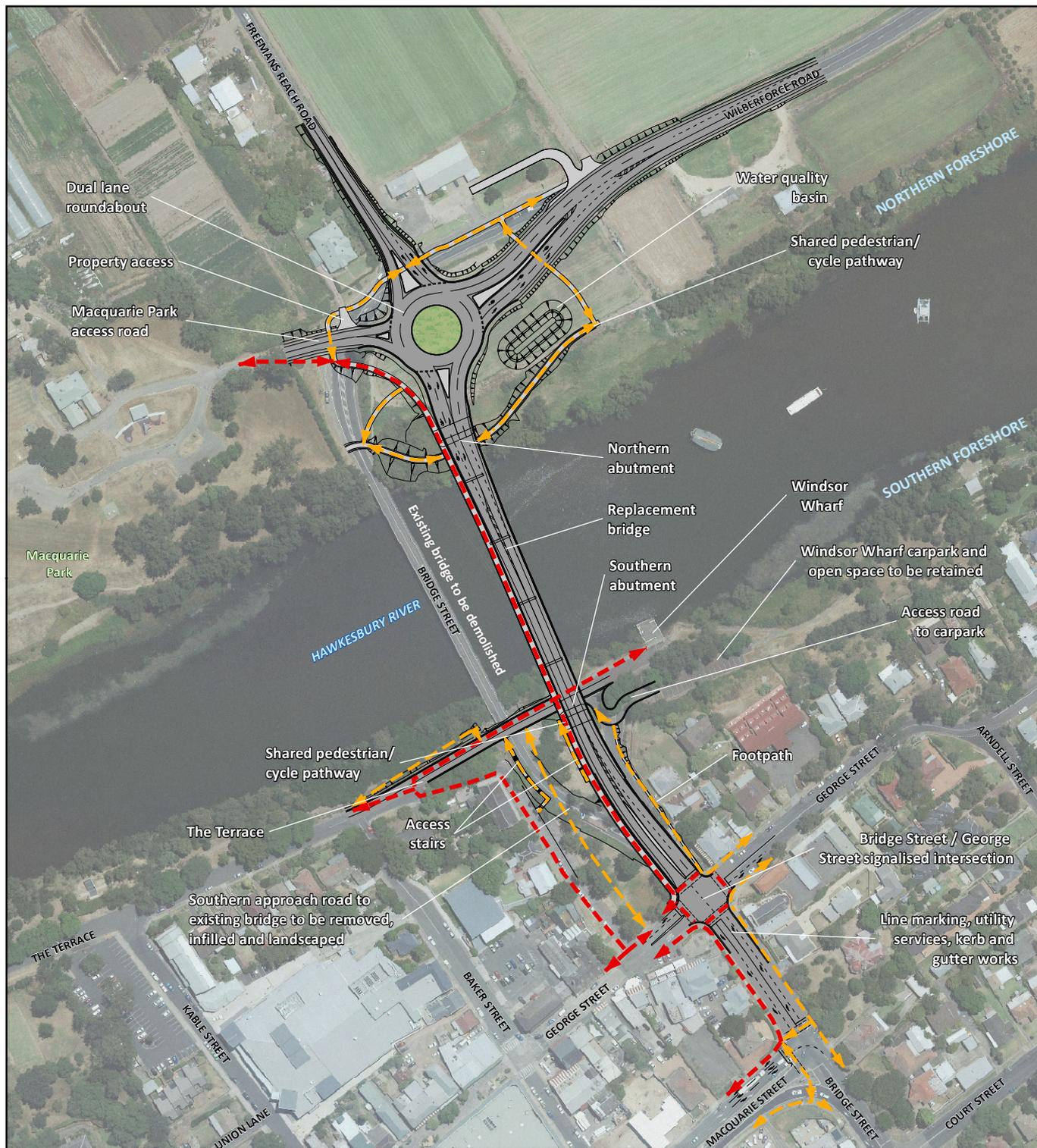


Figure 5-5 | Access and circulation



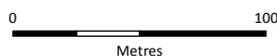
LEGEND

-  Concept design
-  Primary pedestrian and cyclist circulation
-  Secondary pedestrian and cyclist access

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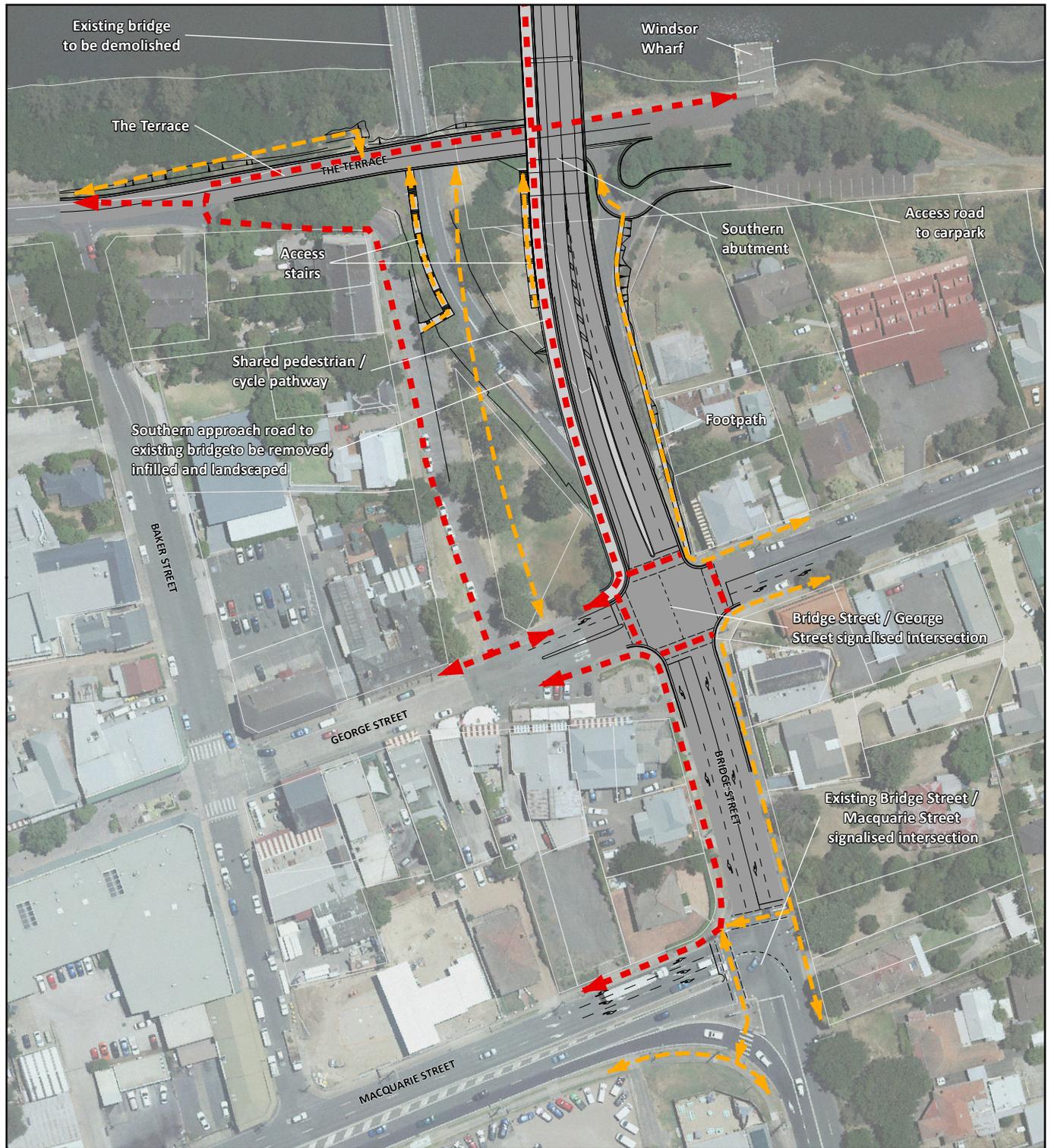
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Indicative only – subject to detailed design



Figure 5-5a | Access and circulation - Southern Approach



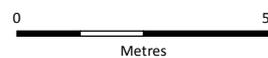
LEGEND

-  Concept design
-  Cadastral boundary
-  Primary pedestrian and cyclist circulation
-  Secondary pedestrian and cyclist access

