



CHATSWOOD TO SYDENHAM  
**ENVIRONMENTAL  
IMPACT STATEMENT  
SUMMARY**

May-June 2016



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Transport for NSW plans to extend the Sydney Metro system from Chatswood through to Bankstown. Sydney Metro City & Southwest will deliver 30 kilometres of new metro rail between Chatswood and Bankstown, including a new crossing beneath Sydney Harbour, new railway stations in the lower North Shore and CBD, and the upgrade and conversion of the current line between Sydenham and Bankstown stations.

On 10 December 2015, the Hon. Robert Stokes, MP, Minister for Planning, declared Sydney Metro City & Southwest to be critical State significant infrastructure, under the *Environmental Planning and Assessment Act 1979* (NSW).

A Sydney Metro Delivery Office has been established as part of Transport for NSW to manage the planning, procurement and delivery of the Sydney Metro network.

Transport for NSW is the New South Wales Government agency that leads the planning and operation of the State's transport infrastructure and services. The vision of the NSW Government is for a truly integrated transport authority which drives better transport outcomes.

Decision making for planning and policy is centralised in Transport for NSW. This agency is responsible for: improving customer experience,

planning, program administration, policy, regulation, procuring transport services, infrastructure and freight. Operating agencies have been freed up to focus on service delivery – providing safe, reliable, clean and efficient transport.

This document is intended to be an overview of the Chatswood to Sydenham component of Sydney Metro City & Southwest Project (excluding Sydenham Station).

For further detail, please see the Environmental Impact Statement and supporting documents available on our website:

- o [www.sydneymetro.info](http://www.sydneymetro.info)

The Sydenham to Bankstown component of the Project will be subject to a separate environmental assessment process.

**Contact us**

To speak to your local Place Manager or a member of the Project team, please contact us.

- o community information line: **1800 171 386**
- o project email: [sydneymetro@transport.nsw.gov.au](mailto:sydneymetro@transport.nsw.gov.au)



Premier's message

The NSW Government is getting on with the job of delivering Sydney Metro, Australia's biggest public transport project.

Stage 1, Sydney Metro Northwest, is being delivered right now, with tunnelling completed and services due to start in 2019.

And now Stage 2, Sydney Metro City & Southwest, is moving ahead - bringing world class metro rail under Sydney Harbour, through new underground stations in the CBD and beyond to Bankstown.

Sydney Metro will change Sydney forever, delivering fast, efficient, congestion-busting rail for our booming city and giving you more time to spend doing the things that you want to do.

The Environmental Impact Statement is your chance to find out more about this city-building project and I encourage you to give further feedback and participate in one of our community forums.

Sydney Metro is bringing world-class public transport to our world-class city, making a great place to live even better.

**Mike Baird MP**  
PREMIER OF NEW SOUTH WALES  
AND MINISTER FOR WESTERN SYDNEY



Minister's message

The NSW Government is proud to be delivering Sydney Metro City & Southwest, a game-changer for Sydney.

Sydney Metro is 21st century public transport infrastructure that will deliver faster, more efficient travel to revolutionise how we get around this great city of ours.

We have consulted widely and we have listened to your feedback as we now gear up to deliver Stage 2 of Sydney Metro.

Sydney Metro Northwest and Sydney Metro City & Southwest combined will deliver 31 metro railway stations and more than 65 kilometres of world-class metro rail.

This document provides an overview of the Project and the Environmental Impact Statement for the tunnelling from Chatswood to Sydenham, and we look forward to continuing to work with the community and with industry on delivering the best possible transport outcomes for this great city.

**Andrew Constance MP**  
MINISTER FOR TRANSPORT  
AND INFRASTRUCTURE

# ABOUT SYDNEY METRO



Artist's impression of Martin Place Station

## Sydney Metro is Australia's biggest public transport project.

A new standalone railway, this 21st century network will deliver 31 metro stations and more than 65 kilometres of new metro rail for Australia's biggest city - revolutionising the way Sydney travels.

Services start in the first half of 2019 using Sydney's new generation of fully-automated metro trains.

From Sydney's booming north west region, metro rail will run under Sydney Harbour, through new underground stations in the CBD and beyond to the south west.

Customers won't need a timetable when Sydney Metro opens - they'll just turn up and go.

When Sydney Metro is extended into the CBD and beyond in 2024, there will be ultimate capacity for

a metro train every two minutes in each direction under the city - a level of service never before seen in Sydney.

Sydney's new metro railway will have a target capacity of about 40,000 customers per hour, similar to other metro systems worldwide. Sydney's current suburban system can reliably carry 24,000 people an hour per line.

Sydney Metro, together with signalling and infrastructure upgrades across the existing Sydney rail network, will increase the capacity of train services entering the Sydney CBD - from about 120 an hour today to up to 200 services beyond 2024. That's an increase of up to 60 per cent capacity across the network to meet demand.



Sydney Metro Northwest prototype station

### Key features

- More than **65 kilometres** of metro rail from Rouse Hill to Bankstown
- New generation** of fast, safe and reliable metro trains
- No timetable** - just turn up and go
- Higher frequency** trains during the day and late at night
- Reduced travel times** for customers across the rail network
- More trains, more often** in the peak through the CBD, providing more options for customers and less crowding on trains, stations and platforms
- Sydney Metro will **help reduce crowding** on the T1 Western Line and on trains from the south west, by creating extra capacity
- More trains** from Sydney's north west and south west
- Opal ticketing** and fares the same as the rest of Sydney providing a seamless journey for customers, making it even easier to move around
- Fast and easy** to change to trains, buses, ferries and light rail
- Stand-alone line** operating independently of the existing rail network, not subject to wider suburban delays
- Connecting** Sydney's economic centres with a boost of activity up to \$5 billion per year
- New choices** for jobs, education and recreation
- Faster transport** to employment growth areas.

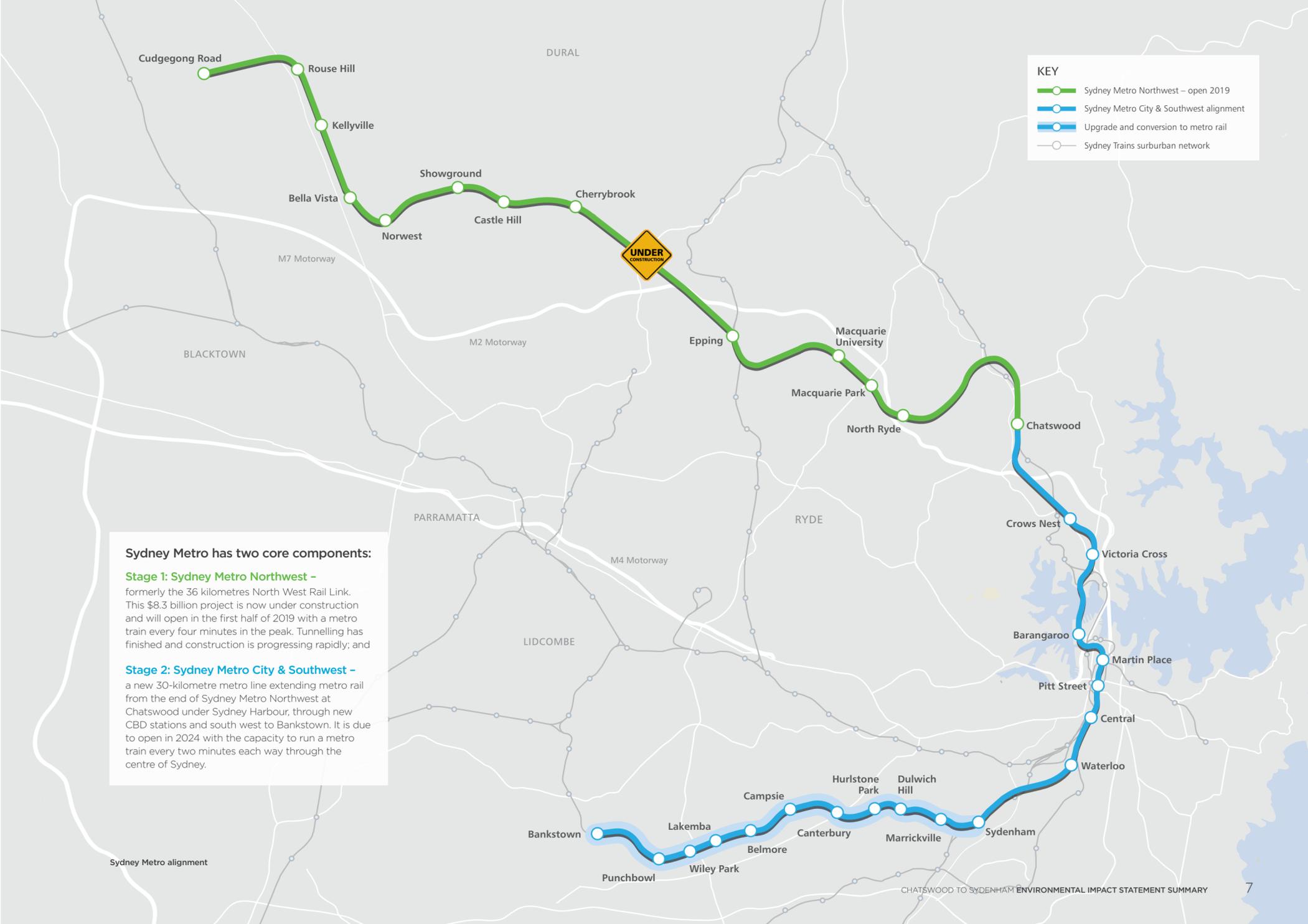
### Sydney's rail future

Sydney Metro has been developed within the framework of the transport and planning strategies identified in State government policies including:

- The NSW Premier's 30 'State priorities'*, including 12 'Premier priorities' to grow the economy, deliver infrastructure, and improve health, education and other services across NSW
- Draft Metropolitan Strategy for Sydney 2031*
- A Plan for Growing Sydney*
- Rebuilding NSW: State Infrastructure Strategy 2014*
- NSW Long Term Transport Master Plan*
- Sydney's Rail Future: Modernising Sydney's Trains*
- Sydney City Centre Access Strategy.*

These policies indicate a strategic need to:

- significantly increase transport capacity in key parts of the network, especially to the Sydney CBD and the Global Economic Corridor
- drive productivity through integrated transport and land use planning
- effectively develop infrastructure to cement Sydney's position among the world's most liveable cities.



Sydney Metro will deliver ultimate capacity for a new metro train every two minutes in each direction under the Sydney CBD – a level of service never before seen in Sydney.

### Project objectives

The objectives of Sydney Metro are to:

- improve the quality of the transport experience for customers
- provide a transport system that is able to satisfy long-term demand
- grow public transport patronage and mode share
- support the productivity of the Global Economic Corridor\*
- serve and stimulate urban development
- improve the resilience of the transport network
- improve the efficiency and cost effectiveness of the public transport system.

\* The Global Economic Corridor runs from Macquarie Park through North Sydney and the Sydney CBD to Sydney Airport. This is where many of the industries that contribute to Sydney's global significance – finance, technology, higher education, health and other services – are located.

### Key benefits of the Sydney Metro network

The Sydney Metro network is expected to provide the following benefits:

- **transport benefits** – including enabling the transport network to better cater for growth, travel time savings, increased network capacity, decreased train and station crowding, increased reliability of the rail network, enhanced customer satisfaction on the use of public transport, and improvement in customer safety
- **city-building benefits** – including increased economic activity, economic productivity, jobs, worker income, savings in infrastructure provision, lower cost of living, sustainability benefits, health benefits, more choice of housing and more affordable housing, greater access to services, and greater social equity.

#### Key transport benefits

Sydney Metro will provide significant additional capability to the Sydney transport network by:

- extending Sydney Metro from Chatswood, under Sydney Harbour and through the Sydney CBD to Sydenham

- increasing the number of primary Sydney CBD stations by building new Sydney Metro stations at Barangaroo, Martin Place and Pitt Street
- providing extra connectivity and interchange capacity at Martin Place, Central Station and Sydenham
- upgrading the T3 Bankstown Line between Sydenham and Bankstown to be part of the high-capacity, high-frequency Sydney Metro system.

#### Catering for growth in demand

Rail is predicted to experience the highest growth in travel demand with the number of people travelling to Sydney's CBD during the morning and evening peaks forecast to grow.

Many parts of the rail system are constrained by network capacity limitations.

Without the creation of additional rail capacity, crowding levels on the network will continue to increase.

Once complete, Sydney Metro City & Southwest would deliver a major increase in the capacity of Sydney's rail network, with the capacity to run up to 30 trains per hour through the Sydney CBD in each direction.

This provides the foundation for delivering a 60 per cent increase in the number of trains operating on Sydney's rail network in peak periods, which would cater for an extra 100,000 customers per hour across CBD rail line.

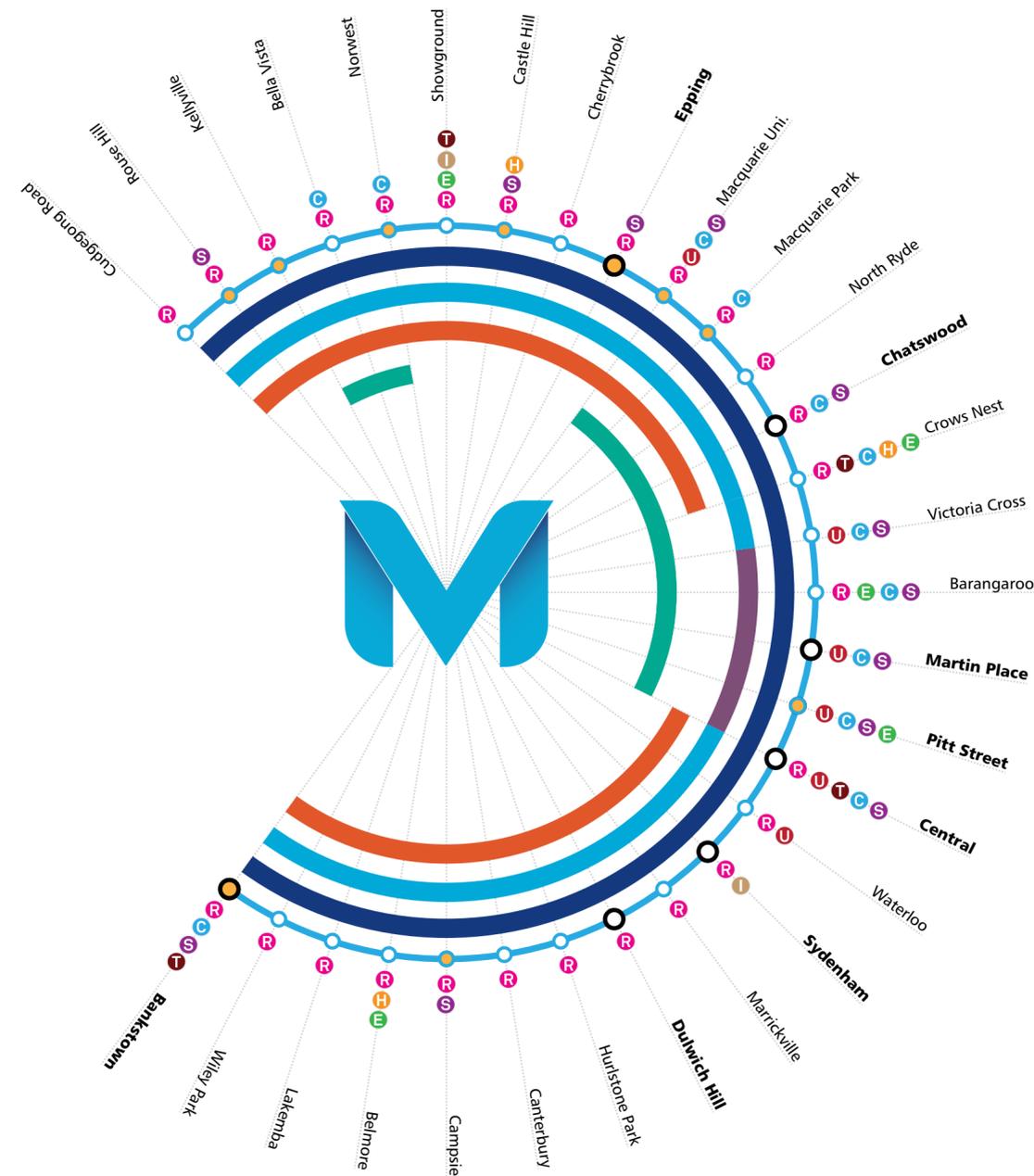
#### Increased accessibility and trip diversity

Sydney Metro will increase the network rail catchment through the provision of:

- new stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street, and Waterloo as well as new underground platforms at Central Station
- more direct connections to high-capacity Sydney CBD stations
- additional interchange capability at key stations, enabling increased network connectivity and demand for rail services.

By increasing the reach of the rail network, frequency of services, interchange with other modes of transport and connections to key destinations, Sydney Metro is expected to increase accessibility, trip diversity and utilisation of the network during both peak and non-peak periods. This will facilitate a greater mode shift to rail from car, particularly during non-peak periods where travel service customers have greater choice.

Sydney Metro will facilitate a diverse range of trips, providing not only a fast journey to work but also encouraging trips for other purposes such as access within the Sydney CBD, local or business trips, access to universities and educational institutions, service and recreational uses.



### Sydney Metro facilitating a diverse range of trips

#### KEY

##### Metro uses

- Access to universities
- Journey to work
- CBD distributor
- Local service and shopping trips
- Local core employment area trips

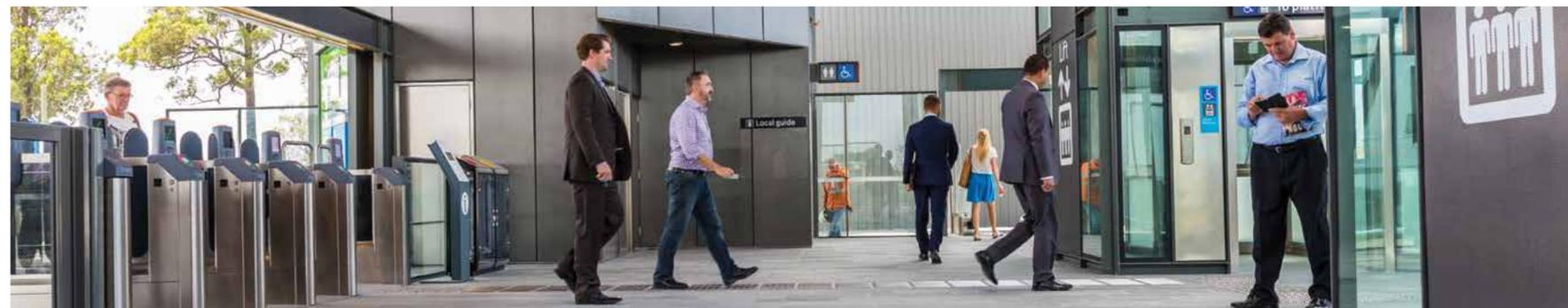
##### Land uses

- Major commercial
- Major industrial
- Major shops
- Residential growth area

##### Facilities

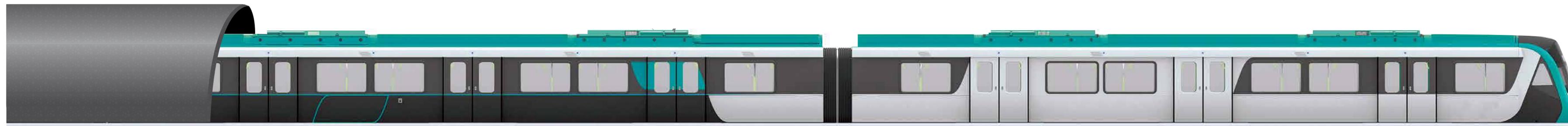
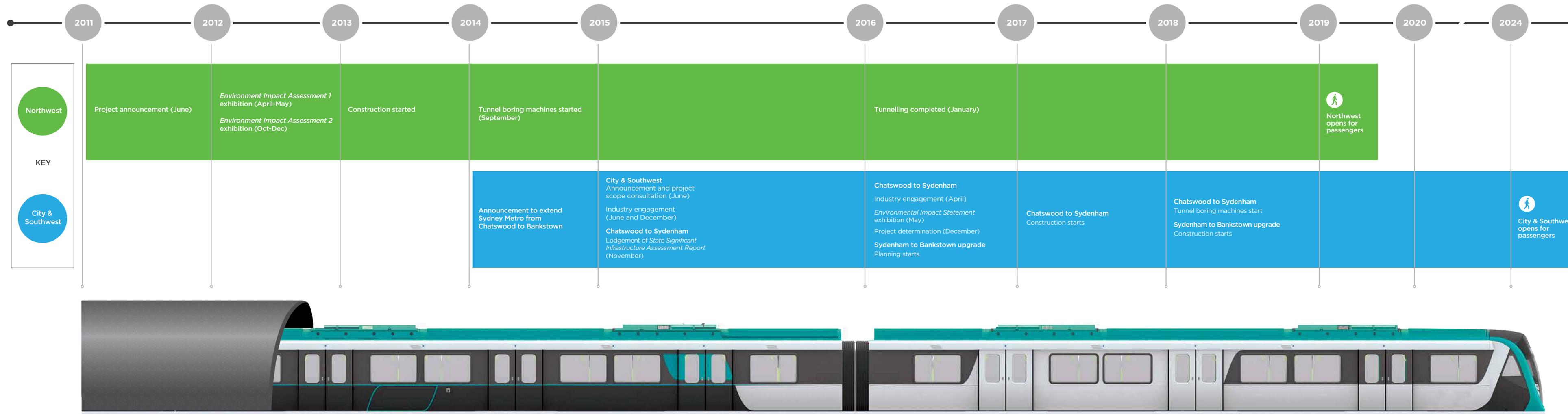
- Light rail / suburban interchange
- Bus interchange
- Rail and bus interchange
- Recreation
- Major hospital
- TAFE
- University

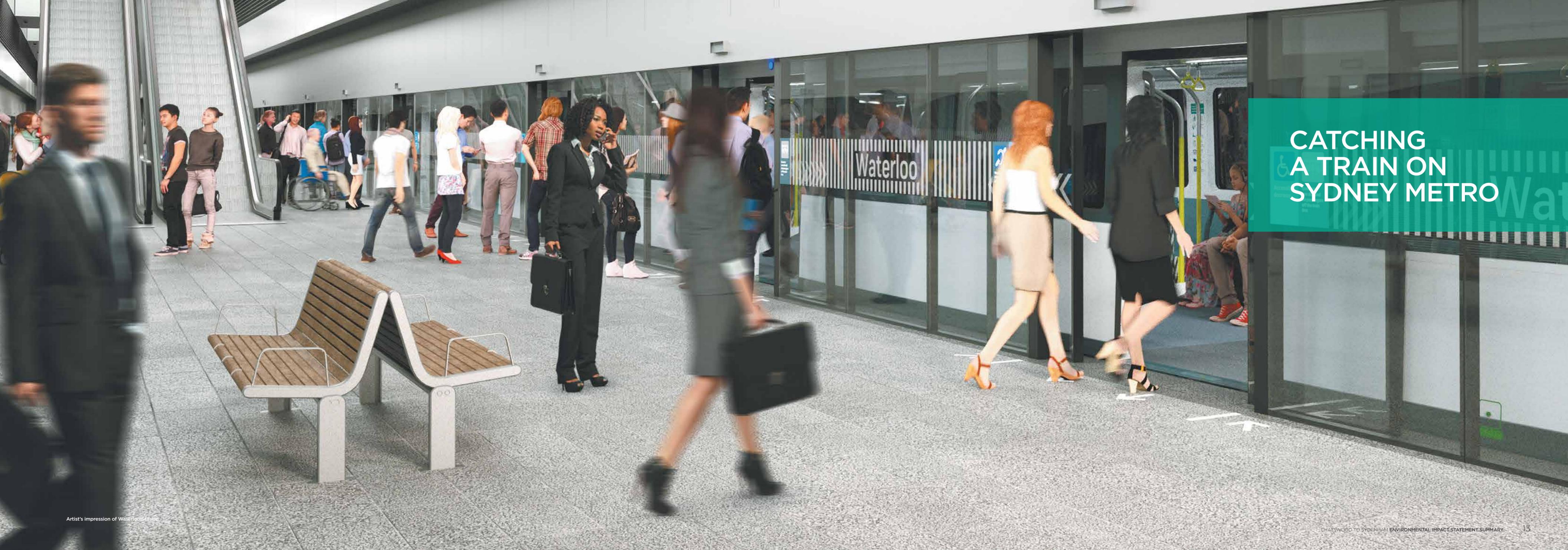
Source: Mecone



Sydney Metro prototype station

### Delivering Sydney Metro





CATCHING  
A TRAIN ON  
SYDNEY METRO

Customers are at the centre of Sydney Metro. Australia's biggest public transport project will deliver an easy door-to-door experience, integrating Sydney's new-generation metro trains with state-of-the-art stations and 21st century technology.

Sydney Metro will make it easy for customers to get where they need to go. New metro services will be integrated with other transport modes, including interchanges with the existing Sydney railway network as well as buses, light rail and ferries.

Customers are at the centre of Sydney Metro's 21st century design, including the development of Sydney's new metro train, new metro railway stations, interchanges and precincts.

State-of-the-art technology will keep customers connected at all stages of their journey, from smart phone travel apps, to real time journey information at metro stations and onboard trains.

This door-to-door approach will help customers achieve their daily tasks, whether it's getting to work, meetings, school or education, sport, a day out or running errands – and, of course, getting home. Making it easy for customers at each stage of their journey will be integral in the successful delivery of Sydney Metro.

Linking communities, schools, hospitals, key destinations and businesses with the new metro railway network is key in attracting and keeping customers as well as meeting broader transport and land use objectives.

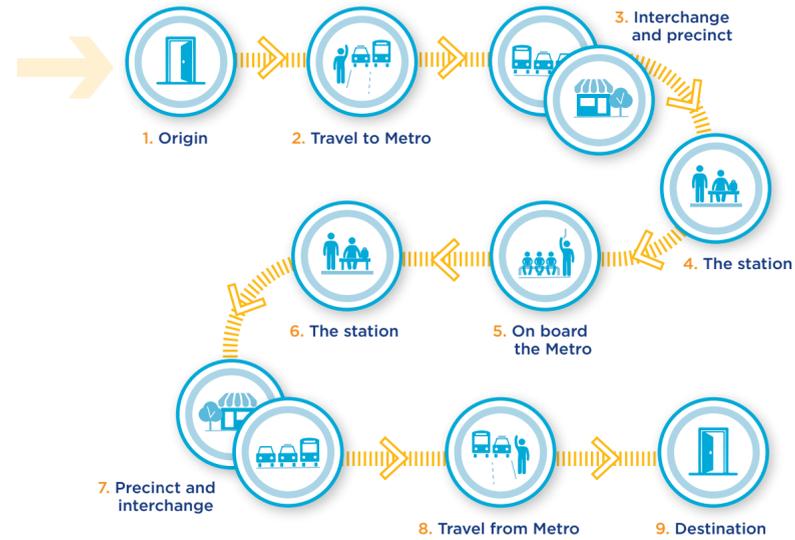
Transport for NSW is working across government and with the community to get customers to and from new metro services easily and, when traveling on the new trains, to ensure they are safe and comfortable.

Sydney Metro is being designed to deliver safe, clean, comfortable services which will run on time and be convenient, efficient, accessible and easy for customers to use.



Sydney Metro prototype station

The customer journey



Sydney's new metro train



Sydney Metro prototype station

Sydney's new metro trains

All trains on Sydney Metro will be modern, single deck trains. The trains will deliver a fast, safe and reliable journey for customers, operating at speeds of up to 100 kilometres per hour both in the tunnels and above ground.

KEY FACTS

- 2019** Sydney Metro Northwest opens
- 2024** Sydney Metro City & Southwest opens
- 31** Metro stations
- 10** Off peak train every 10 minutes
- 98%** On-time running reliability
- 4000** Commuter car parking spaces (Northwest)
- Continuous mobile phone coverage throughout network
- No timetable – just turn up and go
- Opal ticketing like rest of Sydney
- Ultimate capacity a train every two minutes each way under the CBD

Maximum Sydney train customers per hour per line

TRAIN FEATURES

- Customer service assistants at every station and moving through the network during the day and night
- 170 metres long platforms – longer than most of Sydney
- Clean platforms and trains
- Heating and air conditioning
- 26 CCTV cameras per train; inside you can see from one end of the train to the other and video help points
- Platform screen doors keep people and objects away from the edge and allow trains to get in and out of stations much faster
- Three double doors per carriage for faster loading and unloading
- Level access between platform and train
- Two multi-purpose areas per train for prams, luggage and bicycles
- Wheelchair spaces, separate priority seating and emergency intercoms
- Real time travel information and live electronic route maps

SAFETY

- Sydney Metro is Australia's first fully-automated metro rail network**
- Around the world, millions of people use these networks every day in cities like Paris, Singapore, Dubai and Hong Kong**
- Constant monitoring** Expert train controllers monitor entire metro system
- Security** More than 230 tunnel cameras
- Signalling and communications systems** Control the trains, tunnels, platforms and skytrain to deliver a safe and reliable journey
- Operations Control Centre** State-of-the art network controlled from new high-tech facility at Tallawong Road
- Faster journeys** System minimises the time trains are stopped at stations and the time between each train

### Train operations

Sydney Metro City & Southwest will have an ultimate operating capacity of one train every two minutes in each direction under the Sydney CBD and move around 40,000 customers per hour in peak periods.

Customers won't need a timetable – they will be able to just turn up and go with Sydney Metro services.

Sydney Metro will provide frequent rail services, seven days a week. It will operate throughout the day from early morning until late at night.

All Sydney Metro operations will be controlled and monitored from the Sydney Metro Trains Facility in Rouse Hill, which is being built as part of Sydney Metro Northwest, along with maintenance and stabling.

Stabling will also occur at a smaller supplementary facility near the southern end of the network. Any additional facility required to support operations will be delivered and assessed as part of the Sydneyham to Bankstown component of the Project.

Scheduled maintenance will generally occur between the last and first train services, or during planned weekend maintenance periods, when train services will not be in operation on parts of the line.

### Travel time savings

The Project will substantially improve travel times for customers. The largest travel time savings will be experienced by customers travelling from new stations (such as Crows Nest), or where the Project provides a more direct route of travel (such as Victoria Cross to Martin Place).

### Operational power supply

Power will be required to operate the tunnel boring machines (TBM) during construction (construction power supply requirements are outlined site-by-site on pages 44-92). At the end of construction the TBM power supply to the Pitt Street Station construction site will be converted to operational power.

A cable will run through the metro train tunnels from the Pitt Street Station traction substation to the other traction substations at Artarmon, Victoria Cross Station, Barangaroo Station, Waterloo Station and Marrickville services facility, and connect to the Sydney Metro Northwest traction substation at Chatswood North.



Artist's impression of Sydney Metro Trains Facility in Rouse Hill



# ABOUT THE ENVIRONMENTAL IMPACT STATEMENT

Aerial view over North Sydney

## Project approval

The Project must be assessed and approved under the *Environmental Planning and Assessment Act 1979* (NSW) before major construction can start.

The Sydney Metro City & Southwest, Chatswood to Sydenham Environmental Impact Statement (EIS) is presented in two volumes. Volume One contains the main Environmental Impact Statement and the appendices. Volume Two provides the technical papers that form the technical basis of the information in Volume One.

This document is intended to be an overview of the Chatswood to Sydenham component of Sydney Metro City & Southwest (excluding Sydenham Station). For further detail, please see the Environmental Impact Statement and supporting documents.

The Environmental Impact Statement assesses environmental issues including:

- o traffic and transport
- o noise and vibration
- o land use and property
- o business impacts
- o non-Aboriginal heritage
- o Aboriginal heritage
- o landscape character and visual amenity
- o groundwater and geology
- o soils, contamination and water quality
- o social impacts and community infrastructure
- o biodiversity
- o flooding and hydrology
- o air quality
- o hazard and risk
- o waste management
- o sustainability
- o cumulative impacts.

Strategies to avoid, mitigate and manage potential impacts have also been identified and developed. In addition, a construction environmental management framework has been developed to identify the minimum environmental, and stakeholder and community engagement requirements.

The Environmental Impact Statement is on public exhibition until **Monday 27 June 2016**.

Anyone may make a submission and these submissions will be considered by the NSW Department of Planning & Environment (DP&E) in its assessment of the Project.

The NSW Department of Planning & Environment will provide Transport for NSW with a copy of all submissions received during the exhibition period.

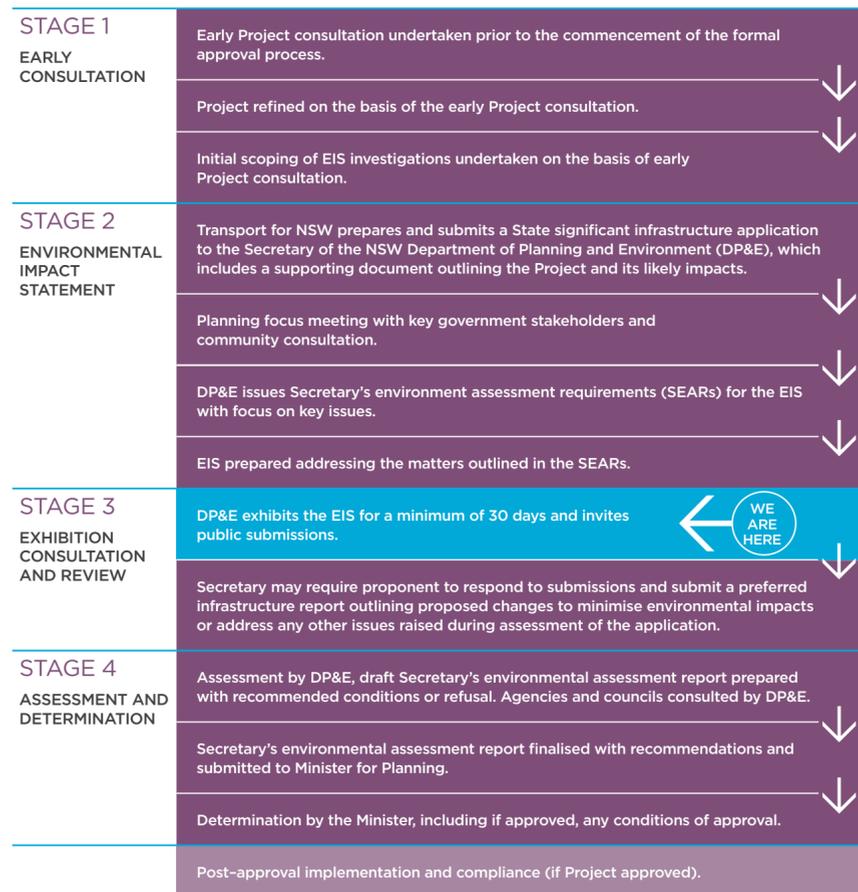
Transport for NSW will review all the submissions and prepare a submissions report to respond to issues raised. If changes are required to the Project as a result of the issues raised or to minimise its environmental impact, a preferred infrastructure report may also be required.

Approval from the Minister for Planning is required before Transport for NSW can proceed with the Project.

## Environmental issues

A number of environmental issues have been examined throughout the design development process. Consultation and engagement has been undertaken with stakeholders during the assessment to ensure that key potential impacts have been identified at an early stage, and where possible, avoided, or appropriate mitigation measures developed. This has resulted in a number of changes that have mitigated many of the potentially significant impacts.

Further investigations will be carried out prior to the start of construction. The results of these investigations will assist in further reducing adverse construction and operational impacts.



Environmental Impact Statement development stages

## Traffic and transport

### Construction traffic and transport

A construction traffic and transport impact assessment has been carried out, based on the analysis of existing traffic movements around each construction site and estimate future construction traffic, to identify potential impacts.

Traffic impacts include increased truck movements, congestion on local and arterial roads, and changes to intersection performance. The assessment also considers pedestrian and cyclist facilities, public transport services (suburban rail and buses) and on-street parking.

Construction traffic information has been included under each construction site in this document. Site-by-site traffic management plans will be implemented during construction.

### CBD Coordination Office

The CBD Coordination Office has been established to oversee all traffic and transport in the Sydney CBD, including decisions, directions and approvals affecting all road and traffic arrangements. Sydney Metro will liaise closely with the CBD Coordination Office during detailed construction planning and throughout the construction phase to minimise the potential construction traffic impacts in the Sydney CBD, including cumulative impacts with other projects, such as CBD and South East Light Rail or during special events.

