NSW GOVERNMENT

Transport for NSW

# Beaches Link and Gore Hill Freeway Connection

## Chapter 6

## Construction work

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DECEMBER 2020

# 6 Construction work

This chapter describes the proposed approach to construction of the project. It outlines the proposed construction program, footprint, methodology, working hours, materials, equipment, traffic management, site access routes, and temporary construction support sites.

The construction works described in this chapter may be refined in response to submissions received during exhibition of this environmental impact statement, to further minimise impacts on the community or environment and/or during further design development and construction planning once a construction contractor has been appointed.

Detailed construction planning would be carried out before construction of the project begins. This would include the identification of specific construction methods and program.

The Secretary's environmental assessment requirements as they relate to construction works, and where in the environmental impact statement these have been addressed, are detailed in Table 6-1.

**Table 6-1 Secretary's environmental assessment requirements - Construction work**

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Environmental impact statement** | |
| 1. The EIS must include, but not necessarily be limited to, the following:<br>b. a description of the project and all components and activities (including ancillary components and activities) required to construct and operate it, including:<br>- the proposed route | This chapter describes the key construction activities and shows the temporary construction support sites along the proposed route.<br>**Chapter 5** (Project description), sections 5.1, 5.2 and 5.3, describe the proposed route. |
| - Design of the tunnels, interchanges (inclusive of tunnel portals and entry and exit ramps), road user, pedestrian and cyclist facilities, and lighting | **Section 6.4** describes the tunnel construction method. **Section 6.5** describes the construction method for surface road works and associated infrastructure.<br>**Chapter 5** (Project description), sections 5.1, 5.2 and 5.3, describe the design of the tunnels, including tunnel-to-tunnel connections and entry and exit ramps as well as road user, pedestrian and cyclist facilities, lighting and other operational ancillary infrastructure. |
| - Surface road upgrade works, including road widening, intersection treatment and grade separation works, property access, parking, pedestrian facilities (including appropriate locations for overbridges) and public transport facilities | **Chapter 5** (Project description), sections 5.2 and 5.3, describe the surface road works and surface connections as well as pedestrian, cyclist and public transport facilities.<br>**Section 6.5** describes the construction method for surface road works and associated infrastructure, including bridgeworks and pedestrian facilities.<br>**Chapter 8** (Construction traffic and transport), **Chapter 9** (Operational traffic and transport), **Chapter 20** (Land use and property) and |

| Secretary's requirement | Where addressed in EIS |
|---|---|
| | **Chapter 21** (Socio-economics) discuss property access. |
| - Ancillary infrastructure and operational facilities, such as operational and maintenance facilities, ventilation structures and systems, and fire and emergency services and infrastructure for the proposal, including (if required) additional infrastructure (such as tolling infrastructure) | **Chapter 5** (Project description), sections 5.2.7 and 5.3.4 describe operational facilities and ancillary infrastructure.<br>**Section 6.8** describes the temporary construction support sites required to construct the project. Construction of operational facilities and ancillary infrastructure is described in **Section 6.4.6**. |
| - Location and operational requirements of construction ancillary facilities and access | **Chapter 5** (Project description), sections 5.2 and 5.3, describe operational facilities and ancillary infrastructure.<br>The location and hours of construction at each temporary construction support site and their respective access arrangements are described in **Section 6.8.2**. |
| - Land use changes as a result of the proposal and the acquisition of privately owned, Council and Crown lands, and impacts to Council and Crown lands | Land use changes as a result of the project are described in **Chapter 20** (Land use and property). |
| - The relationship and/or integration of the project with existing public and freight transport services. | **Chapter 3** (Strategic context and project need) and **Chapter 8** (Construction traffic and transport) discuss the relationship and/or integration of the project with existing public and freight transport services.<br>Additional information about the relationship and/or integration of the project with existing and proposed public and freight transport services is provided in **Chapter 9** (Operational traffic and transport) and **Chapter 27** (Cumulative impacts). |

## 6.1 Overview of construction works

An overview of the temporary construction support sites required for the project is provided in Figure 6-1. Further detail on the key activities to be carried out at each site and typical construction hours for each location is provided in Section 6.8. An overview of the types of construction work required for the project is provided in Table 6-2. Detailed descriptions of each construction activity are also provided in sections 6.3 to 6.7.

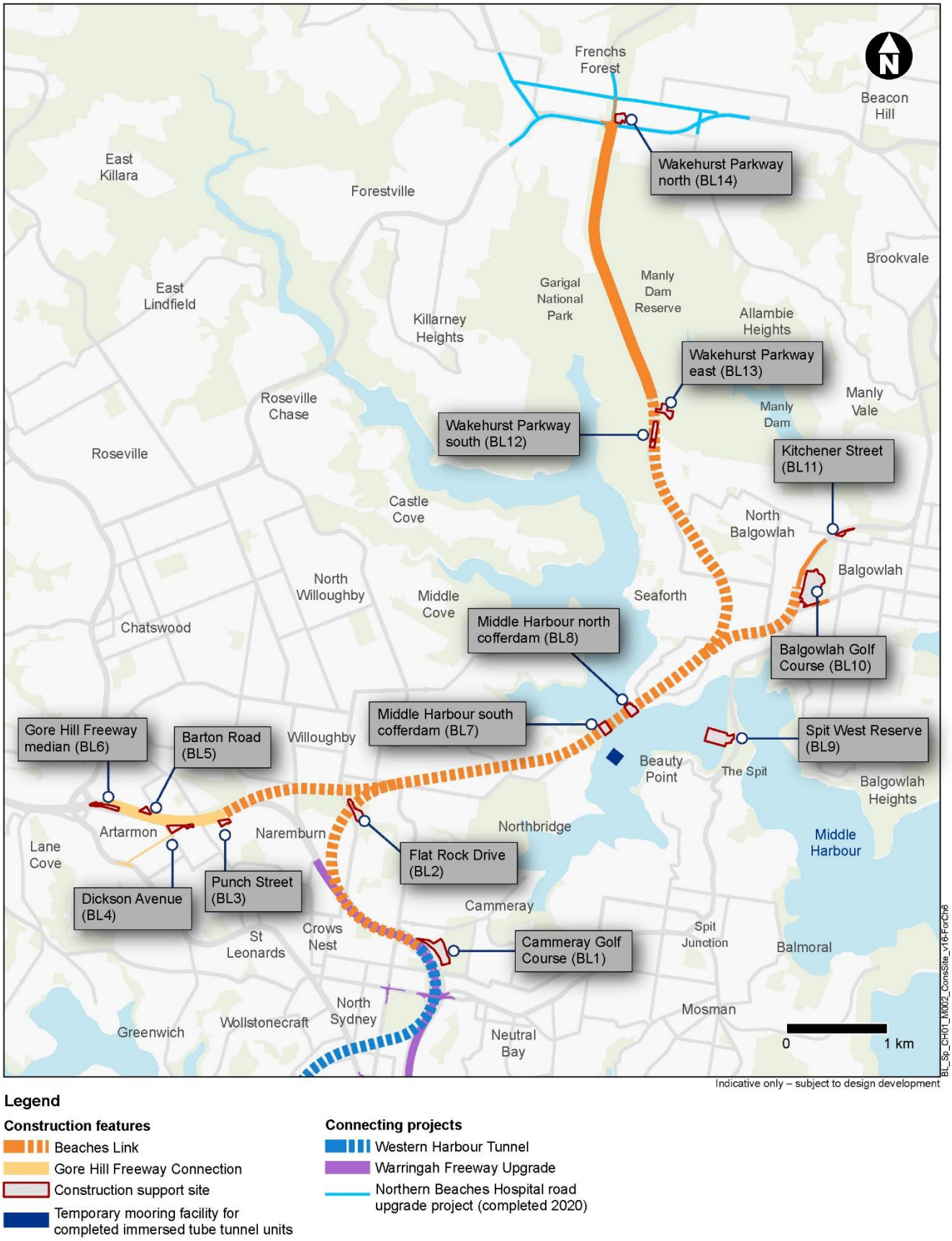



**Figure 6-1 Overview of the temporary construction support sites for the project**

**Table 6-2 Overview of construction works**

| Component | Typical activities |
|---|---|
| Early works and site establishment | • Survey work and investigations (including geotechnical)<br>• Property acquisitions and condition surveys<br>• Utilities installation, protection, adjustment and relocation<br>• Land remediation and heritage conservation and/or salvage works (where required)<br>• Temporary relocation of swing moorings, where required<br>• Provision of alternative facilities (swing mooring or marina berth) for users, where required<br>• Installation of site fencing, environmental controls and traffic management controls<br>• Vegetation clearing, earthworks and demolition of structures<br>• Construction of minor access roads and the provision of access where required<br>• Establishment of temporary construction support sites and acoustic sheds, where required. |
| Construction of the Beaches Link component | • Excavation of tunnel construction access declines<br>• Construction of driven tunnels and surface connections<br>• Construction of cut and cover and trough structures<br>• Cofferdam construction and dredging activities in preparation for the installation of immersed tube tunnels (crossing of Middle Harbour)<br>• Removal of temporary cofferdams<br>• Installation of immersed tube tunnel piled supports and associated concrete headstocks<br>• Casting and installation of immersed tube tunnels<br>• Civil finishing works and tunnel fitout<br>• Construction of operational facilities including:<br>- A motorway control centre within the Artarmon industrial area, next to the Gore Hill Freeway<br>- Motorway facilities and substations at Warringah Freeway, Gore Hill Freeway, Burnt Bridge Creek Deviation and Wakehurst Parkway<br>- Fitout of the Beaches Link ventilation outlet at Warringah Freeway. Civil construction of the ventilation outlet would form part of the Western Harbour Tunnel and Warringah Freeway Upgrade project (subject to separate environmental assessment and approval)<br>- A wastewater treatment plant within the industrial area at Artarmon<br>- Tunnel support facilities at Artarmon and Frenchs Forest<br>- Installation of motorway tolling infrastructure (in tunnel). |
| Surface road works (Beaches Link and Gore | • Traffic staging works to enable access for the road works<br>• Earthworks |

| Component | Typical activities |
|---|---|
| Hill Freeway Connection components) | • Bridgeworks<br>• Construction of retaining walls<br>• Construction of cut and cover and trough for connections to and from the Gore Hill Freeway, the Burnt Bridge Creek Deviation and the Wakehurst Parkway<br>• Construction and installation of stormwater and cross drainage<br>• Pavement works and linemarking<br>• Utilities installation and relocation<br>• Localised adjustment of a small section of Burnt Bridge Creek for road widening and existing culvert extension works<br>• Tolling gantries and associated infrastructure<br>• Installation of road furniture, fauna connectivity structure, lighting, signage and noise barriers<br>• Construction of new active transport infrastructure. |
| New open space and recreation facilities at Balgowlah | • Staged construction of the new and improved open space and recreation facilities<br>• Facilities may include shared user paths, open space areas, amenities, car park, playground, netball courts, soccer field, hockey field and new enlarged AFL/cricket oval. |
| Testing, commissioning and site rehabilitation | • Testing of plant and equipment<br>• Commissioning of the project<br>• Removal of infrastructure at temporary construction support sites<br>• Backfill of access declines<br>• Landscaping and rehabilitation of disturbed areas<br>• Removal of temporary environmental and traffic controls. |

## 6.2 Construction program

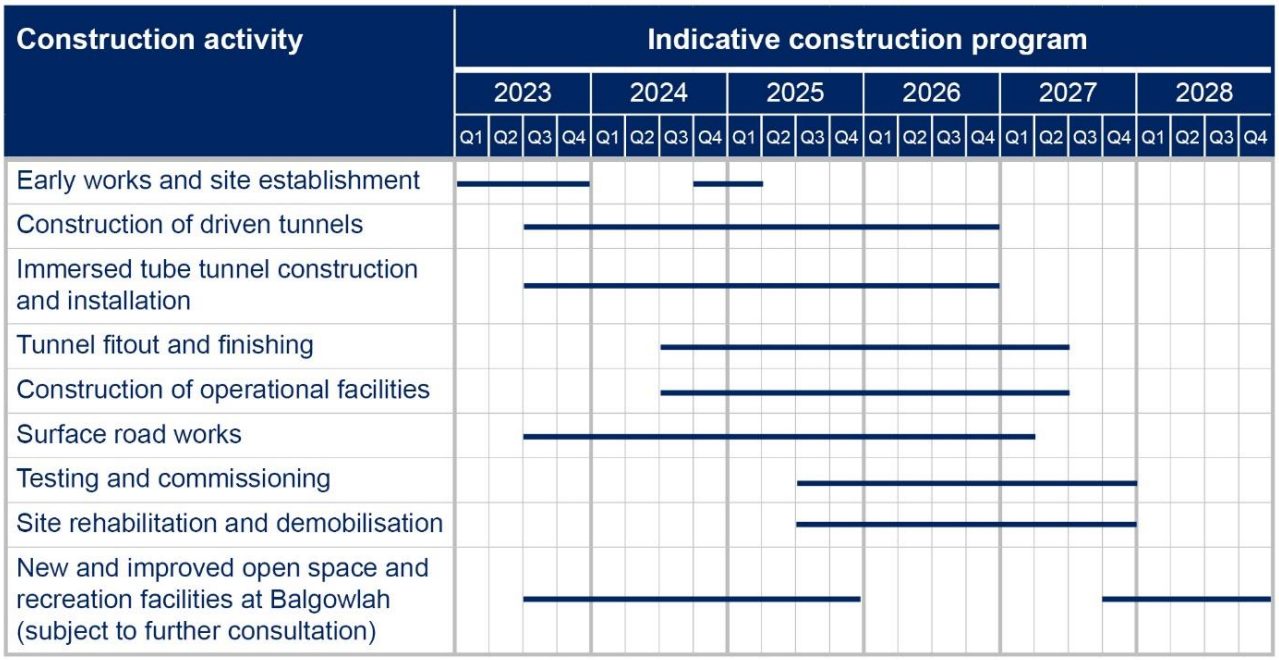
### 6.2.1 Program overview

The construction program presented within this environmental impact statement provides indicative timing only. The final construction program, and commencement of works at each temporary construction support site, may vary. Subject to planning approval and procurement, construction of the Beaches Link and Gore Hill Freeway Connection project is currently planned to commence in 2023. On that basis, completion of the main construction would be around the end of 2027 and construction works for the new and improved open space and recreation facilities would be completed in 2028 - a total construction period of five to six years. Early works and site establishment would be the first works carried out for the project, with substantial construction starting around six months later.

Construction associated with the Gore Hill Freeway Connection component comprises early works and site establishment, surface works and bridgework activities, which would run concurrently from 2023 to around end 2027.

The indicative construction program of the project, including the Gore Hill Freeway Connection component, is shown in Table 6-3. Construction activities outlined in Table 6-3 may not occur continuously during the time period outlined.

**Table 6-3 Beaches Link and Gore Hill Freeway Connection project indicative construction program**




The final construction program for the project would depend on future project procurement and packaging decisions. This may include one or multiple construction contractors.

It is assumed that the Western Harbour Tunnel and Warringah Freeway Upgrade project, which is subject to separate assessment and approval, would commence construction before the Beaches Link and Gore Hill Freeway Connection project. Should timeframes for the project be advanced, some elements of the Beaches Link component may be delivered as part of the Western Harbour Tunnel and Warringah Freeway Upgrade works to maximise construction efficiency and minimise impacts in particular areas.

Delivery of any elements of the Beaches Link component as part of the Western Harbour Tunnel and Warringah Freeway Upgrade works would be subject to the conditions of approval for the Beaches Link and Gore Hill Freeway Connection project and the requirements of this environmental impact statement, including relevant environmental management measures provided in Appendix Y (Compilation of environmental management measures) and any other documents incorporated by reference in the approval.

Works could include but may not be limited to cut and cover and trough works at Cammeray, construction of motorway facilities and ventilation tunnels at Warringah Freeway and traffic staging enabling works for the Gore Hill Freeway Connection.

## 6.3 Early works and site establishment

### 6.3.1 Early works, preparatory investigations and surveys

Early works, preparatory investigations and surveys for major infrastructure projects are carried out prior to substantial construction to prepare sites to facilitate the main construction activities. Typically, these works are of low environmental impact. Subject to conditions of approval some early works, preparatory investigations and surveys would take place prior to the formal approval of the main works construction management plans, and would include but are not limited to:

- Survey work and investigations including investigative drilling
- Carrying out existing condition surveys of buildings and infrastructure
- Property acquisitions and adjustment works including installation of property fencing

- Further contamination testing and land remediation subject to the recommendations of a remediation action plan (where required)
- Relocation, adjustment and protection of utilities and services affected by the project (utility works would be ongoing during the main works to suit staging of surface works)
- Road work adjustments to facilitate access to various temporary construction support sites
- Carrying out detailed heritage investigations, protections, salvage and/or conservation works (where required)
- Carrying out maritime heritage and submerged Aboriginal site investigations, protections, salvage and/or conservation works (where required)
- Upgrade of Spit Bridge pier protection fenders, including piling (if required, subject to condition survey)
- Temporary relocation of swing moorings from within Middle Harbour as close to their existing position as possible (details on swing moorings requiring temporary relocation are provided in Chapter 8 (Construction traffic and transport))
- Provision of alternative facilities (swing mooring or marina berth) for the users of a small number of fixed jetties below Seaforth Bluff that would have access restricted during construction (details on jetties requiring temporary closure are provided in Chapter 8 (Construction traffic and transport)).

### 6.3.2 Site establishment

Site establishment would occur prior to the main construction activities commencing. Similar to the early works described above, subject to conditions of approval (and approval of relevant site establishment plans), site establishment activities also include works which are of low environmental impact and could be carried prior to the formal approval of the main works construction management plans. Site establishment would include, but is not limited to:

- Installation of site environmental management controls (including site fencing, exclusion fencing for sensitive areas, noise attenuation measures and erosion and sediment controls)
- Vegetation clearing, chipping and mulching, where required
- Traffic management controls, including adjustments to road signage where required (showing changes to traffic movements and speed limits)
- Construction of minor access roads and provision of access including the temporary relocation of pedestrian and cycle paths and bus stops
- Earthworks to level the temporary construction support sites in preparation for site work and installation of site facilities
- Building structures and/or erection of demountable buildings within temporary construction support sites including temporary site accesses, acoustic sheds and associated access decline acoustic enclosures, where required
- Demolition of existing structures which require removal to enable construction of the project.

## 6.4 Construction of Beaches Link

Construction of the Beaches Link component would include the following activities:

- Excavation of the tunnel construction access declines
- Construction of driven tunnels
- Construction of cut and cover and trough structures

- Construction of temporary cofferdams in Middle Harbour
- Construction of interface structures between driven tunnel and immersed tube units
- Construction of immersed tube tunnel units
- Dredging to form the trench for installation of immersed tube tunnel units
- Installation of immersed tube tunnel piled supports and associated concrete headstocks
- Installation of immersed tube tunnels for the crossing of Middle Harbour
- Civil finishing and fitout of the tunnels, including drainage, pavement construction, barrier construction, architectural panel installation and other works required to finish the civil works
- Surface works to tie-in to surface roads in Cammeray, Artarmon, Balgowlah, Seaforth, Killarney Heights and Frenchs Forest
- Realignment and upgrade of Wakehurst Parkway between Killarney Heights and Frenchs Forest
- Construction of operational facilities
- Testing and commissioning.

More information on each of these activities is provided in the following sections.

### 6.4.1 Excavation of tunnel construction access declines

To enable construction of the driven tunnels, construction accesses would need to be created from temporary construction support sites to intersect the tunnel alignment. Tunnel construction accesses can take the form of shafts or declines, depending on constraints and construction context. All of the accesses for construction of the Beaches Link tunnels are currently proposed to be declines.

Excavated access declines would be required at the  Cammeray Golf Course (BL1), Flat Rock Drive (BL2), Punch Street (BL3), Balgowlah Golf Course (BL10) and Wakehurst Parkway east (BL13) construction support sites.

The access decline provides access for workers, equipment, material supply, and spoil removal, and would be big enough for construction vehicles, including roadheaders, concrete trucks, spoil removal trucks and other equipment to drive in and out of the tunnel. The temporary tunnel ventilation and services such as compressed air, potable water and drainage return lines would also be installed through the access decline.

The access decline would typically be sized to allow for two-way vehicular traffic and a separated walkway for construction workers. An example of an access decline is shown in Figure 6-2.

While the majority of these tunnel declines would be driven tunnels, trough structures are required where these declines reach the surface. These trough structures are ultimately enclosed within the acoustic shed or covered with their own acoustic enclosure.

The access declines at Cammeray Golf Course (BL1) (partial), Flat Rock Drive (BL2), Punch Street (BL3), Balgowlah Golf Course (BL10) and Wakehurst Parkway east (BL13) construction support sites would be backfilled at the completion of construction. Part of the access decline at Cammeray Golf Course construction support site (BL1) would be used for a permanent ventilation tunnel connecting to the motorway facilities at this location.

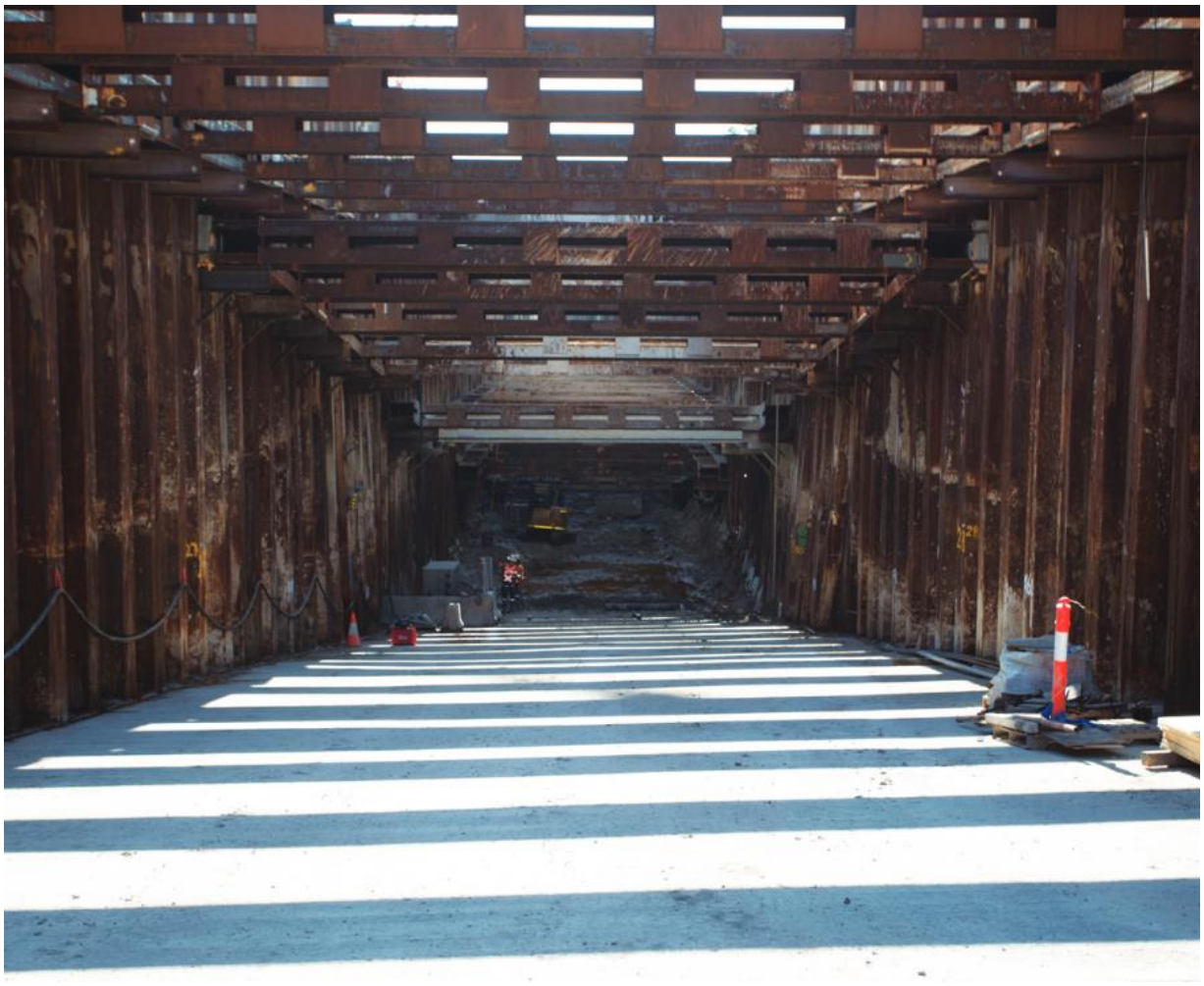


**Figure 6-2 Example tunnel access decline**

### Acoustic sheds

An acoustic shed is an enclosed noise mitigation structure constructed over access declines that access the tunnel for construction. Noisy works required to support out of hours tunnelling, including spoil handling, would take place within the acoustic shed, reducing impacts on nearby receivers. Acoustic sheds would be designed with consideration of the activities that would occur within them and the noise management levels applicable at nearby receivers. They would also be designed to accommodate stockpiled tunnel spoil within the shed thereby removing the requirement for spoil haulage outside of standard hours. An example of an acoustic shed is shown in Figure 6-3.

**Figure 6-3 Example from within an acoustic shed constructed for the New M4 tunnels**

### 6.4.2 Construction of driven tunnels

The project would involve the construction of two mainline tunnels, as well as on and off ramps, cross passages and ventilation tunnels. The majority of this tunnelling work is expected to be carried out in Hawkesbury sandstone using electrically powered machines known as roadheaders.

A roadheader is an excavation machine that has a rotating, rock-cutting head on the front, mounted to a boom. When the underground rock is cut using a roadheader, a loading device typically transfers the rock onto a conveyor belt which runs the spoil onto haulage trucks. An example of a roadheader working underground to construct the New M4 tunnels is shown in Figure 6-4.

Ground support for tunnels excavated using roadheaders would typically consist of cement grouted rock anchors and/or rock bolts and shotcreting as shown in Figure 6-5. In areas which require control of higher levels of groundwater ingress or to accommodate poorer geology, the permanent tunnel lining would include a thicker reinforced concrete lining and waterproofing membrane. Ground support would be installed progressively following tunnel excavation.

In addition to the mainline tunnels and on and off ramp tunnels, cross passages would be excavated between the tunnels at intervals to facilitate emergency egress. These cross passages would be excavated using smaller roadheaders, rock hammers, rock saws or controlled blasting.


**Figure 6-4 Example of a roadheader in the New M4 tunnels loading tunnel spoil into a spoil haulage truck**

**Figure 6-5 Example of tunnel shotcreting**

It is anticipated that tunnel excavation would be carried out using a number of roadheaders, supported from multiple temporary construction support sites, including:

- Cammeray Golf Course (BL1)
- Flat Rock Drive (BL2)
- Punch Street (BL3)
- Balgowlah Golf Course (BL10)
- Wakehurst Parkway east (BL13).

Each of these temporary construction support sites would require additional surface infrastructure to support tunnel construction, such as acoustic sheds, workshops, material and equipment storage areas, heavy and light vehicle parking areas, air intake facilities to supply air for workers, power and water supply, temporary construction wastewater treatment plants, and worker amenities.

Temporary construction wastewater treatment plants would be designed to treat wastewater generated from tunnel construction activities and groundwater inflow during construction (refer to Chapter 17 (Hydrodynamics and water quality) for more detail).

Rock hammering (see Figure 6-6) and rock saws may be used in some areas for excavation of the tunnels, cross passages and areas of sandstone within the cut and cover and trough structures.


**Figure 6-6 Example of rock hammering**

Controlled underground blasting may also be used to improve the efficiency of excavation activities and shorten the overall excavation program. Areas likely to require controlled blasting would be confirmed during detailed construction planning. Refer to Chapter 10 (Construction noise and vibration) for further information on the management of blasting impacts from the project.

### 6.4.3 Construction of cut and cover and trough structures

Cut and cover tunnels would typically be constructed at locations where the tunnel alignment connects to and from the surface and does not have enough rock cover or quality of rock cover for construction using roadheaders. Cut and cover is a tunnel excavation methodology that generally involves excavating downwards from the surface of the ground, and installing a tunnel structure including a base, walls and a roof. Once the roof is in place, the structure is either used for permanent surface roads or covered over with soil and revegetated. These structures can also be constructed by installing the walls and roof and subsequently excavating out the material below from underneath the roof.

Cut and cover structures typically transition to open trough structures which connect to and from the surface (see Figure 6-7). Construction of trough structures is similar to cut and cover, except a roof is not installed (see Figure 6-8).

**Figure 6-7 New M4 tunnel cut and cover structures**

**Figure 6-8 Trough structure for New M4 tunnel ramp at Haberfield**

Cut and cover tunnels and trough structures are anticipated to be constructed at the following locations:

- The Beaches Link connections to the Warringah Freeway Upgrade component of the Western Harbour Tunnel and Warringah Freeway Upgrade project
- The eastbound on ramp from the Gore Hill Freeway to Beaches Link
- The westbound off ramps from Beaches Link to both the Gore Hill Freeway and Reserve Road
- The Wakehurst Parkway on and off ramps
- The Burnt Bridge Creek Deviation on and off ramps.

The Warringah Freeway Upgrade component of the Western Harbour Tunnel and Warringah Freeway Upgrade project would provide the structural works for the cut and cover and trough structures for the Beaches Link ramps to and from the Warringah Freeway. This would allow maximum use of the road corridor by the Warringah Freeway Upgrade contractor and minimise disruption. The structural works would largely comprise the construction of the 'roof' and supporting piles for these structures. The construction impacts of these works have been assessed in the Western Harbour Tunnel and Warringah Freeway Upgrade environmental impact statement (Transport for NSW, 2020b).

The excavation and fitout (including pavement works to tie-in to the Warringah Freeway Upgrade) of the trough and cut and cover structures connecting Beaches Link mainline tunnels and the Warringah Freeway would be carried out as part of the Beaches Link component of this project.

### 6.4.4 Construction process for immersed tube tunnels

An overview of the construction process for the immersed tube tunnel crossing of Middle Harbour is shown in Figure 6-9 and Figure 6-10. During the construction process, temporary anchors for plant associated with marine works would be required to ensure stability and safety.

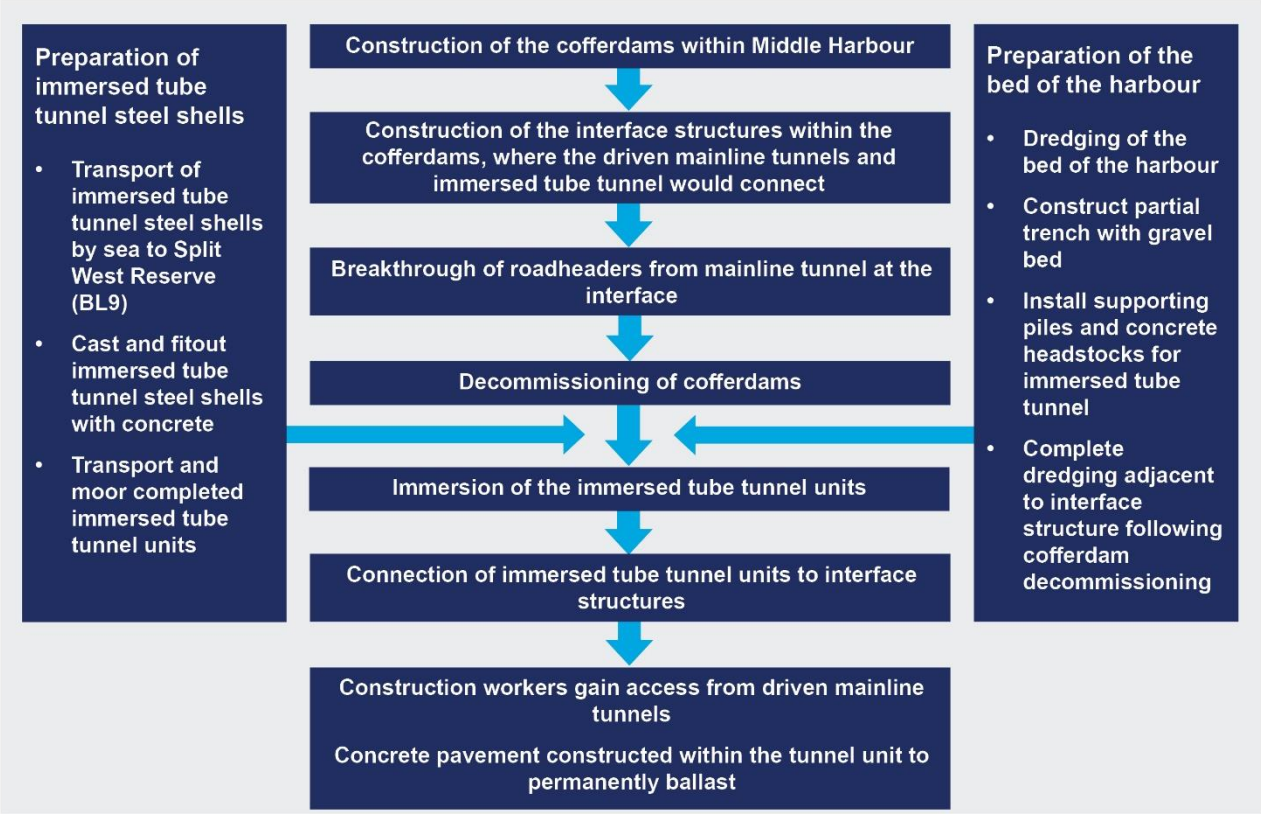
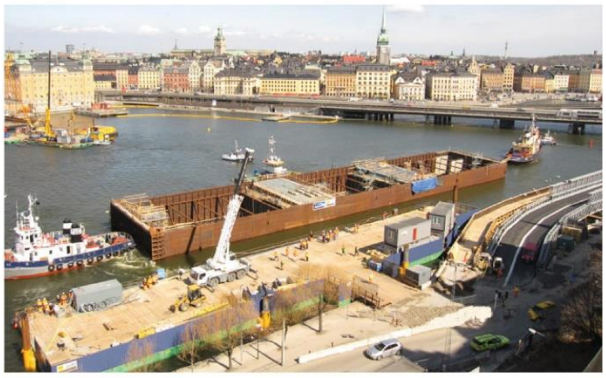


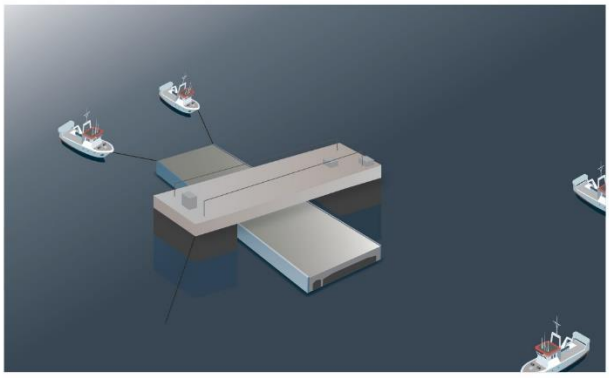

**Figure 6-9 Indicative construction process for the immersed tube tunnels**

Transport of steel shell units through Spit Bridge.

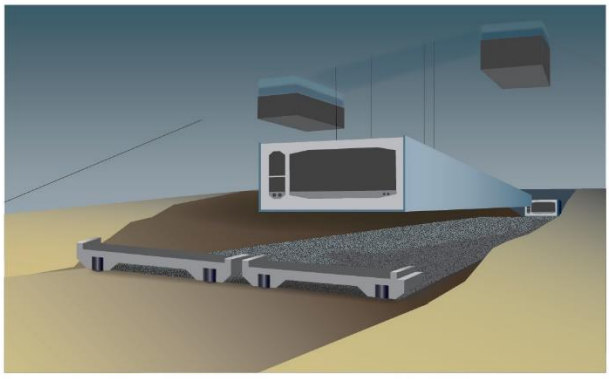
Steel shell unit arrives at Spit West Reserve construction support site (BL9) casting facility.



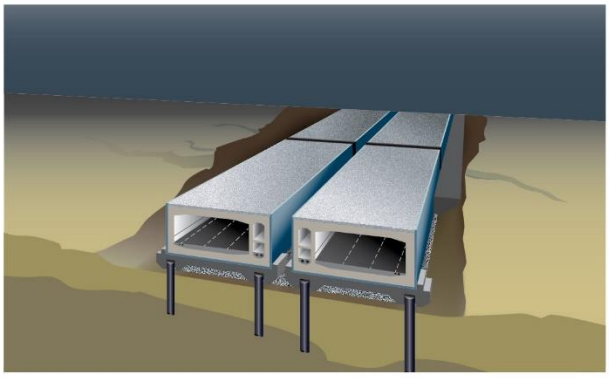
Floating steel shell unit arriving at casting facility for concrete construction. *



Transport completed unit to immersion site.



Immersion of completed tunnel units.



Completed units partially within a trench with locking fill.

*Note: Example of a casting facility for the Soderstrom Tunnel, Stockholm (TunnelTalk, 2013)

**Figure 6-10 Indicative construction sequence for the immersed tube tunnels**

## Cofferdam construction

A cofferdam is a temporary enclosure within a body of water that is constructed to allow dewatering of an enclosed area. The purpose of the cofferdams is to create a relatively dry environment to allow the construction of the interface structures which would connect the driven tunnel and the immersed tube tunnels at each end of the Middle Harbour crossing.

Two temporary cofferdams would be constructed to facilitate construction of the concrete interface structures to enable the connection of the immersed tube tunnels to the driven tunnels off the shoreline at Northbridge and Seaforth. The cofferdams would be about 63 metres wide and 25 metres long. The location and indicative layout of the Middle Harbour cofferdams are shown in Figure 6-36. The cofferdams would be supported (with labour, plant, materials) from both the Spit

West Reserve construction support site (BL9) and Balgowlah Golf Course construction support site (BL10).

The method for the construction of the cofferdams within Middle Harbour is summarised below:

- Ground treatment – before the construction of the cofferdam can occur, the upper layer of the bed of the harbour would be injected with a permanent grouting material to improve its strength and make relatively water-tight. Ground treatment would be carried out by drilling holes into the bed of the harbour. These holes would then be injected with grout by a grouting machine located on a flat top barge. An example of a flat top barge is shown in Figure 6-12
- Piling – the cofferdam structure would be made up of a series of interlocking, tubular piles. Each pile would be driven into the underlying sandstone within the areas that were subject to ground treatment. Piling would take place from a flat top barge (or similar barge) using a crane fitted with a hydraulic vibrating hammer, offshore pile driving hammer and/or a similar piece of construction equipment
- Dewatering and installation of structural support – once all piles have been installed, the water level within the cofferdam would be progressively lowered (dewatered). Structural steel supports would be installed within the cofferdams from a flat top barge so that the cofferdams remain structurally sound.

The construction sequence for the cofferdam and interface structure is provided in Figure 6-11.

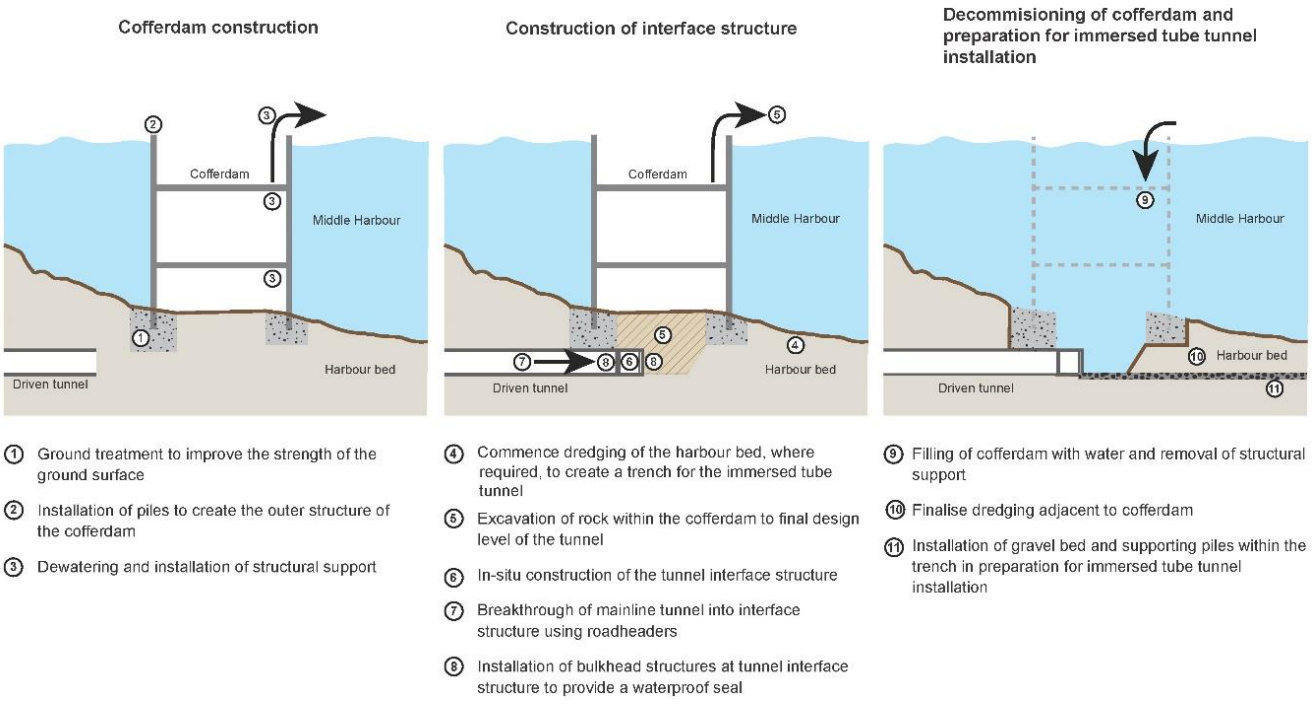



**Figure 6-11 Indicative process for constructing cofferdams and interface structures**

**Figure 6-12 Example of a flat top barge**

### Construction of the interface structures within the cofferdams

The immersed tube tunnels would be connected to the mainline driven tunnels by an interface structure, which would be built within the cofferdams. The interface structure is essentially a structural adaptor between the driven tunnel cross section and the rectangular immersed tube tunnel cross section. Construction of the interface structures within the cofferdams would require excavation of overlying soft sediments and rock from within the cofferdam.

