

7 Construction of the project

This chapter describes the principles that would govern the construction of the CBD Metro, the anticipated construction methods, the location of the construction sites and compounds, the proposed construction program and the delivery strategy.

The Director-General's requirements

The Environmental Assessment must include a description of the project including:

- *Construction facilities, including construction compounds, laydown areas and spoil stockpiling/management areas.*

The construction program and methodologies would be further developed and potentially modified by the contractors selected by Sydney Metro during the detailed construction planning phase. However, the principles and mitigation measures presented in this chapter would still be applied.

The construction of the project includes the tunnels and station boxes, station fitout works (lifts, escalators, ticketing facilities, ventilation and emergency exit stairways) and the stabling and maintenance depot. It does not include or seek approval for the fitout of any over-site development beyond the station complex – these would be subject to further approvals.

7.1 Construction strategy

Due to the urgent need for the CBD Metro project, the NSW Government has set a target for it to begin operating by 2015. Given the large scale and complex nature of the permanent works it would be necessary to have some construction activities occurring over a 24-hour period to meet the 2015 completion date. To achieve this properly, the construction strategy would have the following key construction objectives:

- Safe delivery of infrastructure in an orderly and timely manner.
- Mitigation of environmental impacts resulting from construction activities.
- Community acceptance of the construction management of the impacts.
- Sustainable use of energy, water and material; and the minimisation of waste.
- Infrastructure constructed to be reliable for an efficient railway operation.
- Early commencement of preliminary works to facilitate commencement of operations as soon as practicable.

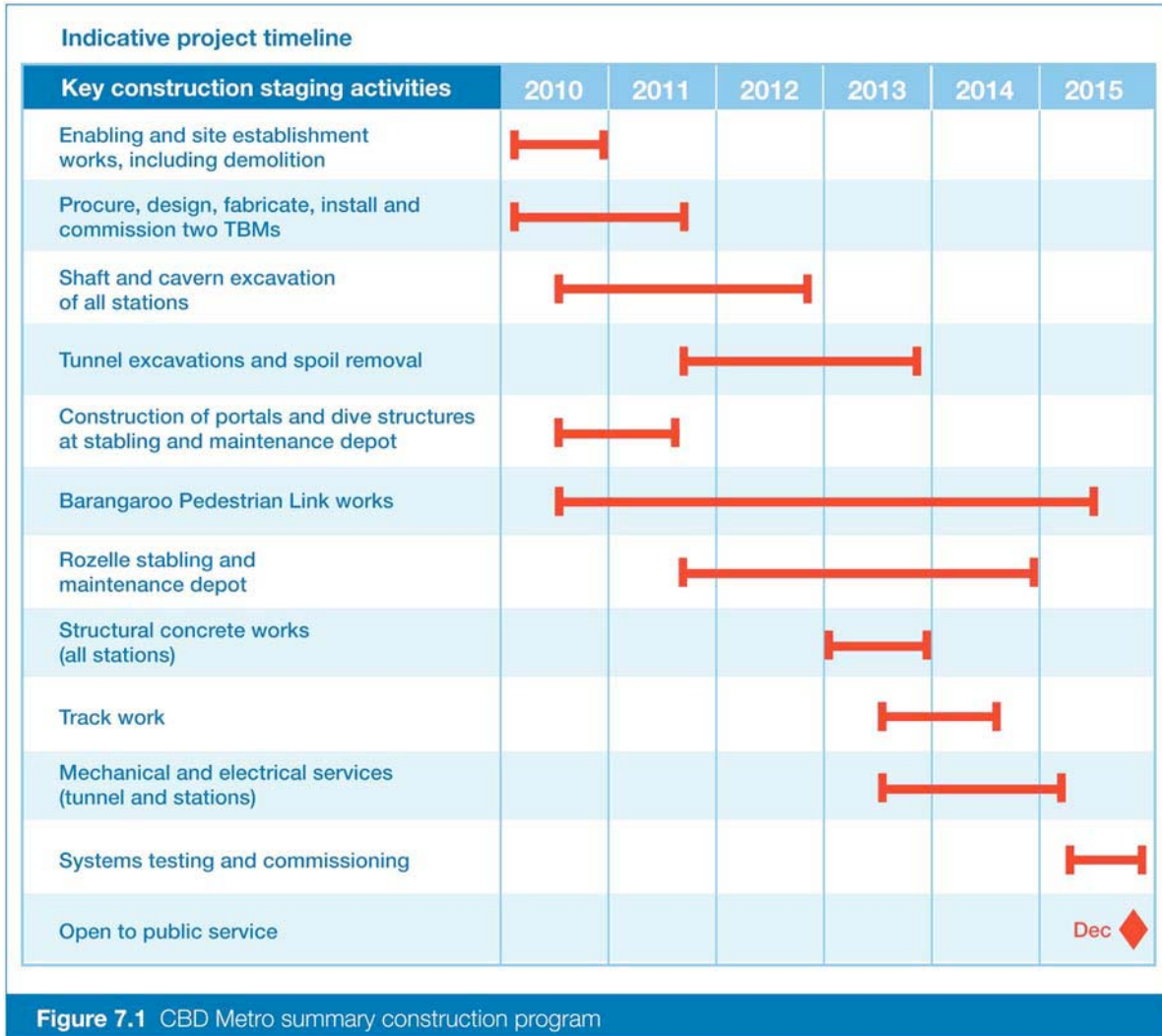
These objectives would be achieved through the application of sound design and construction risk management principles. A Construction Environmental Management Plan (CEMP) would be prepared prior to construction and submitted to the Director-General of the Department of Planning for approval. The CEMP would outline measures to mitigate the impact of construction activities and identify opportunities for environmental benefit. Further development of sub-plans and site-specific Environmental Construction Method Statements (ECMSs) and approaches would be undertaken following consideration of community and stakeholder views.



7.2 Construction program

Subject to planning approval, construction of the project is expected to start in 2010 with the main construction works to take place over the subsequent four-year period. This would be followed by a period of testing, commissioning and preparation for operation. It is expected that the first CBD Metro services would be operational from the end of 2015.

Figure 7.1 shows the principal activities and timescales for the proposed construction program.



The project has been divided into three main construction phases consisting of:

- The enabling works phase.
- The Permanent Route Infrastructure phase.
- The Integrated Metro Operational assets phase.

These construction phases are discussed in more detail below.

7.2.1 Enabling works

The enabling works would involve:

- Relocating various impacted facilities.
- Local roadwork (on City West Link Road).
- Supplying high-voltage construction power for the tunnel boring machines (TBMs).
- Diverting or protecting utility services.
- Dismantling and relocating, and/or demolishing, structures within the footprint of station and construction sites.
- Erecting hoardings.
- Other minor works.

Some of this work would be undertaken in advance of the commencement of tunnel and station construction activities. Further detail on these activities is given section 7.8.

7.2.2 Permanent Route Infrastructure

The construction of the Permanent Route Infrastructure (PRI) involves heavy civil works. It would include tunnelling works and excavation and construction of retaining structures associated with the station boxes at all stations. These works would be delivered by the PRI contractor.

7.2.3 Integrated Metro Operational assets

Integrated Metro Operational assets include rolling stock, rail systems, tunnel services, and station building works, fitout, mechanical and electrical services, and construction of the Rozelle stabling and maintenance depot. These assets would be delivered by the Integrated Metro Operations (IMO) contractor and would form part of the permanent assets of the CBD Metro.

7.3 Tunnel construction

7.3.1 Tunnelling methods

The CBD Metro would have two railway lines, which would be within two underground running tunnels. The preferred excavation method for tunnels and stations is largely driven by the geology and the expected ground conditions to be encountered during construction.

For the 5.3-kilometre section from White Bay to Central Station, the PRI contractor is likely to select two single-shield earth pressure balance (EPB) TBMs capable of operating in dual mode (open and closed) due to the anticipated Sydney Harbour geology and the expected mixed ground conditions. An EPB TBM would be most suited to constructing the tunnels beneath Darling Harbour and Johnstons Bay, which would be predominantly through alluvium material. The use of the EPB TBM would result in nil to negligible settlement on the surface above the tunnel.

A TBM (see Figure 7.2) typically consists of a shield and trailing backup 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 are typically removed by transfer to a conveyor. To provide a lining for the tunnel, the



erector assembles precast concrete segments as the TBM moves forward. Hydraulic jacks pushing on the previously erected segments propel the TBM forward. Gaps between the excavated tunnel wall and the tunnel lining are then filled with grout.



Figure 7.2 Photograph of a Tunnel Boring Machine

The other major tunnelling machinery would be roadheaders. Roadheaders are best used where stable ground conditions are expected (such as sandstone), and have the advantage of significantly shorter lead times for procurement, manufacture, assembly and launching compared to TBMs.

Roadheaders would be used to construct:

- The remainder of the alignment (the 900-metre section from White Bay to Rozelle).
- All of the station caverns.
- The connections between White Bay and the stabling and maintenance depot (each about 300 metres).
- The crossovers, turnbacks and stub tunnels at Central Station.

A roadheader is an excavation machine consisting of a boom-mounted rotating cutter head mounted on tracks, a loading device usually involving a conveyor, and a crawler travelling track to move the entire machine forward into the rock face (refer to Figure 7.3). Tunnel support would consist of a primary lining (likely to be pattern bolting and shotcreting) and either a final cast in-situ or pre-cast concrete lining.



7.3.2 Tunnelling sequence

The White Bay construction site would be used as the launch site for the TBMs and roadheaders (the roadheaders would also be launched from the Rozelle stabling and maintenance depot to construct the Up and Down connections between White Bay and the depot). The typical tunnelling sequence and the location of launch and retrieval sites is shown in Figure 7.4 and described below. The exact method would be developed by the PRI contractor prior to construction.

The first activity would be to launch two roadheaders to White Bay to facilitate the launch of the TBMs. Subsequently, the roadheaders would be driven towards Rozelle Station. The first TBM would then be assembled within the White Bay launch site. Once assembled (this could take about two to four months), the first TBM would be launched to construct one of the running tunnels to Central, and assembly of the second TBM would commence. The second TBM would be launched about two months after the first TBM and would commence excavation of the second running tunnel to Central.

During this time, the station caverns would be under construction (refer section 7.4) to ensure sufficient excavation has occurred prior to the arrival of the TBM or roadheader.

Either concurrently or following completion of the running tunnels to Rozelle Station, the roadheaders would be used to construct the Up and Down connection lines from the Rozelle stabling and maintenance depot. Where the tunnels surface at the portal, a cast in-situ concrete dive structure would be built which would transition into the maintenance depot. The exact timing and direction of the roadheaders would depend upon the contractor's construction program and equipment selection.