Liaison will occur with organisers of large events and the CBD Coordination Office to provide appropriate management of construction vehicle movements to manage potential impacts to event goers, the general public and the construction works. This may involve measures such as temporary adjustments to haul routes, working hours, or potentially stopping works for the duration of the event.

### Haul routes

Designated haul routes will be used by trucks to transport materials to and from construction sites. Haul routes to and from the construction site have been developed in consultation with Roads and Maritime Services and the CBD Coordination Office.

The designated haul routes will:

- o minimise the use of local or residential streets and maximise the use of arterial roads where possible
- o minimise potential safety implications for pedestrians, cyclists and other road users
- o avoid the need to pass through or under the Sydney CBD for the construction sites outside the Sydney CBD
- o exit the Sydney CBD as efficiently as possible for the Sydney CBD construction sites
- o minimise the cumulative use of roads by trucks accessing different Sydney CBD construction sites.

The proposed haul routes have been included under each construction site in this document.

### Traffic safety

Appropriate controls will be established where vehicles are required to cross footpaths to access construction sites. This may include manual supervision, physical barriers or temporary traffic lights as required.

### Operational traffic and transport

An operational traffic and transport impact assessment has been carried out to identify potential impacts when Sydney Metro opens to passengers.

The assessment takes into account how people will access the new stations, including interchanges with other transport modes like buses, suburban trains and light rail; and pedestrians, cyclists and customers dropped off by taxis or at kiss-and-ride facilities.

Operational traffic information has been included under each site in this document.

## Property acquisition

In designing major infrastructure projects, Transport for NSW makes every possible effort to avoid the need to acquire private property. However, in some cases the NSW Government has no alternative but to purchase property to allow construction of a major project.

There is a standard process used by government to buy land which is required for a public purpose such as railway infrastructure. The *Land Acquisition (Just Terms Compensation) Act 1991*, sets out the steps which must be followed, including how compensation is calculated.

Our preference – just as we did on Sydney Metro Northwest – is to come to a fair agreement with land owners.

It will also be necessary to acquire an area of land for the tunnel corridor below the surface of properties under the *Transport Administration Act 1988* (NSW). Properties above the metro corridor will be contacted by the Project team once the tunnel alignment has been finalised.

## Spoil reuse

The Project will target 100 per cent of beneficial reuse of the usable spoil generated during construction, either on site or for other projects.

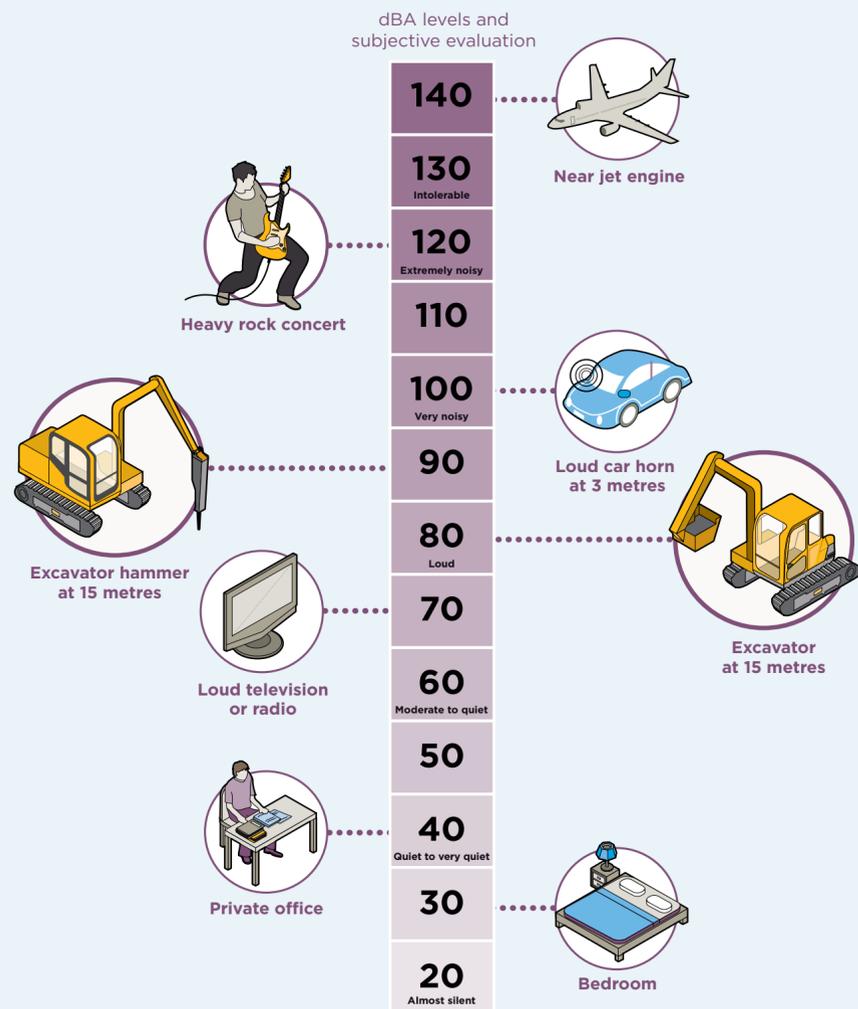
On Sydney Metro Northwest, 100 per cent of the crushed rock from tunnelling was re-used in projects like new residential and commercial developments in Greater Western Sydney, including an environmental re-use project at Prospect Dam. None went to landfill.



Sydney CBD

### Noise level comparisons

People's perception of noise is strongly influenced by their environment. A noise level that is perceived as loud in one situation may appear quiet in another.



**Note:**

- A change of 1 dB or 2 dB in the level of a sound is difficult for most people to detect.
- A 3 dB to 5 dB change corresponds to a small but noticeable change in loudness.
- A 10 dB change corresponds to an approximate doubling or halving in loudness.

### Noise and vibration

#### Construction noise and vibration

The assessment of construction noise and vibration has:

- o identified sensitive receivers
- o measured existing background levels
- o modelled potential noise and vibration levels as a result of construction activities
- o identified mitigation measures to minimise impacts to neighbouring properties.

Assessment of construction noise and vibration includes airborne construction noise, ground-borne noise and vibration and construction traffic noise.

A construction noise and vibration strategy will identify mitigation measures to manage impacts at neighbouring properties.

#### Operational noise and vibration

The assessment of operational noise and vibration includes:

- o Metro trains operating
  - in the tunnels
  - between Chatswood Station and the Chatswood tunnel portal
  - outside the Marrickville tunnel portal
- o suburban trains operating
  - between Chatswood Station and Brand Street Artarmon.

It also includes an assessment of noise from plant and equipment at stations, the Artarmon substation and the southern services facility at Marrickville.

Noise and vibration in the tunnels will generally be mitigated by using the appropriate type of coupling used to connect the train carriages together, and by installing a layer of rubber between the rail and the tunnel floor.

Operational noise at stations and service facilities will be managed through equipment selection and positioning, and acoustic enclosures.

#### Property condition surveys

A property condition survey is an inspection of a building or property to assess its general condition and document any pre-existing cracks and/or damage present. This type of survey will be offered to neighbouring properties or properties above the tunnel alignment before construction or tunnelling work starts on a nearby site.

Sydney Metro will contact property owners or managers who are eligible for a property condition survey.

### Sustainability

For Sydney Metro, sustainability means building public transport for current and future generations that optimises environmental and sustainability outcomes, transit service quality and cost effectiveness.

Sustainability principles have been incorporated throughout the design development process. A project specific environment and sustainability policy has also been developed.

Project contractors will be required to identify clearly how they will achieve specific sustainability objectives, initiatives and targets.

This approach will encourage industry to develop innovative value-for-money sustainability solutions. Key sustainability themes will include: governance, carbon and energy management, pollution control, climate change resilience, resources (water efficiency and waste and materials), biodiversity conservation, heritage conservation, liveability, community benefit, supply chain, workforce development and economic factors.

### Energy consumption and greenhouse emission

When operational, energy consumption is estimated to be around 66,500 megawatt-hours per year (equivalent to around 1000 households). The estimated greenhouse emissions will be around 66,000 tonnes of carbon dioxide equivalent per year.

During the design process, the Project will continue to investigate opportunities to minimise and/or offset 100 per cent of greenhouse gas emissions.

Whilst emissions are difficult to quantify and assess, the Project will also have real potential to reduce regional greenhouse gas emissions by providing a low greenhouse gas alternative to private car travel.

# BUILDING CHATSWOOD TO SYDENHAM



Artist's impression of Crow's Nest Station

The Chatswood to Sydenham component of Sydney Metro City & Southwest involves the construction and operation of a 16.5-kilometre metro line that will extend from Chatswood, under Sydney Harbour and through Sydney's CBD out to Sydenham.

Construction activity	Indicative construction timeframe																																											
	2017				2018				2019				2020				2021				2022				2023				2024															
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4								
Early works	●		●																																									
Tunnel construction					●				●																																			
Station excavation and structural works					●				●				●																															
Services facility excavation and structural works					●				●																																			
Tunnel fit out																	●				●																							
Station construction and fit out																	●				●																							
Services facility construction and fit out																	●				●																							
Testing and commissioning																					●				●																			

**KEY**

- Surface track works
- Tunnelling
- New Metro station
- Construction site
- Tunnel boring machine launch site
- Suburban rail network



## The stations

### Station locations

The Project will deliver seven new metro stations at:

- Crows Nest
- Victoria Cross
- Barangaroo
- Martin Place
- Pitt Street
- Central (new underground platforms)
- Waterloo.

### Over station development

Over station development uses the air-space over some stations. These stations will be designed to allow for possible future over station development. This may include steel and concrete structural elements, space for lift wells, access, parking and building services.

It is proposed that the following stations will have over station development:

- Crows Nest Station
- Victoria Cross Station (between Berry and Mount streets)
- Martin Place Station
- Pitt Street Station
- Waterloo Station.

Over station development at Barangaroo Station will form part of the Central Barangaroo development approvals.

All future over station development will be subject to a separate planning approvals process.

### Residual land

At the completion of construction there will be residual land at Chatswood and Marrickville. Transport for NSW will review opportunities for the appropriate reuse of this land in consultation with stakeholders.

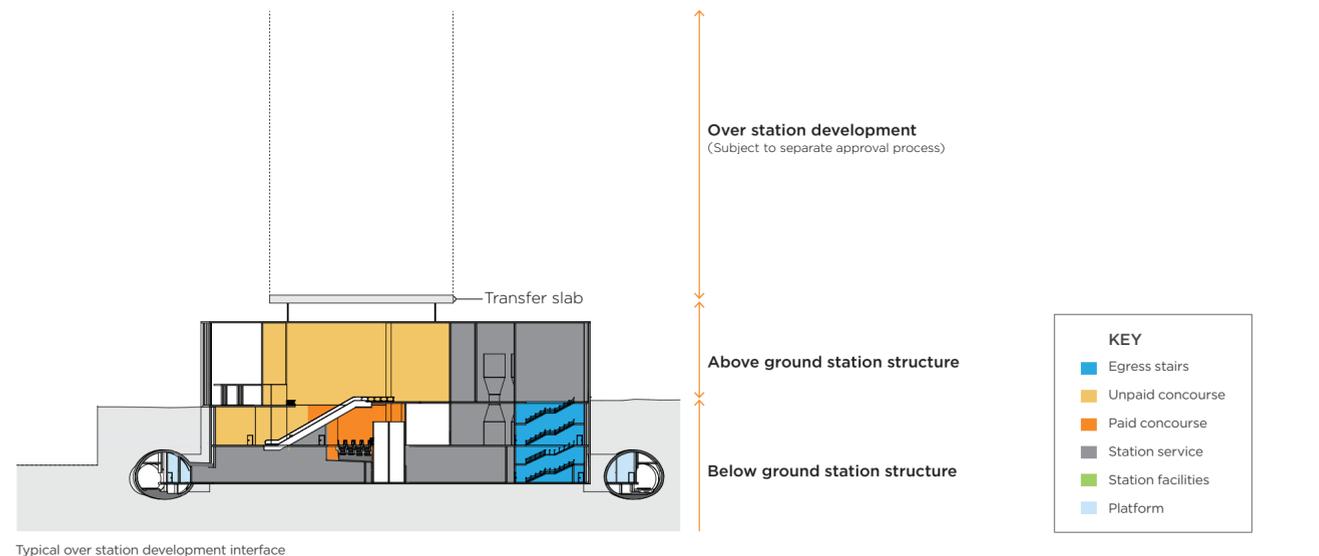
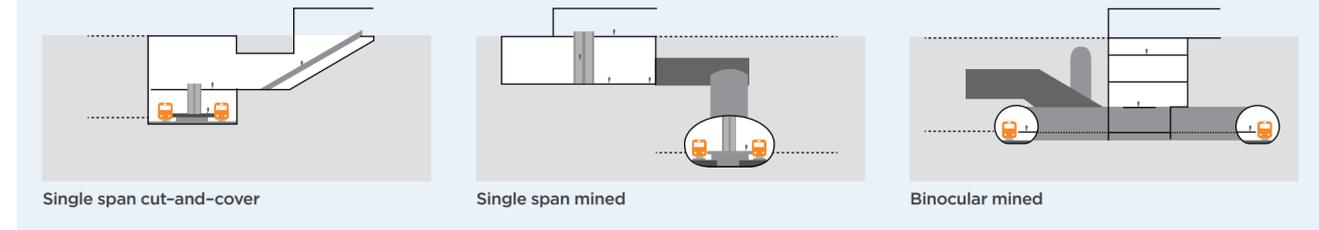
### Station design

All stations will be fully accessible for all customers and integrated with all transport modes.

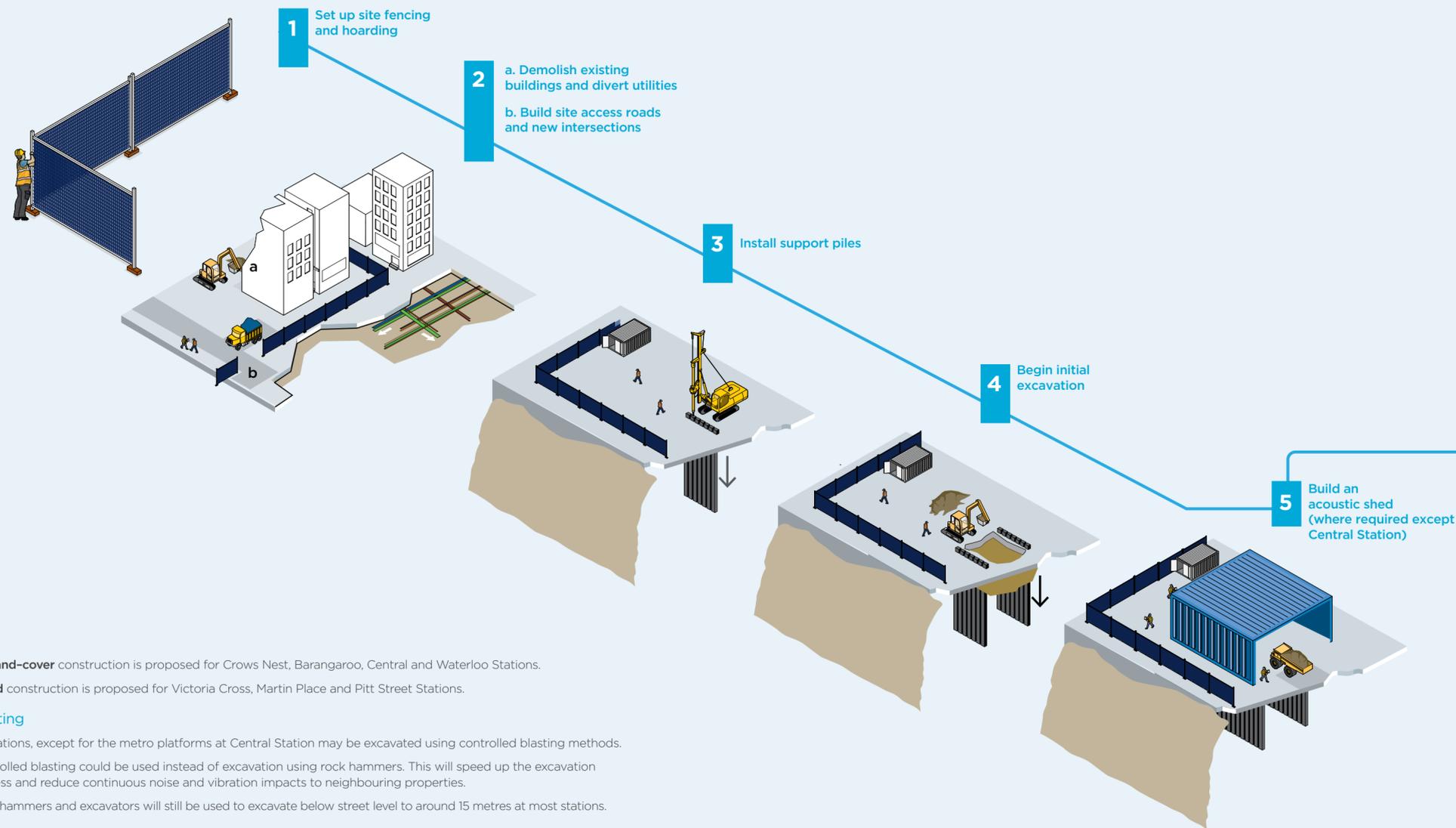
Metro stations will be designed to provide safe and efficient interchange between transport modes, giving priority to pedestrians.

The metro stations will be designed as either single-span or binocular caverns. A single-span mined cavern is proposed at Victoria Cross Station. Single-span cut-and-cover stations are proposed at Crows Nest, Barangaroo, Central and Waterloo. Binocular mined cavern stations are proposed at Martin Place and Pitt Street.

The decision on what type of station cavern will be used is based mostly on constraints to the tunnel alignment such as building basements or other underground infrastructure. Sydney Metro also aims to keep stations as shallow as possible to minimise customer travel time from street level to station platform.



### Building the stations



**Cut-and-cover** construction is proposed for Crows Nest, Barangaroo, Central and Waterloo Stations.

**Mined** construction is proposed for Victoria Cross, Martin Place and Pitt Street Stations.

#### Blasting

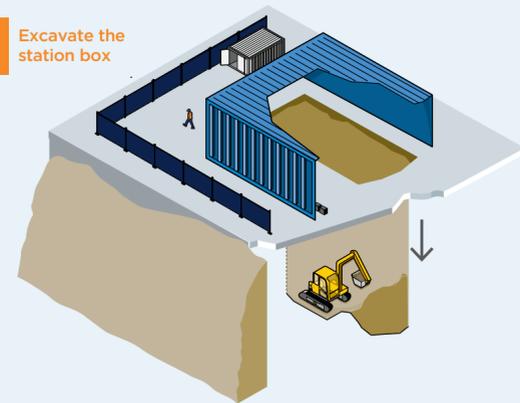
All stations, except for the metro platforms at Central Station may be excavated using controlled blasting methods.

Controlled blasting could be used instead of excavation using rock hammers. This will speed up the excavation process and reduce continuous noise and vibration impacts to neighbouring properties.

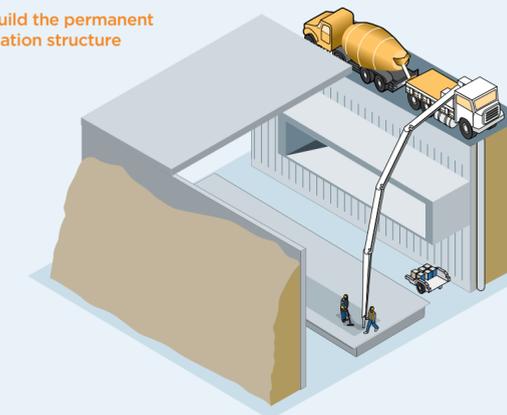
Rock hammers and excavators will still be used to excavate below street level to around 15 metres at most stations.

### Cut and cover construction

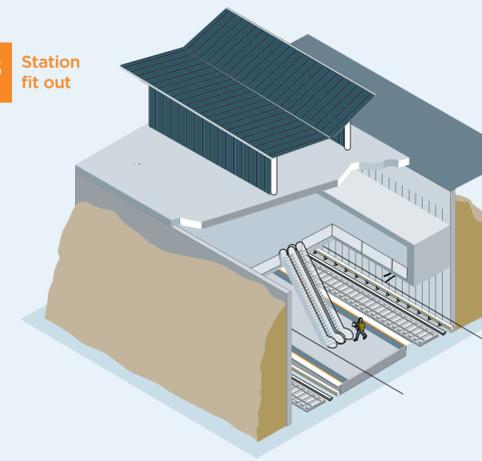
6 Excavate the station box



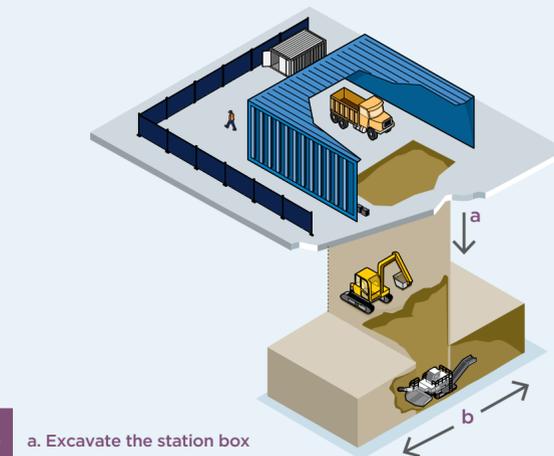
7 Build the permanent station structure



8 Station fit out

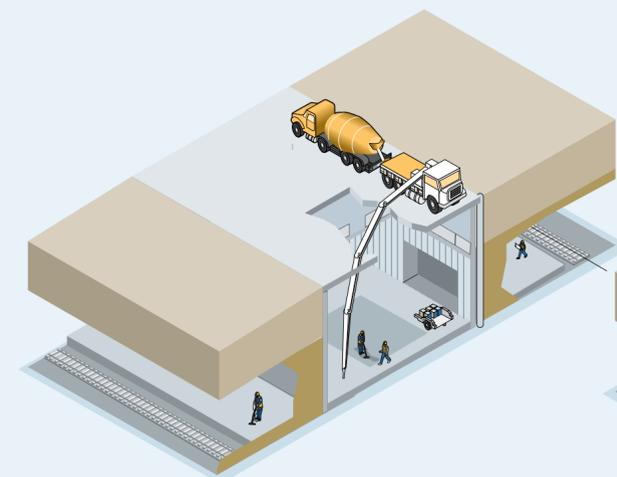


6 a. Excavate the station box

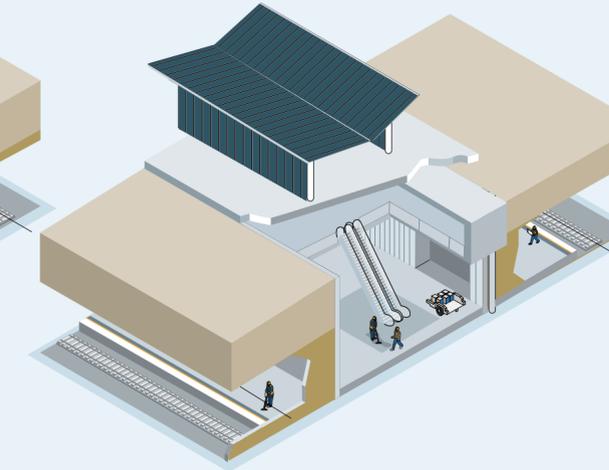


b. Excavate the caverns leading to the station platforms on either side with roadheaders and other equipment

7 Build the permanent station structure



8 Station fit out



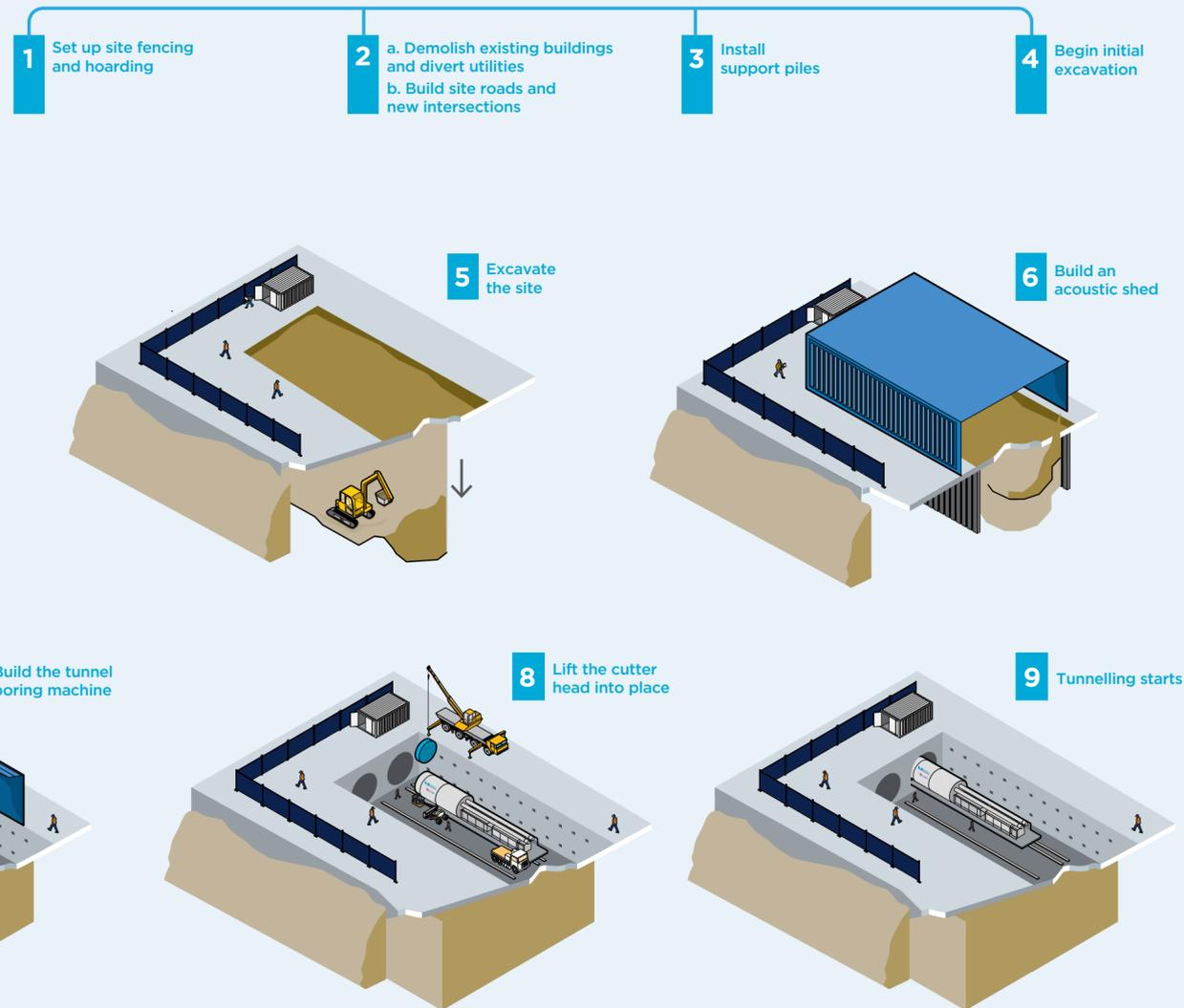
### Mined construction

## Building the dive structures

### Dive structures and tunnel portals

Two dive structures and tunnel portals will be built, one at Chatswood and another at Marrickville. These sites, along with the Barangaroo Station site, will form the tunnel boring machine (TBM) launch sites and provide support for tunnelling operations including:

- o spoil storage and removal
- o pre-cast concrete ring segments storage
- o work trains (or similar) to transport staff and materials to the cutting face
- o water and power supply
- o 24-hour fresh air tunnel ventilation
- o separation plant (Barangaroo only)
- o grout batching plant
- o drainage, water treatment and disposal
- o material storage
- o office facilities, work amenities and parking.



## Building the tunnels

TBMs will be used to excavate 15.5 kilometres of twin rail tunnels between Mowbray Road, Chatswood and Bedwin Road, Marrickville.

Residents and businesses along the tunnel alignment may experience some vibration and ground-borne noise during tunnelling. The impact will vary depending on the geology of the area, depth of the tunnel and the type of buildings above.

Ground-borne noise in buildings comes from ground vibrations rather than through the air. Ground-borne noise does not usually disturb building occupants during the day due to higher background noise levels. At night when surrounding noise levels are lower, residents may notice it more.

The vibration and ground-borne noise will only last for a few days as the tunnel boring machine passes below.

The tunnel alignment is driven by the general location of stations and functional requirements of the metro system including:

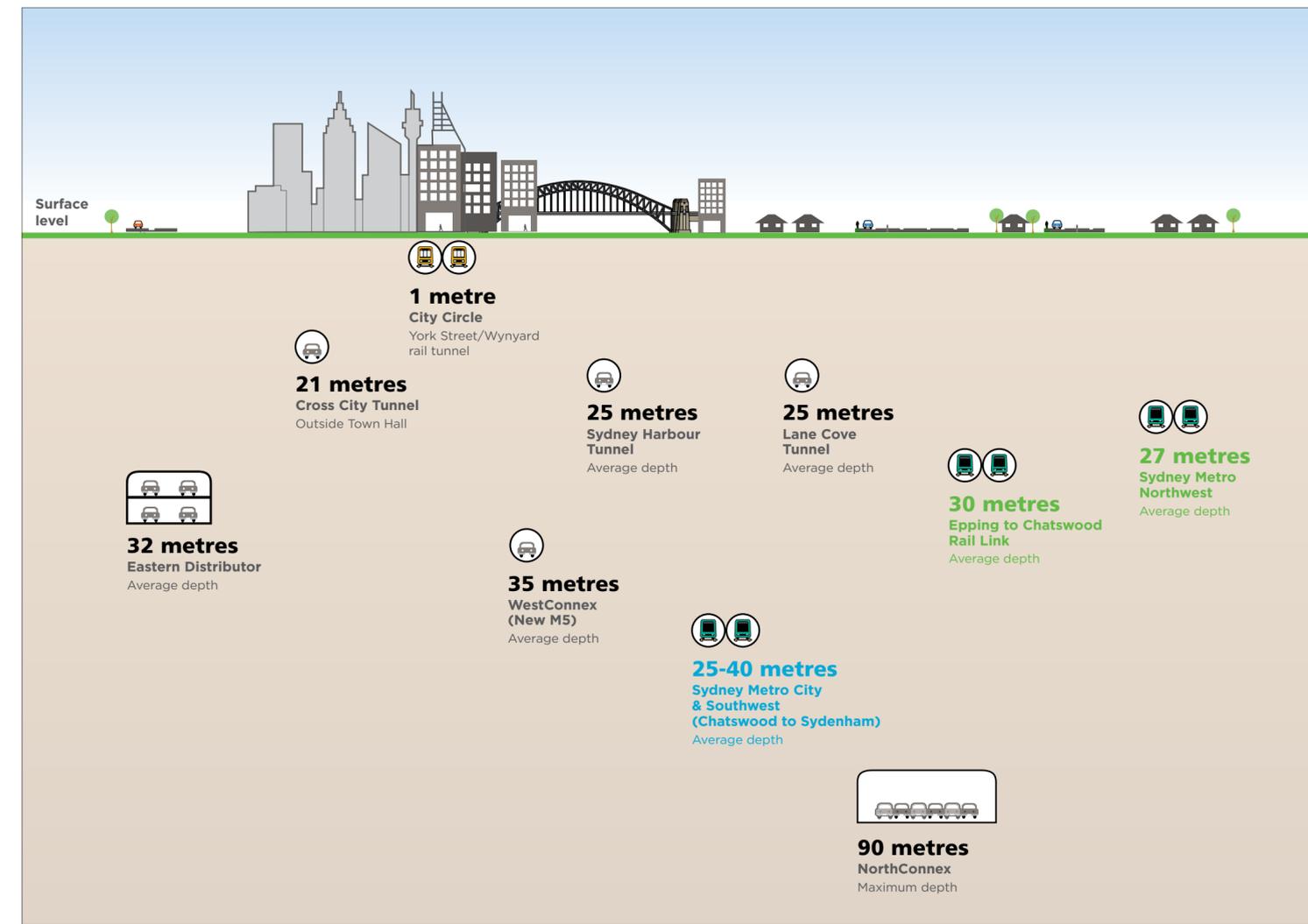
- o location, depth and configuration of stations
- o vertical track grade
- o rock conditions
- o track curvature to allow train speeds of up to 100 kilometres an hour
- o physical constraints of crossing Sydney Harbour.

The alignment is also driven by the need to avoid heritage items, buildings, basements, utilities and other rail and road infrastructure.

The tunnel corridor will extend about 30 metres either side of each tunnel centre line and around all stations.

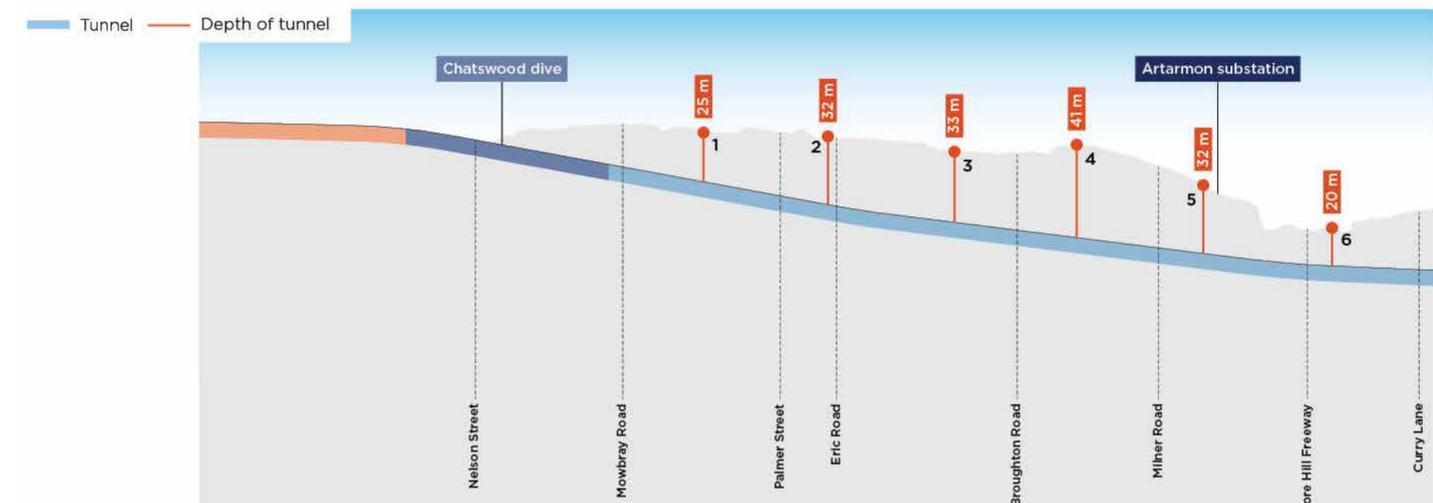
A rail crossover cavern will also be required to allow trains to pass from one track to another. The appropriate location of the crossover cavern is currently being investigated.

The indicative tunnel/corridor alignment is shown on the following pages. Properties above the metro corridor will be contacted by the Project team once the tunnel alignment has been finalised.

