7.3 Traffic and transport

This section assesses traffic, access and transport impacts of the project. The assessment is supported by a traffic and transport working paper, which is presented in Volume 2 - Working paper 4. The assessment has addressed the Director General's requirements for traffic and transport (as detailed in **Table 7-11** below) as well as the relevant requirements of Schedule 2, Part 3 of the *Environmental Planning and Assessment Regulation 2000*. This section also addresses one of the Director General's requirements for Visual Amenity, Urban Design and Landscape that relates to pedestrian and cycle access and networks.

Table 7-11 Director General's requirements

Director Generals requirements	Where addressed
Traffic and transport	
Demonstration of how the preferred bridge alignment and design meets the traffic and transport objectives of the project	Section 7.3.4
Justification for the capacity of the bridge, taking into account future growth areas and traffic (vehicular, cyclist and pedestrian) needs	Section 7.3.4
Construction traffic access to the project (including ancillary facilities) and associated management measures, in particular impacts to the road network (including safety and level of service, access to the town centre and tourist and recreational facilities, disruption to public transport services and access to properties)	Section 7.3.3 & 7.3.5
Operational traffic and transport impacts to the local and regional road network, including impacts of the new bridge alignment through the town centre and Thompson Square	Section 7.3.4
Impacts of the project (construction and operational) on the use and access to Windsor Wharf, and existing and future maritime and recreational use of the Hawkesbury River	Section 7.3.3 & 7.3.4
Safety of navigation in the Hawkesbury River for the water based traffic	Section 7.3.3 & 7.3.4
Visual Amenity, Urban Design and Landscape	
Details of integration of the bridge and Thompson Square with existing and future pedestrian and cycle networks, including design and safety measures for pedestrian and cycle access on the bridge.	Section 7.3.2, 7.3.4, 3.1 and 5.2.4

7.3.1 Guidelines and methodology

Traffic and transport project objectives

The traffic and transport project objectives and associated criteria have been used to guide the development of the project. They can be summarised as follows:

- To improve safety for motorists, pedestrians and cyclists
  - Meets the current design codes (eg traffic lane widths, shoulder widths and shared path widths).
  - Meets a road speed of 50 kilometres per hour.
  - Ensures pedestrian safety.

- To improve traffic and transport efficiency
  - Minimises queue length/delays.
  - Improves performance of the road network (level of service).
  - Enables two heavy vehicles to pass on the bridge without waiting.

How the project meets these objectives is discussed in **Section 7.3.5**.

Traffic assessment

The principal focus of the traffic assessment is the route from Bridge Street (at Macquarie Street) in the south to Wilberforce Road on the northern side of the Hawkesbury River. The study area includes adjacent intersections and roads as shown in **Figure 7-11**. Data relating to current traffic conditions came from three main sources:

- AM and PM peak intersection turning counts conducted in December 2011.
- Twenty-four hour classified bridge traffic counts conducted in March 2012.
- RMS count stations for various years pre-2005, the most recent being from 2005.

Further information about traffic patterns in Windsor was drawn from the 'Windsor Town Centre Traffic Study' (Christopher Hallam & Associates Pty Ltd, July 2011).

Traffic profiles for major roads in the study area, as well as historical growth rates were constructed using 2005, 2011 and 2012 traffic counts. The current performance of intersections was evaluated with intersection modelling software, and a crash analysis was undertaken for roads in the study area.

Traffic forecasts to the anticipated year of opening (2016) and 10 years after opening (2026) for future modelling were determined using the 2011 and 2012 counts with applied growth rates derived from the Sydney Strategic Travel Model. The Sydney Strategic Travel Model (SSTM), which was used to estimate future traffic growth, is a world class tool, operated by the Bureau of Transport Statistics (BTS) within Transport for NSW. It is used for projecting travel patterns in Sydney, Newcastle and Wollongong under different land use, transport and pricing scenarios. It can be used to test alternative settlement, employment and transport policies, to identify likely future capacity constraints, or to determine potential usage levels of proposed new transport infrastructure or services.

The SSTM is a series of models and processes that attempts to replicate, in a simplified manner, people's travel choices and behaviour under a given scenario. The SSTM uses detailed current demographics to synthesise households of different types. This allows for powerful forecasting of the travel behaviour of different market segments. The BTS applies its population projections to these different household types across the greater metropolitan area of Sydney. Workplaces are one of the key travel destinations and therefore it is important to know where workplaces are likely to be located in the future and how their distribution may change. BTS' Employment Projections are used in the SSTM to identify the location of future employment and are an important component of the commute travel model. Use of the SSTM and BTS projections for this project is considered appropriate given the nature of the road network surrounding the project. This would be different for a project in a more dynamic road network such as Sydney Airport, for example.

The SSTM considers regional strategies such as the North West Subregional Strategy however Hawkesbury local development strategies such as the Hawkesbury Residential Lands Strategy were not expressly included. Nevertheless, the household growth assumptions included in the SSTM are consistent with the dwelling targets anticipated by Hawkesbury City Council.

The use of traffic forecasts for 10 years after opening is standard practice for assessing the future performance of road developments. Estimating traffic numbers for periods greater than 10 years after opening is generally not undertaken because the estimates have a high degree of inaccuracy and are dependent upon other factors such as the rate of land development and the location of major employment destinations. The estimates of growth in traffic using the project in 2026 are presented in **Table 7-15** and are relatively high in comparison to other similar roads.

The intersection performance analysis uses Level of Service as the measure of intersection performance. The Level of Service criteria for intersections is shown in **Table 7-12**. Level of Service is a qualitative measure describing operational conditions within a traffic stream, and their perception by motorists and/or passengers.

Table 7-12 Level of Service criteria for intersections

Level of service	Average delay per vehicle (sec/veh)	Traffic signals and roundabouts	Give way and stop signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents will cause delays Roundabouts require other control mode	At capacity, requires other control mode
F	Over 70	Extra capacity required	Extreme delay, traffic signal or other major treatment required.

Source: Austroads Traffic Engineering Practice Series Part 2

Different intersection options were first tested with stand-alone intersection models (SIDRA models) to identify intersection options that provided acceptable traffic performance. Preferred intersection options were then assessed in a regional and local network road model to identify any interaction between the preferred intersection options and the overall performance of the project in the wider road network.

Other issues

For other traffic and transport related issues the following process was undertaken to assess potential impacts and develop environmental management measures:

- The existing patterns of transport, access and use as well as facilities such as paths, wharfs and routes were identified.
- For construction, preliminary construction plans and methodologies were used to identify and assess potential impacts.
- For operation, the design and functional operation of the project were used to identify and assess potential impacts.
- Environmental management measures were then developed for identified impacts.

Figure 7-11 | Key roads in study area

Indicative only – subject to detailed design

LEGEND

- Concept design
- Key roads in study area

GDA 1994 | MGA Zone 56
A4 1:3,500

0 100
Metres

AUSIMAGE SKM

7.3.2 Existing environment

Road traffic

The existing Windsor bridge is a road, cyclist and pedestrian crossing of the Hawkesbury River at Windsor. Major traffic routes through Windsor include:

- Windsor Road-Bridge Street, to Wilberforce.
- Hawkesbury Valley Way, to Richmond.
- Macquarie Street, linking Bridge Street, Hawkesbury Valley Way, through to South Windsor and The Northern Road to Penrith.

