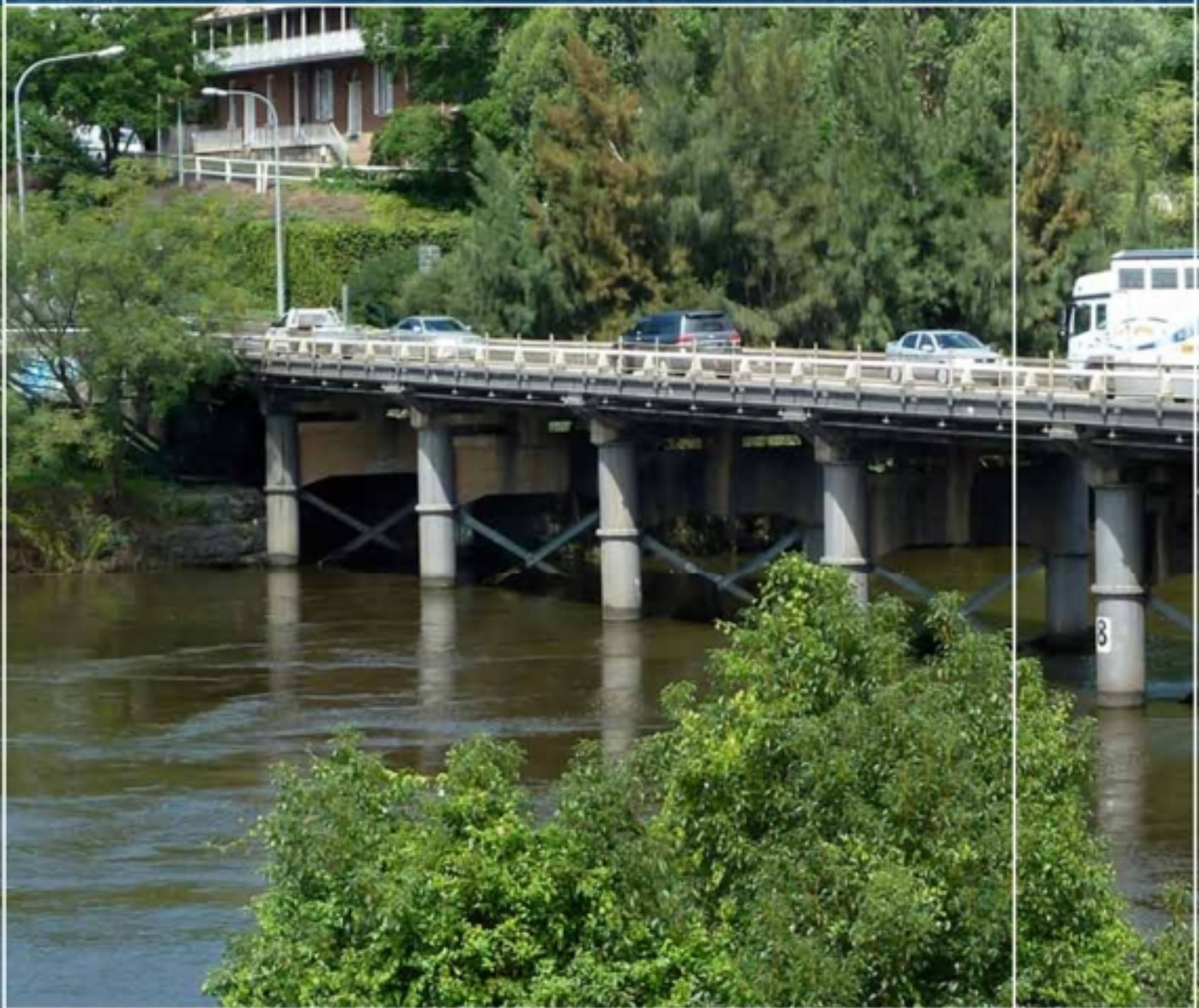




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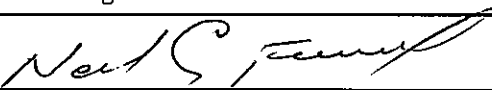
Windsor Bridge replacement

State Significant Infrastructure
application report

OCTOBER 2011

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Prepared by:	RTA Environment Branch
Accepted on behalf of the RTA by:	Neil Forrest Sydney Asset Manager
	Signed: 
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Attachments

Attachment A: Requirements of the *Environmental Planning and Assessment Regulation 2000*
Attachment B: List of heritage items around the project

I Introduction

I.1 Overview of the project

The Roads and Traffic Authority of NSW (RTA) is seeking approval to replace the existing Hawkesbury River Bridge at Windsor (hereafter referred to as Windsor Bridge) with a new bridge located around 35 metres downstream of the existing bridge (the project). It would include upgrading adjacent intersections and approach roads to accommodate the new bridge location. The project is described in further detail in Chapter 3.

The project is located within the Hawkesbury local government area at Windsor, about 57 kilometres north west of Sydney. The regional context of the project is shown in Figure I.1. Windsor is a historic town, which has a high level of non-Aboriginal and Aboriginal heritage significance.

The bridge crossing at Windsor is the oldest existing crossing of the Hawkesbury River and was opened in 1874. It not only provides a local link for communities on either side of the river, but is also an important regional link between western Sydney and the Hunter Valley or Blue Mountains. Around 18,000 vehicles use the bridge crossing per day, with about nine per cent of those being heavy vehicles. Parts of the existing bridge are 137 years old and are deteriorating due to age and heavy usage.

The regional context of the project is shown in Figure I.1. The project and project location are shown in Figure I.2.

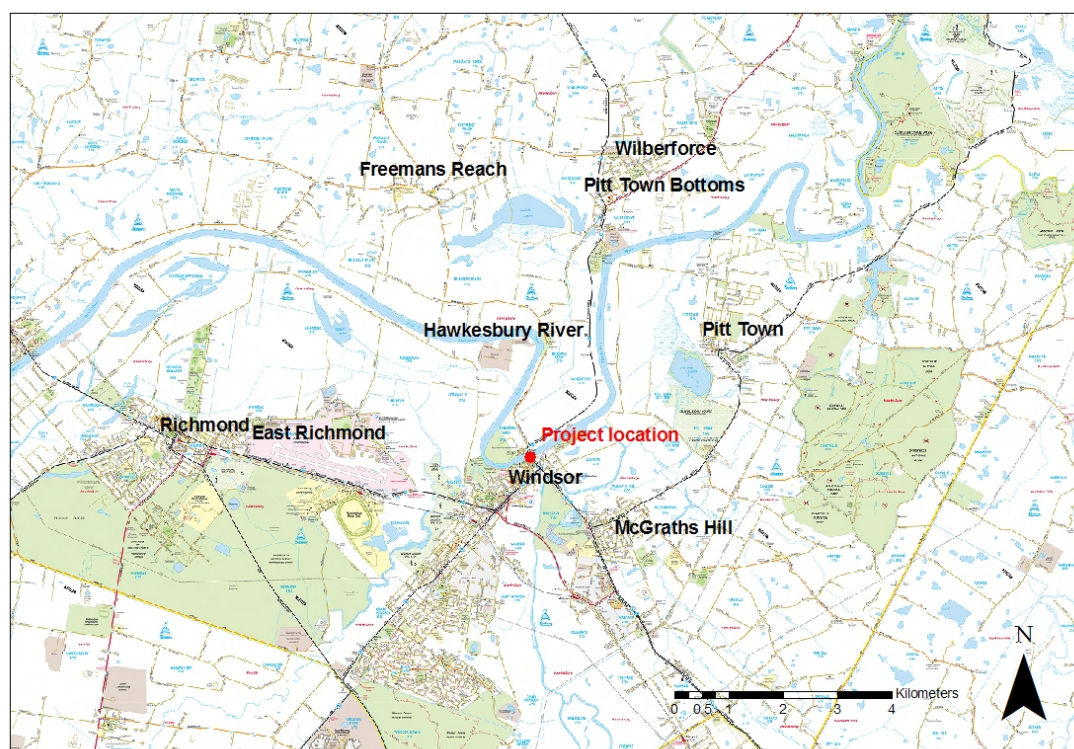


Figure I.1: Regional context of the project

Figure 1.2: Windsor Bridge replacement project and project location



In June 2008, in recognition of the need to replace Windsor Bridge, the NSW Government announced funding of \$25 million for a replacement bridge. Following this announcement the RTA undertook investigations into potential options for Windsor Bridge.

Key benefits of the project include:

- Providing a safe river crossing for the local and regional community.
- Providing a river crossing for a one in five year flood event, which is an improvement on the current one in two year flood level.
- Improved road safety at the Wilberforce Road and Freemans Reach Road intersection.
- Maintaining a central connection with the Windsor township.
- Providing for improved pedestrian facilities and safety.
- Improved intersection management to cope with future increases in traffic levels.
- Replacing the river crossing in a cost effective manner that provides good cost benefits.
- Providing a river crossing that would service the area for the next 100 years.

The RTA recognises that the project would also result in adverse impacts on non-Aboriginal and Aboriginal heritage, noise and vibration, the socio-economic environment, and landscape character and visual amenity. The RTA has formed the opinion that the impact of the project on non-Aboriginal heritage would likely be significant based on direct and indirect impacts to the Thompson Square Heritage Conservation Area as well as at least 13 other items of Commonwealth, State and/or local heritage significance.

1.2 Purpose of this document

The RTA has prepared this application report to support a State significant infrastructure application under section 115X of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

The RTA has formed the opinion that the impact of the project on non-Aboriginal heritage would be likely to significantly affect the environment and would require an environmental impact statement to be obtained under Part 5 of the EP&A Act. The project does not require development consent under Part 4 of the EP&A Act. Accordingly as per clause 14 and Schedule 3 of State Environmental Planning Policy (State and Regional Development) 2011 the project is State significant infrastructure under Part 5.1 of the EP&A Act and requires the approval of the Minister for Planning and Infrastructure.

The requirements of clause 192 of the *Environmental Planning and Assessment Regulation 2000* for applications seeking approval of the Minister for Planning and Infrastructure to carry out State significant infrastructure are addressed in Attachment A to this report.

