

# Appendix 1 – Previous Studies

---

## A1.1 Introduction

The earliest comprehensive RMS study was undertaken between 2003 and 2004. It consisted of a feasibility study followed by an environmental overview report and a corridor evaluation workshop.

The environmental overview report and corridor evaluation workshop identified that the most suitable location for an additional crossing of the Clarence River would be near the existing Grafton Bridge. A Preferred Option Report was to be developed documenting this process and the identification of a preferred route.

Shortly after the corridor evaluation workshop and before the draft Preferred Option Report was finalised and a preferred route identified, investigations into a second crossing of the Clarence River were placed on hold due to funding constraints. There were no further investigations between the end of 2004 and the end of 2008.

In July 2008 the Minister for Roads asked RMS to review all studies including traffic data and cost estimates for an additional crossing, and in 2009 RMS recommenced the investigation of an additional crossing of the Clarence River at Grafton. This investigation built on the outcomes from previous studies.

The 2009 investigations consisted of a revised traffic analysis that compared previous traffic modelling with updated traffic information. This was undertaken to understand the existing transport demands and traffic patterns within Grafton and the surrounding region. The 2009 traffic study confirmed that a new bridge in the vicinity of the existing bridge would best cater for the future traffic needs in the local area.

Based on the outcomes of the 2009 traffic study and 2003-2004 investigations, in February 2010 RMS displayed four preliminary route options in the vicinity of the existing bridge for community comment. A significant amount of feedback was received on these options and requests were made by Clarence Valley Council and the community to investigate options outside of the immediate vicinity of the existing bridge. Several additional locations for a second crossing were also identified by the community at this time.

There have been a number of studies into an additional crossing of the Clarence River at Grafton carried out during the past 10 years.

The earliest comprehensive studies were undertaken between 2003 and 2004. Four key reports resulted from these studies:

- Additional crossing of the Clarence River: Feasibility study report (RTA February 2003).
- Additional crossing of the Clarence River Grafton: Environmental overview (RTA January 2004).
- Additional crossing of the Clarence River at Grafton: Corridor evaluation workshop (RTA April 2004).
- Additional crossing of the Clarence River at Grafton: Draft preferred option report (RTA June 2005).

These reports are discussed in Chapters A1.2, A1.3, A1.4 and A1.5 and are available on the project website.

Investigations were on hold between the end of 2004 and the end of 2008.

In 2009, RMS recommenced investigations into an additional crossing of the Clarence River at Grafton. Since that time, several reports have been developed, including three traffic reports that build on the findings from the 2003-04 studies. These recent reports include:

- South Grafton Traffic Study Microsimulation Model Report (RTA February 2009).
- New crossing of the Clarence River at Grafton: Traffic study report (RTA December 2009).
- Additional crossing of the Clarence River at Grafton: Traffic study for preliminary options (RTA February 2010).
- Additional crossing of the Clarence River at Grafton: Heavy vehicle study (RTA March 2011).
- Main Road 83 Summerland Way Additional Crossing of the Clarence River at Grafton Feasibility Assessment Report (RTA June 2011).

These reports are discussed in Appendices A1.6, A1.7, A1.8, A1.9 and A1.10 are available on the project website.

## A1.2 Additional Crossing of the Clarence River: Feasibility Study Report, February 2003

This study was undertaken during 2002 and 2003 and is documented in *Additional crossing of the Clarence River: Feasibility study report* (RTA February 2003). The primary objective of this feasibility study was to identify feasible locations for an additional crossing of the Clarence River, taking into consideration community needs, traffic and the environment.

The study area was located along the Clarence River from Seelands to Maclean. The study involved the identification of environmental, community, traffic and engineering issues that would potentially affect the feasibility of an additional crossing.

From this, six strategic locations for an additional crossing were identified. These strategic locations are listed below and shown in Figure 61.

- Upstream of the existing bridge including Susan Island.
- At the existing bridge.
- Downstream of the existing bridge including Elizabeth Island.
- Ulmarra.
- Cowper.
- Lawrence.

An assessment of these strategic locations was undertaken. The assessment considered engineering issues, environmental issues including flooding impacts, property and social impacts, major utilities disturbance, and a broad economic analysis. Feedback from the community was also considered in the assessment of the strategic locations.

The key findings from the study were:

- The most feasible location for an additional crossing appears to be in the vicinity of the existing bridge (location 2). An additional crossing in this location would draw more traffic away from the existing bridge when compared with other locations. This would reduce traffic delay and congestion on the existing bridge. The study identified that location 2 would potentially have significant social impacts due to changed traffic conditions, and noise and amenity impacts. More detailed studies and further community consultation would be needed to assess these potential impacts.

- The locations upstream and downstream of the existing bridge (locations 1 and 3) were also considered to be feasible. However, these locations have a number of potential adverse impacts. These include social impacts associated with increasing traffic on quiet residential streets, ecological impacts on the Susan Island Nature Reserve, and potential noise impacts. More detailed traffic analysis, noise monitoring, environmental investigations and further community consultation would be needed to assess these potential impacts.
- The locations at Ulmarra (location 4), Cowper (location 5) and Lawrence (location 6) would not greatly reduce congestion or provide a significant improvement to safety at the existing Grafton Bridge. An additional crossing at these locations was not considered to be feasible.

The outcomes of this study led to further traffic, environmental and social impact investigations being undertaken in the local Grafton region. These investigations included further community consultation and were documented in *Additional crossing of the Clarence River Grafton: Environmental overview*, which is summarised in Appendix A1.3.