Excavation works within the cofferdams would be carried out using excavators that would be lowered into the cofferdam. The excavators would use both buckets, hydraulic hammers and steel cutter blades where required, to load out soft sediments and fracture and load out the underlying rock. To facilitate fracturing of the rock, some pre-cutting may be required using a large steel cutting blade fitted to the excavator. The sediment and fractured rock would be loaded into bins within the cofferdam, and lifted out by a crane, which would be located on the cofferdam work platform. An application for offshore disposal of dredged material will be submitted to the Australian Government Department of Agriculture, Water and the Environment. It is proposed that suitable dredged material would be loaded in a hopper barge and transported to the designated offshore disposal site (refer to Chapter 24 (Resource use and waste management) for further information). Any material not suitable for offshore disposal would be barged to a loadout facility for treatment to be made spadable and then loaded onto trucks and disposed of at a licensed land-based facility.

Construction of the interface structure would be supported by work barges that would be moored at the cofferdams for the duration of construction works (refer to Section 6.8.2 for location of cofferdams). A ferry barge would be used to transport the construction materials and plant, and smaller boats would transfer the workforce, from the Spit West Reserve construction support site (BL9) for the construction of the interface structure.

### Decommissioning of cofferdams

Following completion of the interface structures, the cofferdams would be refilled with seawater pumped from Middle Harbour. As the cofferdams are filled with water, the structural support within the cofferdams would be removed. Once the water levels inside the cofferdams match the water level outside, the tubular piles would be removed, and the marine environment rehabilitated, where required. Where the tubular piles remain fixed in the bed of the harbour, they would be cut off at the harbour bed level and the marine environment rehabilitated where required.

### Dredging

The construction of the immersed tube tunnels would require dredging of the bed of the harbour to create a trench for the installation of the immersed tube tunnels.

Dredging depths would range from 10 metres below the existing bed of the harbour near to the cofferdams, reducing to the existing bed level of the harbour at the mid-harbour section. Most of the mid-harbour section of the immersed tube tunnels would be located on the existing bed of the harbour and would not require substantial dredging. The tunnel trench beyond the mid-harbour section, would be designed to provide a solid foundation for placement of the immersed tube tunnel units.

The immersed tube tunnel units would need to be installed on a piled foundation in the mid-harbour section, due to the very soft marine sediments of lower strength which occur in Middle Harbour.

The method of dredging would depend on the material being dredged and would be carried out for the project using a combination of methods (refer to Table 6-4).

During dredging operations, floating silt curtains would be used to minimise impacts on the surrounding marine environment. Silt curtains are designed and installed to restrict and contain suspended sediments which can be spread into the water column during dredging operations. Dredging operations would be carried out within a localised floating silt curtain enclosure to a depth of two to three metres (sometimes referred to as a ‘moon pool’). Additional containment of suspended sediments would be provided by installation of large enclosed silt curtains extending to a depth of 10 to 12 metres enclosing the broader dredging site. An additional shallow silt curtain would also be installed where required next to any nearshore ecologically sensitive areas to provide additional protection.

Dredging of the sand bar at the entrance to Middle Harbour would not be required. Transport of dredged material, marine construction equipment and steel shell immersed tube tunnel units would be planned to use high tide periods to allow safe travel over this relatively shallow area.

**Table 6-4 Dredging methods for installation of the immersed tube tunnels**

| Type of material to be dredged | Type of dredge to be used | Description |
|---|---|---|
| Soft sediments not suitable for offshore disposal (anticipated to be the top 0.5 – 1.0 metre of the bed of the harbour, subject to further testing (refer to Chapter 16 (Geology, soils and groundwater))) | Backhoe dredge with a closed environmental clamshell | A backhoe dredge consists of a hydraulic excavator that is fixed to a pontoon or work barge (refer to Figure 6-13).<br>A closed environmental clamshell is a closed bucket which is used to minimise the spread of excavated material into the water column (refer to Figure 6-14). This material would be loaded directly into nearby self-propelled split hopper barges (with no overflow allowed). Once fully loaded, the vessel would transport the dredged material to a load out facility. This material would be made spadable, loaded onto trucks and then disposed of at a suitable land-based licensed facility. |

| Type of material to be dredged | Type of dredge to be used | Description |
|---|---|---|
| Soft sediments suitable for offshore disposal | Backhoe dredge with a closed environmental clamshell | A closed environmental clamshell would be used for the removal of soft clay, silt or silty sand material.<br>Dredged material would be loaded directly into nearby self-propelled split hopper barges (with no overflow allowed). Once fully loaded, the vessel would transport and dispose of the dredged material at the designated offshore disposal site. |
| Rock layer suitable for offshore disposal | Backhoe dredge with a set of drum cutters or steel cutting blade and a standard open bucket | The underlying soft rock would be removed using a backhoe dredge with standard open bucket.<br>The underlying hard rock would be crushed with a very large backhoe dredge fitted with a set of rotating drum cutters on a boom (instead of a bucket) (refer to Figure 6-15). The drum cutter would be lowered by the backhoe dredger to crush the rock into small fragments.<br>The fragmented rock would be removed by a backhoe dredge fitted with a standard open bucket. The backhoe dredge would then load the fragmented rock into the self-propelled split hopper barges (with no overflows) for transport and disposal of the dredged material at the designated offshore disposal site.<br>To facilitate crushing of the rock, some pre-cutting of the harder rock may be required using a large steel cutting blade fitted to the backhoe dredge. |

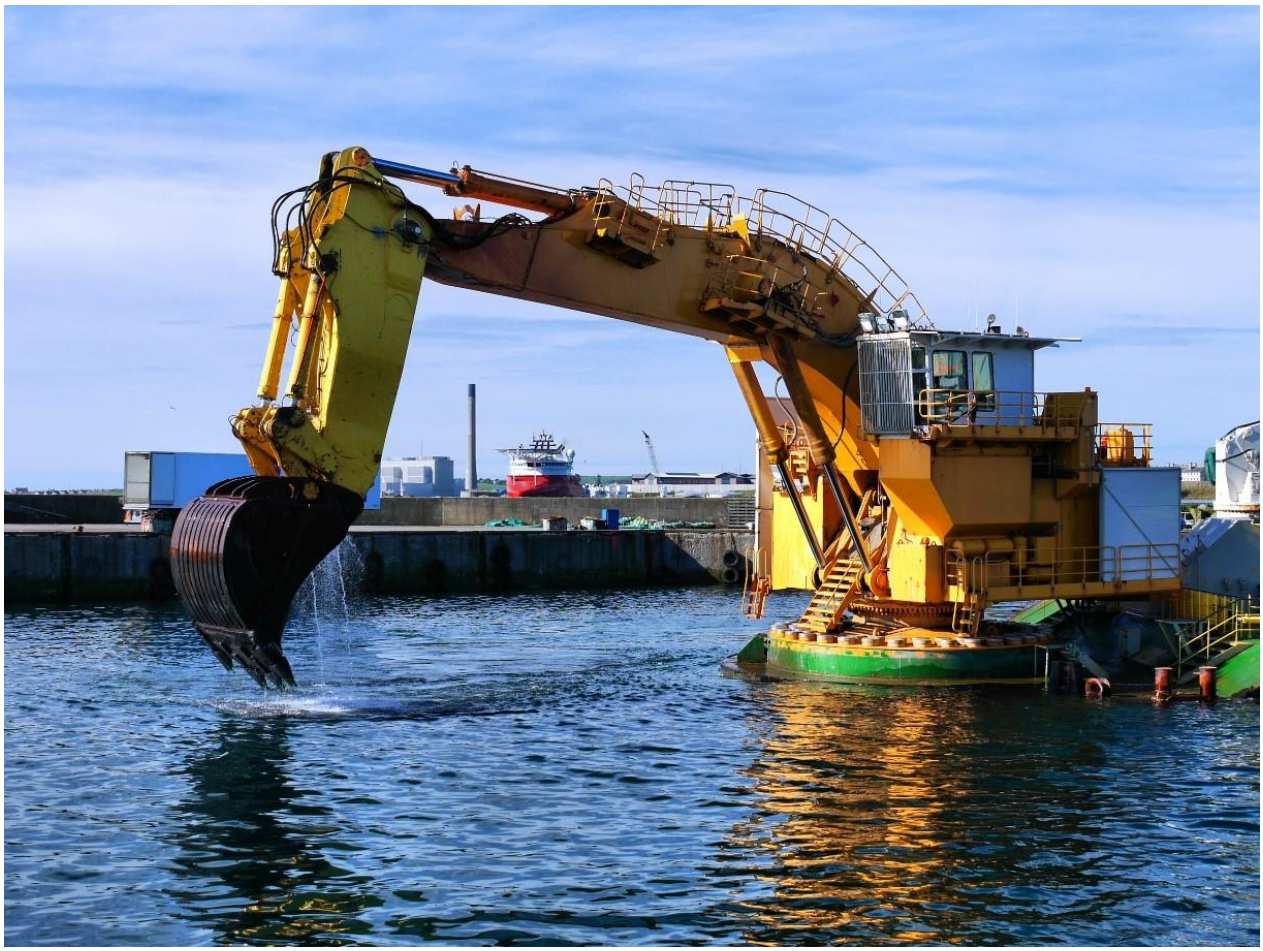


**Figure 6-13 Example of backhoe dredger with an open bucket (Royal Haskoning DHV, 2020)**


**Figure 6-14 Example of an excavator fitted with a closed environmental clamshell loading into a hopper barge (Source: supplied by Royal Haskoning DHV, 2020)**

**Figure 6-15 Example of drum cutters which can be used in a marine situation**

### Installation of the gravel bed

The immersed tube tunnel trench would be lined with gravel to a depth of about 0.8 metres. The gravel bed would be installed using a pontoon with a fall pipe which levels the gravel materials supplied via a conveyor belt from a barge moored against the pontoon.

### Installation of immersed tube tunnel units on support piles

Immersed tube tunnel units would need to be placed on supporting piles due to the soft marine sediments on the bed of the Middle Harbour. Installation of the piles would be carried out using similar sized equipment to the cofferdam construction. The piles would be tubular steel liners, vibrated through the upper sediments and screwed into the underlying rock. The piles would then be filled with reinforced concrete after reaching their final depth. The piles would be cut off to level and a concrete headstock would be cast below water on top of the piles. Alternatively, a pre-cast concrete headstock may be placed on the installed piles and locked in place.

### Construction of the immersed tube tunnel units

The immersed tube tunnels would be about 340 metres in overall length and would each consist of three individual units for each carriageway (six units in total). Refer to Figure 6-16 for an example of an immersed tube tunnel casting facility and Figure 6-17 for an example of a completed immersed tube tunnel unit.

The steel shell immersed tube tunnel units would be transported by sea from a location outside of Middle Harbour (either on a barge or directly towed by a tug) to the Spit West Reserve construction support site (BL9) to be completed. Works to complete the units at the Spit West Reserve construction support site (BL9) would include installation of internal formwork and reinforcement, pouring of concrete in stages to form the permanent immersed tube structure. The cast concrete units would then have fitout works completed prior to immersion. An additional concrete layer would be provided to protect the top of the completed tunnel units from marine activities during operation, including falling or dragging anchors.

Once the casting and fitout of the immersed tube tunnel units is complete, the units would be towed by tug boats to the temporary mooring location east of Clive Park in Middle Harbour (refer to Figure 6-26). The temporary mooring location would enable storage of the first four completed

immersed tube tunnel units prior to installation. The final two completed units would be towed directly to the immersion site.

**Figure 6-16 Example of a casting facility for the Soderstrom Tunnel, Stockholm (Source: TunnelTalk, 2013)**

**Figure 6-17 Example of completed immersed tube tunnel unit for the Amsterdam Metro moored ahead of installation (Source: ITA, n.d.)**

### Immersion of tube tunnels

The immersion of the immersed tube tunnel units would be carried out using pontoons (refer to Figure 6-18). Temporary anchors would be placed prior to the immersion process to position the tunnel units (refer to Figure 6-19).

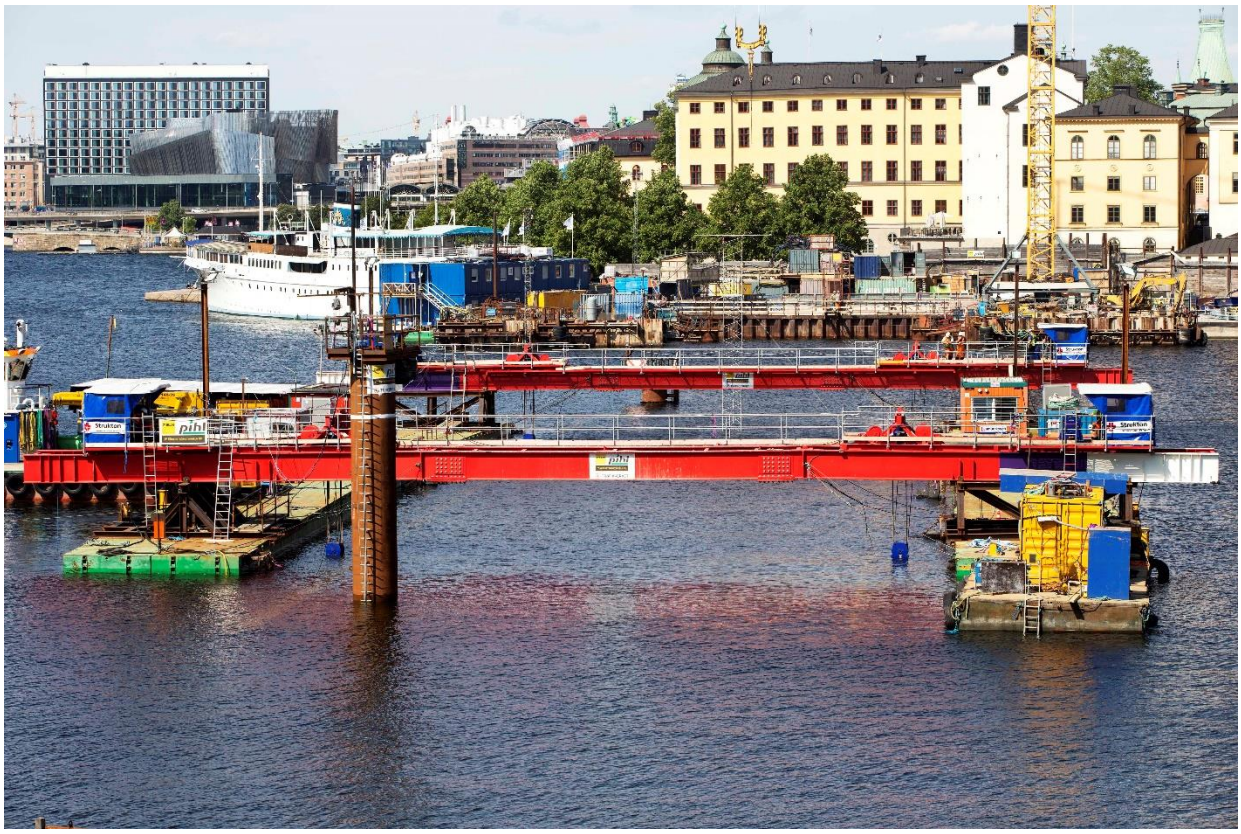


**Figure 6-18 Example of immersed tube tunnel unit being immersed for the Soderstrom tunnel in Stockholm (Source: provided by Strukton)**

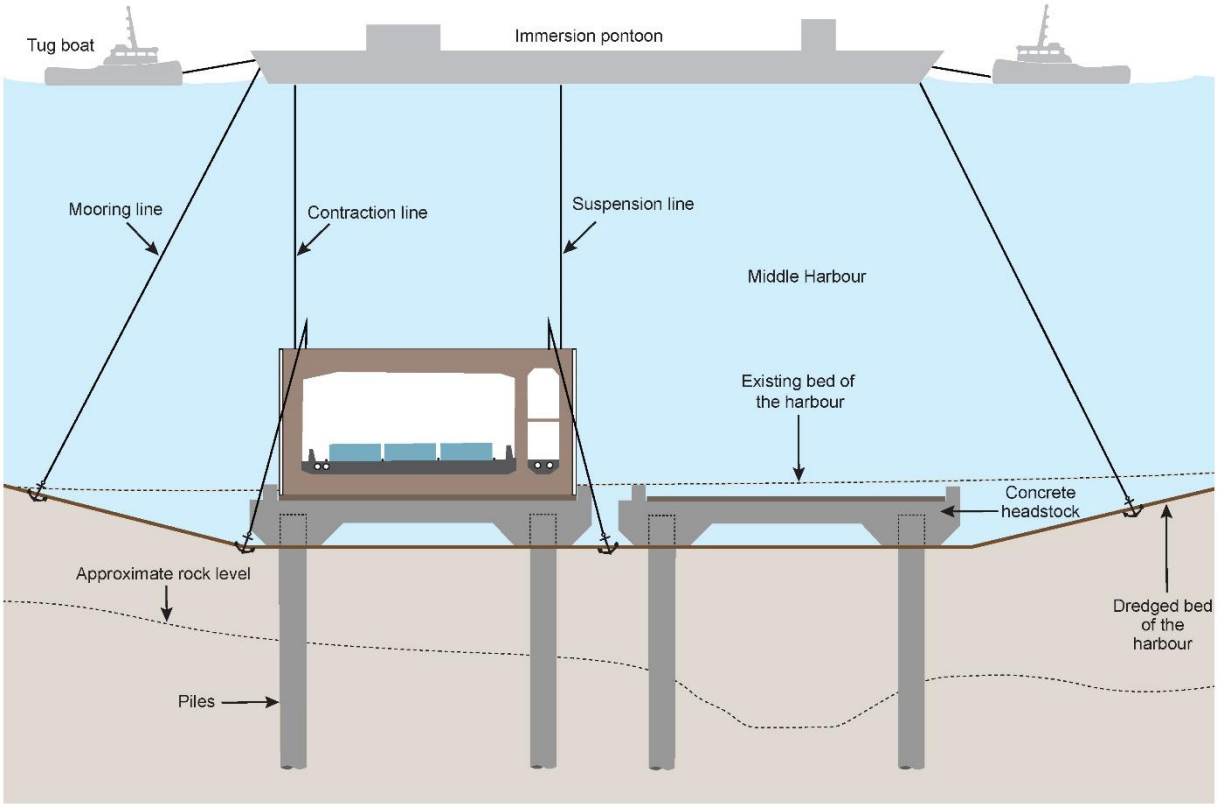



**Figure 6-19 Positioning of immersed tube tunnel units in Middle Harbour**

Immersion would be carried out by pumping water into temporary ballast tanks within the immersed tube tunnel unit. The water ballast tank would be used to control the buoyancy (ie the amount they float) and balance of each unit. A guidance system would be installed on the pontoon deck to guide the immersed tube tunnel unit to the previous immersed unit and/or to the interface structure.

The immersed tube tunnel units would be installed both on supporting piles and within a trench. The middle third of the tunnel would be installed on supporting piles and would sit generally just above the nominally dredged bed of the harbour. The northern and southern thirds of the tunnel would be installed within a trench of varying depth.

Once the immersed tube tunnel units have been placed into their final location in the section within the trench, locking fill would be placed between the sides of the tunnel units and the trench wall to provide initial stability and to prevent it from moving.

Immersed tube tunnel units placed on supporting piles would be founded securely on concrete headstocks installed on the supporting piles.

Following immersion of each unit, and connection to the either the interface structure or an adjacent tunnel unit, the immersion joint would be dewatered and steel bulkhead barriers at the connected end safely removed. Construction workers would then be able to gain access to the unit through the mainline tunnel to complete fit out works within the units. Concrete pavement would be cast within the immersed tube tunnel unit to replace the weight provided by the temporary ballast tanks, allowing them to be removed.

This configuration is shown schematically in Figure 6-20.

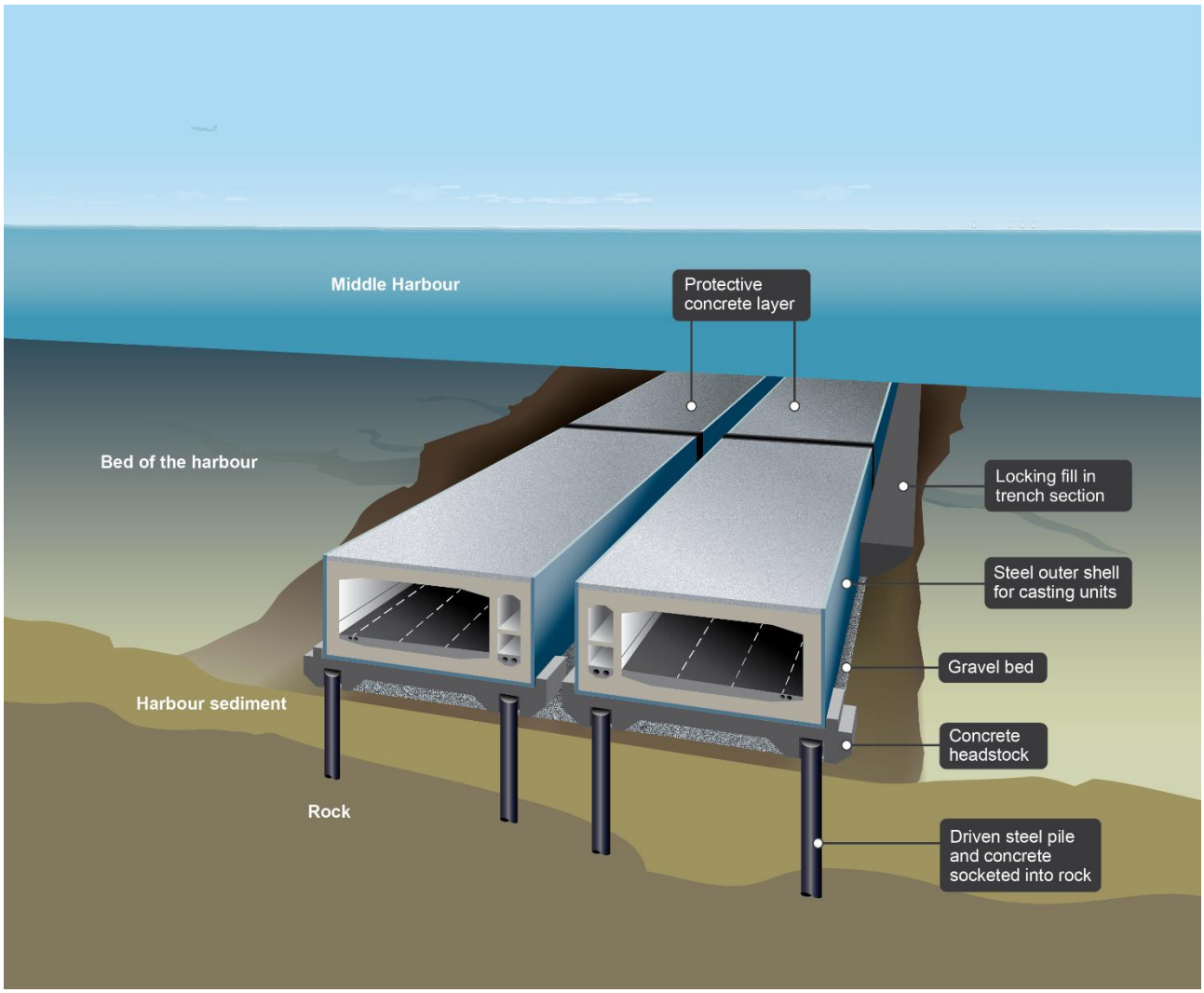
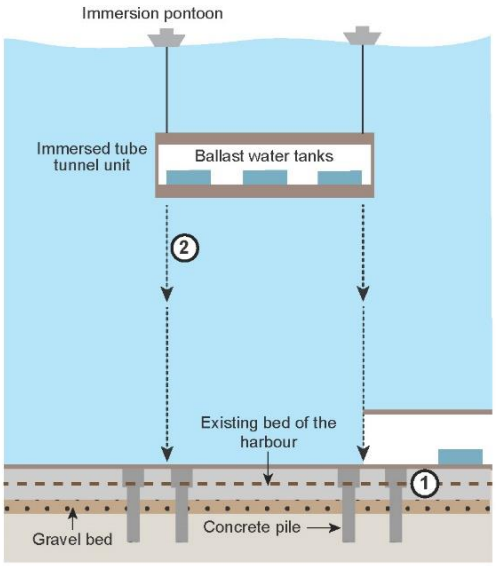



**Figure 6-20 Example of an immersed tube tunnel**

A typical immersion process for one immersed tube tunnel unit would take 24 to 48 hours. Partial harbour closures in the vicinity of the site would be required while each unit is immersed. Full harbour closures may be required during immersion of the two middle units.

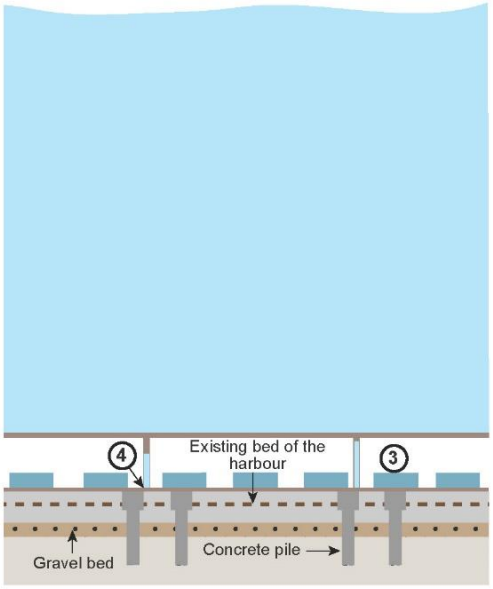
The installation sequence for the immersed tube tunnels is shown in Figure 6-21.




**Immersion of tube tunnel units**

① Installation of gravel bed and/or supporting piles

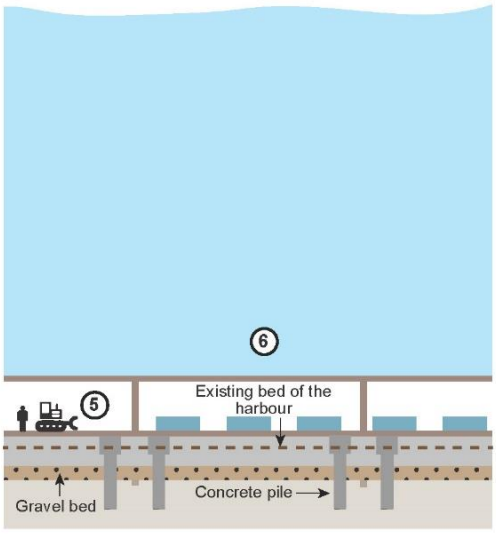
② Immersion of immersed tube tunnel element against previous element




**Connection and dewatering of immersed tube tunnel units**

③ Connection of immersed tube tunnel unit with interface structure or adjacent immersed tube tunnel unit and installation of waterproof joint between units/structures

④ Dewatering of immersion joint




**Fitout and finishing works**

⑤ Removal of water ballast tanks, ballast concrete and fitout

⑥ Placement of backfill between tunnel units and the tunnel trench to close any voids

**Figure 6-21 Indicative immersed tube tunnel installation sequence**

### 6.4.5 Tunnel fitout and finishing works

On completion of the tunnelling works, a variety of fitout and finishing works would be required. Fitout refers to the construction works that need to be carried out after excavation of the tunnels.

Fitout and finishing works to be completed within the Beaches Link tunnels are described in Table 6-5.

**Table 6-5 Tunnel fitout and finishing works**

| Construction activity | Description |
|---|---|
| Service conduits | Trenches would be constructed along the inner wall of the mainline and ramp tunnels under the shoulder of the roadway using a saw mounted on an excavator. Rock would be broken up by an excavator with a hydraulic hammer and loaded out for disposal. Conduits would then be installed within the trench, and the trench then backfilled to cover the conduits. |
| Roadway drainage | Trenches would be constructed in the same way as the service conduits but positioned on the low side of the road pavement where water runoff would be directed during operation. Drainage pipes would be placed within the trench and held in place, and the trench would then be backfilled with concrete. |
| Pavement works | Continuously reinforced concrete pavement would be installed within the tunnels. |
| Traffic barriers | Traffic barriers would be constructed from concrete using a specialised barrier placement machine or alternative hand placement methods where the machine is unable to access that location. |
| Mechanical and electrical infrastructure | The mechanical and electrical infrastructure would include the installation of:<br>• Tunnel lighting and surveillance cameras<br>• Operations management and traffic management equipment<br>• Toll points within the mainline tunnels<br>• Cross passages and equipment rooms, including lighting, power, exit lights and signage<br>• Emergency and surveillance systems<br>• Fire systems and protection equipment<br>• Underground pump stations<br>• Ventilation system, jet fans and support frames<br>• Cabling including high voltage and low voltage cables, power supply cables from substations, power and control cables from jet fans to substations and communications cables<br>• Substation equipment. |
| Finishing works | Finishing works within the tunnels would include:<br>• Testing and commissioning all equipment and systems<br>• Installation of architectural wall panels above the concrete traffic barriers<br>• Painting sections of the tunnels as required<br>• Linemarking<br>• Signage. |

### 6.4.6 Construction of operational facilities and ancillary infrastructure

Permanent operational infrastructure would be required for the ongoing management and operation of the project. Operational infrastructure would be located at Cammeray, Artarmon, Balgowlah, Killarney Heights and Frenchs Forest. The construction methods employed for operational facilities and ancillary infrastructure are summarised in Table 6-6.

**Table 6-6 Construction of operational facilities and ancillary infrastructure**

| Operational | Construction method |
|---|---|
| Tunnel ventilation systems | Construction of the tunnel ventilation systems would involve:<br>• Excavation and fitout of the ventilation tunnels to connect the ventilation outlet to the mainline or ramp tunnels (where required)<br>• Construction and fitout of the Beaches Link motorway facilities buildings at the Warringah Freeway, the Gore Hill Freeway, Burnt Bridge Creek Deviation and Wakehurst Parkway<br>• Connections to utilities, including sewerage, power, potable water and stormwater<br>• Construction of car parking, hardstand areas, and access to the public road network<br>• Fitout of the ventilation outlets<br>• Internal fitout of plant areas, equipment installation and commissioning.<br>The civil construction of the Beaches Link ventilation outlet at the Warringah Freeway would be carried out as part of the Western Harbour Tunnel and Warringah Freeway Upgrade project, which is subject to separate environmental assessment and approval. As such, only fitout and commissioning works for this particular ventilation outlet would be carried out as part of this project. All other ventilation outlets for the project would be constructed as part of the Beaches Link and Gore Hill Freeway Connection project. |
| Motorway control | Construction of the motorway control centre at Artarmon would include:<br>• Demolition of existing structures<br>• Connections to utilities, including sewerage, power, potable water and stormwater<br>• Excavation, footing and base slab installation<br>• Construction of concrete columns, deck and roof<br>• Enclosure of the building<br>• Construction of car parking, hardstand areas, and access to the public road network<br>• Internal fitout of control rooms, computer rooms, offices and workshop and associated staff amenities<br>• Security fencing. |

| Operational facilities | Construction method |
|---|---|
| Tunnel support facilities | Construction of the tunnel support facilities at Artarmon and Frenchs Forest would include:<br>• Demolition of existing structures<br>• Connections to utilities, including sewerage, power, potable water and stormwater<br>• Excavation, footing and base slab installation<br>• Construction of columns and deck to the first floor<br>• Construction of columns to support the roof<br>• Cladding of the building<br>• Internal fitout of control rooms, computer rooms, offices and workshop and associated staff amenities<br>• Construction of car parking, hardstand areas, and access to the public road network<br>• Security fencing. |
| Operational wastewater treatment plant | The operational wastewater treatment plant would be constructed at Artarmon using prefabricated components which would be assembled on site as follows:<br>• Mechanical assembly of operational wastewater treatment plant components, including rising main and discharge pipework<br>• Complete electrical connections between the operational wastewater treatment plant components and incoming power supply<br>• Commission the operational wastewater treatment plant<br>• Connection of the wastewater treatment plant to the local stormwater network for the discharge of treated wastewater. |
| Substations | The substations area located adjacent to the motorway facilities at the Warringah Freeway, the Gore Hill Freeway, Burnt Bridge Creek Deviation and Wakehurst Parkway would be constructed using prefabricated components where feasible. |

## 6.5 Surface road works

Surface road works are required to connect and integrate the new tunnels with the existing road network. The main areas of surface road works for the project include:

- Integration works to connect the new tunnels into the Warringah Freeway
- Upgrade and integration works along the Gore Hill Freeway
- Upgrade and integration works at Balgowlah
- Upgrade and integration works along Wakehurst Parkway, between Seaforth and Frenchs Forest.

This would also include new and upgraded public and active transport infrastructure at Artarmon, Balgowlah, Killarney Heights and Frenchs Forest.

The construction of the surface road works would typically involve the following activities:

- Traffic staging works to enable access for the surface road works
- Demolition of existing kerbs, structures and pavements

- Utility relocation works to suit staging of surface works
- Earthworks
- Bridgeworks at Artarmon and Frenchs Forest
- Construction of retaining walls, noise barriers, traffic barriers and flood walls
- Stormwater drainage
- Road pavement works
- Signage and linemarking
- Installation of new and modification of existing, lighting and lighting structures
- Fauna connectivity structures
- Surface finishing works.

These activities are described in detail in the following sections with utility relocation works detailed in Appendix D (Utilities management strategy).

### 6.5.1 Earthworks

Earthworks would be required for the surface works of the project including:

- The tunnel portals at Warringah Freeway, Gore Hill Freeway, Wakehurst Parkway and Burnt Bridge Creek Deviation
- Upgrade and reconfiguration of the Gore Hill Freeway between the T1 North Shore and Western Line and T9 Northern Line and the Pacific Highway
- Widening of Burnt Bridge Creek Deviation
- Realignment and upgrading of Wakehurst Parkway between Seaforth and Frenchs Forest
- Construction of the new access road at Balgowlah to connect the tunnel portals to Sydney Road and provide access to the new and improved open space and recreation facilities
- The staged construction of the new and improved open space and recreation facilities at Balgowlah
- Local road works at Artarmon, Balgowlah, Seaforth and Frenchs Forest in the vicinity of surface road works.

Earthworks would include bulk excavation, excavation for new pavement or pavement widening, and placement and compaction of general fill and select fill. Excavation work would be carried out using excavators and bulldozers.

Where earthworks are required, excavated material would be loaded directly into trucks and removed from site or unloaded and compacted directly into new fill areas or stockpiled for future reuse on the project.

It is expected that excavated material would consist of a combination of:

- Virgin excavated natural material
- Roadbuilding materials from within existing road corridors, such as concrete, roadbase and asphalt.

Material required for filling and compaction works would typically be imported to temporary construction support sites and/or the construction footprint as this material is required to have specific engineering properties. Tunnelling spoil would be used as fill material if it is available at the time required for surface earthworks. Earthworks in sections of Wakehurst Parkway would potentially be constructed as local cut to fill operations utilising locally sourced materials for reuse where it is practical. This is likely to involve stockpiling to ensure locally sourced materials could be

utilised on site at the appropriate times rather than needing to be transported off site as spoil or to site from other sources.

Fill material imported to site would typically be placed directly from trucks and would be spread with a grader and/or excavator and compacted using vibratory rollers. Where fill material cannot be placed directly from trucks, stockpile areas would be established within temporary construction support sites and/or the construction footprint as required. Watercarts would be used to add moisture to aid compaction and control the generation of dust.

It is anticipated that sections of Wakehurst Parkway may require controlled blasting during bulk earthworks as an alternative to ripping or hammering of rock so as to minimise the duration of this activity. Controlled blasts would not take place during peak hour traffic periods, on Sundays or public holidays. Traffic control measures related to blasting are detailed in Section 6.9.2. Refer to Chapter 10 (Construction noise and vibration) for further information on the management of blasting impacts from the project.

During the earthworks identified above, a number of erosion and sediment controls would be required to mitigate and manage potential erosion and sedimentation impacts from the project, including impacts to water quality. Temporary sediment basins would be used in catchments where the erosion hazard exceeds 150 cubic metres/year (200 tonnes/year) of soil loss. The final location and size of all sediment basins would be determined during further design development and construction planning. Alternative erosion and sediment control measures would be implemented in locations where sediment basins cannot be provided because of site, soil and drainage constraints to constructing large scale sediment basins. For these catchments, smaller sediment basins, sediment sumps, mulch bunds, sediment fences or combinations of these would be used. However, to manage potential associated risks, these catchments would also be subject to enhanced erosion control measures and best management practice, such as limiting the size of disturbed land at any one time and ensuring disturbed areas are re-landscaped progressively. Refer to Chapter 17 (Hydrodynamics and water quality) for further information on the management of potential erosion and sedimentation impacts from the project.

### 6.5.2 Bridgeworks

Bridgeworks required for the project include:

- Modification of the existing Reserve Road bridge and Hampden Road bridge in Artarmon
- Replacement and upgrade of the existing pedestrian bridge across Wakehurst Parkway, south of Aquatic Drive
- Construction of a new shared user bridge over an existing combined fauna underpass/drainage culvert south of Warringah Road at Frenchs Forest.

Typical bridge construction methods are described in Table 6-7. Chapter 5 (Project description) provides more information on the types of new, modified and relocated bridges.

**Table 6-7 Bridge construction methods**

| Bridgeworks | Construction method |
|---|---|
| Bridge modification works at Artarmon | Reserve Road bridge and Hampden Road bridge would generally remain operational during construction but may require lane closures or short-term closures.<br>Modification of Reserve Road bridge would involve:<br>• Traffic staging works to enable access for the bridge modification works<br>• Relocation of utilities as required<br>• Existing bridge lane closures as required<br>• Existing bridge barriers removed down to the existing bridge deck slab |

| Bridgeworks | Construction method |
|---|---|
| | • Existing asphalt removed from the bridge deck<br>• New pre-cast sections positioned with the use of cranes and fixed to the bridge deck<br>• Asphalt applied to the bridge deck to form the roadway surface<br>• Installation of any required barriers, drainage infrastructure, throw screens<br>• Signage, linemarking and lighting adjustments<br>• Footpaths periodically closed to allow for reinstalment of utilities within the bridge prior to reopening.<br>Works at Hampden Road bridge are generally limited to the underside of the bridge at the two abutments. Surface works at Hampden Road bridge would involve piling behind and strengthening of the existing northern abutment. |
| Replacement and upgrade of the existing pedestrian bridge across Wakehurst Parkway and construction of a new shared user bridge over drainage culvert south of Warringah Road | Replacement of the existing pedestrian bridge and construction of the new shared user bridge would generally include:<br>• Relocation of utilities as required<br>• Construction of the substructure, likely to be cast in-situ concrete in the following sequence:<br>  - Piling works, such as bored piles<br>  - Pile cap construction including localised excavation around the piles<br>  - Abutment construction including localised excavation around the piles<br>  - Pier or column construction<br>• Headstock construction<br>• Construction of the new superstructure (including the new bridge deck), likely to be through the placement of pre-cast concrete segments<br>• New pre-cast sections positioned with the use of cranes<br>• Construction of access ramps and integration of these with the surface path network<br>• Installation of any required handrails, drainage infrastructure, throw screens<br>• Demolition of the existing bridge.<br>The new replacement shared user bridge would be constructed just to the north of the existing bridge so the existing bridge can remain operational during construction of the replacement bridge. |

### 6.5.3 Retaining walls

Retaining walls would be required at Cammeray, Artarmon, Balgowlah, Killarney Heights and Frenchs Forest.

