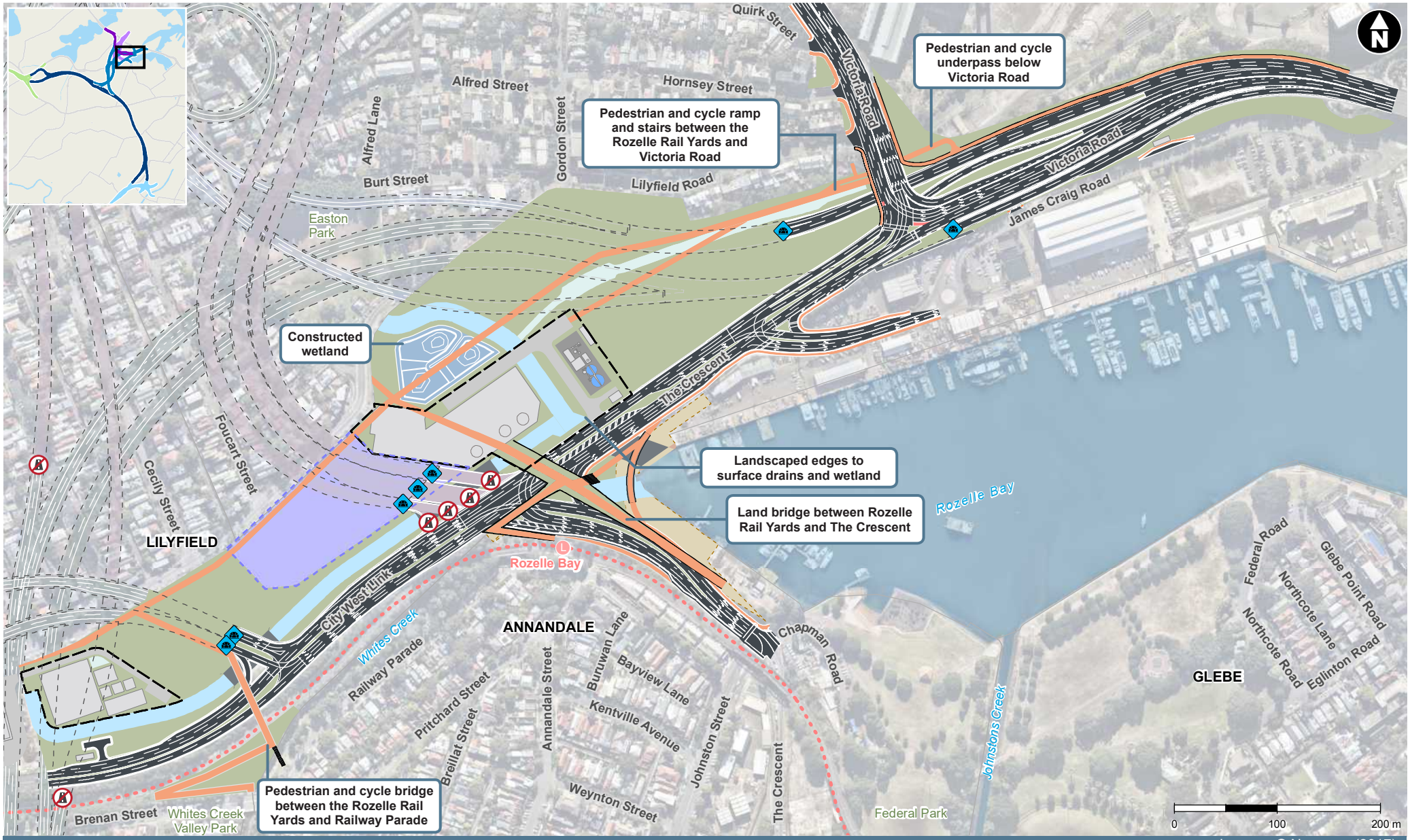


Figure 5-33 Urban design and landscaping works to be carried out by the project – Rozelle Rail Yards

