

6. Route options development

6.1 Process for development of the route options

Route options were developed and evaluated using a multi-criteria approach. This allows systematic comparison of a range of options against a set of different parameters that may be quantitative or qualitative. These parameters reflect the Pacific Highway Upgrade Program objectives, and the project objectives, and encompass social, environmental, engineering/functional and costs issues. Ultimately, this approach assists with the selection of a preferred route.

Physical constraints within the study area were ranked on a scale of 1 to 5. The basis for identifying constraints on this scale is defined in **Table 6-1**.

Table 6-1 Constraint ranking framework for option development

Rank	Category	Constraint to Route Options
Level 5	Very High	Avoid unless no other practical and feasible options exist.
Level 4	High	Avoid where possible. Perimeter impacts may be acceptable.
Level 3	Moderate	Avoid where possible. Direct impacts manageable through mitigation measures.
Level 2	Low	Minimal constraint, or some benefit.
Level 1	Nil	No constraint, or benefit from locating options in these areas.

On the basis of the constraint ranking for each constraint type to be considered in the route option development phase, constraint layers were mapped. Physical constraints, such as habitat, topography and geotechnical conditions, were considered in combination with the design standards and criteria established for the project. Non-physical criteria including traffic and transport considerations, project cost and economic impacts were also considered. These criteria formed part of the assessment of the long list options, described in **Section 6.3**.

Consideration of the principles of Ecologically Sustainable Development (ESD) is a requirement of the Pacific Highway Upgrade Program objectives, and this is a reflection of statutory requirements for environmental assessment in NSW. The ESD principles are inherent in the approach to the project. ESD considerations applied to the development of route options include:

- Conservation of biological diversity and ecological integrity through the use of constraints mapping to identify ecological resources, adopting the principle of avoiding impacts where possible, and where impacts are unavoidable, taking all reasonable steps to minimise impacts.
- Development of route options which, as far as practicable, consider the impacts on local communities and balance these impacts against the requirements of the project, ensuring that the needs and actions of this generation do not compromise the quality of life of future generations.

