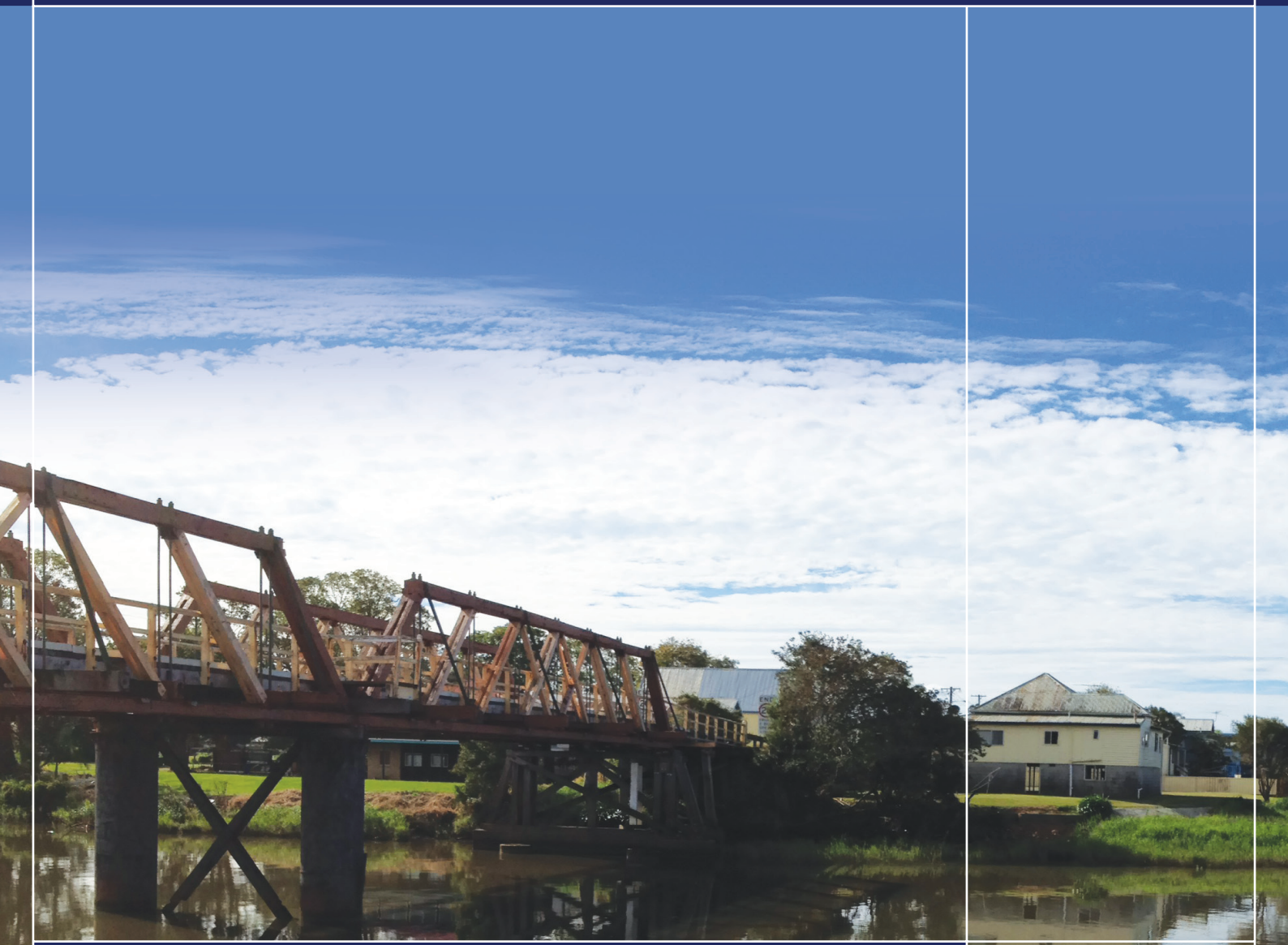
Transport Roads & Maritime Services



Sportsmans Creek new bridge

Preferred Option Report

JULY 2014

RMS 14.256 ISBN: 978-1-925093-74-2

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Background

Roads and Maritime Services (Roads and Maritime) is undertaking investigations for a new bridge over Sportsmans Creek at Lawrence.

Lawrence is located 25 kilometres north of Grafton on the Lawrence Road (MR152) which is managed and maintained by Clarence Valley Council.

Geometry and design limitations of the existing bridge mean it is unable to be upgraded to cater for future haulage requirements of local surrounding agricultural industries, two-way traffic and pedestrian access.

Roads and Maritime has developed and published the Timber Truss Bridge Conservation Strategy for the management of its remaining timber truss bridge stock. As part of this strategy, the Sportsmans Creek bridge has been identified to be removed and replaced with a modern structure.

The new bridge and associated road works will be handed over to Clarence Valley Council for its ongoing ownership, control and maintenance.

The objectives of the project are:

- Build a new bridge over Sportsmans Creek, Lawrence
- Enhance road safety for motorists, residents, cyclists and pedestrians
- Improve traffic efficiency within Lawrence
- Improve road transport productivity, efficiency, maintainability and reliability
- Support local and regional economic development
- Allow for safe removal of the existing bridge, in support of the Timber Truss Bridge Conservation Strategy
- Minimise the impact on the natural, cultural, social and built environment
- Consider community views
- Deliver value for money
- Facilitate handover of the new bridge and associated roadwork to Clarence Valley Council
- Demolish the existing Sportsmans Creek Bridge.

Community consultation

The community has been consulted at various stages of the project development and the comments and suggestions received have been incorporated into the preferred option.

Project Development

Study Area

The study area for the project was publicly announced in June 2013 and residents of Lawrence were advised by letter which included the background of the project, its objectives and the opportunity for community comment.

Two community drop-in sessions were held on 18 July 2013 and were well attended. The drop-in sessions provided background information on the project and gave community members the opportunity to offer suggestions and identify key areas of concern at an early stage.

Preliminary technical and environmental investigations were undertaken to identify likely constraints and opportunities within the study area. These technical papers, including a series of constraints maps, were prepared to help assess the options and to ensure all potential constraints were considered and addressed as part of the option development process.

Options Assessment

An initial review of the study area identified three distinct corridors within the project study area:

- Western corridor – All routes west of Grafton Street
- Grafton Street corridor – Bridge crossing centred on the existing Grafton Street alignment
- Bridge Street corridor – Bridge crossing centred on the existing Bridge Street alignment.

Links across Sportsmans Creek were then grouped into these corridors, with the best six chosen to go forward for further assessment.

The six options were presented for detailed assessment at an internal technical workshop held on 1 August 2013. An assessment of these options was undertaken with consideration given to the project objectives and key constraints of the study area.

The six options were assessed and ranked against the project objectives including road safety, transport efficiency, environment, community views and value for money with the three best performing options selected taken forward for further assessment.

The three short-listed options selected were taken forward for review at an Internal Technical Workshop.

Recommended option

Following the Internal Technical Workshop, the three shortlisted options were further reviewed by Roads and Maritime in conjunction with Transport for NSW.

During this process, one option became clearly preferable and delivered the most benefits.

This review concluded that the recommended option to be taken forward for community comment as it:

- Uses existing roads and minimises development on greenfield sites and overall road length
- Maintains passing trade for local businesses
- Connects Flo Clark Park and Sportsmans Park
- Avoids disruption to the Flo Clark Park boat ramp and allows new access for sail boats
- Delivers value for money
- Minimises impact on natural wetlands
- Reinforces original town plan
- Retains heritage conservation area of Lawrence.

The recommended option was displayed in November 2013 and comment sought on the alternatives available for the intersection treatments that form part of the project.

Preferred option

Following the display of the recommended option, constructability, safety and value engineering investigations were carried out to ensure the preferred option best meets the project objectives and community needs.

The following design refinements were adopted as a result of this process:

- Shifting the alignment adjustment to the west to increase clearance to the boat ramp on the southern abutment. This also allows the existing property accesses to remain adjacent to the northern approach to the new bridge
- Adjustment of the northern intersection alignment to increase the clearance to the Lawrence General and Liquor Store fuel bowser and tank
- Incorporating a gateway treatment on the southern approach as a traffic calming measure as identified in the Concept Road Safety Audit
- Improved road safety by removing the direct connection to Grafton Street North
- Retention of 1.5 metre shoulder width to meet council Auspec standards unless cost savings are achieved by reducing this width to 1.0 metre
- Refined height of the abutment to improve aesthetics and minimise earthworks for the approach embankments
- The central column on the piers has been removed so that only two columns rather than three columns are positioned at each pier. This improves aesthetics and reduces the piling works in the creek
- The end girder voids to be filled or partially filled to avoid maintenance issues associated with cleaning out the voids of the girders after high flood events
- Minimised the need for working over water by avoiding the need for a pile cap at water level. The pier columns/piles will extend to the headstock level of the substructure
- The northern approach to the existing bridge, including the dry stone walls, will remain intact. The turnaround at the southern end of Bridge Street will be shifted further north increasing flood protection for the existing houses in the Bridge Street.

The preferred option is illustrated in figure 1.

Figure 1 Preferred option for the Sportsmans Creek new bridge

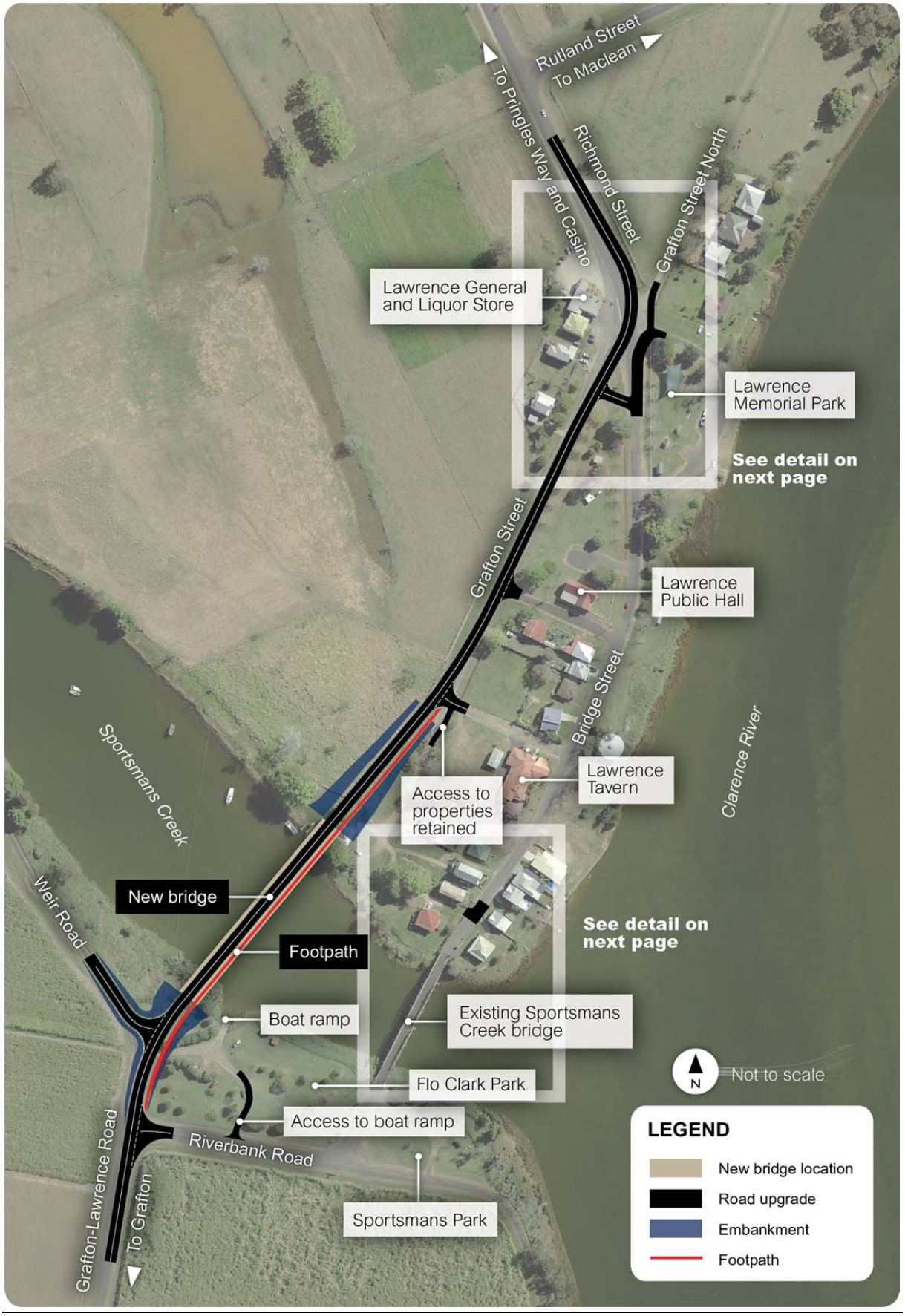

Figure 2 shows the proposed intersection treatments.

Figure 2 Proposed intersection treatments

Next steps

Following the announcement of the preferred option, the next step is to prepare an environmental impact assessment and obtain relevant approvals before starting detailed design and construction. The process is illustrated in Figure 3.

Figure 3 Project activity flowchart

Glossary of terms

AADT	Annual average daily traffic
ABS	Australian Bureau of Statistics
AHD	Australian Height Datum, a common national plane of level approximately equivalent to the height above sea level
AHIMS	Aboriginal Heritage Information Management System
AM peak	Morning traffic peak period, that is, from 7 am to 9 am
ARI	Average recurrence interval, the average or expected value of the periods between exceeding a given rainfall total accumulated over a given duration
ASS	Acid sulphate soils
Austroads	Austroads is the association of Australian and New Zealand road transport and traffic authorities
BCR	Benefit-cost ratio
BOM	Bureau of Meteorology
CBD	Central business district
CMA	Catchment Management Authority
DDA	The Australian Government's Disability Discrimination Act 1992
DP&I	NSW Department of Planning and Infrastructure
EEC	Endangered ecological community
EIS	Environmental Impact Statement
EPA Act	Environmental Planning and Assessment Act 1979
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPL	Environmental Protection Licenses
HML	Higher Mass Limits (HML) is a nationally agreed scheme that permits approved heavy vehicles to operate with additional mass on certain types of axle groups, on a restricted road network and subject to specified conditions
HPAA	High Pedestrian Activity Area
LALC	Local Aboriginal Land Council
LEP	Local environmental plan
LGA	Local government area
MCA	Multi Criteria Assessment
MNES	Matter of National Environmental Significance
Mtpa	Million tonnes per annum
NPV	Net Present Value
OEH	The Office of Environment and Heritage
PAD	Potential Archaeological Deposit

PEP	Protection of the Environment Policies
PM Peak	Afternoon traffic peak period, that is, from 3 pm to 5 pm
POEO	Protection of the Environment Operations
REF	Review of Environmental Factors
RVC	Regional Vegetation Communities
RNP	Road Noise Policy
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
SEWPAC	Department of Sustainability, Environment, Water, Population and Communities
WHS	Work, Health, Safety

1 Introduction

1.1 Project background

Roads and Maritime Services (Roads and Maritime) is undertaking the development and assessment of the options for a new bridge over Sportsmans Creek at Lawrence.

The existing Sportsmans Creek bridge is located on the southern approach to Lawrence within the Clarence Valley Council local government area. Lawrence is located 25 kilometres north of Grafton on the Lawrence Road (MR152) which is managed and maintained by Clarence Valley Council.

Roads and Maritime is responsible for the management of the existing bridge as an 'ex-national' bridge and in accordance with the NSW Government Gazette No 83, 1928. The existing bridge was built in 1985 and reconstructed in 1911. It is 91.7 metres in length, consisting of three timber beam approach spans and two timber Dare truss spans. The bridge has a carriageway of 5.5 metres.

Geometry and design limitations of the existing bridge mean it is unable to be upgraded to cater for future haulage requirements of local surrounding agricultural industries, two-way traffic and pedestrian access.

Significant seasonal cane haulage activities rely on this bridge for access. A total of 300 hectares of cane exists to the south of Sportsmans Creek with 40,000 tonnes (3,720 trips) of harvested cane transported across the bridge each year. There is no available alternative should the current bridge be load limited, putting the viability of this industry at risk.

Roads and Maritime has developed and published the Timber Truss Bridge Heritage Conservation Strategy for the management of its remaining timber truss bridge stock, after conducting public consultation. As part of this strategy, the Sportsmans Creek bridge is proposed to be demolished and replaced with a modern structure. The new bridge and associated road work will be handed over to Clarence Valley Council for their ongoing ownership, control, maintenance and inspection.

The study area for the project is shown in Figure 1.1 below.

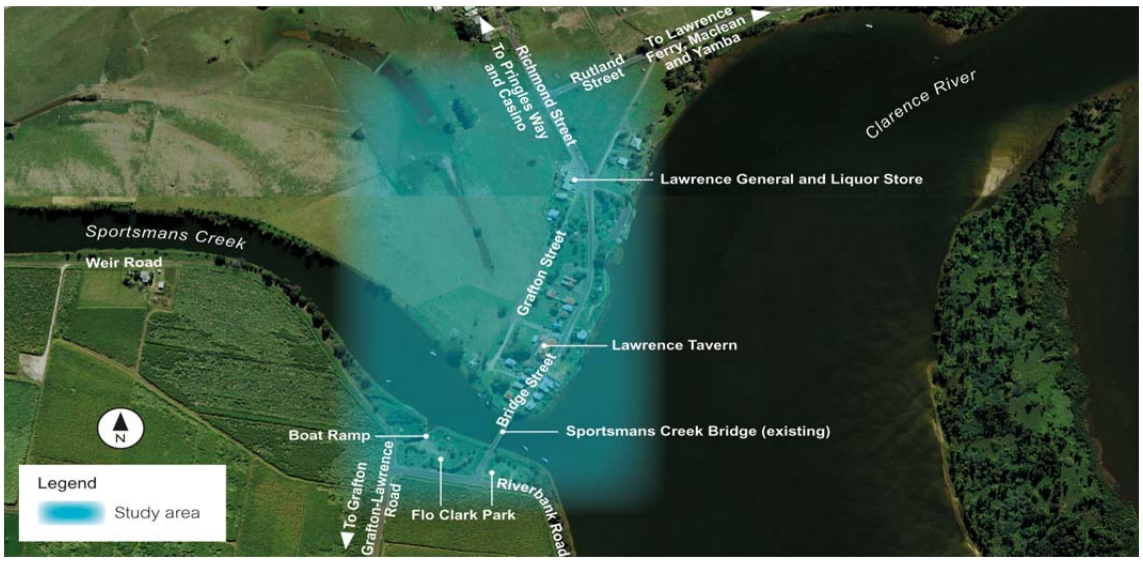

Figure 1.1 Map of the study area and surrounding streets in Lawrence

1.2 Purpose of the report

This report builds on the work documented in the *Recommended Options Report* (Roads and Maritime, November 2013).

The purpose of this *Preferred Option Report* is to document and summarise the project processes, methodology, technical and environmental investigations used to identify a preferred option.

This report:

- Describes the existing environment in the Lawrence area and identifies issues and constraints in the study area
- Documents the development of preliminary options within the study area and subsequent assessment process to shortlist options within three corridors
- Documents the assessment method and process for identifying a recommended and preferred option
- Describes the preferred option
- Outlines the next steps for the development of the Sportsmans Creek new bridge project.

1.3 Assumptions and limitations

This report provides information on the existing environment, issues and constraints related to the development of preferred option for Sportsmans Creek new bridge.

The designs presented in this report have been developed to a strategic concept level. The preferred option may be further refined during the concept and detailed design phases.

2 Project strategic context, need and objectives

2.1 Strategic context

The overarching policies and strategic documents relevant to the Sportsmans Creek new bridge project and to the Clarence Valley LGA are described in detail in the *Recommended Option Report* (Roads and Maritime, November 2013). Key documents directly relevant to this project have again been listed below.

- *NSW 2021: A Plan to Make NSW Number One* (NSW Government, 2011)
- *NSW Long Term Transport Master Plan* (TfNSW, September 2012)
- *Bridges for the Bush initiative* (NSW Government 2012)
- *Strategic Land Use Plan* - Mid-North Coast (NSW Government 2012)
- *Interim Valley Vision 2024* - Clarence Valley Council
- *Clarence River Way Master Plan - Tourism and Investment Infrastructure Plan* (Clarence Valley Council 2009)
- *Timber Truss Bridge Conservation Strategy* (Roads and Maritime 2012).

A selection of these documents is discussed below.

2.1.1 Bridges for the Bush program

The *Bridges for the Bush* initiative is a commitment from NSW Government to improve road freight productivity by replacing or upgrading bridges over the next five years at 17 key locations in regional NSW (see figure 2.1).

Bridges for the Bush program includes replacing or upgrading five key priority Higher Mass Limit (HML) deficient bridges on State managed roads and 12 timber truss bridges on State, regional and local roads.

The Sportsmans Creek new bridge project is directly referenced by being an initiative of the *Bridges for the Bush* initiative. It will replace a timber truss bridge and negate the requirement for ongoing costly repairs of the existing bridge.

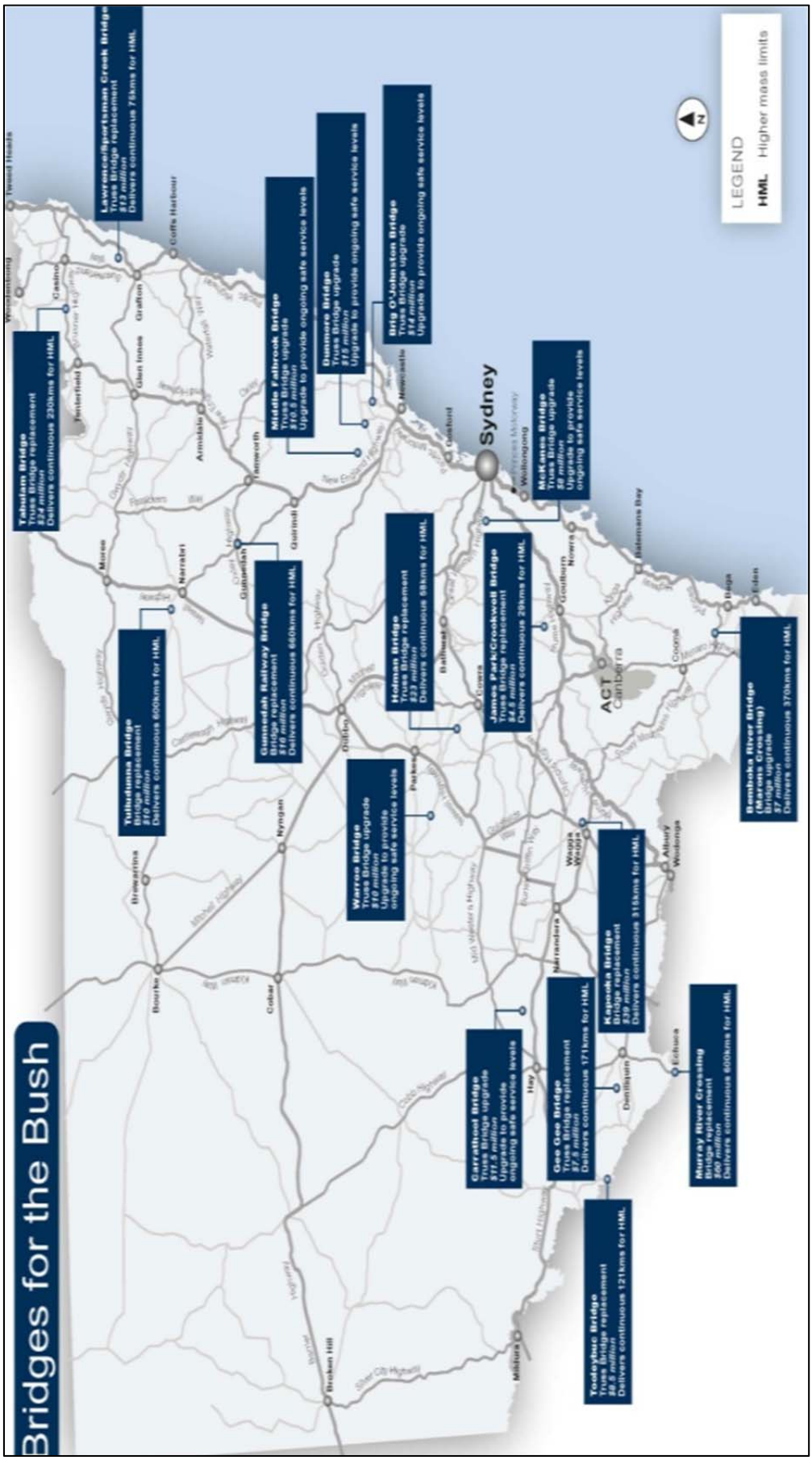

Figure 2.1 *Bridges for the Bush Initiative* (Source: Roads and Maritime)

2.1.2 NSW Strategic Land Use Plan – Mid North Coast Regional Strategy

The *Mid North Coast Regional Strategy 2006 - 2031* aims to guide local planning in the eight local government areas of Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Port Macquarie-Hastings, Greater Taree and the Great Lakes (Department of Planning 2009).