The type of retaining wall required would depend on the location and the ground conditions and would be determined during further design development. The choice of retaining wall would consider the urban design principles and objectives developed for the project (Appendix V (Technical working paper: Urban design, landscape character and visual impact assessment)). The types of retaining walls used on the project could include:

- Piled retaining wall – generally used in areas where the face of the retaining wall is within an area that has been excavated or is to be excavated
- Reinforced soil wall – used where retaining walls would be constructed in areas of fill
- L-shape retaining wall – used where retaining walls would be constructed in areas of fill and are lower in height or where reinforced soil walls are not suitable for structural and/or geometric reasons
- Soil nail retaining wall – used in areas with stable ground conditions where the cut is reinforced with ground anchors and the cut face is stabilised using shotcrete.

The method for constructing retaining walls would vary depending on the type of wall required but could include:

- Excavation
- Piling, installation of concrete footings, provision of structural support (ie rock anchors or soil nails)
- Shotcreting
- Drainage at the base or behind the retaining wall
- Installation of either pre-cast or cast in-situ panels or segments
- Backfilling the retaining walls
- Safety railings
- Planting and architectural finishes (where required).

### 6.5.4 Stormwater drainage

The project would require construction of new drainage infrastructure and alterations to existing drainage infrastructure, including:

- Construction of new pits, pipes, culverts and associated outlet structures for the surface roads
- Alterations to existing drainage infrastructure to suit new road alignments on existing surface roads including Sydney Road at Balgowlah
- Alterations to the existing drainage infrastructure in the vicinity of tunnel connections to the Gore Hill Freeway, Burnt Bridge Creek Deviation and Wakehurst Parkway
- Localised adjustment of a small section Burnt Bridge Creek and provision of scour protection adjacent the downstream side of the culvert extension
- Construction of stormwater basins and associated outlet structures along Wakehurst Parkway.

Stormwater drainage would generally consist of pre-cast concrete pipes or culverts which would be placed in trenches and then backfilled with select material that meets engineering specifications. Where pipes and culverts need to be installed under existing roadways, underboring or pipejacking may be used to avoid the need to trench across live traffic lanes, where this work cannot be feasibly carried out in stages across existing carriageways. In this instance, a pit would be excavated to one side of the roadway, and the drainage pipes installed by drilling horizontally underneath the roadway.

During construction of new drainage infrastructure and alterations to existing drainage infrastructure, there may be a need to carry out temporary drainage works. This could include temporary diversions and drainage line crossings to enable earthworks and for installation of culverts. Temporary diversions and drainage line crossings would be managed to avoid impact on any sensitive receiving environments, including any changes to flow conditions. Depending on local site conditions, temporary diversions may also be required to extend outside the construction

footprint to ensure appropriate connection to existing drainage lines and ensure flow conditions are maintained or impacts minimised where possible.

Due to establishment of the Flat Rock Drive construction support site (BL2), there would also be a need to carry out box culvert drainage works associated with an aboveground constructed drainage line of Flat Rock Creek. This would include construction of a culvert and minor redirection of the drainage line at this location (refer to Figure 6-31).

Scour protection measures would be installed downstream of culverts and disturbed drainage line/creek banks to avoid erosion of the watercourse. Depending on local site conditions, scour protection and/or drainage work may be required to extend outside the construction footprint to ensure appropriate connection to existing waterways and/or drainage lines and ensure hydrologic conditions are maintained or impacts minimised where possible.

Indicative construction methods for permanent stormwater drainage are outlined in Table 6-8.

**Table 6-8 Indicative stormwater drainage construction methods**

| Drainage type | Construction method |
|---|---|
| Drainage pipes | • Excavation of a trench in the existing ground surface<br>• Installation of pre-cast concrete pipes placed in sections onto a bedding layer<br>• Placement and compaction of select material around the pipes using hand-propelled compaction equipment, such as rammers or vibrating plates. |
| Installation of drainage pits and lids | • Excavation of pit location<br>• Installation of pre-cast concrete pits, or casting the pit in-situ<br>• Connection of pipes into concrete pits, which would be backfilled similar to the drainage pipes<br>• Lids and inlets would be installed onto the pits and later incorporated into the kerbs and slabs<br>• Installation of associated outlet structures. |
| Construction of box culverts | • Excavation of a trench in the existing ground surface<br>• Concrete casting of culvert base slab in-situ<br>• Installation of pre-cast culvert units<br>• Backfilling, where required, using select material around the culverts and hand-propelled compaction equipment, such as rammers or vibrating plates<br>• Installation of associated outlet structures. |
| Installation of flood walls | • Excavation of a foundation for the floodwall<br>• Pour concrete foundation<br>• Form, reinforce and pour concrete floodwall in panel sections. |
| Localised adjustment of a small section Burnt Bridge Creek and scour protection | • Localised diversion and protection of existing waterway<br>• Excavation works including lowering and regrading of the creek channel to the required depth<br>• Installation of box culvert base slab<br>• Installation of box culvert units and redirect waterway into new box culvert<br>• Backfill of installed box culvert units<br>• Placement of scour protection<br>• Landscaping and rehabilitation of the localised creek area. |

### 6.5.5 Road pavement works

In areas where existing road pavements would be realigned and/or widened, pavements would be constructed to consist of similar pavement types to the existing road, and to meet Transport for NSW design standards.

Construction of areas of new surface roads would consist of both flexible and rigid pavements. Flexible pavements generally comprise the installation of an upper asphalt base layer (including an asphalt wearing course), placed on a granular or concrete sub-base. Installation of the sub-base pavement layer would involve the placement of material using trucks, excavators and graders, and compacted by vibratory rollers. A bitumen seal would be sprayed onto this layer of material, and aggregate would then be spread and rolled on top of the sprayed bitumen to create a waterproof seal.

Asphalt would be laid on top of the bitumen seal. Hot asphalt material would be transported to site in trucks from an off-site batching plant. Asphalt would be unloaded into paving machines, which would spread the asphalt to the required thickness. The asphalt surface would then be compacted by vibrating rollers and allowed to cool.

Rigid pavements generally comprise a concrete base (this may also include an asphalt wearing course), placed on a granular sub-base or concrete sub-base. The base or sub-base could be constructed using concrete pavers or they could be formed, with fixed forms set at the required pavement levels. Reinforcement would also be placed if required by the design. The concrete would be poured directly from agitator trucks into the concrete paver or into the forms.

Existing road pavements would be modified to integrate with the project where required. This may require milling and resurfacing of the existing pavements to tie-in with new road surfaces. These works are often required to be carried out at night when traffic numbers are reduced to enable the required lane closures.

Shared user path and cycleway pavements would be constructed to consist of similar pavement types to the existing paths, and to meet Transport for NSW design standards

Construction of the three shared user underpasses beneath the Wakehurst Parkway would be staged as part of the surface road works along the Wakehurst Parkway with further planning to include the potential of early access to one or more of the new underpasses. Controlled shared user access across Wakehurst Parkway would be limited but still available at all times with final access to all three underpasses available at the completion of construction works.

The extension of the existing shared user underpass beneath the Burnt Bridge Creek Deviation at Burnt Bridge Creek would be staged to maintain access at all times. Subject to final planning for staging of these works, short term detours may be required due to construction access restrictions.

### 6.5.6 Fauna connectivity structures

Three new fauna underpasses would be constructed along the Wakehurst Parkway as shown in Figure 6-28 and Figure 6-29. Fauna underpasses would be constructed using inverted U-shaped pre-cast concrete units placed on a cast concrete base slab. Following placement of the pre-cast units, the underpasses would be backfilled to the required new roadway level with select backfill material. An example of a fauna underpass is shown in Figure 6-22.

Additionally, three new fauna rope canopy bridges would be constructed about 910 metres and 1370 metres north of Kirkwood Street and 885 metres south of Aquatic Drive along Wakehurst Parkway. Three existing fauna rope canopy bridges would also be replaced by the project due to the widening of the Wakehurst Parkway. One of the fauna rope canopy bridges is located about 330 metres north of Kirkwood Street and the other two are located about 110 metres and 200 metres south of Aquatic Drive which were constructed as part of the Northern Beaches Hospital road upgrade project. Refer to Chapter 19 (Biodiversity) for further information on the management of biodiversity impacts from the project including measures to maintain the function of the existing fauna underpass on the Wakehurst Parkway north of Aquatic Drive during construction.


**Figure 6-22 Example of a fauna underpass (Pacific Highway Upgrade, Woolgoolga to Ballina upgrade)**

### 6.5.7 Surface finishing works

Surface finishing works would be carried out progressively during construction as areas are near completion and would include:

- Linemarking of new road pavement
- Installation of directional signage and other roadside furniture
- Final landscape treatments and rehabilitation works
- Local commercial and residential property adjustments required due to surface road changes
- Local road traffic calming measures.

## 6.6 New open space and recreation facilities at Balgowlah

A dedicated consultation process jointly led by Transport for NSW and Northern Beaches Council would take place to give the community an opportunity to provide input to the final layout of the new and improved open space and recreation facilities at Balgowlah. This consultation would be separate to the consultation for the Beaches Link and Gore Hill Freeway Connection environmental impact statement. This process would start after the environmental impact statement public exhibition period and well in advance of construction starting. As part of this consultation process, a community reference group would be established, with representative stakeholder groups and the community, to support Transport for NSW and Northern Beaches Council with the development of this important public space. The project would return an area, equivalent to around 90 per cent of the current open space, to the community as new and improved public open space and recreation facilities.

Construction of the new and improved open space and recreation facilities at Balgowlah would be delivered progressively. Commencement of the staged works for the new open space and recreation facilities would be subject to completion of the consultation process described above.

Residual land, primarily to the east and north of the new access road, would progressively become available through the construction period, which would facilitate re-purposing it to the new open space and recreation facilities. This would allow it to be handed over progressively for use by the community. The new open space and recreation facilities to the west of the proposed access road, between the access road and Burnt Bridge Creek Deviation, would be constructed after completion of the project and then handed over to Northern Beaches Council.

An indicative layout of the new and improved open space and recreation facilities at Balgowlah is provided in Figure 5-28 of Chapter 5 (Project description).

## 6.7 Testing, commissioning and demobilisation

Testing and commissioning works would be carried out towards the completion of construction to validate the correct operation and integration of tunnel systems prior to road opening.

Site clean-up and demobilisation works would be carried out once construction activities have been completed at that location. This would include:

- Site demobilisation and rehabilitation of temporary construction support sites
- Post construction condition surveys
- Removal of construction-related signage
- Removal of construction-related environmental controls and traffic management infrastructure. In some instances, controls will remain in place until the environment has stabilised (eg vegetation is established).

Residual land refers to those lots that would be wholly or partially occupied during construction of the project but would not be required for operational infrastructure or other operational activities. Where land is leased for construction of the project, reinstatement and rehabilitation of the land would be carried out as part of demobilisation works, in consultation with and to meet the requirements of the relevant landowner.

Any future development of residual land would be subject to separate assessment and approval in accordance with the *Environmental Planning and Assessment Act 1979*. Additional detail about residual land not required following construction of the project is provided in Chapter 20 (Land use and property).

## 6.8 Construction footprint and temporary construction support sites

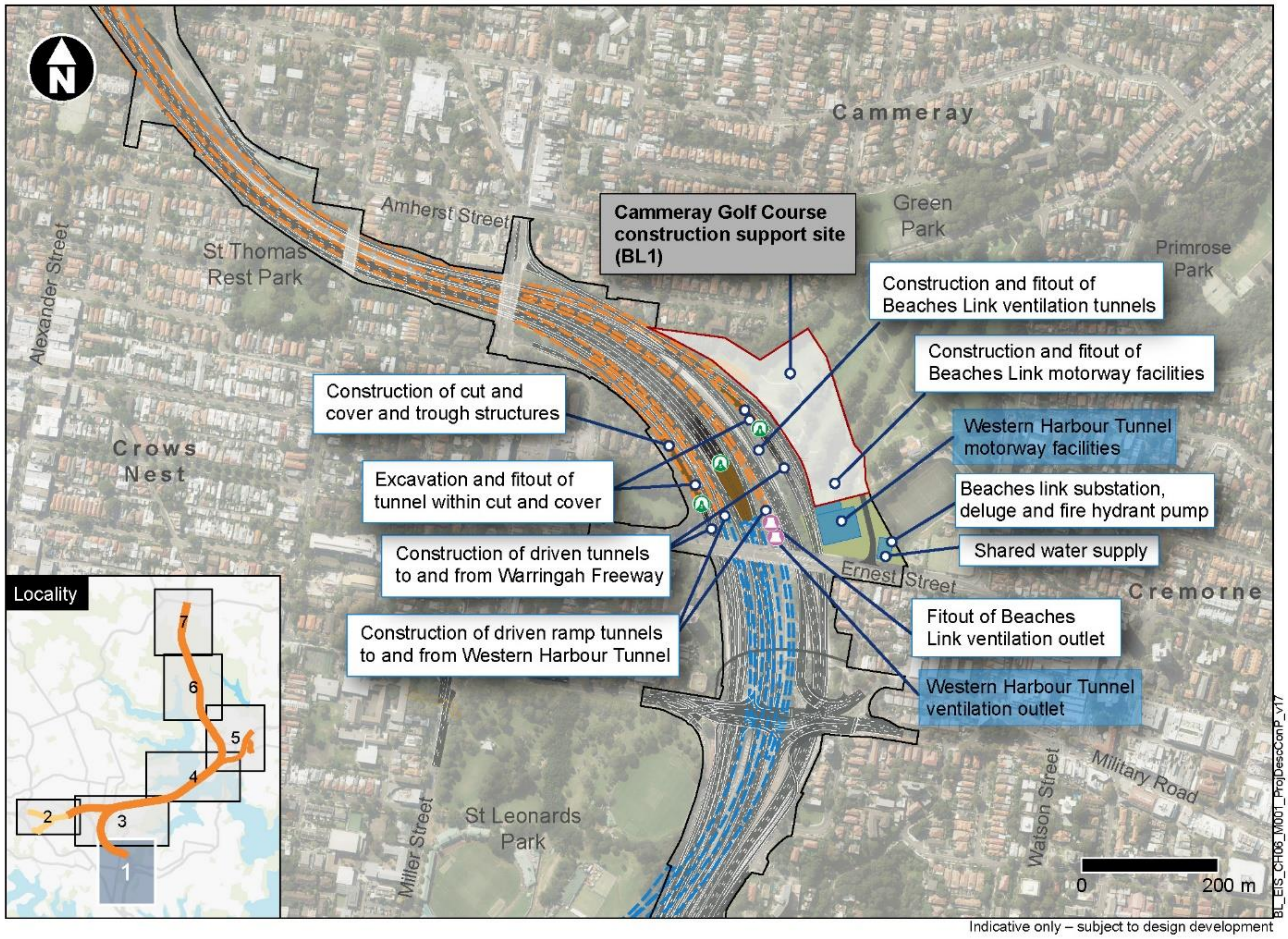
### 6.8.1 Construction footprint

The total area required for construction of the project is referred to as the construction footprint. The construction footprint consists of the anticipated area needed for the project and includes temporary construction support sites and additional areas where work would be required to construct the project. Temporary construction support sites required for the project are discussed in Section 6.8.2.

While a substantial amount of the work for the project would occur underground, temporary construction support sites on the surface would be required to support underground construction activities and to support and construct the surface connections, tunnel portals, surface road works including the realignment and upgrade of the Wakehurst Parkway, active transport facilities (pedestrian and cyclist facilities) and operational facilities.

Apart from the motorway facilities, cut and cover structures, trough structures and tunnelling works in Cammeray, the construction footprint shown on the Warringah Freeway would consist of low impact activities such as traffic control and management, line marking and staged surface roadworks tie in works, and utility and cable works required to connect to the Western Harbour Tunnel and Warringah Freeway Upgrade project and other local roads.

An overview of construction activities and the construction footprint is shown in Figure 6-23 to Figure 6-29.




**Legend**

**Construction**
- Construction footprint
- Construction support site

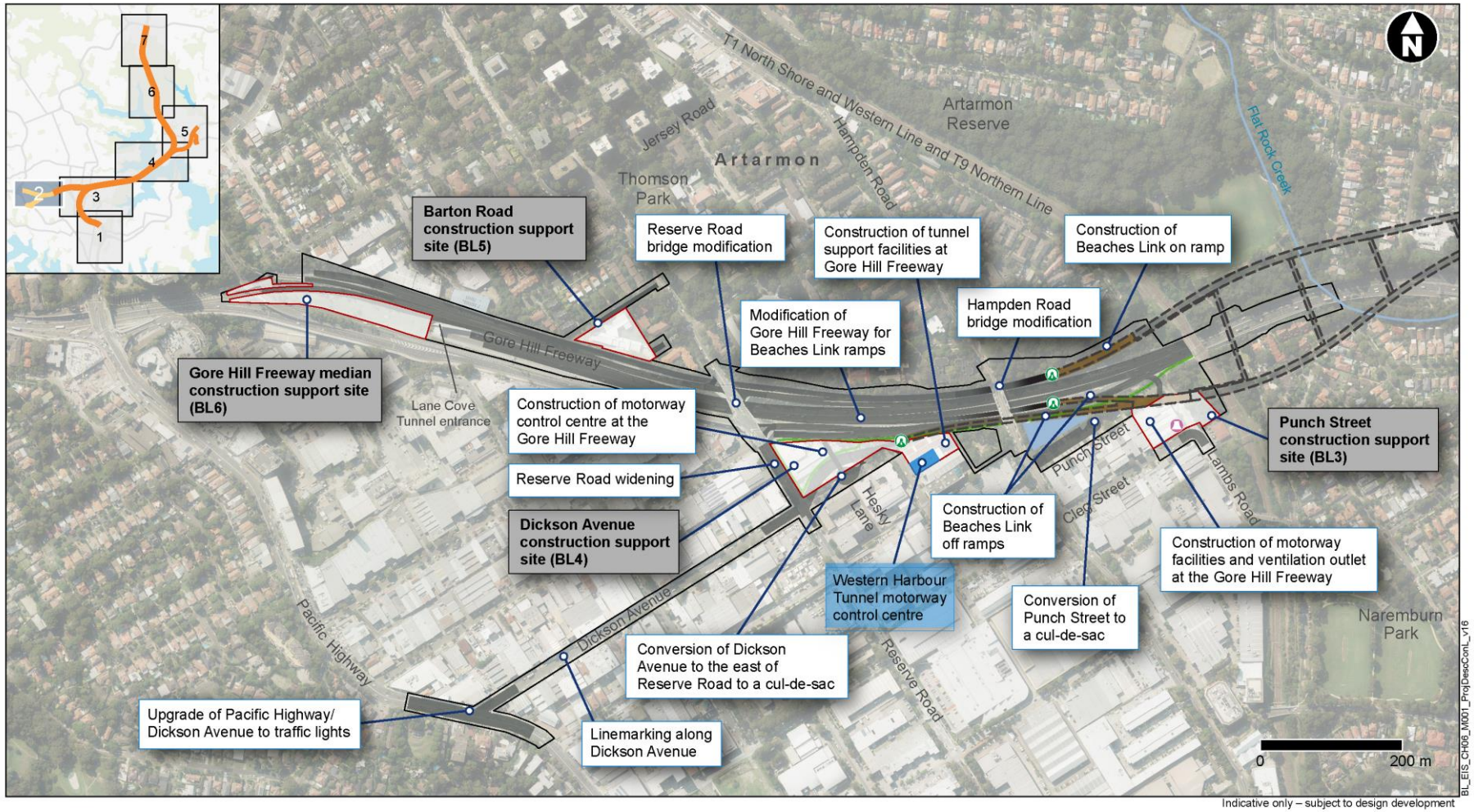
**Alignment**
- Surface connections
- Beaches Link driven tunnel

**Permanent features**
- Ventilation outlet
- Cut and cover
- Trough structure
- Site access

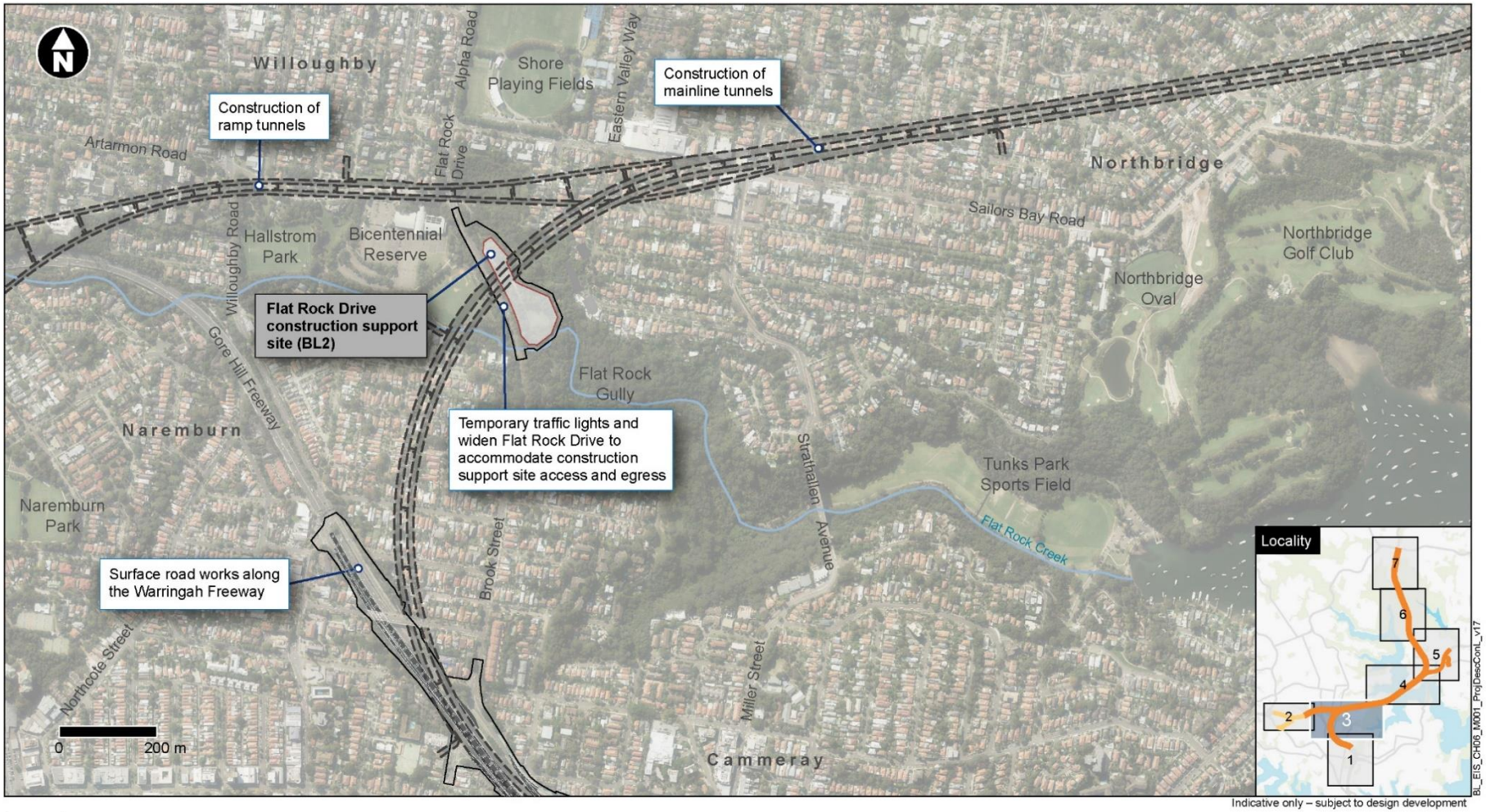
**Connecting projects**
- Western Harbour Tunnel
- Warringah Freeway Upgrade

Note: The Beaches Link construction footprint shown on Warringah Freeway within this area extends to include construction activities that would be associated with traffic control and management, line marking, tie-in works and utility and cable works.

## Figure 6-23 Overview of construction activities and construction footprint (map 1)

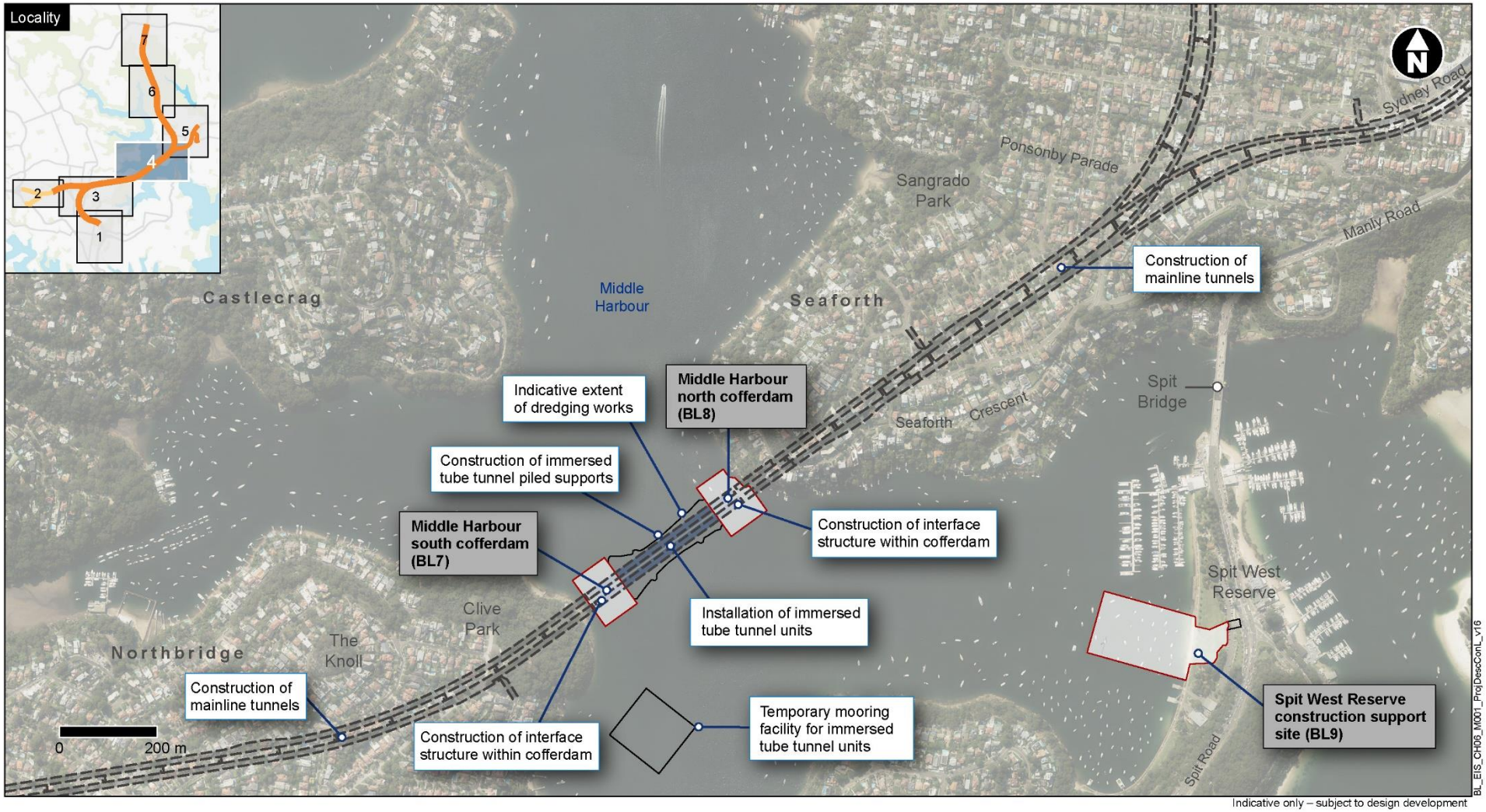



## Figure 6-24 Overview of construction activities and construction footprint (map 2)




Note: The Beaches Link construction footprint shown on Warringah Freeway within this area extends to include construction activities that would be associated with traffic control and management, line marking, tie-in works and utility and cable works.

## Figure 6-25 Overview of construction activities and construction footprint (map 3)




## Figure 6-26 Overview of construction activities and construction footprint (map 4)

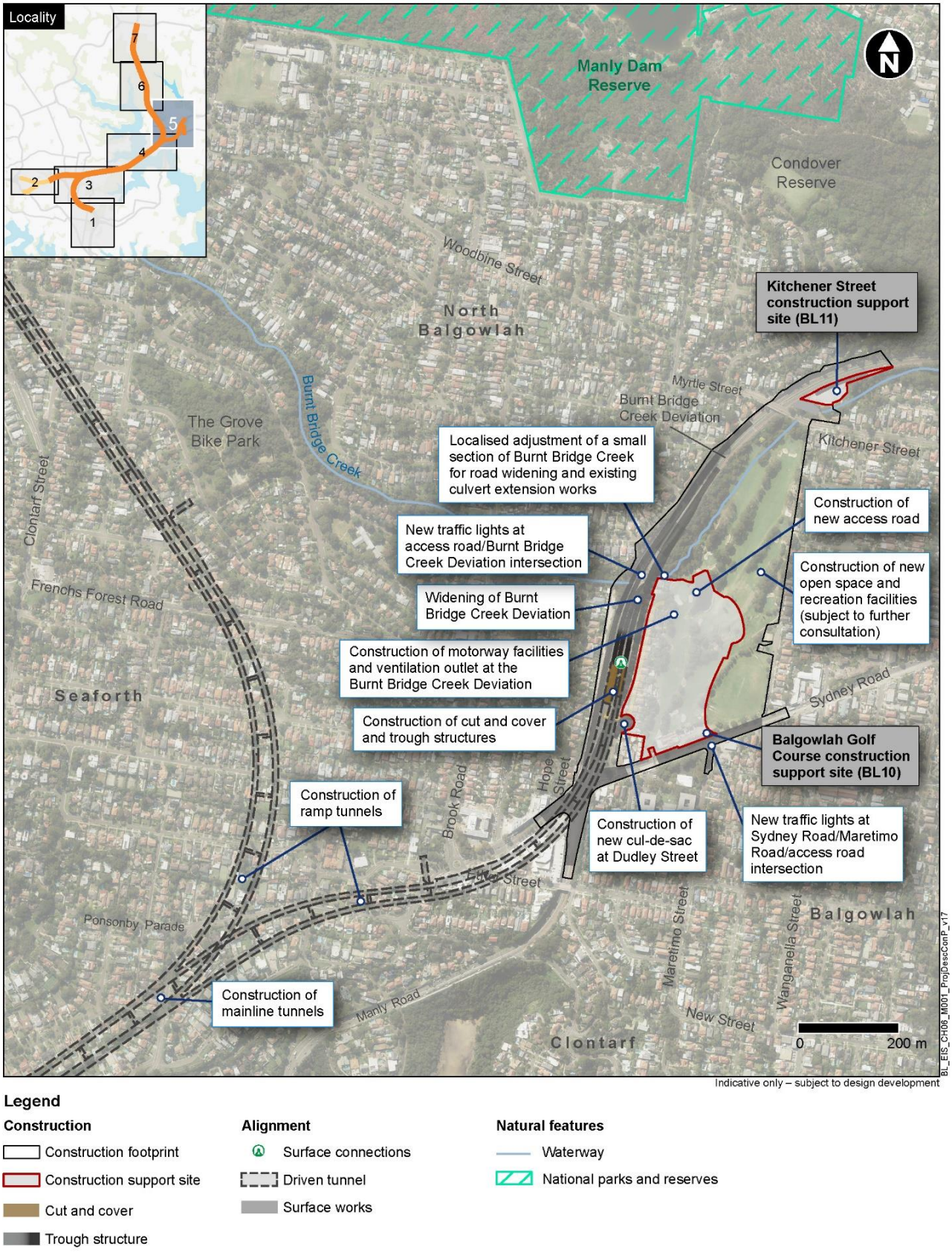



**Figure 6-27 Overview of construction activities and construction footprint (map 5)**

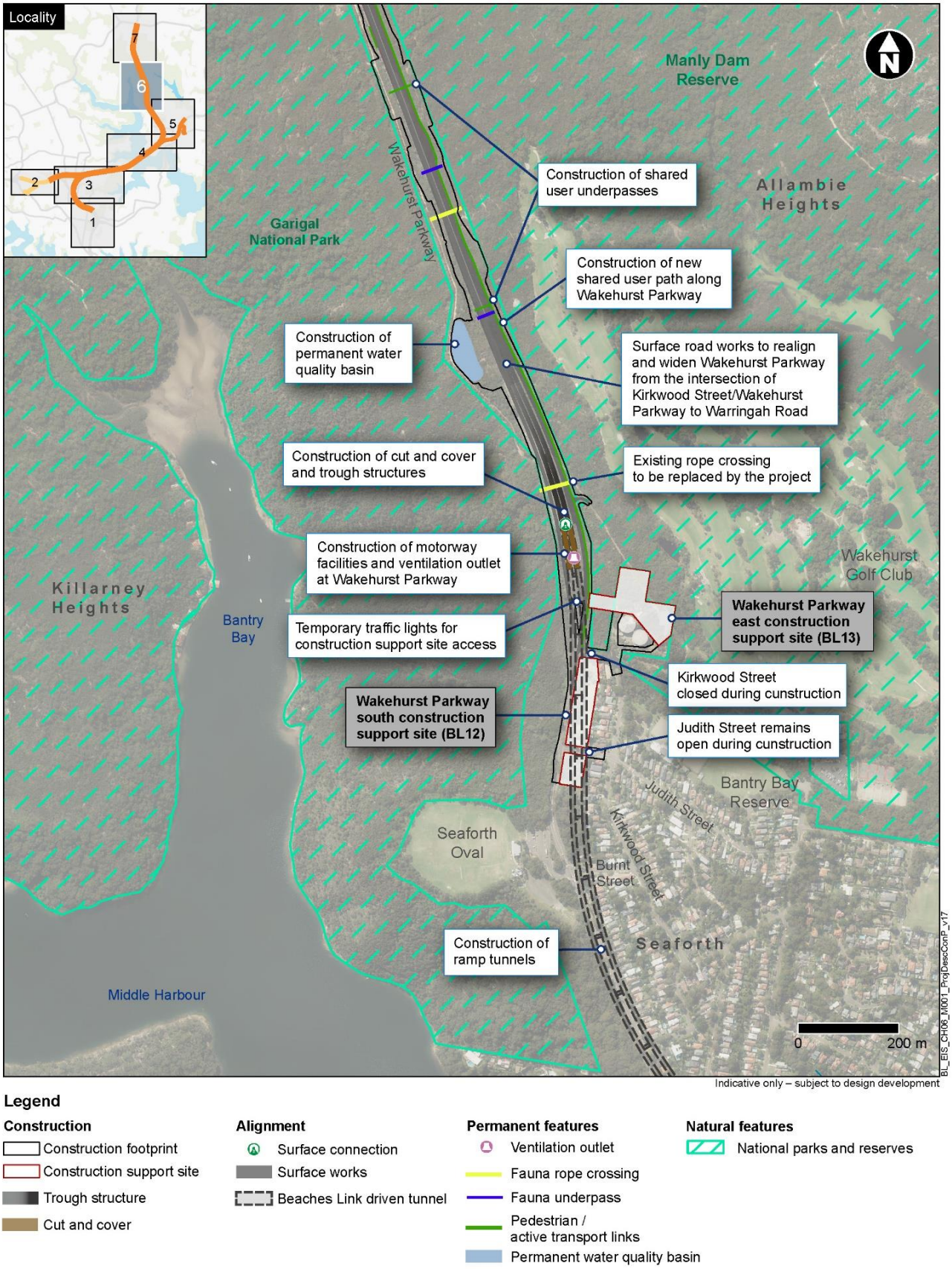



**Figure 6-28 Overview of construction activities and construction footprint (map 6)**

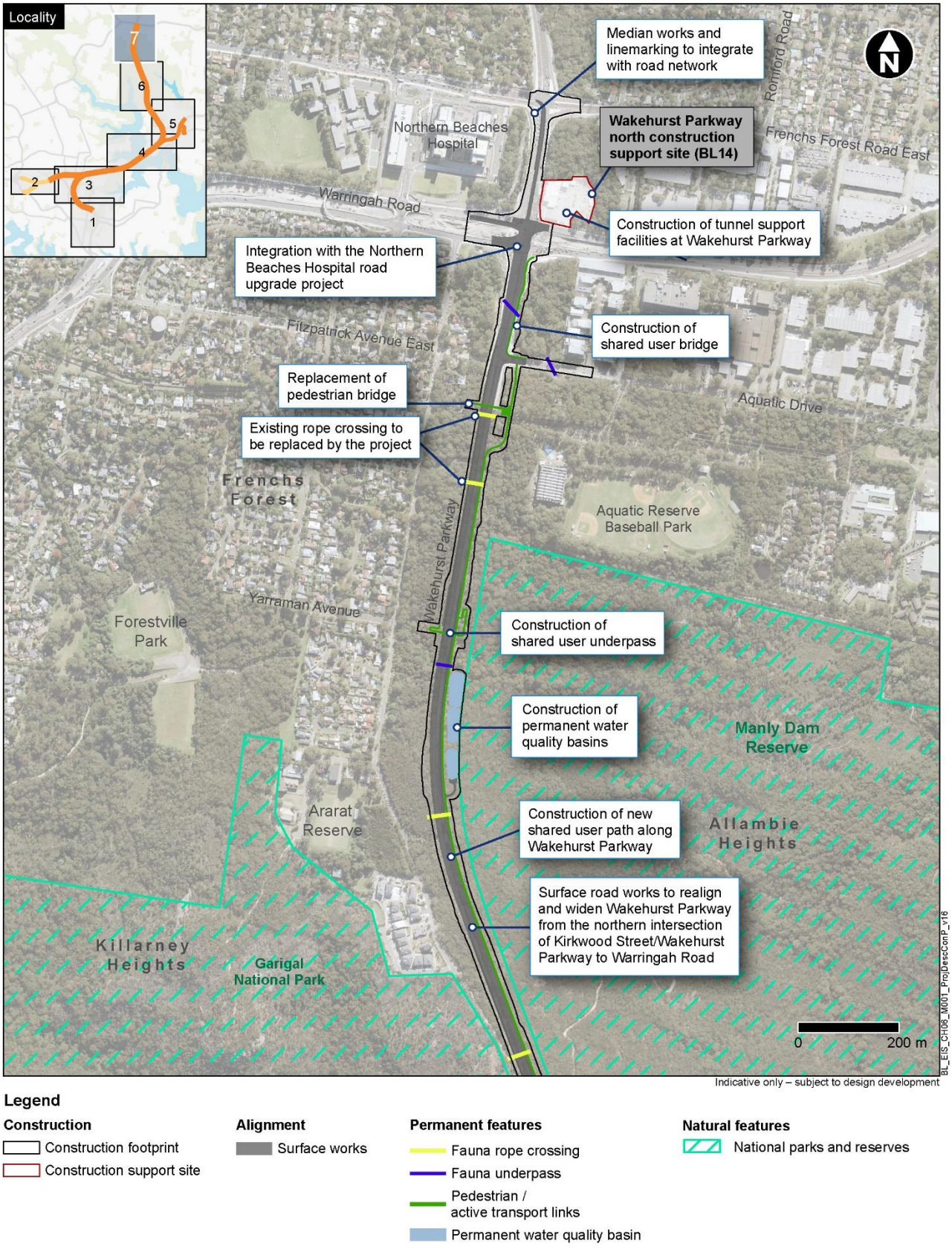



**Figure 6-29 Overview of construction activities and construction footprint (map 7)**

### 6.8.2 Beaches Link and Gore Hill Freeway Connection temporary construction support sites

Temporary construction support sites for the project would include tunnelling and tunnelling support sites, surface civil sites, cofferdams, mooring sites, wharf and berthing facilities, construction storage (laydown) areas, parking and workforce amenities.

All temporary construction support sites would have appropriate boundary fencing. This would be typical construction hoarding or security fencing. Where required, temporary noise barriers would be installed on the site boundary. Indicative locations are shown on the temporary construction support site figures (Figure 6-30 to Figure 6-42).

To support operation of the sites, power, potable water supply and suitable connection for stormwater and sewerage discharge would be required (discussed in Section 6.9.4).

Construction hours at temporary construction support sites would vary depending on the type of construction activity being carried out. Proposed hours for each temporary construction support site are outlined in the following sections and construction work hours associated with specific activities are detailed in Section 6.9.1.

The following sections describe the proposed temporary construction support sites and their anticipated functions/uses during construction.

#### Cammeray Golf Course (BL1)

A summary of the key features of the Cammeray Golf Course construction support site (BL1) is included in Table 6-9. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-30. An indicative program for construction activities is provided in Table 6-10.