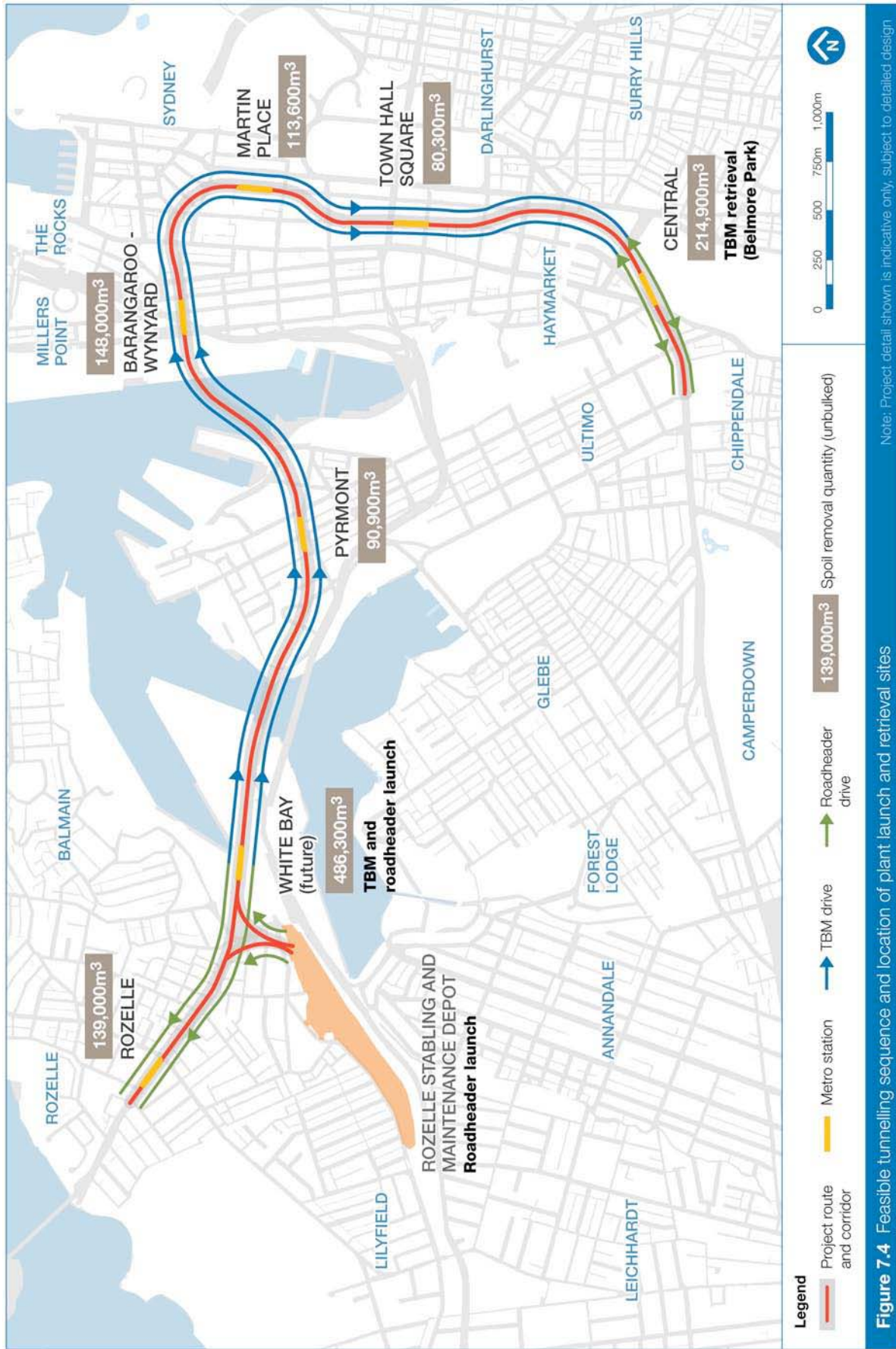
Roadheaders would also be used to construct the crossovers and turnbacks. The crossovers would be excavated from the station boxes at Central, White Bay and Rozelle. Upon completion of the tunnels, the roadheaders would be retrieved at the Rozelle and White Bay construction sites, and the TBMs would be retrieved from the Central Station construction site in Belmore Park.

On average, each TBM would progress at a rate of about 300 metres per month and the roadheaders at a rate of about 110 metres per month.

The construction hours for tunnelling operations are detailed in section 7.8.6.

Spoil from the tunnelling operations would be removed by conveyor (or other transport system) from the tunnel, stockpiled at White Bay and then removed from site. The management and disposal of spoil is discussed in more detail in Chapter 9.

Access arrangements for the White Bay construction site would be agreed with the relevant local authorities, land owners and the RTA. Detailed Construction Traffic Management Plans (CTMP) and Traffic Control Plans (TCP) would be developed and would include details of access arrangements, temporary and permanent closures and diversions, time restrictions on use and traffic signage. Further detail regarding the access arrangements for the construction sites and removal of spoil is detailed in Chapter 10.



7.4 Station construction

7.4.1 Underground construction

The construction of the station boxes would follow this typical sequence of activities:

- Enabling works prior to the start of main construction, consisting of protection or diversion of utility services and other preliminary works to enable construction.
- Clearance of the site, including demolitions and setting up offices and amenity facilities.
- Excavation and piled walls in concrete, reinforced concrete or steel for shafts.
- Construction in reinforced concrete and sprayed concrete lining of shafts, underground tunnels and other underground areas such as pedestrian tunnels and ventilation/services areas/tunnels.

Cavern stations

Cavern stations would be constructed at all of the station sites except for the future White Bay Station (as described below). Each station would be constructed from an access shaft, which would be constructed by a cut-and-cover method, similar to the method described below. Ideally, access shafts to the station caverns would be located along the alignment of the running tunnels, providing direct access to the tunnel faces once the shaft is constructed and facilitating easier removal of spoil and supply of support materials. Where shafts are offset to the tunnel alignment due to site constraints, access to the caverns would be achieved by excavating adits (horizontal tunnels) from the shafts.

Once completed, a gantry crane (or similar) would lower machinery into the shaft to construct the cavern. Typically, the heading (the top section of the cavern) would be excavated using roadheaders, and the bench (lower section of the cavern) and the invert (base of the cavern) would be excavated using plant such as roadheaders, excavators with rippers, rock breakers, rock saw cutting, and line drilling. Spoil from the excavation would be removed via the shaft and temporarily stored in a spoil bin or pit within the construction site.

Drill and blasting or penetrating cone fracture (PCF) techniques may be required to better manage regenerated noise from rock breaker or roadheader mechanical processes. If required, it would be undertaken in accordance with guidelines for managing noise and vibration of sensitive receivers. The primary ground support would be provided by rock bolts and mesh-reinforced or fibre-reinforced sprayed concrete.

Following the construction of the caverns, the TBMs would pass through the station and then the permanent support of the cavern would be installed. The permanent support of the excavation is likely to be drained, which typically involves the installation of permanent rock bolts and sprayed concrete lining. Any ground seepage around the caverns would be diverted to the invert drains by means of a geotextile mat, and a waterproof membrane sandwiched between initial and final linings.

White Bay Station (future)

The safeguarded station box at White Bay would be a drained structure constructed by a bottom-up cut-and-cover method. Cut-and-cover refers to the process of excavating from the surface, constructing the structure within the excavation, and then backfilling over a roof cover and restoring the ground surface.

Prior to construction, a permanent retaining structure consisting of a diaphragm wall with rock anchors or struts would be constructed on the external faces surrounding the site. Once complete, the station box would be excavated to formation level. The station structure would be constructed upward from the base slab and the box structure would then be backfilled to the surface. A temporary wall would be constructed to ensure separation of the station box and running tunnels for fire and life safety

purposes. The temporary wall would facilitate the station to be fully constructed in the future without interruption to metro services.

A permanent roof structure would be built over the station box, and a temporary (removable) structure would be built at existing ground level to ensure that the station would be easily accessible for future construction.

7.4.2 Above-ground construction

Station fitout works

Station fitout works would include the provision of:

- Internal building and structure works including finishes.
- Station access and egress, including emergency provisions (such as pavilions, walkways, passageways, lifts, stairs, and escalators).
- Platforms, concourses and circulation areas.
- Wayfinding and signage, passenger information displays, speakers, CCTV monitor and all associated fixings.
- Station services and other amenities.
- Mechanical and electrical fitout of station services and system.
- Entry/exit gates and barriers.
- Ventilation, platform screen doors and fire and life safety systems.
- Interchange and integration with other transport modes within a defined station precinct area.

The majority of the station fitout works would be undertaken underground, although there would still be a need to maintain a significant construction site at the station surface to facilitate the fitout activities. The activities at the surface would include delivery of manufactured equipment and products, material storage, and crane services.

7.5 Pedestrian links

7.5.1 Barangaroo Pedestrian Link

While the PRI contractor would determine the exact method of construction, the following typical activities are likely for the construction of the Barangaroo Pedestrian Link.

The Barangaroo Pedestrian Link would be constructed primarily from the Napoleon Street construction site, which is bound by the Westpac Forecourt Park (south), Moreton's Hotel existing roadway (west), Kent Street (east) and the eastbound lanes of Napoleon Street (north). The construction site would require two of the existing Napoleon Street westbound lanes. The existing Western Distributor road platform is the preferred area for site offices and crib sheds.

The construction site would provide an area for stockpiling spoil, which would be removed at a rate of about one to two truck movements per hour during tunnel excavation.



Access to the eastern side of Moreton's Hotel would be maintained during construction with a dedicated four metre wide roadway. This temporary access road would become a permanent paved access way (subject to design review and approval) and would be wider than the current access way.

The construction works would be conducted in an east-west direction over a period of about 30 months. At the Napoleon Street construction site the tunnel portal is expected to be constructed as an open cut construction due to the very shallow cover and close proximity to numerous and congested existing services. This would require temporary shoring (such as reinforced concrete bored piles or steel sheet piles) on the northern and eastern perimeter of the site. Existing services would be identified and exposed by trench excavation and relocated prior to bulk excavation.

Once the open cut is completed, the northern, western and eastern construction site boundaries would be adjusted and finalised for the remaining construction stages, and the road would be reinstated in a new configuration.

The second stage of tunnel construction would be the cut and cover construction at the Kent Street/Margaret Street intersection to construct the tunnel portal. A number of services at this location (power, water, gas, communications, sewerage, etc) would be either protected or diverted during excavation.

From the tunnel portal, the pedestrian tunnel would be mined under Margaret Street between Kent and Clarence streets using a roadheader. The tunnel would be about 105 metres long and would connect to the Barangaroo-Wynyard Station shaft at Clarence Street. A one metre stub tunnel would be constructed to assist any future extension to George Street. Following excavation, temporary support would be used to stabilise the formed opening. To provide long-term support, the mined tunnel would be lined with cast in-situ reinforced concrete or pre-cast arches.

A buried Energy Australia substation and a sewer are located under Clarence Street. While both of these services are above the proposed excavation level, care would still need to be taken to ensure they are not impacted.

Following construction of the tunnel the pedestrian bridge over Sussex Street would be constructed. The bridge would comprise reinforced concrete substructures and a structural steel superstructure (hollow box truss structure). During construction of the bridge the area would be surrounded by hoarding of a sufficient height to protect the KPMG building and the general public.