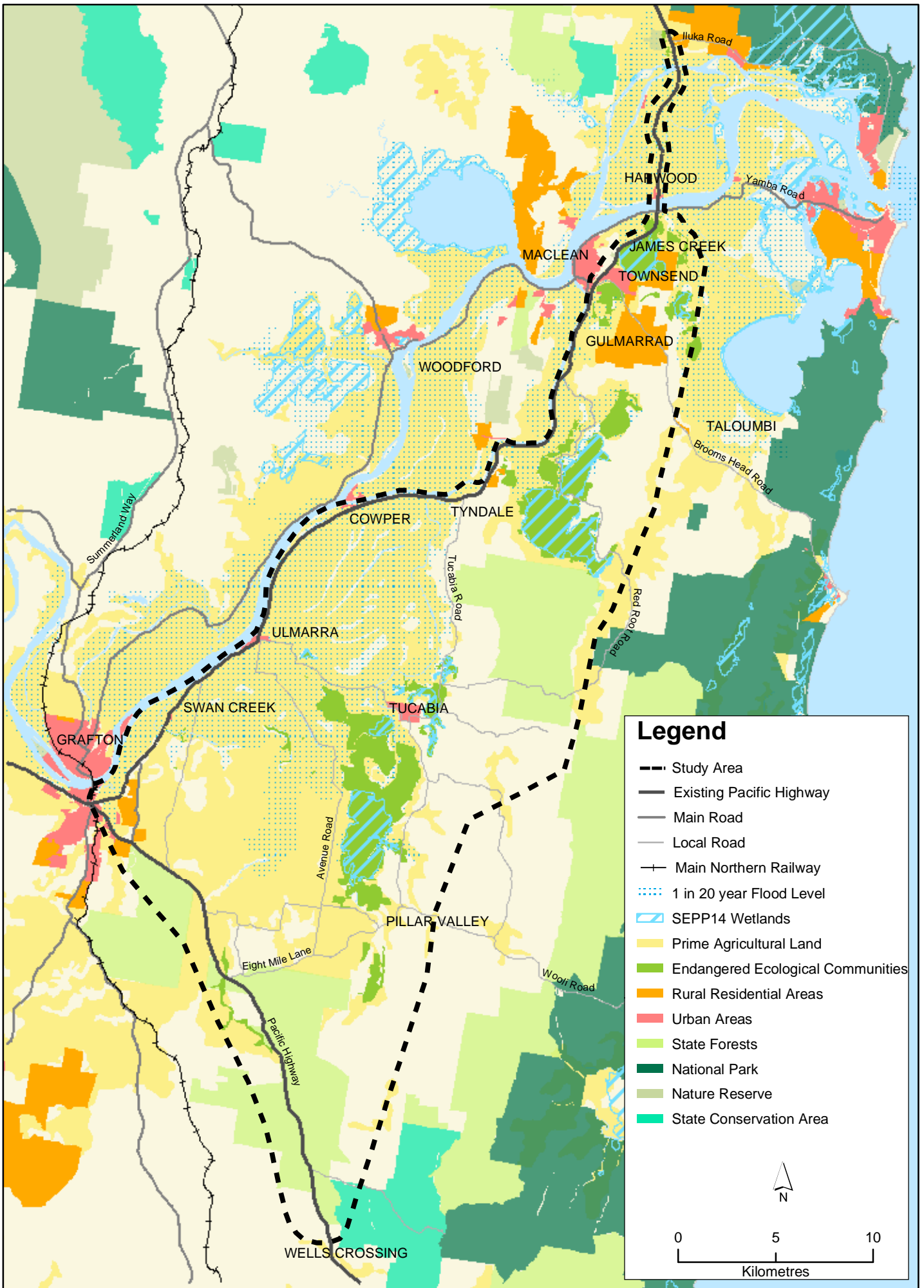
- A precautionary approach to the identification of constraints, recognising that at this early stage of the project there is uncertainty in relation to the accuracy and completeness of data.
- Use of economic indicators where appropriate to value resources within the study area and to consider the impacts of route options on those resources.

Physical constraints were mapped in layers to enable evaluation of a single constraint (eg. vegetation communities) across the entire study area, or to enable composite constraint analysis. Using these data layers, the study area was analysed in terms of a wide range of physical constraints. This analysis enabled the development of a long list of route options that sought to avoid or minimise impacts on major constraints. The key environmental, social and engineering constraints to the development of route options are illustrated in **Figure 6-1**.

Initially, a long list of route options was developed using the constraints mapping, investigations within the study area, and applying other project requirements such as design standards. A range of scenarios were generated and tested to consider the influence of social, environmental and physical constraints on the development of route options. Options suggested by the community were also considered for inclusion in the long list of options.

A GIS software package was used to generate a line of best fit for each scenario, assuming start and finish points for each option at Wells Crossing and Harwood Bridge. Scenarios were also tested using start and finish points at different locations along the highway between these locations.

The long list options were identified as route corridors, rather than specific road alignments. Preliminary concept design was then undertaken to enable assessment of performance against the criteria. While indicative routes were designed for each of the long list options, it was recognised that there was potential for the options to be realigned as investigations become more advanced. Preliminary design included conceptual identification of horizontal and vertical alignments, cut and fill requirements, waterway crossings and cost estimates.



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Figure 6-1 Key constraints in the study area

6.2 Long list of potential route options

A long list of ten potential route options was developed between Wells Crossing and the Harwood Bridge (see **Figure 6-2**). The length, cost and approximate traffic volumes for each of these routes are shown in **Table 6-2**. The development of options between Harwood Bridge and Iluka Road is discussed in **Section 6.4**.

Table 6-2 Summary of long list options

Option	Length (kilometres)	Cost estimate (\$million 2005) ¹	AADT (all) ²	AADT (heavy vehicles)
Red	60	765	4600	1,500
Yellow	65	1140	4600	1,500
Blue	61	950	4600	1,500
Green	60	995	4600	1,500
Purple	66	990	4600	1,500
Orange	67	1020	10,500	2,400
Grey	65	1160	4600	1,500
Light Blue	66	810	4600	1,500
Light Green	65	990	4600	1,500
Brown	69	1220	10,500	2,400

¹ Cost estimates have been determined using the contingencies applicable to the RTA E50 estimate. These costs have subsequently been revised for the short-listed route options, and cost estimates presented in **Section 1** may therefore differ from those reported above.