The purpose of this application report is to assist the formulation of environmental assessment requirements by the Director-General under section 115Y of the EP&A Act. The application report does the following:

- Describes the project.
- Considers the potential environmental issues for the project.
- Identifies key environmental issues for the project.

The application report and Director-General environmental assessment requirements would inform the preparation of an environmental impact statement for the project. The form and content of the environmental impact statement would be in accordance with clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

2 Background

2.1 Strategic context and project need

Windsor Bridge is located on Bridge Street at Windsor. Bridge Street is an arterial road and links to Windsor Road in the south and Wilberforce Road in the north. The bridge crossing over the Hawkesbury River provides one of two structural crossings of this section of the river (the second crossing is located about 14 kilometres upstream at Richmond). This road network provides an important connection between the outer suburbs of Sydney and the Blue Mountains and up to the Hunter Valley.

Windsor Bridge was opened in 1874 and is the oldest existing crossing of the Hawkesbury River with parts of the bridge now over 130 years old. Windsor Bridge is deteriorating due to age and heavy usage.

In December 2003, the RTA completed a bridge inspection and condition assessment report for Windsor Bridge. The structure was assessed as being in poor condition and concluded that the structure requires extensive repairs to ensure its ongoing stability and public safety to meet current traffic demands. Further deterioration of the bridge may require closing the bridge to heavy vehicles which would require a 30 kilometre road detour to the Richmond crossing. This would impact travel times and the local economy. Since 2003 the RTA has conducted regular inspections to monitor the condition of Windsor Bridge. Investigations in May 2011 revealed cracks in the steel caisson of the bridge. A truck and bus speed restriction of 40 km/h was introduced on 14 June 2011 to ensure public safety. A replacement bridge is required to maintain long term access.

An average of over 18,000 vehicles per day use the bridge, having steadily increased over the past few decades. The daily traffic consists of around 90 per cent light vehicles and 10 per cent heavy vehicles. The current road capacity is exceeded with more than 900 vehicles per hour crossing the bridge in both the southbound AM peak and the northbound PM peak periods.

The current height of the bridge and the northern approach is within the 1 in 2 year flood level for the Windsor area while the southern approach roads provide access up to the 1 in 5 year flood level.

The width of the existing bridge and design of the approach roads do not meet current road design standards. The bridge deck is 6.1 metres wide which restricts the movement of heavy vehicles across the bridge. Some drivers choose to wait on one side of the bridge while an oncoming heavy vehicle passes which can delay traffic behind the waiting vehicles.

The crash data at Windsor Bridge (including the bridge, the approach roads and intersections) between 2005 - 2009 shows that 21 crashes occurred in this area. Sixteen crashes involved cars, four involved light truck vehicles and one involved a pedestrian. A total of eight injuries resulted from the crashes.

The project is consistent with relevant supporting Government plans and strategies, including:

- NSW 2021 – A plan to make NSW number one (NSW Government, 2011).
- Metropolitan Plan for Sydney 2036.
- State Infrastructure Strategy – New South Wales 2008-09 to 2017-18 (NSW Treasury, 2008).

2.2 Project objectives

The primary aim of the project is to provide a safe and reliable crossing of the Hawkesbury River at Windsor. In addition a number of project objectives were identified during early project planning. These are outlined below in Table 2.1. The project aims to meet these objectives.

Table 2.1: Project objectives

Objective	Criteria
To improve safety for motorists, pedestrians and cyclists.	• Meets the various design codes (eg traffic lane widths, shoulder widths and shared path widths). • Meets a road speed of 60 km/h. • Ensures pedestrian safety.
To improve traffic and transport efficiency.	• Minimises queue length/delays. • Improves performance of road network (level of service). • Enables two heavy vehicles to pass on the bridge without waiting. • Improves load capacity of the crossing to meet current load standards.
To improve the level of flood immunity.	• Provides a crossing that is above the 1 in 5 year flood event.
To meet long term community needs	• Provides an efficient connection for local and regional traffic. • Provides a pedestrian and cyclist connection to surrounding locations. • Minimises impacts on recreational spaces. • Minimises impacts of noise. • Minimises impacts to businesses and the shopping environment. • Minimises impacts on property access and need for acquisition. • Provides a 100 year life span for the bridge structure.
To minimise the impact on heritage and the character of the local area	• Minimises impact on Aboriginal and non-Aboriginal heritage and conservation areas. • Protects the built heritage of the town and its setting. • Minimises visual impact and impacts on the character of local area.
To be a cost effective and an affordable outcome	• Provides a cost effective solution in terms of: - o Capital cost. - o Maintenance cost - o Investment on return. • Minimises the impact of construction in regards to length and timing.

2.3 Selection of the preferred option

The RTA has undertaken community consultation and preliminary environmental and engineering investigations to help develop the preferred option for the Windsor Bridge project. The nine options considered, and suggested community options, are detailed in the Windsor Bridge Replacement Options Report (RTA, August 2011). The report and supporting technical

papers were made available to the public in August 2011.

Community and stakeholder input has been considered throughout the development of the project and has influenced the selection of the preferred option. Consultation with the local community and stakeholders was undertaken as part of the options assessment in 2009 and after the announcement of the preferred option in August 2011. Details about consultation activities that have been undertaken and the results of this consultation are detailed in the following reports:

- Windsor Bridge Community Consultation Report (RTA, November 2009).
- Windsor Bridge Replacement Options Report (RTA, August 2011).
- Windsor Bridge Replacement Project – Community Issues Report (RTA, October 2011)

Feedback received from this consultation will help inform the further development of the concept design and preparation of an environmental impact statement for the project.

3 Project description

The RTA is proposing to replace the existing Windsor Bridge crossing over the Hawkesbury River at Windsor with a new bridge located around 35 metres downstream of the existing bridge location. The project would include upgrading adjacent intersections and approach roads to accommodate the new bridge location.

The project is presented in Figure 1.2 and would include the following key features:

- Construction of a new bridge over the Hawkesbury River around 35 metres downstream of the existing Windsor Bridge. The new bridge width would be up to about 15.5 metres wide and would provide for two traffic lanes, one in each direction, with wide shoulders and a shared pedestrian and cyclist path on the western side. The new bridge would be supported by piers in the river.
- Realignment of Bridge Street to create a new approach road from George Street along the Old Bridge Street alignment to meet the new elevated bridge. Removal of the existing Old Bridge Street alignment.
- Construction of a new approach road to the new bridge on the northern side of the river. The new approach road would be located between the intersection with Wilberforce Road and Freemans Reach Road and the new bridge.
- Construction of a new signalised intersection at Wilberforce Road, Freemans Reach Road and the new approach road to the bridge.
- Upgrade of Freemans Reach Road and Wilberforce Road approaches to the new intersection between Wilberforce Road, Freemans Reach Road and the new approach road to the bridge.
- Construction of a new U turn facility and upgrade of the entrance road to Macquarie Park.
- Construction of a shared pedestrian and cyclist path along the bridge crossing and approach roads, including through Thompson Square.
- Street lighting on the bridge and approach roads.
- Redevelopment of The Terrace to provide vehicle and pedestrian access underneath the new bridge and reshaping access arrangements to the wharf and car parking area. The new bridge would be sufficiently high to allow access for service and other vehicles to the wharf along The Terrace.
- Adjustments and modifications to the existing George Street / Bridge Street intersection.
- Removal of the existing Windsor Bridge.
- Removal of the existing Bridge Street road alignment through Thompson Square and infilling of the existing cutting.
- Restructuring and landscaping of Thompson Square.
- Infilling, restructuring and landscaping of the northern approach road to the existing bridge.

The project would also include associated or ancillary works, activities, uses, structures, or facilities required for the purposes of the project. The project would not include ongoing maintenance works.

4 Key environmental issues

4.1 Overview

Key issues are those that may have high or moderate impacts (actual or perceived) and assessment is necessary to determine the level of potential impact and to develop appropriate measures to mitigate and manage the impacts.

The outcomes of the preliminary environmental investigations indicate the following key environmental issues will require further detailed assessment and may require project specific impact mitigation measures.

- Non-Aboriginal heritage.
- Aboriginal heritage.
- Noise and vibration.
- Land use, property and socio-economic.
- Urban design (including landscape character and visual impact).

A number of other environmental issues have also been identified. These issues are outlined in Chapter 5 and are considered to be of lesser consequence taking into consideration the project scope, the existing environment and the implementation of standard management and safeguard measures. It is expected that these other environment issues would not likely be key issues; however the potential impact of these other environmental issues would be assessed further in any future environmental impact statement for the project.

4.2 Non-Aboriginal heritage

4.2.1 Overview

The Windsor area is of high heritage significance having been first visited by Europeans in 1789 as part of a Governor Phillip expedition. By 1794, 22 farm land grants had been issued and by 1798 the area was the primary supplier of produce for the colony. From 1810 to 1820 Governor Macquarie oversaw the planning for the town layout and establishment of many buildings in Windsor, including developing Thompson Square as public space.

Thompson Square is the only town square that remains from the original five towns planned and designed by Governor Macquarie (the 'Macquarie towns'). It is surrounded by Georgian style buildings from the period. Thompson Square and the surrounding buildings are listed on the NSW State Heritage Register as being of State heritage significance as a square, and most of the buildings are also listed for their individual historical and architectural merit on the SHR.

As a consequence of this long history and minimal development within the local area, Windsor is a well-known heritage area/town. This is due to its intact layout from the initial Macquarie plan, the large number of early Georgian and Victorian period buildings remaining within the town, Thompson Square as a rare early colonial civic space, its undeveloped rural setting and the sympathetic scale of modern infill architecture.

In 2009, during the options identification process, a preliminary heritage and archaeological assessment (Austral Archaeology, 2009a) was prepared. This report identified potential heritage constraints for all nine options under consideration. This report identified known heritage items and potential archaeological heritage within the area.

All of these State Heritage Register items are also listed on other heritage lists including the Local Environment Plan for Hawkesbury, the Register of National Estate, National Trust of Australia Register, s.170 Registers for both the RTA and Police Department and the Cumberland County Council List of Historic Buildings.

