

# Part C | Sydney Metro West Stage 1

## 9 Stage 1 description

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This chapter describes the likely key construction works for Stage 1 and identifies the construction sites required.

## 9.1 Secretary’s Environmental Assessment Requirements

The Secretary’s Environmental Assessment Requirements relating to Stage 1, and where these requirements are addressed in this Environmental Impact Statement, are outlined in Table 9-1.

Table 9-1: Secretary’s Environmental Assessment Requirements – Stage 1 description

Reference	Secretary’s Environmental Assessment Requirements	Where addressed
<b>2. Environmental Impact Statement</b>		
<b>2.1</b>	d. A description of Stage 1, including key components and activities (including ancillary components and activities) required to construct that stage	This chapter
	i. a concise description of different construction methods that were analysed and justification for preferred methods;	Section 9.4
<b>3. Social and Economic (including property, land use and business impacts)</b>		
<b>3.7</b>	Disruption to utilities and services	Section 9.6

## 9.2 Stage 1 overview

Stage 1 would involve major civil construction works for Sydney Metro West (Westmead to The Bays) including:

- Enabling works such as demolition, utility supply to construction sites, utility adjustments and modifications to the existing transport network
- Tunnel excavation including tunnel support activities
- Station excavation for new metro stations at Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North, Five Dock and The Bays
- Shaft excavation for services facilities at Rosehill (within the Clyde stabling and maintenance facility construction site), between Five Dock Station and The Bays Station construction sites, and at Silverwater
- Civil work for the stabling and maintenance facility at Clyde including earthworks and structures for crossings of A’Becketts Creek and Duck Creek
- A concrete segment facility for use during construction located at the Clyde stabling and maintenance facility construction site
- Excavation of a tunnel dive structure and associated tunnels at Rosehill to support a connection between the Clyde stabling and maintenance facility and the mainline metro tunnels.

The Stage 1 alignment is indicative at this stage and has been used for the purposes of the environmental impact assessment, including all specialist investigations. During detailed design the alignment may change. Any changes to the alignment would be reviewed for consistency with the assessment contained in this Environmental Impact Statement including relevant mitigation measures, performance outcomes and any future conditions of approval.

The location of Stage 1, including the underground tunnel and construction sites for the stations and services facilities are shown on Figure 9-1. Further details and an indicative long section is shown on Figure 9-2(a) to Figure 9-2(h). Sydney Metro are also seeking Interim Corridor Protection through provisions in the State Environmental Planning Policy (Infrastructure) 2007. The proposed interim corridor is also shown on Figure 9-2(a) to Figure 9-2(h).