The Strategy includes maps of identified growth areas designated to contain expected land in the region over the next 25 years. Lawrence is identified as one of those growth areas.

The proposed Sportsmans Creek new bridge project is an important infrastructure project for the Mid-North Coast region in line with anticipated growth.

2.1.3 Clarence Valley Council – Interim Valley Vision 2024

Valley Vision 2024 is Clarence Valley Council's review of the *Valley Vision 2020 strategic plan* for guiding the area's development for the next ten years with an extended timeframe. It states that the aim for the human habitat is characterised by sustainable communities, supported by efficient and effective transport services.

Goal 11 of the Vision outlines efficient transport and access, including efficient private and public transport systems that connect the local government area with the region and the world. It also aims to have the transport network provide good access to facilities and services in conjunction with the layout and provision of well-serviced settlements.

The proposed Sportsmans Creek new bridge project supports this vision by providing unimpeded access for transport needs including the sugarcane haulage freight task.

2.1.4 Timber Truss Bridge Conservation Strategy

The *Timber Truss Bridge Conservation Strategy* was completed in July 2012. The strategy was developed to address the long term management of timber truss bridges in NSW. The strategy, undertaken in consultation with the Heritage Council of NSW aims to establish a balance between infrastructure provision and heritage conservation.

The strategy explains that timber truss bridges are expensive to maintain in terms of planning, approvals, materials, maintenance frequency and skilled resources. The strategy also recognises the road network plays a key role in the efficient transport of freight.

The Sportsmans Creek bridge at Lawrence was assessed as part of the strategy. The strategy found that the existing bridge cannot be upgraded to meet future operational requirements.

Under the strategy, the existing bridge is to be demolished and replaced with a new structure.

2.2 The need for a new bridge crossing

The existing Sportsmans Creek bridge is located at the southern approach to Lawrence on Bridge Street, which connects to the Grafton-Lawrence Road. The bridge comprises three timber beam approach spans and two timber Dare truss spans, which were built in 1911. The substructure and approaches are part of the original bridge which was constructed in 1895.

Due to geometry and design limitations of the existing bridge, it is unable to be safely upgraded to cater for future haulage requirements of local surrounding agricultural industries, two-way traffic and pedestrian access.

Seasonal sugarcane haulage activities rely on this bridge for access, and equate to about 3,720 trips per year. As there is no available alternative should the current bridge be load limited, there is a need for a new bridge to be built to ensure the ongoing viability of this industry.

2.3 Project purpose and objectives

2.3.1 Project purpose

The purpose of this project is to identify and select a preferred option for the new bridge for Sportsmans Creek at Lawrence.

2.3.2 Project objectives

The key objectives for this project have been established by Roads and Maritime in collaboration with key stakeholders. They are to:

- Build a new bridge over Sportsmans Creek, Lawrence
- Enhance road safety for motorists, residents, cyclists and pedestrians
- Improve traffic efficiency within Lawrence
- Improve road transport productivity, efficiency, maintainability and reliability
- Support local and regional economic development
- Allow for safe removal of the existing bridge, in support of the *Timber Truss Bridge Conservation Strategy* (July 2012)
- Minimise the impact on the natural, cultural, social and built environment
- Consider community views
- Deliver value for money
- Facilitate handover of the new bridge and associated road work to Clarence Valley Council
- Demolish the existing Sportsmans Creek Bridge.

2.3.3 Supporting objectives

To assist in achieving these project objectives, the following supporting objectives have been developed and are listed below.

Improve road safety

- Minimise vehicle conflict points
- Manage construction elements to reduce traffic/access impacts
- Provide a design which requires minimum ongoing operation/maintenance works and minimises the Work Health and Safety (WHS) risk for maintenance personnel.

Improve local traffic efficiency/transport productivity and reliability

- Reduced travel time
- Increase network capacity
- Business/services patronage
- Reduced road freight user costs
- Property access
- Pedestrian and cyclist safety.

Minimise impact on the natural, cultural and built environment

- Minimise visual impact
- Minimise ecological impact
- Minimise impact on heritage
- Minimise noise and air quality impact
- Minimise impact on drainage/water quality/flooding
- Minimise impact on property
- Minimise impact on the social environment.

Provide value for money

- Provide a design that is affordable and within the capital budget for the project
- Provide a justifiable benefit/cost ratio for the life of the structure.

3 Community involvement and feedback

This chapter describes the community interactions and feedback obtained from drop-in sessions, private meetings and completed feedback forms.

3.1 Public participation plan

A Public Participation Plan was developed for the project to outline planned communication activities to inform and consult external stakeholders and the broader community.

The Public Participation Plan aligns with the project schedule and divides communication activities into three stages:

1. Study Area announcement

2. *Recommended Option Report* display

3. Announcement of preferred option.

To date, stages one and two have been completed.

3.2 Community interactions to date

Community interactions that have taken place since the start of the project are:

3.2.1 Stage 1 - Study area announcement

In June 2013, the project's study area was announced (see figure 4.2). At this time, the Lawrence community and stakeholders were invited to comment on any issues that should be considered when planning for the new bridge via:

- A letter to the householder distributed to every address in Lawrence inviting members of the community to attend community drop-in sessions
- A media release and advertisements placed in the following local newspapers:
  - Daily Examiner
  - Clarence Valley Review
  - Coastal View.
- Two community drop-in sessions
- A feedback form that was available at the community drop-in sessions and could be submitted there or via email before the end of the submission period
- Individual meetings with the Lawrence Historical Society and the owners of the Lawrence Tavern and Lawrence General and Liquor Store
- An email sent out following the drop-in sessions to thank participants for their attendance and ask for completed feedback forms to be returned.

All community input gathered through the sessions and other channels was entered into the project's stakeholder database. A total of 22 formal feedback forms were returned. An *Early Feedback Summary Report* was also compiled and posted on the Roads and Maritime website.

3.2.2 Stage 2 - recommended option report display

Following investigation and assessment, the project team identified a recommended option with proposed intersection treatments that were announced in November 2013, see section 6.5. At this time, community and stakeholders were invited to comment on the recommended option and intersection treatments via:

- A Community Update (November 2013) that was letter dropped to Lawrence residents (carried out by the Lawrence Post Office)
- A feedback form attached as the last page of the Community Update (November 2013) and made available on the Roads and Maritime website
- Personalised letters and copies of the Community Update (November 2013) sent to property owners within the study area and to all those who had previously expressed an interest in the project and provided their contact details
- A media release and advertisements placed in local newspapers, including the Daily Examiner, Clarence Valley Review and Coastal View
- Two community drop-in sessions staffed by Roads and Maritime, and KBR personnel
- Meetings with property owners and businesses within the study area and Clarence Valley Council.

A *Community Feedback Report* was collated based on the feedback received on the recommended option and proposed intersection treatments. Key findings were used to finalise the preferred option. These findings are discussed in section 3.3 and the complete report is available on the Roads and Maritime website.

A project email, 1800 phone number and reply paid mailing address provide accessibility to the project team. All correspondence has been replied to within the agreed timeframes and recorded in the project's stakeholder database.

3.3 Stage 2 Community feedback and issues

3.3.1 Recommended option

The recommended option was well supported. A total of 40 forms were returned, which provided the following feedback:

- Twenty three forms expressly preferred the recommended option
- Four forms preferred other options (namely option 1 and 3) but agreed with the reasoning behind the selection of the recommended option
- Two forms preferred another option (option 1 or 3)
- 11 forms did not comment on the recommended option.

3.3.2 Proposed intersection treatments

Community feedback was received outline proposed intersection treatments:

- Grafton/Bridge Street intersection
- Riverbank Rd/Weir Rd connection
- Southern end of Bridge St turning bay.

The feedback on these intersections also saw a few suggestions for refinement and safety such as signage and traffic calming. Refer to figure 8.2 for the proposed layout sketch plans of intersection options.

Grafton/Bridge Street intersection feedback

The community preferred the intersection option consisting of a curve through the intersection rather than a T intersection. The results of the feedback are:

- 15 of the 40 feedback forms expressly preferred option B (through route from Grafton Street to Richmond Street) with suggestions for refinement and safety

- Three forms preferred option A (T-intersection from Grafton Street to Bridge Street) because of the traffic calming ability, concerns about parking at the Lawrence General Store and Liquor Store and pedestrian safety
- 22 forms did not comment on the proposed intersection treatments.

Riverbank Road/ Weir Road intersections

- The community concurred with the proposed treatment option treatment for these intersections.

Southern end of Bridge Street

- The community concurred with the proposed option treatment. It was requested that the turnaround bay be moved further north away from Sportsmans Creek and that the northern approach to the existing bridge remain intact to improve flood protection to the adjoining existing houses.

3.3.3 Key topics raised

All comments recorded within the feedback form and during discussions at the drop-in sessions were classified by topic. The top five topics raised were:

- Road safety
- Traffic flow and travel times
- Business/service patronage
- Flooding/drainage
- Community facilities and services.

These are illustrated in figure 3.1 as part of the 10 topics raised.

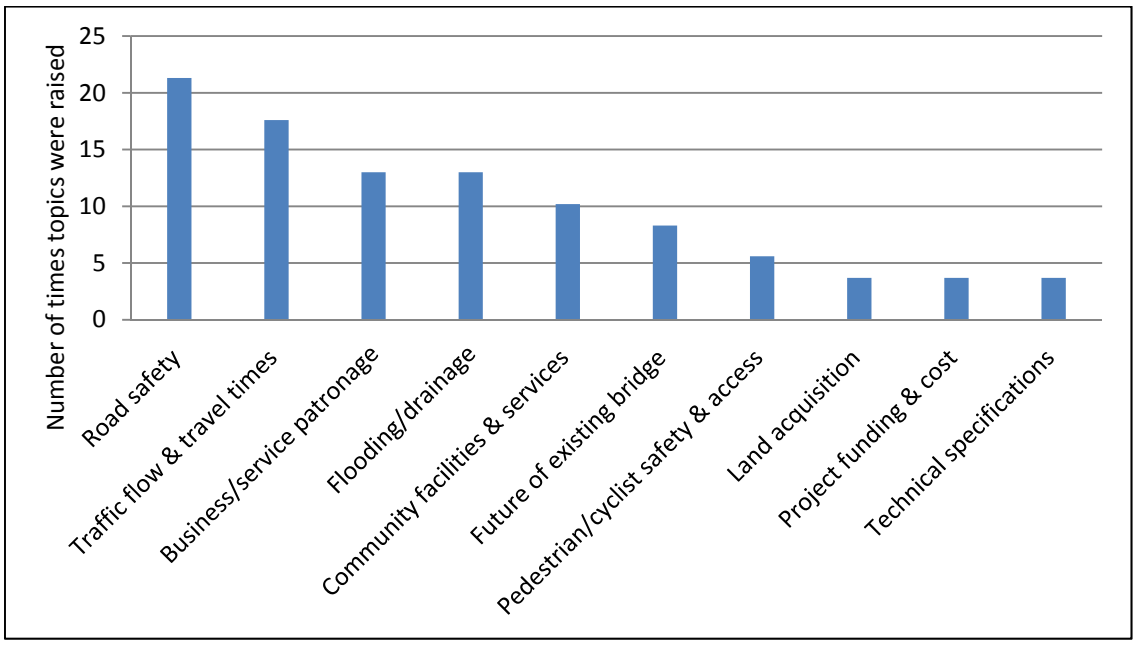

Figure 3.1 Top 10 topics raised in feedback process

3.3.4 Next steps in community consultation

Following the announcement of this preferred option, copies of the report with a community update will be made available. The next step is to project is to prepare an environmental impact assessment and obtain relevant approvals before starting detailed design and construction.

4 Transportation

4.1 Existing transport infrastructure

The following section provides an overview of the road network surrounding the Sportsmans Creek bridge and its importance to regional and local traffic.

4.1.1 Regional road network

Figure 4.1 illustrates the road network between Grafton and Maclean.

The Pacific Highway (Route A1) is the key route in the Clarence Valley and connects Grafton to Maclean.

The Summerland Way (Route B91) forms an inland route linking Grafton with Casino and Kyogle.

Between Grafton and Maclean, the Grafton-Yamba Regional Road (MR152) runs west of the Clarence River through Lawrence.

Part of the MR152 route between Grafton and Maclean is a ferry crossing of the Clarence River between Bluff Point in Lawrence and the Woodford Dale Road on Woodford Island, linking Lawrence to Maclean and beyond to Yamba. The existing Sportsmans Creek bridge at Lawrence forms part of the MR152 route.

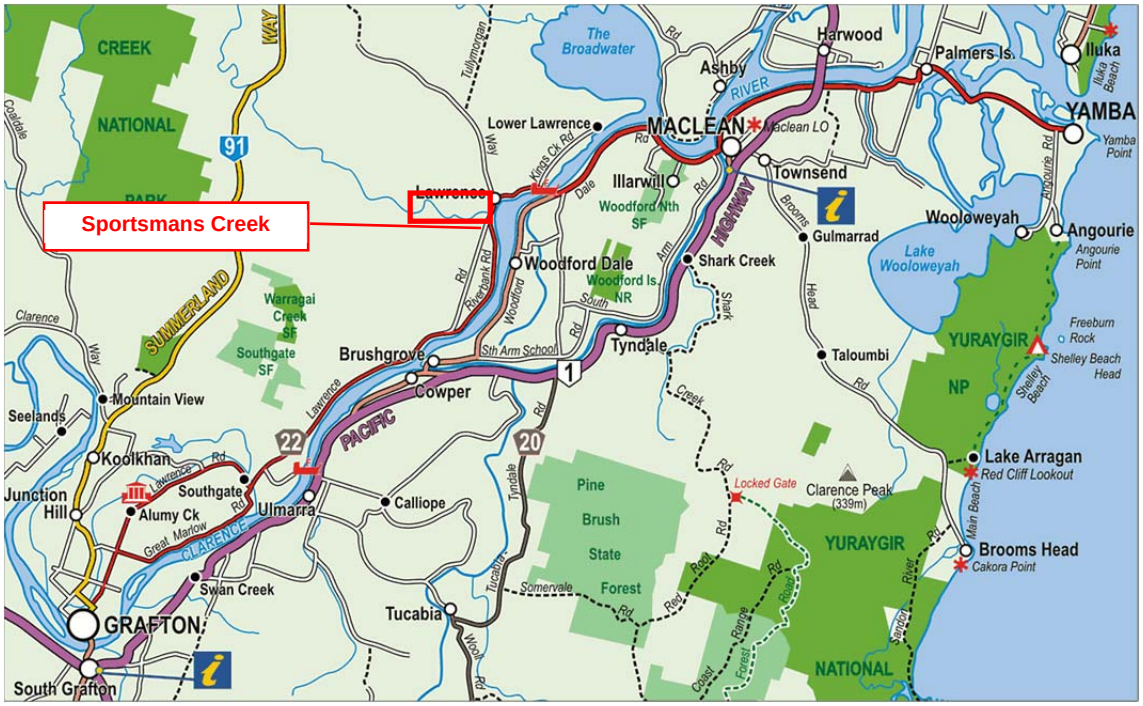

Figure 4.1 Road network (Source: Clarence Valley Tourism)

4.1.2 Local roads

Key local roads in the vicinity of the study area include Bridge Street, Grafton Street and Rutland Street. Figure 4.2 shows the context of key local roads, key features and the extent of the study area.

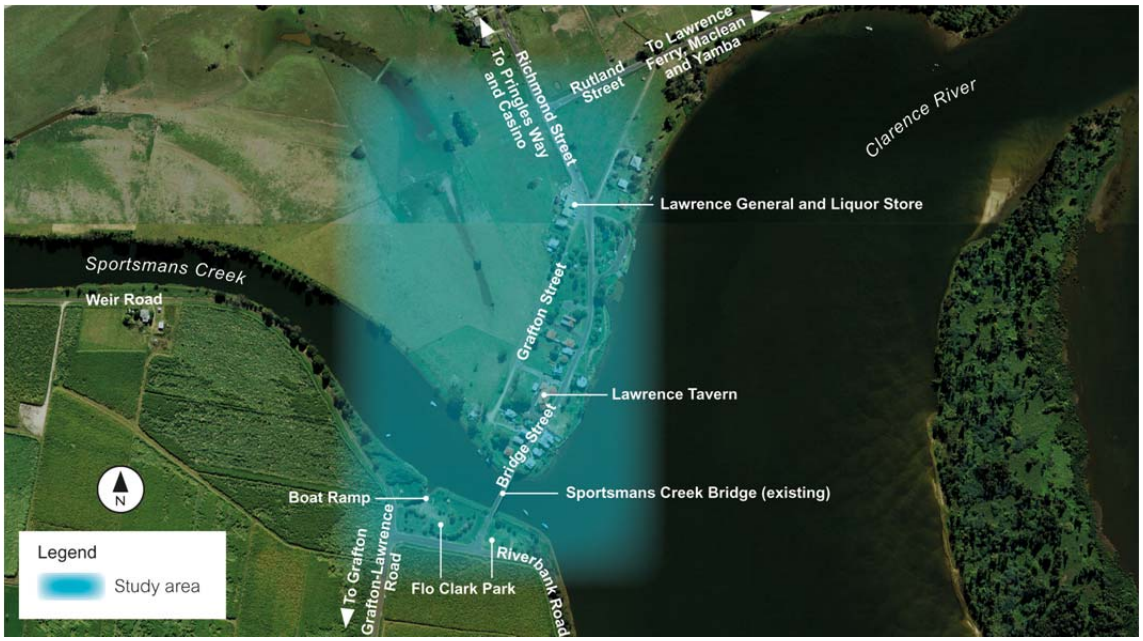

Figure 4.2 Local Road Network (Source: Roads and Maritime Services)

Bridge Street

Bridge Street is part of the Grafton-Yamba route and carries through traffic and provides property access. It is a regional road and has a 10 metre wide road reserve.

Bridge Street runs north-south with the existing Sportsmans Creek bridge at the southern end. Its northern end intersects with Grafton Street where the Lawrence General and Liquor Store is located.

Figure 4.2 shows views of the Grafton-Lawrence Road and Bridge Street immediately north of Sportsmans Creek Bridge.

Grafton Street

Grafton Street runs parallel and to the west of Bridge Street, with the southern end terminating at Sportsmans Creek. It is a local road and has a 20 metre wide road reserve.

Grafton Street provides access to properties fronting Grafton Street and rear access to some properties with frontage to Bridge Street. The western side of Grafton Street is largely undeveloped.

Figure 4.3 shows a view of Grafton Street looking north towards the Lawrence General and Liquor Store.

Rutland Street

Rutland Street provides the link to the Bluff Point Ferry about 1 kilometre north east of the Lawrence village centre.

Figure 4.3 below shows views of Rutland Street from the vicinity of the Richmond Street/Bridge Street intersection.

Figure 4.3 Street views

4.1.3 Traffic volumes

Traffic counts undertaken by Roads and Maritime in February 2013 indicate that the Annual Average Daily Traffic (AADT) across Sportsmans Creek bridge is 1,032 vehicles per day, of which about 7.4 per cent are heavy vehicles.

The AM peak hour occurs between 8:00 and 9:00, with an average of 96 vehicles recorded over the survey period. The weekday AM peak volume was 116 vehicles for both directions. The recorded PM peak hour was between 4:00pm and 5:00pm, with an average of 91 vehicles.

Figure 4.4 shows the hourly variation of traffic volumes across Sportsmans Creek in February 2013.

Previous counts undertaken in 2002 indicate that the traffic volume measured 1061 vehicles per day, with heavy vehicles comprising 10.2% of the volume. While not specifying when in 2002 the counts were undertaken, it is understood that heavy vehicle traffic is influenced by seasonal sugarcane haulage activities (June – December).

Significant seasonal sugarcane haulage activities rely on this bridge for access. A total of 300 hectares of cane exists to the south of Sportsmans Creek with 40,000 tonnes (3,720 trips) of harvested cane transported across the bridge per year.

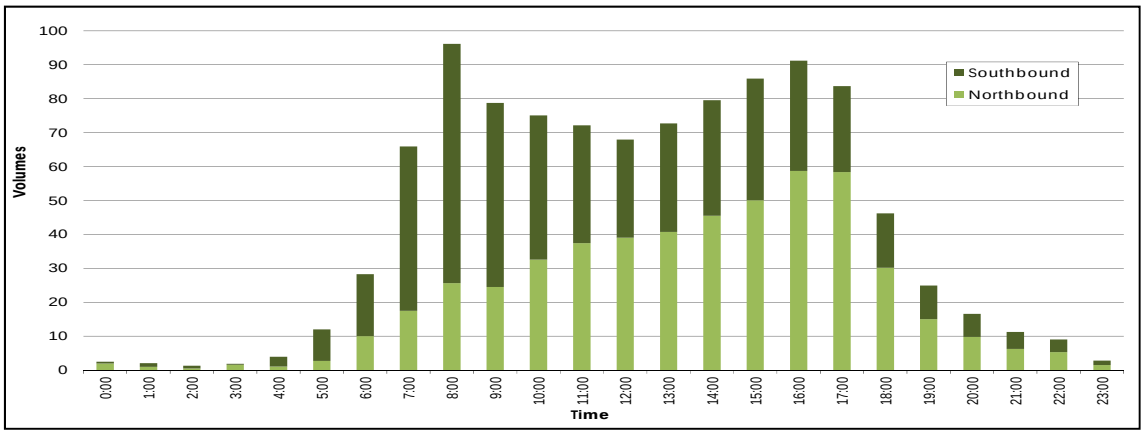

Figure 4.4 Average hourly traffic volumes (06-19 February 2013)

4.1.4 Bluff Point Ferry

The Bluff Point Ferry is a cable ferry linking Rutland Street and Bluff Point on the Lawrence side and the Woodford Dale Road – Lawrence Road junction on Woodford Island. It is part of the transport link between Lawrence and Maclean and is used by more than 800 vehicles daily which accounts for between 70 and 80 per cent of the volume on Sportsmans Creek bridge.

The ferry operates 24 hours a day, seven days a week. There is no interruption to service due to maintenance as an alternate ferry is available at the crossing. The capacity of the Bluff Point ferry has recently been upgraded from 35,000 to 46,800 vehicles a month.

Figure 4.5 shows the Bluff Point Ferry and Sportsmans Creek bridge at Lawrence.

Figure 4.5 Crossings at Lawrence

4.1.5 Public transport

Lawrence Bus Service operates two routes in Lawrence:

Route 384: Lawrence to Grafton

- A daily weekday AM service to Grafton departing at 7:45am and arriving at 8:30am
- An additional Town Bus AM service to Grafton on Tuesdays and Fridays, departing 9:30am and arriving at 10:10am
- A daily weekday PM service from Grafton departing at 3:10pm and arriving at 4:10pm
- An additional Town Bus PM service from Grafton on Tuesdays and Fridays, departing at 2:00pm and arriving at 2:30pm
- No services operate on public holidays.

Route 385: Lawrence to Maclean

- A daily weekday AM service to Maclean departing at 7:45am and arriving at 8:45am
- An additional Town Bus AM service to Maclean on Thursdays, departing 10:30am and arriving at 11:00am
- A weekday PM service from Maclean departing at 3:20pm and arriving at 4:10pm
- An additional Town Bus PM service from Maclean on Tuesdays and Fridays, departing at 2:00pm and arriving at 2:30pm
- No services operate on public holidays.

Site observations indicate that the main bus stop in Lawrence is outside the Lawrence General and Liquor Store, although no formal bus passenger facilities are provided.

4.1.6 Walking and cycling

There are no designated cycleways in Lawrence and no formal footpaths exist in the study area.

4.1.7 Traffic growth

Based on a review of previous traffic counts in Lawrence, future traffic growth over the period 1970 to 1990 was at an average of 1.1 per cent per annum. More recent traffic counts undertaken in 2002 and 2013 indicated that traffic volume over the bridge is expected to increase at an annual growth rate of 2.5 per cent per annum for the next 25 years.

4.2 Transport and traffic issues

Key transport and traffic issues and constraints that need to be considered for the Sportsmans Creek new bridge include:

- Road safety
- Traffic capacity
- Integration with the user and community needs
- Constructability.

4.2.1 Road safety

Pedestrian facilities

One of the design objectives for the new bridge at Sportsmans Creek is to accommodate pedestrians and cyclists on the downstream side of the bridge.