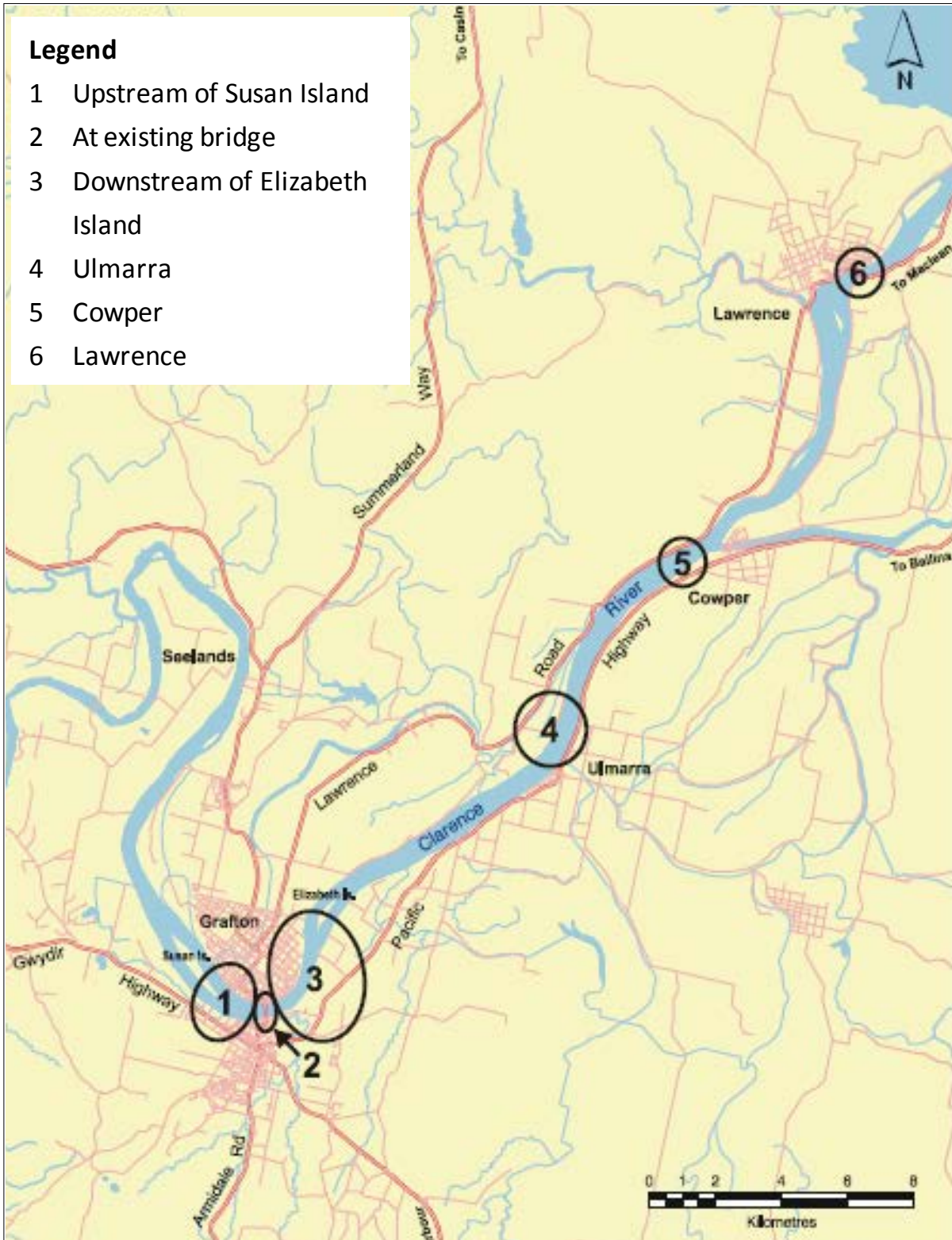


Figure 61: Strategic locations for an additional crossing of the Clarence River from the *Additional crossing of the Clarence River: Feasibility study report* (RTA February 2003).

## A1.3 Additional crossing of the Clarence River Grafton: Environmental overview, January 2004

This study was undertaken in the strategic locations identified as feasible in the *Additional crossing of the Clarence River: Feasibility study report* (ie locations 1, 2 and 3 in Figure 61) and is documented in *Additional crossing of the Clarence River Grafton: Environmental overview* (RTA January 2004). The study area covered the area between Susan Island and Elizabeth Island. Within this area, seven broad localities were identified for an additional crossing of the Clarence River at Grafton. These localities are shown in Figure 62.

The purpose of the environmental overview was to identify likely environmental constraints and/or potential issues that would need to be considered as part of the investigations for an additional crossing of the Clarence River at Grafton. The environmental overview was then used as the basis for making decisions on the localities that should be considered further as part of a route selection process.

The environmental overview involved further traffic assessment, environmental and social impact assessment. Further community consultation was also undertaken. The assessment process involved a short-listing of localities workshop held in November 2003. The workshop included participants from the RMS project team and representatives from the former Grafton City Council, Copmanhurst Shire Council and Pristine Waters Council (all three now form part of the Clarence Valley Council). The assessment criteria for the workshop were developed from the proposed additional crossing objectives.

The outcome of this process was that two localities were found to be more feasible than the other localities. These were locality 2 and locality 3. It was concluded that these localities should undergo further detailed investigations.

The other localities were not considered feasible for the following reasons:

- Locality 1 would have impacts on Susan Island, including potentially significant ecological impacts. It would impact on traffic within the Grafton CBD and have other social impacts, such as impacts on Memorial Park.
- Localities 4 and 5 would have major social impacts associated with increased traffic in residential streets that currently have low traffic volumes. There would also be substantial increases in road traffic noise and potential community segregation.
- Localities 6 and 7 are too remote and would not significantly improve traffic efficiency on the existing bridge. The further away an additional crossing is from the existing bridge affects how well it can meet the proposed additional crossing objectives. These localities did not sufficiently meet the project objectives.

During the short-listing of localities workshop, it was also identified that there are some issues with localities 2 and 3 that would need to be addressed in future investigations. These include:

- Social impacts.
- Noise.
- Community issues.
- Heritage concerns.



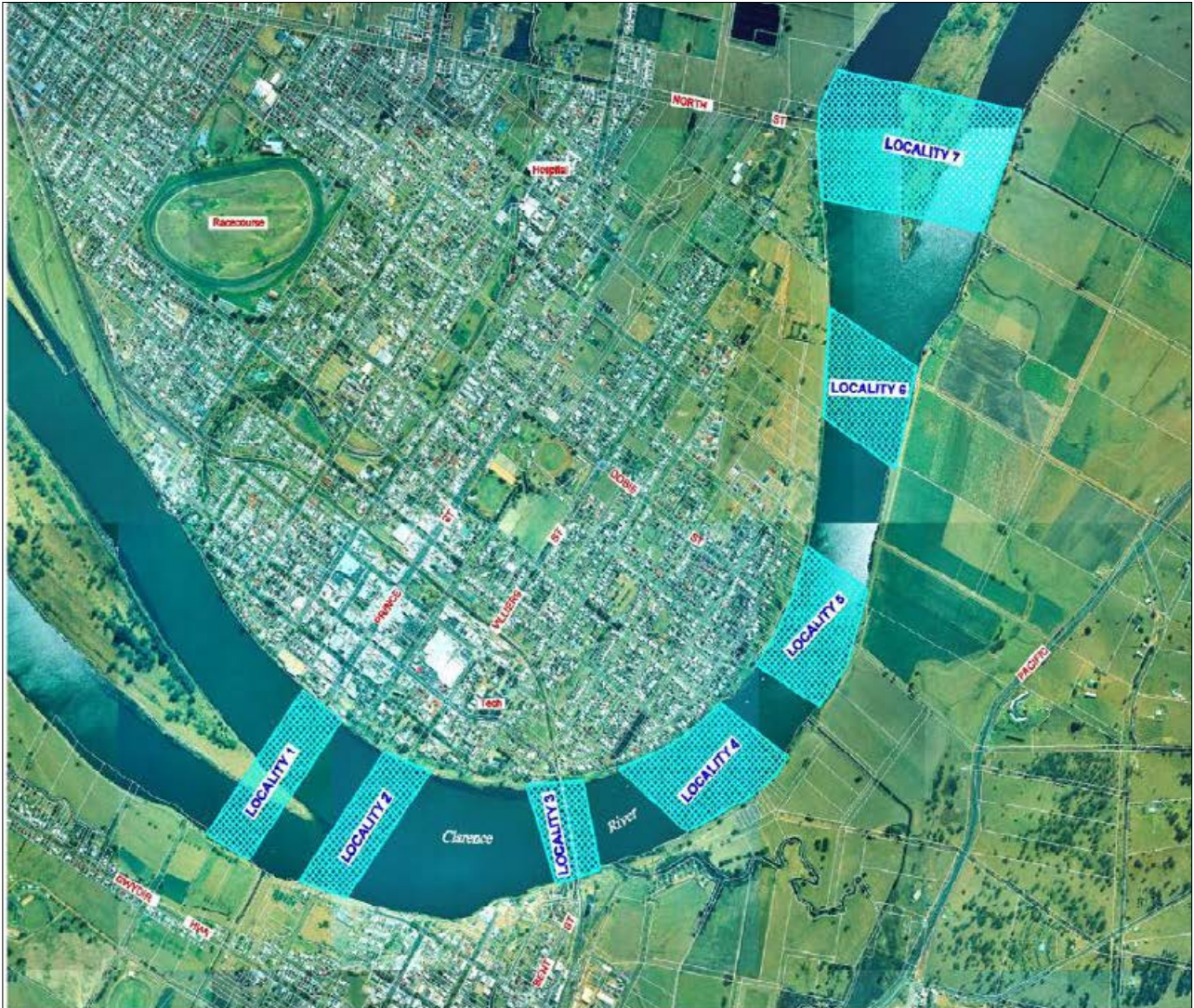


Figure 62: Possible crossing locations investigated as part of the *Additional crossing of the Clarence River Grafton: Environmental overview* (RTA January 2004).

