6 Project description

6.1 The project

The project would comprise a new multi-lane road between the New M5 Motorway at Arncliffe and President Avenue at Kogarah. The project would connect underground with the New M5 Motorway tunnel and to a new surface level intersection at President Avenue, Kogarah. The project would allow commuters to connect to the motorway network and travel north on the New M5 Motorway to St Peters Interchange or the M4-M5 Link.

Detailed illustrations of project components are provided in **Figure 6-1** and **Figure 6-2**.

The project description presented in this EIS represents the concept design for the project. If approved, a further detailed design process would follow which may include refinements to the concept design. The final design may therefore vary from the concept design described in this chapter. Any changes would be reviewed for consistency with the assessment contained in this EIS including relevant mitigation measures, performance outcomes and any future conditions of approval.

Key components of the project are detailed in **section 6.3** to **section 6.12** would include:

- Twin mainline tunnels. Each mainline tunnel would be around 2.5 kilometres in length, sized for three lanes of traffic, and line marked for two lanes as part of the project
- A tunnel-to-tunnel connection of two additional lanes in each carriage way to the New M5 Motorway southern extension stub tunnels, including line marking of the New M5 Motorway tunnels from the stub tunnels from the F6 Extension connection to St Peters interchange
- Entry and exit ramp tunnels about 1.5 kilometres long (making the tunnel four kilometres in length overall) and a tunnel portal connecting to the President Avenue intersection
- An intersection with President Avenue including entry and exit ramps and the widening and raising of President Avenue
- Upgrade of the President Avenue / Princes Highway intersection to improve intersection capacity
- Shared cycle and pedestrian pathways connecting Bestic Street, Brighton-Le-Sands to Civic Avenue, Kogarah (including an on-road cycleways)
- Three motorway operation complexes:
  - Arncliffe, including a water treatment plant, substation and fitout (mechanical and electrical) of a ventilation facility currently being constructed as part of the New M5 Motorway project (MOC1)
  - Rockdale (north), including a motorway control centre, deluge tanks, a workshop and an office (MOC2)
  - Rockdale (south), including a ventilation facility, substation and power supply (MOC 3)
- Reinstatement of Bicentennial Park and recreational facilities
- In-tunnel ventilation systems including jet fans and ventilation ducts connecting to the ventilation facilities
- Drainage infrastructure to collect surface water and groundwater inflows for treatment
- Ancillary infrastructure for electronic tolling, traffic control and signage (both static and electronic signage)
- Emergency access and evacuation facilities (including pedestrian and vehicular cross and long passages); and fire and life safety systems
- A permanent power supply connection from the Ausgrid Canterbury sub-transmission substation, to Rockdale Motorway Operations Complex south
- New service utilities, and modifications and connections to existing service utilities.

The project does not include:

- Ongoing motorway maintenance activities during operation
- Future upgrades to other intersections in the vicinity of the project.

These works are permitted under separate existing approvals and / or are subject to separate assessment and approval.

LEGEND

- The project in tunnel
- Shared cycle and pedestrian pathways
- Motorway operations complex
- Permanent power supply line
- Substation
- Water treatment facility
- Operational discharge location
- New M5 Tunnel
- Arncliffe ventilation facility*
- * Under construction as part of the New M5 Motorway project
- Railway station
- Railway line

Figure 6-1 Project operational layout - Map 1

LEGEND

- The project in tunnel
- The project on surface
- The project as an open slot
- On-road cycleway
- Shared cycle and pedestrian pathways
- President Avenue shared cycle and pedestrian bridge
- Building
- Embankment
- Water quality basin
- Motorway operations complex
- Permanent power supply line
- Substation
- Rockdale ventilation facility
- Railway station
- Railway line

Figure 6-2 Project operational layout - Map 2

The project would interface with several aspects of the New M5 Motorway project; these are outlined in **Table 6-1**. The tunnel-to-tunnel connection, lane configuration, ventilation facility and water treatment facility associated with the New M5 Motorway are shown in **Figure 6-3**.

Table 6-1 The project's interface with the New M5 Motorway

Interface	New M5 Motorway	The project
Tunnel-to-tunnel connection	The stub tunnels at Arncliffe will be built in a south-westerly direction and at a depth of about 75 metres underground.	The project would connect to the New M5 stub tunnels and continue south, with the northbound tunnel passing beneath the New M5 at about 100 metres underground.
Lane configuration	The New M5 tunnels, between Arncliffe and St Peters interchange, will be constructed for four lanes (allowing for an ultimate five lanes) and marked for two lanes as part of the New M5.	The project would include line marking of two additional lanes, for a total of four lanes, in the New M5 tunnels from St Peters interchange to where the project would join the New M5 tunnels at Arncliffe.
Ventilation facility	The New M5 includes a motorway operations complex at Arncliffe, which will house the Arncliffe ventilation facility.	The project would include the mechanical and engineering fit out, and the operation of the project's ventilation facility at Arncliffe constructed by the New M5 project.
Water treatment plant	The New M5 includes a water treatment plant within the motorway operations complex at Arncliffe.	The project would construct its own water treatment plant at Arncliffe.
Substation	The New M5 includes a substation which will be designed and constructed to include sufficient capacity to supply power to the New M5 project.	The project would construct its own substation at Arncliffe to supply power to the mainline tunnels. Power supply to this substation would be determined in detailed design.
Signage	The New M5 does not include directional signage for the project.	The project would include the installation of signage within the New M5 tunnels to provide guidance for motorists wishing to access the project.
Motorway control centre	The WestConnex motorway control centre will be built at St Peters interchange.	The project would include the installation of communication infrastructure within the motorway tunnels and provide a communications and operational connection between the WestConnex motorway control centre and the project's motorway control centre at MOC2 in Rockdale.
Tolling	The New M5 tolling arrangement is part of an overall WestConnex tolling strategy.	The project would be tolled separately from WestConnex.
Construction ancillary facilities	The New M5 construction ancillary facility would be demobilised as part of the New M5.	The project would utilise the New M5 construction site. Following completion of the project, the remaining land would be rehabilitated and returned to Bayside Council.

The F6 Extension Stage 1 will be a toll road. Tolls provide a fair and equitable means to help fund the project where the people using the new infrastructure help to pay for it.

In this way, tolls will contribute to funding the construction and ongoing operation and maintenance of the F6 Extension Stage 1. A tolling framework has been developed for the project that is consistent with other recent motorway projects. The motorway tunnel is proposed to be tolled at a flat rate of $1.77 each way (2017 dollars). The shortest trip possible when using the motorway tunnel would be between President Avenue and St Peters Interchange, via the New M5 Motorway. The WestConnex flagfall and distance based toll will also apply to journeys along that part of the road network.

Heavy vehicles will pay three times the toll of light vehicles, reflecting the greater wear and tear that trucks have on our roads. This is consistent with other recent motorways including WestConnex and NorthConnex.

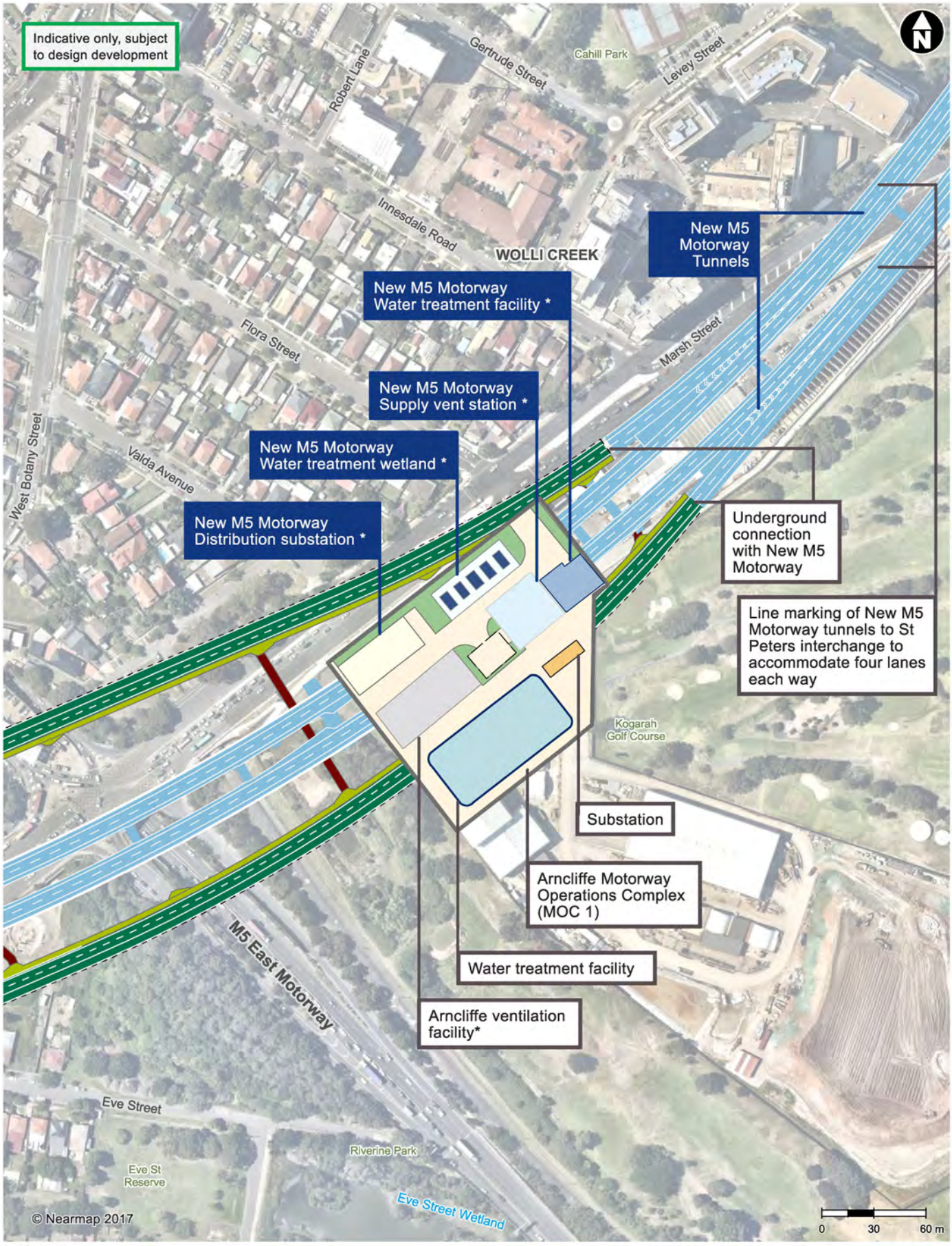


Figure 6-3 Connection with the New M5 Motorway

6.2 Urban design objectives and principles

Urban design principles have been developed for the project, consistent with the key urban design guidelines and policies including *Beyond the Pavement: Urban Design Procedures and Design Principles*[1] and *Tunnel urban design guidelines*[2]. The urban design principles applied to the design of the project and the rationale for their use is provided in **Figure 6-4**. Further detail is provided in **Appendix C** (Place making and urban design).