The provision of a pedestrian and cyclist shared path on the new bridge will improve the level of safety for pedestrians and cyclists.

Design speed

The approach to the existing bridge from the south incorporates two 90-degree turns that slow down traffic speeds on the southern approach to the town.

The design speed for the project is 50 kilometres per hour. The posted speed limit from the southern approach to the new bridge will be 50 kilometres per hour.

The southern approach to the Sportsmans Creek new bridge is a long straight (100 kilometres per hour sign posted). Further design investigations for an “entry” into Lawrence and traffic calming will be undertaken in the concept design.

Sight lines

The new bridge alignment will consider sight lines which provide a higher level of road safety.

4.2.2 Traffic capacity

Traffic growth

The design and alignment of the Sportsmans Creek new bridge has incorporated increases in traffic through growth in normal economic activities, as well as growth opportunities identified in a number of strategies and policies that have an impact on Lawrence. These include the Clarence Valley Council’s vision and the anticipated growth in tourism traffic as part of the *Clarence River Way Strategy*.

Investigations undertaken for the upgraded ferry at Bluff Point have considered, as the traffic demand for the Sportsmans Creek new bridge and the upgraded Bluff Point Ferry are intertwined.

Seasonal variation

Traffic demand in Lawrence, particularly by heavy vehicles, increases significantly during the sugarcane harvest season (June to December).

4.2.3 Integration with user and community needs

Key desire lines

The preferred option will provide connectivity through Lawrence whilst achieving local access to the village.

5 Existing environment and constraints

5.1 Landscape and urban character

This section summarises the landscape and visual constraints that apply to the selection of a preferred option for a new bridge over Sportsmans Creek.

5.1.1 Landscape context

The landscape setting of the project's study area is defined by key elements including township (the higher village), heritage village, ephemeral wetlands, waterways and sugarcane fields. These elements define the pattern of the landscape setting and are shown in figure 5.1.

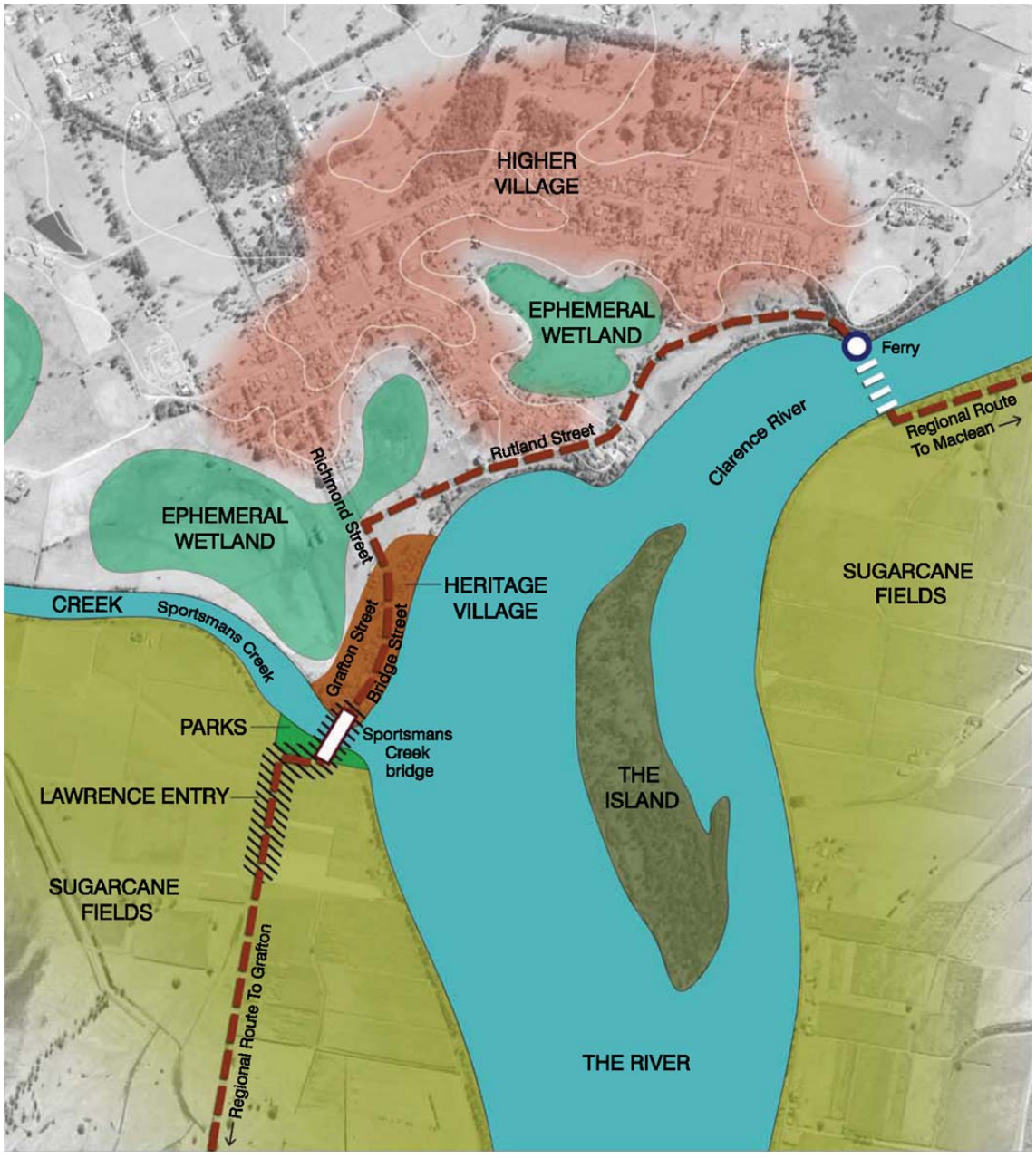

Figure 5.1 Landscape settings

Township

The main village of Lawrence is situated on the mid and upper slopes north of the older settlement of the study area. This area is on a ridgeline that affords views of the Clarence River and surrounding lower areas including wetlands, rural areas, Sportsmans Creek and sugarcane areas. The village is spread over a wide area and is characterised by low built form elements typically one to two storeys in height.

Heritage village

The Heritage Conservation Area of Lawrence is located along the western bank of the Clarence River at this location and is focused on Bridge Street. This area with a number of heritage properties, combined with the bridge structure, creates a memorable gateway setting as the entry point into town from the south. This entry point is defined by the bridge, historic buildings as well as open space/parks that provide a strong visual and spatial relationship with the Clarence River.

The visual relationship is considered significant as it strongly contributes to the sense of place and character and provides a strong sense of arrival that partly defines the impression of the town.

Ephemeral wetlands

These areas surround the higher village and form a distinctive, strong green lush zone along the western edge of town that highly contrasts with the otherwise relatively semi-arid landscape.

Waterways

The waterways are defined by the Clarence River and Sportsmans Creek. The wide waterways of the Clarence River offer expansive vistas including views to Woodford Island that underpin the high quality of the setting and natural beauty of the area and strongly contribute to the identity of the township. Sportsmans Creek, a rather narrow tributary/water element in comparison to the expanse of the river, provides a more intimate character and has a limited interface with the village.

Sugarcane fields

Further afield and towards the east and south across the waterways, sugarcane fields dominate the setting. These fields are located within the low-lying land adjacent to the waterways and are characterised by the green uniformity of the fields.

5.1.2 Landscape characteristics

Several key landscape characteristics have been identified within and around the study area based on preliminary information available and the site visit. These key characteristics include landscape and built form elements which contribute to the sense of place within the village of Lawrence as shown in figure 5.2.

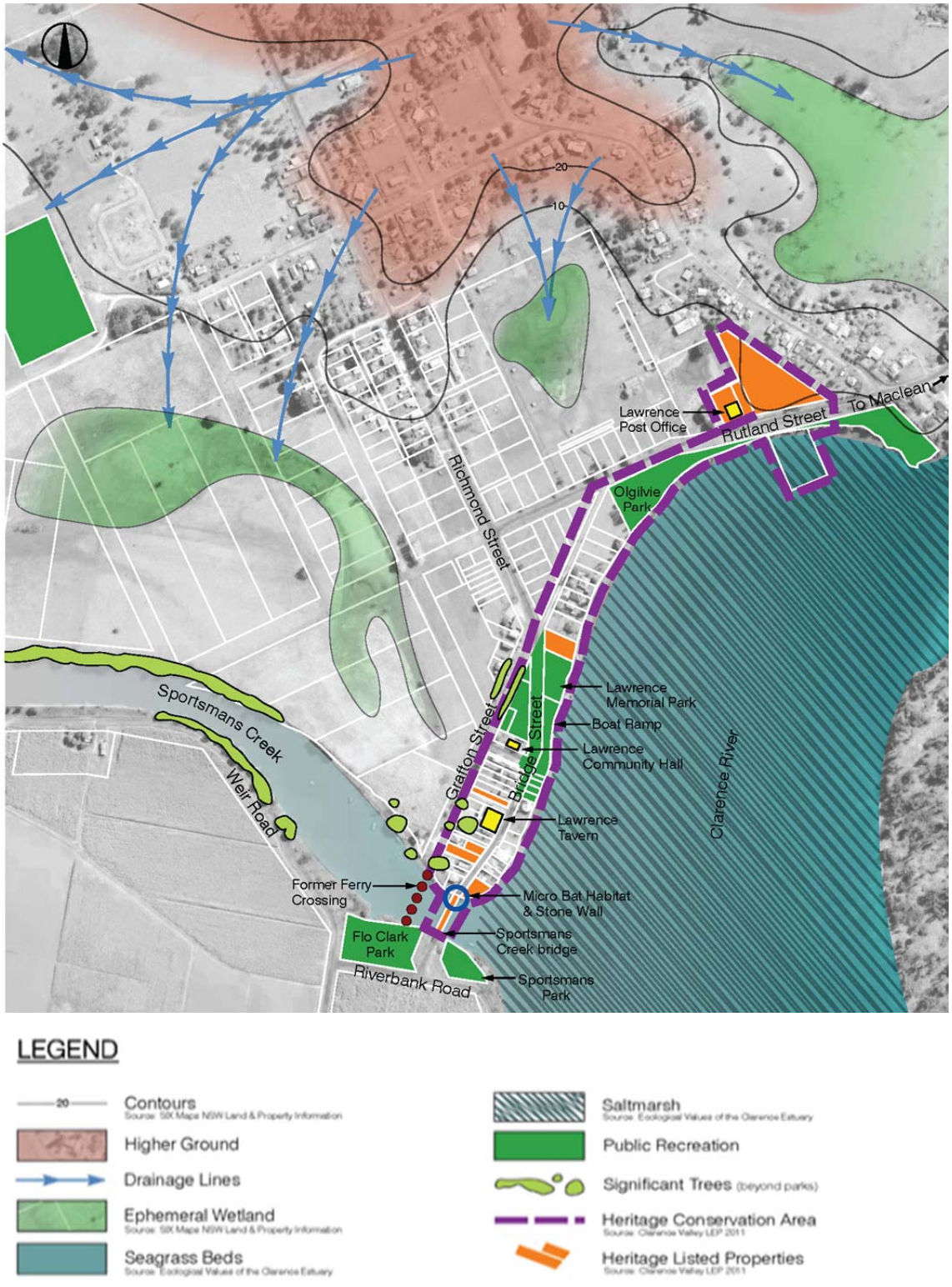

Figure 5.2 Landscape characteristics

Higher ground

The higher ground to the north of the village forms the skyline setting and commands views down onto the floodplain, waterways and heritage village below.

Drainage lines

There are many drainage lines, some defined, others broader and the general direction of fall is shown in figure 5.2. They run into the ephemeral wetlands which provide ecological and bird habitat to the west and north of the study area.

Salt Marsh, sea grass and wetlands

The study area is in the vicinity of seagrass beds, wetlands of national significance and saltmarsh areas. All three areas provide bird habitat and the location of a bridge should consider potential impacts upon these areas, or to adjacent areas.

The *Clarence River Way Masterplan* highlights the need to improve public accessibility to the waterfront road reserves, and to provide bird hide/interpretation of wetlands from road reserves (Clarence Valley Council 2009).

Significant trees

There are mature Eucalypts and other trees/vegetation within and around the study area (beyond the salt marsh, and wetland vegetation and park areas) that provide high landscape value to the village and overall setting of the area. Key trees/vegetation from a landscape/visual point of view includes:

- Mature Eucalypts in the vicinity of Grafton Street
- Avenue plantings to the northern end of Grafton Street
- Indigenous vegetation along Sportsmans Creek banks.

Open space/recreation areas

There are three main open space/recreation reserves in the village area, per the *Clarence Valley Local Environment Plan 2011* including Ogilvie Park (outside of the study area), Lawrence Memorial Park and Flo Clark Park. In addition, there is Sportsmans Park, which whilst it is not allocated as “recreation” in the *Clarence Valley Local Environment Plan 2011*, is situated at the mouth of the creek, and opposite bank to the village.

Ecological resource - bridge and wetlands

The ecological value of the waterways surrounding the site, including the ephemeral wetlands to the west of the study area and the habitat provided by the bridge for the Large Footed Myotis (Microbats) and Eastern Osprey.

Sportsmans Creek is also a key fish habitat breeding ground.

Heritage precinct

The small scale of the Heritage Conservation Area of the village, the 10 metre wide road reserve of Bridge Street and relationship of the village to water are all elements that require a sensitive approach to planning and designing a new bridge and road infrastructure. The bridge provides an iconic gateway to the township.

5.1.3 Opportunities and constraints

Figure 5.3 identifies the key opportunities and constraints of the study area and surrounding context. The key elements relevant to the assessment of a preferred option are summarised below.

Heritage conservation area

This area requires sensitive attention to ensure that any proposals do not adversely impact upon the character of the village, including built form and landscape elements. Widening Bridge Street from 10 metre to 20 metre for example, would have a high impact upon the character of the village and change its sense of place as many dwellings would be impacted.

Grafton Street

This street was originally planned as the main street, as seen from the original 1902 town plan. The road has a 20 metre wide reserve, has some large trees set back from the pavement edge and follows the alignment of the previous ferry across Sportsmans Creek. The trees to the east and west of the Grafton Street interface with the water and should be retained as much as practical.

Park consolidation

Sportsmans Park and Flo Clark Park will be consolidated into one park area as the southern approaches to the existing bridge, the current divider between these spaces, will be removed. The two parks will be seamlessly linked, thereby improving recreational opportunities for the community and consolidating green space.

Environmental and heritage interpretation

It is proposed to erect a heritage marker for the existing bridge and Roads and Maritime is working with Clarence Valley Council, the community and the museum to determine the appropriate treatment. As the bridge location is at the meeting point of the sea grass and salt marsh areas, the area also provides an opportunity for saltwater plan interpretation.

Ephemeral wetlands

These ephemeral wetlands are an important ecological resource and form an important visual resource for the town. They are viewed from the higher slopes of the more densely populated areas of Lawrence. The preferred option will not impact these areas.

Pedestrian accessibility

The preferred option addresses the need for safe and convenient access to the Memorial Park foreshore area.

A slow speed environment with strong, legible links between the town and river foreshore will be created at the Grafton/Bridge Street intersection.

Streetscape improvements

The preferred option provides opportunity for streetscape improvements in Grafton Street

Northern entry

In the vicinity of the Lawrence General and Liquor Store, car parking design will enhance the legibility, quality and safety of this location.

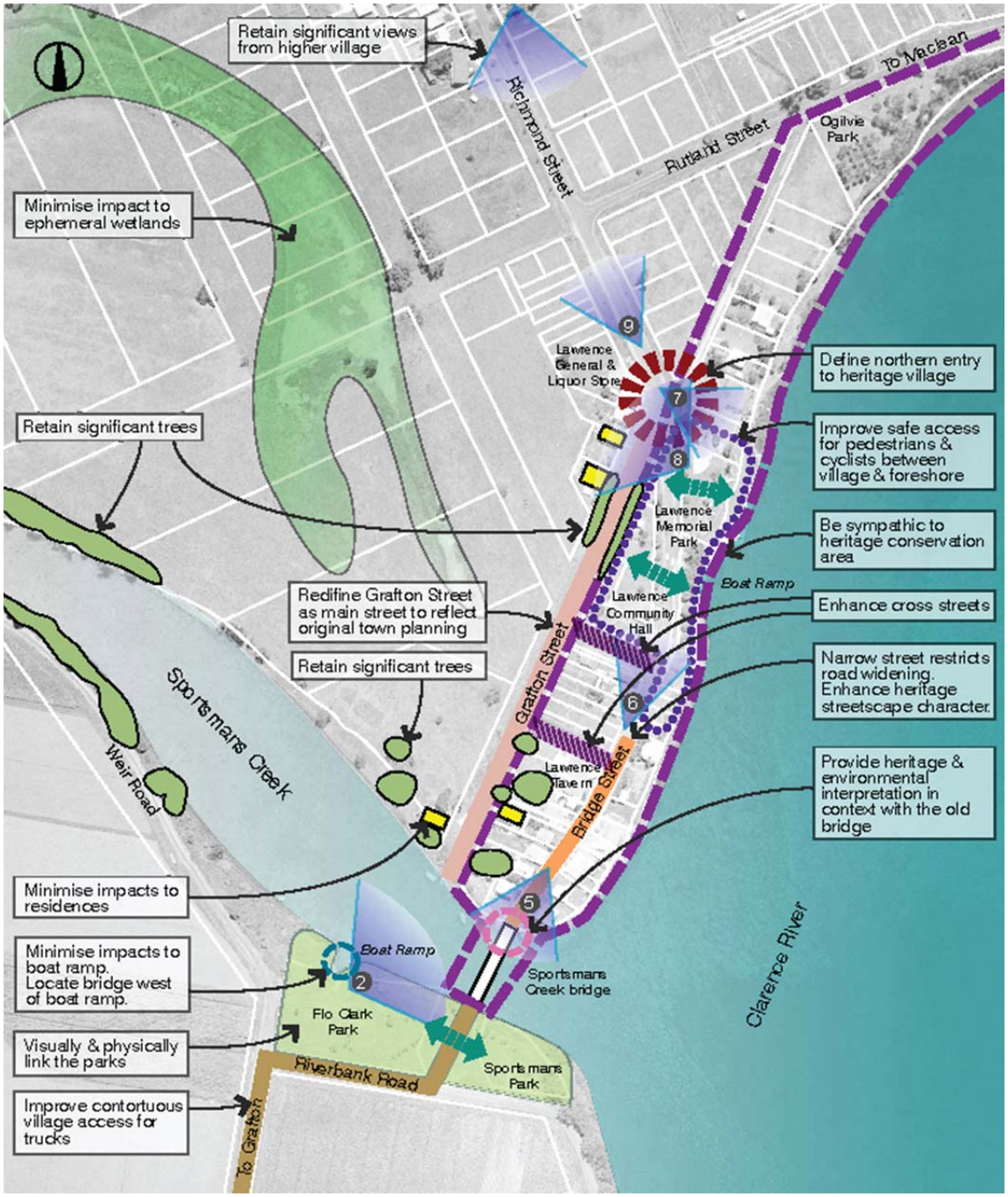

Figure 5.3 Landscape opportunities and constraints

5.2 Planning and zoning

5.2.1 Planning framework

The Sportsmans Creek new bridge project falls within the definitions of ‘road infrastructure facilities’ under Division 17, Reg 93 of the *State Environmental Planning Policy (Infrastructure)* 2007 . Under the *State Environmental Planning Policy (Infrastructure)* 2007, Reg 94 states that development for the purposes of road infrastructure facilities by or on behalf of a public authority is permissible without development consent.

This means the project is not subject to the provisions of Part 4 of the *Environmental Planning and Assessment Act*, 1979 but instead is defined as an ‘activity’ under Part 5 of the *Environmental Planning and Assessment Act*, 1979.

Part 5 of the *Environmental Planning and Assessment Act*, 1979 permits the environmental assessment and determination of an ‘activity’ by a ‘determining authority’. Under Section 110 of the *Environmental Planning and Assessment Act*, 1979, a determining authority can be a public authority which includes the NSW Roads and Maritime Services Authority (the proponent).

Under Part 5 of the *Environmental Planning and Assessment Act*, 1979, Section 111 states that a determining authority has a duty to consider the environmental impacts of an activity and is required to ‘examine and take into account to the fullest extent possible all matters affecting or likely to affect the environment’ as a result of the activity.

Given these planning provisions and the requirements of Part 5 of the *Environmental Planning and Assessment Act*, 1979, Roads and Maritime must consider the environmental impact of an ‘activity’ under Sections 111 and 112 of the *Environmental Planning and Assessment Act*, 1979. This would most likely be in the form of an environmental assessment (Review of Environmental Factors (REF)). This environmental assessment would determine the need for further more detailed environmental assessment (EIS) and or Species Impact Statements (SIS). At this stage, it is envisaged that this further detailed environmental assessment would not be required.

As part of the environmental assessment under Part 5 of the *Environmental Planning and Assessment Act*, 1979, the project may require consideration of approvals, permits and licenses under other State environmental legislation. Relevant legislation is summarised in Table 5.1.

Table 5.1 Relevant legislation

Legislation	Responsible Authority	Aspect of development
Environment Protection and Biodiversity Conservation Act 1999	Commonwealth Minister for Environment Department of SEWPAC	Referrals to Minister for any potential 'controlled actions', being impact on any Matters of National Environmental Significance (MNES). None identified at initial concept stage.
Native Title Act 1993 (Cth)	Given the extent of public lands, Native title may still exist over parts of the study area. Native title is not extinguished over leasehold land.	Search of the National Native Title Tribunal registers will identify if there are any current registered claims or any determined claims of native title over the study area.
Fisheries Management Act 1994	Minister for Primary Industries (Fisheries and Aquaculture) Department of Primary Industries	Conserve biological diversity of fish and marine vegetation and promote ecologically sustainable development and activities. Notification for dredging or reclamation and permit to harm marine vegetation. Sportsmans Creek is included as a Key Fish Habitat (KFH) as defined under FM Act.
Native Vegetation Act 2003	Local Catchment Authority (Northern Rivers CMA) Minister for Environment and Heritage	Permits for clearing of native vegetation. Section 25 exemptions apply to the proposed project
Threatened Species Conservation Act 1995	Minister for the Environment and Heritage (Office for Environment and Heritage)	If potential threatened species are present or likely, 7 Part assessment of significance with threatened species, populations and ecological communities.
National Parks and Wildlife Act 1974	Minister for the Environment and Heritage (Office for Environment and Heritage)	Conservation of fauna, native plants, threatened species, and Aboriginal cultural heritage and relevant assessment and approvals to disturb.
Water Management Act 2000	Minister for Water, (Office of Water, Department of Primary Industries)	To protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality.
Protection of the Environment Operations Act 1997	Minister for the Environment and Heritage (NSW EPA)	Regulation of Scheduled activities under the POEO Regulations 2008. Issuing of EPLs.
Waste Avoidance and Resource Recovery Act 2001	Minister for Environment and Heritage (NSW EPA)	Consideration of resource management in terms of the waste hierarchy, avoidance, resource recovery and disposal.

Legislation	Responsible Authority	Aspect of development
Contaminated Land Management Act 1997	Minister for Environment and Heritage (NSW EPA)	Management of listed contaminated sites in NSW. Review NSW EPA Contaminated Lands Register at option identification stage.
Rural Fires Act 1997	Minister for Police and Emergency Services (Ministry for Police and Emergency Services)	The prevention, mitigation and suppression of bush and other fires in local government areas. Notification required to LGA if fires will be required.
Soil Conservation Act 1938	NSW Department of Primary Industries, Catchments and Lands - Soil Conservation Service	Protection and conservation of NSW soils, erosion prone and erosion hazard areas, definition of soil catchments.
Heritage Act 1977	Minister for Environment and Heritage (NSW EPA)	To encourage the conservation of the State's heritage (e.g. any listed under the LEP or on state registers / in addition revocation of existing Dare Timber Truss Bridge) Permits required for any proposed impacts to listed heritage.
Roads Act 1993	Minister for Roads and Ports (for relevant parts) Roads and Maritime Services (Roads and Maritime)	Sets out rights and makes provisions for roads authorities and hierarchy of roads, certain exemptions e.g. native vegetation clearing.

5.2.2 Commonwealth legislative framework

The following Commonwealth legislations apply to this project:

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

Under the *Environment Protection and Biodiversity Conservation Act* 1999, an action will require approval from the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) if the action has, will have, or is likely to have, a significant impact on a Matter of National Environmental Significance (MNES).