The present Windsor Bridge is identified as an item of State heritage significance, although it is not on the State Heritage Register. It has been modified a number of times, including raising of the deck level and deck replacement (in 1897), but some of the elements of the bridge, particularly the caisson deck supports are original fabric.

The southern approach (Bridge Street) to Windsor Bridge runs diagonally through the centre of Thompson Square. The road bisects the park into two triangular segments. It is noted on a number of heritage listings that the existing road alignment detracts from the heritage significance of the square.

Table B.1 in Attachment B provides a list of all the listed heritage items in the areas surrounding the project. This includes reference to what other heritage databases they are listed on. Figure 4.1, below, provides a map showing the location of the heritage items in respect to the project area.

A number of potential archaeological items were also identified within Thompson Square, and in the vicinity of the proposed bridge. These items are listed in Table B.2 of Attachment B. Given the long history of European settlement in this area, and changes to development over time further archaeological items may be found as part of a more detailed heritage assessment. These may also be impacted as a result of the project.

4.2.2 Summary of issues

The Thompson Square Conservation Area is listed on the State Heritage Register and a number of local and Commonwealth listings as being of significant heritage value. The project would be likely to significantly impact on this State significant heritage item during both construction and operation of the project.

In addition, other items of State and local heritage value would also be impacted as a result of the project.

The following potential non-Aboriginal heritage issues have been identified for the project:

Construction

- Direct impacts to the Thompson Square Conservation area:

Parts of Thompson Square would need to be excavated for investigations and for construction of the new bridge, the abutments and the approach roads. Further excavation may be required at and around the roundabout of George Street / Bridge Street to allow for adjustments and modifications to this intersection. Excavation may also be required for the construction of the through road at The Terrace. Adjustments to existing underground utilities in Thompson Square may also require deep excavation.

In addition the existing road alignment would need to be in-filled and some restructuring of the square would need to occur as part of the reinstatement of the existing road corridor and landscaping of the remaining Thompson Square. Construction may require the removal of trees and vegetation from within Thompson Square.

- Direct and indirect impacts to other items of State heritage significance:

The project would require the construction of the new road alignment, bridge approaches,

bridge abutments, new intersections and changes to the existing road arrangements within the State heritage-listed square, and close to State heritage significant buildings. These activities would cause vibration impacts which may impact the structural integrity of the heritage buildings.

Construction activities would also alter the heritage vistas to and from the heritage buildings and impact on the historical character of the area to the community.

The project would require the demolition of the existing Windsor Bridge, which is listed on the RTAs s.170 register and has been servicing Windsor and its surrounds since 1874.

- Direct and indirect impacts to items of local heritage significance:

The project would require the construction of the new road alignment, bridge approach, bridge abutment, a new intersection and changes to the existing road arrangements close to items of local heritage significance. These activities may impact both the structural integrity of the heritage building, would alter the heritage vistas to and from the heritage buildings and impact on the historical character of the area to the local and regional community.

- Direct and indirect impacts to potential archaeological heritage items:

Excavation of land in the location of the new road alignment through Thompson Square and on the northern side of the river may disturb known and potential archaeological items. Construction of piers and abutments in Thompson Square may impact potential archaeological heritage items at deeper levels.

The former wharf is located in-line with the alignment for the new bridge. Construction would likely require destroying the existing remains and other unmapped associated features.

The restructuring and landscaping of Thompson Square, including the construction of the road at The Terrace may also disturb potential archaeological items.

Operation

- Direct impacts to the Thompson Square conservation area:

The formation of Thompson Square would be permanently changed by the project. The Bridge Street alignment would be altered and the existing Old Bridge Street would be removed. The new road alignment would be substantially wider through Thompson Square and may include changes to the intersection arrangements at George St/Bridge St. These changes would be a significant change from the historical arrangements for vehicles through the square.

The new bridge approach through the square would follow and extend the rectilinear Macquarie town plan, and allow the consolidation of severed sections of the park. The landscaping would be changed and the square may need to be terraced to provide for the change in elevation towards the river.

The heritage vistas from the adjacent buildings would be changed due to the new arrangements of the square and the higher and wider road corridor.

Access arrangements to adjacent heritage properties would be altered.

- Direct and indirect impacts to other items of State heritage significance:

The heritage vistas to and from buildings adjacent to Thompson Square and along Bridge Street would be permanently altered. The heritage vistas from other prominent locations around Windsor towards the square would also be impacted.

The project would require moving a wider arterial road closer to a number of State heritage listed properties. Vibration from the operation of the road may impact on the structural integrity of these buildings and require vibration treatments to be undertaken. These vibration treatments may further impact the heritage value of the buildings.

In addition, noise mitigation measures at these properties are likely to be required. These measures may include architectural treatment which will require impact upon historic building fabric and may change structural heritage aspects or the appearance of the buildings.

- Direct and indirect impacts to items of local heritage significance:

The heritage vista to and from buildings of local heritage significance would be permanently altered. The heritage vistas from other prominent locations around Windsor towards these buildings would also be impacted.

The project would require moving a wider arterial road and intersections closer to local heritage properties. Vibration from the operation of the road may impact on the structural integrity of these buildings and require vibration treatments to be undertaken. These vibration treatments may further impact the heritage value of the buildings.

In addition, noise mitigation measures at these properties are likely to be required. These measures may include architectural treatment which will require impact upon historic building fabric and may change structural heritage aspects or the visual appearance of the buildings.

- Direct and indirect impacts to potential archaeological heritage items:

Ongoing vibration from the operation of the road may impact any undisturbed archaeological items underneath Thompson Square.

4.2.3 Proposed further assessments

A detailed heritage assessment would be prepared to provide (as a minimum):

- Updated searches of non-Aboriginal heritage databases.
- An assessment of significance for all known State and local heritage items adjacent to the project.
- An assessment of potential impacts to the known State and local heritage items adjacent to the project.
- A detailed building condition survey to identify sympathetic noise and vibration treatment methods to be applied to impacted heritage buildings.
- An understanding and assessment of the heritage values of Thompson Square to the community over time.
- An understanding and assessment of the visual heritage aspects of the local area.
- An archaeological investigation to determine the presence of potential archaeological items and the potential impacts as a result of the project, using remote sensing technology and archaeological test excavation.
- Mitigation measures to identify opportunities to minimise impacts on the heritage value of the area.

As identified in Section 5.6, a landscape character and visual impact assessment would be prepared to understand and assess the potential impacts of the project on the heritage vistas to and from heritage buildings, within Thompson Square and to the square from other areas of the township and across the river.

As identified in Section 5.4, a detailed noise and vibration impact assessment would be undertaken for the project to assess the construction and operation noise and vibration impacts of the project. This may recommend mitigation measures to treat noise and vibration impacts that require structural adjustments to heritage-listed buildings. All noise and vibration management measures that may impact on heritage items or vistas would be considered and further assessed.

Figure 4.1 - Heritage listed properties in the vicinity of Windsor



4.3 Aboriginal heritage

4.3.1 Overview

Aboriginal occupation of the Cumberland Plain focussed on accessing resources from diverse ecological niches. Major rivers like the Hawkesbury remained constant and reliable places that attracted camping, fishing and inter-clan contact, as well as facilitating travel. Aboriginal occupation in the Sydney Basin is known to have extended beyond the last glacial maximum, when the environment was drier and significantly cooler and the permanent water sources even more critical to survival.

A preliminary Aboriginal archaeological and cultural baseline investigation (Austral Archaeology, 2009b) was undertaken to inform the selection of the preferred option for the project. The investigation included a desktop study, site inspection and initial Aboriginal community consultation regarding nine options then under consideration. Consultation was undertaken in accordance with Stage 2 of the RTA 'Procedure for Aboriginal Cultural Heritage Consultation and Investigation' (PACHCI) (RTA, 2008). The baseline investigation identified known Aboriginal archaeological and cultural sites and likely areas of Aboriginal archaeological sensitivity.

The preliminary Aboriginal archaeological and baseline investigation identified that the township of Windsor is located on relatively deep alluvial deposits and, despite previous disturbance through development of the town, there remains a high likelihood that intact and potential archaeologically significant deposits and sites are located in and around the project location.

The preliminary investigation identified the area in the vicinity of the project as having high archaeological potential and that Aboriginal archaeological sites could be found at any point within the project location. Two specific areas of potential archaeological deposit (PAD) were identified; one on the northern bank of the Hawkesbury River and another on the southern bank. The PAD on the northern bank has an area of about 7500 square metres and the PAD on the southern bank has an area of about 3000 square metres. Both PADs are located to the east of the existing Windsor Bridge. Each PAD contains areas of higher and lower archaeological potential. The areas of high potential were identified as having the likelihood of containing highly detailed stratigraphic and contextual data below an initial layer of soil disturbed by historic and recent land use.

Four isolated finds were recorded near the existing bridge on the northern bank of the Hawkesbury River.

Consultation with the local Aboriginal stakeholder representatives identified that there were no specific cultural places, issues or concern associated with the project. However, it was considered given the proximity of the project to the Hawkesbury River that it contains intrinsic Aboriginal cultural value as a place that would have been central to the lives of Aboriginal people who lived in the area. The potential for burials to exist within otherwise undisturbed sand deposits was also identified as highly likely.

4.3.2 Summary of issues

The following potential Aboriginal heritage issues have been identified for the project:

Construction

- Direct impact to potential Aboriginal archaeological deposits due to construction works for the project.
- Direct impact to known Aboriginal archaeological sites (isolated finds) due to construction works for the project.

- Potential direct impacts to unknown/unidentified archaeological items that may be uncovered, disturbed, damaged or destroyed during construction works.
- Impact on the intrinsic Aboriginal cultural value of the Hawkesbury River and its surrounds due to construction of the new bridge and road approaches.
- Potential impact on untouched sand deposits that may contain items or sites of archaeological value, including potential burial sites.

Operation

- Impact on the intrinsic Aboriginal cultural value of the Hawkesbury River and its surrounds due to the ongoing presence of the new bridge and road approaches.