**Table 6-9 Key features of the Cammeray Golf Course construction support site (BL1)**

| Key feature | Summary |
|---|---|
| Site area | 27,600 $m^2$ |
| Site description | Located within the north-west portion of the Cammeray Golf Course. The site is bound by the Cammeray Golf Course to the north, Cammeray Golf Course and Cammeray Park to the east, Warringah Freeway to the west and Ernest Street to the south. Residential properties are located to the north on Warringa Road and Morden Street and to the south across Ernest Street. |
| Key activities | This site would be used for the construction and fitout of motorway facilities at the Warringah Freeway and would provide tunnel and construction support for the Beaches Link component of the project.<br>The site would initially be established as a temporary construction support site for the Western Harbour Tunnel and Warringah Freeway Upgrade project and was assessed as part of the environmental impact statement for Western Harbour Tunnel and Warringah Freeway Upgrade (Transport for NSW, 2020b). The site has been designed and developed to minimise impacts to the golf course, and allow for a reconfigured nine-hole golf course to operate throughout construction and operation.<br>Key activities that would occur on, or be supported by this site would include:<br>• Site reconfigured for Beaches Link project works including construction and operation of temporary site facilities, including |

| Key feature | Summary |
|---|---|
| | an acoustic shed, workshop, wastewater treatment facility, air intake, staff offices and amenities, pavements and car parking<br>• Excavation of a tunnelling access decline connecting to a modified ventilation tunnel<br>• Excavation of driven mainline tunnels from Cammeray towards Naremburn<br>• Excavation of shafts and ventilation tunnels for the ventilation outlet and motorway facilities at the Warringah Freeway<br>• Construction and fitout of the Beaches Link motorway facilities and fitout of the ventilation outlet structure at the Warringah Freeway (the ventilation outlet civil works would be constructed as part of the Western Harbour Tunnel and Warringah Freeway Upgrade project)<br>• Construction support for the Beaches Link cut and cover and trough structures and their connection to the Warringah Freeway<br>• Construction of the substation and operational support facilities<br>• Treatment of wastewater from tunnelling activities<br>• Excavation, handling and stockpiling of tunnel spoil<br>• Utility works associated with surface works<br>• Tunnel civil and mechanical and electrical fitout<br>• Backfill access decline<br>• Testing, commissioning and site rehabilitation. |
| Hours of construction | General site activities and spoil haulage would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday). No spoil haulage or surface civil works would occur on Sundays or public holidays.<br>Tunnel construction and fitout would be carried out up to 24 hours per day, seven days per week either within an acoustic shed or underground. Night time deliveries would be required to support the tunnelling activities. |
| Access arrangements | Access in and out of the site would be primarily via Warringah Freeway around the location of the existing bus layover area at Cammeray. A secondary access would be provided at Ernest Street. |

Note: Leasing and acquisition at this site would be carried out as part of the Western Harbour Tunnel and Warringah Freeway Upgrade project.

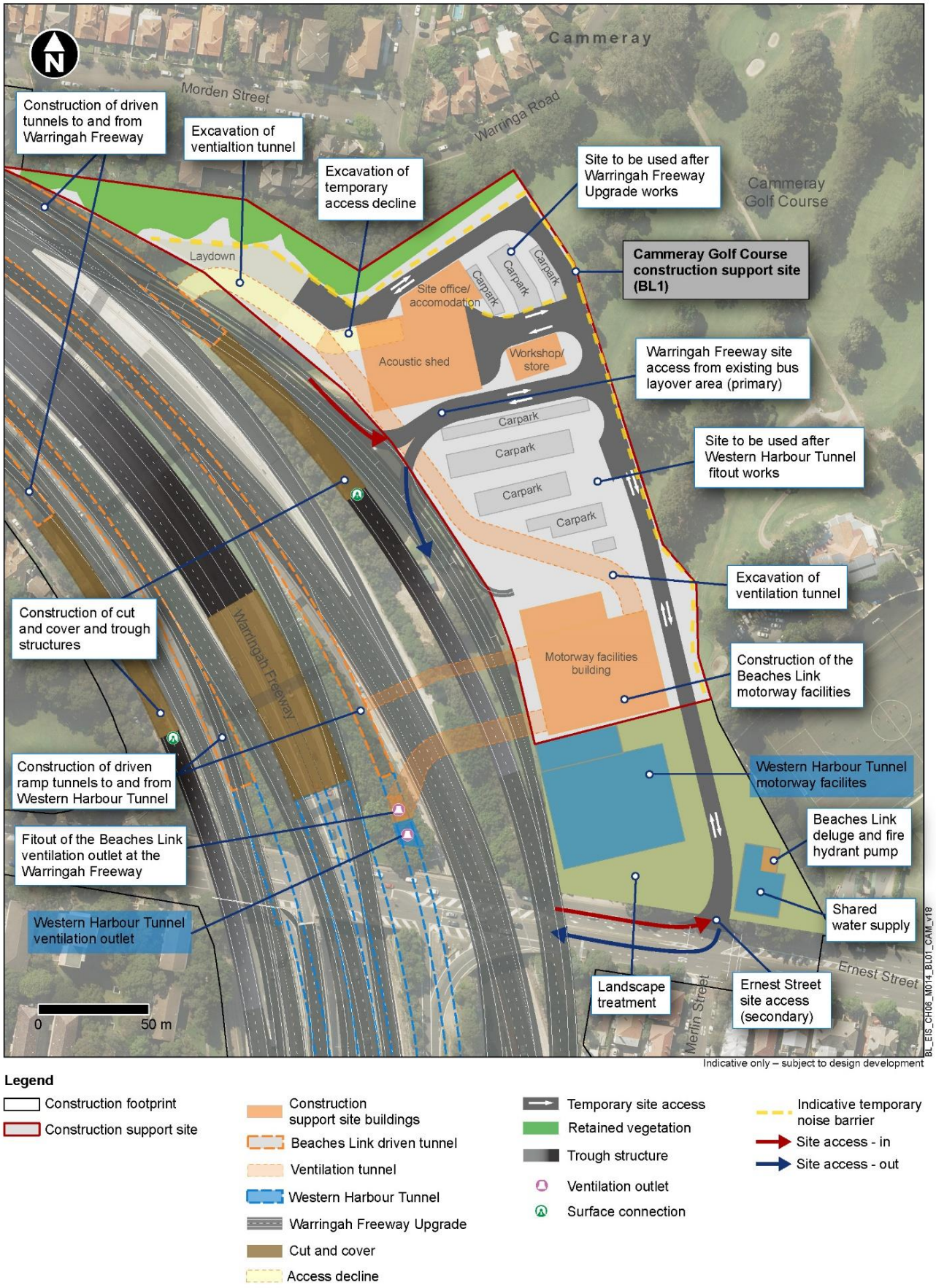
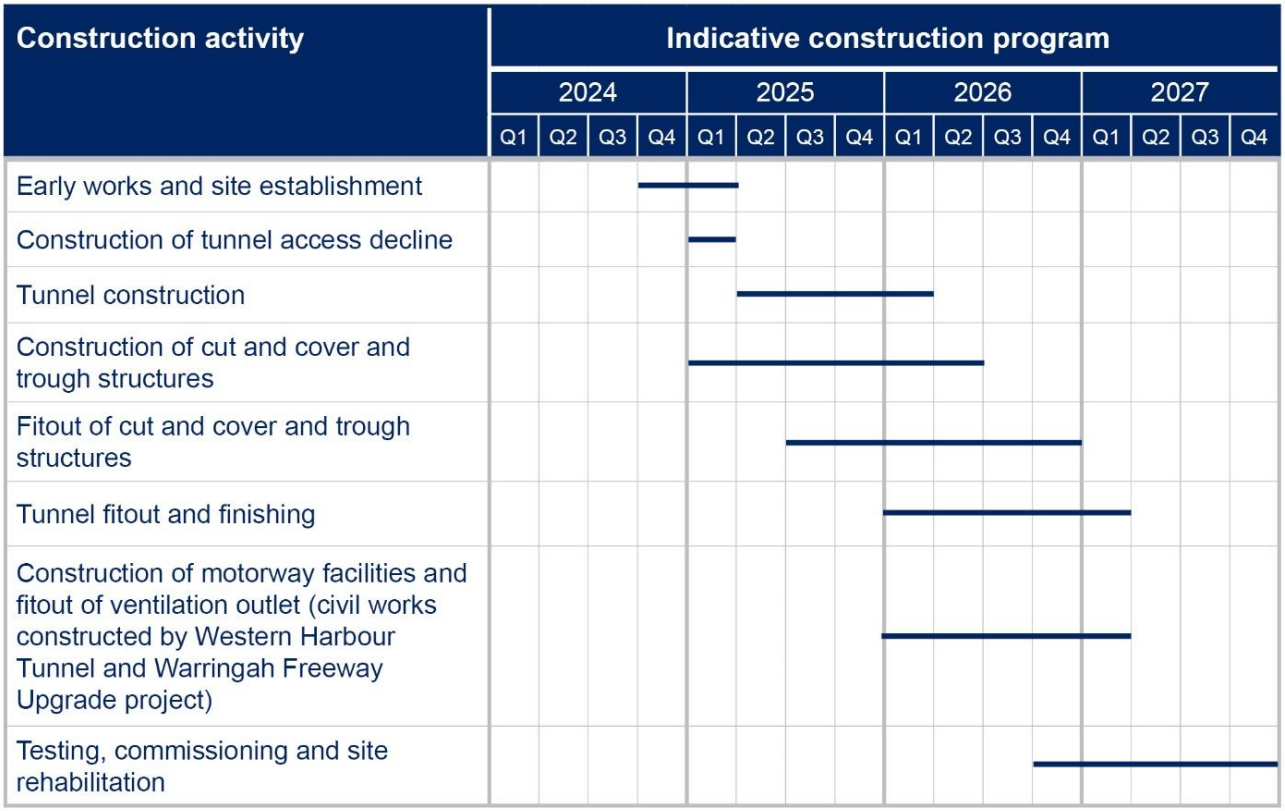



**Figure 6-30 Indicative layout - Cammeray Golf Course construction support site (BL1)**

**Table 6-10 Cammeray Golf Course construction support site (BL1) indicative construction program**



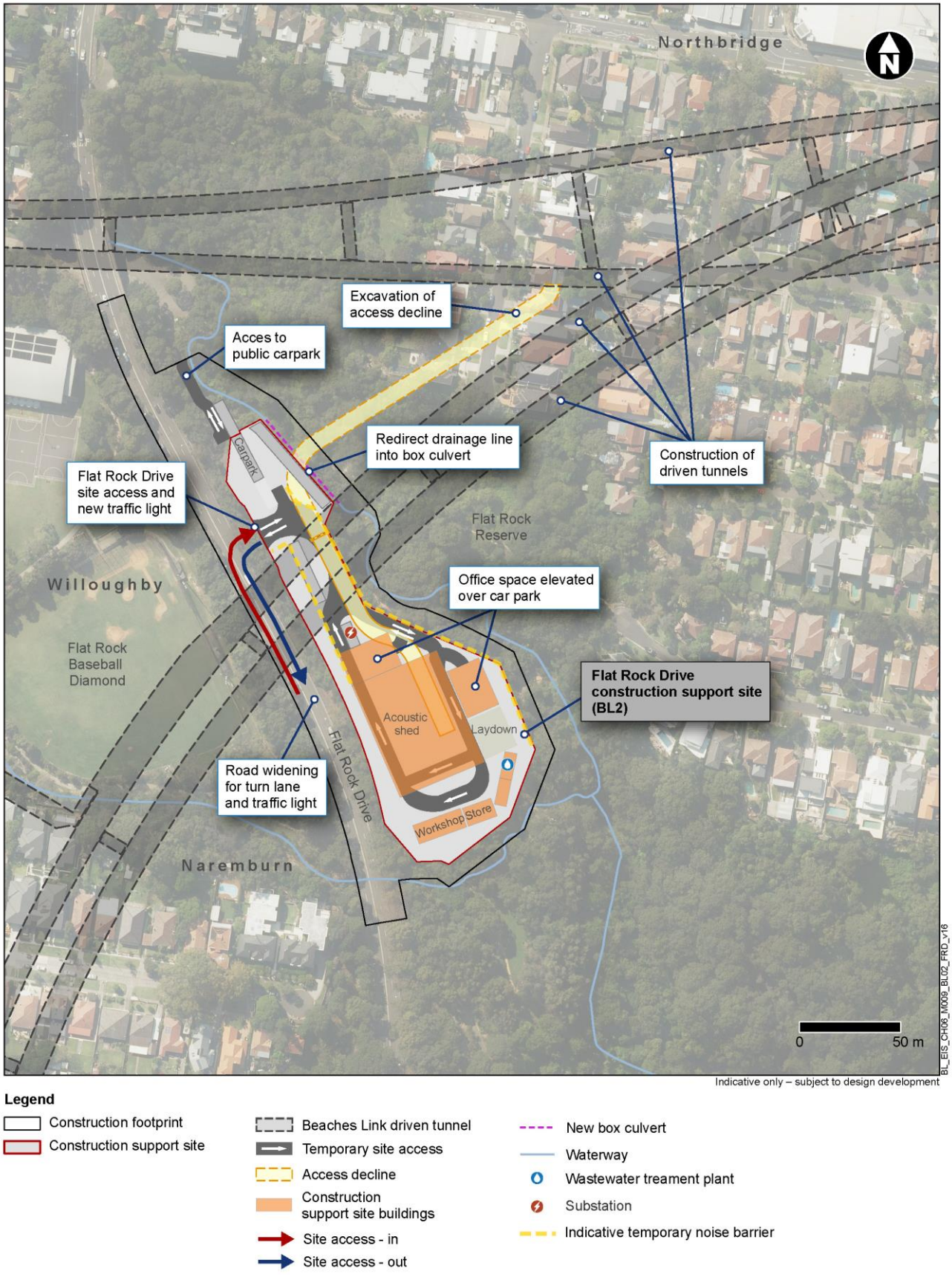

## Flat Rock Drive (BL2)

A summary of the key features of the Flat Rock Drive construction support site (BL2) is included in Table 6-11. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-31. An indicative program for construction activities is provided in Table 6-12.

**Table 6-11 Key features of the Flat Rock Drive construction support site (BL2)**

| Key feature | Summary |
|---|---|
| Site area | 11,760 $m^2$ |
| Site description | Located in Flat Rock Reserve, on the eastern side of Flat Rock Drive, opposite to the Flat Rock Baseball Diamond in Northbridge. This site was chosen to avoid direct impact on nearby residential or commercial properties, the Flat Rock Baseball Diamond, or the Willoughby Leisure Centre indoor facilities, netball courts or car park. It also provides direct access to and from the site via a main road, avoiding the need to use local roads for site access.<br>The temporary construction support site is located on a revegetated former landfill site. Potentially contaminated materials disturbed during site establishment and access decline construction would be subject to further investigation, remediation and/or management. All identified contaminated materials would be managed during construction with the implementation of environmental management measures detailed Chapter 16 (Geology, soils and groundwater) and in accordance with the |

| Key feature | Summary |
|---|---|
| | *Guideline for the Management of Contamination* (Roads and Maritime Services, 2013a). |
| Key activities | This would be a tunnel support site. Key activities that would occur on, or be supported by, this site would include:<br>• Support site works including the temporary diversion of existing shared user paths and walking tracks, clearing and grubbing, topsoil stripping, bulk earthworks, management of potentially contaminated waste, retaining structures to reshape and regrade existing reserve<br>• Construction and operation of temporary site facilities, including an acoustic shed, temporary noise barriers, workshop, wastewater treatment facility, air intake, staff offices and amenities, pavements and car parking<br>• Installation of a culvert in an existing aboveground watercourse within the northern extent of Flat Rock Reserve along the north eastern boundary of the site<br>• Excavation of an access decline to the main tunnel alignment (via the westbound ramp tunnel connection at the Gore Hill Freeway)<br>• Excavation of the main tunnel alignment towards both Cammeray and Middle Harbour and excavation of ramp tunnels toward Artarmon<br>• Treatment of wastewater from tunnelling activities<br>• Support for tunnel excavation works<br>• Support for tunnel fitout and finishing works<br>• Utility works associated with surface works<br>• Excavation, handling and stockpiling of tunnel spoil<br>• Backfill of access decline<br>• Testing, commissioning and site rehabilitation. |
| Hours of construction | General site activities and spoil haulage would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday). No spoil haulage or surface civil works would occur on Sundays or public holidays.<br>Tunnel construction and fitout would be carried out up to 24 hours per day, seven days per week either within an acoustic shed or underground. Night time deliveries would be required to support the tunnelling activities. |
| Access arrangements | Access in and out of the site would be via a temporary signalised intersection at Flat Rock Drive. Local surface works for road widening, shared user path and utility adjustments would be required on Flat Rock Drive to establish a traffic light intersection and turning lane. Road widening works would be carried out on the eastern side of Flat Rock Drive. |




Note: The waterway includes a constructed surface creek, above ground concrete lined stormwater channels, a naturalised bedrock channel and an underground box culvert. Flat Rock Creek is within a box culvert from Willoughby Road to a point 150m east of Flat Rock Drive. Further detail on Flat Rock Creek characteristics is provided in Chapter 17 (Hydrodynamics and water quality) (refer to Figure 17-2).

## Figure 6-31 Indicative layout - Flat Rock Drive construction support site (BL2)

**Table 6-12 Flat Rock Drive construction support site (BL2) indicative construction program**

| Construction activity | Indicative construction program | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | | 2027 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Early works and site establishment | | | | | | | | | | | | | | | | | | | | |
| Construction of tunnel access decline | | | | | | | | | | | | | | | | | | | | |
| Tunnel construction | | | | | | | | | | | | | | | | | | | | |
| Tunnel fitout | | | | | | | | | | | | | | | | | | | | |
| Testing, commissioning and site rehabilitation | | | | | | | | | | | | | | | | | | | | |

## Punch Street (BL3)

A summary of the key features of the Punch Street construction support site (BL3) is included in Table 6-13. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-32. An indicative program for construction activities is provided in Table 6-14.

**Table 6-13 Key features of the Punch Street construction support site (BL3)**

| Key feature | Summary |
|---|---|
| Site area | 4800 $m^2$ |
| Site description | Located within the Artarmon industrial area, next to the T1 North Shore and Western Line and T9 Northern Line rail corridor, on the southern side of the Gore Hill Freeway. The western portion of the site is currently occupied by industrial buildings and the eastern portion is vegetated. |
| Key activities | This would be a tunnel support and project management site for Beaches Link. Key activities that would occur on, or be supported by this site would include:<br>• Demolition of existing structures<br>• Construction and operation of temporary site facilities, including an acoustic shed, temporary noise barrier, workshop, wastewater treatment facility, air intake, staff offices and amenities<br>• Excavation of an access decline<br>• Excavation of ramp tunnels and cross passages from the Gore Hill Freeway Artarmon to the mainline tunnels under Northbridge<br>• Treatment of wastewater from tunnelling activities<br>• Support for tunnel fitout and finishing works<br>• Utility works associated with surface works including existing 132kV utility support works over cut and cover. Access for the service provider would be maintained throughout construction<br>• Excavation, handling and stockpiling of tunnel spoil |

| Key feature | Summary |
|---|---|
| | • Construction of permanent operational facilities, including motorway facilities<br>• Backfill access decline<br>• Testing, commissioning and site rehabilitation. |
| Hours of construction | General site activities and spoil haulage would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday). No spoil haulage or surface civil works would occur on Sundays or public holidays.<br>Tunnel construction and fitout would be carried out up to 24 hours per day, seven days per week either within an acoustic shed or underground. Night time deliveries would be required to support the tunnelling activities. |
| Access arrangements | Access into the site would be via Reserve Road and Cleg Street, and out of the site via Punch Street. An alternative heavy goods vehicle exit would be constructed and staged with the cut and cover works to connect directly to the Gore Hill Freeway westbound. |

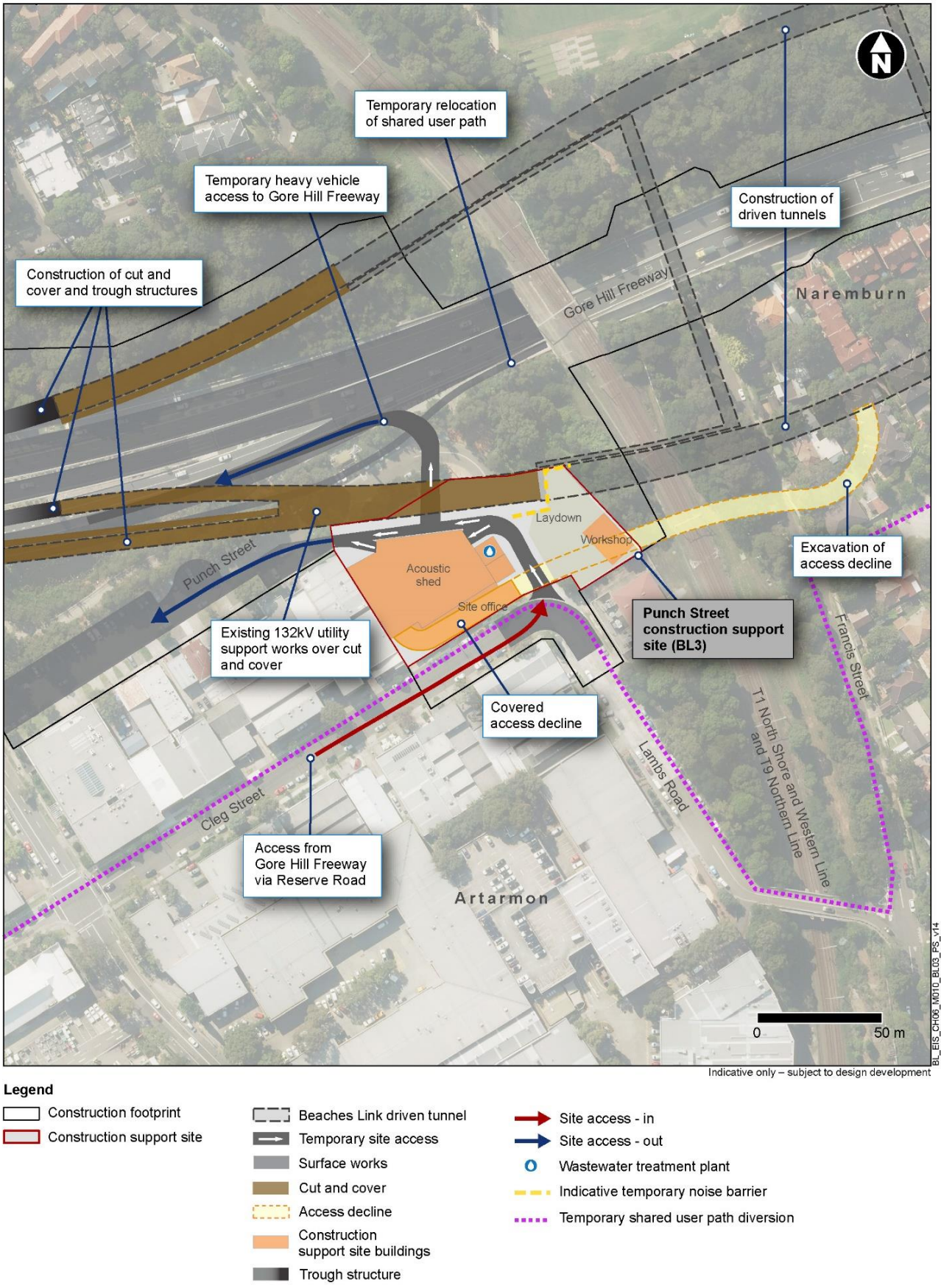



**Figure 6-32 Indicative layout - Punch Street construction support site (BL3)**

**Table 6-14 Punch Street construction support site (BL3) indicative construction program**

| Construction activity | Indicative construction program | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Early works and site establishment | | | | | | | | | | | | | | | | |
| Excavation of tunnel access decline | | | | | | | | | | | | | | | | |
| Tunnel construction | | | | | | | | | | | | | | | | |
| Tunnel fitout | | | | | | | | | | | | | | | | |
| Construction of operational facilities | | | | | | | | | | | | | | | | |
| Testing, commissioning and site rehabilitation | | | | | | | | | | | | | | | | |

## Dickson Avenue (BL4)

A summary of the key features of the Dickson Avenue construction support site (BL4) is included in Table 6-15. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-33. An indicative program for construction activities is provided in Table 6-16.

**Table 6-15 Key features of the Dickson Avenue construction support site (BL4)**

| Key feature | Summary |
|---|---|
| Site area | 9900 $m^2$ |
| Site description | Located within the Artarmon industrial area, between Reserve Road, Dickson Avenue and Waltham Street, on the southern side of the Gore Hill Freeway. The site is currently occupied by industrial buildings and the Freeway Hotel.<br>It is noted that an area in the eastern part of this site (off Waltham Street) would be occupied by the Western Harbour Tunnel motorway control centre (delivered as part of the Western Harbour Tunnel and Warringah Freeway Upgrade project). The area allocated for the Western Harbour Tunnel motorway control centre is not currently proposed for use by the project for construction activities. |
| Key activities | The site would support construction activities for both the Beaches Link and Gore Hill Freeway Connection components of the project.<br>The site would initially involve support site works including:<br>• Demolition of existing structures<br>• Construction and operation of temporary site facilities, including laydown areas, staff offices and amenities, pavements and car parking.<br>For the Beaches Link construction works, the site would be used for supplementary support for tunnelling activities that occur from the Punch Street construction support site (BL3) and construction of operational facilities.<br>For the Gore Hill Freeway Connection construction works the site would be used as a project management site and used for equipment laydown, car parking for construction workers and temporary site office buildings. Once most of the surface and tunnelling works have been completed, the temporary construction |

| Key feature | Summary |
|---|---|
| | support site would be rearranged to allow for construction of permanent infrastructure (ie the off ramp trough structures and surface works to Reserve Road, the motorway control centre and the tunnel support facility). |
| Hours of construction | General site activities, including construction of the motorway control centre and tunnel support facilities and most surface works, would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday and no construction works on Sundays or public holidays).<br>Some construction activities (eg some more complex and constrained surface works and utility adjustments) supported by this site would require out of hours work due to site access restrictions and constraints presented by existing traffic staging requirements. This would require periods throughout the construction program where works at this site would occur outside of standard construction hours. |
| Access arrangements | Access in and out of the site would be via Dickson Avenue/Reserve Road. |


**Figure 6-33 Indicative layout - Dickson Avenue construction support site (BL4)**

**Table 6-16 Dickson Avenue construction support site (BL4) indicative construction program**

| Construction activity | Indicative construction program | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Beaches Link construction works | | | | | | | | | | | | | | | | |
| Early works and site establishment | ■ | ■ | | | | | | | | | | | | | | |
| Additional tunnel support at Punch Street | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | |
| Construction of operational facilities | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| Testing and commissioning | | | | | | | | | | | | | | | ■ | ■ |
| Gore Hill Freeway Connection construction works | | | | | | | | | | | | | | | | |
| Early works and site establishment | ■ | ■ | | | | | | | | | | | | | | |
| Construction of Gore Hill Freeway surface works and bridge modifications | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | |
| Construction of the off ramp trough and surface works to Reserve Road | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | | |
| Site rehabilitation | | | | | | | | | | | | | | | ■ | ■ |

## Barton Road (BL5)

A summary of the key features of the Barton Road construction support site (BL5) is included in Table 6-17. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-34. An indicative program for construction activities is provided in Table 6-18.

**Table 6-17 Key features of the Barton Road construction support site (BL5)**

| Key feature | Summary |
|---|---|
| Site area | 3830 $m^2$ |
| Site description | Located on the northern side of Gore Hill Freeway, between Butchers Lane and Barton Road. |
| Key activities | Used for equipment laydown facilities, car parking for construction workers and temporary site office buildings associated with the Gore Hill Freeway Connection works. |
| Hours of construction | General site activities, including most surface works, would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday and no construction works on Sundays or public holidays).<br>Some construction activities (eg some more complex and constrained surface works and utility adjustments) supported by this site would require out of hours work due to site access restrictions and constraints presented by existing traffic staging requirements. This would require periods throughout the construction program where works at this site would occur outside of standard construction hours. |

| Key feature | Summary |
|---|---|
| Access arrangements | Access in and out of the site would be via Barton Road and Butchers Lane, via Reserve Road. |


**Figure 6-34 Indicative layout - Barton Road construction support site (BL5)**

**Table 6-18 Barton Road construction support site (BL5) indicative construction program**

| Construction activity | Indicative construction program | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | | 2027 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Early works and site establishment | | | — | — | | | | | | | | | | | | | | | | |
| Construction support for surface works | | | | | — | — | — | — | — | — | — | — | — | — | — | — | | | | |
| Site restoration and demobilisation | | | | | | | | | | | | | | | | | — | — | | |

## Gore Hill Freeway median (BL6)

A summary of the key features of the Gore Hill Freeway median construction support site (BL6) is included in Table 6-19. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-35. An indicative program for construction activities is provided in Table 6-20.

**Table 6-19 Key features of the Gore Hill Freeway median construction support site (BL6)**

| Key feature | Summary |
|---|---|
| Site area | 7700 $m^2$ |
| Site description | Located within the Gore Hill Freeway road corridor on top of the Lane Cove Tunnel portal. The site is currently a grassed area with scattered juvenile and mature trees. |
| Key activities | Used for equipment laydown facilities associated with the Gore Hill Freeway Connection works. |
| Hours of construction | General site activities, including most surface works, would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday and no construction works on Sundays or public holidays).<br>Some construction activities (eg some more complex and constrained surface works and utility adjustments) supported by this site would require out of hours work due to site access restrictions and constraints presented by existing traffic staging requirements. This would require periods throughout the construction program where works at this site would occur outside of standard construction hours. |
| Access arrangements | Access into the site would be primarily via Gore Hill Freeway, a secondary access would be provided via Epping Road. Access out of the site would be via Gore Hill Freeway (eastbound). |

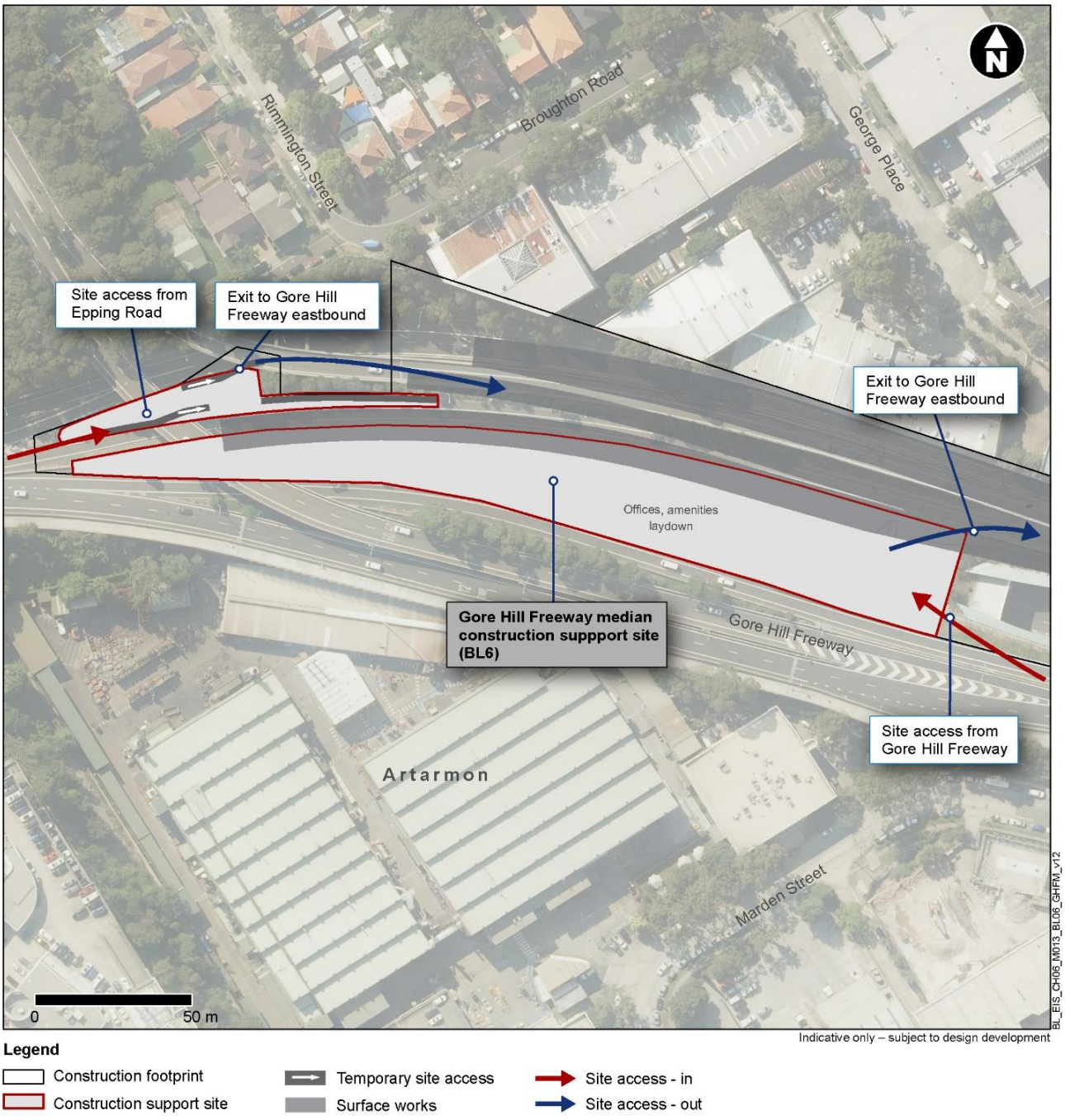



**Figure 6-35 Indicative layout - Gore Hill Freeway median construction support site (BL6)**

**Table 6-20 Gore Hill Freeway median construction support site (BL6) indicative construction program**

| Construction activity | Indicative construction program | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | | 2027 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Early works and site establishment | | | ▬ | ▬ | | | | | | | | | | | | | | | | |
| Construction support for surface works | | | | | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ | | | | |
| Site restoration and demobilisation | | | | | | | | | | | | | | | | | ▬ | ▬ | | |

## Middle Harbour south cofferdam (BL7) and Middle Harbour north cofferdam (BL8)

A summary of the key features of the Middle Harbour cofferdams (BL7 and BL8) is included in Table 6-21. An indicative layout for the cofferdams is shown in Figure 6-36. An indicative program for construction activities is provided in Table 6-22. Marine transport routes are shown in Figure 6-36.

**Table 6-21 Key features of the Middle Harbour cofferdam construction support sites (BL7 and BL8)**

| Key feature | Summary |
|---|---|
| Site area | 9200 $m^2$ (BL7) and 9900 $m^2$ (BL8) |
| Site description | Temporary cofferdams would be constructed at each end of the Middle Harbour crossing and within the harbour off the shore at Northbridge to the south and Seaforth to the north. Access would be from Spit West Reserve construction support site (BL9). |
| Key activities | The cofferdams would facilitate construction of the interface structures which connect the driven mainline tunnels and the immersed tube tunnel units.<br>Key activities that would occur on, or be supported by, these sites would include:<br>• Temporary relocation of about 10 moorings below Seaforth Bluff<br>• Construction of temporary cofferdam structure, including ground treatment, piling, dewatering, installation of structural steel supports and excavation<br>• Construction of interface structure (connection between the driven tunnels and the immersed tube tunnels, refer to Section 6.5.4) within the cofferdams<br>• Construction support from the water, including the use of a work barge (such as a flat top barge as shown in Figure 6-12, and barge movements for transfer of dredged material, deliveries and staff transport<br>• Construction of immersed tube tunnel piled supports<br>• Removal of cofferdam structure and site rehabilitation.<br>Alternative facilities (swing mooring or marina berth) would be provided nearby for the users of the three fixed jetties below Seaforth Bluff that would have access restricted during construction. |

| Key feature | Summary |
| --- | --- |
| Hours of construction | General site activities and spoil haulage would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday). No spoil haulage or surface civil works would occur on Sundays or public holidays. Rock hammering, piling and dredging would be carried out during standard construction hours only.<br>However, certain activities may be carried out up to 24 hours per day, seven days per week. This would include dewatering of cofferdams.<br>Some transport by barge to the designated offshore disposal site may take place outside standard construction hours.<br>It is noted that weekends are typically the busiest period for recreation including recreational boating, and this would be considered during detailed construction planning stages to minimise impacts to recreational activities and residents. |

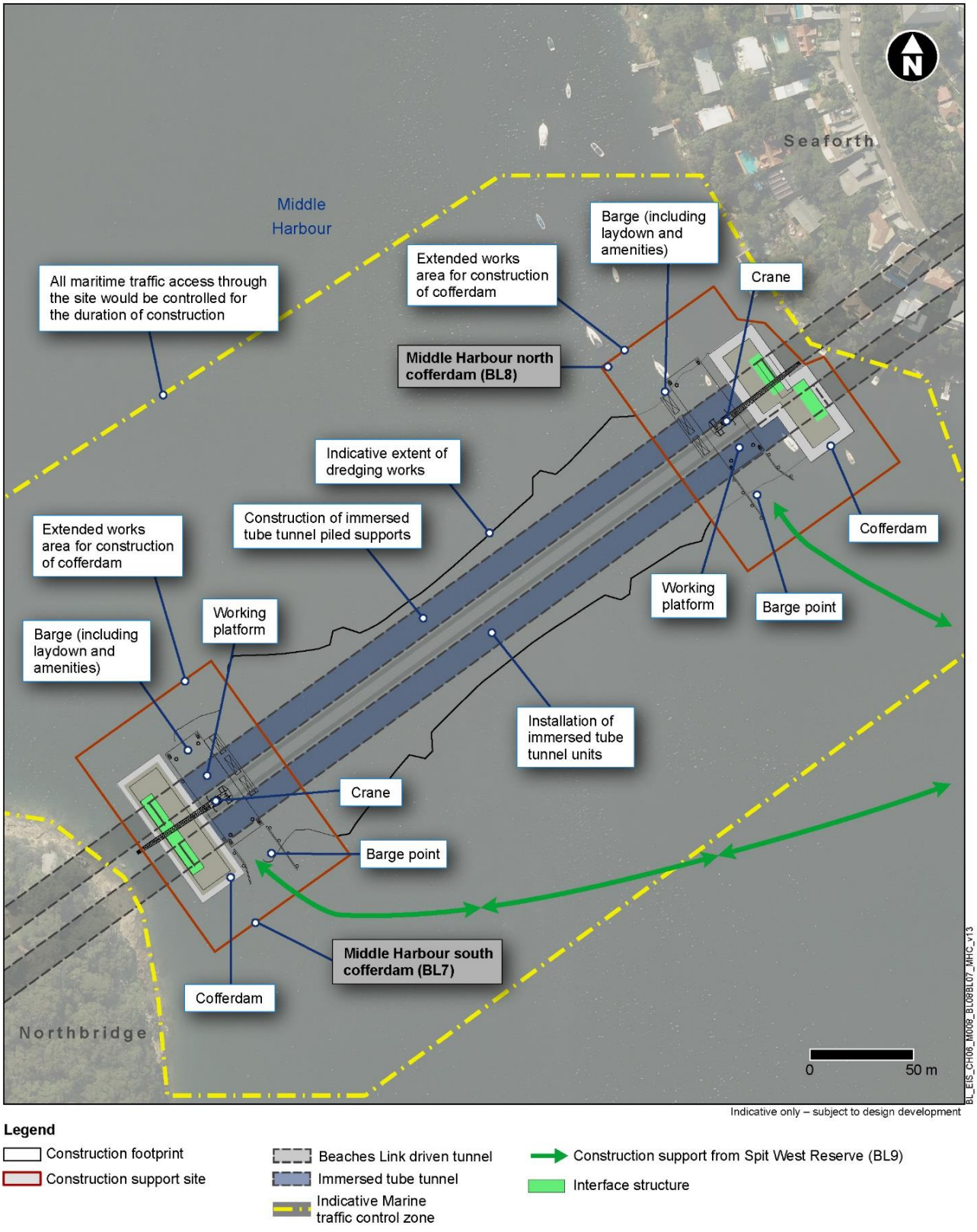
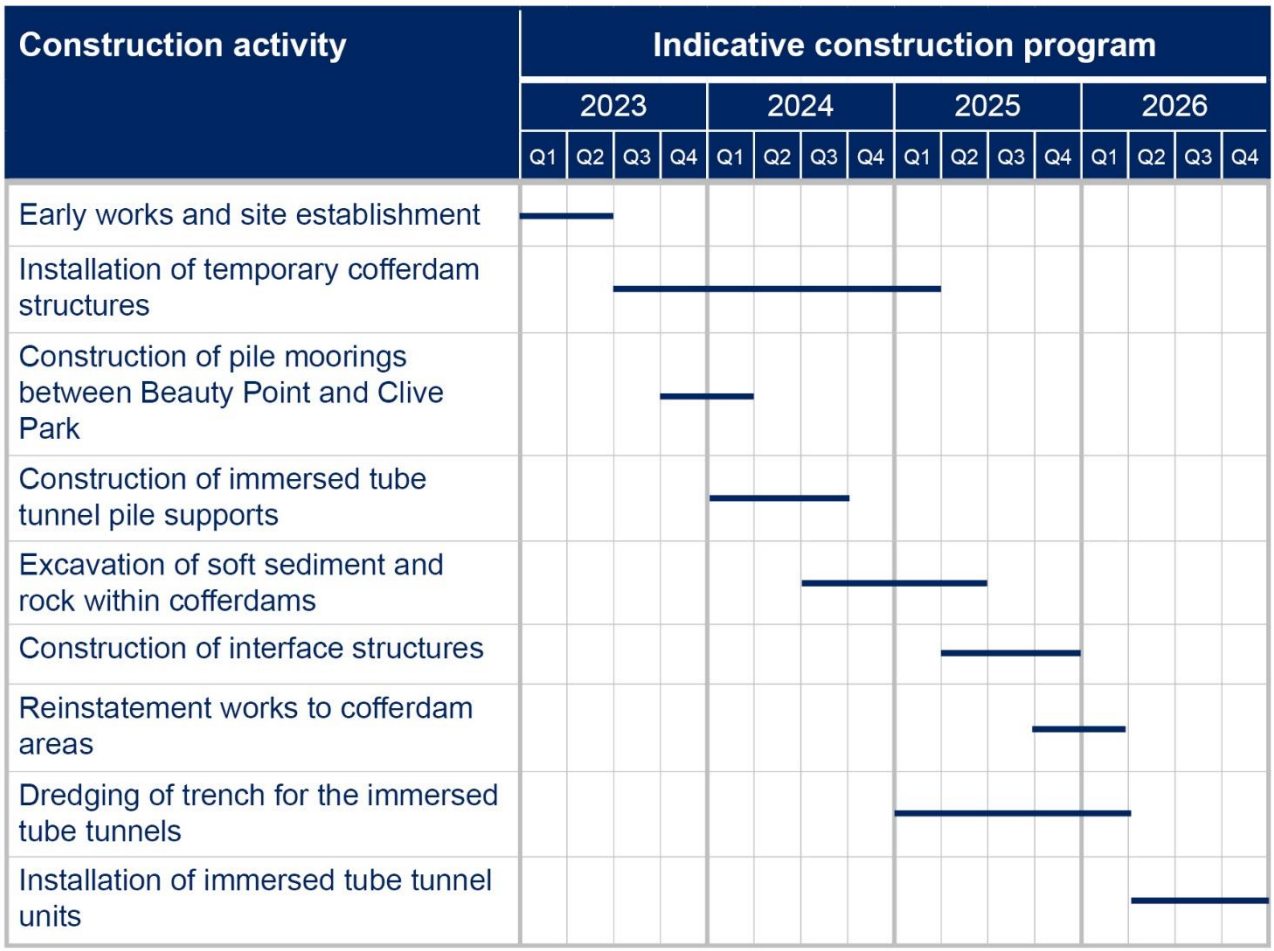



**Figure 6-36 Indicative layout – Middle Harbour cofferdams (BL7 and BL8)**

**Table 6-22 Middle Harbour cofferdams (BL7 and BL8) and other activities indicative construction program**




### Spit West Reserve (BL9)

A summary of the key features of the Spit West Reserve construction support site (BL9) is included in Table 6-23. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-37. An indicative program for construction activities is provided in Table 6-24. Marine transport routes are shown in Figure 6-43.