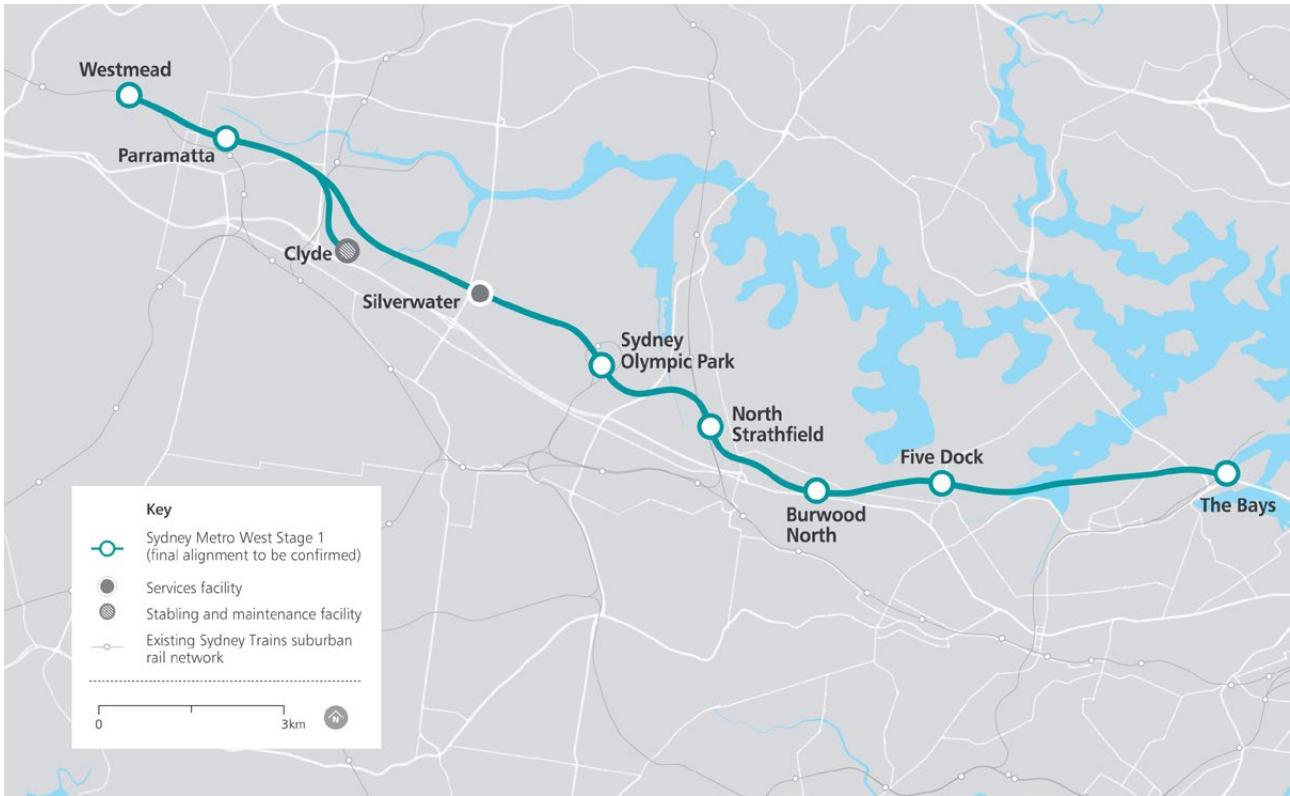


Figure 9-1: Location of Stage 1



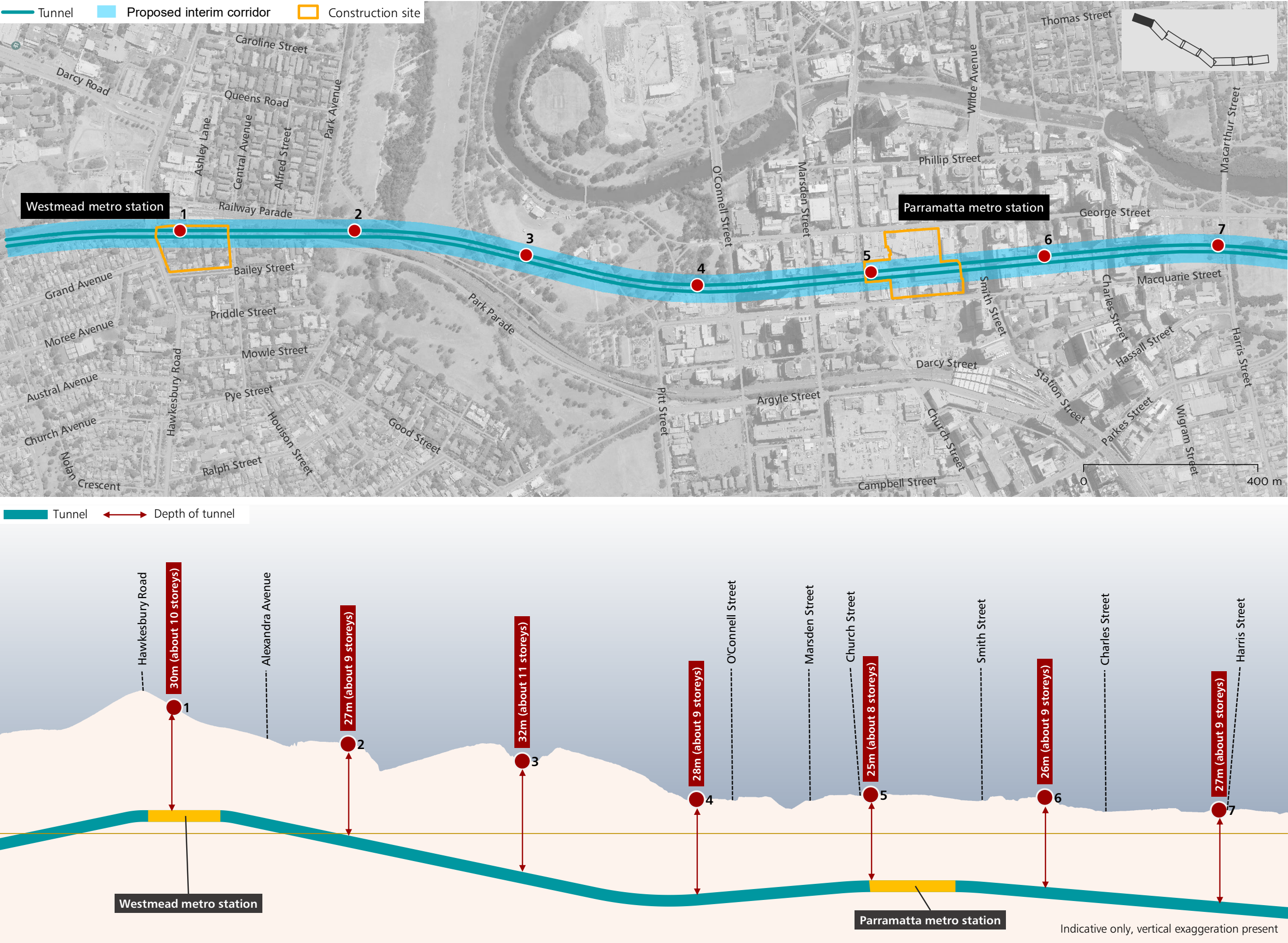


Figure 9-2(a): Indicative alignment plan and long section



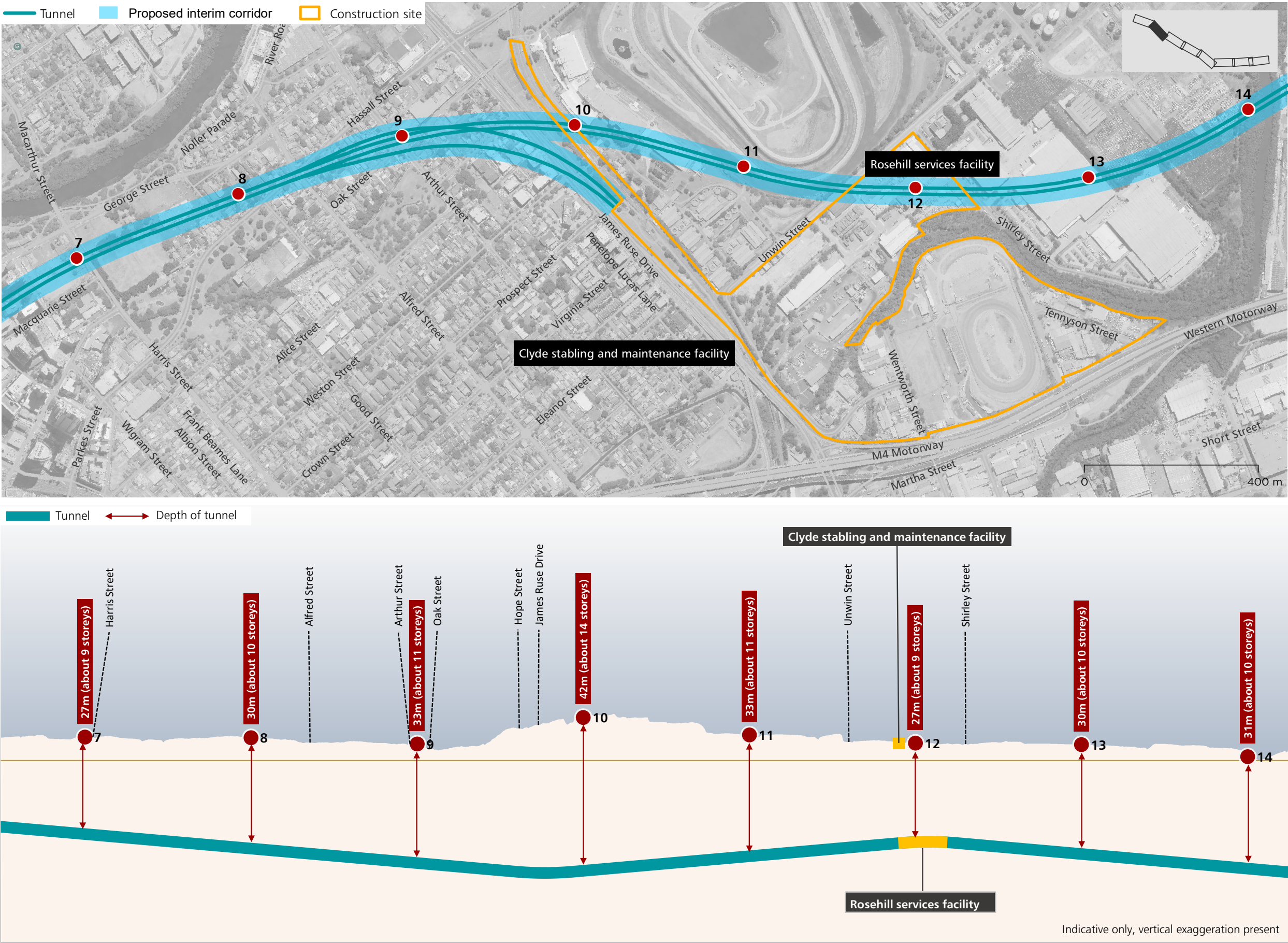


Figure 9-2(b): Indicative alignment plan and long section



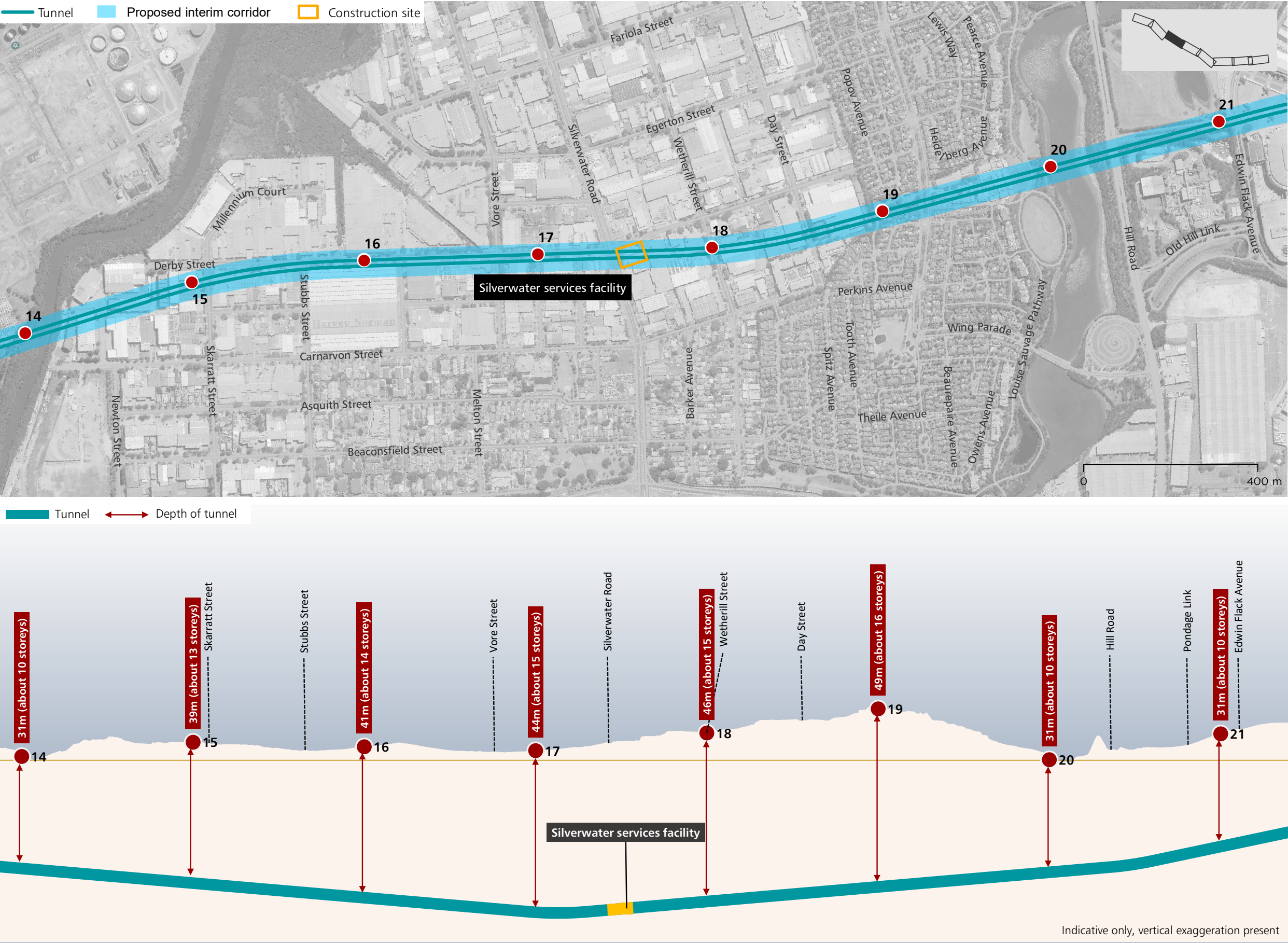


Figure 9-2(c): Indicative alignment plan and long section



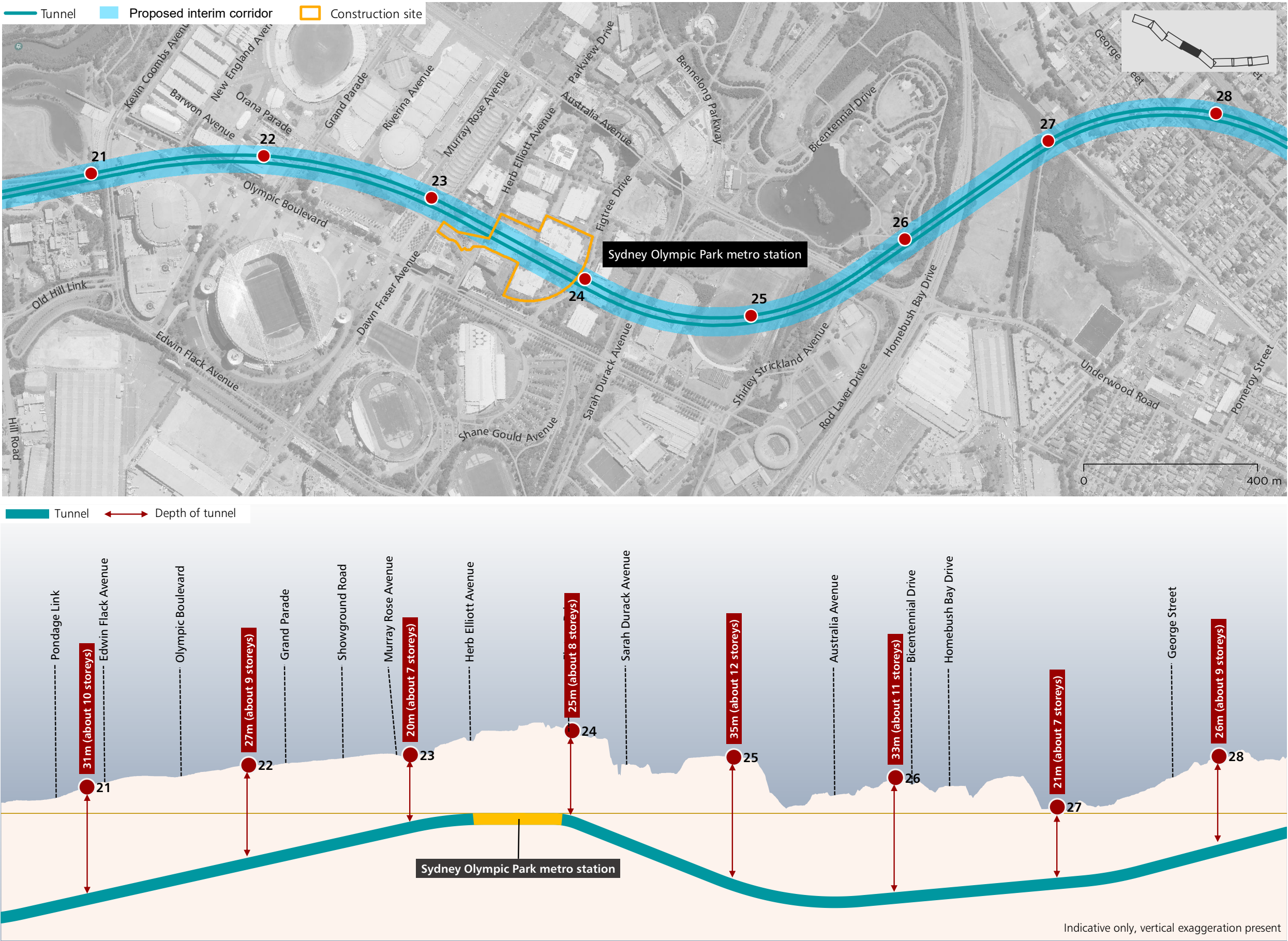


Figure 9-2(d): Indicative alignment plan and long section



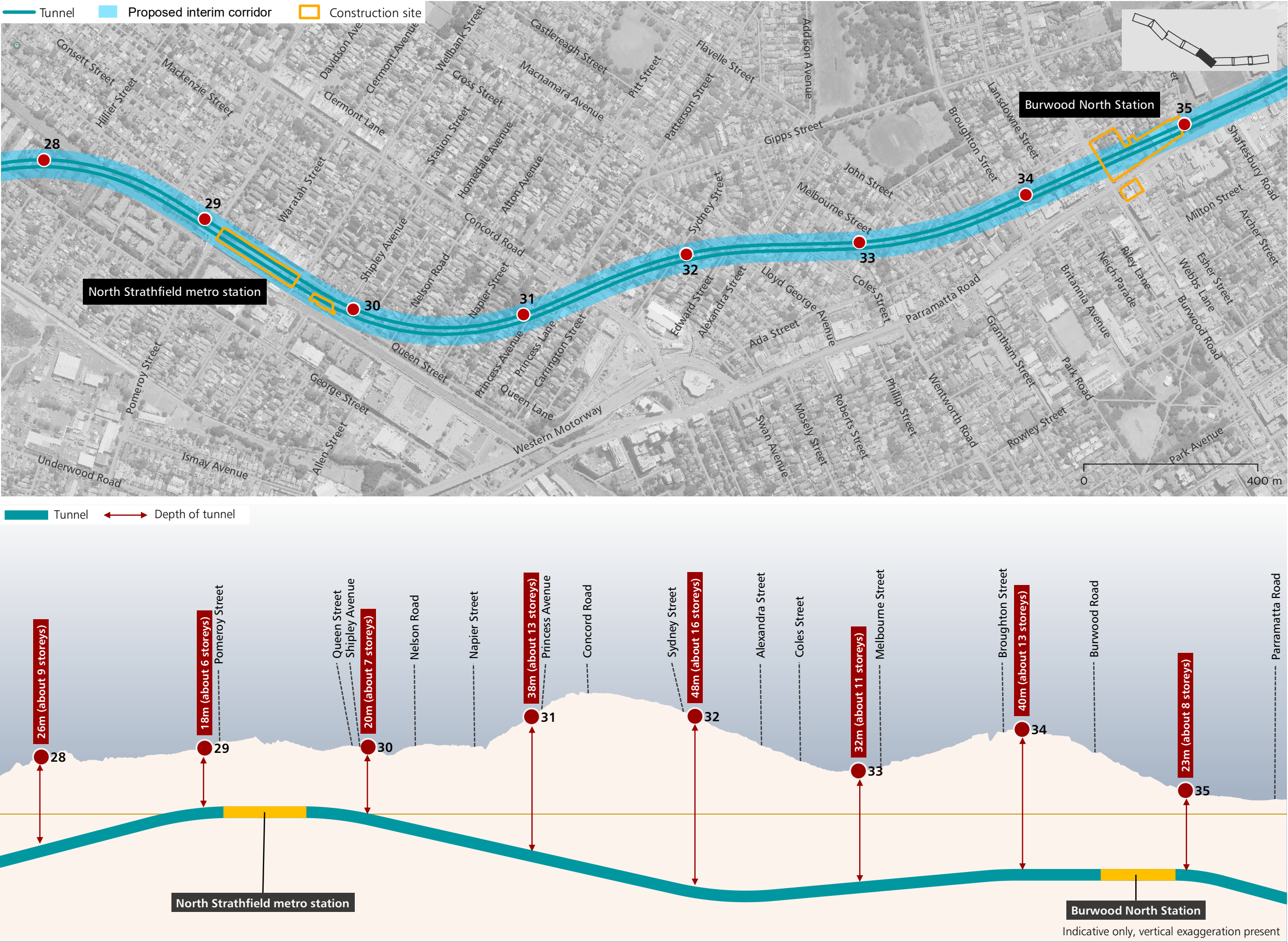


Figure 9-2(e): Indicative alignment plan and long section



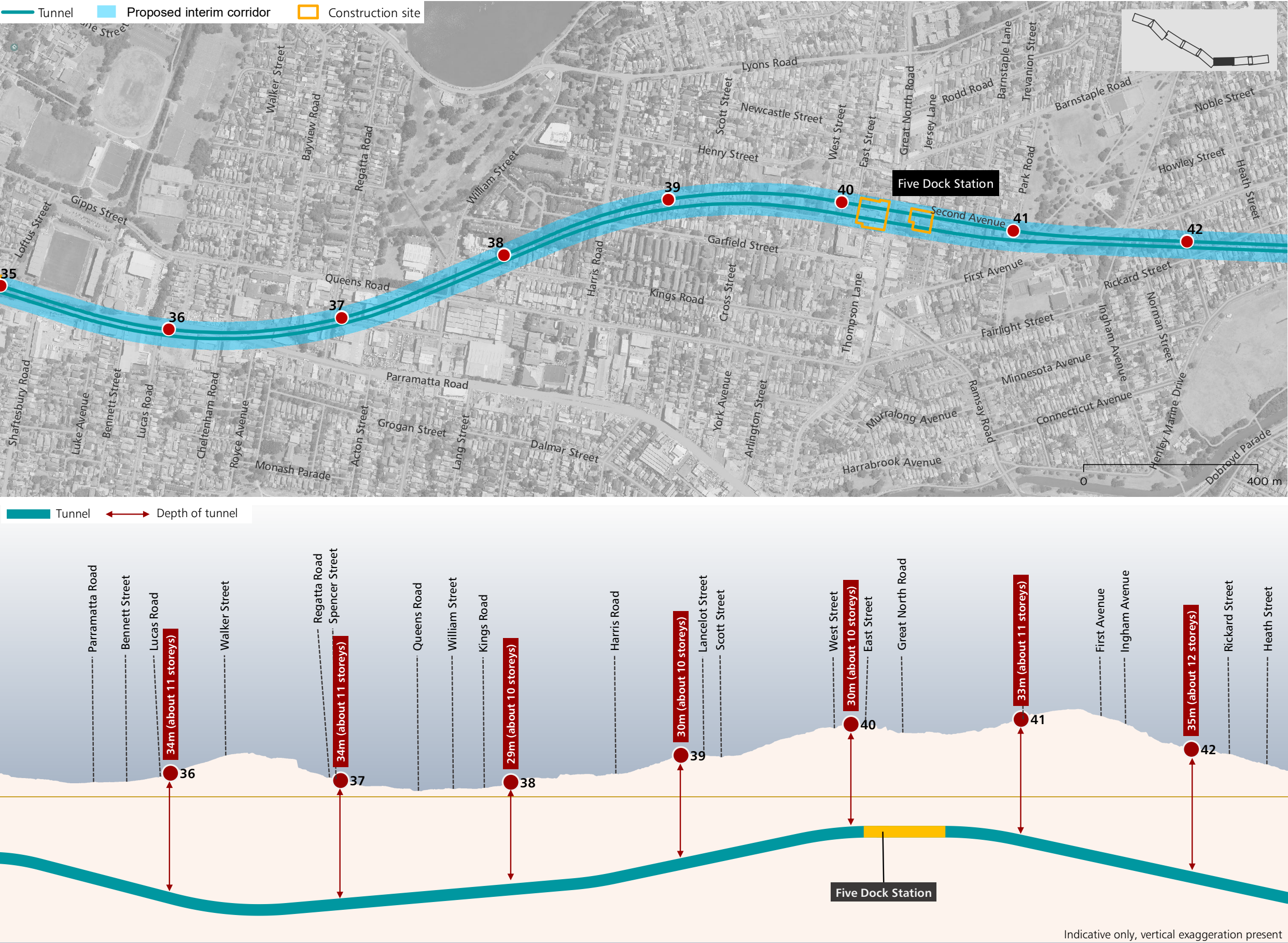


Figure 9-2(f): Indicative alignment plan and long section



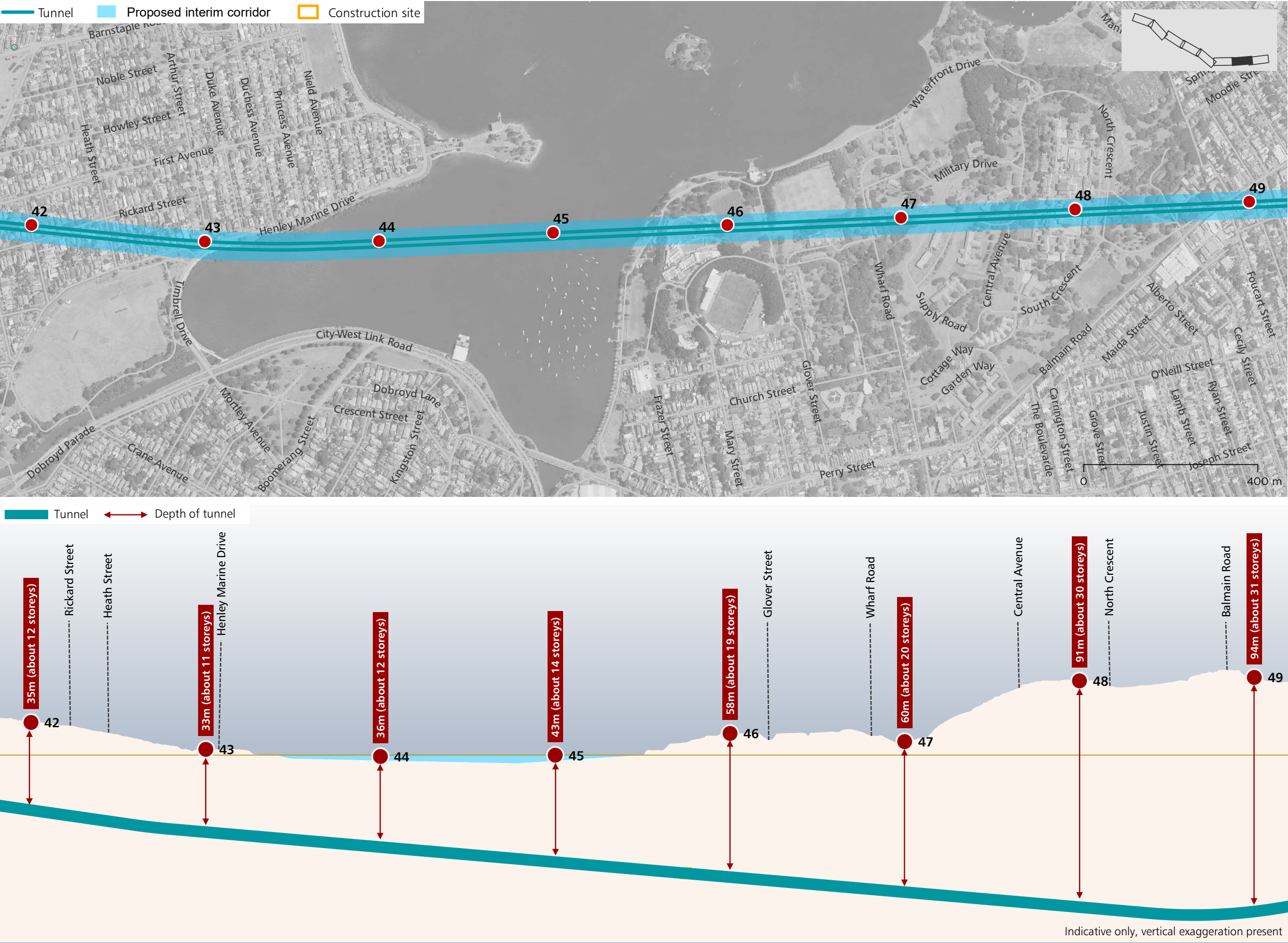


Figure 9-2(g): Indicative alignment plan and long section



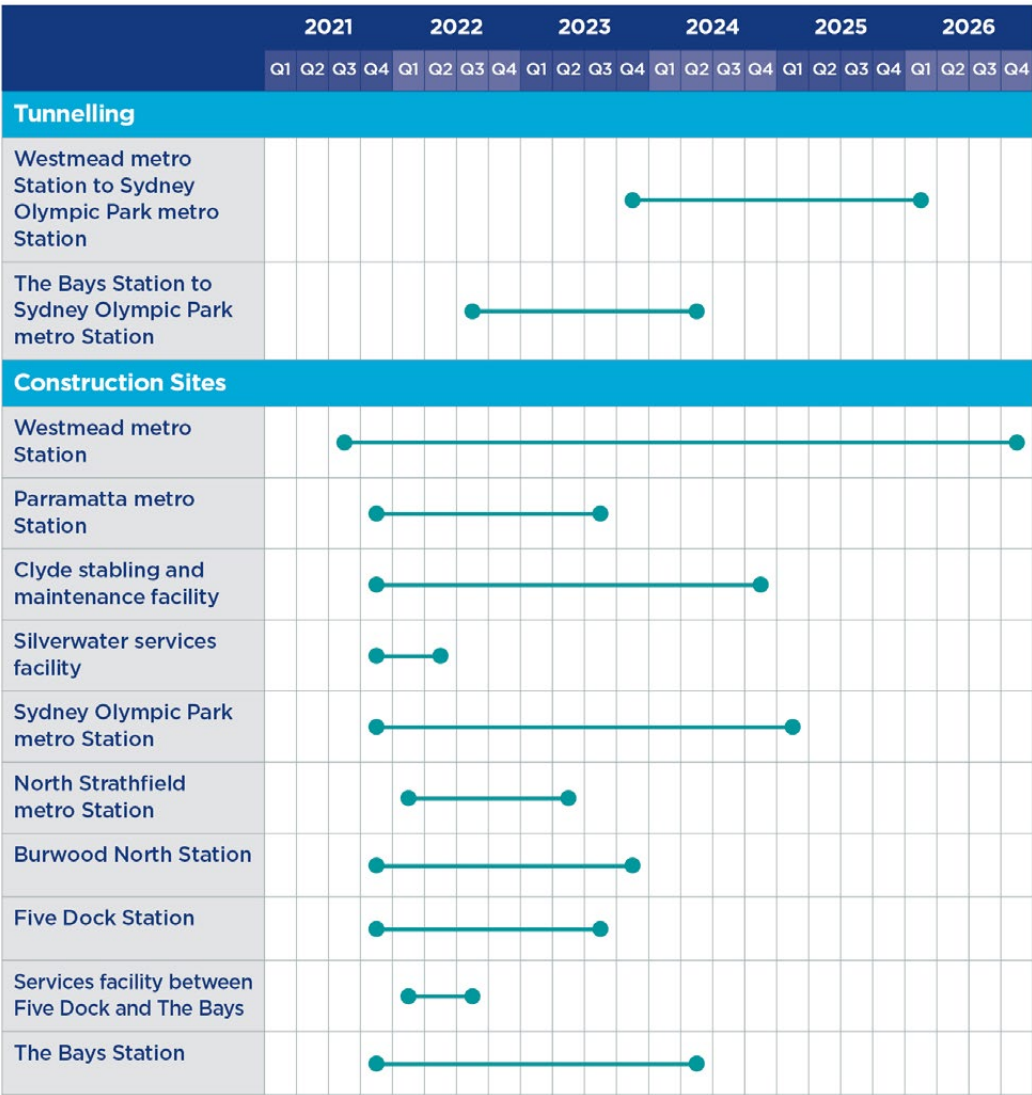


Figure 9-2(h): Indicative alignment plan and long section



9.3 Indicative construction program for Stage 1 - major civil works

Enabling works (preliminary construction works required to facilitate commencement of substantial construction) would likely begin prior to the commencement of major construction works. The total period for the major civil works (Stage 1- construction works) between Westmead and The Bays would be around five years followed by a further period for construction of stations, depots and rail systems with time also required to test and commission and bring the rail line into operation. An indicative construction program for just the major civil works (Stage 1) is shown in Figure 9-3. The actual program and commencement of the civil works at each construction site may vary and is subject to the final delivery strategy and actual construction program to be agreed with the successful contractor for each work package.



Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 9-3: Indicative construction program

9.4 Construction methods

9.4.1 Enabling works

Enabling works are activities that would typically be carried out before the start of substantial construction in order to make ready the key construction sites and to provide protection to the public. Enabling works are expected to include:

- Construction site establishment (refer to Section 9.5)
- Demolition of buildings and structures within the proposed construction footprint (refer to Section 9.6.4)
- Utility adjustments and protection (refer to Section 9.6.5)
- Utility supply to the construction sites including power and water (refer to Section 9.6.5)
- Transport network modifications to roads, public transport, and pedestrian and cyclist facilities (refer to Section 9.6.7)
- Heritage investigations, protection and archival recordings (refer to Chapter 12 (Non-Aboriginal heritage – Stage 1) and Chapter 13 (Aboriginal heritage – Stage 1))
- Additional geotechnical and contamination investigations and remediation where required (refer to Chapter 18 (Groundwater and ground movement – Stage 1) and Chapter 20 (Contamination – Stage 1)).

These works are described further in the relevant sections of this chapter.

9.4.2 Tunnels

Tunnel boring machines would be used to excavate twin tunnels about 21 kilometres long. The tunnel alignment for Stage 1 is shown in on Figure 9-2(a) to Figure 9-2(h). The two bored tunnels would have a circular cross-section with an internal lined diameter of about six metres and an excavated diameter of about seven metres.

The following underground features would also be excavated using roadheaders and rock hammers:

- Cross passages between the two tunnels at intervals of about 240 metres to allow for emergency access
- Stub tunnels from the twin tunnels near Westmead metro station to safeguard a potential future extension to the metro network.

The centre lines of the two tracks would typically be about 14 metres apart, however this would depend on specific geological constraints and the need to avoid building basements. The tunnels would be lined with precast concrete segments to ensure the long term life of the asset and minimise groundwater inflow into the tunnel.

The depth of the tunnels would vary from about 15 to 90 metres deep due to changes in topography. The shallower tunnel sections would generally be near the tunnel portal at Rosehill and near cut-and-cover stations.

Tunnelling methods

Tunnel boring machines

Tunnel boring machines are likely to be used to excavate most of the twin tunnels as they are faster than roadheaders and excavate the desired tunnel profile, thereby reducing spoil volumes. Each tunnel boring machine would typically consist of a shielded cutting head and trailing backup support services and mechanisms. At the front of the shield is a rotating cutter head, and behind the cutter head is a chamber where the excavated rock and sediments (spoil) are removed. The spoil is transferred to a conveyor to transport the spoil to the tunnel boring machine support site for removal. The tunnel boring machine is propelled forward by hydraulic jacks pushing off the previously erected segments or pushing off the tunnel wall with rock grippers. Photos of tunnel boring machines are shown in Figure 9-4 and Figure 9-5.





Figure 9-4: Photo of a tunnel boring machine cutter head



Figure 9-5: Photo of a tunnel boring machine at Epping Station on the Metro North West Line

**Roadheaders**

Roadheaders would be used to excavate irregular shaped tunnels such as stub tunnels, cross passages, crossover and turnback caverns and niches. These would generally be constructed following excavation of the main tunnels by the tunnel boring machines. Roadheaders would also be used to excavate mined station caverns, underground pedestrian connections, shafts and the connecting tunnels between the Rosehill dive structure and the mainline tunnels.

A roadheader is an excavation machine consisting of a boom mounted rotating cutter head mounted on bulldozer style tracks, a loading device, and a crawler track to move the machine forward into the rock face. A photo of a typical roadheader is shown in Figure 9-6. Tunnel support for roadheader sections would consist of a primary lining (likely to be pattern rock bolting and shotcreting) and a final cast in-situ or sprayed concrete lining.



Figure 9-6: Photo of a roadheader



**Rock hammers**

Excavators with rock hammer attachments would be used to excavate cross passages and niches within the tunnels. These would generally be constructed following excavation of the main tunnels by the tunnel boring machines. Tunnel support for rock hammer sections would consist of a primary lining (likely to be pattern rock bolting and shotcreting) and a final cast in-situ or sprayed concrete lining. A photo of a typical rock hammer is shown in Figure 9-7.



Figure 9-7: Photo of a rock hammer

**Tunnel lining**

Tunnels would be lined with precast concrete segments which are erected by the tunnel boring machines as it moves forward. The precast concrete segments would be manufactured at a dedicated precast facility at the Clyde stabling and maintenance facility construction site with storage at each tunnel boring machine launch site.

**Tunnelling launch and support**

**Launch sites and sequence**

It is anticipated that tunnelling would occur from two tunnel boring machine launch and support sites:

- Westmead metro station construction site
- The Bays Station construction site.

Two tunnel boring machines would be launched from each of the launch sites. Following launch of the tunnel boring machines, these construction sites would provide necessary support for the tunnelling operation including spoil storage and removal, power supply to the tunnel boring machines, fresh air ventilation, grout batching, water treatment and disposal, material storage as well as office facilities, worker amenities and parking. A photo of the Sydney Metro City & Southwest Marrickville dive site, which is a tunnel boring machine launch site, is shown in Figure 9-8.

Tunnelling would occur concurrently, with the use of four tunnel boring machines. The tunnelling sequence is shown on Figure 9-9.



Figure 9-8: Photo of the Sydney Metro City & Southwest Marrickville dive site

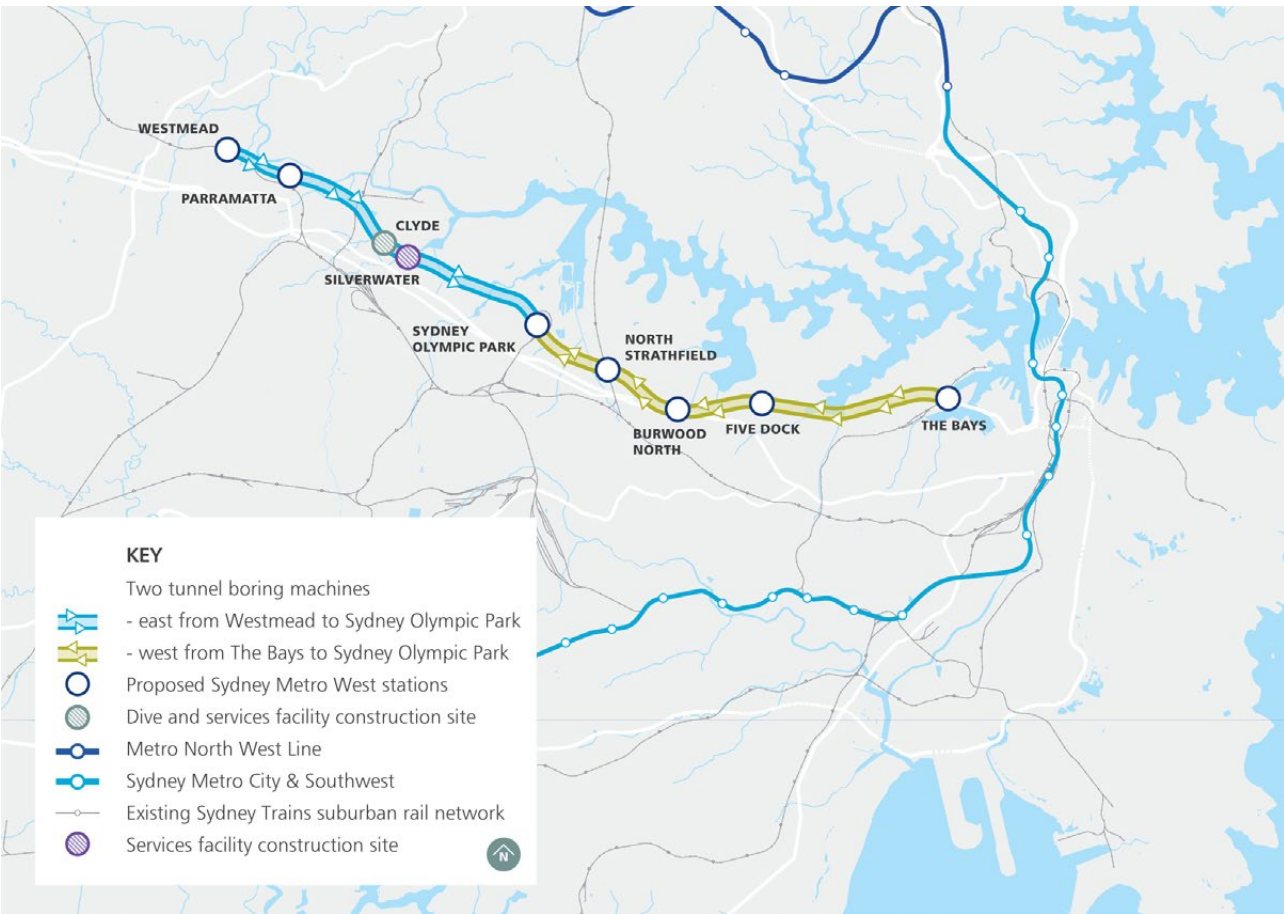


Figure 9-9: Indicative tunnelling sequence



***Tunnelling from Westmead***

Two tunnel boring machines (one for each tunnel) would be launched from the Westmead metro station construction site. These two tunnel boring machines would be driven about nine kilometres eastwards to the Sydney Olympic Park metro station construction site.

The tunnel boring machines would be launched from the station box excavation. Station box excavation may be carried out using excavators and rock hammers, however, drill and blast or penetrating cone fracture techniques may also be used (described in Section 9.4.2).

The tunnel boring machines would be dismantled and retrieved at the Sydney Olympic Park metro station construction site.

***Tunnelling from The Bays***

Two tunnel boring machines (one for each tunnel) would be launched from The Bays Station construction site. These two tunnel boring machines would be driven about 11 kilometres westwards to the Sydney Olympic Park metro station construction site.

The tunnel boring machines would be launched from the station box excavation. Station box excavation may be carried out using excavators and rock hammers, however, drill and blast or penetrating cone fracture techniques may also be used (described in Section 9.4.2).

The tunnel boring machines would be dismantled and retrieved at the Sydney Olympic Park metro station construction site.

***Support services***

The two launch sites would require support services for the tunnel boring machines, incorporating power supply, fresh air ventilation, work trains, grout batching plant, storage space for precast concrete lining segments, water supply, drainage and water treatment, workforce facilities, and spoil handling and removal facilities. Section 9.5.1 and Section 9.5.10 provides further details regarding these construction sites at Westmead metro station and The Bays Station respectively.

The tunnel boring machine support sites and the station and services facility construction sites would provide fresh air ventilation (both the extraction of air and the provision of fresh air) to the tunnels during construction to ensure the safety of workers. Fresh air ventilation fans would operate 24 hours per day, seven days per week during tunnelling and station construction.

Work trains may be required within the tunnels to transport materials, precast concrete lining segments and the workforce to the cutting face. If these are used, temporary rail tracks for the work trains would be progressively laid in sections as the tunnel boring machines advance. At the completion of tunnelling, the temporary rail tracks would be removed. Alternatively, transport of materials into the tunnels may be carried out with conveyor systems and special purpose rubber tyred vehicles.

**9.4.3 Stations**

Seven stations are proposed along the tunnel alignment for Stage 1. This section provides an overview of the station excavation and structural work required at each of these stations.

**Station excavation and structural work**

***Excavation method***

The depth of the stations would vary from about 18 to 35 metres. Excavation of the stations would usually be carried out using excavators and rock hammers. Due to the anticipated impacts associated with this excavation method, several contemporary alternatives were explored.

Preliminary construction planning suggests that track sawing, wire cutting, rock bursting/splitting or penetrative cone fracture could be used to supplement other excavation methods to reduce overall construction noise and vibration impacts.

At most sites, controlled blasting is likely to result in an overall reduced duration of excavation, including the associated impacts from rock hammering. In order to achieve compliance with the relevant criteria for blasting, the use of rock hammers would still be necessary until appropriate offset depths for blasting are reached.

Based on construction planning, the preferred excavation method for the stations would be a combination of rock hammers, excavators and controlled blasting. Initial excavation at each station site would involve the use of rock hammers and excavators until appropriate offset depths are reached in order to achieve compliance with the relevant blasting criteria. Controlled blasting may also be used for the construction of vertical shafts for the services facilities at Rosehill, Silverwater and between Five Dock and The Bays (described in Section 9.4.4). Based on the anticipated ground conditions, the depth at which blasting could commence at each site is provided in Table 9-2.

The blasting charge sizes would likely be between 0.25 kilograms and five kilograms. The initial charge size would be selected to meet the relevant criteria and increased as the excavation becomes deeper (and the offset distances to receivers increases). Further details regarding controlled blasting and appropriate mitigation are provided in Chapter 11 (Noise and vibration – Stage 1).

**Table 9-2: Indicative initial depth of controlled blasting**

Construction site	Indicative initial depth of controlled blasting (metres) <sup>1</sup>
Westmead metro station	15
Parramatta metro station	20
Clyde stabling and maintenance facility	15 (dive structure) 20 (services facility shaft)
Silverwater services facility	15
Sydney Olympic Park metro station	15
North Strathfield metro station	15
Burwood North Station	15
Five Dock Station	15
Services facility between Five Dock and The Bays	15
The Bays Station	20

*Note 1: 15 metres is the equivalent of around five storeys below ground, and 20 metres is the equivalent of around six to seven storeys below ground*

***Cut-and-cover stations***

Cut-and-cover construction is proposed for Westmead, Parramatta, Sydney Olympic Park, North Strathfield, Burwood North and The Bays metro stations.

A typical construction method for cut-and-cover station excavation is shown in Figure 9-10. Generally, the construction method would involve:

- Securing the site perimeter, demolishing buildings and diverting utilities
- Establishing site access roads, signalised intersections and hardstand areas
- Excavating the station from the surface down to the level of the base slab with a temporary shoring retention system in place.

As noted above, a temporary shoring retention system would be required to maintain the stability of the open excavation and minimise groundwater ingress in soft/weak ground. The retention system would likely consist of one or more of the following:

- Secant piles in areas of potentially soft/weak and permeable soil/rock
- Diaphragm walls in areas of potentially soft/weak and permeable soil/rock at substantial depths
- Soldier piles with sprayed concrete panels between.

With the exception of Parramatta metro station and North Strathfield metro station construction sites (as regular out of hours excavation works are not proposed at these sites), acoustic sheds are proposed at cut-and-cover stations, although alternative means of achieving the same noise outcome (reduced noise to receivers), such as acoustic panels over the station excavations, may be adopted. Specific noise mitigation measures would be determined during detailed construction planning taking into account construction program, construction working hours and construction traffic management in accordance with the Construction Noise and Vibration Standard (refer to Appendix E).



Typically, station excavation would occur prior to arrival of the tunnel boring machines although at some sites the tunnel boring machines may pass through prior to completion of station excavation. The construction of the station would progress down to the level of the base slab with intermediate temporary horizontal braces, anchors and shoring installed as required.

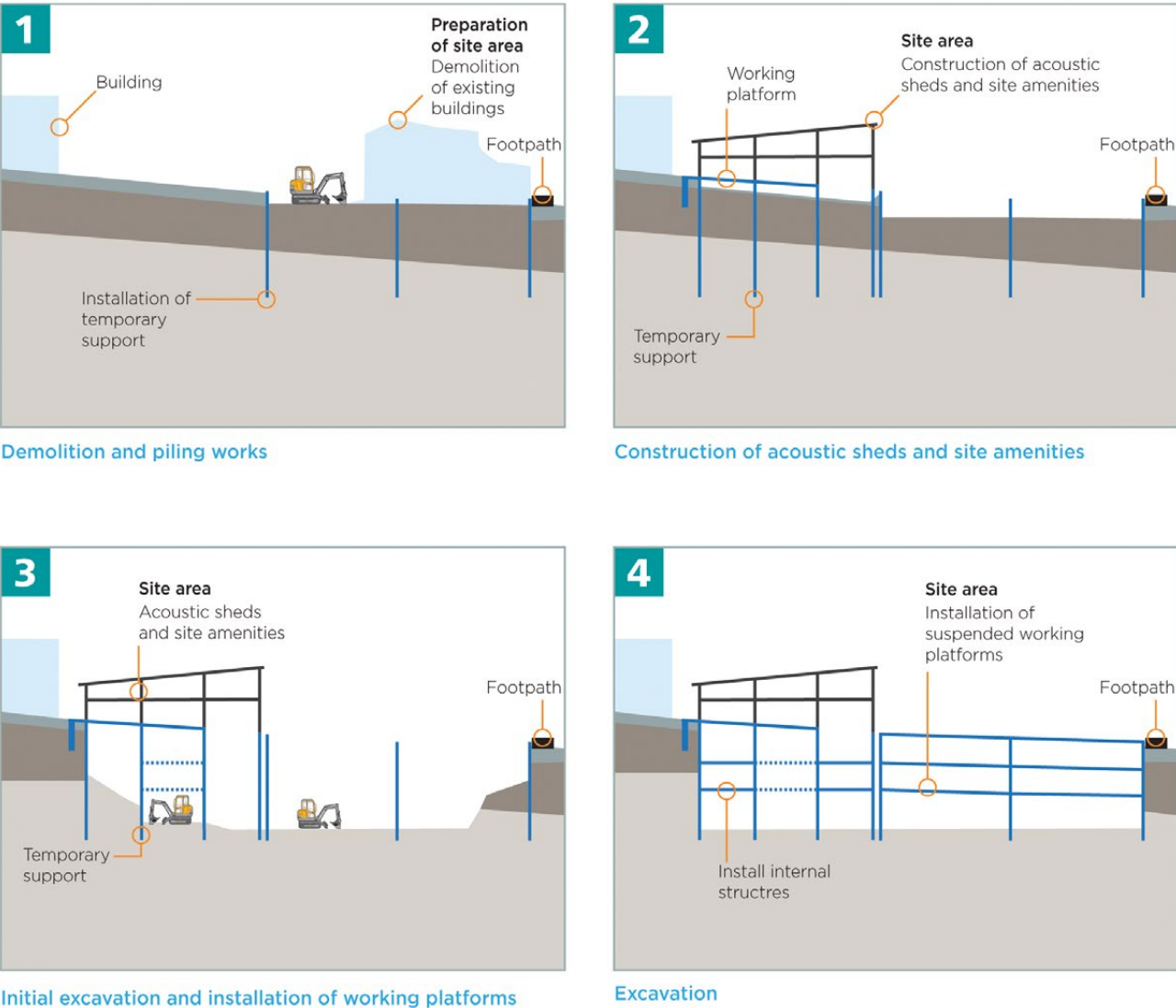


Figure 9-10: Typical cut-and-cover station construction

**Mined cavern stations**

Five Dock Station would be constructed as binocular mined caverns. A typical construction method for cavern station excavation is shown in Figure 9-11.