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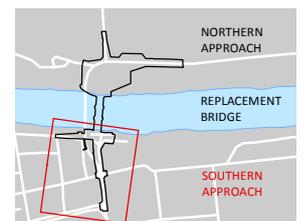
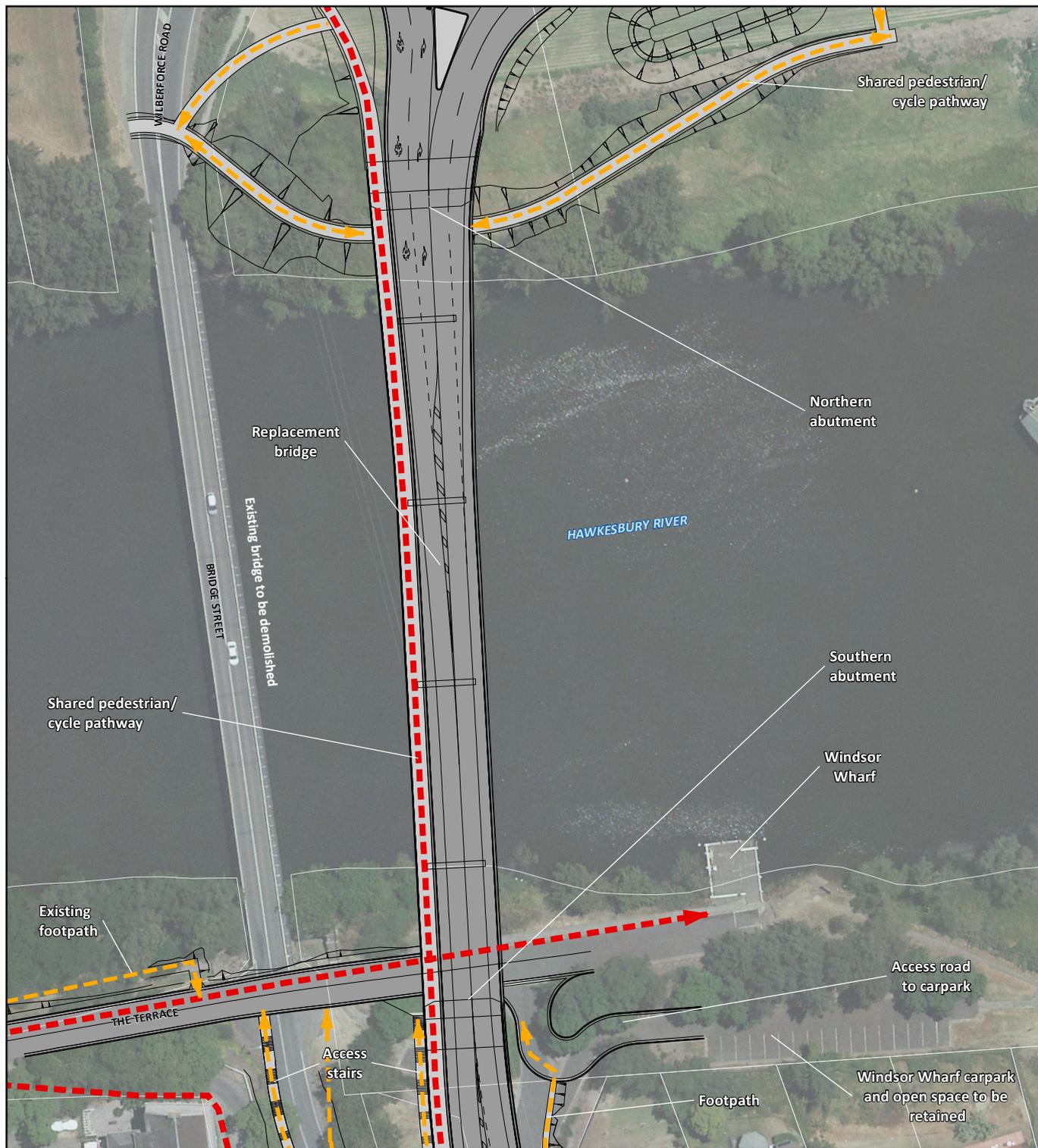


Figure 5-5b | Access and circulation - Replacement Bridge



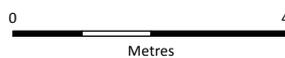
LEGEND

-  Concept design
-  Cadastral boundary
-  Primary pedestrian and cyclist circulation
-  Secondary pedestrian and cyclist access

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GDA 1994 | MGA Zone 56
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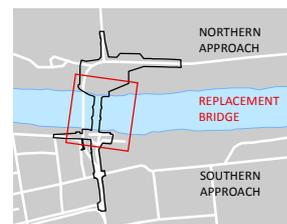
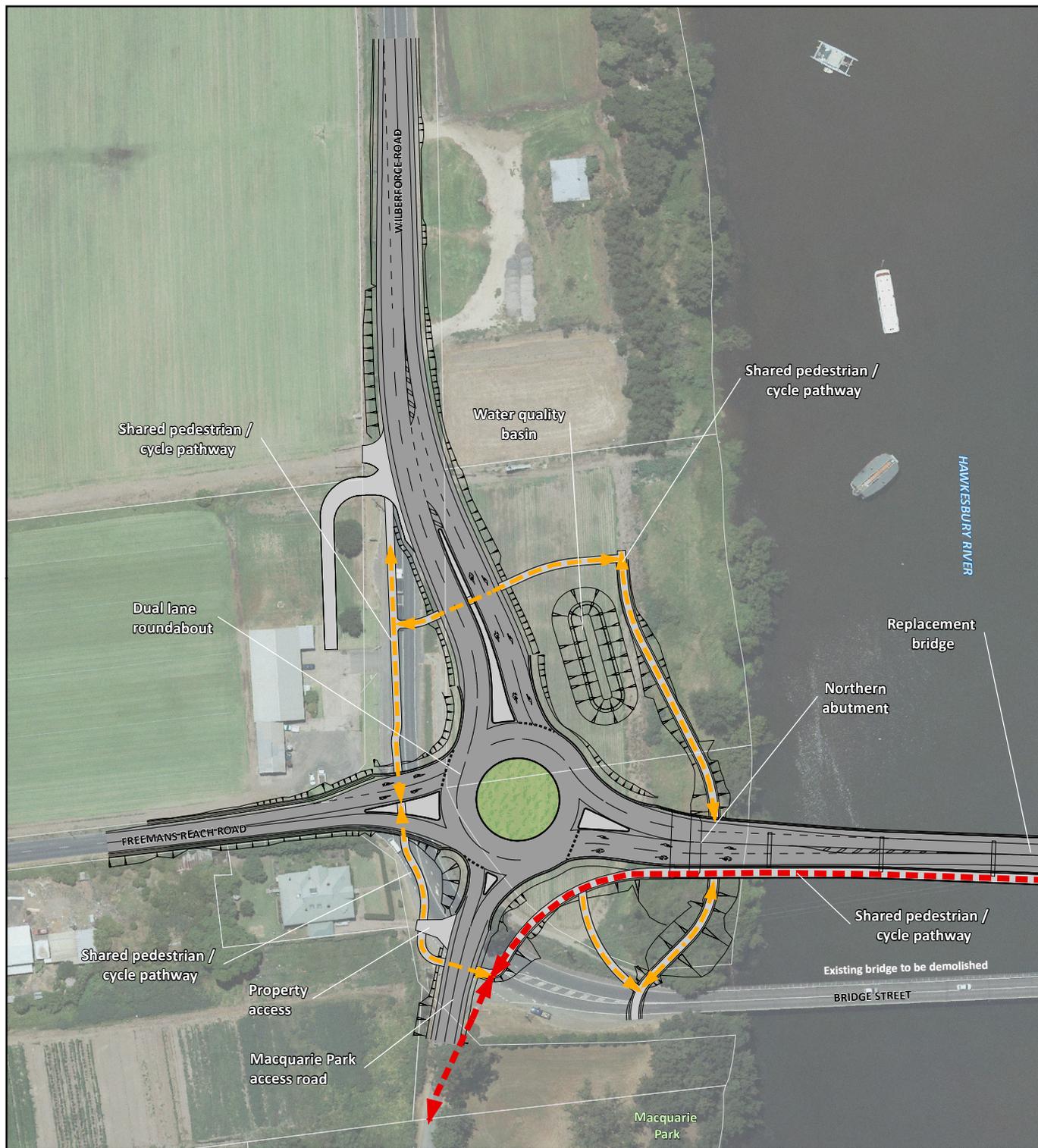


Figure 5-5c | Access and circulation - Northern Approach



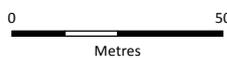
LEGEND

-  Concept design
-  Cadastral boundary
-  Primary pedestrian and cyclist circulation
-  Secondary pedestrian and cyclist access

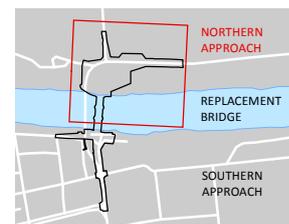
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GDA 1994 | MGA Zone 56
A4 1:1,800



Indicative only – subject to detailed design



5.2.6 Demolition of the existing bridge

The existing Windsor bridge would be removed following commissioning of the replacement bridge and associated bridge approach roads. Works associated with the demolition would include:

- Disconnection and relocation of existing public utility services on the bridge (see **Section 5.2.7**).
- Management of bridge elements painted with lead based paints.
- Rehabilitation of the bridge site, including treating and/or removing any contaminated soils or materials identified.

A detailed methodology for the demolition of the existing bridge has yet to be developed and would be subject to further investigations and studies. The poor condition of the bridge and the relatively low load bearing capacity of the bridge spans would be considered in the development of the demolition methodology.

While a final methodology has not been developed it is likely that the existing bridge superstructure and substructure would be removed in sections, with temporary bracing installed, as required, to maintain the stability of remaining sections during the demolition process. Where possible, the process of demolition would involve cutting the superstructure and substructure into sections, with each section transported off-site for demolition at a licensed facility. This approach would minimise potential environmental impacts, such as noise, dust, disturbance of roads and contamination of the river. Disruption of waterway traffic would be limited to the greatest extent practicable, with alternative navigation channels provided while the existing navigation span is closed for the demolition works.

Bridge materials resulting from the demolition would be recycled where possible. Materials that have the potential to be re-used include the iron piers, railing, metal components of the bridge abutment and the service conduits. Lead-based paint has been identified on some elements of the existing bridge and would need to be removed before recycling or reuse of materials. Recycling facilities and reuse options would be identified prior to the preparation of the demolition contract and written into the demolition contract. Further details of the demolition process are provided in **Section 5.5**.