7.5.2 Other pedestrian links

Subterranean pedestrian links would be required at the following locations:

- The connection to the Devonshire Street tunnel at Central Station.
- East-west pedestrian link between the metro Central Station and Chalmers Street (staged).
- The pedestrian link from the Quay Street entrance at Central Station (staged).
- The pedestrian link under Park Street at Town Hall Square.
- The pedestrian link between the metro Town Hall Square Station and CityRail's Town Hall Station.
- The pedestrian link under Victoria Road and Darling Street at Rozelle Station.

These pedestrian links would most likely be constructed using the horizontal piped roof method to minimise surface disturbance. Using this method can allow roads above pedestrian tunnels to remain open (with speed restrictions) during construction and services under the road generally do not need to be relocated or diverted. Cut-and-cover may, however, be required in some locations. Other similar

methods that do not disturb the surface may be selected by the construction contractor once ground conditions have been investigated in detail at each location.

In addition to these subterranean pedestrian links, a surface pedestrian bridge link would be constructed over the Rozelle stabling and maintenance depot. Construction of the bridge over the depot would require the establishment of small construction sites once the detailed design is confirmed.

7.6 Stabling and maintenance depot

The construction of the Rozelle stabling and maintenance depot would involve:

- Surface civil works including removal of unsuitable material, regrading and raising the site level. The formation would include installation of new stormwater drainage infrastructure throughout the depot, and crossing of City West Link Road to a new stormwater outfall to Rozelle Bay.
- Construction of the dive structure for Up and Down connections to the running lines.
- Construction of the stabling facilities for 11 five-car trains, including trackform and rail systems.
- Construction of a concrete slab over portions of the stabling yard to ensure that maintenance regimes are consistent throughout the metro system.
- Construction of the maintenance building and the control building, which are likely to require a piled slab foundation due to the poor ground conditions.
- Construction of new power supply infrastructure and protection of existing power infrastructure.
- Construction of site access roads, car park and hardstands, hard and soft landscaping works.
- Construction of other works to facilitate the operation of the stabling and maintenance depot (such as utility corrections, security facilities, and boundary fencing).

7.7 Construction sites and methods

The project would require construction sites at each of the station locations, at the site of the proposed Rozelle stabling and maintenance depot, and at White Bay. Other sites required but not detailed in this section would be the subject of further assessments once the requirement for and scope of any such additional sites is known. In general, all station construction sites are required to construct an access shaft from which to construct the station cavern, provide an entrance to the station and as a location for services.

General construction activities at all station worksites would include:

- Construction site planning, including survey, inspections, erection of hoarding, rubbish removal and establishment of site-specific occupational health and safety procedures.
- Enabling works and site establishment consisting of protection or diversion of utility services, treatment of heritage elements (where required), installation of temporary construction power supply, clearance of the site (including demolition) and setting up site offices, amenities, materials/plant storage areas, and spoil handling facilities.
- Aboveground station construction activities, including shaft excavation for entrances and services (such as vent shafts and emergency access), followed by building works and station fitout.



- Underground station cavern construction using roadheaders and rock breakers via the access shafts.
- Ground support and cavern lining, with plant and material delivered to the underground cavern from the surface.
- Structural concrete works for station entrances, emergency egress and ventilation shafts, followed by internal building works and station architectural fitout/finishes.
- Specialised installation works associated with installing station platforms, concourses, accommodation and circulation areas, services and other amenities, station entry/exit gates, platform screen doors and barrier installation.
- Mechanical and electrical fitout of station services and communication systems (including local power supply, lighting, public address, plant room cooling/humidity control, building management systems, smoke exhaust, gas purging, water and waste water, mechanical ventilation, etc.)
- Underground pedestrian concourse areas using a combination of mining methods (to minimise disturbance of the road surfaces) and cut-and-cover.
- Removal of spoil from construction of entrances, service shafts etc, as there would be minimal spoil storage space within these construction sites.
- Testing and commissioning station systems.

All station construction sites (or at least one of the construction sites at each proposed station location) would generally include:

- Space for a gantry crane (or similar) to lower the excavation equipment into the shaft and to remove excavated spoil.
- A water treatment plant to treat any surface runoff or groundwater inflow that may collect in the shaft.
- Offices for site staff (including lunch room, offices, washroom facilities).
- A substation and generator to power the electrical equipment (such as TBMs and roadheaders).
- A spoil stock area (for example, a bin or pit).
- A storage and workshop area.
- Other facilities required to support station construction activities.

The location of these sites, including vehicle access, is provided in the following sections.

All construction sites would be managed to protect the health and safety of the community and stakeholders, including users of nearby childcare facilities and schools. Regular communication with childcare facilities and schools would be prescribed within the Community Involvement Plan. This would include notification of works, updates, and feedback on concerns regarding the project.

Construction worksites would be under the control of a principal contractor who has a statutory duty under the *NSW Occupational Health and Safety Act 2000* to prevent unauthorized access to the site and protect the public place from work activities and comply with provisions of the *Occupational Health and Safety Regulation 2001* that relate to work sites adjoining a public place.

7.7.1 Other temporary worksites

In addition to the main construction sites identified above, other temporary worksites would be required from time to time. The temporary worksites would be short in duration (in comparison with the main CBD Metro construction sites). They would operate from less than 24 hours (for overnight delivery of oversized loads to site), up to 12 months (for worksites required for utility diversions, initial stages of building demolition works, and other staged areas to facilitate infrastructure construction).

The size, location and extent of temporary worksites have not been determined at this stage of the project. However, the activities would likely involve:

- Delivery and removal (lifting) of large construction equipment, materials, and components (such as escalators, lifts, steel or concrete beams, and columns) from within the road reserve, that cannot be undertaken from within the main construction sites due to space limitations.
- Installation of pit and duct systems for bulk power supply (during operation) and 11 kilovolt (kV) power supply for construction at all station sites, and 33 kV supply at the Pymont and Rozelle stabling and maintenance depot.
- Provision of construction and permanent depot access connections onto City West Link Road at the Rozelle stabling and maintenance depot.
- Relocation or diversion of existing services/utilities clear of the main CBD Metro construction sites.
- Building demolition works where there is no suitable vehicular access within the property boundary.
- Utility/services connections for construction purposes and the operational CBD Metro infrastructure in the vicinity of stations, and the stabling and maintenance depot.
- Facilitation of infrastructure construction works.
- Station precinct and stabling and maintenance depot works external to the main worksite locations.

Measures and management processes that would be implemented to minimise impacts associated with temporary worksites would include:

- Coordinating the works to ensure concurrent worksites at any one location do not coincide.
- Staging the works to minimise the extent of impact. For example 'rolling' worksites would be used for linear worksites required for utilities.
- Using alternative 'trenchless' construction methods where space and methods permitted; these methods reduce disturbance on the surface.
- Undertaking night-time work or using road plates, where works in roadways are required to cross through or are near intersections, or other constrained areas, to ensure day-time traffic is not impacted.
- Preparing Traffic Control Plans (TCPs) and road occupancy permits for each worksite for approval by the relevant authorities (for example, RTA and/or Council) prior to the works commencing on site. The construction contractors would prepare these.



- Providing suitable traffic control and warning devices as detailed in the TCPs, such as traffic control personnel, and signage.
- Providing suitable worksite fencing/barricades to ensure safety of the public and the workers.
- Managing access and security of temporary worksites at all times, including when no activity is being undertaken within the sites.
- Minimising storage of materials and equipment within temporary worksites.
- Considering proposed working hours, duration of works, and proximity of residential and other sensitive receivers when selecting noisy construction equipment and methods.
- Using and managing suitable environmental controls such as cleaning of truck wheels, sweeping of pavements, control of excavated material to prevent mud tracking and dust, silt socks around stormwater inlets.
- Maintaining access to adjacent properties and access for emergency services at all times.
- Undertaking appropriate community notification and liaison prior to and during the works.

7.7.2 Central Station construction sites

The works at Central Station would be undertaken from one primary construction site and two secondary construction sites as shown in Figure 7.5.

The primary construction site would be located in the south-western portion of RailCorp's Central Station Western Forecourt (known as the 'Western Forecourt'), bound by Pitt Street in the north-east and Ambulance Avenue to the south. This area currently includes a small 'garden', 59 parking spaces for commuters and staff, and vehicle access to Central Station Country Link Platforms and CityRail rail-replacement buses. The site would be used to construct the main shaft, as well as a diamond crossover and turnback within the tunnels at the southern end of the station box. A brick oviform sewer (main northern sewer) that passes through the Central Station precinct is located adjacent to the station box. Protection works would be required around the sewer structure and would be developed with Sydney Water.

A second shaft would be constructed within the south-western corner of Belmore Park to facilitate retrieval of the TBMs (used to construct the running tunnels).

Temporary earth retention walls at both construction sites would be required to maintain the stability of the open excavation and minimise groundwater ingress. These walls may comprise soldier piles or sheet piles, and a combination of rock bolt and sprayed concrete support, depending on ground conditions.

The staged construction of a new east-west pedestrian connection between the metro station and Chalmers Street requires further detailed design, but would be constructed below the operational CityRail platforms.

A small construction site would also be required at Quay Street for the construction of another station entrance. The entrance would be constructed as a shaft down to a mined tunnel crossing of Pitt Street to avoid disturbance of major utility services. A portion of Quay Street would be reinstated on a cover structure around the entrance. The works would be undertaken later in the construction program.

