

# Executive summary

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## What is proposed?

NSW Roads and Maritime Services (Roads and Maritime) is seeking approval to construct and operate the WestConnex M4-M5 Link (the project), which would comprise a new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (the Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange.

Together with the other components of the WestConnex program of works and the proposed future Sydney Gateway, the project would facilitate improved connections between western Sydney, Sydney Airport and Port Botany and south and south-western Sydney, as well as better connectivity between the important economic centres along Sydney's Global Economic Corridor and local communities. A more comprehensive description of the project elements and construction work is provided in **Chapter 5** (Project description) and **Chapter 6** (Construction work) respectively.

The M4-M5 Link is part of the WestConnex program of works. Separate planning applications and assessments have been completed for each of the approved WestConnex projects. Roads and Maritime has commissioned Sydney Motorway Corporation (SMC) to deliver WestConnex, on behalf of the NSW Government. However, Roads and Maritime is the proponent for the project.

The project is generally located in the inner west region of Sydney within the Inner West and City of Sydney local government areas (LGAs). The project traverses the suburbs of Ashfield, Haberfield, Leichhardt, Lilyfield, Rozelle, Annandale, Stanmore, Camperdown, Newtown and St Peters.

In addition to linking to other WestConnex projects, the M4-M5 Link would provide connections to the proposed future Western Harbour Tunnel and Beaches Link, the Sydney Gateway (via the St Peters interchange) and the F6 Extension (via the New M5).

WestConnex (including the approved component projects and the M4-M5 Link) and other proposed future projects including Sydney Gateway, Western Harbour Tunnel and Beaches Link and the F6 Extension, would form a network of motorways to improve the efficiency of traffic flows between western Sydney, the Sydney central business district (CBD), Sydney Airport and Port Botany precinct, with onward connectivity to both the south and north of Sydney.

Roads and Maritime has commissioned Sydney Motorway Corporation (SMC) to finance, deliver and operate WestConnex, on behalf of the NSW Government. However, Roads and Maritime is the proponent for the project. The M4-M5 Link would be operated as part of the combined WestConnex program of works.

## Key features of the project

The proposed alignment and key operational features of the project include:

- Twin mainline motorway tunnels between the M4 East at Haberfield and the New M5 at St Peters. Each tunnel would be around 7.5 kilometres long and sized to accommodate up to four lanes of traffic in each direction
- Connections of the mainline tunnels to the M4 East project, comprising:
  - A tunnel-to-tunnel connection to the M4 East mainline stub tunnels, east of Parramatta Road near Alt Street at Haberfield
  - Entry and exit ramp connections between the mainline tunnels and the Wattle Street interchange at Haberfield (which is currently being constructed as part of the M4 East project)
  - Minor physical integration works with the surface road network at the Wattle Street interchange including road pavement and line marking