Acoustic sheds are proposed at the Five Dock Station construction site, although alternative means of achieving the same noise outcome, such as acoustic panels over the shaft excavations, may be adopted. The specific noise mitigation measures would be determined during detailed construction planning taking into account the construction program, construction working hours and construction traffic management in accordance with the Construction Noise and Vibration Standard (Appendix E).

For mined cavern stations, the shafts for future station entry and vertical transport would be typically offset from the location of future station platforms. Shafts would be progressively excavated from the surface within the footprint of the future vertical transport to an intermediate floor level. Roadheaders and other excavation equipment would then be lowered through the shaft to excavate the underground station cavern and pedestrian connections. Spoil would be moved to the shafts, transferred to the surface and then removed from site.

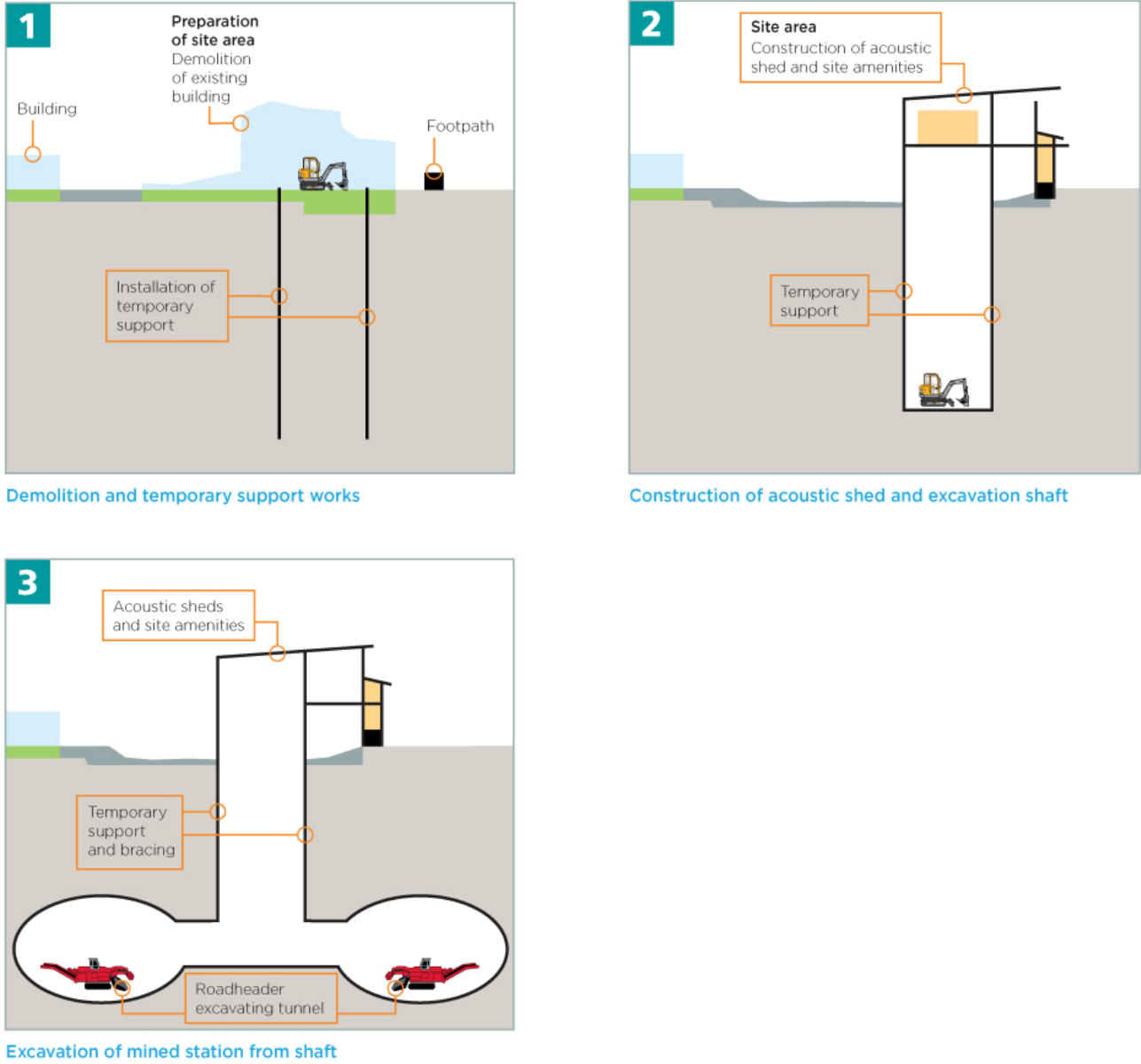


Figure 9-11: Typical cavern station construction



9.4.4 Services facilities

Vertical shafts would be constructed at Rosehill, Silverwater and between Five Dock and The Bays to house future services facilities. Stage 1 construction works for the services facilities would involve:

- Enabling works including protection or diversion of utilities and establishment of site access points
- Demolition of structures on the site and vegetation removal, where required
- Excavation of a vertical shaft to the tunnels below. This may be carried out using excavators and rock hammers, however drill and blast or penetrating cone fracture techniques may also be used (described in Section 9.4.3)
- Temporary lining and reinforcement of the shaft.

These sites are described further in Section 9.5.

9.4.5 Stabling and maintenance facility

Civil works for the formation of the stabling and maintenance facility would involve:

- Enabling works including protection or diversion of utilities and establishment of site access points
- Demolition of structures on the site and clearance of vegetation (if present)
- Import and placement of fill material. The stabling and maintenance facility would be designed and constructed to be protected from the one per cent Annual Exceedance Probability flood event. In some areas, this may also involve the construction of retaining walls
- Structures for crossings of A’Becketts Creek and Duck Creek.

A temporary precast concrete segment construction production facility to support tunnelling would also be located at the Clyde stabling and maintenance facility construction site (described in Section 9.5.3).

9.4.6 Dive structures and tunnel portals

A dive structure and tunnel portal would be constructed at Rosehill (within the Clyde stabling and maintenance construction site) to facilitate a surface connection to the Clyde stabling and maintenance facility. The construction of the dive structure and tunnel portal would generally involve:

- Piling work along the walls of the dive structure
- Excavation of existing material to below future track level
- Placement of precast concrete for the cut-and-cover section and to form the tunnel portal.

The dive structures would be designed and constructed to be protected from the probable maximum flood level.

9.5 Construction sites

A number of construction sites would be required for:

- Tunnel boring machine launch, support and retrieval
- Roadheader support
- Station excavation
- Services facility shaft excavation
- Civil works for the stabling and maintenance facility.

Wherever possible, construction sites would be co-located within the operational footprint to minimise the construction footprint and disruption to surrounding areas. Table 9-3 shows the proposed construction sites and their uses. All construction sites would provide staff facilities such as offices, lunch rooms and amenities.

Table 9-3: Construction site works

Construction site	Tunnel boring machine launch and support	Tunnel boring machine retrieval	Roadheader works and support	Spoil removal	Station excavation	Services facilities excavation	Construction staff facilities	Stabling and maintenance facility civil works	Creek crossings	Tunnel dive structure
Westmead metro station	●		●	●	●		●			
Parramatta metro station				●	●		●			
Clyde stabling and maintenance facility				●		●	●	●	●	●
Silverwater services facility				●		●	●			
Sydney Olympic Park metro station		●		●	●		●			
North Strathfield metro station				●	●		●			
Burwood North Station			●	●	●		●			
Five Dock Station			●	●	●		●			
Services facility between Five Dock and The Bays				●		●	●			
The Bays Station	●			●	●		●			

Site establishment activities would initially be carried out at each construction site. This would involve:

- Demolishing buildings and vegetation removal, where required
- Protecting and/or relocating utilities
- Providing services required for construction, such as power, water, sewer and communications
- Establishing site compound and ancillary facilities such as offices, amenities and workshops
- Establishing vehicle access and egress points
- Establishing truck wheel wash or rumble grid
- Establishing internal roads
- Establishing hardstand areas for storage and car parking
- Establishing site hoardings, noise barriers and/or fencing around the perimeter of the site.

Some of these site establishment activities may be carried out as enabling works (refer to Section 9.4.1).

9.5.1 Westmead metro station construction site

The Westmead metro station construction site would cover about 15,750 square metres within the block bound by the T1 Western Line rail corridor, Hawkesbury Road, Bailey Street and Hassall Street. The site currently contains residential and commercial buildings.

The construction site would be used to:

- Carry out the excavation of Westmead metro station and turnback cavern
- Launch and support two tunnel boring machines for the drive east to the Sydney Olympic Park metro station construction site.

This construction site would include tunnel boring machine support services including high voltage power supply, spoil storage and removal, fresh air ventilation, work train, grout batching plant, water supply, water treatment and disposal, material storage as well as office facilities, worker amenities and parking, and storage and installation of precast concrete lining elements.

This station would be constructed using a cut-and-cover technique and the turnback cavern would be constructed using a mined technique. The station excavation and cavern would require the removal of about 245,000 cubic metres of spoil and an additional 675,000 cubic metres of spoil would be removed from tunnelling works from the Westmead metro station construction site to Sydney Olympic Park station construction site.



Access to and egress from the Westmead metro station construction site would be left-in from Bailey Street via Hawkesbury Road and left-out via Hawkesbury Road.

The location and indicative layout of the Westmead metro station construction site, including vehicle access and egress, are illustrated in Figure 9-12.

Alexandra Avenue would be closed between Hassall Street and Hawkesbury Road during Stage 1. Traffic would be temporarily diverted via Hassall Street and Bailey Street, with new and altered traffic signals provided where required.

At the end of Stage 1 construction works at the Westmead metro station construction site, Alexandra Avenue would be permanently realigned between Hassall Street and Hawkesbury Avenue, including a new signalised intersection at Alexandra Avenue, Hawkesbury Road and Grand Avenue (refer to Figure 9-13).

The indicative construction program is outlined in Figure 9-14.

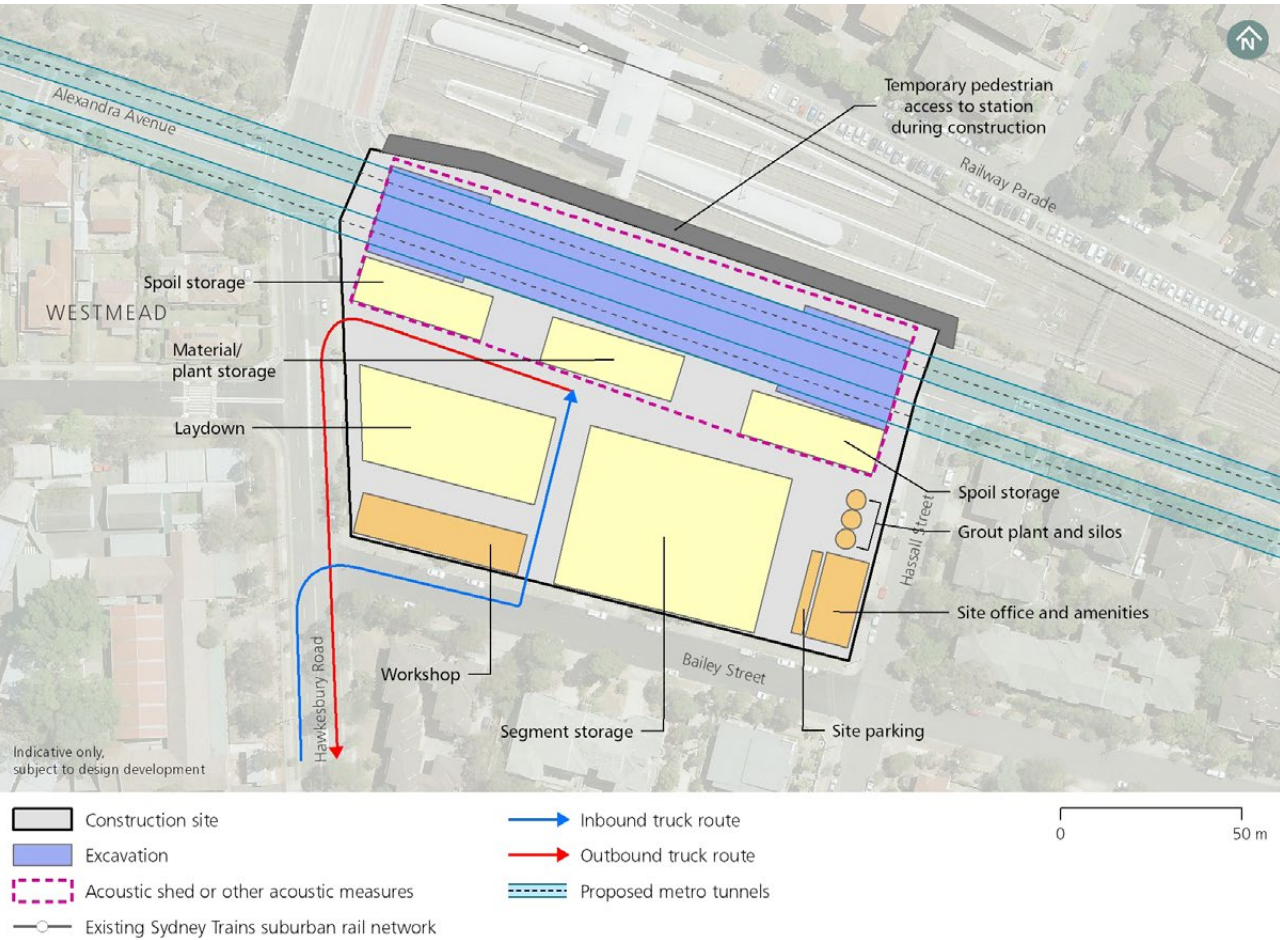


Figure 9-12: Westmead metro station indicative construction site layout

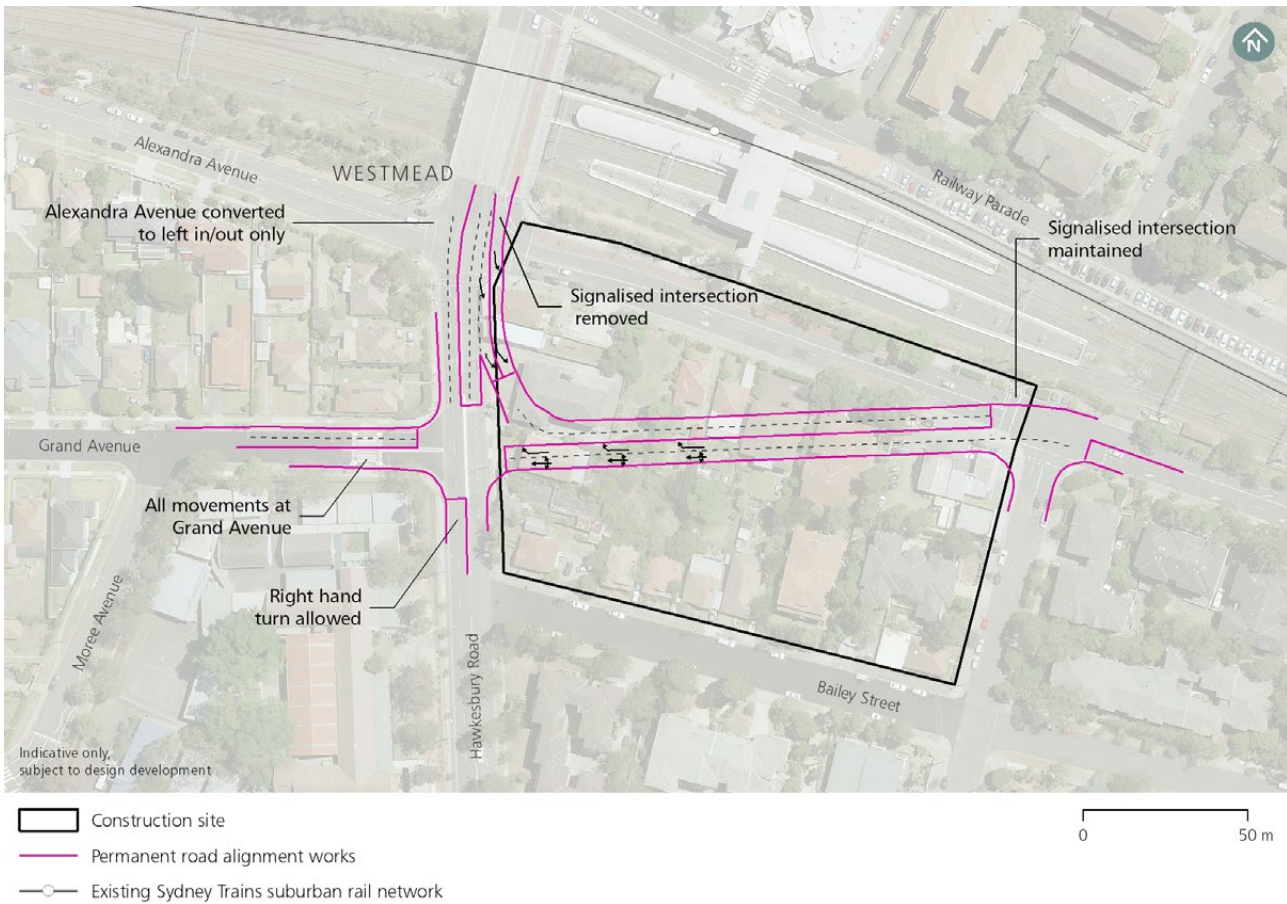


Figure 9-13: Westmead road realignment works



Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 9-14: Westmead metro station construction site indicative construction program

### 9.5.2 Parramatta metro station construction site

The Parramatta metro station construction site would cover about 24,150 square metres within the block bounded by George, Church, Macquarie and Smith streets. The site currently contains commercial buildings and a multi-storey car park.

