept design stage to provide a single, improved access route to the school. The southern vehicular access has been deleted (being modified for pedestrians/cyclists access only), and the northern access modified to provide two-way access with a turning circle to the north of the playground. No northbound deceleration lane has been proposed because traffic volumes are projected to be low and warrants have not been met.

Other features of the concept design which specifically address the requirements of the school include widened pedestrian/cycle footways on the western side of the bridges over the Herons Creek floodway and Herons Creek itself. Each bridge would have the normal 2.5 m outside shoulder, a vehicle barrier, a 1.5 m wide pedestrian/cycleway and then a pedestrian/cycle barrier at the edge of the bridge.

The order of cost to the Proposal to provide for safe pedestrian, cyclist and vehicular access to the school is about \$0.7 million including noise walls.

Addition of southbound deceleration lanes at Bobs Creek Road

At the Value Engineering Workshop in February 2004 it was agreed that southbound deceleration lanes should be provided on both sides of the southbound carriageway approaching Bobs Creek Road junction, which is just outside the original study area. The available sight distance on the southbound approach to the intersection is limited and it is believed that this may be contributing towards the number of rear end accidents occurring on this approach.

5.7.5 Summary - Preferred Option

A number of adjustments and refinements have been made to the Preferred Option. Taking these into account, the Preferred Option considered and addressed in this EIS is shown in Figure 6-1A to 6-1N.

5.8 Ecologically sustainable development (ESD)

The four principles of ESD were considered in the following way in the options development and route selection process.

5.8.1 The precautionary principle

The route selection process adopted the precautionary principle through the development and comparison of feasible options and the selection of a route alignment that avoided direct contact with environmentally sensitive areas such as Middle Brother National Park, Middle Brother State Forest and SEPP 14 wetland areas. This EIS identifies a range of appropriate mitigation measures to be incorporated into the design and operation of the Proposal if it proceeds. Monitoring is also a key element of mitigation that would assist in ensuring that relevant environmental standards and guidelines are met.

5.8.2 Intergenerational equity

The route selection process provided the opportunity to carry out a comparative analysis against a number of engineering, economic and environmental factors, which were cognisant of the maintenance of environmental attributes, both now and in the future. The preferred option components were chosen to reduce environmental and social effects both during the construction process and operation for the well-being of future generations, particularly in relation to Middle Brother National Park, areas of SEPP 14 wetland, Middle Brother State Forest and Watson Taylors Lake, and the amenity of residents of Johns River and Kew. However, it is recognised that some level of adverse environmental impact is likely to be caused by the construction and operation of the Proposal. A range of appropriate mitigation measures along the route of the preferred option has been developed to assist in the protection of environmental resources within the study area both now and in the future.

5.8.3 Conservation of biological diversity

A major influencing factor associated with the development of all route options was the proximity of Middle Brother National Park, Watson Taylors Lake, Crowdy Bay National Park, known Acid Sulfate Soil (ASS) areas, and the SEPP 14 wetlands which flank to varying degrees the eastern sides of all the options considered. The preferred option avoids direct contact with National Park and SEPP 14 wetland areas as well as other areas of conservation value. There will, however, be impact on native vegetation and a range of appropriate mitigation measures has been developed.

5.8.4 Improved valuation and pricing of environmental resources

The route selection process gave detailed consideration to the influence of environmental resources in the evaluation and selection of the preferred option. Specific design responses, such as the decision to avoid Middle Brother National Park and SEPP 14 wetlands, and to minimise incursion into areas of ASS and flood-prone land, were made to minimise environmental disturbance and the potential for environmental harm. New or upgraded culverts were integrated into the initial concept designs to facilitate both transverse drainage cross-flow and faunal movements under the highway at various intervals along the route alignment. Such design treatments resulted in increases in overall cost estimates and, while they do not translate directly into valuation and pricing of environmental resources, they are indicative of a minimum valuation being applied to those resources in relation to the Proposal. For example, the additional cost involved in avoiding impact on the Middle Brother National park is around \$1 million and, as noted in Section 5.7.4, the cost of improved amenity for the Herons Creek Public School is \$0.7 million. The importance of improvements in environmental amenity in terms of reductions in traffic noise and air emissions that would be experienced by the residents of Johns River and Kew as a result of bypass options of these townships were also included in the consideration of the highway upgrade options.