4.3.3 Proposed further assessment

- Updated searches of Aboriginal heritage databases.
- An Aboriginal cultural heritage assessment report (CHAR) for the whole project area would be prepared in accordance with the following policy documents and heritage guidelines:
 - RTA 'Procedure for Aboriginal Cultural Heritage Consultation and Investigation' (PACHCI) (RTA, 2011).
 - 'Aboriginal Cultural Heritage Consultation Requirements for Proponents' (DECCW, 2010).
 - 'Code of Practice for Archaeological investigation of Aboriginal Objects in NSW' (DECCW, 2010).
- Ongoing consultation with the local Aboriginal community throughout the environmental impact assessment process.
- The development of mitigation measures to identify opportunities to minimise impacts on Aboriginal heritage.

4.4 Noise and vibration

4.4.1 Overview

The noise environment of the area is influenced by the surrounding land use context, which is dominated by residential properties and rural agricultural uses. The main noise source in the area would be traffic, including heavy vehicles, using the existing road network.

The existing noise sensitive receivers for the project include:

- Residential properties.
- Commercial properties such as cafes, restaurants, speciality stores, a learning centre and pub.
- Mixed use residential/commercial properties.
- Recreational and open space areas.

4.4.2 Summary of issues

The following potential noise and vibration issues have been identified for the project:

Construction

- Substantial exceedance of construction noise criteria for the project at a number of sensitive noise receiver locations is likely without noise mitigation measures. This is due to the close proximity of the proposed works to the noise sensitive receiver locations. The extent of impact would vary according to the relative relationship of the construction works to the receiver location, intervening structures and the nature of construction works at various stages of the construction process.

- Increased noise levels for noise sensitive receivers during out of standard construction hours due to construction works during these times. Construction works would generally occur during standard working hours. Some works outside of standard working hours (including night works) may be required to maintain the operational integrity of existing roads.
- Potential vibration impacts on nearby buildings and other structures due to small offset distances between the works and sensitive receiver locations.
- Potential vibration impacts on nearby heritage structures and known or potential Aboriginal and Non-Aboriginal archaeological deposits.
- Amenity impacts on the Thompson Square open space area due to construction noise and vibration.

Operation

- Increases in road traffic noise levels for receiver locations generally to the north east of the current alignment due to the easterly realignment of the road. Likely exceedance of road redevelopment criteria for up to around 50 metres from the road alignment without noise mitigation.
- Reduction in traffic noise levels for residential and commercial properties located generally south west of the existing Windsor Bridge and west of Bridge Street (north of George Street).
- Reduction in traffic noise for the rural property immediately north of the existing Windsor Bridge.
- Reduction in traffic noise for the existing Macquarie Park north west of the existing Windsor Bridge.
- Potential increase in road traffic noise levels for some noise receivers due to adjustments and modifications to the George Street / Bridge Street intersection.
- Potential impacts to heritage buildings that may require architectural treatments to address noise impacts.

4.4.3 Proposed further assessment

- A detailed noise and vibration assessment would be undertaken for the project to assess the construction and operation impacts of the project and to assist in the development of noise and vibration mitigation measures. The assessment would include the following:
 - o Identification of potentially affected noise and vibration sensitive receivers.
 - o An assessment of noise and vibration impacts from the construction and operational phases of the project on identified residential and other sensitive receivers.
 - o Recommendations for detailed feasible and reasonable noise and vibration mitigation measures during construction and operation, where required.
 - o Where possible full detail of the noise attenuation measures (eg architectural treatment or other) would be assessed in order to input into statements of heritage impact, where required.

The noise assessment would adopt the NSW 'Road Noise Policy' (DECCW, 2011) and the 'Interim Construction Noise Guide' (DECC, 2009). The vibration assessment would consider the potential for both structural damage and amenity impacts associated with human comfort guidelines. The assessment would consider the 'Assessing vibration: a technical guideline' (DEC, 2006) for human comfort, 'German Standard DIN4150' and 'British Standard BS7385' relating to cosmetic and structural damage.

4.5 Land use, property and socio-economic

4.5.1 Overview

The Hawkesbury local government area (LGA) is the largest in the Sydney region with an area of 2773 km², 70 per cent of which is reserved as national park (1930 km²). About two thirds of the LGA population (60,562 at the 2006 census) reside in the two main urban centres of Windsor and Richmond. Other townships in the area are relatively isolated. The Windsor area includes rural, semi-rural, urban/residential and industrial/commercial land uses which have developed over the past 200 years.

At the time of the 2006 Australian census, the Windsor township had a population of 22,159. The main industry within Windsor is retail, followed by cultural and recreational services and health and community services. The majority of retail activity is concentrated in the east of the town centre and along George Street. Surrounding Thompson Square are a number of restaurants, coffee shops, cafes and other types of specialist food stores. Many of these provide outdoor dining overlooking the Georgian style landscape and the park. The square is a popular weekend picnic spot and the Macquarie Arms Hotel sometimes provides live music on weekends for pub and park users. Other properties surrounding Thompson Square include private residences and retail shops. There is a restaurant located on the northern side of the river in Macquarie Park, with views to the river and the town.

Local farms provide fresh produce and other products to the Sydney markets. This is an important land use in the area. The area to the immediate north east of the existing bridge is a turf farm, one of many in the local area.

An area of George Street between Baker Street and Fitzgerald Street in Windsor has been opened as a pedestrian mall. This area is lined with art works, water features and speciality shops and is the venue for the Windsor Craft Markets every Sunday, which is popular among tourists.

Tourism and recreation are important for the local area and economy. Windsor is known for its heritage features. Many local businesses promote these heritage features with activities such as ghost tours, history tours and horse-drawn dining tours through the area. The Hawkesbury Paddle Wheeler also operates from Windsor wharf and provides dining facilities downstream of Windsor.

A number of public open spaces are provided within Windsor and are used by locals and tourists. These include:

- Thompson Square is a heritage square on the southern bank of the Hawkesbury River providing a gateway into Windsor. The public space is currently divided in two by the approach road to the existing bridge.
- Howards Park is a narrow strip running along the southern river bank west of the existing bridge.
- Macquarie Park is a large public park on the northern river bank to the west of the existing bridge. It provides a playground, picnic areas, public toilets and access to the river via sand dunes.
- Governor Phillip Park is located about 400 metres east of the existing bridge on the southern river bank. This area provides a four lane boat ramp into South Creek/Hawkesbury River, picnic tables, public facilities and a parking area. This park hosts many local and regional boating events for this area and includes the Upper Hawkesbury Power Boat Club house.

Private vehicles are the primary form of transport to/from and within the Windsor area for the local population. There is a local train station which is located about 1.5 km south west of

Windsor Bridge. Local bus services operate in the local area supplied by private bus companies. Vehicle access to private properties adjacent to the southern part of the project is provided along Old Bridge Street. Old Bridge Street also provides vehicle access to the wharf parking spaces within Thompson Square and along the river to the east of the wharf. Vehicle access to private properties on the northern side of the existing bridge is provided along Wilberforce Road. Wilberforce Road and Bridge Street also provide vehicle access to Macquarie Park.

A shared cyclist and pedestrian pathway runs along Windsor Road from Groves Road to Macquarie Street. This includes a pedestrian bridge over South Creek, adjacent to Fitzroy Bridge. A pedestrian path is provided on the eastern side of the existing bridge connecting to Wilberforce Road to the north. A pedestrian survey in the area around Thompson Square suggested that pedestrian activity around Thompson Square, along George Street and The Terrace is high, but limited activity crosses the existing bridge.

The Hawkesbury River is used for many aquatic activities including boating, fishing, water skiing, and swimming with public access to the river for boats available from the Windsor wharf and a boat ramp at Governor Phillip Park. Given the low height of the existing bridge and the number of piers in the water only small water craft such as dinghies, kayaks, jet skis and small powerboats are able to pass under the existing bridge. The area immediately downstream of the existing Windsor Bridge is used by the community and boat clubs for speed boat races. The Upper Hawkesbury Power Boat Club hosts monthly events which are part of the Australian Power Boat Association annual calendar. In addition an annual Bridge to Bridge Power Boat Race (May) and Water Ski Classic event (November) use the existing Windsor Bridge as their finish point. These events can attract over 1200 competitors and spectators to Windsor.

4.5.2 Summary of issues

The following potential land use, property and socio-economic issues have been identified for the project:

Construction

- Sections of Thompson Square would need to be closed to the public throughout construction. This would include closing the main part of the square while the existing road is in-filled and the square landscaped.
- The amenity of Thompson Square and the surrounding businesses (in particular outdoor dining) would be impacted due to construction activities, which may impact on business functions.
- The loss of amenity may impact tourism to the area during the construction period.
- Access to Windsor wharf may need to be closed for some of the construction period. This would impact on public access to the river and the business function of the paddle wheeler.
- Access to parking within Thompson Square would be removed.
- Access to the parking area adjacent to the river to the east of the wharf may be limited during construction.
- Vehicle access to private and commercial properties along Old Bridge Street may be limited throughout construction.
- Property acquisition would be required, including partial acquisition of the turf farm on the northern bank of the river and land (public and potentially private) within Thompson Square.
- Access for aquatic vessels on the Hawkesbury River may be limited near the project for construction of the bridge and demolition of the existing bridge. This may require restricting access upstream of the bridge.
- Amenity for surrounding commercial properties may be impacted.

Operation

- The height and size of the new bridge would impact the amenity of users of Thompson Square.
- The height and size of the new bridge would impact on the amenity at businesses that provide outdoor dining facilities surrounding Thompson Square.
- Access would be provided to Windsor wharf for all vehicles along The Terrace. Arrangements for coaches would be provided to the Windsor wharf via a new detour through the town centre.
- The changes to the heritage value of the square may impact on tourism businesses that utilise this area.
- There would be changes to existing land uses adjacent to the project.
- Five parking spaces would be removed along Old Bridge Street at Windsor wharf.
- Existing access arrangements to properties along Old Bridge Street would be altered.

4.5.3 Proposed further assessment

A detailed assessment on the land use, property and socio-economic values of the area would be undertaken. This would include:

- An understanding of the socio-economic values of the Windsor area.
- The identification of local land uses, existing access arrangements and potential property acquisition for both public and private land adjacent to the project.
- Assessment of the potential impacts of the project on the socio-economic values, property, land use and access arrangements for both construction and operation.
- Identification of potential mitigation and management measures to minimise these impacts.