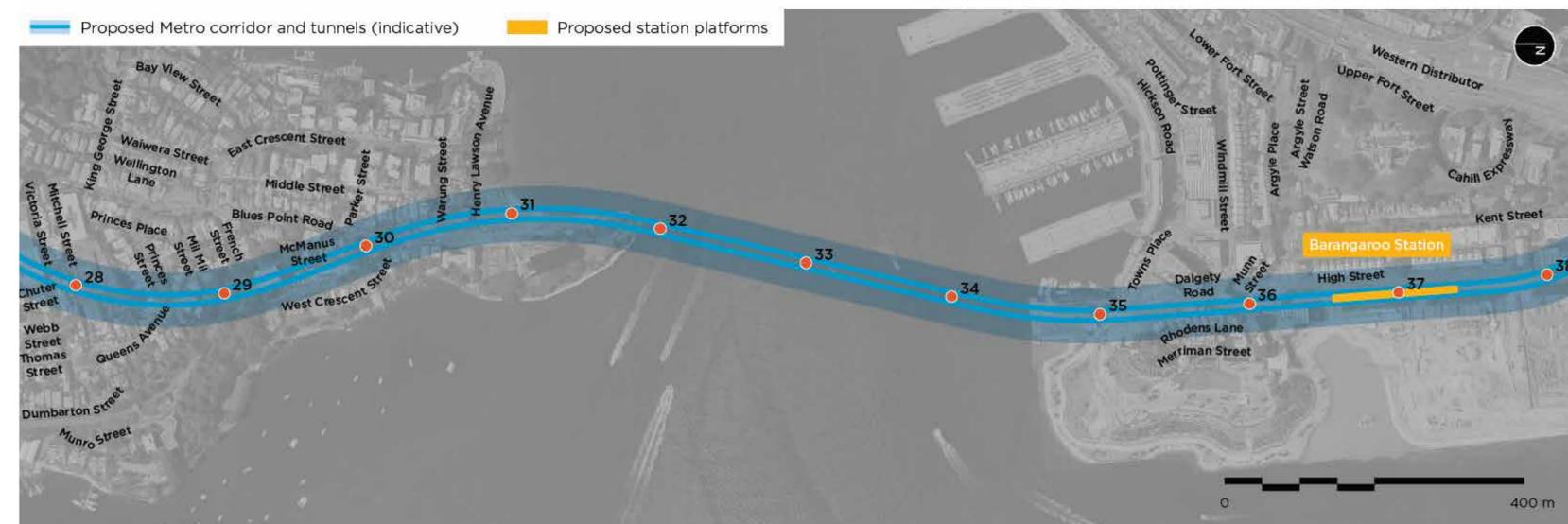


Indicative depths of major Sydney tunnels

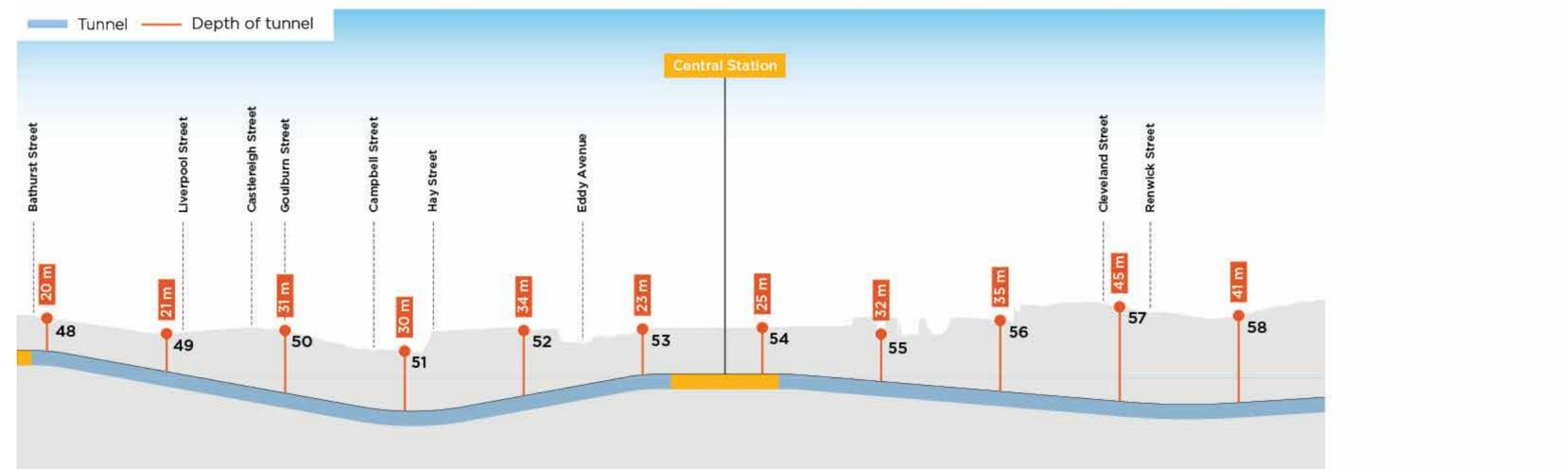
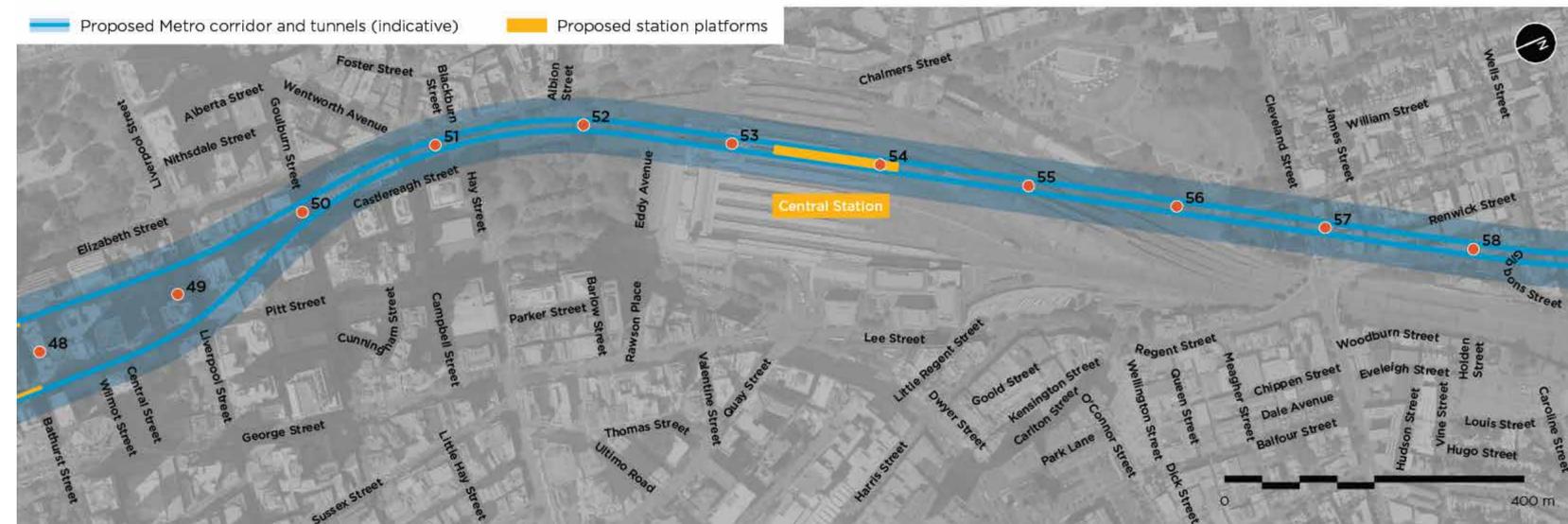
Chatswood to Crows Nest tunnel alignment



Crows Nest to Barangaroo tunnel alignment



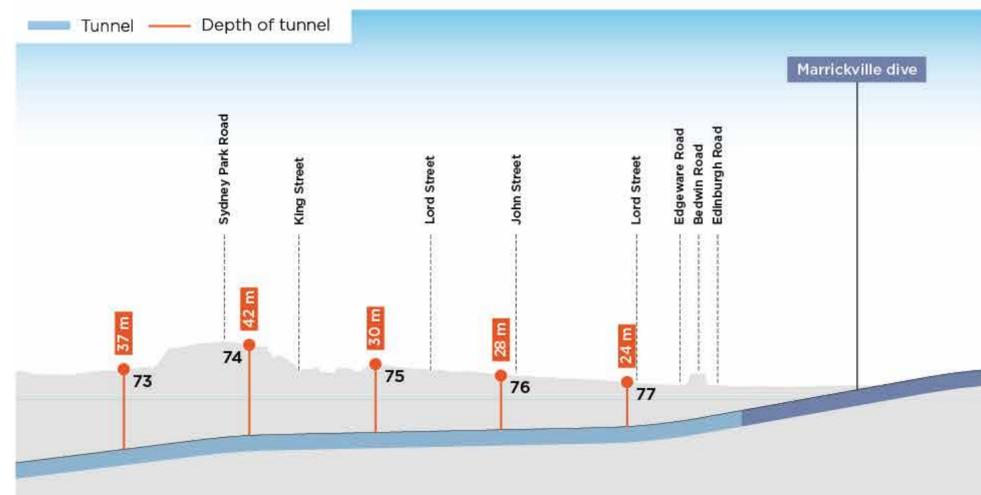
Barangaroo to Central tunnel alignment



Central to Marrickville tunnel alignment



Marrickville to Sydenham tunnel alignment



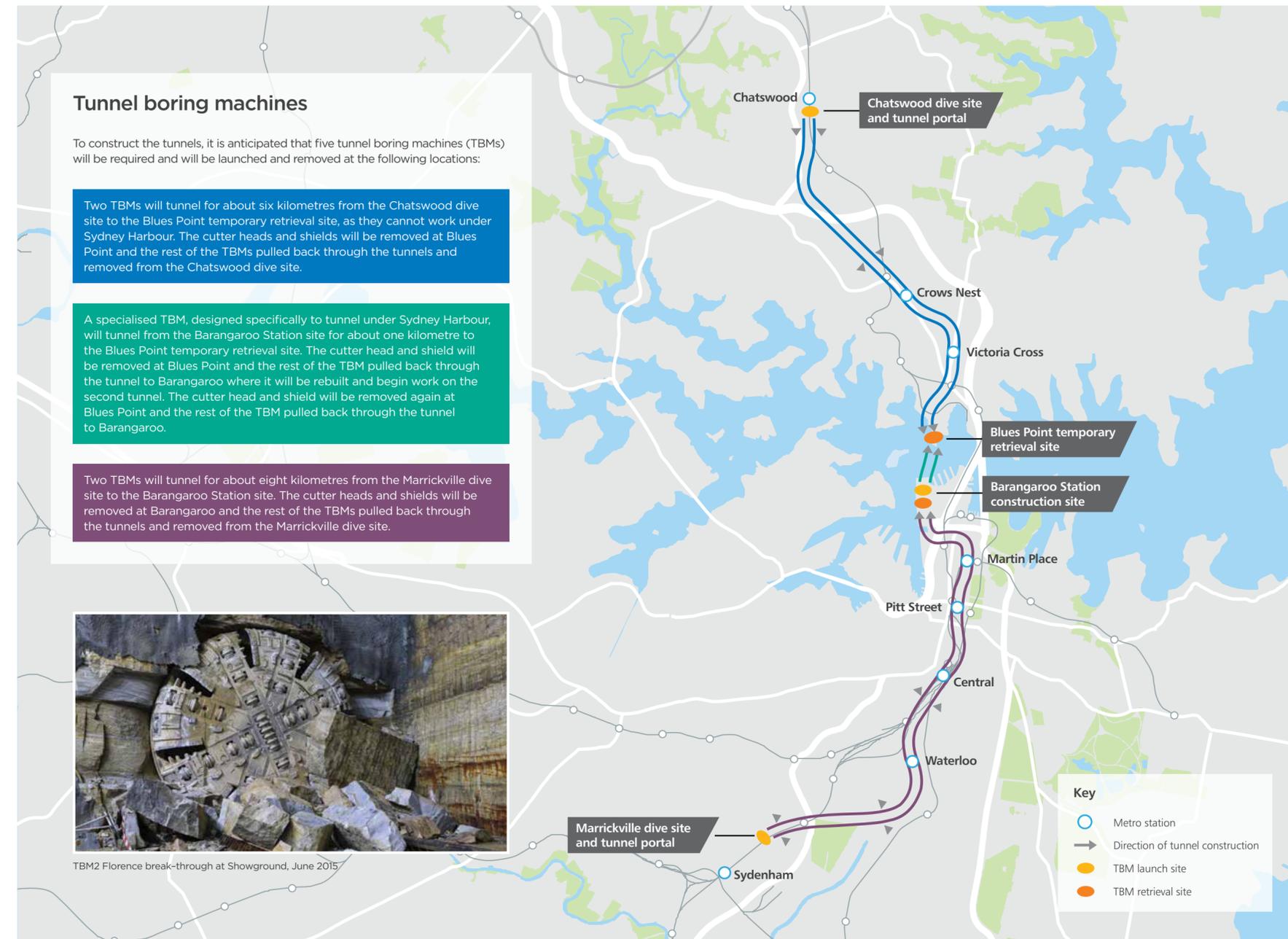
Tunnel boring machines

To construct the tunnels, it is anticipated that five tunnel boring machines (TBMs) will be required and will be launched and removed at the following locations:

Two TBMs will tunnel for about six kilometres from the Chatswood dive site to the Blues Point temporary retrieval site, as they cannot work under Sydney Harbour. The cutter heads and shields will be removed at Blues Point and the rest of the TBMs pulled back through the tunnels and removed from the Chatswood dive site.

A specialised TBM, designed specifically to tunnel under Sydney Harbour, will tunnel from the Barangaroo Station site for about one kilometre to the Blues Point temporary retrieval site. The cutter head and shield will be removed at Blues Point and the rest of the TBM pulled back through the tunnel to Barangaroo where it will be rebuilt and begin work on the second tunnel. The cutter head and shield will be removed again at Blues Point and the rest of the TBM pulled back through the tunnel to Barangaroo.

Two TBMs will tunnel for about eight kilometres from the Marrickville dive site to the Barangaroo Station site. The cutter heads and shields will be removed at Barangaroo and the rest of the TBMs pulled back through the tunnels and removed from the Marrickville dive site.



Surface level

## How a tunnel boring machine (TBM) works

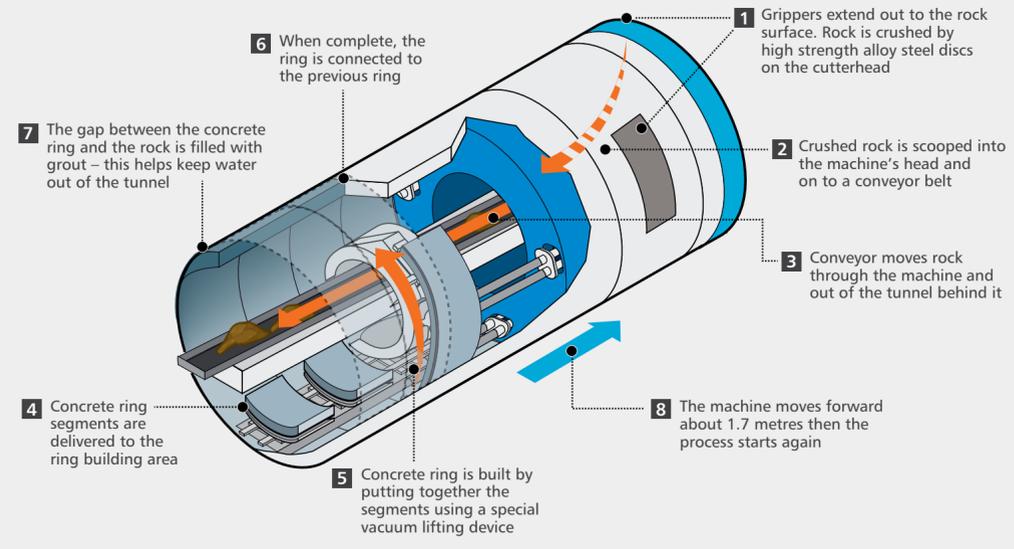


Following the first break-through, TBM Elizabeth traverses the Norwest Station site, February 2015



Size and scale of a TBM in action at Norwest in March 2015

### A typical TBM



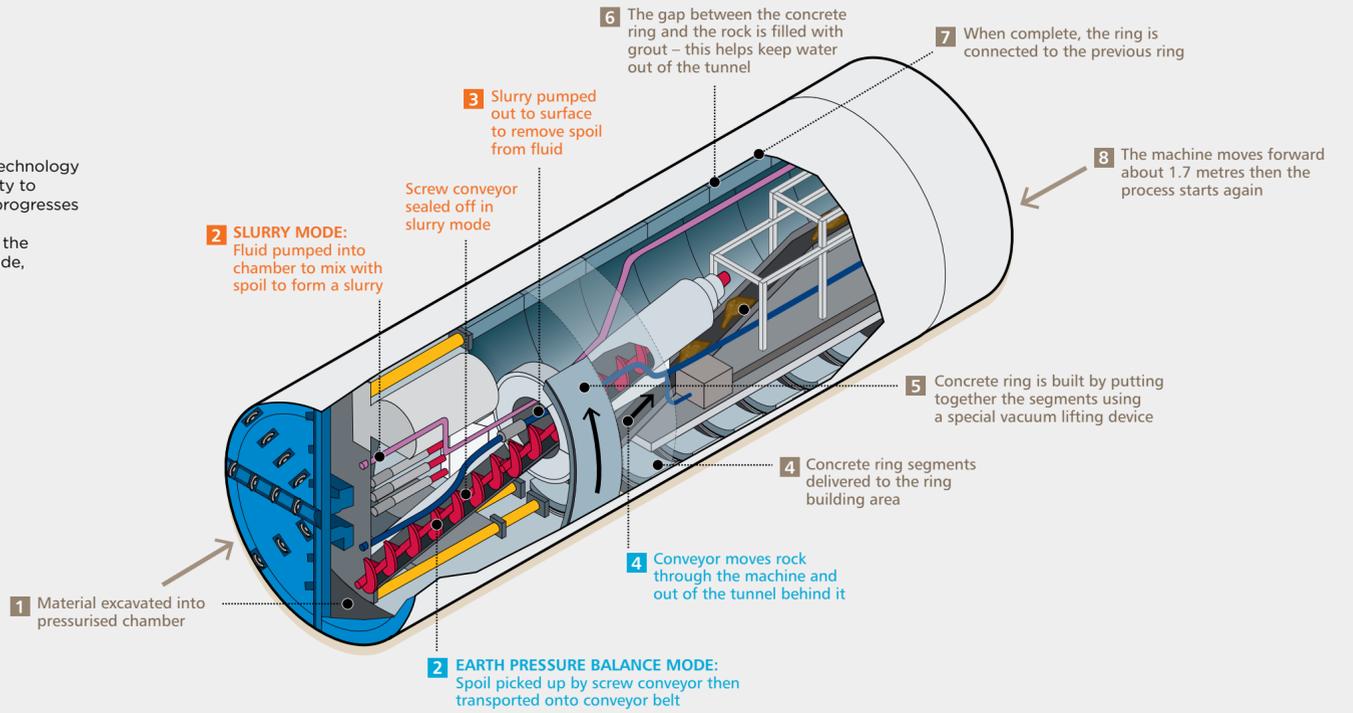
### A specialised TBM

The specialised TBM will combine two types of TBM technology into one machine, allowing tunnel builders the flexibility to adapt to different ground conditions as the machine progresses

Both these two technologies keep the pressure inside the chamber the same as the pressure in the ground outside, to control the excavation process:

> **EARTH PRESSURE BALANCE MODE**  
Uses a screw conveyor and valve to control the pressure by regulating the amount of spoil in the machine. Used for rock conditions

> **SLURRY MODE**  
Uses pipes and fluid to control the pressure in the machine, by turning the excavated material into a slurry and pumping it out. Used for sediment materials



25-40 metres  
Average tunnel depth



About 54 metres  
Maximum tunnel depth

**HOW BIG IS IT?**

Length: up to 120 metres

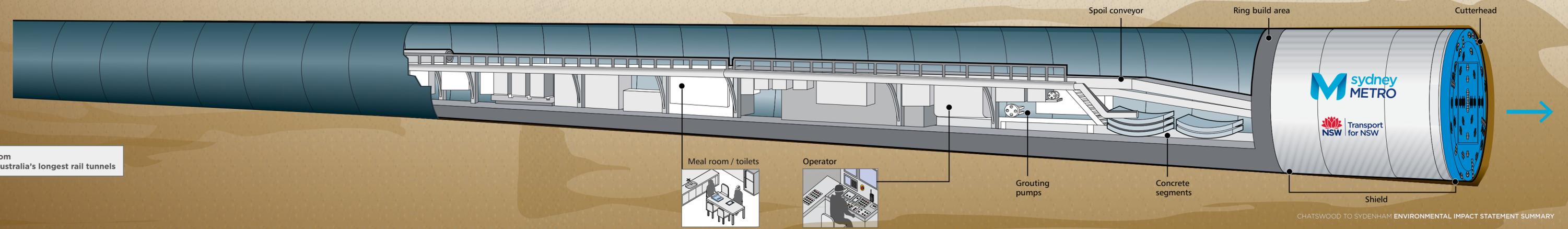
>900 tonnes weight

570 Holden Commodores

4 standard tunnel boring machines

1 specialised tunnel boring machine

15.5 kilometres of twin tunnels from Chatswood to Sydenham - Australia's longest rail tunnels



**Pre-cast concrete segments**

Pre-cast concrete segments will be manufactured at a concrete batch plant and pre-cast facility at the Marrickville dive site.

At peak production, the pre-cast facility will produce about 75 tunnel lining rings per day. About 1200 tonnes of sand, aggregate, cement, polypropylene and steel reinforcement combined will be delivered to the Marrickville site every day to keep up with production.

The segments will be transported to each of the tunnelling launch sites and stored until required.

**Inside the tunnels**

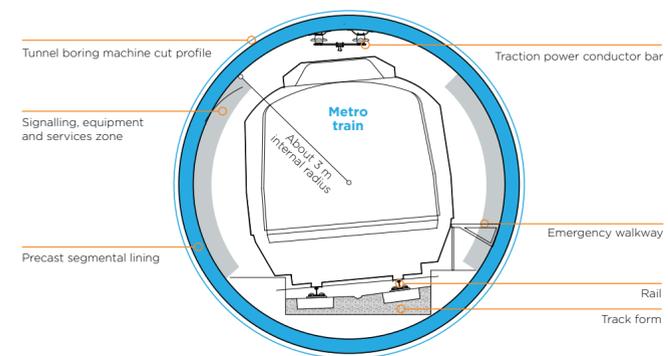
The internal diameter of the tunnels will be about six metres to accommodate single deck Metro trains. The tunnels will be lined with pre-cast concrete segments, installed by the TBMs. The track will consist of a fixed concrete slab with continuously welded rail tracks.

A raised walkway inside the tunnel will be the same height as the train floor so customers could evacuate in an emergency. Cross passages will be built about every 240 metres to allow access between the two tunnels. These passages are an important safety feature, as they allow people to move from one tunnel to another if there is an incident.

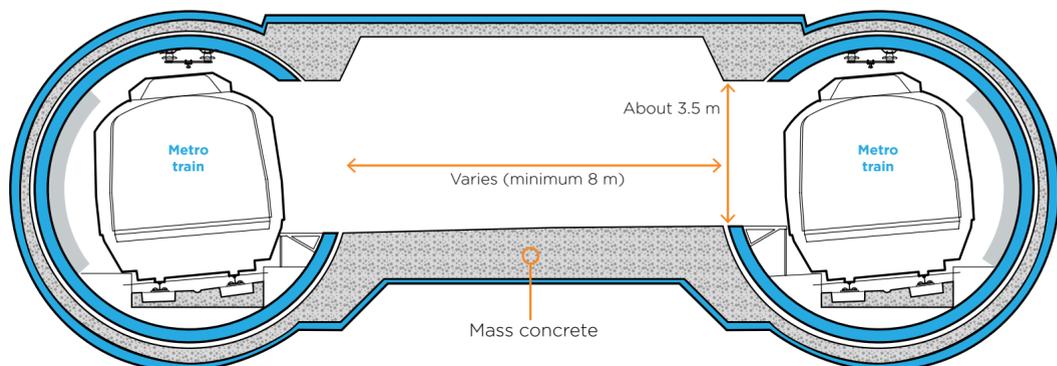
The tunnel will be fitted out with equipment and services like rail signalling, controls and communication, overhead traction power, ventilation, fire and life safety systems and lighting.

Drainage will be incorporated into the concrete slab under the railway tracks and wastewater from the tunnels, stations and other underground facilities will be pumped to the water treatment plant at Marrickville.

**Indicative cross-section of a metro tunnel**



**Indicative section of a tunnel cross passage**



**Roadheaders and rock hammers**

Roadheaders will be used to excavate cross passages. This work will take place 24 hours a day. Rock hammers may be required to excavate cross passages where hard rock is encountered.



Excavator with rock hammer at the Epping construction site, April 2015



Roadheader excavating the crossover cavern at Epping, March 2015



A tunnel under construction on Sydney Metro Northwest (mid-2015)

Chatswood dive site and tunnel portal

The Chatswood tunnel portal will be located adjacent to the T1 North Shore Line at Chatswood between Mowbray Road and Nelson Street. The dive structure will be about 400 metres long and include an open section before closing into a tunnel portal.



TBM Elizabeth from above, just before her launch at Bella Vista, September 2014

Final arrangements

Feature	Description
Location	Adjacent to the T1 North Shore Line at Chatswood between Mowbray Road and Nelson Street
Operational access	Nelson Street
Main features and traffic arrangements	<p>Noise barriers along the rail corridor</p> <p>Rail dampers and deck absorption to provide mitigation for operational train noise</p> <p>Tunnel portal</p> <p>Fire protection wall along the entire length of the dive structure to provide separation between the two metro tracks</p> <p><b>Frank Channon Walk</b> - will be extended from Nelson Street to Mowbray Road</p> <p><b>Nelson Street</b> - bridge permanently removed. Access to Orchard Road and Pacific Highway via Mowbray Road</p> <p><b>Mowbray Road</b> - new traffic lights at Hampden Road</p> <p><b>Mowbray Road</b> - potentially modified traffic light phasing at Orchard Road</p> <p><b>Pacific Highway</b> - new right turn from the Pacific Highway southbound to Mowbray Road westbound</p>
Rail	<p><b>T1 North Shore Line</b> - tracks realigned and a new rail bridge built over the dive structure</p> <p><b>Maintenance access</b> - new stairs from Albert Avenue, new access point from Brand Street and changes to the existing access maintenance point from Drake Street</p> <p><b>Metro tracks</b> - about 250 metres of new aboveground tracks connecting to Sydney Metro Northwest at Chatswood Station</p>
Maintenance access	<p>Weekly light vehicles for inspections and testing of track and in-tunnel equipment</p> <p>Occasional light and utility vehicles for track and equipment maintenance</p>
Operational noise	<p>Noise barriers will be used between Chatswood Station and to the south of Mowbray Road to mitigate train noise</p> <p>Existing noise barriers will be increased in height to about four metres between:</p> <ul style="list-style-type: none"> <li>Chapman Avenue and Nelson Street on the eastern side of the rail line</li> <li>the Frank Channon Walk pedestrian underpass and Albert Avenue on the western side the rail line</li> <li>Nelson Street and Gordon Avenue on the western side the rail line</li> </ul> <p>A two metre high noise barrier will also be built to the south of the Mowbray Road on the western side of the rail line</p>

Operational map



**KEY**

- Proposed Metro tunnels and corridor (indicative)
- Residual land
- Dive structure
- Operational area
- Access closed
- Frank Channon Walk (existing)
- Proposed Frank Channon Walk extension (indicative)

Construction at Chatswood

The Chatswood site will be used to:

- excavate and construct the Chatswood dive structure and tunnel portal
- launch and support two tunnel boring machines
- support the realignment of the T1 North Shore Line between Chatswood Station and Brand Street, Artarmon to accommodate the new metro tracks
- support the construction of about 250 metres of new aboveground metro tracks
- support the fit-out of the tunnel rail systems.

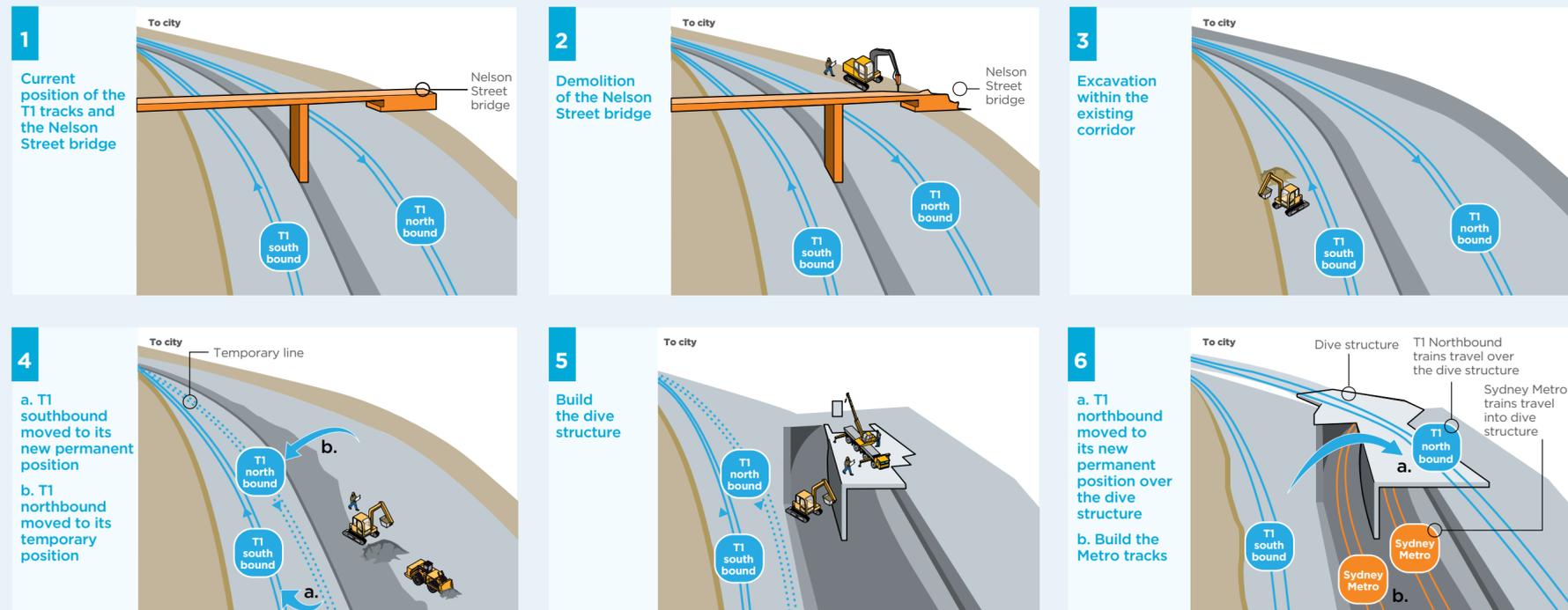
Construction of the Chatswood dive structure and tunnel portal will involve construction techniques outlined on page 26.

Surface track work

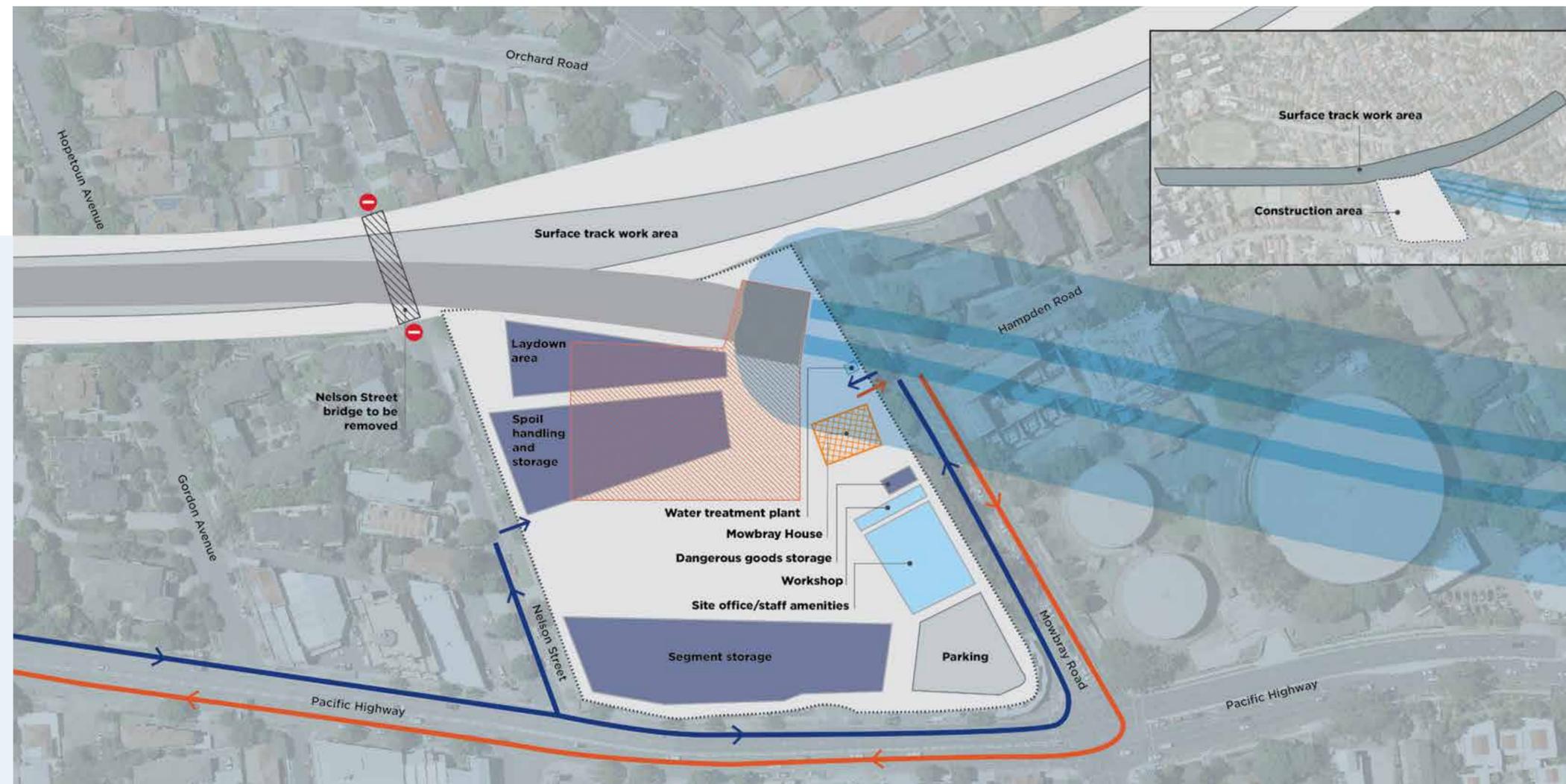
In order to connect Sydney Metro City & Southwest to Sydney Metro Northwest, the T1 North Shore Line tracks need to be realigned within the existing rail corridor and about 250 metres of new metro track laid. These works will be coordinated with the existing Sydney Trains maintenance schedule to reduce impacts to customers. Temporary rail replacement bus services will be provided.

To make room for this work, the Nelson Street bridge will be permanently removed. The Nelson Street bridge allowed motorists travelling south on the Pacific Highway to access Mowbray Road westbound via Orchard Road. A new right turn from the Pacific Highway to Mowbray Road westbound will be built before the Nelson Street bridge is demolished.