5.2.7 Ancillary works

Public utility works

The project would require adjustment, relocation and protection of existing public utilities and services, including water mains, sewer mains and electrical and telecommunications cables. The main public utility works would be associated with the services that are supported by the existing bridge superstructure. The existing bridge supports:

- A 450 millimetre water main (cement lined steel pipe).
- A 50 millimetre sewer rising main (galvanised iron pipe).
- A 100 millimetre electrical conduit.
- Three 80 millimetre galvanised iron telecommunications conduits.

These services would need to be removed and replaced with new services on the replacement bridge. The replacement bridge would also need to be able to accommodate additional future services which may include a recycled water main and high voltage power.

Other public utilities that may need to be adjusted as part of the project include:

- High voltage (33 kV) overhead power lines. If technically feasible, the 33 kV overhead power lines would be relocated within the replacement bridge. This would involve placing the cables underground along Bridge Street between Macquarie Street and the replacement bridge and locating the high voltage power lines within conduits within the replacement bridge. If the 33 kV power lines are unable to be relocated in the replacement bridge they would remain as overhead lines but would be relocated to be clear of replacement bridge. The 33kV power lines may need to be temporarily relocated to allow construction of the the bridge – before they are installed on their final alignment.
- Power lines near the corner of Wilberforce Road and Freemans Reach Road.
- Local stormwater drainage infrastructure.
- A sewer rising main from Windsor Wharf to the local sewer system, which is used to pump out boat sewage holding tanks.
- A gravity sewer main, which runs beneath Old Bridge and Bridge Streets.
- A number of water mains on both the northern and southern river banks.
- Street lighting would be provided throughout the project.
- Telstra assets located near the proposed southern bridge abutment, which would need to be relocated prior to construction of the bridge abutment.
- Additional telecommunications assets located on the northern side of the river.

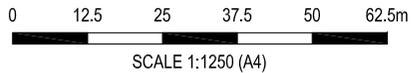
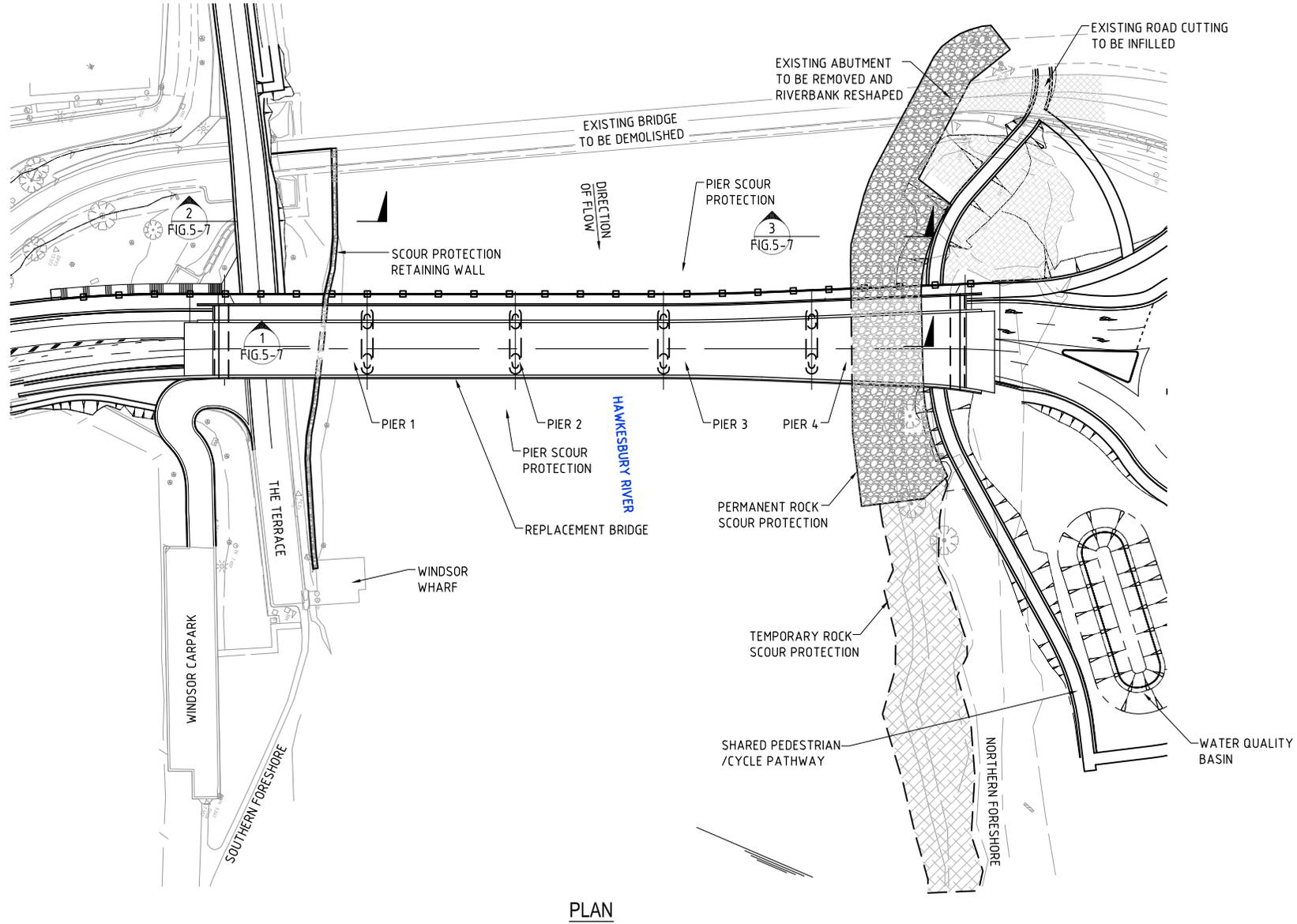
Scour protection works

Scour protection may need to be installed around the bridge abutments and the bridge piers to protect these structures from bank and/or river bed erosion during flood or high flow events. **Figure 5-6** and **Figure 5-7** show the extent and design of potential scour protection. The requirements for the scour protection would be reviewed during the detailed design and it may be possible to reduce the amount of scour protection in some locations.

If required, scour protection would extend about eight metres around each of the two piers in the centre of the river to a depth of about 4.5 metres. The scour protection would consist of rocks about 900 millimetres in diameter – with the top of the rock scour protection level with the existing bed of the river.

Scour protection for the pier adjacent to the northern bank would be incorporated with the scour protection for the northern abutment, if required. The scour protection for the northern bank would consist of rocks about 900 millimetres in diameter to a depth of about 1.6 metres and would extend to a height of about five metres above the mean water level to the new pedestrian/cyclist path. For scour protection above the water level, options to soften the appearance of rock scour protection would be investigated and assessed during detailed design. Options to be considered include overlaying the rock scour protection with sandstone facing blocks and/or including vegetation and landscaping within the scour protections works. The selection of a preferred treatment would also consider maintenance, durability and safety to install and maintain.