4.6 Urban design (including landscape character and visual impact)

4.6.1 Overview

Windsor is a historic township located on the outskirts of the Sydney metropolitan area along the Hawkesbury River. The town is located on a ridge above the southern bank of the Hawkesbury River. The area is bounded by the Blue Mountain Ranges to the north and the Nepean Valley Floodplain to the south, east and west. The area is defined by the watercourses of the Hawkesbury River and South Creek. The area is surrounded by undulating semi-rural countryside with fertile alluvial soils. Land use around Windsor comprises an extensive amount of pastoral landscapes and agricultural land. Agriculture and market gardens in this area have historically been an important aspect of the local community. Today these aspects still play an important part of the character of Windsor.

The town of Windsor is a typical early colonial grid pattern, overlaid on a distinct topography that provides picturesque qualities. George Street forms the characteristic main street along the ridge form, which is crossed by steep secondary streets running down slope to the river. Thompson Square is a distinctly urban open space that acts as a gateway to the town connecting the river and the main street creating panoramic views of the landscape. Uniquely the properties along The Terrace face onto the river taking advantage of the views. For the time period these were planned this was an unusual approach. Views from the buildings surrounding Thompson Square onto the public open space are also important historically. Today the views from the square back towards these Georgian style buildings add to the vista of the square and maintain a historical connection.

The current cultural and scenic values of Windsor Bridge suggest a high level of historic, technical, aesthetic and social significance. It is an important historical and physical landmark to the wider Sydney region and the local area having defined the life of several generations of the local community. It also helps to define the surrounding road network.

Historically, road access through Thompson Square has changed a number of times as facilities at the river banks changed. This included structural changes to the square and approach roads when the wharf was constructed in 1815 and when the bridge was opened in 1874. The square was also refurbished as part of the bicentenary celebrations in 1988 and a memorial was established to mark the importance of the river trade to the history of the area.

4.6.2 Summary of issues

The following potential urban design issues (including landscape character and visual impact) have been identified for the project:

Construction

- Sections of Thompson Square would need to be closed to the public throughout construction. This would impact on the visual amenity from both within the square and for areas outside looking towards the square. This would include closing the main part of the square while the existing road is in-filled and the square landscaped.
- Construction activities and storage of equipment would impact on the visual amenity looking towards the bridge from the both banks of the river both upstream/downstream, including from Macquarie Park and Governor Phillip Park.
- The visual amenity from surrounding buildings, on both sides of the river, looking towards the construction zone would be impacted.
- The visual amenity of road users and river users would be impacted.

Operation

- The operation of the project would have permanent impacts on the physical and visual attributes of Thompson Square as a result of:
 - o A high, modern bridge structure through a heritage town square.
 - o A wider road footprint than that of the existing bridge and approach roads.
 - o Wider verges to accommodate stopping sight distances at the George Street/Bridge Street intersection.
 - o The removal of mature trees from within open spaces.
 - o Overshadowing caused by the new bridge abutments and bridge structure on the public open space.
 - o The inclusion of abutment walls along the sides and underneath the new bridge that would be visible from adjacent areas.
 - o Changes to the open space within Thompson Square resulting from the new alignment, including possible new retaining walls as part of the in-filling and restructuring of the existing road alignment.
- Views to and from the buildings surrounding Thompson Square would be impacted.
- Visual amenity and views from George Street, including from the pedestrian mall, towards the George Street/Bridge Street intersection would be impacted.
- As a result of the additional height and larger form of the new bridge, views towards the new bridge from the banks of the river, in particular from Governor Phillip Park, Macquarie Park and users of the river would be impacted.

Potential noise mitigation treatments may alter the physical appearance of those properties and further impact the heritage vista of Thompson Square.

4.6.3 Proposed further assessment

Draft urban design principles have been developed for the project that would be carried into the concept and detailed design of the new bridge:

- *Objective: Develop an integrated concept design that fits sensitively with the existing qualities and characteristics of Windsor and its Hawkesbury River setting.*

Design principles:

- Maintain the landmark qualities of a bridge crossing at Windsor.
- Minimise the physical footprint and scale of the bridge, approach roads and associated intersections.
- Ensure the design and character of the bridge and associated roadworks are well integrated with the adjoining built areas, open space, historic and natural settings, rather than being a dominant feature.
- Minimise negative physical impacts on parklands, open space, the river and other foreshore areas adjacent to the bridge.
- Design all road and bridge elements carefully to integrate and coordinate with adjoining elements and structures. Materials and details to be robust, low maintenance and suitable for its purpose and place.
- Minimise the intrusion of road-related elements (fencing and water quality control measures) on the local landscape.

- ***Objective: Maintain the integrity of cultural and historic buildings, structures, elements and spaces of Windsor.***

Design principles:

- Maintain the physical and visual integrity of State-significant items including historical buildings, public spaces and their curtilage, particularly in Thompson Square.
- Preserve the integrity of heritage items and areas of cultural importance to the local community.
- Minimise the impact on historical archaeological sites, particularly those associated with Thompson Square.
- Enhance the setting of Thompson Square and its buildings.
- Minimise the impact on Aboriginal heritage sites and their associated heritage values.
- Minimise or avoid alterations to heritage items, except where the removal of intrusive elements would have a positive impact on their heritage significance.

- ***Objective: Enhance the existing amenity, visual character and cultural landscapes of Thompson Square and Windsor.***

Design principles:

- Redevelop any residual road space as parkland to be integrated within Thompson Square.
- Maximise opportunities to enhance the connection between Thompson Square and the commercial area around the intersection of George Street and Bridge Street.
- Enhance views of Thompson Square and its buildings to and from the bridge and approach roads on both sides of the river.
- Retain, and where possible improve, views to important landmarks in particular the Hawkesbury River, Thompson Square and the historic buildings around the Square.

- ***Objective: Improve connectivity for vehicles, pedestrians and cyclists.***

Design principles:

- Provide safe, direct and obvious connections between the bridge and approach roads with the local road network in Windsor.
- Provide generous and direct cycle and pedestrian connections across the bridge and enhance the existing pedestrian and cycle networks along the approach roads.
- Consider opportunities for public transport throughout the project.
- Maintain and enhance connections to the existing river edge and adjoining open space network.

Further investigation and a detailed assessment against the urban design objectives and principles, as well as a landscape character and visual impact assessment, would be undertaken. This would include:

- Investigations into the urban design, landscape character and visual qualities that define the area and that are important to the local community.

- Investigations into the role that Thompson Square has played as part of the community historically, what role it currently plays, and how these can be incorporated into the design of the new bridge, approaches and adjoining spaces.
- The above findings would then be used to assist in the development of the concept and detailed design, ensuring the scale and design of the new bridge and approaches best fit into the local surroundings.

5 Other environmental issues

5.1 Overview

Other environmental issues listed below are considered to be of lesser consequence taking into account the scope of the project, the existing environment and the implementation of standard and best practice management and mitigation measures. It is considered unlikely that these would be key issues for the project; however, further assessment would be undertaken as part of any future environmental impact assessment for the project. Any environmental management and safeguard measures required to minimise and mitigate impacts would be documented as part of the environmental impact statement.

5.2 Traffic and transport

5.2.1 Overview

Transport around the area adjacent to the proposal is primarily by road (private vehicles and buses) or on foot. A pedestrian path is provided on the downstream side of the existing bridge. Pedestrian paths are also found along the river bank on the south side.

The current bridge approach runs along Bridge Street which dissects the Thompson Square open space and continues across the bridge to link to Wilberforce Road on the northern bank. The road is a two lane road, one lane in each direction posted at 60 km/h (for light vehicles). The elevation of the road drops from the George Street/Bridge Street roundabout to the height of the river bank where it joins the current bridge. The George Street/Bridge Street roundabout provides for all turning movements into adjacent roads.

Access to Old Bridge Street from Bridge Street is available by a right hand turn slightly north of the roundabout. Exit from Old Bridge Street is incorporated as an arm of the George Street roundabout. Old Bridge Street provides vehicle access to Windsor wharf and access to private properties adjacent to the road. One of these properties is a business with parking facilities within the property boundary.

A T-intersection along Wilberforce Road provides the Freemans Reach Road connection. This turning facility can be dangerous as the road then immediately bends onto the bridge approach, which creates a blind spot with traffic heading north from the bridge. The approach to the bridge also provides access to Macquarie Park.

Traffic lights at Macquarie Street/Windsor Road provide access to Bridge Street. Private property access is available off Windsor Road between Macquarie Street and Fitzroy Bridge. No right hand turn northbound along Windsor Road onto Court/North Street is currently provided.

Public transport in Windsor includes Windsor train station and local bus operators. Windsor train station is located about 1.5 km south west of Thompson Square. The railway line is a single line currently undergoing duplication. Westbus and Hawkesbury Valley buses operate the local bus services. In Windsor these services run along Macquarie Street, George Street (west of Kable Street), Fitzpatrick Street and Kable Street. Two Westbus services cross the Windsor Bridge running from Thompson Square to Freemans Reach, Glossodia and Sackville. Other services provide links to the train station and neighbouring suburbs and townships.

Origin and destination traffic surveys identified that almost two thirds of traffic in the Windsor

area for the AM peak pass through the area without stopping, with about half of traffic in the PM peak passing through the town. Consequently in the AM peak, congestion occurs at the George Street/Bridge Street and Macquarie Street intersections. This leads to queuing for several hundred metres across the existing bridge and onto Wilberforce Road. Queuing is also experienced from the George Street roundabout in the PM peak. These delays have resulted in an informal 'rat-run' through the local streets with vehicles seeking to avoid the Macquarie Street and Bridge Street intersection.

5.2.2 Potential impacts

Construction

- Construction of the new bridge could be completed with minimal impacts to existing traffic movements along Bridge Street and crossing the river.
- Changes to the existing road arrangement and tie-ins to intersections would result in some traffic delays and impacts to traffic movements (eg detours).
- Vehicle access to Windsor wharf may need to be closed during construction of the new bridge and approaches.
- Vehicle access to the properties along Old Bridge Street may be impacted during construction.
- Vehicle access to Macquarie Park may require some alterations during construction.
- Periodic pedestrian access to Thompson Square would be closed to the public during construction.