Surface track work construction



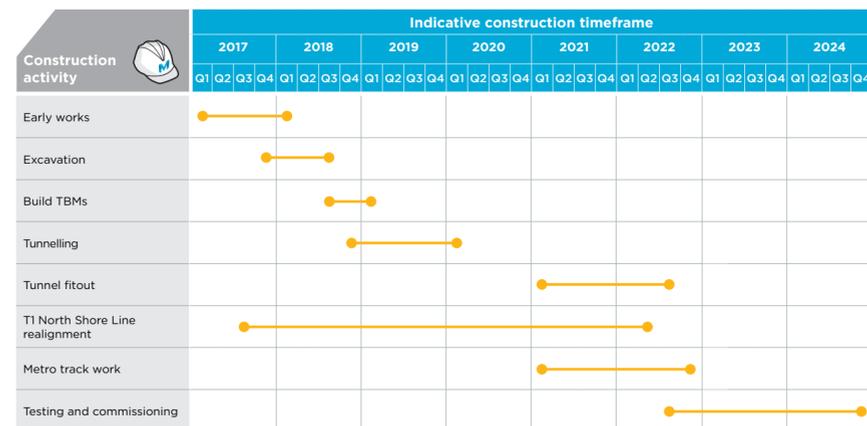
Construction site map



**KEY**

- Proposed Metro tunnels and corridor (indicative)
- Construction area
- Acoustic shed
- Noise barrier or hoarding
- Dive structure
- Site access - out
- Site access - in
- Access closed

Construction at Chatswood



Construction at a glance

Feature	Description
Size	24,000 square metres (m <sup>2</sup> )
Construction hours	<b>Demolition and excavation:</b> Monday to Friday 7 am–6 pm and Saturday 8 am–1 pm <b>All other work:</b> 24 hours a day
Site access	<b>Dive site</b> Nelson Street (right-in) Mowbray Road (left-in and right-out) at a new traffic lights at Hampden Road  <b>Rail corridor</b> Existing access points on Hopetoun Avenue Chatswood and Drake Street, Artarmon and the new access point at Brand Street, Artarmon
Truck movements	<b>Demolition:</b> Trucks 96 per day and light vehicles 78 per day <b>Excavation:</b> Trucks 234 per day and light vehicles 248 per day <b>Tunnel excavation:</b> Trucks 286 per day and light vehicles 248 per day <b>Tunnel fit out:</b> Trucks 254 per day and light vehicles 248 per day
Demolition	Seven buildings (including the Ausgrid depot) Nelson Street road bridge
Heritage	The locally heritage listed Mowbray House will be retained and protected within the site Archival recording and reporting will be undertaken before work starts
Landscape	Trees will be removed within the rail corridor between Nelson Street and Mowbray Road (includes native vegetation mixed with invasive exotic species), and from the Ausgrid site

Feature	Description
Excavation	Open cut and cut and cover
Spoil removal	520,000 cubic metres (m <sup>3</sup> ) of mostly sandstone by truck Spoil removal by freight train is not feasible at this location because the T1 North Shore Line is not currently rated for freight transport
Activities	Excavate and construct the dive structure and tunnel portal Launch and support two tunnel boring machines Realign T1 North Shore Line between Chatswood Station and Brand Street, Artarmon to accommodate the new metro tracks Construct about 250 metres of new aboveground metro tracks Fit-out tunnel rail systems <b>Corridor works including:</b> <ul style="list-style-type: none"> <li>new retaining walls between Ellis Street, Chatswood and Drake Street, Artarmon</li> <li>relocating noise barriers (where required)</li> <li>closure of the existing Sydney Trains maintenance access from Hopetoun Avenue (around 2019)</li> <li>upgrades to the Drake Street, Artarmon access point including a new entrance and Hi-Rail access pad (where rail maintenance vehicles are placed onto the tracks)</li> <li>new maintenance access stairs for Sydney Trains from Albert Avenue</li> <li>new maintenance access from Brand Street, Artarmon</li> <li>new support to the western side of the Mowbray Road bridge, including soil nails, shotcrete and a deflection wall</li> </ul>
Staff facilities	Offices, lunch rooms and amenities
Staff parking	About 300 onsite parking spaces Contractors may consider 'park and shuttle' services to transfer workers to and from this site
Plant and equipment	Two tunnel boring machines Eight piling rigs Six drilling jumbos 14 excavators Four front-end loaders Three bobcats Eight mobile cranes Two truck-mounted cranes 12 generators 12 compressors Four concrete pumps Two water carts Water treatment plant
Utility and power supply	Water, sewer and telecommunications Power for TBMs will be supplied from the Chatswood substation (100 metres away)
Major utility impacts	Protection of Telstra cables along the T1 North Shore Line rail corridor Adjustments to T1 North Shore Line rail systems

Feature	Description
Traffic changes	<b>Nelson Street</b> – permanent closure and demolition of the road bridge. Motorists will be redirected via Mowbray Road  <b>Pacific Highway</b> – new right turn from the Pacific Highway southbound to Mowbray Road westbound, including the localised widening of the Pacific Highway to the north of the Mowbray Road intersection and changes to the traffic light phasing. This will be built prior to the removal of the Nelson Street bridge  <b>Mowbray Road</b> – new traffic lights at the Mowbray Road / Hampden Road intersection, with potential modifications to the traffic lights at the Mowbray Road / Orchard Road intersection
Public transport changes	<b>Train services</b> – temporary rail replacement services on the T1 North Shore Line during: <ul style="list-style-type: none"> <li>demolition of the Nelson Street road bridge</li> <li>adjustments to the T1 North Shore Line</li> <li>metro track and rail systems works</li> </ul> These works will be coordinated with the existing Sydney Trains maintenance schedule and closures required for the conversion of the Epping to Chatswood Rail Line to reduce impacts to customers  <b>Bus services</b> – temporary relocation of the bus stop at 575 Pacific Highway (between Bryson Street and Mowbray Road)
Street parking changes	Nil
Noise management	There will be noise and vibration impacts at this site. Management practices to minimise impacts include: <ul style="list-style-type: none"> <li>a noise barrier or hoarding will be built around the site</li> <li>an acoustic shed may be constructed over the excavation to reduce noise impacts</li> <li>night-time heavy vehicle movements will be restricted to the Pacific Highway and Mowbray Road, if compliance with noise criteria cannot be met</li> </ul>
Pedestrian and cyclist changes	<b>Frank Channon Walk</b> – temporary short-term (weekend) closures of the shared path linking Chatswood Station and Nelson Street during surface track works. Pedestrians and cyclists will be redirected via the Pacific Highway or Orchard Road  <b>Nelson Street</b> – permanent removal of pedestrian and cyclist connectivity at Nelson Street over the T1 North Shore Line. Pedestrians and cyclists will be redirected via Mowbray Road to cross the rail line or Frank Channon Walk and the underpass adjacent to Chatswood Oval
Finishing works	Residual land is likely to be stabilised prior to future development
Other major projects in the area	Sydney Metro Northwest (2013-19), includes a new 33 kilovolt (kV) underground transmission line between Ausgrid's Willoughby subtransmission substation and Transport for NSW's Chatswood North traction substation  Mowbray Road / Pacific Highway intersection and Mowbray Road / Hampden Road intersection (further upgrades by Roads and Maritime Services, in planning)



Aerial view over Chatswood

## Artarmon substation

The substation will supply traction power to the metro trains. The site will include an above-ground building (around five metres high) for the substation and electrical equipment and a small shaft (around three metres wide) for cables to the tunnels below.

The architectural treatment of Artarmon substation will be focused on maintaining visual amenity and landscape character of the site.

### Electric and magnetic fields

Transport for NSW will meet relevant health standards for electric and magnetic fields (EMF), which are found wherever electricity is present. This includes home and office appliances, substations and electrical cables.

*The Draft Radiation Standard – Exposure Limits for Magnetic Fields* (Australian Radiation Protection and Nuclear Safety Agency, 2006) provides exposure limits that are typically applied when considering electric and magnetic fields from new developments. The detailed design of electrical infrastructure will ensure that the exposure limits for the local community suggested by the Draft Radiation Standard will not be exceeded within public areas.

Appliance measurements were taken at typical distances experienced by users.		
Common EMF Sources		Range of measurements (mg)
 PC		2-20
 Refrigerator		2-5
 Substation		1-8 (at substation fence)
Source ARPANSA		

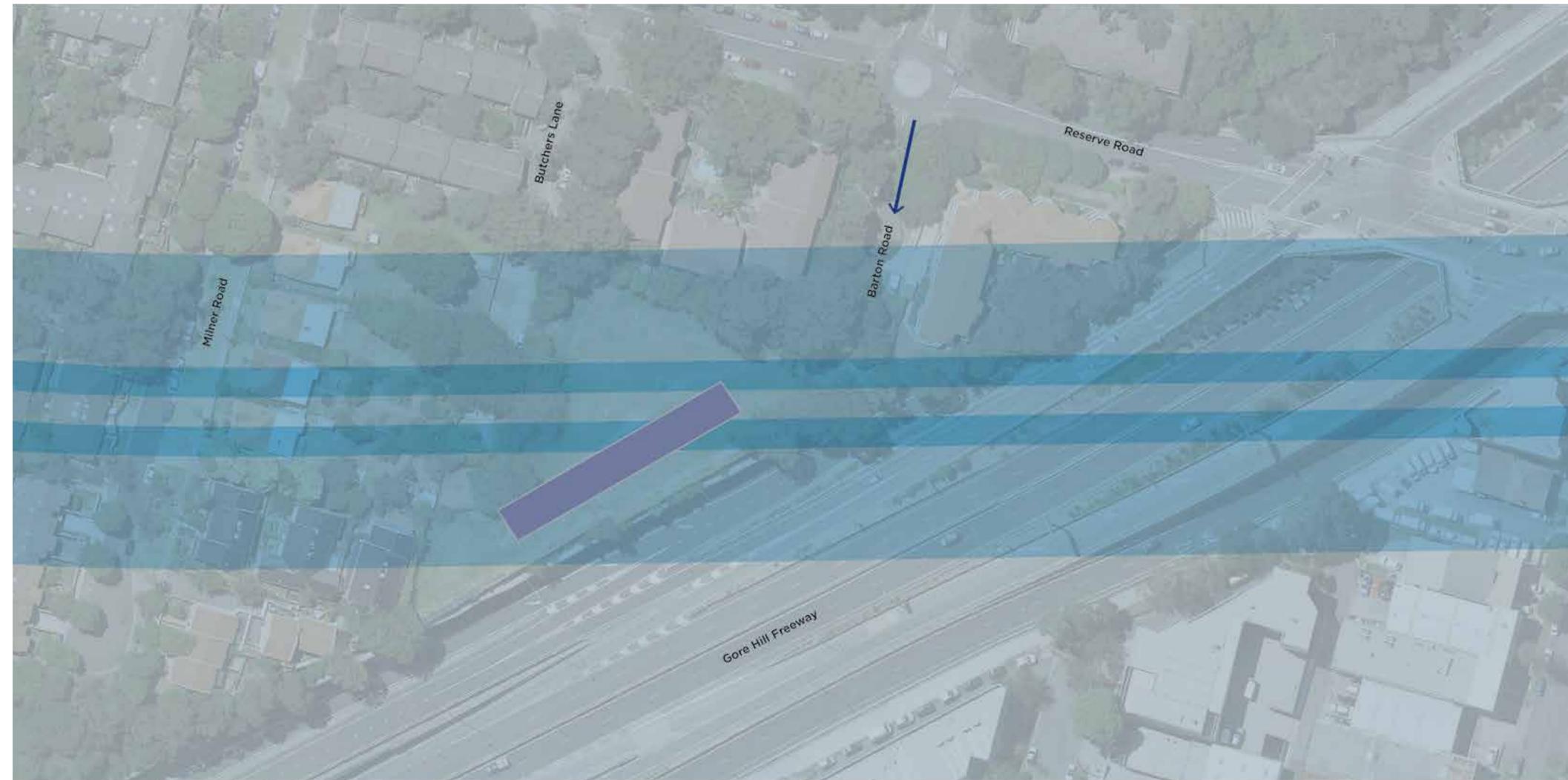
### Final arrangements

Feature	Description
Location	Above the tunnels on land near the edge of the Gore Hill Freeway
Operational access	Barton Road, Artarmon
Main features	Traction substation
Maintenance access	Fortnightly light vehicles for visual inspections Quarterly light and utility vehicles for replacement of consumables Yearly heavy rigid trucks and cranes for major maintenance and replacement of large plant items
Finishing works	Landscaping



Artist's impression of Artarmon substation

## Operational map



**KEY**

-  Proposed Metro tunnels and corridor (indicative)
-  Traction substation
-  Maintenance access

### Construction at Artarmon

Construction of the Artarmon substation will involve:

- o excavating a vertical shaft to the tunnels below. This is likely to be carried out using a large diameter piling rig or raised bore. Drill and blast or penetrating cone fracture techniques may also be used
- o lining and reinforcing the shaft
- o building above-ground components
- o installing electrical equipment.

The site is currently occupied by temporary school buildings associated with the nearby Artarmon Public School. The school has existing plans in place to relocate prior to Sydney Metro requiring the site.

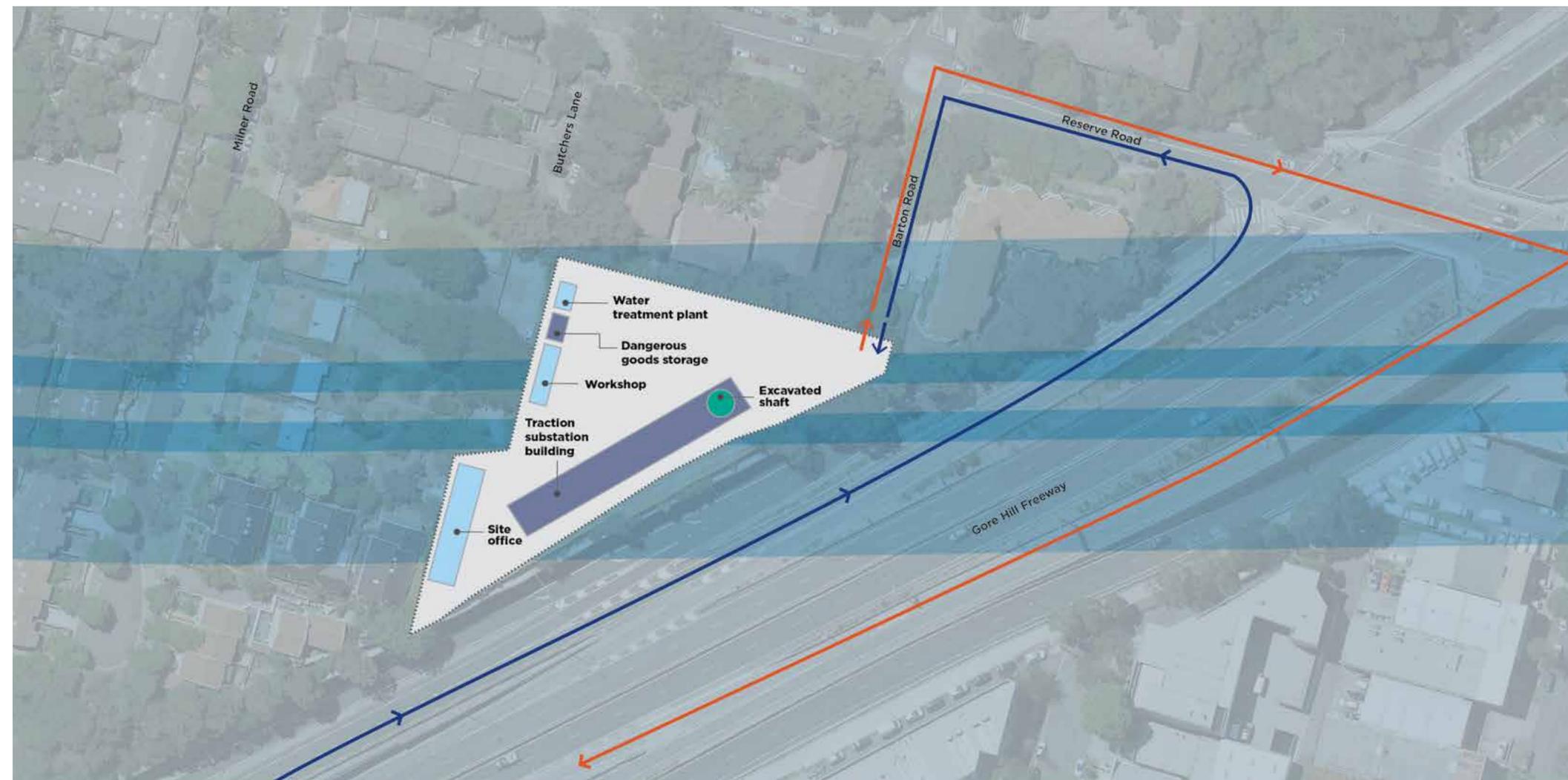
#### Construction at a glance

Feature	Description
Size	3500 square metres (m <sup>2</sup> )
Site access	Barton Road
Construction hours	Monday to Friday 7 am-6 pm and Saturday 8 am-1 pm
Truck movements	<b>Site establishment:</b> Trucks 54 per day and light vehicles 78 per day <b>Excavation:</b> Trucks 54 per day and light vehicles 78 per day <b>Fit out:</b> Trucks 42 per day and light vehicles 78 per day
Demolition	Nil
Landscape	Grass, scrub and trees will be removed within the site
Excavation	Vertical shaft
Spoil removal	2000 cubic metres (m <sup>3</sup> ) of mostly sandstone by truck
Activities	Spoil removal Ancillary infrastructure construction
Staff facilities	Offices, lunch rooms and amenities
Staff parking	Four to 10 parking spaces for use by engineers and other management staff will be provided Contractors may consider 'park and shuttle' services to transfer workers to this site
Utility and power supply	Power, water, sewer and telecommunications
Major utility impacts	Nil

Construction activity	Indicative construction timeframe																															
	2017			2018			2019			2020			2021			2022			2023			2024										
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4				
Early works																																
Excavation and structural works																																
Build substation																																
Substation fitout																																
Testing and commissioning																																

Feature	Description												
Plant and equipment	<table border="0"> <tr> <td>Piling rig</td> <td>Two bobcats</td> <td>Six compressors</td> </tr> <tr> <td>Drilling jumbo</td> <td>Mobile crane</td> <td>Two concrete pumps</td> </tr> <tr> <td>Two excavators</td> <td>Truck-mounted crane</td> <td>Water treatment plant</td> </tr> <tr> <td>Front-end loader</td> <td>Six generators</td> <td>Water cart</td> </tr> </table>	Piling rig	Two bobcats	Six compressors	Drilling jumbo	Mobile crane	Two concrete pumps	Two excavators	Truck-mounted crane	Water treatment plant	Front-end loader	Six generators	Water cart
Piling rig	Two bobcats	Six compressors											
Drilling jumbo	Mobile crane	Two concrete pumps											
Two excavators	Truck-mounted crane	Water treatment plant											
Front-end loader	Six generators	Water cart											
Traffic changes	Nil												
Public transport changes	Nil												
Street parking changes	Nil												
Noise management	There will be noise and vibration impacts at this site. Management practices to minimise impacts include: <ul style="list-style-type: none"> <li>o a noise barrier or hoarding will be built around the site</li> </ul>												
Pedestrian and cyclist changes	Nil												
Other major projects in the area	Sydney Metro Northwest (2013-19), includes a new 33 kilovolt (kV) underground transmission line between Ausgrid's Willoughby subtransmission substation and Transport for NSW's Chatswood North traction substation												

### Construction site map



**KEY**

	Proposed Metro tunnels and corridor (indicative)		Construction area		Noise barrier or hoarding		Site access - out		Site access - in
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Crows Nest Station

Crows Nest Station will provide new metro rail access to the Crows Nest residential area and will serve people within walking and cycling distance. It will improve travel to local schools, businesses and Crows Nest village.

The station will create a new transport focus on the southern side of the St Leonards specialised centre which supports the St Leonards southern gateway to commercial and mixed-use activities.



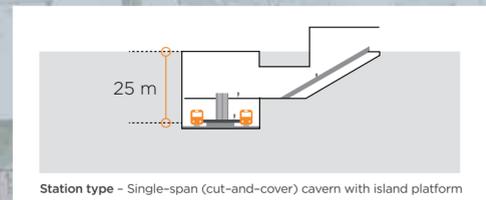
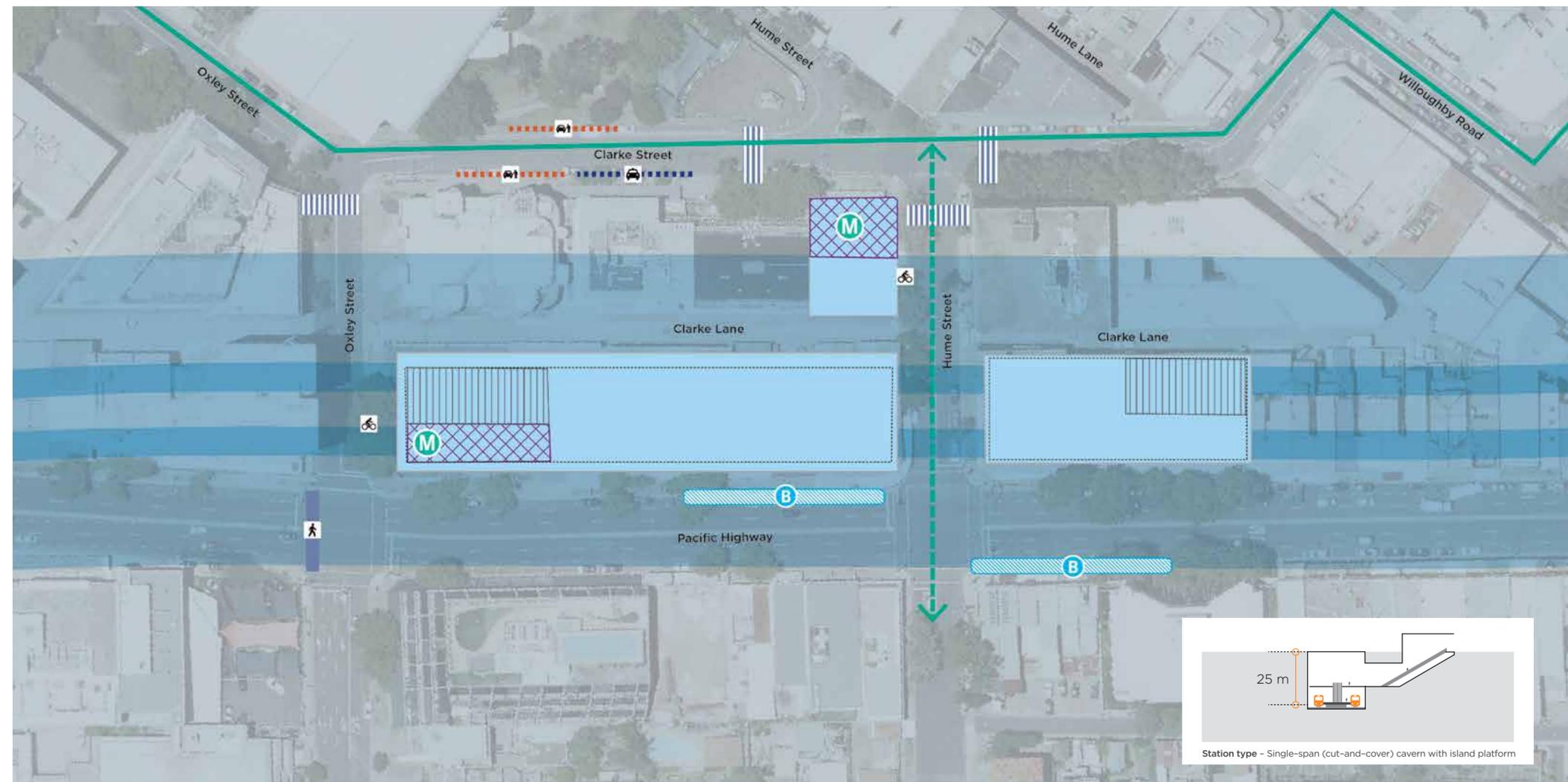
Artist's impression of Crows Nest Station

Final arrangements

Feature	Description
Location	Between the Pacific Highway and Clarke Lane (eastern side of the Pacific Highway) and between Oxley Street and south of Hume Street
Station entry	Corner of Hume and Clarke streets Corner of Pacific Highway and Oxley Street
Transport interchange	Walking, cycling, bus, taxi and kiss-and-ride
Main features and traffic arrangements	New pedestrian crossing with traffic lights at the Pacific Highway / Oxley Street intersection New pedestrian crossings on Clarke, Hume and Oxley streets New bike parking at both station entries New on-road marked cycle link on Hume Street New kiss-and-ride and taxi bays on Clarke Street Existing bus stops close to the station retained on the Pacific Highway Installation of wayfinding signage and Sydney Metro information Enhancement of pedestrian infrastructure around the station will be investigated further in consultation with Roads and Maritime Services and Willoughby Council
Station statistics	Depth - 25 metres Platform length - 170 metres Platform width - 10 metres Overall station length - 210 metres
Customers	Customers accessing the leisure, entertainment and retail strip along Willoughby Road Customers accessing the employment area along Willoughby Road, Christie Street and the Pacific Highway Customers travelling to and from nearby employment, education and residential precincts
Local amenities	Hume Street Park Marist College Mater Hospital North Sydney Boys High School North Sydney Girls High School North Sydney Indoor Sports Centre Northern Sydney Institute of TAFE Royal North Shore Hospital Royal North Shore Private Hospital Stores and restaurants on Pacific Highway Stores and restaurants on Willoughby Road



Operational map



**KEY**

- Proposed Metro tunnels and corridor (indicative)
- Metro entry
- Bus stop
- Proposed kiss-and-ride
- Proposed taxi rank
- Proposed cycle parking
- Existing cycle route
- Proposed Council cycle route
- Proposed pedestrian crossing with traffic lights
- Proposed pedestrian crossing
- Pedestrian plaza / station lobby
- Station services building
- Possible future over station development area

## Construction Crows Nest Station

The Crows Nest construction site will function as two separate construction zones split by Hume Street. The station excavation will cover the majority of the site, with a temporary street-level working platform.

Construction of Crows Nest Station will involve the cut-and-cover construction techniques outlined on page 24.

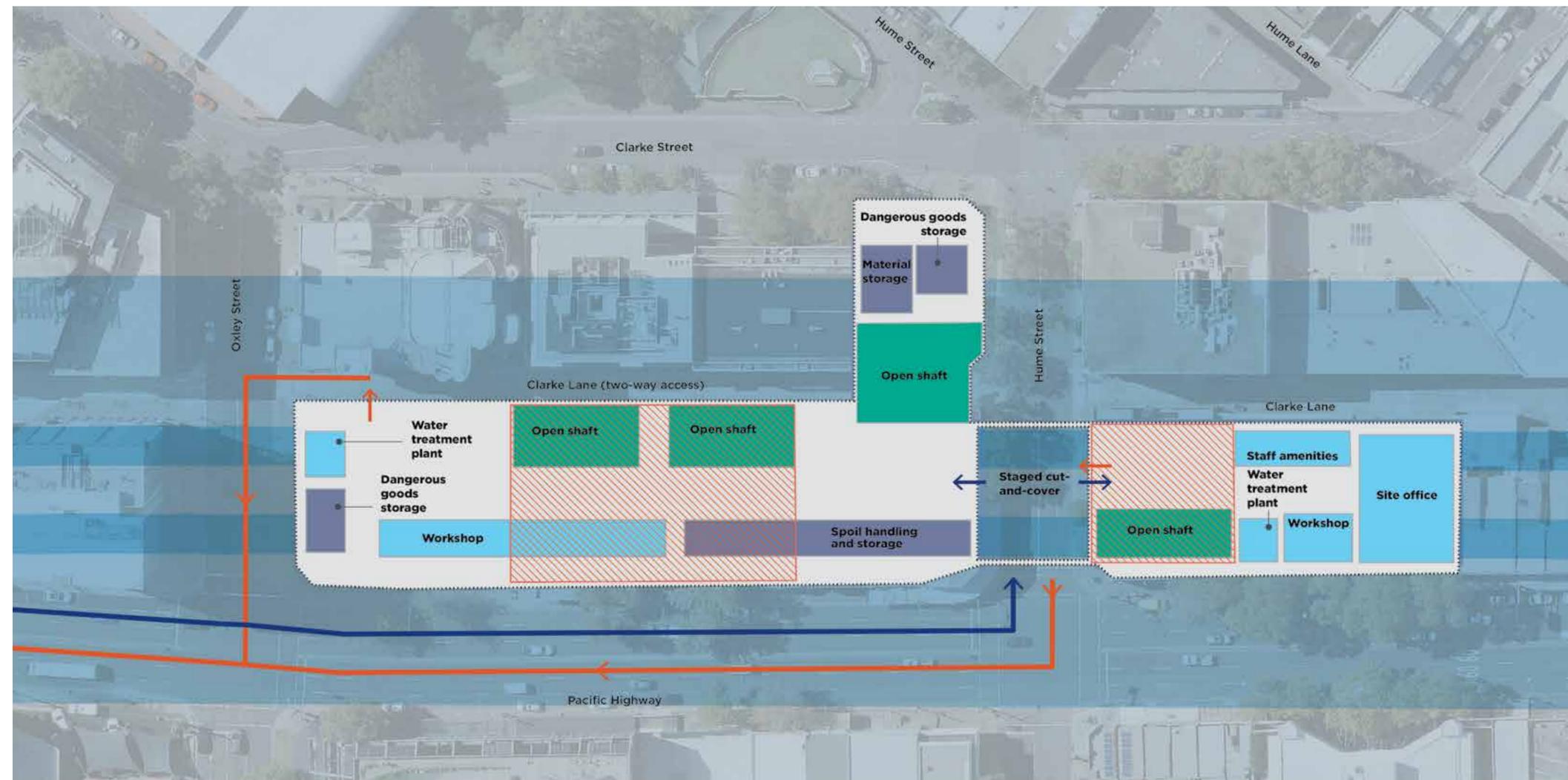
### Construction at a glance

Feature	Description															
Size	<b>North</b> - 4500 square metres (m <sup>2</sup> ) <b>South</b> - 1500 square metres (m <sup>2</sup> )															
Site access	<b>North</b> - Clarke Lane and Oxley Street (left out) <b>South</b> - Hume Street															
Construction hours	<b>Demolition:</b> Monday to Friday 7 am-6 pm and Saturday 8 am-1 pm <b>All other work:</b> 24 hours a day															
Truck movements	<b>Demolition:</b> Trucks 96 per day and light vehicles 78 per day <b>Excavation:</b> Trucks 234 per day and light vehicles 104 per day <b>Station fit out:</b> Trucks 202 per day and light vehicles 104 per day															
Demolition	10 buildings															
Landscape	Street trees will be removed on Oxley, Hume and Clarke streets and the Pacific Highway															
Excavation	Cut-and-cover															
Spoil removal	150,000 cubic metres (m <sup>3</sup> ) of mostly sandstone and shale by tipper truck															
Activities	Roadheader support Spoil removal Station construction															
Staff facilities	Offices, lunch rooms and amenities															
Staff parking	Four to 10 parking spaces for use by engineers and other management staff on site Contractors may consider 'park and shuttle' services to transfer workers to this site															
Utility and power supply	Water, sewer and telecommunications Power for the roadheader will be supplied from the existing cables in Clarke Lane (30 metres away)															
Major utility impacts	Nil															
Plant and equipment	<table border="0"> <tr> <td>Roadheader</td> <td>Three bobcats</td> <td>Six compressors</td> </tr> <tr> <td>Four piling rigs</td> <td>Six mobile cranes</td> <td>Two concrete pumps</td> </tr> <tr> <td>Four drilling jumbos</td> <td>Two truck-mounted cranes</td> <td>Water treatment plant</td> </tr> <tr> <td>Eight excavators</td> <td>Seven generators</td> <td>Water cart</td> </tr> <tr> <td>Two front-end loaders</td> <td></td> <td></td> </tr> </table>	Roadheader	Three bobcats	Six compressors	Four piling rigs	Six mobile cranes	Two concrete pumps	Four drilling jumbos	Two truck-mounted cranes	Water treatment plant	Eight excavators	Seven generators	Water cart	Two front-end loaders		
Roadheader	Three bobcats	Six compressors														
Four piling rigs	Six mobile cranes	Two concrete pumps														
Four drilling jumbos	Two truck-mounted cranes	Water treatment plant														
Eight excavators	Seven generators	Water cart														
Two front-end loaders																



Feature	Description
Traffic changes	<p><b>Clarke Lane</b> - temporary closure near Hume Street with two-way access via Oxley Street</p> <p><b>Hume Street</b> - temporary closure between Clarke Lane and the Pacific Highway during construction of the station (around six months); motorists will be redirected via Oxley Street</p> <p><b>Pacific Highway / Oxley Street intersection</b> - an additional traffic light phase will be added to allow a right turn movement from Oxley Street to the Pacific Highway northbound</p>
Public transport changes	Temporary relocation of bus stop at 497 Pacific Highway (north of Hume Street) Route 265 runs along Oxley Street and may be impacted by stop/go traffic control or vehicle movements
Street parking changes	<b>Hume Street</b> - temporary removal of about two to four parking spaces as required
Noise management	There will be noise and vibration impacts at this site. Management practices to minimise impacts include: <ul style="list-style-type: none"> <li>a noise barrier or hoarding will be built around the site</li> <li>an acoustic shed may be constructed over the excavation to reduce noise impacts</li> <li>night time heavy vehicle movements will be restricted to the Pacific Highway, Hume Street and Oxley Street if compliance with noise criteria cannot be met</li> </ul>
Pedestrian and cyclist changes	<p><b>Hume Street and Pacific Highway</b> - footpaths adjacent to the site will be narrowed to 2.4 metres in width</p> <p><b>Hume Street</b> - during the temporary closure (about six months) pedestrians and cyclists will be redirected around the construction site</p>
Other major projects in the area	<p>Sydney Metro over station development (potentially concurrent)</p> <p>St Leonards Central (in planning)</p> <p>St Leonards / Crows Nest Planning Study (in planning)</p>

## Construction site map



**KEY**

Proposed Metro tunnels and corridor (indicative)	Construction area	Acoustic shed	Noise barrier or hoarding	Site access - out	Site access - in
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## Victoria Cross Station

Victoria Cross Station will support the continued growth of the North Sydney CBD and enhance Sydney's status as a global city. It will also improve the customer experience at the existing North Sydney Station by relieving demand in peak times.



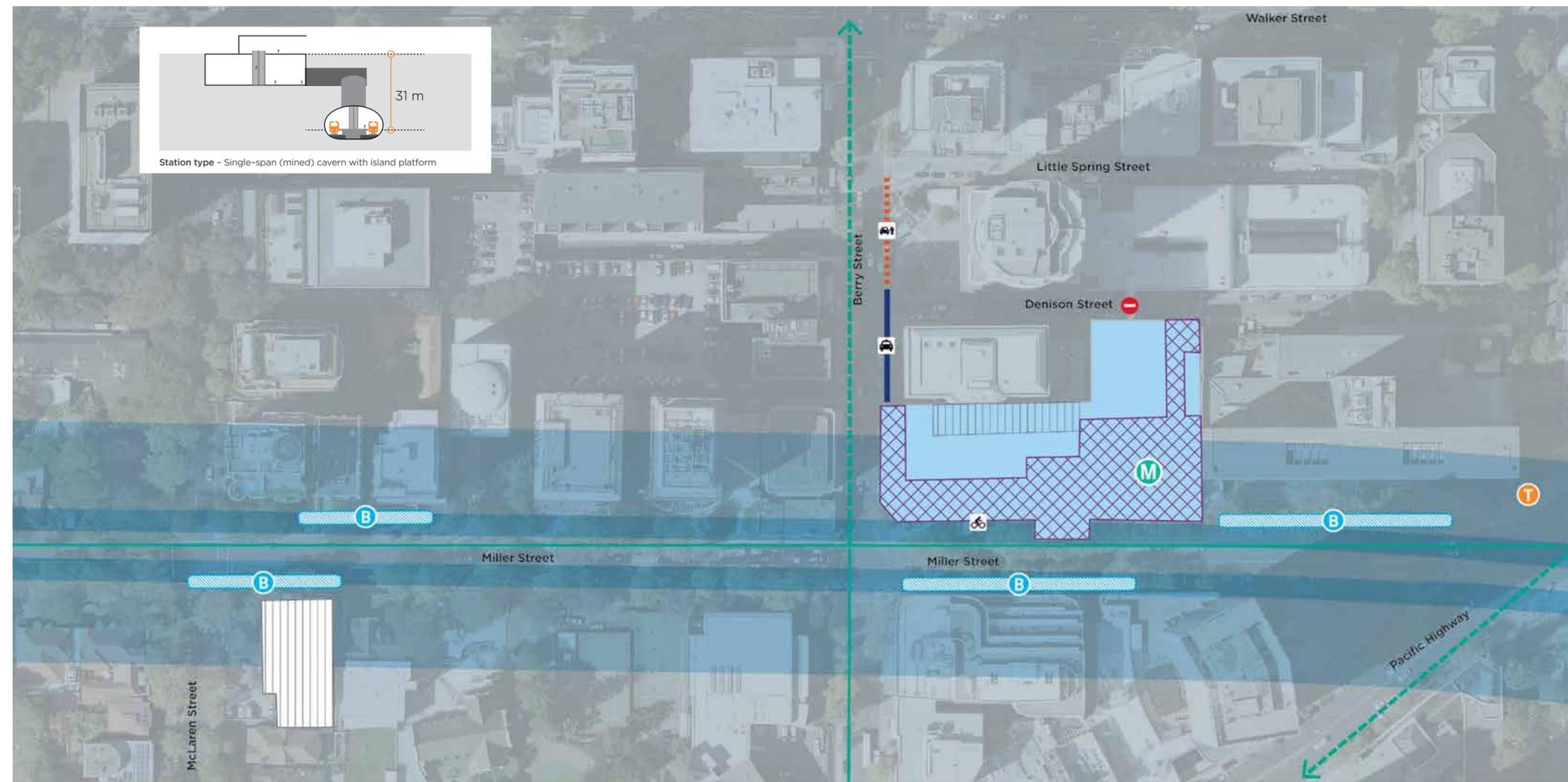
Artist's impression of Victoria Cross Station

### Final arrangements

Feature	Description																
Location	Beneath Miller Street (to the north of the Pacific Highway) between McLaren Street and south of Berry Street																
Station entry	Pedestrian plaza opening to Miller, Denison and Berry streets																
Transport interchange	Walking, cycling, bus, taxi and kiss-and-ride																
Main features and traffic arrangements	<ul style="list-style-type: none"> <li>New bike parking near the corner of Miller and Berry streets</li> <li>New kiss-and-ride bays on Berry Street</li> <li>Existing bus stops close to the station retained on Miller Street</li> <li>Wayfinding signage and Sydney Metro information within the North Sydney CBD</li> <li>Traction substation integrated into the station building (partially underground)</li> <li>Services building on Miller Street to the north of the station providing station and tunnel services</li> <li>Enhancement of pedestrian infrastructure around the station will be investigated further in consultation with Roads and Maritime Services and North Sydney Council</li> </ul>																
Station statistics	<ul style="list-style-type: none"> <li>Depth - 31 metres</li> <li>Platform length - 170 metres</li> <li>Platform width - 10 metres</li> <li>Overall station length - 220 metres</li> </ul>																
Customers	Customers travelling to nearby employment, education and residential precincts																
Local amenities	<table border="0"> <tr> <td>Australian Catholic University</td> <td>North Sydney Girls High School</td> </tr> <tr> <td>Cammeraygal High School</td> <td>North Sydney Oval</td> </tr> <tr> <td>Greenwood Shopping Centre</td> <td>North Sydney Train Station</td> </tr> <tr> <td>Marist College</td> <td>St Leonards Park</td> </tr> <tr> <td>Mater Hospital</td> <td>Sydney Church of England Grammar School (SHORE)</td> </tr> <tr> <td>Monte Sant' Angelo Mercy College</td> <td>Wenona School</td> </tr> <tr> <td>North Sydney Boys High School</td> <td></td> </tr> <tr> <td>North Sydney Council Chambers</td> <td></td> </tr> </table>	Australian Catholic University	North Sydney Girls High School	Cammeraygal High School	North Sydney Oval	Greenwood Shopping Centre	North Sydney Train Station	Marist College	St Leonards Park	Mater Hospital	Sydney Church of England Grammar School (SHORE)	Monte Sant' Angelo Mercy College	Wenona School	North Sydney Boys High School		North Sydney Council Chambers	
Australian Catholic University	North Sydney Girls High School																
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Monte Sant' Angelo Mercy College	Wenona School																
North Sydney Boys High School																	
North Sydney Council Chambers																	



## Operational map



### KEY

- Proposed Metro tunnels and corridor (indicative)
- Proposed Council cycle route
- Metro entry
- Pedestrian bridge access closed
- Suburban train station entry
- Pedestrian plaza / station lobby
- Bus stop
- Station services building
- Proposed kiss-and-ride
- Existing taxi rank
- Proposed cycle parking
- Existing cycle route
- Possible future over station development area

Construction at Victoria Cross

Construction at Victoria Cross will be split across two sites with temporary street-level working platforms over the excavations.