**Table 6-23 Key features of the Spit West Reserve construction support site (BL9)**

| Key feature | Summary |
|---|---|
| Site area | 26,000 $m^2$ (water area) and 4500 $m^2$ (land area) |
| Site description | Located primarily in the water west of Spit West Reserve, with a small adjoining land-based site. The land-based site is currently a public recreational space. However, a section of the land-based site has been recently used to support construction of the Northern Beaches B-Line infrastructure. |
| Key activities | The temporary construction support site will include a land-based support site facility in Spit West Reserve including car park, access road, laydown area and shed.<br>The proposed support site works would include construction of a temporary floating immersed tube tunnel casting facility that would be connected to Spit West Reserve by two temporary fixed jetties. |

| Key feature | Summary |
|---|---|
| | The floating facility and fixed jetties will require the installation of temporary piling and associated marine structures.<br>The casting facility would provide space for two immersed tube tunnel units to be cast concurrently. The site would also provide support for:<br>• Middle Harbour cofferdams<br>• Interface structures<br>• Immersed tube tunnel unit support piles<br>• Dredging works<br>• Immersed tube tunnel immersion<br>• Immersed tube tunnel granular backfill placement<br>• Site rehabilitation.<br>A mooring location would be provided in Middle Harbour to the west of the Spit West Reserve site to temporarily moor the immersed tube tunnel units prior to immersion. The mooring location would provide space for four immersed tube tunnel units. The proposed mooring location is shown in Figure 6-43.<br>The Spit West Reserve construction support site (BL9) would require the relocation of about 45 moorings in Middle Harbour for about two years.<br>In an effort to minimise impacts to traffic during peak periods and consideration of the limited construction footprint, the construction workforce would be transported to the site by a bus from the Balgowlah Golf Course construction support site (BL10), where required.<br>Following the completion of construction works, both the marine and land-based sites would be rehabilitated and landscaped. |
| Hours of construction | General site activities would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday). Where possible concrete pours would be scheduled to take place within standard construction hours; however, the process of casting the tunnel elements may require some works outside of standard construction hours.<br>Support works (immersion and installation) for the immersed tube tunnel installation would be required on six occasions for continuous periods lasting between 24 to 48 hours for each unit. |
| Access arrangements | Access in and out of the site would be via Spit Road. Barge access would also service this site. |

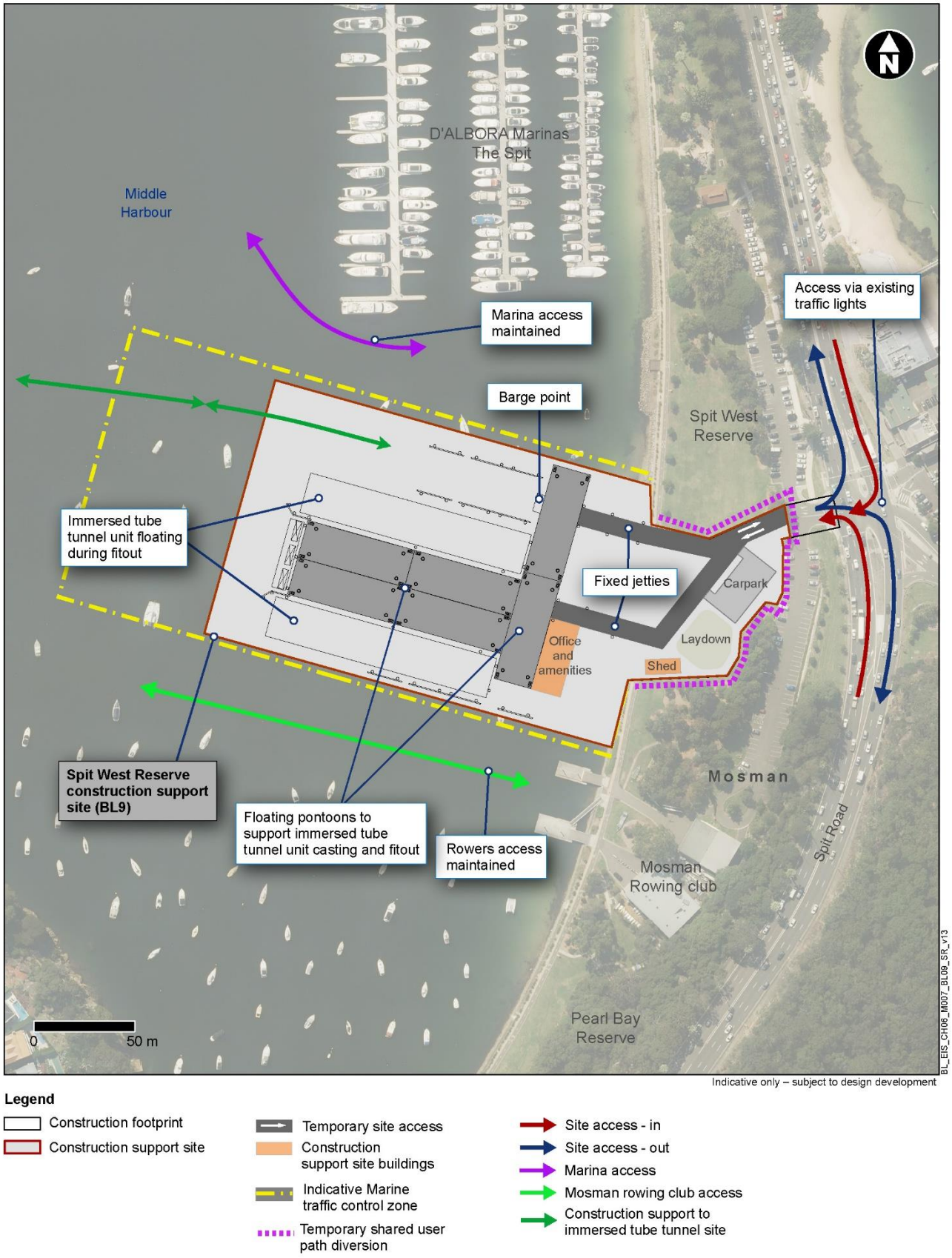



**Figure 6-37 Indicative layout – Spit West Reserve construction support site (BL9)**

**Table 6-24 Spit West Reserve construction support site (BL9) indicative construction program**

| Construction activity | Indicative construction program | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | | 2027 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Early works and site establishment | | | | | | | | | | | | | | | | | | | | |
| Cofferdam support works | | | | | | | | | | | | | | | | | | | | |
| Immersed tube tunnel unit pile support works | | | | | | | | | | | | | | | | | | | | |
| Immersed tube tunnel unit casting and fitout | | | | | | | | | | | | | | | | | | | | |
| Dredging support works | | | | | | | | | | | | | | | | | | | | |
| Support for the installation of immersed tube tunnel units | | | | | | | | | | | | | | | | | | | | |
| Site rehabilitation | | | | | | | | | | | | | | | | | | | | |

## Balgowlah Golf Course (BL10)

A summary of the key features of the Balgowlah Golf Course construction support site (BL10) is included in Table 6-25. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-38. An indicative program for construction activities is provided in Table 6-26.

**Table 6-25 Key features of the Balgowlah Golf Course construction support site (BL10)**

| Key feature | Summary |
|---|---|
| Site area | 74,250 $m^2$ |
| Site description | Located partially within Balgowlah Golf Course and on privately owned lots on Dudley Street. |
| Key activities | This would be a tunnel support site, surface works support site and project management site.<br>Key activities that would occur on, or be supported by this site would include:<br>• Demolition of existing structures<br>• Construction and operation of temporary construction facilities, including an acoustic shed, temporary noise barriers, workshops, wastewater treatment facility, air intake, staff offices and amenities, pavements and car parking and concrete batch plant<br>• Localised adjustment of a small section of Burnt Bridge Creek for road widening and existing culvert extension works<br>• Construction of new and improved open space and recreation facilities (refer to Section 6.6 and Chapter 5 (Project description) for further detail). Construction would be staged and the final layout would subject to a dedicated consultation process with the community and jointly led by Transport for NSW and Northern Beaches Council |

| Key feature | Summary |
|---|---|
| | • Excavation of an access decline to the ramp tunnel alignment<br>• Excavation of the tunnels and cross passages under Seaforth between Balgowlah and Middle Harbour<br>• Treatment of wastewater from tunnelling activities<br>• Excavation, handling and stockpiling of tunnel spoil<br>• Support for tunnel fitout (driven and immersed tube tunnels) and finishing works<br>• Utility works associated with surface works, the temporary construction site, and permanent operational infrastructure<br>• Support for cut and cover works, trough works, surface works and road widening works at Burnt Bridge Creek Deviation and Sydney Road<br>• Construction of a new access road between Burnt Bridge Creek Deviation and Sydney Road to provide connectivity between the project and Sydney Road and service future users of the new and improved open space and recreation facilities. This would include construction of new traffic lights at both the new Sydney Road and Burnt Bridge Creek Deviation intersections. A car park would also be constructed for users of the open space and recreation facilities<br>• Construction of permanent operational facilities, including a ventilation outlet and motorway facilities<br>• Additional support for construction of the immersed tube tunnels at the Spit West Reserve construction support site (BL9)<br>• Construction of new active transport links through the new and improved open space and recreation facilities and along the widened section of Burnt Bridge Creek Deviation<br>• Backfill of access decline<br>• Testing, commissioning and site rehabilitation. |
| Hours of construction | General site activities and spoil haulage would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday). No spoil haulage or surface civil works would occur on Sundays or public holidays.<br>Limited out of hours work would be required to stage traffic lanes during surface works construction, to minimise disruption to the road network and to ensure safety of road users, construction personnel and the public, and for delivery of oversized equipment.<br>Tunnel construction and fitout would be carried out up to 24 hours per day, seven days per week either within an acoustic shed or underground. Night time deliveries would be required to support the tunnelling activities. |
| Access arrangements | Access in and out of the site would be via Burnt Bridge Creek Deviation and Sydney Road. |

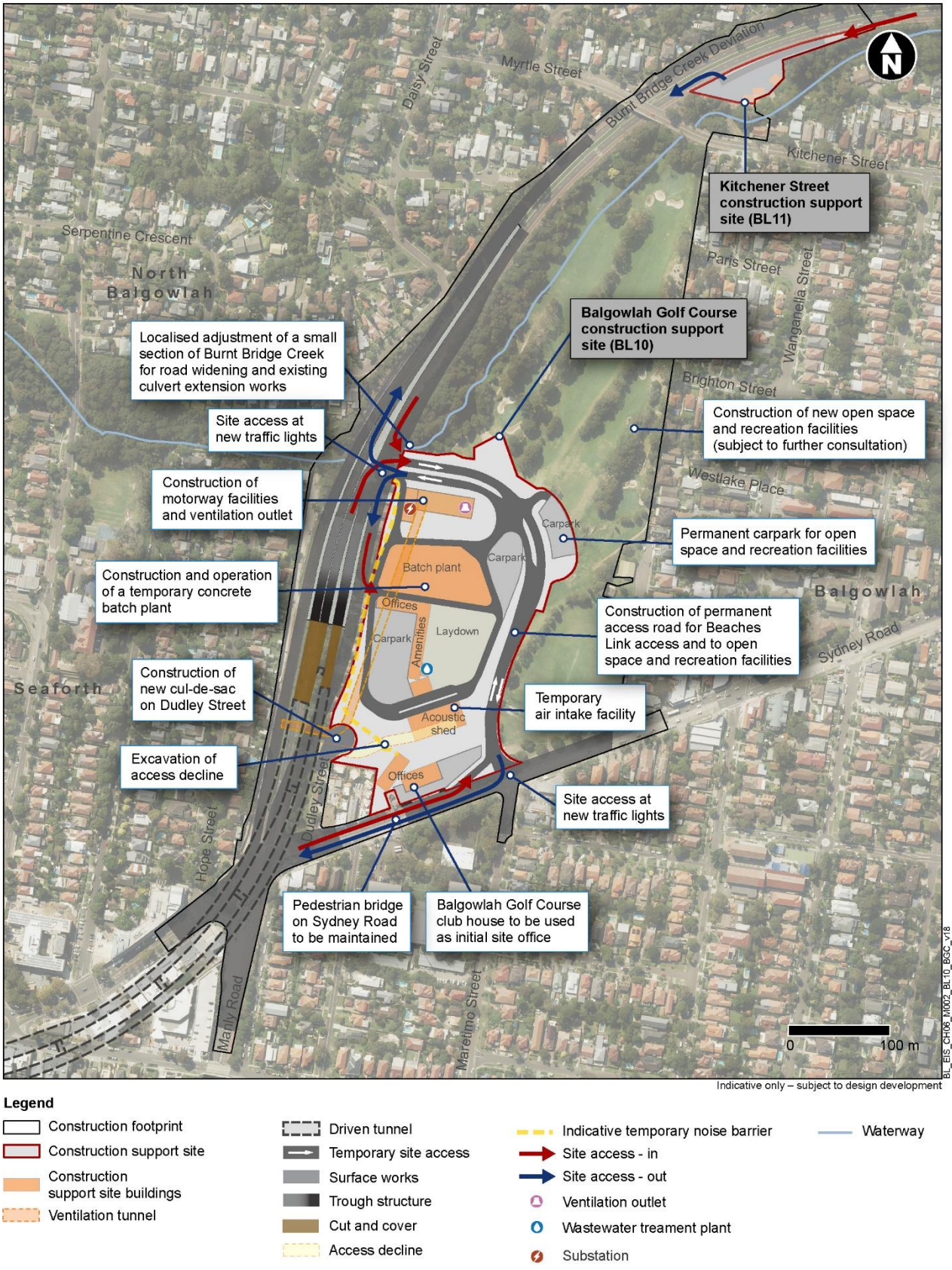
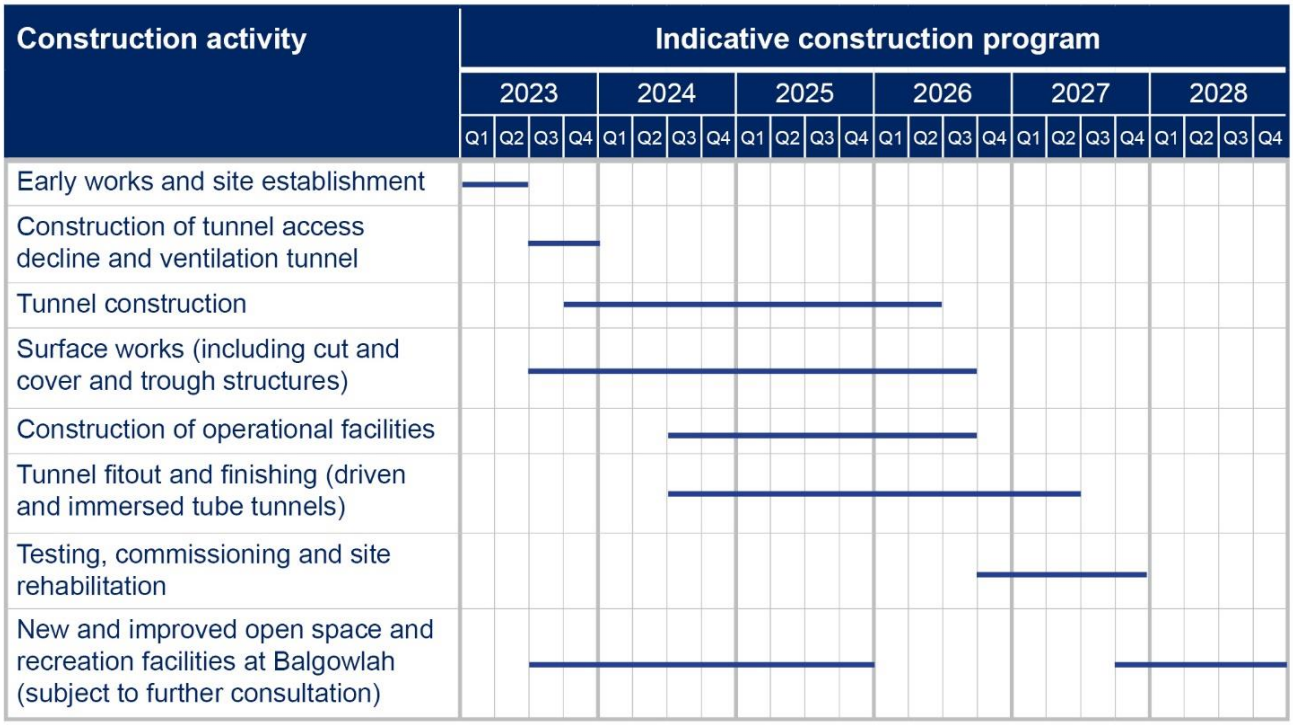



**Figure 6-38 Indicative layout – Balgowlah Golf Course construction support site (BL10)**

**Table 6-26 Balgowlah Golf Course construction support site (BL10) indicative construction program**




## Kitchener Street (BL11)

A summary of the key features of the Kitchener Street construction support site (BL11) is included in Table 6-27. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-39. An indicative program for construction activities is provided in Table 6-28.

**Table 6-27 Key features of the Kitchener Street construction support site (BL11)**

| Key feature | Summary |
|---|---|
| Site area | 5400 $m^2$ |
| Site description | Located next to Burnt Bridge Creek Deviation directly north of Kitchener Street bridge. The site is currently unoccupied and largely comprises cleared gravel space bordered by mature trees and shrubs.<br>An adjacent property at 36 Kitchener Street is owned by Transport for NSW and is intended to be used by the project as a site office and amenities. The property is included within the construction footprint and should it be used as a site office, an access road would be provided to connect to the construction support site shown in Figure 6-38. This would be confirmed during further design development. |
| Key activities | The site would support the surface road works and utility relocation works along Burnt Bridge Creek Deviation. |

| Key feature | Summary |
| --- | --- |
| Hours of construction | General site activities would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday). No spoil haulage or surface civil works would occur on Sundays or public holidays. |
| Access arrangements | Access in and out of the site would be via the existing southbound lanes of Burnt Bridge Creek Deviation. Limited access for light vehicles would be via Kitchener Street. |

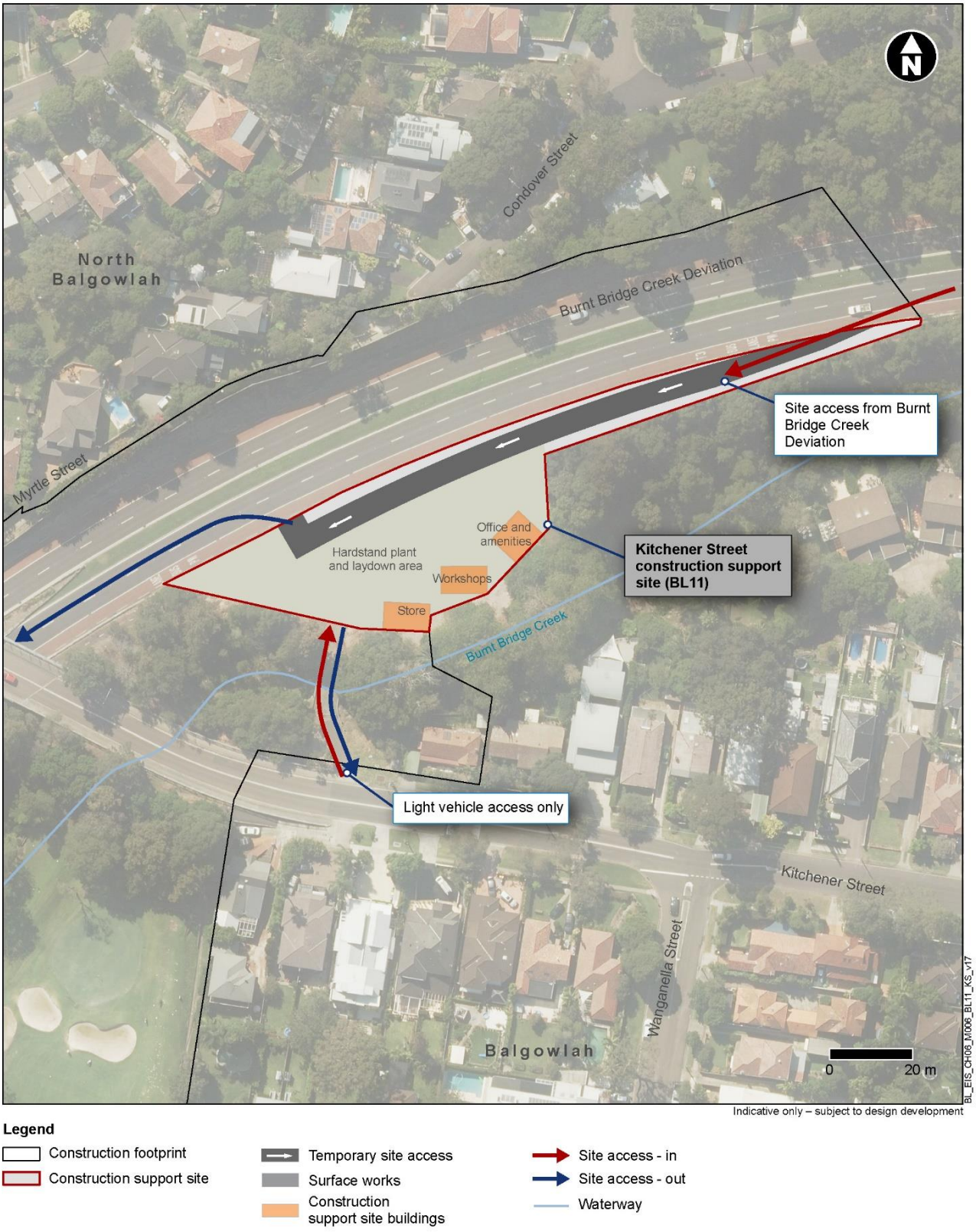



**Figure 6-39 Indicative layout – Kitchener Street construction support site (BL11)**

**Table 6-28 Kitchener Street construction support site (BL11) indicative construction program**

| Construction activity | Indicative construction program | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | | 2027 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Early works and site establishment | | | | | | | | | | | | | | | | | | | | |
| Support surface road works at Burnt Bridge Creek Deviation | | | | | | | | | | | | | | | | | | | | |
| Support utility relocation works | | | | | | | | | | | | | | | | | | | | |

### Wakehurst Parkway south (BL12)

A summary of the key features of the Wakehurst Parkway south construction support site (BL12) is included in Table 6-29. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-40. An indicative program for construction activities is provided in Table 6-30.

**Table 6-29 Key features of the Wakehurst Parkway south construction support site (BL12)**

| Key feature | Summary |
|---|---|
| Site area | 10,200 $m^2$ |
| Site description | Located on the eastern side of Wakehurst Parkway just south of Judith Street and Kirkwood Street at Seaforth. |
| Key activities | Key activities that would occur on, or be supported by, this site would include:<br>• Support site works including clearing and grubbing, topsoil stripping, bulk earthworks, minor retaining structures to reshape and regrade existing site<br>• Construction and operation of temporary site facilities, including a workshops, staff offices and amenities, pavements and car parking<br>• Support the upgrade of Wakehurst Parkway and also the construction of the cut and cover tunnel and trough and motorway facilities at Wakehurst Parkway<br>• Supplementary office support for tunnelling works at Wakehurst Parkway east construction support site (BL13). |
| Hours of construction | General site activities and spoil haulage would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday). No spoil haulage or surface civil works would occur on Sundays or public holidays.<br>Occasional works outside of standard hours to support traffic staging and switches on the Wakehurst Parkway and intersection modifications during site establishment may be required. |
| Access arrangements | Access in and out of the site would be via Judith Street and Kirkwood Street directly to the Wakehurst Parkway. |

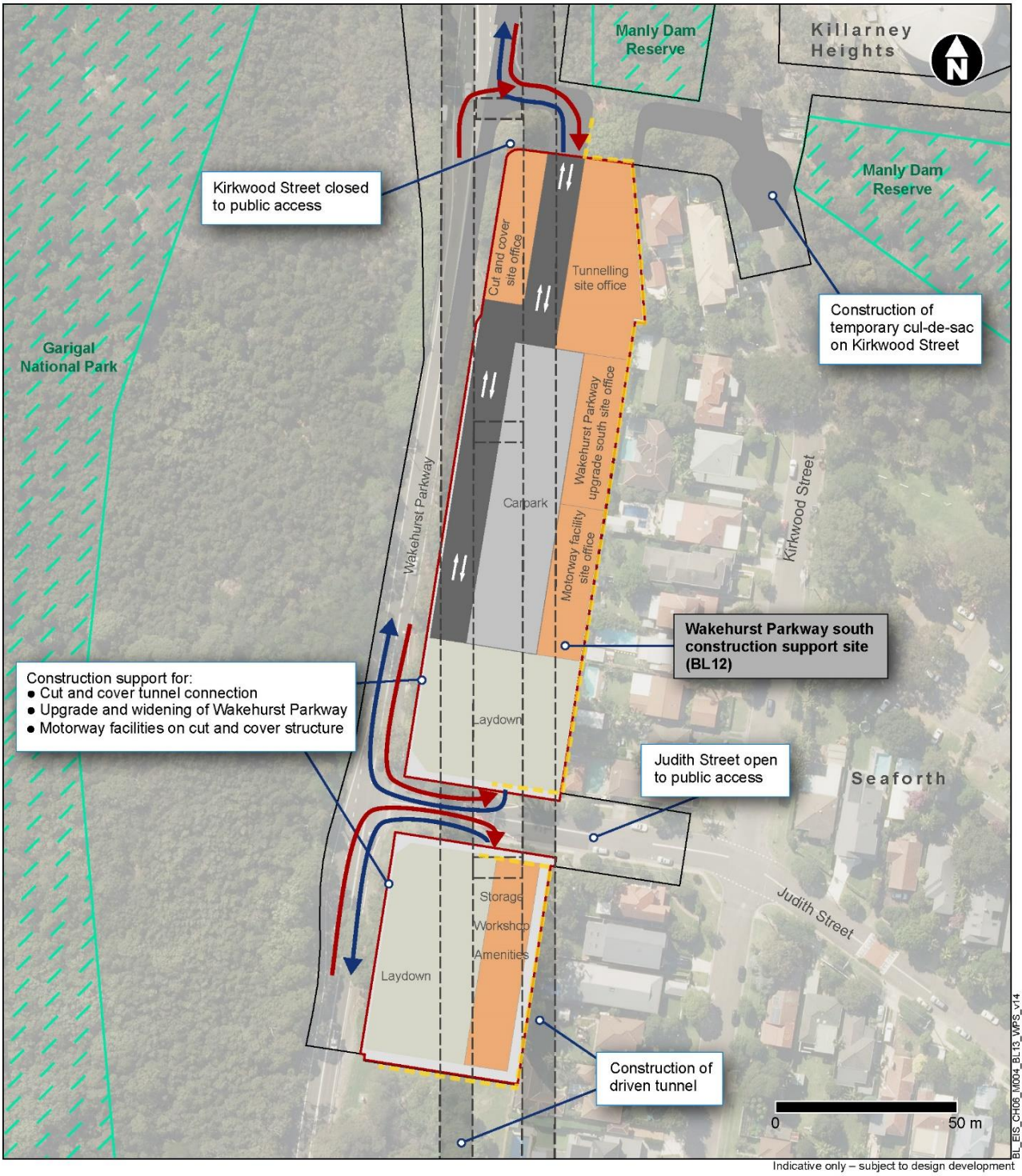



**Figure 6-40 Indicative layout – Wakehurst Parkway south construction support site (BL12)**

**Table 6-30 Wakehurst Parkway south construction support site (BL12) indicative construction program**

| Construction activity | Indicative construction program | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | | 2027 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Early works and site establishment | | | | | | | | | | | | | | | | | | | | |
| Surface road works support | | | | | | | | | | | | | | | | | | | | |
| Cut and cover and trough support | | | | | | | | | | | | | | | | | | | | |
| Motorway facilities support | | | | | | | | | | | | | | | | | | | | |
| Testing, commissioning and site rehabilitation | | | | | | | | | | | | | | | | | | | | |

### Wakehurst Parkway east (BL13)

A summary of the key features of the Wakehurst Parkway east construction support site (BL13) is included in Table 6-31. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-41. An indicative program for construction activities is provided in Table 6-32.

**Table 6-31 Key features of the Wakehurst Parkway east construction support site (BL13)**

| Key feature | Summary |
|---|---|
| Site area | 11,000 $m^2$ |
| Site description | Located on the eastern side of Wakehurst Parkway, on land within Sydney Water's Bantry Bay Reservoir site, next to the Wakehurst Parkway Golf Course. The site is mostly level and includes vegetated areas that would be cleared as part of the site establishment works.<br>Sydney Water facility operations and the on-site Telstra tower would remain operational for the duration of the construction activities on the site. Existing driveways and services crossings would be upgraded as required to suit access for heavy vehicles. |
| Key activities | The Wakehurst Parkway east construction support site (BL13) would be a tunnel support site and project management site. The site would be used for the construction of Beaches Link tunnelled ramps between the Wakehurst Parkway and the mainline tunnels beneath Seaforth.<br>Key activities that would occur on, or be supported by this site would include:<br>• Support site works including clearing and grubbing, topsoil stripping, bulk earthworks, minor retaining structures to reshape and regrade existing site<br>• Construction and operation of temporary construction facilities, including an acoustic shed, temporary noise barrier, workshop, wastewater treatment facility, air intake and staff offices and amenities, pavements and car parking<br>• Excavation of an access decline<br>• Construction of the Wakehurst Parkway tunnel ramps to mainline tunnels at Seaforth |

| Key feature | Summary |
|---|---|
| | • Treatment of wastewater from tunnelling activities<br>• Support for tunnel fitout and finishing works<br>• Utility works associated with surface works, the temporary construction site, and permanent operational infrastructure<br>• Excavation, handling and stockpiling of tunnel spoil<br>• Backfill of access decline<br>• Testing, commissioning and site rehabilitation. |
| Hours of construction | General site activities and spoil haulage would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday). No spoil haulage or surface civil works would occur on Sundays or public holidays.<br>Tunnel construction and fitout would be carried out up to 24 hours per day, seven days per week either within an acoustic shed or underground. Night time deliveries would be required to support the tunnelling activities. |
| Access arrangements | Access in and out of the site would be via a new temporary connection to the Wakehurst Parkway. |

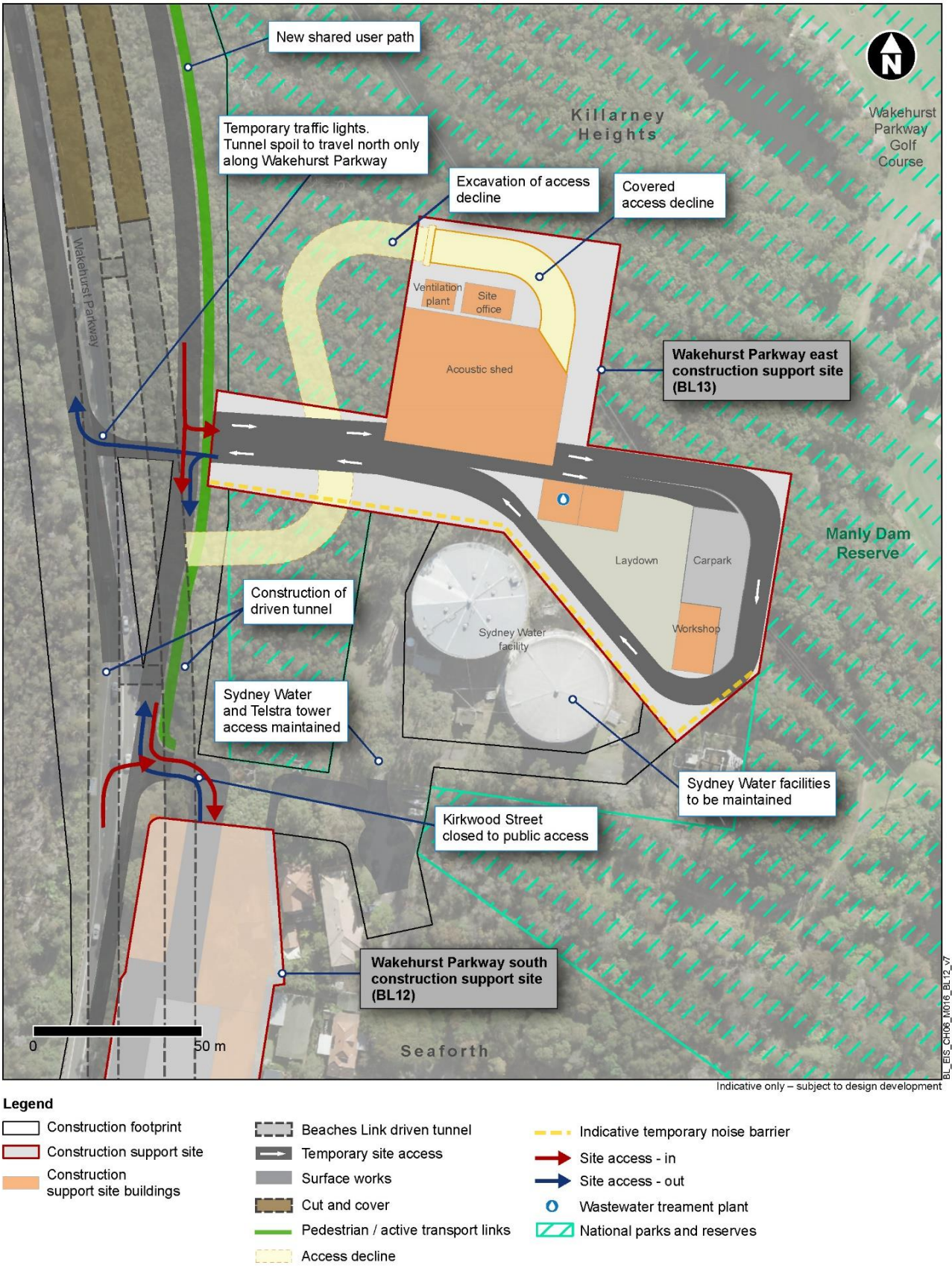



**Figure 6-41 Indicative layout – Wakehurst Parkway east construction support site (BL13)**

**Table 6-32 Wakehurst Parkway east construction support site (BL13) indicative construction program**

| Construction activity | Indicative construction program | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | | 2027 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Early works and site establishment | | | | | | | | | | | | | | | | | | | | |
| Construction of tunnel access decline | | | | | | | | | | | | | | | | | | | | |
| Tunnel construction | | | | | | | | | | | | | | | | | | | | |
| Tunnel fitout | | | | | | | | | | | | | | | | | | | | |
| Testing, commissioning and site rehabilitation | | | | | | | | | | | | | | | | | | | | |

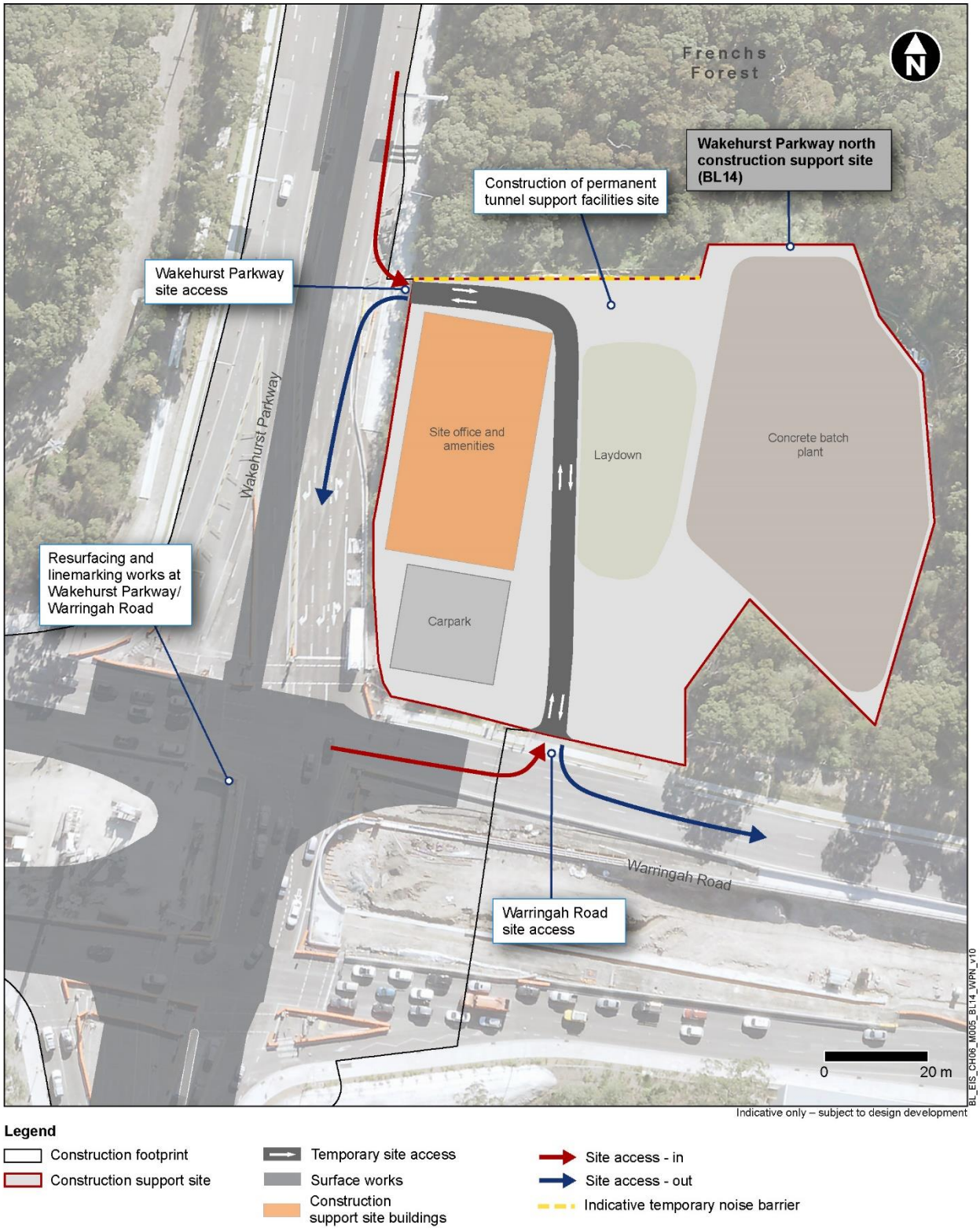
## Wakehurst Parkway north (BL14)

A summary of the key features of the Wakehurst Parkway north construction support site (BL14) is included in Table 6-33. An indicative layout for the temporary construction support site, and construction site access routes, is shown in Figure 6-42. An indicative program for construction activities is provided in Table 6-34.