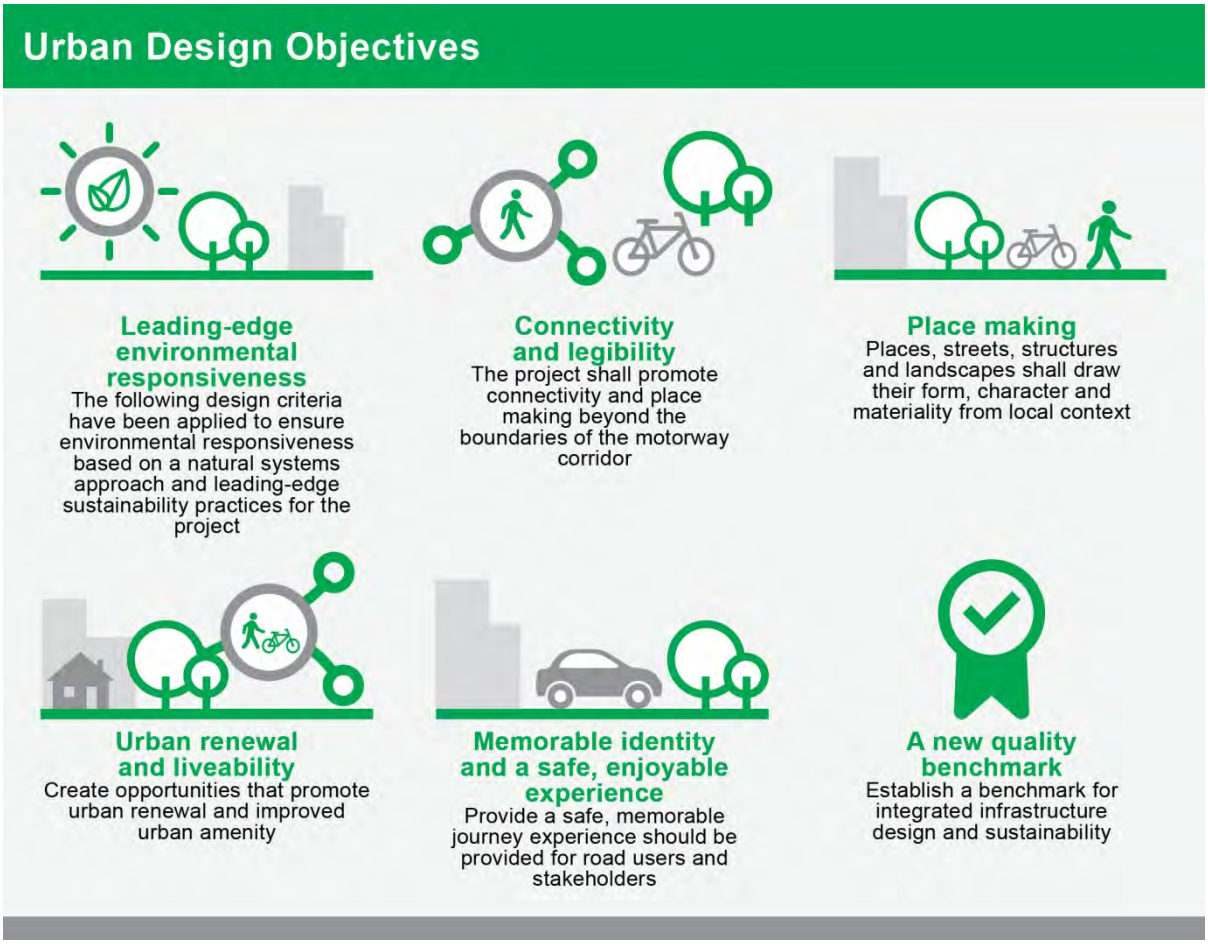


Figure 6-4 Urban design objectives

During detailed design, there would be a detailed review and finalisation of the architectural treatment of the motorway's operational ancillary facilities, ventilation facilities, the President Avenue intersection portals and all permanent infrastructure, including the President Avenue shared cycle and pedestrian bridge. The architectural treatment of these facilities would be guided by ventilation facility performance requirements, the outcomes of community consultation and urban design principles. Landscaping works would be carried out next to disturbed areas; around operational infrastructure (such as ventilation facilities); and along the shared cycle and pedestrian pathways.

Preliminary concept plans have also been prepared for Rockdale Bicentennial Park and the President Avenue surface works in consideration of the urban design objectives described in **Figure 6-4**. These would inform the Urban Design and Landscape Plan that would be prepared for the project**.**

Further details about urban design for the project are provided in **Appendix C** (Place making and urban design).

[1] Roads and Maritime (2014) Beyond the Pavement: Urban Design Procedures and Design Principles
[2] Roads and Maritime (2017) Tunnel urban design guidelines

6.3 Tunnels

6.3.1 Tunnel design

The tunnels would comprise two mainline tunnels (about 2.5 kilometres in length) in each direction, together with entry and exit ramp tunnels to the tunnel portal (about 1.5 kilometres in length). Each mainline tunnel would extend from the underground connection with the New M5 Motorway through to stub tunnels for a connection to a future stage of the F6 Extension (underground, just north of Bay Street). The mainline tunnel would be connected to the surface road network at President Avenue via the entry and exit ramp tunnels leading to and from the surface.

The tunnels would range in depth from just below the surface near the tunnel portal, to about 100 metres underground. The average depth of the mainline tunnels would be 70 metres underground. Each tunnel would be around 6.5 metres in height from floor to ceiling with a vehicle height clearance of 5.3 metres (see **Figure 6-5**). Mainline tunnel grades would not exceed four percent and the entry and exit ramp tunnels would not exceed grades of 6.25 per cent.

6.3.2 Lane configuration

Under the concept design assessed in this EIS, the mainline tunnels would be marked for two lanes in each direction, although the tunnels would be constructed to allow for a potential future third lane in each direction. The width of the caverns for the mainline tunnels has been designed to allow for this capacity increase without the need for further excavation. It should be noted that any change in operation from two lanes to three lanes would be subject to future environmental assessment and approval. To prevent driving in the wide shoulder during Stage 1, temporary barriers would be installed to limit the shoulder to 2.5 metres.

The project would include line marking of two additional lanes, for a total of four lanes, in the New M5 tunnels from St Peters interchange to where the project would join the New M5 tunnels at Arncliffe (about two kilometres).

The configuration of traffic lanes within the mainline tunnels and the entry and exit ramp tunnels is described in **Table 6-2**. Indicative cross-sections of the mainline tunnels are shown in **Figure 6-5**. An indicative cross-section of the entry and exit ramp tunnels is shown in **Figure 6-6**.

Table 6-2 Lane configuration and widths for the tunnels

Tunnel section	No. of lanes to each tunnel	Width of lanes (metres)	Width of nearside shoulder (metres)	Width of offside shoulder (metres)	Carriageway width kerb to kerb (min.) (metres)	Posted speed (km/h)
New M5 Motorway mainline tunnel connection to merge/diverge with F6 Extension mainline tunnel	2	3.5	2.5	1	10.5	80
Mainline tunnel (New M5 Motorway stub tunnels to F6 Extension stub tunnels)	2[1]	3.5	4.5[1]	1	12.5	80
Entry and exit ramp tunnels to tunnel portal	2	3.5	1	1	9	60

[1] The mainline tunnels would be built to three lanes wide and line marked for two lanes as part of this project. This allows for a future third 3.5m lane and 1.0m shoulder. To prevent driving in the wide shoulder during Stage 1, a nominal 2m shoulder will be line marked and temporary barriers installed.