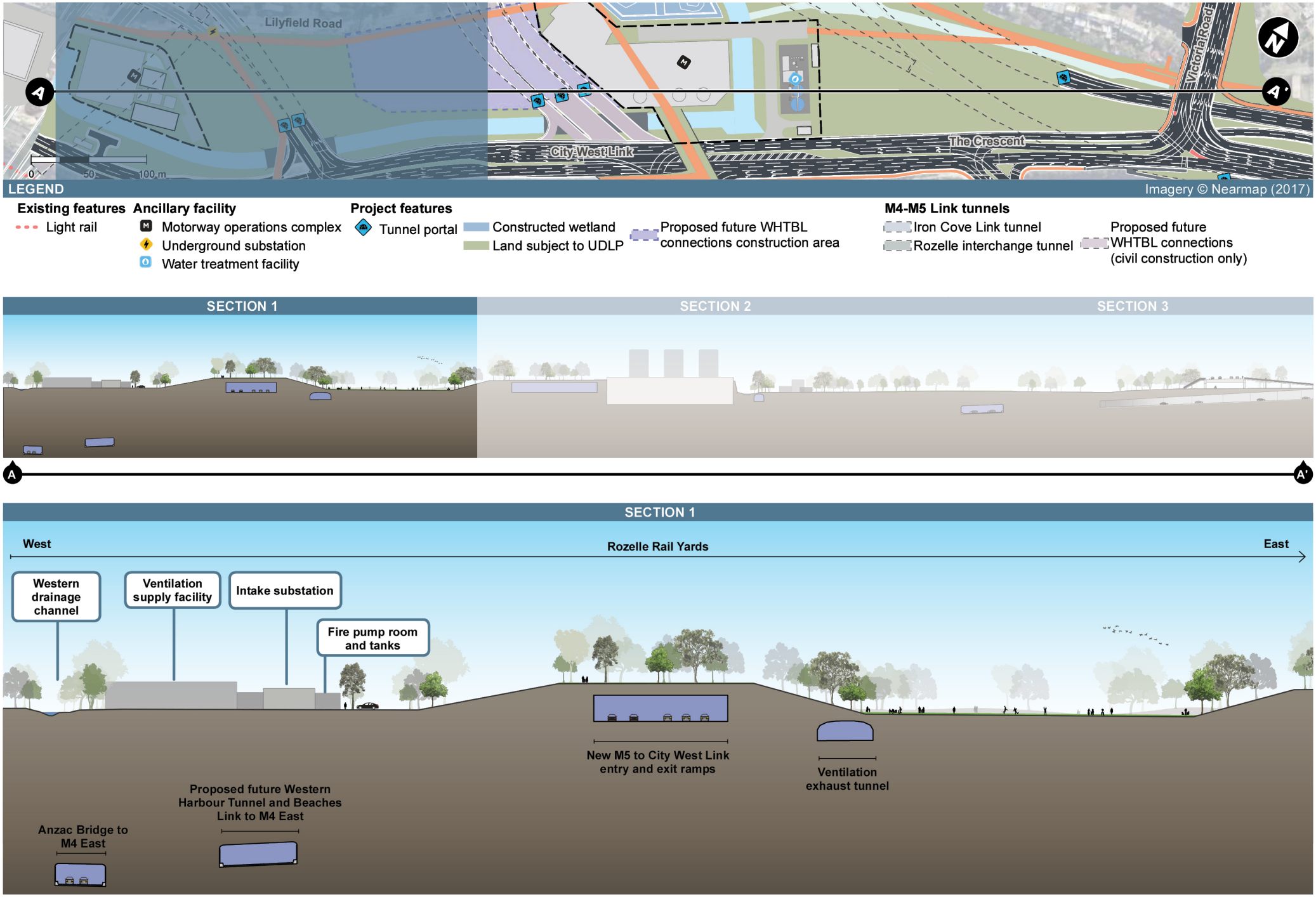


Figure 5-34 Long-section of the Rozelle Rail Yards - east-west - section 1

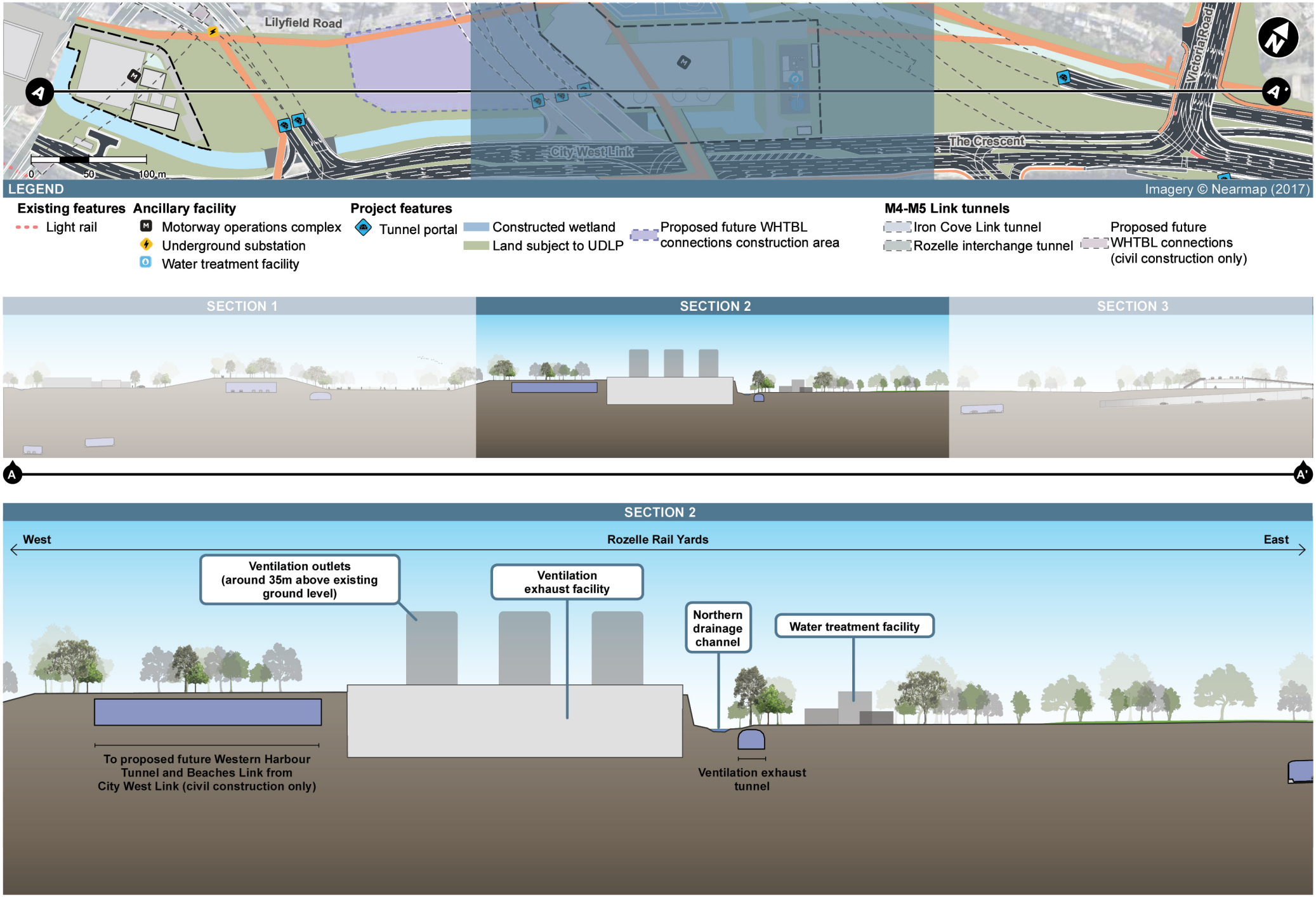


Figure 5-35 Long-section of the Rozelle Rail Yards - east-west - section 2

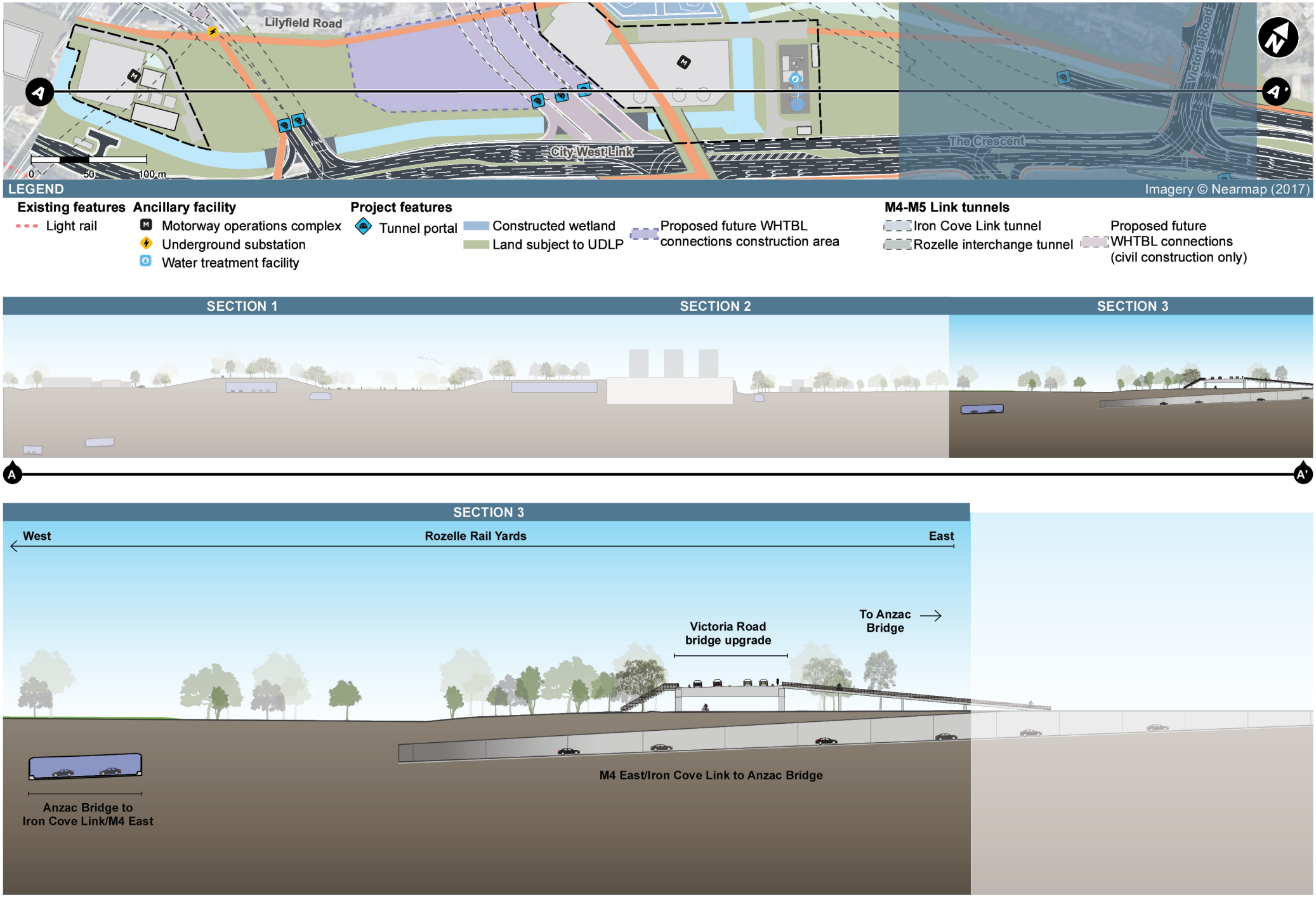


Figure 5-36 Long-section of the Rozelle Rail Yards - east-west - section 3

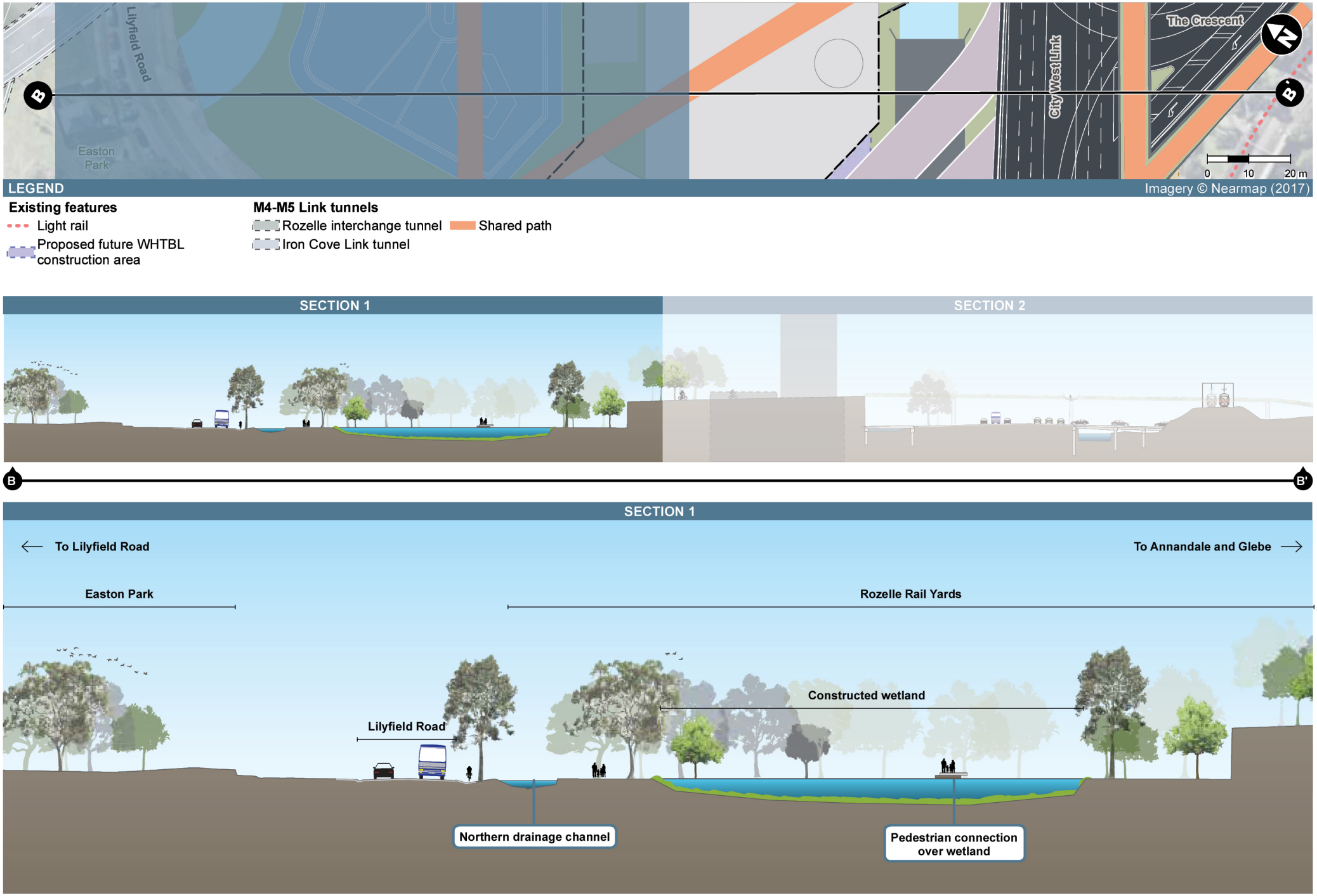


Figure 5-37 Long-section of the Rozelle Rail Yards - north-south - section 1

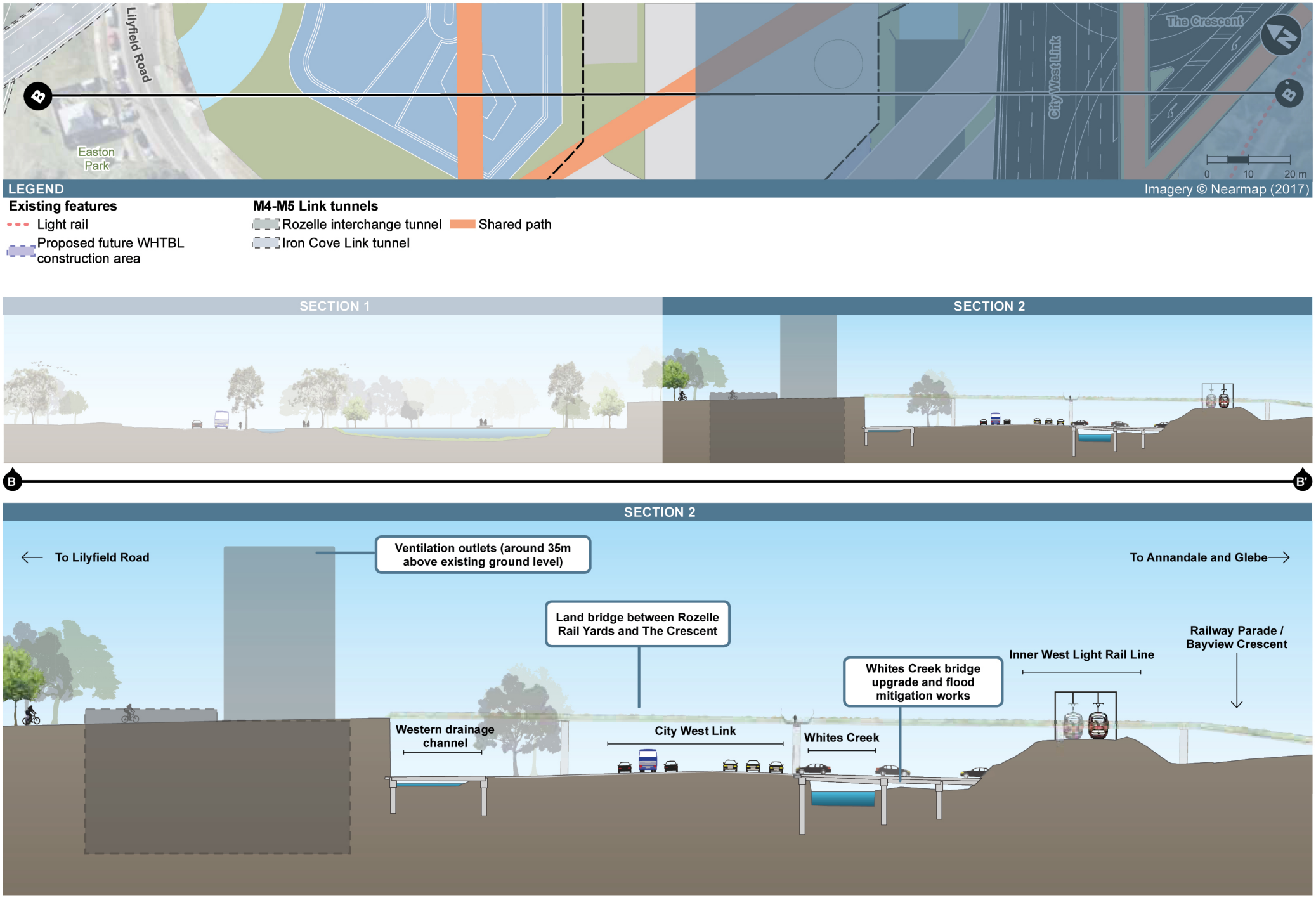


Figure 5-38 Long-section of the Rozelle Rail Yards - north-south - section 2

5.7 Iron Cove Link surface works

5.7.1 Overview

The Iron Cove Link surface works would connect the Iron Cove Link tunnels with Victoria Road around the eastern abutment of Iron Cove Bridge and would include:

- Four new lanes (two eastbound and two westbound) to connect Victoria Road to the Iron Cove Link including dive structure and tunnel portals
- Realignment and modifications to the Victoria Road eastbound and westbound carriageways between the eastern abutment of Iron Cove Bridge and around Springside Street at Rozelle. The Victoria Road surface lanes would travel on the northern and southern sides of the Iron Cove Link lanes
- Construction and installation of the Iron Cove Link ventilation facility on the southern side of the Victoria Road carriageway between Springside Street and Callan Street at Rozelle
- A ventilation outlet in the middle of the widened Victoria Road carriageway connected to the ventilation exhaust facility
- Modifications to the right turn from Victoria Road into Terry Street. This right-turn lane would extend across the cut-and-cover structures for the Iron Cove Link between the eastbound and westbound Victoria Road carriageways
- Closing Clubb Street at Victoria Road, creating a permanent cul-de-sac
- Tie-in works to connect the realigned westbound carriageway of Victoria Road with Toelle and Callan streets
- Landscaping on the southern side of Victoria Road between around Springside and Byrnes streets
- Realignment and improvements to the shared pedestrian and cyclist path that runs along the footpath on the southern side of the westbound carriageway of Victoria Road, including reinstatement of the Bay Run connection to Iron Cove Bridge
- A new stormwater bioretention facility and upgrades to the existing car park within King George Park (adjacent to Manning Street) at Rozelle, to treat stormwater runoff generated by the surface road works associated with the Iron Cove Link. Around 30 car-parking spaces would be formalised as part of these works.

The configuration and layout of the Iron Cove Link surface works are shown in **Figure 5-39** and **Figure 5-40**. An indicative cross-section of the Victoria Road carriageways and the Iron Cove Link entry and exit ramps is shown in **Figure 5-41**. An indicative layout of the bioretention facility at Manning Street at Rozelle, within King George Park, is shown in **Figure 5-43**.

The Iron Cove Link would provide motorists with an underground alternative to Victoria Road. A traffic analysis shows the Iron Cove Link would result in reductions in traffic demand along Victoria Road between Iron Cove Bridge and the intersection with The Crescent. The traffic analysis carried out for this section of Victoria Road is provided in **Chapter 8** (Traffic and transport) and in **Appendix H** (Technical working paper: Traffic and transport).

By reducing traffic demand along sections of Victoria Road, the Iron Cove Link could enable potential future revitalisation opportunities along Victoria Road, including the provision of better active transport and public transport facilities. These suggested active transport and public transport facilities do not form part of the project and would be subject to separate environmental assessment as appropriate.

Further detail on surface road upgrades at Victoria Road to accommodate the tunnel entry and exit ramps and tunnel portals is provided in the following section. The Iron Cove Link motorway operations complex (MOC4) is described in **section 5.8.1**.

5.7.2 Bridges and structures at the Iron Cove Link surface works

The Iron Cove Link surface works would include construction of tunnel dive and cut-and-cover structures between the eastbound and westbound Victoria Road carriageways for the Iron Cove Link entry and exit ramps.

The cut and cover structures would extend from the tunnel portals near Callan Street to around Toelle Street. The dive structures for each tunnel portal would be located within the cut-and-cover tunnel sections. The cut-and-cover structures would support the right-turn lane from Victoria Road to Terry Street, and a pedestrian path connecting Toelle and Terry streets (via a signalised pedestrian crossing).

A typical cross-section of the structural arrangement of the cut-and-cover tunnel and dive structures is shown in **Figure 5-22**. The location of the cut-and-cover structures is shown in **Figure 5-39** and a cross-section is shown in **Figure 5-41**.

5.7.3 Victoria Road intersection modifications

Works to intersections would be carried out to integrate adjoining local roads with the new alignment of Victoria Road. These works are described in **Table 5-6** and shown in **Figure 5-39** and **Figure 5-40**. Access to properties would be maintained during these works.

Table 5-6 Victoria Road near Iron Cove Bridge - intersection modifications

Intersection	Modifications
Victoria Road/Byrnes Street	· Existing cul-de-sac at the northern end of Byrnes Street at Rozelle would be retained but moved south.
Victoria Road/Clubb Street	· Closure of Clubb Street to the south of Victoria Road and establishment of a cul-de-sac and a pedestrian connection to Victoria Road.
Victoria Road/Toelle Street	· Tie-in works to connect with the realigned westbound carriageway of Victoria Road.
Victoria Road/Callan Street	· Tie-in works to connect with the realigned westbound carriageway of Victoria Road.
Victoria Road/Terry Street	· Realignment of the signalised right turn lane from the westbound Victoria Road carriageway into Terry Street · Tie-in works to connect Terry Street with the eastbound carriageway of Victoria Road.

Figure 5-39 Iron Cove Link surface works - Map 1

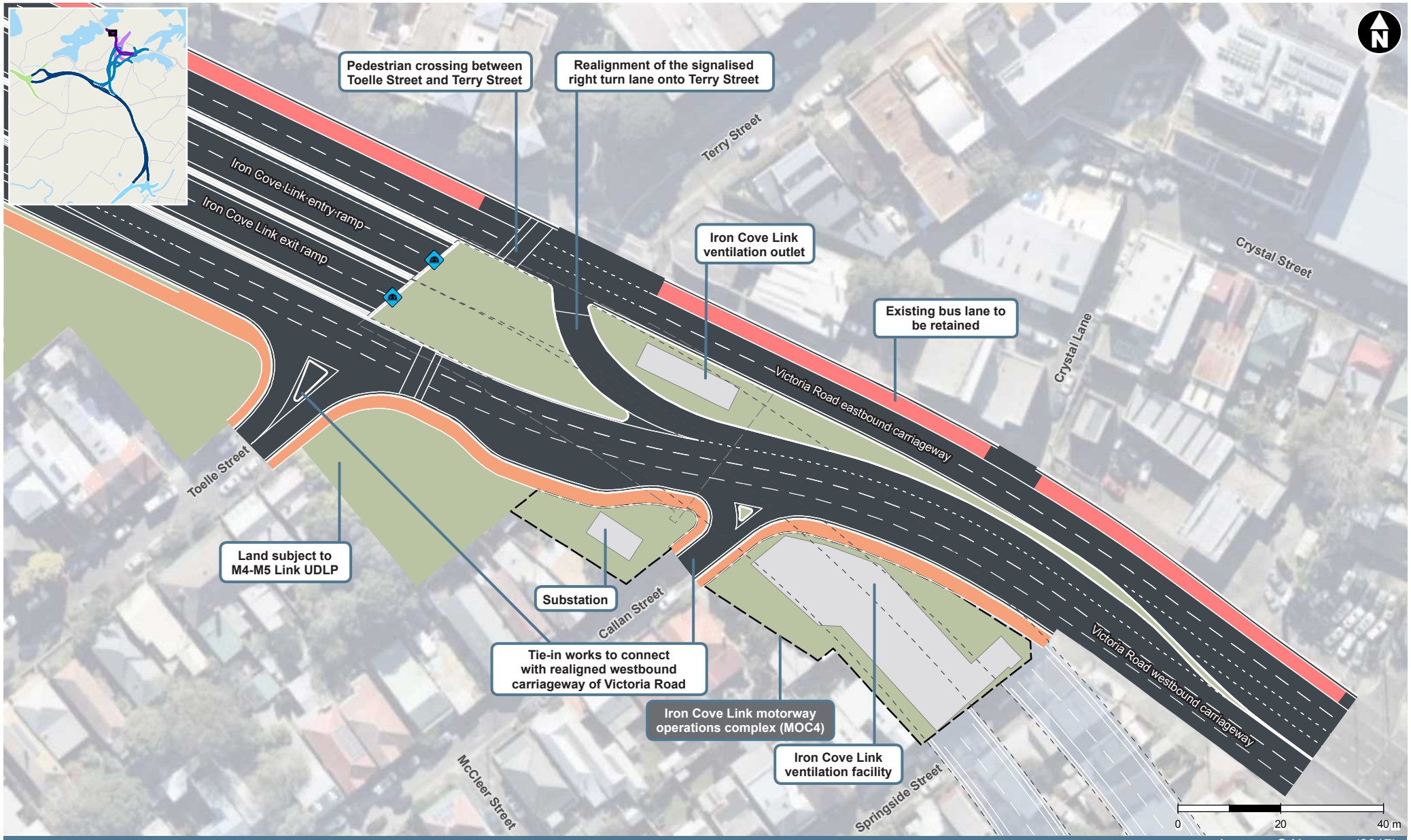
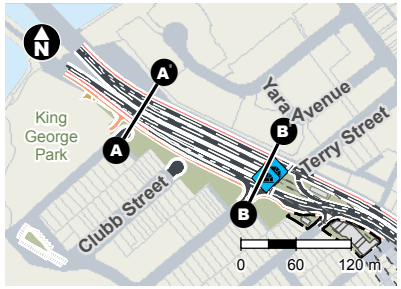
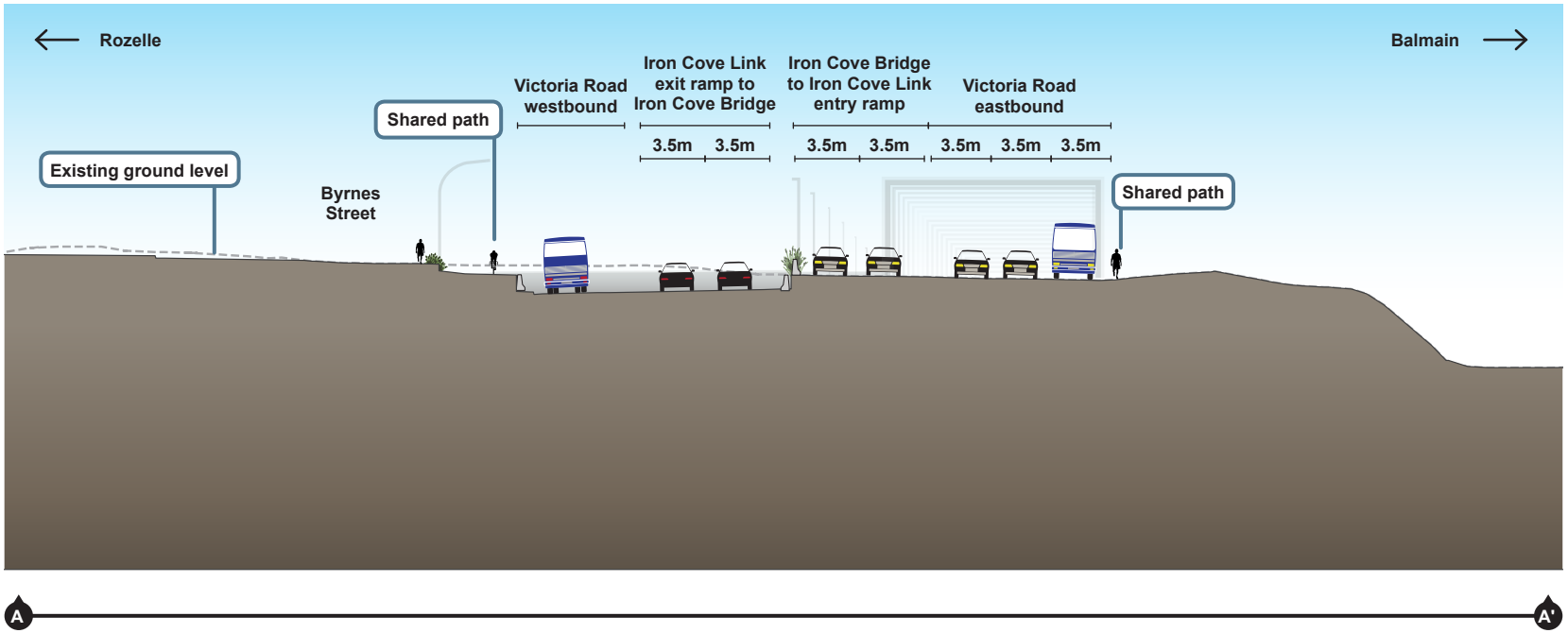