**Table 6-33 Key features of the Wakehurst Parkway north construction support site (BL14)**

| Key feature | Summary |
|---|---|
| Site area | 8400 $m^2$ |
| Site description | The Wakehurst Parkway north construction support site (BL14) would be located on the north-east corner of the intersection between Wakehurst Parkway and Warringah Road at Frenchs Forest.<br>The same site was used as the main construction support site for the Northern Beaches Hospital road upgrade project, which was completed in August 2020. Revegetation works were carried out within the Northern Beaches Hospital road upgrade project's main construction support site as part of decommissioning. This included planting with species consistent with the Duffys Forest endangered ecological community within the eastern section of the decommissioned construction support site.<br>During site establishment of the Wakehurst Parkway north construction support site (BL14), this revegetated area would remain fenced off and protected from disturbance. Due to the timing of these recent revegetation works, the current site layout of Wakehurst Parkway north construction support site (BL14) does not show the revegetation area. During further design development and construction planning, the temporary construction support site layout would be refined to show the revegetation area, and ensure it is avoided and protected during construction. |

| Key feature | Summary |
|---|---|
| Key activities | Key activities that would occur on, or be supported by this site would include:<br>• Construction and operation of temporary construction facilities, including a temporary noise barrier, workshop, staff offices and amenities, pavements and car parking and concrete batch plant<br>• Construction works for Wakehurst Parkway surface road works, minor intersection works at Wakehurst Parkway/Warringah Road and Wakehurst Parkway/Frenchs Forest Road East and construction of the permanent tunnel support facilities. |
| Hours of construction | General site activities would be carried out during standard construction hours (7am to 6pm Monday to Friday, 8am to 1pm Saturday and no construction works on Sundays or public holidays). Occasional night time deliveries to the site may be required.<br>This site would support occasional night staging works that are necessary for upgrading Wakehurst Parkway between Seaforth and Warringah Road at Frenchs Forest. |
| Access arrangements | Access in and out of the site would be via Warringah Road. Access from the site would also be provided onto Wakehurst Parkway. |




Note: The indicative layout does not show the revegetation area associated with the recent demobilisation of the Northern Beaches Hospital road upgrade project. During further design development and construction planning, the temporary construction support site layout would be refined to ensure the revegetated area is avoided and protected.

**Figure 6-42 Indicative layout – Wakehurst Parkway north construction support site (BL14)**

**Table 6-34 Wakehurst Parkway north construction support site (BL14) indicative construction program**

| Construction activity | Indicative construction program | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2023 | | | | 2024 | | | | 2025 | | | | 2026 | | | | 2027 | | | |
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Early works and site establishment | | | | | | | | | | | | | | | | | | | | |
| Surface road works | | | | | | | | | | | | | | | | | | | | |
| Construction of operational facilities | | | | | | | | | | | | | | | | | | | | |
| Testing, commissioning and site rehabilitation | | | | | | | | | | | | | | | | | | | | |

## 6.9 Construction management and resources

### 6.9.1 Construction workforce and hours

#### Construction workforce

The project would be expected to support up to 7500 full time equivalent jobs (direct employment) during the five to six years of construction. About 2350 full time equivalent jobs (2000 for Beaches Link and 350 for the Gore Hill Freeway Connection) would be expected to be supported during peak construction.

#### Construction work hours

Construction work hours required for the project would generally fall within the following categories:

- Early works and site establishment
- Tunnelling, tunnelling support and underground activities
- Construction traffic for material supply and spoil movement
- Surface construction activities (not covered by the other categories)
- Blasting and rock breaking
- Other activities.

The proposed construction hours for various construction activities are provided in Table 6-35. Standard construction hours from the *NSW Interim Construction Noise Guideline* (DECC, 2009a) are:

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturday
- No construction works on Sundays or public holidays.

Recent planning approval conditions for State significant infrastructure projects have included an extension to standard construction hours on Saturdays, allowing certain activities to be carried out until 6pm. This approval condition has been provided on other major infrastructure projects such as Sydney Gateway, M6 Motorway (Stage 1) and WestConnex M4-M5 Link. Should the project construction contractor elect to use this additional allowance on Saturdays to shorten the construction program and reduce the overall duration of impacts to amenity, site specific construction noise and vibration impact statements prepared for the project will assess any associated noise impacts and adopt appropriate noise mitigation measures accordingly.

Out of hours works would be carried out in specific circumstances at any time, subject to individual requirements for safety and public infrastructure operational reasons (ie to minimise traffic disruptions). Specific management measures would be developed for each relevant activity or

group of activities to manage potential impacts on sensitive receivers (refer to Chapter 10 (Construction noise and vibration) for further details on management of out of hours work). This would include use of respite periods.

Table 6-36 to Table 6-38 provides the proposed out of hours work, locations and an indicative duration of the work outside standard construction hours required. The indicative duration may change as the further construction planning.

Indicative timeframes for construction activities are provided in Table 6-35. The proposed construction hours at each of the temporary construction support sites are summarised in Section 6.8.

**Table 6-35 Proposed construction hours**

| Activity | Construction hours | Comments or exceptions |
|---|---|---|
| Early works and site establishment | Standard construction hours and works outside of standard construction hours | Works that require lane occupancy or are immediately adjacent to live traffic would be required outside of standard construction hours to minimise impacts to road users and for the safety of both construction personnel and the public. |
| **Tunnelling, tunnelling support and underground activities** | | |
| Underground tunnel excavation and tunnel fitout | Up to 24 hours per day, seven days per week | Tunnelling using roadheaders would occur 24 hours per day, seven days a week, due to each excavation cycle taking around eight to 10 hours (dependent on geological conditions). Once complete, newly excavated sections need to be supported immediately to ensure the tunnel is stable and minimise any potential ground movement. This work cannot be completed entirely during a work shift in standard construction hours.<br>Some other tunnel excavation activities using rock hammers might also need to occur outside standard construction hours for the above reasons. |
| Surface-based support of underground tunnelling, activities and tunnel fitout | Up to 24 hours per day, seven days per week | Surface-based activities at temporary construction support sites are typically required to support underground tunnelling and tunnel fitout. The support activities would need to occur 24 hours per day, seven days per week when tunnelling and tunnel fitout are occurring.<br>Spoil handling outside of standard construction hours at the surface would be carried out within acoustic sheds at tunnel temporary construction support sites. |
| Dewatering of cofferdams during construction and filling | Standard construction hours and outside | Dewatering required to create a relatively dry and safe environment to allow the construction of the interface structures. |

| Activity | Construction hours | Comments or exceptions |
|---|---|---|
| of cofferdams during removal | standard construction hours | Pump operation is not expected to generate noise in excess of the applicable noise management level at any sensitive receiver. |
| Dredging and excavation of the bed of the harbour, and barge movements for associated marine spoil transportation | Standard construction hours | Dredging works would be carried out during daytime hours. Some transport by barge to the designated offshore disposal site may take place outside standard construction hours. |
| Piling works in Middle Harbour | Standard construction hours | Required for construction of the cofferdams and at the temporary mooring facility east of Clive Park in Middle Harbour.<br>Impact piling in Middle Harbour would only take place one to two hours per day or five to six hours on a single day per week. |
| Barge movements for transport of immersed tube tunnel units | Standard construction hours and works outside of standard construction hours, for discrete periods | Barges to transport immersed tube tunnel units from the casting facility at the Spit West Reserve construction support site (BL9) to a temporary mooring east of Clive Park in Middle Harbour. |
| Immersed tube tunnel installation | Standard construction hours and works outside of standard construction hours, for discrete periods | Carried out during closures of Middle Harbour at the crossing location. Likely four partial closures (for outer units) and two full closures (for middle units), each for a continuous period for around 24 to 48 hours. |
| Fabrication of tunnel tube units | Standard construction hours and works outside standard construction hours for discrete periods | Fabrication of concrete tunnel units would typically occur during standard construction hours. However, some concrete pours might need to continue into the evening period where required to ensure appropriate concrete curing and the structural integrity of the fabricated concrete unit. |
| **Construction traffic for material supply and spoil removal** | | |
| Construction traffic for material deliveries and spoil removal | Standard construction hours | Spoil haulage would be carried out during standard construction hours.<br>Some deliveries to and from the temporary construction support sites would be required outside of standard construction hours. |

| Activity | Construction hours | Comments or exceptions |
|---|---|---|
| **Surface construction activities** | | |
| Cut and cover, trough structures and bridgeworks | Standard construction hours and works outside of standard construction hours | These works would generally be scheduled during standard construction hours wherever feasible and reasonable.<br>Works that require lane occupancy or are immediately adjacent to or above live traffic areas (eg bridge demolition and girder lifts) would be required outside standard construction hours to minimise potential disruption to the road network and to minimise potential safety risks to road users, construction personnel and the public |
| Demolition and surface construction activities including major surface road upgrades (including major traffic switches), infrastructure construction and utility relocations. | Standard construction hours and works outside of standard construction hours | Non-disruptive (low noise intensive) preparatory work, repairs or maintenance that does not generate noise in excess of the applicable noise management level at any sensitive receiver would be carried out outside standard construction hours.<br>Works that require lane occupancy, are immediately adjacent to live traffic or involve substantial changes to lane configurations and traffic management arrangements would be carried out outside of standard construction hours to minimise impacts to road users as well as to ensure the safety of both construction personnel and the public. Key locations include:<br>• Warringah Freeway<br>• Gore Hill Freeway<br>• Pacific Highway (near Dickson Avenue at Artarmon)<br>• Flat Rock Drive<br>• Burnt Bridge Creek Deviation and Sydney Road. |

| Activity | Construction hours | Comments or exceptions |
|---|---|---|
| **Blasting and rock breaking** | | |
| Controlled blasting (underground and surface based along Wakehurst Parkway) | 9am to 5pm Monday to Friday<br>9am to 1pm Saturdays<br>No blasting on Sundays or public holidays | Controlled blasting may be used for cross passage excavation and bench removal in mainline and ramp tunnels, and excavation and surface works along Wakehurst Parkway (refer to Section 10.6.15).<br>Controlled blasting might also be adopted along Wakehurst Parkway to minimise the duration over which traditional excavation methods for rock (eg rock hammers) would be required. |
| Rock breaking and other high impact noise activities | Standard construction hours, and outside of standard construction hours | Respite periods described in *Construction Noise and Vibration Guideline* (Roads and Maritime Services, 2016) would be provided and scheduled.<br>Rock breaking and other high impact noise activities that require lane occupancy or are immediately adjacent to live traffic would be required outside of standard construction hours to minimise impacts to road users as well as to ensure the safety of both construction personnel and the public |
| **Other activities** | | |
| Minor activities | At any time | Includes activities that do not generate noise in excess of the applicable noise management level at any noise sensitive receiver. |
| Works that require road occupancy licences | At any time (typically outside standard construction hours) | Works on busy roads typically must occur under a road occupancy licence issued by the Transport Management Centre. Road occupancy licences specify the allowable working hours and typically require the road works to occur outside standard construction hours when traffic volumes are low. Road occupancy licences can also require works to occur over multiple consecutive nights. |
| Activities authorised by an environment protection licence | As specified in the environment protection licence (can include works outside standard construction hours) | Construction activities would be managed as required by an environment protection licence issued by the NSW Environment Protection Authority. |
| Emergency or directed activities | At any time | Activities carried out if required to prevent an imminent injury, loss of life or environmental damage. |

**Table 6-36 Surface road works – works outside standard construction hours**

| Work area | Indicative duration | Indicative percentage of work days on which work outside standard construction hours required |
|---|---|---|
| Warringah Freeway surface road works and associated use of Cammeray Golf Course construction support site (BL1) | 1 year 6 months | 10% |
| Gore Hill Freeway Connection surface road works and associated use of Dickson Avenue (BL4), Barton Road (BL5) and Gore Hill Freeway median (BL6) construction support sites | 4 years | 10% |
| Upgrade of Pacific Highway/Dickson Avenue intersection and surface road works and associated use of Dickson Avenue construction support site (BL4) | 3 months | 30% |
| Balgowlah surface road works and associated use of Balgowlah Golf Course construction support site (BL10) | 3 years | 10% |
| Wakehurst Parkway surface road works and associated use of Wakehurst Parkway south (BL12) and Wakehurst Parkway north (BL14) construction support sites | 3 years 3 months | 10% |
| Widening of Flat Rock Drive and associated use of Flat Rock Drive construction support site (BL2) | 6 months | 30% |
| Create site access for Wakehurst Parkway east construction support (BL13) and road/intersection modification during site establishment | 6 months | 10% |

**Table 6-37 Middle Harbour crossing – works outside standard construction hours**

| Activity | Indicative duration | Indicative works outside standard construction hours |
|---|---|---|
| Dewater cofferdams | 1 year 9 months | Continuous pump operation is required during initial dewatering of each cofferdam and then as required once dewatered. |
| Cast and fitout of immersed tube tunnel units at Spit West Reserve construction support site (BL9) | 1 year 6 months | Occasional concrete pours would extend into evening period depending on technical and quality requirements. |
| Installation of immersed tube tunnel units and associated use Spit West Reserve construction support site (BL9) | 9 months | One continual work period of around 48 hours is required for the immersion of each of the six tunnel units. Use of Spit West Reserve construction support site (BL9) outside standard construction hours would be required to provide support each time. |
| Decommissioning and refill of cofferdams | 6 months | Continuous pump operation during to refill of each cofferdam is required prior to commencement of cofferdam removal. |

**Table 6-38 Surface-based support of underground tunnelling and tunnel fitout activities outside standard construction hours**

| Temporary construction support site | Indicative duration | Indicative works outside standard construction hours |
|---|---|---|
| Cammeray golf course construction support site (BL1) | 2 years | Low noise impact activities 24 hours per day, seven days a week while underground tunnel activities are occurring. |
| Flat Rock Drive construction support site (BL2) | 3 years 9 months | Low noise impact activities 24 hours per day, seven days a week during underground tunnel activities are occurring. |
| Punch Street construction support site (BL3) | 2. years 6 months | Low noise impact activities 24 hours per day, seven days a week during underground tunnel activities are occurring. |
| Balgowlah Golf Course construction support site (BL10) | 3 years 9 months | Low noise impact activities 24 hours per day, seven days a week during underground tunnel activities are occurring. |
| Wakehurst Parkway east (BL13) construction support site | 3 years 3 months | Low noise impact activities 24 hours per day, seven days a week during underground tunnel activities are occurring. |

## 6.9.2 Traffic management and access

### Road transport

The construction of the project would be subject to comprehensive traffic management measures to ensure the ongoing functionality of surrounding roads, and the safety of members of the public, motorists and construction personnel.

A number of stages of traffic management and traffic switches would be required around the tunnel connections and for Wakehurst Parkway surface road works to facilitate the construction of the on and off ramps and tie-ins to arterial and local roads. Traffic staging at the Gore Hill Freeway Connection would be fundamental to enable access for surface works to be carried out and is likely to require works outside of standard construction hours. Signage would be installed for road closures or detours, where required, to facilitate traffic movement.

Controlled blasting may be required along sections of the Wakehurst Parkway. Controlled blasts would not take place during peak hour traffic periods and not on Sundays or public holidays. Traffic near the area would be stopped while the controlled blast is initiated and delays of up to 10 minutes may be experienced. Traffic control measures and advanced signage would be in place to notify vehicles using Wakehurst Parkway of any proposed controlled blasting.

The project would also necessitate the temporary alteration of pedestrian and cyclist facilities, although alternative access arrangements would be implemented around construction sites and access points. Appropriate detour routes would be established, utilising existing cycle routes and paths where feasible.

The proposed access points to and from the temporary construction support sites are described in Section 6.8 and shown in figures for each temporary construction support site. Where possible, site access points have been configured to provide access directly to and from arterial roads.

Over-size and over-mass vehicles would be required for the delivery and removal of large plant and equipment on discrete occasions. There would be a higher proportion of these movements during site establishment and site closure, as large plant and equipment (such as roadheaders) are moved to and from site respectively.

Peak construction daily light vehicle and heavy vehicle numbers associated with spoil and waste removal, material deliveries and arrival and departure of construction works are summarised in Table 6-39.

Potential traffic and transport impacts from the construction of the project, and measures which address these impacts, is provided in Chapter 8 (Construction traffic and transport).

**Table 6-39 Peak construction vehicle movement and access**

| Site | Proposed access route | Daily heavy vehicle movements[1] | Daily light vehicle movements | Construction vehicle movements during AM peak hours (6am to 10am) | | Construction vehicle movements during PM peak hours (3pm to 7pm) | |
|---|---|---|---|---|---|---|---|
| | | | | Heavy vehicles | Light vehicles | Heavy vehicles | Light vehicles |
| Cammeray Golf Course (BL1) | Warringah Freeway<br>Ernest Street | 275 | 305 | 72 | 99 | 73 | 142 |
| Flat Rock Drive (BL2) | Flat Rock Drive | 545 | 355 | 145 | 165 | 146 | 136 |
| Punch Street (BL3) | Cleg Street<br>Punch Street<br>Gore Hill Freeway | 370 | 580 | 110 | 222 | 87 | 203 |
| Dickson Avenue (BL4) | Dickson Avenue | 90 | 500 | 40 | 160 | 8 | 132 |
| Barton Road (BL5) | Reserve Road | 35 | 120 | 5 | 45 | 10 | 45 |
| Gore Hill Freeway median (BL6) | Gore Hill Freeway<br>Epping Road | 10 | 100 | 2 | 20 | 0 | 21 |
| Spit West Reserve (BL9) | Spit Road | 220 | 200 | 60 | 71 | 60 | 86 |
| Balgowlah Golf Course (BL10) | Burnt Bridge Creek Deviation<br>Sydney Road | 495 | 1195 | 149 | 429 | 119 | 460 |
| Kitchener Street (BL11) | Burnt Bridge Creek Deviation | 10 | 65 | 2 | 27 | 2 | 25 |
| Wakehurst Parkway south (BL12) | Judith Street<br>Kirkwood Street | 15 | 285 | 6 | 119 | 1 | 102 |

| Site | Proposed access route | Daily heavy vehicle movements[1] | Daily light vehicle movements | Construction vehicle movements during AM peak hours (6am to 10am) | | Construction vehicle movements during PM peak hours (3pm to 7pm) | |
|---|---|---|---|---|---|---|---|
| | | | | Heavy vehicles | Light vehicles | Heavy vehicles | Light vehicles |
| Wakehurst Parkway east (BL13) | Wakehurst Parkway | 275 | 305 | 72 | 99 | 73 | 142 |
| Wakehurst Parkway north (BL14) | Warringah Road<br>Wakehurst Parkway | 95 | 180 | 29 | 58 | 26 | 52 |

Note 1: Vehicle movements are each way (ie a heavy/light vehicle arriving at a site and leaving a site counts as two movements).

### Construction workforce car parking

A portion of the project's labour force would be required to drive and park at temporary construction support sites. The numbers of construction personnel requiring parking would vary over the duration of the construction program.

Due to the generally constrained nature of temporary construction support sites, only limited car parking for construction workers would be available on site. Car parking areas would be provided at the following temporary construction support sites:

- Cammeray Golf Course (BL1)
- Flat Rock Drive (BL2)
- Punch Street (BL3)
- Dickson Avenue (BL4)
- Barton Road (BL5)
- Spit West Reserve (BL9)
- Balgowlah Golf Course (BL10)
- Kitchener Street (BL11)
- Wakehurst Parkway south (BL12)
- Wakehurst Parkway east (BL13)
- Wakehurst Parkway north (BL14).

The number of car parking spaces at the above temporary construction support sites would be determined during construction planning. Shuttle bus transfers between temporary construction support sites would also be provided, where required.

The construction workforce would be encouraged to use public transport (except where construction personnel are required to travel to site with construction-related tools and equipment). The public transport provisions available near the project to provide access to temporary construction support sites include:

- Military Road/Spit Road, the Pacific Highway, Epping Road, Eastern Valley Way, Frenchs Forest Road, Warringah Road and Condamine Street/Pittwater Road are key bus corridors near the project with multiple bus routes that would provide access to temporary construction support sites along the project
- Artarmon Station and North Sydney Station on the Sydney Trains suburban train network would provide access to construction sites around Artarmon and Cammeray respectively.

Measures to manage any potential parking impacts during construction are discussed in Chapter 8 (Construction traffic and transport).

### Property access

At locations where temporary and/or permanent road closures are required, access to properties would be maintained or alternative arrangements made in agreement with the affected stakeholder(s). For further details on property impacts refer to Chapter 20 (Land use and property).

### Marine transport

Marine construction vessels would be required during construction. Figure 6-43 shows the main routes which would be used during construction. Table 6-40 details the indicative type and number of marine transport and construction vessels likely to be used during construction. Refer to Chapter 8 (Construction traffic and transport) for discussion on maritime navigation during construction.

**Table 6-40 Marine-based construction vessel movements**

| Site | Indicative vessel movements per day at peak |
|---|---|
| Between Spit West Reserve construction support site (BL9) and Middle Harbour south (BL7) and Middle Harbour north (BL8) cofferdams | • Twelve small boats movements for transporting construction workforce<br>• Four barge movements for support of cofferdam dredging, piling and tube tunnel immersion<br>• Three barge movements for disposal of dredged material to sea<br>• 48 barge movements for concrete deliveries. |

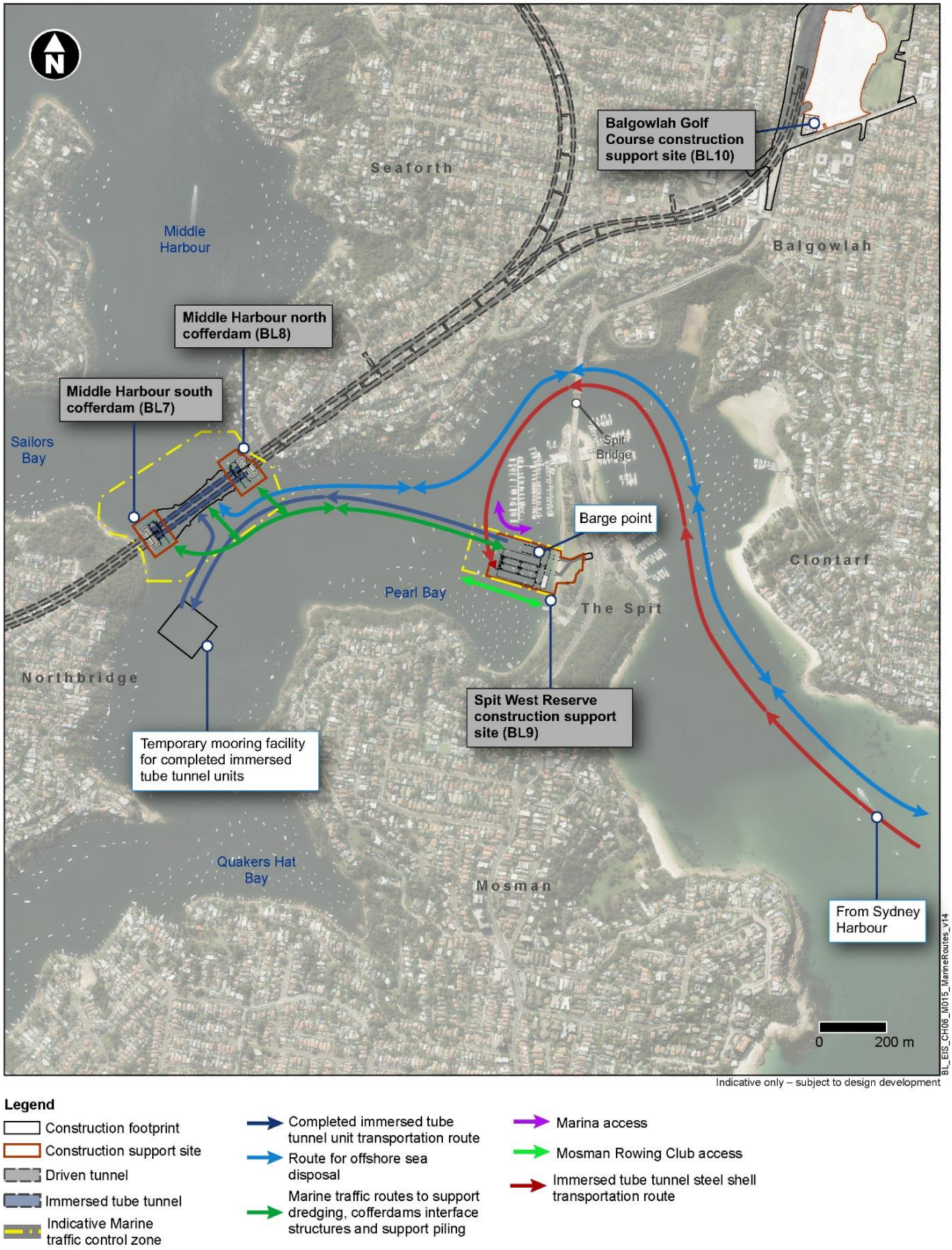



**Figure 6-43 Marine transport and construction vessel routes in Middle Harbour**

### 6.9.3 Construction plant and equipment

The plant and equipment listed in Table 6-41 are likely to be used during construction of the project. The final list of plant and equipment required for each construction activity would depend on the final construction methodology developed by the construction contractor.

**Table 6-41 Indicative construction plant and equipment**

| Plant and equipment | Early works | Site establishment | Construction of driven tunnels | Installation of immersed tube tunnels | Construction of operational facilities | Tunnel fitout and finishing works | Surface road works | Testing, commissioning and demobilisation |
|---|---|---|---|---|---|---|---|---|
| Vacuum truck | X | | | | | | X | |
| Grader, excavator, excavator with rock hammer | X | X | X | X | X | | X | |
| Bulldozer | | X | | | | | X | |
| Backhoe, bobcat, front end loader | X | X | X | | X | X | X | X |
| Chainsaw[1] | | X | | | | | X | |
| Grinder, mulcher[1] | | X | | | | | X | X |
| Forklift | | X | X | | | X | | |
| Elevated work platform, scissor lift | | X | | X | X | X | X | X |
| Light tower[2] | | | | X | | | X | |
| Mobile crane[2] | X | X | X | X | X | X | X | X |
| Light vehicle | X | X | X | X | X | X | X | X |
| Dump truck, cement delivery truck, concrete agitator | X | X | X | X | X | X | X | X |
| Truck | X | X | X | | X | X | X | X |
| Linemarking truck | | X | | | | | X | |
| Pavement laying machine | | X | | | | X | X | |
| Vibratory roller, compactor | | X | | | | | X | |
| Power generator | | | | X | X | X | X | X |
| Compressor | | X | X | X | X | | X | |
| Jackhammer[1] | | | | X | | X | X | |
| Rock crusher[1] | | | | | | | X | |

| Plant and equipment | Early works | Site establishment | Construction of driven tunnels | Installation of immersed tube tunnels | Construction of operational facilities | Tunnel fitout and finishing works | Surface road works | Testing, commissioning and demobilisation |
|---|---|---|---|---|---|---|---|---|
| Concrete saw[1] | X | | | | | X | X | |
| Concrete pump, concrete vibrator | | X | X | X | X | X | X | |
| Concrete batch plant | | | X | X | X | X | X | |
| Hand tools, welding equipment | X | X | X | X | X | X | X | X |
| Piling rig (bored)[1] | | X | X | | X | | X | |
| Piling rig (impact)[1] | | | | X | | | X | |
| Drilling machine (diesel) | | | X | | | | | |
| Pneumatic hammer/vibrator[1] | | | X | | | X | | |
| Shotcrete rig | | | X | | | | X | |
| Air track drilling rig[1] | | | X | | | | X | |
| Roadheader | | | X | | | | | |
| Dust scrubber | | | X | | | | | |
| Ventilation fan | | X | X | | | | | |
| Water cart | | X | | | | X | X | X |
| Road sweeper | | | X | | | X | X | X |
| Barge, small boat, tugboat | | | X | X | | | | |
| Flat top barge | | | | X | | | | |
| Mooring pontoon | | | | X | | | | |
| Dredging equipment | | | | X | | | | |

Note 1: Refers to high noise generating equipment

Note 2: Refers to plant and equipment likely to generate a visual impact

### 6.9.4 Construction resources and waste management

#### Construction resource use

Construction would require various resources and materials. The main construction materials required would include:

- General fill and select fill for earthworks (sourced from within the project cutting and from tunnel spoil where the material is available and of suitable quality)
- Pavement materials, cement, concrete and steel reinforcement

- Materials for lining drainage channels
- Aggregate used for concrete and asphalt
- Water
- Pre-cast concrete including pipes, culvert segments, bridge elements, retaining wall elements and roadside barriers
- Structural steel
- Plastics used for drainage, piping and conduits
- Pre-fabricated steel and road furniture units
- Wood for use in formwork and other temporary structures.

Construction material would generally be sourced from off-site suppliers. Where reasonable and feasible, local sources of construction materials would be preferred to minimise haulage distances.

Indicative quantities of the main sources of materials required for construction are provided in Chapter 24 (Resource use and waste management).

### Construction power requirements

Power supply would be required during the construction works at the majority of temporary construction support sites. In particular, high voltage power would be required at the tunnel support sites. Prior to the connection of mains power supply to the tunnel support sites, roadheaders may be powered by diesel generators.

The power supply for each site would be sourced from outside the project area. The power supply requirements for temporary construction support sites is described in Chapter 24 (Resource use and waste management). Potential supply source, supply route and power demand is described in Appendix D (Utilities management strategy).

### Construction water requirements

Tunnelling works would require substantial volumes of water for excavation and would generate wastewater requiring treatment and disposal.

Construction water supply would also be required for tunnel connection construction and surface activities, including earthworks, concreting, building construction and dust suppression. Additional information about construction water requirements is provided in Chapter 24 (Resource use and waste management).

Suitable connections for water discharge from wastewater treatment plants at temporary construction support sites would be required at:

- Cammeray Golf Course (BL1) – to Willoughby Creek
- Flat Rock Drive (BL2) – to a drainage pit on Flat Rock Drive then to Flat Rock Creek
- Punch Street (BL3) – to Flat Rock Creek near Station Street at Artarmon
- Balgowlah Golf Course (BL10) – to Burnt Bridge Creek
- Wakehurst Parkway east (BL13) – to a drainage channel to be formed at the eastern section of the site (which would drain towards a Wakehurst Golf course dam for reuse by the golf course).

Further details are provided in Chapter 17 (Hydrodynamics and water quality).

### Spoil and waste management

The project is estimated to generate a substantial volume of spoil from tunnelling, surface works, and dredging operations. Spoil generation and dredged material from each temporary construction support site is provided in Chapter 24 (Resource use and waste management).

Excess spoil that cannot be reused within the project would require offsite disposal. The final destination(s) for excess spoil from construction of the project would be planned prior to construction commencing.

The majority of the spoil generated by the project would be virgin excavated natural material (VENM) – typically consisting of crushed sandstone and shale. VENM is generally considered a desirable material for clean and stable fill in development sites and major earthworks projects across Greater Sydney. Recent examples include the use of crushed sandstone from Sydney Metro to construct runway pavements for the new Western Sydney Airport, and reuse of crushed sandstone from the WestConnex tunnels for numerous development projects.

An application for offshore disposal of suitable dredged material will be submitted to the Australian Government Department of the Agriculture, Water and the Environment under the *Environment Protection (Sea Dumping) Act 1981*. It is proposed that suitable dredged material would be transported by barge and disposed of at a designated offshore disposal site (in accordance with legislative requirements). These sites have been carefully selected by the Commonwealth to provide suitable disposal grounds for dredge material and minimise impacts on sensitive marine ecology. The designated offshore disposal site is over 20 square-kilometres in area and is a non-dispersive ground, meaning that material placed within the area generally does not migrate from that area. Any material not suitable for offshore disposal would be barged to a loadout facility for treatment to be made spadable and then loaded onto trucks and disposed of at a suitably licensed land-based facility and classified according to the NSW Environment Protection Authority's *Waste Classification Guidelines* (NSW EPA, 2014a).

Any contaminated material disturbed during construction would be separated from uncontaminated material on site to prevent cross contamination. Contaminated material would be encapsulated on site where appropriate, and in accordance with relevant regulatory requirements. Any material that is not suitable for encapsulation would be loaded into sealed and covered trucks for disposal at a suitably licensed facility. Further site investigations during the further design development and construction planning phases would inform contamination management including determining where encapsulation is appropriate. Other waste streams which would be generated during construction include:

- Demolition waste from existing structures and properties
- General construction waste such as concrete, steel and timber formwork off-cuts
- Vegetation waste from clearing and grubbing
- Plant and vehicle maintenance waste such as oils and lubricants
- General office waste such as paper, cardboard, plastics and food waste
- Sewage waste.

Further details are provided in Chapter 24 (Resource use and waste management) including potential opportunities for reuse.

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# Beaches Link and Gore Hill Freeway Connection

## Chapter 7

## Stakeholder and community engagement

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# 7 Stakeholder and community engagement

This chapter provides an overview of the stakeholder and community engagement activities carried out during the project's development and during the preparation of this environmental impact statement. An overview of engagement and consultation tools which would be used to support the public exhibition of this environmental impact statement and during delivery of the project is also provided.

The Secretary's environmental assessment requirements as they relate to stakeholder and community engagement, and where in the environmental impact statement they have been addressed, are detailed in Table 7-1.

**Table 7-1 Secretary's environmental assessment requirements – Stakeholder and community engagement**

| Secretary's requirement | Where addressed in EIS |
|---|---|
| **Consultation** | |
| 1. The project must be informed by consultation, including with relevant local, State and Commonwealth government agencies (including the Harbour Master where disturbance of seabeds, shipping channel closures or marine movement of materials/spoil are proposed), infrastructure and service providers, special interest groups (including Local Aboriginal Land Councils, Aboriginal stakeholders, and pedestrian and bicycle user groups), affected landowners, businesses and the community. | A summary of consultation carried out to date is provided in **Section 7.1** and **Section 7.2**.<br>A summary of feedback received is provided in **Section 7.3**.<br>A summary of project refinements in response to feedback is provided in **Section 7.4**. Project refinements have also been considered in **Chapter 5** (Project description). |
| 2. The Proponent must document the consultation process, and demonstrate how the program has responded to the inputs received. | The consultation process is documented in **Section 7.1** and **Section 7.2**.<br>A summary of the feedback received and how the feedback has been addressed is provided in **Section 7.3**. A summary of project refinements in response to feedback is also provided in **Section 7.4**.<br>Project refinements have also been considered in **Chapter 5** (Project description). |
| 3. The Proponent must describe the timing and type of community consultation proposed during the design and delivery of the project, the mechanisms for community feedback, the mechanisms for keeping the community informed, and procedures for complaints handling and resolution. | The engagement timeline is provided in **Section 7.1.2**. Ongoing and future engagement for the project is outlined in **Section 7.5**.<br>A detailed Community communication strategy would be developed and implemented during delivery of the project. This would be based on the community consultation framework provided in **Appendix E** (Community consultation framework).<br>Mechanisms for distributing information and seeking feedback, and procedures for complaints handling and resolution are provided in |

| Secretary's requirement | Where addressed in EIS |
|---|---|
| | **Appendix E** (Community consultation framework). |
| 4. The Proponent must assess the potential for complaint fatigue to occur during construction of the project and describe how mitigation measures, complaint handling procedures and community consultation mechanisms will mitigate complaint fatigue.<br>The assessment must consider the cumulative impacts from the program and other major projects in the area. | The potential for complaint fatigue to occur and proposed mitigation measures are described in **Section 7.5**. Complaint handling procedures are outlined in **Appendix E** (Community consultation framework).<br>Potential cumulative impacts from the project are considered in **Chapter 27** (Cumulative impacts). |
| **Socio-economic, Land Use and Property** | |
| 6. A draft Community Consultation Framework must be prepared identifying relevant stakeholders, procedures for distributing information and receiving/responding to feedback and procedures for resolving stakeholder and community complaints during construction and operation. Key issues that must be addressed in the draft Framework include, but are not limited to:<br>a. traffic management (including property access, pedestrian access);<br>b. landscaping/urban design matters;<br>c. construction activities including out of hours work; and<br>d. noise and vibration mitigation and management. | A Community consultation framework is provided in **Appendix E**.<br>The content of the framework is summarised in **Section 7.5**. |

## 7.1 Engagement and consultation process

Consultation forms a key component of engagement. For the purpose of this document, the definitions of consultation and engagement are provided in Table 7-2 in line with International Association of Public Participation definitions.

**Table 7-2 Engagement and consultation definitions**

| Term | Definition |
|---|---|
| Engagement | In this document, engagement refers to any type of interaction with the community or stakeholders and is also used to refer to the community and stakeholder engagement program holistically. Engagement includes communication, consultation, notification and education. |
| Consultation | In this document, consultation refers to the level of engagement of a specific activity. Specifically where the term consultation has been used, this describes the process where the aim of the engagement is to obtain public and community feedback on a matter and use this information for project development. |

### 7.1.1 Engagement objectives and strategy

The engagement process aims to provide opportunities for community and stakeholder involvement throughout all phases of the project. To achieve this, the following engagement objectives have been applied:

- Provide clear, consistent and timely information about the project to stakeholders and the community
- Provide communications in a variety of mediums
- Promote and raise awareness of the project and engagement activities being carried out
- Foster and develop positive and meaningful relationships with stakeholders and the community
- Identify opportunities for community and stakeholder groups to be proactively involved in the project
- Collaborate with the community and stakeholders to help shape the design of the project at each key development phase
- Address and respond to community and stakeholder issues raised in a timely and transparent manner
- Use lessons learnt from other major infrastructure projects to improve on community and stakeholder engagement
- Meet the statutory requirements for consultation under the *Environment Planning and Assessment Act 1979*
- Meet the Secretary's environmental assessment requirements.

Community and stakeholder engagement has been an integral component in the development of the project and the Western Harbour Tunnel and Beaches Link program of works more widely. The engagement process has proactively informed and engaged stakeholders and community members during project development. This approach aimed to increase public understanding of the project, encourage participation in the development process, and promote the benefits of the project to local communities and stakeholders. The project has benefited from the input of local knowledge, insight, experience, goals and priorities and learnings from other major infrastructure projects, which has helped to identify issues, potential mitigation strategies and opportunities to improve project outcomes.

### 7.1.2 Engagement timeline

Engagement for the Beaches Link and Gore Hill Freeway Connection project was carried out by Transport for NSW as part of the engagement process for the wider Western Harbour Tunnel and Beaches Link program of works. Engagement with key government and other project stakeholders, including Port Authority of NSW, Sydney Metro, Infrastructure NSW, Greater Sydney Operations (including Transport Management Centre and Sydney Coordination Office) (within Transport for NSW) and Northern Beaches B-Line, has occurred since early 2016 to help shape the design and plan investigations. Engagement with the community and broader stakeholders commenced in March 2017 and has continued through to the preparation of this environmental impact statement.

Community and stakeholder engagement has been carried out in accordance with the Secretary's environmental assessment requirements. A summary of the community and stakeholder engagement process and timeline for the project is shown in Figure 7-1.