The updated ecological study to be undertaken for the replacing the existing bridge may find, in addition to that already found in previous studies, evidence of threatened species including bats and/or osprey and their habitats at the existing timber truss bridge and in proximity to the proposed project options. If a threatened species is also found to be listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999, then it would require referral and potential approval under that Act. However, it is not anticipated to be required from the initial review of the proposed project. Section 5.6 of this report discusses the current ecological assessment in further detail.

Commonwealth Native Title Act 1993

The *Commonwealth Native Title Act* 1993 provides recognition for the rights and interests over land and water by Australian Indigenous people under traditional laws and customs. A search of the National Native Title Tribunal registers undertaken as part of the Indigenous heritage constraints (refer to section 5.4) analysis will identify if there are any current registered claims or any determined claims of native title over the Project area. Given the extent of public lands and the presence of leasehold lands in the study area, Native Title may still exist over parts of the study area.

5.2.3 Relevant State Environmental Planning Policies

The following State Environmental Planning Policies apply to this project:

State Environmental Planning Policy (infrastructure) 2007 (Infrastructure SEPP)

The *State Environmental Planning Policy (infrastructure)* 2007 provides a consistent planning regime for infrastructure and the provision of services across NSW. It allows greater flexibility in locating key infrastructure and facilities. Clause 94 of this policy applies to this project and allows development of road infrastructure facilities on behalf of a public authority without consent on any land.

State Environmental Planning Policy Rural Lands 2008 (Rural Lands SEPP)

The *State Environmental Planning Policy Rural Lands* 2008 aims to facilitate the orderly and economic use and development of rural lands for rural and related purposes. This policy applies to the Clarence Valley local government area and sets out several planning principles to be considered as part of the progression and development of options for assessment. The proposed Project is providing the future means for upholding the rural planning principles outlined in the *State Environmental Planning Policy Rural Lands* 2008 being the orderly and economic use of the rural lands associated with the Project and the immediate rural area.

5.2.4 Local planning instruments

The *Clarence Valley Local Environmental Plan* 2011 is the relevant environmental planning instrument for the locality. However, the provisions of the *State Environmental Planning Policy (infrastructure)* 2007 (as outlined in section 5.2.3) state inter alia that development for the purposes of roads can be undertaken by a public authority without consent on any land, therefore the proposed development would not be assessed under the *Clarence Valley Local Environmental Plan* 2011.

The existing Sportsmans Creek Bridge is listed on the *Clarence Valley Local Environmental Plan* 2011.

5.2.5 Land use zoning and development

The study area as includes the following land use zonings as shown in *The Clarence Valley Local Environmental Plan* 2011 (the LEP) online mapping tool, associated with the LEP as follows:

- RU1 Primary Production (light brown)
- RE1 Public Recreation (lime green)
- R2 Low Density Residential (pink)
- B1 Neighbourhood Centre (pale blue).

The *Clarence Valley Local Environmental Plan 2011* is the relevant environmental planning instrument for the locality. However, the provisions of the *State Environmental Planning Policy (infrastructure)* 2007 (as outlined in section 5.2.3) state inter alia that development for the purposes of roads can be undertaken by a public authority without consent on any land, therefore the proposed development would not be assessed under *The Clarence Valley Local Environmental Plan* 2011.

5.2.6 Summary of assessment processes relevant to the project

The following steps outline the anticipated assessment process for the project.

1. *Recommended Option Report*
2. *Preferred Option Report*
3. Announcement of preferred option
4. Level of assessment determined by Roads and Maritime
5. Activity under Part 5 of the *Environmental Planning and Assessment Act*, 1979
6. Environmental assessment under Part 5, (Review of Environmental Factors (REF) at this stage)
7. Request for requirements from other government approval bodies as outlined in Table 5.1
8. Comments received back from other government approval bodies and incorporated into REF
9. REF submitted to determining authority for approval under s112 of the *Environmental Planning and Assessment Act*, 1979
10. Approval by Roads and Maritime as determining authority under s112 of the *Environmental Planning and Assessment Act*, 1979

5.3 Socio-economic constraints

This section summarises the land use and planning requirements for input to the development of options for the Sportsmans Creek new bridge.

5.3.1 Social

The profile of the existing social environment in Lawrence and the Clarence Valley is based on review and assessment of several data sources, including the following:

- Publically available Clarence Valley Council reports and website information
- Desktop study of aerial photography, maps and other sources using a Geographic Information System (GIS)
- Demographic data from the Australian Bureau of Statistics (ABS) 2011 Census
- Feedback from the consultation with community and businesses
- Field investigations.

Population characteristics

The following key elements of Lawrence's demographic profile are summarised below:

At the 2011 ABS Census, the Urban Centre and Locality (UCL) of Lawrence had a total population of 740 with the following age breakdown:

- 3.7 per cent aged less than 14 years
- 29.2 per cent aged over 65 years.

Compared with the Clarence Valley Local Government Area which has the following features:

- 18.7 per cent aged less than 14 years
- 21.2 per cent aged over 65years
- The median age of the population is 55 years, compared with 46 in the Clarence Valley LGA and 38 in NSW
- The Clarence Valley LGA has an indigenous population of 2.6 per cent which is lower than the Lawrence average of 5.7 per cent. A significantly lower portion of Lawrence residents are born overseas, 13.2 per cent than the NSW average of 31.4 per cent.

Population growth

According to the Social Plan, the Clarence Valley LGA population is growing, with the population reported at 48,425 at the 2006 census, which was an increase of 1026 (2.17 per cent) during 2001-2006 (Clarence Valley Council 2010). This growth is attributed to an increase in retirees and those looking for a sea change and/or tree change and moving to the area. At the 2011 census, the population of the LGA was reported as 49,665 and is projected to grow to 54,500 by 2021 and further to reach 57,300 by 2036 (Clarence Valley Council 2010, ABS 2011b).

Public transport usage

Public transport usage rates are very low in Lawrence LGA. This is due to the limited public transport options (one bus company offers services between Lawrence and Grafton and Lawrence and Maclean).

Housing

Lawrence is generally characterised by low density, detached housing, which makes up 96.9 per cent of the total dwellings in the village. A very low portion of the population of Lawrence live in Group households (2.5 per cent) and the greatest portion live in family households (73.6 per cent). The figures are similar to Clarence Valley and NSW.

56.7 per cent of homes are fully owned, with only 10.9 per cent rented in the village. This is significantly higher than the Clarence Valley LGA and NSW.

Key community facilities, services and events

Few services and retail opportunities exist for the Lawrence community. Residents travel to Grafton or Maclean to access health, education and other related services, retail and employment. Services and businesses in the village are the post office, Lawrence Primary School, Lawrence Tavern (accommodation and restaurant/bar), Lawrence Nursery, Lawrence General and Liquor Store and Lawrence Museum.

The study area contains approximately 21 houses (one under construction), two businesses and one cane farm, located in the south of the study area. Two houses were noted for sale during the field investigations.

There are also two reserves in the study area being Flo Clark Park, located on the southern side of Sportsmans Creek and the Lawrence Memorial Park on the banks of the Clarence River. Both of these parks have boat ramps which are frequently used. Two other recreation reserves exist in the village; Ogilvie Park (near the Lawrence Post Office) and Sportsmans Park (on the opposite bank to the village at the mouth of Sportsmans Creek).

The Lawrence Public Hall is also popular for hosting community events and clubs such as the over 50s Club and the Community Musical Fellowship.

Community values

The following key community values have been identified as part of previous consultation by Clarence Valley Council:

- Scenic views, rural activities, community interactions with their surroundings
- Natural environment and flora and fauna within it and the recreational opportunities it provides
- Protection of natural environment in developing future economic benefits
- Healthy waterways and clean water
- Sense of place, cultural heritage, relationship to surrounding landscapes and human scale
- Community size is such that members can build relationships with others, feel connected and supported. The ability to ‘pull together’ in times of tragedy and natural disaster
- Safe and respectful communities (both safety and property security).

5.3.2 Economic

Business activity

The local economy of Lawrence is very small and is best viewed through an analysis of statistical data for the Clarence Valley LGA. Local economy is identified as a growth area with the *Clarence River Way Masterplan*, particularly in relation to encouraging investment from the tourism industry and improving infrastructure to facilitate industry transport (Clarence Valley Council 2010).

According to the *Interim Valley Vision*, there were approximately 4,090 businesses in the Clarence Valley in 2011, which has been in steady decline since 2007 (ABS 2011d, Clarence Valley Council 2013). Of the total businesses registered, the Agriculture, Forestry and Fishing industry has the highest number (26.3 per cent), followed by Construction (16.6 per cent), Rental, Hiring & Real Estate Services (7.8 per cent) and Retail Trade (7.6 per cent).

The estimated turnover for industry in the Clarence Valley was $1.3 billion in 2010/2011, which has also decreased by 0.4 per cent annually, however, the average turnover of all businesses has increased by 0.2 per cent. Overall the Gross Domestic Product (GDP) is growing for the Clarence Valley at around 8 per cent per annum and is presently worth approximately $1,703.9 Million (Clarence Valley Council 2013).

The core economic base is comprised of industries such as fishing, timber, agriculture and sugar, with emerging economics in tourism, regional food, arts and design, education, boat building and timber value adding (Clarence Valley Council 2013).

Investment within the region is increasing, in particular in aged care, tourism, timber and core infrastructure, encouraged by sea-change immigration, growing population, more affordable land and lower operational costs (Clarence Valley Council 2013).

Employment, labour force and income

Unemployment rates within Lawrence and Clarence Valley are higher than those rates in NSW, with 13.4 per cent of the population in Lawrence unemployed and 8.9 per cent in the Clarence Valley compared with 5.9 per cent in NSW.

Economic values and trends

The following trends and strategic directions are of note for the region in general:

- Encouraging capital expenditure to improve infrastructure such as, recreational areas, site and landscaping improvements, road upgrades and environmental improvements
- Foster economic prosperity through environmentally sustainable activities
- Encourage economic growth and investment utilising federal funding support (through the Masterplan) to promote the rural coast area as a touring region
- Protection of high value natural environments to ensure that new urban development avoids key habitat corridors, threatened species, vegetation communities, coastal lakes, estuaries and aquifers
- Ensure development and growth does not impact upon the coast and character of local villages
- Increase housing stock to meet the demand of 59,600 by 2031 to meet the population growth, however, also ensure this meets the needs of smaller households and the elderly population
- Ensure the demand for land supports economic growth and capacity of the additional employment opportunities

- Support and value voluntary work and build opportunities for training and mentoring to retain expertise in communities (in particular for disadvantaged, youth and less skilled community members).

5.3.3 Key project socio-economic issues

Further project development will consider the following social and economic issues and ensure the appropriate mitigation measures are developed to minimise potential impacts:

- Changes to access and passing trade to businesses within the local area, in particular the Lawrence General and Liquor Store and Lawrence Tavern
- Direct property impacts, such as land acquisitions
- Amenity based impacts on community, residences and businesses relating to noise and air quality during both construction and operation
- Changes to existing cyclist, pedestrian and public transport movements, including the needs of the elderly and disabled
- Indirect impacts on the local road network and community within the village as a result of any changes in traffic movements
- Any clearing of vegetation within undisturbed areas or modifications to recreational areas or the visual character of the village.

The likelihood and severity of these potential impacts will be dependent upon the option chosen. By assessing and considering each of the potential environmental and community impacts further during the next stage of the project, any anticipated negative impacts are unlikely to be significant and the project would expect to result in an overall positive benefit for the Lawrence community.

5.4 Aboriginal heritage

This section summarises the desktop and field investigations and assessment of potential items of aboriginal heritage significance in the study area and in relation to the preferred option.

5.4.1 Desktop assessment

Initially, a desktop assessment was undertaken of the relevant heritage databases covering the study area in order to identify any potential issues which may impact project options.

A search of the Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS) register revealed six known Aboriginal sites are currently recorded within five kilometres of the study area and include three modified trees, two artefacts and one burial site, see table 5.2.

Table 5.2 Results of Aboriginal Heritage database searches

Database Name	Search Date	Search Type	Comment
Office of Environment and Heritage (OEH) Aboriginal Heritage Information Management System (AHIMS)	02-07-2013	AGD, Zone : 56, Eastings : 504000 - 514000, Northings : 6731000 - 6741000 with a Buffer of 50 meters,	six AHIMS sites within the search area

The study area has been cleared and primarily used for pastoral purposes (grazing), involving the wholesale clearance of native vegetation, the introduction of pasture grass, the construction of dams, housing, fencing, tracks, roads, developments and associated infrastructure as well as

flooding on account of the low lying alluvial flats along Sportsmans Creek. These impacts are expected to have resulted in a low potential for in situ indigenous sites within the study area.

Sites are expected to be located on elevated land, which the study area is lacking. Furthermore, based on archaeological sites registered in the region, the results of past archaeological studies, and the location of the study area within low lying flood plains, no sites are likely to occur in the study area.

5.4.2 Field investigations

Methodology

For ease of management, the study area was divided into four Survey Units (SUs) that were based on the proposed development impact areas (refer to figure 5.4).

The survey units were surveyed on foot by the archaeologist and included transects at approximately four metres apart. Transects focused on areas of high ground surface visibility and exposures such as erosional features, creek bank, tracks, and cleared areas.

Consideration was given to the effective coverage, which is comprised of two components: the visibility of the bare ground and exposure, which is the likelihood of revealing subsurface cultural materials. The overall effective coverage of the study area was determined as 15.64 per cent, with grass being identified as the limiting factor, and erosion across the study area identified as minimal.

Figure 5.4 Survey units in the study area

Results

No archaeological sites were identified as:

- the study area is situated on Sportsmans Creek alluvial plains and is subject to regular flooding; and
- the high level of land uses and impacts as well as natural factors (such as erosion and flooding) would have destroyed any evidence of past occupation.

No PADs were identified due to two main factors:

- the study area is situated on Sportsmans Creek alluvial plains and is subject to regular flooding; and
- the high level of land uses and impacts as well as natural factors (such as erosion and flooding) would have destroyed any evidence of past occupation.

In view of the survey results, the predictive model of site location was reassessed for the study area. The potential for artefacts to occur within the investigation is assessed as very low or negligible. There remains a low to no potential for evidence to occur in the areas currently obscured by vegetation.

Proximity to water on an elevated landform was an important factor in past occupation of the area, with most sites located within 50 metres of the tributaries. The surrounding area contains no raw materials that are typically used in the manufacture of stone tools, no exposed sandstone is evident, and no elevated landform is present within close proximity. The study area is highly disturbed and is considered not to have been suitable for past occupation.

5.4.3 Potential impacts and mitigation measures

As no sites or PADs were identified, there are no impacts on the archaeological record within the study area and no further investigations are required.

The persons responsible for the management of on-site works will ensure that all staff, contractors and others involved in construction and maintenance related activities are made aware of the statutory legislation protecting sites and places of significance. Of particular importance is the *National Parks and Wildlife Amendment (Aboriginal Objects and Aboriginal Places) Regulation* 2010, under the *National Parks and Wildlife Act* 1974.

5.5 Historical heritage

5.5.1 Desktop assessment

The desktop assessment using heritage databases and available hard and soft copy resources was undertaken to identify any items or places of potential historical heritage significance within the study area, as shown in table 5.3.

Table 5.3 Results of the heritage database searches

Database Name	Search Date	Search Target	Outcome
Australian Heritage Database http://www.environment.gov.au/heritage/ahdb/	13.07.2013	The townships of Lawrence, Maclean and Copmanhurst in the Clarence Valley LGA, NSW	one resource was listed in the Lawrence town precinct
NSW Heritage Office State Heritage Register and State Heritage Inventory http://www.heritage.nsw.gov.au/	13.07.2013	The townships of Lawrence, Maclean and Copmanhurst in the Clarence Valley LGA, NSW	five listings within the Lawrence town precinct, of which 3 fell within the study area
The Clarence Valley Local Environmental Plan , 2011 http://www.legislation.nsw.gov.au	13.07.2013	The localities of Lawrence, Maclean and Copmanhurst	15 listings within the Lawrence town precinct, of which 6 fell within the study area
Local Heritage Studies : The Maclean Community Based Heritage Study, 2006, http://www.clarence.nsw.gov.au	14.07.2013	The area of the former Maclean Shire LGA	15 listings within the Lawrence town precinct, of which five fell within the study area
The Copmanhurst Community Based Heritage Study, 2005 http://www.clarence.nsw.gov.au/	14.07.2013	The area of the former Copmanhurst Shire LGA	one listing within Lawrence town precinct, which fell within the study area
The Maclean Shire (former) Community Based Thematic History, 2006 http://www.clarence.nsw.gov.au/	14.07.2013	The area of the former Copmanhurst Shire LGA	one listing within Lawrence town precinct, which fell within the study area
Roads and Maritime Heritage and Conservation Register, under s170 Heritage Act, 1977 http://www.rta.nsw.gov.au	13.07.2013	The Northern Region	...the detailed listing for the present Sportsmans Creek bridge

Review of databases and information supplied indicates the primary items of historical heritage significance relevant to the current project are summarised below:

- The search of the Australian Heritage Database revealed the listing only of the present Sportsmans Creek bridge within the Lawrence area
- A search of the State Heritage Register and Inventory revealed no item listed as possessing State level heritage significance within the Lawrence area. A further five sites were listed on the State Heritage Inventory, four reflecting their listing on the former *Maclean Shire Local Environmental Plan*, 2001, those within the study area marked by asterisk:
    - Lawrence Anglican Church

    - Former Lawrence Baptist Church*
    - C.S. Manton's residence
    - Lawrence School of Arts*
- The remaining listing (twice) was for the present Sportsmans Creek bridge reflecting listing in both the former *Copmanhurst Shire Local Environmental Plan*, 2008 and the Roads and Maritime Heritage and Conservation Register pursuant to s170, the *Heritage Act*, 1977
- The most recent Clarence Valley Council *Local Environmental Plan* (2011) lists 15 resources in the Lawrence precinct, six of which fall within the study area (marked with an asterisk below):

    - Former Lawrence Baptist Church*
    - Lawrence School of Arts
    - Lawrence War Memorial and Park
    - Former Baptist Manse, Lawrence*
    - Residence, 11 Bridge Street, Lawrence*
    - Sportsmans Creek bridge*
    - Lawrence Cemetery
    - Lawrence Anglican Church
    - Bluff Point ferry
    - Lawrence Museum
    - Lawrence Post Office/Residence
    - Lawrence Police Station
    - Remains of the former Lawrence Baths
    - Residence, 6 Stuart Lane, Lawrence
    - Lawrence Cricket Canteen.

Previously, the heritage resources of the former Maclean and Copmanhurst Shire LGAs were reviewed as community-based studies co-ordinated by J Gardiner, respectively in 2006 and 2005 more or less concurrently with a community based historical study. The results of these studies are reflected in the present listing in the *Clarence Valley Local Environmental Plan*.

Roads and Maritime (then Roads and Traffic Authority) undertook a study of the heritage values of its properties, in the course of which listing the Sportsmans Creek Bridge in its Heritage and Conservation Register, maintained pursuant to s170 of the *Heritage Act,* 1977. Subsequently, in 2002, Austral Archaeology completed a *Statement of Heritage Impact* in respect of plans for the bridge.

5.5.2 Constraints

Desktop investigations undertaken as part of this constraints analysis sought to correlate all previously identified heritage items and to identify previously unassessed heritage resources. Based on the historical evidence contained in Town and Parish Maps and the community-based historical study, attention has also been drawn to the location of Clarence River wharves on the shoreline in and near the study area. There is a possibility that material evidence remains of these wharves and of their associated infrastructure between the shoreline and the eastern alignment of Bridge Street.

The location of potential historical heritage constraints is shown on figure 5.5.

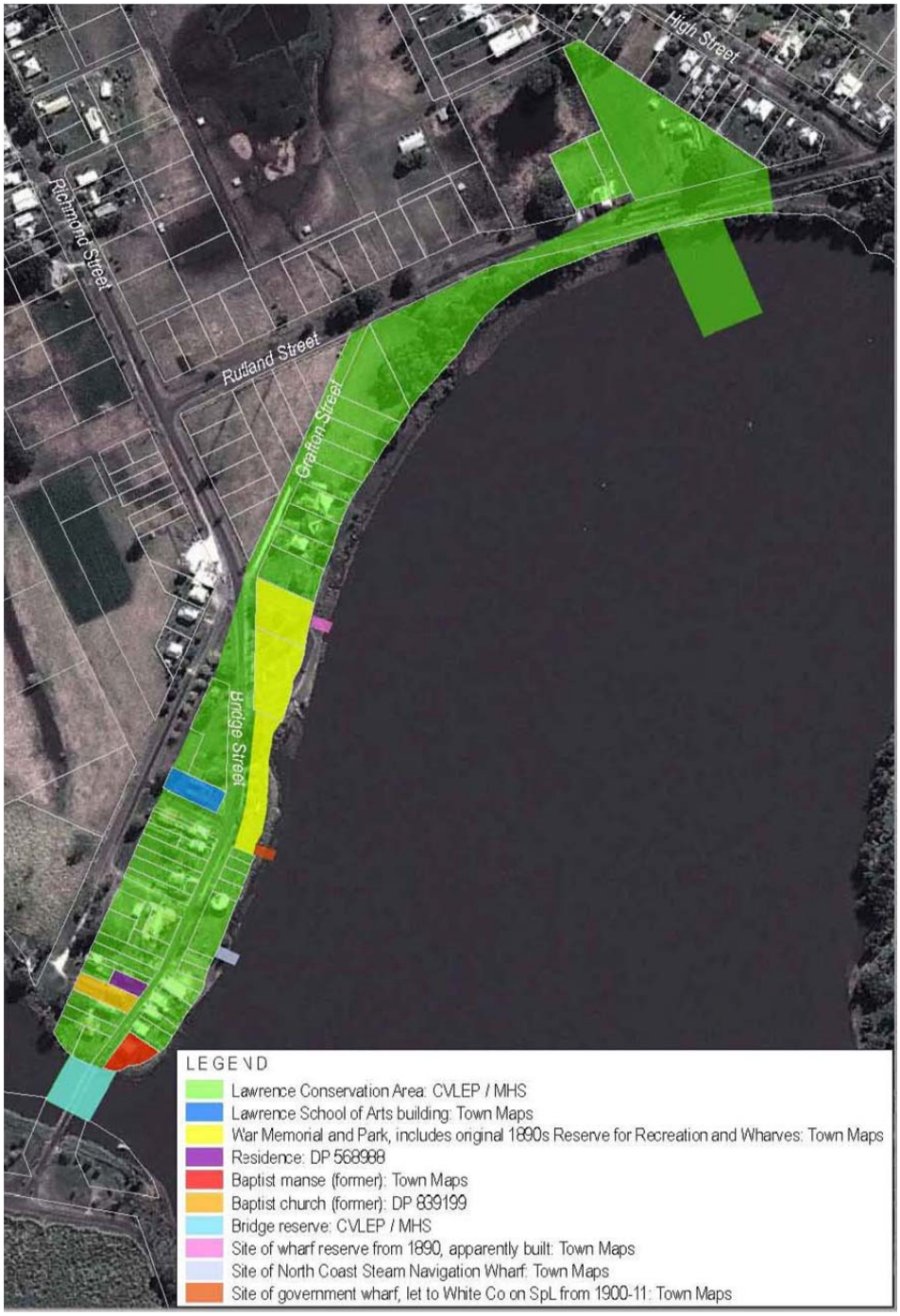

Figure 5.5 Potential historical heritage constraints

5.6 Ecology

5.6.1 Desktop assessment

A desktop assessment and review of available biodiversity information was undertaken for the study area and surrounds. Search results of a number of biodiversity databases and registers were also utilised as well as a literature review of ecological studies previously undertaken in the area and liaison with local ecologists.

Subsequent field investigations of study area were undertaken on 16 December 2013 and 3 February 2014.

5.6.2 Flora

The desktop assessment found that one threatened flora species is known to occur within the study area namely, a planted Durobby (*Syzygium moorei*) within Flo Clark Park which is of low conservation significance due to occurring well outside its natural range.

Two threatened flora species have potential to occur within the study area associated with ephemeral wetland areas to the west of the study area. These are:

- Hairy Jointgrass (*Arthraxon hispidus*)
- Maundia (*Maundia triglochinoides*)

A number of listed Endangered Ecological Communities (EECs) were identified as potential occurrences at the site with Freshwater Wetland EEC likely to be associated with areas of ephemeral wetland.

5.6.3 Fauna

The study area provides potential habitat for 15 threatened fauna species and eight listed migratory species. Three threatened microbat species have been previously recorded at the site including a roosting colony of Large-footed Myotis (*Myotis macropus*) on the existing Sportsmans Creek bridge which are still present. A number of threatened wetland bird species have been regularly sighted around Sportsmans Creek and its surrounds including the Black-necked Stork (*Ephippiorhynchus asiaticus*) and Brolga (*Grus rubicund*). Both of these species have potential to utilise the ephemeral wetlands to the west of the study area for foraging.