Key roads in the study area have been classified within a hierarchy according to the role they fulfil in the road network and their traffic carrying capacity. The different road classifications are described in detail in the Traffic and transport working paper (Volume 4 – Working paper 4). The key roads in the study area are described below:

- **Bridge Street**, shown in **Figure 7-12**, is a sub-arterial road running north-west/south-east. It is 700 metres long in total and stretches from Macquarie Street to Wilberforce Road. It is the road which crosses over Windsor bridge, and forms part of State Route 69 to Singleton. Major intersecting roads include Macquarie Street, George Street and Freemans Reach Road. Bridge Street is primarily one lane in each direction, with additional turning lanes provided at the intersection with Macquarie Street. The posted speed limit is 60 km/h, and the road bends sharply at both ends of the bridge. Trucks and buses are limited to 40 km/h across the existing bridge. Traffic volumes over the bridge are estimated to be around 19,000 vehicles per day (Average Daily Traffic estimated from peak hour traffic surveys undertaken in 2011). Bridge Street is part of the B-Double Route from Windsor Road to Wilberforce Road.

Figure 7-12 Bridge Street at Windsor bridge (looking south towards Windsor)

Figure 7-13 Looking north along Freemans Reach Road from Wilberforce Road

- **Wilberforce Road** is a sub-arterial road running north-east/south-west from Bridge Street, connecting Windsor to Wilberforce and forming part of State Route 69 to Singleton. The road is one lane in each direction with a posted speed limit of 80 km/h in the section approaching Windsor bridge. About 13,000 vehicles travel on the road each day. Wilberforce Road is part of a B-Double Route running from Windsor Road via Bridge Street.
- **Freemans Reach Road,** shown in **Figure 7-13**, is a collector road running north-south from Bridge Street, connecting Windsor to Freemans Reach. The road has one lane in each direction with a posted speed limit of 80 km/h, reducing to 60 km/h on the southbound approach to the intersection with Wilberforce Road. About 7000 vehicles travel on the road each day.
- **George Street**, shown in **Figure 7-14**, is a local road within the study area. It connects Bridge Street to the Windsor town centre, which is to the west of the Bridge Street/George Street intersection. It connects Bridge Street to a residential area on the eastern side of the Bridge Street/George Street intersection. George Street has one lane in each direction with space for on-street parking on both sides of the street. It has a posted speed limit of 50 km/h. Daily traffic volume data for the roads within the study area is unavailable. However, the Windsor Town Centre Traffic Study' (Christopher Hallam & Associates Pty Ltd, July 2011) suggests that the eastern approach of George Street to Bridge Street experiences higher than expected volumes in peak times due its role as a link in the 'rat run' of drivers avoiding the left turn from Macquarie Street into Bridge Street. Instead, these drivers turn right from Macquarie Street into Bridge Street, then left into Court Street, left into Arndell Street, left into George Street and right into Bridge Street.

Figure 7-14 George Street / Bridge Street intersection (looking south west)

- **Macquarie Street** is an arterial road running north-east/south-west. The section within the study area links the Windsor town centre with Richmond, Penrith and Campbelltown, and forms part of Metroad 9. There are three northbound lanes and two southbound lanes, with a posted speed limit of 60 km/h.
- **Old Bridge Street** is a 100 metre long local road running north/south. It connects Bridge Street, adjacent to the George Street intersection, to Windsor Wharf. It provides access to local properties and the car parks adjacent to Windsor Wharf. There is a turning bay for northbound drivers on Bridge Street entering Old Bridge Street.
- **Thompson Square road** is a local road running north-west/south-east. It is a brick-paved road that connects George Street to The Terrace. It forms the western edge of Thompson Square parkland. The road is one-way in the north-west direction.
- **The Terrace** is a local road running north-east/south-west, parallel to the Hawkesbury River, primarily between Thompson Square and Moses Street / Tebbutt Street. The road connects the Windsor town centre to residences in the west, and is one lane in each direction with parking lanes on both sides. An 80 metre long section of The Terrace runs to the east of the junction with Baker Street, terminating at a dead-end at the western side of Bridge Street. In addition, a former part of The Terrace lies to the east of Bridge Street, consisting of a short 65 metre stretch connecting Windsor Wharf to Old Bridge Street.
- The **Macquarie Park access road** is the driveway for Macquarie Park, on the northern bank of the Hawkesbury River. It joins Bridge Street on the northern bend after Windsor bridge, near the Wilberforce Road / Freemans Reach Road intersection. A turning bay for southbound drivers from Bridge Street to Macquarie Park is marked.

The number of vehicles per hour on Bridge Street, south of Windsor bridge averaged over seven days in March 2012, are shown in **Figure 7-15**, split by classification, and in **Figure 7-16**, split by direction. Traffic is mostly made up of light vehicles, with heavy vehicles making up seven per cent of vehicles. The highest morning traffic volumes occur at 8:00am, with the majority of flow in the southbound direction towards Sydney, whilst the highest evening traffic volumes occur at 5:00pm with most traffic travelling northbound.

Intersection operation

Intersection analysis for the AM and PM peaks was undertaken at the following intersections:

- Bridge Street / Macquarie Street.
- Bridge Street / George Street.
- Wilberforce Road (Bridge Street) / Freemans Reach Road.

Table 7-13 shows the results of the analysis for both the AM and PM peaks at key intersections.

Table 7-13 Level of Service at existing intersections

Intersection	Control	AM Peak		PM Peak	
		Level of Service for worst movement	Average Delay per Vehicle (seconds)	Level of Service for worst movement	Average Delay per Vehicle (seconds)
Bridge Street / Macquarie Street	Signals	D	45.2	D	45.8
Bridge Street / George Street	Roundabout	B	20.0	B	27.4
Wilberforce Road/ Bridge Street / Freemans Reach Rd	Give Way	F	>100	F	>100

Notes: LoS = Levels of Service (refer to Table 7-12)

The intersection analysis shows that the Bridge Street / George Street intersection is operating well with acceptable delays and some spare capacity, whilst the Bridge Street / Macquarie Street intersection is operating near the maximum desired capacity. The Wilberforce Road / Freemans Reach Road intersection is also shown to perform unsatisfactorily, which is consistent with community observations of long queue lengths and delays in peak periods.