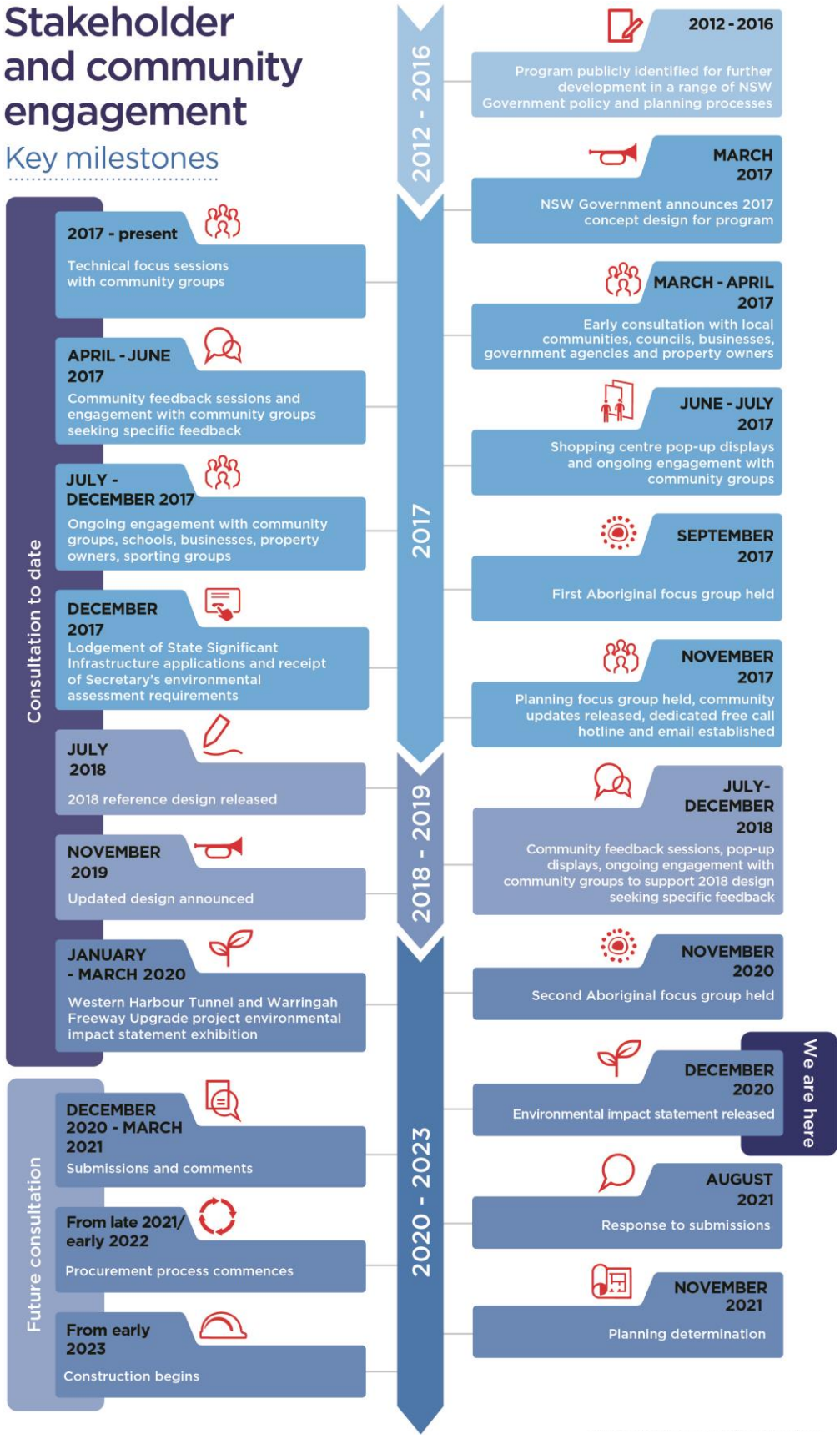


**Figure 7-1 Beaches Link and Gore Hill Freeway Connection project community and stakeholder engagement process**

### 7.1.3 Stakeholders

Stakeholders were identified through consideration of the project's potential direct and indirect impacts and from records of previous correspondence with relevant government bodies, business groups and community groups. Engagement has included ongoing liaison and consultation with the following stakeholder groups:

- Government Ministers and elected representatives
- Australian and NSW government agencies
- Local councils
- Property owners and residents along and near the alignment
- Members of the community
- Community service providers
- Business and industry groups
- Education, health and sporting facilities along or near the alignment
- Local precinct committees and/or resident action groups
- Marine stakeholders and waterway users
- Aboriginal groups and the Metropolitan Local Aboriginal Land Council (LALC)
- Pedestrians and cyclists
- Service and utility providers.

### 7.1.4 Engagement and consultation tools

A variety of two-way consultation and communication tools have been used to provide information to the community, providing a range of opportunities for the community to be consulted and involved throughout the project's development.

Communication and consultation tools established for the project include:

- Toll free community information line (1800 931 189)
- Project email (whtbl@transport.nsw.gov.au (previously whtbl@rms.nsw.gov.au))
- Project website (nswroads.work/whtbl)
- Interactive project portal (nswroads.work/blportal)
- Project database to record correspondence relevant to the project, including contact details and issues raised during the life of the project
- Community update newsletters, fact sheets, and letters to residents
- Guide to the environmental impact statement
- Community information sessions including virtual information sessions, information displays and staffed displays at local shopping centres
- Registered stakeholder database email updates
- Stakeholder briefings, meetings, workshops, and presentations
- Interest group correspondence including letters and phone calls
- Face-to-face meetings and doorknocks with individual property owners and residents of properties which may be affected by the project

- Advertisements and proactive media articles in the local press
- Letterbox drops
- Translating and Interpreting services for Culturally and Linguistically Diverse (CALD) communities (131 450)
- Media events at key milestones of the project.

These tools would be used to support the public exhibition of this environmental impact statement and during further design development and delivery of the project (subject to COVID-19 requirements).

Due to COVID-19 restrictions, staffed displays and face to face community information sessions of the environmental impact statement are not proposed to occur during the exhibition period. However this requirement will be reviewed if restrictions are eased and safety controls allow. In order to ensure that adequate opportunities are available for the community to ask questions on the content of the environmental impact statement, Transport for NSW will be running virtual information sessions throughout January and February 2021. Transport for NSW will continue to investigate the opportunity for face to face community information sessions provided COVID-19 guidelines allow.

Details of the times and topics for the virtual information sessions, as well as any potential face to face community information sessions, would be provided through the project website, email notifications to registered stakeholders, community updates, and advertisements in local and metropolitan media.

## 7.2 Engagement activities to date

An extensive community engagement process has been carried out for the project before exhibition of the environmental impact statement. This has included two rounds of formal public consultation for the Western Harbour Tunnel and Beaches Link program of works:

- Between April and June 2017 following the announcement of the concept design
- Between July and December 2018 following the publishing of the proposed reference design.

Between 29 January and 30 March 2020, the Department of Planning, Industry and Environment placed the Western Harbour Tunnel and Warringah Freeway Upgrade project environmental impact statement on public exhibition for feedback. As part of this process, various community engagement activities were carried out. Although the purpose of the engagement was to support the Western Harbour Tunnel and Warringah Freeway Upgrade project, community enquiries about the Beaches Link project were also responded to by members of the project team.

In addition to these formal engagement periods, engagement and consultation with stakeholders has been ongoing throughout the project's development, with the project team holding numerous workshops and meetings with councils, community groups and other stakeholders. The following provides a summary of engagement activities carried out to date.

### 7.2.1 Australian, NSW and local government agencies

Engagement and consultation has been carried out with key Australian, NSW and local government agencies as summarised in Table 7-3. Feedback on specific environmental, technical and socio-economic matters provided by government stakeholders has informed the design development of the Beaches Link and Gore Hill Freeway Connection project.

**Table 7-3 Consultation with Australian, NSW and local government agencies**

| Stakeholder | Timeframe | Engagement topics/activities |
|---|---|---|
| Other divisions of Transport for NSW (eg Sydney Trains) | 2016 – present | • Various project updates to different functional areas across the Transport cluster to maintain coordinated planning across projects and operations<br>• Northern Beaches B-Line and bus service coordination and future network planning post completion of the Western Harbour Tunnel and Beaches Link program of works<br>• Consultation with Greater Sydney Operations (including Transport Management Centre and Sydney Coordination Office) in carrying out site investigations<br>• Planning sessions with Greater Sydney Operations (including Transport Management Centre and Sydney Coordination Office) to plan traffic management during construction and operation<br>• Site visit to the Traffic Management Centre to discuss and observe existing operation of the Warringah Freeway, the Sydney Harbour Bridge, Warringah Road, Military Road and other critical road links to understand how key adjoining transport corridors perform during peak traffic demand periods<br>• North Sydney public transport integration and transport planning<br>• Transport integration working group<br>• North Sydney Integrated Transport Program working group<br>• Health, safety and environmental briefings<br>• Marine construction overview to understand implications for marine traffic<br>• T1 North Shore and Western Line and T9 Northern Line underground interface. |
| Sydney Metro | 2016 – present | • Sydney Metro City & Southwest tunnel design and construction coordination<br>• North Sydney public transport integration and precinct planning. |
| Department of Planning, Industry and Environment (Crown Lands) | 2017 – present | • General project overview and updates. |
| Metropolitan LALC | 2017 – present | • Regular meetings and correspondence to provide project briefings and seek feedback<br>• Correspondence with CEO, Metropolitan LALC, regarding location of sites in Artarmon, Northbridge, Wakehurst Parkway and Balgowlah<br>• Involvement of site officers in archaeological surveys and field surveys |

| Stakeholder | Timeframe | Engagement topics/activities |
|---|---|---|
| | | • Involvement of site officers in survey, recording and condition assessment of cultural heritage close to the construction footprint, including site adjacent to the Wakehurst Parkway. |
| Australian Government Department of Agriculture, Water and the Environment | 2017 – present | • General project overview and updates<br>• Consultation regarding the potential for offshore disposal of dredged material at the designated offshore disposal site<br>• Development of testing plans and permit applications. |
| Australian Government Department of Infrastructure, Transport, Regional Development and Communications | 2017 | • General project overview and update. |
| Infrastructure Australia | 2017 – present | • General project overview and updates. |
| Department of Planning, Industry and Environment (Planning and Assessment) | 2017 – present | • General project overview and updates<br>• Warringah Freeway and Gore Hill Freeway concept overview presentation<br>• Frenchs Forest precinct planning and transport integration<br>• Planning focus session on lodgement of State Significant Infrastructure application<br>• Western Harbour Tunnel and Beaches Link program of works site tour to understand design and key challenges<br>• Western Harbour Tunnel and Beaches Link program of works construction methodology, noise, vibration and spoil management presentation. |
| Greater Sydney Commission | 2017 – present | • Multiple project overview and update meetings<br>• North Sydney precinct and transport planning sessions<br>• Frenchs Forest precinct planning<br>• Land use and employment assumptions for design development. |
| Government Architect NSW | 2017 – present | • Project overviews and updates<br>• North Sydney Integrated Transport Program working group<br>• Reference Design Urban Design review panel. |
| Port Authority of NSW | 2017 – present | • Regular project updates and briefings<br>• Stakeholder sessions prior to geotechnical investigations in Sydney Harbour and Middle Harbour<br>• Simulation with Sydney Harbour Pilots undertaken at Brisbane Smartship facility for transporting immersed |

| Stakeholder | Timeframe | Engagement topics/activities |
|---|---|---|
| | | tube tunnel units into Middle Harbour and through the Spit Bridge<br>• Development of Harbour Master's conditions for proposed dredging, cofferdams, immersed tube tunnel construction and general marine logistics within Sydney Harbour and Middle Harbour<br>• Planning focus meeting on lodgement of State Significant Infrastructure application. |
| NSW Urban Growth (now Infrastructure NSW from July 2019) | 2016 – present | • Project overviews and updates<br>• Planning focus meeting on lodgement of State Significant Infrastructure application. |
| NSW Small Business Commissioner | 2018 | • Project briefing/update. |
| Department of Planning, Industry and Environment (Regions, Industry, Agriculture and Resources) | 2017 – present | • General project overview and updates<br>• Agency briefings on terrestrial biodiversity, freshwater and contamination, marine water (hydrodynamics and dredging)<br>• Marine ecology survey and water quality testing<br>• Consultation for the development of the project application for offshore disposal of dredged material<br>• Planning focus meeting on lodgement of State Significant Infrastructure application. |
| NSW Environment Protection Authority (EPA) | 2017 – present | • General project overview and updates<br>• Marine ecology survey and water quality testing<br>• Planning focus meeting on lodgement of State Significant Infrastructure application<br>• Western Harbour Tunnel and Beaches Link program of works construction methodology, noise, vibration and spoil management presentation<br>• Consultation for the development of the project application for offshore disposal of dredged material<br>• Briefing to the Advisory Committee on Tunnel Air Quality (ACTAQ). Members of the committee were provided the air quality technical report and health impact assessment for review and comment. |
| Infrastructure NSW | 2016 – present | • Multiple project overview and update sessions<br>• Multiple reviews by Infrastructure NSW on various aspects on the design and construction aspects of the project<br>• Review of environmental and community impacts, mitigation and assessment process<br>• Planning focus meeting on lodgement of State Significant Infrastructure submission. |
| NSW National Parks and Wildlife Services | 2017 | • Planning focus meeting on lodgement of State Significant Infrastructure application. |

| Stakeholder | Timeframe | Engagement topics/activities |
|---|---|---|
| Department of Premier and Cabinet (Environment, Energy and Science) | 2016 – present | • Multiple project overview and update sessions<br>• Planning focus meeting on lodgement of State Significant Infrastructure application<br>• Agency briefings on terrestrial biodiversity, freshwater and contamination, marine water (hydrodynamics and dredging). |
| Department of Premier and Cabinet (Heritage) | 2017 | • Planning focus meeting on lodgement of State Significant Infrastructure application<br>• Agency briefings on Aboriginal heritage and non-Aboriginal heritage. |
| NSW Treasury | 2016 – present | • Multiple project overview and update sessions<br>• Planning focus meeting on lodgement of State Significant Infrastructure application<br>• Regular engagement via Western Harbour Tunnel and Beaches Link program of works steering committees. |
| Sydney Harbour Federation Trust | 2017 | • Planning focus meeting on lodgement of State Significant Infrastructure application. |
| Ministry of Health | 2017 – present | • Planning focus meeting on lodgement of State Significant Infrastructure application<br>• Project update during environmental impact statement development<br>• Briefing to the Advisory Committee on Tunnel Air Quality. Members of the committee were provided the air quality technical report and health impact assessment for review and comment. |
| NSW Chief Scientist & Engineer | 2017 – present | • Project overview and update session<br>• Planning focus meeting on lodgement of State Significant Infrastructure application<br>• Joint public consultation on approach to Western Harbour Tunnel and Beaches Link air quality and ventilation outlet locations<br>• Briefing to the Advisory Committee on Tunnel Air Quality. Members of the committee were provided the air quality technical report and health impact assessment for review and comment. |
| Northern Beaches Council | 2017 – present | • Project briefings and updates, including briefings on geotechnical investigations, project design, potential project impacts and temporary construction support sites, noise, air quality, future land use after the project is complete and the development of the environmental impact statement<br>• Discussion of feedback from the local community<br>• Planning focus meeting on lodgement of State Significant Infrastructure application. |

| Stakeholder | Timeframe | Engagement topics/activities |
|---|---|---|
| Willoughby City Council | 2017 – present | • Project updates on geotechnical work planning, potential project impacts, temporary construction support sites, noise, air quality, future land use after the project is complete and the development of the environmental impact statement<br>• Discussion of feedback from the local community<br>• Planning focus meeting on lodgement of State Significant Infrastructure application. |
| Mosman Council | 2017 – present | • Project updates on the project design, potential project impacts and temporary construction support sites, noise, air quality, and the development of the environmental impact statement<br>• Planning focus meeting on lodgement of State Significant Infrastructure application. |
| Lane Cove Council | 2017 – present | • Project updates on the development of the design, construction methodology, active transport connections, motorway facilities, ventilation outlets, tunnel entry and exit points, spoil transport, tunnel depth and alignment, potential community impacts, air quality, and the development of the environmental impact statement<br>• Planning focus meeting on lodgement of State Significant Infrastructure application. |
| North Sydney Council | 2017 – present | • Updates on tunnel design, project justification, urban design, community engagement process, public transport integration, ventilation outlet locations, air quality and monitoring, potential impacts to Cammeray Golf Course, active transport and pedestrian connections, opportunities and potential impacts to the North Sydney area, and the development of the environmental impact statement<br>• North Sydney Integrated Transport Program working group<br>• North Sydney urban design workshops to discuss potential impacts and proposed mitigation measures – particularly at and around temporary construction support sites and permanent facilities<br>• Planning focus meeting on lodgement of State Significant Infrastructure application. |
| City of Sydney Council | 2017 | • General project overview and update. |

### 7.2.2 Utility providers

Engagement and consultation has been carried out with utility providers through activities including briefings, meetings and ongoing technical engagement. These activities provided:

- An overview of the Western Harbour Tunnel and Beaches Link program of works including the proposed design and construction method
- Discussions about the possible impact on utility assets
- Discussion and development of potential relocation and protection strategies
- An opportunity to provide feedback and discuss any issues or concerns.

Providers that have been engaging with the Beaches Link and Gore Hill Freeway Connection project team include:

- Ausgrid
- Jemena
- Telstra
- Sydney Water.

Feedback from these utility providers has informed the design for utility relocation and/or protection, where applicable.

### 7.2.3 Aboriginal stakeholders

Consultation with Aboriginal stakeholders was carried out in accordance with requirements outlined in Chapter 15 (Aboriginal cultural heritage) of this environmental impact statement.

Table 7-4 provides a summary of engagement and consultation activities carried out. Refer to Appendix L (Technical working paper: Aboriginal cultural heritage assessment report) for further details on Aboriginal stakeholder engagement.

**Table 7-4 Consultation with Aboriginal stakeholders**

| Stakeholder | Summary |
|---|---|
| National Native Title Tribunal | Contacted to identify any registered native title claimants of native title holders for the options assessment area. No registered native title claimants were identified in relation to the study area. |
| Aboriginal site officers | Aboriginal site officers nominated by the Metropolitan LALC were present for archaeological surveys, recording and condition assessment of cultural heritage. |
| • Department of Premier and Cabinet (Heritage)<br>• NSW Aboriginal Land Council<br>• Metropolitan LALC<br>• Aboriginal Heritage Office<br>• Registrar appointed under the *Aboriginal Land Rights Act 1983*<br>• National Native Title Tribunal | Organisations were written to during June and July 2017 seeking the details of Aboriginal people who may have an interest in the project and who may hold cultural knowledge about objects and places in the study area. |

| Stakeholder | Summary |
|---|---|
| • Native Title Services Corporation Limited<br>• Northern Beaches Council<br>• North Sydney Council. | |
| Aboriginal Focus Group | Identified Aboriginal stakeholders (registered Aboriginal parties) were contacted by letter and advertisement and invited to attend focus group meetings to discuss the project and received comment on the draft archaeological survey methodology. The first Aboriginal Focus Group was held in September 2017.<br>A second Aboriginal Focus Group was held in November 2020 to outline the findings of the Aboriginal cultural heritage assessment and seek feedback from registered Aboriginal parties. |

### 7.2.4 Business stakeholders

A business survey was carried out to gain a better understanding of the main issues, perceptions and concerns of businesses in regard to construction and operation of the project. Surveys were conducted during a three-week period in November 2017 in nine local centres that may be susceptible to direct or indirect effects of construction and/or operation. Businesses were approached at random within these local centres, with every effort made to survey a range of business types across the study area. The results of the business survey are provided Appendix U (Technical working paper: Socio-economic assessment) and discussed in Chapter 21 (Socio-economics).

Local business owners also attended community information sessions. Further engagement with business stakeholders would be carried out during the environmental impact statement exhibition period, this may include door knocking and letter box drops (subject to COVID-19 requirements and with social distancing and other safety measures implemented as required).

### 7.2.5 Directly impacted landowners and residents

In March 2017, property owners affected by the concept design were notified. In July 2018, property owners affected by the proposed reference design were notified. In November 2019, property owners affected by the updated access road design at Balgowlah were notified and assigned a Personal Manager Acquisition. Residential property owners were provided the opportunity to start the acquisition process (at owner discretion). Further engagement would be carried out with affected property owners as the project progresses.

All acquisition required for the project is carried out in a manner consistent with the *Land Acquisition (Just Terms Compensation) Act 1991* (NSW) (Just Terms Act), the *Land Acquisition Information Guide* and the land acquisition reforms announced by the NSW Government in 2016.

Transport for NSW has appointed a Personal Manager Acquisition to help land owners who may be affected by acquisition for the project. The Personal Manager Acquisition is in regular contact with these individuals to provide updates on the project and respond to questions and queries. Should acquisition for the project be confirmed for a particular property, the Personal Manager Acquisition would work with the affected land owners and residents to offer assistance and support throughout the acquisition and relocation process (refer to Chapter 20 (Land use and property)).

## 7.2.6 Community

### Western Harbour Tunnel and Beaches Link program of works engagement

Community engagement was carried out for the whole Western Harbour Tunnel and Beaches Link program of works by Transport for NSW (formerly Roads and Maritime). The following section describes the community feedback received during the 2017 and 2018 consultation periods for the program of works, in addition to engagement carried out with a number of community and interest groups.

#### *2017 concept design*

In March 2017, the NSW Government announced the Western Harbour Tunnel and Beaches Link program of works design. Feedback on the concept design was invited between 16 March 2017 and 31 July 2017, supported by community engagement activities summarised in Table 7-5.

**Table 7-5 2017 concept design – community engagement activities**

| Activity | Details |
|---|---|
| **General program information and feedback channels** | |
| Program website | nswroads.work/whtbl (previously rms.nsw.gov.au/whtbl). |
| Program email address | Over 700 emails were sent to the program email account: whtbl@transport.nsw.gov.au (previously motorwaydevelopment@rms.nsw.gov.au). |
| Program 1800 number | Over 1000 telephone calls were received via the program information line: 1800 789 297. |
| Letterbox drops | More than 330,000 program fact sheets and community feedback session information flyers delivered. |
| Online community engagement map | More than 1700 comments posted on specific topics by members of the community. |
| Subscribers to program updates | Over 2300 subscribers to receive ongoing program updates. |
| Ministerial | About 90 customer enquiries issued as ministerial inquiries. |
| **Hosted events** | |
| Community Feedback Sessions attended by program team and technical specialists | Sixteen sessions attended by more than 2100 people at the following locations:<br>• Mosman Club (two sessions)<br>• McMahons Point Community Centre (two sessions)<br>• Chatswood Club (two sessions)<br>• Balmain Town Hall (two sessions)<br>• Manly-Warringah Leagues Club (two sessions)<br>• Northbridge Bowling Club (two sessions)<br>• North Sydney Oval Function Centre (two sessions)<br>• Seaforth Community Centre (one session)<br>• Fred Hutley Hall, North Sydney Council Chambers (one session). |
| Pop up information displays | Twelve displays in major shopping centres attended by more than 800 people including:<br>• Birkenhead Point Shopping Centre (two sessions) |

| Activity | Details |
|---|---|
| | • Warringah Mall (four sessions)<br>• Balgowlah Stockland (two sessions)<br>• Chatswood Westfield (four sessions). |
| **Direct engagement with individual stakeholders** | |
| Meetings with residents and stakeholders | More than 25 meetings were attended by more than 1000 people. |
| Door knocks | More than 1500 residences. |
| **Notifications of investigation work** | |
| Marine geotechnical notifications | More than 170 notifications to properties in the vicinity of the proposed harbour crossings. |
| Land based geotechnical notifications | More than 5500 notifications and more than 1200 door knocks. |
| Noise monitoring installation notifications | More than 590 notifications and more than 470 door knocks. |
| Air quality monitoring station installations | More than 50 notifications and more than 40 door knocks. |
| **Media** | |
| Newspaper advertisements | 89 half page advertisements, placed in the local media in the weeks preceding the community feedback sessions. |
| Media releases | One media release was issued by the NSW Government to coincide with the announcements of the preferred corridor and start of field investigation works. |
| Facebook | More than 169,000 people reached through two direct program related Facebook posts on the NSW Roads Facebook page, as well as a broadly targeted Facebook advertising campaign. |

### *2018 proposed reference design*

In July 2018, the NSW Government announced the proposed reference design for the Western Harbour Tunnel and Beaches Link program of works. Feedback on the proposed reference design was invited between 26 July 2018 and 1 December 2018, supported by community engagement activities summarised in Table 7-6.

Feedback from this period helped to inform the design which has been included in this environmental impact statement. A summary of this feedback and where it has been addressed is provided in Table 7-8.

**Table 7-6 2018 proposed reference design – community engagement activities**

| Activity | Detail |
|---|---|
| **General program information and feedback channels** | |
| Program website | nswroads.work/whtbl (previously rms.nsw.gov.au/whtbl). |
| Program email address | Around 2320 emails were sent to the program email account: whtbl@transport.nsw.gov.au (previously whtbl@rms.nsw.gov.au). |

| Activity | Detail |
|---|---|
| Program 1800 number | More than 300 telephone calls were received via the program information line: 1800 931 189. |
| Letterbox drops | About 400,000 program fact sheets and community feedback session information flyers delivered. |
| Online community engagement map | More than 4000 comments posted on specific topics by members of the community (https://www.rms.nsw.gov.au/projects/western-harbour-tunnel-beaches-link/consultation-map-bl.html). |
| Feedback forms | More than 530 written feedback forms received at community sessions. |
| Subscribers to program updates | Over 3300 subscribers to receive ongoing program updates. |
| Ministerial | Over 90 customer enquiries issued as ministerial inquiries. |
| **Hosted events** | |
| Community Feedback Sessions attended by program team and technical specialists | Twenty sessions attended by more than 2600 people at the following locations:<br>• Balgowlah Club Totem (one session)<br>• Balgowlah Golf Club (one session)<br>• Crows Nest Centre (two sessions)<br>• Mosman RSL (two sessions)<br>• Fred Hutley Hall, North Sydney Council Chambers (two sessions)<br>• Waverton Bowling Club (two sessions)<br>• Balgowlah RSL (three sessions)<br>• Manly Warringah Leagues Club (two sessions)<br>• Balmain Town Hall (two sessions)<br>• Northbridge Golf Club (two sessions)<br>• Cammeray Golf Club (one session). |
| Pop up information displays | Six displays in major shopping centres attended by more than 590 people including:<br>• Birkenhead Point Outlet Centre (three sessions)<br>• Balgowlah Stockland (three sessions). |
| **Direct engagement with individual stakeholders** | |
| Stakeholder meetings | More than 88 meetings were held with local precinct committees, schools and associated Parents & Citizens (P&C) Associations, resident groups, special interest groups, sporting associations, Government agencies and local councils. |
| Door knocks | More than 3890 residences. |
| **Notifications of investigation work** | |
| Land based geotechnical notifications | More than 132 notifications and more than 20 doorknocks. |
| **Media** | |
| Newspaper advertisements | Eighteen half page advertisements, placed in the local media in the weeks preceding the community feedback sessions. |

| Activity | Detail |
|---|---|
| Media releases | One media release was issued by the NSW Government to coincide with the announcements of the further developed design. |

### 2019 project updated design

In November 2019, the NSW Government announced an updated design for the Beaches Link and Gore Hill Freeway Connection project.

The community were advised of the preferred temporary construction support sites at Wakehurst Parkway east (BL13) and Flat Rock Drive (BL2), an updated design of the Balgowlah access road (noting the Balgowlah access road has since evolved to that presented in this environmental impact statement) and the updated timing for the Beaches Link and Gore Hill Freeway Connection project environmental impact statement.

Community updates were uploaded onto the project website and distributed to 46,500 properties along the Beaches Link alignment and suburb specific fact sheets were created to update the community about design changes in their area. The fact sheets focussed on Balgowlah, Cammeray, Willoughby, Seaforth and Frenchs Forest.

In addition, an email was sent to 2592 subscribers, informing them of the changes and linking them to the community update on the website.

### 2020 Western Harbour Tunnel and Warringah Freeway Upgrade project environmental impact statement public exhibition

As stated in Section 7.2, during the display period of the Western Harbour Tunnel and Warringah Freeway Upgrade project environmental impact statement between 29 January and 30 March 2020, general questions around the design, project alignment, project timelines and impacts of the Beaches Link and Gore Hill Freeway Connection project were asked by community members. A dedicated technical expert from the Beaches Link and Gore Hill Freeway Connection project team attended the information sessions in order to respond to these questions.

Submissions made on the Western Harbour Tunnel and Warringah Freeway Upgrade project environmental impact statement that related to the Beaches Link and Gore Hill Freeway project were considered in the preparation of this environmental impact statement.

### Community and interest groups

Engagement and consultation has been carried out with a number of community and interest groups through activities such as briefings, meetings, presentations and workshops. These activities provided:

- An overview of the Western Harbour Tunnel and Beaches Link program of works, including the proposed design and construction method
- Information on potential impacts during construction and operation including air quality, noise and vibration, traffic and transport, biodiversity, and maritime issues
- Further detail on options considered and their advantages and disadvantages
- The opportunity to provide feedback and discuss any issues or concerns
- The opportunity to present community options for analysis by the technical and environmental team.

Engagement and consultation has occurred with the following community and interest groups:

- Artarmon Progress Association
- Naremburn Progress Association
- Northbridge Progress Association

- Federation of Willoughby Progress Associations
- North Sydney Precinct Committees
- Plateau Precinct (Cammeray)
- Waverton Precinct Committee
- Waverton Progress Association
- Willoughby Progress Association
- Willoughby South Progress Association
- Wollstonecraft Precinct Committee
- Crows Nest Rotary Club
- North Sydney Rotary Club
- Mosman Rotary Club
- Northbridge Rotary Club
- Marist College North Shore
- North Sydney Boys High School
- Seaforth Primary School and P&C
- Northern Beaches Secondary College Balgowlah Boys Campus
- St Cecilia's Catholic Primary School
- St Mary’s Primary School
- Anzac Park Public School
- Anzac Park Public School P&C Association
- Cammeray Public School
- Cammeray Public School P&C Association
- Monte Sant' Angelo Mercy College
- Wenona School
- Balgowlah Golf Club
- Cammeray Golf Club
- Seaforth Residents Group
- Serpentine Crescent Residents Group
- Balgowlah Residents Group
- Dudley Street residents
- Seaforth Football Club
- Northbridge Sailing Club
- The Greens North Sydney
- Save Manly Dam Catchment Committee.

## 7.3 Feedback received

Feedback and issues identified during the engagement program by stakeholders and the community have informed the environmental assessment and the ongoing development of the project. A summary of these issues and where they have been addressed is provided in the following section.

### 7.3.1 Summary of feedback received

Feedback received was recorded and considered during the preparation of this environmental impact statement and throughout the development of the project.

Table 7-7 provides a summary of the feedback topics and number of comments received during the 2017 and 2018 engagement periods for the Western Harbour Tunnel and Beaches Link program of works, and where this has been considered in the environmental impact statement for the Beaches Link and Gore Hill Freeway Connection project.

**Table 7-7 Summary of stakeholder and community feedback**

| Feedback topic | Number of comments 2017 | Number of comments 2018 | Environmental impact statement reference |
|---|---|---|---|
| Air quality impacts, location and operation of tunnel ventilation system, potential impact on health | 1068 | 4729 | Air quality impacts are assessed in Chapter 12 (Air quality)<br>Location and operation of tunnel ventilation outlets and motorway facilities is described in Chapter 5 (Project description) and Appendix H (Technical working paper: Air quality)<br>Assessment of potential human health impact is provided in Chapter 13 (Human health) and Appendix I (Technical working paper: Health impact assessment) |
| Design – tunnel entry and exit portals, alignment, road connections, depth, project description, suggested design changes, motorway features | 928 | 1566 | Chapter 4 (Project development and alternatives), Chapter 5 (Project description) and this chapter in Section 7.4 |
| Transport mode, public transport alternatives, network integration, connectivity, integration with other key projects and proposed infrastructure (eg Northern Beaches B-Line, Sydney Metro) | 547 | 1974 | Chapter 3 (Strategic context and project need)<br>Chapter 4 (Project development and alternatives)<br>Chapter 5 (Project description)<br>Chapter 8 (Construction traffic and transport), Chapter 9 (Operational traffic and transport) and Appendix F (Technical working paper: Traffic and transport) |

| Feedback topic | Number of comments 2017 | Number of comments 2018 | Environmental impact statement reference |
|---|---|---|---|
| Potential property impact on directly and indirectly affected properties, including property value and potential increase in urban density, property condition surveys, property access, property acquisition | 501 | 1756 | Chapter 20 (Land use and property) and Appendix U (Technical working paper: Socio-economic assessment) |
| Construction impact, location of temporary construction support sites, impact of temporary construction support sites, hours of work, night work, spoil transport, cumulative impacts, light spill | 383 | 3475 | Chapter 6 (Construction work) |
| Potential impact on local streets, rat runs, local road safety, construction traffic, impact on parking spaces, congestion, road network performance, local road connections, increased traffic, cumulative traffic impact, travel time | 398 | 4023 | Chapter 8 (Construction traffic and transport), Chapter 9 (Operational traffic and transport) and Appendix F (Technical working paper: Traffic and transport)<br>Chapter 27 (Cumulative impacts) |
| Traffic modelling | 273 | 312 | Chapter 8 (Construction traffic and transport), Chapter 9 (Operational traffic and transport) and Appendix F (Technical working paper: Traffic and transport) |
| Satisfaction with engagement | 151 | 86 | This chapter provides an overview of the engagement and consultation process feedback received |
| Impact on fauna, flora, vegetation, green spaces, National Parks | 177 | 1676 | Chapter 19 (Biodiversity) and Appendix S (Technical working paper: Biodiversity development assessment report) |
| Need for land bridges and open space | 1 | 2175 | Chapter 22 (Urban design and visual amenity) |
| Drainage and flooding | 2 | 133 | Chapter 18 (Flooding) and Appendix R (Technical working paper: Flooding) |
| Project cost, cost benefit ratio and tolling | 97 | 437 | A description of tolling infrastructure is provided in Chapter 5 (Project description). Tolling cost modelling is not subject to this environmental impact assessment |

| Feedback topic | Number of comments 2017 | Number of comments 2018 | Environmental impact statement reference |
|---|---|---|---|
| Support for project | 89 | 184 | This chapter provides an overview of the engagement and consultation process feedback received |
| Dissatisfaction with engagement process, need for further project detail, consideration of different ways to engage with the community and stakeholders including different mediums | 81 | 232 | Consultation has been adapted as the project progresses. The project has endeavoured to provide information in a variety of different mediums for stakeholders as detailed in this chapter |
| Noise impact, construction noise, cumulative noise impact, road traffic noise changes, noise walls, noise monitoring | 73 | 2646 | Chapter 10 (Construction noise and vibration), Chapter 11 (Operational noise and vibration) and Appendix G (Technical working paper: Noise and vibration) |
| Cycling, cycleway facilities, active transport | 61 | 336 | Chapter 8 (Construction traffic and Transport), Chapter 9 (Operational traffic and transport) and Appendix F (Technical working paper: Traffic and transport) |
| Oppose project | 59 | 2243 | This chapter provides an overview of the engagement and consultation process and feedback received |
| Visual amenity, visual impact of temporary/permanent structures, overshadowing, urban design | 21 | 306 | Chapter 22 (Urban design and visual amenity), Chapter 21 (Socio-economics) and Appendix U (Technical working paper: Socio-economic assessment) |
| EIS process and project approval | 18 | 58 | Chapter 2 (Assessment process) |
| Aboriginal and non-Aboriginal heritage | 14 | 486 | Chapter 15 (Aboriginal cultural heritage), Appendix L (Technical working paper: Aboriginal cultural heritage assessment report), Chapter 14 (Non-Aboriginal heritage) and Appendix J (Technical working paper: Non-Aboriginal heritage) |
| Impact on community amenity during construction/operation, neighbourhood character, local business impact | 8 | 39 | Chapter 21 (Socio-economics) and Appendix U (Technical working paper: Socio-economic assessment) |
| Project timing | 6 | 80 | Chapter 5 (Project description) and Chapter 6 (Construction work) |

### 7.3.2 Issues raised by government agencies and local government

A list of government stakeholders consulted and details on engagement activities and topics is provided in Section 7.2.1. Feedback from government stakeholders has informed the design development of the Beaches Link and Gore Hill Freeway Connection project and is addressed throughout the chapters of this environmental impact statement.

### 7.3.3 Issues raised by the community

All questions, comments and issues raised by the community have been recorded in the project's database. Feedback received during both consultation periods has been considered and addressed as part of the environmental assessment and, wherever possible, has been incorporated into the design.

Feedback from the 2017 consultation period was addressed in the Beaches Link and Gore Hill Freeway Connection scoping report (Roads and Maritime Services, 2017c), submitted to Department of Planning, Industry and Environment in October 2017. This feedback informed the development of the proposed reference design, as discussed further in Section 7.4.

Feedback from the 2018 consultation period, including key issues raised by community members, stakeholder interest groups and local businesses are provided in Table 7-8. To consolidate the feedback received by the community, feedback has been grouped by issue category and summarised where appropriate. This table also provides the Transport for NSW response and/or the reference to where this feedback has been addressed in this document.

### 7.3.4 Issues raised by Aboriginal stakeholders

Feedback from Aboriginal stakeholders, including key issues, and how they have been addressed are provided in Chapter 15 (Aboriginal cultural heritage) and Appendix L (Technical working paper: Aboriginal cultural heritage assessment report). Feedback from the Aboriginal Focus Group sessions is provided in Annexure A of Appendix L (Technical working paper: Aboriginal cultural heritage assessment report).