Following the short-listing of localities workshop, three options were identified within localities 2 and 3. These comprised one option approximately 750 m upstream of the existing bridge (within locality 2) and two options in the vicinity of the existing bridge (within locality 3). These route options are shown in the map in Figure 63 and described as follows:

- Option 1: linking Abbott Street in South Grafton with Villiers Street in Grafton.
- Option 2A: immediately upstream of the existing bridge, connecting Bent Street and Fitzroy Street.
- Option 2B: Immediately downstream of the existing bridge, connecting Bent Street and Fitzroy Street.

These options were displayed for community comment in the *Community Update, April 2004* which is available on the project website.

## A1.4 Additional crossing of the Clarence River at Grafton: Corridor evaluation workshop, April 2004

Following the April 2004 display, a corridor evaluation workshop was held to assess the three options shown in Figure 63. This workshop was held on 28 and 29 April 2004 and is documented in *Additional crossing of the Clarence River at Grafton: Corridor evaluation workshop* (RTA April 2004).

The objectives of the workshop were to:

- Clarify the objectives of the additional crossing.
- Review the planning parameters for the additional crossing.
- Examine the short-listed options developed and identify potential value improvements to meet the additional crossing objectives.
- Recommend a preferred option(s) to RMS to progress the additional crossing.
- Develop an action plan to progress the additional crossing.

The workshop involved representatives from RMS, the local community, Clarence Valley Council, the Environment Protection Authority (now Office of Environment and Heritage), the Department of Infrastructure Planning and Natural Resources (now Department of Planning and Infrastructure), NSW Waterways Authority (now part of RMS), Rail Infrastructure Corporation, and specialists from the RMS project team.

The key outcomes from the workshop were as follows:

- The purpose of the additional crossing was confirmed as: To provide an additional crossing of the Clarence River at Grafton in order to improve road safety, reduce traffic delays and provide improved access to the local and state road network north and south of the Clarence River.
- The broad objectives for an additional crossing were confirmed as:
  - Significantly improve traffic efficiency.
  - Significantly reduce the potential for road accidents and injuries.
  - Be socially acceptable to the regional and local community.
  - Be managed in accordance with ecologically sustainable development principles (minimise the impact on the environment).
  - Achieve maximum effectiveness of expenditure (value for money).
- It was recommended that Option 2b be considered the preferred route for further investigation, as it performed on balance better than the other two options. Option 2a was recommended as a fallback option if Option 2b was found to be unsuitable following further investigation.



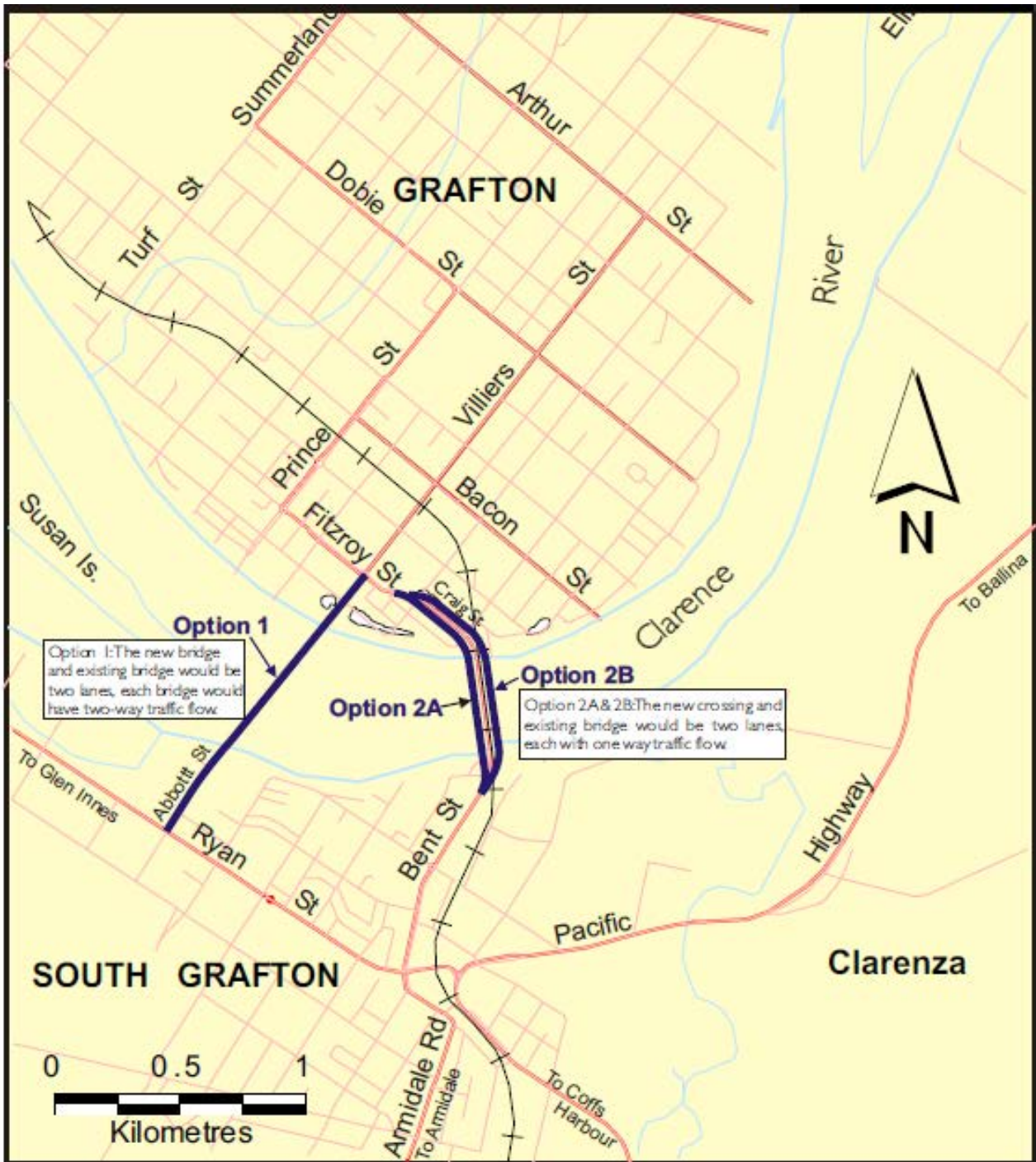


Figure 63: Route options displayed in April 2004 and examined in the *Additional crossing of the Clarence River at Grafton: Corridor evaluation workshop* (RTA April 2004).



## A1.5 Additional crossing of the Clarence River at Grafton: Draft Preferred option report, June 2005

The *Draft Preferred option report* (RTA June 2005) assessed the three route options shown in Figure 63 to identify the best value for money alignment for the additional crossing to improve road safety, reduce traffic delays and provide improved access for the local and state road network between the north and south of the Clarence River.