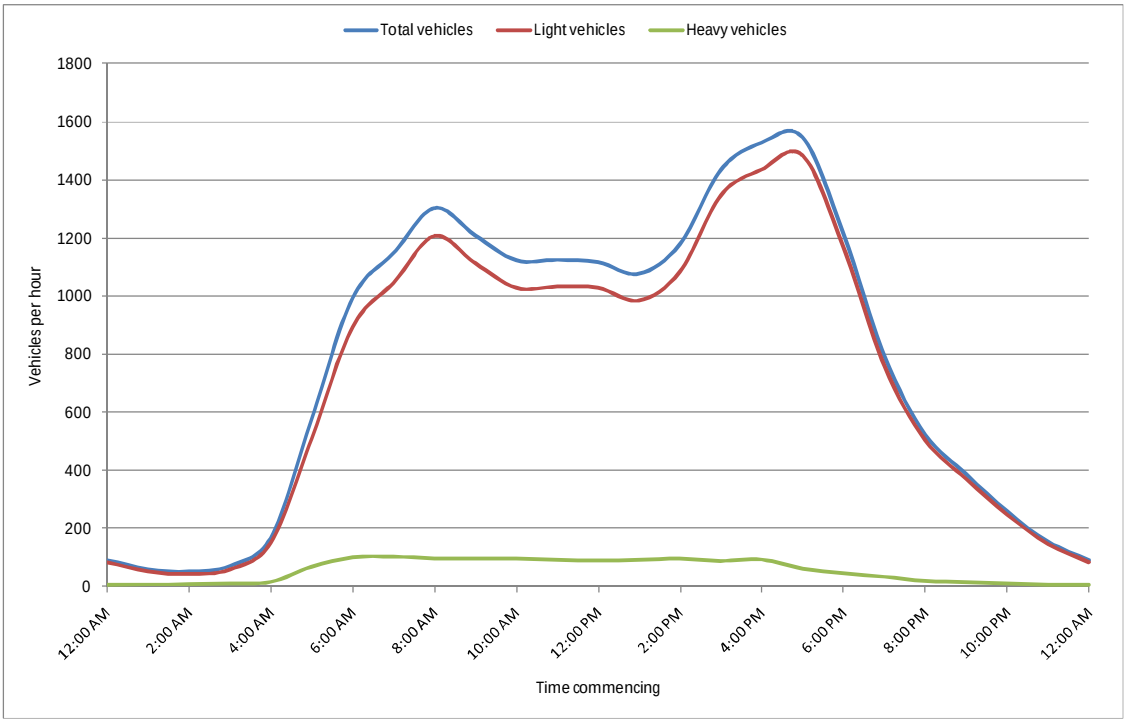

Figure 7-15 Hourly profile of vehicles in Bridge Street, split by classification

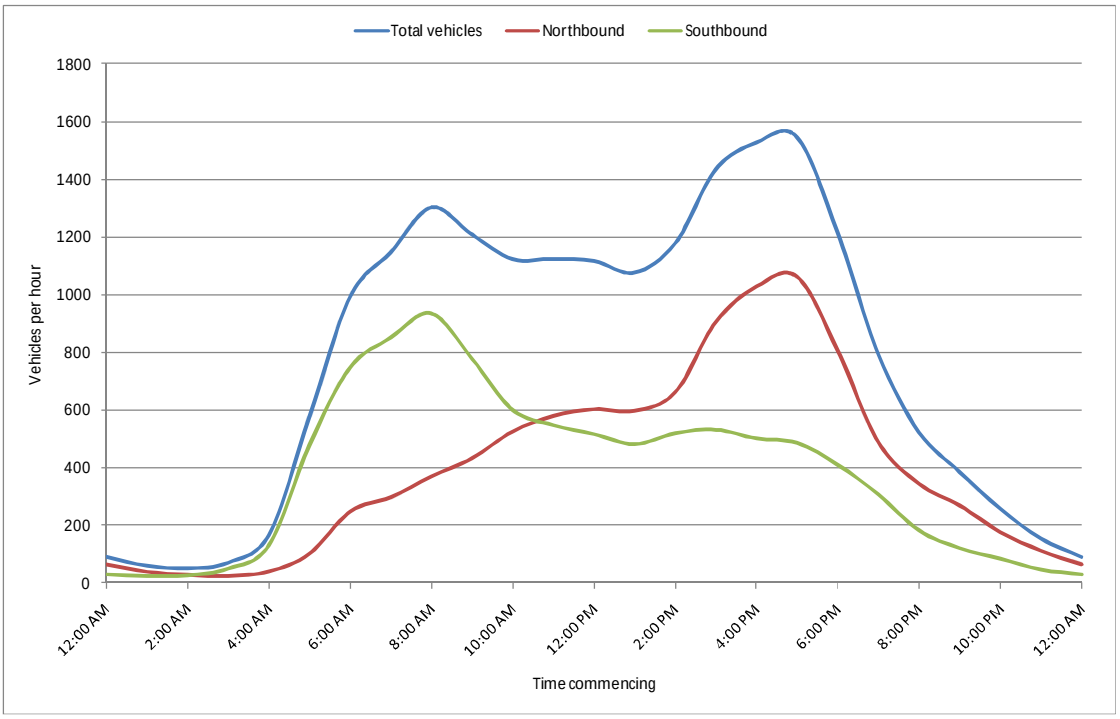

Figure 7-16 Hourly profile of vehicles in Bridge Street, split by direction

Crash history

Crashes recorded along Wilberforce Road between Freemans Reach Road and the eastern end of Windsor bridge for the five-year period ending 2009 were analysed. Of the 16 reported crashes during that period, the majority were recorded at Wilberforce Road near Freemans Reach Road and most of these crashes occurred when vehicles were approaching from adjacent roads. This type of crash occurred ten times in the five year period. There was also one head on crash at this location. On the northern approach road there was one crash associated with a head-on collision, two were rear-end collisions, and one crash resulted from a vehicle losing control on a curve and hitting an object. A single 'pedestrian hit' crash was recorded at the intersection of Bridge and George streets however pedestrian and cycle crashes are known to be under-reported.

Public transport

Bus routes in the region are provided by Westbus and Hawkesbury Valley Buses, with several routes servicing the Windsor town centre. Westbus Route 668 is the only service which travels on Bridge Street north of Macquarie Street, over the Windsor Bridge. The route accesses Glossodia and Richmond from Windsor via Wilberforce, and also provides a shuttle between Windsor and Wilberforce for passengers on Westbus Route 669. Daily school bus routes also use the Windsor bridge.

Pedestrians and cyclists

Windsor bridge carries a narrow pedestrian and cycle path on its eastern side. This shared path links The Terrace and Old Bridge Street in the south with the intersection of Wilberforce and Freemans Reach Roads in the north. The shared path on the existing bridge also forms an off-road link in the local cycle network, as shown in **Figure 7-17**. This figure also shows potential future cycle routes which would be the responsibility of Hawkesbury City Council or others to develop and fund in the future.

There are some key shared paths within the Hawkesbury LGA for both recreational and transport purposes. These include the Ham Common shared path between Richmond and Clarendon, the shared path along the Bells Line of Road between North Richmond and Kurmond and the Parramatta to Windsor off-road cycleway which follows the alignment of Windsor Road. These paths do not link with each other, particularly the Ham Common path which does not extend to either Windsor or Richmond.

A plan has been developed for a Great River Walk, which would extend for 570 kilometres along the length of the Hawkesbury-Nepean River, from the estuary at Broken Bay to its source in the Southern Highlands and beyond to Canberra (GTA Consultants, 2010). The Great River Walk would extend along the southern foreshore of the Hawkesbury River in the study area linking Governor Philip Reserve, Deerubbin Park, Macquarie Park, Howe Park, Holland's Paddock, Thompson Square and Windsor Wharf reserve.

No pedestrian crossing facilities are provided at the Bridge Street / George Street roundabout intersection. Pedestrians have difficulty identifying a safe gap in which to cross during peak traffic periods and sightlines are poor as the intersection is located at the top of a crest. The lack of pedestrian crossing facilities at this intersection is also a barrier to direct pedestrian movements from the eastern section of the town, where much of the accommodation and Governor Phillip Park is located, to the town centre.

No pedestrian crossing facilities are available on the northern bank for pedestrians wanting to cross from the shared path on the existing bridge to Macquarie Park. An underpass of the existing bridge is currently provided for pedestrians on The Terrace, but this route requires climbing a number of stairs and is, therefore, not accessible for pedestrians with restricted mobility.

Water-based activities at Windsor

The following water-based activities occur in the Hawkesbury River near Windsor:

- **Hawkesbury Paddle Wheeler** - Operates daily passenger cruises from the Wharf on The Terrace, just downstream (east) of the existing bridge. The 11 metre high vessel is too high to pass under the existing Windsor Bridge.
- **Hawkesbury River Boat Cruises** - The vessel "River Dream" provides regular cruises from Windsor. This low height vessel should be able to pass under the existing Windsor Bridge.
- **Hawkesbury River Canoe Classic** - This is an annual 111 kilometre overnight race from Windsor Bridge to Brooklyn. The 2011 event in October attracted over 500 competitors.
- **Bridge to Bridge Events** - Two annual races are held. The water ski race takes place in November each year and a power boat race is held every May. The course for both races is the Hawkesbury River from Brooklyn to Windsor (111 kilometres). Both events attract competitors from Australia and overseas. The 2010 power boat event had 57 vessels completing the course.
- **Personal craft** - The Hawkesbury River is navigable and tidal for over 130 kilometres from Broken Bay to Richmond (about 13 kilometres upstream of Windsor). However, between Windsor and Richmond, the river is very shallow in places and subject to weed infestations.

The river is used by a wide range of craft, including canoes, kayaks, motor boats and houseboats. There are five houseboat operators on the river. Houseboats cater for up to 12 people and are typically hired for periods of three days to one week. It is unlikely that houseboats would attempt to pass under the Windsor Bridge due to the shallow water upstream of Windsor.