- Connections of the mainline tunnels to the New M5 project, comprising:
  - A tunnel-to-tunnel connection to the New M5 mainline stub tunnels north of the Princes Highway, near the intersection of Mary Street and Bakers Lane at St Peters
  - Entry and exit ramp connections between the mainline tunnels and the St Peters interchange at St Peters (which is currently being constructed as part of the New M5 project)
  - Minor physical integration works with the surface road network at the St Peters interchange including road pavement and linemarking
- An underground interchange at Leichhardt and Annandale (the Inner West subsurface interchange) that would link the mainline tunnels with the Rozelle interchange and the Iron Cove Link (see below)
- A new interchange at Lilyfield and Rozelle (the Rozelle interchange) that would connect the M4-M5 Link mainline tunnels with:
  - City West Link
  - Anzac Bridge
  - The Iron Cove Link (see below)
  - The proposed future Western Harbour Tunnel and Beaches Link
- Construction of connections to the proposed future Western Harbour Tunnel and Beaches Link project as part of the Rozelle interchange, including:
  - Tunnels that would allow for underground mainline connections between the M4 East and New M5 motorways and the proposed future Western Harbour Tunnel and Beaches Link (via the M4-M5 Link mainline tunnels)
  - A dive structure and tunnel portals within the Rozelle Rail Yards, north of the City West Link/ The Crescent intersection
  - Entry and exit ramps that would extend north underground from the tunnel portals in the Rozelle Rail Yards to join the mainline connections to the proposed future Western Harbour Tunnel and Beaches Link
  - A ventilation outlet and ancillary facilities as part of the Rozelle ventilation facility (see below)
- Twin tunnels that would connect Victoria Road near the eastern abutment of Iron Cove Bridge and Anzac Bridge (the Iron Cove Link). Underground entry and exit ramps would also provide a tunnel connection between the Iron Cove Link and the New M5/St Peters interchange (via the M4-M5 Link mainline tunnels)
- The Rozelle surface works, including:
  - Realigning The Crescent at Annandale, including a new bridge over Whites Creek and modifications to the intersection with City West Link
  - A new intersection on City West Link around 300 metres west of the realigned position of The Crescent, which would provide a connection to and from the New M5/St Peters interchange (via the M4-M5 Link mainline tunnels)
  - Widening and improvement works to the channel and bank of Whites Creek between the light rail bridge and Rozelle Bay at Annandale, to manage flooding and drainage for the surface road network
  - Reconstructing the intersection of The Crescent and Victoria Road at Rozelle, including construction of a new bridge at Victoria Road
  - New and upgraded pedestrian and cyclist infrastructure
  - Landscaping, including the provision of new open space within the Rozelle Rail Yards
- The Iron Cove Link surface works, including:
  - Dive structures and tunnel portals between the westbound and eastbound Victoria Road

- carriageways, to connect Victoria Road east of Iron Cove Bridge with the Iron Cove Link
- Realignment of the westbound (southern) carriageway of Victoria Road between Springside Street and the eastern abutment of Iron Cove Bridge
  - Modifications to the existing intersections between Victoria Road and Terry, Clubb, Toelle and Callan streets
  - Landscaping and the establishment of pedestrian and cycle infrastructure
  - Five motorway operations complexes; one at Leichhardt (MOC1), three at Rozelle (Rozelle West (MOC2), Rozelle East (MOC3) and the Iron Cove Link (MOC4)) and one at St Peters (MOC5). The types of facilities that would be contained within the motorway operations complexes would include substations, water treatment plants, ventilation facilities and outlets, offices, on-site storage and parking for employees
  - Tunnel ventilation systems, including ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels
  - Three new ventilation facilities, including:
    - The Rozelle ventilation facility at Rozelle
    - The Iron Cove Link ventilation facility at Rozelle
    - The Campbell Road ventilation facility at St Peters
  - Fitout (mechanical and electrical) of part of the Parramatta Road ventilation facility at Haberfield (which is currently being constructed as part of the M4 East project) for use by the M4-M5 Link project
  - Drainage infrastructure to collect surface and groundwater for treatment at dedicated facilities. Water treatment would occur at:
    - Two operational water treatment facilities (at Leichhardt and Rozelle)
    - The new constructed wetland within the Rozelle Rail Yards
    - A bioretention facility for stormwater runoff within the informal car park at King George Park at Rozelle (adjacent to Manning Street). A section of the existing informal car park would also be upgraded, including sealing the car park surface and landscaping
  - Treated water would flow back to existing watercourses via new, upgraded and existing infrastructure
  - Ancillary infrastructure and operational facilities for electronic tolling and traffic control and signage (including electronic signage)
  - Emergency access and evacuation facilities, including pedestrian and vehicular cross and long passages and fire and life safety systems
  - Utility treatments including protection and/or adjustment of existing utilities, removal of redundant utilities and installation of new utilities. A Utilities Management Strategy has been prepared for the project that identifies management options for utilities, including relocation or adjustment
  - Temporary construction facilities and temporary works to facilitate the construction of the project.

The project does not include:

- Site management works<sup>1</sup> at the Rozelle Rail Yards. These works were separately assessed and determined by Roads and Maritime through a review of environmental factors under Part 5 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act)
- Ongoing motorway maintenance activities during operation. These would be subject to separate assessment and approval as appropriate
- Operation of the components of the Rozelle interchange which are the tunnels, ramps and associated infrastructure being constructed to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project. That project would be subject to separate assessment and approval as appropriate.