Figure 5-40 Iron Cove Link surface works - Map 2



LEGEND

- Existing road corridor
- Iron Cove Link tunnel
- Surface road
- Bus lane
- Operational facilities
- Land subject to UDLP
- Shared path
- Tunnel portal



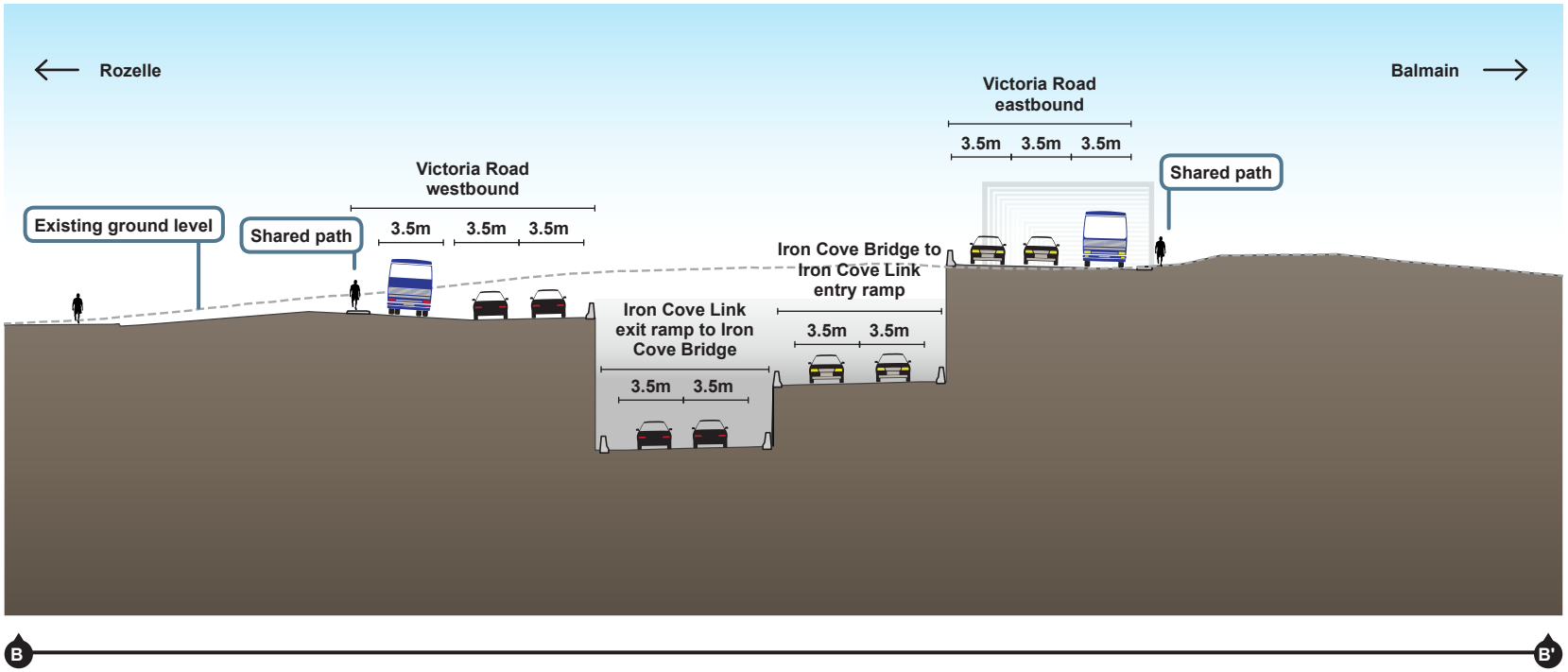


Figure 5-41 Indicative cross-section - Victoria Road carriageways and Iron Cove Link entry and exit ramps

5.7.4 Pedestrian and cyclist facilities

An upgraded shared pedestrian and cyclist path on the southern side of the westbound carriageway of Victoria Road would be provided as part of the Iron Cove Link surface works (see **Figure 5-39** and **Figure 5-40**). This infrastructure has been designed to maintain and enhance pedestrian and cyclist connectivity to local and regional destinations including King George Park, the Bay Run and the new public open space and active transport links to be provided at the Rozelle Rail Yards.

Detailed descriptions of the active transport connections to be provided and potentially enabled along Victoria Road at Rozelle as part of the Iron Cove Link are provided in **Appendix N** (Technical working paper: Active transport strategy).

5.7.5 Urban design and landscape

As part of the project, urban design and landscaping works would be carried out adjacent to disturbed areas associated with the Iron Cove Link surface works. The urban design and landscaping works that would be carried out as part of the Iron Cove Link surface works are shown in **Figure 5-42** and would include (but not be limited to):

- Detailed review and finalisation of the architectural treatment of the motorway operational infrastructure
- Earthworks to reshape the land around the motorway operational infrastructure
- Reinstatement of an improved pedestrian and cyclist path along the southern side of Victoria Road, that would connect to The Bay Run and Iron Cove Bridge
- Provision of new open space, including landscaping
- Revegetation, including tree planting, at key locations including:
  - Around permanent operational infrastructure such as the ventilation facility
  - Adjacent to pedestrian and cyclist paths
  - Along the southern boundary.

A concept design for these urban design and landscaping works has been prepared having regard to the urban design objectives and principles in **section 5.2**. The concept design is included in **Appendix L** (Technical working paper: Urban design) and **Chapter 13** (Urban design and visual amenity) and includes identification of potential future uses of land around the Iron Cove Link surface works that could be delivered as part of the urban design and landscaping works, including the provision of social and community facilities.

The concept design would be refined during the development of a UDLP, which would be prepared based on the detailed design and in accordance with relevant commitments in this EIS, and in consultation with relevant councils, stakeholders and the community.

5.7.6 Integration with public transport

Changes to bus infrastructure

The project would not require permanent changes to bus infrastructure around the Iron Cove Link. Bus lanes and AM and PM peak hour restrictions would be retained in generally the same configuration as the existing arrangement. Temporary changes to bus infrastructure are outlined in **Chapter 6** (Construction work).

The project offers a flexible design which does not preclude bus priority measures being included in the future, including along Victoria Road. Roads and Maritime and Transport for NSW will continue to work together to deliver Sydney's Bus Future, which may be extended to the area along Victoria Road around the Iron Cove Link tunnel portals in due course, at which point the surface road network can be adapted to include such measures.

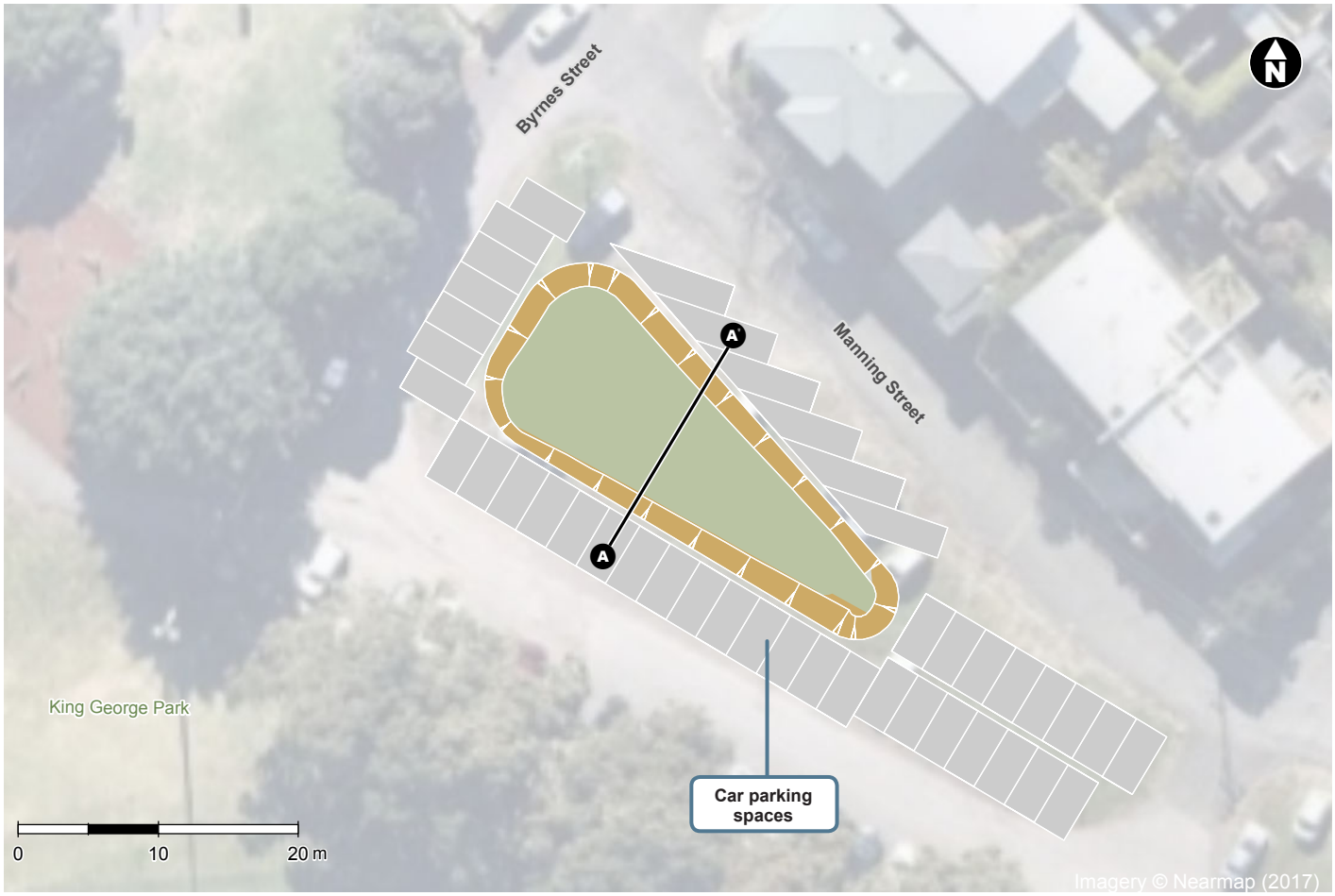
5.7.7 Potential future uses for remaining land around the Iron Cove Link surface works

In most cases, at the end of construction, land around the Iron Cove Link surface works would be landscaped to be consistent with the UDLP to be prepared for the project.

Remaining project land (land required for construction but not required for operation) that does not form part of the UDLP would be rehabilitated at the end of the construction period and made suitable for either return to the previous owner or lessee, or potential development for permissible uses under land use zoning provisions.

Where this is the case, future development would be subject to separate development assessment and approval and the restrictions of the relevant consent authority. The project would not rezone or consolidate remaining project land and therefore there would be no changes to land use zoning for future development around the Iron Cove Link surface works.

Figure 5-42 Urban design and landscaping works to be carried out by the project – Iron Cove Link



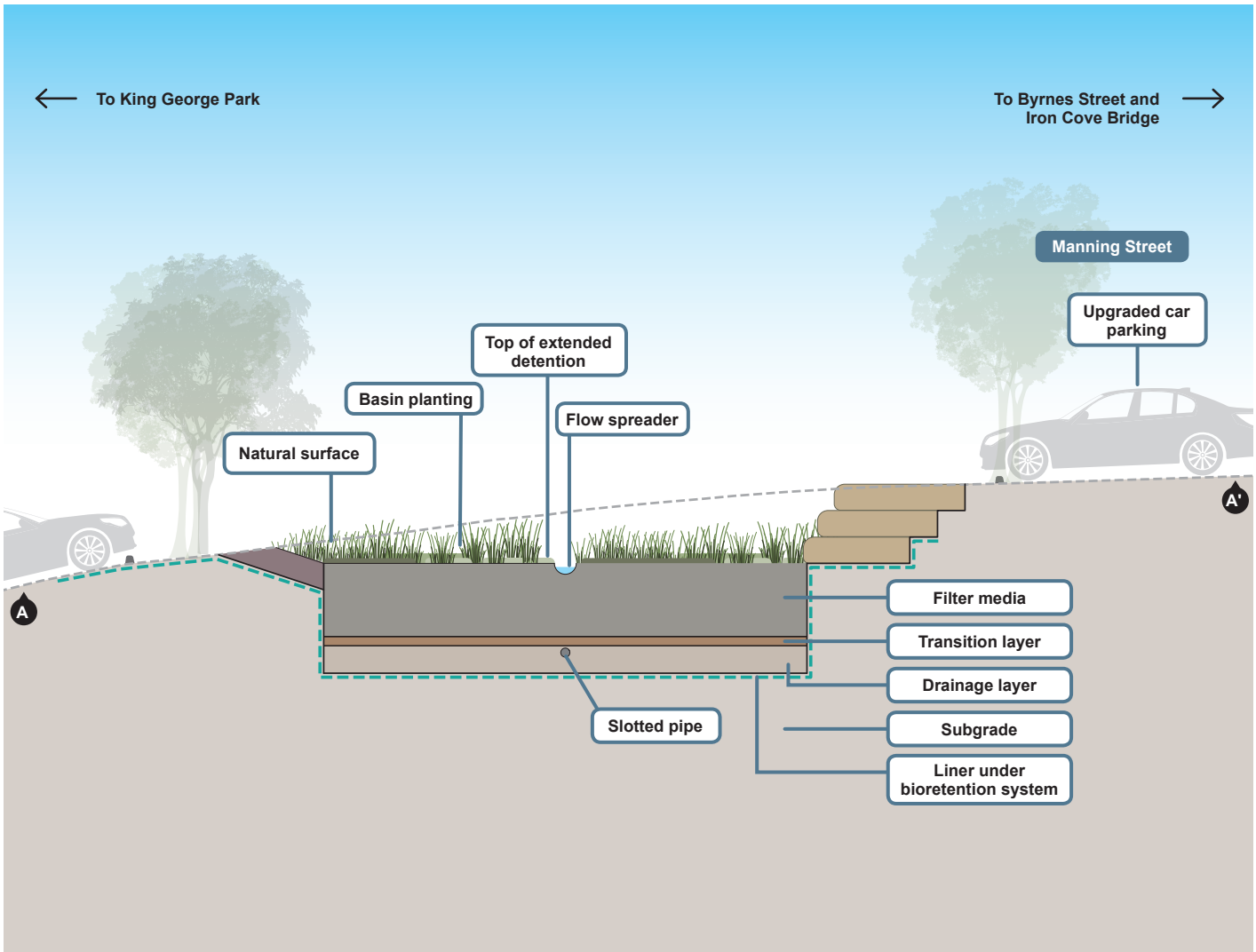


Figure 5-43 Indicative layout of the bioretention facility at Manning Street at Rozelle

5.8 Motorway operational ancillary infrastructure

The project would require permanent operational ancillary infrastructure including:

- Five motorway operations complexes (MOCs)
- Operational management control systems and incident and emergency response infrastructure
- Tunnel ventilation systems and facilities
- Drainage and water treatment facilities
- Noise attenuation measures
- Utilities
- Roadside furniture and lighting.