Operation

- Old Bridge Street would be removed.
- Properties on Old Bridge Street would front onto the Bridge Street approach. Northbound access to properties on (current) Old Bridge Street would be banned. This would require vehicles to cross the bridge, turn into the Macquarie Park entrance, u-turn at the roundabout provided and return across the bridge to turn left into these properties.
- Adjustments and modifications to the intersection at George Street/Bridge Street may restrict some turning movements.
- An increase in traffic, including heavy vehicles (coaches and service vehicles), would occur along The Terrace to access Windsor wharf.
- Access and road safety at the Wilberforce Road / Freemans Reach Road would be improved.
- Access and road safety at the Macquarie Park entrance would be improved.
- New intersection arrangements may reduce delays and queues of traffic on the northern side.

5.2.3 Proposed further assessment

Further assessment and development of the traffic movements and access arrangements would be undertaken. This would investigate, but not be limited to, the following:

- Access arrangements during construction.
- Current and future predicted traffic volumes in the project area.
- Intersection arrangements and turning facilities at:
 - o The George Street / Bridge Street intersection.
 - o The Wilberforce Road / Freemans Reach Road intersection.
- Access and parking arrangements along The Terrace. This includes turning facilities for heavy vehicles at Windsor wharf.

5.2.4 Management and safeguard measures

Traffic and access issues are commonly encountered on all road projects and are generally adequately managed through standard RTA management measures and safeguards. These

include consideration of traffic direction/movement, traffic volumes and private and commercial access arrangements. For construction, a traffic and access management plan would be developed to manage impacts on traffic and maintain access throughout the site. The local community would be kept up to date with traffic arrangements and potential delays during construction. Operational traffic and access arrangements would be further considered and developed during the detailed design process.

Recommendations from the further investigations and assessments identified above would be considered and where appropriate to the project would be applied.

5.3 Soil and water quality

5.3.1 Overview

The project is located within the Windsor township situated at the northern end of the Cumberland Plain. It is surrounded by an area of gently undulating rises forming part of the Hawkesbury-Nepean floodplain. The area is generally characterised by a gently sloping alluvial plain with occasional terraces or levees.

Elevations in the area range between five and 20 metres Australian height datum (AHD). The local relief is mainly level with slopes generally less than five per cent. Windsor is situated on a ridge above the river, however is prone to flooding in larger flood events.

The geology of the area is derived from Hawkesbury Sandstone, Narrabeen Group and the Wianamatta Group. The soils are primarily sands and sandy loams and soil profiles are typical of those found in an active floodplain. The soils are considered to be highly erodible and are particularly subject to scour, sheet and rill erosion during floods.

The project is located within the Hawkesbury-Nepean catchment, which covers an area of about 22,000 square kilometres. Given the large area of the catchment water quality of the Hawkesbury-Nepean River can vary greatly depending on the specific location and other environmental conditions at the time. Within the Windsor area rural activities, grazing, market gardens, intensive farming, urban and industrial land uses have impacted on the water quality of the Hawkesbury-Nepean River.

Part of the project is located within the South Creek sub-catchment of the Hawkesbury-Nepean catchment. A number of major sewerage treatment plants discharge into South Creek and these, along with stormwater from urban areas and agricultural run off, contribute to poor water quality in the catchment.

There are no known contaminated land sites within the vicinity of the project. There is potential for acid sulfate soils (ASS) to occur within Windsor and its surrounds. The project would be within class 4 and 5 on the Hawkesbury City Council's ASS vulnerability map. Salinity is a natural part of the landscape in western Sydney, with salt being found in rocks, soil and shallow groundwater of the region.

5.3.2 Potential impacts

The project has the potential to impact on soil and water as follows:

Construction

- Direct impacts to bank stability and erosion due to the clearing of riparian vegetation and the removal of the existing bridge structure during the construction phase.
- Direct erosion impacts due to the exposure of soils during construction. This may potentially impact on water quality of the Hawkesbury River and South Creek.

- Direct impact to water quality from potential spillages of materials during construction including chemicals and run-off from exposed or un-clean surfaces.
- Potential for contamination of groundwater where groundwater intersection occurs during construction.
- Potential exposure of acid sulfate soils to the air as a result of excavation and construction works, resulting in the potential for sulphuric acid to impact groundwater, soils and waterways in addition to the built environment.
- Potential impact on salinity as a result of changes to the local landscape, which affects the way salt and water move through the environment and where they concentrate.

Operation

- Impact to water quality as a result of any spills that may occur during operation from maintenance activities or vehicle crashes.
- Potential scouring impact on the banks and bed of the Hawkesbury River due to potential changes to drainage.
- Potential changes to groundwater movement during operation as a result of construction works.
- Potential impact to water quality from road runoff containing suspended solids, nutrients from atmospheric fallout and other pollutants from vehicle, tyre and pavement wear.

5.3.3 Proposed further assessment

Further investigations and assessment would be undertaken into soil and water issues that would include:

- Detailed assessment of soil and water impacts and identification of management and mitigation measures.
- Assessment of the risk of erosion and sedimentation in accordance with the RTA Erosion and Sedimentation Management Procedure.
- Identification of surface and groundwater that may be impacted by the project and subsequent assessment of the potential impacts.
- Identification of any actual or potential acid sulfate soils and an appropriate management approach, if required.
- Phase I contaminated land assessment to identify any potential contamination.

5.3.4 Management and safeguard measures

Soil and water issues are commonly encountered on all road projects and are generally adequately managed through standard RTA management measures and safeguards, which include consideration during the detailed design process and the development of construction soil and water management plans.

Recommendations from the further investigations and assessments identified above would be considered and where appropriate to the project would also be applied.

5.4 Hydrology and flooding

5.4.1 Overview

A preliminary hydraulic investigation (WMAwater, 2010) was undertaken to inform the route selection process for the project. A summary of the investigation outcomes is provided below.

The Hawkesbury-Nepean catchment covers an area of about 22,000 square kilometres and extends from Goulburn to the mouth of the Hawkesbury River at Broken Bay. The flooding environment is affected by the topography of the Hawkesbury-Nepean valley, which starts as a narrow gorge until downstream of Wallacia, where it widens into a floodplain between Penrith and Castlereagh. At Yarramundi the valley opens into a further major floodplain in the area of

North Richmond, Richmond, Windsor and Wilberforce. A gorge downstream of Wilberforce controls flows further downstream so that in major flood events outflow through the gorge is exceeded by inflows into the Hawkesbury-Nepean and its tributaries, creating major flooding across the valley. Floodwaters can rise rapidly and to depths that can inundate a number of towns, including Windsor.

South Creek is a tributary to the Hawkesbury River. South Creek flood behaviour is influenced by flooding of the local South Creek sub-catchment and is compounded by backwater flooding from the Hawkesbury River. The South Creek sub-catchment encompasses most of the Cumberland Plain of western Sydney.

The height of the existing Windsor Bridge is seven metres AHD, which makes it prone to flooding in a one in two year flood event. The design flood level for the new bridge would be the one in five year flood event which is at about 11.05 metres AHD. The one in 100 year design flood level would be 17.29 metres AHD. Both existing approach roads have sections that are prone to flooding in one in five year flood events.

The preliminary hydraulic investigation found that the project would produce very little afflux.

More intense and extreme rainfall events in the future are predicted for the Sydney region as a result of climate change. This would affect flooding regimes in the Hawkesbury-Nepean catchment and consequently for the project.

5.4.2 Potential impacts

The project has the potential to impact on hydrology and flooding as follows:

Construction

- Potential direct impacts to the project in the case that a large flood event occurs during the construction period.

Operation

- Potential impacts to afflux as a result of construction of the new bridge and removal of the existing bridge are expected to be minor.
- Potential impacts to peak flood levels immediately downstream of the new bridge are expected to be minor.
- Potential impacts of the project in a one in 100 year flood event would be localised to immediately upstream of the new bridge structure.
- Minimal impact on flooding behaviour in both the one in five and one in 100 year flood events.
- Improved access across the Windsor Bridge during floods as a result of the elevated height of the new bridge.

5.4.3 Proposed further assessment

A hydrology and flooding assessment would be undertaken as part of the environmental impact statement. The assessment would input into the design of the project and would detail recommended management and mitigation measures for hydrology, flooding and groundwater. This further assessment would consider the impacts of projected climate change.

5.4.4 Management and safeguard measures

RTA standard safeguards and management measures for hydrology, flooding and groundwater would be applied to the project. Recommendations from the further hydrology and flooding assessment would be considered and where appropriate to the project would also be applied.

5.5 Biodiversity

5.5.1 Overview

Terrestrial ecology

Since European settlement most of the natural habitat in the locality has been cleared for development and agricultural activities. Minimal remnant native vegetation exists in the riparian zone along the Hawkesbury River.

A preliminary flora and fauna investigation was undertaken (LesryK Environmental Consultants, 2008) to assist with the selection of the preferred option. The preliminary investigation was limited to the northern and southern banks of the Hawkesbury River adjacent to the existing Windsor Bridge. A summary of the findings of this report is provided below.

At least two endangered ecological communities (EECs) occur or potentially occur within a 10 kilometre radius of the project including the Cumberland Plain Woodland (listed as endangered under both State and Commonwealth legislation) and the River-flat Eucalypt Forest on Coastal Floodplains (listed as endangered under State legislation).

Vegetation on the southern bank of the Hawkesbury River on either side of the existing bridge has been mapped by LesryK Environmental Consultants (2008) as River-flat Eucalypt Forest on Coastal Floodplains. This community is listed as an EEC under the NSW *Threatened Species Conservation Act 1995* (TSC Act). The preliminary flora and fauna investigation indicates that the vegetation present may not conform to the typical description of this EEC provided by the NSW Scientific Committee (2004). The majority of this vegetation appears to have been planted and is impacted on by weed and exotic species. A preliminary assessment of significance for the River-flat Eucalypt Forest on Coastal Floodplains has been undertaken and concluded that the project would not have a significant impact on this EEC. This would be addressed in further assessments as part of any future environmental impact statement.