There are numerous public and private boat ramps downstream of Windsor. The nearest ramp to the town is at the eastern end of Governor Philip Park, at the confluence of South Creek and the Hawkesbury River.

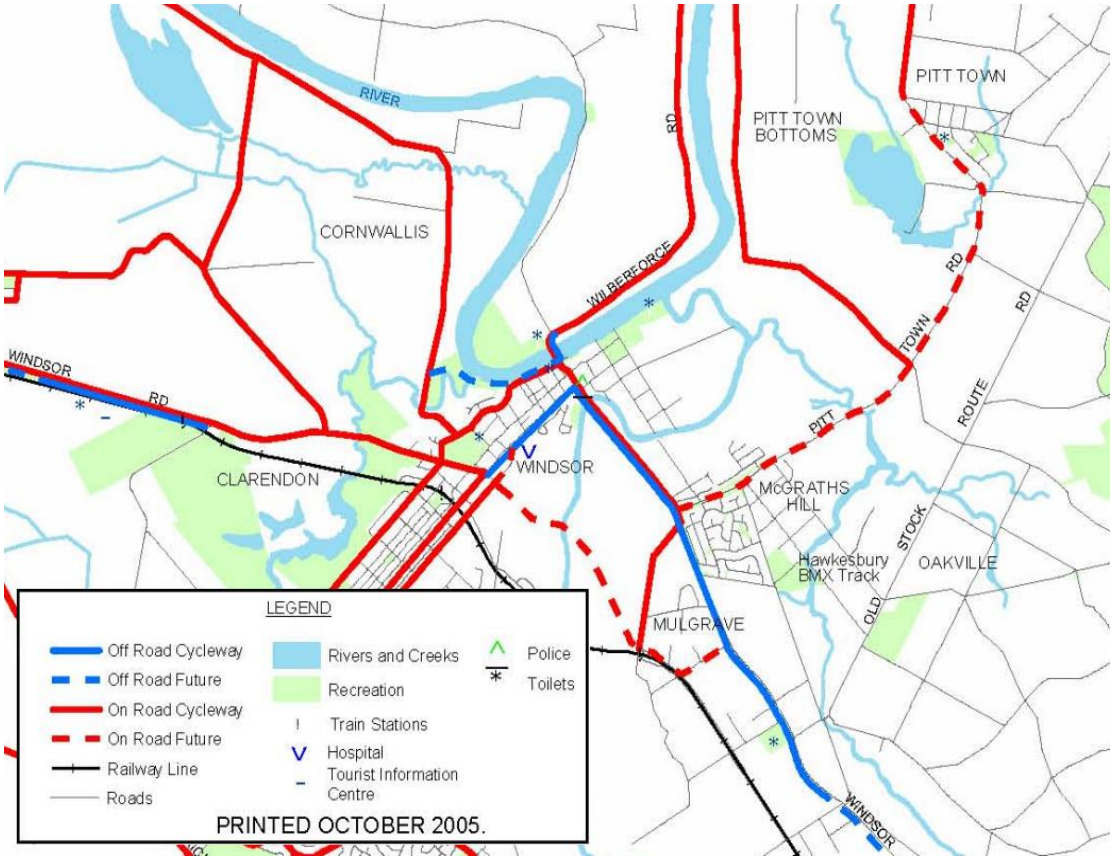

Figure 7-17 Local cycle routes

Adapted from Hawkesbury City Council 2011 – http://www.hawkesbury.nsw.gov.au/__data/assets/pdf_file/0012/723/Cycling-in-the-hawkesbury-2011-May.pdf

7.3.3 Construction impacts

Impacts on traffic

The construction of the project would generate construction traffic travelling to, from, and within the project. It is likely that most of the heavy vehicle construction traffic would originate from the south of the project. The construction traffic movements to / from the work sites would have the potential to impact the efficient movement and safety of other road users. Additional traffic movements would be generated by:

- Construction workers travelling to and from worksites.
- The delivery of heavy vehicles and machinery, and other equipment required for construction.
- The delivery of construction materials including concrete, steel, aggregates, imported fill as detailed in **Table 7-14**, as well as pre-fabricated structural elements.
- The movement of spoil generated by earthworks, including the movement of materials within the site, transferral to stockpile sites and/or removal from the project site.

The potential for the most substantial traffic impacts would be where construction site accesses intersect with existing roads. These locations are likely to be Wilberforce Road east of the intersection of Freemans Reach Road and Wilberforce Road for the northern site compound and at the intersection of The Terrace and Bridge Street for the southern site compound. Minor temporary road works would be undertaken on Wilberforce Road to provide a safe and efficient access to the northern site compound. Temporary traffic lights or similar traffic control measures would be installed for access to the southern site compound.

The quantities of materials and heavy vehicle trips generated by the construction of the project would be relatively low when compared to average daily traffic volume of about 19,000 vehicles. (see **Table 7-14**). Consequently, the existing operational performance of roads and intersections would not be significantly impacted by construction.

The activity that would generate the most heavy vehicle movements would be concrete pours for the incrementally launched bridge. These would generally occur every fortnight and involve up to twenty concrete trucks over a ten hour period. This number of concrete trucks over a ten hour period would not cause significant impacts. Other arrivals and departures of heavy vehicles would generally be evenly spread throughout the construction period.

At its peak there would be about 110 workers and other construction personnel on site who would generate about 220 traffic movements a day travelling to and from site. This represents an increase in daily traffic movements of around one percent. Most construction workers would come from south of Windsor and therefore would be travelling in the opposite direction of the AM and PM peak traffic flows. Overall the impact on road traffic capacity of construction workers travelling to and from site would be negligible.

Table 7-14 Estimate of types and quantities of materials for construction

Description	Approximate quantities	Truck Movements	Duration (months)	Average Daily Movements
Road works				
Earthworks (cut to fill)	1,500 m^3	120	1	6
Earthworks (imported fill)	10,000 m^3	800	3	14
Concrete	3,500 m^3	280	3	5
Asphalt	1,000 tonnes	80	1	4
Dense grade base (DGB)	650 m^3	52	1	2 -3
Structural steel	30 tonnes	3	3	1
Bridge works				
Concrete	2400 m^3	192	6	2
Steel reinforcement	450 tonnes	45	6	1
Asphalt	500 tonnes	50	2 weeks	5
Imported fill	800 m^3	64	1	3

The overall impact of construction on local traffic is anticipated to be minor, as construction would generally be undertaken clear of existing traffic and works potentially disrupting traffic would be undertaken outside of high traffic periods. The level of service of the existing bridge, approach roads and intersections would not be significantly impacted.

Minor delays for traffic using Bridge Street, George Street, Wilberforce Road and Freemans Reach Road would occur during construction when reduced speed limits are in place or when manual traffic control is required for construction vehicles to access and exit work sites. There would also be delays during periods when the existing sections of road are being tied in with the newly constructed sections of road, however these would be scheduled to occur outside of peak hours.

Construction haulage routes

The construction of the project would not require major earthworks and only a relatively small quantity of imported fill material (about 11,800 m^3) would be required. Consequently the number of earthworks related truck movements would be low and there would be no significant internal haul routes between project sites. The majority of truck movements associated with the construction of the project would be generated by the delivery of materials such as fill material, concrete, pre-cast elements, steel, pipes and formwork. These materials would be sourced from various locations within the region and the Sydney metropolitan area although most deliveries would originate south of Windsor and would access the project area via major arterial roads such as Windsor Road and Macquarie Street.