5.8.1 Motorway operations complexes

Most operational ancillary infrastructure would be established in five main motorway operations complexes (MOCs). The locations of these motorway operations complexes are shown in **Figure 5-44** to **Figure 5-48**. Operational infrastructure outside of the motorway operations complexes is also described in this section, and in **section 5.9** and **section 5.10**.

Motorway operations complexes for the project would comprise:

- The Darley Road motorway operations complex (MOC1) at Leichhardt, located south of City West Link and the Inner West Light Rail line on land occupied during construction by the Darley Road civil and tunnel site (C4)
- The Rozelle West motorway operations complex (MOC2) at Rozelle, located at the western end of the Rozelle Rail Yards on land occupied during construction by the Rozelle civil and tunnel site (C5)
- The Rozelle East motorway operations complex (MOC3) at Rozelle, located at the central/eastern end of the Rozelle Rail Yards, on land occupied during construction by the Rozelle civil and tunnel site (C5)
- The Iron Cove Link motorway operations complex (MOC4) at Rozelle, located south of the realigned Victoria Road carriageway between Callan Street and Springside Street at Rozelle, on land occupied during construction by the Iron Cove Link civil site (C7)
- The Campbell Road motorway operations complex (MOC5) at St Peters, located within the St Peters interchange, south of Campbell Road at St Peters, on land occupied during construction by the Campbell Road civil and tunnel site (C10).

The Rozelle West motorway operations complex (MOC2) and the Rozelle East motorway operations complex (MOC3) would both be located within the Rozelle Rail Yards. The need for two separate motorway operations complexes within the Rozelle Rail Yards is due to the requirement to co-locate facilities (ie the water treatment plant next to the constructed wetland) and to locate the ventilation supply and exhaust facilities as close to the associated ventilation supply and exhaust tunnels as possible. Opportunities to co-locate the motorway operations complexes within the Rozelle Rail Yards would be investigated during detailed design.

Operational ancillary infrastructure that would be located within each motorway operations complex is summarised in **Table 5-7** and detailed in the following sections.

Table 5-7 Summary of motorway operations complexes and operational ancillary infrastructure

Operational ancillary facilities	Motorway operations complex				
	Darley Road (MOC1)	Rozelle West (MOC2)	Rozelle East (MOC3)	Iron Cove Link (MOC4)	Campbell Road (MOC5)
Ventilation facility		ü[1]	ü[2]	ü	ü
Emergency smoke extraction facility					ü
Deluge water tanks[3, 4]		ü			
Car parking	ü	ü	ü	ü	ü
Substation/power supply	ü[5]	ü	ü	ü	ü
Workshop/offices	ü	ü	ü	ü	ü
Storage	ü	ü	ü	ü	ü
Water treatment plant/infrastructure	ü		ü		

Notes:

[1] Rozelle ventilation supply facility

[2] Rozelle ventilation exhaust facility

[3] Deluge water tanks at the Parramatta Road ventilation facility (being built as part of the M4 East project) would be used for the M4-M5 Link project

[4] Deluge water tanks at the at the north-western perimeter of the St Peters interchange (being built as part of the New M5 project) would also be used for the M4-M5 Link. The location of these is shown in **Figure 5-9**

[5] The need for a substation at the Darley Road motorway operations complex (MOC1) is being investigated and would be confirmed during detailed design

Figure 5-44 Darley Road motorway operations complex (MOC1)

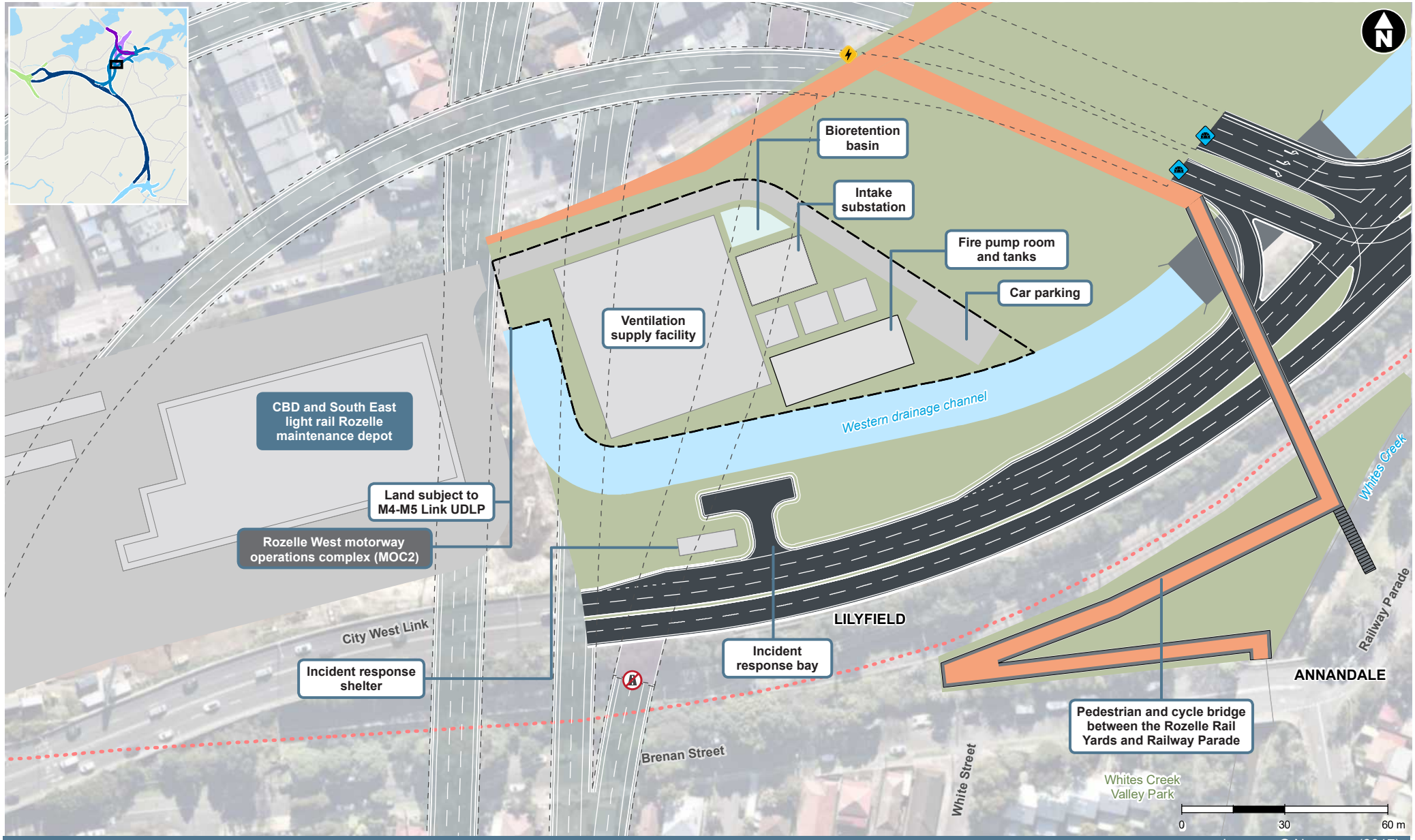


Figure 5-45 Rozelle West motorway operations complex (MOC2)

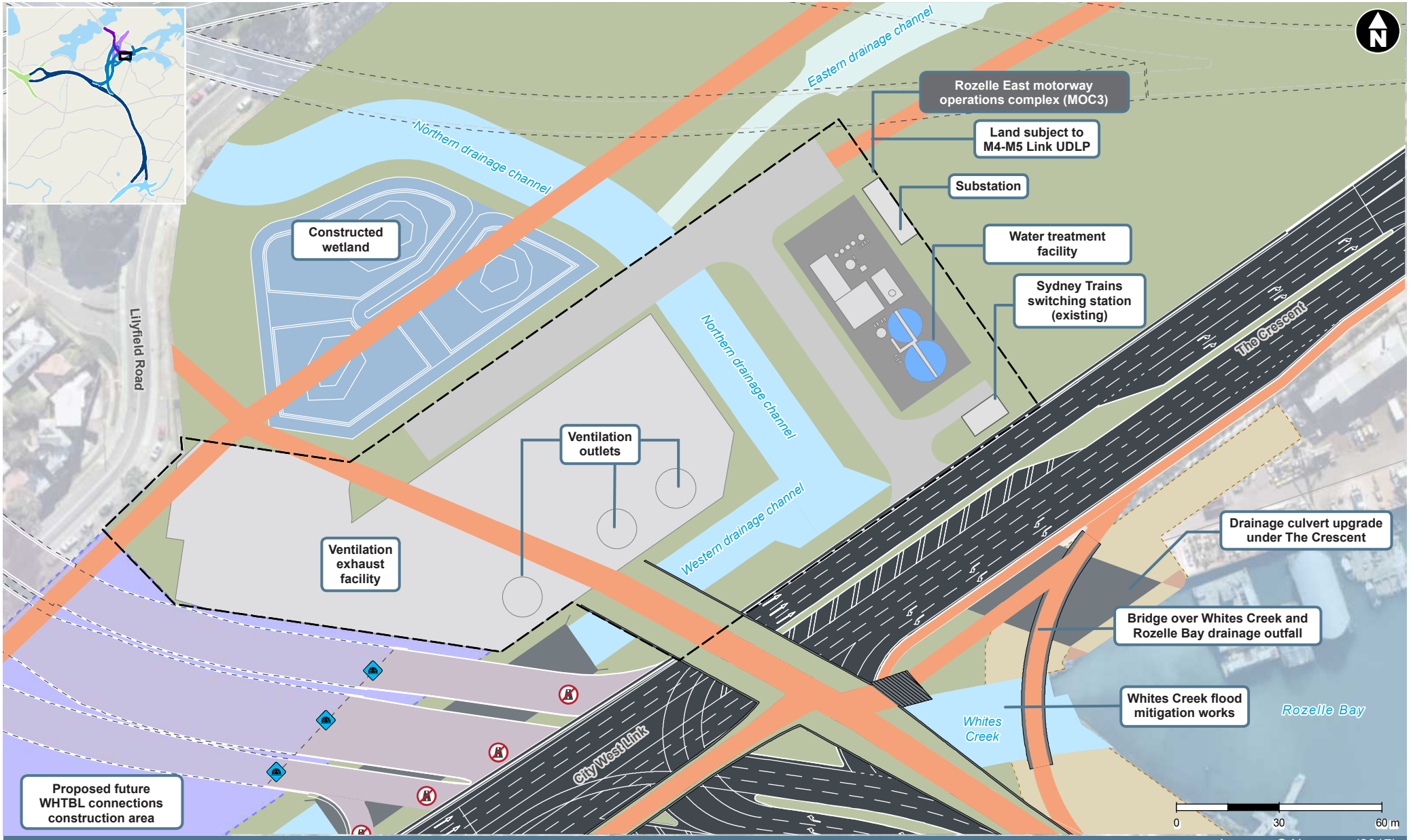


Figure 5-46 Rozelle East motorway operations complex (MOC3)

Figure 5-47 Iron Cove Link motorway operations complex (MOC4)

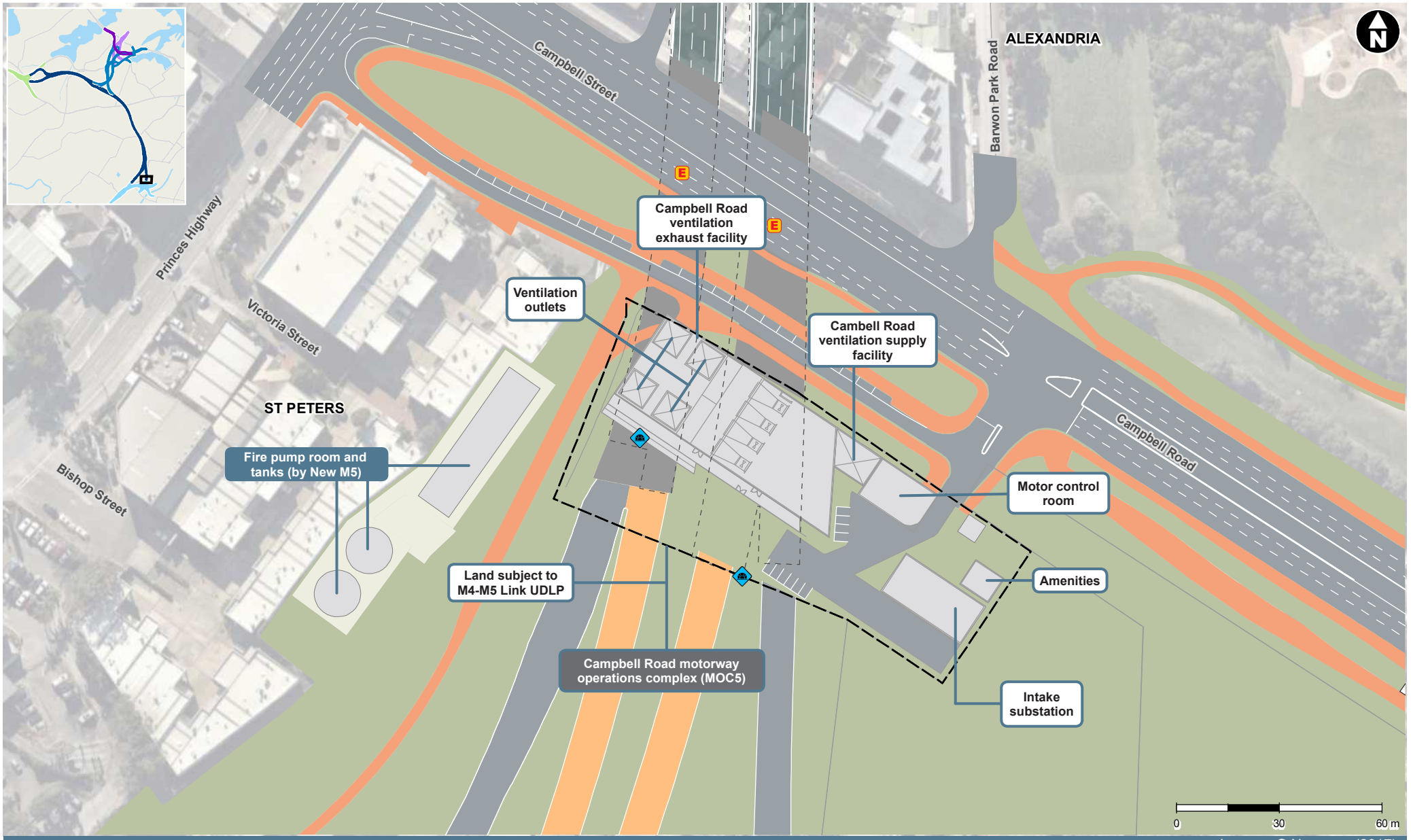


Figure 5-48 Campbell Road motorway operations complex (MOC5)

5.8.2 Ventilation system and facilities

The project's ventilation system has been designed to:

- Ensure the safety and health of motorists using the tunnels during normal operation, heavy traffic conditions and emergency conditions
- Ensure that air inside and outside the tunnels meets the air quality criteria relevant to the project as described in **Chapter 9** (Air quality)
- Operate in a safe, effectively controlled and managed manner, including during major and minor incidents
- Meet the requirements of the Australian Government's Civil Aviation Safety Authority (CASA) noting the limitations on the velocity and height of plume rise as well as limitations on the height of buildings and structures around Sydney Airport as described in **Chapter 25** (Hazard and risk)
- Minimise the consumption of energy and other resources, where doing so would not jeopardise the health and amenity of motorists using the tunnels or the achievement of applicable air quality criteria inside and outside the tunnels
- Integrate with the adjoining M4 East and New M5 tunnels, and the proposed future Western Harbour Tunnel and Beaches Link.

In-tunnel air quality design criteria

The tunnel ventilation system has been designed to achieve acceptable in-tunnel air quality outcomes for carbon monoxide (CO), nitrogen dioxide (NO_2) and visibility (as a measure of in-tunnel particulate matter concentrations) for traffic volumes up to and including the maximum traffic throughput capacity of the tunnels.