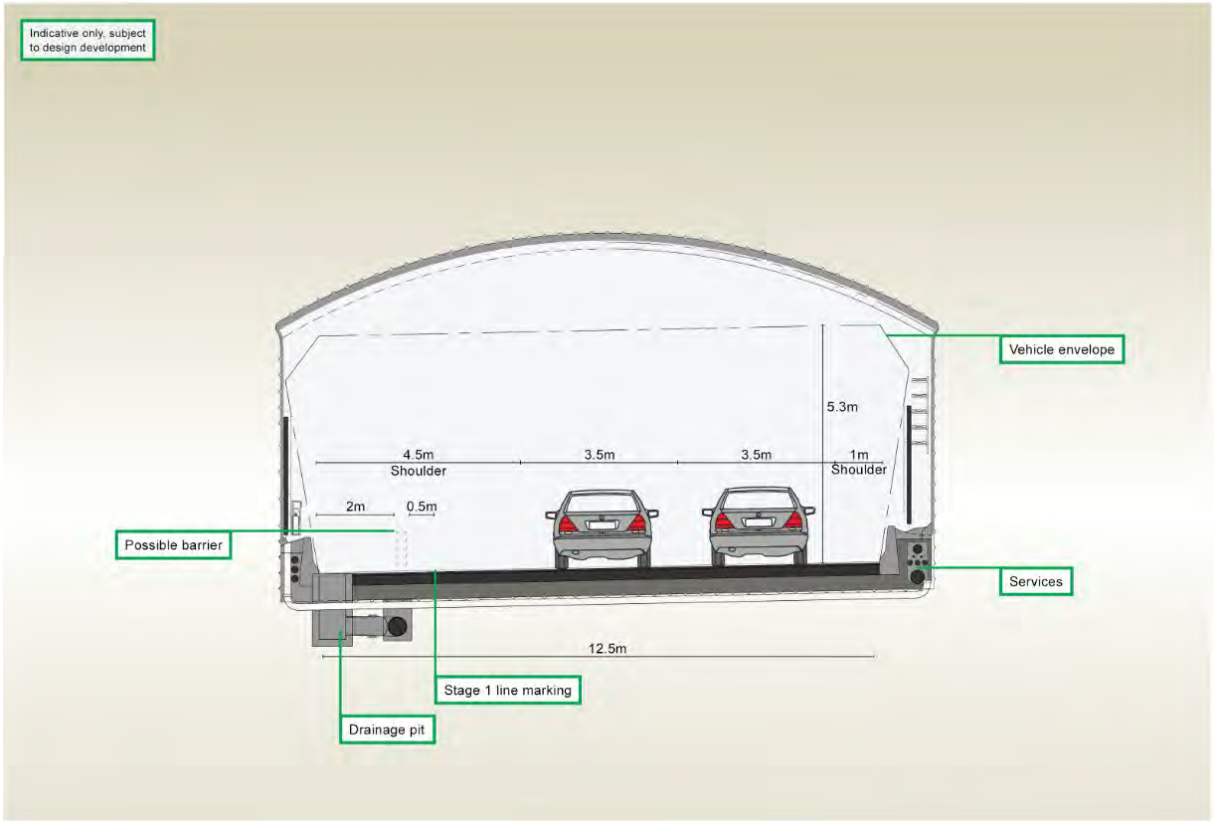


Figure 6-5 Indicative cross-section of the mainline tunnels

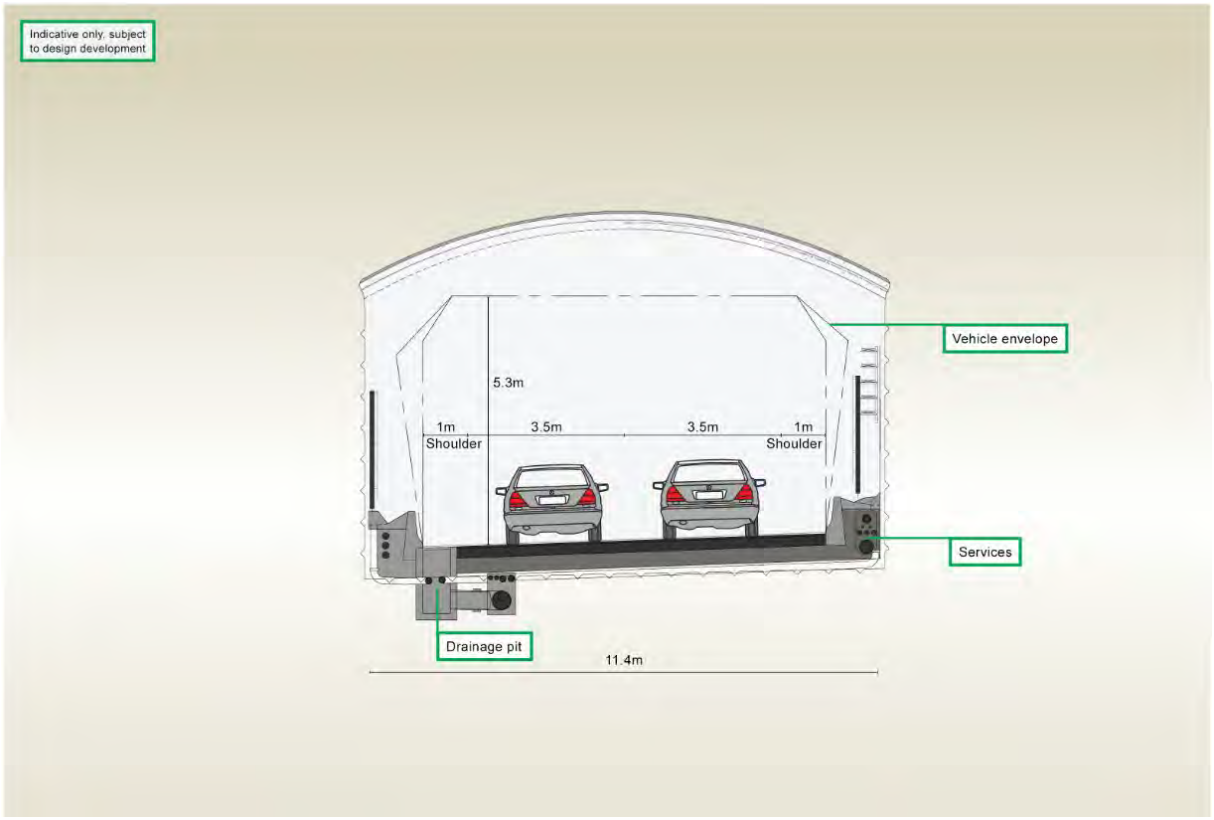


Figure 6-6 Indicative cross-section of the entry and exit ramp tunnels

6.3.3 Emergency breakdown facilities

The tunnels would include one vehicular cross-passage to allow for emergency services vehicles to switch between the northbound and southbound tunnels, as well as multiple pedestrian cross-passages at regular distances of around every 120 metres and longitudinal egress passages with doors that provide emergency pedestrian egress between tunnels. Additional access passages would be included so that there is a maximum walking distance of 250 metres for Fire and Rescue NSW personnel from a vehicle to an incident site. An indicative cross-passage layout is shown in **Figure 6-7**.

Fire and life safety provisions for the project are discussed in more detail in **section 6.9.5**.

Tunnels would include breakdown bays, large enough for vehicles to park safely without interrupting traffic flow. An indicative layout of a mainline tunnel maintenance and breakdown bay is shown in **Figure 6-8**.

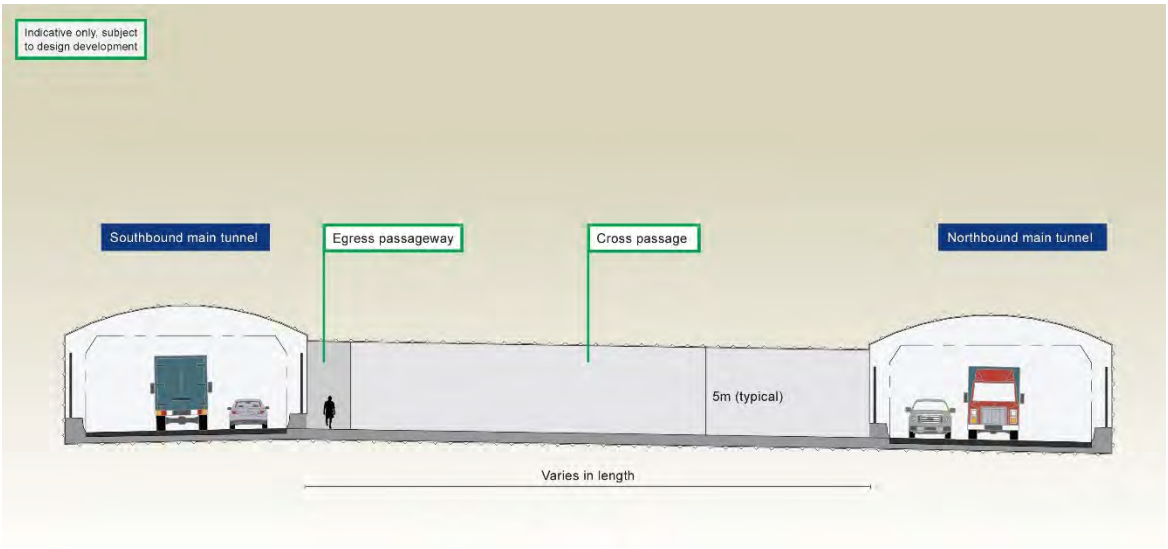


Figure 6-7 Indicative cross-passage layout

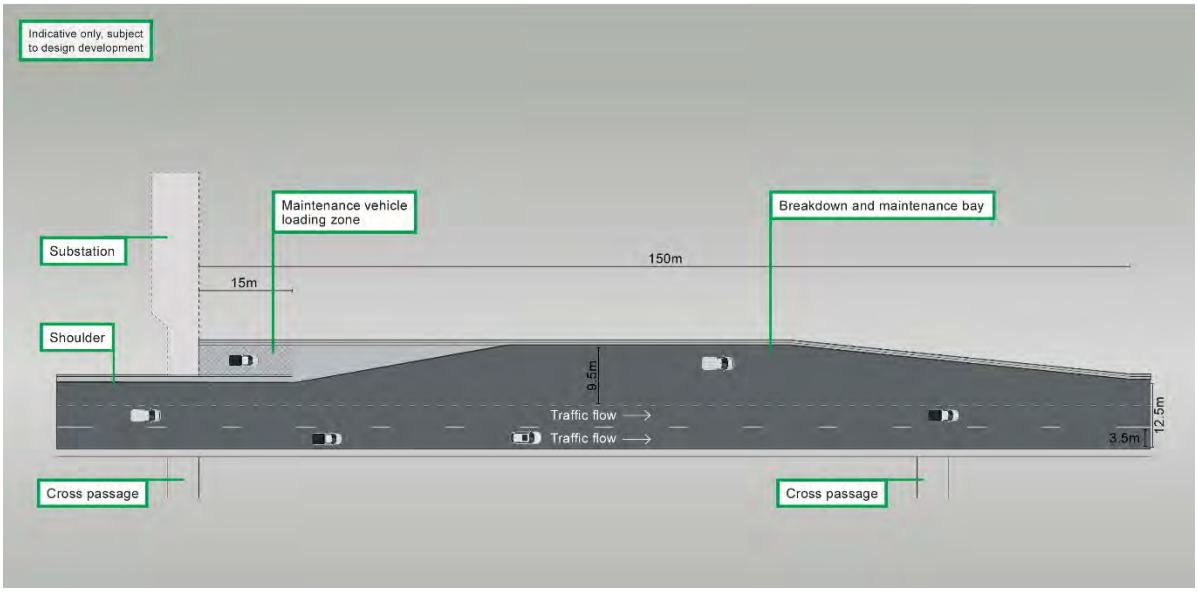


Figure 6-8 Indicative layout of a mainline maintenance and breakdown bay

6.3.4 Tunnel portal and slot structure

A tunnel portal would be located north of President Avenue, within the current Rockdale Bicentennial Park East. The portal has been designed to provide for a 5.4 metre vertical clearance consistent with Roads and Maritime guidelines, and Austroads' *Guide to Road Design*[3] and *Guide to Road Tunnels*[4]. An open slot structure would provide a connection between the tunnel portal and the surface road network. The slot structure would consist of north facing ramps with two lanes in each direction. Typical lane configuration and widths for the ramps are outlined in **Table 6-3**. This open slot structure for the entry and exit ramps is shown in **Figure 6-9**.

Table 6-3 Lane configurations and widths for entry and exit ramps

Element	No. of lanes	Width of lanes (metres)	Width of nearside shoulder (metres)	Width of offside shoulder (metres)	Carriageway width kerb to kerb (min.) (metres)	Posted speed (km/h)
President Avenue intersection entry and exit ramps	2	3.5	1	1	9	60

[3] Austroads (2016) Guide to Road Design
[4] Austroads (2015) Guide to Road Tunnels