The construction site would be used to excavate Parramatta metro station using a cut-and-cover technique. This construction site would include spoil storage and removal, water supply, water treatment and disposal, material storage as well as office facilities, worker amenities and parking. The excavation would require the removal of about 125,000 cubic metres of spoil.

Access to and egress from the site would be right-in and left-out via George Street.

The location and indicative layout of the Parramatta metro station construction site, including vehicle access and egress, are illustrated in Figure 9-15.

The indicative construction program is outlined in Figure 9-16.



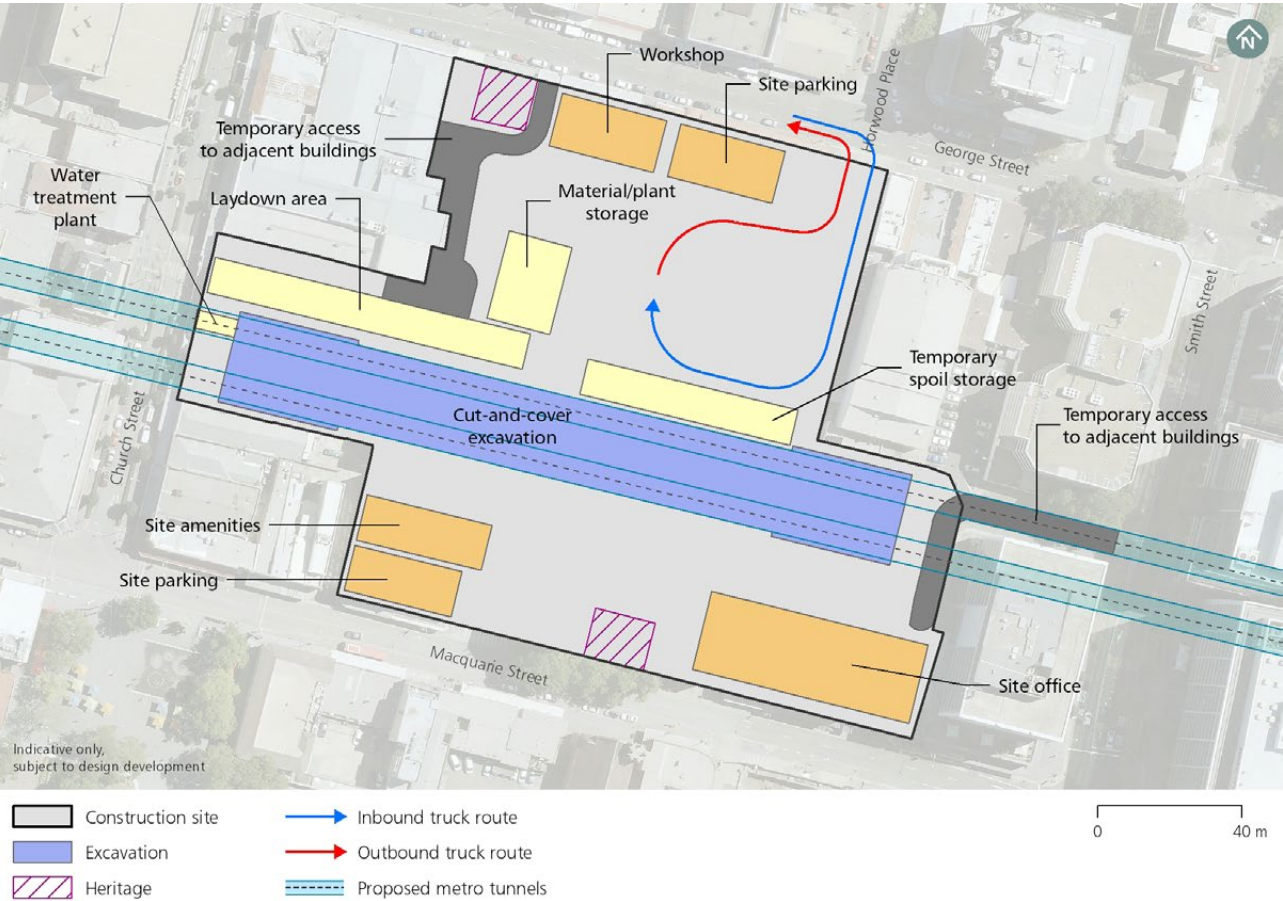


Figure 9-15: Parramatta metro station indicative construction site layout



Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 9-16: Parramatta metro station construction site indicative construction program

9.5.3 Clyde stabling and maintenance facility construction site

The Clyde stabling and maintenance facility construction site would cover about 380,000 square metres between the M4 motorway, James Ruse Drive and Rosehill Gardens Racecourse. The site currently contains industrial and commercial buildings, Sydney Speedway (location on NSW Government owned land) and the redundant T6 Carlingford Line at Rosehill.

The site would be used to:

- Construct the land formation for the stabling and maintenance facility
- Construct structures over A'Becketts Creek and Duck Creek, including creek realignment works
- Construct and operate a temporary precast concrete segment production facility
- Excavate the Rosehill services facility
- Excavate and construct the Rosehill dive structure and tunnel portal (described in Section 9.4.6).

The formation of the site for the stabling and maintenance facility is described in Section 9.4.5. The stabling and maintenance facility formation would cover about 330,000 square metres of the construction site.

This construction site would include spoil storage and removal from the excavations for the services facility shaft and dive structure and portal, water supply, water treatment and disposal, material storage as well as office facilities, worker amenities and parking. It would also include a section of the redundant T6 Carlingford Line required for the construction of future stages of Sydney Metro West.

Kay Street and Unwin Street would be permanently realigned around the construction site and would include a bridge over the future metro rail tracks.

The excavation of the Rosehill dive structure, tunnel portal and services facility would require the removal of about 195,000 cubic metres of spoil.

Access to and egress from the site would be via Wentworth Street to Parramatta Road.

The location and indicative layout of the Clyde stabling and maintenance facility construction site, including vehicle access and egress is illustrated in Figure 9-17.

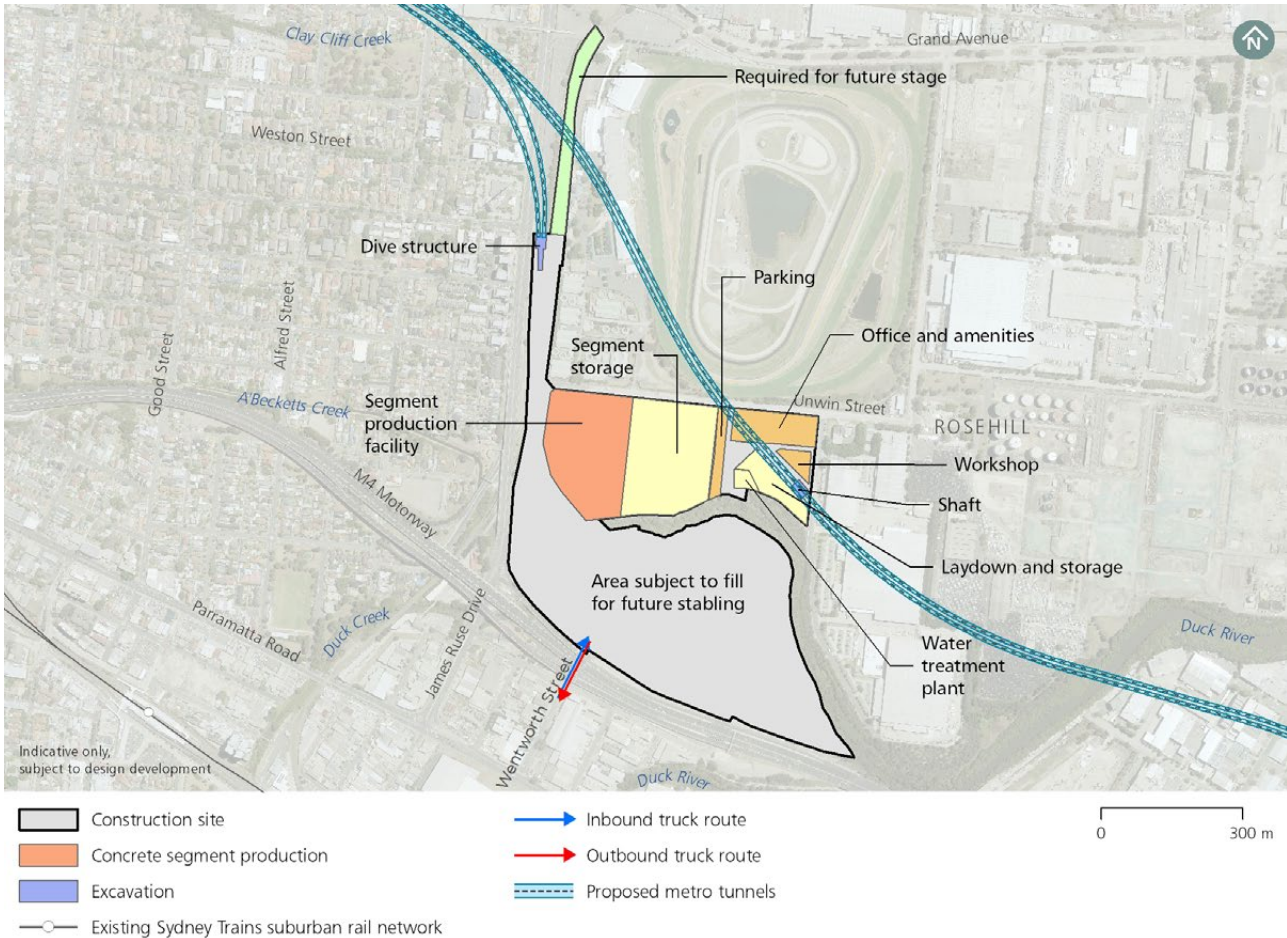


Figure 9-17: Clyde stabling and maintenance facility indicative construction site layout

Road and creek realignment works

The permanent realignment of Unwin Street and Kay Street around the Clyde stabling and maintenance facility (refer to Figure 9-18) would maintain the existing two-lane road configuration and would be designed to accommodate B-double trucks. The realigned road would cross over the redundant T6 Carlingford Line, A'Becketts Creek and Duck Creek. The road would be elevated on piles for about 500 metres to avoid flooding impacts.

A'Becketts Creek and Duck Creek would be realigned during Stage 1 as shown in Figure 9-18.

The creeks would generally flow through culverts and new open channels, and would be naturalised where possible.



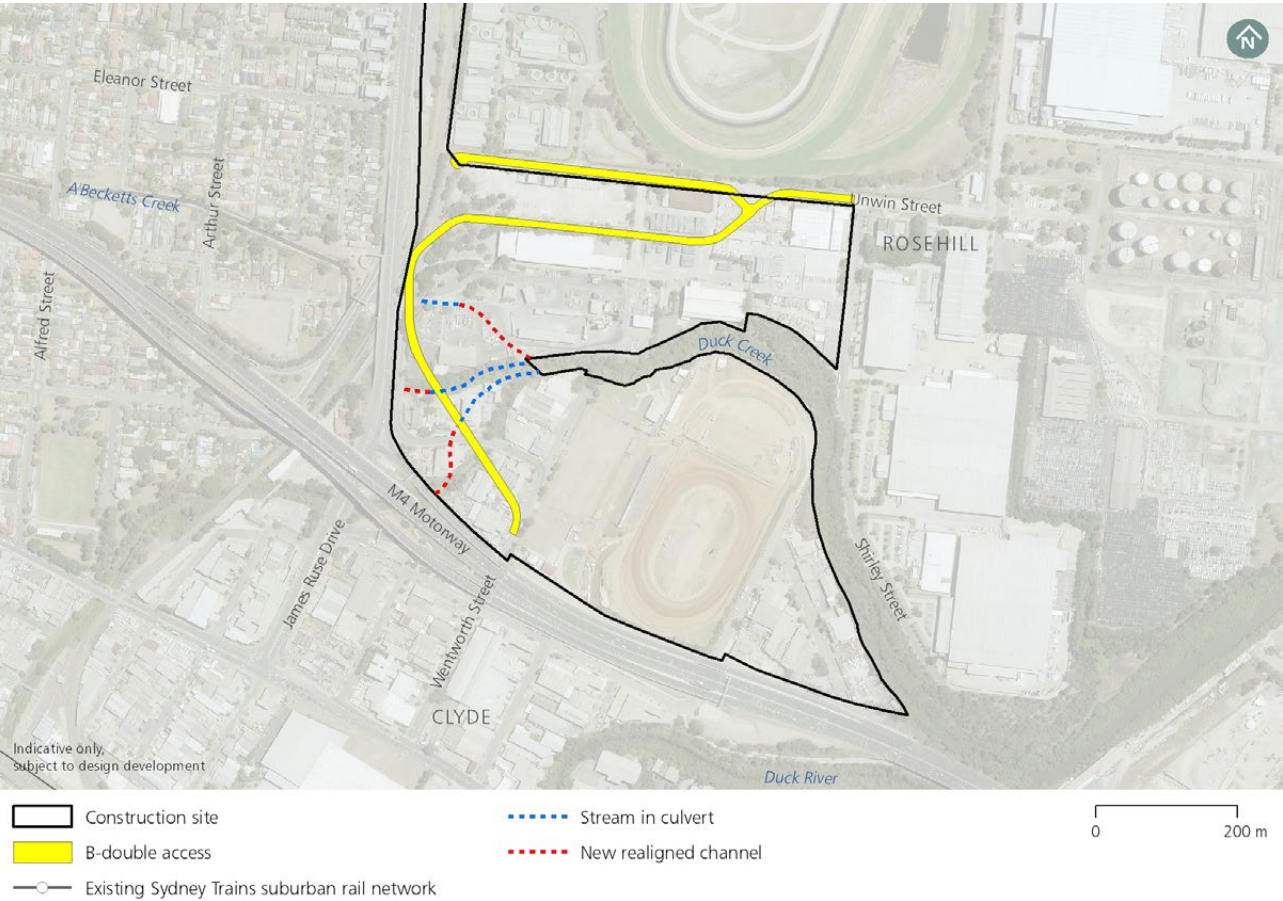


Figure 9-18: Clyde road and creek realignment works

Temporary precast concrete segment production facility

The temporary precast concrete segment production facility and storage yard would be established at the north-east end of the construction site and would cover about 120,000 square metres of the construction site. The concrete segment production facility would cover about 60,000 square metres, and the storage yard would cover about 60,000 square metres. Works would include site establishment and enabling works for the production facility and storage yard, construction of sheds for segment production, and construction of production infrastructure such as concrete batching plant. Waste water treatment facilities would also be established at the facility.

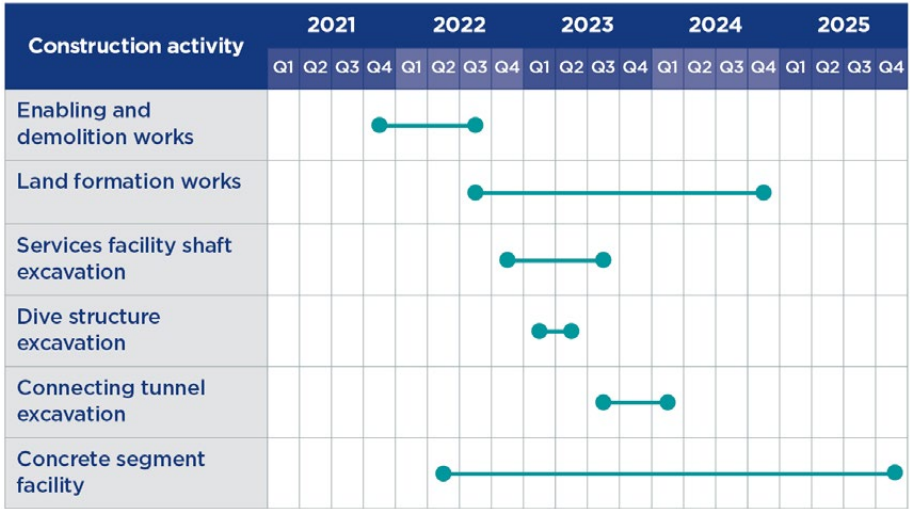
Rosehill services facility

Construction of the services facility would involve excavation of a shaft to the mainline tunnels below. This would require removal of about 20,000 cubic metres of spoil.

Rosehill dive structure and tunnel portal

A dive structure and tunnel portal would be constructed in Rosehill (within the disused part of the Carlingford Rail Line) to provide for a future connection from the Clyde stabling and maintenance facility to the mainline tunnels. The construction of the dive structure and tunnel portal is described in Section 9.4.6. Underground connecting tunnels would be excavated by road header from the tunnel portal to the mainline tunnels.

The indicative construction program for the Clyde stabling and maintenance facility is outlined in Figure 9-19.



Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 9-19: Clyde stabling and maintenance facility construction site indicative construction program

9.5.4 Silverwater services facility

The Silverwater services facility construction site would cover about 2,700 square metres on the corner of Silverwater Road and Derby Street. The site is currently a vacant lot.

The construction site would be used to excavate a shaft to the mainline tunnels below for a future services facility. This construction site would include spoil storage and removal from the shaft excavation, water supply, material storage as well as office facilities, worker amenities and parking.

The shaft excavation would require the removal of about 20,000 cubic metres of spoil.

Access to and egress from the site would be left-in and left-out via Derby Street to Silverwater Road.

The location and indicative layout of the Silverwater services facility construction site, including vehicle access and egress is illustrated in Figure 9-20. The indicative construction program is outlined in Figure 9-21.