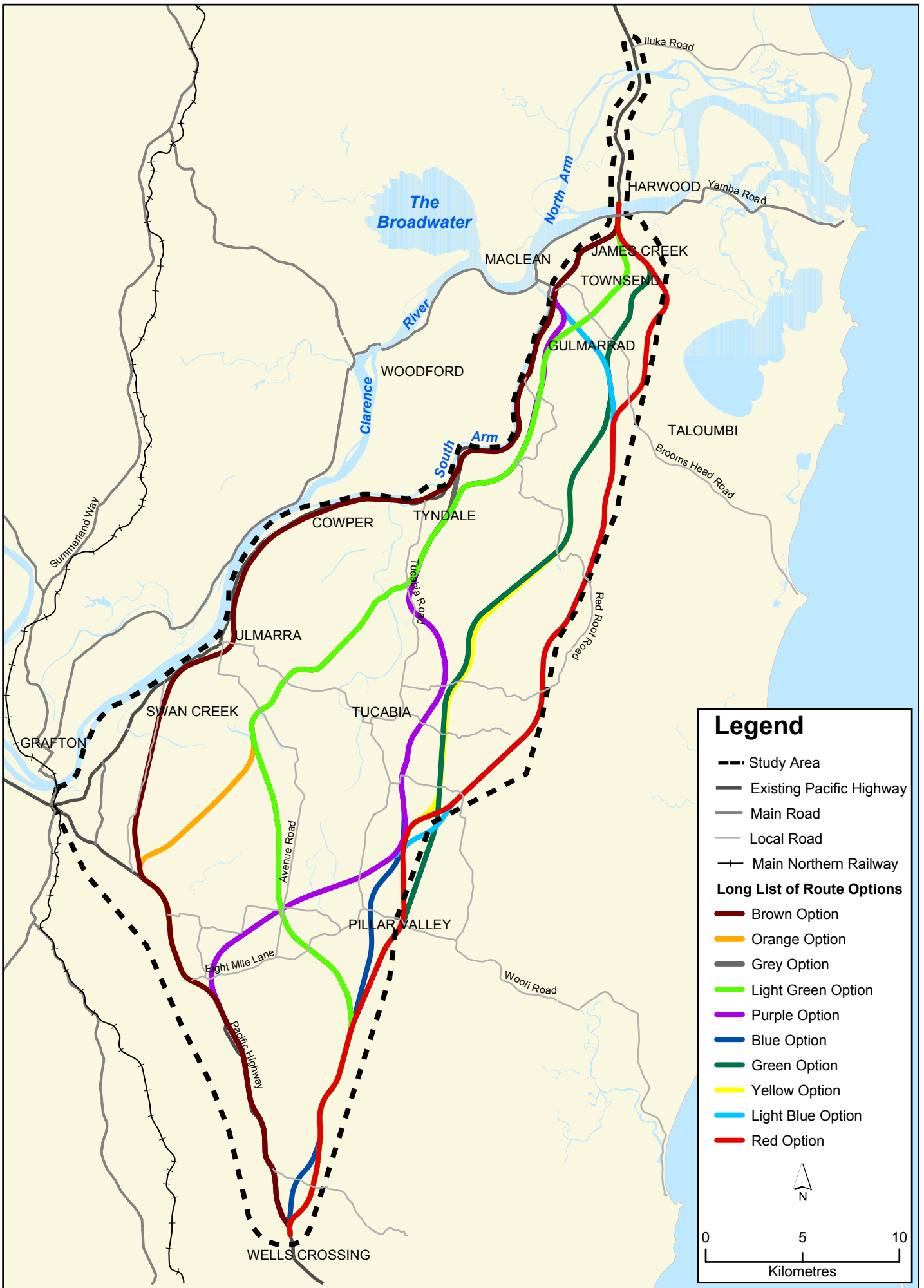
² AADT was calculated at mid-points on each route option (south of Maclean) and is based on predicted traffic volumes in 2021.