In-tunnel air quality criteria for the engineering design of the ventilation system have been based on:

- For CO, a tunnel average of 87 parts per million as a 15-minute average and 50 parts per million as a 30-minute average exposure based on the *World Health Organisation Guidelines for Indoor Air Quality* (World Health Organisation 2010) (WHO Guidelines). These averages are to be applied for all possible journeys through the tunnel, including entry and exit ramps. The WHO Guidelines recommend a maximum short-term exposure (15-minute exposure) of 100 mg/m^3 (equivalent to 87 parts per million at 25ºC) and long-term exposure (30-minute exposure) of 60 mg/m^3 (equivalent to 50 parts per million at 25ºC)
- For NO_2, an average concentration of 0.5 parts per million for the length of all possible travel routes through the tunnel, including entry and exit ramps (M4-M5 Link) measured as a 15-minute rolling average, based on the conditions of approval for the M4 East and New M5 projects
- For measurements of visibility or in-tunnel haze, an extinction coefficient[1] of $0.005m^{-1}$ based on the recommendations of the Permanent International Association of Road Congresses (PIARC) for free-flowing peak traffic travelling speeds of 50 to 100 kilometres per hour.

Overview of the ventilation system design and operation

The project would include longitudinally ventilated tunnels, which rely on the movement of air through the tunnels in the same direction as the flow of traffic. This air moves from the tunnel entry portals towards ventilation facilities located near the tunnel exit portals, before it is emitted through elevated outlets. Other tunnel ventilation configurations considered as alternatives to this method of tunnel ventilation are discussed in **Chapter 4** (Project development and alternatives).

With longitudinal ventilation, air would move through the project tunnels using two mechanisms, namely:

[1]Visibility is reduced by the scattering and absorption of light by particles suspended in the air. The measurement of visibility in a tunnel (using an opacity meter) is based on the concept that a light beam 'decays' (reduces in intensity) as it passes through air. The level of decay can therefore be used to determine the opacity of the air. For tunnel ventilation, visibility is expressed by the extinction coefficient K.

- The 'piston effect', caused by the movement of vehicles through the project tunnels. The piston effect is an aerodynamic effect caused by the movement of vehicles as they enter and pass through the project tunnels, pushing air in front of them, and pulling fresh air in behind them
- Jet fans would be installed in the ceiling of the project tunnels and would be orientated along the tunnels. The fans would operate to assist the piston effect if for any reason it is not sufficient to keep enough air moving through the tunnels.

Through a combination of the piston effect and the operation of jet fans, air would be moved from the entry portals of the mainline tunnels and on-ramps in a single forward direction (the direction of traffic flow) through the tunnels. Before the tunnel air reaches the exit portals, the air would be drawn from the tunnels into the ventilation outlets using large exhaust fans (referred to as axial fans).

The project has been designed to avoid the emission of tunnel air from the exit portals. This is achieved by the inclusion of the axial fans, which create a difference in air pressure between the ventilation exhaust facility offtake point and the tunnel exit portals. This pressure difference is used to draw air back into the tunnels from the exit portals against the flow of traffic, preventing tunnel air from escaping from the exit portals. Air drawn from the tunnels using axial fans would be mixed with fresh air and expelled from the elevated ventilation outlets. Ventilation outlets provide an effective means of dispersing air drawn from the tunnels. Further detail regarding ventilation outlets and potential air quality impacts associated with ventilation outlet emissions is provided in **Chapter 9** (Air quality).

In the unlikely event of a fire within the tunnels, the jet fans in the ceiling of the tunnels would be operated to prevent smoke spreading upstream of the fire where traffic is likely to be stopped behind an incident. Smoke would be forced in the direction of vehicle travel as vehicles in front of the fire would potentially be able to safely drive out of the tunnel ahead of the smoke. The fire and life safety systems (see **section 5.8.3**) would operate to bring the fire under control, and to remove smoke from the tunnels.

Depending on the location of a fire, smoke would be contained and removed from the tunnels from the nearest practical and safe point, which may be:

- The ventilation facilities located at Haberfield, Rozelle, Iron Cove or St Peters
- The tunnel portals, if the fire is close to a portal.

Further details of tunnel fire hazards and their management are provided in **Chapter 25** (Hazard and risk).

Ventilation facilities

Ventilation facilities include ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels.

Three new ventilation facilities would be provided as part of the project, including:

- The Rozelle ventilation facility at the Rozelle Rail Yards, which would include a ventilation supply facility at the Rozelle West motorway operations complex (MOC2) and a ventilation exhaust facility at the Rozelle East motorway operations complex (MOC3)
- The Iron Cove Link ventilation facility at Rozelle
- The Campbell Road ventilation facility at St Peters, within the St Peters interchange site.

In addition, part of the Parramatta Road ventilation facility at Haberfield, being built as part of the M4 East project, would be fitted out and used by the M4-M5 Link project.

Key components of the project's ventilation systems are provided in **Table 5-8**. The locations of ventilation facilities for the project are shown in **Figure 5-45** to **Figure 5-48**. The layouts of the ventilation tunnels at Rozelle and St Peters are shown in **Figure 5-49** and **Figure 5-50**. The indicative cross-section for the ventilation facility at St Peters is shown in **Figure 5-51**. Further details regarding external and in-tunnel air quality are provided in **Chapter 9** (Air quality).

Table 5-8 Key component of the project's ventilation systems

Ventilation system component	Description
Jet fans	· Jet fans would be mounted throughout the tunnels and would operate as required to maintain in-tunnel air quality · About 440 jet fans would be installed as part of the project. Of these around 120 would be installed in the northbound mainline tunnel, around 120 in the southbound mainline tunnel and around 200 in the Rozelle interchange and the Iron Cove Link tunnels. The final numbers of jet fans would be determined during the detailed design phase.
Parramatta Road ventilation facility	· A ventilation facility at Haberfield being built as part of the M4 East project would also be used for the M4-M5 Link project. This facility would consist of both a ventilation exhaust facility and a ventilation supply facility. Fitout works would be carried out within part of this structure as part of the project (refer to **Chapter 6** (Construction work) for a description of these fitout works).
Rozelle ventilation facility (comprising a ventilation supply facility at the Rozelle West motorway operations complex (MOC2) and a ventilation exhaust facility at the Rozelle East motorway operations complex (MOC3)	· The facility would service the M4-M5 Link project and the proposed future Western Harbour Tunnel and Beaches Link · The ventilation supply facility would provide fresh air to the southbound mainline tunnels, and to the northbound mainline tunnels (in the event the proposed future Western Harbour Tunnel and Beaches Link project is approved) · The ventilation exhaust facility would consist of one building, with two outlets for the M4-M5 Link and a separate outlet for the proposed future Western Harbour Tunnel and Beaches Link · The M4-M5 Link ventilation exhaust facility at Rozelle would extract exhaust from the mainline northbound tunnels, the Rozelle interchange tunnels and from the Iron Cove Link · The ventilation outlet for the proposed future Western Harbour Tunnel and Beaches Link would be constructed as part of the Rozelle ventilation facility and would comprise the structure only. Fitout of the outlet would occur as part of construction of the proposed future Western Harbour Tunnel and Beaches Link (if approved). These fitout works do not form part of the project · The ventilation exhaust facility for the proposed future Western Harbour Tunnel and Beaches Link at Rozelle would extract exhaust from the southbound Western Harbour Tunnel and Beaches Link mainline and portals · The ventilation outlets would have a height of around 35 metres above existing ground level. The ventilation outlets have been designed at this height to meet project air quality criteria, urban design and visual amenity objectives, and to avoid impacts on civil air operations · An electrical substation would be provided at the ventilation supply facility and the ventilation exhaust facility to supply power for the operation of the ventilation facilities.
Iron Cove Link motorway operations complex (including the Iron Cove Link ventilation facility and an intake substation)	· The Iron Cove Link ventilation facility would extract exhaust from the westbound Iron Cove Link tunnel and would consist of a ventilation exhaust facility located on the south side of Victoria Road and a separate ventilation outlet located between the eastbound and westbound carriageways of Victoria Road · The ventilation outlet would have a height of around 20 metres above existing ground level and would be designed to meet project air quality criteria, urban design and visual amenity objectives, and to avoid impacts on civil air operations · An electrical substation would be provided at the ventilation facility to provide power for its operation.

Ventilation system component	Description
Campbell Road motorway operations complex (including the Campbell Road ventilation facility and an intake substation)	· The ventilation exhaust facility would consist of one building, with four outlets for the M4-M5 Link · The M4-M5 Link ventilation exhaust facility at St Peters would extract exhaust from the southbound M4-M5 Link mainline tunnel and the southbound St Peters exit-ramp · The ventilation outlets would have a height of around 22 metres above existing ground level. The ventilation outlets have been designed at this height to meet project air quality criteria, urban design and visual amenity objectives, and to avoid impacts on civil air operations · A ventilation supply facility would also be provided that would supply fresh air to the southbound M4-M5 Link mainline tunnel · The facility would also include a substation.
Ventilation tunnels	· Ventilation tunnels would connect the road tunnels with the ventilation facilities (including the ventilation supply and exhaust facilities) at Rozelle and St Peters. Ventilation tunnels that connect to the Parramatta Road ventilation facility will be built by the M4 East project. Indicative ventilation tunnel layouts for Rozelle and St Peters shown in **Figure 5-49** and **Figure 5-50**. An indicative cross-section of the Campbell Road ventilation facility is shown in **Figure 5-51**.