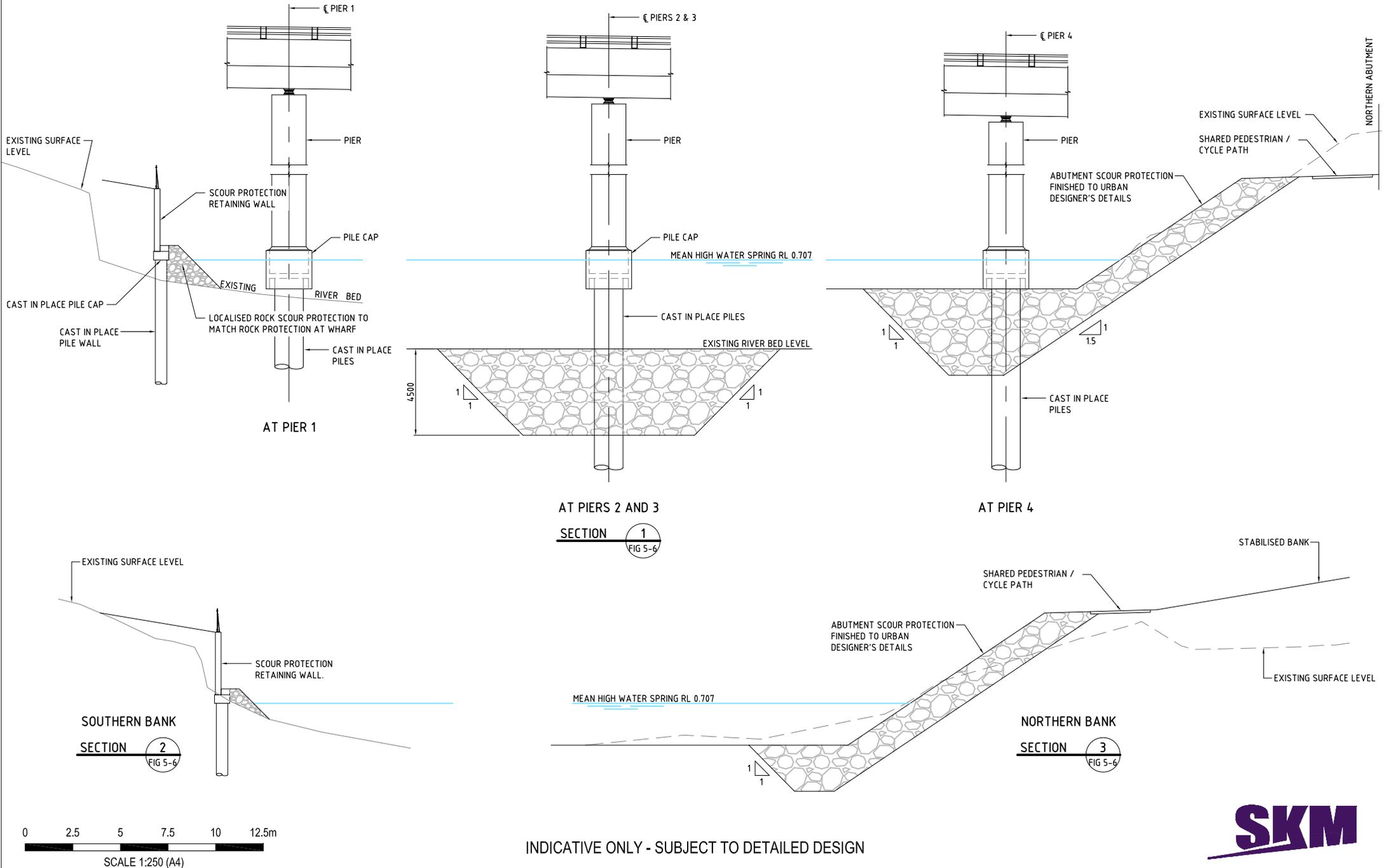
FIGURE 5-6 | Scour Protection to Bridge



INDICATIVE ONLY - SUBJECT TO DETAILED DESIGN



FIGURE 5-7 | Scour Protection to Bridge



Additional scour protection would be provided north of the new path adjacent to the northern bridge abutment and this would be reinforced grass. Temporary scour protection may be required further downstream of the northern abutment during construction to stabilise the existing river bank and allow a construction access road to the river to be safely constructed, however all temporary scour protection would be removed after construction.

Rock scour protection for the southern pier would be less extensive than the northern side of the river as bedrock is closer to the surface. Rock scour protection around the southernmost bridge pier and along the river bank below the water line would be as required but likely consist of a single layer of 900 millimetre diameter rocks. The primary scour protection for the southern abutment would be a new retaining wall about three to four metres high, which would extend from the existing bridge to Windsor Wharf.

Additional scour protection would be provided around the demolished abutments of the existing bridge, once the existing bridge has been demolished and removed.

Water quality management

The project would include construction of a permanent water quality basin to intercept and treat stormwater runoff from the bridge and northern approach roads before it enters the Hawkesbury River. The basin would be located on the eastern side of the proposed roundabout at the junction of Freemans Reach Road, Wilberforce Road and the Macquarie Park access road.

On the southern bank, a net to capture litter would be installed at the end of the stormwater drainage system for the southern approach road. A hand operated shut-off valve would also be installed near the end of the stormwater drainage system to capture any spills within the stormwater system resulting from a road accident.

Noise mitigation works

Some residential properties along Old Bridge Street would likely require works to reduce the impact of increased traffic noise generated during operation of the project. These works could include:

- Ventilation systems and air conditioning to allow windows and outside doors to be closed.
- Double glazing or similar measures to reduce the transmission of noise through windows.
- Sealing of other gaps in facades, doors and windows.
- Roof, wall and/or floor insulation.

An inspection of the upper floor residential premises at the heritage listed 10 Bridge Street property was undertaken by a heritage architect to identify potential noise mitigation options that would be appropriate to the heritage item (CityPlan, 2012). The precise noise mitigation works would be in keeping with the recommendations of CityPlan (2012) and would be implemented in consultation and with the agreement of the affected property owner.

Works may also be required at Number 4 Old Bridge Street and 53 George Street; however as these buildings are not heritage listed these works would be determined during detailed design.

Other buildings would not qualify for noise mitigation works as they either are commercial premises or noise levels would comply with the criteria in the Road Noise Policy (DECCW, 2011).

All noise mitigation works would be undertaken in consultation and with agreement of the property owners. Where possible the noise mitigation works would be installed before construction of the project commences to provide mitigation during the construction period as well as operation.

Flood mitigation works

Based upon the flood modelling undertaken on the concept design, potential flood mitigation works would be required for a number of properties upstream of the replacement bridge. Detailed design may identify further properties that require flood mitigation works.

Flood mitigation works may include but would not necessarily be limited to:

- Improvement to property access for minor flood events.
- Property protection measures such as sealing doors and windows or bunding.
- Developing or revising a flood emergency plan.

All flood mitigation works would be undertaken in consultation and with agreement of the affected property owners.

5.2.8 Urban design and landscape works

This section provides an outline of the proposed urban design and landscape component of the project. Further details of the proposed urban design and landscape concept are provided in Chapter 7, **Section 7.4**.

Urban design and landscape works

The urban design and landscape concept design for the project would involve:

- Application of bridge architecture design principles as part of the integrated engineering and urban design of the bridge superstructure and approach roads, including the area adjacent to the northern approach intersection of Wilberforce Road, Freemans Reach Road and the Macquarie Park access road.
- Redevelopment of The Terrace for pedestrian and vehicle access along the southern bank of the river to Windsor Wharf.
- Removal of the existing bridge approach road that runs through Thompson Square and reinstatement of this land as part of the Thompson Square parkland.
- Improvement of existing areas of open space by linking the Thompson Square open space area with the river foreshore, including new access steps, pathways and landscape treatments.
- Revegetation of areas of the river bank disturbed by construction, including the southern and northern banks of the river adjacent to the replacement bridge and the former site of the existing bridge (once demolished).
- Application of urban design principles to the scour protection works.

Urban design and landscape works on the southern side of the river and within Thompson Square parkland would include:

- Removal of some trees that would be impacted by the project.
- Minor earthworks in the upper Thompson Square parkland to provide a gentle slope and improve the physical and visual connection from the park to the river.
- Planting of trees and other vegetation in Thompson Square parkland.
- Construction of stairs from the bridge pedestrian/cyclist shared path to The Terrace and from Thompson Square road to The Terrace to provide pedestrian access.
- Construction of other paths within Thompson Square parkland as agreed with Council.
- Reinstatement of the section of The Terrace and river bank currently impacted by the existing bridge and approach roads.
- Hard and soft landscape works in the road reserve between the three properties on Old Bridge Street and the new southern bridge approach road.
- Architectural treatment of the southern bridge abutment to minimise visual impacts.
- Application of urban design treatments to scour protection works.

Urban design and landscape works on the northern side of the river would include:

- Minor earthworks to improve the visual appearance of the bank.
- Planting of trees and other vegetation.
- Architectural treatment of the northern bridge abutment to minimise visual impacts.
- Application of urban design treatments to scour protection works.

Figure 5-8 shows the extent and type of works proposed for Thompson Square, the southern bank, the northern bank and adjacent areas. In developing this scope of works, Council and other relevant stakeholders have been consulted, however, further consultation and public comment on the proposed design is planned to be sought and incorporated into the detailed design of the project. This may result in changes to some of the components and / or locations of urban design works.

THOMPSON SQUARE - PROPOSED WORKS



Figure 5-8 Concept design of Thompson Square

5.2.9 Property acquisition and transfer of ownership

Some land would be acquired to enable the construction of the replacement bridge and approach roads. Excess land that is no longer required for the existing bridge and approach roads would be rehabilitated and transferred (returned) to the control of Council. Details of the land that would be acquired and the land that would be transferred to the control of Council are shown in **Table 5-1 and Table 5-2**.

On the northern side of the river, two lots would be acquired and there would be partial acquisition of two other lots. Land that would be acquired on the northern side is currently used for turf farming. The lot containing the northern approach road to the existing bridge would be rehabilitated and returned to the control of Council. Overall there would be an increase in the land for public open space on the northern bank of the river.

On the southern bank, acquisition of two parcels of Crown land would be required. Small areas of these parcels of Crown Land would be incorporated into the project footprint. Old Bridge Street, which is currently owned by Council and zoned road reserve, would be transferred to RMS and incorporated in the project footprint. The southern approach road to the existing bridge would be rehabilitated and incorporated into the Thompson Square parkland in consultation with Council. Overall there would be an increase in the land for public open space in Thompson Square. The impact of these proposed changes in land use is addressed in **Section 7.8**.

Table 5-1 Land acquisition - directly affected properties

Property	Tenure	Existing land use	Impact
Northern bank			
Lot 2 DP1096472	Private	Commercial – turf farm	Total acquisition of 8960 m ² of which about 40% would be used for the project and 60% would be public open space.
Lot 2 DP65136	Private	Commercial – turf farm	Total acquisition of 4650 m ² of which about 70% would be used for the project and 30% would be public open space.
Lot 1 DP1096472	Private	Residential/ commercial – turf farm	Partial acquisition (422 m ² of 4770 m ²).
Lot 68 DP751665	Private	Commercial – turf farm	Partial acquisition (135m ² of 139,600 m ²).
Lot 1 DP226141	Public	Road and reserve for existing bridge approach	About 1400m ² of extra open public space would be generated resulting from removal of the northern approach road.
Southern bank			
Lot 345 DP752061	Crown land	Thompson Square	Total acquisition – 338 m ² of the 524 m ² lot area would be used for the project and the rest would be retained as open space.
Lot 7008 DP1029964	Crown land	Park, car parking and Windsor Wharf	Total acquisition – 334 m ² of the 7089 m ² lot area would be used for the project and the rest would be retained as open space.

Table 5-2 Land to be transferred (returned) to Council

Property	Tenure	Existing land use	Impact
Existing road reserve	Crown land	Road reserve for existing bridge approach through Thompson Square	About 1400m ² of extra open space would be generated resulting from removal of the southern approach road. Land would be incorporated into Thompson Square parkland.

5.2.10 Temporary construction facilities

Construction of the project would require establishment and operation of temporary construction and compound sites for the duration of the construction period (about 20 months). These facilities would be removed at the completion of construction and the sites would be restored and landscaped.