**Table 7-8 Issues raised by the community**

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| **Strategic justification and project need** | Project viability studies, including the business case, should be released to public. | An overview of the strategic context and project need are provided in Chapter 3 (Strategic context and project need). An overview of the development process and options considered are provided in Chapter 4 (Project development and alternatives). |
| | Requested more information on whether increased private vehicle road capacity would impact the future development of the North District and Northern Beaches employment centres. | The project would provide increased capacity, connectivity, resilience, and result in a decrease in travel time between employment centres. This is anticipated to have a positive impact and encourage future development in the business centres. Refer to Chapter 9 (Operational traffic and transport) and Appendix F (Technical working paper: Traffic and transport) for further information. The potential social and economic impacts of the project are considered and assessed in Chapter 21 (Socio-economics). |
| **Project development and alternatives** | Further investigations into other transport mode options should have been carried out prior to choosing a road option. | An overview of the strategic context and project need are provided in Chapter 3 (Strategic context and project need). An overview of the development process and options considered are provided in Chapter 4 (Project development and alternatives). |
| | Preference for public transport over motorways. | The project (as part of the broader Western Harbour Tunnel and Beaches Link program of works) has been planned as part of an integrated transport network to meet the diverse travel and transport needs of Sydney. This includes a well-developed road, rail, bus, ferry, walking and cycling network. An overview of the strategic context and project need are provided in Chapter 3 (Strategic context and project need).<br><br>The project has been designed to provide high quality access for express bus services expected to travel via the proposed Beaches Link tunnels in |
| | Project should be replaced by a metro or heavy rail. | |
| | Consideration should be given to a dual rail/road. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | | the future – providing a significant improvement in public transport travel times and reliability. The project has also been designed to provide significant improvement in existing public transport route travel times by reducing congestion on existing arterial roads.<br>In addition, the Western Harbour Tunnel and Warringah Freeway Upgrade project would provide significant improvements to the efficiency and connectivity of the southbound bus lane on the Warringah Freeway from Miller Street to Sydney Harbour Bridge and direct access to North Sydney to enable interchange with the new Sydney Metro and Sydney Trains. The core capacity improvement offered by the Western Harbour Tunnel and Warringah Freeway project is key to enabling the proposed Beaches Link and Gore Hill Freeway Connection project and the associated significant change in connectivity and reliability for the northern transport network.<br>More information on public and active transport connections can be found in Chapter 3 (Strategic context and project need) and Chapter 5 (Project description).<br>An overview of the development process and alternatives is provided in Chapter 4 (Project development and alternatives). Public transport is also addressed in Chapter 9 (Operational traffic and transport). |
| | Concerns about toll prices. | A description of tolling infrastructure is provided in Chapter 5 (Project description). The potential social and economic impacts of the project are considered and assessed in Chapter 21 (Socio-economics). Tolling cost modelling is not subject to this environmental impact assessment. |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| **Tunnel design** | Potential impacts to property due to tunnel depth. | Pre-construction building/structure condition surveys would be offered and prepared for properties (where the offer is accepted by the owner) within the zone of influence of tunnel settlement (where the degree of severity has been assessed as 'slight' or above and within the minimum working distances for cosmetic and structural damage due to vibration) prior to the commencement of tunnelling and vibration intensive activities in the vicinity with the potential to affect the building/structure. This survey provides a clear record of the property's condition prior to works starting.<br>Post-construction building condition surveys would be offered to property owners of buildings for which a pre-construction building condition survey was carried out. Where the project is deemed the cause of building and/or property damage, the damage would be repaired at no cost to the property owner.<br>An Independent Property Impact Assessment Panel, comprising geotechnical and engineering experts, would be established prior to the commencement of works to independently verify building condition survey reports, resolve any property damage disputes and establish ongoing settlement monitoring requirements.<br>Potential impacts to property due to tunnel depth is considered and assessed in Chapter 16 (Geology, soils and groundwater). |
| **Construction** | Proximity of temporary construction support sites to homes, businesses and schools. | Proposed temporary construction support sites have been selected to support safe and efficient construction. Key factors applied to identification of potential temporary construction support sites include:<br>• Locate the temporary construction support sites as close as possible to the tunnels or surface works they support to minimise unnecessary tunnelling or heavy vehicle movements<br>• Avoid sensitive environments and community locations where possible<br>• Avoid material impacts to heritage sites or items |
| | Objections to the proposed site locations. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | | • Maximise opportunities for direct access to motorways and arterial roads or water transport opportunities for construction traffic, and avoid the need to use local residential streets if possible<br>• Minimise direct and indirect property impacts and acquisitions, particularly in residential areas.<br>More information on the sites can be found in Chapter 6 (Construction work). |
| | Impacts to ambulance and patient transport and access to the Northern Beaches Hospital during construction. | The realignment and upgrade of the Wakehurst Parkway would be staged to maintain traffic at all times. Works in the hospital precinct area would mainly be pavement works and linemarking works. |
| | Potential hours of operation and impacts of construction activities carried out up to 24 hours per day seven days a week. | Above ground civil construction work such as spoil haulage would, where feasible, generally be carried out between the following standard construction hours:<br>• 7am to 6pm Monday to Friday<br>• 8am to 1pm Saturday<br>• Generally, no work on Sundays or public holidays.<br>Activities that support tunnelling works and fitout, including above ground work supporting underground activities such as spoil handling, may need to occur 24 hours per day, up to seven days per week. Tunnel excavation and spoil handling outside of standard construction hours would be carried out within acoustic sheds at temporary construction support sites that would support tunnel excavation.<br>For works undertaken outside of standard hours, the potentially affected community would be notified in advance.<br>More information can be found in Chapter 6 (Construction work). |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Duration of construction work and potential for long program delays. | Significant effort has been invested in understanding the key construction activities, their durations, key delay risks and mitigation strategies. More information can be found in Chapter 6 (Construction work). |
| | Future use of temporary construction support sites including proposed rehabilitation and/or use during operation. | Proposed temporary construction support sites and would be returned at completion of works to the community as open space, wherever possible. Rehabilitation of temporary construction support sites would be carried out with relevant landowners, the local council and community.<br>A dedicated consultation process jointly led by Transport for NSW and Northern Beaches Council would take place to give the community an opportunity to provide input to the final layout of the new and improved open space and recreation facilities at Balgowlah. This consultation would be separate to the consultation for the Beaches Link and Gore Hill Freeway Connection environmental impact statement. This process would start after the environmental impact statement public exhibition period and well in advance of construction starting. As part of this consultation process, a community reference group would be established, with representative stakeholder groups and the community, to support Transport for NSW and Northern Beaches Council with the development of this important public space. The project would return an area, equivalent to around 90 per cent of the current open space, to the community as new and improved public open space and recreation facilities.<br>Residual land, primarily to the east and north of the new access road, would progressively become available through the construction period, which would facilitate re-purposing it to the new open space and recreation facilities. This would allow it to be handed over progressively for use by the community. The new open space and recreation facilities to the west of the proposed access road, between the access road and Burnt |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | | Bridge Creek Deviation, would be constructed after completion of the project and then handed over to Northern Beaches Council.<br>More information can be found in Chapter 5 (Project description) and Chapter 6 (Construction work). |
| **Consultation process** | Inadequate consultation and dissatisfaction with the process. | This chapter provides an overview of the communication and engagement activities carried out to date, and engagement and communication tools which would be used to support the public exhibition of this environmental impact statement and during project delivery. Communication tools and activities for informing and consulting with stakeholders would continue to be flexible, to suit the nature and scale of each stakeholder's interests and issues, and to reflect any restrictions on face to face engagement pending any COVID-19 requirements in place during the life of the project.<br>A detailed Community communication strategy would be developed prior to the start of construction pending project approval. This would be based on the framework developed and included in Appendix E (Community consultation framework). |
| | Lack of transparency and community involvement as part of the early project development. | |
| | Timing and inadequacy of available project information and distribution. | |
| | Lack of trust in the validity of the information provided. | |
| | Dissatisfaction with project team response timeframes. | |
| | Accessibility, location selection and timing of community information sessions. | |
| **Air quality** | Effectiveness of the proposed tunnel ventilation system. | The independent NSW Chief Scientist and Engineer has released a report (ACTAQ, 2018b) in relation to road tunnel air quality. The report found that emissions from well-designed road tunnels cause a negligible change to surrounding air quality, and as such, there is little to no health benefit for |
| | Locations of ventilation outlets. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Proximity of ventilation outlets to sensitive receivers including schools and recreational facilities. | surrounding communities in installing filtration and air treatment systems in such tunnels. Further information is available at www.chiefscientist.nsw.gov.au and nswroads.work/airquality.<br>Ventilation outlet locations have been carefully selected to make sure they operate efficiently and there would be minimal changes to local air quality. The air quality assessment has demonstrated that the emissions from the project's ventilation outlets would have a negligible impact on existing ambient pollutant concentrations and would pose a very low risk to human health. In this context, there is no basis to justify the cost and energy use associated with installation and operation of filtration systems.<br>The ventilation systems for Beaches Link would be built strictly in compliance with any conditions specified in the Department of Planning, Industry, and Environment's planning approval, and would be operated to comply with the terms of the Environment Protection Licence to be issued by the NSW Environment Protection Authority.<br>A description of the ventilation systems and facilities is provided in Chapter 5 (Project description), Chapter 12 (Air quality) and Appendix H (Technical working paper: Air quality). |
| | Air quality impacts would be more around the ventilation outlets and portals than at other locations. | |
| | Concern five kilometres of tunnel would then place five kilometres "worth" of emissions into a single local area. | |
| | Cumulative air quality impacts when multiple ventilation outlets were present in a single area/suburb. | |
| | Preference for the ventilation system to include filtration. | |
| | Multiple citations of use of ventilation outlets overseas and suggestion this is best and standard practice. | |
| | Health implications to residents and children's schools due to the proximity of unfiltered ventilation outlets to Lambs Road and Clegg Street. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Potential impacts during construction including exposure to emissions and carcinogens produced from processing of sandstone and granite producing silica dust. | Potential construction air quality impacts are considered and assessed in Chapter 12 (Air quality) and Appendix H (Technical working paper: Air quality). |
| | Potential air quality impacts as the result of road widening. | |
| | Impacts from contaminants and dust from construction work and spoil haulage. | |
| | Request for accurate on-going air quality monitoring. | Ongoing air quality monitoring would occur during both construction and operation. Refer to Chapter 12 (Air quality) for further information. |
| | Climate change impacts. | Chapter 26 (Climate change and greenhouse gas) assesses the potential impacts of climate change on the project, and greenhouse gas emissions generated by the construction and operation of the project. |
| **Operational traffic** | New motorway would result in increased traffic on local streets and key arterial routes. | Potential operational traffic and transport impacts have been assessed and considered in Chapter 9 (Operational traffic and transport) and in Appendix F (Technical working paper: Traffic and transport). |
| | New motorway would create new rat runs. | |
| | Increased vehicles on local streets trying to access the new portals. | |
| | Increased commuter traffic creating parking needs in local street which cannot accommodate the demand. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Project will encourage the use of private vehicles for longer trips. | Refer to Appendix F (Technical working paper: Traffic and transport) for an assessment of likely induced traffic due to the project. |
| | Requested details on the potential for the program to deliver long term traffic reduction benefits for Military Road and whether a local road improvements program will be delivered as part of the program. | Traffic modelling has indicated that there would be traffic reductions on alternative routes like Military Road, Warringah Road and Eastern Valley Way due to the Western Harbour Tunnel and Beaches Link program of works. As part of the Beaches Link and Gore Hill Freeway Connection project, adjustments would not be made to Military Road; however, the project would provide the opportunity for agencies (eg councils and Transport for NSW network management teams) to consider other opportunities for local road improvements.<br>Operational traffic impacts and benefits are outlined in Chapter 9 (Operational traffic and transport) and in Appendix F (Technical working paper: Traffic and transport). |
| **Construction traffic** | Increased traffic on local streets around temporary construction support sites. | Temporary construction support sites have been selected to provide direct access to the arterial road network, dedicated parking for construction workers (where possible) and would keep trucks and vehicles off local streets during construction, wherever possible. During construction, the main priority is to maintain the safety of the public in and around the sites and the immediate areas adjacent to the sites. Vehicle access to and from temporary construction support sites would be managed to maintain pedestrian, cyclist and motorist safety.<br>Assessment of construction traffic impacts including potential benefits is provided in Chapter 8 (Construction traffic and transport) and in Appendix F (Technical working paper: Traffic and transport). |
| | Increased traffic around Eastern Valley Way and Edinburgh Road, Willoughby. | |
| | Disruptions to Northbridge residents due to congestion on Flat Rock Drive, Alpha Road, Brook Street, Sailors Bay Road, Eastern Valley Way and Strathallen Avenue. | |
| | Reduced safety on local streets as the result of increased heavy vehicles. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Access to construction areas from residential roads and residents impacted along truck haulage routes. | |
| | Loss of residential parking on local streets as the result of project staff parking. | |
| | Increased rat running down local streets by both construction staff and community avoiding areas under construction. | |
| | Reduced road safety around schools as the result of increased heavy vehicle traffic. Particularly in areas where children are required to cross roads alone and during peak periods including drop off and collections. | |
| | Heavy vehicle use of narrow local streets and impacts to adjacent residents. | |
| | Rat runs at Woodbine Street, North Balgowlah to connect to the access road due to no Wakehurst Parkway access when tunnel is operational. | |
| | Traffic flow impacts for Sydney Road. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| **Public transport** | Potential impacts to bus routes during construction and operation. | Assessment of potential impacts to public transport is provided in Chapter 8 (Construction traffic and transport), Chapter 9 (Operational traffic and transport) and in Appendix F (Technical working paper: Traffic and transport). |
| | Preference for dedicated express bus lanes in current road infrastructure. | Public transport is addressed in Chapter 9 (Operational traffic and transport).<br>An overview of the strategic context and project need is provided in Chapter 3 (Strategic context and project need). |
| **Noise and vibration** | Potential damage to property as a result of tunnelling activities. | Minimum working distances for vibration intensive construction activities and vibration monitoring would be implemented where applicable to manage potential vibration impacts to property during construction. Ground movement impacts would be managed through predictive settlement models, building condition surveys (including for heritage assets) and the establishment of an Independent Property Impact Assessment Panel.<br>Pre-construction building/structure condition surveys would be offered and prepared for properties (where the offer is accepted by the owner) within the zone of influence of tunnel settlement (where the degree of severity has been assessed as 'slight' or above and within the minimum working distances for cosmetic and structural damage due to vibration) prior to the commencement of tunnelling and vibration intensive activities in the vicinity with the potential to affect the building/structure. This survey provides a clear record of the property's condition prior to works starting.<br>Post-construction building condition surveys would be offered to property owners of buildings for which a pre-construction building condition survey was carried out. Where the project is deemed the cause of building and/or property damage, the damage would be repaired at no cost to the property owner. |
| | Potential damage to property as the result of underground blasting activities. | |
| | Conservation of heritage homes and potential for cosmetic damage as a result of tunnelling activities, underground blasting and heavy vehicle movements. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | | The Independent Property Impact Assessment Panel, comprising geotechnical and engineering experts, would be established prior to the commencement of works to independently verify building condition survey reports, resolve any property damage disputes and establish ongoing settlement monitoring requirements.<br>Refer to Chapter 10 (Construction noise and vibration), Appendix G (Technical working paper: Noise and vibration) and Chapter 16 (Geology, groundwater and soils) for further information. |
| | Noise during construction activities. | Potential noise impacts are considered and assessed in Chapter 10 (Construction noise and vibration) and Appendix G (Technical working paper: Noise and vibration). |
| | Noise as the result of 24 hour tunnelling activities. | Potential noise and vibration impacts from tunnelling activities are considered and assessed in Chapter 10 (Construction noise and vibration) and Appendix G (Technical working paper: Noise and vibration). |
| | Vibration issues as the result of tunnelling activities. | |
| | Hours of work and potential noise impacts. | Ongoing engagement would be carried out with schools about the timing and duration of construction work and management of potential impacts. Where possible additional mitigation measures would be implemented to further reduce impacts.<br>Proposed hours of work are discussed in Chapter 6 (Construction work). Potential construction noise impacts are considered and assessed in Chapter 10 (Construction noise and vibration) and Appendix G (Technical working paper: Noise and vibration). |
| | Duration of activities and subsequent duration of noise impacts. | |
| | Potential impacts of noise at sensitive receivers like schools during peak exam periods. | |
| | Noise impacts during construction. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Noise from heavy vehicle traffic. | Heavy vehicle traffic is considered as part of the noise assessment and is addressed in Chapter 10 (Construction noise and vibration) and Appendix G (Technical working paper: Noise and vibration). |
| | Low frequency noise and vibration during construction and operation. | Potential noise and vibrations impacts are considered and assessed in Chapter 10 (Construction noise and vibration), Chapter 11 (Operational noise and vibration) and Appendix G (Technical working paper: Noise and vibration). |
| | Potential noise impacts as a result of road widening. | Potential noise impacts during construction are considered and assessed in Chapter 10 (Construction noise and vibration) and Appendix G (Technical working paper: Noise and vibration). |
| **Open space** | Loss of open space during construction for recreational and leisure activities. | Potential social and economic issues are considered and assessed in Chapter 21 (Socio-economics). Also refer to Chapter 22 (Urban design and visual amenity). |
| | Closure of Manly Dam mountain bike trail. | The realignment and upgrade of the Wakehurst Parkway would be staged with existing walking and bike trails to remain operational. Some minor diversions of these would be required from time to time during staging of works to ensure safe passage of the public through the project.<br>Refer to Chapter 8 (Construction traffic and transport), Chapter 9 (Operational traffic and transport) and Appendix F (Technical working paper: Traffic and transport) for an assessment on impacts to active transport due to both construction and operation. |
| | Adequate design options to include active transport options. | The project has been planned as part of an integrated transport network to meet the diverse travel and transport needs of Sydney. This includes a well-developed road, rail, bus, ferry, walking and cycling network. |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | | An overview of the strategic context and project need are provided in Chapter 3 (Strategic context and project need).<br>Assessment of potential impacts to active transport is provided in Chapter 9 (Operational traffic and transport) and in Appendix F (Technical working paper: Traffic and transport). |
| | Increased population to the Peninsula that is considered to be already over-developed with a need for more sporting facilities and parking. | The project has the opportunity to enhance and/or add to the amount of public open space, and recreation facilities and associated parking through potential re-purposing works at Balgowlah, Seaforth/Killarney Heights and Flat Rock Reserve. The final design of the re-purposing of open space would be determined in collaboration with the relevant council and through further community consultation. |
| | Reduction of Artarmon Park at the end of the construction. | The project would require the permanent acquisition of a portion of land at Artarmon Park adjacent to the Gore Hill Freeway to accommodate road infrastructure associated with the Gore Hill Freeway Connection component. This would not impact the ongoing use or functioning of the park and its facilities. |
| | Students from Northern Beaches Secondary College Balgowlah Boys Campus cannot access the oval. | Works associated with the project at Balgowlah Golf Course, including the surface connections at Balgowlah, would be staged to maintain safe access to Balgowlah Oval for the public, including students, clubs and scouts would continue to have access. Some minor temporary diversions of the existing access arrangements would be required from time to time during staging works to provide safe passage of the public through the project. The existing pedestrian bridge across Sydney Road adjacent to the high school is expected to remain in place and remain operational at all times. |
| | Clubs and Scouts from the Balgowlah Scout Hall could not access open space. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Lack of active transport from Artarmon Park to Artarmon Reserve. | The cycle network in the Gore Hill Freeway and Artarmon area consists of a mix of off-road shared user paths and on-road cycle routes on local and collector roads. Refer to Chapter 8 (Construction traffic and transport), Chapter 9 (Operational traffic and transport) and Appendix F (Technical working paper: Traffic and transport) for an assessment on impacts to active transport due to both construction and operation. |
| | Closure of the Balgowlah Golf Course and acquisition of Dudley Street properties. | Acquisition of Crown land at Balgowlah Golf Course would result in closure of the golf course. The project has been designed to optimise opportunities for the re-purposing of the remaining Crown land into new open space and recreation facilities. Final designs would be determined in conjunction with the Northern Beaches Council and through further community consultation. A dedicated consultation process jointly led by Transport for NSW and Northern Beaches Council would take place to give the community an opportunity to provide input to the final layout of the new open space and recreation facilities at Balgowlah. This consultation would be separate to the consultation for the Beaches Link and Gore Hill Freeway Connection environmental impact statement. This process would start after the environmental impact statement public exhibition period and well in advance of construction starting. As part of this consultation process, a community reference group would be established, with representative stakeholder groups and the community, to support Transport for NSW and Northern Beaches Council with the development of this important public space. The project would return an area, equivalent to around 90 per cent of the current open space, to the community as new and improved public open space and recreation facilities.<br>Further information regarding future opportunities for re-purposing of the remaining Crown land is provided in the Chapter 20 (Land use and property). |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | | All acquisition required for the project is carried out in a manner consistent with the *Land Acquisition (Just Terms Compensation) Act 1991* (NSW) (Just Terms Act), the *Land Acquisition Information Guide* and the land acquisition reforms announced by the NSW Government in 2016.<br><br>Transport for NSW has appointed a Personal Manager Acquisition to help land owners who may be affected by acquisition for the project. The Personal Manager Acquisition is in regular contact with these individuals to provide updates on the project and respond to questions and queries. Refer to Chapter 20 (Land use and property) for further information. |
| **Visual amenity** | Loss of amenity to Clive Park and the Northbridge Baths. | Temporary construction support sites, including at Spit West Reserve (BL9) and the Middle Harbour cofferdams (BL7 and BL8), would be temporary and would be developed to minimise visual impacts for adjacent receivers where feasible and reasonable. Refer to Chapter 22 (Urban design and visual amenity) for further information. |
| | Design and visual amenity of the ventilation outlets. | A description of ventilation systems and facilities is provided in Chapter 5 (Project description). Consideration and assessment of urban design and visual amenity is provided in Chapter 22 (Urban design and visual amenity). |
| | Light pollution from compounds and work during construction. | Site lighting would be designed to minimise glare issues and light spillage into adjoining properties. Refer to Chapter 22 (Urban design and visual amenity) for further information. |
| | Visual impacts for residents living adjacent to construction compounds. | Hoardings and temporary noise walls would be erected to provide visual screening where appropriate. Refer to Chapter 22 (Urban design and visual amenity) for further information. |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Visual impacts of the noise attenuation sheds on adjacent residents. | Acoustic sheds would be designed to be visually recessive and to minimise potential overshadowing impacts where possible. Refer to Chapter 22 (Urban design and visual amenity) for further information. |
| | Permanent loss of amenity. | Potential visual amenity impacts are considered and assessed in Chapter 22 (Urban design and visual amenity). |
| **Flora and fauna (on land)** | Potential impacts to threatened species such as the Powerful Owl and the Eastern Pygmy Possum due to Wakehurst Parkway widening. | Vegetation removal along Wakehurst Parkway would be timed to avoid the winter breeding period for the Eastern Pygmy-possum (May to July), where feasible and reasonable.<br>Refer to Chapter 19 (Biodiversity) and Appendix S (Biodiversity development assessment report) for further information on potential impacts to threatened species including the Powerful Owl and Eastern Pygmy Possum. |
| | Impacts on mature trees currently within the Balgowlah Golf Course and on Burnt Bridge Creek Deviation. | Final works to be carried out within Balgowlah Golf Course including adjacent to the existing Burnt Bridge Creek would be subject to further design development. Development of the final layout of the new open space and recreation facilities would be undertaken in conjunction with the Northern Beaches Council and through further community consultation. Every effort would be made to retain mature trees, however the dedicated consultation process would determine the final layout and this would influence decisions regarding vegetation.<br>More information on vegetation removal and potential impacts can be found in Appendix W (Technical working paper: Arboricultural impact assessment). |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Loss of tree cover at Artarmon Park and the assurance of offset vegetation and mature trees. | The project has endeavoured to limit vegetation removal wherever possible and replanting would be carried out as part of rehabilitation work. Transport for NSW would work with Willoughby Council to develop a plan for the rehabilitation of Artarmon Park where the area may have been impacted by excavation works adjacent to the Gore Hill Freeway Connection component.<br>More information on vegetation removal and potential impacts can be found in Appendix W (Technical working paper: Arboricultural impact assessment). |
| | Desire for fauna crossings at Wakehurst Parkway. | Fauna crossings along Wakehurst Parkway have been included in the design. Refer to Chapter 5 (Project description) for further information. |
| **Flora and fauna (marine)** | Damage to marine environments. | Design development for the project included a strong focus on evaluation of potential tunnelling methods for the crossing of Middle Harbour. This analysis was carried out by a multidisciplinary team including design, construction, transport planning, and environmental specialists to ensure a comprehensive analysis.<br>An immersed tube tunnel has been selected as the preferred tunnelling method for the Middle Harbour crossing. The dredging methodology has been designed to minimise impacts on the marine environment and is detailed in Chapter 6 (Construction work). This includes use of appropriate environmental controls to minimise the risk of sediment and contaminants within the sediments being mobilised into the water. These measures reflect best environmental practice to reduce the water quality impacts of dredging and would result in an overall reduction in the extent and intensity of the dredge plumes.<br>There are precedents for successful and environmentally sensitive dredging and immersed tube tunnel construction in sensitive marine environments, like that found at the Middle Harbour crossing, with |
| | Potential impacts to the marine environment including effects to tidal flows and disturbance of toxic sediments. | |
| | Environmental impacts to seagrass beds, mangroves and other species affected by tidal and sediment changes and seabed or increased run off. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | | appropriate technology and methodologies available. Industry experts with direct experience in such work have been engaged for the project to develop the appropriate methodology, equipment and controls.<br>Detailed studies and modelling have been carried out as part of the Western Harbour Tunnel and Beaches Link program of works to understand the harbour's tides, currents, water quality, and marine ecology, along with extensive testing of the sediments at the location of the proposed harbour crossing.<br>Consultation has taken place with technical, marine ecology and human health experts, as well as drawing on knowledge of Sydney Harbour obtained during previous projects.<br>For further information refer to:<br>• Chapter 16 (Geology, groundwater and soils)<br>• Chapter 17 (Hydrodynamics and water quality)<br>• Chapter 19 (Biodiversity) and Appendix T (Technical working paper: Marine ecology). |
| **Hazards and waste** | Run off of hazardous materials. | Management and treatment of wastewater discharge is discussed in Chapter 17 (Hydrodynamics and water quality). Management of spoil, including management of potential runoff from stockpiles, is discussed in Chapter 24 (Resource use and waste management). |
| | Impacts of dumping soil. | The project design has taken into account the principles of the resource management hierarchy as defined in the *Waste Avoidance and Resource Recovery Act 2001.* For further details on the management of waste disposal refer to Chapter 24 (Resource use and waste management). |
| **Social amenity** | Reduction in property values as the result of construction activities including noise, pollution | Property values are driven by a range of economic, social and amenity factors, for example housing supply and demand, interest rates, economic |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | concerns, dust, presence of tunnels underneath homes, the proximity of ventilation outlets and tunnel ramps, increased traffic and parking issues.<br>Loss of open space would result in reduction of property prices. | growth, local amenity and accessibility to such things as employment and social infrastructure. It is likely that broader external factors would influence property values more than perceived or actual impacts resulting from the project. Furthermore, improvements to transport access, reduced travel times and reduced congestion on surface arterial roads delivered by the project are likely to improve liability in many areas. Refer to Chapter 21 (Socio-economics) and Appendix U (Technical working paper: Socio-economic assessment) for further information. |
| | Impacts to social amenity because of construction vehicles in nearby residential streets. | Temporary construction support sites have been selected to provide direct access to the arterial road network, dedicated parking for construction workers (where possible) and to keep trucks and light vehicles off local streets during construction wherever possible. Construction workers would be encouraged to use public transport wherever possible and demand for construction personnel parking would be managed with shuttle buses where appropriate.<br>Potential traffic impacts are considered and assessed in Chapter 8 (Construction Traffic and transport). Also refer to Chapter 21 (Socio-economics) for information on potential impacts on socio-economic issues. |
| **Cumulative impacts** | Cumulative construction traffic impacts as the result of multiple projects active in the area. | Multi-party engagement and cooperation would be established prior to construction to maximise the opportunities for all contributors to work together to minimise adverse impacts or enhance benefits of multiple projects occurring concurrently or consecutively.<br>Potential cumulative construction impacts are assessed and considered in Chapter 27 (Cumulative impacts). For further details, also refer to:<br>• Chapter 6 (Construction work)<br>• Traffic and transport: Chapter 8 (Construction traffic and transport) and Appendix F (Technical working paper: Traffic and transport) |
| | Potential for construction fatigue as a result of ongoing construction activities. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | | • Noise and vibration: Chapter 10 (Construction noise and vibration) and Appendix G (Technical working paper: Noise and vibration)<br>• Air quality: Chapter 12 (Air quality) and Appendix H (Technical working paper: Air quality)<br>• Human health: Chapter 13 (Human health) and Appendix I (Technical working paper: Health impact assessment)<br>• Chapter 19 (Biodiversity)<br>• Chapter 21 (Socio-economics). |
| **Heritage** | Impacts to local Aboriginal sites. | Assessment of potential impacts to Aboriginal heritage is provided in Chapter 15 (Aboriginal heritage) and Appendix L (Aboriginal cultural heritage assessment report). |
| **Health** | General concerns about health as the result of air quality. | During construction, the priority would be to ensure public health and safety. Potential air quality impacts would be managed through standard construction air quality mitigation and management measures, which would include dust suppression measures, selection of construction equipment and/or materials handling techniques that minimise dust generation, minimisation of exposed areas during construction and monitoring activities. Emissions from plant and equipment would be minor and localised. Assessment of construction and operational air quality impacts is provided in Chapter 12 (Air quality) and Appendix H (Technical working paper: Air quality). Potential impacts to health are addressed in Chapter 13 (Human health). |
| | Potential adverse impacts to health as the result of existing medical conditions like asthma and allergies. | |
| | Exposure to silica dust from spoil transport. | |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Health concerns and risks around contaminated harbour spoil. | Design development for the project included a strong focus on evaluation of potential tunnelling methods for the crossing of Middle Harbour. This analysis was carried out by a multidisciplinary team including design, construction, transport planning, and environmental specialists to ensure a comprehensive analysis.<br>An immersed tube tunnel has been selected as the preferred tunnelling method for the Middle Harbour crossing. The dredging methodology has been designed to minimise impacts on the marine environment and is detailed in Chapter 6 (Construction work). This includes use of appropriate environmental controls to minimise the risk of sediment and contaminants within the sediments being mobilised into the water. These measures reflect best environmental practice to reduce the water quality impacts of dredging and would result in an overall reduction in the extent and intensity of the dredge plumes.<br>There are precedents for successful and environmentally sensitive dredging and immersed tube tunnel construction in sensitive marine environments, like that found at the Middle Harbour crossing, with appropriate technology and methodologies available. Industry experts with direct experience in such work have been engaged for the project to develop the appropriate methodology, equipment and controls.<br>For further information refer to:<br>• Chapter 16 (Geology, groundwater and soils)<br>• Chapter 17 (Hydrodynamics and water quality). |

| Issue category | Issue raised | Response to issue and where addressed |
|---|---|---|
| | Potential impacts to health of stakeholder using sporting facilities adjacent to temporary construction support sites. | A comprehensive and robust environmental assessment has been carried out for the project which assesses the potential risks to health and safety as a result of the project. Assessment of construction and operational air quality impacts is provided in Chapter 12 (Air quality) and Appendix H (Technical working paper: Air quality). Potential impacts to health are addressed in Chapter 13 (Human health). |
| | Potential increases in population, and associated issues, in the Northern Beaches due to increased access due to the Western Harbour Tunnel and Beaches Link program of works. | The potential social and economic impacts of the project are considered and assessed in Chapter 21 (Socio-economics). Also refer to Chapter 9 (Operational traffic and transport) and Chapter 13 (Human health). |

## 7.4 Summary of project refinements in response to feedback

A summary of how community and stakeholder feedback has been incorporated into the project is provided in Table 7-9 below.

**Table 7-9 Design refinements – considerations in response to feedback**

| Stakeholder and community | Response |
|---|---|
| Ventilation outlets should be located to minimise community concerns, environmental and property impact. | Permanent ventilation outlets would be placed in the Warringah Freeway corridor allowing the motorway facilities for Western Harbour Tunnel and Beaches Link to be co-located, simplifying long-term operational and maintenance activities and allowing for design synergies and reduced property impact.<br>The air quality assessment has demonstrated that operation of the ventilation outlets for the project would have a negligible impact on existing ambient pollutant concentrations and would pose a very low risk to human health.<br>Chapter 4 (Project development and alternatives) details the alternative tunnel design and ventilation options considered to meet the air quality criteria for the project. |
| Concerns regarding proximity of connections to and from the and Seaforth Oval, including: Wakehurst Parkway to houses<br><br>1. Tunnel portal locations<br>2. Ventilation outlet located near residential streets. | The proposed tunnel portal including motorway facility and ventilation outlet would be located about 500 metres north of Seaforth Oval on Wakehurst Parkway, compared to the initial design location west of Kirkwood Street in 2017. Further project development has reduced private property impacts by relocating the temporary construction support site from the Seaforth Oval overflow carpark to the Sydney Water site north of Kirkwood Street (Wakehurst parkway east construction support site (BL13)). With respect to the connections to and from the Wakehurst Parkway, temporary construction support facilities are now located wholly within Transport for NSW and Sydney Water owned land.<br>The connection to and from the Wakehurst Parkway north of Kirkwood Street was adopted which moved the portal, motorway facility and ventilation outlet north of residential properties. The relocated portal also allowed for ramp tunnel grades to be reduced therefore resulting in improved operational efficiencies.<br>Reduced impacts to Duffys Forest endangered ecological community within Transport for NSW land associated with the original option of a temporary construction support site for tunnelling adjacent to Seaforth Oval.<br>Refer to Chapter 4 (Project development and alternatives) for further details. |
| Options for alternative construction methodologies, temporary construction support sites, and routes to minimise the project impact. | The current proposed construction methodologies for the project have been developed in conjunction with a team of national and international experts with direct experience in the design and construction of major infrastructure within urban environments. These methods have considered the following key factors: |

| Stakeholder and community feedback | Response |
|---|---|
| | • Ability to deliver the required project scope and connectivity<br>• Minimise environmental impacts<br>• Minimise impacts to communities<br>• Ensure safety for construction workers and the public<br>• Minimise the time and cost risks associated with construction<br>• Maximise value for money<br>• Maximise efficiency of construction and future operations of the asset to minimise energy use and operational costs.<br>Proposed temporary construction support sites have been selected to support safe and efficient construction. Key factors applied to identification of potential temporary construction support sites include:<br>• Locate the temporary construction support sites as close as possible to the tunnels or surface works they support to minimise unnecessary tunnelling or heavy vehicle movements<br>• Avoid sensitive environments and community locations where possible<br>• Avoid material impacts to heritage sites or items<br>• Maximise opportunities for direct access to motorways and arterial roads or water transport opportunities for construction traffic, and avoid the need to use local residential streets if possible<br>• Minimise direct and indirect property impacts and acquisitions, particularly in residential areas<br>• Impacts to the functionality of open space.<br>Two temporary construction support sites in particular have been subject to more detailed alternative evaluation:<br>• Wakehurst Parkway east construction support site (BL13)<br>• Flat Rock Drive construction support site (BL2)<br>Refer to Chapter 4 (Project development and alternatives) and Chapter 6 (Construction work) for further information. |
| Concerns about potential changes to local roads, including rat-runs through local streets to access the tunnels. | Potential rat-running would be addressed further through consultation with relevant councils and may include the implementation of traffic calming measures in local streets (refer to Chapter 9 (Operational traffic and transport)). |
| Concern Seaforth Oval sports field would be directly impacted by construction. Concern about construction traffic on local streets and around the oval. | Temporary construction support sites have been chosen and would be designed to minimise local impacts. The Wakehurst Parkway east construction support site (BL13) for tunnelling has been relocated away from the Seaforth Oval carpark and is located at the rear of the Sydney Water Bantry Bay water tanks and north of Kirkwood Street (see Wakehurst Parkway east construction support site (BL13) in Chapter 6 (Construction work)). The relocated temporary construction support site would reduce potential impacts on Seaforth Oval and the Seaforth local community. |

| Stakeholder and community feedback | Response |
|---|---|
| | Additionally, construction traffic carrying tunnel spoil would head north (not south) on Wakehurst Parkway from Wakehurst Parkway east (BL13) construction support site and avoid any potential impact to the Seaforth shopping precinct along Sydney Road. |
| Desire for safe and accessible active transport and connections to existing cycle and walking trails, including the desire to keep shared user path under Burnt Bridge Creek Deviation. | The project would improve safe and accessible active transport and connections by providing new dedicated shared user paths along Wakehurst Parkway, including new underpasses to connect existing trails of Garigal National Park and Manly Dam Reserve.<br>The shared user path crossing Burnt Bridge Creek Deviation would be maintained throughout and after construction. |
| Preference for tunnel ramps and construction to use Balgowlah Golf Course rather than impacting homes, Burnt Bridge Creek bushland or Seaforth Public School (west of Burnt Bridge Creek Deviation). | The modified surface connections at Balgowlah detailed in Chapter 5 (Project description) have been made to reduce community, bushland and private property impacts. The proposed tunnel alignment has been changed so that the tunnel ramps would be located in the centre of Burnt Bridge Creek Deviation. The revised tunnel alignment would also avoid impacts on private properties and minimise impacts to bushland west of Burnt Bridge Creek Deviation.<br>Part of the Balgowlah Golf Course would be used for a temporary construction support site and permanent facilities including a ventilation outlet and new access road, which would mean:<br>• Reduced construction impact on local residences and Seaforth Public School<br>• Less disruption to traffic and buses<br>• Opportunity to re-purpose the Balgowlah Golf Course as new open space and recreation facilities to improve amenity and help manage the growing shortfall in recreational space in the area, in line with Northern Beaches Council objectives. The final design of the re-purposing works would be determined in conjunction with Northern Beaches Council and through further community consultation. |
| Concern about a ventilation outlet to be located in the Burnt Bridge Creek ‘valley’. | The design of the ventilation systems, including ventilation outlet locations, has been carefully developed to make sure they operate efficiently and there would be minimal changes to local air quality. The proposed ventilation outlet would be located near the tunnel ramps, in the Balgowlah Golf Course precinct.<br>Operation of these facilities would be carried out in accordance with strict guidelines and would be monitored closely by the relevant authorities.<br>Refer to Chapter 12 (Air quality), Appendix H (Technical working paper: Air quality), Chapter 13 (Human health) and Appendix I (Technical working paper: Health impact assessment) for details on operational impacts and management measures in relation to ventilation outlets. |

| Stakeholder and community feedback | Response |
|---|---|
| Concern about queuing of vehicles going in and out of the tunnel ramps and traffic impacts on local roads. | Improved design of connections to Condamine Street and a new access road to Sydney Road would provide improved access outcomes and reduced congestion for the local road network.<br>Refer to Chapter 9 (Operational traffic and transport) for further details on operational impacts. |
| Desire to avoid Artarmon Reserve sports field | There would be no temporary construction support site located at Artarmon Reserve or direct impact to Artarmon Reserve sports field. |
| Desire to avoid the homes to the north of Gore Hill Freeway | No residential properties would be acquired in this area. |
| Preference to locate the ventilation outlet to the south of Gore Hill Freeway in industrial area | The proposed ventilation outlet would be located in the Artarmon industrial area, south of Gore Hill Freeway.<br>Refer to Chapter 12 (Air quality), Appendix H (Technical working paper: Air quality), Chapter 13 (Human health) and Appendix I (Technical working paper: Health impact assessment) for details on operational impacts and management measures in relation to ventilation outlets. |
| Concerns about the clearing of bushland adjacent to Gore Hill Freeway | The project has avoided impact to Artarmon Reserve through redesign and by further widening to the south. Widening to the north would require vegetation removal in Artarmon Park. The final extent of removal would be assessed during further design development and detailed construction planning, and further reduced where feasible and reasonable. Appendix W (Technical working paper: Arboricultural impact assessment) provides a preliminary assessment of trees that could be retained subject to further design development and construction planning. |
| Desire to be able to access both the Western Harbour Tunnel and Beaches Link from Artarmon. | Access to Beaches Link via Gore Hill Freeway and Reserve Road and access to Western Harbour Tunnel provided via Gore Hill Freeway. |
| Concern regarding proximity to schools in the Cammeray and North Sydney area, in particular in relation to ventilation outlets. | The design of the ventilation systems, including ventilation outlet locations, has been carefully developed to make sure they operate efficiently and there would be minimal changes to local air quality. The air quality assessment has demonstrated that the emissions from the ventilation outlets of the project have a negligible impact on existing ambient pollutant concentrations and would pose a very low risk to human health.<br>Operation of these facilities would be carried out in accordance with strict guidelines and would be monitored closely by the relevant authorities.<br>Refer to Chapter 12 (Air quality), Appendix H (Technical working paper: Air quality), Chapter 13 (Human health), Appendix I (Technical working paper: Health impact assessment), Chapter 10 (Construction noise and vibration) and Appendix G (Technical working paper: Noise and vibration) for details on construction management measures. |

## 7.5 Future engagement

A Community consultation framework (Appendix E) has been prepared to guide the planning and delivery of communication and stakeholder engagement activities across the project.

The objective of ongoing communication and stakeholder engagement program for the project, guided by the Community consultation framework, is to provide the community with:

- Accurate and accessible information about the processes and activities associated with the project
- Information in a timely manner
- Appropriate avenues for providing comment or raising concerns, and to ensure the community is aware of the avenues
- A high level of responsiveness to community feedback and concerns throughout development and delivery of the project.

The Community consultation framework informs the delivery of the communication and stakeholder engagement in line with the requirements of the Secretary's environmental assessment requirements. The framework addresses key issues of concern to the community, including:

- Enquiries and complaints handling procedures
- Monitoring, reporting and evaluation procedures
- Mechanisms for distributing information and seeking feedback
- Specific issues management including:
  - Traffic management (including property access and pedestrian access)
  - Landscaping and urban design matters
  - Construction activities including out of hours work
  - Noise and vibration mitigation and management.

### 7.5.1 Submissions report

Following exhibition of this environmental impact statement, the Secretary would provide copies of submissions from the community and stakeholders to Transport for NSW as the proponent. Transport for NSW would then prepare a submissions report to respond to the feedback received in submissions. The Secretary may also require Transport for NSW to prepare a preferred infrastructure report to outline any proposed changes to the project. This report may be made publicly available if significant changes to the project are proposed.

The Secretary would prepare an assessment report and provide it to the Minister for Planning and Public Spaces, who would then decide whether to approve the project and, if approved, identify a set of conditions of approval for Transport for NSW to adhere to during construction and operation of the project.

Community involvement would continue as part of the project's construction, should the project be approved. A construction contractor would be engaged to carry out further design development and construction. Together with the proponent, the construction contractor would be responsible for communication and engagement and a detailed communication and engagement strategy would be developed and implemented. This would be based on the framework provided in Appendix E (Community consultation framework).

Community liaison would also continue during the operation phase of the project. A communication plan would be developed to support maintenance and operations of the motorway as a key part of the operational environmental management plan framework.

### 7.5.2 Managing consultation fatigue

The extent and impacts of consultation fatigue would be assessed by:

- Identifying potentially impacted stakeholders and community members by both previous/current projects and the project
- Analysing the type, extent and timing of consultation, for both this project and other projects, that has been/would be received by these community members
- Determining whether consultation for the project is likely to result in overload or disinterest for community members.

The community relations team would continue to work with the project teams for other major projects and developments in the area to identify those persons or organisations who may be susceptible to consultation fatigue.

The community relations team would work to develop an integrated approach to contacting persons or organisations which may experience consultation fatigue and would determine which communication mechanisms stakeholders prefer.

### 7.5.3 Managing construction fatigue

The extent and impact of construction fatigue would be assessed by:

- Identifying where the project would have sustained impacts to stakeholders or community members
- Identifying whether the project would result in similar or overlapping impacts with other projects, to the same stakeholders or community members
- Analysing whether the project would increase the magnitude and intensity of overlapping impacts on any stakeholders or community members
- Analysing the extension of duration of impacts for stakeholders or community members.

A preliminary assessment was completed to identify areas where the project would potentially have sustained impacts to stakeholders or community members who may be susceptible to construction fatigue. Project activities which could lead to construction fatigue, potentially impacted groups, and a summary of management measures proposed to address these issues is provided in Chapter 27 (Cumulative impacts).

During construction of the project, the community relations team would build a working relationship with the project teams for other major projects to identify stakeholders or community members who may be susceptible to construction fatigue. The community relations team would ensure the expectations of these stakeholders or community members are managed for the project.

### 7.5.4 Managing complaint fatigue

The extent and impact of complaint fatigue would be assessed by:

- Identifying regular complainants from previous and current projects close to the temporary construction support sites
- Analysing the cause and solution to each complaint
- Determining whether the project would result in similar or overlapping impacts with other projects, which are likely to result in a complaint.

A complaints management system would be implemented for the duration of construction. This would include the recording of complaints and how the complaint has been addressed (within a complaints register). Complainants would be contacted within 24 hours to follow up and respond to their complaint. A Community Complaints Commissioner (an independent specialist) would

oversee the system and follow up on any complaint where the public is not satisfied with the response.

The community relations team would build a working relationship with the project teams for other major projects and developments which would be under construction at the same time as the project to identify stakeholders and community members who may be susceptible to complaint fatigue.

Transport for NSW would ensure a number of different complaint mechanisms are provided to cater to different needs and preferences. Complaint management tools for the project are outlined in Appendix E (Community consultation framework).

### 7.5.5 Interface management

The community relations team would work closely with other government agencies to ensure the various State Government and local government projects are releasing and/or consulting on projects in collaboration with each other and to reduce consultation and construction fatigue in local communities.

At present there is a formal group, the Intergovernmental Working Group – Northern Beaches/Mosman, which meets regularly to manage potential cumulative impacts. The group consists of engagement leads from agencies which have an interface around the Northern Beaches/Mosman precinct. Attendance at meetings varies depending on the work and activities being carried out at the time and includes:

- Mosman Council
- Northern Beaches Council
- Manly MP office
- Pittwater MP office
- Transport for NSW.

Additional coordination groups would be developed as required.