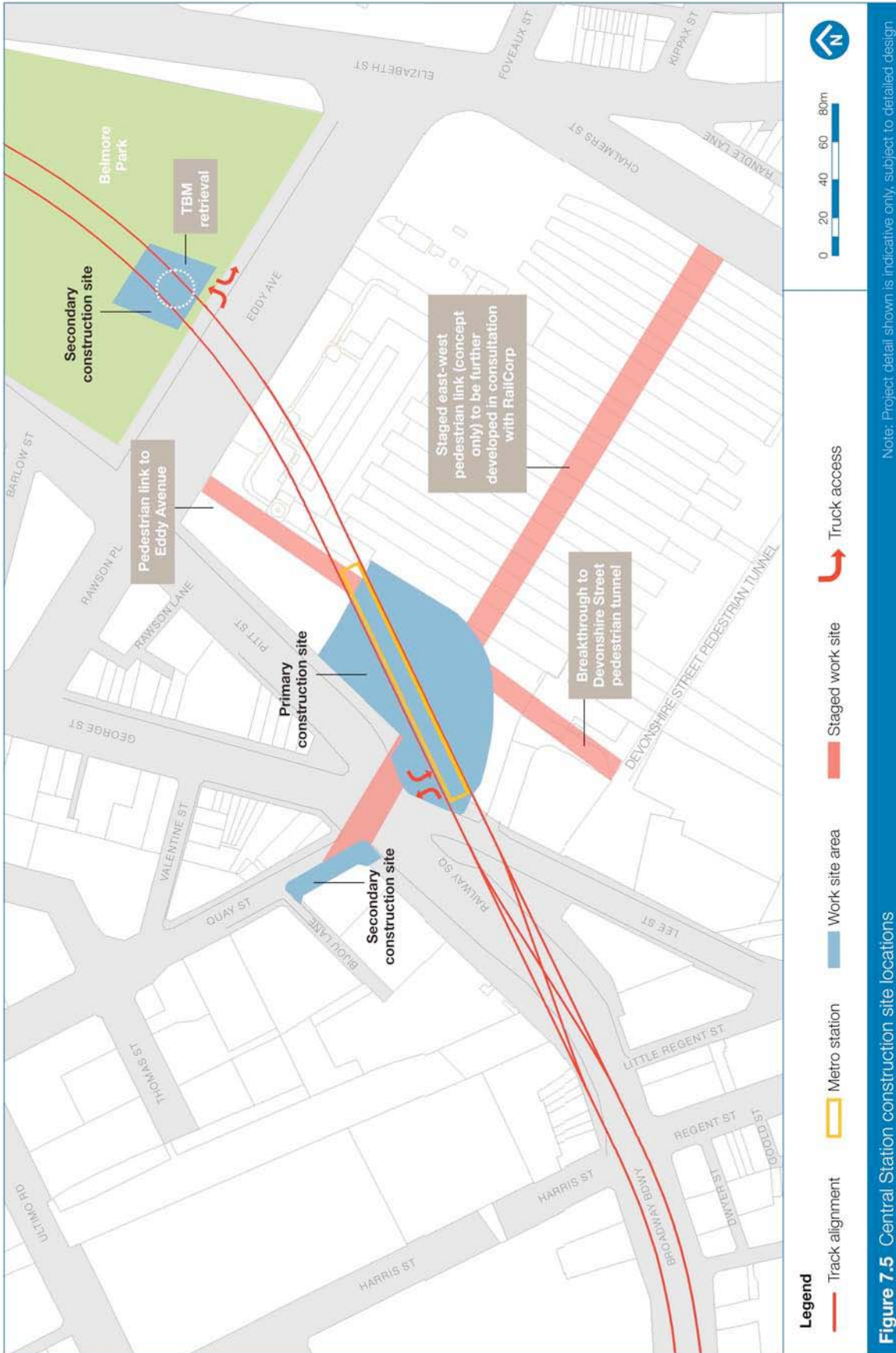
A breakthrough to the Devonshire Street pedestrian tunnel would also be constructed after 2015 as passenger demand increases.

Indicative construction timeframes at the primary construction site are shown in Table 7.1.

Table 7.1 Indicative construction timeframes at the primary construction site at Central Station

Construction activities	Indicative station construction timeframe						
	2010	2011	2012	2013	2014	2015	
Site establishment & protection works	■	■	■				
Shaft structure & excavation		■	■				
Cavern excavation		■	■	■	■	■	
West tunnels and cross-over			■	■	■	■	
Support and cavern lining (PRI)				■	■	■	
Structural concrete works (IMO)					■	■	■
Station structural building works						■	■
Mechanical and electrical services						■	■
Entry structures							■
Systems testing and commissioning							■





7.7.3 Town Hall Square Station construction sites

Town Hall Square Station would be located under Pitt Street between Bathurst and Park streets. The works to build the station cavern would be undertaken from one primary construction site (see 0). The primary construction site would be located along Park Street, between George and Pitt streets. The site is currently occupied by Woolworth’s supermarket, retail and commercial office buildings, which would be demolished prior to construction commencing. Along Park Street, hoardings would be gantried above the footpath, with site sheds located on top of the gantry.

A secondary construction site would be located at 125–135 Bathurst Street, on the south-eastern corner of Pitt and Bathurst streets. The site is required to support station shaft excavation and to locate services buildings. The site currently houses retail buildings, which would be demolished prior to construction commencing.

In addition, a shorter term construction area on Pitt Street, north of Park Street, would be required to support construction of an underground pedestrian link and at Pitt Street north of Bathurst Street to support building basement protection works. At these sites utility protection and relocation works would be required.

Indicative construction timeframes at the primary construction site are shown in Table 7.2.

Table 7.2 Indicative construction timeframes at the primary construction site at Town Hall Square Station

Construction activities	Indicative station construction timeframe						
	2010	2011	2012	2013	2014	2015	
Demolition / site establishment works	■	■	■				
Shaft structure and excavation		■	■				
Cavern excavation			■	■	■	■	
Support and cavern lining (PRI)				■	■	■	
Structural concrete works (IMO)					■	■	
Station structural building works						■	■
Mechanical and electrical services						■	■
Surface entry structure							■
Systems testing and commissioning							■



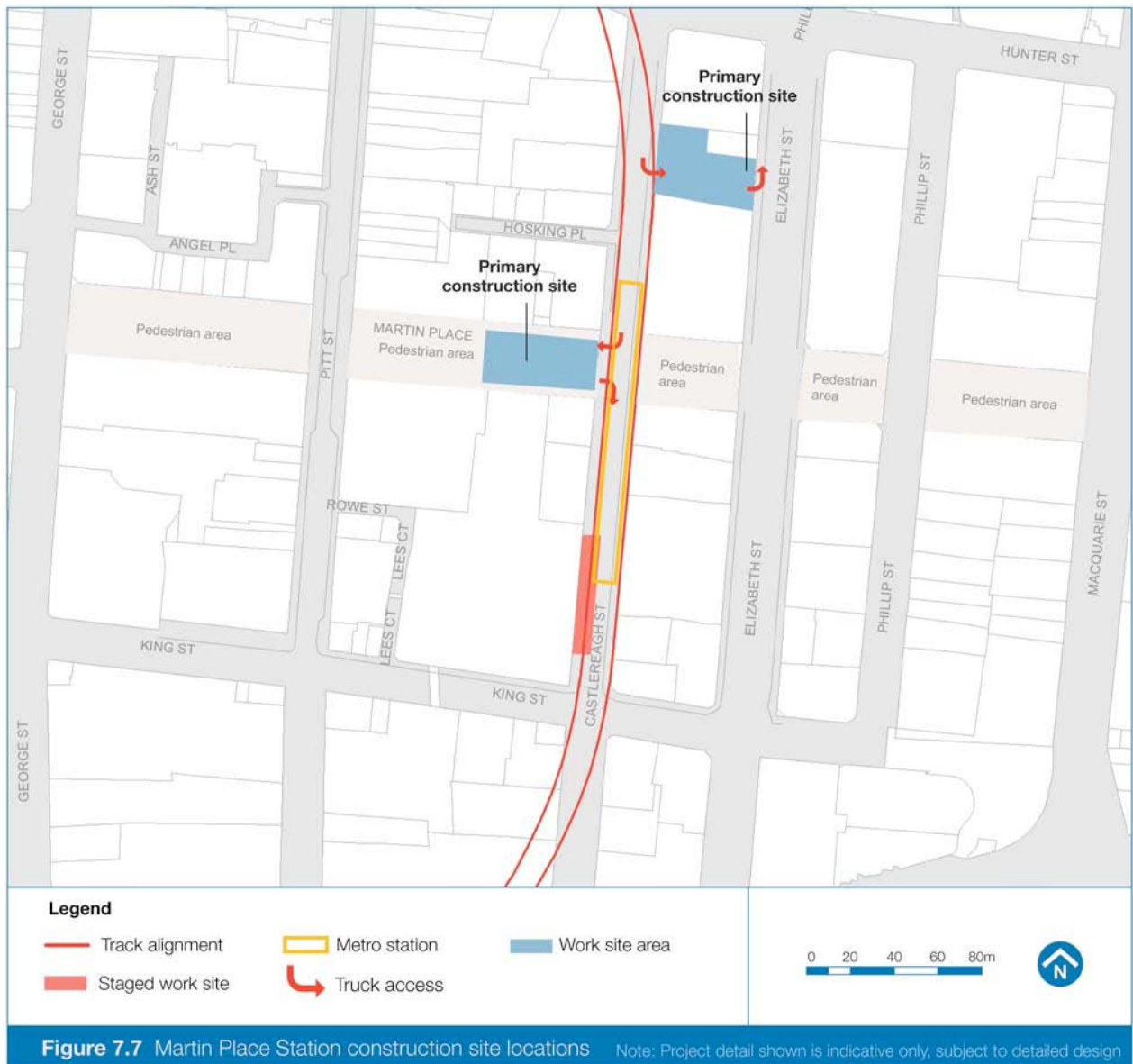


7.7.4 Martin Place Station construction sites

Martin Place Station would be located under Castlereagh Street. Construction of the station cavern would be undertaken from two primary construction sites and one secondary site (see Figure 7.7). The primary construction site located between Castlereagh and Elizabeth streets (9 Elizabeth Street and 8 to 12 Castlereagh Street) would be required to support station shaft, cavern, ventilation and emergency egress adit excavation. The site is currently occupied by retail and commercial buildings, which would be demolished prior to construction commencing.

The primary construction site within Martin Place on the western side of Castlereagh Street would be required to support station shaft and cavern excavation and to construct the station entrance. The site currently houses public space and walkways leading to the entrance to CityRail's Martin Place Station. Access to CityRail's Martin Place Station and the MLC Centre would be retained during construction.

A staged secondary construction site would be located on Castlereagh Street, north of King Street, for excavations down to platform level in order to construct tunnel vents. This site would remove loading bays currently at this location and would require localised relocation or protection of utilities. Access to the hotel car park at the corner of Castlereagh and King streets would be maintained.



Indicative construction timeframes at the primary construction sites are shown in Table 7.3 and Table 7.4 below.



Table 7.3 Indicative construction timeframes at the primary construction site at Castlereagh and Elizabeth streets

Construction activities	Indicative station construction timeframe								
	2010	2011	2012	2013	2014	2015			
Demolition / site establishment works	■	■	■						
Shaft structure and excavation		■	■						
Cavern excavation			■	■	■				
Support and cavern lining (PRI)				■	■				
Structural concrete works (IMO)					■	■			
Station structural building works						■	■		
Mechanical and electrical services						■	■	■	
Systems testing and commissioning								■	■

Table 7.4 Indicative construction timeframes at the primary construction site in Martin Place

Construction activities	Indicative station construction timeframe								
	2010	2011	2012	2013	2014	2015			
Demolition / site establishment works	■	■							
Shaft structure and excavation		■	■	■					
Cavern excavation			■	■	■				
Support and cavern lining (PRI)				■	■				
Structural concrete works (IMO)					■	■			
Station structural building works						■	■		
Mechanical and electrical services						■	■	■	
Surface entry structure						■	■	■	
Systems testing and commissioning								■	■

7.7.5 Barangaroo-Wynyard Station construction sites

Barangaroo-Wynyard Station would be located under Margaret Street between Sussex and York streets. Construction of the station cavern would be undertaken from two construction sites (see Figure 7.8).