The main construction compound would be located on the north side of the river within the existing turf farm between the Hawkesbury River and Wilberforce Road (Lot 2 DP 1096472 and Lot 2 DP65136). This main construction compound is identified as the Turf Farm Site on **Figure 5-2** and is discussed in further detail below.

Additional areas would be used for construction purposes and as secondary compound sites. These include:

- Windsor Wharf carpark and open space (Lot 7008 DP1029964) – On the south side of the river immediately to the south of Windsor Wharf between Old Bridge Street and Windsor Wharf. Construction compounds and facilities would be limited to the existing paved areas and grassed areas.
- The lower Thompson Square parkland (Lot 345 DP752061) – this area would be required to allow construction of the southern bridge abutment and approach road.
- Office space in a building near the project – this location has not yet been identified.

Temporary construction facilities would be the main focus of construction activity and would also be used for temporary storage of construction materials and equipment and the placement of temporary facilities for construction workers. The key factors considered in selecting the proposed construction compound sites were as follows:

- Access to the main road network.
- Access to services such as electricity and water.
- Proximity to key construction areas.
- Minimising local traffic disruptions.
- Distance to residences and other land uses that would be particularly sensitive to the impacts of construction activities.
- Minimising heritage, visual and vegetation impacts.

The main construction compound site, secondary compound site and additional areas would be used for construction purposes are described below

Turf farm site

The main construction and compound site would be located within the area of land designated as Lot 2 DP 1096472 and Lot 2 DP65136 between Wilberforce Road and the northern side of the Hawkesbury River. This land is currently used for turf farming and would be acquired by RMS for the project. The site would support bridge construction activities and would include the main compound facilities and site office for the project. The casting yard, large cranes, laydown areas and other facilities supporting the incrementally launched bridge would be located on this site. Piling and excavation of up to about 4000 cubic metres of soil for establishment of the casting yard and supporting facilities would be required.

The site is generally level and would only require very minor grading and contour works to provide for safe vehicle turning areas and access to/from Wilberforce Road. Access to the main construction and compound site would be from Wilberforce Road. Minor modifications to Wilberforce Road such as the construction of temporary road pavements, a roundabout or slip lanes would be required to provide safe access to the site.

Temporary jetties or pontoons would also be established on the foreshore to allow water access to and from the bridge piers for workers and materials. A temporary access road from the construction compound to the temporary jetties or pontoons would also be constructed.

Establishment of the construction compound would require removal of irrigation water pipes and sprinklers that currently provide water for turf farming. The site includes an area of land at the foreshore that would need to be cleared of vegetation to allow for the construction of scour protection works associated with protecting the northern abutment and a temporary access road.

Construction activities at the site would be predominantly confined to standard daytime working hours, with some intermittent deliveries by heavy vehicles and unloading of bridge components and equipment taking place at night. Inaudible works may be undertaken in the casting yard outside standard construction work hours.

Part of the site would also form the permanent northern abutment for the replacement bridge as well as the new intersection of Wilberforce Road, Freemans Reach Road and the Macquarie Park access road.

Windsor Wharf carpark and open space

This secondary construction and compound site would be established on council-owned car parks and open space near Windsor Wharf (Lot 7008 DP1029964). Construction facilities would be limited to the existing paved areas and grassed areas. Clearing of the existing vegetation would be limited to a number of small planted trees that may require removal or trimming to allow access.

The car park immediately to the west of Old Bridge Street is about 180 square metres and would support road and bridge construction activities. It would also form part of the new bridge approach road between George Street and the replacement bridge. The car park adjacent to Windsor Wharf is about 500 square metres and would be used for a secondary project office, compound facilities and storage area. The grassed areas would be used as a storage area or portable offices may be located in these areas. Construction activities on the sites would be predominantly confined to standard day time working hours, with some intermittent deliveries by heavy vehicles and unloading of construction components and equipment taking place at night.

Vehicle access to the construction site would be via Old Bridge Street or via The Terrace. Public vehicle access to Windsor Wharf would need to be temporarily closed until road works between George Street and the replacement bridge are completed. Pedestrian access (via The Terrace) would generally be maintained to Windsor Wharf during construction. Pedestrian access would be temporarily restricted during critical activities, such as landing the final bridge span into position, reconstructing The Terrace and constructing the southern bridge abutment.

Lower Thompson Square parkland

The lower Thompson Square parkland has been identified as a secondary compound for the project. While it would be required for construction, the types of activities undertaken in the parkland would be limited and would include:

- Part of the southern approach road and abutment would be located in the lower parkland area and these areas would be directly disturbed by construction activities.
- An area directly adjacent to the southern approach road and abutment would be required to provide access to enable construction of these project elements.
- A small demountable may be located near The Terrace for security and traffic control for access to the southern bank construction area.
- Temporary fencing would be installed for security and safety reasons.

In recognition of the heritage values of the lower Thompson Square parkland, the area would not be used for parking, storage of materials, office demountables or any other typical construction compound activity.

It should be recognised that heritage excavations in the lower parkland area may be substantial and extend outside the directly impacted construction area as this area contains both Aboriginal and historic areas of interest.

While not all of the lower Thompson Square parkland would be required for construction, the lower parkland would be closed to public access during construction for safety reasons.

Office space

Office space may be leased in a building near the project. The location of potential office space has yet to be identified. The office space would be used to accommodate administration and construction personnel to avoid the need to locate temporary office space in flood prone areas on the northern and southern bank of the river. As the location and need for off-site office space has yet to be determined, RMS are not seeking approval for this activity.

Table 5-3 Proposed construction site compound facilities

Site location	Proposed uses/ facilities	Potential site establishment works
Turf farm site	Storage facility Stockpile area Site offices Lunch rooms Toilet and shower facilities First aid shed Fuel and hazardous goods storage Concrete washout Parking Concrete casting bed and launching yard Temporary jetties or pontoons	<ul style="list-style-type: none"> Erect temporary fencing Install environmental controls Survey area Minor modifications to Wilberforce Road Construction of casting yard and associated facilities Construct temporary driveway (and carpark if required) Establish crane Construct hardstand areas Erect sheds using cranes and trucks Connect services to the compound Install office equipment Install temporary jetties or pontoons and provide access
Windsor Wharf car park and open space	Storage facility Stockpile area Lunch rooms Toilet facilities First aid shed Parking Site offices	<ul style="list-style-type: none"> Erect temporary fencing Install environmental controls Gain service approvals and carry out works as per the approvals Erect sheds using cranes and trucks Connect services to the compound
Lower Thompson Square parkland	Access to southern abutment and approach road Storage facility	<ul style="list-style-type: none"> Erect temporary fencing Install environmental controls

Water-based construction facilities

As well as temporary piers/pontoons, the construction of the piers closest to both river banks could require temporary land reclamation works to provide a suitable working platform as the locations may be too restricted to move barges into position in the shallow water. The area of land reclamation would be about 500 square metres. Reclamation would be carried out by placing large rocks into position followed by increasingly smaller sized aggregates until a level work platform is achieved. The materials used would be removed once the works are complete. Appropriate environmental management measures such as silt curtains would be used to minimise any impacts on water quality during construction and removal of these temporary facilities.

Alternatively temporary steel jetties may be installed to access the construction locations for the bridge piers. Temporary steel piers would be installed followed by a steel deck to support a variety of construction activities and plant. The steel jetties would be removed once construction of the bridge piers is completed.

5.2.11 Heritage investigations

Early works involving additional field investigations for Aboriginal and historic heritage (including maritime heritage) would be carried out as part of the project environmental management measures. Further detailed design and consultation with regulatory authorities would be undertaken to determine the location, type and scope of heritage investigations required. The early works would also involve establishment of site compounds and ancillary facilities (including several portable buildings and toilets) for the heritage investigations, as well as protection and/or relocation of services and utilities.

Aboriginal heritage investigations (salvage)

The early works for Aboriginal heritage investigations would include:

- Salvage excavation at identified Aboriginal heritage sites on the southern bank of the river in accordance with the procedures identified in the Aboriginal heritage chapter (refer to **Section 7.2**).
- Recording and protection of Aboriginal heritage in accordance with the procedures identified in the Aboriginal heritage chapter (refer to **Section 7.2**).

The salvage excavation works on the southern bank of the river would involve two areas of open excavation as follows:

- An area of about 100 square metres at the corner of George and Bridge Streets, extending along the length of the proposed approach road formation to The Terrace.
- An area of about 25-50 square metres between Bridge Street, Old Bridge Street and the wharf carpark.

These areas have been identified as locations where there is a high probability of finding Aboriginal archaeological material and as being of sufficient size to obtain the necessary archaeological coverage of the impacted area.

Removal of archaeological material from the excavation area would be carried out by hand and machinery until sufficient material has been recovered and recorded. The depth of excavation is expected to extend until the maximum depth of construction impact is reached, although excavation beyond the base of impact depth may be required to optimise information retrieval. The works would be accompanied by signage for public information and interpretation, including signage providing Aboriginal heritage information and signage providing information on the scope of the investigations.

Terrestrial historic heritage investigations (salvage)

The early works for terrestrial historic heritage investigations would include:

- Salvage excavation at identified historic heritage sites on the southern bank of the river in accordance with the procedures identified in the non- Aboriginal heritage chapter (refer to **Section 7.1**).
- Recording and protection of historic heritage in accordance with the procedures identified in the historic heritage chapter (refer to **Section 7.1**).

The salvage excavation works on the southern bank of the river would involve all areas that would be disturbed as part of construction of the replacement bridge.