A number of threatened flora and fauna species, listed under the TSC Act and the Australian *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and their habitats occur or potentially occur within a 10 kilometre radius of the project. The preliminary flora and fauna investigation concluded that there are unlikely to be any threatened flora or fauna species present within the area affected by the project.

A number of freshwater wetlands are located about 300 metres south of South Creek. Two of those wetlands are identified in the Sydney Regional Environmental Plan No. 20 (Hawkesbury-Nepean River) 1997.

Riparian vegetation along the banks of the Hawkesbury River is predominantly Exotic grassland, Disturbed woodland and Casuarina woodland. While some of the species along the banks are native to the area, the majority of vegetation includes exotic and weed species.

Vegetation along the banks of South Creek adjacent to Windsor Road has been planted over the last decade as part of a local revegetation program to stabilise the creek banks and improve the health of the creek. Plantings have included native riparian species to a width of about 20 metres from the creek line. There is little to no remnant vegetation in this section of the creek, with most vegetation having been planted. None of the species used in the plantings are listed as threatened under State or Commonwealth legislation, however, the plantings may make up the components of the EEC River-flat Eucalyptus Forest on Coastal Floodplains. This would be addressed in further assessments as part of any future environmental impact statement.

Five declared noxious weeds were recorded near the existing Windsor Bridge.

The remainder of the area around the project location comprises agricultural lands and urban development, which provides minimal habitat. There are a number of mature trees within the Thompson Square open space area as well as street trees along the project, which provide minimal habitat.

Few native fauna species were recorded within the Windsor Bridge locality. Those species recorded were mostly birds that would be considered to be generalist / urban tolerant animals. The project would not present a barrier to the dispersal of native animals or further isolate their necessary habitat.

No eucalypts listed as Koala feed trees under State Environmental Planning Policy No. 44 – Koala Habitat Protection were recorded within the riparian vegetation along the Hawkesbury River.

No major local or regional fauna corridors are present within the local area primarily due to the fragmented structure of vegetation in the area.

Aquatic ecology

Emergent and submerged aquatic habitat features (snags), as well as overhanging vegetation, were observed in the locality at irregular intervals along the northern and southern banks of the Hawkesbury River. Watercrafts navigate along the Hawkesbury River, which is consequently kept free of obstacles (including snags) within the main channel.

The Hawkesbury River is a permanently flowing waterway with clearly defined banks and beds. Fish habitat is known to be present. As such the Hawkesbury River would be a class 2 waterway type.

One endangered aquatic fauna species, the Trout Cod (*Maccullochella macquariensis*), has been identified as potentially occurring in the Hawkesbury River around the existing Windsor Bridge.

5.5.2 Potential impacts

The project has the potential to impact on flora and fauna as follows:

Construction

- Direct impact to vegetation due to clearing of riparian vegetation, vegetation within Thompson Square and potentially some street trees. Based on a worst case scenario the project would result in the clearing of about 4000 square metres of vegetation.
- Potential introduction and/or spread of weeds, including noxious weeds.
- Positive impact due to the removal of exotic and weed species within some of the riparian zone of the Hawkesbury River.
- Potential direct impacts to fish passage through the installation of in-stream structures for construction.
- Potential impact to aquatic vegetation and habitat through the installation of in-stream structures requiring clearing and disturbance of the river banks and bed.
- Potential impact to the threatened Trout Cod (*Maccullochella macquariensis*) as a result of in-stream works for the construction of the new Windsor Bridge and demolition of the existing Windsor Bridge.
- Potential impact to aquatic habitat through the potential removal or disturbance of snags due to construction works on the banks of the Hawkesbury River and in-stream.
- Potential mortality of fauna individuals during the construction of the project.
- Potential impact to the aquatic environment, habitats and species as a result of potential mobilisation of sediments and pollutants, which may enter the waterway.

Operation

- Potential direct impacts to fish passage through the installation of in-stream structures such as bridge piers.
- Potential impact to aquatic vegetation and habitat through the installation of in-stream structures. For example through shading.
- Impact on remaining riparian vegetation along the Hawkesbury River through the increase in edge effects.
- Potential mortality of fauna individuals during the operation of the project.

5.5.3 Proposed further assessment

A flora and fauna assessment would be undertaken for the project. The assessment would include:

- Targeted surveys for terrestrial and aquatic threatened species, populations and ecological communities.
- An assessment of the full project impacts on biodiversity including an assessment of the impacts on threatened terrestrial and aquatic species, populations and ecological communities.
- Targeted surveys for terrestrial and aquatic threatened species, populations and ecological communities.
- Recommendations for detailed biodiversity safeguards and management measures to minimise impacts.

5.5.4 Management and safeguard measures

Biodiversity management and safeguard measures would be informed by the further flora and fauna assessment identified above and would be detailed in the environmental impact statement for the project.

5.6 Air quality

5.6.1 Overview

Windsor is located in the north west Sydney air quality monitoring zone for the NSW Office of Environment and Heritage (OEH) Air Quality Index. The closest air quality monitoring station to the project is the Richmond monitoring station, which is located about four kilometres from the project. A review of available data for Richmond indicates that air quality in the area is generally very good to fair. Occasional exceedances of air quality goals in the area are likely due to variations in metrological conditions and bushfires.

Sources of air pollution in the Hawkesbury include emissions from industry, motor vehicles, commercial operations and domestic activities such as fires and use of solid fuel heaters.

Sensitive receivers for air quality, including residences and businesses, are located adjacent to the project location area.

5.6.2 Potential impacts

The project has the potential to impact on local air quality as follows:

Construction

- Temporary increase in dust during clearing, earthworks and construction activities.
- Temporary air quality impacts from emissions, such as exhaust fumes, generated by the operation of machinery and other construction vehicles. The impact of these emissions would be limited to the construction phase.

Operation

- Operational impacts to air quality would be negligible given traffic volumes through the area are not expected to increase as a result of the project.

5.6.3 Management measures and safeguards

Air quality issues are commonly encountered on all road projects and are generally adequately managed through the development of construction management plans and appropriate consideration to air quality issues during the detailed design process. Best practice management measures and safeguards (particularly dust suppression measures) would be implemented during construction of the project. Management and safeguard measures would be detailed in the environmental impact statement for the project.

5.7 Greenhouse gas and climate change

5.7.1 Overview

Climate change refers to the warming temperatures and altered climatic conditions associated with the concentration of gases in the atmosphere, known as greenhouse gases. There is a need to understand how these potential changes can impact future climatic conditions and the effect they could have on the project in addition to how the project may contribute to climate change.

The Intergovernmental Panel on Climate Change has produced climate change projections. In Australia, both the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Bureau of Meteorology have produced regional downscaled projections for Australia from these projections. In 2008 the NSW Government published refined climate change projections for each region in NSW.

In summary climate change predictions for the Sydney region, including the project location, are:

- More intense extreme rainfall events.
- Higher average temperatures.
- More frequent occurrence of extreme temperatures.
- Higher summer rainfall.
- Drier conditions in winter and spring.

5.7.2 Potential impacts

The project has the potential to impact on climate change as follows:

Construction

- Direct generation of greenhouse gas emissions due to construction works such as the transport of materials, operation of plant and equipment and vegetation clearing.
- Indirect generation of greenhouse gas emissions that are produced off-site through for example the consumption of electricity for the project.
- Indirect generation of greenhouse gas emissions through the embodied energy of products used for construction works, and their supply chains.

The project has the potential to be impacted by climate change as follows:

Operation

- Increases in temperature may affect the integrity of pavement, bridges and other structures in the long-term. This may occur either directly or through evaporative changes and changes in soil moisture content and soil instability, which in the long term may impact on the foundations of structures, softening of pavements, and road rutting.

- Changes in rainfall intensity may result in the following impacts in the long-term:
 - o Increased potential for localised flooding.
 - o Drainage and stormwater impacts.
 - o Aquaplaning (cars sliding in pooled water on the road).
 - o Changes to pest and weed species and distribution, and alterations to ecosystem services.
 - o Erosion impacts, resulting in sediment loss from the site.
 - o Watercourse impacts, including changes to channel structure and other characteristics resulting from changed hydrological conditions.

5.7.3 Management and safeguard measures

Climate change issues are commonly encountered on all road projects and are generally adequately managed through the development of construction management plans and appropriate consideration to climate change issues during the detailed design process. Best practice management measures and safeguards would be implemented during construction of the project. Management and safeguard measures would be detailed in the environmental impact statement for the project.

5.8 Hazard and risks

5.8.1 Overview

Hazards and risks to human health and the environment have the potential to arise as a result of incidents during construction and operation of the project. The main potential incident of concern for the project would be the accidental release of toxic, flammable or explosive material during the storage, use and transport of hazardous substances.

The quantities of hazardous substances that would be stored on the project are anticipated to be small.

5.8.2 Potential impacts

The project has the potential to result in the following hazard and risk impacts:

Construction

- Potential release of hazardous substances during construction as a result of the transport, use and storage of these substances (if required).

Operation

- Potential release of hazardous substances during operation from vehicles transporting these substances along the project. This risk is considered to be low given existing stringent legislative controls for the transport of dangerous goods and given the minor proportion of vehicles transporting dangerous goods.

5.8.3 Management and safeguard measures

The specific hazards and risks would be considered in the environmental impact statement. Project specific environmental risk analysis would identify the level of assessment required. Best practice management and mitigation measures would include:

- Occupational health and safety risks associated with construction would be managed through the implementation of an occupational health and safety plan.
- Specific risks associated with the transport of hazardous substances to and from the work site would be managed through the implementation of standard environmental management measures.

- The risks associated with the use and storage of hazardous substances during construction would be mitigated through appropriate design, preparation of a construction environmental management plan and establishment of bunded areas.
- The final locations of construction site compounds where hazardous substances would be stored would be determined during detailed design based on specific environmental criteria.
- Construction stormwater control basins and operational water quality control measures would be designed to reduce the environmental effects of pollutant runoff from the road surface and to contain spills of chemicals and hazardous substances.

5.9 Existing utilities

5.9.1 Overview

The existing Windsor Bridge carries utilities attached to the pedestrian path. These are water main utilities that also run underneath Thompson Square to access the bridge. In addition power lines currently run high over the Hawkesbury River from George Street to Wilberforce Road. The alignment of these lines is in line with the proposed alignment of the new bridge.