6.3 Assessment of long list of options

The options from the long list were assessed against criteria derived from the Pacific Highway Upgrade Program and project objectives. The criteria sought to enable development of route options that would ensure:

- Engineering, traffic, economic and design outcomes such as alignment, constructability and value for money can be achieved (ie. assessment of ‘fitness for purpose’).
- Environmental outcomes can be met by avoiding or minimising impacts or constraints with high environmental values.
- Social issues are considered such as impacts on amenity, community and property severance and local access.

The assessment was then reviewed to consider how well each option met the objectives of the project. The evaluation of the long list options identified some key differences between options that intersect with the highway only at or near Wells Crossing and Harwood, typically the more easterly options, and options that utilise the existing highway for greater distances, typically the more westerly options. **Table 6-3** summarises the key advantages and disadvantages of the easterly and westerly options.



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Figure 6-2 Long list of route options

Table 6-3 Summary of long list options assessment

Options	Key Advantages	Key Constraints
Easterly options	<ul style="list-style-type: none"> ▪ Direct routes with generally greater travel time reductions for through traffic. ▪ Mostly avoid the floodplain except around James Creek. ▪ Relatively low project cost due to short project distance and avoidance of major flooding and geotechnical constraints. ▪ Minimal impacts on residences, urban areas and villages, except around Gulmarrad and James Creek for some options. 	<ul style="list-style-type: none"> ▪ Limited potential to attract high volumes of local traffic from the existing highway (likely to attract only through traffic, which is approximately 30-35% of total traffic). ▪ No or limited opportunities to stage construction. ▪ No or limited use of the existing highway. ▪ Some options would require large cut and fill volumes due to steep terrain. ▪ Low traffic volumes limit economic benefits. ▪ Relatively high impact on remnant bushland and habitat. ▪ Impacts on Glenugie and Newfoundland State Forests.
Westerly options	<ul style="list-style-type: none"> ▪ Potential to attract a high proportion of highway traffic where connections to Grafton are improved. ▪ Greater opportunities to utilise sections of the existing highway. ▪ Some opportunities to stage construction. ▪ Minimal impacts on remnant vegetation and fauna habitat. 	<ul style="list-style-type: none"> ▪ Generally limited opportunities to reduce travel times due to longer project lengths. ▪ Generally high impacts on flooding (high proportion of routes within the floodplain). ▪ Geotechnical constraints associated with soft soils within the floodplain. ▪ Economic benefits are limited by high project cost resulting from construction constraints (soils and flooding) and project lengths. ▪ High impacts on residences, farms and businesses that front the highway. ▪ Greater impacts on high value agricultural land. ▪ High potential for noise impacts due to the density of residences.

The summary above demonstrates that the easterly options generally perform better than the westerly options in terms of travel time reduction for through traffic, project cost and social impacts. However, the westerly options perform better in terms of attracting local traffic (and therefore a higher volume of traffic overall), ecological impacts, and potential for staging. This level of assessment demonstrated that both the easterly and westerly options had potential advantages that warranted further consideration as part of the short list of route options.

On this basis, a further analysis was made of which of the easterly and westerly options best met the Pacific Highway Upgrade Program and project objectives. That assessment identified the following options for potential inclusion in short list of feasible options:

- The **Brown option**, modified to be located essentially on the alignment of the existing highway from north of Swan Creek to Harwood, with deviations at Ulmarra and Tyndale.
- The **Orange option**, subject to further consideration of flooding and geotechnical constraints that may impose significant constraints to construction and cost.

- The **Purple option**, with a potential north-east connection to the Red option in the vicinity of Shark Creek, and modified in the north to avoid Gulmarrad/Townsend by following the existing highway.
- The **Green option**, subject to further consideration of ways to reduce the potential for environmental impacts on the Pine Brush State Forest and Shark Creek SEPP 14 wetland.
- The **Red option**, modified in the vicinity of Wells Crossing to avoid direct impacts on the Yuraygir State Conservation Area and flora reserve within the Newfoundland State Forest.