Removal of archaeological material from the excavation area would be carried out by hand and machinery until sufficient material has been recovered and recorded. The works would be accompanied by signage for public information and interpretation, including signage providing historic heritage information and signage providing information on the scope of the investigations.

Early works – maritime historic heritage investigations (salvage)

The early works for maritime historic heritage investigations would include:

- Salvage excavation at identified historic heritage sites on the southern bank of the river and within the river in accordance with the procedures identified in the non- Aboriginal heritage chapter (refer to **Section 7.1**).
- Recording and protection of historic heritage in accordance with the procedures identified in the historic heritage chapter (refer to **Section 7.1**).

The salvage excavation works on the southern side of the river would involve the area of the old Windsor wharf including the river banks – and the water immediately around the old wharf.

Removal of archaeological material from the excavation area would be carried out by hand and machinery until sufficient material has been recovered and recorded. Divers would be required to salvage the areas within the river. The depth of excavation is expected to extend until the maximum depth of construction impact is reached, although excavation beyond the base of impact depth may be required to optimise information retrieval. The works would be accompanied by signage for public information and interpretation, including signage providing non- Aboriginal heritage information and signage providing information on the scope of the investigations.

5.3 Design criteria

5.3.1 Urban design objectives

Urban design objectives and principles were identified for the project to achieve a concept design outcome that is physically, visually and operationally integrated with the surrounding environment. The urban design objectives are as follows:

- Develop an integrated concept design that fits sensitively with the existing qualities and characteristics of Windsor and its Hawkesbury River setting.
- Enhance the existing amenity, visual character and cultural landscapes of Thompson Square and Windsor.
- Maintain the integrity of cultural and historic buildings, structures, elements and spaces of Windsor.
- Improve connectivity for vehicles, pedestrians and cyclists.

A landscape character and visual assessment is contained in **Section 7.3** and working paper 4 in Volume 3. These contain further detail on the objectives, including the design principles that apply to each. The design responses to these objectives are also provided.

5.3.2 Design standards and criteria for the replacement bridge

The proposed replacement bridge has been designed in accordance with the Australian Standard for Bridge Design (AS 5100). It meets the design criteria for Bridge Classification Type II, earthquake design category BEDC-1, and the additional engineering criteria presented in **Table 5-4** (refer to the glossary for clarification of terms).

One of the key criteria for the design of the replacement bridge was to improve the flood immunity of the river crossing. The proposed replacement bridge has a flood immunity that is just below the 1 in 3 year flood level. This provides an improved level of flood immunity relative to existing conditions and matches the flood immunity of the northern approach roads.

The replacement bridge would be above the river water level for floods approaching the 1 in 3 year flood event but would be inundated during larger floods. The bridge design has therefore been selected based on the need to withstand regular immersion. The proposed replacement bridge has also been designed to withstand floods up to the 1 in 2000 year event without collapse or loss of structural integrity.

The piers of the replacement bridge have been designed to withstand the impact of vessels on the river. A 60 tonne vessel travelling at 2.1 metres per second (four knots), which equates to a 1950kN collision loading, has been selected as the criteria for determining the impact resistance requirements of the bridge piers.

The road across the replacement bridge (and the bridge approach roads) would meet the design criteria for a 50 kilometre per hour speed limit – which has been reduced from the original project objective of 60 kilometres per hour design speed limit. This lower design speed allows the height of the southern approach road to decrease as it approaches the river and thereby reduces the potential visual impact of the bridge on Thompson Square. Further reductions in the height of the replacement bridge and southern approach road through Thompson Square parkland were not considered to be feasible as there needs to be at least 3.6 metres of under bridge clearance to The Terrace to allow service vehicles and emergency service vehicles to access Windsor Wharf.

5.3.3 Design standards and criteria for the approach roads

The road works component of the project has been designed in accordance with Austroads - Guide to Road Design. The engineering design parameters for the road works component are summarised in **Table 5-5**.

Additional factors that were taken into account in the design of the approach roads and intersections were associated with the need to maintain and improve traffic flow and the need to minimise impacts on heritage and properties. These factors are summarised in **Table 5-6**. Urban design considerations, including the need to minimise impacts on heritage items and the overall heritage character of the Windsor township, are discussed in **Section 5.4**.

Table 5-4 Engineering design parameters for the bridge structure

Item/ parameter	Value
Horizontal alignment	Design speed - 50 km/h
	Curve radius – not applicable as the bridge is straight
Vertical alignment	Design speed - 50 km/h
	Crest "K" min value – not applicable
	Southern bridge abutment Sag "K" minimum value - 7.1
	Grade – Maximum 1.35 %
Traffic loading	SM1600
Earthquake loading acceleration coefficient	0.08
Site factor	1.0
Crossfall	Maximum 1.5%
Overall bridge width	Maximum 15.24 metres
Road carriageway width	Maximum 11 metres
Number of lanes on bridge	Northbound – 1
	Southbound – 1 initially, with provision in the width of the proposed road shoulders to provide two southbound lanes in the future, if required, by changing the lane markings.
Lane width (on bridge) at time of opening	3.5 metres with 2.0 metres wide shoulders
Lane width (on bridge) when re-line marked to three lanes	3.3 metres approximately with 0.5 metres wide shoulders
Road clearance at The Terrace	Minimum 3.6 metres
Proposed navigational clearance	Minimum 7.5 metres at MHWS
Shared use path width	3.0 metres

Table 5-5 Engineering design parameters for the road works

Item / parameter	Criteria
Horizontal alignment	Design speed - 50 km/h
	Curve radius and location - 150 metres minimum on northern approach road, 300 metres minimum on southern approach road, 118.5 metres minimum on Wilberforce Road, 200 metres minimum on Macquarie Park access road, straight on Freemans Reach Road
Vertical alignment	Design speed - 50 km/h
	Crest "K" min value - 3.5 on southern approach road
	Sag "K" min value - 10.3 on northern approach road, 7.1 on southern approach road, 5.4 on Wilberforce Road, 9.4 on Macquarie Park access road, 4.9 on Freemans Reach Road
	Grade – Maximum 8.4 %
Stopping sight distance	Reaction time 1.5 sec
	Horizontal - 45 metres
	Vertical - 39 metres
Traffic lane width	Two lanes 3.5 metres wide
Road shoulder width	2 metres (both carriageways on the northern and southern approach roads)
Crossfall/superelevation	Maximum 3.0 %

Table 5-6 Additional design objectives for the approach roads

Component	Design criteria
Southern approach road	Minimise disturbance of Thompson Square by minimising the width of the southern approach road and aligning the southern approach road to maximise open space in Thompson Square.
	Lower the road level as much as possible through Thompson Square
	Provide left in/left out access for the two properties at 4 and 6 Old Bridge Street.
Northern approach road	Maintain access to Macquarie Park.
	Avoid impacts on the local heritage listed building "Bridgeview".
	Improve traffic flow and safety at the Freemans Reach Road, Wilberforce Road and northern bridge approach road intersection.

5.3.4 Design standards and specifications for pedestrian and cyclist facilities

The following design standards and specifications would be applied to the design and construction pedestrian and cyclist facilities:

- Austroads – Guide to Road Design part 6A – Pedestrian and Cyclist Paths.
- Austroads – Cycling Aspects of Austroads Guides.
- AS/NZS1158 (Set): 2007, Lighting for roads and public spaces set.
- AS/NZS 1158.1.1: 2005, Lighting for roads and public spaces, vehicular traffic (category V) lighting – performance and design requirements.
- AS/NZS 1158.1.3: 1997, Road lighting part 1.3: vehicular traffic lighting (category V) – guide to design, installation, operation and maintenance.
- AS/NZS 1158.3.1:2005, Lighting for roads and public spaces, pedestrian area (Category P) lighting – performance and design requirements.
- AS 1428.1-2001, Design for access and mobility part 1: general requirements for access: new building work.

5.3.5 Design standards and specifications for the demolition works

The following design standards and specifications would be applied to the demolition of the existing bridge:

- RMS Specification B341 – Demolition of Existing Structures.
- AS2601-2001 – The Demolition of Structures.

5.3.6 Other design standards and specifications

Standards and specifications for the design of other project elements include:

Drainage and scour infrastructure including water quality basins

- Austroads – Guide to Road Design Part 5 – Drainage Design.
- Austroads – Guide to Bridge Technology Part 4: Design Procurement and Concept Design.

Utility relocation design and / or protection

- Relevant Australian Standards.
- NSW Streets Opening Conference - Guide to Codes and Practices for Streets Opening (2009).

Traffic signals

- Specification SI/TCS/8 - Installation and Reconstruction of Traffic Light Signals (RTA).
- Traffic Signals Practice, Design (RTA).
- Traffic Signal Design Standards - RTA-TC-189 (RTA).
- Traffic Signal Design (RTA).
- AS/NZS 3000:2000 – Electrical Installations (Standards Australia).

5.4 Construction works

Construction would be staged to minimise environmental and traffic impacts. The likely staging of construction activities would be as follows:

- Pre-construction activities.
- Early works activities.
- Construction of temporary pavement at Wilberforce Road and near the corner of George and Bridge streets to provide additional road width to enable construction of next stages.
- Bridge construction activities.
- Construction of the northern roundabout and approach road and most of the southern approach road.
- Construction of the remainder of the southern approach road and the new sections of Freemans Reach Road, Wilberforce Road and Macquarie Park access road.
- Commissioning and opening of the replacement bridge to traffic.
- Removal, backfill and landscaping of existing bridge approach roads.
- Demolition of the existing bridge.
- Urban design and landscape works.
- Removal of temporary structures and demobilisation of the construction facilities.