Following the value engineering workshop, a microbat field survey was undertaken to confirm the presence and extent of microbat habitat likely to be impacted by the preferred option. The results of this survey are summarised in section 8.

5.6.4 Fisheries

A search of the NSW Department of Primary Industries (DPI) (Fisheries) Records Viewer for threatened/endangered aquatic fauna did not find any records of threatened aquatic fauna in the vicinity of the study area. Previous studies for the existing Sportsmans Creek bridge identified that the bridge would be likely to provide habitat for the Estuary Rock Cod (*Epinephelus coioides*) which is listed as protected under the *Fisheries Management Act* 1994. Additionally Sportsmans Creek would provide habitat for a number of other fish species including the Australian Bass (*Macquaria novemaculeata*) which would be likely spawn within this estuary. The creek is a known breeding ground for crustaceans. Sportsmans Creek is also included as part of an area of mapped Key Fish Habitat within the Clarence Valley Council LGA.

5.6.5 Endangered populations

No endangered populations have been identified in the study area.

5.6.6 Wetlands

Four Important Wetlands listed in the NSW DIWA Spatial Database were indicated by the *Environment Protection Biodiversity Conservation Act* 1999 Protected Matters Search Tool as occurring within a 10 kilometre radius of the site. These are:

- Clarence River Estuary
- Everlasting Swamp
- The Broadwater
- Upper Coldstream.

Two of these wetlands occur in proximity to the study area namely, the Everlasting Swamp which occurs approximately 2 kilometres to the west of the study area and the Clarence River wetland which occurs within the Clarence River immediately to the east of the existing Sportsmans Creek bridge.

A review of aerial photographs indicates that a number of wetland areas occur in the western portion of the study area. These areas are considered most likely to be ephemeral wetlands occurring on the periphery of the Little Broadwater system of wetlands. Although not formally listed as wetlands, these areas are likely to have habitat value to locally occurring wetland bird species including some listed threatened and migratory wetland birds species. As mentioned these areas are likely to contain flora assemblages that are indicative of the listed Freshwater Wetland EEC. Further investigations of these areas will be undertaken during the field surveys.

5.6.7 Conclusion

A small number of potential ecological constraints were identified by the desktop assessments and are shown in figure 5.6. Upcoming detailed field investigations will verify these and any other potential constraints associated with the site.

A future impact assessment is to be prepared regarding the potential impacts of the demolition of the bridge upon the Large-footed Myotis (*Myotis macropus*) populations in the area. The demolition of the bridge would potentially require the re-location of the population and mitigation measures would need to be developed once the extent of the impact is known. Recommended mitigations to be investigated could include:

- Alternative roosting habitat on the new bridge
- Alternative roosting habitat on the river banks
- Consideration of the demolition methodology, staging and timing
- Monitoring of the species as part of a demolition bat management plan.

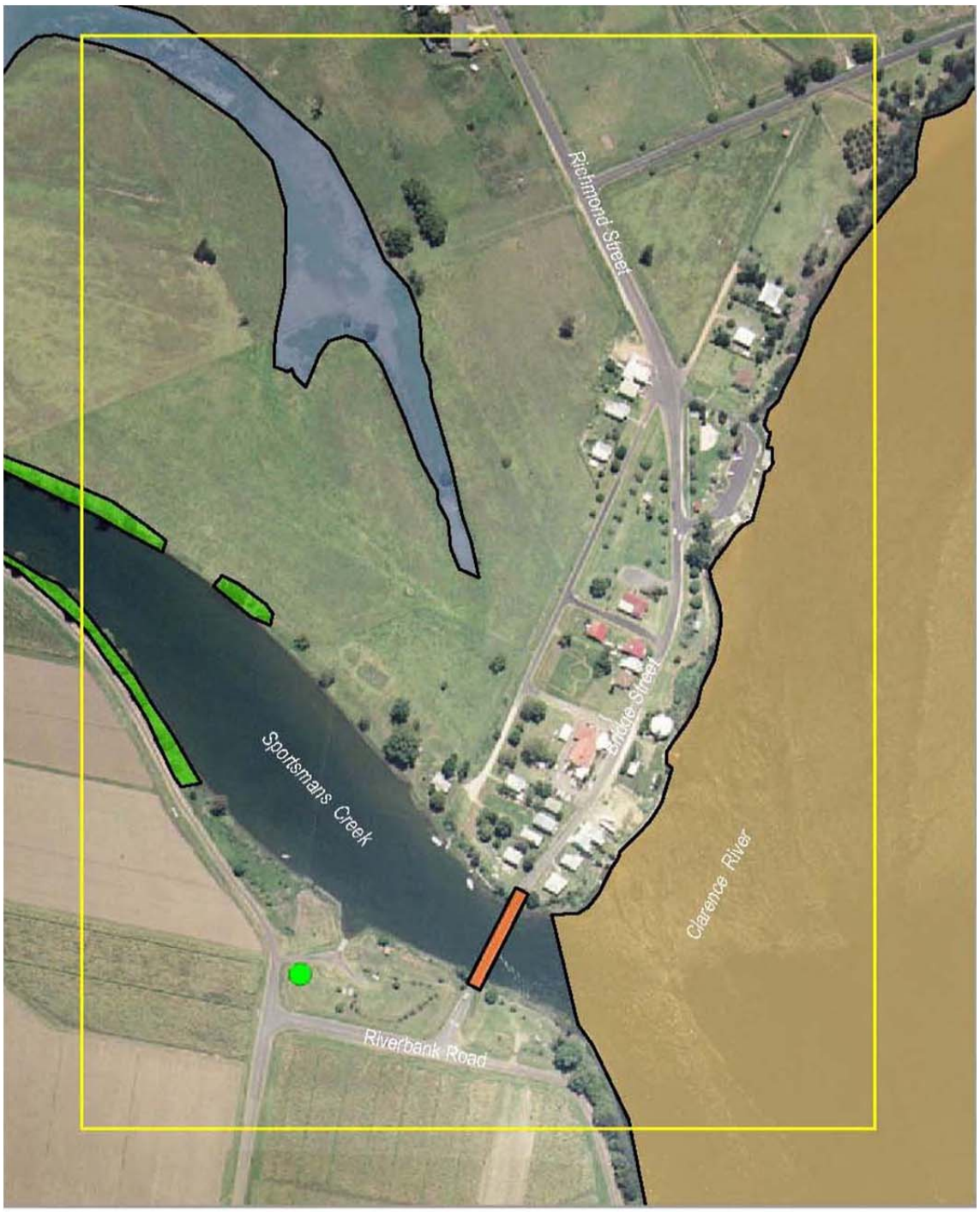

Figure 5.6 Potential ecological constraints associated with the study area

5.7 Flooding

5.7.1 Existing flooding conditions

The Lower Clarence River Flood Study Review shows that the study area is impacted by flooding. Figure 5.7 illustrates the extent of the February 2013 flood event and the subsequent remaining impact after one week.

Figure 5.7 Recent flood event photos (Source: Roads and Maritime)

Figures 5.8 and 5.9 are extracts from the Clarence River Flood Study Review and show the extent of flooding in the study area for a 5 year Average Recurrence Interval (ARI) and 100 year ARI flood event.

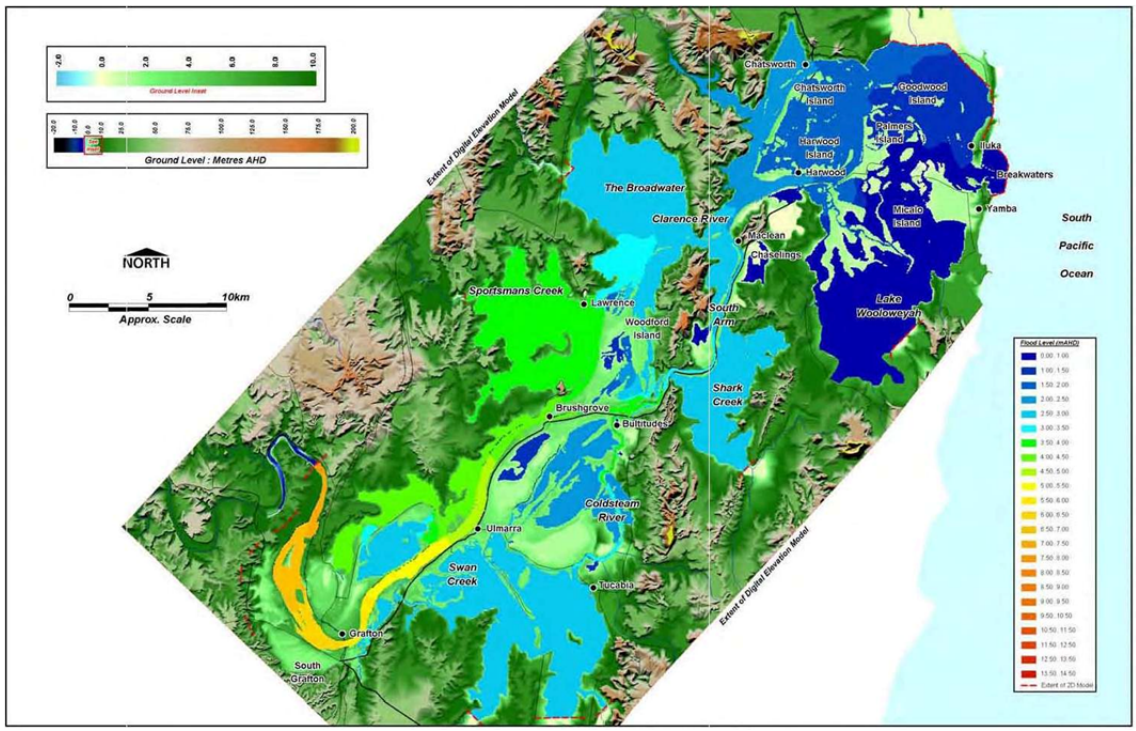

Figure 5.8 Five year ARI flood level (Source: WBM Oceanics)

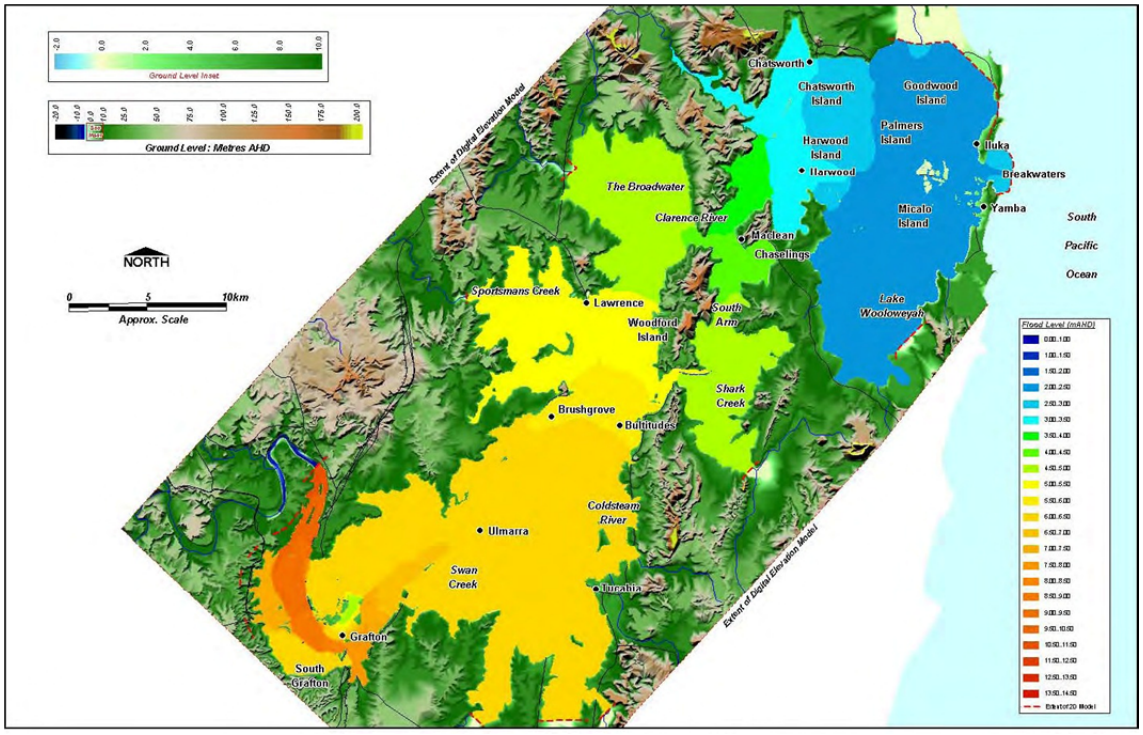

Figure 5.9 100 year ARI flood level (Source: WBM Oceanics)

Figures 5.10 and 5.11 show the flood velocities along Sportsmans Creek for the corresponding five year ARI and 100 year ARI flood events. It should be noted that due to the size of the model grid used to prepare this study, velocities greater than 0.5 metres per second may be experienced along the creek.

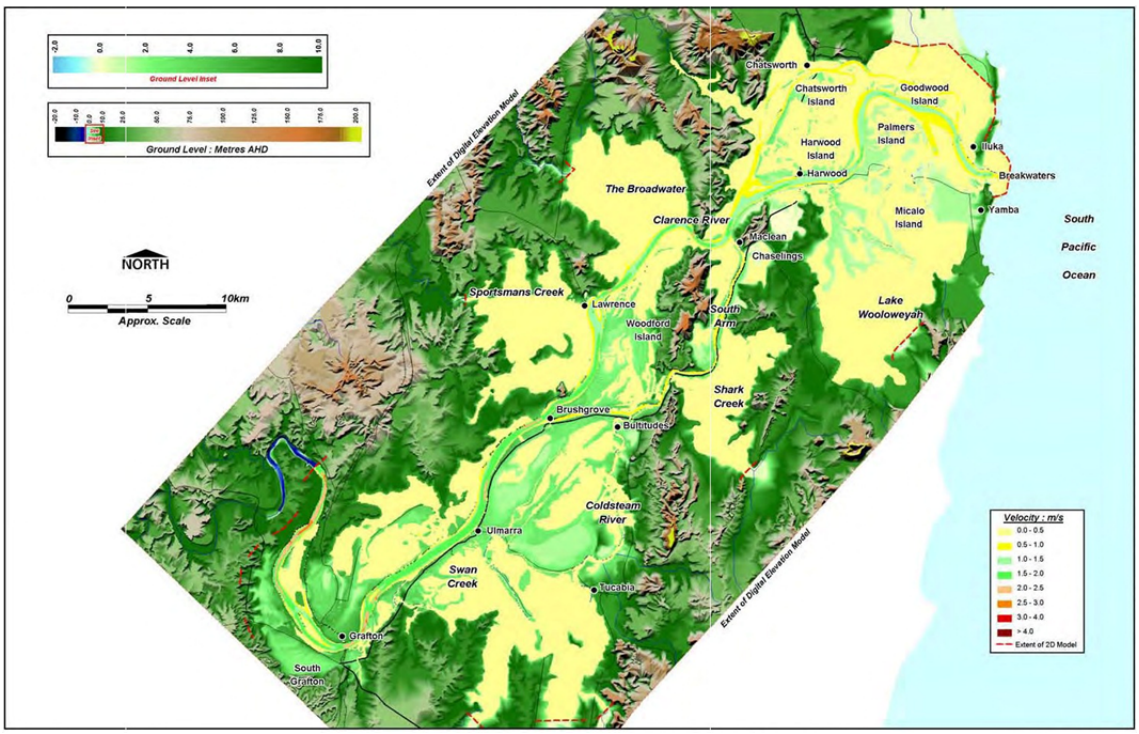

Figure 5.10 Five year ARI flow velocities (Source: WBM Oceanics)

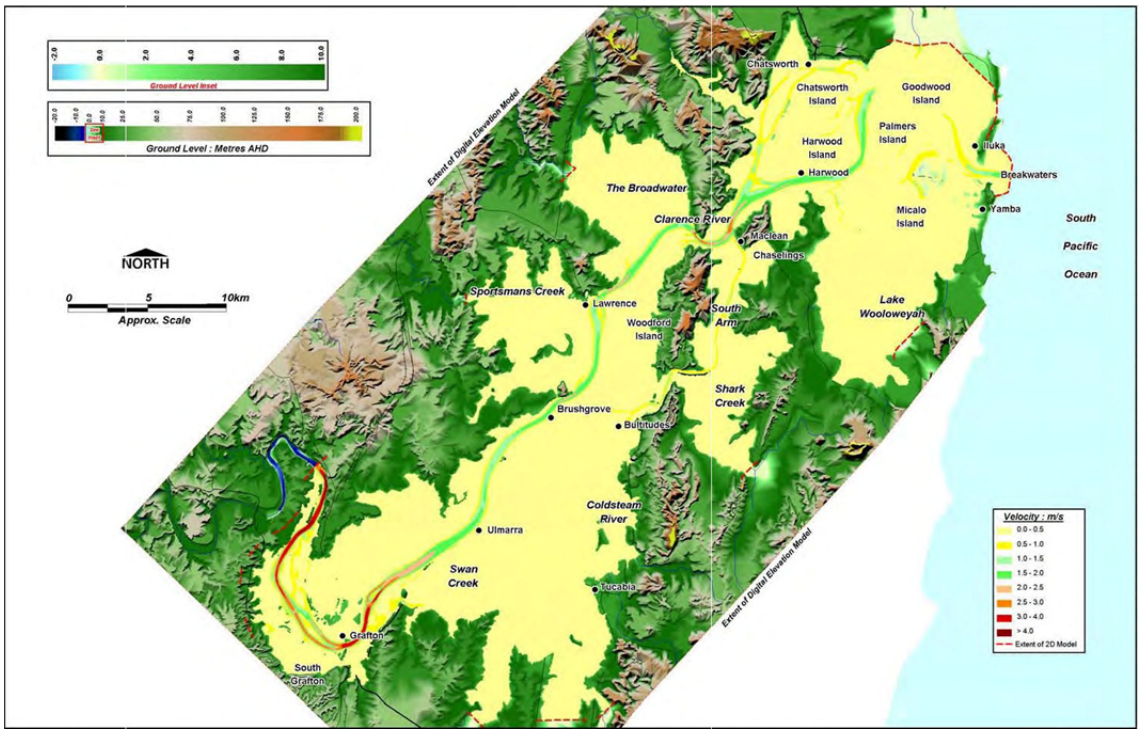

Figure 5.11 100 year ARI flow velocities (Source: WBM Oceanics)

5.7.2 Flooding constraints and impact assessment

Flooding is a significant consideration the Sportsmans Creek new bridge. In flooding terms, it is generally best to mimic the existing situation as this usually minimises additional impacts.

A design level of 4.39 metre minimum clearance above mean high water to the underside of the central span of the bridge has been adopted. This is the same navigable clearance as the existing Sportsmans Creek bridge. The existing 20 year ARI water level as a result of flooding in the Clarence River is 70 millimetres below the soffit of the design deck, with the existing 100 year ARI water level being 650 millimetres above the soffit of the deck. This will mean the deck may be subject to debris loading in a 100 year ARI flood event.

Following the value engineering workshop, a detailed flooding investigation was undertaken to quantify the flow velocities and afflux likely to be encountered by adopting the preferred option. The results of this investigation have been summarised in section 8.

5.8 Noise and vibration

A desktop review of the project area identified residential, commercial, and other noise and vibration sensitive receivers within the study area. The most potentially affected receivers are located in the southern part of Lawrence village along Bridge and Grafton Streets. Other receivers with the potential to be impacted are located along Richmond Street.

A detailed assessment of noise and vibration impacts of the changed traffic conditions during construction and operation has been undertaken following the value engineering workshop. The results of this assessment have been summarised in section 8.

5.9 Geotechnical constraints

This section summarises the results of the preliminary desktop investigations and assessment of geotechnical constraints in the vicinity of the study area.

Subsequent to the value engineering workshop, further geotechnical assessment and field verification was undertaken for the preferred option. The results of this assessment have been summarised in section 8.

The following key information was identified as part of the initial desktop investigation:

- Existing geotechnical information is limited within the study to alignments nearest to Grafton Street. Shallow ground conditions within the study area are likely to comprise alluvial deposits of gravel, sand, silt and clay. The depth to bedrock ranges from 4 metres to 34 metres
- Sportsmans Creek presents several geotechnical constraints, including the potential for settlement of compressible soils if loaded, the depth to bedrock and competent strata within the creek, and the potential impact on flooding from development within the creek and surrounds.
- An absence of underground mining within the study area has been confirmed by the regulator. There is no mining in close proximity to the study area
- Potential for contaminated soils in the study area exist from agricultural residues, underground storage tanks at the general store, fill in existing bridge abutments, previous demolition of structures, and historical industrial sites
- The results of a previous shallow investigation and review of the acid sulphate soils (ASS) maps indicated that the study area has a risk of ASS, showing as Class 1, 2 and 3 on the ASS risk map. There is also potential that soils at depth would likely be aggressive towards buried steel and/or concrete structures
- Geotechnical considerations are generally consistent across the study area.

5.10 Engineering constraints

This section summarises the critical design requirements and constraints that have been considered in developing the options for the Sportsmans Creek new bridge. The designs comply with the following:

- *Austroads Guide to Road Design* (2009)
- *Roads and Maritime Supplements to Austroads Guides* (2009)
- *New South Wales Development Design Specification D1, AUS-SPEC Geometric Road Design, Urban and Rural* (January 2006) as applying to Clarence Valley Council local government area.

5.10.1 Design requirements

Table 5.4 below provides a summary of the key design criteria used in developing the preferred option.

Table 5.4 Key road design criteria

Design Criteria	Design Requirement
Horizontal Alignment - Design Speed	50 kilometres /hour
Vertical Alignment – Design Speed	50 kilometres /hour
Crest 'K' Parameter	5.2
Sag 'K' Parameter	4
Lane width	3.5 metres
Shoulder width	1.0 metre minimum
Maximum Vertical Grade	5 %

Further design work, including superelevation design, safety barrier design, earthworks, retaining walls, sight distance checks, pavement widening and aquaplaning checks will be considered during the next stage of the project.

Figure 5.12 illustrates the typical bridge cross section, based on Roads and Maritime and Clarence Valley Council design criteria for this project.

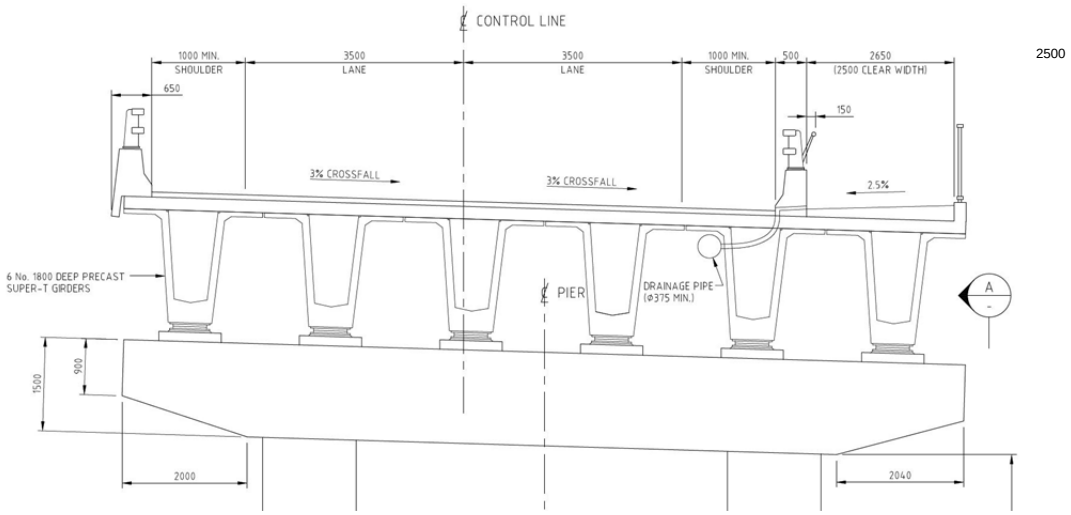

Figure 5.12 Typical bridge cross section

5.10.2 Utilities

Existing utilities and services in the vicinity of the study area were identified from the 'Dial Before You Dig' search across the study area. Table 5.5 below summarises the results of the preliminary utilities investigation works to date.