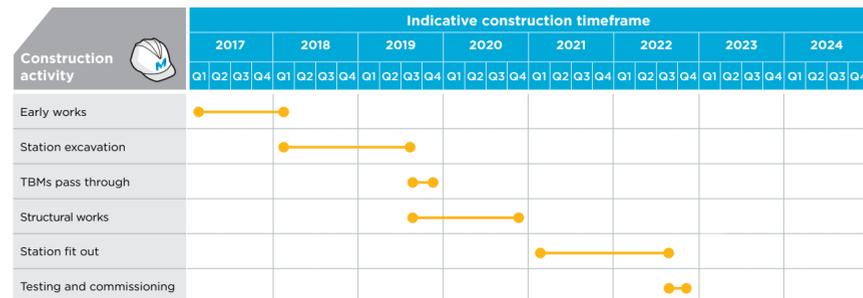
A shaft will be excavated within the south site adjacent to the proposed station cavern. This shaft will be used to provide the future station entry and vertical access. The station cavern will then be excavated from this shaft.

A second shaft will be excavated within the north site to the proposed station cavern. This shaft will become a future service facility. During construction, this shaft may also be used for material delivery to the excavation below.

Construction of Victoria Cross Station will involve mined cavern construction techniques outlined on page 24.

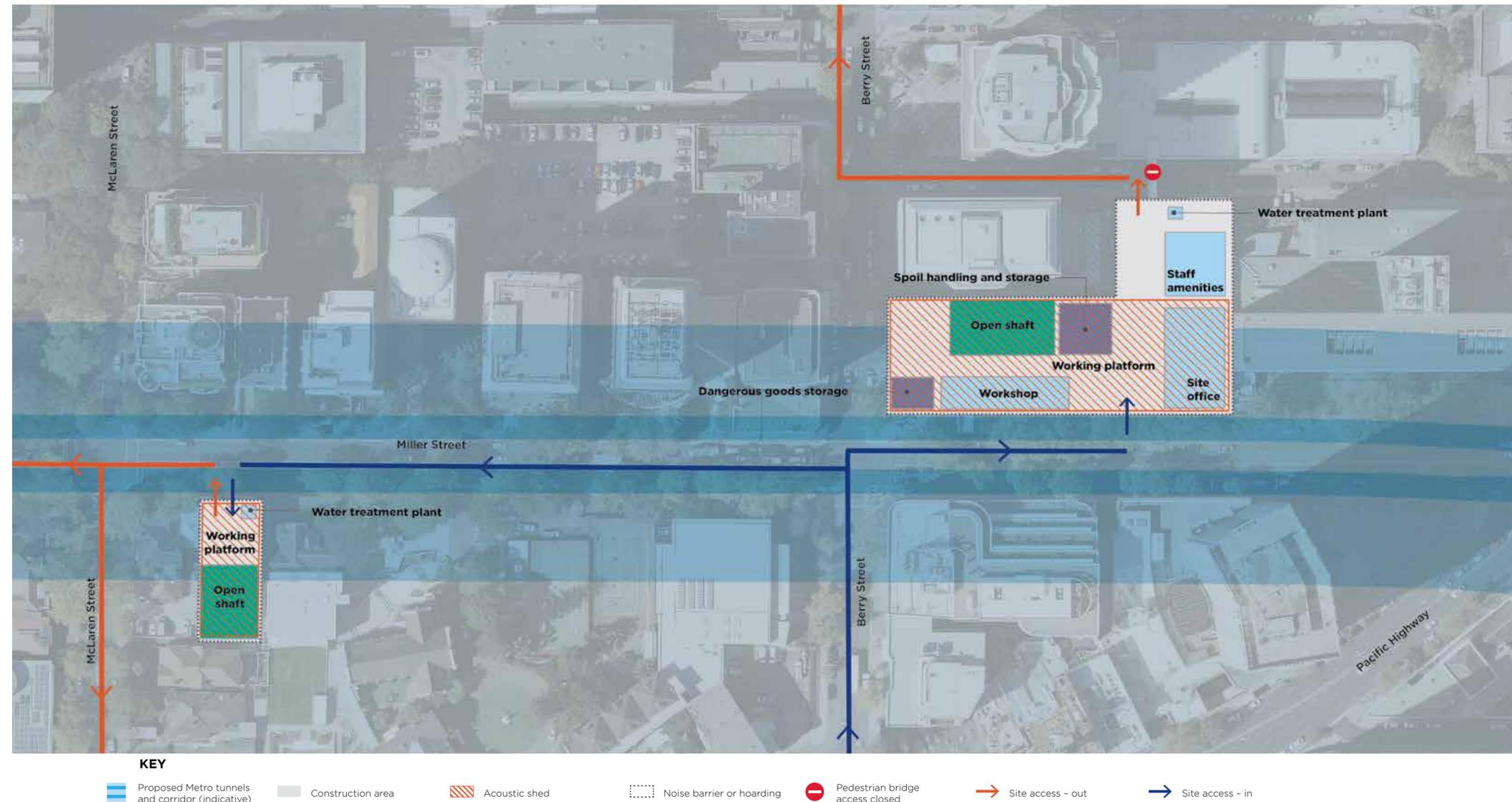
Construction at a glance

Feature	Description
Size	<b>North</b> – 700 square metres (m <sup>2</sup> ) <b>South</b> – 4700 square metres (m <sup>2</sup> )
Site access	<b>North</b> – Miller Street (left-in and left-out) <b>South</b> – Miller Street (left-in) and Denison Street (left-out)
Construction hours	<b>Demolition:</b> Monday to Friday 7 am–6 pm and Saturday 8 am–1 pm <b>All other work:</b> 24 hours a day
Truck movements	<b>Demolition:</b> Trucks 96 per day and light vehicles 78 per day <b>Excavation:</b> Trucks 234 per day and light vehicles 104 per day <b>Station fit out:</b> Trucks 202 per day and light vehicles 104 per day 15% of truck movements from northern site and 85% of truck movements from southern site
Demolition	Four buildings The pedestrian bridge across Denison Street connecting Berry Square and Tower Square
Heritage	The locally heritage listed shop at 187 Miller Street will be demolished The locally heritage listed bus stop at 194 Miller Street will be removed and relocated Archival recording and reporting will be undertaken before work starts
Landscape	The Harbour Cycles sculpture at 189 Miller Street will be relocated in consultation with North Sydney Council Street trees will be removed on Berry and Miller streets
Excavation	Mined cavern
Spoil removal	175,000 cubic metres (m <sup>3</sup> ) of mostly sandstone by truck
Activities	Roadheader support Spoil removal Station construction
Staff facilities	Offices, lunch rooms and amenities
Staff parking	Four to 10 parking spaces for use by engineers and other management staff on site Contractors may consider ‘park and shuttle’ services to transfer workers to this site
Major utility impacts	Nil



Feature	Description
Utility and power supply	Water, sewer and telecommunications Power for roadheaders will be supplied from the existing cables in Berry Street (50 metres away)
Plant and equipment	Two roadheaders      Four bobcats      Six compressors Four piling rigs      Three mobile cranes      Two concrete pumps Four drilling jumbos      Truck-mounted cranes      Water treatment plant Eight excavators      Nine generators      Water cart Two front-end loaders
Traffic changes	The taxi rank on Miller Street may be temporarily impacted by the removal of about two to four parking spaces (as required)
Public transport changes	Temporary relocation of the bus stop at 194 Miller Street (corner Miller and McLaren streets)
Street parking changes	<b>Miller Street</b> – temporary removal of about two to four parking spaces as required (spaces may be removed around the north and/or south site) as required
Noise management	There will be noise and vibration impacts at this site. Management practices to minimise impacts include: <ul style="list-style-type: none"> <li>o a noise barrier or hoarding will be built around the site</li> <li>o an acoustic shed may be constructed over the excavation to reduce noise impacts</li> <li>o night-time heavy vehicle movements will be restricted to McLaren, Miller and Berry streets if compliance with noise criteria cannot be met</li> </ul>
Pedestrian and cyclist changes	<b>Pedestrian bridge demolished</b> – across Denison Street connecting Berry Square and Tower Square <b>Miller Street</b> – footpaths adjacent to both sites will be narrowed to 2.4 metres in width <b>Cyclists</b> – may like to use alternative cycle paths along Mount and Edward streets <b>Monte Sant’ Angelo Mercy College</b> – Sydney Metro will consult with the school to ensure safe pedestrian and drop off arrangements are provided for school children during construction
Other major projects in the area	Sydney Metro over station development (potentially concurrent) North Sydney Centre Traffic and Pedestrian Study network projects (in planning) Brett Whiteley Place development stage two (2016)

Construction site map



Blues Point temporary retrieval site

A temporary retrieval site will be required for the removal of TBM cutter heads and shields at Blues Point Reserve. Once tunnelling has been completed the site will be backfilled and the parkland reinstated in consultation with North Sydney Council.

Work at Blues Point

Work involved at Blues Point will involve:

- setting up site fencing, hoarding, site sheds and amenities
- diverting utilities like water, sewer, gas and electricity if required
- excavating the shaft with excavators, rock hammers or blasting
- lifting out the cutter heads and shields as they arrive
- backfilling the area and reinstating the park.

Excavation will take around 12 months, and afterwards, the site will only be active when a TBM arrives and when the park is reinstated. There will be four retrieval events taking about four weeks each.

Two TBMs will arrive from Chatswood and their cutter heads and shields will be removed at Blues Point and the rest of the TBMs pulled back through the tunnels and removed from the Chatswood dive site.

The specialised TBM will arrive from Barangaroo and its cutter head and shield will be removed at Blues Point and the rest of the TBM pulled back through the tunnel to Barangaroo where it will be rebuilt and begin work on the second tunnel. The cutter head and shield will be removed again at Blues Point and the rest of the TBM pulled back through the tunnel to Barangaroo.

Trucks will remove the cutter heads and shields from the site over a number of days. This is likely to occur at night to minimise the potential impacts to traffic on Blues Point Road.

Once a TBM arrives, the cutter head and shield will be removed using a crane and placed on an oversized truck to transport the TBM cutter heads and shields away from the site.

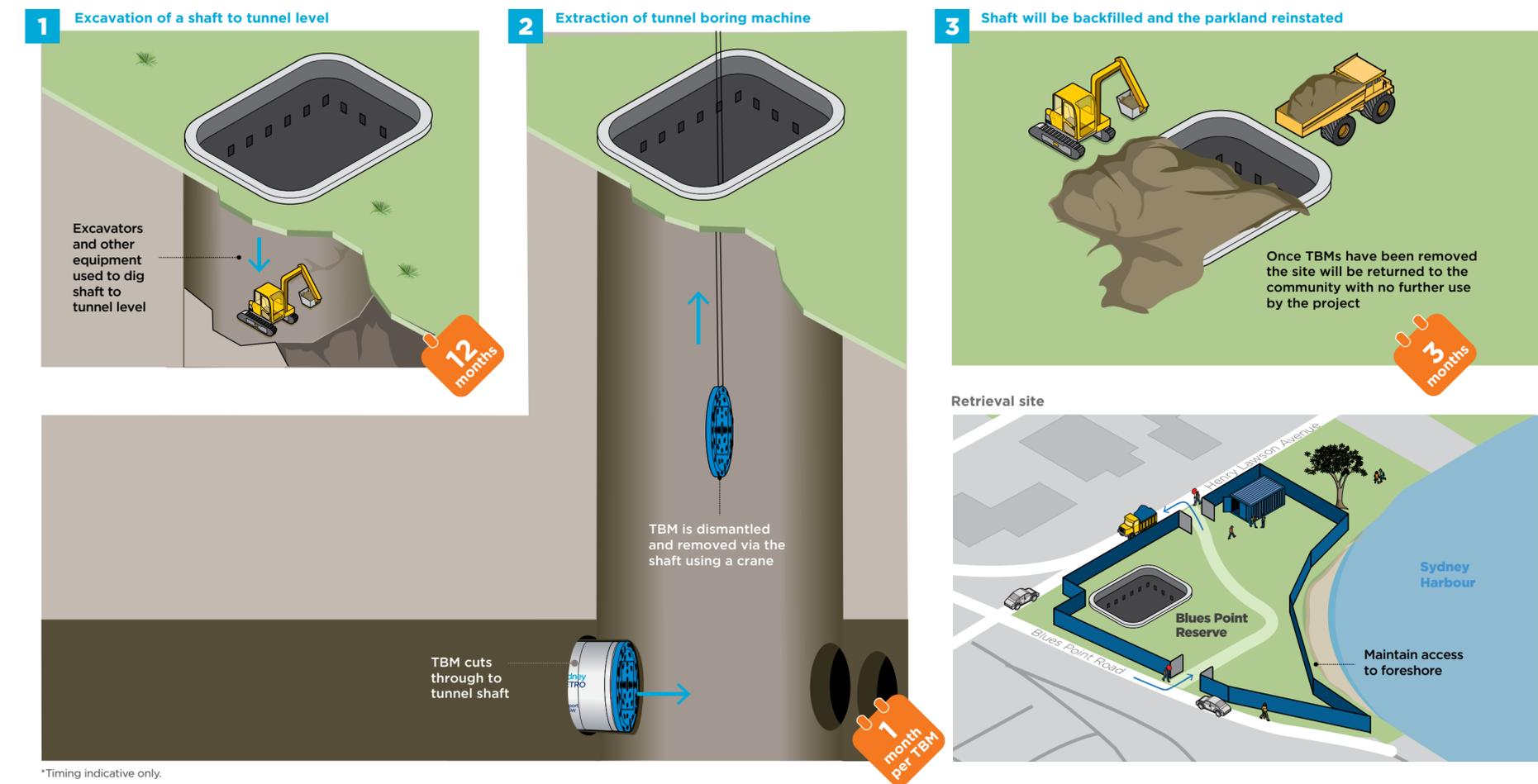
During retrieval of the TBM cutter head and shield, the temporary site will need to expand to include the parking areas on Blues Point Road adjacent to the reserve. Additional car parking spaces may also be required temporarily for short periods of time along Blues Point Road. Bollards may need to be removed from the roadway to accommodate the oversized trucks.

To minimise potential impacts to the local road network, investigations are being undertaken into the possibility of removing the TBMs and spoil via barge, using the wharf at the end of Blues Point Road. To use the existing wharf for TBM removal, an upgrade to the wharf facilities may be required.



Aerial view over Blues Point

Construction map



\*Timing indicative only.

Work at Blues Point

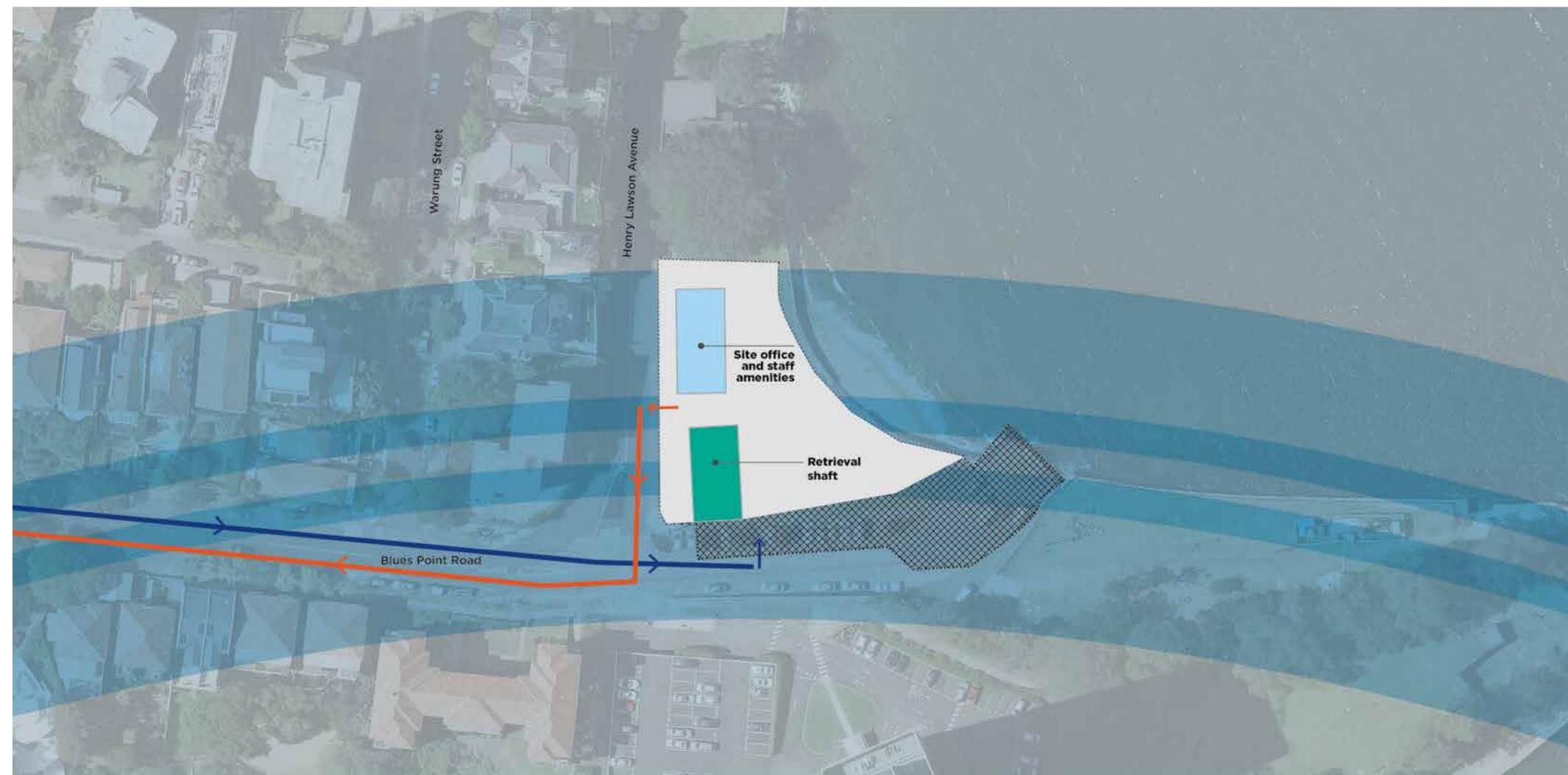
Construction at a glance

Feature	Description												
Size	2100 square metres (m <sup>2</sup> )												
Site access	Blues Point Road (left-in) Henry Lawson Avenue (left-out) It may be feasible to remove the TBM cutter heads and shields via barge												
Construction hours	Monday to Friday 7 am–6 pm and Saturday 8 am–1 pm Removal of TBM cutter heads and shield is likely to be done at night												
Truck movements	<b>Shaft establishment:</b> Trucks – 54 per day and light vehicles – 78 per day <b>TBM removal:</b> Trucks – 44 per day and light vehicles – 102 per day <b>Backfilling:</b> Trucks – 32 per day and light vehicles – 78 per day												
Demolition	Nil, the site contains public open space and a public road												
Heritage	Blues Point Reserve is within the McMahons Point South Heritage Conservation Area The locally heritage listed bus stop on Henry Lawson Avenue will be removed and relocated Archival recording and reporting will be undertaken before work starts												
Landscape	Harbour foreshore open space will be used for the construction site Existing mature trees will be retained and protected												
Excavation	Shaft excavation and backfilling												
Spoil removal	8000 cubic metres (m <sup>3</sup> ) of mostly sandstone by truck Spoil removal by barge may be feasible at this location, subject to further investigations												
Activities	TBM removal Spoil removal Shaft construction												
Staff facilities	Offices, lunch rooms and amenities												
Staff parking	Four to 10 parking spaces for use by engineers and other management staff on site Contractors may consider 'park and shuttle' services to transfer workers to this site												
Utility and power supply	Power, water, sewer and telecommunications												
Major utility impacts	Nil												
Plant and equipment	<table border="0"> <tr> <td>Piling rig</td> <td>Three mobile cranes</td> <td>Two concrete pumps</td> </tr> <tr> <td>Drilling jumbo</td> <td>Six generators</td> <td>Water treatment plant</td> </tr> <tr> <td>Eight excavators</td> <td>Six compressors</td> <td>Water cart</td> </tr> <tr> <td>Two front-end loaders</td> <td></td> <td></td> </tr> </table>	Piling rig	Three mobile cranes	Two concrete pumps	Drilling jumbo	Six generators	Water treatment plant	Eight excavators	Six compressors	Water cart	Two front-end loaders		
Piling rig	Three mobile cranes	Two concrete pumps											
Drilling jumbo	Six generators	Water treatment plant											
Eight excavators	Six compressors	Water cart											
Two front-end loaders													



Feature	Description
Traffic changes	<b>Blues Point Road</b> – temporary short-term, full closures (likely overnight) during TBM cutter head and shield removal
Public transport changes	Temporary relocation of the bus stop on Henry Lawson Avenue (late 2018 – early 2021)
Street parking changes	<b>Blues Point Road</b> – temporary removal of about four parking spaces during site establishment and shaft excavation <b>Blues Point Road</b> – temporary removal of about 23 parking spaces during TBM cutter head and shield removal (four weeks at a time) Options to retain some car parking at the end of Blues Point Road, including a disabled parking space, will be investigated during detailed design
Noise management	There will be noise and vibration impacts at this site. Management practices to minimise impacts include: <ul style="list-style-type: none"> <li>a noise barrier or hoarding will be built around the site</li> </ul>
Pedestrian and cyclist changes	<b>Blues Point Road</b> – temporary closure of the footpath adjacent to Blues Point Reserve during TBM shield and cutter head removal. Detours will be provided <b>Foreshore</b> – a five metre wide area will be maintained along the foreshore to maintain the existing pedestrian access to the harbour
Other major projects in the area	Nil

Construction site map



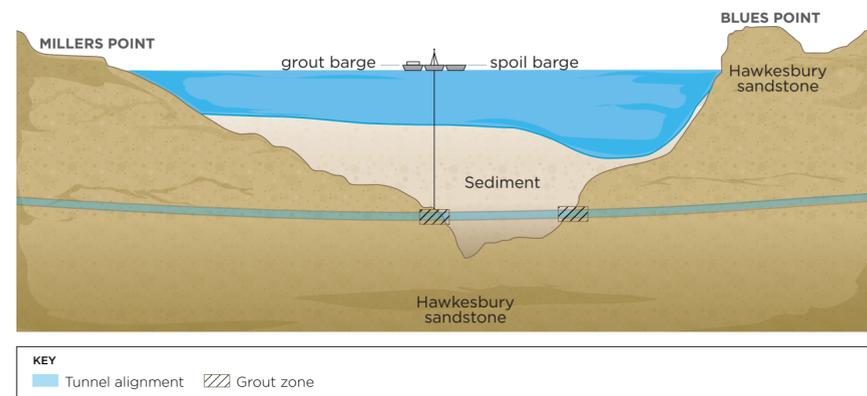
Work in Sydney Harbour

A specialised TBM that can tunnel through rock and harbour sediment may be used to tunnel under Sydney Harbour. In order to tunnel through the sediment, it is likely that ground improvement work may be required in Sydney Harbour.

Based on the current design, jet grouting is the preferred method, although alternative approaches may be considered during detailed design. Jet grouting will involve the injection of a cement grout into two points where the tunnel passes through a rock-sediment transition zone.

Environmental protection measures will be implemented in Sydney Harbour, including a silt curtain around the work barges and water quality monitoring.

The two locations of the potential ground improvement works are shown in the diagram below.

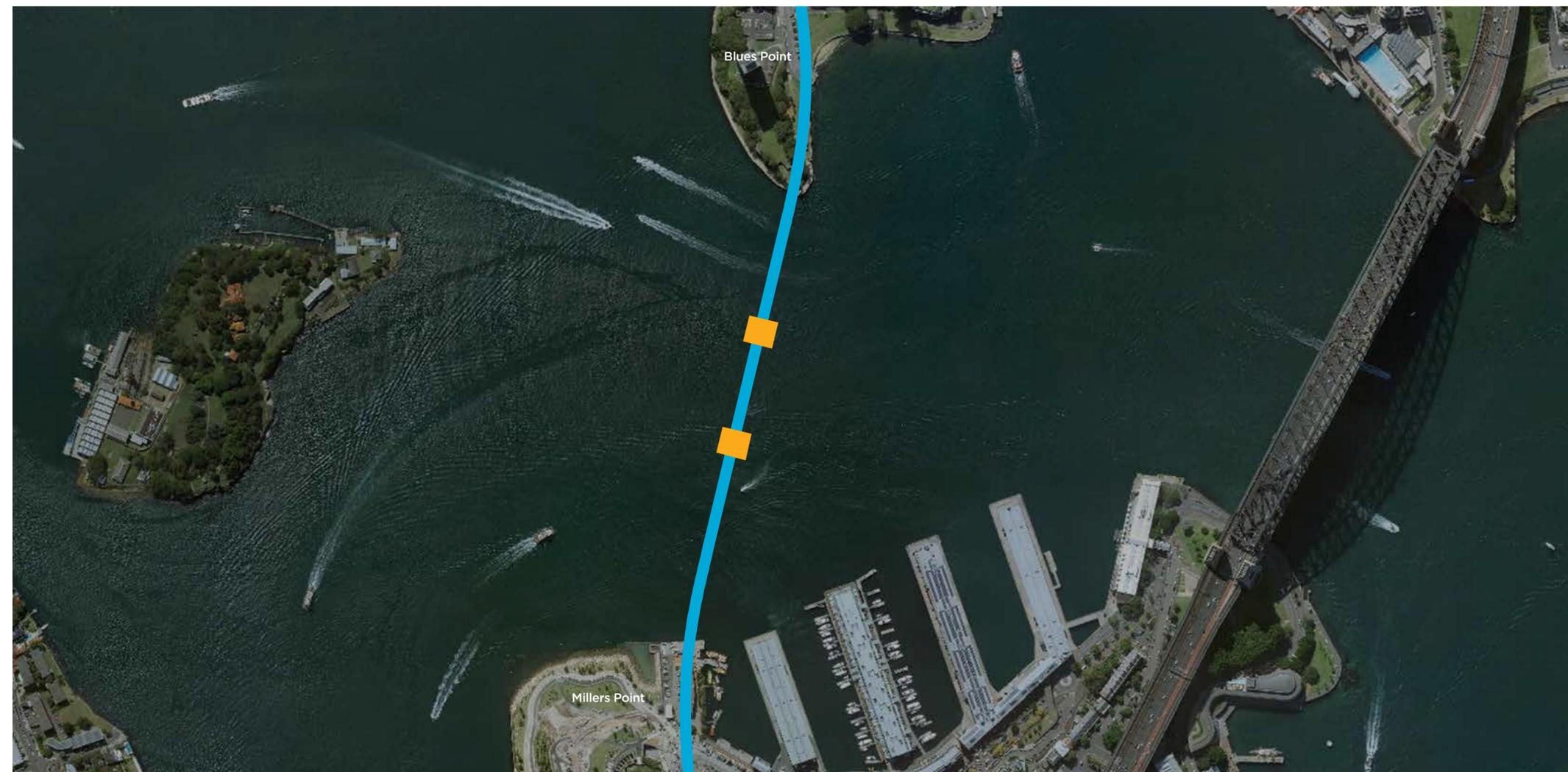


Barge working in Sydney Harbour

Construction at a glance

Feature	Description
Site access	An on-shore facility will be established to support the work in Sydney Harbour. A suitable site for this facility is still being investigated Barges, tug boats and other smaller boats will carry staff and materials from the on-shore facility to the ground improvement area
Construction hours	24 hours a day
Truck movements	Trucks will remove spoil and supply materials to and from the on-shore facility
Spoil removal	Barges will carry spoil to the on-shore facility for removal by truck
Activities	Jet grouting
Staff facilities	Offices, lunch rooms, amenities and parking will be provided at the on-shore facility
Plant and equipment	Three barges will be used to do this work. One barge will carry out the grout works using a crane and drilling lead, and will generally remain in the harbour. The other two barges will be used to transport grout and spoil between the work area and the on-shore facility Tug boats will help move the barges and small boats will transport construction workers
Shipping channels	Consultation will be carried out with the Port Authority of NSW, Roads and Maritime Services and Sydney Ferries to maintain open shipping channels during ground improvement works

Operational map



**KEY**  
█ Proposed Metro corridor (indicative)    █ Proposed ground improvement works

### Sydney Harbour drilling work uncovers city's ancient past

Sydney Harbour has revealed some of its ancient past during geotechnical work for the new twin metro railway tunnels, including shells undisturbed for about 20,000 years.

The shells were found 38 metres below the surface during drilling work while, another 14 metres below, were layers of charcoal and timber – about 50,000 years old and the product of ancient bushfires.

In April this year, Transport for NSW started geotechnical work to help determine the best way to deliver the new twin metro railway tunnels under Sydney Harbour.

With drilling up to 80 metres below the surface taking place just west of the Sydney Harbour Bridge – deeper than ever before – a picture has emerged of an ancient landscape.

The work further confirms that Sydney Harbour was most likely a vegetated valley about 20,000 years ago, with a small river running through it about the size of a present-day Lane Cove or Woronora Rivers.

This freshwater river, about 50 metres below the current sea level, was sourced from the headwaters of what is now the Parramatta River, then flowed out towards the Sydney Heads and the ancient coastline – which was about 25 kilometres further east than today.

The shells and wormhole secretions uncovered during drilling had not seen daylight for about 20,000 years.

This new work has resulted in a new map of the bottom of Sydney Harbour – revealing the rock level under this section of the harbour, west of the Sydney Harbour Bridge, is about 21 metres deeper than previously mapped.

Sydney Metro's experts started with aerial images of Sydney Harbour from the 1940s, geophysical surveys from the 1970s and the boreholes drilled for the Sydney Harbour Tunnel in the 1980s.

Sonar and other geophysical scans defined the level of the sea bed and the material below it.

Targeted borehole drilling – using two barges on the harbour – saw 22 boreholes drilled up to 80 metres deep to sample rock conditions as well as another 30 probes to classify the sediment sitting above the rock on the seabed.

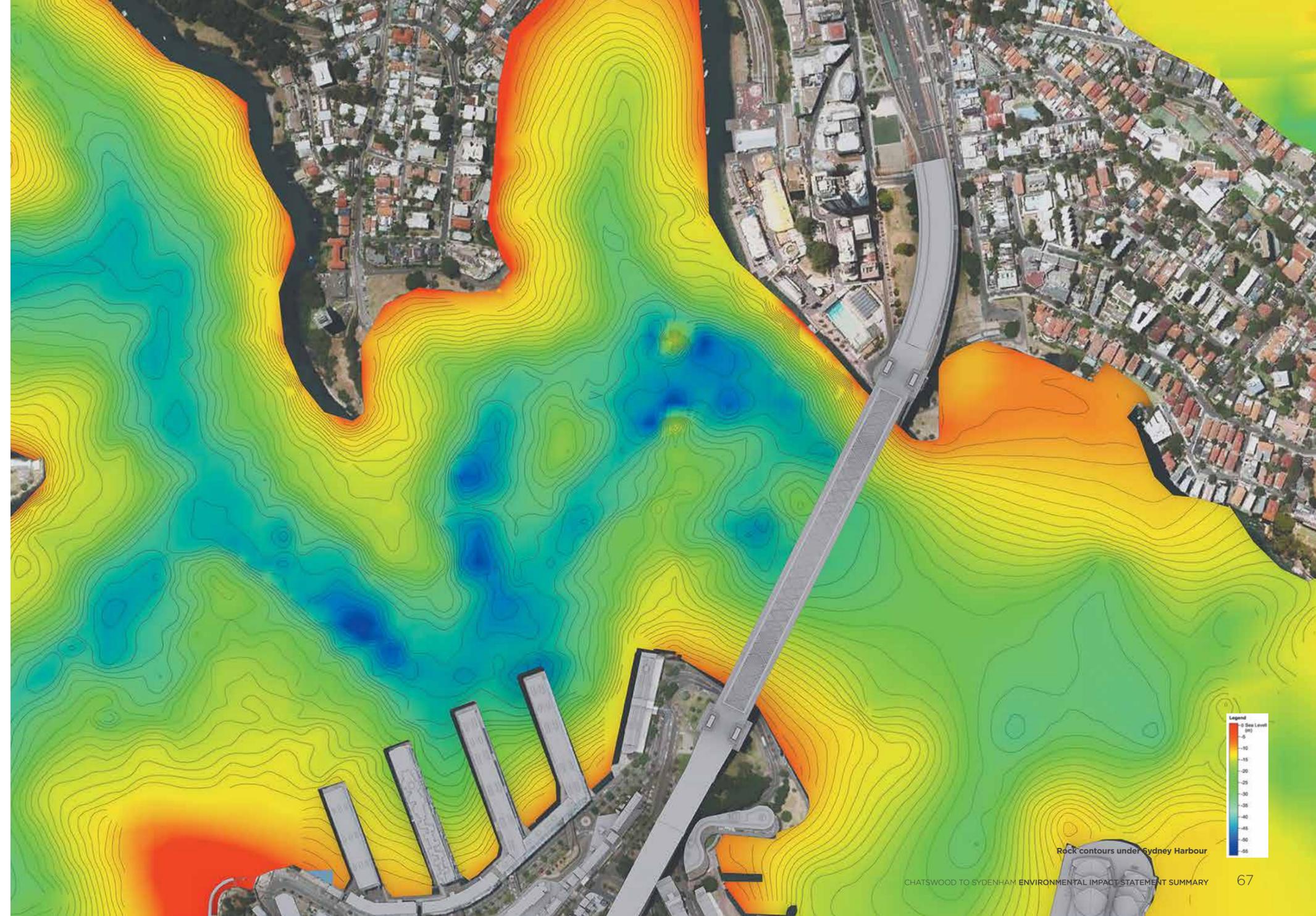
The conclusion of this major scientific effort: the Hawkesbury Sandstone under Sydney Harbour is deeper than first thought.

One of the big engineering challenges of delivering Sydney Metro through the city is how to get under the harbour.

This geological work indicates tunnel boring machine technology is the best way to tunnel under the harbour.