The draft preferred option report confirmed that Option 2b was the best of the three options assessed. Option 2b was recommended to be considered for further investigation for the following reasons:

- It was the highest ranked option when assessed against functional, social and environmental criteria.
- Capital costs were similar for all three options.
- The benefit cost ratio analysis supported its selection.
- It retained the iconic vista and role of the existing bridge towards the majority/larger community focus/activities.
- The riverscape upstream was maintained.
- It can be built with a minimum clearance to the existing bridge.
- Least effect on the fabric of Grafton.
- The option best meets the purpose and project objectives.

The *Draft Preferred option report* (RTA June 2005) also recommended investigating 2, 3 and 4 lane configurations in the next stages of the project.

Shortly after the Corridor evaluation workshop and before the Draft Preferred option report was finalised and a preferred route identified, investigations into a second crossing of the Clarence River were placed on hold due to funding constraints. As a result, the Draft Preferred option report did not receive RMS corporate endorsement and was not considered by the then Minister for Roads.

The *Draft Preferred option report* has been released to the public as it provides additional background information to the current investigations.

## A1.6 South Grafton traffic study microsimulation model report, February 2009

In 2009 RMS recommenced investigations into an additional crossing of the Clarence River at Grafton to develop a better understanding of traffic movements within Grafton and its surrounds. The results of these investigations are documented in the *South Grafton traffic study microsimulation model report* (RTA February 2009) and *New Crossing of the Clarence River at Grafton: Traffic study report* (RTA December 2009).

The traffic study for the South Grafton area was commissioned by RMS in partnership with Clarence Valley Council. The objectives of the *South Grafton Traffic Study Microsimulation Model Report* (RTA February 2009) were to:

- Develop a comprehensive traffic management scheme for the South Grafton area that will identify key improvement works required now and in the future.
- Evaluate the current performance of the network and assess its traffic capacity.

- Assess the impact of planned (approved) and future development on the existing network.
- Determine key network infrastructure requirements for vehicles based on predicted growths.
- Assess the actual impacts of nominated recent development.
- Provide a network microsimulation model that can be used to make predictions.
- Investigate the potential for improvements based on a number of given scenarios.

The study involved the development of a microsimulation model for South Grafton. A microsimulation model uses a computer software package and has the ability to individually model each vehicle, including buses, taxis, etc, within a road network. It enables a realistic representation of driver behaviour such as overtaking and lane changing and can also illustrate network performance. It is a particularly useful tool in modelling congested road networks.

A microsimulation traffic model is also useful for predicting the likely impact of changes in traffic patterns resulting from changes to traffic flow (demand) and/or changes to the physical environment (road network). The approximate area covered by the model is shown in Figure 64.

Traffic counts on key roads in the vicinity of the site were undertaken on 15 and 16 November 2007 during the AM peak (between 7 am and 10 am) and PM peak (between 4 pm and 7 pm) periods.

The traffic study found that travel times between Grafton and South Grafton and queuing over the existing bridge will progressively increase and the network will become more vulnerable to blockages or grid lock caused by future additional traffic volumes.

The following network improvement options were assessed:

- Introduction of two traffic lights in each direction on the Pacific Highway, east of South Grafton.
- Introduction of a signalised intersection at the intersection of Pacific Highway, Iolanthe Street and Spring Street.
- A roundabout at the Spring Street and Bent Street intersection.

These network improvement options were found to provide only marginal and short term benefits to the operating performance of the network.

The study recommended an additional crossing of the Clarence River as a solution that would significantly improve the operating conditions of the network within South Grafton.



Figure 64: Study area for the South Grafton traffic study microsimulation model report (RTA February 2009).



## A1.7 New crossing of the Clarence River at Grafton: Traffic study report, December 2009

In 2009, RMS commissioned the development of a regional transport model and microsimulation model of Grafton and its surrounds to complement the microsimulation model documented in the *South Grafton traffic study microsimulation model report (RTA February 2009)*. The objectives of the traffic study which is documented in the *New crossing of the Clarence River at Grafton: Traffic study report (RTA December 2009)* were to:

- Obtain an understanding of the existing transport demand, existing travel patterns, existing traffic flow and existing traffic constraints both within the Grafton township and at a wider regional level.
- Forecast future year travel demands, taking into consideration future developments and network growth.
- Identify any recommendation for improvements in the operation of the adjacent road network.

The study involved the development of a strategic traffic model (a computer model used to analyse the overall road network performance of a suburb, town or region) and a microsimulation model for the Grafton areas. The approximate area covered by the models is shown in Figure 65.



Figure 65: Study area for the traffic study for the new crossing of the Clarence River at Grafton: Traffic study report (RTA December 2009)

The study included traffic movement counts on key roads in the vicinity of the bridge undertaken on 11 March 2009 during the AM peak (between 7 am and 10 am) and PM peak (between 4 pm and 7 pm) periods.

The key findings from the study were:

- Approximately 98 per cent of vehicles using the existing bridge have an origin and/or destination within Grafton or South Grafton. Only a very small proportion of traffic using the existing bridge (2 per cent) is through traffic.
- Traffic on the bridge has grown at an annual average rate of 0.9 per cent between 1990 and 2009.
- Traffic demands across the river will increase significantly in the next 20 and 30-year periods, based on regional planning studies and long-term expected regional population and employment growth rates.
- Travel times between the Pacific Highway in South Grafton and Prince Street in Grafton are likely to be more than 13 minutes for the northbound movement and 8.5 minutes for the southbound movement by 2039 during peak hour periods (ie 8 am – 9 am and 4 pm – 5 pm).
- Additional river crossing capacity will be required in the future to accommodate the additional demand.

The conclusion drawn from the modelling exercise was that “doing nothing” would lead to extended periods throughout the day where traffic on the existing bridge would experience unacceptable delays and queuing. This would result in localised congestion within Grafton and South Grafton and queues would be increased on the approaches impacting on key intersections.

To address this issue, it was recommended that an additional crossing be investigated in the vicinity of the existing bridge. The investigation would also need to consider the approach roads for an additional crossing. This would help to determine the optimum location for the crossing and the potential traffic impacts on Grafton and South Grafton.

## **A1.8 Additional crossing of the Clarence River at Grafton: Traffic study for preliminary options, February 2010**

This study was undertaken following the completion of the traffic study described in Appendix A1.7 and is documented in *Additional crossing of the Clarence River at Grafton: Traffic study for preliminary options* (RTA February 2010).

Based on the conclusions of the traffic study completed in December 2009, RMS developed four preliminary route options. These preliminary route options consisted of additional crossings of the Clarence River in the vicinity of the existing bridge and any associated roads needed to connect the additional crossings to the existing road network. These four preliminary route options are shown in Figure 66. Route options A and B were the same as route options 2A and 2B respectively as documented in the April 2004 corridor evaluation workshop (shown in Figure 63). Route options C and D were two new route options to connect to different areas of the road network. Route options A and B were three-lane bridges while options C and D were two two-lane bridges.

The purpose of the study was to develop a more detailed understanding of existing and future traffic demands and network capacity within and around Grafton. It provides an assessment of the traffic impacts that each of the four preliminary route options would have in and around Grafton and South Grafton.

The objectives of the traffic study for the preliminary route options were to:

- Obtain an understanding of the existing transport demand, travel patterns, traffic flow and traffic constraints within Grafton and South Grafton, and at a wider regional level.

- Forecast future year travel demands, taking into consideration future developments and network growth.
- Undertake preliminary assessment of whether alternative bridge connection options provide traffic flow benefits.
- Identify any recommendations for improvements in the operation of the adjacent road network.