Table 5.5 Existing utilities within the study area

Utilities	Description
Water main	Water mains run along Bridge Street and Grafton Street. The water supply also crosses Sportsmans Creek to the west of the existing bridge from Riverbank Road to Grafton Street. The location of the water main is clear of the preferred option alignment.
Sewer	Sewer rising mains are present along Bridge Street and Grafton Street.
Telecommunications	Telstra cables, electrical poles and underground earth wires were identified in the vicinity of the study area. Due to the relatively simple relocation works involved, it is a minor constraint.
Electrical	Overhead power lines for both 11 kV and 66 kV were identified along the existing roads. An existing 66 kV power pole located at the proposed southern bridge approach embankment will require relocation. Existing 11kV poles (2 off) located on the western side of Grafton Street will require relocation.
Stormwater	Stormwater pipes and pits along local streets were identified in the study area. Due to the relatively small sizes of the pipes, and the fact that road improvements will require upgrades to the stormwater network as part of the works, this is a very minor constraint.

Figure 5.13 shows the existing sewer (green) and water (blue) utilities within the study area.

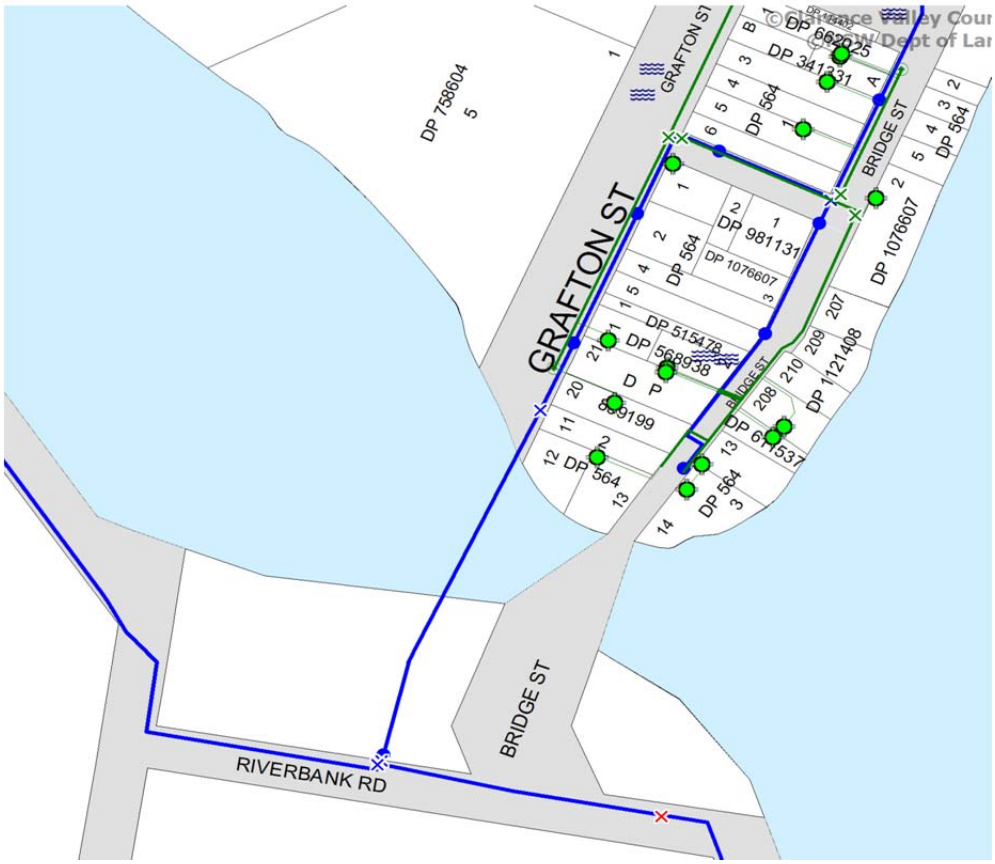

Figure 5.13 Existing sewer and water utilities in the study area

Figure 5.14 shows the existing power (green) utilities within the study area.

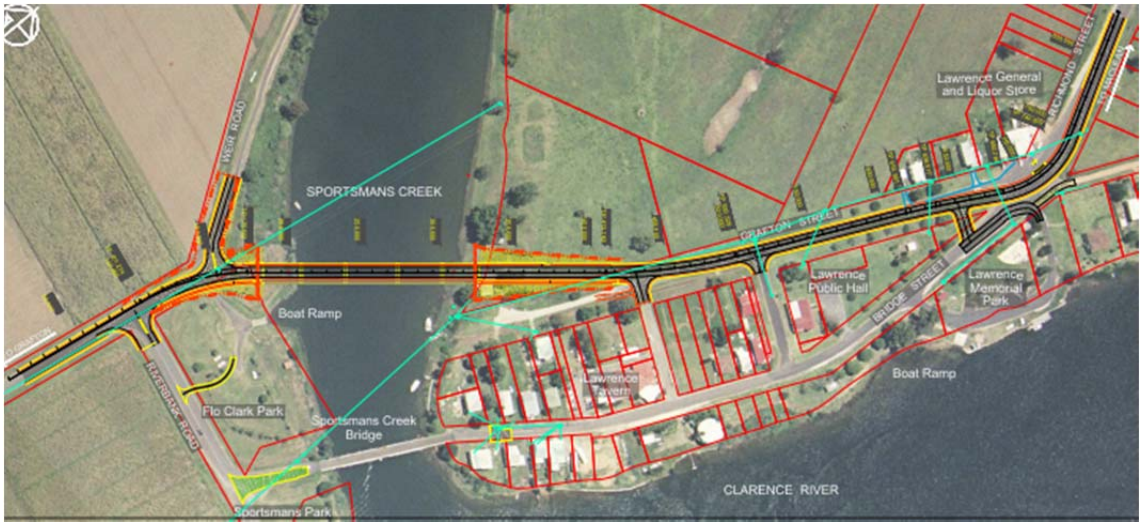

Figure 5.14 Existing power utilities in the study area shown in green

6 Options assessment

This section outlines the process used to develop and assess the concept options and presents the findings of this assessment.

The aim of the assessment process is to identify a preferred concept option for further value engineering and public consultation.

6.1 Assessment methodology

The process of assessing and recommending a preferred concept option was based on the principles of a Multi Criteria Analysis (MCA). This allows preferences to be objectively established between options using criteria relevant to the needs of the project and ensuring transparency.

An overview of the process is presented in the figure 6.1.

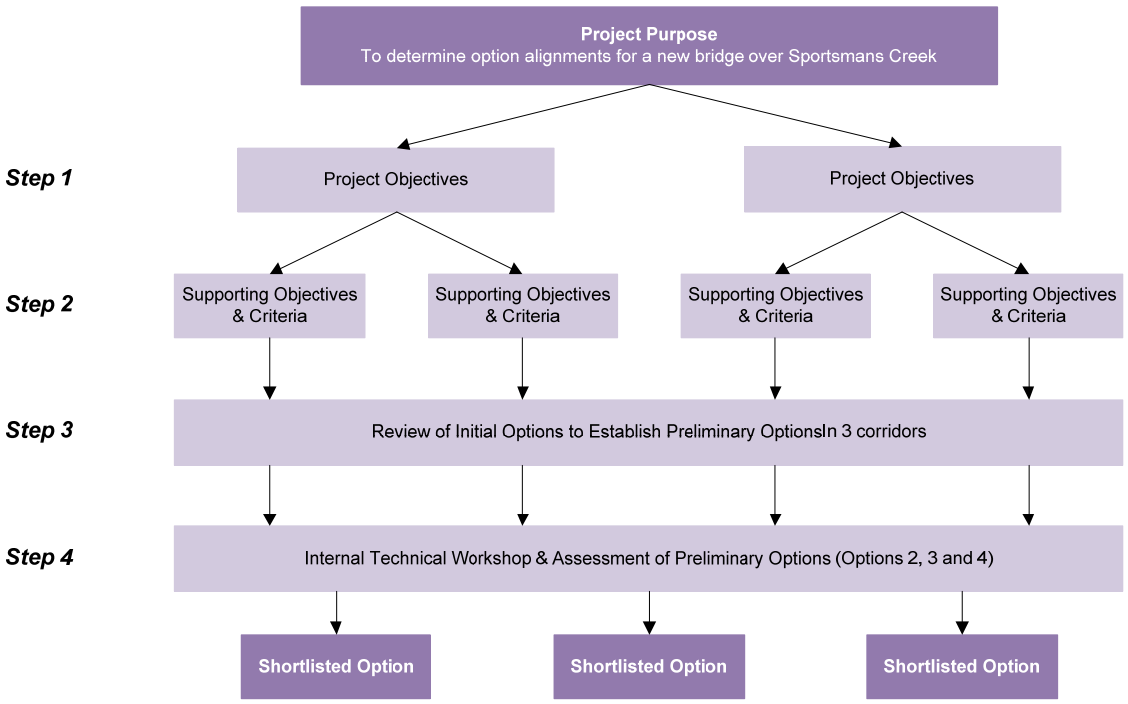

Figure 6.1 Assessment methodology

6.2 Previous stage works

The project objectives that form the basis for the MCA assessment are outlined below:

- Improve road safety
- Improve local traffic efficiency / transport productivity and reliability
- Minimise the impact on the natural, cultural and built environment
- Provide value for money.

These objectives, together with the supporting objectives described in figure 6.2, provided the general framework with which the preliminary options were reviewed and assessed.

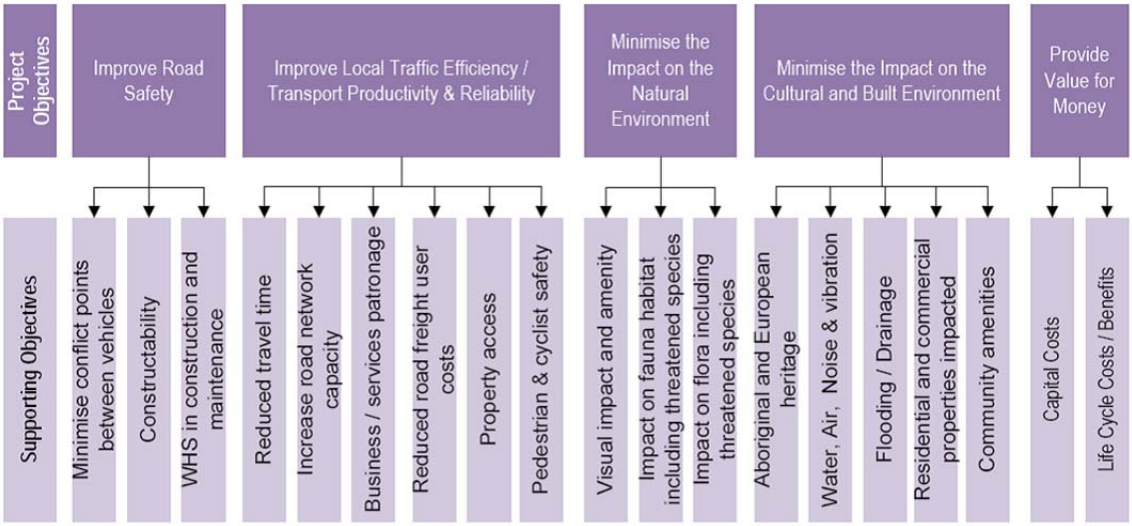

Figure 6.2 Project and supporting objectives

6.3 Development and review of initial options

The assessment of initial options for the Sportsmans Creek new bridge and the process for shortlisting these options is described in the following sections.

6.3.1 Initial option identification

An initial workshop and site visit was undertaken in Lawrence on 25 and 26 June 2013 as part of the project familiarisation and was attended by members of the project team. This workshop provided the team with an opportunity to identify a variety of options without consideration of constraints. The exercise identified a significant number of diverse options which were then categorised into three corridors.

The options generally fell into three corridors as follows:

Table 6.1 Corridor description

Corridor	Corridor Description
Western	This corridor consists of a new bridge to the west of Grafton Street.
Grafton Street	This corridor consists of a new bridge in the vicinity of Grafton Street.
Bridge Street	This corridor consists of a new bridge in the vicinity of existing Bridge Street location.

The workshop then examined the three corridors to identify issues associated with each corridor. As a result of the considerations of this workshop, six options were designed and alignments developed for each. These preliminary options are illustrated in figure 6.3.

Figure 6.3 Preliminary alignment options

The six preliminary options were categorised into the following corridors within the study area:

- Western corridor – Option 1
- Grafton Street corridor – Options 2, 3 and 4
- Bridge Street corridor – Options 5 and 6.

Key features of each option are summarised in table 6.2.

Table 6.2 Description of each initial option

Option	Description
Option 1	This option has a new bridge crossing to the west of Grafton Street and connects to the intersection of Richmond and Rutland Street. New intersections and local realignment of Weir Road and Riverbank Road would be required. Alternative access to the Boat Ramp would be required from Riverbank Road.
Option 2	This option has the same horizontal alignment starting point as option 1 with a different alignment crossing the creek to connect into the existing Grafton Street. New intersections and local realignment of Weir Road, Riverbank Road and Bridge Street would be required. Alternative access to the Boat Ramp would be required from Riverbank Road. Local adjustments for property accesses would be required along Grafton Street.
Option 3	This option has the same southern alignment as option 2. The alignment then diverges to the west of the Lawrence General and Liquor Store and connects to the intersection of Richmond and Rutland Street. New intersections and local realignment of Weir Road, Riverbank Road and Bridge Street would be required. Alternative access to the Boat Ramp would be required from Riverbank Road. Local adjustments for property accesses would be required along Grafton Street.
Option 4	This option follows the existing Grafton Street alignment with an intersection connecting to Riverbank Road and Bridge Street. New intersections on Riverbank Road and Bridge Street would be required. Local adjustments for property accesses would be required along Grafton Street. Acquisition of cane land on the southern approach is required.
Option 5	This option follows the existing Bridge Street alignment with the new bridge to the west of the existing structure. A new intersection with the Riverbank Road would be required. Local adjustments to properties and property accesses would be required along Bridge Street. Acquisition of cane land on the southern approach is required.
Option 6	This option follows the existing Bridge Street alignment with the new bridge in the same location of the existing structure. A temporary crossing structure or long term closure would be required to facilitate construction.

6.4 Internal technical workshop and preliminary option assessment

6.4.1 Workshop aims

An Internal Technical Workshop was held on 1 August, 2013 to assess the six preliminary options using the adopted MCA criteria. The objective of this workshop was to confirm and agree on a shortlist of options to take forward to the next stage of the project. The workshop was attended by 21 representatives including the project team and Roads and Maritime stakeholders.

6.4.2 Workshop process

The process to assess the preliminary options involved:

- A brief discussion on the background and work undertaken to date
- A series of discussions and presentations by KBR and specialist sub-consultants to identify and describe key constraints
- Dividing workshop participants into four groups (5 to 6 people) to develop and agree ratings ranking of option, with reference to the objectives
- Predetermining composition of the groups prior to the workshop to ensure a balance between client and project team representatives and multi-discipline expertise
- Scoring sheets and guide notes used to highlight issues and provide prompts under the four higher level objectives
- Illustrating the six preliminary options with ‘Pros & Cons’ sheets to allow participants to record their opinions of positive and negative aspects of the options.
- Ratings for each option were recorded and agreed within the groups under the four higher level objectives.
- The rating sheets were discussed within the groups and reviewed by all participants, to agree an overall rating.

6.4.3 General assessment results

The general assessment of each option was summarised in the pros and cons sheets provided underneath each of the option displays. Table 6.3 below summarises the workshop assessment of each option.

Table 6.3 Key assessment results for the six initial options

Option	Pros	Cons
Option 1	Improved traffic efficiency – best option Road Safety Improves access to boat ramp, sail boats Enhances integrity of village Best for noise overall Least impact on: Non Indigenous Heritage Homes/Property Enables Flo Clark Park to be consolidated Retains connectivity with Weir Road and Riverbank Road	Longest embankment/flood land crossing Longest bridge Longest road work High cost – may be prohibitive Impacts ephemeral wetlands; Landscape/Visual Removes passing trade from existing businesses Flood Impact – increased afflux may affect homes Difficult soils/settlement Longer travel distance to village for bus and cyclists and pedestrian integration New noise receivers on Lawrence Hill Highest impact to ecology Loose passing access to parks and toilets Land acquisitions high Speed risk due to horizontal alignment
Option 2	Shorter bridge Squared off alignment Minimises impact on ephemeral wetlands Retains heritage conservation area of village Uses existing infrastructure Avoids heritage conservation area Reinforces original town plan Better soils than option 1 Connectivity to store and town maintained Provides opportunity for a direct future link to Rutland Street via option 3 alignment Retains main vistas Allows Bridge Street to be improved Good pedestrian and cycle connectivity Allows good access to Grafton Street homes near bridge Decrease noise on Bridge Street Less environmental impacts than option 1 Improves access to boat ramp – sail boats Enables Flo Clark Park/Sportsmans Park to be consolidated Improves access to allotments in Grafton Street adjoining Sportsmans Creek Uses existing road infrastructure Weir Road/	New noise receivers on Grafton Street (due to new traffic on Grafton Street) Unclear road hierarchy at northern end Impact on properties - acquisition Limited access during construction (Grafton Street) Encroaches on heritage conservation area - minor Potential to direct headlights into homes (north bound)

Option	Pros	Cons
	Riverbank Road Provides improved view of Flo Clark Park and Clarence River from southern approach Maximum business exposure to passing trade Opportunity to rejuvenate area in vicinity of Lawrence General and Liquor Store	
Option 3	Tavern access is maintained (in options 2-6) Least encroachment into heritage conservation area Second best for transport Could be parallel with an additional Grafton Street laneway for local access Good connectivity to Rutland Street Shorter bridge Squared off alignment for bridge Retains heritage conservation area Avoids conservation area Allows Bridge Street to be improved Allows good access to Grafton Street homes near bridge Decreases noise on Bridge Street Less environmental impacts than option 1 Improves access to boat ramp – sailing Enables Flo Clark Park/Sportsmans Park to be consolidated Improves access to allotments in Grafton Street adjoining Sportsmans Creek Uses existing road infrastructure Weir Road / Riverbank Road Provides improved view of Flo Clark Park and Clarence River from southern approach	Decrease in passing trade to Lawrence General and Liquor Store Impact on wetlands/ecology Additional acquisitions required Big footprint Increased construction costs/low use of existing roads Pedestrian/cyclists poor connectivity (not the worst) Foreign to town grid layout Segmentation of rural land No opportunity to improve Lawrence General and Liquor Store / Park access for pedestrian movements Construction of new road across wetland areas will increase Afflux, impacting homes and Lawrence General and Liquor Store
Option 4	Natural landscape impacts Heritage constraints Flo Clark Park constraints Good Pedestrian/Cycle connectivity (Options 1-4) Compatible with town development including access to riverfront Maximum business exposure to passing trade Provides opportunity for a direct future link to Rutland Street via option 3 alignment Slows north traffic to town if existing approach road alignments maintained Fits heritage grid form	Constructability issues – constrained site Cuts off boat ramp to sail boats Segments Flo Clark Park Isolates one house to the west Car park for boat ramp reduced – serviceability Increased property acquisition of prime cane land on southern approach Adversely effects access to Grafton Street properties adjoining Sportsmans Creek Southern approach road levels may require the raising of Riverbank Road Weir Road intersection to be re-configured

Option	Pros	Cons
	Shorter bridge length Opportunity to rejuvenate area in vicinity of Lawrence General and Liquor Store Headlights parallel to village (not in windows) Least disturbance to acid sulphate soils	
Option 5	Builds alongside existing alignment Decrease length of works required Existing situation maintained with respect to noise for residents (noise receivers) along Bridge Street User friendly for pedestrian/cyclists	Continues to take heavy traffic through town Higher bridge – prevents access to one home from road Insufficient road width – will require road widening High safety risk Continues to dissect Flo Clark Park and Bridge Street residents from river foreshore Maximum construction/noise/vibration and operational noise due to traffic Does not meet safety objectives efficiently Prohibitive heritage impacts Major (unacceptable) land acquisitions Major (unacceptable) property purchases and social disruption
Option 6	Maintains existing conditions Shortest route Existing situation maintained with respect to noise for residents (noise receivers) along Bridge Street User friendly for pedestrians / cyclists	Severe construction issues Heavy traffic through village Higher bridge – prevents access to one home from road Highest safety risk Insufficient road reserve width to accommodate proposed bridge approach width on northern side Dissects Flo Clark park Doesn't meet safety objectives Prohibitive heritage impacts Major (unacceptable) land acquisitions Major (unacceptable) property purchases and social disruption Alternative crossing required. Temporary bridge and ferry Major social disruption if temporary ferry used to maintain access to Grafton during construction – unacceptable to community

Following the assessment process, each option was scored and subsequently ranked to identify the best performed options to be carried forward for further assessment. These results are summarised in table 6.4.

Table 6.4 Assessment rankings for initial options

Groups	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Group 1	13	17	15	15	6	5
Group 2	12	20	15	16	8	4
Group 3	12	15	13	18	11	9
Group 4	15	18	17	20	5	4
Total Score	52	70	60	69	30	22
Overall Rank	**4**	**1**	**3**	**2**		

Based on the assessment rankings above, the workshop agreed on the following shortlist of options:

- First preference Option 2 (Grafton Street corridor)
- Second preference Option 4 (Grafton Street corridor)
- Third preference Option 3 (Grafton Street corridor).

Option 1 (west of Grafton Street) was excluded on the basis of anticipated high project costs predicted to be beyond the financial scope of the project.

6.4.4 Strategic cost estimates of options

Following the internal technical workshop, strategic cost estimates were undertaken on each of the shortlisted option as well as option 1, to confirm the excessive project costs that were assumed to be likely during the workshop.

The estimates were based on details appropriate to this early stage of design. Contingency has been based on the applicable range for strategic level estimate from the Roads and Maritime guidelines. The value of this is 40 per cent on the base estimate (infrastructure only), and 40 per cent on all other delivery costs.

A large number of assumptions have been made and appropriate contingencies reflecting the level of detail of the design.

Table 6.5 provides a summary of the strategic costs associated with each shortlisted option.

Table 6.5 Strategic cost estimates for shortlisted options

Item	Option 1	Option 2	Option 3	Option 4
Project Development	$0.33 M	$0.28 M	$0.28 M	$0.28 M
Detail Design / Documentation	$0.51 M	$0.43 M	$0.44 M	$0.44 M
Property Acquisitions	$0.67 M	$0.22 M	$0.44 M	$0.22 M
Utility Adjustments	$0.22 M	$0.28 M	$0.22 M	$0.28 M
Infrastructure	$12.39 M	$10.45 M	$10.74 M	$10.69 M
Finalisation	$0.34 M	$0.26 M	$0.26 M	$0.26 M
Preliminary Total	$14.45 M	$11.92 M	$12.39 M	$12.18 M
Total Including Contingency	$20.23 M	$16.69 M	$17.35 M	$17.05 M

Refinement of the strategic estimates will be undertaken as the design progresses. It should be noted that the following key areas will have the largest impact on estimates:

- Length of the bridge structure
- Height of the road approach embankments: minimising these works will aid in reducing costs due to soft soils
- Local roads interfaces: minimising the amount of permanent and temporary works on and near local roads
- Utility adjustments: finalising the impact for temporary and permanent utility locations will aid in confirming costs and thus reducing risk
- Confirmation of survey and geotechnical conditions: will aid in confirming the requirements for the bridge
- For the purpose of this cost estimate a ‘Super T’ construction methodology is adopted (Super T girders enable spans of 30 metres to be achieved) They are a cost effective element for bridge construction.

The strategic estimate for option 1 (west of Grafton Street) is $20.0M which is substantially higher than the shortlisted options, and is outside the project financial scope. This confirmed the workshop recommendation to exclude option 1.

6.4.5 Shortlisted options

Based on the adopted assessment methodology and criteria, it was determined that options 2, 3 and 4 provide the solutions that best deliver the project objectives.

Table 6.6 summarises the rankings of these three shortlisted options according to the scores achieved in the technical workshop.

Table 6.6 Summary assessment for shortlisted options

Description	Option 2	Option 3	Option 4
Ranking of each shortlisted option	1	3	2
Estimated Cost ($M)	$16.69M	$17.35M	$17.05M

The three shortlisted options are illustrated in figure 6.4.

Figure 6.4 Three shortlisted options

6.5 Recommended option

Following the Internal Technical Workshop, the shortlisted options were reviewed by Roads and Maritime in conjunction with Transport for NSW.

This review concluded that option 2 was the recommended option to be taken forward for community display and comment as it provided key benefits in comparison to options 3 and 4. Table 6.7 provides a summary of the key benefits of option 2. This is further detailed in the *Recommended Option Report* (November 2013) which is available on the project website.