Figure 9-20: Silverwater services facility indicative construction site layout



Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 9-21: Silverwater services facility construction site indicative construction program

9.5.5 Sydney Olympic Park metro station construction site

Sydney Olympic Park metro station construction site would cover about 23,900 square metres between Herb Elliot Avenue and Figtree Drive. The site contains commercial buildings.

The construction site would be used to:

- Carry out the excavation of Sydney Olympic Park metro station
- Retrieve the tunnel boring machines driven east from the Westmead metro station construction site and west from The Bays Station construction site.

This construction site would include spoil storage and removal, water supply, water treatment and disposal, material storage as well as office facilities, worker amenities and parking.

This station would be constructed using a cut-and-cover technique, requiring the removal of about 225,000 cubic metres of spoil.

Access to and egress from the site would be left-in and right-out via Herb Elliot Avenue.

The location and indicative layout of the Sydney Olympic Park metro station construction site, including vehicle access and egress is illustrated in Figure 9-22. The indicative construction program is outlined in Figure 9-23.

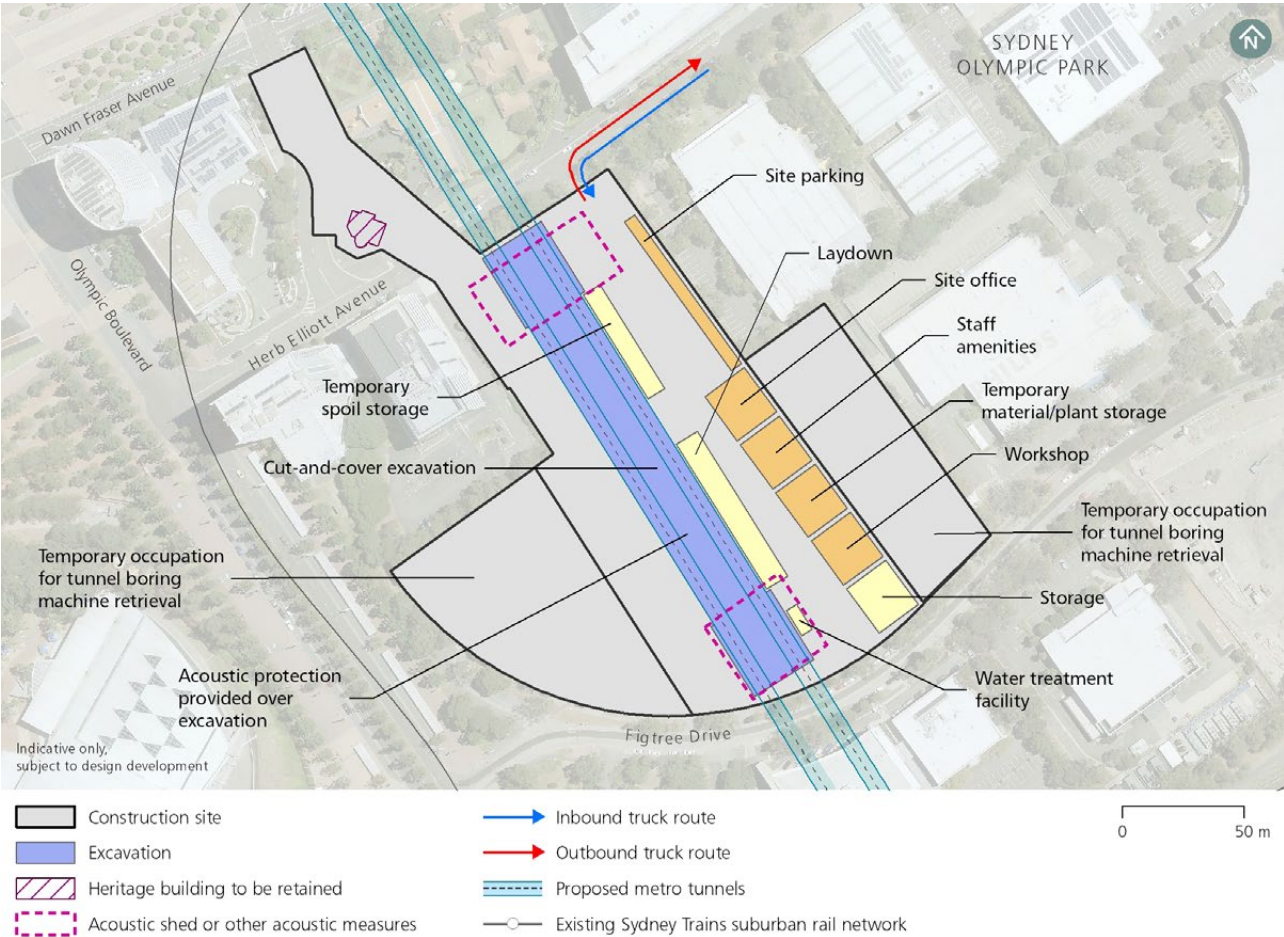


Figure 9-22: Sydney Olympic Park metro station indicative construction site layout



Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 9-23: Sydney Olympic Park metro station construction site indicative construction program

9.5.6 North Strathfield metro station construction site

Construction of North Strathfield metro station would require two sites, a northern construction site and a southern construction site:

- The North Strathfield metro station northern construction site would cover about 6,500 square metres between the existing North Strathfield Station and Queen Street, bounded by Pomeroy Street to the north and the pedestrian entrance to the existing North Strathfield Station to the south. The site predominately comprises vacant land within the T9 Northern Line rail corridor, the northbound lane of Queen Street, and gardens at the eastern pedestrian entry to North Strathfield Station. This construction site would include spoil storage and removal, water treatment and disposal and material storage



- The North Strathfield metro station southern construction site would cover about 1,000 square metres and occupy land between the existing North Strathfield Station and Queen Street, bounded by Shipley Avenue to the south and the pedestrian entrance to the existing North Strathfield Station to the north. The site is currently used as a private car park and facilities site for the existing North Strathfield Station and rail lines. This site would be used for site offices, worker amenities and parking only.

The construction site would be used to excavate North Strathfield metro station using a cut-and-cover technique. This would require the removal of about 110,000 cubic metres of spoil.

Access to and egress from the North Strathfield Station northern construction site would be left-in and right-out via Queen Street. Access and egress from the North Strathfield metro station southern construction site would be from the existing access point on Queen Street.

The location and indicative layout of the North Strathfield metro station construction sites, including vehicle access and egress, is illustrated in Figure 9-24. The indicative construction program is outlined in Figure 9-25.



Figure 9-24: North Strathfield metro station indicative construction site layout



Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 9-25: North Strathfield metro station construction site indicative construction program

9.5.7 Burwood North Station construction site

Construction of Burwood North Station would require two construction sites, a northern construction site and a southern construction site:

- The Burwood North Station northern construction site would cover about 12,900 square metres and would be located on Parramatta Road bound by Burwood Road and Loftus Street. This site currently contains a number of commercial and residential properties fronting Burwood Road
- The Burwood North Station southern construction site would cover about 1,400 square metres bound by Burwood Road, Parramatta Road and Esher Lane. The site currently contains commercial buildings.

The northern construction site would include spoil storage and removal, water supply, water treatment and disposal, material storage as well as office facilities, worker amenities and parking.

The northern construction site would be used to excavate Burwood North Station using a cut-and-cover technique. The crossover cavern would be constructed using a mined technique.

A shaft would be excavated at the southern construction site for the southern station entrance and connected to the station box via a mined adit. About 235,000 cubic metres of spoil would be removed from the Burwood North Station construction sites.

Access to and egress from the northern site would be left-in from Parramatta Road, and left-out to Loftus Street and Burwood Road. Access to and egress from the southern construction site would be left-in from Burwood Road and left-out to Parramatta Road.

The location and indicative layout of the Burwood North Station construction sites, including vehicle access and egress, is illustrated in Figure 9-26. The indicative construction program is outlined in Figure 9-27.

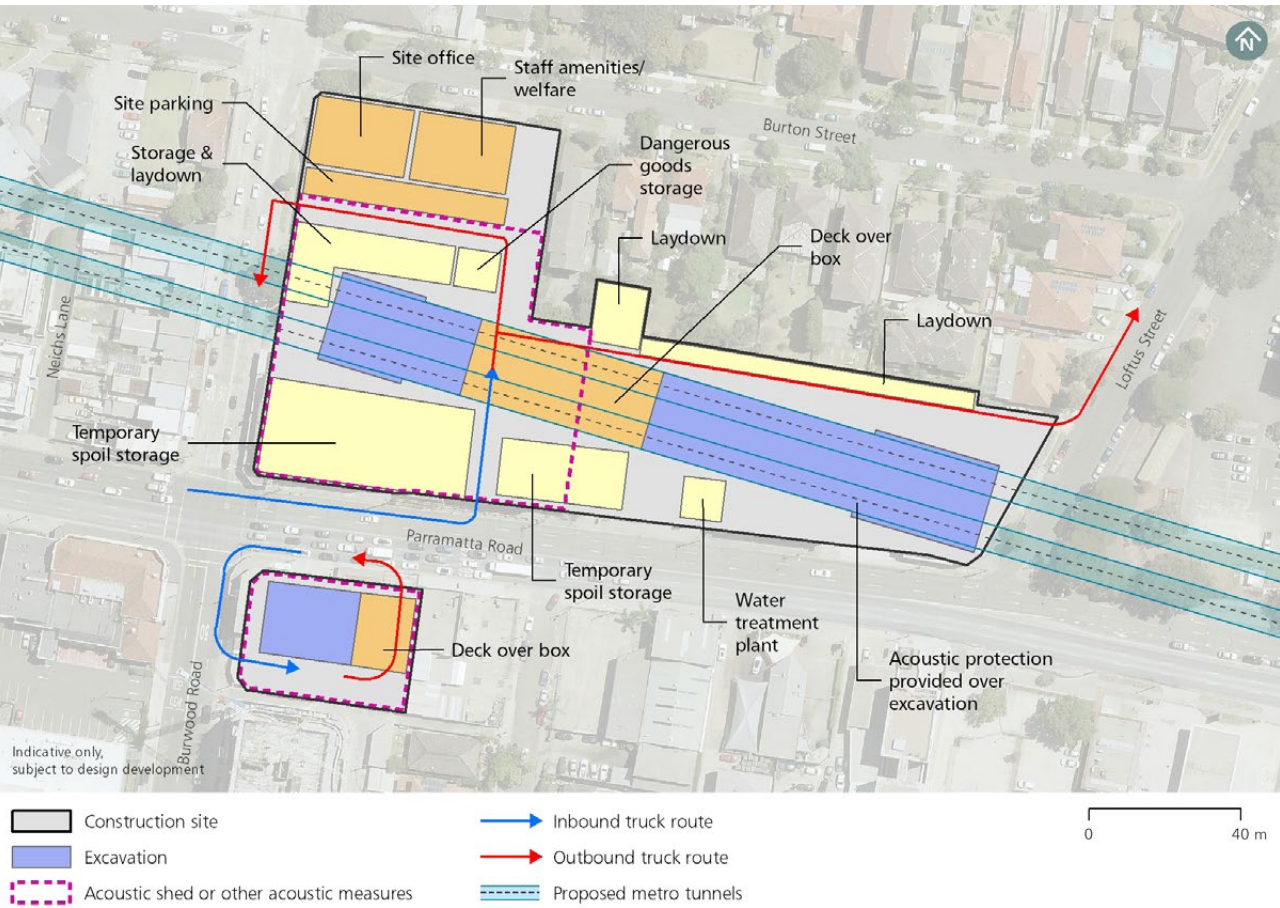


Figure 9-26: Burwood North Station indicative construction site layout





Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 9-27: Burwood North Station construction site indicative construction program

9.5.8 Five Dock Station construction site

Five Dock Station would require two construction sites, a western construction site and an eastern construction site:

- The Five Dock Station western construction site would cover about 4,150 square metres and would be located between Great North Road and East Street, to the north of Fred Kelly Place and south of St Albans Anglican Church. This site currently contains commercial buildings
- The Five Dock Station eastern construction site would cover about 2,150 square metres and would occupy the Second Avenue council car park and a number of residential properties located on Waterview Street.

The construction site would be used to excavate Five Dock Station using a mined technique. Shafts would be excavated within the two construction sites to the binocular station caverns to provide access during construction.

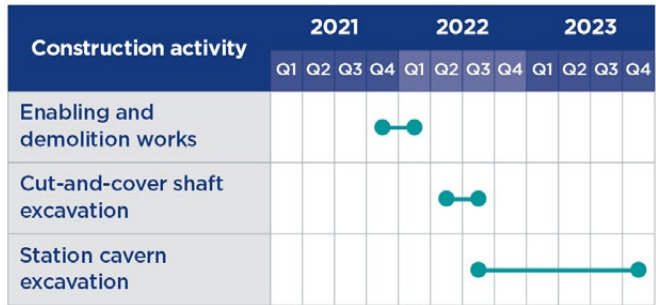
The construction sites would include spoil storage and removal, water supply, water treatment and disposal, material storage and office facilities, worker amenities and parking would be included at the eastern construction site. The excavations would require the removal of about 165,000 cubic metres of spoil.

Access to and egress from the western construction site would be left-in and left-out via Great North Road. Access to and egress from the eastern construction site would be left-in from Waterview Street and left-out on Second Avenue to Great North Road.

The location and indicative layout of the Five Dock Station construction sites, including vehicle access and egress is illustrated in Figure 9-28. The indicative construction program is outlined in Figure 9-29.



Figure 9-28: Five Dock Station indicative construction site layout



Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 9-29: Five Dock Station construction site indicative construction program

9.5.9 Services facility between Five Dock and The Bays

A services facility is required between Five Dock Station and The Bays Station for fresh air ventilation and emergency egress during operations of the electric train fleet. To meet rail operations of the electric train fleet and engineering requirements, the facility would need to be located within a zone determined by an approximate distance of 3.5 kilometres from both Five Dock Station and The Bays Station, and the horizontal curvature of the rail line.

A part of Stage 1, construction would involve the excavation of the shaft to the mainline tunnels below. The construction site would need to be around 4,500 square metres, and the shaft would have a footprint of around 20 metres by 20 metres.

The construction site would include spoil storage and removal from the shaft excavation, water supply, water treatment, material storage, office facilities, workers amenities and parking. Stage 1 construction works (including site establishment and shaft excavation works) would likely occur over a period of around 12-18 months.



The location of the services facility is currently being investigated. The following locational and design criteria would be used as part of determining the preferred location:

- The site would not be located on existing residential land
- There would be no removal of vegetation that constitutes a locally occurring Plant Community Type
- There would be no direct impacts on items listed on the State Heritage Register
- There would be no direct impacts to significant elements of any locally listed heritage items
- The construction of the facility would not result in any negative impacts to groundwater users, groundwater dependent surface flows or groundwater dependent ecosystems.

In addition to the above, the facility would need to achieve the performance outcomes set for the Concept – refer to Chapter 8 (Concept environmental assessment).

Potential impacts associated with Stage 1 construction works at the services facility construction site would vary depending on its location and proximity to sensitive receivers, such as residences and community facilities. The types of impacts and environmental performance during shaft excavation works for similar services facilities constructed at Epping and Cheltenham for the Metro North West Line, and those that could occur for a services facility between Five Dock and The Bays, are discussed in Appendix H.

9.5.10 The Bays Station construction site

The Bays Station construction site would cover about 61,200 square metres in front of the former White Bay Power Station. The site primarily comprises industrial and wharf operations for White Bay.

The construction site would be used to:

- Carry out the excavation of The Bays Station
- Launch and support two tunnel boring machines for the drive west to the Sydney Olympic Park metro station construction site.

This construction site would include tunnel boring machine support services including high voltage power supply, spoil storage and removal, fresh air ventilation, work train, grout batching plant, water supply, water treatment and disposal, material storage as well as office facilities, worker amenities and parking, and storage and installation of precast concrete lining elements.

This station would be constructed using a cut-and-cover technique, requiring the removal of about 155,000 cubic metres of spoil. An additional 860,000 cubic metres of spoil would be removed from tunnelling works from The Bays Station construction site to the Sydney Olympic Park metro station construction site.

Access to and egress from the construction site would be from James Craig Road via Port Access Road, Sommerville Road and Solomons Way. Port Access Road would be relocated prior to Stage 1 and is subject to a separate planning approvals process.

The location and indicative layout of The Bays Station construction site, including vehicle access and egress is illustrated in Figure 9-30. The location for a potential conveyor to a barge to remove spoil is discussed in Section 9.6.1 and shown on Figure 9-30. The indicative construction program is outlined in Figure 9-31.