The key findings from the investigation were that:

- Option A and Option B, which use the same northern and southern road connections as the existing bridge, were likely to be subject to high congestion levels after 2019 and, by 2039, the network would not be able to handle the additional traffic and would reach gridlock.
- Option C and Option D, which use different northern and southern road connections to the existing bridge, would provide alternate connections between Grafton and South Grafton. This would reduce traffic on the existing bridge and reduce reliance on the key intersections approaching the existing bridge. Preventing heavy vehicles from using the existing bridge by diverting them to a new bridge would also improve traffic flow on the existing bridge.
- All options yield positive results in terms of the overall network performance, however Options C and D were found to be more capable of managing the future increased traffic demands than Options A and B.

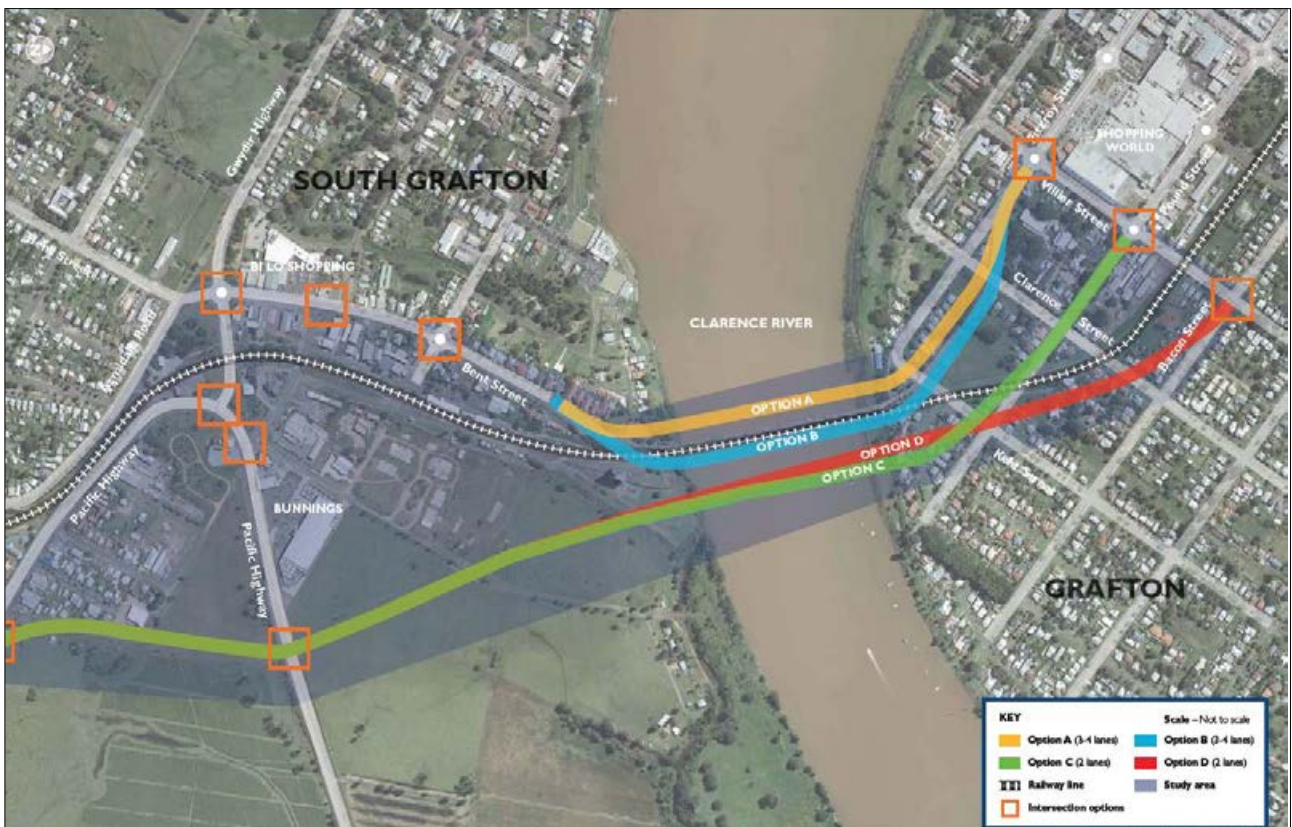


Figure 66: Preliminary route options investigated in the *Additional crossing of the Clarence River at Grafton: Traffic study for preliminary options* (RTA, February 2010).



## **A1.9 Additional Crossing of the Clarence River at Grafton: Heavy Vehicle Traffic Study, March 2011**

The heavy vehicle traffic study aimed to provide a comprehensive understanding of the heavy vehicle travel patterns in Grafton. The study carried out three types of surveys:

- An origin-destination survey using video camera technology.
- Automated classified tube counts.
- A questionnaire survey of transport businesses and bus companies in the local area.

The origin-destination survey showed that only 12 per cent of heavy vehicles crossing the Grafton Bridge are considered “through trips” that do not have an origin or destination within Grafton and South Grafton. The remaining 88 per cent of heavy vehicles crossing the Grafton Bridge have an origin and/or destination within Grafton and/or South Grafton.

The origin-destination survey also showed that only three per cent of all vehicles crossing the Grafton Bridge are considered “through trips” that do not have an origin or destination within Grafton and South Grafton. The remaining 97 per cent of all vehicles crossing the Grafton Bridge have an origin and/or destination within Grafton and/or South Grafton.

The automated classified tube counts showed that the Grafton Bridge carries approximately 29,500 vehicles in both directions per week-day of which about 5 per cent are heavy vehicles. It also showed that 84 per cent of heavy vehicles that cross the Clarence River travel between 7 am and 10 pm and 16 per cent travel between 10 pm and 7 am.

The questionnaire survey responses from transport businesses and bus companies indicated that they felt it was common for companies to establish routes and times to avoid peak hour congestion on the bridge, where possible. A prominent issue identified by business was the B-Double restriction on the bridge during peak traffic times. Also, it was noted that late running of services due to bridge congestion incurred additional operation costs for business owners.

## **A1.10 Main Road 83 Summerland Way Additional crossing of the Clarence River at Grafton Feasibility Assessment Report, June 2011**

In December 2010 a community update described a revised consultation process for identifying and preserving a corridor for an additional crossing of the Clarence River at Grafton. The community update displayed 13 preliminary route options for an additional crossing of the Clarence River at Grafton including the four options identified in the February 2010 community update, Option 1 from the April 2004 Corridor evaluation workshop and eight other options suggested by the community following the February 2010 display.

The December 2010 community update included a community postal survey regarding the additional crossing. A total of 437 responses to the postal survey were received between 6 December 2010 and 8 March 2011. From the responses to the postal survey, a further 28 new route suggestions were identified. The addition of these 28 community suggestions brought the total number of suggestions and preliminary options for an additional crossing location to 41. We refer to these as 41 suggestions.

The *Main Road 83 Summerland Way Additional Crossing of the Clarence River at Grafton Feasibility Assessment Report* (RTA, June 2011) documents the process and results of the feasibility assessment of these 41 suggestions (Figure 67).