Preliminary geotechnical assessments undertaken for the Orange option indicated that the floodplain areas through which the option would pass contain highly compressible soils, which would require extensive pre-loading or expensive foundation construction methods. These factors were concluded to contribute substantially to a high cost and high degree of construction risk for this option. The Orange option was subsequently excluded from the feasible options on the basis of these constraints.

The Green option is the shortest of the long list options and includes the shortest floodplain crossing, and therefore has the potential to deliver the greatest benefits for through traffic, at a lower cost than other options. However, significant constraints associated with the Green option included impacts on areas of conservation value in Pine Brush State Forest and the Shark Creek SEPP 14 wetland, high cost due to large earthworks volumes in some sections and high impacts on the rural residential areas of Gulmarrad and James Creek.

Further assessment of the Green option was undertaken with the aim of reducing these impacts. A modified Green option was developed and included in the short list of feasible options. The Green option was modified as follows:

- The southern end was realigned further west to avoid the Yuraygir State Conservation Area.
- The route was realigned further east in Pine Brush State Forest to minimise impacts on ecologically significant areas and avoid areas of steep terrain.
- The route around Gulmarrad and James Creek was realigned further to the east to minimise direct impacts on residential areas.

The short listed feasible route options, Brown, Purple, Green and Red and possible connections, are described and assessed in **Section 1**.

6.4 Options between Harwood Bridge and Iluka Road

Between Harwood Bridge and the Iluka Road intersection, the RTA strategy for upgrading the highway is to generally follow the alignment of the existing highway. Initially, this section of the project may be developed to Class A standard, and would require one new bridge at Harwood and the North Arm, and a new single carriageway duplication of the existing highway. Minor re-alignment of the existing highway may also be required to achieve design standards. Provision is to be made to develop this section of the road to Class M standard in the future. This would require two new carriageways plus the existing highway, which would operate as a local access road or alternative route. Upgrading to Class M standard would require two additional bridges over the Clarence River.

Consideration was given to upgrading the highway either to the east or west of the current alignment. Constraints are similar on both sides of the existing road. However, upgrading to the east would involve less risk of impacts on Harwood village. At the North Arm, upgrading to the east would enable use of the current north-bound bridge as part of the local access or alternative route, as this bridge is not suitable for the upgraded highway. This would require one additional bridge at this crossing, with the existing south-bound bridge converted to north-bound.

For the purposes of assessment, a nominal alignment has been identified to the east of the existing highway in this section. The impacts of an upgrade to Class M standard have been assessed, based on a 100 metre wide road reserve. However, as with other options south of Harwood, a 250 metre wide corridor has been identified, centred on the nominal alignment, and the road may be located anywhere within this corridor, to the east or west of the existing highway. The assessment of the nominal alignment between Harwood Bridge and Iluka Road is described in **Section 7.7**.

The Pacific Highway currently crosses the Clarence River south of Harwood via a single two lane steel truss bridge approximately 700 metres long. The bridge has a clearance of approximately 18 metres from the water level but includes a lifting span that, when open, provides a clearance of approximately 36 metres. Records from the past few years provided by Maritime NSW indicate that the lift span is opened about 12 times per month.

Discussions are continuing with Maritime NSW as to the clearance requirements for new bridge crossings over the Clarence River. Consultation with Maritime NSW will also determine whether it is necessary to maintain the current opening clearance of Harwood Bridge for the new bridges. The final clearance height to be adopted will also affect the overall length of the bridge and therefore the costs. Initial design for this bridge indicates the following relationship between the bridge clearance and length:

- 18 metre clearance – 700 metres long.
- 25 metre clearance – 1000 metres long.

- 30 metre clearance – 1200 metres long.
- 36 metre clearance – 1600 metres long.

The length of the bridge also potentially impacts on the layout of any interchanges located at either end of the bridge. The higher and therefore longer the new bridge is, the further set back from the river the interchanges would be located. The location of interchanges in this area is an important consideration in minimising the land use and environmental impacts of the project.