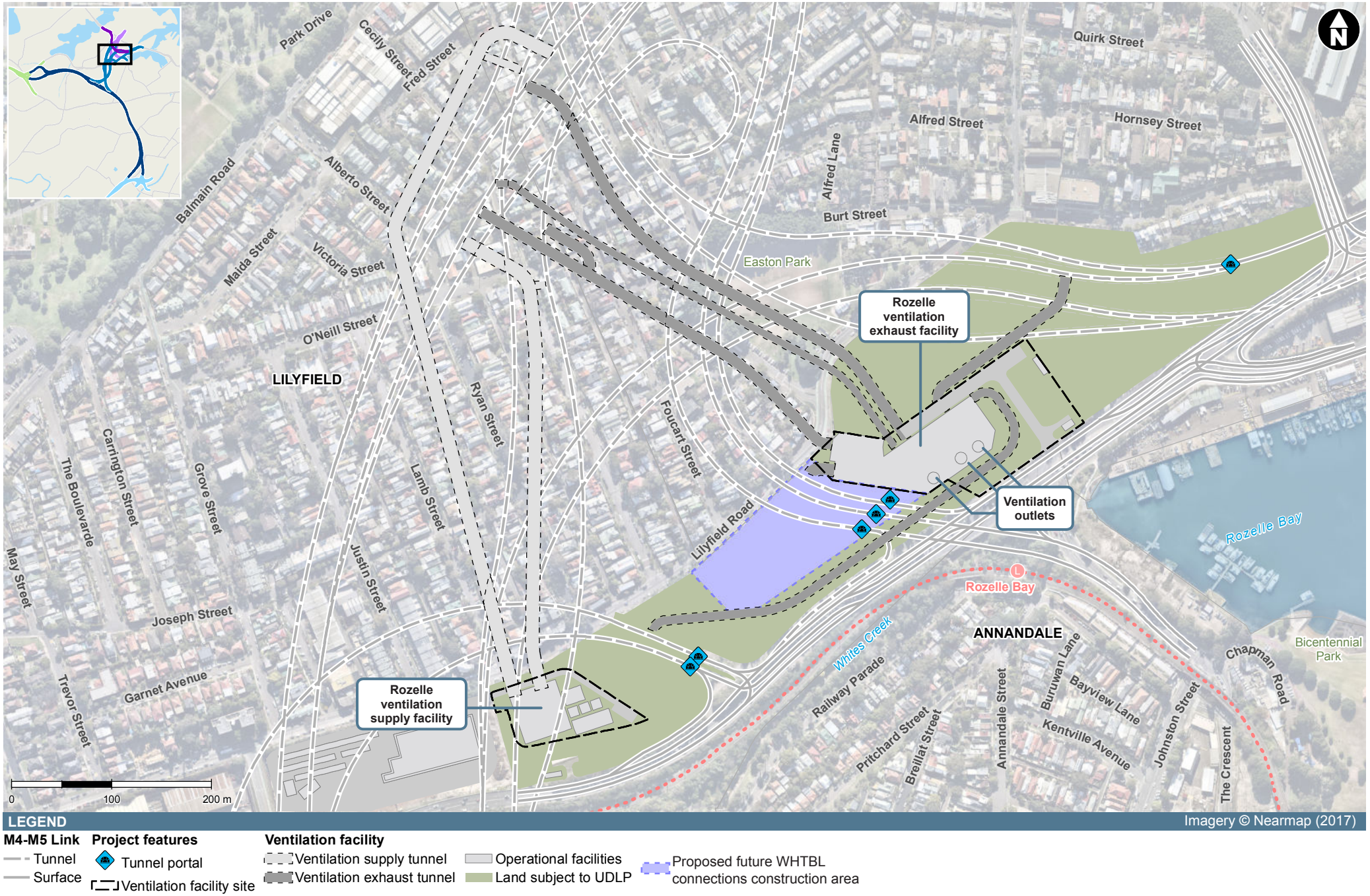


Figure 5-49 Indicative ventilation tunnel layout at Rozelle

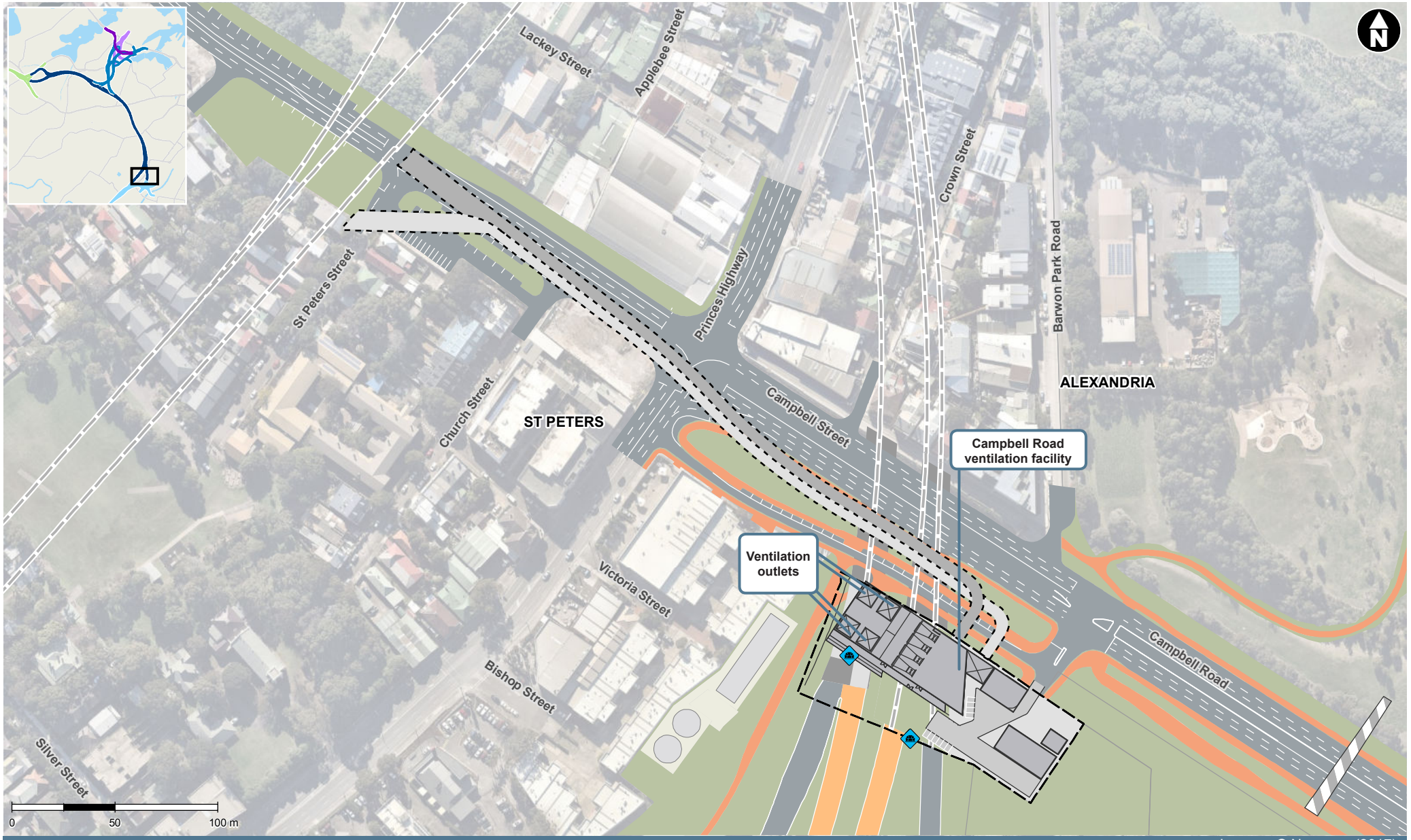


Figure 5-50 Indicative ventilation tunnel layout at St Peters

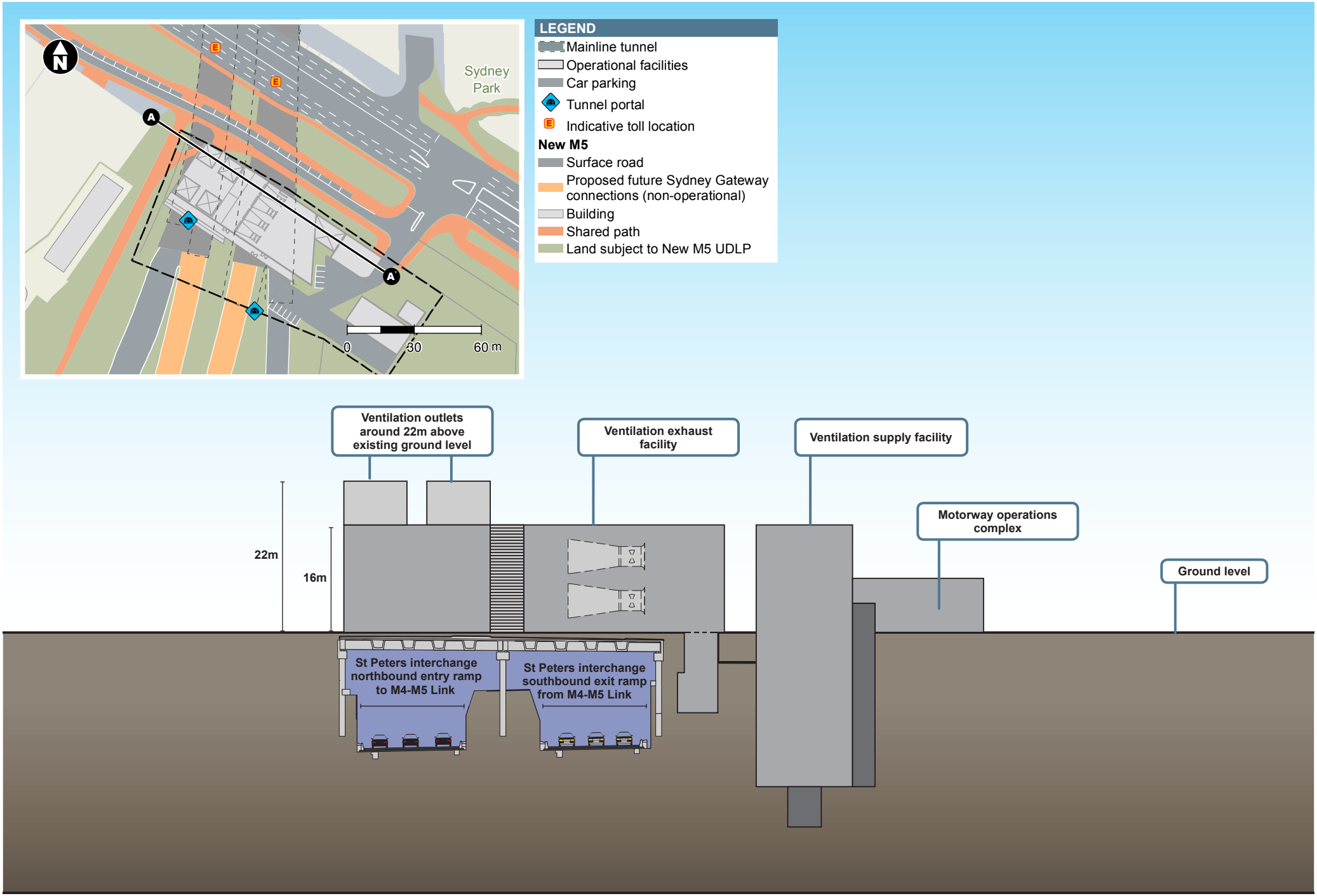


Figure 5-51 Indicative cross-section of the Campbell Road ventilation facility and outlets

Operating modes

The tunnel ventilation system would operate in three modes:

- Normal (expected) traffic conditions
- Maximum capacity traffic, used to assess the highest likely in-tunnel pollution levels
- Emergency conditions.

Operation of the ventilation system under these three conditions is detailed in the following sections.

Normal traffic conditions

Normal traffic conditions are considered to be when traffic flow within the tunnel is at capacity and travelling at posted speed limits (as outlined in **Table 5-9**).

Table 5-9 Posted speeds within the tunnel

Road element	Posted speed (km/h)
Mainline tunnels	
Main carriageways	80
St Peters interchange ramps	80
Rozelle interchange connections	80
Wattle Street interchange ramps	60
Rozelle interchange	
Inner West subsurface interchange to future Western Harbour Tunnel (approaching from the St Peters interchange)	80
Inner West subsurface interchange to future Western Harbour Tunnel (approaching from Wattle Street interchange)	70
Inner West subsurface interchange to Rozelle	80
Rozelle interchange to Anzac Bridge	60
Iron Cove Link	60
Rozelle interchange ramps from tunnel to surface	60
City West Link/The Crescent/James Craig Road	60
Victoria Road	60

Under normal traffic conditions, ventilation would occur due to the piston effect, where fresh air is drawn into the tunnels at entry portals by the aerodynamic drag of vehicles entering the tunnel or supplied at dedicated air supply stations. This fresh air would move along the tunnel with the traffic and be extracted at the ventilation outlets.

Under these conditions, the volume of air moving along the tunnel would be sufficient to satisfy the fresh air demand inside the tunnels. Further details regarding in-tunnel air quality are provided in **Chapter 9** (Air quality).

Maximum traffic flow conditions

Where traffic flow within the tunnel is travelling at low speeds (ie around 40 kilometres per hour or less), typically as a result of a traffic incident or congestion, the piston effect associated with traffic movement would be reduced. Under these conditions, longitudinal ventilation may require mechanical support to maintain air movement through the tunnels. Jet fans, which would be directly controlled by operators in the WestConnex Motorway Control Centre (see **section 5.8.4**), would increase tunnel airflows in the same direction as the traffic flow, when traffic speeds are low. This would ensure sufficient fresh air to dilute vehicle emissions to meet the relevant air quality criteria. Under these traffic conditions, additional fresh air may also be required to ensure that acceptable air quality is maintained. Additional air may be injected into the mainline tunnels via ventilation supply facilities located at Rozelle and St Peters. Air quality monitoring and management is described in **section 5.8.7**. Further details regarding external and in-tunnel air quality are provided in **Chapter 9** (Air quality).

Emergency conditions

During a major incident, when traffic is stopped in the tunnel, the jet fans would be used to increase the air flow to protect vehicle occupants and emergency services personnel from a build-up of emissions. Drivers would be requested, via the public address system, to turn off vehicle engines if there is an extended delay, while the incident is cleared. This would assist in reducing emissions inside the tunnel.

In the case of a fire, the carriageway on which the incident occurred would be closed to incoming traffic and traffic downstream of the fire (ie between the fire and a tunnel portal) would exit the tunnel. Jet fans would be used to propel the smoke downstream to the nearest ventilation outlet, or tunnel portal(s), depending on the location of the fire. This would prevent smoke flowing backwards from the fire source over any vehicles that are stationary behind the fire. See **section 5.8.3** for further detail of the smoke control system.

5.8.3 Fire and life safety

Fire safety in Australian road tunnels follows a defined fire safety engineering process outlined in Australian Standard AS4825 – *Tunnel fire safety*, which also provides a 'Trial Concept Design' when developing road tunnel fire safety systems. As the M4-M5 Link mainline tunnels would connect directly to the New M5 tunnels and M4 East tunnels below ground, the fire safety systems would be coordinated between the projects to ensure safety during an incident. A single Motorway Control Centre at St Peters interchange would provide for coordinated normal and emergency operations for the entire WestConnex program of works (including the M4-M5 Link, the New M5 Motorway, the King Georges Road interchange, the widened M4 Motorway and the M4 East Motorway).

Fire and life safety objectives

The following fire safety objectives would form the basis of the fire safety design for the M4-M5 Link tunnels:

- Occupant life safety - this includes providing all necessary fire safety systems and measures to minimise the impact of fire on occupants of the tunnels
- Facilitate fire services intervention - this includes the provision of fire safety measures and systems, which allow fire service personnel to access the tunnel
- Protection of adjoining property and third parties - the potential for fire spread and tunnel collapse due to fire requires appropriate structural fire resistance
- Asset protection - the level of asset protection is dependent on the road authority requirements and the importance of the asset. M4-M5 Link would provide an important link within the road network, and therefore fire protection and resilience of structures and systems would be critical
- Operational continuity - once operational, the network would become dependent on the M4-M5 Link and therefore systems would be provided to minimise any disruption to service
- Return to service - fire events would require tunnel closure and in some cases repair and clean-up. Appropriate systems and measures would be provided to minimise the time taken to make the M4-M5 Link operational again after an event
- Environmental protection - this includes aspects such as minimising fire size through suppression and therefore minimising smoke production during a fire by use of a deluge system, and managing runoff from water suppression.

Fire and life safety measures

Key components of the project's fire and life safety measures are described in the following sections.

Twin tunnels

The tunnels would be separated by fire-rated materials to provide for one-way, fire-separated carriageways. This arrangement would allow motorists to move to a safe place underground into a non-incident fire-separated carriageway.

For the entry and exit ramps, the principle of access and egress to a fire-separated tunnel is the same, but would not necessarily need to be to an adjoining ramp.

Emergency egress and access for emergency response teams

The tunnels would include vehicular cross-passages to allow for traffic to be moved from one tunnel into another in the case of an emergency. Around three vehicular cross-passages would be provided in both the mainline tunnels and the Rozelle interchange tunnels and would be designed to accommodate a 14.5 metre long bus; so that general traffic could be evacuated during incidents that required tunnel closure. In the event that a vehicle over this size is in a closed tunnel during an incident, vehicle occupants would be evacuated and the vehicle would remain in the closed tunnel until the tunnel reopens.

Cross-passages would be located within the tunnel, around every 120 metres. Cross-passages would connect to the adjoining tunnel, providing access to a non-incident zone during an emergency. Connections between the tunnels would cater for egress for people with disabilities by minimising stairs or ramps with steep grades and providing alternative safe holding zones.

For the entry and exit ramps, connection to an adjoining tunnel is in some cases impractical and therefore the use of longitudinal egress passages would be required. Longitudinal egress passages are generally required where the adjoining entry and exit ramps are separated by long distances, are at significantly different elevations or are on either side of the mainline tunnels, which prevents the use of a level cross-passage. Where the ramps begin to move closer to each other, both in separation distance and elevation, the longitudinal egress passages would end and cross-passages would be provided. The use of cross-passages is preferred because the access travel distance to the incident site is minimised when compared with longitudinal egress passages. Longitudinal egress passages would also be required where the northbound and southbound mainline tunnels are at different depths.

With the use of longitudinal egress passages, additional Fire & Rescue NSW (FRNSW) access passages are required such that the maximum walking distance for FRNSW from its vehicle to an incident site, approaching from the upstream side, does not exceed 250 metres.

The alignments of the twin tunnels between the mainline tunnels and the Rozelle interchange are vertically separated, requiring long longitudinal egress-passages. Longitudinal egress-passages are also required at the Wattle Street and the St Peters interchange ramps. Emergency egress at Rozelle would be provided through a combination of cross-passages and longitudinal egress-passages.

The tunnels would also include emergency stopping bays spaced around 2.5 kilometres apart. Breakdown bays would potentially be combined with maintenance bays and would be large enough to allow a B-double vehicle to pullover into the bay and safely park away from operational traffic lanes, without blocking traffic flow. An indicative layout of a mainline tunnel maintenance and breakdown bay is shown in **Figure 5-52**.

Smoke control system

Longitudinal smoke control is proposed as the primary means of smoke management for the M4-M5 Link project. This would involve blowing smoke along the tunnel in the direction of vehicle travel to ensure that vehicles stopped upstream of (or before) an incident are safe and vehicles downstream of (or after) an incident keep driving out of the tunnel or into the next ventilation section. Smoke would then be removed from the tunnel at portals or via the ventilation outlets.

The M4-M5 Link would also be separated into ventilation sections defined by the location of the ventilation outlets and portals. The ventilation outlets and portals would be used to remove smoke and prevent smoke spreading to adjoining tunnel sections. This is particularly important at the M4-M5 Link interfaces with New M5 and M4 East, where the ventilation system would be designed to prevent smoke spreading between the different tunnel ventilation sections.

Water suppression system

Water suppression (deluge) would be used to manage fire and ensure occupant safety, operational continuity and asset protection. A deluge suppression system would minimise the fire size, reduce fire spread and heat generation and assist the fire brigade in managing a fire event. These factors allow for efficient incident management and minimise the time it takes for the tunnels to be able to be used again.

Water supply for the M4-M5 Link suppression system would be provided from water tanks located at:

- Parramatta Road ventilation facility at Haberfield (being constructed as part of the M4 East project). As part of the project, additional pumps and associated pipework would be installed
- St Peters interchange (being constructed as part of the New M5 project). As part of the project, additional pumps and associated pipework would be installed
- Rozelle West motorway operations complex (MOC2).

Transport of Dangerous Goods

Vehicles transporting dangerous goods as defined by the *Australian Dangerous Goods Code* (National Transport Commission 2015) would be prohibited within the M4-M5 Link tunnels.

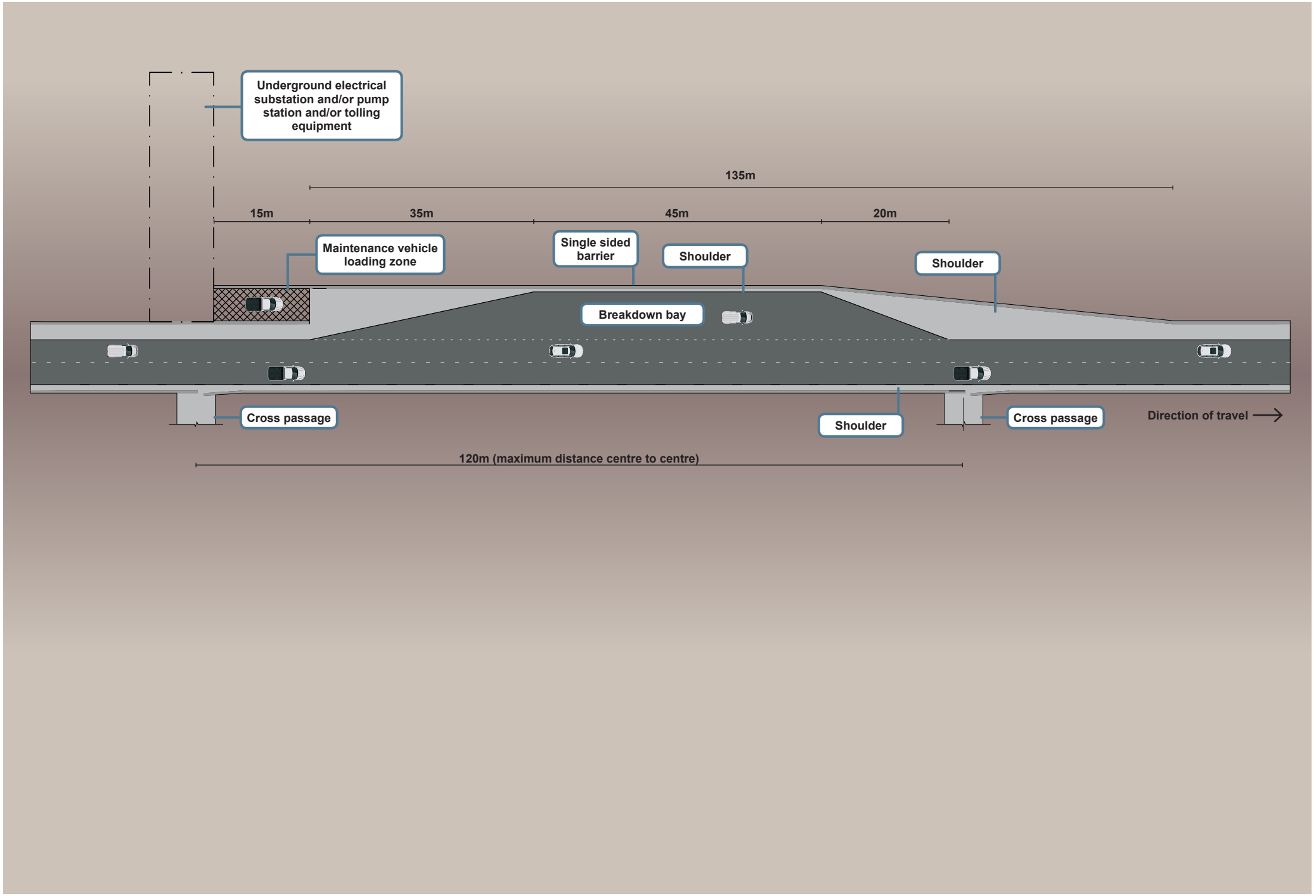


Figure 5-52 Indicative combined breakdown and maintenance bay

5.8.4 Operational management

A 'single operating entity' would undertake day-to-day 'coordinated operations' for the widened M4 (M4 Widening project), M4 East, New M5 and M4-M5 Link (the 'WestConnex Motorway') projects, as well as the existing M5 East, from a combined traffic control room located at the St Peters interchange WestConnex Motorway Control Centre (WMCC). This WMCC is being built as part of the New M5 project, and is proposed to also be used for the M4-M5 Link.