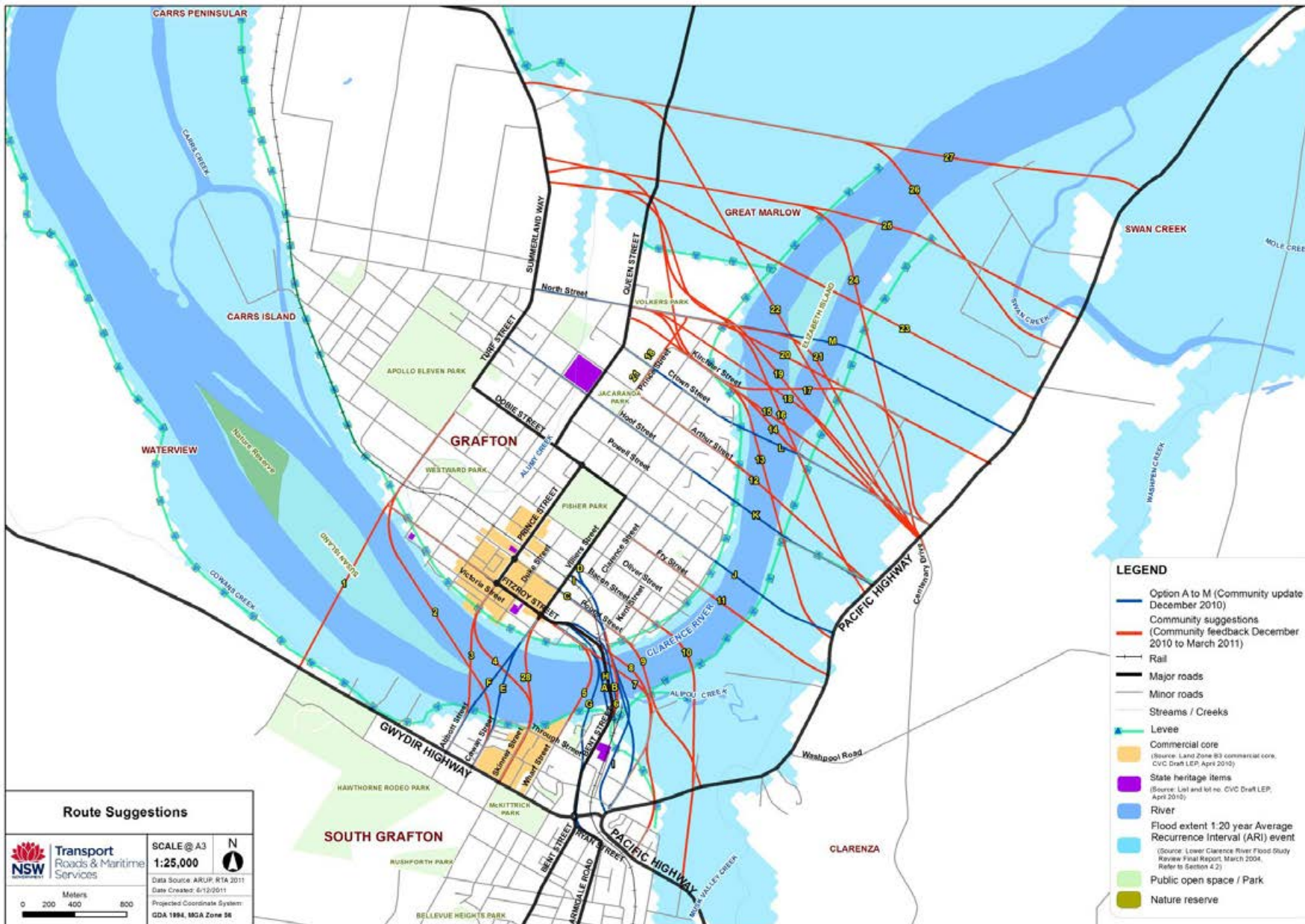


Figure 67: 41 suggestions for an additional crossing of the Clarence River at Grafton as presented in the *Main Road 83 Summerland Way Additional Crossing of the Clarence River at Grafton Feasibility Assessment Report, June 2011*.

The purpose of the feasibility assessment was to identify those suggestions that were not feasible due to significant constraints and therefore did not warrant further investigation. The feasibility assessment was undertaken using the following considerations:

- Engineering and constructability issues.
- Land use and land use zoning impacts.
- Aboriginal heritage impacts.
- Impacts on native plants and animals.
- Flooding impacts.

The feasibility assessment recommended 25 preliminary route options within five corridors for further engineering and environmental studies to inform the ongoing process of the identification of a preferred location for an additional crossing of the Clarence River at Grafton.

The 25 preliminary route options and five corridors are presented in Figure 68.



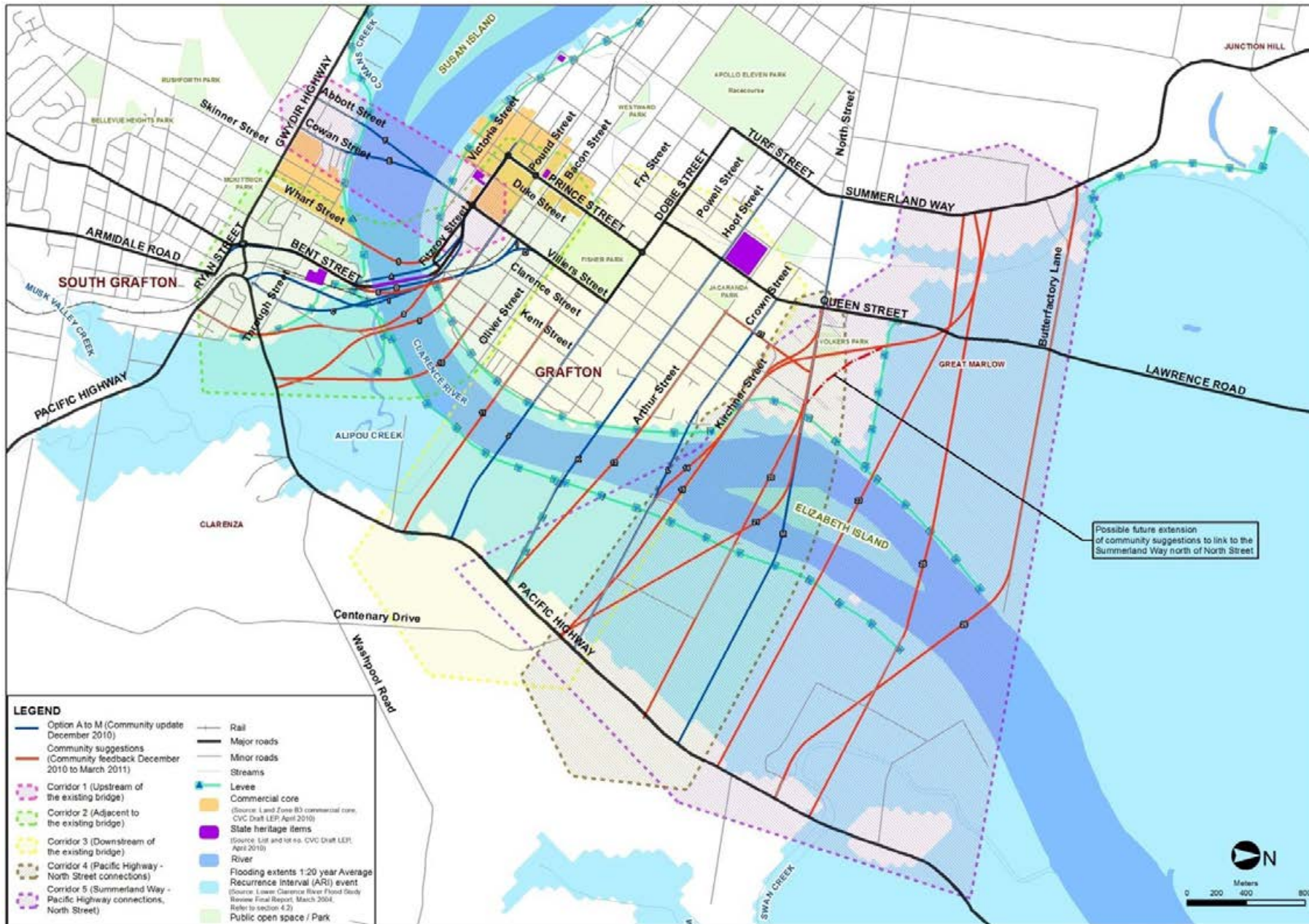


Figure 68: Preliminary route options for further consideration as documented in the Main Road 83 Summerland Way Additional Crossing of the Clarence River at Grafton Feasibility Assessment Report, June 2011.