A detailed description of construction stages and activities is presented below. This proposed sequence of activities is indicative and may change once detailed construction planning is completed. It is also likely that some stages may overlap.

5.4.1 Pre-construction activities

Pre-construction activities include:

- Leasing and acquiring land.
- Notifying residents and the affected community of the start of works.
- Undertaking surveys to identify and mark out the construction footprint on the ground.
- Undertaking additional geotechnical and other soil/sediment investigations.
- Undertaking dilapidation surveys.

Pre-construction activities may be undertaken at various times over the duration of the project corresponding to different construction stages and project components. For each construction stage or project component, the various types of pre-construction activities may also be undertaken collectively or in isolation, depending on the specific requirements of the stage or component.

5.4.2 Early works

Presented in the following section are works that RMS is seeking approval to be undertaken as early works. These works would be undertaken if the project is approved but before approval of key management plans or other requirements. A specific Early Works Environmental Management Plan would be prepared and implemented. The proposed early works are generally minor in nature, but are important precursors to allow the major construction works to commence. These early works would consist of:

- Historic and Aboriginal heritage investigations (see **Section 5.2.11**). Approval of heritage investigation plans for these works by relevant stakeholders would be required before these works would commence.
- Applying noise mitigation treatments to those buildings that have been identified in this EIS as requiring treatment (where agreed to in consultation with affected property owners).
- Adjustment, relocation and protection of public utilities and services. Heritage investigations and clearance would be required before some public utility adjustments could be undertaken.
- Clearing of some vegetation on the river bank to allow further investigations and the establishment of temporary construction activities. This would be minimised where possible until full construction approval has been obtained.
- Site establishment activities, which would include:
 - Establishment of temporary construction facilities and compound sites, which would involve clearing, minor earthworks, installation of office accommodation, utilities and other facilities.
 - Establishment of construction site fencing, signage and lighting.
 - Establishment of construction site access points, traffic management measures, alternative public access routes and diversions. This would include any minor road modifications to Wilberforce Road, The Terrace and Bridge Street.
 - Construction of the casting bed and associated facilities for the incrementally launched bridge. This would require some minor piling and earthworks.

- Establishment of temporary drainage.
- Installation of environmental controls, including but not limited to erosion and sediment controls and barrier fencing.
- Installation of temporary jetties or pontoons, which could be secured by one or a combination of methods, including anchor blocks or temporary piles. Access to these temporary facilities would also be constructed.

5.4.3 Bridge construction activities

Bridge construction includes construction of the piers in the river, construction of the bridge abutments and construction and launching of the bridge superstructure. It includes both land-based and water-based activities as described below. The exact methods of all elements of construction have not yet been determined and possible alternatives are described below – and have been assessed in Chapter 7.

Land-based construction

The proposed replacement bridge would be constructed using the incrementally launched method. A temporary concrete casting bed and launching yard would be established on the northern side of the Hawkesbury River to cast segments of the bridge. Once a segment has been completed it would then be 'pushed' using large hydraulic jacks (i.e. launched) across the river on to the piers from north to south. For the project, each segment is likely to be about 15.7 metres long (half a span length) and would incorporate all elements of the bridge superstructure except for the traffic barriers. Other construction methods would be considered during detailed design with the aim of further reducing impacts.

The land-based construction components associated with the proposed bridge would include construction of the abutments on each foreshore. The construction activities could include (but would not be limited to) the following:

- Importation of fill. Local fill from the project construction sites would be used where possible, although additional general and select imported fill (about 10,800 cubic metres) is likely to be required.
- Completion of earthworks to create temporary level working platforms.
- Installation of piles at abutment locations by boring to the required depth, placing a steel reinforcement cage in the hole then placing concrete in each pile. Around five piles of about 900 millimetres in diameter are likely to be required directly under each abutment. Piles are required to support each abutment and to transfer bridge loads from the bridge deck through each abutment onto the ground. The final number would be subject to engineering requirements to be determined during detailed design.
- Construction of the abutment walls and retaining structures for the bridge approach roads.
- Completion of permanent earthworks as part of road works between the George Street / Bridge Street intersection and the southern bridge abutment.
- Casting of superstructure segments, post tensioning them to the previous segment and launching them out across the piers.
- Finishing works, including traffic barriers, surfacing, drainage and lighting.

Superstructure segments may either be pre-cast at an appropriately approved off-site facility (and transported to the project site) or cast on-site at a temporary concrete casting bed facility located behind the northern bridge abutment.

For the incrementally launched bridge, a casting bed of about a 15.7 metre section of the bridge (half a span) would be created in the casting yard using formwork. Steel reinforcing for the bridge would also be installed in the formwork. and once complete concrete would be pumped from concrete trucks into the formwork. The concrete would be allowed to set and cure– and then some sections of the formwork would be removed to allow the completed section to be gradually launched (i.e. pushed or pulled) using hydraulic jacks over the bridge piers. The formwork would then be reinstated within the casting yard and the process of constructing and launching a 15.7 metre section of the bridge repeated until the bridge is completed.

Some components of the bridge superstructure such as the traffic barriers may be precast at an off-site facility and attached to the bridge, prior to or after the launching process is complete.

For both the precast and cast in-situ methods, large equipment and heavy machinery such as cranes or scaffold systems would be required to lift elements of each segment into place. This equipment would be located on the work sites within the turf farm, the Windsor Wharf car park and open space areas and the lower Thompson Square parkland for the duration of the construction of each component of the bridge.

Water-based construction

The water-based construction components associated with the project would include construction of four piers in the Hawkesbury River and installation of scour protection below the water line. The construction activities for pier construction could include, but are not limited to:

- Installing piles at pier locations to the required depth by bored piling methods. A steel case would be driven to the required depth and the pile bored within this tube. A steel reinforcing cage would then be placed in the steel casing and the concrete poured into the pile from a barge or a series of temporary platforms using a concrete line pump. Around four piles of about 1500 millimetres in diameter or seven piles of 900 millimetres diameter would be required at each pier location.
- Installing pile caps and pier columns using a combination of precast or cast in-situ methods.
- Finishing works including edge barriers, surfacing, drainage and lighting.

As with the land-based components, the construction methods would be either based on precast or cast in-situ concrete components. If precast methods are used, the components of the pile caps, pier columns or bridge spans would be cast at either an appropriately approved off-site facility or within the turf farm construction and compound site, before being transported to the intended location. The components would be lifted into place by cranes.

Cast in situ methods for construction of the pile caps and pier columns would involve installation of formwork or precast concrete shells supported by a temporary scaffold system, and fixing of steel reinforcement into which concrete would be poured. The concrete line pump would be supported over water by a series of temporary platforms or barges.

There are a number of alternative options for access to the pier construction sites including:

- Barge access – pier construction may be undertaken from a combination of small and large barges. Minor dredging of river bed near the banks may be required to provide access for barges.
- Temporary partial reclamation of the river – temporary rock platforms may be constructed in the river and construction of the piers would occur from these platforms. This method of access may only be appropriate for the piers closest to the banks.
- Temporary steel jetties – temporary steel jetties may be constructed to access the pile construction locations. It may be possible to access all pier locations using this method.
- Either one or a combination of the above options may be used. Some barges and other water craft would still be required no matter what option is selected for pier access. Some equipment and materials would be transported to the work sites via barges from a suitable wharf facility within the Hawkesbury River, subject to negotiation and approval (if required). The equipment required would depend on the method selected but would generally include bulk equipment such as barge-mounted cranes, gantries or scaffold systems.

If installation of scour protection below the water line is required, two methods of construction would be used. For the scour protection in the river bed, areas would require dredging to create an excavated area to place the rock scour below the river bed level. Once a sufficient sized excavation had been dredged, rock would be placed from a barge. For rock scour protection on the bank, an excavator would be used to remove the bank material and then rock placed in the excavated area. This may be completed from a barge mounted excavator or a land-based excavator.

For the scour protection of the southern bank, a retaining wall would be constructed. This could involve drilling a bored pile about every five metres and then installing precast concrete panels between the piles or constructing a continuous piled wall. The design of the scour protection in this area would be considered further during detailed design.

5.4.4 Road construction activities

For the southern approach roadworks through Thompson Square, the roundabout at the intersection of Bridge Street and George Street would be completely removed. Some of the existing pavement would be retained and new pavement would be constructed generally within the confines of the existing kerbs where required. This work could involve a combination of saw cutting, excavation and truck operations. The existing pavement on Bridge Street between George Street and Macquarie Street would need to be replaced using a profiling machine, an asphalt paver, trucks, sweepers, rollers and bobcats. The process would involve removing the existing pavement and constructing new pavement to achieve the required road surface levels. Where possible any excavation for new pavement would not extend below the existing pavement levels to minimise any possible disturbance of unknown heritage items and sites.

New kerb and gutter would be required in George Street for a length of around 10 metres east and west of Bridge Street to allow the required road surface levels and minimum road design standards to be achieved. The new kerb and gutter located on the south western corner of the Bridge Street / George Street intersection would be located behind the existing kerb and gutter by a distance of 0.5 metres to allow for vehicles to safely turn left into George Street. Existing kerb and gutter affected by the proposed roadworks would be removed.

New kerb and gutter would also be required along Bridge Street (south of George Street) for a length of around 45 metres to allow the required road surface levels at the intersection of Bridge Street and George Street to be achieved.

The installation of traffic signals would involve constructing new foundations and installing new pits and conduits to tie into the existing traffic signal system at the intersection of Bridge Street and Macquarie Street. New conduits would need to be laid under the existing footpath (using trenching methods) along the eastern side of Bridge Street between Macquarie Street and George Street in order to connect the existing traffic signals at Macquarie Street with the proposed traffic signals at George Street. The footpath would be reconstructed once the conduits had been laid. The foundations for the traffic signal posts would be piled or excavated and may require existing services to be relocated.