The demolition of the bridge would generate about 800 total truck movements (around 400 trucks travelling to and from site) over a six month period to remove demolished sections of the bridge. On average there would be about six truck movements a day (with a daily peak of about 12 truck movements) which is less than 0.1 percent of daily traffic movements. Most truck movements would be to and from locations south of the project area including metal recyclers for the steel components of the bridge that are suitable for recycling, concrete recyclers for the bridge deck and landfill for the parts of the bridge that are not able to be recycled or reused. The southern routes to access and exit the project area are Windsor Road and Macquarie Street from the southern bank and from the northern bank - Wilberforce Road, Kurmond Road and Blacktown Road /Richmond Road or Hawkesbury Valley Way and Windsor Road.

There would be demolition truck movements from both the northern bank (Wilberforce Road and Kurmond Road to Richmond) and from the southern bank (The Terrace and Baker Street). If feasible, the bridge would be demolished from south to north with the majority of truck movements from the northern bank, avoiding the local roads in Windsor. However because of the poor structural condition of the existing bridge, this may not be possible and the demolition of the bridge may have to start from the middle and progress both north and south.

Impacts on property access

Access to properties would be maintained throughout the construction of the project, although temporary interruptions to access would be required at various times. Properties most likely to be impacted by interruptions in access would be 4 and 6 Old Bridge Street.

Impacts on access to the town centre

There would be no major impacts on access to the town centre during construction. Reconstruction of the George Street/Bridge Street intersection would be undertaken in low traffic periods (ie evenings and night time) when the demand for access to the town centre would be low. If temporary road closures are required, alternative routes to access the town centre would be provided at all times.

Impacts to tourist and recreational facilities

There would be temporary impacts on access to some recreational facilities. The lower parkland areas of Thompson Square would be closed to the public during construction of the project. Once the replacement bridge is open, a portion of the upper parkland in Thompson Square would also be closed for public access for about two months to allow the safe removal and infilling of the southern approach road to the existing bridge and to undertake landscaping.

There would be some temporary changes and potentially some minor delays in access to Macquarie Park during the construction of the new access roads and paths to the park. However, pedestrian and vehicle access would be maintained at all times and any impacts would be minimised especially on weekends or for planned events in the park.

Access to Governor Phillip Park would be unaffected by the construction of the project. Apart from Thompson Square, access to other tourist facilities in close proximity to the project such as the Hawkesbury Museum, Macquarie Inn and motels would not be directly impacted during the construction.

Impacts on cyclists and pedestrians

No specific on road facilities are currently provided for cyclists within the road network impacted by the project except for the shared path on the existing bridge. Cyclists currently travel in amongst general traffic and would, therefore, be subjected to the same minor delays as general traffic.

Pedestrian access would be maintained to Windsor Wharf via Old Bridge Street. The lower Thompson Square parkland, the Windsor Wharf parkland and The Terrace east of the existing bridge would be closed to public access during construction. Other pedestrian paths would not be impacted.

Impacts on bus operations

There would be no disruption to existing passenger and school bus routes during construction as no roads would be closed. Minor delays may be experienced due to reduced speed limits or during manual traffic control.

Impacts on emergency vehicles

Construction would not impact on emergency vehicles, as vehicular access along all roads impacted by the work would be maintained.

Access to Windsor Wharf

Public vehicle access to Windsor Wharf would be closed once construction commences as the Windsor Wharf car park and The Terrace would be used as a construction compound. Service vehicle access to Windsor Wharf would be maintained for as long as possible until The Terrace is temporary closed for safety reasons due to the incrementally launched bridge. Pedestrian access to Windsor Wharf would be maintained at all times.

Impacts on maritime activities

Temporary exclusion zones and/or no wash zones around water-based construction sites and activities would be required. However at all times passage up and downstream of the construction areas would be maintained. Water-based construction activities would not impact upon the operation of Windsor Wharf.

Impacts on safety

All temporary accesses, road works and other traffic management measures would be designed and operated to confirm with relevant road safety and RMS requirements and would not impact upon the safety of the users of the existing road network.

Safe pedestrian access designed to relevant safety requirements would be provided for all path and other pedestrian facilities.

Impacts on parking

Parking for construction workers would be provided within the nominated construction compounds where possible, with only limited parking provided on the southern bank and a larger parking area on the northern bank. Preliminary discussions have been held with Hawkesbury City Council on the use of an area of Macquarie Park for overflow parking for construction workers and this would be the likely solution for construction worker's parking. As construction works on the weekend would be limited, it is unlikely that the project would require overflow parking in Macquarie Park during the weekend – which is the period of higher usage of the park.

Parking would be discouraged from the Windsor town centre and surrounding roads.

7.3.4 Operational impacts

Future traffic volumes

Future traffic volumes were determined using 2012 intersection counts and growth rates from the Sydney Strategic Travel Model. These growth rates are presented in **Table 7-15**. The project would not be expected to generate any additional traffic or change travel patterns as it is a replacement of an existing section of road.

Table 7-15 Growth rates of key roads (using 2011 as the base year)

Road	Growth to 2021 (%)	Growth to 2026 (%)
Bridge Street, over Windsor Bridge	17.3	25.3
Wilberforce Road, north of Freemans Reach Road	15.2	22.9
Freemans Reach Road, north of Wilberforce Road	20.7	29.3

Using the growth rates and average daily traffic (ADT) volumes over the Windsor bridge in March 2012, 2021 and 2026 traffic volumes were estimated and are presented in **Table 7-16**. Planning assumptions, such as the scope of developments and their timeframes may change and consequently projected traffic growth may be achieved earlier or later than predicted.

Table 7-16 Bridge Street ADT projections

Road	2012 ADT (base)	2021 ADT	2026 ADT
Bridge Street, over Windsor bridge	19,000	22,500	24,000

Intersections

For each of the key intersections, a number of different options were investigated and assessed using SIDRA intersection modelling software. A full description of the different options assessed is presented in the Traffic and transport working paper (Volume 4 – Working paper 4) and Chapter 4. Relevant results from the SIDRA assessment are presented in the tables below.

At the Freemans Reach/Wilberforce Road intersection, the existing “Give way” intersection type currently has an unacceptable Level of Service. A number of alternative intersections types were investigated and assessed using SIDRA. Traffic signals at the intersection were found to provide the best Level of Service of all options. However the intersection is in the floodplain and would be subject to periodic inundation by flood water which would decrease operational reliability and increase maintenance costs of traffic signals. Also the intersection is located in a rural setting and traffic signals would not be appropriate in this type of visual environment. A number of roundabout options were also assessed and a dual lane 4 legged roundabout intersection was identified as providing an acceptable Level of Service in 2026.

While the existing George Street/Bridge Street roundabout intersection currently has an acceptable Level of Service, by 2016 the Level of Service would decrease to an unacceptable level in the PM peak (see Traffic and transport working paper (Volume 4 – working paper 4)). Therefore alternative intersections options were investigated. Alternative roundabout designs were not considered suitable for the Bridge Street/George Street intersection as there is no available land to increase the size of the roundabout due to heritage and property constraints and a roundabout does not provide for effective and safe pedestrian crossing. The alternative intersections options investigated all included traffic lights and had various lane and turning configurations. The preferred option for the George Street/Bridge Street intersection is presented in **Figure 7-18**. The key features of the intersection would be:

- Vehicles travelling south on Bridge Street north would be able to turn right into George Street west via a dedicated right hand turn lane. Vehicles under nine metres in length would be able to turn left into George Street east.
- Vehicles travelling north on Bridge Street south would be able to turn left into George Street west via a dedicated left hand turn lane. Vehicles would not be permitted to turn right into George Street east as this would result in unacceptable Level of Service for the intersection as a whole. For vehicles wanting to access east Windsor and Governor Phillip Park, a dedicated right turn bay would be provided at the intersection of Bridge Street and Court Street about 170 metres south of the George Street/Bridge Street intersection.