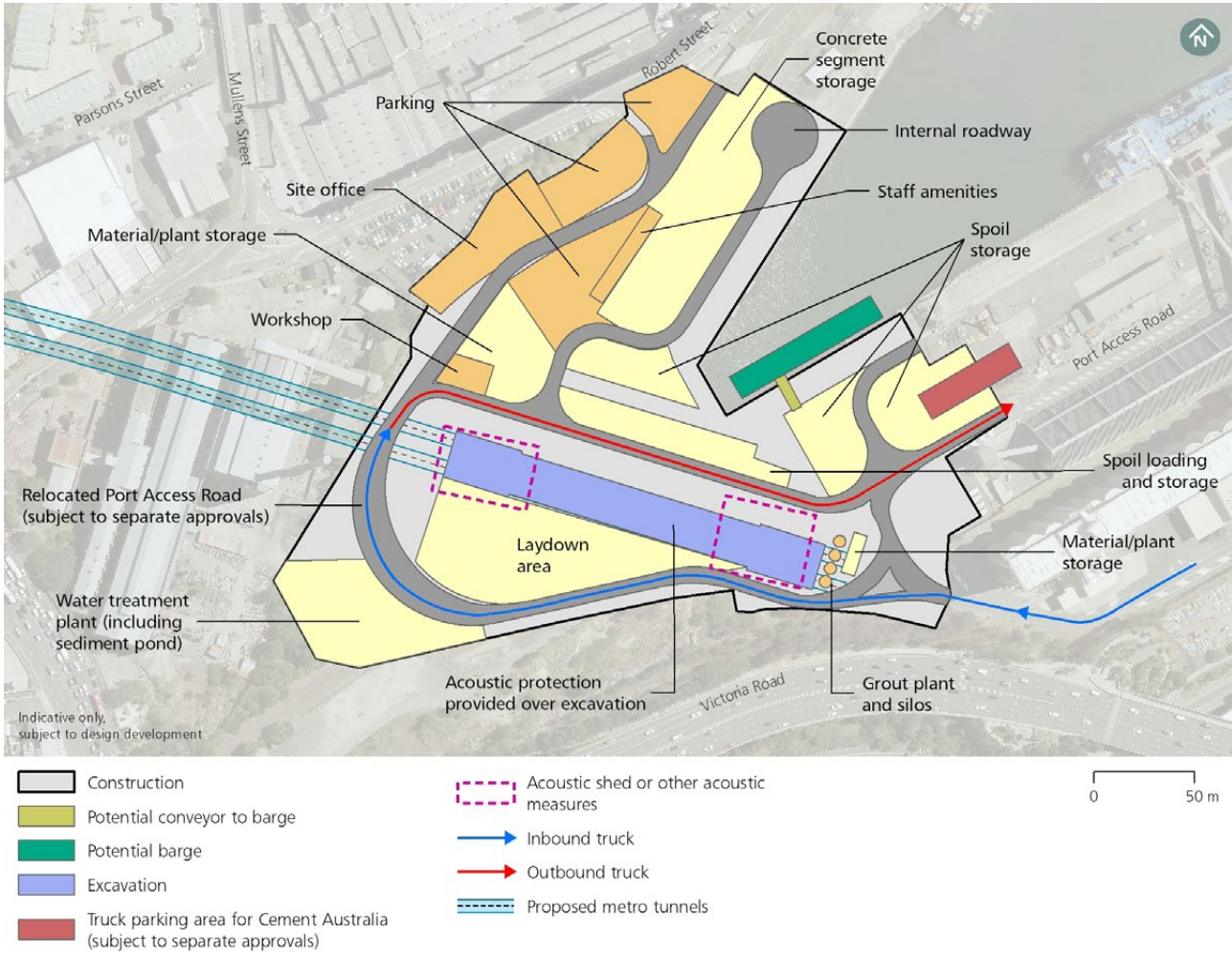


Figure 9-30: The Bays Station indicative construction site layout



Note: This program only shows major civil works (Stage 1) indicative duration and not the total works.

Figure 9-31: The Bays Station construction site indicative construction program

9.6 Other construction elements

This section provides an overview of other construction elements that may occur at one or more of the construction sites.

9.6.1 Spoil management

It is estimated that excavation for Stage 1 would generate about 2,762,000 cubic metres of spoil, including all tunnels, stations, shafts and dive structures. Indicative volumes for each construction site are provided in Table 9-4.

Further details on the impacts associated with spoil generation and management is provided in the relevant chapters of this Environmental Impact Statement including Chapter 10 (Transport and traffic – Stage 1), Chapter 23 (Air quality – Stage 1) and Chapter 24 (Spoil, waste management and resource use – Stage 1).



Table 9-4: Indicative spoil generation by construction site

Construction site	Volume of spoil (m³)
Westmead metro station	245,000
	675,000 (from tunnelling to Sydney Olympic Park metro station)
Parramatta metro station	125,000
Clyde stabling and maintenance facility	20,000 (services facility shaft)
	90,000 (dive structure)
	85,000 (connecting tunnels)
Silverwater services facility	20,000
Sydney Olympic Park metro station	225,000
North Strathfield metro station	110,000
Burwood North Station	235,000
Five Dock Station	165,000
Services facility between Five Dock and The Bays	35,000
The Bays Station	155,000
	860,000 (from tunnelling to Sydney Olympic Park metro station)

9.6.2 Construction traffic

Proposed access to and egress from the construction sites is described in Section 9.5.1 to Section 9.5.10. Wherever possible, access and egress is proposed to be directly via major arterial roads.

Construction traffic would be managed through the Construction Traffic Management Framework (refer to Appendix F). Construction traffic management plans for each site would be submitted to the relevant roads authority for review before work starts. Further information relating to haulage routes, the daily profile of construction traffic movements for each site, construction traffic impacts and mitigation is provided in Chapter 10 (Transport and traffic – Stage 1).

9.6.3 Construction hours

Proposed construction hours are shown in Table 9-5. These hours have been developed based on a balanced consideration of the construction program and the need to minimise noise and traffic related impacts. As the tunnel boring machines would operate continuously, the tunnelling and associated support works would need to be carried out up to 24 hours per day and seven days per week.

Most aboveground construction works would be carried out during the following hours:

- 7am to 6pm Monday to Friday
- 8am to 1pm Saturdays
- No works on Sundays or Public Holidays.

However, other substantial construction works (as identified in Table 9-5) would need to be carried out outside these hours.

Table 9-5: Proposed construction hours

Construction works	Construction hours	Comments or exceptions
Underground construction works		
Tunnelling	<ul style="list-style-type: none"><li>• 24 hours per day, seven days per week</li></ul>	Construction works at tunnel support sites that support tunnelling may need to occur 24 hours per day, up to seven days per week.

Construction works	Construction hours	Comments or exceptions
Underground excavation at station construction sites and the Clyde stabling and maintenance facility construction site (refer to Section 9.4.3)	<ul style="list-style-type: none"><li>• 24 hours per day, seven days per week</li></ul>	Construction works requiring rail possessions may need to be carried out outside standard construction hours up to 24 hours per day, seven days per week.  Construction works requiring the temporary possession of roads or to accommodate road network requirements may need to be carried out outside standard daytime construction hours during periods of low demand to minimise safety impacts and inconvenience to motorists.
Aboveground construction works		
Demolition	<ul style="list-style-type: none"><li>• 7am to 6pm Monday to Friday</li></ul>	Aboveground work supporting underground construction works (e.g. concrete pumping, truck loading) are expected to be required 24 hours per day, up to seven days per week where noise mitigation is in place. Aboveground work at Parramatta metro station and North Strathfield metro station construction sites would generally be restricted to standard construction hours.
Aboveground construction works	<ul style="list-style-type: none"><li>• 8am to 1pm Saturdays</li><li>• No works on Sundays and Public Holidays.</li></ul>	Saturday works at Parramatta metro station and The Bays Station construction sites may be carried out between 8am to 6pm.  Construction works requiring rail possessions may need to be carried out outside the standard construction hours up to 24 hours per day, seven days per week.  Construction works requiring the temporary possession of roads or to accommodate road network requirements may need to be carried out outside the standard daytime construction hours during periods of low demand to minimise safety impacts and inconvenience to commuters.
Construction traffic for material supply to, and spoil removal from, tunnelling and underground excavation (station and services facility sites)	<ul style="list-style-type: none"><li>• 24 hours per day, seven days per week</li></ul>	Restrictions would be in place during peak hours and special events.  At locations where night-time sensitive noise receivers are close to construction sites, substantial construction vehicle movements are likely to be restricted during evening and night-time periods.
Utility management and power supply works	<ul style="list-style-type: none"><li>• 24 hours per day, seven days per week</li></ul>	Utility works requiring the temporary possession of roads may need to be carried out outside standard daytime construction hours during periods of low demand to minimise safety impacts and inconvenience to motorists.

Other construction works that would be carried out outside of standard daytime construction hours would include:

- Work determined to comply with the relevant noise management level at the nearest sensitive receiver
- Work required to be carried out during rail possessions
- Delivery of materials outside approved hours as required by the NSW Police or other authorities for safety reasons
- Emergency situations where it is required to avoid the loss of lives and property and/or to prevent environmental harm
- Situations where agreement is reached with affected receivers.

Except for emergencies, construction works would not take place outside standard daytime construction hours without prior notification of local residents, businesses and the Environment Protection Authority.

9.6.4 Demolition

It is anticipated that construction of Stage 1 would require the demolition of about 114 buildings. Some demolition would occur in the enabling works phase before substantial construction works begin.

The indicative number of buildings proposed to be demolished at each construction site and their current primary use is provided in Table 9-6.



Table 9-6: Indicative number and types of buildings proposed for demolition

Construction site	Commercial	Industrial	Residential	Subtotal
Westmead metro station	4	0	14	18
Parramatta metro station	16	0	0	16
Clyde stabling and maintenance facility	0	50	0	50
Silverwater services facility	0	0	0	0
Sydney Olympic Park metro station	3	0	0	3
North Strathfield metro station	0	0	0	0
Burwood North Station	12	0	4	16
Five Dock Station	6	0	5	11
The Bays Station	0	0	0	0
Totals	41	50	23	114

Typically, access to and egress from construction sites during demolition would use existing driveways however, alternative site access may be required. Indicative heavy vehicle movements associated with the demolition phase are provided in Chapter 10 (Transport and traffic – Stage 1).

Demolition would be carried out by licensed demolition contractors and in a staged manner where possible. Typically, building demolition would involve:

- Establishment of hoarding, scaffolding and protection barriers around the perimeter of the site
- All services into the buildings would be decommissioned and made safe and redundant
- A hazardous materials assessment would be carried out prior to stripping and demolition of the main structure
- Soft stripping internal building materials
- Demolition of the building using an excavator, bobcat, cranes or other conventional methods following a top-down approach. Temporary propping and/or waterproofing would be provided for structural integrity of adjacent structures as required during the demolition works.

If any hazardous materials are found, they would be removed and disposed of in accordance with the relevant legislation, codes of practice and Australian Standards.

Materials such as bricks, tiles, timber, plastics and metals would be sorted where feasible and reasonable, and sent to a waste facility with recycling capabilities.

Construction contractors would be required to meet the requirements of the Construction Environmental Management Framework (refer to Section 9.7).

Structures other than buildings to be cleared and/or demolished are listed in Table 9-7.

Table 9-7: Indicative structures other than buildings proposed for clearance and/or demolition

Construction site	Structure type
Westmead metro station	<ul style="list-style-type: none"><li>• Vacant land</li><li>• Existing roadways</li></ul>
Parramatta metro station	<ul style="list-style-type: none"><li>• Multi-storey car parking</li><li>• Existing roadways</li></ul>
Clyde stabling and maintenance facility	<ul style="list-style-type: none"><li>• Recreational land</li><li>• Existing roadways</li></ul>
Silverwater services facility	<ul style="list-style-type: none"><li>• Vacant land</li></ul>
North Strathfield metro station	<ul style="list-style-type: none"><li>• Paved car parking</li><li>• Vacant land</li></ul>
Five Dock station	<ul style="list-style-type: none"><li>• Paved car parking</li></ul>
The Bays Station	<ul style="list-style-type: none"><li>• Paved industrial land</li></ul>

9.6.5 Utilities management

Utilities would need to be adjusted, relocated and/or protected where there is a possibility they would otherwise be impacted by construction. Utilities which may require protection and/or relocation include water, sewer, stormwater, drainage, recycled water, electricity, gas and communications assets. The location of utilities has been determined from Dial Before You Dig plans, utility geographic information system data supplied by the utility companies, and local authority and council records. Further investigation and consultation with service asset owners would be carried out as the design develops to confirm exact locations, heights and depths of the utilities.

Where an existing utility conflicts with the proposed design, it may be necessary to:

- Provide physical protection for the utility where the utility is not directly affected but may be indirectly affected by vibration or accidental impact. Protection could include constructing a piled wall between the excavation and the utility, plating over the utility to minimise the impact of construction traffic, or marking out or fencing off the location of a utility to avoid it being accidentally damaged
- Modify construction methods to avoid impacting a nearby utility. For example, this could involve using only hand excavation and compaction tools such as hand digging tools, a vibration plate or pedestrian rollers where compacting within a specified distance of utilities
- Wrap and support the utility service to provide mechanical protection
- Relocate the utility around the construction site
- Abandon the utility.

Table 9-8 summarises the major utilities in the vicinity of Stage 1 construction sites which may require treatment.

Table 9-8: Major utilities in the vicinity of Stage 1 construction sites

Construction site	Utility type							
	High voltage cable	Sewer	Water main	Stormwater	Communications	Gas	Signal post (Transport for NSW)	Sydney Trains assets
Westmead metro station	●	●	●	●	●	●	●	●
Parramatta metro station	●	●	●	●	●	●		
Clyde stabling and maintenance facility	●	●	●	●	●	●		
Silverwater services facility	●	●	●	●	●	●		
Sydney Olympic Park metro station	●	●	●		●	●		●
North Strathfield metro station	●	●		●	●			
Burwood North Station	●	●	●	●	●	●		
Five Dock Station	●	●	●	●	●	●		
The Bays Station	●	●	●	●	●			

A utilities coordination manager would be appointed for Stage 1 to coordinate the delivery of the utility works. Utility works includes any construction or physical modification of utility infrastructure to ensure continual operation of utility assets/services during Stage 1. Utility work does not include investigative works (such as surveying or potholing of utility assets) to gather information to inform design and construction methodologies.

Preliminary consultation has been held with the utility owners in Table 9-9. In addition, Sydney Metro would consult with local councils and utility providers to identify any opportunities to support future initiatives or utility augmentations. Consultation with utility providers would continue during detailed design and construction to mitigate the risk of unplanned and unexpected disturbance of utilities.



Table 9-9: Preliminary consultation with utility owners

Utility type	Utility owners
Electricity	<div><div></div><div>Ausgrid</div><div>Transgrid</div><div>Endeavour Energy</div></div>
Water/Sewer/Stormwater/Recycled Water	<div><div></div><div>Sydney Water</div><div>AquaNet Recycled Water</div><div>Council (Local Authorities) – Various</div><div>Relevant parts of Transport for NSW</div></div>
Gas	<div><div></div><div>Jemena Gas</div><div>Caltex</div><div>Viva Energy</div></div>
Telecommunications	<div><div></div><div>NBN</div><div>Telstra</div><div>Optus/Ucomm</div><div>Vocus Communications (Amcon/Nextgen/M2/Dodo/iprimus/Engine/Commander)</div><div>TPG (AAPT/PowerTel/Pipenetworks/Soul Australia Communications)</div><div>Verizon/Worldcom</div><div>AARNet</div><div>Vodafone</div></div>

The utilities coordination manager would:

- Establish a utilities working group with nominated representatives from utility service providers that may be impacted by Stage 1
- Review design and construction methodologies to assist with identifying potentially impacted utility assets
- Assist with coordination of design and construction methodology reviews by utility service providers to identify necessary utility works
- Communicate with the working group and Sydney Metro’s contractors’ delivery teams to understand the proposed program of works to coordinate intercepting, interconnecting and interrelated works and manage priorities as they may arise
- Observe utility works, where relevant
- Manage escalation of utility work-related issues within Sydney Metro and the utility service providers as required.

If receivers are anticipated to be impacted by proposed utility works, respite periods would be considered throughout the coordination and management of the utility works in accordance with the Construction Noise and Vibration Standard (Appendix E) and a future Community Communications Strategy. Respite may be offered in the form of a reduction or absence of noise emissions for a period of time, or by removing the affected receiver from the noise emission point source (e.g. dinner/movie tickets and/or alternative accommodation offers). Consideration of respite would take into account many factors, including but not limited to the predicted noise level, duration, time of day, surrounding land uses and community feedback. The utility coordination manager would endeavour to coordinate works to avoid the same receiver being affected more than three consecutive nights as much as possible. Furthermore, the utilities coordination manager would endeavour to stagger the timing of works by different contractors that affect the same receiver as much as possible in order to maximise the respite period between the works.

9.6.6 Utilities and power supply

Utilities such as water, sewer and telecommunications would need to be supplied to each of the major construction sites. Generally, these utilities are located close to the sites (such as the adjacent footpath) and the supply is considered ‘business as usual’ for supply companies.

Power supply

High voltage power supply would be required for the operation of tunnel boring machines at the Westmead metro station construction site and The Bays Station construction site and for roadheaders at the station sites and services facility sites. The power supply for each site would need to be brought in from existing substations outside the Stage 1 corridor. Table 9-10 describes the power supply required at each construction site. Indicative supply routes are provided on Figure 9-32 to Figure 9-35.

Power supply routes would generally be located within existing road reserves. Construction of these power supply routes would generally be carried out by open trench. Underbores would be used when crossing major infrastructure or to avoid other major constraints.

Preliminary consultation has been carried out with energy suppliers. A program of ongoing consultation is underway to further assess the requirements for Stage 1.

Construction contractors would be required to meet the requirements of the Construction Environmental Management Framework (refer to Section 9.7).