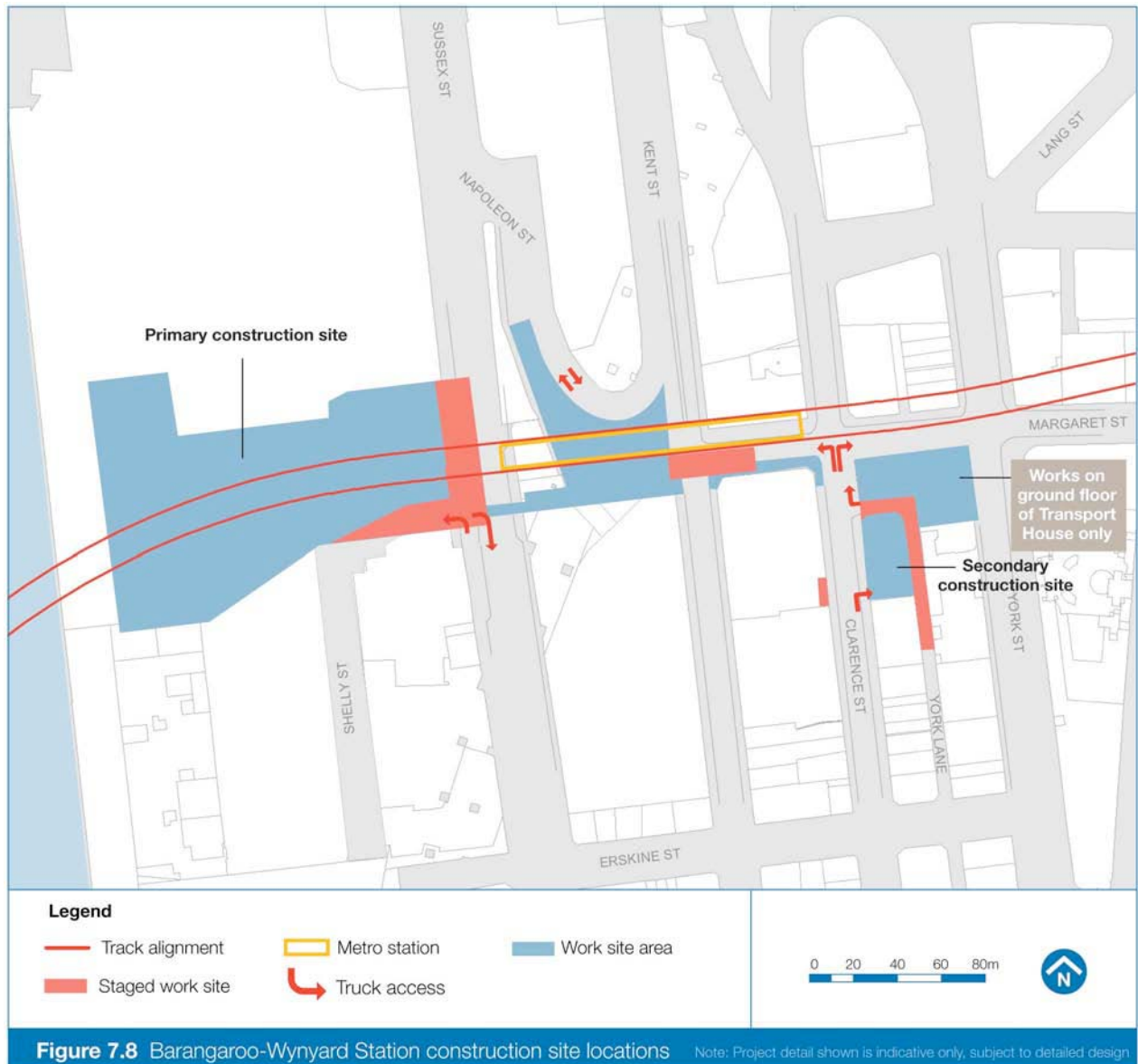


Figure 7.8 Barangaroo-Wynyard Station construction site locations Note: Project detail shown is indicative only, subject to detailed design

The primary construction site would be located mainly within the Barangaroo development site at the intersection of Sussex and Shelley streets and would be required to support station shaft and cavern excavation. The site is currently occupied by the Sydney Ports Corporation’s cruise ship terminal operations. The operations would be reconfigured to allow continuation, with the main entrance canopy demolished during the early phase of the construction activities commencing. The timing and alternative arrangements have been agreed with Sydney Ports and in consultation with Sydney Harbour Foreshore Authority and Barangaroo Development Authority. There are several short-term sites in Sussex and Shelley streets that would require traffic management and relocation or protection of underground services.

The secondary construction site would be located at *De La Salle House*, at 30 and 36-38 Clarence Street, and would be required to support station shaft, ventilation and emergency egress adit excavation. The site is adjacent to York Lane and is currently occupied by retail and commercial office space, which would be demolished prior to construction commencing. In addition, components within the ground level of Transport House (corner of York and Margaret streets) would be removed to facilitate the construction of the station entrance and provision of retail space. Other floors other than the ground floor to Transport House would not be affected and the building use would continue throughout construction.



A staged worksite in the western side of Clarence Street is needed to provide an entrance to the Barangaroo Pedestrian Link and the station from the bus stops.

Indicative construction timeframes at the primary construction site are shown in Table 7.5.

Table 7.5 Indicative construction timeframes at the primary construction site at Barangaroo-Wynyard Station

Construction activities	Indicative station construction timeframe						
	2010	2011	2012	2013	2014	2015	
Demolition / site establishment works	■	■					
Shaft structure and excavation		■	■	■			
Cavern excavation			■	■	■		
Support and cavern lining (PRI)				■	■		
Structural concrete works (IMO)					■	■	
Station structural building works					■	■	
Mechanical and electrical services					■	■	■
Surface entry structure						■	■
Systems testing and commissioning							■

7.7.6 Pyrmont Station construction sites

Pyrmont Station would be located approximately under Union Square, between Mount and Pyrmont streets. Construction of the station cavern would require one primary and one secondary construction site (see Figure 7.9 and Figure 7.10).

The primary construction site would be located at 102–108 Miller Street (on the corner of Mount Street) and would be required to support station shaft and cavern excavation. This site is currently occupied by retail and commercial office space and surrounded by residential development. The existing commercial buildings would be demolished to facilitate construction of the station box and station entrance, and to locate station services.

The secondary construction site would be required to support station shaft, ventilation and emergency egress adit excavation, as well as cut and cover methods to create the shallow passenger circulation link below Union Street. The site would be located either within the entire site occupied by 3-9 Union Street (Alternative 1) or within part of the site occupied by 3-11 Union Street (Alternative 2). These properties are currently occupied by retail premises. To facilitate construction of the station box and station entrance and to locate station services, all (Alternative 1) or part (Alternative 2) of these buildings would need to be demolished.

During construction, the eastbound traffic lane on Union Street would be closed between Paternoster Row and Pyrmont Street to accommodate the work site. Paternoster Row (northbound) would be rerouted through Union Square shared zone to the Harris Street and Miller Street intersection.

Indicative construction timeframes at the primary construction site are shown in Table 7.6 below.



Table 7.6 Indicative construction timeframes at the primary construction site at Pymont Station

Construction activities	Indicative station construction timeframe						
	2010	2011	2012	2013	2014	2015	
Demolition / site establishment works	■	■					
Shaft and cavern excavation		■	■	■	■		
Support and cavern lining (PRI)			■	■	■		
Structural concrete works (IMO)				■	■	■	
Station structural building works					■	■	
Mechanical and electrical services					■	■	■
Surface entry structure						■	■
Systems testing and commissioning							■