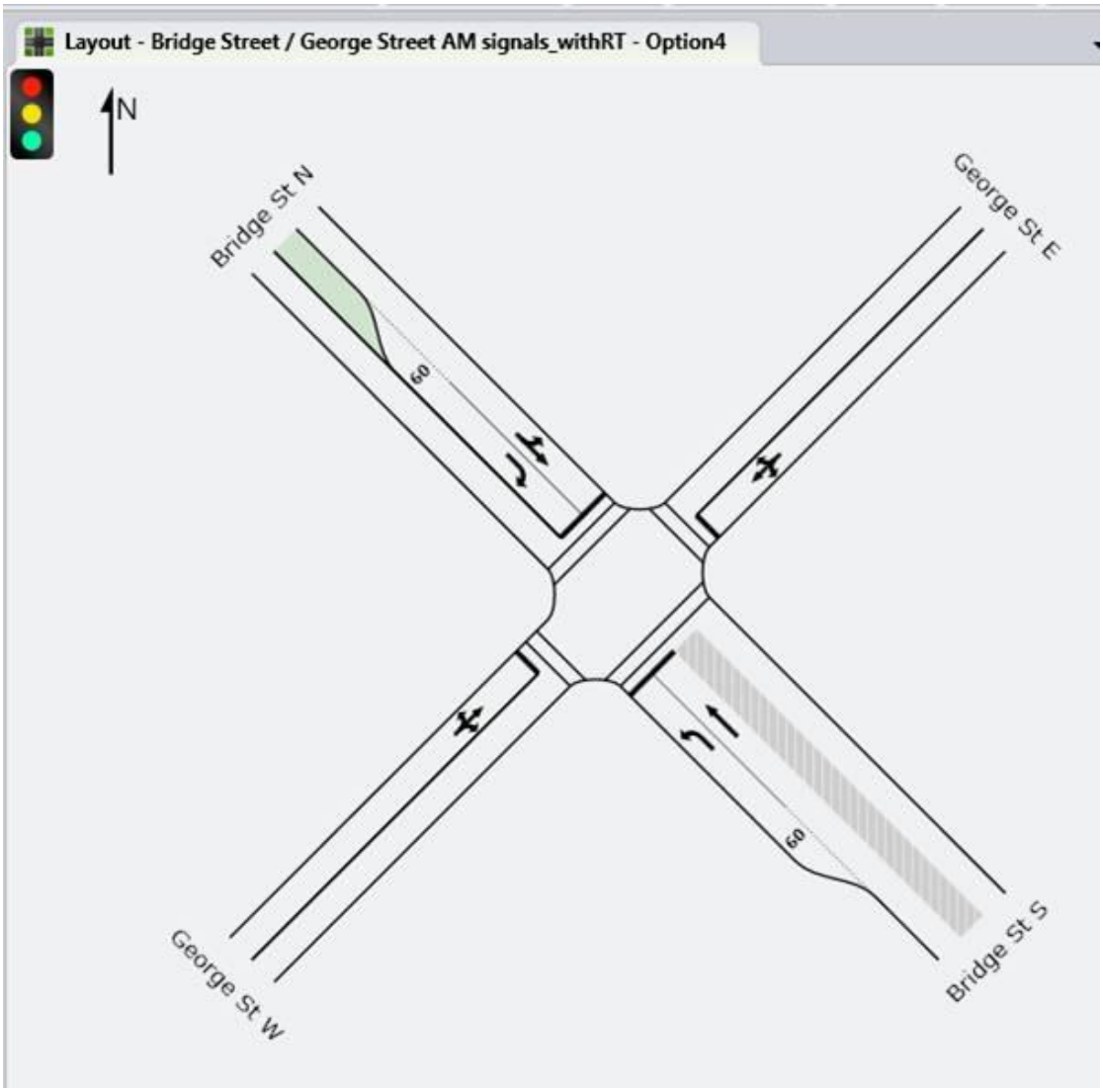

Figure 7-18 Configuration of new George Street/Bridge Street intersection

Network modelling

Due to the close proximity of the intersections, assessment of the local road network was required to confirm the performance of the preferred intersection types. The results of the network modelling for the AM and PM peak hours are provided in **Table 7-17** and **Table 7-18** below in terms of Level of Service for each leg of the intersections.

Modelling for the AM peak was undertaken for the initial road configuration of one lane in each direction on the replacement bridge and for the ultimate configuration of two lanes southbound and one lane northbound. For the PM peak the two lane southbound option was not modelled as the dominant traffic movements are northbound and providing additional southbound capacity would not alter the performance of the intersections.

With only one lane southbound on the bridge the Level of Service for Wilberforce Road in AM Peak in 2026 is predicted to be unacceptable at F. However with two lanes southbound the Level of Service would be acceptable with a Level of Service of B (See **Table 7-17**).

Therefore, when southbound traffic increases to a point when delays become unacceptable, the replacement bridge would be reconfigured to provide one northbound and two southbound lanes. The only other road predicted to have a poor Level of Service is George Street, however only five per cent of traffic movements in the AM peak originate from George Street – and the other 95 per cent of traffic movement have a Level of Service of A or B. For the PM peak (see **Table 7-18**) similar results are obtained. Based on the network modelling, the overall performance of the new intersections and lane configurations in both the AM and PM peak would be acceptable.

Table 7-17 Results of network modelling (AM Peak Hour) – 2026 traffic levels

Project Case	One lane southbound		Two lanes southbound	
Approach	**Average Delay per Vehicle (seconds)**	**Level of Service**	**Average Delay per Vehicle (seconds)**	**Level of Service**
Freemans Reach Road / Wilberforce Road				
Freemans Reach Road	20	B	8	A
Wilberforce Road	135	F	16	B
Bridge Street	4	A	4	A
All	**70**	**F**	**11**	**A**
George Street / Bridge Street				
Bridge Street (N)	26	B	22	B
George Street (E)	56	E	62	E
Bridge Street (S)	4	A	4	A
George Street (W)	50	D	53	D
All	**23**	**B**	**21**	**B**

Table 7-18 Results of network modelling (PM Peak Hour) – 2026 traffic levels

Approach	Average Delay per Vehicle (seconds)	Level of Service
Freemans Reach Road / Wilberforce Road		
Freemans Reach Road	15	B
Wilberforce Road	5	A
Bridge Street	18	B
All	**15**	**B**
George Street / Bridge Street		
Bridge Street (N)	26	B
George Street (E)	104	F
Bridge Street (S)	18	B
George Street (W)	105	F
All	31	C

Queuing

Queuing predictions for the northern and southern intersection from modelling 2026 traffic levels are provided in **Table 19** and **Table 7-20.**

In the AM peak (see **Table 7-19**) the queuing results show that with a single southbound lane on the new bridge, the two lanes exiting the northern roundabout would be required to merge which would result in an average and maximum queue length along Wilberforce Road of around 77 metres and 513 metres respectively. With the provision of the second southbound lane, the merge would be eliminated and the queuing results on Wilberforce Road show that there would be a considerable reduction in the average and maximum queue lengths.

On opening in 2016, in the PM peak (see **Table 7-20**) the queue lengths would be low and reflect the improved Level of Service of the new intersections. However over time the queues would increase due to growth in traffic and in 2026 the length of the queue of northbound traffic on Bridge Street would be unacceptable. To reduce queue lengths to acceptable levels, the right hand turn from Bridge Street north into George Street west may have to be banned in the PM peak period. This would allow more green light time for northbound traffic on Bridge Street and reduce queue length to acceptable levels (see **Table 7-20**).

While the queue lengths on Bridge Street south would extend back to the Macquarie Street/Bridge Road intersection, this would only occur for short periods of time. The maximum queue lengths presented in **Table 7-20** would occur for less than five per cent of the peak period.