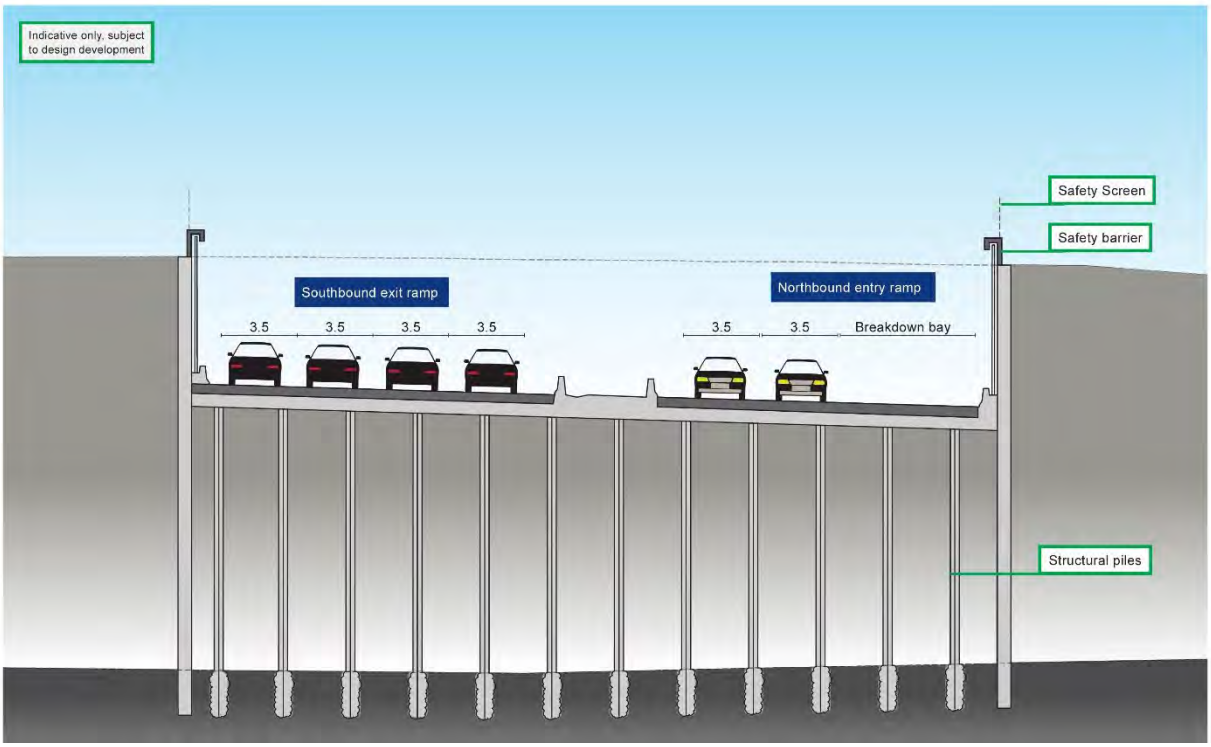


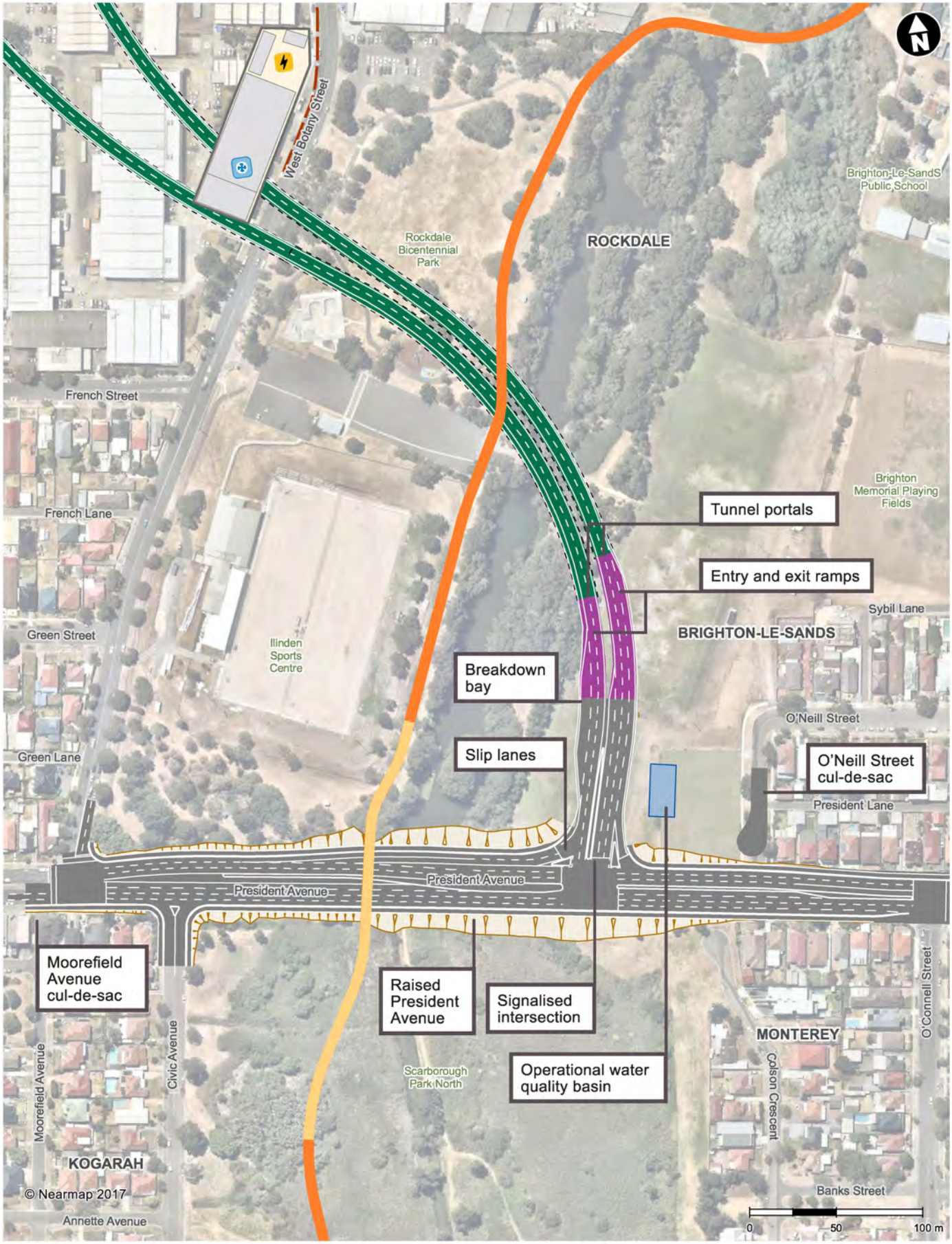
Figure 6-9 Indicative slot structure for entry and exit ramps

6.4 President Avenue intersection

The President Avenue intersection would connect the tunnels and entry and exit ramps with the existing surface road network. All traffic would enter and exit the project at the President Avenue intersection. Traffic signals would be installed at the intersection. The operational layout of the President Avenue intersection is shown in **Figure 6-10**.

The project would retain existing signalised pedestrian crossings of President Avenue at Princes Highway, West Botany Street and O'Connell Street. Footpaths would be upgraded where widening of President Avenue is proposed.

Between West Botany Street and O'Neill Street, the main east-west pedestrian movement would be on the southern side of President Avenue, adjacent to Scarborough Park North, by way of a new shared path. Pedestrian connectivity would be provided within and around Rockdale Bicentennial Park to enable movement of pedestrians and cyclists within the parkland and to/from President Avenue.



LEGEND

- The project in tunnel
- The project on surface
- The project as an open slot
- Shared cycle and pedestrian pathways
- President Avenue shared cycle and pedestrian bridge
- Building
- Embankment
- Water quality basin
- Motorway operations complex
- Substation
- Permanent power supply line
- Rockdale ventilation facility

Figure 6-10 President Avenue intersection layout

6.5 President Avenue surface works

The project would involve upgrade and widening works along President Avenue to ensure safe and efficient connections with the road infrastructure proposed as part of the project, and to cater for additional future traffic demand.

Surface works on President Avenue would allow the project to integrate with the existing arterial roads and would cater for future demand. These works would include:

- Consolidate street accesses and egresses to remove safety issues with right turning traffic in to and out of Moorefield Avenue
- Widening sections of President Avenue to three through lanes eastbound and three through lanes westbound
- Addition of slip lanes to provide a connection to the intersection with the project
- Raising President Avenue about three metres at the location of the President Avenue intersection with the tunnel portal
- Creating cul-de-sacs to close existing local road intersections with President Avenue including Moorefield Avenue and O'Neill Street
- Conversion of Civic Avenue to allow left in/left out movements only at President Avenue
- Conversion of Lachal Avenue to a two way street to enable all vehicle movements to occur
- Addition of a right turn bay and refuge bay to formalise a right turn into Lachal Avenue from President Avenue.

The lane configuration and operational layout of President Avenue is outlined in **Table 6-4** and shown in **Figure 6-10** and **Figure 6-11.**

Roads and Maritime would continue to work with Bayside Council to confirm modifications to the local road network, particularly in the vicinity of President Avenue between West Botany Street and Princes Highway.

Table 6-4 Lane configuration of President Avenue

Element	No. of lanes	Width of lanes (metres)	Width of nearside shoulder (metres)	Width of offside shoulder (metres)	Carriageway width kerb to kerb (min.) (metres)	Posted speed (km/h)
President Avenue	3	3 to 3.5	-	-	9	60

6.6 President Avenue / Princes Highway intersection

The project would include widening of President Avenue and Princes Highway at their intersection to provide additional turning lanes and to increase the intersection's capacity and performance (refer to **Figure 6-11**), as follows:

- Upgrade from a two lane signalised right turn to a three lane signalised right turn from northbound Princes Highway to eastbound President Avenue. The additional northbound right turn lane would have 110 metres of car space and would provide additional intersection capacity for northbound vehicles on Princes Highway turning right onto President Avenue
- Upgrade from three lanes southbound on Princes Highway with a shared straight/ left turn lane to four lanes including a dedicated, signalised, left turn from Princes Highway southbound onto President Avenue eastbound. The new southbound left turn lane would have 70 metres of storage.

The additional lanes would require realignment of the intersection and alterations to the traffic signal phasing at the intersection.

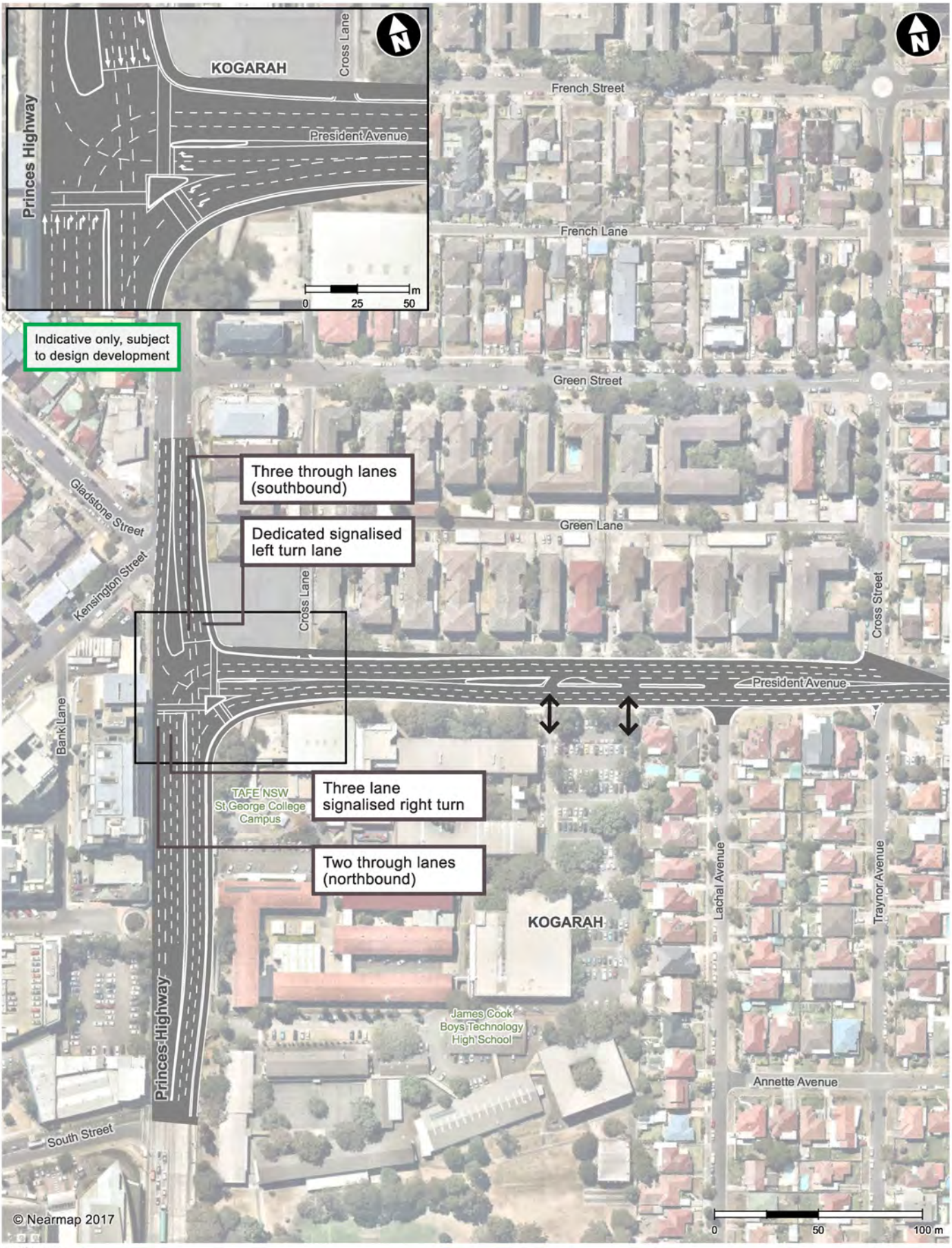


Figure 6-11 Princes Highway and President Avenue operational layout

6.7 Reinstatement of Rockdale Bicentennial Park

Sporting fields and recreational facilities within Rockdale Bicentennial Park would be directly impacted by the project, including a playground with equipment, a skate park, an open recreational oval and up to three soccer playing fields.