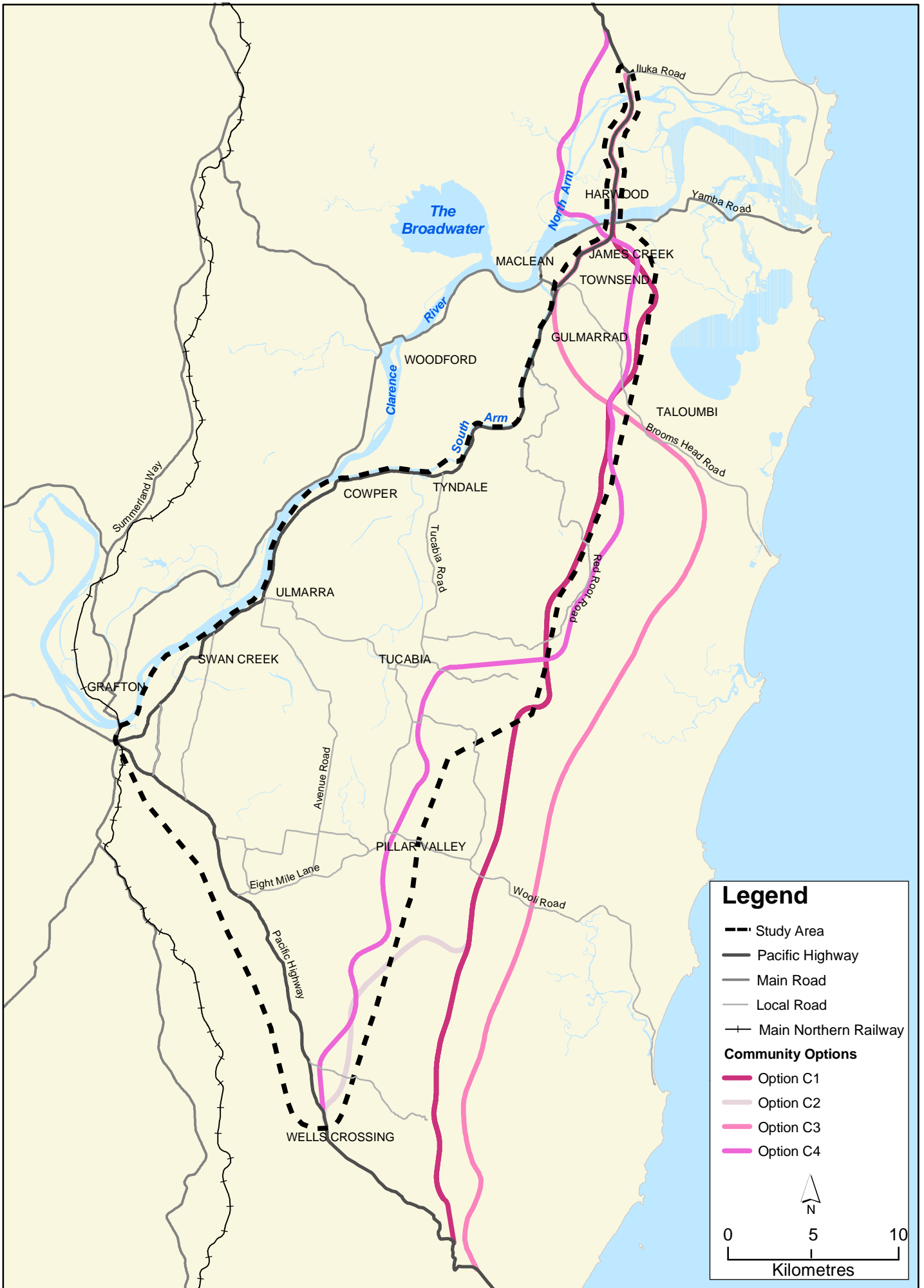
The urban design components of a second crossing of the Clarence River will also be a major input for the design. Issues that need to be addressed include the appearance of the existing and new bridges side by side and height differences.