Table 7-19 Summary of predicted queuing results (AM peak) – 2026 traffic levels

Project Case	One lane southbound		Two lanes southbound	
Approach	**Average Queue (metres)**	**Maximum Queue (metres)**	**Average Queue (metres)**	**Maximum Queue (metres)**
Northern Intersection				
Bridge Street	0	12	0	25
Freemans Reach Road	2	27	1	28
Macquarie Park access	0	0	0	0
Wilberforce Road	77	513	9	107
Southern intersection				
Bridge Street north	61	340	57	187
Bridge Street south (straight)	3	64	3	58
Bridge Street south (left turn)	0	0	0	0
George Street east	3	16	3	16
George Street West	6	55	6	55

Table 7-20 Summary of predicted queuing results (PM peak) – 2016 and 2026 traffic levels

Approach	2016 Right turn from Bridge St (N) to George St (W) permitted		2026 Right turn from Bridge St (N) to George St (W) permitted		2026 Prohibited right turn from Bridge St (N) to George St (W)	
	Average Queue (metres)	Maximum Queue (metres)	Average Queue (metres)	Maximum Queue (metres)	Average Queue (metres)	Maximum Queue (metres)
Freemans Reach Road / Wilberforce Road						
Bridge Street	1	29	0	22	0	13
Freemans Reach Road	2	20	2	28	5	28
Macquarie Park	0	0	0	0	0	0
Wilberforce Road	0	14	0	13	0	14
George Street / Bridge Street						
Bridge Street N	14	95	45	333	8	126
Bridge Street S (ahead)	47	181	214	431	63	226
Bridge Street-S (Left)	0	0	0	0	0	0
George Street E	6	25	3	16	78	118
George Street W	39	90	91	251	34	121

Capacity

The project has been developed and designed to cater for future growth in traffic and provide efficient traffic movements in all conditions. The bridge would initially be configured to have one southbound and one northbound lane and wide two metres shoulders. These wide shoulders would allow vehicles to pull over safely or allow two lanes of vehicles to divert around a stopped vehicle or an accident. The new bridge and approach roads would of sufficient width to be reconfigured to accommodate an additional lane for southbound traffic. This would occur when the growth in traffic has resulted in unacceptable delays and congestion. Network modelling results presented in **Table 7-17** and **Table 7-19** demonstrate that with only one southbound lane, unacceptable levels of service and queuing would occur in 2026. With the additional southbound lane, the level of service and queuing would be acceptable with the predicted 2026 traffic levels.

There would be no benefit in capacity or travel times with two lanes northbound on the bridge because:

- There are no intersections on Freemans Reach Road or Wilberforce Road near the project that would restrict northbound traffic flow so no additional capacity (or lanes) on the bridge would be required.
- The new configuration of the George Street and Bridge Street intersection would be one lane northbound – so providing two northbound lanes on the new bridge before the majority of traffic travel on to the single lane Freemans Reach Road or Wilberforce Road would provide no improvement in traffic flow.

Regional traffic

The project would provide increased capacity to the regional road network as shown by the network modelling. This benefit would be largely experienced by the Bridge Street/Windsor Road corridor and the increased capacity of this route would support future development within the region particularly on the northern side of the Hawkesbury River.

The reduction in queuing along Bridge Street south in the PM peak due to the project would also benefit the Macquarie Street/Bridge Street intersection – which is part of a regional traffic route to the west.

Freight routes

The project does not aim to create a new freight route across the Hawkesbury River as the existing Windsor bridge currently has no load restrictions. Rather the project aims to preserve the existing freight routes by providing a new bridge structure that would not be subject to load restrictions over its 100 year design life. As noted in Section 3 due to the deteriorating condition of the existing Windsor bridge, load restrictions may be required in the short term if the bridge is not replaced.

Some submissions on the project have raised concerns that the project would result in increased truck movements, especially trucks travelling between the Hunter and Sydney via Putty Road. While the project would improve the capacity and safety of a Hawkesbury River crossing at Windsor it is unlikely to encourage more trucks to use Putty Road as the project is only a 600 metre section of a 172 kilometre road between Sydney and Singleton and there are no load restrictions on the existing Windsor bridge.

Crashes

The project would result in a reduction in the number and severity of crashes as the design of the project would meet relevant road safety design guidelines. Also specific project elements which would reduce the potential for crashes include:

- The introduction of a roundabout at the Wilberforce Road/ Freemans Reach Road/ Macquarie Park access/northern approach road intersection.
- The replacement of the roundabout with traffic signals at the Bridge Street/ George Street intersection.
- The new alignment of the replacement bridge.

The majority of historical crashes were recorded at Wilberforce Road near Freemans Reach Road, with most occurring when vehicles were approaching from adjacent roads. This is due to the current method of control where Freemans Reach Road gives way to Wilberforce Road at a 'T intersection'. Under this form of control, right turning vehicles have to give way to both directions of traffic on Bridge Street and Wilberforce Road. This type of control is heavily reliant on the driver's ability to correctly select safe gaps. The provision of a roundabout at the Wilberforce Road/ Freemans Reach Road/ Bridge Street intersection would improve road safety by:

- Controlling the approaching vehicle speeds through entry and circulating carriage width geometry.
- Operating under roundabout 'right of way' control all vehicles need only 'give way' to traffic on the roundabout and as such it is easier to select safe gaps.

A single crash was also recorded on the curve at the northern end of Bridge Street on the approach to Freemans Reach Road. The project would eliminate this curve, reduce the speed limit to 50 kilometres per hour and introduce a roundabout controlled intersection resulting in an overall slower approach speed to this curve.

The traffic signal upgrade at the intersection of Bridge Street and George Street would be expected to improve pedestrian, cyclist and driver safety in this area. Similarly, the likelihood of rear-end crashes, such as those recorded on Bridge Street in the vicinity of the bridge, would be likely to be reduced due to the improved horizontal and vertical alignment of the project.

Local access

To meet current road safety standards, a raised median would be required to separate northbound and southbound traffic on Bridge Street north of the George Street and Bridge Street intersection. The raised median would prevent right turns into and from 4 and 6 Bridge Street.

Alternative permanent access arrangements to 4 and 6 Bridge Street were investigated. There is a back lane which extends from George Street along the rear of 6 and 10 Bridge Street, however it does not extend as far north to the rear of 4 Bridge Street. While it would be possible to create an access from 6 Bridge Street to the lane, a substantial brick garage appears to block access to the rear lane from the property. There are no options for alternative access to 4 Bridge Street.

While 6 Bridge Street is a commercial premise, it would be unlikely to experience a reduction in business due to the changed traffic arrangements. The building currently houses a legal practice which is a destination based business that does not rely on passing trade and whose customers would be unlikely to select the use of a legal practice based upon accessibility by vehicle.

Vehicle access to 4 and 6 Bridge Street would only be available via the northern approach through “left-in” / “left-out” turning movements. Drivers travelling from the south would need to cross the bridge, circle the roundabout and re-cross the bridge from the northern side to gain access to these properties. Vehicles exiting these properties and wanting to go northbound have a number of options to return to Bridge Street northbound (eg. turn right at Macquarie Street, right at one of the cross streets, right into George Street and then left into north bound Bridge Street).

Access to Number 33 Wilberforce Road would also be altered under the new traffic arrangements. For safety, vehicles would no longer be able to turn right into (or out of) the existing access at Number 33 Wilberforce Road. Driveway access to Number 33 Wilberforce Road would be relocated further north (away from the proposed dual lane roundabout) to a point where all tuning movements onto and off Wilberforce Road could be maintained.

For Bridgeview (Number 27 Wilberforce Road) vehicle access would be provided via the Macquarie Park access road.

The project would involve reconstructing The Terrace to provide both light vehicle and pedestrian access underneath the new bridge (including provision for emergency vehicle access).

Local parking

There would be no change to the current parking arrangements and number of car spaces on George Street and Bridge Street. Five car parking spaces in the lower Thompson Square parkland would be lost as they would be directly in the footprint of the southern approach road to the new bridge. However the number of parking spaces in the adjacent Windsor Wharf carpark would remain unchanged and there is plenty of on-street parking in nearby streets. Overall the impact of the project on parking would be minor.