Prior to construction commencing, some of these facilities would be offset with new facilities at nearby locations. The construction and installation of these facilities would be subject to separate planning approvals.

Following completion of the motorway elements of the project, and to ensure the park's ongoing use, Rockdale Bicentennial Park would be reconfigured as part of the project. Roads and Maritime is in consultation with Bayside Council, as the facility owner, and the sporting groups that use the facilities to develop a master plan for the reconfiguration of the Rockdale Bicentennial Park and associated facilities. The aim of the plan would be to enhance the recreational, scenic and ecological values of Rockdale Bicentennial Park.

Reconfigured facilities would be comparable with existing facilities and where possible enhanced according to the needs of the users. The reinstatement would involve:

- Earthworks and landscaping to reshape the site around the motorway operational infrastructure
- Landscape works to improve pedestrian circulation and integration with the shared cycle and pedestrian pathways/existing path network
- Reconfiguration of sporting fields and associated amenities
- Landscape works to provide additional recreational amenity including seating, bin enclosures, shelters and drinking fountains
- Revegetation, including tree planting, at key locations including around the reinstated wetlands and water quality basin.

A concept design for the reinstatement of Rockdale Bicentennial Park has been prepared (refer to **Figure 6-12**) having regard to the urban design objectives and principles in **section 6.2**. The concept design is detailed further in **Appendix C** (Place making and urban design).

The concept design would be refined during the development of an Urban Design and Landscape Plan, which would be prepared based on the detailed design for the project and in accordance with relevant commitments in this EIS. The Urban Design and Landscape Plan would also be prepared in consultation with Bayside Council, other key stakeholders and the community.

Figure 6-12 Preliminary concept plan for reinstated Rockdale Bicentennial Park

6.8 Shared cycle and pedestrian pathways

The project would deliver new shared cycle and pedestrian pathways. These would be developed from Bestic Street, Brighton-le-Sands south to Civic Avenue, Kogarah through the reinstated Rockdale Bicentennial Park, including some parts as an on-road cycleway. As part of the project, a dedicated shared bridge would be built over President Avenue. The shared cycle and pedestrian pathways would be designed to respond to the surrounding context without obstructing visibility or creating a safety concern. The design would also fit with the redevelopment of Rockdale Bicentennial Park following construction and does not preclude a legible connection with President Avenue shared cycle and pedestrian bridge.

The shared cycle and pedestrian pathways would provide connections with several existing and proposed routes including:

- Bestic Street and cycleways north of Bestic Street, along Muddy Creek
- West Botany Street, opposite Ador Avenue Reserve
- Bruce Street, Francis Street, Bay Street and England Street, Brighton-le-Sands
- West Botany Street, next to Rockdale Bicentennial Park
- Rockdale Bicentennial Park
- Civic Avenue, Kogarah.

The shared bridge over President Avenue is intended to provide a corridor scale connection for pedestrians and cyclists, rather than a pedestrian crossing for short trips back and forth across President Avenue. For these movements, pedestrians would be able to cross President Avenue via the signalised intersections at West Botany Street and O'Connell Street. However, if so desired, pedestrians would also be able to access the shared bridge, on the northern side via footpaths or on the southern side via Civic Avenue.

Where possible the shared pathways would be a separate pedestrian path and cycle way unless surrounding constraints require a shared section. Where space permits the key components of the shared cycle and pedestrian pathways are:

- The average width would be five metres, comprising a three metre two-way cycle lane, 1.5 metre pedestrian path and 0.5 metre buffer
- The President Avenue shared cycle and pedestrian bridge would be 5.5 metres high (from underside of bridge to road surface)
- Lighting would be provided along the length of the shared cycle and pedestrian pathways where required (refer to **section 6.9.7**).

The key design guidelines of the shared cycle and pedestrian pathways are:

- Design pathways and cycle facilities to current best practice and design standards
- Provide tree planting to provide shade as well as improve visual amenity
- Provide appropriate street and pathway lighting for users to safely and comfortably navigate outside daylight hours
- Develop a prioritised program of appropriate way-finding tools (e.g. directional signage and distance markers) at critical locations on the network
- Provide continuous cycle and pedestrian path treatment past driveways to reinforce the priority of pedestrians and cyclists over crossing vehicles
- Remove barriers along the route that may create hazardous situations
- Ensure appropriate surface quality to pathways
- Include kerb build outs to reduce crossing distances and pedestrian refuges to aid the safe movement of pedestrians and cyclists across busy roads
- Paint white bicycle symbols on the road to raise driver awareness when cyclists need to share the road with vehicles.

A cross section of the shared cycle and pedestrian pathways is shown on **Figure 6-13**. The general alignment of the shared cycle and pedestrian pathways is shown on **Figure 6-14**. Detailed descriptions of the shared cycle and pedestrian pathways are also provided in **Appendix C** (Place making and urban design).

Figure 6-13 Indicative cross section of the shared cycle and pedestrian pathways through Rockdale Bicentennial Park

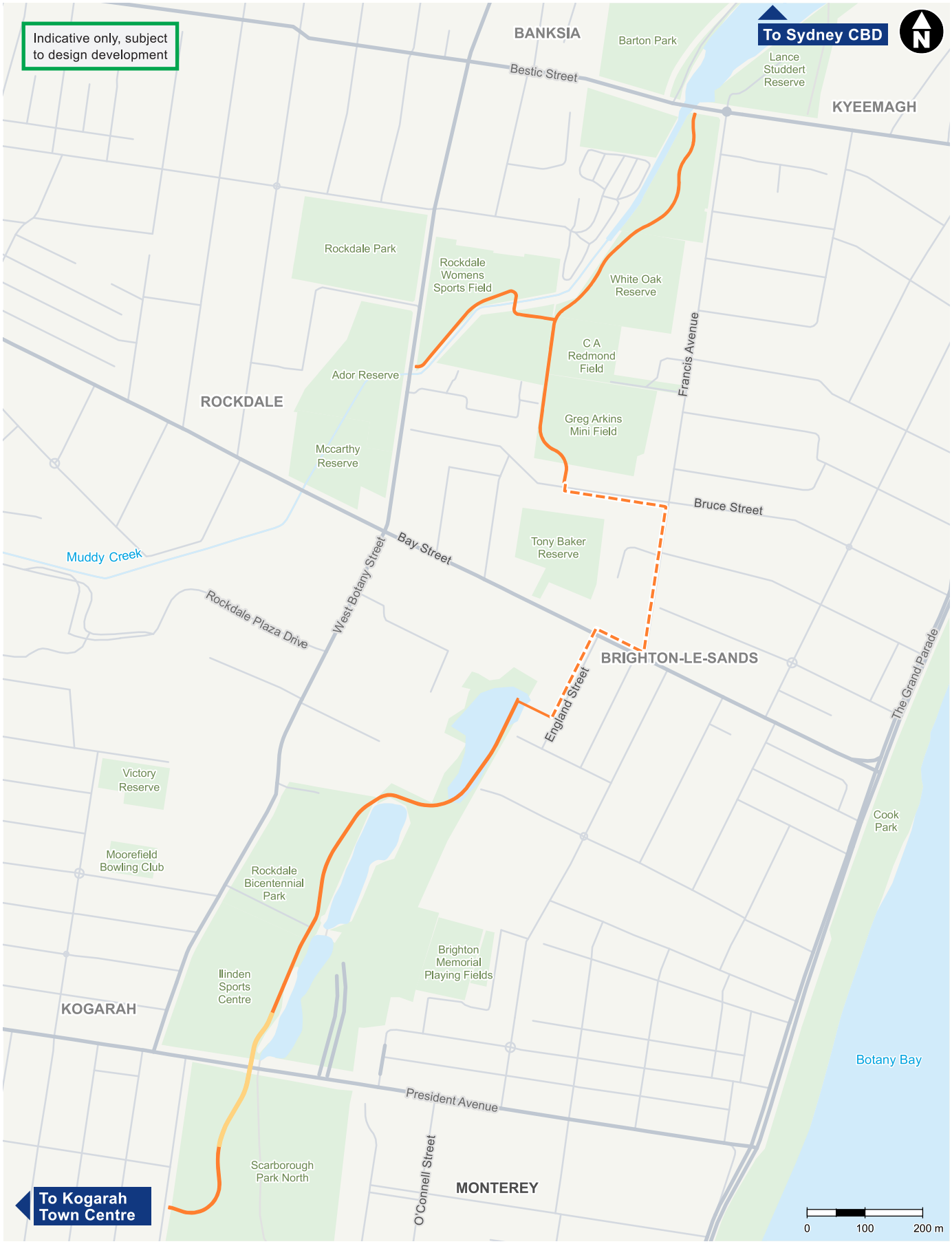


Figure 6-14 Shared cycle and pedestrian pathways

6.9 Motorway operational ancillary infrastructure

6.9.1 Motorway operations complex

The Arncliffe Motorway Operations Complex being constructed as part of the New M5 Motorway would be used for the Arncliffe ventilation facility. A substation and water treatment plant would be constructed adjacent to the New M5 Motorway Arncliffe Motorway Operations Complex, within MOC1 for the project.

The operational infrastructure in the south of the project area would be shared between two separate facilities, Rockdale Motorway Operations Complex (north) (MOC2) and Rockdale Motorway Operations Complex (south) (MOC3). The operational infrastructure that would be located within each of these complexes is listed in **Table 6-5** and shown in **Figure 6-15**.

Table 6-5 Rockdale motorway operations complexes

Motorway operations complex	Operational infrastructure
Arncliffe Motorway Operations Complex (MOC1)	• Substation • Water treatment facility • Mechanical fitout of ventilation facility
Rockdale Motorway Operations Complex (north) (MOC2)	• Operational motorway control centre • Car parking • Deluge tanks • Workshop • Office • Bulky equipment store • Pump station and pump room • Work yard
Rockdale Motorway Operations Complex (south) (MOC3)	• Ventilation facility • Car parking • Two substations and power supply • Disaster recovery site

6.9.2 Operational management

The motorway would be controlled and managed from the motorway control centre located within Rockdale Motorway Operations Complex (north) (MOC2) at West Botany Street as shown in **Figure 6-15**. The motorway control centre would operate 24 hours a day, seven days a week.

This centre would house the control systems for the project to allow monitoring and operation of the tunnel systems. A computerised operations management and control system would be provided that integrates the traffic management and control system and the plant management and control system. The operations management and control system would enable operators to monitor and control the section of the project tunnel between Arncliffe and Kogarah. The traffic management and control system would interface with and control:

- Electronic signage
- Vehicle detection
- Closed-circuit television (CCTV) and video based incident detection
- Tunnel closure devices
- Messaging via the rebroadcast break-in and public address systems
- Security systems and doors.

The Plant Management and Control System would interface with and monitor and control:

- Power supply and distribution equipment
- Air quality instruments, ventilation fans and dampers
- Fire detection and suppression (deluge)
- Carriageway main lighting (e.g. transition and threshold levels) and wayfinding lighting
- Drainage sumps and pumps
- Water treatment
- Plant room building services.

The operations management and control system would be equipped with real time external interfaces to the WestConnex operations management and control system and with Transport for NSW's Transport Management Centre.

The interface with the WestConnex system would permit integration of the project for coordinated operation of nearby tunnel infrastructure. During detailed design, the operations management and control system for the tunnels would require the development of robust and reliable communications system to implement coordinated incident responses. This is of particular importance where ventilation systems are linked and to respond to incidents that occur at or near the interface between the tunnels. The project's Rockdale ventilation facility would be operated by the WestConnex motorway control system.