Between George Street and the southern bridge abutment, the road would generally be in fill (above the existing ground surface level) and would require the importation of fill to build the road surface level up to the final road pavement level. Despite being in fill some areas would require excavation below the existing ground surface to remove geotechnically unsuitable material, for service relocations or for the footings required for retaining walls. Prior to filling, excavation works up to two metres deep would be required to expose suitable foundation conditions required to support the fill embankment and retaining walls. Where fill embankments would otherwise extend into private property or into the Thompson Square parkland, vertical retaining walls would be constructed to support the road carriageway. Retaining walls would minimise the area of road within Thompson Square.

An alternative option to a filled earth embankment for the southern approach would be construction of a land bridge for the majority of the length of approach road. This would involve boring a number of piles along the alignment of the road, constructing headstocks between the piles and then placing pre-cast concrete beams between the headstocks to form the bridge deck. Additional elements such as precast concrete panels between the bridge deck and the natural ground and traffic barriers would be installed. Some sections of the southern approach road would still require conventional filling construction methods as described above.

The Terrace, in the vicinity of the replacement bridge, would be connected to the section of The Terrace to the west of the existing bridge. To make this connection a new road pavement to Council standards would be constructed for a length of about 50 metres. To access Council's car park located adjacent to Windsor Wharf, a new connection road would also be required. This connection would involve constructing new road pavement for a length of about 30 metres between The Terrace and Council's car park immediately to the east of the southern bridge abutment.

On the northern side of the Hawkesbury River, road construction activities would involve excavating into the existing ground to a varying depth of about one to two metres using excavators to allow suitable foundation conditions to be exposed to support the road pavement. The roundabout road surface level would be at similar height to the existing ground levels.

5.4.5 Other construction activities

Other construction activities would be undertaken as required and would include:

- Installing connections and links to existing utilities, where required, along the length of the project. This would involve trenching and excavation.
- Constructing kerb and guttering.
- Installation of traffic and safety barriers.
- Drainage works, including excavating, laying and backfilling storm water pipes and pits.
- Street lighting on the replacement bridge and its approach roads where required to meet minimum road lighting levels.
- Construction of pedestrian and shared pathways as shown in **Figure 5-5** and **Figure 5-5a to c**.
- Modifying existing signs and installing new signs.
- Providing road pavement markings.
- Landscaping, fencing and finishing works.

5.4.6 Traffic management and earthworks

The majority of construction traffic movements would relate to importation of fill for the earthworks phase of the project and transport of concrete in trucks for the construction of the replacement bridge. Apart from where the approach roads to the replacement bridge tie in with existing roads, the proposed works would generally be constructed clear of existing traffic. The Construction Environmental Management Plan and contract documents would include traffic and safety management procedures which address management of traffic during construction: traffic switches, line marking, signage (including temporary advanced warning variable message signage), earthworks and material haulage, intersection access, local property access and emergency and incident response. **Section 7.2** provides further information on construction traffic impacts.

A total of about 12,300 cubic metres of fill material would be required for the construction works. The breakdown of earthworks quantities is shown in **Table 5-7**. Local fill from the project construction site in the order of 1500 cubic metres would be reused where possible, although additional imported fill of around 10,800 cubic metres would be required.

Table 5-7 Estimate of types and quantities of materials for construction

Description	Approximate quantities
Road works	
Earthworks (cut to fill)	1500 m ³
Earthworks (imported fill)	10,000 m ³
Concrete	3500 m ³
Asphalt	1000 tonnes
Dense grade base (DGB)	650 m ³
Structural steel	30 tonnes
Bridge works	
Concrete	2400 m ³
Steel reinforcement	450 tonnes
Asphalt	500 tonnes
Imported fill	800 m ³

5.4.7 Demolition of the existing bridge

A detailed methodology for the demolition of the existing bridge would be developed based upon further investigations and studies. For the purposes of the EIS a methodology has been developed and used to identify and assess potential impacts. This is described in the following sections.

Removing the bridge superstructure

The existing bridge would be demolished once the replacement bridge is open to traffic.

The walkway across the existing bridge would be demolished first. This would involve stripping out the collapsible handrail, plywood decking, storage racks and services then removing the steel beams and supporting brackets.

The bridge deck would be removed by saw cutting it into small sections and lifting each section onto trucks positioned on the bridge. Structure sections would be cut from either edge progressively using temporary braces to maintain the stability of the concrete girders until they are lifted out by crane.

The strength of the existing superstructure limits the size of the crane that can feasibly be used to lift the girders and adjacent sections of slab deck. As such, the removal of the concrete girders would be carried out using one of the following methods:

- The deck slabs between the girders could be removed prior to the girders to limit the size of the crane required.
- Girders and bridge sections could be lifted from the river using a crane supported on a barge.

A possible alternative method, involving building a platform underneath the bridge deck to allow the bridge to be broken up in situ, was investigated but found to have substantial disadvantages. Disadvantages included the high cost of building the platform, the risk to construction plant and equipment being washed away during a flood, as well as higher noise and dust levels in comparison to the above-listed crane options.

Removing the bridge substructure

The substructure, including the cast iron cylinders and cross-girders that support the existing bridge deck, would be cut into sections and then removed using a crane on a barge. Cylinder sections would be cut underwater using cutting rods, one metre below the existing river bed level, in accordance with the relevant RMS quality specifications for bridgeworks. Containment measures would be installed around underwater sections of the cylinders to protect water quality and minimise disturbance of the river bed. A cutter suction dredge with a storage tank on the barge may be used to clean up the river bed.

Existing retaining walls adjacent to each bridge abutment would be demolished using an excavator positioned on land behind each abutment or on a barge in front of each abutment. The fill material behind the retaining walls would be removed by the excavator and loaded directly onto trucks. The existing retaining walls and removed fill would be replaced by rock as part of the scour protection works for the project.

5.4.8 Decommissioning activities

At the completion of construction, the construction sites would be decommissioned and rehabilitated, with each area restored to suit its intended post-construction use. Activities involved in this stage of the project would include:

- Cleaning up the site.
- Removing site compounds, barriers, fencing, signage and other temporary structures.
- Removing material from the reclaimed areas.
- Removing material stockpiles.
- Providing full waterway access.
- Opening areas to traffic through a series of traffic switches.
- Restoring and landscaping disturbed areas.

5.5 Construction timing and duration

5.5.1 Construction period

It is anticipated that a construction period of around 20 months would be required to complete the project, including demolition of the existing bridge. The work would be completed in one continuous period as funding permits.

5.5.2 Work hours

There would be four broad categories of works for the project: bridge works, water-based works, road works and bridge demolition works. The bridge works would occur predominantly at the turf farm construction and compound site (refer to **Section 5.2.5**) while road works would occur on both sides of the Hawkesbury River. The water-based works would occur on the river and would be serviced either from a temporary jetty or pontoon on the northern and southern river banks or another appropriately approved wharf downstream of the replacement bridge location.

The majority of the construction works would be carried out during standard working hours, as detailed in **Table 5-8**. Some construction activities, in particular those requiring road closures, would need to be undertaken outside of standard working hours to prevent major disruptions to traffic and access. Low noise activities may also be undertaken outside of normal working hours to optimise construction efficiency. Activities that are likely to occur outside of standard work hours include:

- Bridge works:
 - Deliveries involving large loads or escorted over-sized vehicles.
 - Completion of large concrete pours.
 - Some barge movements.
 - Low noise activities such as steel fixing.
- Road works:
 - Works requiring major road closure, such as works at tie-in locations.
 - Low noise activities.
- Service relocations
 - Where works require road closures.
 - Cutovers from old to new infrastructure – generally need to be undertaken when demand is lowest (i.e. in the middle of the night).

Where required, construction works occurring outside of standard working hours would be in accordance with RMS' Environmental Noise Management Manual Practice Note vii (RTA, 2001). Relevant agencies and affected members of the community would be provided with notification of any works outside of standard working hours.

Table 5-8 Standard working hours

Day	Start time	Finish time
Monday to Friday	7am	6pm
Saturday	8am	1pm
Sunday and public holidays	No work	

5.6 Construction materials and equipment

5.6.1 Construction equipment

The types of construction equipment likely to be used for the project would include (but would not necessarily be limited to) the following:

- Excavation plant for pavement cutting and removal.
- Bobcats and sweepers.
- Compaction plant, including rollers, vibrating rollers, concrete vibrators and trench plate compactors.
- Pneumatic jack hammers.
- Profiling, milling and road paving plant.
- Jet-blasting and shot-blasting machines.
- Miscellaneous vehicles, including utilities, trucks, bogies and semi-trailers.
- Miscellaneous hand tools and equipment.
- Generators, lighting towers, signage and variable message boards.
- Various barges, workboats, temporary work platforms and pontoons.
- Piling rigs and various mobile cranes (up to 200 tonnes).
- Concrete and grouting pumps and transport vehicles.
- Support trusses, stress jacks and scaffold systems.
- Tower or crawler crane.
- Hydraulic jacks for launching the bridge.

5.6.2 Construction materials

An estimate of the types and quantities of materials likely to be required for the project is provided in **Table 5-7**. This information is indicative only and would be subject to refinement during detailed design.

Construction materials would be sourced locally, where possible, and opportunities for procurement of materials with recycled content would be investigated where equivalent quality can be achieved.

Concrete for the construction of the project would be sourced from an off-site local or regional batch plant and no on-site batch plant would be required.