5.9.2 Potential impacts

The project has the potential to result in the following utilities impacts:

- Facilities would need to be provided for utilities to be incorporated into the new bridge alignment. These would likely need to be placed on the downstream side of the bridge to minimise impacts during flood events.
- The existing water utilities underneath Thompson Square would require adjustment.
- An extension of the bridge utilities would be required to reach the location of the new bridge, potentially requiring excavation along the river bank.
- The powerlines over the river would likely need relocating due to the extra height of the new bridge.
- Provisions would need to be made for constructing around the powerlines.
- Minor disruptions to the provision of utilities for properties on either side of the river may occur during construction.

5.9.3 Management and safeguard measures

Working around and relocating utilities is an issue commonly encountered on many road projects. Further assessment and development of the location of these utilities would be undertaken during concept and detailed design. Best practice management and mitigation measures would include:

- Consultation with the appropriate facility providers would be undertaken throughout detailed design to provide for their input into location and construction methodologies for the utilities. The utilities providers may be engaged to undertake the relocation works.
- Residents would be notified for any disruptions to services, should these be required.
- Standard construction safety protocols would be built into the construction environmental management plan and enforced if the powerlines are not relocated prior to construction.

Management and safeguard measures would be detailed in the environmental impact statement for the project.

5.10 Resource use and waste management

5.10.1 Overview

Various waste streams would be generated during the construction and operation of the project, including construction and demolition waste, vegetation waste, packaging materials and liquid wastes.

5.10.2 Potential impacts

Construction

- Potential impact on resource availability as a result of resource use requirements for the project.
- Potential amenity impacts due to the potential haulage of resources, which would likely impact air quality, noise and construction traffic.
- Generation of waste during construction of the project, including:
 - o Demolition wastes from existing structures (including the existing Windsor Bridge), pipe work and pavement that require removal.
 - o Excavation wastes that are unable to be reused within the project may be produced.
 - o Vegetation waste from the removal of trees, shrubs and groundcovers that are unable to be mulched and reused within the project.
 - o Packaging materials such as crates, pallets, cartons, plastics and wrapping materials.
 - o Site compound waste such as liquid wastes from cleaning, repairing and maintenance, waste from spillages, fuel or oil waste, sewage waste from site amenities and general office wastes.

5.10.3 Proposed further assessment

The environmental impact statement would provide further details, including:

- Identification of the approximate resource requirements for the project and an assessment of the resource use impacts of the project.
- Identification of specific waste impacts of the project and the waste management approach.
- Investigation into the re-use of heritage materials within the project.

5.10.4 Management and safeguard measures

Resource use and waste management impacts are commonly encountered on all road projects and are generally adequately managed through the development of construction management plans and appropriate consideration during the detailed design process. Management and safeguard measures would be detailed in the environmental impact statement for the project.

6 Conclusion

The RTA is seeking approval to replace the existing Windsor Bridge with a new bridge located around 35 metres downstream of the existing bridge (the project). It would include upgrading adjacent intersections and approach roads to accommodate the new bridge location.

The RTA has formed the opinion that the impacts of the Windsor Bridge replacement project on non-Aboriginal heritage would be likely to significantly affect the environment and require the preparation of an environmental impact statement under the EP&A Act. Accordingly, the project is State significant infrastructure under Part 5.1 of the EP&A Act. Approval from the Minister for Planning and Infrastructure is required for the project.

The key environmental issues identified for the project include:

- Non-Aboriginal heritage.
- Aboriginal heritage.
- Noise and vibration.
- Land use, property and socio-economic impacts.
- Urban design (including landscape character and visual impact).

7 References

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Attachment A

Requirements of the *Environmental Planning and Assessment Regulation 2000*

Clause 192 of the *Environmental Planning and Assessment Regulation 2000* requires that an application for approval of the Minister to carry out State significant infrastructure must include:

- (a) details of any approval that would, but for section 115ZG of the Act, be required for the carrying out of the State significant infrastructure, and
- (b) details of any authorisations that must be given under section 115ZH of the Act if the application is approved, and
- (c) a statement as to the basis on which the proposed infrastructure is State significant infrastructure, including, if relevant, the capital investment value of the proposed infrastructure.

Approvals that would otherwise apply

Approvals that may be required to carry out the SSI, if not for section 115ZG of the EP&A Act, include:

- A permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*.
- An approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977*.
- An Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974*.
- An authorisation referred to in section 12 of the *Native Vegetation Act 2003* (or under any Act repealed by that Act) to clear native vegetation or State protected land.
- A water use approval under section 89, a water management work approval under section 90 or an activity approval (other than an aquifer interference approval) under section 91 of the *Water Management Act 2000*.

Authorisations if the application is approved

Authorisations that may be required for the project under section 115ZH of the EP&A Act include:

- An environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997* (for any of the purposes referred to in section 43 of that Act).

State significant infrastructure statement

Clause 14(1) of State Environmental Planning Policy (State and Regional Development) 2011 provides that development is declared to be State significant infrastructure pursuant to section 115U(2) of the Act if it is permissible without development consent under Part 4 of the Act under a State environmental planning policy; and is specified in the categories of development in Schedule 3.

State Environmental Planning Policy (Infrastructure) (ISEPP) permits development for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. As the Windsor Bridge replacement project is for a road and road infrastructure facilities, and is to be carried out by the RTA, the project is permissible without development consent under Part 4 of the EP&A Act.

Schedule 3 of State Environmental Planning Policy (State and Regional Development) 2011

provides that general public authority activities for infrastructure or other development that (but for Part 5.1 of the EP&A Act and within the meaning of Part 5 of the Act) would be an activity for which the proponent is also the determining authority, and would, in the opinion of the proponent, require an environmental impact statement to be obtained under the EP&A Act.

For the Windsor Bridge replacement project, the RTA has formed the opinion that the impact of the project on non-Aboriginal heritage would be likely to significantly affect the environment and would require an environmental impact statement to be obtained under Section 112 of the EP&A Act.

On this basis the project is State significant infrastructure. Approval from the Minister for Planning and Infrastructure is required under section 115W of the EP&A Act.

Attachment B

List of heritage items around the project

Table B.1: Listed heritage items within the areas surrounding the project

No.	Heritage item	Location	Heritage listing
1	Thompson Square Conservation Area	Thompson Square	State Heritage Register Register National Estate National Trust Australia Register Hawkesbury Local Environmental Plan 1989
2	Reserve and Streets	Thompson Square, Windsor	State Heritage Register Hawkesbury Local Environmental Plan 1989 Register National Estate Forms part of Thompson Square Conservation Area (item 1)
3	Doctors House	1 – 3 Thompson Square, Windsor	Register National Estate Hawkesbury Local Environmental Plan 1989 Forms part of Thompson Square Conservation Area (item 1)
4	Shop	80 George Street, Windsor	State Heritage Register Hawkesbury Local Environmental Plan 1989 Forms part of Thompson Square Conservation Area (item 1)
5	Shop	82 George Street, Windsor	State Heritage Register Hawkesbury Local Environmental Plan 1989 Forms part of Thompson Square Conservation Area (item 1)
6	Macquarie Arms Hotel	99 George Street, Thompson Square, Windsor (Cnr Thompson Square & George Street)	State Heritage Register Hawkesbury Local Environmental Plan 1989 Register National Estate Forms part of Thompson Square Conservation Area (item 1)
7	House	6 Bridge Street, Thompson Square, Windsor	State Heritage Register Register National Estate Hawkesbury Local Environmental Plan 1989 Forms part of Thompson Square Conservation Area (item 1)
8	House and Outbuildings	5 Thompson Square, Windsor	State Heritage Register Register National Estate Hawkesbury Local Environmental Plan 1989 National Trust Australia Register Forms part of Thompson Square Conservation Area (item 1)
9	Hawkesbury Museum and Tourist Information Centre	7 Thompson Square, Windsor	State Heritage Register Register National Estate Hawkesbury Local Environmental Plan 1989 Forms part of Thompson Square Conservation Area (item 1)
10	Precinct of buildings and land	62-68 George Street, Windsor	State Heritage Register Hawkesbury Local Environmental Plan 1989 Register National Estate Forms part of Thompson Square Conservation Area (item 1)

No.	Heritage item	Location	Heritage listing
11	A.C Steam Building	74 George Street, Windsor	State Heritage Register Register National Estate Hawkesbury Local Environmental Plan 1989 National Trust Australia Register Forms part of the Thompson Square Conservation Area (item 1)
12	Bungalow	4 Bridge Street, Windsor	State Heritage Register Register National Estate Hawkesbury Local Environmental Plan 1989 Forms part of Thompson Square Conservation Area (item 1)
13	Building	10 Bridge Street, Windsor	State Heritage Register Register National Estate Hawkesbury Local Environmental Plan 1989 National Trust Australia Register Forms part of the Thompson Square Conservation Area (item 1)
14	Hawkesbury River Bridge (Windsor Bridge)	Over Hawkesbury River	RTA s.170 Heritage and Conservation Register Hawkesbury Local Environmental Plan 1989

Table B.2 : potential archaeological heritage items within Thompson Square

Item	Rough potential location	Comment
Punt dock	At the current bridge location.	The Hawkesbury River was originally crossed by a punt service established in 1814. There may have also been a small 'punt house' located immediately behind it on the banks.
Windsor Wharf	Between the existing bridge and the new wharf.	The first Windsor Wharf was recorded in 1795, however Governor Macquarie ordered a new wharf and approach in 1814 and again in 1815. The remains of the wharf were identified in June 2008 on the river bank between the existing bridge and the current wharf.
Brick-barrel drain/s	Unknown under Thompson Square	A contract for the construction of a brick-barrel drain beneath the surface of Thompson Square was awarded in 1815. An entrance to a drain on the river bank behind the remains of the wharf has been identified, however the exact route of the drain or how many there are is unclear.
Building remains	Close to the bank underneath Old Bridge Street.	Old photos identify a building likely belonging to Andrew Thompson in this location.
Gallows	Underneath George Street/Bridge Street.	It has been verbally identified that there may have been the town gallows located at this intersection.