The operations management and control system would include incident management functionality that facilitates implementation of pre-planned, location and incident-specific, coordinated responses to incidents by:

- Deploying electronic signage plans such as lane closures, warning signage and reduced speed limits
- Playing appropriate pre-recorded radio rebroadcast and public address messages as required periodically to different tunnel zones to alert motorists
- Changing ventilation strategies to suit traffic or fire conditions
- Implementing wayfinding lighting strategies as required
- Prompting appropriate operator steps including:
  - Notifying emergency services, Transport Management Centre and other tunnels/roads
  - Recording of details
  - Archiving recorded CCTV footage
- Restoring normal operations at the conclusion of an incident.

6.9.3 Traffic monitoring and management

The project would include the integration of 'Smart Motorway' (also known as 'managed motorway') features. This means that it would use real-time information, communication and incorporated traffic control systems into and alongside the road, in order to improve traffic flow and the safety of the road environment.

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

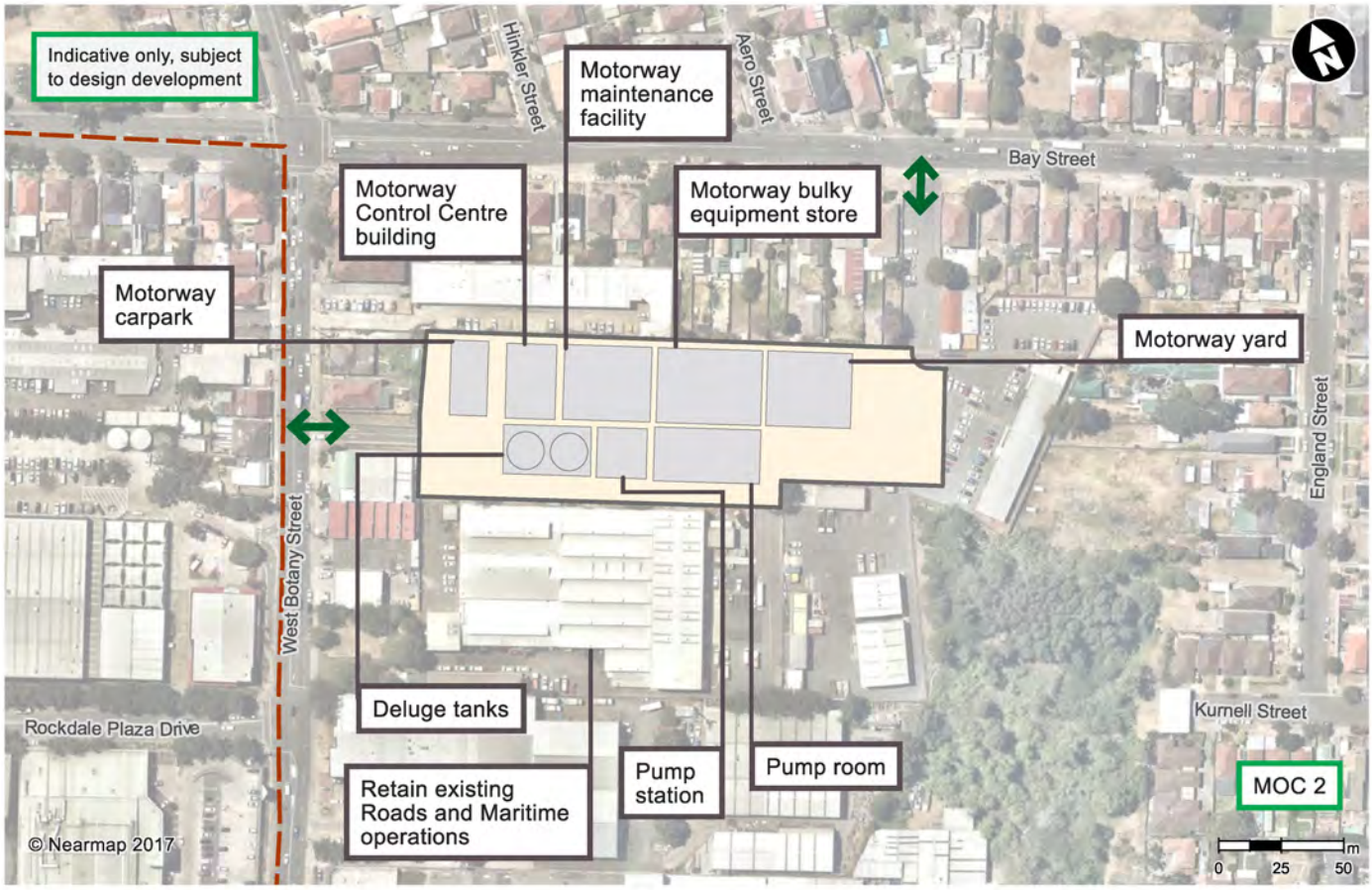
- Variable message signs on the tunnel entry portals and approaches along President Avenue
- Tunnel message signs at about 120 metre intervals in the tunnel to coincide with egress points
- Integrated speed and lane use signs within the tunnel at mid-points between tunnel message signs
- Vehicle detectors placed to detect traffic congestion
- Fixed CCTV cameras at about 60 metre intervals within the tunnel
- Pan-tilt-zoom CCTV cameras at about 240 metre intervals within the tunnel, providing full coverage of the portals, ramps and approach intersections
- Over-height vehicle detection and dynamic diversion signage integrated with the President Avenue variable message signs
- Tunnel closure and diversion measures:
  - Overhead changeable message signs and in-pavement lights on President Avenue to delineate changed lane configurations
  - Advanced warning signs to slow traffic
  - Portal physical barriers (boom gates)
  - Traffic signals at the entry portals coinciding with physical barriers
  - Interface with traffic signals on President Avenue.

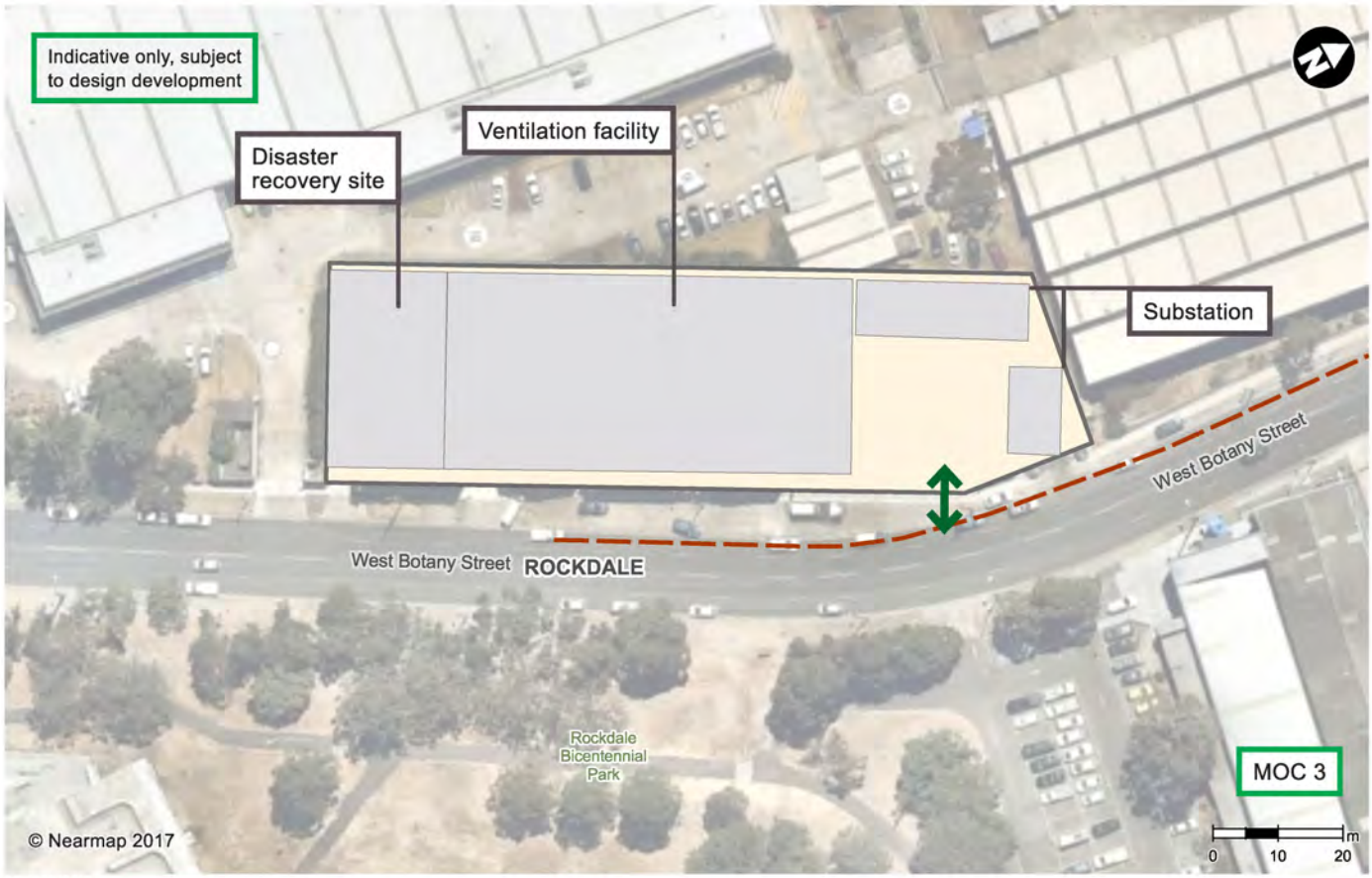
Additional tunnel infrastructure would include:

- In-tunnel radio rebroadcast providing:
  - Rebroadcast of popular AM and FM radio stations complete with zoned audio break-in facilities to communicate with motorists
  - Coverage for emergency services two-way radios
  - Mobile phone coverage
- Zoned public address system to carriageways and egress passages
- Lighting control system with the ability to dynamically control wayfinding signage for compatibility with incident response
- Video-based incident detection for fixed cameras.

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

- Signs would be used to notify road users of the incident ahead, and to display lowered speed limits, if required
- Public address and re-broadcast systems would notify road users of the management measures in place within the tunnels
- A tunnel closure system would be used to prevent additional vehicles from entering the mainline tunnels, where appropriate
- Traffic signals on President Avenue would be controlled to prevent entry to the tunnel when a closure is implemented.





LEGEND

- Building
- Motorway operations complex
- Permanent power supply line
- Heavy and light vehicle access

Figure 6-15 Rockdale Motorway Operations Complexes (north and south)

6.9.4 Ventilation system and facilities

The project ventilation system for the northbound tunnels would be integrated with the New M5 Motorway project, while a separate system has been designed for the southbound tunnels. The project's ventilation system has been designed to:

- Ensure the safety and health of motorists using the tunnels during normal operation, maximum (heavy) traffic conditions and emergency conditions
- Ensure that air inside and outside the tunnels meets relevant air quality criteria
- 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 10** (Health, safety and hazards)
- Minimise the consumption of energy and other resources, in a manner which 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 New M5 Motorway tunnel and future stages of the F6 Extension.

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 (refer to **Figure 6-16**).