Ancient shells recovered from under Sydney Harbour (cm)



Rock contours under Sydney Harbour

## Barangaroo Station

Barangaroo Station will improve pedestrian connections to the northern part of the CBD, The Rocks and Walsh Bay and alleviate congestion at Wynyard and Martin Place Stations.

A station at Barangaroo will improve access to the Walsh Bay Arts and Culture precinct and the residential areas at Millers Point and Walsh Bay. It will also provide easy access to the new public, residential, commercial and entertainment areas at Barangaroo and the new ferry hub.

Transport for NSW is working in consultation with Barangaroo Delivery Authority to deliver Barangaroo Station.



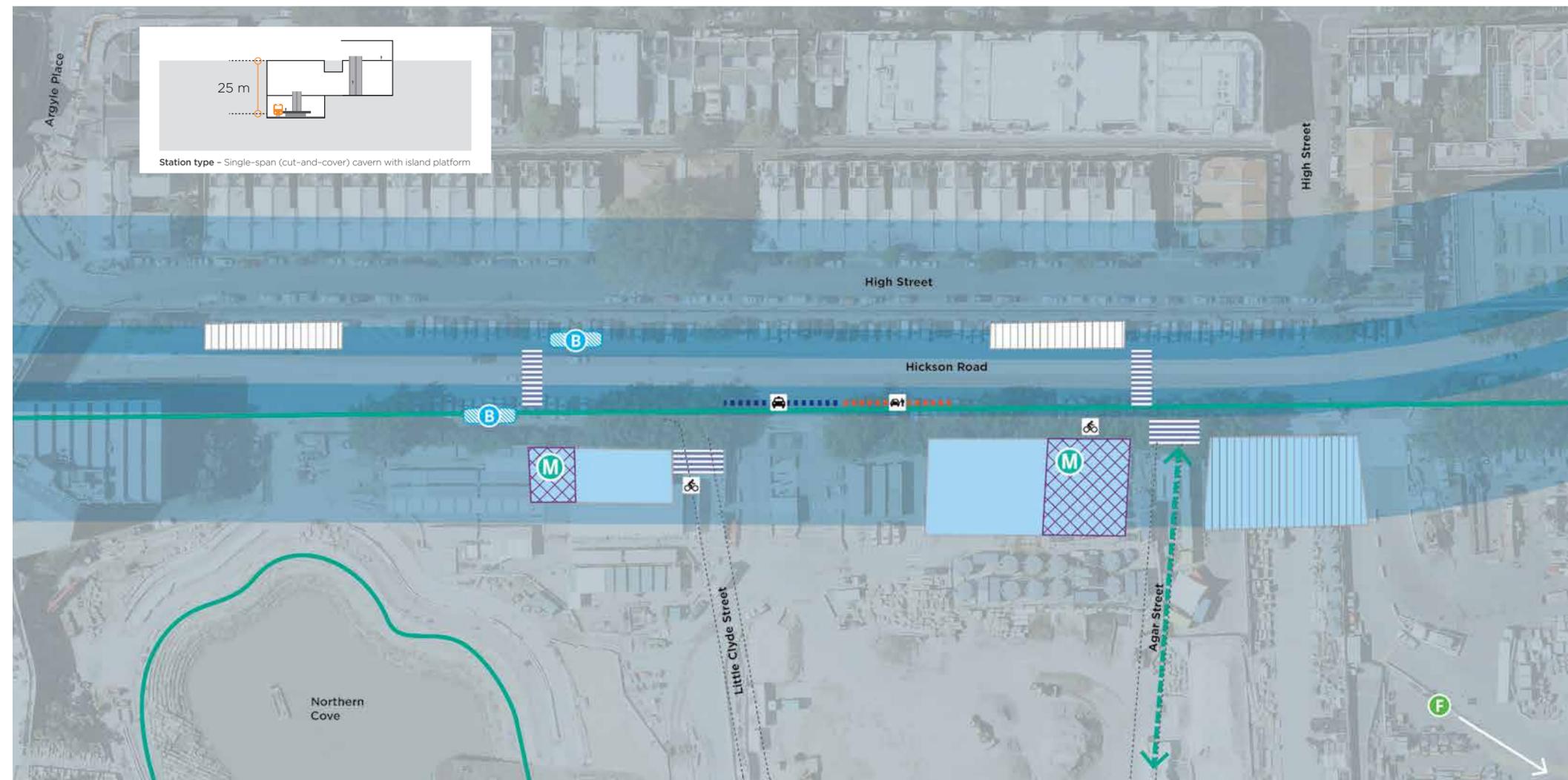
Artist's impression of Barangaroo Station

### Final arrangements

Feature	Description										
Location	Beneath the northern end of Hickson Road, south of Munn Street in Millers Point										
Station entry	Central Barangaroo and Barangaroo Reserve										
Transport interchange	Walking, cycling, bus, taxi, kiss-and-ride and ferry										
Main features and traffic arrangements	<ul style="list-style-type: none"> <li>New pedestrian crossings on Hickson Road, Little Clyde and Agar streets</li> <li>New bike parking on Little Clyde and Agar streets</li> <li>Relocation of the bus stops on Hickson Road closer to the station entry</li> <li>New kiss-and-ride and taxi bays on the western side of Hickson Road</li> <li>Traction substation integrated into the station building (partially underground)</li> <li>Wayfinding signage and Sydney Metro information within the Barangaroo area</li> <li>Transport and access arrangements will be developed in consultation with Barangaroo Delivery Authority</li> </ul>										
Station statistics	<ul style="list-style-type: none"> <li>Depth - 25 metres</li> <li>Platform length - 170 metres</li> <li>Platform width - 10 metres</li> <li>Overall station length - 210 metres</li> </ul>										
Customers	<ul style="list-style-type: none"> <li>Customers travelling to nearby employment, recreation and tourist precincts</li> <li>Customers travelling to and from nearby existing and future residential areas</li> </ul>										
Local amenities	<table border="0"> <tr> <td>Barangaroo Reserve</td> <td>Sydney Observatory</td> </tr> <tr> <td>Barangaroo South</td> <td>The Rocks</td> </tr> <tr> <td>Central Barangaroo</td> <td>Walsh Bay</td> </tr> <tr> <td>Future Barangaroo Ferry Wharf</td> <td>Wynyard Train Station</td> </tr> <tr> <td>King Street Wharf</td> <td></td> </tr> </table>	Barangaroo Reserve	Sydney Observatory	Barangaroo South	The Rocks	Central Barangaroo	Walsh Bay	Future Barangaroo Ferry Wharf	Wynyard Train Station	King Street Wharf	
Barangaroo Reserve	Sydney Observatory										
Barangaroo South	The Rocks										
Central Barangaroo	Walsh Bay										
Future Barangaroo Ferry Wharf	Wynyard Train Station										
King Street Wharf											



## Operational map



### KEY

- Proposed Metro tunnels and corridor (indicative)
- Metro entry
- Ferry
- Bus stop
- Proposed kiss-and-ride
- Proposed taxi rank
- Proposed cycle parking
- Existing cycle route
- Proposed Council cycle route
- Proposed pedestrian crossing
- Pedestrian plaza / station lobby
- Station services building
- Possible future over station development area
- Planned roads

## Construction at Barangaroo

The Barangaroo Station construction site will be used to:

- o launch and support the tunnel boring machine under Sydney Harbour to the Blues Point temporary retrieval site
- o retrieve the cutter heads and shields of the two tunnel boring machines that tunnel from the Marrickville dive site
- o carry out the excavation and construction of the future Barangaroo Station.

A separation plant will be used to remove excavated spoil from the slurry material. The slurry material will then be reused at the cutting face. The separation plant will only be required when the TBM is operating in a 'slurry mode' through sediment under Sydney Harbour.

Construction of Barangaroo Station will involve the cut-and-cover construction techniques outlined on pages 24 and 25.

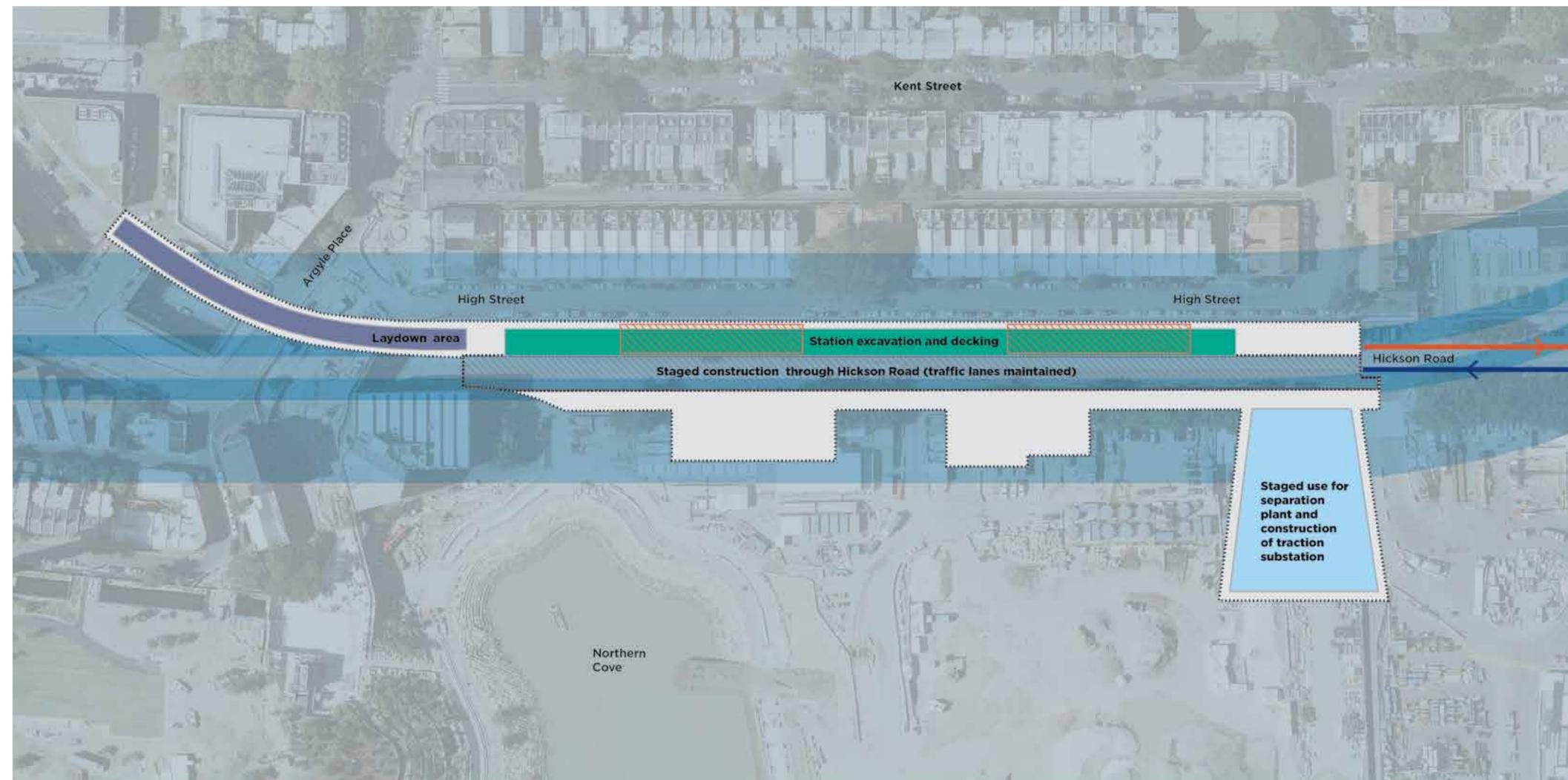
### Construction at a glance

Feature	Description
Size	13,800 square metres (m <sup>2</sup> )
Site access	Hickson Road
Construction hours	24 hours a day
Truck movements	<b>Excavation:</b> Trucks 244 per day and light vehicles 104 per day <b>Tunnelling:</b> Trucks 234 per day and light vehicles 104 per day <b>Station fit out:</b> Trucks 202 per day and light vehicles 104 per day
Demolition	Nil, the site is located within the Hickson Road road reserve
Heritage	The construction site is within the State heritage listed Millers Point Conservation area and Millers Point and Dawes Point Village Precinct Archival recording and reporting will be undertaken before work starts
Landscape	Street trees will be removed along Hickson Road
Excavation	Cut-and-cover
Spoil removal	235,000 cubic metres (m <sup>3</sup> ) of mostly sandstone and marine sediment by truck During the detailed design phase, we will also consider opportunities to remove spoil from this site by barge in consultation with Barangaroo Delivery Authority
Activities	TBM launch and support    Roadheader support    Station construction TBM removal                      Spoil removal
Staff facilities	Offices, lunch rooms and amenities
Staff parking	Four to 10 parking spaces for use by engineers and other management staff on site Contractors may consider 'park and shuttle' services to transfer workers to this site
Utility and power supply	Water, sewer and telecommunications Power for the TBM and roadheaders will be supplied from the City North substation (950 metres away)
Major utility impacts	Protection and/or relocation of underground services in Hickson Road
Public transport changes	Bus stops - may be temporarily relocated



Feature	Description															
Plant and equipment	<table border="0"> <tr> <td>Tunnel boring machine</td> <td>Two front-end loaders</td> <td>Two concrete pumps</td> </tr> <tr> <td>Two roadheaders</td> <td>Six mobile cranes</td> <td>Water treatment plant</td> </tr> <tr> <td>Four piling rigs</td> <td>Truck-mounted crane</td> <td>Separation plant</td> </tr> <tr> <td>Four drilling jumbos</td> <td>Six generators</td> <td>Water cart</td> </tr> <tr> <td>Eight excavators</td> <td>Six compressors</td> <td></td> </tr> </table>	Tunnel boring machine	Two front-end loaders	Two concrete pumps	Two roadheaders	Six mobile cranes	Water treatment plant	Four piling rigs	Truck-mounted crane	Separation plant	Four drilling jumbos	Six generators	Water cart	Eight excavators	Six compressors	
Tunnel boring machine	Two front-end loaders	Two concrete pumps														
Two roadheaders	Six mobile cranes	Water treatment plant														
Four piling rigs	Truck-mounted crane	Separation plant														
Four drilling jumbos	Six generators	Water cart														
Eight excavators	Six compressors															
Traffic changes	<p><b>Hickson Road</b> - two traffic lanes will generally be maintained with temporary lane restrictions during staged construction</p> <p><b>Hickson Road</b> - temporary short-term, full closures (likely overnight) during launch and removal of TBMs</p> <p><b>Overseas Passenger Terminal</b> - Sydney Metro will consult with The Port Authority of NSW to ensure access via Hickson Road is maintained for coaches and delivery vehicles</p>															
Street parking changes	<p><b>Hickson Road</b> - temporary removal of about 125 parking spaces</p> <p>Sydney Metro will consult with the Barangaroo Delivery Authority to identify locations for alternative car parking spaces, or to implement alternative strategies to reduce the demand for parking by construction workers across the two projects</p>															
Noise management	<p>There will be noise and vibration impacts at this site. Management practices to minimise impacts include:</p> <ul style="list-style-type: none"> <li>o a noise barrier or hoarding will be built around the site</li> <li>o an acoustic shed may be constructed over the excavation to reduce noise impacts</li> </ul>															
Pedestrian and cyclist changes	<p><b>Hickson Road</b> - footpaths adjacent to the site will be narrowed to 2.4 metres in width</p> <p><b>Hickson Road</b> - temporary footpath closures; one footpath will be open at all times except during TBM launch and removal works. Full overnight closures may be required, detours will be provided</p> <p><b>Cyclists</b> - full overnight closures of the road may be required, detours will be provided</p>															
Other major projects in the area	<p>One Carrington Redevelopment (2015-18)</p> <p>Central Barangaroo (2017-23)</p> <p>Barangaroo South (2012-21)</p>															

## Construction site map



Proposed Metro tunnels and corridor (indicative)	Construction area	Acoustic shed	Noise barrier or hoarding	Site access - out	Site access - in
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Martin Place Station

Martin Place Station will be integrated with the existing Martin Place Station and serve Sydney's high-end commercial and financial district, the Macquarie Street precinct and the Pitt Street retail zone.

The station will provide efficient interchange in the CBD through convenient, direct connections to the T4 Eastern Suburbs and Illawarra Line platforms and integrate with the public domain and transport access improvements.



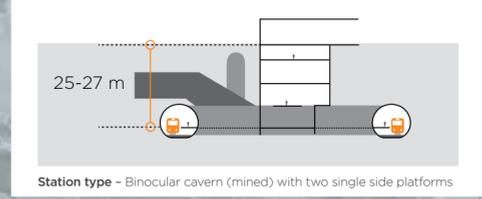
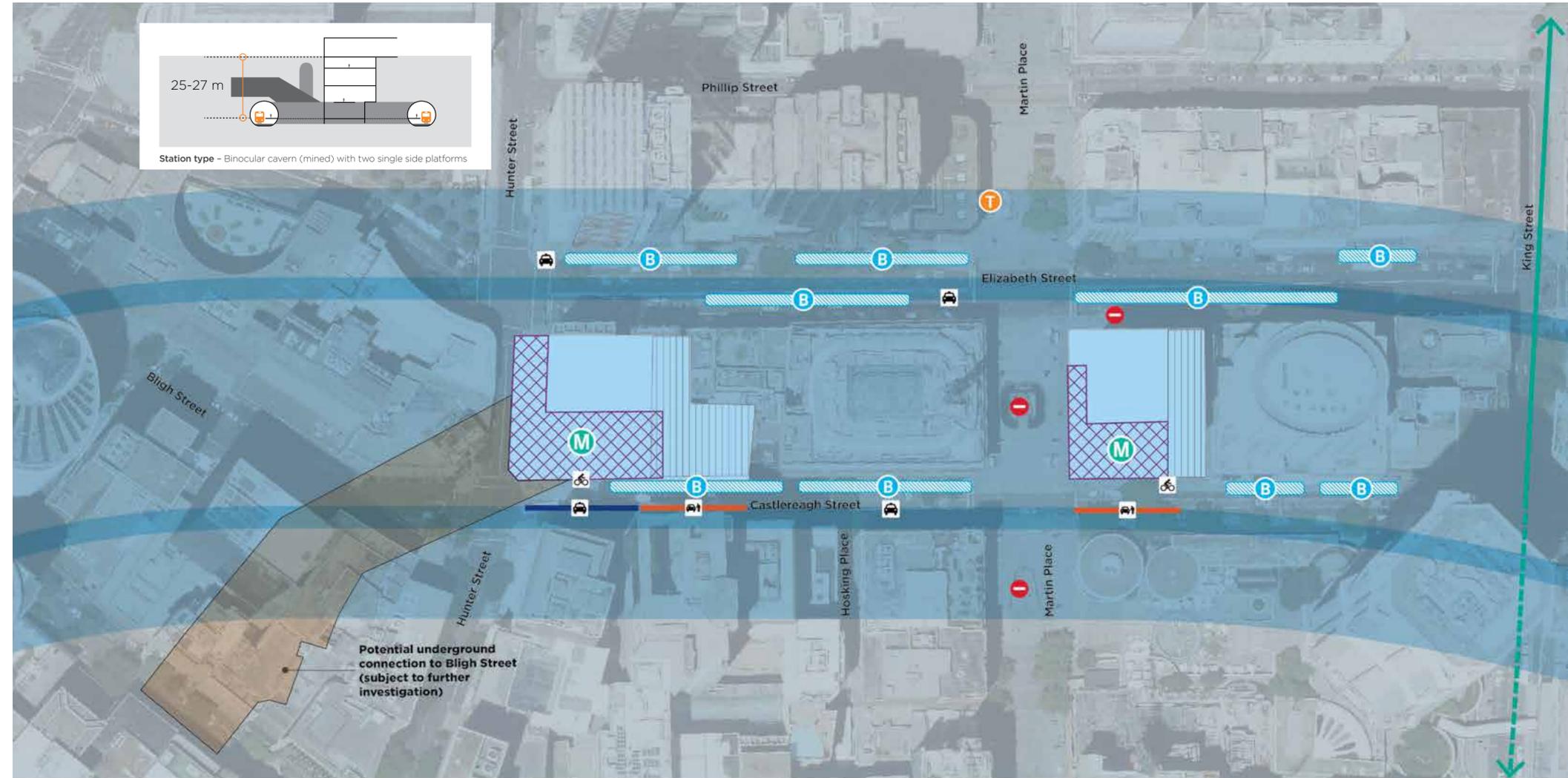
Artist's impression of Martin Place Station

Final arrangements

Feature	Description																		
Location	South of Hunter Street between Castlereagh and Elizabeth streets																		
Station entry	A northern pedestrian plaza opening to Castlereagh, Hunter and Elizabeth streets A southern pedestrian plaza opening to Martin Place and Castlereagh Street Underground pedestrian connections to 33 Bligh Street will be investigated in consultation with City of Sydney and local businesses																		
Transport interchange	Walking, cycling, taxi, kiss-and-ride, bus, and light, suburban and intercity rail																		
Main features and traffic arrangements	New underground pedestrian link between the existing suburban and intercity Martin Place Station platforms and the metro station platforms New bike parking on Castlereagh Street at both station entries Existing bus stops retained on Elizabeth and Castlereagh streets Existing taxi ranks close to the station retained Wayfinding signage and Sydney Metro information																		
Station statistics	Depth - 25 (north end) - 27 (south end) metres Platform length - 170 metres Platform width - 6 metres (each platform) Overall station length - 200 metres																		
Customers	Customers travelling to and from nearby employment, civic, commercial, retail, entertainment and recreational precincts Customers interchanging to and from metro services and other modes of transport																		
Local amenities	<table border="0"> <tr> <td>Circular Quay</td> <td>State Library</td> </tr> <tr> <td>George Street shopping precinct</td> <td>Sydney Conservatorium of Music</td> </tr> <tr> <td>Hyde Park</td> <td>Sydney Hospital</td> </tr> <tr> <td>Hyde Park Barracks</td> <td>St James Station</td> </tr> <tr> <td>Martin Place</td> <td>The Domain</td> </tr> <tr> <td>Museum of Sydney</td> <td>The Mint</td> </tr> <tr> <td>NSW Parliament</td> <td>Wynyard Station</td> </tr> <tr> <td>Pitt Street Mall shopping precinct</td> <td></td> </tr> <tr> <td>The Royal Botanic Garden</td> <td></td> </tr> </table>	Circular Quay	State Library	George Street shopping precinct	Sydney Conservatorium of Music	Hyde Park	Sydney Hospital	Hyde Park Barracks	St James Station	Martin Place	The Domain	Museum of Sydney	The Mint	NSW Parliament	Wynyard Station	Pitt Street Mall shopping precinct		The Royal Botanic Garden	
Circular Quay	State Library																		
George Street shopping precinct	Sydney Conservatorium of Music																		
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Martin Place	The Domain																		
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The Royal Botanic Garden																			



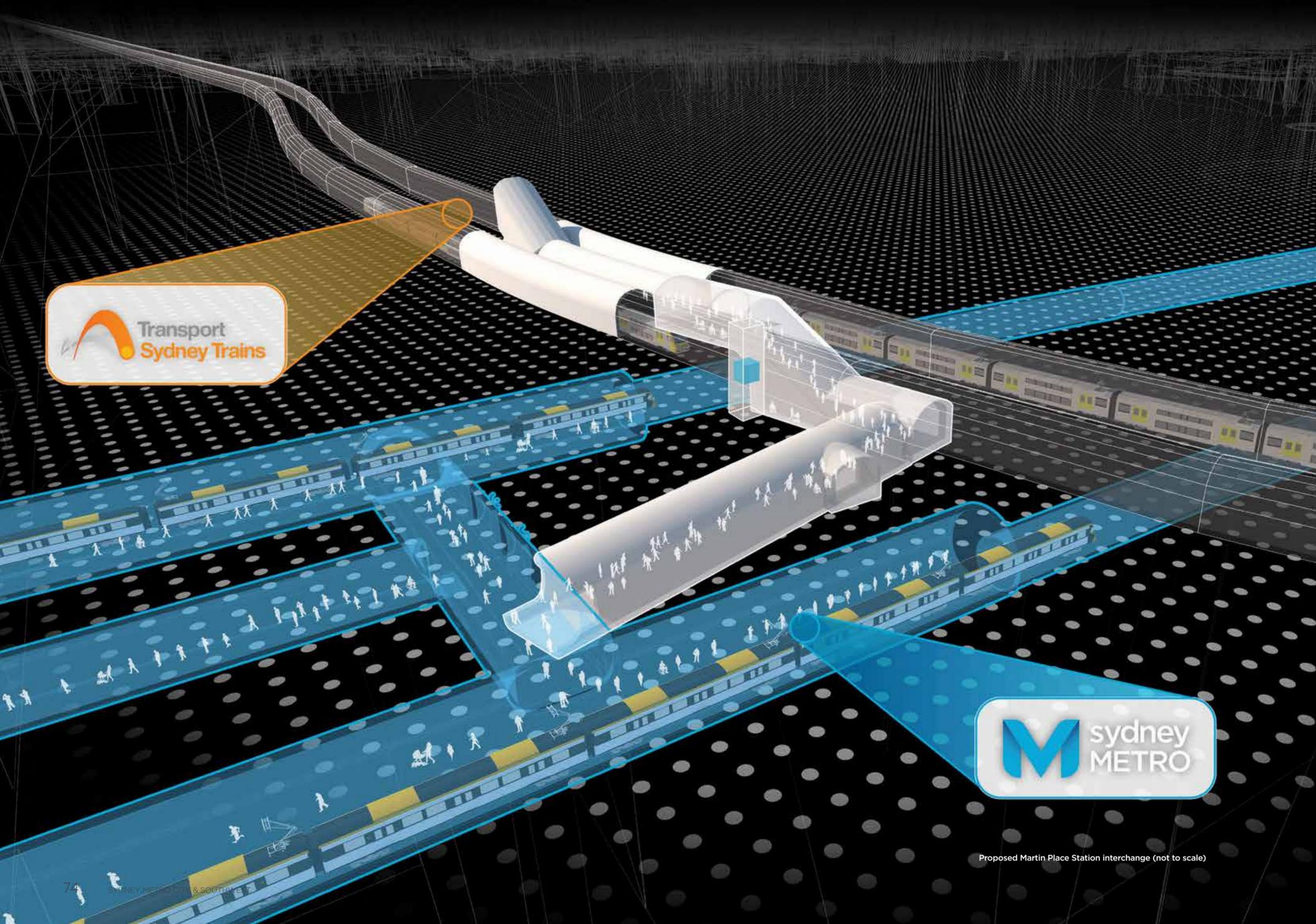
Operational map



Station type - Binocular cavern (mined) with two single side platforms

KEY

- Proposed Metro tunnels and corridor (indicative)
- Metro entry
- Suburban train station entry
- Bus stop
- Existing kiss-and-ride
- Existing taxi setdown
- Existing taxi rank
- Proposed cycle parking
- Existing cycle route
- Proposed cycle route (City Centre Access Strategy)
- Pedestrian access closed
- Pedestrian plaza / station lobby
- Station services building
- Possible future over station development area



Transport Sydney Trains

sydney METRO

Proposed Martin Place Station interchange (not to scale)



A photomontage of the Martin Place Station entrance on Castlereagh Street

Construction at Martin Place

Construction at Martin Place will be split across two sites with temporary street-level working platforms over the excavation.

The underground platform-to-platform connection between the existing Martin Place Station and the Sydney Metro Martin Place Station will mainly be built by excavating new pedestrian tunnels from the Sydney Metro construction site.

Construction of Martin Place Station will involve mined cavern construction techniques outlined on pages 24 and 25.

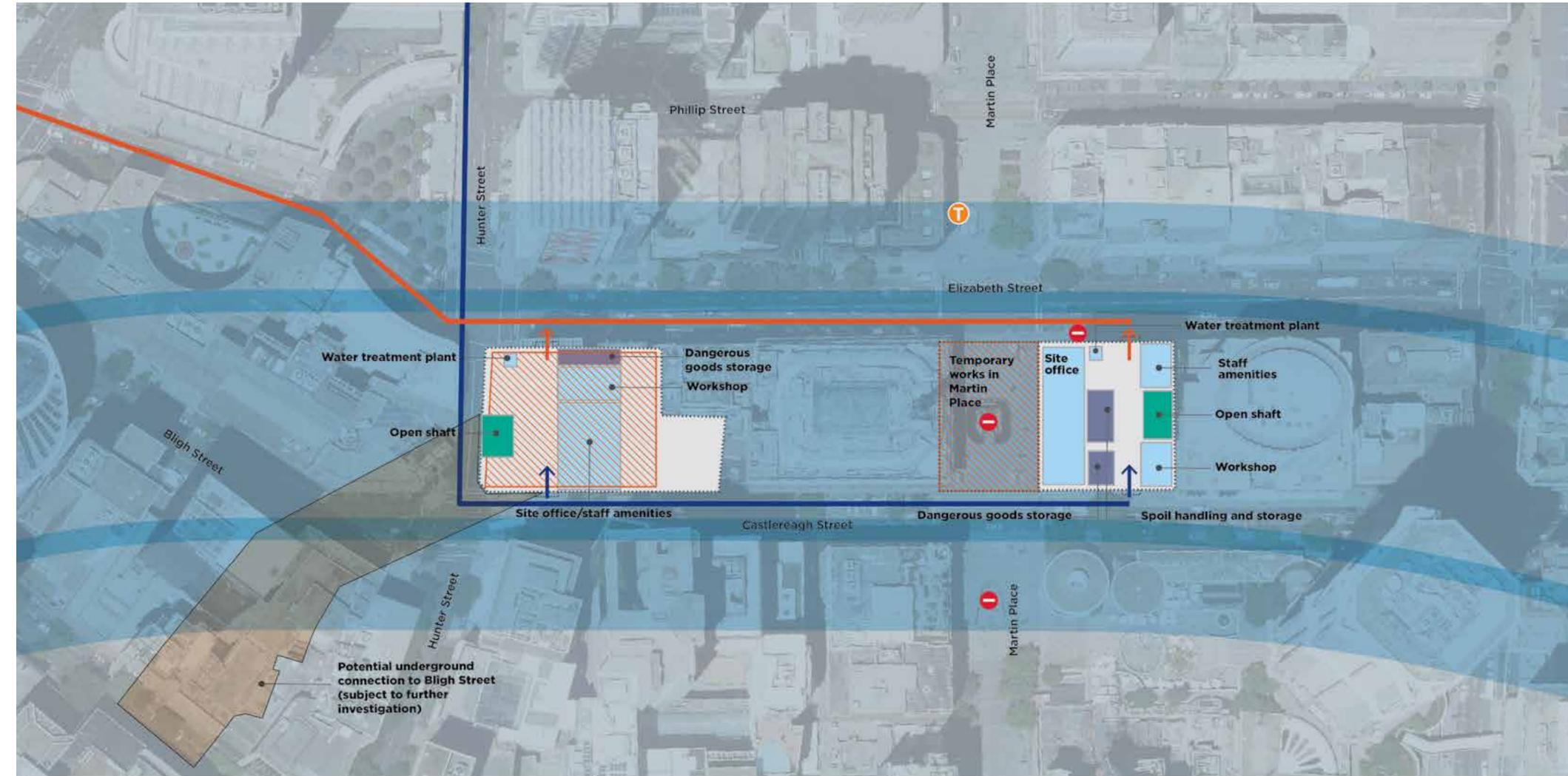
Construction at a glance

Feature	Description
Size	North - 2800 square metres (m <sup>2</sup> ) South - 2000 square metres (m <sup>2</sup> )
Site access	North - Castlereagh Street (left-in via Hunter Street) South - Elizabeth Street (left-out)
Construction hours	<b>Demolition:</b> Monday to Friday 7 am-6 pm and Saturday 8 am-1 pm <b>All other work:</b> 24 hours a day
Truck movements	<b>Demolition:</b> Trucks 96 per day and light vehicles 78 per day <b>Excavation:</b> Trucks 249 per day and light vehicles 104 per day <b>Station fit out:</b> Trucks 202 per day and light vehicles 104 per day
Demolition	Five buildings The pedestrian connection beneath Martin Place between Castlereagh and Elizabeth streets
Heritage	The locally heritage listed building at 7 Elizabeth Street will be demolished The construction site is within the locally heritage listed Martin Place The State heritage listed Martin Place Railway Station will have original features removed (including some red ceramic tiling) to make way for new concourse connections. Salvage and reuse of these features will be considered Archival recording and reporting will be undertaken before work starts
Landscape	The P&O Fountain at 55 Hunter Street will be relocated in consultation with City of Sydney Council Street trees in Martin Place will be removed
Excavation	Mined cavern
Spoil removal	175,000 cubic metres (m <sup>3</sup> ) of mostly sandstone by truck
Activities	Roadheader support Spoil removal Station construction
Staff facilities	Offices, lunch rooms and amenities
Staff parking	Four to 10 parking spaces for use by engineers and other management staff on site Contractors may consider 'park and shuttle' services to transfer workers to this site
Utility and power supply	Water, sewer and telecommunications Power for roadheaders will be supplied from the City North substation (1.3 kilometres away)
Major utility impacts	Protection and/or relocation of services within the underground pedestrian connection beneath Martin Place

Construction activity	Indicative construction timeframe																							
	2017			2018			2019			2020			2021			2022			2023			2024		
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Early works	●	●																						
Station excavation					●	●	●	●	●	●	●	●												
TBMs pass through									●	●														
Structural works									●	●	●	●												
Station fit out													●	●	●	●								
Testing and commissioning																					●	●		

Feature	Description
Street parking	Nil
Plant and equipment	Two roadheaders Four piling rigs Four drilling jumbos Eight excavators Two front-end loaders Four bobcats Two mobile cranes Two truck-mounted cranes Nine generators Six compressors Two concrete pumps Water treatment plant Water cart
Traffic changes	Potential full or partial temporary closures (night time only)
Public transport changes	<b>Train services - temporary rail replacement services will be provided during:</b> <ul style="list-style-type: none"> <li>service relocations and strengthening works to existing rail tunnels</li> <li>modifications to existing underground pedestrian facilities</li> </ul> <b>Bus services</b> <ul style="list-style-type: none"> <li>construction vehicles will load and unload inside the construction site to minimise impacts to bus travel times along Elizabeth and Castlereagh streets</li> </ul>
Noise management	There will be noise and vibration impacts at this site. Management practices to minimise impacts include: <ul style="list-style-type: none"> <li>a noise barrier or hoarding will be built around the site</li> <li>an acoustic shed may be constructed over the excavation to reduce noise impacts</li> </ul>
Pedestrian and cyclist changes	<b>Elizabeth and Castlereagh streets</b> - footpaths adjacent to the site will be narrowed to 2.4 metres in width <b>Martin Place (between Castlereagh and Elizabeth streets)</b> - alternative access arrangements for around six months <b>Access to Martin Place Station</b> - station entry on Elizabeth Street and adjacent to Tiffany's and the MLC building will be permanently closed. Rail customers may use alternative entry points to the east of Elizabeth Street and the east of Philip Street
Other major projects in the area	CBD and South East Light Rail (2015-19) 60 Martin Place Redevelopment (2016-19) 33 Bligh Street Redevelopment (2009-18) Sydney Metro over station development (potentially concurrent) AMP Circular Quay redevelopment (2017-20) Sandstone buildings - Bridge Street, Sydney (2018-21)

Construction site map



**KEY**

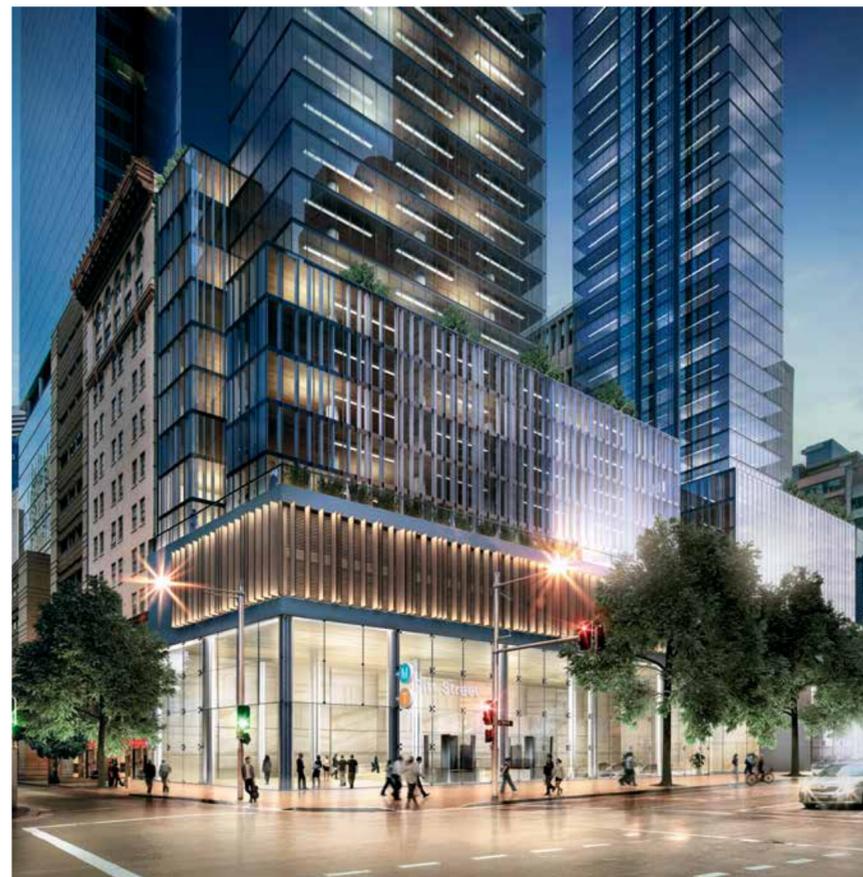
- Proposed Metro tunnels and corridor (indicative)
- Construction area
- Acoustic shed
- Noise barrier or hoarding
- Existing train station entry/exit
- Pedestrian access closed
- Site access - out
- Site access - in

Pitt Street Station

Pitt Street Station will be strategically located at the junction of Sydney's southern CBD and the Midtown retail precinct close to mixed employment, residential, entertainment, cultural and events-based activities within the southern Sydney CBD and Chinatown.