6.5 Route options suggested by the community

A number of route options were suggested by individuals. These were evaluated in a similar way to the long list of options, against the project and Pacific Highway Upgrade Program objectives, to determine whether they are potentially feasible options and if they presented any opportunities not identified in the long list options. The assessment of these options against the Pacific Highway Upgrade Program objectives is summarised below.

Options suggested by the members of the community (illustrated at **Figure 6-3**) were:

- An option to the east of the original study area, commencing south of Wells Crossing and continuing east of the study area until approximately due east of Tucabia, where it enters the study area and continues north to Harwood (Option C1).
- An option commencing at Wells Crossing and travelling north-east, outside the study area between Wells Crossing and Pillar Valley, before heading north to Harwood following a similar alignment to the option described above (Option C2).
- Options that commence substantially south of the study area, around the Barcoongere Way, and travel through state forests and the Yuraygir National Park, as well as areas of private land, to the east of the main escarpment of the Coast Range (Option C3).
- An option that travels from Wells Crossing north to around Tucabia, then, south of Sommervale Road and east of Tucabia, turns east before heading north through the Yuraygir National Park, then generally north and west towards Harwood Bridge. It crosses the existing Highway south of Harwood Bridge, and crosses the Clarence River west of the existing bridge, then crosses North Arm and Ashby Island before heading north along the western side of North Arm. It rejoins the existing highway north of Iluka Road, and would also pass through the Mororo Creek Nature Reserve (Option C4).
- An option that utilises the Summerland Way rather than the Pacific Highway, from Grafton north (Option C5).



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Figure 6-3 Options suggested by the community

Option C1

Option C1 is approximately 72 kilometres long (from south of Wells Crossing to Iluka Road), including approximately 9.5 kilometres that extends to the south of Wells Crossing and is outside the scope of the Wells Crossing to Iluka Road project. The overall strategy for upgrading of the Pacific Highway has identified that the road from Woolgoolga to Wells Crossing is generally a high standard alignment and is in good condition, with the exception of some short sections that would require a modified alignment to meet the Pacific Highway Upgrade Program objectives. In terms of value for money, the RTA has determined that it is more cost-effective to utilise the existing alignment from Woolgoolga to Wells Crossing than to pursue options such as Option C1.

Option C1 also fails to meet the Pacific Highway Upgrade Program objectives for the following reasons:

- Preliminary calculations of earthworks volumes for this option indicate that construction costs would be very high, and well in excess of the strategic estimates prepared by the RTA.
- Because it is located a substantial distance east of Grafton, Option C1 is unlikely to attract local traffic from the existing highway.
- It is also comparatively longer than options within the study area, and would therefore provide little travel time or cost savings.
- It would result in substantial direct impacts on the Yuraygir National Park (approximately 2.5 kilometres), which has been conserved by the NSW Government for ecological reasons and because of the value of the ecological resources to the people of NSW.
- Impacts on the ecological and economic resources of the Newfoundland and Candole State Forests would be substantial (approximately 10 kilometres).

Option C2

Option C2 is approximately 63 kilometres long, and extends from Wells Crossing to Harwood. Option C2 is similar to the Red option, which is included in the long list of options (see **Section 6.2**). It deviates outside the study area south of Pillar Valley. In this area it passes through steep terrain and preliminary estimates of earthworks volumes for construction indicate that this option would be substantially more expensive to construct than options within the study area.

The southern section of Option C2 deviates east of the study area. This increases the length of this option, and is likely to result in steeper gradients or significant earthworks volumes. It therefore has less potential to reduce travel time and transport costs than options within the study area and would be more expensive to construct. The southern section of this route option is not considered to meet the Pacific Highway Upgrade Program objectives as effectively as options within the study area.

North of Pillar Valley, this option is similar to the Red option, and is assessed as part of the long list of route options.

Option C3

Option C3 has arisen through numerous submissions to the project team indicating a desire by some members of the local community for the assessment of an option along the Coast Range. Several comments at community meetings and in submissions have indicated that it would be preferable to locate the upgraded road within land already in public ownership, including State Forests and National Parks, rather than on private land to reduce impacts on land owners.