With longitudinal ventilation, air would move through the project tunnels in the direction of traffic flow using two mechanisms. The first mechanism is the 'piston effect', caused by the movement of vehicles through the project tunnels which pushes air in front of moving vehicles and pulls fresh air behind them. Secondly, jet fans would be installed to assist the piston effect if and when required. Before the tunnel air reaches the exit portals, the air would be drawn from the tunnels into the ventilation outlets using large exhaust fans. The project has been designed to avoid the emission of tunnel air from the exit portals.

Ventilation outlets provide an effective means of dispersing air drawn from the tunnels. Further detail about 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. The fire and life safety systems (see **section 6.9.5**) 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 through the nearest practical and safe point, which may be:

- The ventilation facilities located at Arncliffe or Rockdale
- The tunnel portals, if the fire is close to a portal.

Further details of tunnel fire hazards and their management are provided in **Chapter 10** (Health, safety and hazards).

In-tunnel air quality 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. **Chapter 9** (Air quality) provides details on the in-tunnel air quality criteria applied for the engineering design of the ventilation system.

Ventilation facilities

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

Two ventilation facilities would be used as part of the project, namely:

- Arncliffe ventilation facility - constructed as part of the New M5 Motorway project at 15 Marsh Street, Arncliffe
- Rockdale ventilation facility - a new ventilation facility located at 427-441 West Botany Street, Rockdale, within the Rockdale Motorway Operations Complex (south) (MOC3).

Key components of the project's ventilation systems are shown in **Figure 6-16**. The locations of ventilation facilities for the project are shown in **Figure 6-1** and **Figure 6-2**.

Operating modes

The tunnel ventilation system would operate in three modes:

- Normal (expected) traffic conditions
- Maximum traffic flow
- 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 steady and travelling at posted speed limits (as outlined in **Table 6-6**).

Table 6-6 Posted speed limits for road elements of the project

Road elements	Posted speed
Mainline carriageways	80 km/hr
Entry and exit ramps for President Avenue	60 km/hr
President Avenue	60 km/hr

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 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.

Maximum traffic flow conditions

The piston effect associated with traffic movement would be reduced where traffic flow within the tunnel is travelling at low speeds (i.e. around 40 kilometres per hour or less). This is typically as a result of a traffic incident or congestion. Under these conditions, longitudinal ventilation may require mechanical support to maintain air movement through the tunnels. Jet fans would increase tunnel airflows in the same direction as the traffic flow, when traffic speeds are low. These would be directly controlled by operators in the operational motorway control centre and would ensure sufficient fresh air to dilute vehicle emissions to meet relevant air quality criteria. Under these traffic conditions, additional fresh air may also be required to maintain acceptable air quality. Additional air may be injected into the mainline tunnels via the ventilation facility at Arncliffe.

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 help in reducing emissions inside the tunnel.

Air quality monitoring and management

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 coordinated across the motorway to ensure:

- Air quality remains within specified limits for motorists and road workers, irrespective of their origin and destination
- 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, CO and NO_2, visibility 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.

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

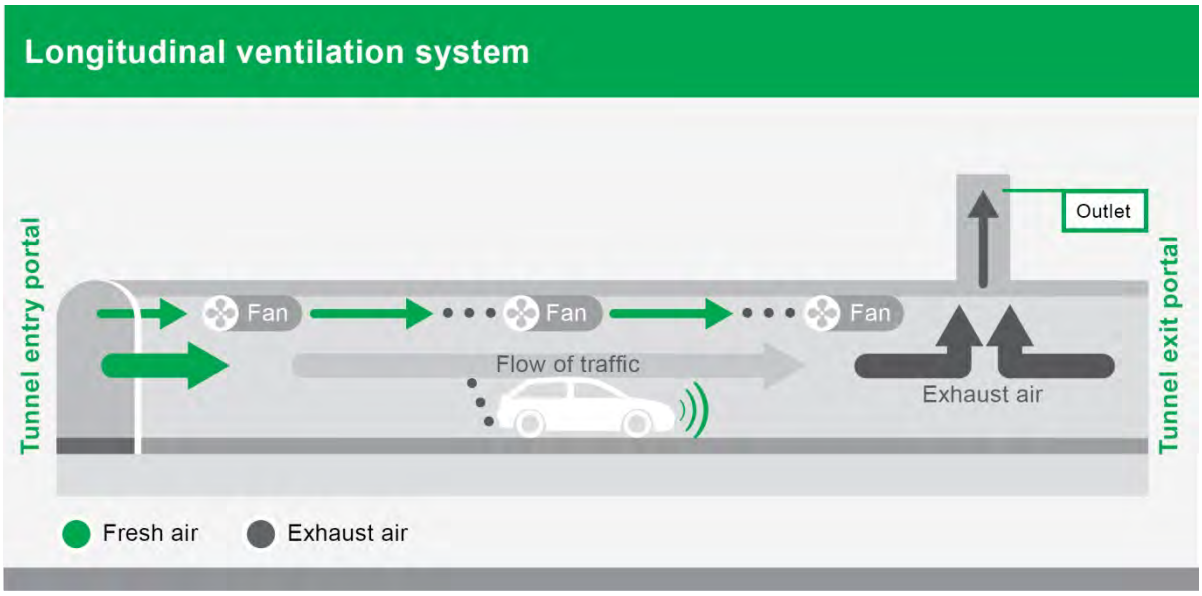


Figure 6-16 Key components of the project's ventilation system

6.9.5 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 mainline tunnels for the project would connect directly to the New M5 Motorway tunnels below ground, the fire safety systems would be coordinated between the projects to ensure safety during an incident. The operational motorway control centre at West Botany Street would coordinate the operation of tunnel systems under emergency conditions.

Key objectives of the fire and life safety design would be to protect life and assets, control the incident and facilitate intervention by the emergency services.

Fire and life safety measures

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 fire-separated carriageway not affected by the incident.

For the entry and exit ramp tunnels, there is the same objective to provide access and egress to a safe place underground, however there would not need to be an adjoining ramp.

Emergency egress and access for emergency response teams

The tunnels would include at least one vehicular cross-passage to allow for emergency vehicles and traffic to be moved from one tunnel into another in the case of an emergency (refer to **Figure 6-7**). The vehicular cross-passage would be provided between the northbound and southbound 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 incident is resolved and the tunnel reopens.

Pedestrian cross-passages would be located within the tunnel, at regular distances of around every 120 metres (refer to **Figure 6-8**). 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 by providing alternative safe holding zones.

Shoulders would be provided within the tunnels to enable safe passage to the cross-passages. These shoulders would be appropriately sized for the project and also the ultimate possible configuration of the mainline tunnel.

For the entry and exit ramp tunnels in some locations, it may be impractical to connect them to an adjoining tunnel. This would therefore require the use of longitudinal egress passages which are generally needed where adjoining entry and exit ramps are separated by long distances; are at significantly different elevations or are on either side of the mainline tunnels, all of which prevents the use of a level cross-passage.

Longitudinal egress passages would be located in:

- Mainline tunnels from the northern stub tunnels to the south where the two tunnels are at different depths
- The entry and exit ramps from the mainline tunnel to just before the driven tunnel portal, near West Botany Street.

Additional access passages would also be required so that there is a maximum walking distance of 250 metres for Fire and Rescue NSW personnel from a vehicle to an incident site.

Breakdown bays would also be included as part of the project as described in **section 6.3.3** and as shown in **Figure 6-8.**

Smoke control system

Longitudinal smoke control is proposed as the primary means of smoke management for the project, involving blowing smoke along the tunnel in the direction of vehicle travel. This has two effects; firstly, it ensures the safety of vehicles stopped upstream of (or before) an incident and secondly it allows vehicles downstream of (or after) an incident to keep driving out of the tunnel or into the next ventilation section. Smoke would be removed from the tunnel at portals or via the ventilation outlets.

The ventilation outlets and portals would be used to remove smoke and to prevent it from spreading to adjoining tunnel sections. This is particularly important at the project's interface with the New M5 Motorway where the ventilation system would be designed to prevent smoke spreading between the two projects.

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 help 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 reopen.

Water supply for the project's suppression system would be provided from water tanks located at the Motorway Operations Complex (MOC2) at West Botany Street, Rockdale.

Transport of Dangerous Goods

Vehicles transporting dangerous goods as defined by the *Australian Dangerous Goods Code*[5] would be prohibited within the project tunnels consistent with the prohibitions applying to other tunnels within Sydney's motorway network.

6.9.6 Motorway tolling infrastructure

Tolling points would be installed at the President Avenue entry and exit ramps or the tunnel portal. The location would be determined based on accessibility, protection from weather and space availability.

An electronic tag-based free-flow type of roadside tolling equipment would be used and would include:

- Vehicle classification signage
- Electronic tag readers
- Cameras for enforcement and number plate identification
- Toll point lighting
- Overhead gantry complete with maintenance access
- Secure roadside technical shelter, housing servers and communication equipment.

Due to the close proximity of the northbound and southbound lanes, a radio frequency barrier may be required between the carriageways to prevent tags being read at both toll points in one passage. This would be developed during the design and delivery phase.

6.9.7 Lighting

In-tunnel lighting

In-tunnel lighting would be based on road geometry and would be 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 changed in response to varying levels of brightness due to time of day and weather conditions. Uniform lighting would be provided along the tunnels, in rows along the ceilings.

Surface road lighting

Surface road lighting, including at ramps, intersections and along local roads upgraded as part of the project would be 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.

[5] National Transport Commission, 2015. Australian Dangerous Goods Code

Shared cycle and pedestrian pathways lighting

Lighting along the shared cycle and pedestrian pathways, including the dedicated shared bridge, has been designed to meet the requirements of Australian Standard AS/NZS 1158: *Lighting for roads and public spaces*. Light poles would be offset one metre from the path to minimise risk of collisions for road users.

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 Rockdale ventilation facility. All aviation hazard lighting would be provided in accordance with the protection of airspace regulations required by the Civil Aviation Safety Authority.

6.9.8 Signage

Message signs related to traffic, location, directions, warnings and variable conditions would be incorporated within the tunnels and on surface roads at tunnel approaches. Message signs would operate as part of the integrated signage provided within the tunnel network. 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 and enhancing road safety.

Variable message signs would be mounted on gantries along those roads which approach the tunnels and would be used to advise motorists of traffic conditions. The signs would be located directly adjacent to existing arterial roads such as President Avenue, the Princes Highway and The Grand Parade. Other locations on the arterial road network may also benefit from variable message signs. Specific locations would be chosen to minimise impacts to existing land use, biodiversity and the visual environment and would be determined during detailed design.

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 operational motorway control centre to display variable speed limits in response to incidents and congestion.

6.9.9 Drainage and water treatment facility

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

- Tunnel water drainage, including the construction of an operational water treatment facility to treat surplus groundwater collected within the project tunnels before discharge into the Cooks River.
- Surface water drainage and management infrastructure.

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 18** (Surface water and flooding) and **Chapter 17** (Groundwater and geology).

Tunnel drainage and treatment infrastructure

This 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.

Further information about the likely treatment methods and wastewater volumes is provided in **Chapter 18** (Surface water and flooding).

The southbound and northbound mainline tunnels would drain towards tunnel 'sumps' (low points), from which the water would be pumped and conveyed north-east via a rising main towards the water treatment facility. The water would then be treated and discharged to the Cooks River. The same drainage arrangements would transport tunnel wash-down water, fire suppressant deluge and liquid from flammable or other hazardous material spills.