## Appendix 2 – Additional crossing design criteria

This chapter summarises some of the key design criteria and engineering constraints relevant to the development of options for an additional crossing of the Clarence River at Grafton.

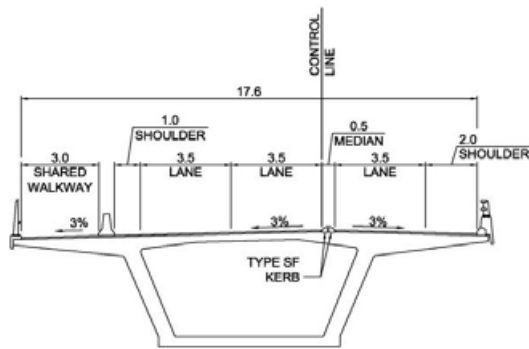
### A2.1 Bridge and road design criteria

Minimum bridge and road design criteria for an additional crossing of the Clarence River at Grafton are summarised in the following table. Bridge and road design criteria are based on the *Austrroads Road Design Guidelines*, the *RTA Supplements to the Austrroads Design Guidelines* and other Australian Standards.

Table 30: Basic Bridge and road design criteria.

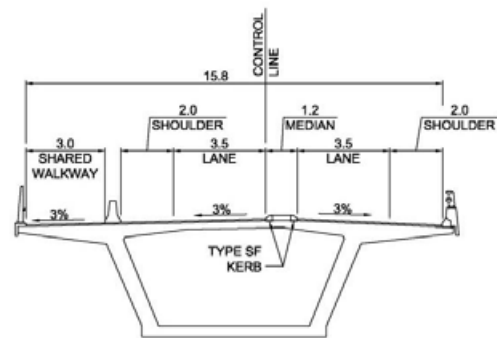
Bridge and main approach carriageways	Design Requirement
Speed:	
On bridge and approach roads for options within urban areas:	
Posted Speed Limit	60 km/h
Design Speed (Desirable)	70 km/h
Design Speed (Minimum)	60 km/h
On bridge and approach roads for options outside urban areas:	
Posted Speed Limit	80 km/h
Design Speed (Desirable)	90 km/h
Design Speed (Minimum)	80 km/h
Footpath/cycleway widths:	
Shared pedestrian/cyclist path.	3.0 m
Lane widths:	3.5 m
Lane configuration on bridge – refer cross sections in Figure 69 below	

The structural elements of an additional crossing will be designed and detailed for a design life of 100 years. If the preferred route for an additional crossing is located adjacent to the existing bridge, the pier locations and span lengths of the new bridge will align with those of the existing bridge structure and the new bridge abutments are to be set back to match the location of the existing abutments. If the proposed bridge is located away from the existing bridge, the span arrangement and abutment locations are to be determined based on engineering and environmental constraints and NSW Maritime (now part of RMS) requirements as set out below.



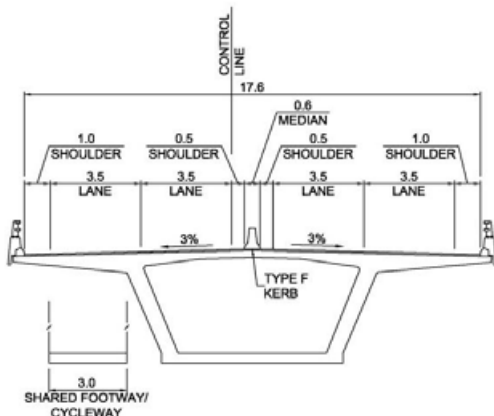
**THREE LANE CONFIGURATION WITH A SHARED FOOTWAY/CYCLEWAY**  
(ALL DIMENSIONS ARE IN METRES)

TYPICAL CROSS SECTION FOR 60km/hr



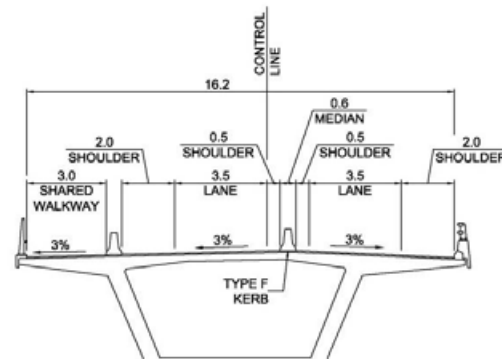
**TWO LANE CONFIGURATION**  
(ALL DIMENSIONS ARE IN METRES)

TYPICAL CROSS SECTION FOR 60km/hr



**POTENTIAL RECONFIGURATION OF THREE LANE LAYOUT TO FOUR LANES WITH SHARED FOOTWAY/CYCLEWAY RELOCATED UNDERNEATH BRIDGE DECK**  
(ALL DIMENSIONS ARE IN METRES)

TYPICAL CROSS SECTION FOR 60km/hr



**TWO LANE CONFIGURATION**  
(ALL DIMENSIONS ARE IN METRES)

TYPICAL CROSS SECTION FOR 80km/hr

Figure 69: Typical bridge cross sections.

## A2.2 Maritime design requirements

### ***Navigational clearance requirements for an additional crossing***

NSW Maritime (now part of RMS) has advised that an additional crossing over the Clarence River at Grafton requires the following minimum clearances (Table 31).

Table 31: Minimum required clearances for a second crossing over the Clarence River at Grafton

Location	Minimum clearance (metres above Mean High Water Springs (MHWS))	
Upstream (west) of existing bridge	Vertical clearance	9.1
	Horizontal clearance	35
Downstream (east) of existing bridge (between existing bridge and Pound Street)	Vertical clearance	9.1
	Horizontal clearance	60 metres or 2 spans of 35 metres
Downstream (east) of Pound Street	Vertical clearance	15
	Horizontal clearance	60 metres or 2 spans of 35 metres



The vertical clearance to the soffit of the existing bridge above Mean High Water Springs is approximately 7.9 metres. The vertical clearance requirements stated above indicate that the soffit level of an additional bridge will be required to be higher than the soffit of the existing bridge lower rail deck.

### **Scour**

Scour is the removal of soil or fill material by the flow of floodwaters. The term is frequently used to describe storm induced, localised conical erosion around foundation supports where the obstruction of river flow increases turbulence.

### **Pier alignment**

If the proposed bridge is located adjacent to the existing bridge, the pier locations for a new bridge should align with the existing bridge piers to minimise backwater and scour.

The detailed location and orientation of the piers could be determined with the assistance of the flood model. The preferred route for an additional bridge crossing should be as perpendicular as possible to the direction of the vessel traffic passing through and the direction of current water flow.

Piers should be located and shaped such that they are clearly visible to river users and that the local flows do not represent an unnecessary danger to river users. The shape of the piers and pile caps should not generate large downward flows or surfaces that may trap river users. The pier shape should not trap small boats below the pile or pile cap due to wave action or a rising tide. The visible extent of the pile cap or pier should represent the full area of any structure above high tide and below low tide so that river users are aware of the extent of any structure that may be hidden below the water level.