A metro station at Pitt Street will serve the retail areas on George and Pitt streets, the civic and entertainment uses on George Street and the emerging southern Sydney CBD residential developments between Park Street and Belmore Park.

The station will also provide relief to Town Hall Station, and allow interchange onto other modes of public transport including light rail and buses.



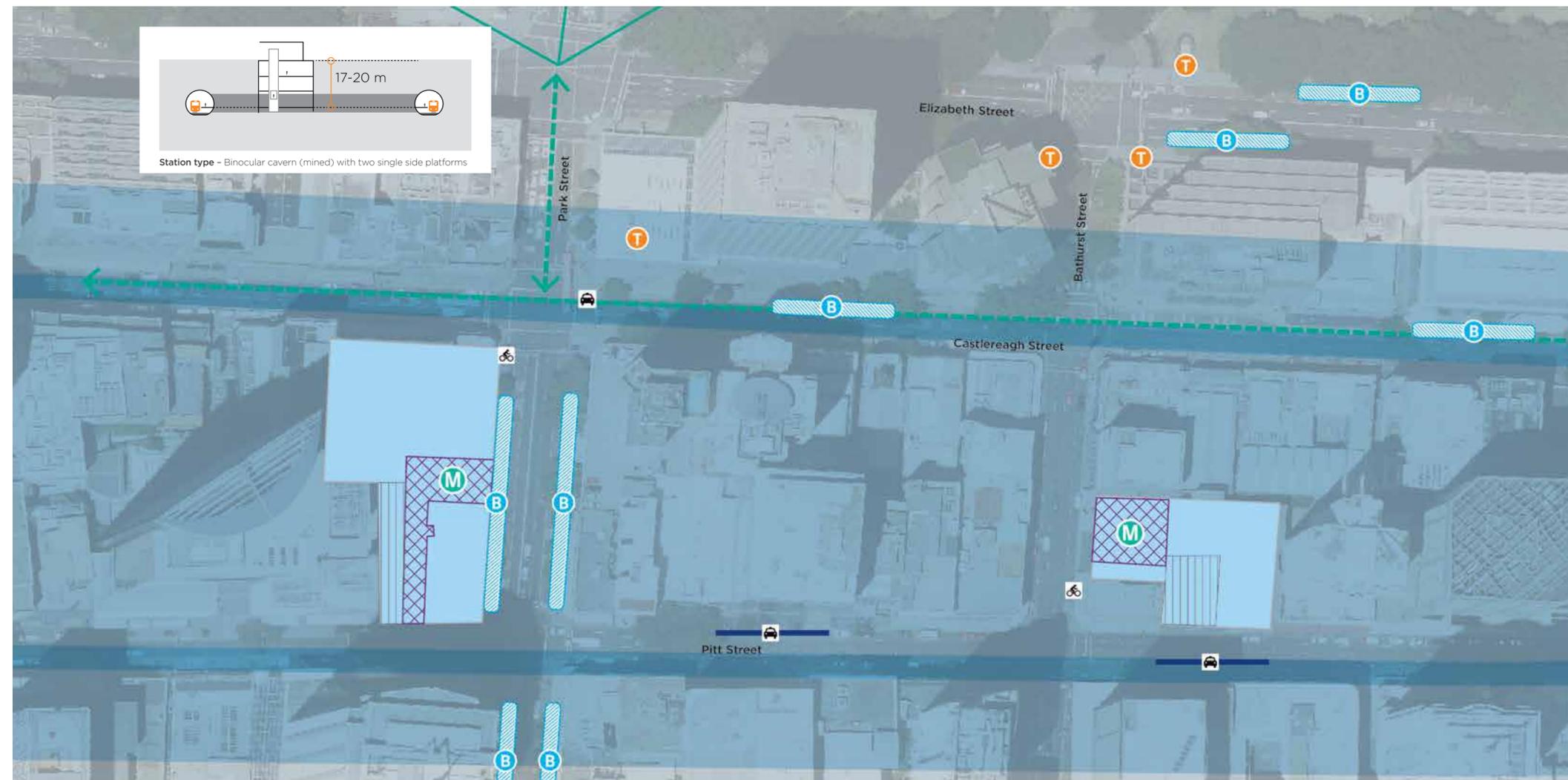
Artist's impression of Pitt Street Station

Final arrangements

Feature	Description
Location	Beneath Pitt and Castlereagh streets, north of the Park Street intersection and south of the Bathurst Street intersection
Station entry	A northern pedestrian plaza opening to Pitt and Park streets A southern pedestrian plaza opening to Bathurst Street
Transport interchange	Walking, cycling, taxi, bus, light rail
Main features and traffic arrangements	New bike parking on Park and Bathurst streets Existing bus stops close to the station retained on Park and Castlereagh streets Existing taxi bays close to the station retained on Castlereagh and Pitt streets Wayfinding signage and metro information will be provided in the Sydney Traction substation integrated into the station building Enhancement of pedestrian infrastructure around the station will be investigated further in consultation with the CBD Coordination Office, Roads and Maritime Services and City of Sydney Council
Station statistics	Depth - 17 metres (north end) - 20 metres (south end) Platform length - 170 metres Platform width - 5 metres (each platform) Overall station length - 200 metres
Operational power supply	The TBM power supply to the Pitt Street Station construction site will be converted to an operational power supply once construction is finished A cable will run through the metro train tunnels from the Pitt Street Station traction substation to the other traction substations at Artarmon, Victoria Cross Station, Barangaroo Station, Pitt Street Station, Waterloo Station and Marrickville services facility, and connect to the Sydney Metro Northwest traction substation at Chatswood North
Customers	Midtown retail, employment, entertainment and residential precinct
Local amenities	Australian Museum Chinatown Darling Harbour Major Cinema Complex Hyde Park Pitt Street Mall, Myer and David Jones Queen Victoria Building St Mary's Cathedral Town Hall World Square



Operational map



KEY

- Proposed Metro tunnels and corridor (indicative)
- Metro entry
- Suburban train station entry
- Bus stop
- Existing taxi setdown
- Existing taxi rank
- Existing cycle parking
- Existing cycle route
- Proposed cycle route (City Centre Access Strategy)
- Pedestrian plaza / station lobby
- Station services building
- Possible future over station development area

### Construction at Pitt Street

Construction at Pitt Street will be split across two sites with temporary street-level working platforms over the excavation.

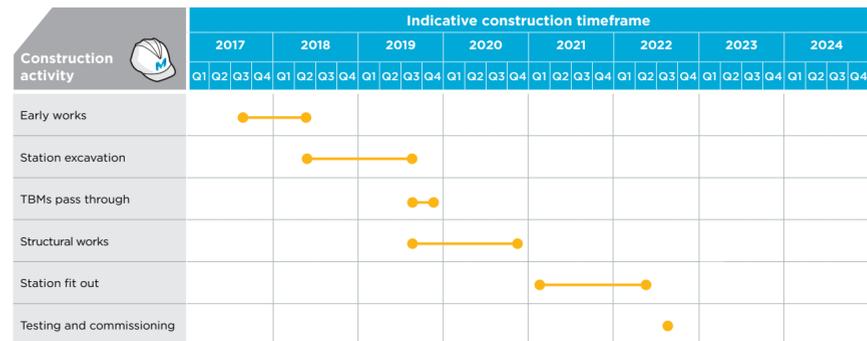
Shafts will be excavated within both sites adjacent to the proposed station cavern. The shafts will be used to provide the future station entry and vertical access. The station caverns and other underground pedestrian connections will then be excavated from the shafts.

Construction work will avoid the heritage listed hotel on the corner of Bathurst and Pitt streets.

Construction of Pitt Street Station will involve mined cavern construction techniques outlined on page 24.

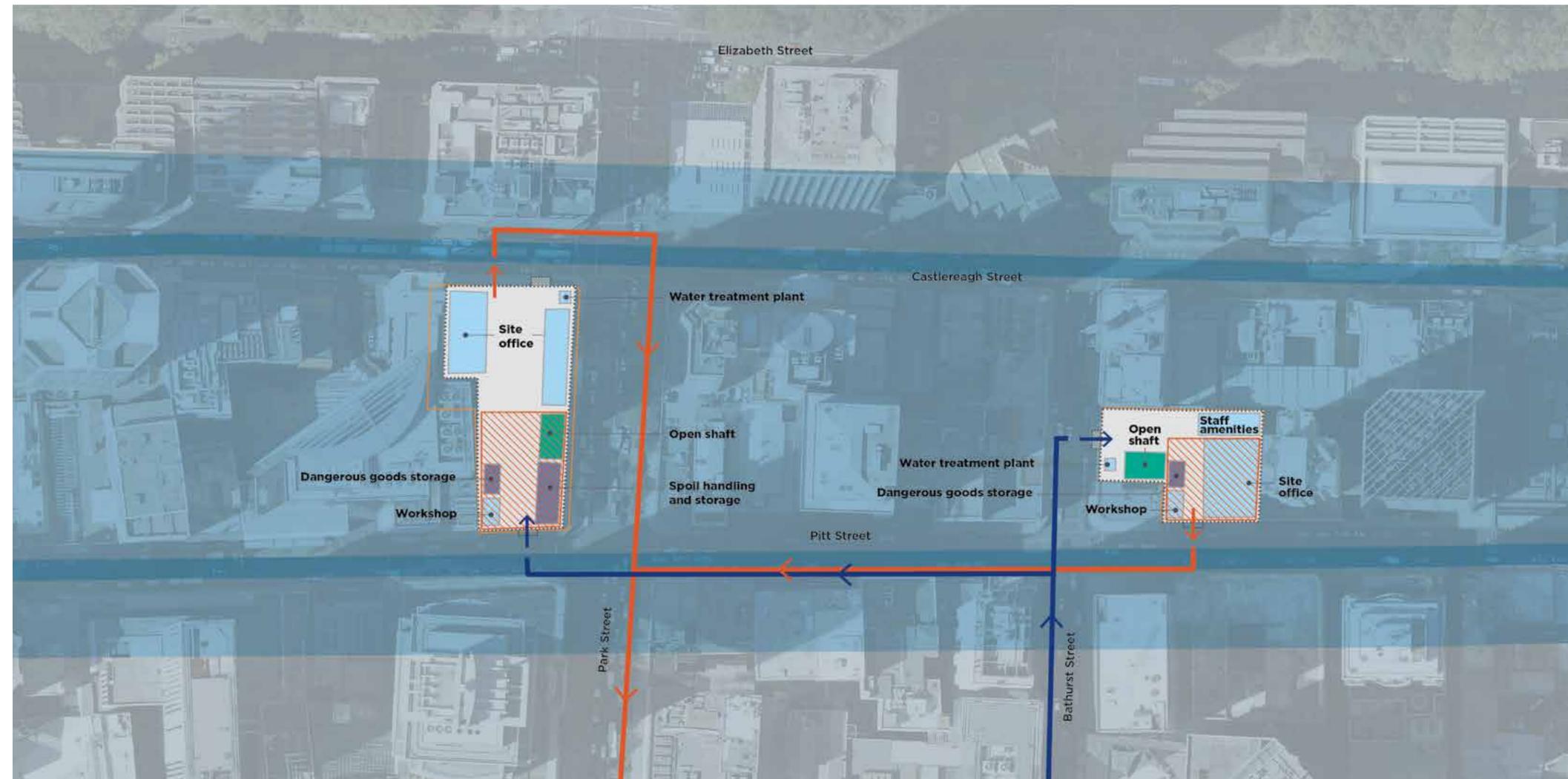
#### Construction at a glance

Feature	Description
Size	<b>North</b> - 3100 square metres (m <sup>2</sup> ) <b>South</b> - 1700 square metres (m <sup>2</sup> )
Site access	<b>North</b> - Pitt Street (right-in) and Castlereagh Street (right-in and right-out) <b>South</b> - Bathurst Street (right-in) and Pitt Street (right-out)
Construction hours	<b>Demolition:</b> Monday to Friday 7 am-6 pm and Saturday 8 am-1 pm <b>All other work:</b> 24 hours a day
Truck movements	<b>Demolition:</b> Trucks 96 per day and light vehicles 78 per day <b>Excavation:</b> Trucks 234 per day and light vehicles 104 per day <b>Station fit out:</b> Trucks 202 per day and light vehicles 104 per day
Demolition	12 buildings
Landscape	Street trees will be removed
Excavation	Mined cavern
Spoil removal	160,000 cubic metres (m <sup>3</sup> ) of mostly sandstone by truck
Activities	Roadheader support Spoil removal Station construction
Staff facilities	Offices, lunch rooms and amenities
Staff parking	Four to 10 parking spaces for use by engineers and other management staff on site Contractors may consider 'park and shuttle' services to transfer workers to this site
Utility and power supply	Water, sewer and telecommunications Power for roadheaders will be supplied from the Surry Hills substation (1.2 kilometres away) or Pyrmont substation (1.7 kilometres away)
Major utility impacts	Nil
Traffic changes	Potential full or partial temporary closures (night time only)
Public transport changes	Construction vehicles will load and unload inside the construction site to minimise impacts to bus travel times along Elizabeth, Castlereagh and Park streets



Feature	Description															
Plant and equipment	<table border="0"> <tr> <td>Two roadheaders</td> <td>Four bobcats</td> <td>Six compressors</td> </tr> <tr> <td>Four piling rigs</td> <td>Two mobile cranes</td> <td>Two concrete pumps</td> </tr> <tr> <td>Four drilling jumbos</td> <td>Two truck-mounted cranes</td> <td>Water treatment plant</td> </tr> <tr> <td>Eight excavators</td> <td>Nine generators</td> <td>Water cart</td> </tr> <tr> <td>Two front-end loaders</td> <td></td> <td></td> </tr> </table>	Two roadheaders	Four bobcats	Six compressors	Four piling rigs	Two mobile cranes	Two concrete pumps	Four drilling jumbos	Two truck-mounted cranes	Water treatment plant	Eight excavators	Nine generators	Water cart	Two front-end loaders		
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Four piling rigs	Two mobile cranes	Two concrete pumps														
Four drilling jumbos	Two truck-mounted cranes	Water treatment plant														
Eight excavators	Nine generators	Water cart														
Two front-end loaders																
Street parking changes	Nil															
Noise management	There will be noise and vibration impacts at this site. Management practices to minimise impacts include: <ul style="list-style-type: none"> <li>o a noise barrier or hoarding will be built around the site</li> <li>o an acoustic shed may be constructed over the excavation to reduce noise impacts</li> </ul>															
Pedestrian and cyclist changes	<b>Pitt, Bathurst and Castlereagh streets</b> – footpaths adjacent to the site will be narrowed to 2.4 metres in width															
Other major projects in the area	CBD and South East Light Rail (2015-19) 115-119 Bathurst Street Redevelopment (2015-17) Sydney Metro over station development (potentially concurrent) 410 Pitt Street Redevelopment (in planning) 505-523 George Street Redevelopment (in planning) 116 Bathurst Street Redevelopment (in planning) Town Hall Square Precinct Urban Design Strategy (in planning)															

### Construction site map



## Central Station metro platforms

Metro platforms at Central Station will provide a critical interchange with suburban, intercity and regional rail services, buses, coaches and light rail.

To provide construction and operational maintenance access for both Sydney Metro and Sydney Trains, an access bridge will be constructed from Regent Street into the rail corridor (Sydney Yard) as part of the Project.



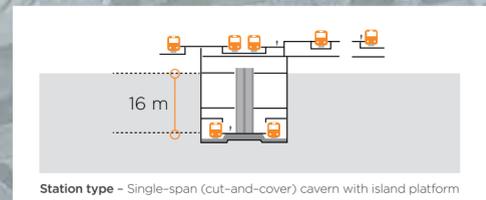
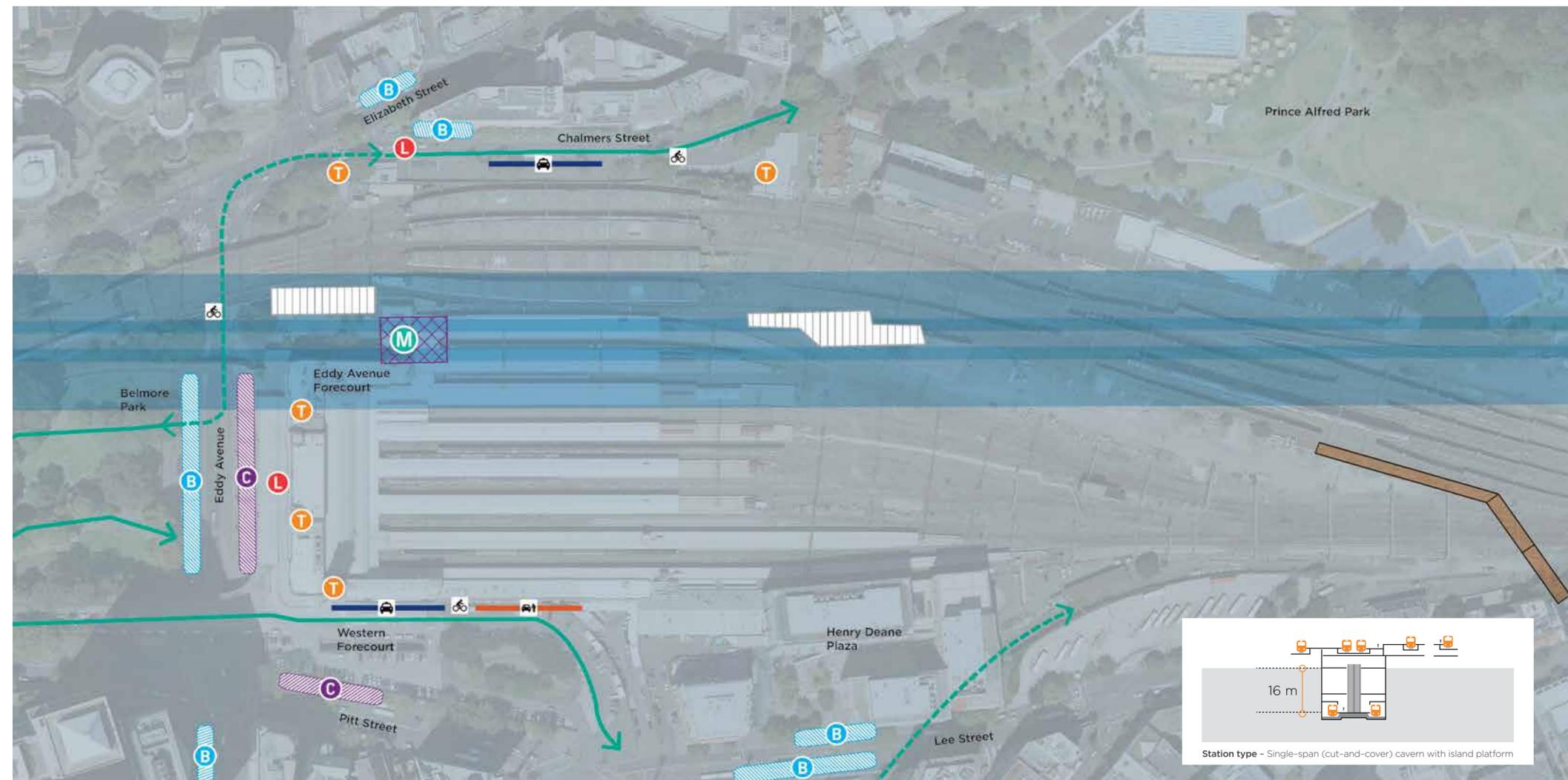
Central Station

### Final arrangements

Feature	Description												
Location	Within the existing Central Station precinct, below platforms 13, 14 and 15												
Station entry	Existing northern station entry from Eddy Avenue and the main northern concourse Existing paid underground pedestrian connections within Central Station												
Transport interchange	Walking, cycling, intercity rail, suburban rail, light rail, bus, coach, taxi and kiss-and-ride												
Main features and traffic arrangements	Suburban and intercity train interchange via the existing northern concourse and underground paid pedestrian connections Existing kiss-and-ride, taxi ranks, bike parking and bus stops retained Services building (at the end of platforms 13 and 14) Platforms 13 and 14 will be reinstated as intercity platforms, and platform 15 possibly converted to a suburban platform												
Station statistics	Depth - 16 metres Platform length - 170 metres Platform width - 12 metres Overall station length - 220 metres												
Customers	Customers travelling to nearby employment, education and entertainment precincts Customers interchanging to and from metro services and other modes of transport Customers entering and departing Sydney from interstate and regional areas												
Local amenities	<table border="0"> <tr> <td>Central Park</td> <td>Sydney Exhibition Centre</td> </tr> <tr> <td>Chinatown</td> <td>Sydney Institute of TAFE</td> </tr> <tr> <td>Notre Dame University</td> <td>The University of Sydney</td> </tr> <tr> <td>Prince Alfred Park</td> <td>University of Technology, Sydney</td> </tr> <tr> <td>Railway Square</td> <td>World Square</td> </tr> <tr> <td>Royal Prince Alfred Hospital</td> <td></td> </tr> </table>	Central Park	Sydney Exhibition Centre	Chinatown	Sydney Institute of TAFE	Notre Dame University	The University of Sydney	Prince Alfred Park	University of Technology, Sydney	Railway Square	World Square	Royal Prince Alfred Hospital	
Central Park	Sydney Exhibition Centre												
Chinatown	Sydney Institute of TAFE												
Notre Dame University	The University of Sydney												
Prince Alfred Park	University of Technology, Sydney												
Railway Square	World Square												
Royal Prince Alfred Hospital													



### Operational map



#### KEY

- Proposed Metro tunnels and corridor (indicative)
- Metro entry
- Suburban train station entry
- Light rail stop
- Bus stop
- Coach stop
- Existing kiss-and-ride
- Existing taxi rank
- Existing cycle parking
- Existing cycle route
- Proposed cycle route (City Centre Access Strategy)
- Pedestrian plaza / station lobby
- Station services building
- Regent Street access bridge to Sydney Yard

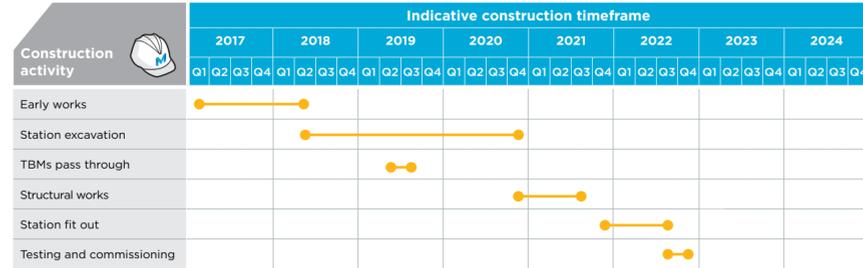
## Construction at Central Station

Construction of the new metro platforms at Central Station will require the area around the existing platforms 13, 14 and 15 and between the suburban and country lines to the south. This site will incorporate the footprint of the future underground metro platforms. This site is currently part of the Central Station operational area.

Construction of the Central Station underground platforms will involve the cut-and-cover construction techniques outlined on page 24 beneath platforms 13, 14 and 15.

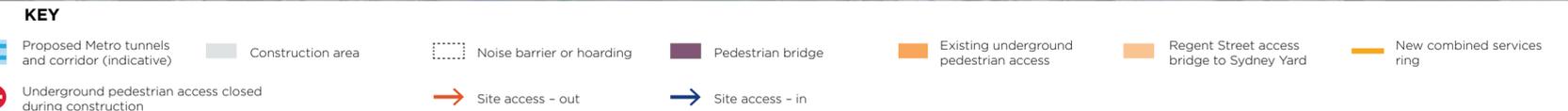
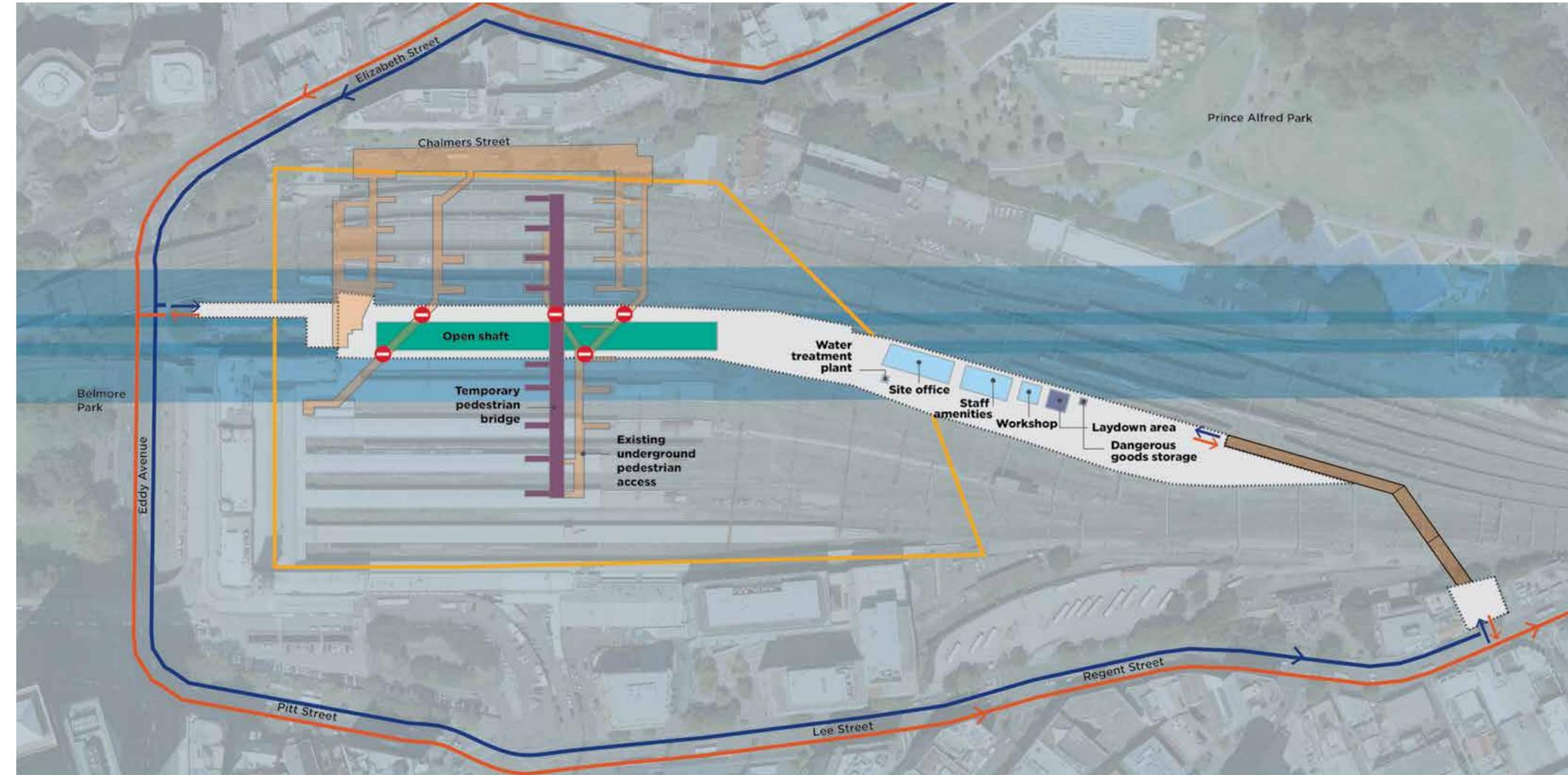
### Construction at a glance

Feature	Description
Size	16,500 square metres (m <sup>2</sup> )
Site access	<b>Eddy Avenue</b> (left-in and left-out) - this will be the main access until the Regent Street bridge is constructed, then for light vehicles and pedestrians only <b>Regent Street</b> (left-in and left-out) - a new access bridge from Regent Street over the intercity rail lines into Sydney Yard will be built. The bridge will provide access during construction of the metro platforms and permanent access for Sydney Metro and Sydney Trains
Construction hours	<b>Demolition:</b> Monday to Friday 7 am-6 pm and Saturday 8 am-1 pm <b>All other work:</b> 24 hours a day
Truck movements	<b>Demolition:</b> Trucks 96 per day and light vehicles 78 per day <b>Excavation:</b> Trucks 234 per day and light vehicles 104 per day <b>Station fit out:</b> Trucks 202 per day and light vehicles 104 per day
Demolition	Eight buildings Existing platforms, canopies, overhead supports and underground pedestrian connections
Heritage	Construction will demolish existing platforms, buildings, canopies, overhead supports and underground pedestrian connections that are part of the Sydney Terminal and Central Railway Station Group A number of mitigation measures are proposed to minimise and manage impacts at Central Station, including design review by a heritage architect, consideration of the requirements of the Central Station Conservation Management Plan, consultation with Sydney Trains and the Heritage Council of NSW during design development Archival recording and reporting will be undertaken before work starts
Landscape	Nil
Excavation	Cut-and-cover
Spoil removal	230,000 cubic metres (m <sup>3</sup> ) of mostly sandstone by truck Spoil removal by freight train is not feasible at this location
Activities	Roadheader support    Bridge construction    Spoil removal    Station construction
Staff facilities	Offices, lunch rooms and amenities
Staff parking	Four to 10 parking spaces for use by engineers and other management staff on site Contractors may consider 'park and shuttle' services to transfer workers to this site
Plant and equipment	Roadheader    Four bobcats    Six compressors Four piling rigs    Six mobile cranes    Two concrete pumps Four drilling jumbos    Two truck-mounted cranes    Water treatment plant Eight excavators    Seven generators    Water cart Two front-end loaders



Feature	Description
Utility and power supply	Water, sewer and telecommunications Power for the roadheader will be supplied from the Belmore Park substation (600 metres away)
Major utility impacts	Protection and/or relocation of Sydney Trains rail, station and building services Relocation of existing power, communications and signalling cables, and fire services into a combined service ring located around the perimeter of the station
Changes to the existing station	Relocating utilities, adjusting overhead wiring, removing platform canopies and carrying out piling works at Central Station
Traffic changes	Nil
Public transport changes	Sydney Trains and NSW Trains timetable changes due to closure of platforms 13, 14 and 15 Temporary rail replacement services during: <ul style="list-style-type: none"> <li>construction of access bridge from Regent Street into Sydney Yard</li> <li>construction of the temporary pedestrian bridge</li> <li>adjustments to rail systems around platforms 13, 14 and 15</li> <li>adjustments to rail systems around platforms, the paid pedestrian connections and Devonshire Street tunnel</li> </ul>
Street parking changes	Nil
Noise management	There will be noise and vibration impacts at this site. Management practices to minimise impacts include: <ul style="list-style-type: none"> <li>a noise barrier will be built around the site</li> </ul>
Pedestrian and cyclist changes	<b>Devonshire Street tunnel</b> - short-term closure (about two weeks). Pedestrians will be redirected via Eddy Avenue, the northern station concourse or Cleveland Street <b>Some underground passenger paid connections</b> - closed. Opportunities will be investigated to retain some underground connectivity by staging the construction works <b>Temporary pedestrian bridge</b> - between platforms four to 23 with stair connections to each platform <b>Lift</b> - the existing lift access at the northern concourse at Central Station will be maintained
Other major projects in the area	CBD and South East Light Rail (2015-19) University of Technology Sydney (UTS) Central project (2017 onwards) Central Park (2010-20) Central to Eveleigh Urban Transformation and Transport Program (in planning)

## Construction site map



Waterloo Station

A new metro station at Waterloo will help revitalise the Waterloo precinct and support the extension of the CBD.

It will also:

- provide a high quality connection with bus services along Botany Road
- provide additional connectivity to Australian Technology Park and Redfern Station
- contribute to the NSW Government objective to transform Waterloo and Redfern.

The metro station will also allow further development and expansion of the Global Economic Corridor between the Sydney CBD and Green Square.