Table 6.7 Summary of key benefits for option 2

Recommended Option – Key Benefits
Description - Option 2 - Grafton Street
The recommended option is to build a new bridge west of the existing Sportsmans Creek bridge and boat ramp. This new bridge will connect the Grafton - Lawrence Road with Grafton Street and re-join Bridge Street at of the Lawrence General and Liquor Store.
Benefits
Makes use of existing roads and minimises development on greenfield sites
Maintains passing trade for local businesses
Connects Flo Clark Park and Sportsmans Park
Avoids disruption to the boat ramp and allows new access for sail boats
Delivers value for money
Minimises impact on natural wetlands
Reinforces original town plan
Reduces fragmentation of the Heritage Conservation Area of Lawrence.

Option 2 was deemed superior to options 3 and 4 for the following reasons:

Option 3 - Grafton Street west

- Excessive land acquisition at northern approach – The northern approach crosses agricultural farmland to the west of the Lawrence General and Liquor Store and adjoining residences. The land acquisition is extensive
- Potential flooding impacts on residences and Lawrence General and Liquor Store in Grafton Street – during the recent (February 2013) flood event, floodwater from the Clarence River flowed across Rutland Street to Sportsmans Creek, damaging the road pavement. Option 3 has the potential to impede water flows across this area which may result in increased local flood heights impacting the Store and adjacent residences
- Bypass Lawrence General and Liquor Store – The Lawrence General and Liquor Store has significant passing trade business. This option would redirect passing trade away from the store
- Potential environmental effects – Potential Archaeological Deposit (PAD) in undeveloped land - Due to the undeveloped land on the northern approach, there is a possibility that a PAD could be found as a result of further site investigations. Whilst this could be managed, this risk is unique to this option
- Reconfiguration of the Richmond/Rutland Street intersection – Crossroad intersections are to be avoided due to traffic safety aspects. The intersections with Richmond Street may need to be offset, resulting in higher cost, land acquisition, etc.

Option 4 - Grafton Street - southern alignment

- Extensive land acquisition at southern approach – The land acquisition on the southern approach is extensive and involves prime agricultural land. Productive cane land will attract a premium land value
- Dissection of Flo Clark Park – the alignment of this option will dissect the existing park, alienating the boat ramp from the remainder of the park
- Impedes access to boat ramp for sail boats – With the alignment being on the downstream side of the existing boat ramp, maritime access will be limited due to the clearance under the structure
- Local access to land in Grafton Street adjacent to Sportsmans Creek is restricted – There are properties on the eastern side of Grafton Street adjoining Sportsmans Creek. The bridge approaches for this option will impact access.

7 Constructability and value engineering

Following the community display and the feedback of the Recommended Option, the project team undertook a series of workshops to refine the design and to confirm the extent of likely impacts. The outcomes of these workshops are summarised in sections 7.1 and 7.2 below.

7.1 Project constructability and safety workshop

A constructability assessment and safety workshop was conducted on 26 November 2013 and was attended by representatives of Roads and Maritime and the project team.

The purpose of the workshop was to identify construction and design issues to ensure efficient construction and maintenance, in order to meet project lifecycle objectives for cost, time, quality, WHS and environmental management.

7.1.1 Key constructability risks

As part of the workshop, constructability issues were identified and discussed, together with their consequential impacts and potential mitigation measures.

Each issue was allocated a ranking to allow identification of high risk items. These high risk items have been summarised in table 7.1.

Table 7.1 High risk constructability issues

Issue	Affect	Mitigation Measure / Action
Proximity to 66 kV Power Pole for both horizontal and vertical clearances	Risk of delays during co-ordination with Authorities for any potential protection works (Essential Energy). Clearance restrictions may impact construction techniques including cranage (spotters will likely be required). Shutdowns may be considered (the line has been duplicated).	Staging of construction works to be developed taking into account the location of the existing pole. Work, Health, Safety (WHS) clearances required while working in and around the services. This needs to be considered in the staging. Understand Essential Energy Safety in Design Requirements and the Roads and Maritime tip sheet for working around power and utilities. Consider cranage in design of bridge.
Access for delivery of equipment and girders to site.	Maybe restricted access for delivery and placement of large precast girders.	Construction methodology to consider placement of girders possibly using launching beam.
Transport logistics for delivery of equipment and girder to site.	Restricted transport links. Possibly restricted barge size due to the existing bridge. Grafton has a number of roundabouts which may impact logistic routes.	Logistic plan to be developed by the contractor.
Working over water	WHS and environmental issues.	Environmental management plan and safe work method statement to be developed. Limit the activities through design (e.g. no pile caps, headstocks only).
Existing services.	Delays to works due to relocation of existing services.	Identification with survey and potholing to confirm services to be relocated.

Issue	Affect	Mitigation Measure / Action
Bridge demolition works	WHS issues and environmental issues. Removal of piers may require divers and significant effort to demolish.	Demolition plan and risk assessment to be developed.
Crane lifts, restricted access.	Conflicts with existing services and issues with crane platforms on poor ground.	Consider the use of launching beams.
Maritime traffic beneath the existing bridge and new bridge.	Conflicts during construction and demolition	Consider closing the boat ramp during construction.
Divers	May be required during demolition of the existing bridge.	Safe work method statements.
Bats potentially impacted during construction.	Delays due to breeding season (October to April).	Construction program to consider this for demolition of the existing bridge. May also need to consider high noise or vibration activities for the new bridge.

7.1.2 Bridge construction and cranes

During the workshop it was identified that installation of the bridge girders has high ranking constructability constraints. For constructability reasons, the desire to minimise construction in the waterway indicates that the bridge concept should be developed with the minimum number of spans and supports.

Use of precast, prestressed concrete girders would typically limit span lengths to around 35 metre for a road bridge. However, 35 metres long, concrete girders can weigh in excess of 75 tonnes which requires a very large mobile crane to lift and place.

Given the site constraints, that include both unstable river banks, soft soils and a downstream bridge with limited vertical clearance, the opportunity to perform heavy lifts from either the river bank or water may be compromised. An alternative method for placing the concrete girders on a span-by-span basis is to use a launching beam to deliver the beams into place on each support. The use of a launching beam involves additional pre-construction work, and a potentially longer construction schedule due to the span by span construction necessary (including casting of the deck). However, it has the advantage of significantly reducing the reach at which cranes are required to operate and therefore means that smaller cranes can be used to place the beams.

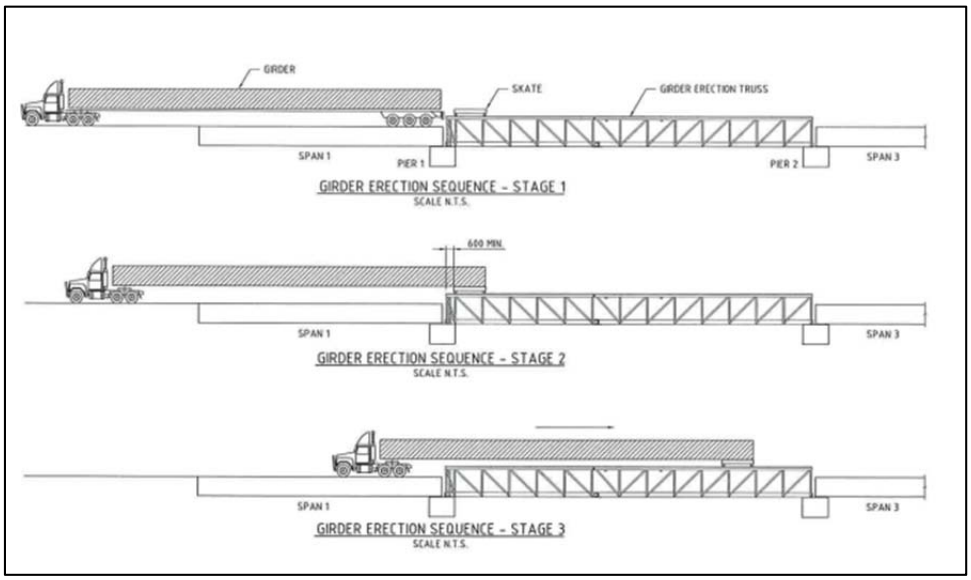

Figure 7.1 Potential girder erection sequence (source KBR)

Further constraints exist in the transport of precast girders to the bridge construction site. Further investigation into the feasibility of transporting 35 metres long precast girders, using either the existing ferry or a construction barge will be undertaken prior to this construction methodology being adopted. Refer to section 8 for further consideration of these issues.

7.1.3 Potential safety considerations

As part of the workshop, safety issues were also identified and recorded for further consideration during the development of the strategic concept design.

Table 7.2 provides a summary of the identified safety considerations.

Table 7.2 Identified safety considerations

Hazard	Mitigation Measure
Traffic and pedestrian movements.	Traffic management plan to be developed by the contractor.
Construction footprint - room for plant, cranes and equipment to safely operate.	Design and construction methodology to consider available space.
Utilities overhead power, underground etc.	Identify location of all services and maintain clearance to infrastructure. Use spotters and minimise cranage by using smaller beams / components for the bridge design.
People working on foot around plant.	Traffic management plan. Segregation of vehicles and pedestrians / site staff.
Working at heights and over water (construction of bridge).	Provide details Safe Work Method Statements and minimise working at height/over water (e.g. no pile caps, headstocks only).
Drivers and human nature - how will the road operate, even if the drivers are breaking the law (southern approach to the bridge is a well known local speeding track)	Implement traffic measures to reduce speed.

7.2 Value engineering workshop

7.2.1 Process

As part of the development of the preferred option, a value engineering workshop was held on 11 February 2014.

The workshop was attended by representatives of the project team, Roads and Maritime and other key stakeholders including Transport for NSW and Clarence Valley Council.

It provided an opportunity for stakeholders and the project team to fully assess proposed directions with the aim of ensuring the strategy taken forward delivers the best overall value and meets community expectations.

The value engineering workshop followed a structured process that sought to enhance value by eliminating unnecessary costs while maintaining function for the preferred option.

7.2.2 Workshop objectives and methodology

The objectives presented to the participants were to:

- Consider value improvement ideas implemented to date.

Generate ideas for specific cost and time savings.

Maintain the required levels of quality and performance (function).

The workshop methodology involved five distinct phases which aimed to add value to the process by achieving the following outcomes:

1 Background: confirmation and agreement of workshop and project objectives.
2 Information gathering. This consisted of project overview, status, community feedback, as well as outlining the functional and performance brief and value engineering initiatives considered to date
3 Ideas generation: these were generated under the following project elements, suggested by the project team prior to the workshop:
    - Bridge - elevation, spans, substructure
    - Road levels, alignment, intersections and landscape treatments (Flo Clark Park, Lawrence General and Liquor Store, Bridge St treatments, boat ramp access)
    - Geotechnical – embankment settlement
    - Project delivery - construction packaging and boundaries
    - Traffic calming – south village entry
    - Pavement design
    - Demolition – safe delivery methodology, sequence and timing
4 Ideas evaluation: the participants evaluated how well the alternatives and ideas meet the required functions and the extent of cost savings
5 Decisions confirmation and action plan agreement: a sanity check was done on the generated ideas and the action plan agreed for further work by the project team.

The process allowed participants to clarify objectives, to express concerns and to make suggestions regarding the optimum solutions. The items identified were classified as ideas to be adopted, rejected or requiring investigation.

The participants agreed at the completion that the workshop provided a successful decision making process leading to an agreed action plan.

7.2.3 Workshop outcomes and action plan

Table 7.3 below provides a summary of the ideas that were considered practical and worthwhile to action in developing the preferred option for the project.

Table 7.3 Action plan for further post value engineering workshop investigation

Action	Responsibility
Investigate bridge options regarding no. of spans, maximum span length, issues associated with submerging Super Ts (1:50 event), bridge width subject to confirmation of shoulder width and number of traffic barriers.	KBR
Investigate options for reducing the number of piles from three to two or potentially using a pile cap.	KBR
Remove connection to Grafton Street north from the main carriageway – the road will connect to the boat ramp road.	KBR
Organise for additional Geotechnical Investigation suitable for detailed design.	KBR
Provide additional advice regarding reducing the shoulder width on the bridge	Roads and Maritime
Provide advice on council's preference for access and parking to Flo Clark Park.	Clarence Valley Council
Provide advice on councils typical approach to bridge barriers and separation of pedestrians and vehicles	Clarence Valley Council
Provide advice on whether a concrete deck is acceptable to council (discuss with council bridge engineers)	Clarence Valley Council

These actions were addressed as part of the design refinement process outlined in section 8 of this report.

8 Post Value Engineering design refinement

Following the value engineering workshop, the project team further developed the design of the preferred option in an attempt to resolve issues that remained for the project. This work included:

- Field ecological survey and microbat investigation
- Flood modelling investigation
- Noise and vibration modelling and assessment
- Field geotechnical investigations
- Concept design road safety audit
- Further development of the strategic concept design to incorporate actions from the value engineering workshop.

The results of this additional work have been summarised in the following sections.

8.1 Ecological investigation

In addition to the initial desktop assessment, a targeted field assessment was undertaken for the Large-footed Myotis (*Myotis macropus*) which is a microbat species that is listed as vulnerable on the *NSW Threatened Species Conservation Act 1995* and is known to inhabit the Sportsmans Creek bridge.

A survey of the bridge was undertaken on 16 December 2013 and 3 February 2014 (which coincide with breeding periods) via direct inspection from a boat with scaffolding. The purpose of the survey was to identify species present, numbers, breeding status, roost habitat features and locations.

A further field investigation of road drainage features (culverts and bridges) within a 10 kilometres radius of Sportsmans Creek bridge was undertaken on 3-4 February 2014. The purpose of this additional investigation was to obtain a better understanding of the Large-footed Myotis populations in the area.

Field investigations to confirm the presence or absence of other species would be undertaken in future assessments.

Microbats (field investigation)

The microbats survey at Sportsmans Creek bridge identified the following:

- Around 300 Large-footed Myotis (*Myotis macropus*) were recorded roosting at the bridge during both surveys (308 and 301). The population comprised adults and young indicating a breeding population.
- Potential bridge roosting features including:
    - Split (two piece) stringers common across the bridge, some of which were occupied
    - Decking gaps (below longitudinal decking, between transverse decking and all above or adjacent to the middle three stringers – none above the outer stringers), which are a common feature across bridge and some of which were occupied
    - Rotted timber features uncommon and non-occupied
    - Larger bat groups roosting in split stringers which also often occupied the above decking gaps
- All roosting sites were in Span 2 and 3 and located above the water

- A total of 21 occupied roosting sites were detected. Other sections of the bridge supported similar structures, providing potential bat roosting habitat however were not occupied at the time of the survey
- Some areas showed heavy signs of usage (stained/ polished timber), however, were not occupied
- No other microbat species were recorded. However, the bridge provides potential non-breeding roosting habitat for the two other threatened bat species: Little Bent-wing Bat and Eastern Bent-wing Bat.

The results showed that bats congregated in larger roosting groups during the second (February) survey. This may be due to disturbances associated with emergency works prior to the first (January) survey. Roads and Maritime maintenance crews also reported the presence of Pythons in the bridge, which may have affected bat roosting behaviour.

The additional survey in a 10 kilometre radius identified the following in regard to other local Large-footed Myotis Populations:

Three other known Large-footed Myotis (*Myotis macropus*) breeding colonies were recorded or are known to occur within a10 kilometre radius of Sportsmans Creek bridge:

- Coldstream Bridge (concrete bridge), unknown population size
- Shark Creek Bridge (concrete plank bridge), population size greater than 300 located 8.8 kilometres away
- Pipe culvert – Pringles Way (4 x 1800 mm diameter), Population size greater than 20 located 4.1 kilometres away
- Other known Large-footed Myotis breeding colonies in the broader area include:
- McFarlane Bridge (timber bridge): population size between 200 and 600 located 10 kilometres away
- Mororo Bridge (concrete bridge), population size around 30, located 21.1 kilometres away
- Oyster Creek Channel (Yamba), unknown population size.

A number of other culvert and bridges locally provide potential (some known non-breeding) roosting habitat, however, offer limited potential to support breeding Large-footed Myotis colonies due to only exposed roosting opportunities and inundation susceptibility.

There are no known cave or other subterranean (e.g. disused mines or tunnel) roosting opportunities within the locality for the Large-footed Myotis. Hollow-bearing trees are locally uncommon as the local landscape is largely cleared. While Large-footed Myotis hollow-bearing tree maternity roosts may occur within the locality, they are unlikely to support large populations (eg > 100 bats).

8.2 Flood investigation

Following the value engineering workshop, a flood model was prepared and analysed to better understand the impacts of major flood events on the proposed bridge.

The purpose of this investigation was to identify peak flow velocities in Sportsmans Creek to facilitate design of the proposed bridge to accommodate large storm events.

8.2.1 Assessment methodology

Peak hydrological flows in Sportsmans Creek have been estimated based on the data included in the Clarence River Flood Study undertaken be BMT WBM, together with the data included in

the previous Sportsmans Creek hydraulic investigation. Additional detailed hydrological calculations were not considered necessary, at this stage.

Hydraulic analysis was subsequently undertaken by preparing two separate HEC-RAS one dimensional open channel flow models of the following:

- Proposed bridge (option 2) at Sportsmans Creek – to calculate the maximum flood velocities and scour for bridge design purposes
- Existing bridge at Sportsmans Creek – to identify any locations in which significant changes in velocities occur between the existing and proposed conditions.

Several calibration and sensitivity checks were also undertaken to confirm the accuracy of the results.

8.2.2 Results

The assessment results are summarised in table 8.1.

The estimated average flow velocity of less than 2.5 m/s at the proposed bridge does not present any bridge design issues. The maximum localised peak velocity calculated at the proposed bridge is 3.47 m/s and will be used in bridge foundation and protection design. The proposed bridge will increase flow velocities by up to 10 per cent from the case with no bridge and consequently scour is not likely to present design issues.

The maximum calculated scour at the bridge piers is caused by ARI 20 year flood event. The combined pier and contraction scour is estimated to be 3.8 metres. The abutments scour depth for ARI 100 year is expected to be 6.5 metres or approximately -4.4 AHD.

According to the geotechnical report prepared in 2013, the proposed new bridge will require piles extending to rock formation level. It was found that the depth to the rock formation varies greatly from approximately 5 metres to 30 metres between the southern and northern bridge abutments. Therefore the depth of bridge piles and abutments are governed by creek's geomorphology rather than the creek's flow velocity and scour.

Community consultation with Clarence residents experienced with the flooding conditions revealed that the southern end of Bridge Street, including the stone wall, provides an effective local flood protection to adjacent properties and this will be retained as part of the project.

Table 8.1 Flood investigation results

Design element (Measured at the proposed bridge site)	Result
Estimated average flow velocity	Less then 2.5m/s
Maximum localised peak velocity.	3.47m/s
Maximum calculated scour at the bridge piers (combined pier and contraction scour at ARI 20 year flood event)	3.8m
Estimated scour at the bridge abutments (at ARI 100 year flood event)	6.5m (or at -4.4 AHD)

8.3 Noise and vibration assessment

In addition to the initial desktop assessment, a detailed investigation into operational and construction noise and vibration impacts was undertaken to better inform the project team on

the likely mitigation measures needed for the recommended option. The results of this investigation are summarised below.

8.3.1 Ambient noise environment

The ambient noise monitoring locations NM1 to NM3 are indicated in figure 8.1. Both attended and unattended ambient measurements were taken at each monitoring location.

Figure 8.1 Ambient noise monitoring locations

In accordance with the Roads and Maritime document Preparing an *Operational Traffic and Construction Noise and Vibration Assessment Report*, traffic counting was undertaken concurrently with the noise monitoring during the period 9 December to 15 December 2013.

It was noted that traffic volumes and mix are not anticipated to change as a result of the proposal. The 'build' and 'no build' traffic scenarios are therefore consistent.

The results of the noise monitoring have been processed in accordance with the procedures contained in the *NSW Industrial Noise Policy* (INP) so as to establish representative noise levels from all noise sources in the area at the residences. The LA90 background noise levels1 for all periods are considered to be relatively low during the operator unattended ambient measures.

Although construction noise impacts will be an issue that needs consideration, any assessment will focus on operational traffic noise and will be guided by the *NSW Government EPA's Road Noise Policy*. The noise and vibration impacts of the changed traffic conditions during operation and construction for a replacement bridge were assessed for the listed noise sensitive users in accordance with the *NSW Government EPA's Road Noise Policy* assessment criteria for the maximum levels of traffic noise, such as from a heavy vehicle pass-by event. Ambient noise surveys were conducted to determine existing noise levels.

This reflects the intermittent nature of vehicle traffic in this area where there are also no major noise sources of a continuous nature (such as industrial plant or natural sources such as waves breaking on an ocean foreshore). The daytime operator attended noise levels were slightly higher and at locations NM1 and NM2 were largely dominated by natural environmental noise

[1] The LA_{90} noise level is the A-weighted sound pressure level exceeded for 90% of a given measurement period and is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the "background" level.

from wind in trees, birds and/or insects, with some influence from nearby road traffic sources. Measured daytime ambient noise levels at location NM3 were dominated by road traffic from Bridge/Richmond Street.

8.3.2 Noise goals

Operational goals

The *NSW Road Noise Policy* was applied to the preferred option to assess potential road and traffic noise impacts from traffic. Although it is not mandatory to achieve the noise goals in the *NSW Road Noise Policy*, project proponents need to provide justification if it is not considered feasible or reasonable to achieve them.

Construction goals

The applicable construction noise goals (Noise Management Levels - NMLs) adopted are those described in the *Interim Construction Noise Guideline* (ICNG - DECC 2009). In order to minimise the potential noise impacts upon nearby sensitive receivers, construction works are proposed to be undertaken during standard daytime periods (7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays). As such, night-time noise impacts are not included in this assessment

8.3.3 Construction vibration goals

The effects of vibration in buildings can be divided into three main categories – those in which the occupants or users of the building are inconvenienced or possibly disturbed, those where the building contents may be affected and those in which the integrity of the building or the structure itself may be prejudiced.

Goals have been set in accordance with the EPA's *Assessing Vibration: a technical guideline* and *Australian Standard AS 2187: Part 2-2006 Explosives - Storage and Use - Part 2: Use of Explosives and British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2*.

8.3.4 Operational noise assessment

The potential noise impacts of the preferred option were modelled using SoundPLAN V7.1 which allows for traffic volume and mix, type of road surface and vehicle speed. Both the 'build' and 'no build' scenarios were assessed.

Predicted operational noise levels

A number of exceedences and decreases were identified against the RNP as a result of the preferred option.

The change in noise levels between the design year 'build' and 'no build' scenarios range from +8.4 dB for the daytime and night-time periods to -18.3 dB and -18.8 dB for the daytime and night-time respectively. Traffic noise levels are predicted to decrease at a total of 16 receivers in the project area in the design year, while traffic noise levels are predicted to increase at 10 other receivers in the project area. The maximum increase is not greater than +12 dB in either the daytime or night-time; therefore, the project does not exceed the RNP relative increase criteria in the design year. Exceedances are predicted at four receivers for the daytime period.

Maximum noise levels

In accordance with the *Roads and Maritime Procedure Preparing an Operational Noise and Vibration Assessment* (July 2011), a maximum noise level assessment was conducted. This includes an evaluation of the number and distribution of night-time pass by events where the LAFmax - LAeq(1hour) difference is greater than 15 dB, and the maximum noise level of that event is greater than 65 dBA.

It is predicted that maximum noise level events at sensitive receivers in the study area are likely to exceed the guideline levels. Therefore, it can be concluded that there is potential for sleep disturbance to occur.

8.3.5 Construction noise assessment

In order to the determine the predicted construction noise, the combined Sound Power Level for each works scenario has been calculated as an estimated worse-case scenario assuming the equipment items are operating simultaneously in the same location. An assessment of likely 'annoying' construction activities was also conducted to determine predicted noise levels.

A worst-case exceedance of the daytime (standard construction hours) LAeq(15minute) noise goal of up to 46 dB is predicted at the most affected sensitive receiver location within the proposal area. While this level of exceedance is common for these types of construction activities at similar separation distances, mitigation measures should be undertaken to minimise the impact on all sensitive receivers.

8.3.6 Vibration assessment

The major potential sources of vibration from the proposed construction equipment are during rock breaking or during the use of a vibratory roller. Lesser impacts may be apparent during the use of bored piling, jackhammers, and compactors. All other proposed activities either contain plant items that are not significantly vibration intensive.

During any potential rock breaking activities, receivers would be within the safe working distances for human response. This includes residential receivers located on Grafton Street, South of Richmond Street. The identification of potentially affected assumes works are being conducted at the closest point of the works area to each receiver. Potential vibration impacts should be re-assessed during the detailed design stage and addressed in the construction noise and vibration management plan once equipment and construction locations have been defined in more detail.

8.3.6.1 Heritage buildings

Several heritage buildings are located within 100 metres of the proposed construction works. The construction vibration impacts from works surrounding these building should be managed through judicious selection of plant and equipment, as well as other vibration mitigation strategies, due to the potential for significant levels of vibration from construction works.