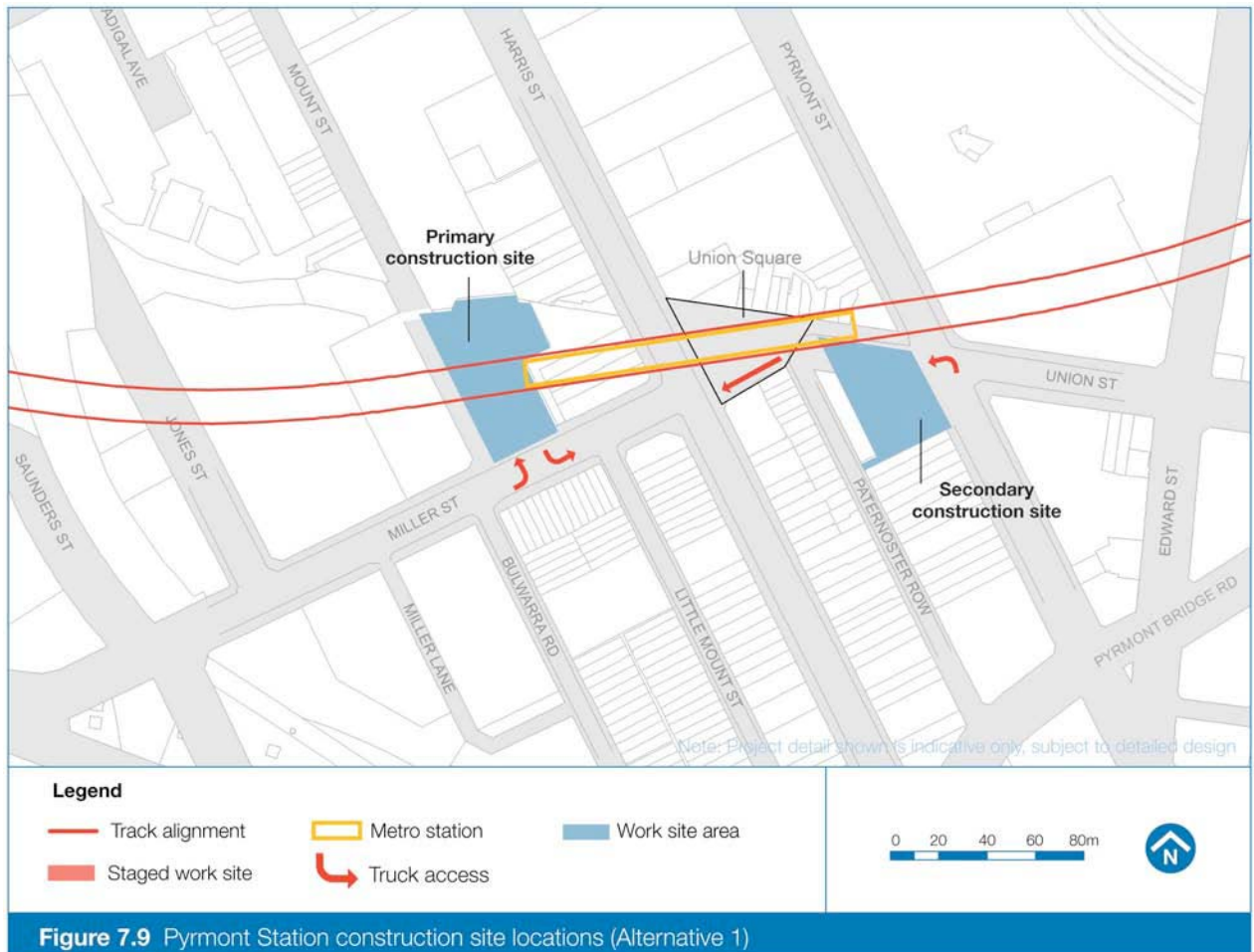
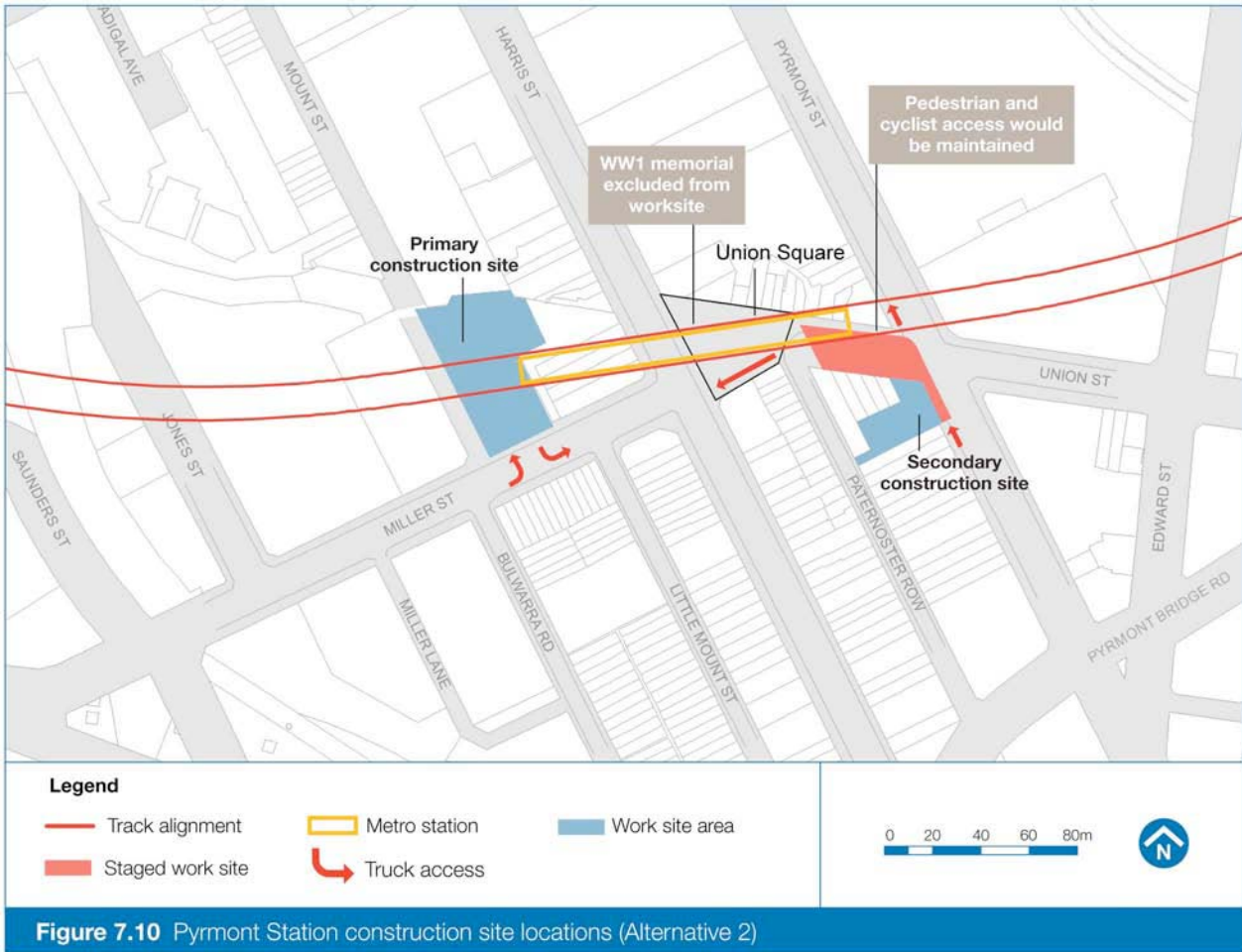


Figure 7.9 Pymont Station construction site locations (Alternative 1)





Note: Project detail shown is indicative only, subject to detailed design

7.7.7 Rozelle Station construction sites

The primary construction site for Rozelle Station would be located within the Balmain Leagues Club development site along the south-western side of Victoria Road, and the adjacent block of retail premises on the corner of Victoria Road and Darling Street (see Figure 7.11).

Construction activities at this site would include constructing the shafts and station entrances, launching the roadheaders to construct the crossover, constructing a sub-surface pedestrian access to the opposite side of Victoria Road (refer to section 7.5.2), and excavating stub tunnels for a future metro connection to the north-west.

Two smaller secondary construction sites for station entrances would be located on the opposite side of Victoria Road, on either side of Darling Street. These sites would be required to support shallow station shaft excavation. The entrances would be constructed within excavated vertical shafts that would then be closed over by a cover structure.

Indicative construction timeframes at the primary construction site are shown in Table 7.7 below.

Table 7.7 Indicative construction timeframes at the primary construction site at Rozelle Station

Construction activities	Indicative station construction timeframe						
	2010	2011	2012	2013	2014	2015	
Demolition / site establishment works	■	■					
Shaft and cavern excavation		■	■	■	■	■	
Support and cavern lining (PRI)				■	■		
Structural concrete works (IMO)				■	■	■	
Station structural building works					■	■	■
Mechanical and electrical services					■	■	■
Surface entry structure						■	■
Systems testing and commissioning							■





7.7.8 White Bay Station construction site

The White Bay Station construction site would be located on land at White Bay adjacent to the White Bay Power Station, Western Distributor and Roberts Street (see Figure 7.12). This land is currently used by Sydney Ports. The existing functions would be relocated prior to work commencing on the site. The site would be used to launch and support the TBMs and roadheaders, as a spoil storage area, and to construct a station box for a future White Bay Station. The surface area occupied for the construction site would be about 50,000 square metres and the size of the excavation would be about 3,300 square metres at the surface.

Access to the site would be via the intersection of James Craig Road and The Crescent. James Craig Road is a private road owned by NSW Maritime. It is also proposed to provide construction vehicle access under the Victoria Road bridge to provide a link between the White Bay construction site and the Rozelle stabling and maintenance depot construction site to obtain access directly from City West Link Road.

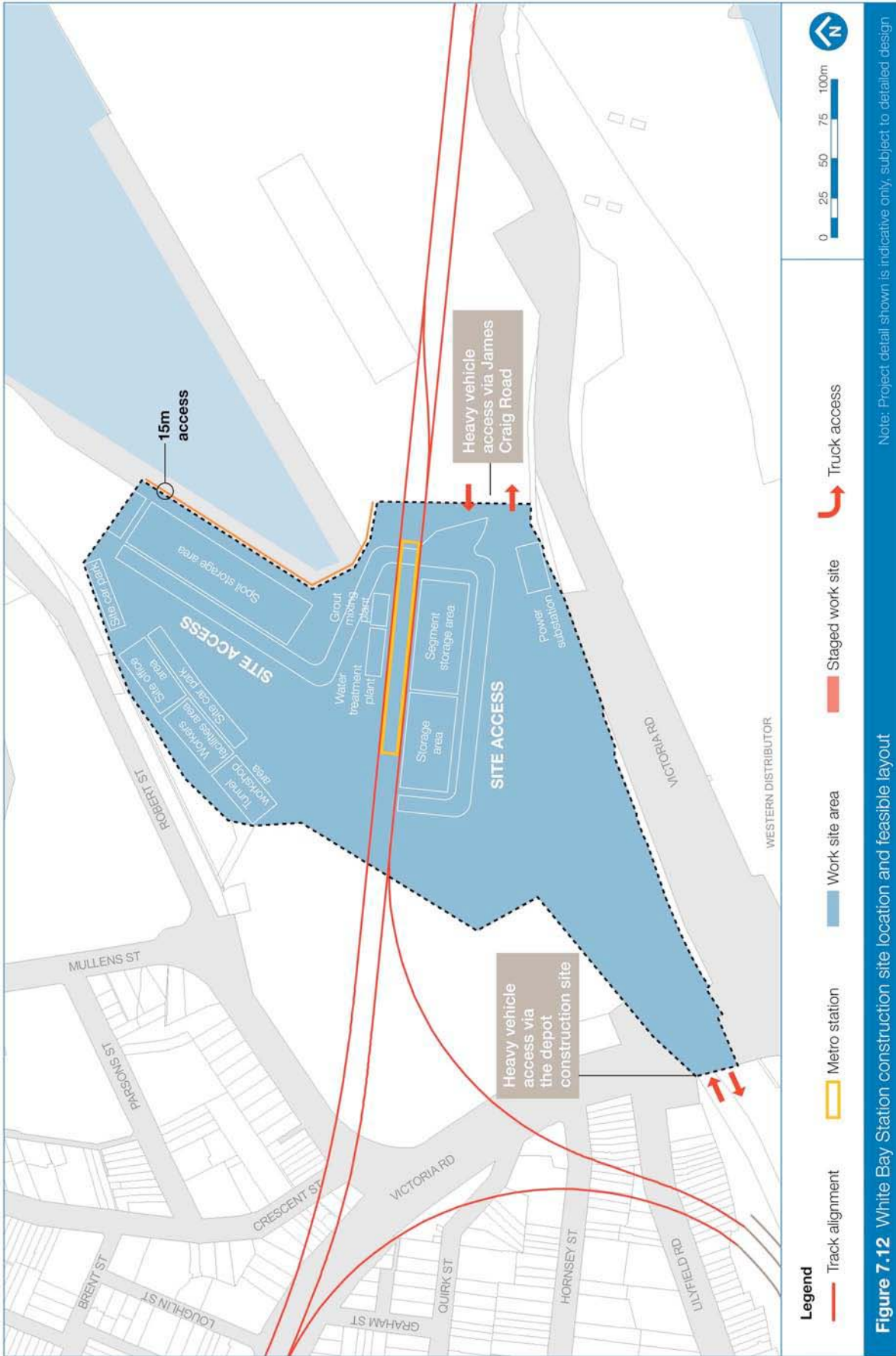
Activities at the White Bay construction site would include:

- Excavating the station box/launch site (as described in section 7.3).
- Undertaking temporary works, such as constructing HV power supply and a substation for operating TBMs and roadheaders, relocating services, demolition works, clearing vegetation, and levelling.
- Undertaking ground improvement works, such as grouting at the eastern end of the station box.
- Establishing site facilities.
- Delivering and storing pre-cast segmental lining for the tunnels.
- Concrete and/or grout batching for building the tunnel and station.
- Delivering, assembling and launching the roadheaders to Rozelle (they may also be launched from the Rozelle stabling and maintenance depot site), installing pre-cast segments, and removing spoil generated by the roadheader.
- Delivering, assembling and launching the TBMs to Central, installing pre-cast segmental lining and removing spoil generated by the TBM.
- Storing and collecting spoil.
- Treating construction water.
- Installing tunnel air ventilation and extraction plant and dust extraction/plant filtration.