The single operating entity would use an Integrated Operations and Management Control System (IOMCS) and a stand-alone M5 East Operations and Management Control System (OMCS). In addition, a WestConnex Disaster Recovery Site (WDRS), fitted with a secondary OMCS, would be established at the M4 Motorway Control Centre located at Homebush Bay Drive (being built as part of the M4 East project). If the WMCC is temporarily out of service, WestConnex Motorway coordinated operations would be carried out at the WDRS and the M5 East Motorway Control Centre at Marsh Street at Arncliffe.

The WMCC at the St Peters interchange would be located at the Burrows Road motorway operations complex, a component of the approved New M5 project. The use of this site for coordinated operations for the WestConnex Motorway would not require a change to the use, access, vehicle movements or operational hours that were approved as part of the New M5 project.

The project would carry out internal fitout works at the WMCC to provide for integrated use. In addition, there may be a need for minor car parking upgrades to be carried out at the WMCC. The need for car parking upgrades at this location would be confirmed during detailed design and in coordination with the New M5 project.

The M4 Motorway Control Centre at Homebush Bay Drive (approved as part of the M4 East project) is proposed to be converted to be the WDRS. Internal fitout would be carried out to add equipment to the modified space to enable integrated operational functionalities. The project would not change access, vehicle movements or operational hours that were approved as part of the M4 East project and an application to modify the M4 East approval, if required, will be lodged to support these works.

5.8.5 Coordinated operations

The M4-M5 Link mainline tunnels would join and integrate the M4 East and New M5 projects to form a continuous WestConnex Motorway. Prior to the project opening to motorists, M4 and M5 motorway operations would be transferred to the combined Traffic Control Room located in the WMCC.

The WestConnex Motorway would be operated by a 'single operating entity' which would:

- Operate, using the integrated traffic, plant and voice communication systems, a single seamless interface for the efficient management of WestConnex network traffic, facilities and equipment
- Manage traffic through the implementation of WestConnex network traffic and incident management strategies, the coordinated deployment of resources and the execution of traffic control plans through an integrated control system
- Provide motorist roadside assistance and incident response though a coordinated traffic control room to ensure the road user is provided with prompt and reliable breakdown assistance and incidents are cleared quickly
- Plan, train and respond to emergencies and threats. The Transport Management Centre (TMC) would liaise with the single operating entity to coordinate the wider network and community response to incidents and emergencies
- Have the resources and systems to manage one or more incidents/emergencies (including fire scenarios), while continuing to operate unaffected sections
- Coordinate resources and systems used to respond to incidents, emergency and threats across the WestConnex Motorway to provide a rapid and coherent response unconstrained by concession boundaries.

5.8.6 Traffic monitoring and management systems

The project would include the integration of 'smart motorways' (also known as managed motorways) features, that would use real-time information, communication and traffic control systems incorporated into and alongside the road, to improve traffic flow.

The following smart motorway infrastructure would be provided as part of the traffic monitoring and management systems to support the future implementation of a smart motorway solution:

- Automatic video-based incident detection within the project tunnels
- Closed-circuit television (CCTV) including a digital video management system
- Infrastructure to enable the future implementation of ramp signalling (ramp metering)
- Driver advisory signs including:
  - Variable message signs (VMS)
  - Changeable message signs
  - Integrated speed limit and lane-use signs
  - Tunnel message signs within the mainline tunnels.

Additional traffic monitoring and management systems to be provided along the tunnels would include:

- Motorway emergency telephones
- Over-height vehicle detection systems
- Public address and radio re-broadcast systems throughout the project tunnels
- A traffic monitoring system
- A tunnel closure system.

The traffic monitoring and management systems would be used to monitor traffic volumes and speeds within the mainline tunnels. Should the video-based detection systems identify heavy congestion and/or an incident within the mainline tunnels, the following measures would be implemented to manage traffic, where required:

- Integrated speed limit and lane-use signs would be used to notify road users of the incident ahead, and to display lowered speed limits, if required
- Road users within the tunnels would be notified of the congestion/incident and the management measures in place within the tunnels over the public address and re-broadcast systems
- The tunnel closure system would be used to prevent additional vehicles from entering the mainline tunnels, where appropriate.

5.8.7 Air quality monitoring and management systems

A description of proposed tunnel ventilation is provided in **section 5.8.2**. Continuous emission monitoring and ambient air quality monitoring would be undertaken during operation of the project to monitor:

- In-tunnel air quality
- Air quality within ventilation outlets
- Ambient air quality at representative locations for a defined period of project operation.

Air quality monitoring and ventilation would be integrated and coordinated across the WestConnex Motorway to ensure:

- Air quality remains within specified limits for motorists and road workers, irrespective of their origin and destination, within the WestConnex Motorway
- Required airflows for safety outcomes in the event of an incident or emergency can be achieved
- Ventilation systems are used efficiently to minimise day-to-day energy usage and cost and to maximise asset life
- Airflows required for safety outcomes in the event of an incident can be achieved.

Continuous emission monitoring equipment for key contaminants (particulate matter ($PM_{2.5}$ and PM_{10}), NO_2 and CO and potentially other pollutants) would be installed at appropriate locations in the tunnels and on the ventilation outlets to ensure the project is operating within the prescribed emission limits for the project set by the conditions of approval, and as set by the NSW Environment Protection Authority (NSW EPA).

Periodic manual monitoring of ventilation outlet emissions would also be undertaken to validate the accuracy of the continuous emission monitoring equipment.

Further details regarding external and in-tunnel air quality and the assessment of the project's ventilation system are provided in **Chapter 9** (Air quality).

5.8.8 Motorway tolling infrastructure

Tolling points would be installed for the M4-M5 Link project. Each tolling point would have a gantry and associated shelter.

Tolling points would be installed at the following locations:

- The entry and exit ramps at the Wattle Street interchange
- The entry and exit ramps at the St Peters interchange
- Within the Rozelle interchange.

5.8.9 Lighting, roadside furniture and signage

Lighting

Lighting that would be installed as part of the project includes:

- Traffic lighting within the tunnels
- Traffic lighting along surface roads and pedestrian/cyclist facilities
- Lighting within and around operational ancillary facilities
- Emergency lighting
- Aviation hazard-lighting.

Tunnel lighting

In-tunnel lighting would be based on road geometry and designed to comply with the Australian/New Zealand Standard AS/NZS 1158.5:2007: *Lighting for roads and public spaces*, and the International Standard CIE 88-2004: *International Commission of Illumination Publication Guide for the Lighting of Road Tunnels and Underpasses*.

Lighting at the tunnel portals would be able to be switched between daytime and night-time lighting in response to varying levels of brightness due to time of day and weather conditions. Uniform lighting would be provided along the tunnels. Tunnel lighting would be provided in rows along the ceilings at sufficient spacing to allow for deluge piping to be installed. Lighting would be adjusted where required to allow jet fans and signage (directional and other) to be installed with the appropriate sight lines maintained.

Surface road lighting

Surface road lighting, including at interchanges, ramps, intersections, roundabouts, bus stops and along local roads upgraded as part of the project have been designed to meet the requirements of Australian Standard AS/NZS 1158: Lighting for roads and public spaces.

To provide lighting at the tolling points, the proposed overhead gantries would emit a blue light during the operations phase similar to that used on many of Sydney's existing toll roads. The lighting is designed to meet the requirements of international and Australian Standards concerning electrical safety and eye safety. The proposed lights would be hooded and directed down towards the toll points to minimise potential light spill.

Emergency lighting

Emergency lighting would be installed to provide adequate illumination for evacuation of the tunnels in the event that primary lighting is inoperable. Emergency lighting would be provided as fixed direction exit signage, illuminated signage and LED light fittings within and in the vicinity of cross-passages and emergency egress paths.

Aviation hazard lighting

Aviation hazard lighting may be required at the Rozelle and St Peters ventilation facilities. All aviation hazard lighting would be provided in accordance with the regulations required by the CASA.

Signage

Traffic, locational, directional, warning and variable message signs would be incorporated within the tunnels and on surface roads at approaches to the tunnels. Directional signage would be installed in accordance with the Austroads and Roads and Maritime standards, with a focus on providing clear and unambiguous direction to motorists. All signage within the tunnels would be backlit and located to provide clear, highly visible, progressive and instructive decision-making information for motorists.

Variable message signs would be mounted on gantries along roads which approach the tunnels and would be used to advise motorists of traffic conditions. The variable message signs within the tunnels would comprise single-line-text advisory signs above traffic lanes.

Integrated speed and lane-use signs would be installed along the length of the project. These signs would generally display the regulatory speed limit along the project, and would be modified at the motorway control centre to display variable speed limits in response to incidents and congestion. The signs would be located around 200 metres before the tunnel portals, around 50 metres before each exit ramp and around 50 metres after each entry ramp.

5.9 Drainage and water treatment facilities

The drainage and water treatment facilities for the project would include three main components:

- Tunnel water drainage and treatment infrastructure
- Surface water drainage and management infrastructure
- Operational water treatment plants to treat surplus groundwater collected within the project tunnels prior to discharge. These would be located at the Darley Road motorway operations complex (MOC1) and the Rozelle East motorway operations complex (MOC3).

The drainage system would be designed to prevent flooding and aquaplaning within the tunnels and to avoid adverse effects on private properties and the surface road networks surrounding the project. Further details on drainage and water quality can be found in **Chapter 15** (Soil and water quality), **Chapter 17** (Flooding and drainage) and **Chapter 19** (Groundwater).

5.9.1 Tunnel drainage and treatment infrastructure

Tunnel drainage and treatment infrastructure would be designed to accommodate a combination of water ingress events including:

- Groundwater ingress
- Stormwater ingress at portals
- Tunnel wash-down water
- Fire suppressant deluge or fire main rupture
- Spillage of flammable or other hazardous materials.

Separate sumps would be provided at tunnel low points to collect tunnel drainage from two input streams: groundwater ingress and other potential water sources. Further information regarding the likely treatment methods and wastewater volumes is provided in **Chapter 15** (Soil and water quality) and **Chapter 17** (Flooding and drainage).

Water that enters the mainline tunnel drainage systems would be pumped to a water treatment plant at the Darley Road motorway operations complex (MOC1) at Leichhardt. Options for discharge of treated water from the Darley Road water treatment plant include:

- Direct discharge to Hawthorne Canal, which would require a pipe to be installed along Canal Road and the construction of a new outlet in the wall of the Hawthorne Canal
- Direct discharge to the existing stormwater pipework in an adjoining road (ie Canal Road), which would require a pipe to be installed to connect to existing piped drainage
- Direct discharge into the sewer system located on the site, which would require a Trade Waste Agreement with Sydney Water.

Further detail regarding these discharge options is included in **Appendix F** (Utilities Management Strategy). The preferred option for treated water discharge from the Darley Road water treatment plant would be confirmed during detailed design.

In addition, tunnel drainage from about one kilometre of the northbound mainline tunnel and 600 metres of the southbound mainline tunnel would be captured by the New M5 drainage system and conveyed to the New M5 operational water treatment plant at Arncliffe.

Tunnel drainage for Rozelle and the Iron Cove Link tunnels would be pumped to a water treatment plant at the Rozelle East motorway operations complex (MOC3), with treated flows discharged to a constructed wetland within the Rozelle Rail Yards. This would provide some 'polishing' of the effluent, helping to remove residual dissolved constituents such as nitrogen and phosphorus not removed by the water treatment plant. Treated flows would ultimately flow to Rozelle Bay, via the northern drainage channel and the culvert to be installed below City West Link (see **section 5.6.6** for additional details about this culvert structure).

5.9.2 Surface water drainage and management infrastructure

Surface water drainage and management infrastructure would be provided for new surface roads constructed as part of the project, and where existing, drainage conditions would be modified as part of the project.

Surface water drainage and management infrastructure would be designed to:

- Limit the flow in gutters to acceptable widths
- Convey runoff collected from a 10-year average recurrence interval (ARI) storm event
- Capture pavement runoff at the tunnel portals for storms up to the 100-year ARI event, to limit the volume of rainfall runoff that enters the tunnel drainage system
- Direct collected surface-water runoff through appropriate water quality treatment devices prior to appropriate discharge or disposal.

In addition, temporary drainage infrastructure for the proposed future Western Harbour Tunnel and Beaches Link would be provided. Further detail on the works that would be carried out as part of civil works to construct connections to, and parts of, the proposed future Western Harbour Tunnel and Beaches Link is provided in **Chapter 6** (Construction work).

Wattle Street interchange

At the Wattle Street interchange, the exit ramp drainage would be connected to the entry ramp drainage via a cross-passage. The combined ramp runoff pipe would discharge to a sump located at the entry ramp portal. The sump would not capture any tunnel drainage. A stormwater treatment device would be provided immediately upstream of the sump. Stormwater captured in the portal sump would be pumped to the surface and discharged to the surface drainage network constructed as part of the M4 East project.

St Peters interchange

At the St Peters interchange, drainage is being provided by the New M5 project. The design incorporates a rising main to convey flows away from the portals for treatment and subsequent discharge to Alexandra Canal. The minor flows that bypass this drainage as well as those generated by the small catchment between the limit of the New M5 drainage works and the M4-M5 Link tunnel portals would be captured by the M4-M5 Link tunnel drainage system that starts immediately inside the tunnel portals.

Rozelle interchange and the Iron Cove Link

A local catchment drainage system would be provided to drain features such as external catchment areas, batter slopes and road surfaces. External flows would be kept separate to road surface drainage where possible and practical. The overall system would be designed with due consideration of the urban and landscape design objectives, including implementing aspects of water sensitive urban design (WSUD) where practical.

In general, runoff originating from pervious catchments or those unaffected by the project works would bypass water treatment facilities and discharge at a suitable location to avoid unnecessary flow through treatment infrastructure. A number of external catchments currently drain toward the project works and require diversion through or around the works. Key surface water drainage infrastructure to be provided as part of the Rozelle interchange and Iron Cove Link surface works are described in **Table 5-10** and shown in **Figure 5-25** and **Figure 5-26**.

Table 5-10 Key surface water drainage infrastructure – Rozelle interchange and the Iron Cove Link

Key infrastructure	Description
Rozelle interchange	
Western drainage channel	New drainage infrastructure works being constructed as part of the adjoining CBD and South East Light Rail Rozelle maintenance depot are expected to discharge flows from an external catchment to the west of the Depot into the Rozelle Rail Yards. Flows would enter the Rozelle Rail Yards from two separate outlets constructed by the Sydney Light Rail project. Flows from these outlets would be directed to the western drainage channel. The channel would convey flows along the north of City West Link. The channel would combine with others from throughout the Rozelle Rail Yards before being culverted under City West Link and discharging to Rozelle Bay.
Northern drainage channel	The Easton Park drain currently conveys the runoff from a local urbanised catchment of roughly 55 hectares and passes through the Rozelle Rail Yards from Lilyfield Road in the north to Rozelle Bay in the south. The existing drain would be affected by the project works and a replacement channel would be constructed. The channel would convey the majority of the Easton Park catchment runoff through the Rozelle Rail Yards and would be bridged by a footbridge and a bridge providing maintenance access to the ventilation facility.

Key infrastructure	Description
Eastern drainage channel	A channel would be required to convey runoff from a small catchment draining from the eastern end of the Rozelle Rail Yards. In its upper reaches this channel would resemble a bioretention swale to provide stormwater treatment in addition to drainage. The channel would constrict to a narrower V-shaped channel or similar before discharging to the northern drainage channel.
Whites Creek	Flood mitigation works would be performed along Whites Creek between the light rail bridge and Rozelle Bay. Downstream of the new The Crescent bridge, the flood mitigation works would include widening and improvement works to the channel and naturalisation of the creek banks. The creek design would aim to deliver a similar outcome to that of the planned Sydney Water – Whites Creek Naturalisation works upstream, including sandstone block walls and saltmarsh area (see **Figure 5-30** for an indicative arrangement for these naturalisation works).
City West Link culvert and Rozelle Bay outfall	A culvert would be constructed beneath City West Link to convey flows from the new drains in the Rozelle Rail Yards to Rozelle Bay. The culvert would incorporate a two-tiered arrangement consisting of: · Marine-class reinforced concrete pipes would discharge low flows from the contributing catchments to Rozelle Bay. A floodgate structure would be installed at the upstream end of the pipes to prevent tidal water entering the Rozelle Rail Yards. The downstream invert of these pipes would be set around mean low tide to allow regular draining and flushing from upstream · A bank of precast reinforced-concrete box culverts would be installed above the culverts to allow larger flood flows to discharge from the site. The box culverts would be installed at a level that prevents any tidal ingress.
Iron Cove Link surface works	
Iron Cove Link portals	An external catchment of roughly seven hectares drains from the north along Victoria Road northbound and towards the Iron Cove Link portals. To ensure flood protection of the Iron Cove Link tunnels, overland flows from this catchment that are not contained in the southbound carriageway would require capture and diversion. This would be achieved by upgrading the pit and pipe network along the southbound carriageway of Victoria Road and along Byrnes Street at Rozelle. Flows would then be directed to the new bioretention facility within a car park area south of Manning Street at Rozelle.