8.3.7 Reasonable and feasible mitigation measures

Operational noise

Where exceedances of the noise criteria are identified, the RNP describes noise mitigation measures to be considered in order of priority:

1 Road design and traffic management
2 Quieter pavement surfaces

3 In-corridor noise barriers/mounds
4 At-property treatments or localised barriers/mounds.

The priority of mitigation measures recognises that noise control at the source is preferable over noise path control and noise mitigation at the receiver.

Construction noise and vibration mitigation measures

The expected noise management level exceedances are likely to be concerning for surrounding residents and particular effort should be directed towards the implementation of all reasonable noise mitigation and management strategies. In order to minimise the potential noise and vibration impacts upon nearby sensitive receivers, all construction works are proposed to be undertaken during the OEH's standard daytime construction periods (7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays).

The standard suite of mitigation measures includes management measures such as:

- community consultation
- site inductions (with guidance on how to minimise noise and vibration)
- the preparation of site specific construction noise and vibration management plans.

As the highest NML exceedances are predicted during works required over a relatively large area, noise walls/mounds are unlikely to provide a practical mitigation option for these scenarios. For these works scenarios at the nearest location to the receivers (ie at the extent of the site/approaches), it is recommended particular attention is directed to scheduling these works during less noise-sensitive periods.

Building condition surveys should also be completed both before and after the works at all affected properties to ensure no damage occurs as a result of the works. Attended vibration monitoring should be undertaken in the event that vibration intensive works are required within the cosmetic damage safe working distances, for example if rock breaking is required within 7 metres of a receiver (medium rockbreaker). The aim of the attended vibration monitoring would be to ensure levels remain below the criteria for cosmetic damage at all receivers (heritage or otherwise).

A Construction Noise and Vibration Management plan should be developed prior to the construction works to address each major stage of the constructions work and identify the appropriate mitigation and management measures, consistent with the requirements of the *Interim Construction Noise Guideline*.

8.4 Geotechnical field investigation

8.4.1 Field investigation results

In addition to the initial desktop assessment, geotechnical field investigations focussing on the preferred option 2 were carried out in late 2013 to facilitate further development of the design. The results of this investigation are summarised below.

To the north of the creek, the alignment of the road approaches is underlain by low strength alluvial soils to about 5 metres depth, over weathered rock. Beneath the creek the rock surface slopes to the south, so that the depth to rock under the proposed position of the southern bridge abutment is about 30 metres. The soils on the south side of the creek are low strength alluvial deposits, comprising mainly soft to firm normally to slightly over-consolidated clay, with loose sands at about 5 to 9 metres depth. The soils are desiccated and firm to stiff in an up to 1

metres thick layer at the surface. The alluvial deposits are potential acid sulfate soils with a high potential for releasing acid into the environment if they are disturbed.

The rock observed in cores taken from boreholes was sandstone and siltstone, slightly weathered and of medium to high strength. Noticeable was the abrupt transition from alluvial soils to competent rock and the absence of a transitionary residual soil layer or deep weathering profile in the rock.

Groundwater is present below about 2 metres depth, corresponding to the water level in Sportsmans Creek and the nearby Clarence River.

8.4.2 Bridge foundations recommendations

Given the significant thickness of low strength soils, the proposed new bridge will need to be supported on piles extending to rock. On the northern side, where the depth to rock is about 5 metres, bored piles installed using casing are an option that could be considered. The piles would need to be drilled into rock to form a socket deep enough to resist lateral and axial loads. Other pile types, such as precast driven piles may also be feasible, but may not provide adequate lateral load carrying capacity if they are unable to penetrate far enough into rock.

On the southern abutment, and for piers within the river channel, driven open steel tubes are an option. Steel tubes can be driven to significant depths through the water laden alluvial sediments from a barge. Other pile types, such as precast piles and bored piles, whilst feasible, may be more challenging to install from a floating platform.

8.4.3 Embankment foundations recommendations

The construction of approach embankments to the new bridge could involve the placement of up to 5 metres of new fill above the existing ground surface. The placement of fill will induce settlements in the low strength alluvial deposits. Some of this settlement will occur during construction and could be about 600 to 2200 millimetres for a 5 metre high embankment, depending on the construction duration and adopted ground treatment. However, significant settlement made up of ongoing primary consolidation and creep (secondary consolidation) will occur after construction is completed. This ongoing settlement has the potential to damage the pavement.

A typical ground treatment option aimed at reducing the amount of post-construction settlement is preloading and surcharging with the installation of wick drains to accelerate the rate of primary consolidation. A surcharge is an additional height of fill placed above the proposed finished pavement level. Calculations indicate that even after preloading (with a 3 metres high surcharge and wick drains) for a period of six to 12 months, the post-construction settlement would be of the order 500 millimetres over the next 40 years and the design settlement criteria stipulated by Roads and Maritime Services would not be achieved. A 5 metre high embankment could be built without the need for treatment; however application of an additional surcharge would require the use of staged construction, geogrid or stability berms. The impact of the ongoing settlement on the pavement performance would need to be managed by periodically “topping” up the road level.

An alternative approach to ground treatment would be piled embankment approaches. A piled embankment could be designed to meet the settlement criteria, with the aim of limiting ongoing pavement maintenance. A piled embankment also avoids the need for additional quantities of fill that would be brought to site for surcharging. The feasibility of piled embankments will need to be addressed at the design development stage.

8.4.4 Road subgrade recommendations

The new at-grade road approaches should be designed using a CBR of four per cent. Roads constructed on new engineered fill in accordance with Roads and Maritime Specification R44 can be designed using a CBR of 12 per cent, provided the CBR of the fill is verified during construction.

8.4.5 Other issues

Other issues that will need to be considered include:

- Sources and availability of fill for embankment construction as fill will need to be imported
- Managing the potential disturbance of acid sulfate soils during construction activities
- Managing construction during wet weather when trafficability across the low-lying alluvial floodplains is likely to be poor
- The design and construction of temporary works, such as working platforms for piling, which could extend into the river and may be prone to flood events during the construction period
- Potential for contaminated soils in the study area exist from agricultural residues, underground storage tanks at the general store, fill in existing bridge abutments, previous demolition of structures, and historical industrial sites.

8.5 Concept design road safety audit

To identify potential deficiencies with the recommended option at an early stage and to allow improvements to the alignment to be undertaken, and independent road safety audit was prepared for the strategic concept design of the preferred option.

This safety audit examined the proposed bridge, with consideration of the surrounding road environment and the tie-in with the existing surrounds. Potential safety issues and deficiencies were identified and documented.

Following the safety audit, a total of 22 deficiencies were identified either with the existing road network or the preferred option configuration. Of these, only three were rated as being high risk. These have been summarised in table 8.2.

Table 8.2 Concept Design Road Safety Audit - High risk deficiencies

Audit Ref #	Classification	Deficiency / Non-conformance	Risk
1	Traffic Management Devices	The existing speed limit on Grafton-Lawrence Road in the northbound direction is 100 km/h. It is noted that a Gateway Treatment on approach to the Lawrence township is not provided on the proposed scheme. The proposed plans do not indicate a change in the posted speed limit between the rural environment and the urban environment on approach to Lawrence. Consequently, vehicles may travel faster than the prescribed conditions for the road environment, therefore increasing the risk of a run-off type crash	High

Audit Ref #	Classification	Deficiency / Non-conformance	Risk
6	Pedestrian Infrastructure	Pedestrian footpath facilities are provided on the eastern side of Grafton Street which starts at chainage 100m and then extends across the new bridge and ends at chainage 410 m. However, there are no footpath facilities provided north of chainage 410 m. Pedestrians may continue walking on the road verge to and from the Lawrence Public Hall, General and Liquor Store and the Memorial Park. As such, pedestrians may trip and fall, particularly elderly pedestrians, pedestrians with a pram, mobility impaired pedestrians or vision impaired pedestrians.	High
19	Delineation	A limited number of road alignment markers or guide posts are currently provided on Grafton Street. Hence, there is insufficient delineation, increasing the risk of a crash, particularly during night-time conditions.	High

Where appropriate, the remedies have been incorporated into the development of the strategic concept design for the preferred option. These will be further refined during the detailed design process.

8.6 Preferred option design development

Following the value engineering workshop, several issues were identified that required additional investigation and refinement of the preferred option alignment. Improvements were made to the alignment and design of the preferred option to address the feedback from stakeholders and to ensure the design best met the project objectives and community needs.

8.6.1 Alignment and design refinement

The key outcomes of this process have been summarised in table 8.3.

Table 8.3 Value engineering improvements to the design of the preferred option

Project element	Design improvements
Northern intersection alignment	Alignment was adjusted to increase the clearance to the Lawrence General and Liquor Store fuel bowser and tank
Bridge pile cap	Pile cap eradicated at water level. The pier columns/piles will extend through to the headstock level of the substructure and will minimise the need for working over water
Bridge abutment height	Refined height of the abutment to improve aesthetics and minimise earthworks and settlement issues for the embankments.
Bridge five span structure	Bridge spans refined to a five span structure instead of four spans to improve aesthetics by providing shorter spans at the ends of the bridge.
Bridge shoulder width	The shoulder width across the bridge to be reduced to 1.0m instead of Council standard 1.5m, subject to consideration of real cost savings and the acknowledged need for a 2.5m shared path.
Bridge Columns	The central column on the piers removed so that only two columns rather than three columns are at each pier. This improves aesthetics and reduces the piling works in the creek.
Grafton Street/ Bridge Street intersection	In response to community input and to improve road safety the connection to Grafton Street/ Bridge Street refined to keep the trough main road priority.
Southern approach traffic calming	A gateway treatment Incorporated on the southern approach as a traffic calming measure. This will be developed during the concept design as identified in the Concept Road Safety Audit.
Northern approach to the existing bridge	The approach, including the dry stone walls, will remain intact. The turnaround at the southern end of Bridge Street will be shifted further north increasing flood protection for the existing houses in the Bridge Street.
Southern end of Bridge Street	To be regarded and landscaped in consultation with the Clarence Valley Council. This will unite Flo Clark park and Sportsmans Park into one entity.

In addition to these improvements, the alignment of the bridge was moved slightly to the west (upstream) to increase the clearance to the Flo Clark Park boat ramp on the southern abutment. This also increases clearances to the properties on eastern side of Grafton Street adjacent to the northern abutment and enables the existing access road to these properties to remain open. The updated design is shown in figure 9.1.

8.6.2 Intersection treatments

Following the value engineering workshop, treatments were developed for each intersection of the preferred option alignment and community input and comment were taken into account. These treatments are discussed below and outlined in figure 8.2.

Grafton/Bridge Street

Designs for the intersection at Grafton / Bridge Street were developed for review and comment. Refer to Inset 2 – figure 8.3.

Option A is a T intersection from Grafton Street to Bridge Street.

A refined Option B involves a minor realignment of Grafton Street to form a through route from Grafton Street to Richmond Street. Realignment of Bridge Street and Grafton Street North is required to accommodate this revised through route.

In both options A and B vehicles will continue to travel along Richmond Street before turning right onto Rutland Street when heading towards Maclean.

Option B has been included in the preferred option for the following reasons:

- Is strongly supported by the community
- It maintains the through road hierarchy
- Is compatible with the Lawrence Memorial Park vehicular movements, for school buses and boat trailer regular use
- Is more appropriate for heavy vehicle movements
- Reduced noise levels due to unimpeded through traffic flow.

The preferred option as shown in figure 9.1 also includes a refined design for the properties accessed from Grafton Street north.

Riverbank Road and Weir Road

A single option (Inset 1 - figure 8.3) was developed for these intersections as the most appropriate treatments for this location. The design involves offset T intersections for Riverbank Road and Weir Road.

Southern end of Bridge Street

A hammerhead turning bay is proposed at the south end of Bridge Street following the removal of the existing Sportsmans Creek bridge. The turning bay will be located within the existing 10m wide road reserve. See figure 8.3.

Access will be provided to the existing residences. The existing northern approach to the bridge including the dry stone wall will remain following removal of the bridge to provide flood velocity protection to the existing adjacent dwellings. The end of the Bridge Street will be landscaped in consultation with the Clarence Valley Council requirements.

Figure 8.2 Proposed intersection treatments displayed for community comment

Figure 8.3 Proposed intersection treatments for preferred option showing turning paths

8.6.3 Bridge construction and property acquisition investigations

Property acquisition

The preferred option alignment will impact an allotment (Lot 1, Sec 5, DP758604) on the northern side of Sportsmans Creek (see chainages 350 to 450 on Figure 9.1). There is an existing dwelling on the allotment which will require removal, relocation or demolition to permit the construction of the new bridge and approaches.

The allotment is considered to be suitable for the construction site compound.

Transport and erection of the Super T girders

Investigation of the possible transport routes for the Super T girders indicates that the roads surrounding Lawrence have considerable limitations. A possible route has been identified for transport vehicles for transporting the girders similar to the example shown in figure 8.4 and will be investigated further. Other options such as barge transport will also be considered.

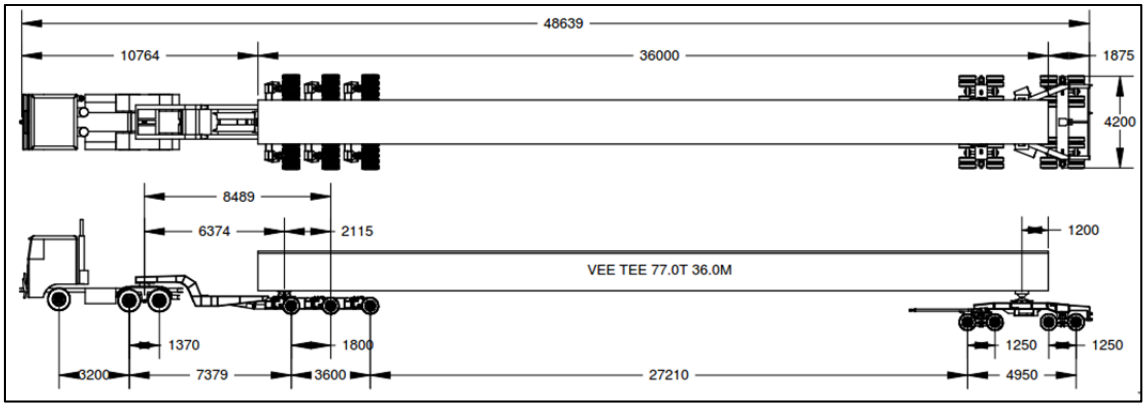

Figure 8.4 Example of jinker used for Super T girder transport

The erection of the large Super T girders will require careful planning and consideration of the soft soils at bridge approaches.

The above transport and erection issues have led to a proposal to reduce the central span for the bridge from 35 metres (1800 deep) to 30 metres (1500 deep). This would result in five bridge spans of 27.5/30/30/30/27.5metres. The likely benefits would include:

- Weight saving
- Consequent transport/crane/ erection saving
- Potential 0.3 metre lowering of the bridge deck height and approaches.

This will be confirmed during the next design phase through structural, urban design, geotechnical and cost estimate investigations.

Plans and long-section for the proposed bridge is shown in figure 8.6

Figure 8.5 below shows a photomontage of the preferred option bridge looking south.

Figure 8.5 Photomontage of the preferred option bridge looking south

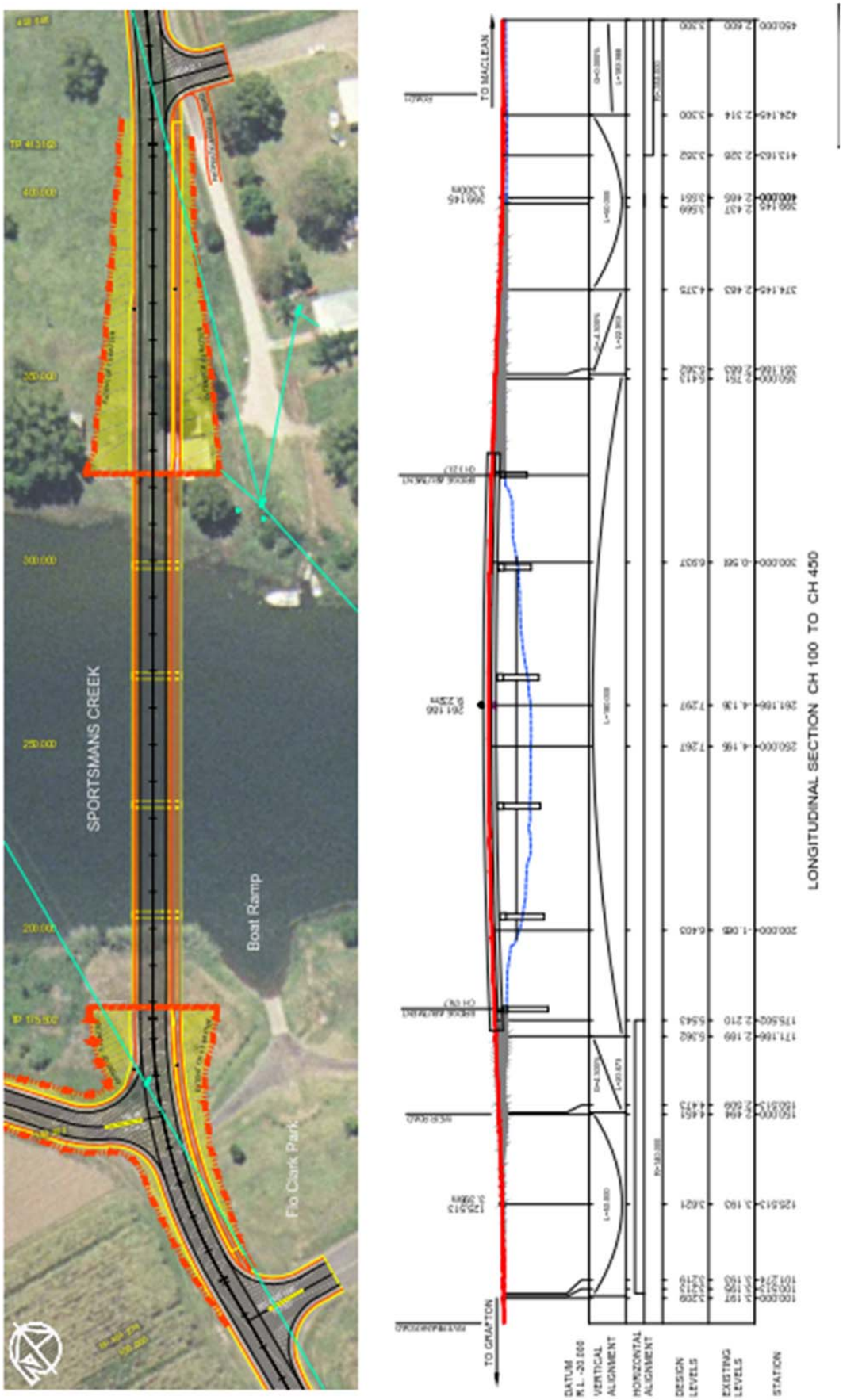

Figure 8.6 Preferred option bridge plan and longsection

9 Preferred option

The results of the technical assessment, the outcomes of the value engineering workshop and community input were all considered in the development of the preferred option for the Sportsmans Creek new bridge. The preferred option is shown in figure 10.1.

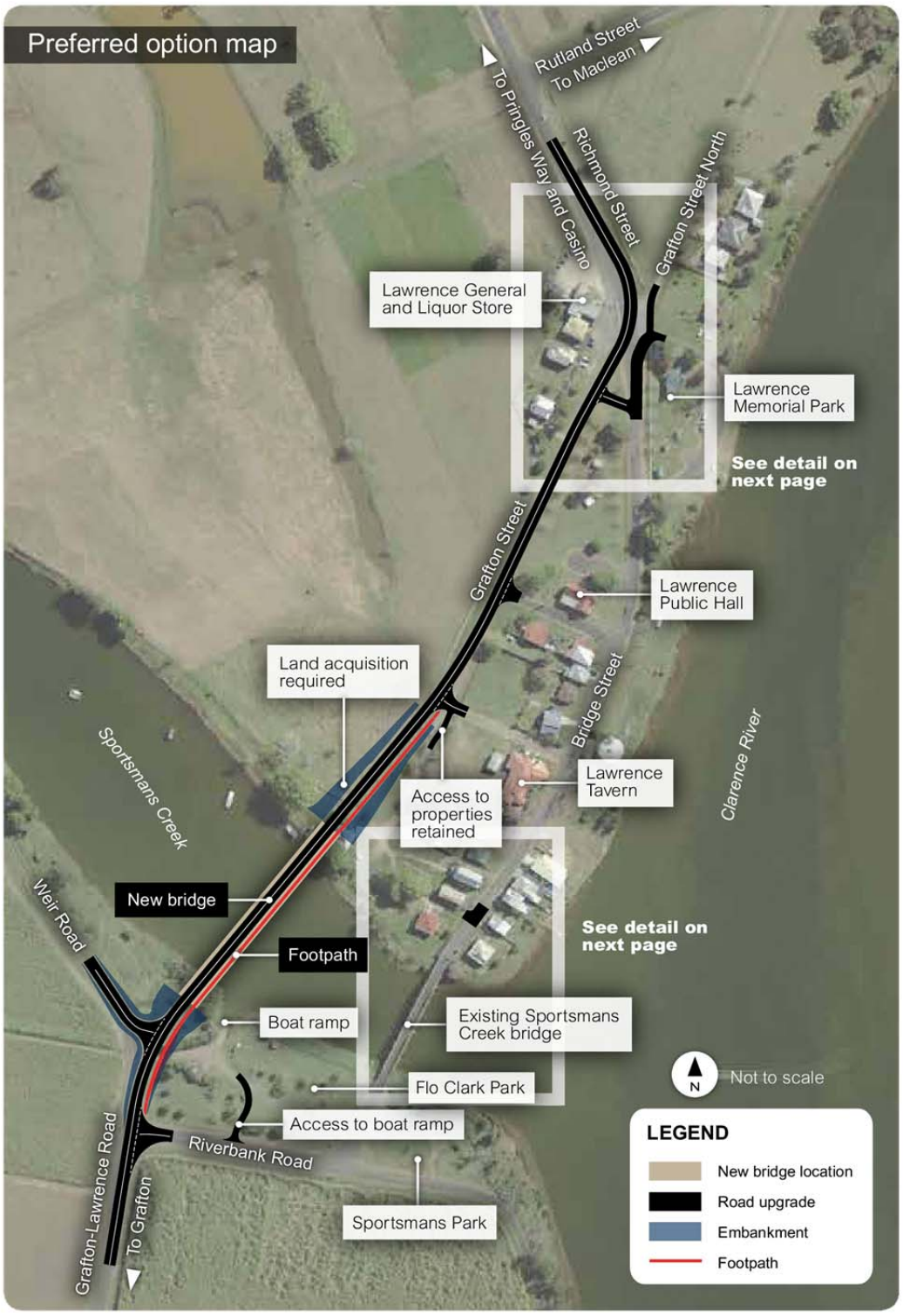

Figure 10.1 Preferred option for the Sportsmans Creek new bridge

Figure 10.2 shows the proposed intersection treatments.

Figure 10.2 Preferred Intersection Treatments

10 Next steps

Following the announcement of the preferred option, the next step is to prepare an environmental impact assessment and obtain relevant approvals before starting detailed design and construction. The process is illustrated in Figure 11.1.

Figure 10.1 Project activity flow chart

11 References

Clarence Valley Local Environmental Plan 2011

Clarence Valley Council, 2000, *Sportsmans Creek Bridge Lawrence Investigation - Advantages & Disadvantages of Options.*

Clarence Valley Council (CVC) 2006, *Clarence Valley Sustainability Initiative.*

Clarence Valley Council (CVC) 2008*, Clarence Valley Vision 2020.*

Clarence Valley Council (CVC) 2009, *Clarence River Way Masterplan.*

Clarence Valley Council (CVC) 2010, *Clarence Valley Council Social Plan 2010 – 2014*, *March 2010.*

Clarence Valley Council (CVC) 2011, *SOE Supplementary Report 2009 / 2010*.

Clarence Valley Council (CVC) 2013, *Interim Valley Vision 2024*.

Department of Planning 2009, *Mid North Coast Regional Strategy 2006-2031*.

Roads and Maritime Service 2013, *Timber Truss Road Bridges*.

Roads and Traffic Authority 2002, *Demolition of Existing Bridge and Construction of New Bridge Over Sportsmans Creek Lawrence – Environmental Impact* Statement, May 2002.

WBM Oceanics Australia 2004, *Lower Clarence River Flood Study Review Final Report, March 2004*

END OF REPORT