Concrete casting facilities may be required to produce components (or pre-cast segments) for the tunnel wall and roof lining. These components would be produced in a yard or shed located on site; there would potentially be up to 24 hours of production per day.

Spoil from the tunnelling works would be stockpiled on site and would subsequently be removed by truck, rail or barge.





Note: Project detail shown is indicative only, subject to detailed design

Figure 7.12 White Bay Station construction site location and feasible layout

7.7.9 Construction site for the Rozelle stabling and maintenance depot

The construction site for the Rozelle stabling and maintenance depot would be located within the disused former Rozelle Marshalling Yard and adjacent to the Western Distributor and Lilyfield Road (see Figure 7.13). The surface area occupied for the construction site would be about 55,000 square metres. Access is proposed via one or two dedicated entry and exits from City West Link Road and also through the White Bay construction site. Access from Gordon Street is proposed from Lilyfield Road west only.

Construction activities at this site would include:

- Constructing the depot facilities. This would be the main activity and would include internal road works, hard stands, building areas and parking. Maintenance buildings would be constructed by conventional methods and fitted out with specialist equipment.
- Demolishing existing buildings.
- Protecting existing power supply infrastructure.
- Providing a 33kV underground power supply from the EnergyAustralia Rozelle substation to the site via Gordon Street.
- Removing existing rail infrastructure and adjusting levels for drainage and flood protection.
- Constructing an underground pipe drainage system to replace the existing services that drain to Rozelle Bay and Whites Creek, with a significant crossing of the City West Link Road and entry structure at Rozelle Bay.
- Constructing tunnel portals (for Up and Down connections) and the tunnel dive structure.
- Undertaking earthworks (including ground improvements) and removing tunnel spoil.
- Launching and supporting roadheaders.
- Undertaking tunnel fitout activities, including trackform, track, rail systems installation, electrical and mechanical related installation works.

7.7.10 Commissioning of the Rozelle stabling and maintenance depot

Once the basic construction of the Rozelle stabling and maintenance depot has been completed, the various buildings and facilities would be commissioned in readiness for the delivery of the trains, system testing, trial running and eventual service operations.

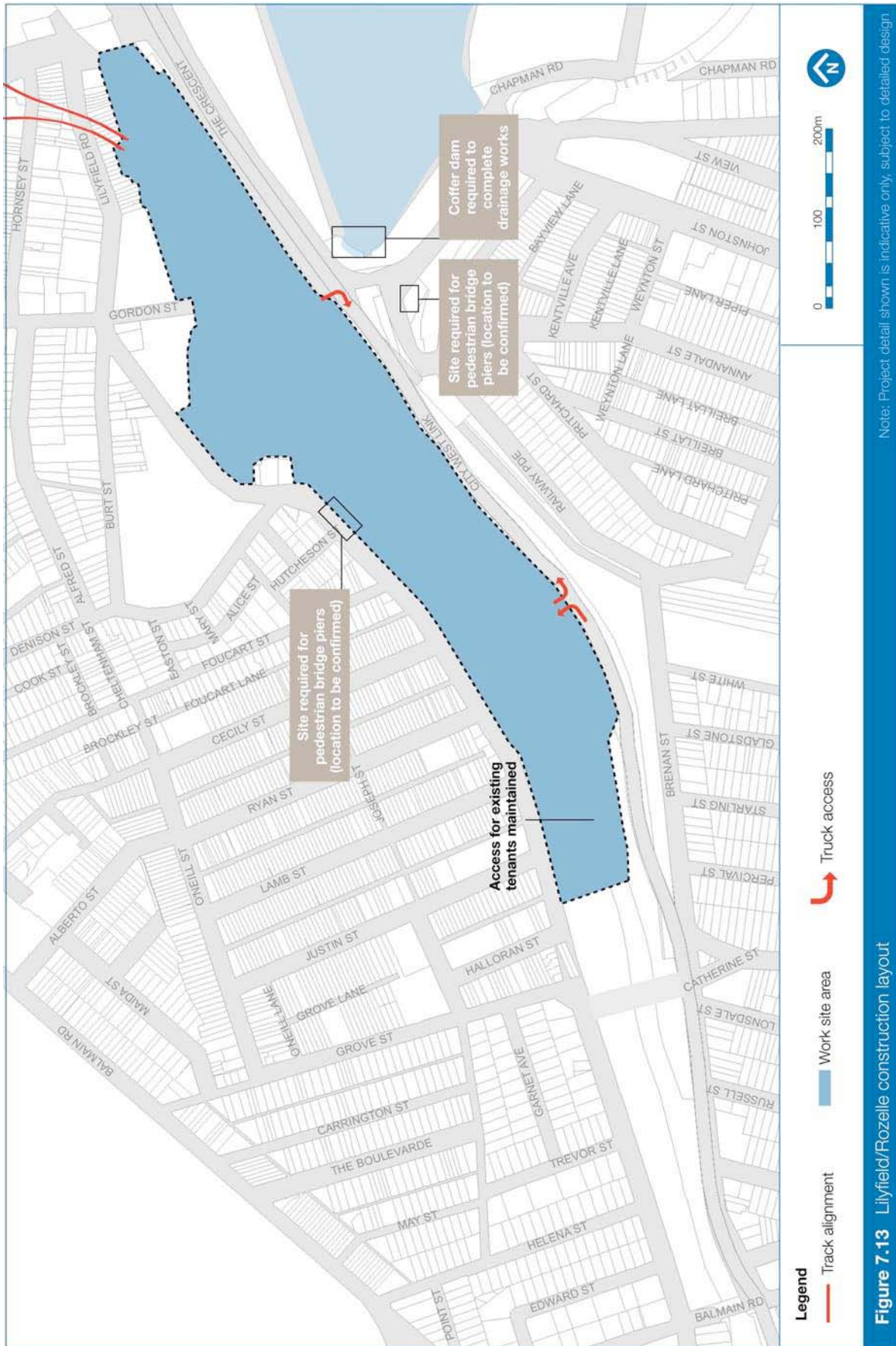
Activities to be undertaken in this phase would include:

- Commissioning of the low voltage power supplies to the various facilities.
- Commissioning of the individual facilities (rolling stock maintenance facility, wash plant, etc).
- Commissioning of the overhead wiring and traction supply system within the depot.
- Delivery of the trains. The trains would most likely be delivered by road as individual cars and, due to their size, would be 'special loads' as defined by the RTA. Delivery of the 65 cars, which would make up the 13 train sets for the CBD Metro, may require temporary road closures and may only be able to be undertaken in the early hours of the morning (approximately midnight to 6am).



- Assembly of the metro trains. Once delivered and placed on the tracks, the individual train cars would be moved into the rolling stock maintenance facility where they would be assembled into trains. As this activity would be occurring in the facility, there would be no visual and only minor, if any, noise impacts.
- Commissioning and testing of the trains. This activity would be undertaken during the day in the rolling stock maintenance facility. It would generate only minor, if any, noise.
- Initial trial running. Low-speed proving trials, which would generate only minimal noise, would be undertaken within the depot during the day. Operational testing would take place in the running tunnels.

It is anticipated that these testing and commissioning activities should be completed within approximately 12 to 24 months following completion of the depot facilities.



Note: Project detail shown is indicative only, subject to detailed design

Figure 7.13 Lylfield/Rozelle construction layout



7.8 Other construction aspects

7.8.1 Building demolition

Building the CBD Metro would require the acquisition and demolition of 33 buildings currently used for offices, retailing, industrial uses, and residences (refer Table 7.8). These properties all lie within the footprint of the metro stations or areas required for the access to and construction of the station caverns. Once the project is approved, it is likely that the first phase of demolitions would occur in early 2010, but only where the acquired properties have been vacated. Demolition within the CBD would occur from late 2010.

Table 7.8 Demolition sites by station location

Property location	Use	Number of buildings
Town Hall	Retail	5
	Offices	1
	Subtotal	6
Martin Place	Retail	1
	Offices	2
	Mixed offices/retail	1
	Subtotal	4
Barangaroo-Wynyard	Mixed offices/retail	1
	Offices	1
	Subtotal	2
Pyrmont (Alternative 1) ¹	Retail	4
	Mixed offices/retail	1
	Subtotal	5
Rozelle	Retail	11
	Commercial	1
	Commercial (Leagues Club)	1
	Residential	3
	Subtotal	16
TOTAL		33

Note 1: Only rear elements of buildings would be demolished for Alternative 2

Prior to demolition, hoardings that comply with Council requirements would be erected where practicable and dust and debris screens would be raised over the entire site, where practicable. Hoarding design and placement in the City would be in accordance with the City of Sydney Council's Hoardings and Scaffolding (Local Approvals Policy). Similar formal codes as approved by Leichhardt Municipal Council for Rozelle Station would also be adhered to. The hoardings would be a safety and security feature and would also serve as a noise barrier.

Demolition would be controlled, and undertaken in stages where practicable. This could involve stripping the inside of buildings prior to demolition of the main structure. Glass and metal items would

be removed prior to the building being demolished using a tracked excavator. Hard materials, such as bricks and tiles would be used as hardcore for working platforms and haul roads during construction. All other materials such as timber, plastic and metals would be separated where practicable and sent to a waste handler with recycling capabilities. All services into the buildings would be made redundant.

7.8.2 Utility adjustments

Utilities would need to be adjusted and relocated where they would otherwise be impacted by construction. The location of utilities has been determined from Dial Before You Dig (DBYD) plans, utility data and local authority and council records. Further work would be necessary during the next stages of design to confirm exact locations and depths. Where an existing utility conflicts with the proposed design, it may be necessary to either:

- Provide physical protection for the utility where the utility is not directly impacted but may be indirectly impacted by vibration or accidental impact. Protection could include constructing a piled wall between the excavation and the utility or plating over the utility to minimise the transmission of vibration, 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 when compacting within a specified distance of utilities.
- Wrap and support the utility service to provide mechanical protection.
- Divert the utility around the construction site.

Table 7.9 outlines the utilities that have been identified as potentially affected by the project and that may require protection or diversion. The list of utilities presented in this table is indicative only, and subject to further design refinements and investigations.