### **Separation to existing bridge**

The separation of a new bridge to the existing bridge should be at least 22 metres plus a factor of safety, to:

- Limit the reciprocal impact of local scour of the two bridges.
- Limit adverse conditions of recreational craft users by providing enough “line of sight” for navigation from one bridge to another (and also allow time and swept path space for steering adjustments).
- Facilitate construction of the new bridge and maintenance of both bridges eg repair and painting of the existing bridge without adverse impact to the traffic on the new bridge.

## **A2.3 Drainage and flooding design**

Drainage infrastructure will be designed to comply with the requirements specified in Table 32, as a minimum, based on RMS and Council guidelines.

In major storms events, drainage infrastructure would be designed to prevent damage to properties outside the site in 100-year average recurrence interval rainfall events and to prevent structural damage to the bridge or approach roads in 2,000-year average recurrence interval rainfall events. The bridge approaches would be at least trafficable in a flood event of up to a 20-year average recurrence interval.

The design of any bridge structure would consider:

- Mitigation of any adverse hydraulic effects.
- Consideration of afflux.
- Upstream and downstream impacts.
- Minimising changes in flow distribution (where practical).

Afflux (increase in flood levels upstream of the new bridge due to backwater caused by restriction of water flow at the bridge) will be minimised where feasible and, where appropriate, mitigation measures will be identified to maintain the flood protection provided by the existing Grafton and South Grafton levies.

Table 32: Drainage infrastructure design requirements.

Drainage Infrastructure	Average recurrence interval
Open drains (surface drains including table drains, bench drains, catch drains, contour banks, drop downs, basin inflows and basin outflows).	5 years
Piped system (including pits)	10 years
Culverts where surcharge is allowable	50 years
Structures where surcharge is undesirable	100 years
Gross pollutant traps	1 year
Cycleway	1 year

Pavement surfaces will be modelled for a 100-year average recurrence interval event to check flow levels and to ensure that nuisance flooding is minimised. The pavement drainage system will be designed where practical to collect all pavement water. Pavement drainage will be designed to prevent concentrations of water and long surface flow paths on pavements in superelevated areas.

Pavement wearing surface flows will be modelled through each superelevation transition. Bridge drainage should be connected to the pavement drainage system, where practical. Pavement wearing surfaces will be designed so that for the 50 mm per hour rainfall design event:

- The maximum water depths at any point on the pavement wearing surfaces are not greater than 5 mm on the bridge, approach roads and intersections.
- Changes in the depth of flow at any point on the pavement wearing surfaces will not increase at a rate greater than 0.4 mm per metre.

## Appendix 3 – Community feedback

Table 33: August 2011 information and feedback sessions: feedback received.

Submission Topic	Feedback	RMS response
Social: maritime access to Grafton	The need for minimum height above water level for navigation clearance for sail boats. Currently power lines 19.4m at Elizabeth Island and existing bridge approximately 8m.	Previous advice from NSW Maritime (now part of RMS) regarding minimum vertical and horizontal clearances per Table 6 in Chapter 4.9 has been confirmed again with NSW Maritime (now part of RMS). Additional discussions are being held with Clarence Valley Council regarding impact to the Grafton Waterfront Precinct Plan. Transgrid will be consulted regarding their overhead powerlines crossing above the river at Elizabeth Island.
General: update to maps in PROR - Part 1	Maps show Apollo Eleven Park at the racecourse - actual location is across the road on Turf St.	Feedback noted and maps updated.
General: update to maps in PROR - Part 1	Flood levee not shown in the correct location at end of Pound St near eg Girl Guide Park.	Feedback noted and maps updated.
General: existing maritime traffic	Boral Barge goes downstream from the bridge instead of 'upstream only' as stated in the report.	Feedback noted and report updated accordingly.
Social: additional existing community facilities	Additional existing child care, aged care, church & retirement village around North St & Hoof St should be shown on the maps. Additional existing helipad next to the hospital near Gordon Wingfield Park. Additional existing South Grafton Airfield. Additional existing St Josephs School, St Graham High School and Anglican Church and cemetery in South Grafton vicinity should be shown on maps. Additional existing conservatorium on Fitzroy St and St Andrew's Presbyterian Church on Prince St. Additional existing sports/entertainment centre on Powell St. Additional existing childcare centre on Fry St.	Feedback noted and maps updated to show these facilities.
Ecology: riparian rainforest	Ecology Map - why is 'riparian forest' referred to as 'degraded riparian forest'? It may be degraded, it is still rainforest. Its physical state can be discussed in the report.	Feedback noted and maps and discussion updated to show this.
General: identification of options	Identify the option numbers/letters at the connection points where overlapping.	Feedback noted and maps updated.
Social: additional existing community facilities	School bus pick up area in Fitzroy St and bus drop off area in Clarenza.	Feedback noted.

Submission Topic	Feedback	RMS response
Social: community facilities	St Mary's has closed.	Feedback noted.
Noise sensitive receivers: additional existing community facilities	Additional existing child care, aged care, church & retirement village around North St & Hoof St should be shown on the maps. Additional existing St Josephs School, St Graham High School and Anglican Church and cemetery in South Grafton vicinity should be shown on maps. Additional existing conservatorium on Fitzroy St and St Andrew's Presbyterian Church on Prince St. Additional existing childcare centre on Fry St.	Feedback noted and maps updated.
Land use zoning	Land use zoning is the same for houses surrounding the current transport infrastructure and those further to the east.	Land use zoning is based on the draft <i>Clarence Valley Local Environment Plan 2010</i> .
Social: recreational river users	Report does not mention water skiing on the Clarence River.	The water skiing area is shown as part of Figure 25 and Figure 28. Report has been updated to include water skiers as recreational users of the river.
Flooding	Options J, K and 11 are underwater in the 1:5 year flood. Raised approaches will have to expose and have their foundations in acid sulphate soils.	All bridge options will be designed for a 1:100 year flood on the bridge deck and a 1:20 year flood for approach roads. This flood immunity for the approach roads will be provided by the use of viaducts and embankments. All foundations will be designed to allow for the acid sulphate soils.
Future urban residential areas	Mapping of new residential area at Clarenza is exaggerated in some maps (Figure 17 and Figure 23) and encroaches on an area of ecological constraint. Waterview Heights, in comparison gets very little attention.	Figures 17 and 23 refer to the proposed future urban residential area as opposed to the existing. The proposed future urban residential area is expected to be larger than existing. The area shown is based on the Mid North Coast Regional Strategy. The encroachment of the proposed future urban residential area on an ecological constraint is not part of the route assessment. Growth in Waterview Heights has been noted in the population growth forecast and therefore in the traffic studies. Table 5 addresses the population growth.
Non-Aboriginal heritage	Dobie St was mentioned as an iconic tree street but the river end where there are a couple of memorial trees for the Dawsons was not on the non-Aboriginal heritage maps.	The heritage items shown are listed on the State Heritage Register, Section 170 Register of the Heritage Act 1977, the North Coast REP 1988, the National Shipwrecks Database, the Commonwealth heritage List, the Register of the National Estate and the National Trust Register. More detailed investigation including further fieldwork will be undertaken at the next stage of the project and these comments will be further considered at this stage.
Social: maritime access to Grafton	Report mentions a height of bridge as 15.5m above high water spring tide. This will not allow for larger yachts. It would be better if the bridge had a height of at least 19m.	Previous advice from NSW Maritime (now part of RMS) regarding minimum vertical and horizontal clearances per Table 6 in Chapter 4.9 has been confirmed again with NSW Maritime (now part RMS). Additional discussions are being held with Clarence Valley Council regarding impact to the Grafton Waterfront Precinct Plan.