Water treatment facilities

The operational water treatment facility has been designed to treat tunnel water before discharge to the stormwater drainage system. The facility consists of:

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

The location of the water treatment facility is shown in **Figure 6-3**. Further information about the likely treatment methods and wastewater volumes is provided in **Chapter 18** (Surface water and flooding).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 any 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 before appropriate discharge or disposal.

Pavement drainage

Changes to the existing pavement drainage system in the vicinity of the President Avenue surface works as part of the project would include:

- A new pavement drainage system to intercept runoff generated by direct rainfall at the President Avenue intersection to minimise stormwater ingress into the tunnels
- Diversion of runoff from the tunnel portal to temporary storage tanks and pump wells located beneath the carriageways before pumping to a water quality basin (refer to **Figure 6-17** for the location of this basin) and discharges into Scarborough Ponds
- A new pavement drainage system along President Avenue. Runoff from the upgraded section of President Avenue would discharge directly to Scarborough Ponds.

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 18** (Surface water and flooding) and to deliver water-sensitive urban design outcomes
- Stormwater treatment infrastructure for the project would include the water quality basin to the east of the President Avenue intersection within the south-east corner of Rockdale Bicentennial Park
- Runoff captured before entering the tunnel portals would be pumped to the basin where it would be treated before discharge into Scarborough Ponds.

Flood mitigation

The following works would form part of the project:

- Raised openings to the ventilation facility and substation at Rockdale to protect against the ingress of floodwater for events up to the Probable Maximum Flood (PMF)
- Raising of President Avenue to improve its level of flood immunity to the 1% Annual Exceedance Probability (AEP) level
- Provision of flood protection barriers around the open slot structure to a minimum elevation in order to prevent the ingress of floodwater for events up to the PMF
- Replacement of existing concrete box culverts that cross President Avenue at Scarborough Ponds (refer to **Figure 6-17**)
- Replacement of the weir that is located upstream of the existing concrete box culvert with a similar arrangement to maintain the existing permanent water level in the section of Scarborough Ponds upstream of President Avenue
- Lowering of ground levels along the eastern side of the tunnel portal extending to the existing Scarborough Ponds within Scarborough Park North to provide an overland flowpath to control flow that approaches the tunnel portal from O'Neill Street for events up to the PMF
- Regrading of the western overbank of the existing Scarborough Ponds immediately south of President Avenue to provide an overland flow path to control flow that surcharges the transverse drainage structure (refer to **Figure 6-17**).

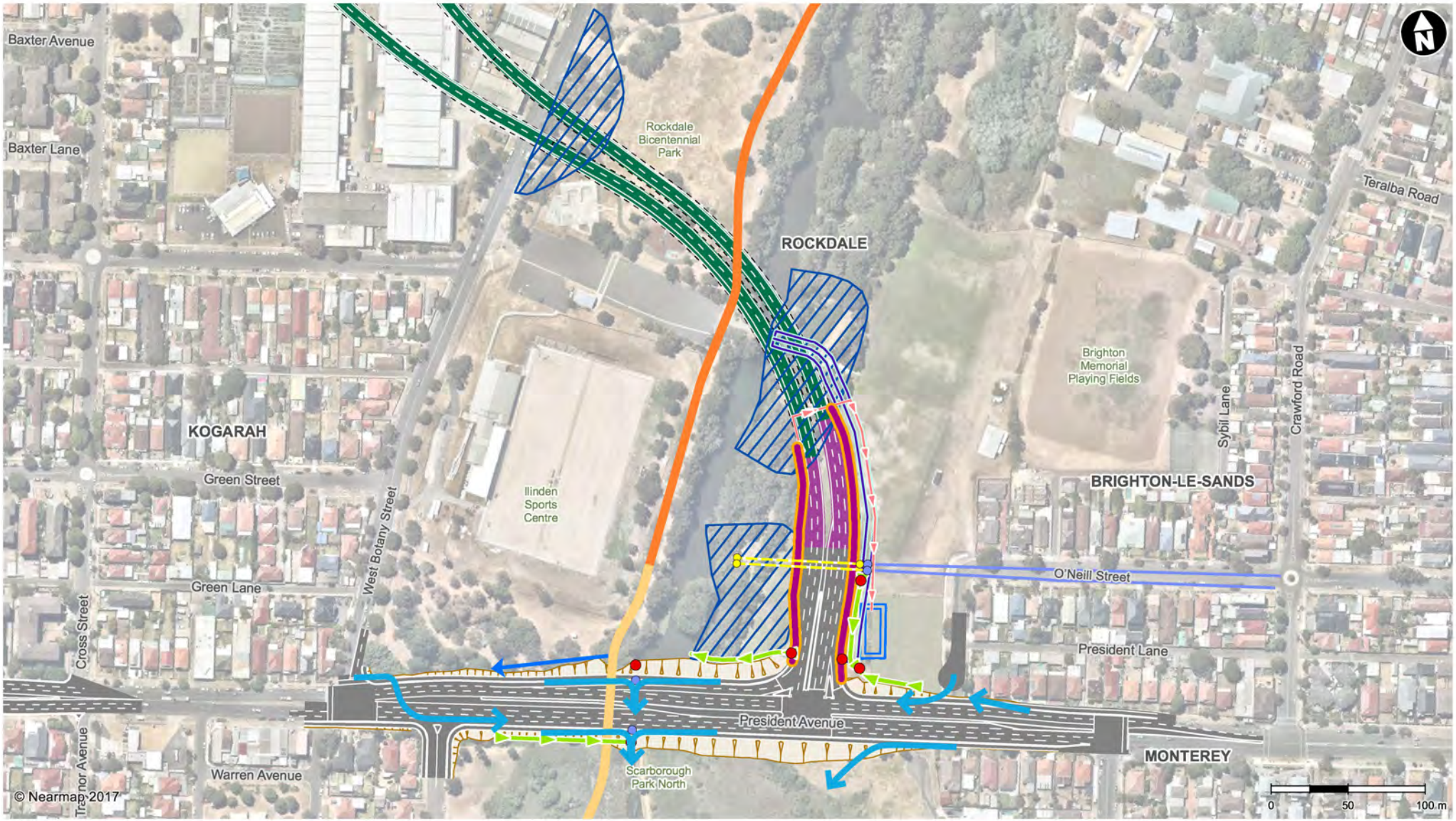


Figure 6-17 Existing and proposed surface flooding and drainage system

6.10 Property access and acquisition

6.10.1 Property access

Access to properties not acquired, leased or otherwise occupied for the project 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 (e.g. footpath and pavement works), the landowner and/or tenant would be consulted regarding provision of an appropriate alternate access, which would be to the equivalent standard where possible. Temporary parking where access to private parking is blocked would also be provided if necessary.

Short-term changes to access during construction are described further in **Chapter 7** (Construction).

Chapter 8 (Traffic and transport) includes discussion on indirect, permanent changes to access resulting from road closures and / or modifications, and their associated impacts. **Chapter 14** (Property and land use) includes discussion on impacts on pedestrian and cyclist access and indirect impacts on property access.

6.10.2 Property acquisition

Where land required for the project is not currently owned by the NSW Government, discussions are being held with affected owners concerning the purchase, lease or licence of the land. The project would require full acquisition of 12 privately owned properties and partial acquisition of three privately owned properties. **Chapter 14** (Property and land use) provides further detail.

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*[6] and the land acquisition reforms announced by the NSW Government in 2016[7], 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 relevant government departments about the temporary or permanent use of this land. Where government-owned land is required temporarily, this would generally be established through a lease or a Memorandum of Understanding.

6.11 Noise attenuation

The project may require measures to minimise the levels of traffic noise experienced at residences and other sensitive receptor locations once the project is operational.

The project has been designed to include all feasible and reasonable noise mitigation and management measures, where it is predicted that noise assessment thresholds in the *Road Noise Policy*[8] would be exceeded. This has included the following (in order of application and priority):

- Minimising noise generation at the source. This would be achieved through careful selection of road pavement materials, and by design that minimises the potential for secondary traffic noise sources, such as compression (or engine) braking
- Constructing noise walls, berms and earthworks at the Rockdale construction ancillary facility
- Consideration of where residential properties may be eligible for at property treatment.

More information regarding the process for identifying noise mitigation measures is detailed in **Chapter 11** (Noise and vibration) and **Appendix G** (Noise and vibration technical report).

[6] NSW Government (2014) Land Acquisition Information Guide
[7] NSW Government (2016) Review of the NSW *Land Acquisition (Just Terms) Compensation Act 1991*
[8] Department of Environment, Climate Change and Water (2011). Road Noise Policy

6.12 Utility services

Utilities and services located in close proximity to the project would 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 and gas services.

Chapter 14 (Property and land use) includes discussion on the relocation of utilities.

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

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

The project includes construction / installation of electrical supply networks to connect the project to existing supply locations (refer **section 6.12.3**).

6.12.1 Water

The project would require the use of water for operation purposes. This would include water for maintenance activities, fire testing and for domestic purposes at each of the motorway operation complexes.

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

Water for use inside the buildings within the motorway operation complexes would be supplied via a connection to the Sydney Water mains feed. Fire water would be stored within tanks and pumps that would be located at MOC2. 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 Fire and Rescue NSW.

6.12.2 Wastewater / sewer

The tunnels, 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, wash-down water and hydrant water.

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

6.12.3 Electricity

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

Estimated power demand

The projected estimate of maximum power demand for the project is 30 Gigawatt hours (GWh) per year.

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

Power supply connection location

A bulk power supply would be provided in a single location and then distributed to the ventilation outlets and jet fans within the tunnels.

A substation at the Rockdale Motorway Operations Complex (south) (MOC3) would provide the bulk power supply connection for the project. A connection from MOC3 to a substation at the Arncliffe Motorway Operations Complex (MOC1) would be provided through the tunnel.

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
- 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.

Permanent power supply

A permanent power supply connection would be required within and outside of the construction boundary to service the operation of the project. The permanent power supply connection is proposed to run from the Ausgrid Canterbury sub-transmission substation, located at 16A Hansen Avenue Earlwood, to the Rockdale Motorway Operations Complex south (MOC3).

The power supply would be 33 kV and could potentially run mainly underground from Westfield Street, along Mooney Avenue, through local roads until Harthill-Law Avenue in the suburb of Earlwood. It would then pass through the local roads in Bardwell Park and Bardwell Valley including part of Bardwell Valley Golf Club and the along the edge of Silver Jubilee Park. It would then run along Wolli Creek Road, Kimpton Street through the T4 Eastern Suburbs and Illawarra Line, the Princes Highway and Tarbrett Street in the suburb of Banksia and through Farr Street, Bay Street and finally ending in West Botany Street in Rockdale.

The total length of the power line would be about seven kilometres. The permanent power supply would be either installed underground using a cut and cover trench method or, where the power line crosses waterways or railways, installed in a conduit attached to existing bridges. Where it would be required to cross Bardwell Valley Golf Club, it would be installed using a horizontal under boring method.

The power line would generally be located within the existing road reserve with the exception of where it would cross Bardwell Valley Golf Club where it would be installed using a horizontal under boring method. The location of the permanent power supply route is shown in **Figure 6-18**. The route is indicative and would be further refined and confirmed in consultation with Ausgrid and other key stakeholders.

LEGEND

- The project in tunnel
- The project on surface
- The project as an open slot
- On-road cycleway
- Shared cycle and pedestrian pathways
- President Avenue shared cycle and pedestrian bridge
- Permanent power supply line
- Substation
- Rockdale ventilation facility
- Arncliffe ventilation facility*
- Motorway operations complex

Figure 6-18 Permanent power supply