Table 7.9 Utilities likely to require protection or adjustment

Construction sites	Location	Utility type	
Central	Primarily in Pitt Street. Sewer through site.	Optic fibre cables Communications cable tunnel 11 kV feeder High voltage cables	Telephone cables Sewer main Water main
Town Hall Square	Primarily in Pitt Street.	Optic fibre cables Electrical distribution cables Heritage stormwater channel	Water main Gas main
Martin Place	In Castlereagh Street and Martin Place.	Optic fibre cables Communications cable tunnel Electrical distribution cables Electrical substation	Heritage stormwater channel Sewer main Gas main
Barangaroo-Wynyard	In Sussex, Kent, Margaret and Clarence streets, and York Lane.	Optic fibre cables High voltage electricity transmission cables Electrical substation Electrical distribution cables Water main	Sewer main Stormwater pits and pipes Sewer pits and manholes Gas mains Cable tunnel



Construction sites	Location	Utility type	
Pymont	Primarily in Union Street.	Optic fibre cables Electrical distribution cables Sewer main	Water main Stormwater
White Bay and Rozelle stabling and maintenance depot	Throughout the depot site.	Optic fibre cables Electrical distribution cables Substation Transmission line Water conduit and slit well	Sewer Stormwater Heritage stormwater tunnel Water main Cable tunnel
Rozelle	Victoria Road.	Optic fibre cables Substation	Water main Sewer main

The majority of locations noted above are avoided through tunnels and restriction of works on the road reserves where the utilities are located. The exceptions on road reserves are in Union Street at Pymont where, under Alternative 2, the services would require careful excavation and protection as the cut and cover excavation is performed. A similar situation would occur at Pitt and Castlereagh streets for works on the Town Hall Square and Martin Place stations. At all these locations detailed planning with the utility owners would be necessary.

7.8.3 Road modifications

The project would also require temporary full or partial closures of a number of streets and a number of modifications to the road network during the construction period, as outlined below.

Town Hall Square Station construction site

- Temporary lane closures in Pitt Street (northbound – parking only) on its approach to Park Street during off peak periods to enable trucks to serve the Pitt Street construction site.
- To provide building basement support works a single temporary lane and footpath closure is likely to be required in Pitt Street.

Martin Place Station construction site

- The temporary removal of on-street parking on Castlereagh Street and Elizabeth Street adjacent to the site access locations to facilitate truck turns from the kerbside lane and avoid delays to through-traffic movements.
- The temporary lane closure on Castlereagh Street to construct the ventilation facilities in existing parking bays.

Barangaroo-Wynyard Station and Barangaroo Pedestrian Link construction sites

- Removal of parking in Kent Street, Hickson Road, Sussex Street, Napoleon Street, Margaret Street and Clarence Street.
- Removal of the loading zone (two spaces) in York Lane and, potentially, elsewhere in York Street, Clarence Street and Kent Street.

- Removal of authorised RailCorp parking from York Lane.
- Lane closures and, potentially, temporary road closures in Margaret, Kent and Sussex/Shelly streets due to staged cut-and-cover activity in these streets.
- Temporary reduction in lanes on Sussex, Margaret, Kent and Napoleon streets, and reconfiguration of Shelly and Lime streets.
- Permanent loss of lanes in Napoleon Street (due to Barangaroo Pedestrian Link).
- Loss of parking and the potential reduction in the number of eastbound lanes in Margaret Street adjacent to the Transport House for the purpose of pedestrian management.
- Removal of the right-turn bay into the Sussex Street development (corner of Sussex and Shelly Streets).
- Temporary closure of Shelly Street, north of Lime Street.

Pymont Station construction site

- Local access and traffic diversions at Paternoster Row and Union Square/Pymont Street.
- Closure of the eastbound traffic lane on Union Street between Paternoster Row and Pymont Street to accommodate the work site.
- Re-routing of Paternoster Row (northbound) through Union Square shared zone to the Harris Street and Miller Street intersection (Alternative 1 and 2).
- Displacement of on-street car parking from Mount Street (six spaces) and Union Street (five spaces).
- Closure of lanes and displacement of on-street car parking in Pymont Street (about 11 spaces) would also occur under Alternative 2.

In addition, at most station sites during the enabling works, there would likely be extended periods of localised lane and road closures for safety purposes during the demolition of multi-storey buildings.

7.8.4 Construction power

Power during construction would primarily be required to power the TBMs, roadheaders and associated tunnelling equipment (such as conveyors and grout batching plant). Power consumption at the White Bay construction site is expected to be about 300 gigawatt hours, and 30 gigawatt hours at each of the other station construction sites.

The temporary construction power supply would be installed as part of the preliminary site works about six to 12 months prior to commencement of the TBM tunnelling. This would include construction of new transformer substations at White Bay worksites with associated trenching works to install underground feeders. Localised trenching works would be required in Pymont to make connection into the substation of an existing 33 kilovolt (kV) cable that runs to the worksite areas and within the Rozelle stabling and maintenance depot and White Bay site. The construction activities are intended to be undertaken by the electricity supply authority and would involve trenching in local streets.

The construction contractor for the CBD Metro would be responsible for installing each of the temporary construction supplies from the supply authority's 11 kV reticulation system substation to the high-voltage supply point at each station construction site where roadheaders are required. As the supply authority's reticulation system is located at a distance from the station construction site, cabling and conduit works would be required along streets to the construction sites. Trench construction would be the most likely method for installing this temporary construction supply at Central, Pymont and



Rozelle, with existing pit and duct proposed for the CBD sites of Town Hall Square, Martin Place and Barangaroo-Wynyard.

7.8.5 Materials

Construction of the CBD Metro would require the use of many different materials. The principal items and indicative quantities would include:

- 323,100 cubic metres of concrete (including grout and shotcrete).
- 29,100 tonnes of steel reinforcement.
- 2,500 tonnes of steel rails.

A full consideration of the use of resources and measures proposed to reduce their use or attain more sustainable practice on the project are detailed in Chapter 8 and section 19.8 *Resource use and waste*.

7.8.6 Construction hours

The proposed construction hours for the underground and aboveground activities are outlined in Table 7.10. In exceptional cases of urgency, it may be necessary to depart from these assumed hours. This would not take place without prior discussion with and/or notification of local residents, businesses and the Department of Environment, Climate Change and Water (DECCW).

The majority of the aboveground construction activities would be undertaken within standard NSW construction hours (7.00am–6.00pm on weekdays and 8.00am–1.00pm on Saturdays), but some activities (as identified in Table 7.10) would need to be undertaken outside of these hours. The underground construction activities (tunnelling works and the construction of station caverns) would be undertaken 24 hours per day, up to seven days per week.

In addition, there may be instances where construction works could be undertaken outside standard construction hours to avoid potential impacts on sensitive receivers. For example, some specific sensitive receivers are less active (or have no activities) during the weekend or night. Therefore, flexible construction hours would be investigated where there would be a better environmental outcome.

Table 7.10 Proposed construction hours

Activity	Construction hours	Comments or exceptions
Underground construction activities		
Tunnelling works Construction of station caverns	24 hours per day, up to seven days per week.	Vertical excavation is likely to be undertaken over two 9-hour shifts. Some activities that support tunnelling and fitout works may need to occur 24 hours per day, up to seven days per week. Rock hammering in the tunnel between 10.00pm and 7.00am would be precluded where it may impact on residential receivers.
Aboveground construction activities		
Construction sites Demolition works	Standard DECCW construction hours – 7.00am to 6.00pm on weekdays and 8.00am to 1.00pm on Saturdays	The following activities would be undertaken 24 hours per day, up to seven days per-week where noise impact management measures have been established: <ul style="list-style-type: none"> • Surface works supporting underground construction (e.g. concrete pumping, truck loading). • Excavation and spoil removal from station entry shafts over two shifts. • Station fitout works. Non-disruptive preparatory work, repairs or maintenance may be carried out on Saturday afternoons or Sundays between 8:00am and 5:00pm. Activities requiring temporary possession of roads may need to be undertaken outside the assumed hours during periods of low demand to minimise safety impacts and inconvenience to commuters.
Construction traffic	24 hours per day, up to seven days per week	Restrictions would be in place during peak hours and during city-wide special events. At locations where sensitive noise receptors are close to construction sites, significant construction vehicle movements are likely to be restricted during evening and night-time periods.

7.8.7 Workforce

During the construction of the CBD Metro, almost 3,600 jobs are expected to be created (refer to Figure 7.14). This includes about 2,700 people directly engaged in the management and the execution of the works. About 900 jobs would also be indirectly created by the project. Labour required for the tunnelling and systems works would be distributed along the whole length of the project. Further detail on the likely labour distribution over the construction period and the economic benefits arising out of the construction phase are provided in Chapter 16.



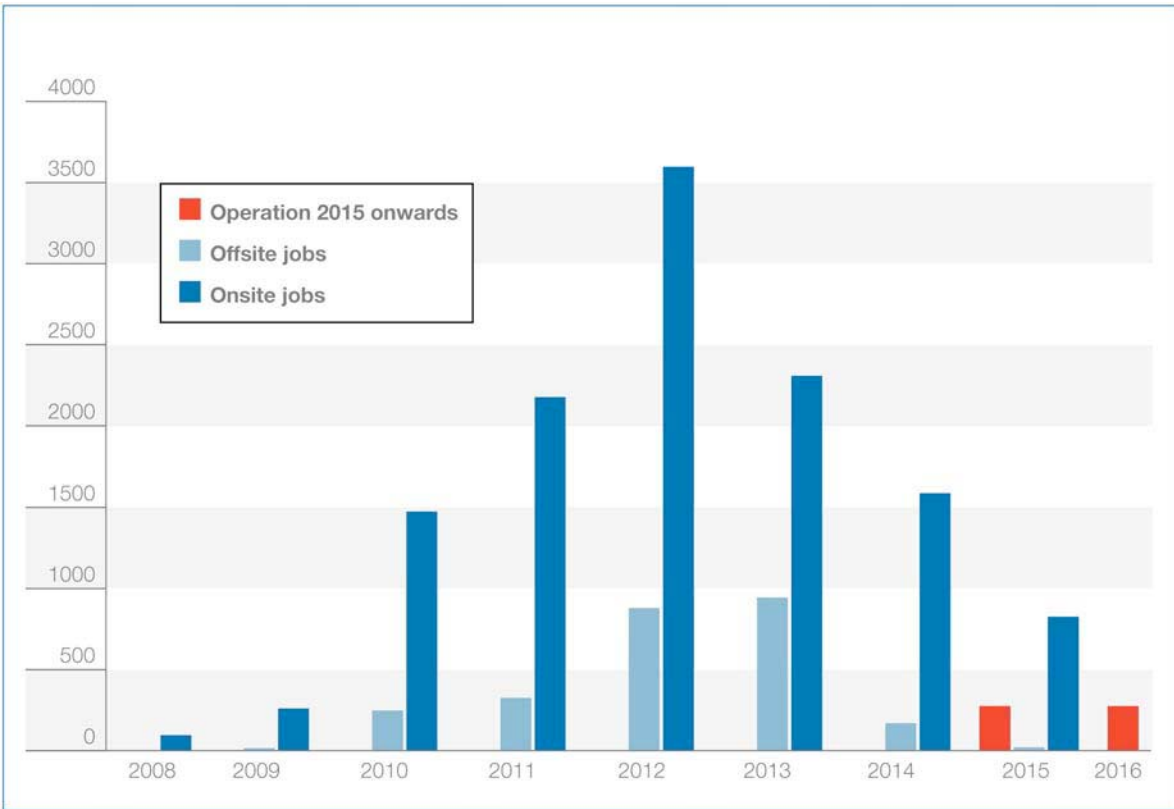


Figure 7.14 CBD Metro jobs created