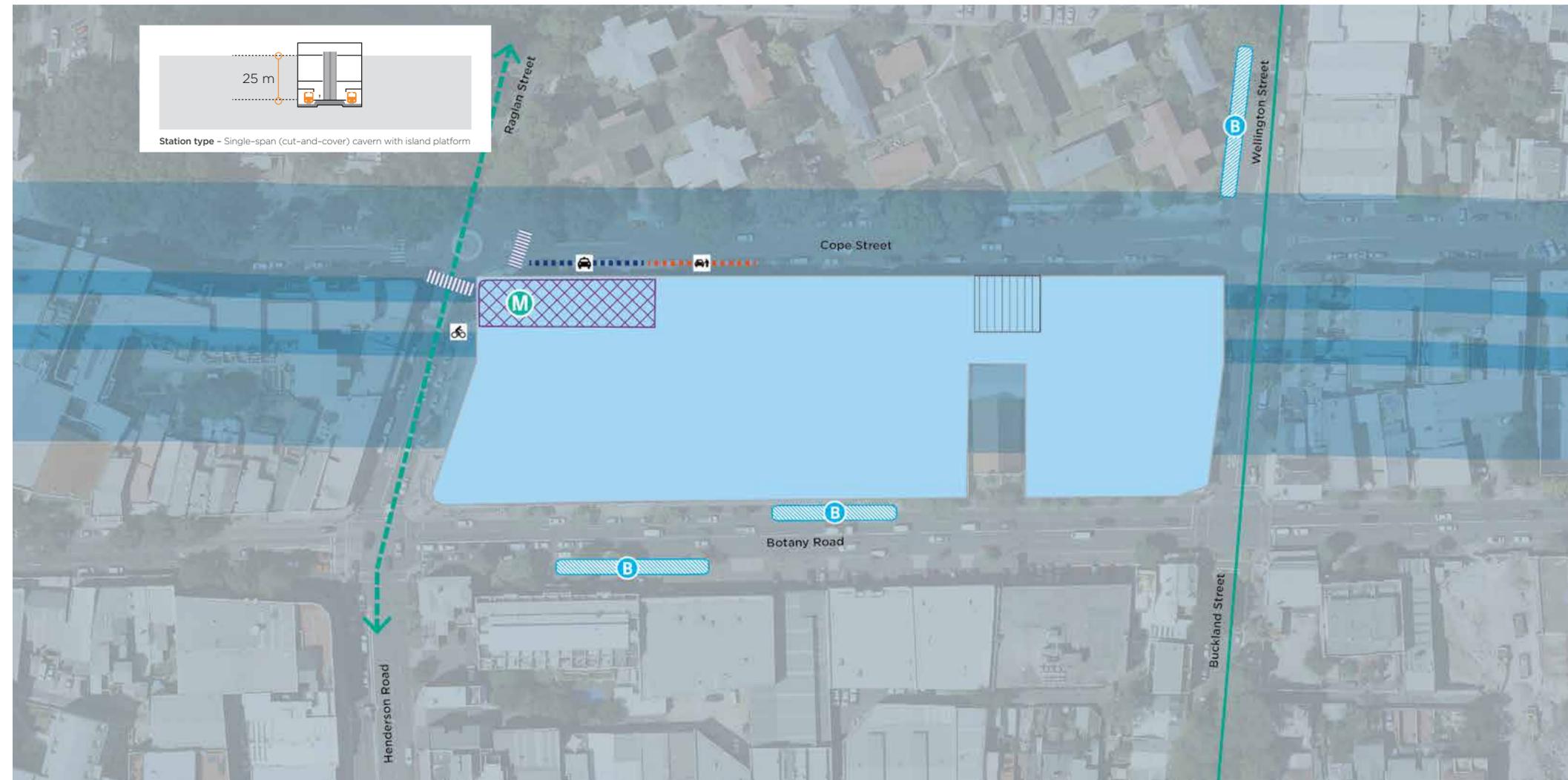
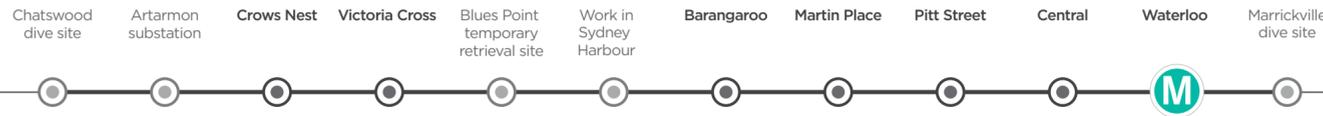
Artist's impression of Waterloo Station

Final arrangements

Feature	Description
Location	Between Botany Road, Cope Street, Raglan Street and Wellington Street
Station entry	Corner of Raglan and Cope streets
Transport interchange	Walking, cycling, bus, taxi, and kiss-and-ride
Main features and traffic arrangements	<ul style="list-style-type: none"> <li>New pedestrian crossings on Raglan and Cope streets</li> <li>New taxi, kiss-and-ride bays and bike parking on Cope Street</li> <li>New on-road marked cycle link on Raglan Street</li> <li>Existing bus stops retained northbound along Botany Road</li> <li>Relocation of the bus stops southbound on Botany Road closer to Raglan Street</li> <li>Relocation of the bus stops on Cope Street to Botany Road</li> <li>Traction substation integrated into the station building</li> <li>Enhancement of pedestrian infrastructure around the station will be investigated further in consultation with the CBD Coordination Office, Roads and Maritime Services and City of Sydney Council</li> </ul>
Station statistics	<ul style="list-style-type: none"> <li>Depth - 25 metres</li> <li>Platform length - 170 metres</li> <li>Platform width - 10 metres</li> <li>Overall station length - 210 metres</li> </ul>
Customers	<ul style="list-style-type: none"> <li>Customers travelling to and from the nearby residential developments (existing and future)</li> <li>Customers travelling to and from commercial precincts</li> </ul>
Local amenities	<ul style="list-style-type: none"> <li>Alexandria Park</li> <li>Australian Technology Park</li> <li>Factory outlet and retail precinct</li> <li>Green Square Station</li> <li>Redfern Station</li> </ul>



Operational map



KEY

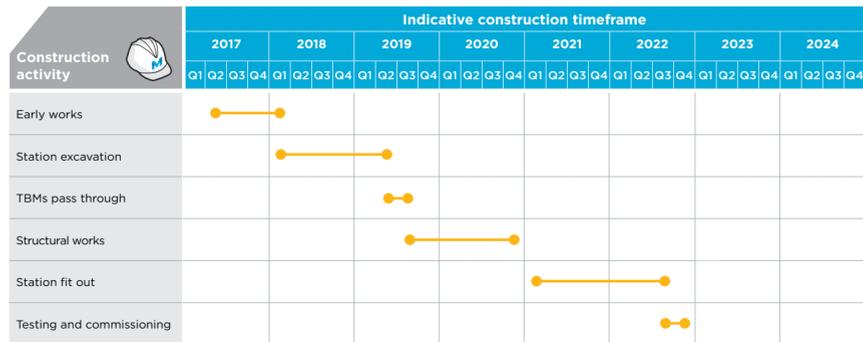
- Proposed Metro tunnels and corridor (indicative)
- Metro entry
- Suburban train station entry
- Bus stop
- Proposed kiss-and-ride
- Proposed taxi rank
- Proposed cycle parking
- Existing cycle route
- Proposed Council cycle route
- Proposed pedestrian crossing
- Pedestrian plaza / station lobby
- Station services building
- Possible future over station development area

Construction at Waterloo

Construction of Waterloo Station will involve the cut and cover construction techniques outlined on page 24. The heritage listed Waterloo Congregational Church will be retained and protected.

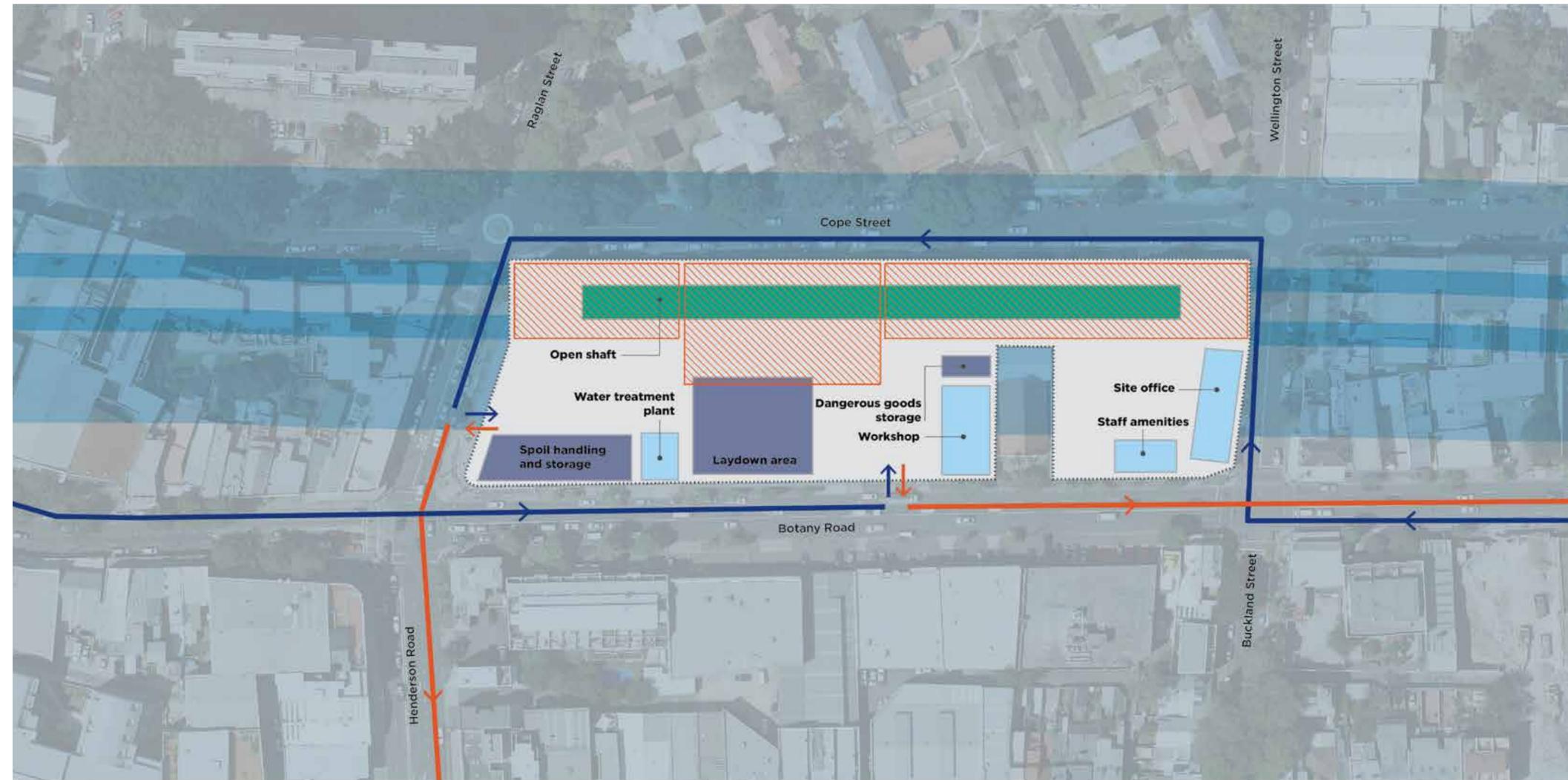
Construction at a glance

Feature	Description
Size	12,000 square metres (m <sup>2</sup> )
Site access	Botany Road (left-in and left-out) Raglan Street (left-in, right-in and left-out)
Construction hours	<b>Demolition:</b> Monday to Friday 7 am-6 pm and Saturday 8 am-1 pm <b>All other work:</b> 24 hours a day
Truck movements	<b>Demolition:</b> Trucks 96 per day and light vehicles 78 per day <b>Excavation:</b> Trucks 234 per day and light vehicles 104 per day <b>Station fit out:</b> Trucks 202 per day and light vehicles 104 per day
Demolition	18 buildings
Heritage	The locally heritage listed Waterloo Congregational Church will be retained and protected Archival recording and reporting will be undertaken before work starts
Landscape	Street trees will be removed
Excavation	Cut-and-cover
Spoil removal	115,000 cubic metres (m <sup>3</sup> ) of mostly sandstone and shale by truck
Activities	Spoil removal Station construction
Staff facilities	Offices, lunch rooms and amenities
Staff parking	Four to 10 parking spaces for use by engineers and other management staff on site Contractors may consider 'park and shuttle' services to transfer workers to this site
Utility and power supply	Water, sewer and telecommunications Power for the roadheader will be supplied from the Zetland substation (850 metres away)
Major utility impacts	Nil



Feature	Description															
Plant and equipment	<table border="0"> <tr> <td>Roadheader</td> <td>Three bobcats</td> <td>Six compressors</td> </tr> <tr> <td>Four piling rigs</td> <td>Six mobile cranes</td> <td>Two concrete pumps</td> </tr> <tr> <td>Four drilling jumbos</td> <td>Two truck-mounted cranes</td> <td>Water treatment plant</td> </tr> <tr> <td>Eight excavators</td> <td>Seven generators</td> <td>Water cart</td> </tr> <tr> <td>Two front-end loaders</td> <td></td> <td></td> </tr> </table>	Roadheader	Three bobcats	Six compressors	Four piling rigs	Six mobile cranes	Two concrete pumps	Four drilling jumbos	Two truck-mounted cranes	Water treatment plant	Eight excavators	Seven generators	Water cart	Two front-end loaders		
Roadheader	Three bobcats	Six compressors														
Four piling rigs	Six mobile cranes	Two concrete pumps														
Four drilling jumbos	Two truck-mounted cranes	Water treatment plant														
Eight excavators	Seven generators	Water cart														
Two front-end loaders																
Traffic changes	Nil															
Public transport changes	Temporary relocation of the bus stop near 103 Botany Road															
Street parking changes	<b>Raglan Street</b> – temporary removal of about two to four on-street parking spaces as required <b>Cope and Wellington streets</b> – temporary removal of car parking during demolition															
Noise management	There will be noise and vibration impacts at this site. Management practices to minimise impacts include: <ul style="list-style-type: none"> <li>a noise barrier or hoarding will be built around the site</li> <li>an acoustic shed may be constructed over the excavation to reduce noise impacts</li> </ul>															
Pedestrian and cyclist changes	<b>Botany Road and Cope, Raglan and Wellington streets</b> – footpaths to be narrowed to 2.4 metres in width <b>Cyclists</b> – existing cycle facilities on Botany Road (south of Wellington Street), Buckland Street and George Street in the vicinity of the site will not be impacted															
Other major projects in the area	Nil															

Construction site map



Marrickville dive site and tunnel portal

The Marrickville tunnel portal will be located west of the T3 Bankstown Line in Marrickville (to the north of Sydenham Station).

The dive structure will be about 400 metres long and include an open section before closing into a tunnel portal. The dive structure has been designed to be protected from the probable maximum flood level to avoid floodwater flowing into the tunnel.

The southern services facility will include a tunnel water-treatment plant and a traction substation and will be located adjacent to the dive structure.

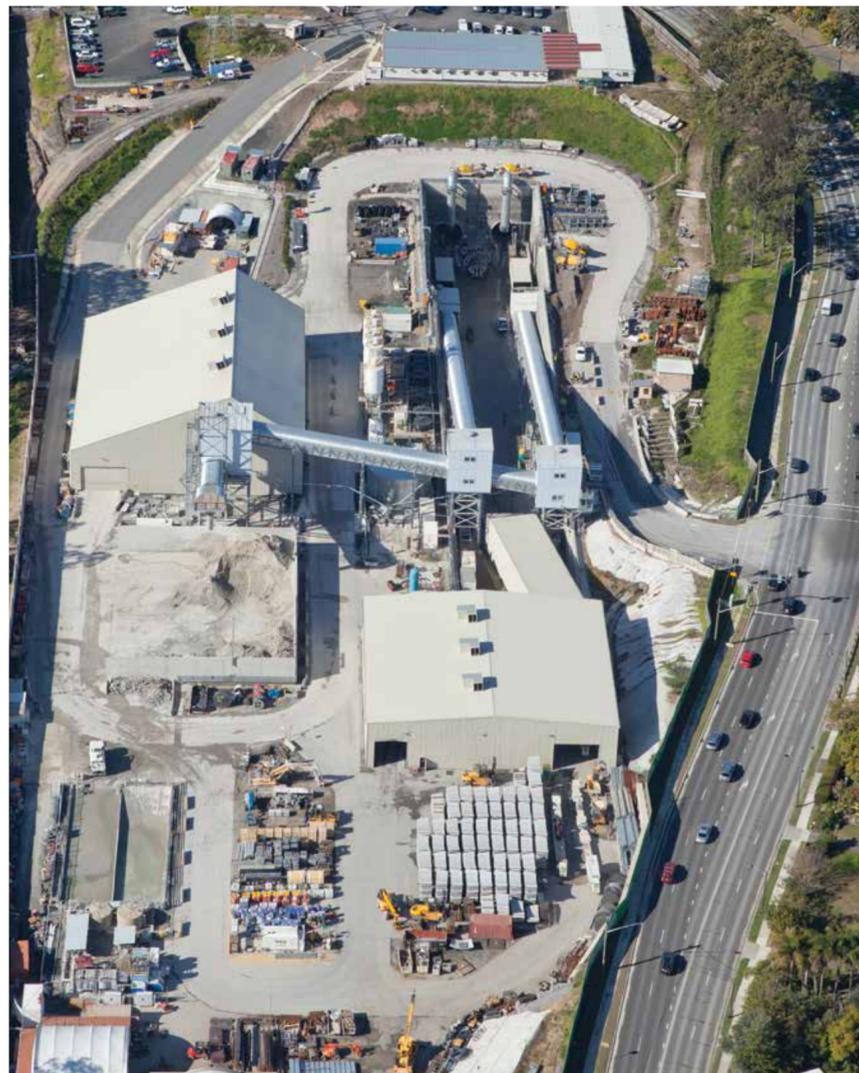
The tunnel water-treatment plant will treat wastewater pumped from the tunnels, stations and other underground facilities. The building will be about eight metres high, covering an area of about 500 square metres (m<sup>2</sup>). The building will house holding tanks, chemical treatment tanks and filters. Drainage pipes will connect the water treatment plant with the tunnels.

The substation will supply traction power to the metro trains. The above-ground building (around five metres high) will house the substation and electrical equipment. Trenches and/or above-ground conduits will connect the electrical cables into the tunnels.

Surface metro tracks will also be required to connect the Chatswood to Sydenham component of City & Southwest to the Sydenham to Bankstown upgrade. This will be subject to a separate assessment as part of the Sydenham to Bankstown upgrade Project.

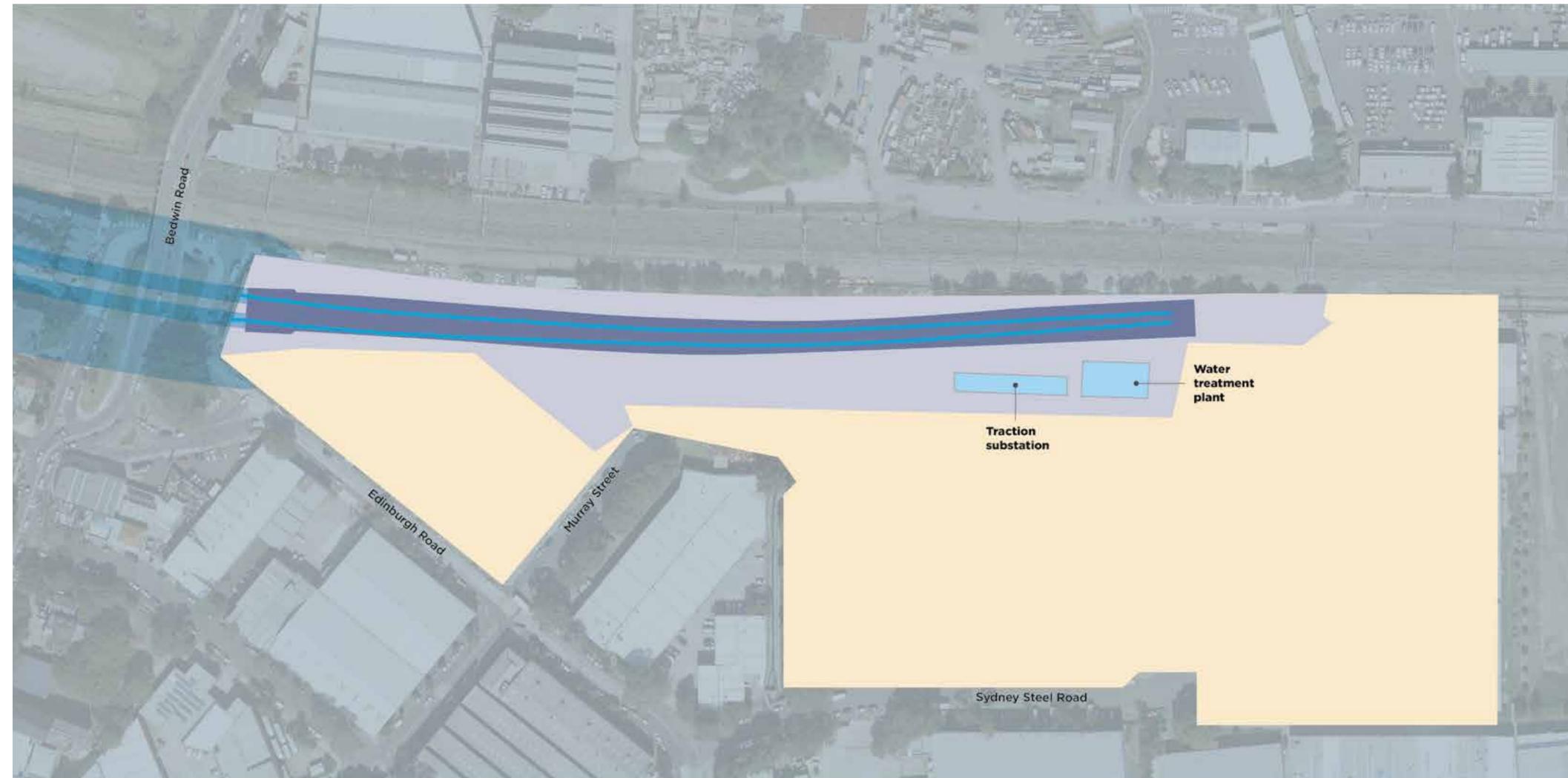
Final arrangements

Feature	Description
Location	Marrickville (north of Sydenham Station and south of Bedwin Road), bordered by Edinburgh Road and Murray Street
Operational access	To be confirmed
Main features and traffic arrangements	Tunnel portal Fire protection wall along the entire length of the dive structure to provide separation between the two metro tracks Tunnel water-treatment plant Traction substation Construction traffic lights at the Edinburgh Road / Bedwin Road / Edgeware Road intersection will be retained Opportunities will be investigated to provide a permanent wall for street art at the dive site in consultation with Marrickville Council
Maintenance access	Weekly light vehicles for inspections and testing of track and in-tunnel equipment Weekly light vehicles and heavy rigid trucks for delivery of consumables and waste removal Occasional light and utility vehicles for track and equipment maintenance



Cherrybrook Station TBM dive site and tunnel portal, July 2015

Operational map



KEY

- Proposed Metro tunnels and corridor (indicative)
- Residual land
- Dive structure
- Operational area

Construction at Marrickville

During construction, the Marrickville site will be used to:

- o excavate and construct the Marrickville dive structure and tunnel portal
- o launch and support two tunnel boring machines
- o manufacture the pre-cast concrete tunnel lining segments
- o support the construction of the southern services facility
- o support the fit-out of the tunnel rail systems.

Construction of Marrickville dive structure and tunnel portal will involve construction techniques outlined on page 26.

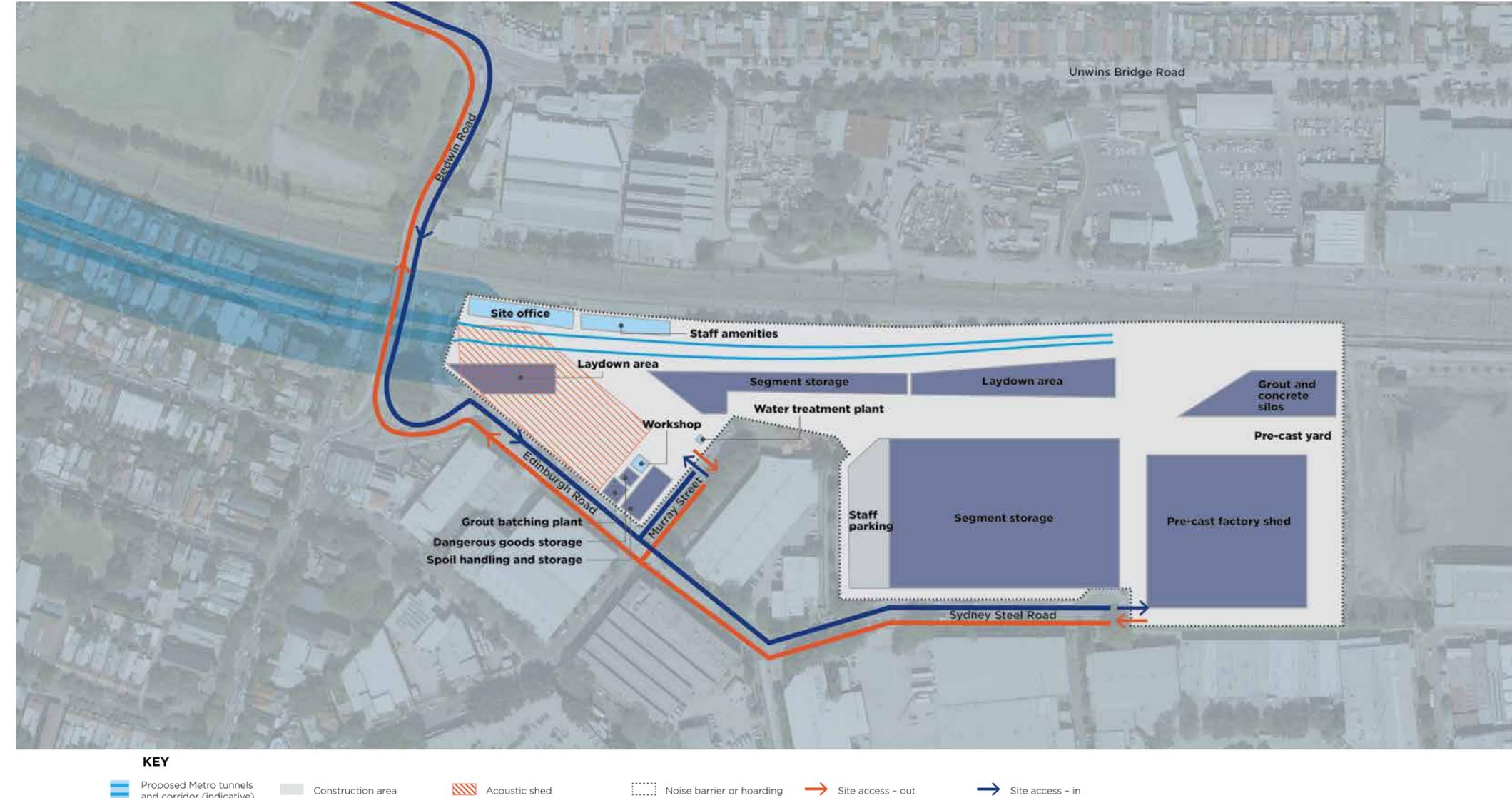
Construction at a glance

Feature	Description
Size	81,500 square metres (m <sup>2</sup> )
Site access	Murray Street (left-in and right out) Sydney Steel Road (left-in and right out)
Construction hours	<b>Demolition:</b> Monday to Friday 7 am–6 pm and Saturday 8 am–1 pm <b>All other work:</b> 24 hours a day
Truck movements	<b>Demolition:</b> Trucks 102 per day and light vehicles 80 per day <b>Excavation:</b> Trucks 234 per day and light vehicles 248 per day <b>Tunnelling and pre-cast production:</b> Trucks 444 per day and light vehicles 676 per day <b>Fit-out:</b> Trucks 194 per day and light vehicles 428 per day
Demolition	15 buildings
Landscape	A small strip of planted natives will be removed from alongside the railway line
Excavation	Cut-and-cover
Spoil removal	630,000 cubic metres (m <sup>3</sup> ) of mostly sandstone and shale by truck During the detailed design phase, we will also consider opportunities to remove spoil from this site by train
Activities	TBM launch and support Roadheader support Spoil removal Ancillary infrastructure construction Rail system fit-out Pre-cast concrete facility
Staff facilities	Offices, lunch rooms and amenities
Staff parking	About onsite 300 parking spaces Contractors may consider 'park and shuttle' services to transfer workers to and from this site
Utility and power supply	Water, sewer and telecommunications Power for TBMs will be supplied from existing cables in Princes Highway (850 metres away)
Major utility impacts	Widening and strengthening of the existing bridges over the stormwater channel Protection and/or relocation of a Transgrid 330 kilovolt (kv) cable



Feature	Description
Plant and equipment	Two tunnel boring machines Six piling rigs Four drilling jumbos 10 excavators Two front-end loaders Five bobcats Six mobile cranes Two truck-mounted cranes Six generators Six compressors Two concrete pumps Water treatment plant Water cart
Traffic changes	<b>Bedwin Road / Edinburgh Road / Edgware Road intersection</b> - new traffic lights <b>Unwins Bridge Road / Bedwin Road / May Street</b> - new right turn light from May Street into Bedwin Road
Public transport changes	Temporary rail possessions may be required and will be negotiated with Sydney Trains
Street parking changes	<b>Edinburgh Road</b> - temporary removal of about two to four on-street parking spaces as required
Noise management	There will be noise and vibration impacts at this site. Management practices to minimise impacts include: o a noise barrier or hoarding will be built around the site o an acoustic shed may be constructed over the excavation to reduce noise impacts
Pedestrian and cyclist changes	Nil
Other major projects in the area	WestConnex Stage 2: New M5 - Beverley Hills to St Peters (2015-19) WestConnex Stage 3: M4 -M5 link (2019-23) Sydney Metro City & Southwest Sydenham to Bankstown Upgrade (2017-23)

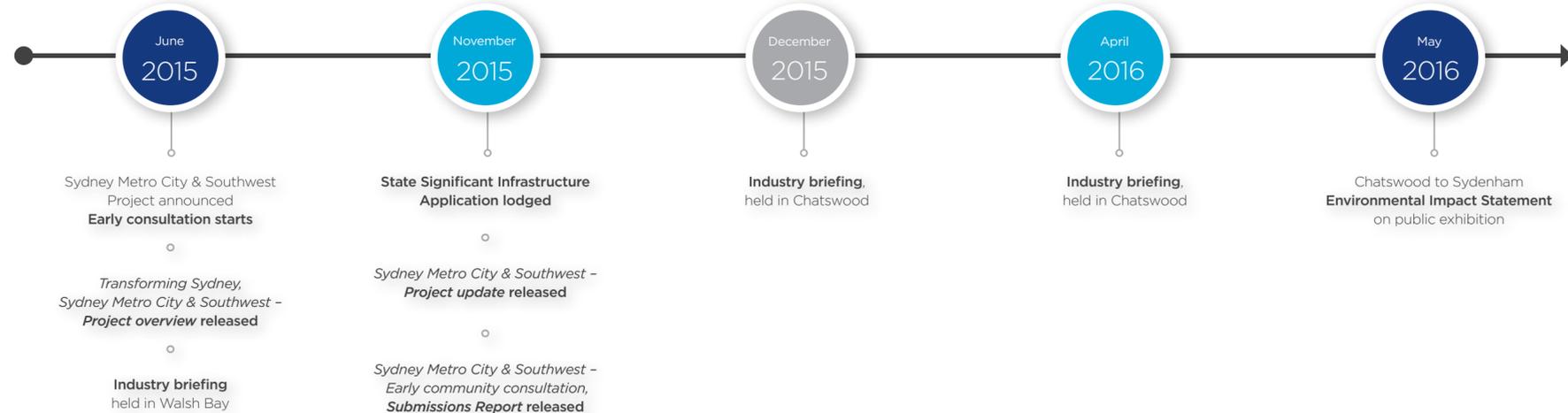
Construction site map





**WORKING  
WITH OUR  
STAKEHOLDERS**

Artist's impression of Victoria Cross Station



### Early consultation

Transport for NSW undertook consultation along the Sydney Metro City & Southwest Project corridor in June 2015. This was not a statutory consultation process, but was carried out by Sydney Metro to proactively engage with the community before starting the Environmental Impact Statement process.

The aim was to collect stakeholder and community feedback on the Project with a focus on preferred station locations, options for extra stations and information about the proposed rail line route.

Meetings were held with key stakeholders (including local government, New South Wales and Australian Government departments, peak bodies and industry associations). Around 800 people attended eight community information sessions, 10,000 people participated in our online feedback forums and the Project team received more than 1500 submissions.

Early input from the community, business and key stakeholders has assisted the Sydney Metro City & Southwest team to refine and determine preferred station locations between Chatswood and Sydenham.

### Working with Industry

Sydney Metro has held two industry briefings attended by almost 1000 industry representatives from Australian and international firms. The briefings detailed plans for the Project scope and the process for industry to contribute to the Project and take part in its delivery.

This engagement process has maximised industry input at this early stage of the Project and help ensure an outcome which provides an outstanding transport product that is value for money and puts the needs of the customer first.

### Place Managers working with the community

Our Place Managers will continue to play a vital role in maintaining close and ongoing contact with local communities and stakeholders during the design and delivery of Sydney Metro.

Their role is to be a direct point of contact between affected members of the community and the Project team.

### Contact us

**To speak to your local Place Manager or a member of the Project team, please contact us.**

- community information line: **1800 171 386**
- project email: **[sydneymetro@transport.nsw.gov.au](mailto:sydneymetro@transport.nsw.gov.au)**

**For more information, visit our website or one of our Community Information Centres:**

- [www.sydneymetro.info](http://www.sydneymetro.info)**
- Transport for NSW Community Information Centre:** 388 George Street, Sydney
- Sydney Metro Northwest Community Information Centre:** Shop 490, Castle Towers Shopping Centre, Castle Hill



**HAVE YOUR SAY**

Inside Sydney's new Metro train

The Environmental Impact Statement is on public exhibition until Monday 27 June 2016.



Government agencies, Project stakeholders and the community may make a submission on the Environmental Impact Statement to the NSW Department of Planning and Environment. At the end of exhibition, the Department will collate submissions and publish them on its website.

It is the NSW Department of Planning and Environment's policy to also place a copy of your submission on their website. If you do not want your name made available to Transport for NSW, or on the Department's website, please clearly state this in your submission.

Your submission must reach the NSW Department of Planning and Environment by Monday 27 June 2016 and must include:

1. Your name and address
2. The name of your application
3. The application number **SSI 15\_7400**
4. A brief statement on whether you support or object to the proposal
5. The reasons why you support or object to the proposal.

Your submission should be marked **Attention: Director, Transport Assessments** and can be sent via:

- o **Website:** [www.majorprojects.planning.nsw.gov.au](http://www.majorprojects.planning.nsw.gov.au) and follow the 'on exhibition' links;
- o **Post to:** **Director, Transport Assessments**  
**Department of Planning and Environment**  
**GPO Box 39, SYDNEY, NSW 2001**

Anyone lodging submissions must declare reportable political donations (including donations of \$1000 or more) made in the previous two years.

For more details, and a disclosure form, go to [www.planning.nsw.gov.au/donations](http://www.planning.nsw.gov.au/donations)

Under section 1152(5) of the *Environmental Planning and Assessment Act 1979* (NSW), the Director - General may provide copies of submissions received during the exhibition period, or a summary of the submissions, to the proponent.

All submissions and information obtained during the public exhibition period will be used in accordance with the [Privacy Statement](#). All submissions received are regarded as public documents and any information contained in them can be published in subsequent assessment documents. Copies of the submissions received on the Project may be issued to interested parties. If the author of a submission does not wish the information to be distributed, this needs to be clearly stated in the submission.

**Enquiries, please contact the NSW Department of Planning and Environment:**

- o **Phone:** **1300 305 695**
- o **Email:** [information@planning.nsw.gov.au](mailto:information@planning.nsw.gov.au)

### Where to view the Environmental Impact Statement

The Environmental Impact Statement and its accompanying documents may be viewed on the NSW Department of Planning and Environment website: [www.majorprojects.planning.nsw.gov.au](http://www.majorprojects.planning.nsw.gov.au) and [www.sydneymetro.info](http://www.sydneymetro.info)

You can also view the documents at:

- o **NSW Department of Planning and Environment Information Centre:** 23-33 Bridge Street, Sydney
- o **Transport for NSW Community Information Centre:** 388 George Street, Sydney
- o **Sydney Metro Northwest Community Information Centre:** Shop 490, Castle Towers Shopping Centre, Castle Hill

- o **Willoughby Council Customer Service Centre:** Level 4, 31 Victor Street, Chatswood
  - Willoughby Council Libraries
  - Chatswood Library on The Concourse: 409 Victoria Avenue, Chatswood
  - Artarmon Library: 139 Artarmon Road, Artarmon
- o **North Sydney Council Customer Service Centre:** 200 Miller Street, North Sydney
  - Stanton Library: 234 Miller Street, North Sydney
- o **Lane Cove Council:** 48 Longueville Road, Lane Cove
- o **Crows Nest Centre:** 2 Ernest Place, Crows Nest
- o **City of Sydney Customer Service Centre:** Town Hall House Level 2, 456 Kent Street, Sydney
  - City of Sydney Libraries
  - Haymarket: 744 George Street, Sydney
  - Waterloo Town Hall: 770 Elizabeth Street, Waterloo
- o **State Library:** Macquarie Street, Sydney
- o **Nature Conservation Council:** Level 2, 5 Wilson Street, Newtown
- o **Marrickville Council Customer Service Centre:** 2-14 Fisher Street, Petersham
  - Marrickville Council Libraries
  - Marrickville Town Hall: Corner Marrickville and Petersham Roads, Marrickville
  - St Peters Town Hall: Unwins Bridge Road, Sydenham.

### Community information sessions

The Project team has organised a series of community information sessions where displays and information about the Environmental Impact Statement will be available.

You are invited to attend these sessions and meet expert members of the Project team who will be there to answer any questions you may have. There is no need to make a booking.

Date and time	Location
<b>Saturday 21 May</b> 10 am-2 pm	<b>Dougherty Community Centre</b> 7 Victor Street, Chatswood
<b>Wednesday 25 May</b> 4-8 pm	<b>Masonic Centre:</b> 66 Goulburn Street, Sydney
<b>Saturday 28 May</b> 10 am-2 pm	<b>McMahons Point Community Centre</b> 165 Blues Point Road, McMahons Point
<b>Wednesday 1 June</b> 4-8 pm	<b>Northside Conference Centre</b> Oxley Street & Pole Lane, St Leonards
<b>Saturday 4 June</b> 10 am-2 pm	<b>Redfern Oval</b> 51 Redfern Street, Redfern
<b>Thursday 16 June</b> 4-8 pm	<b>Concordia Club</b> 1 Richardson Crescent, Tempe

### Information stalls

The Project team will also have a stall at the following community markets:

Date and time	Location
<b>Saturday 28 May</b> 8 am-12 pm	<b>Kirribilli Markets</b> Kirribilli Bowling Green, Kirribilli
<b>Saturday 18 June</b> 9 am-1 pm	<b>Crows Nest Markets</b> Ernest Place, Crows Nest



Aerial view of Sydney CBD

[sydneymetro.info](http://sydneymetro.info)

[sydneymetro@transport.nsw.gov.au](mailto:sydneymetro@transport.nsw.gov.au)

 If you require the services of an interpreter, please contact the **Translating and Interpreting Service on 131 450** and ask them to call **Sydney Metro on 1800 171 386**. The interpreter will then assist you with translation.

Information in this document has been prepared in good faith and is correct at the time of printing. May 2016. © Sydney Metro 2016

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