Table 9-10: Construction power supply requirements

Construction site	Supply source	Supply source	Power (mega volt ampere)
Westmead metro station	Endeavour	West Parramatta Zone substation	15
Parramatta metro station	Endeavour	West Parramatta zone substation	4
Clyde stabling and maintenance facility	Endeavour	Rosehill Zone substation	10
Silverwater services facility	Ausgrid	Silverwater Road 11 kilovolt line	4
Sydney Olympic Park metro station	Ausgrid	Herb Elliot Avenue 11 kilovolt line	4
North Strathfield metro station	Ausgrid	Queen Street 11 kilovolt line	4
Burwood North Station	Ausgrid	Parramatta Road 11 kilovolt line Burton Street feeder line	8
Five Dock Station	Ausgrid	Second Avenue 11 kilovolt line	8
The Bays Station	Ausgrid	Rozelle sub-transmission substation	35

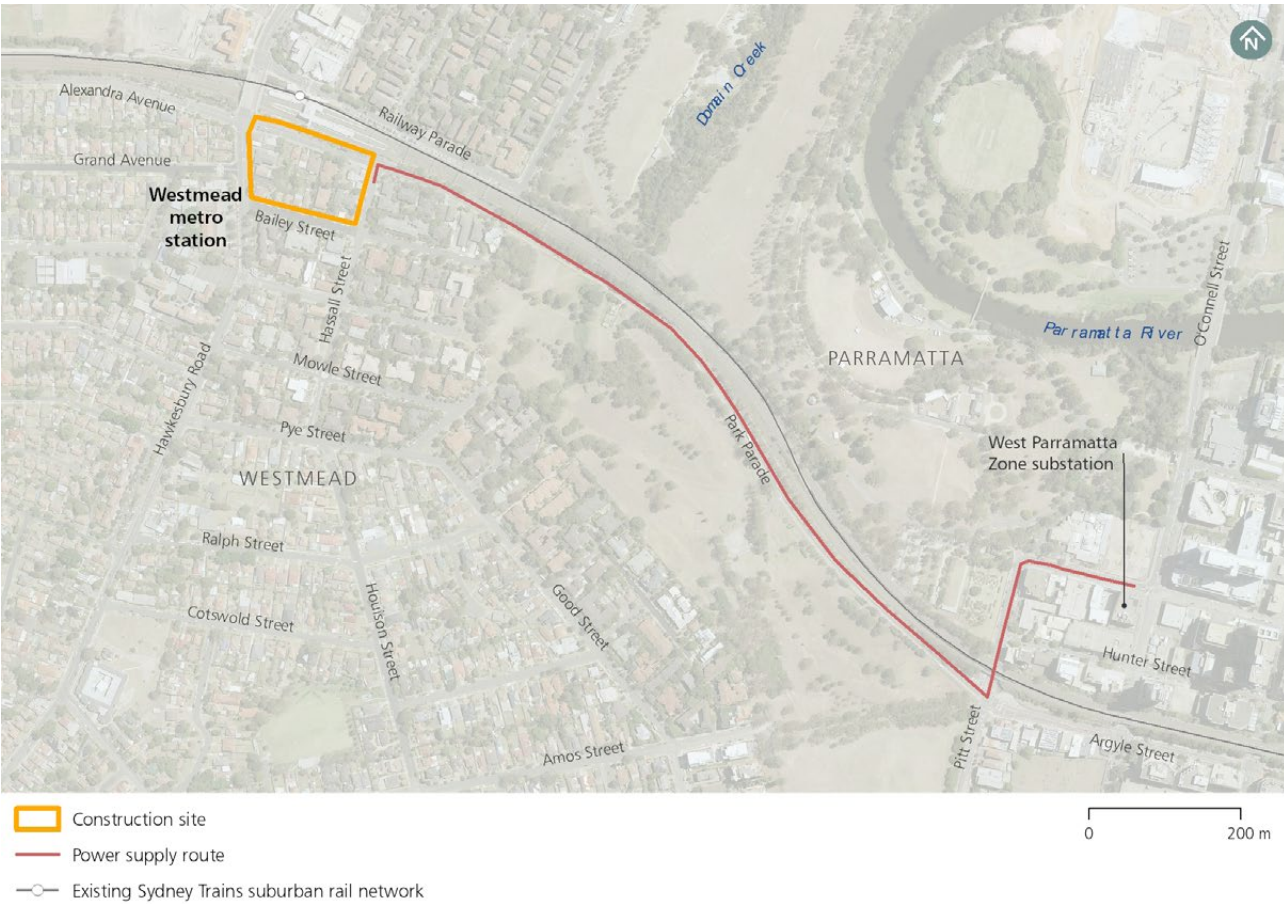


Figure 9-32: Westmead metro station – power supply route





Figure 9-33: Parramatta metro station – power supply route



Figure 9-34: Clyde stabling and maintenance facility – power supply route

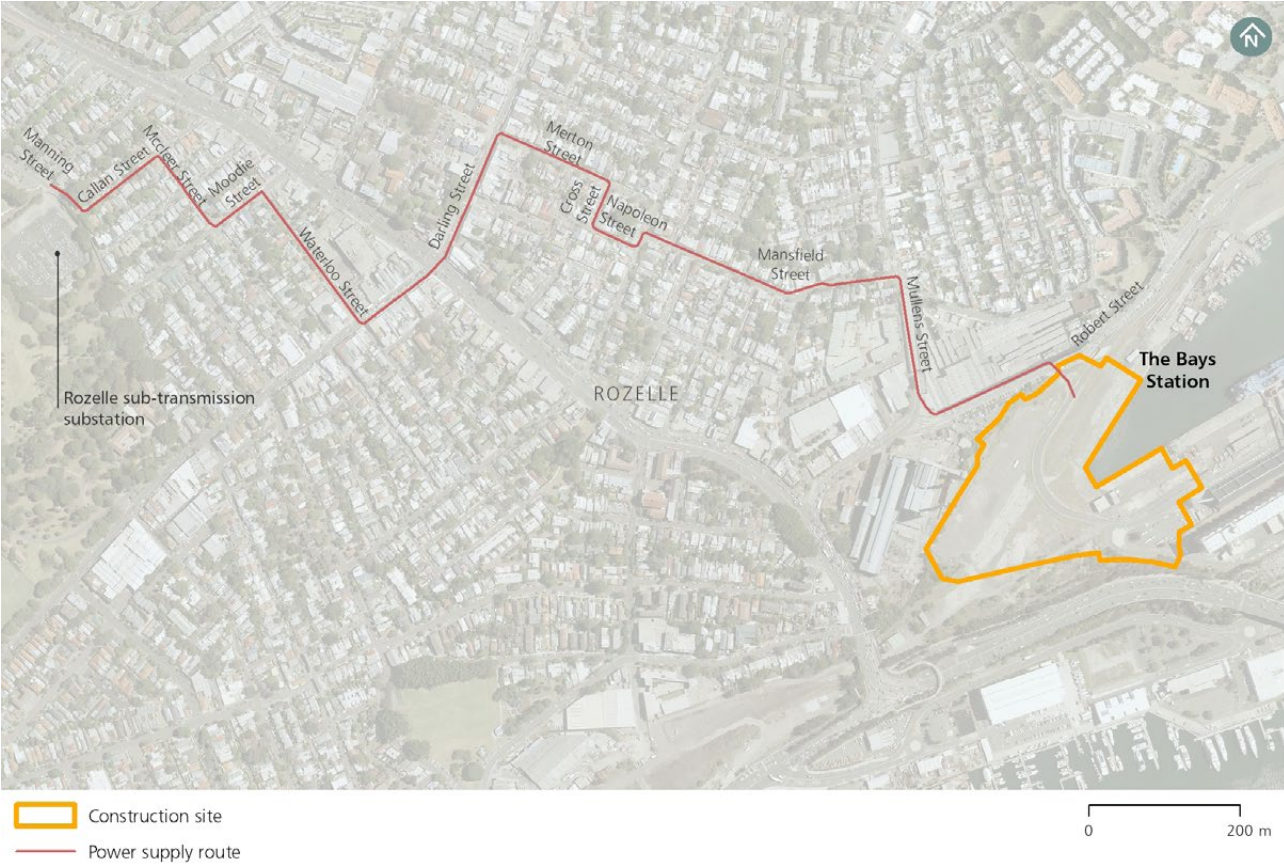


Figure 9-35: The Bays Station – power supply route

### Use of generators

At a number of the station construction sites, generators may be used instead of providing a mains power supply connection, or for a period of time prior to the mains power supply becoming available. Each generator is likely to be around 1,000 kVA in order to supply the necessary power for Stage 1. Generators would be managed to minimise potential noise impacts as required, including acoustic attenuation and appropriate site positioning. The likely sites and number of generators required is as follows:

- Westmead metro station – three generators
- Parramatta metro station – one generator
- Sydney Olympic Park metro station – one generator
- North Strathfield metro station – one generator
- Burwood North Station – three generators
- Five Dock Station – three generators
- The Bays Station – one generator.

### 9.6.7 Transport network modifications

This section provides an overview of the modifications anticipated to be required to the road network, the public transport network and the pedestrian and cyclist network in the vicinity of each construction site. Further details and the potential impacts of these modifications are provided in Chapter 10 (Transport and traffic – Stage 1).

#### Road network

It is anticipated that road network modifications would be required to facilitate construction of Stage 1. These modifications are outlined in Table 9-11. The modifications would be reviewed by the construction contractor during the preparation of construction traffic management plans, with the objective of minimising disruptions to the road network.



Table 9-11: Indicative road network modifications

Construction site	Indicative road network modifications
Westmead metro station	<p>Temporary road network changes (for the duration of Stage 1 construction):</p> <ul style="list-style-type: none"><li>Detour between Hawkesbury Road and Hassall Street (via Bailey Street) around the closed section of Alexandra Avenue</li><li>Modification of traffic signals at the Hawkesbury Road/Alexandra Avenue and Alexandra Avenue/Hassall Street intersections</li><li>Signalisation of the Hawkesbury Road/Bailey Street intersection</li><li>Removal of about 35 parking spaces on Hassall Street and Bailey Street adjacent to the construction site and to accommodate signalisation infrastructure.</li></ul> <p>Permanent road network changes (at the end of Stage 1 construction):</p> <ul style="list-style-type: none"><li>Closure and realignment of Alexandra Avenue between Hassall Street and Hawkesbury Road</li><li>New signalised intersection at Hawkesbury Road, Grand Avenue, and the realigned Alexandra Avenue</li><li>Modification of traffic signals at the Hawkesbury Road/Alexandra Avenue and Alexandra Avenue/Hassall Street intersections.</li></ul>
Parramatta metro station	<ul style="list-style-type: none"><li>Temporary closure of Horwood Place for the duration of Stage 1 construction</li><li>Construction of temporary rear access lanes for properties fronting Church Street</li><li>Permanent removal of around 850 off-street car parking spaces accessible from Horwood Place – including the City Centre Car Park and a small at-grade car park</li><li>Permanent removal of around 35 on-street parking spaces from Horwood Place.</li></ul>
Clyde stabling and maintenance facility	<ul style="list-style-type: none"><li>Permanent realignment of Kay Street and Unwin Street around the construction site, including the construction of a bridge over the future metro rail tracks.</li></ul>
Silverwater services facility	<ul style="list-style-type: none"><li>Temporary removal of around six on-street parking spaces on Derby Street near the construction site access and egress location for the duration of Stage 1 construction.</li></ul>
Sydney Olympic Park metro station	<ul style="list-style-type: none"><li>Temporary closure of Herb Elliot Avenue (full or staged closures subject to ongoing design development)</li><li>Temporary relocation of taxi rank on Herb Elliot Avenue for the duration of Stage 1 construction</li><li>Pedestrianisation of Showground Road at the intersection with Dawn Fraser Avenue.</li></ul>
North Strathfield metro station	<ul style="list-style-type: none"><li>Temporary removal of around 20 on-street parking spaces and the kiss and ride facilities on the western side of Queen Street between Wellbank Street and Pomeroy Street for the duration of Stage 1 construction.</li></ul>
Burwood North Station	<ul style="list-style-type: none"><li>Temporary removal of around six on-street parking spaces on Loftus Street for the duration of Stage 1 construction</li><li>Permanent removal of Neichs Lane between Parramatta Road and Burwood Road.</li></ul>
Five Dock Station	<ul style="list-style-type: none"><li>Temporary removal of around 12 on-street car parking spaces along Great North Road adjacent to the Five Dock Station western construction site for the duration of Stage 1 construction</li><li>Temporary removal of around 10 on-street car parking spaces on Waterview Street and Second Avenue adjacent to the Five Dock Station eastern construction site for the duration of Stage 1 construction</li><li>Permanent removal of around 12 restricted off-street parking spaces accessible from Second Avenue.</li></ul>
The Bays Station	<ul style="list-style-type: none"><li>No modifications as part of Stage 1. The realignment of the Port Access Road and reconfiguration of Solomons Way would be subject to a separate approval process.</li></ul>

Public transport modifications

It is anticipated that some modifications would be needed to the public transport network to facilitate construction of Stage 1. These modifications are outlined in Table 9-12. The modifications would be reviewed during detailed design with the objective of minimising disruptions to public transport services. Final locations for relocation of public transport infrastructure would be determined in consultation with Transport for NSW, transport operators and local councils.

Table 9-12: Indicative modifications to public transport during construction

Construction site	Indicative public transport network modifications
Westmead metro station	<ul style="list-style-type: none"><li>Relocation of bus stops on Alexandra Avenue between Hawkesbury Road and Hassall Street to the east of the Alexandra Avenue/Hassall Street intersection for the duration of Stage 1 construction. The final location of these bus stops would be determined as part a future stage</li></ul>
Parramatta metro station	<ul style="list-style-type: none"><li>No modifications</li></ul>
Clyde stabling and maintenance facility	<ul style="list-style-type: none"><li>No modifications</li></ul>
Silverwater services facility	<ul style="list-style-type: none"><li>No modifications</li></ul>
Sydney Olympic Park metro station	<ul style="list-style-type: none"><li>No modifications</li></ul>
North Strathfield metro station	<ul style="list-style-type: none"><li>Temporary relocation of the bus stop on the western side of Queen Street north of Wellbank Street for the duration of Stage 1 construction</li><li>Reconfiguration of stairs and vertical transport connections from the existing North Strathfield Station to Queen Street to maintain access for the duration of Stage 1 construction</li></ul>
Burwood North Station	<ul style="list-style-type: none"><li>Temporary relocation of bus stops along the northern and southern side of Parramatta Road and the eastern side of Burwood Road (adjacent to both the north and south sites) for the duration of Stage 1 construction</li></ul>
Five Dock Station	<ul style="list-style-type: none"><li>No modifications</li></ul>
The Bays Station	<ul style="list-style-type: none"><li>No modifications</li></ul>

Pedestrian and cyclist facilities

It is anticipated that some modifications would be needed to pedestrian and cyclist facilities to facilitate construction of Stage 1. These modifications are outlined in Table 9-13. The modifications would be reviewed by the construction contractor during detailed design and/or during the preparation of construction traffic management plans, with the objective of minimising disruptions to pedestrians and cyclists.

Table 9-13: Indicative modifications to pedestrian and cyclist facilities during construction

Construction site	Indicative pedestrian and cyclist network modifications
Westmead metro station	<ul style="list-style-type: none"><li>Construction of a temporary pedestrian footpath to the existing Westmead Station on Alexandra Avenue between Hassall Street and Hawkesbury Road for the duration of Stage 1 construction</li><li>Relocation of bicycle racks and lockers on the northern side of Alexandra Avenue near the existing Westmead Station for the duration of Stage 1 construction.</li></ul>
Parramatta metro station	<ul style="list-style-type: none"><li>Temporary closure of pedestrian and cyclist routes on Horwood Place for the duration of Stage 1 construction</li><li>Closure of Batman Walk between Macquarie Street and Macquarie Lane</li></ul>
Clyde stabling and maintenance facility	<ul style="list-style-type: none"><li>Closure of the footpaths on Unwin Street and Kay Street</li></ul>
Silverwater services facility	<ul style="list-style-type: none"><li>No modifications</li></ul>
Sydney Olympic Park metro station	<ul style="list-style-type: none"><li>Pedestrianisation of Showground Road</li></ul>
North Strathfield metro station	<ul style="list-style-type: none"><li>Temporary closure of the footpath along the western side of Queen Street adjacent to the construction site between Wellbank Street and Pomeroy Street for the duration of Stage 1 construction</li><li>Temporary relocation of pedestrian crossing across Queen Street from the north of Wellbank Street to the south of Wellbank Street for the duration of Stage 1 construction</li></ul>
Burwood North Station	<ul style="list-style-type: none"><li>No modifications</li></ul>
Five Dock Station	<ul style="list-style-type: none"><li>No modifications</li></ul>
The Bays Station	<ul style="list-style-type: none"><li>No modifications</li></ul>



9.6.8 Construction plant and equipment

Plant and equipment likely to be used during construction are listed in Table 9-14. This list is indicative only. Actual plant and equipment used on site and the numbers required would be further refined during the detailed design phase of Stage 1.

Table 9-14: Indicative construction plant and equipment

Plant and equipment	Westmead metro station	Parramatta metro station	Clyde stabling and maintenance facility	Silverwater services facility	Sydney Olympic Park metro station	North Strathfield metro station	Burwood North Station	Five Dock Station	Services facility between Five Dock and The Bays	The Bays Station
Excavator	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Concrete cutter	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Jackhammer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Diesel generator	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Compressor	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mobile crane	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water treatment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Piling rig	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Vibratory pile driver			✓							
Concrete boom pump	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pumps	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Articulated dump truck	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Frontend loader	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bulldozer	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Crawler crane	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Conveyors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Air track drill	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Shotcrete robot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dust scrubber	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ventilation fan	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Mobile elevated work platforms	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Roadheader	✓		✓				✓	✓		
Rock breaker	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Jumbo drill rig	✓		✓	✓	✓		✓	✓	✓	✓
Subsurface concrete truck	✓		✓	✓	✓		✓	✓	✓	✓
Concrete pump	✓		✓	✓	✓		✓	✓	✓	✓
Portal crane	✓		✓	✓	✓		✓	✓	✓	✓
Flatbed trucks										✓
Access lift										✓
Tele-handler										✓
Front-end loader			✓							
Scraper			✓							
Grader			✓							

Plant and equipment	Westmead metro station	Parramatta metro station	Clyde stabling and maintenance facility	Silverwater services facility	Sydney Olympic Park metro station	North Strathfield metro station	Burwood North Station	Five Dock Station	Services facility between Five Dock and The Bays	The Bays Station
Backhoe			✓							
Vibratory roller			✓							
Steel drum roller			✓							
Compactor			✓							
Ballast tamper			✓							

9.6.9 Construction workforce

Table 9-15 provides a breakdown of the peak construction workforce numbers across the alignment. Sydney Metro has developed a Workforce Development and Industry Participation strategy which includes objectives to support local employment and business opportunities, provide skills development and increase workplace diversity.

Table 9-15: Construction workforce

Construction site	Peak workforce numbers
Westmead metro station	330
Parramatta metro station	150
Clyde stabling and maintenance facility	300
Silverwater services facility	40
Sydney Olympic Park metro station	370
North Strathfield metro station	150
Burwood North Station	150
Five Dock Station	190
Services facility between Five Dock and The Bays	40
The Bays Station	330

9.6.10 Demobilisation, rehabilitation and handover

At the end of the Stage 1 construction phase, the contractor(s) would demobilise all construction equipment, site sheds and other temporary construction site elements not required for future construction stages, and stabilise the construction sites prior to the construction of future stages.

Where elements (such as acoustic sheds, site offices and amenities) are required for future stages of construction, these may be retained on site at the completion of Stage 1.

9.7 Construction Environmental Management Framework

A Construction Environmental Management Framework was developed and successfully implemented as part of the Sydney Metro Northwest and Sydney Metro City & Southwest projects. This framework has been reviewed and amended to be applicable to Stage 1 and is provided in Appendix D.

The Construction Environmental Management Framework details environmental, management systems and processes for construction of Stage 1. Specifically, it details the requirements in relation to the content of the construction environmental management plan, sub-plans and other supporting documentation for each specific environmental aspect.