The coast range route has been schematically defined as Option C3, from the intersection of the Pacific Highway and Barcoongere Way, north through the Yuraygir National Park, Newfoundland and Candole State Forests, and to the east of Clarence Peak before turning west to rejoin the existing highway to the south of Maclean. This option has been located generally to the east of the main ridge, as the topography is more suited to road construction than along the ridge. This option is approximately 74 kilometres long from south of Wells Crossing to Iluka Road.

Whilst it would, for much of its length, avoid impacts on private lands, Option C3 is not considered to meet the objectives of the Pacific Highway Upgrade Program for the following reasons:

- It would have substantial ecological impacts, and is not considered to be consistent with the ESD objectives of the Pacific Highway Upgrade Program, as a result of direct impacts by passing through the Yuraygir National Park for a distance of approximately 14 kilometres.
- It would pass through the Newfoundland and Candole State Forests for a total distance of approximately 33 kilometres and would impact on the economic and ecological values of these forests.
- It would result in severance of a large, contiguous area of high quality habitat for native flora and fauna, including threatened species.
- Creation of a new route for the highway south of Wells Crossing is not an efficient use of the existing assets, as the existing highway in this area is of a high standard and suited to duplication.
- Compared with options within the study area, benefits for traffic are limited by steep terrain, which would limit fuel cost savings or require substantial earthworks to meet vertical gradient standards, and the longer length of options east of the study area, which reduces travel time savings.
- It would have substantial impacts on local residents, particularly through the rural residential areas of Taloumbi and Gulmarrad.

Option C4

Option C4 is approximately 77 kilometres long, and extends from Wells Crossing to north of Iluka Road. Key issues associated with this option relate to project cost and value for money, impacts on communities and environmental impacts.

Option C4 proposes a new alignment between Harwood and Iluka Road, and extends beyond Iluka Road to the north before rejoining the existing highway alignment. It would not make use of the high standard existing highway between Harwood and Iluka Road.

Bridge costs would also be high, as existing bridge assets at the Clarence River and North Arm would not be used (limiting the potential for staging of construction) and crossings would be long. It is not considered to present value for money for these reasons. In addition, it is relatively long, and this would add to project cost and reduce the potential for travel time and fuel savings.

The impacts of Option C4 are not consistent with the ESD objectives of the Pacific Highway Upgrade Program. Option C4 would impact on several areas of conservation value, including the Wells Crossing Flora Reserve (although impacts could be avoided through realignment), Yuraygir National Park (east of Pine Brush State Forest), the Mororo Creek Nature Reserve (west of Iluka Road) and potentially the Chatsworth Hill State Conservation Area. The suggested interchange location south of Harwood Bridge potentially results in direct impacts to the Yaegl Nature Reserve.

Option C5

Several submissions indicated a preference for the route to follow the Summerland Way, from Grafton through to Kyogle and Casino and the Queensland border, rather than upgrade the Pacific Highway. Upgrading the Summerland Way would not meet the Pacific Highway Upgrade Program objectives in relation to travel demand because the majority of demand for transport movements is along the coastal strip, where the population is concentrated. A route that does not provide access to major centres along the coast, such as Ballina, Byron Bay and Tweed Heads (north of Grafton) would not serve a large proportion of the travel demand. Low traffic volumes on the Summerland Way are indicative that it does not serve predominant travel demand along the north coast.

Use of the Summerland Way would result in an increase in traffic volumes (including heavy vehicles) through Grafton, or would require the development of a new route to bypass Grafton. It is not considered to be in the interests of the Grafton community to increase vehicle movements through town. Identification of a new bypass would be expensive, as it would require a new crossing of the Clarence River, and would be located in areas of poor soils and flooding risk, which would add to the cost of the project.

Options which utilise the Summerland Way are not considered to meet the Pacific Highway Upgrade Program objectives because they would not serve underlying traffic demand, and would not be cost effective. For these reasons, Option C5 was not included in the long list of options.