Pavement drainage

Drainage would be provided to all new road surfaces to meet the relevant criteria where achievable for a 10-year ARI event for a drainage system. This would include:

- Upgrades to existing pavement drainage networks where necessary, including connection of new drainage at appropriate locations
- New pavement drainage for surface areas fed by gravity to suitable treatment and discharge locations
- Pavement drainage for tunnel portals collected in sumps and pumped to suitable treatment and discharge locations.

Bridge runoff would be captured and conveyed to a suitable outlet location. Where not otherwise provided downstream, spill containment would be incorporated prior to each outlet.

Stormwater treatment

Where suitable space is available, stormwater runoff generated by the project would be treated in an effort to achieve the targets identified in **Chapter 15** (Soil and water quality) and deliver WSUD outcomes. Stormwater treatment infrastructure would include:

- A bioretention swale in the east of the Rozelle Rail Yards to treat runoff from parts of Victoria Road, Anzac Bridge and the Victoria Road/Anzac Bridge to M4 East/Wattle Street interchange portals
- A constructed wetland in the Rozelle Rail Yards, treating surface stormwater runoff from some nearby impermeable catchments and tunnel portals. The wetland would also provide polishing of treated groundwater from the Rozelle water treatment facility
- A linear bioretention strip incorporated in the batter slope between City West Link and the western drainage channel to treat runoff from eastbound and some westbound lanes of City West Link
- A small bioretention basin to treat runoff from Rozelle West motorway operations complex (MOC2) in the west of the Rozelle Rail Yards
- A bioretention facility within a car park area on Manning Street at Rozelle to treat runoff from the Iron Cove Link. The car park area at this location would be upgraded as part of the project.

In some instances, due to the highly constrained urban environment and relative levels, there may not be opportunity to install treatment devices within individual surface catchments and achieve the pollutant load reduction targets. In these highly constrained areas good practice treatment techniques such as gross pollutant traps and hydrodynamic separators (a device that removes sediment and other pollutants from stormwater) would be deployed where feasible and reasonable.

Water treatment facilities

The operational water treatment plants would be designed, constructed and operated to treat tunnel water prior to discharge to the stormwater drainage system. Operational water treatment facilities would be located at:

- The Darley Road motorway operations complex (MOC1) at Leichhardt
- The Rozelle East motorway operations complex (MOC3) at Rozelle.

The water treatment facilities would consist of:

- A balance tank to regulate flows into the plant
- A treatment plant, including clarifier and control room, to treat water prior to discharge into the stormwater drainage system.

The proposed location of the water treatment facilities is shown in **Figure 5-44** and **Figure 5-46**. Further information regarding the likely treatment methods and wastewater volumes is provided in **Chapter 15** (Soil and water quality) and **Chapter 17** (Flooding and drainage).

5.9.3 Noise attenuation

New motorways and other major roads sometimes require additional measures to minimise the levels of traffic noise experienced at residences and other sensitive receiver locations.

The *Road Noise Policy* (Department of Environment Climate Change and Water (DECCW), 2011), *Noise Criteria Guideline* (Roads and Maritime 2015a) and the *Environmental Noise Management Manual* (NSW Roads and Traffic Authority, 2001) establish a process to identify appropriate noise attenuation measures for road projects. This process and how it has been applied to the M4-M5 Link are detailed in **Chapter 10** (Noise and vibration) and **Appendix J** (Technical working paper: Noise and vibration).

The project has been designed to include all feasible and reasonable noise mitigation and management measures, where the noise assessment thresholds in the *Road Noise Policy* (DECCW 2011) have been predicted to be exceeded. This has included the following (in order or application and priority):

- Minimising noise generation at the source. This has been achieved for the project through careful selection of road pavement materials, and design of the project to minimise the potential for secondary traffic noise sources, such as compression (or engine) braking

- Attenuating noise between the noise source and the noise receiver. This has been taken into account for the project through the design and application of noise barriers
- Minimising and managing noise at the receiver. Properties that are potentially eligible for consideration for architectural acoustic treatments to minimise noise impacts have been identified and would be confirmed through the detailed design of the project.

Despite the design of the project to minimise the generation of traffic noise, the noise impact assessment (refer to **Chapter 10** (Noise and vibration)) identifies the need for noise barriers in some areas.

5.10 Utility services

Utilities and services located within proximity of the project would likely need to be protected, relocated or realigned during construction, particularly in areas of surface or shallow soil disturbance. These services include electricity, telecommunications, sewer, water, stormwater, gas and Sydney Trains services.

The project would also require connection to electricity, water and wastewater/sewer utilities.

A Utilities Management Strategy has been prepared for the project and is included in **Appendix F** (Utilities Management Strategy). The Utilities Management Strategy provides information in relation to:

- Utility relocations and adjustments which are currently known and proposed within the project footprint. These have been considered as part of this EIS
- Utility relocations and adjustments which are currently unknown and/or located outside of the project footprint. The Utilities Management Strategy provides the framework for how these utility relocations and adjustments would be assessed and managed
- Utility connections required to facilitate construction and operation of the project.

The Utilities Management Strategy should be read in conjunction with **Chapter 6** (Construction work) and **Chapter 12** (Land use and property).

The location of existing utility service and any changes required would be confirmed by the construction contractor during the detailed design of the project in consultation with the relevant utility provider.

5.10.1 Electricity

Electricity supply infrastructure would be installed to supply power to the tunnels and associated mechanical and electrical equipment needed during operation. It is essential that electrical power to the tunnels be uninterrupted for ventilation, lighting and other safety reasons.

Estimated power demand

The projected estimates of maximum power demands are shown in **Table 5-11**. Operational power for the proposed future Western Harbour Tunnel and Beaches Link project would be supplied separately and as a result no allowance has been included for this project in the estimate of power demand.

Table 5-11 Estimate of maximum power demand

Project element	MVA	Accuracy estimate
Mainline tunnel	35	+10 – 10%
Rozelle interchange and Iron Cove Link	30	+20 – 20%
Total	**65**	

The maximum power demand for the tunnels is driven predominantly by the ventilation system, particularly for scenarios involving congested traffic conditions or a fire within the tunnels. During normal free-flowing traffic conditions the power demand for ventilation is significantly reduced by comparison. Therefore much of the network capacity remains unused for most of the time.

Power supply connection locations

A bulk power supply would be provided in a single location or two locations and then distributed to the ventilation outlets and jet fans within the tunnels. The Ausgrid transmission voltage is 33kV and this is the nominated preference for the bulk power supply.

There are two substations best located to provide the bulk power supply connection for the project:

- Alexandria zone substation, at Bourke Road, Alexandria. This substation is currently under construction and is expected to be completed in late 2017
- Rozelle zone substation, at Manning Street, Rozelle.

An upgrade of the Rozelle zone substation would be required to accommodate the bulk power supply connection for the M4-M5 Link project. It is anticipated that these works would be carried out by Ausgrid.

Substations

Intake substations (substations that would connect to the Ausgrid network and would manage the intake and distribution of the project's power needs) would be required. These would be constructed above ground at the following locations:

- Rozelle West motorway operations complex (MOC2) at Rozelle
- Campbell Road motorway operations complex (MOC5) at St Peters.

The indicative locations of intake substations are shown in **Figure 5-45** and **Figure 5-48**.

From the intake substations, electricity would be distributed to the project via the tunnels, to connect to substations at the Rozelle East motorway operations complex (MOC3) and the Iron Cove Link motorway operations complex (MOC4). In addition, the need for a substation at the Darley Road motorway operations complex (MOC1) is being investigated and would be confirmed during detailed design. The project would also include a series of underground substations at a spacing not exceeding around 1.2 kilometres within the tunnel. An indicative layout of an underground substation is shown in **Figure 5-53**.

Further information about electricity connections for the project is provided in **Appendix F** (Utilities Management Strategy). Where practicable, energy efficiency initiatives would be incorporated into the project to minimise energy consumption (refer to **Chapter 22** (Greenhouse gas) for additional detail).

Redundancy has been built into the electricity supply system for the project. If electricity supply is not available despite the inbuilt redundancy, a system of uninterrupted power supplies would provide back-up power for operation of essential equipment for at least one hour. Essential operational equipment would include:

- Communications and monitoring equipment
- Computer systems
- Fire and life-safety systems
- Tolling systems
- Tunnel signage
- Emergency power outlets
- Closed-circuit television
- Emergency lighting, which would be distributed evenly along the tunnels.

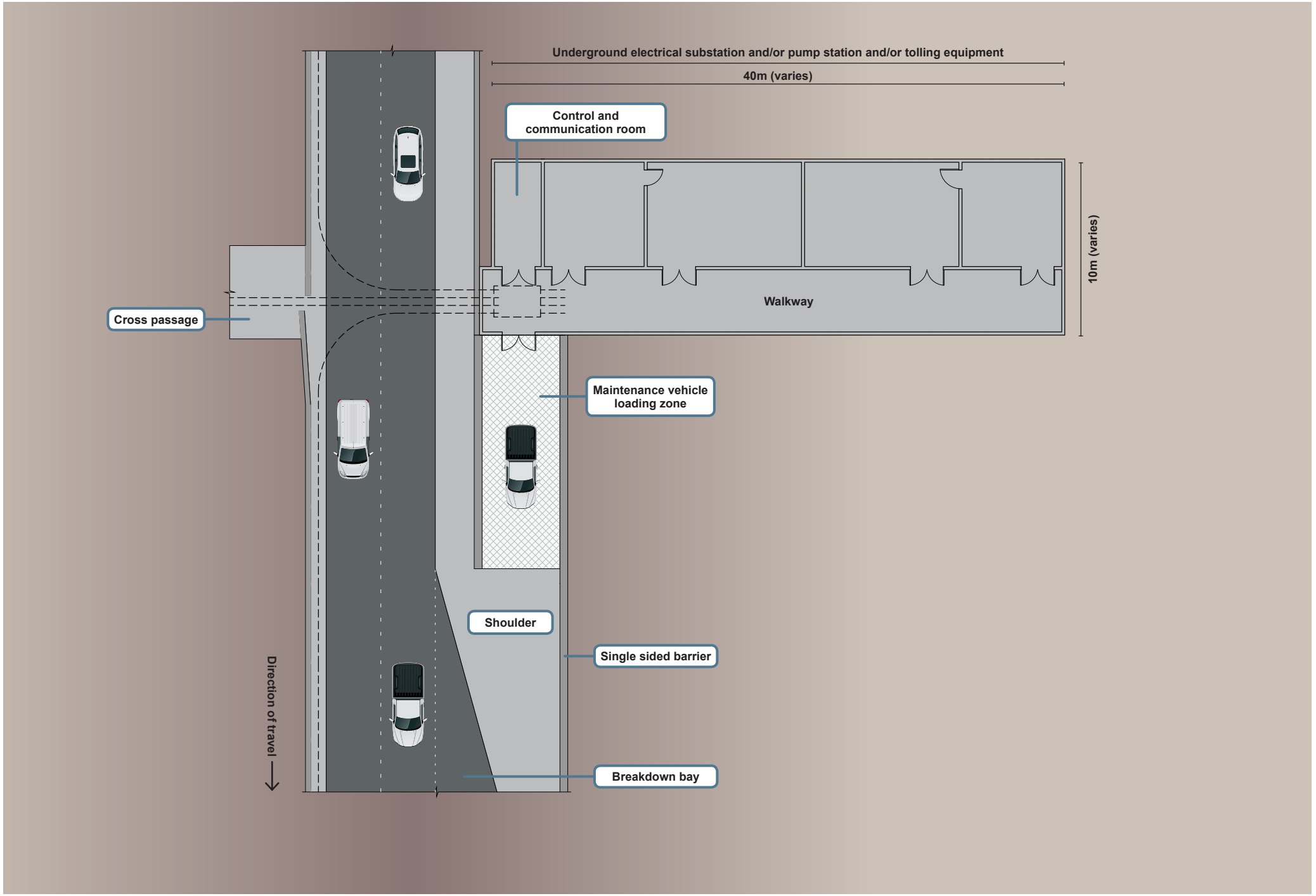


Figure 5-53 Indicative underground substation layout

5.10.2 Water

The project would require around four megalitres of water per annum for operations purposes. This would include water for maintenance activities, fire testing and for domestic purposes at each of the four motorway operations complexes.

Where water quality requirements are met, treated tunnel water would be used to minimise the need to consume potable water. This may include use of treated tunnel water for landscaping management.

Water for use inside the buildings within the motorway operations complexes would be supplied via a connection to the Sydney Water mains feed. Fire water would be stored within tanks at the Rozelle West motorway operations complex (MOC2), and within tanks at the Parramatta Road ventilation facility at Haberfield and at the St Peters interchange, which will be built by the M4 East and New M5 projects respectively. Fire water storage tanks would be sized to provide 100 per cent of the maximum design water flow requirements for up to two hours, and would be fed via connection to the Sydney Water mains feed.

The tunnel deluge and fire suppression system, including number, location and capacity of water storage facilities, would be designed and sized to meet the requirements of FRNSW.

5.10.3 Wastewater/sewer

The tunnels and entry and exit ramps would be subject to groundwater and road runoff ingress. Wastewater captured within the tunnels would also include stormwater entering the tunnels via the portals, deluge water, washdown water and hydrant water. Tunnel wastewater treatment is described in **section 5.9**.

The five motorway operations complexes would be connected to Sydney Water's wastewater system for domestic purposes.

5.11 Property access and acquisition

Where land required for the construction and operation of the project is not currently owned by the NSW Government, discussions are being held with the affected property owners concerning the purchase, lease or licence of the land. As at August 2017, the project would require 51 surface property acquisitions. These property acquisitions are summarised in **Table 5-12**. Further detail is provided in **Chapter 12** (Land use and property). Roads and Maritime would also be required to manage a number of leases on land subject to acquisition.

Table 5-12 Indicative property acquisition requirement for the project

Location	Land use (type)	No. of total acquisitions[1]
Wattle Street interchange surface works	Acquisitions were carried out at this location as part of the M4 East project	None[2]
Parramatta Road West and East civil and tunnel sites	Mixed use	1
Darley Road surface works	Commercial	1
Rozelle surface works	Commercial/industrial	4
Iron Cove Link surface works	Residential	26
	Commercial/industrial	10
Pyrmont Bridge Road tunnel site	Commercial/industrial	9
St Peters interchange surface works	Acquisitions were carried out at this location as part of the New M5 project	None[3]

Notes:

[1] Multiple strata titles may exist within each parent lot to be acquired.

[2] Refer to the M4 East EIS (September 2015) for acquisitions that occurred at this location.

[3] Refer to the New M5 EIS (November 2015) for acquisitions that occurred at this location.

All compulsory acquisition required for the project would be carried out in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* (NSW), the *Land Acquisition Information Guide* (NSW Government 2014b) and the land acquisition reforms announced by the NSW Government in 2016 (NSW Government 2016b), which can be viewed online at: https://www.finance.nsw.gov.au/sites/default/files/NSW_Government_Response.pdf

Relocation and some other categories of expenses would be claimable under this Act and related policies.

The project would also use government owned land. Roads and Maritime would enter into agreements with the relevant government departments regarding the temporary or permanent use of this land – including acquisition or lease arrangements. Where government owned land is required temporarily, this would generally be established through a lease or a Memorandum of Understanding.

Access to properties not acquired, leased or otherwise occupied for project purposes would generally be maintained at all times during construction and operation. Where temporary impacts on existing property access are unavoidable as a result of construction activities (eg footpath and pavement works), consultation would be carried out with the landowner and/or tenant to provide equivalent standards of access. Short-term changes to access during construction are described further in **Chapter 6** (Construction work).

Indirect, permanent changes to access resulting from road closures and/ or modifications are discussed in the following section. The traffic and transport impacts from these changes are described in **Chapter 8** (Traffic and transport). Impacts on pedestrian and cyclist access and indirect impacts on property access are described in **Chapter 12** (Land use and property).