Windsor Wharf

The operation of Windsor Wharf would not be affected by the project. Access to Windsor Wharf would change and would be via The Terrace under the new bridge, rather than Old Bridge Street which is the current situation. The new bridge would have a minimum clearance of 3.6 metres over The Terrace which would allow cars, Council garbage trucks, emergency services vehicles and small coaches direct access to the wharf. Large coaches over 3.6 metres in height would be required to park on the western side of the project. There is coach parking on Thompson Square road and Baker Street – which are relatively close to the wharf.

In response to Hawkesbury City Council's concerns about large coach access to Windsor Wharf RMS will investigate the possibility of increasing the clearance of the the new bridge over the The Terrace to allow large coach access during detailed design. Investigations would consider limiting impacts on heritage views and vistas.

Public transport

There would be no negative impact on the existing bus services as a result of the project. The project would result in reduced overall delay on the road network.

Pedestrians and cyclists

The project would provide substantial access and safety benefits for pedestrians and cyclists. A shared pedestrian/cycle pathway meeting current design guidelines would be provided, from Wilberforce Road and Macquarie Park, across the western side of the new bridge, along the western side of the southern approach road to the corner of George and Bridge Streets. This would result in a safe and accessible link between the northern and southern banks of the river and would be a substantial improvement on the existing pedestrian facilities.

Pedestrian and cyclist access along the southern bank of the river would also be improved with the connection and redevelopment of The Terrace. In addition, pedestrian and cyclist safety and access would be improved through the following general works which form part of the project:

- Improved pedestrian access and connectivity would be provided through the construction of a new 1.2 metre wide footpath adjacent to properties fronting Old Bridge Street. The footpath would extend from the intersection of Bridge Street and George Street and connect to The Terrace on the eastern side of the new southern approach road.
- Pedestrian safety and access would be substantially improved between the town centre and east Windsor by the new signalised pedestrian crossings across all four approaches to the intersection of Bridge Street and George Street.

- Pedestrian access and safety would be improved through the construction of new pedestrian footpaths around and across the dual lane roundabout at the junction of Freemans Reach Road, Wilberforce Road and the Macquarie Park access road.

The project would also help to facilitate part of the Great River Walk and would achieve two of the key recommendations of the Hawkesbury Mobility Plan 2010 (GTA Consutlants, 2010). The Hawkesbury Mobility Plan specifically identifies the Bridge Street and George Street intersection as a major barrier to east-west pedestrian movements and an area with poor pedestrian facilities. It recommends investigating redesign of the intersection to accommodate greater pedestrian movement.

Maritime

The new bridge would have a minimum and maximum clearance of 7.8 metres AHD and 9.2 metres AHD, respectively, and would have four piers. This compares to a clearance of 7.15 metres AHD and ten piers for the existing bridge. All vessels that are capable of passing under the existing bridge would be able to pass under the replacement bridge. The reduced number of piers supporting the new bridge would improve the safe navigation of the river. While future maritime and recreational use of the river is not currently anticipated to differ markedly from the existing uses, the increased vertical and horizontal clearances would improve opportunity for future uses. The paddle steamer, which is 11 metres in height, would continue to be restricted to the eastern side of the bridge due to insufficient clearance.

Comparison of the project to traffic and transport project objectives

The project has been compared against the traffic and transport project objectives in **Table 7-21**.

Table 7-21 Comparison of the project to traffic and transport project objectives

Objective	Response
To improve safety for motorists, pedestrians and cyclists	
Meets the current design codes (eg. traffic lane widths, shoulder widths and shared path widths).	The bridge, approach roads, shared cyclist/pedestrian paths would be designed to meet current design codes and would result in an improvement in the safety of all road and pathway users compared to the existing bridge and approach roads.
Meets a road speed of 50 km/h.	The bridge and approach roads would be designed for a 50km/h speed limit.
Ensures pedestrian safety.	Pedestrian safety would be considerably improved with a design code compliant shared path across the bridge. The pedestrian path across the existing bridge does not comply with current design codes. Also the signalised intersection at the intersection of George and Bridge Streets would provide for pedestrian crossings, where for the existing roundabout there are no provisions for pedestrian crossings. Pedestrian access and safety would be improved through new pedestrian footpaths around and across the proposed dual lane roundabout at the junction of Freemans Reach Road, Wilberforce Road and the Macquarie Park access road. There are no existing pedestrian facilities at this intersection.

Objective	Response
To improve traffic and transport efficiency	
Minimises queue length/delays.	The intersection types and configurations have been selected to minimise queue length and delays as much as possible. To achieve this, the existing intersection at Bridge Street, Freemans Reach Road and Wilberforce Road is proposed to be modified from a "Give Way" priority controlled intersection to a dual lane roundabout. The existing intersection at Bridge Street and George Street is proposed to be modified from a single lane roundabout to a traffic signal controlled intersection.
Improves performance of road network (level of service).	The overall performance of the road network would be substantially improved with the project. For 95 per cent of traffic movements in the peak periods Levels of Service of A or B would be achieved in 2026 with two lanes southbound on the bridge.
Enables two heavy vehicles to pass on the bridge without waiting.	The bridge and approach roads would be designed to meet current design codes with 3.5 metre lane widths which are sufficient to allow for heavy vehicles to pass in opposite directions without waiting.

7.3.5 Environmental management measures

Construction

A Construction Traffic Management Plan will be prepared and implemented which would enable the safe management of traffic and minimising impacts on the local community. The plan will be structured to address the following issues:

- Identification of public roads to be utilised by construction traffic.
- Management measures to ensure that construction traffic utilise the identified roads.
- Identification of any public roads that may be partially or completely closed during the construction phase and the relevant expected timings and duration of closures.
- Identification of sources of major construction materials and routes for their delivery to site.
- Temporary access and traffic arrangements to be implemented during construction.
- Access arrangements to construction sites and compounds and measures to prevent construction traffic from obstructing traffic flow inadvertently.
- Parking for construction workers.
- A response plan for any construction traffic incident.
- Monitoring, review and amendment mechanisms.

Other environmental management measures that will be included in the Construction Traffic Management Plan include:

- Traffic Control Plans will be developed and implemented for specific areas and/or phases of construction. These will be prepared in accordance with relevant guidelines and by appropriately qualified personnel.
- Traffic controls schemes will be inspected regularly and modified, if required.
- Drivers and construction workers will be inducted in the requirements of the traffic management plan.
- Deliveries and other major construction traffic movements will be timed to occur outside peak traffic periods, where possible.
- Queuing on public roads will be avoided by the use of two-way radios to call up haulage trucks from layover areas on a 'just in time' basis.
- Dilapidation surveys of roads around the project site will be undertaken prior to their use for construction as well as after construction is complete. Any damage to roads will be repaired.
- Consultation will be undertaken with the emergency services, bus operators, local business and other major stakeholders to inform them on changes in traffic management during construction.
- Construction related parking in local areas will be in accordance with the relevant parking restrictions. Opportunities to limit the impact this may have on the community will be investigated in consultation with the Hawkesbury City Council.

Environmental management measures during construction activities in the river may include introducing a temporary navigational speed limit (four knots or below) within the construction zone and/or introducing a temporary no wash zone. Exclusion zones around marine construction sites will be required, however at all stages passage up and downstream would be provided to watercraft. Other RMS maritime requirements will be complied with.

Consultation with maritime operators will be undertaken to ensure any impacts are minimised.

Operation

Environmental management measures for the operation of the project have largely been incorporated into the design of the project. The only additional key environmental management measure that will be implemented will be:

- Operational traffic levels and delays will be monitored. When delays due to traffic growth become unacceptable reconfiguration of the lanes on the bridge and approach roads from the initial two lane configuration to two southbound and one northbound lane will be undertaken.