The delivery mechanism for the design and construction of the M4-M5 Link differs from the approach adopted for the M4 East and New M5 projects. For the M4 East and New M5 projects, a design and construction contractor was appointed early and had direct input into the design development, environmental impact statement (EIS) preparation and construction planning for those projects. This meant that the EIS for the M4 East and New M5 projects assessed the construction contractor's design. For the M4-M5 Link project, design and construction contractors would be appointed to undertake the detailed design and construction planning following determination of the application for project approval, should it be approved.

This means the detail of the design and construction approach presented in this EIS is indicative only based on a concept design and is subject to detailed design and construction planning to be undertaken by the successful contractors. The intent of the concept design for the project is to provide a sound and clear basis for refinement during the detailed design to a standard required to minimise impacts of the permanent infrastructure as much as possible.

### **Staged construction and opening of the project**

It is anticipated that the project would be constructed and opened to traffic in two stages.

Stage 1 would include:

- Construction of the mainline tunnels between the M4 East at Haberfield and the New M5 at St Peters, stub tunnels to the Rozelle interchange (at the Inner West subsurface interchange) and ancillary infrastructure at the Darley Road motorway operations complex (MOC1) and Campbell Road motorway operations complex (MOC5)
- These works are anticipated to commence in 2018 with the mainline tunnels open to traffic in 2022. At the completion of Stage 1, the mainline tunnels would operate with two traffic lanes in each direction. This would increase to generally four lanes at the completion of Stage 2, when the full project is operational.

Stage 2 would include:

- Construction of the Rozelle interchange and the Iron Cove Link including:
  - Connections to the stub tunnels at the Inner West subsurface interchange (built during Stage 1)
  - Ancillary infrastructure at the Rozelle West motorway operations complex (MOC2), Rozelle East motorway operations complex (MOC3) and the Iron Cove Link motorway operations complex (MOC4)
  - Connections to the surface road network at Lilyfield and Rozelle
  - Construction of tunnels, ramps and associated infrastructure as part of the Rozelle interchange to provide connection to the proposed future Western Harbour Tunnel and

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<sup>1</sup> The site management works at the Rozelle Rail Yards will remove waste, existing stockpiles, vegetation, above ground rail infrastructure, redundant services and railway ballast, generally to a depth of around 500 millimetres below ground level. As the site management works will be completed prior to construction of the M4-M5 Link commencing, the environment at the completion of these works is considered to be the baseline environment against which activities of the project at that location have been assessed.

## Beaches Link project

- Stage 2 works are expected to commence in 2019 with these components of the project open to traffic in 2023.

The total construction period for both stages of the project is expected to be around five years.

## Why is it needed?

The transport network in Sydney is expected to be put under increasing pressure over the next 20 years. *A Plan for Growing Sydney* (NSW Government 2014) indicated that from 2011 to 2031, Sydney's population is forecast to increase from 4.3 to 5.9 million, which equates to an average of 80,000 additional residents per year. Moreover, by 2036, the number of trips made around Sydney each day is forecast to increase by 31 per cent, from 16 to 21 million vehicle trips. This growth will place increasing pressure on the NSW transport network and the key travel demand corridors connecting regional cities and major centres across the greater Sydney metropolitan area.

The road network in the study area for the traffic and transport assessment currently functions under high levels of traffic demand, which often exceeds the operational capacity, especially citybound during the AM peak period. This includes some of the most highly congested road corridors in Sydney. Major routes in the study area, such as Parramatta Road, City West Link, Victoria Road, Anzac Bridge/Western Distributor, Southern Cross Drive, Princes Highway and King Street experience significant congestion, with resultant increases in travel time and variability, which can cause typical morning and evening peak hours to spread over longer periods.

The current congestion on arterial roads and the missing links in the motorway network impede the efficient flow of traffic to the important economic centres along Sydney's Global Economic Corridor. The Global Economic Corridor extends from the Sydney Airport and Port Botany precinct, through the Sydney central business district (CBD) and North Sydney to Macquarie Park and Sydney's geographical centre, Parramatta, with connections also to the developing economic hubs on the Rhodes peninsular.

The *NSW Long Term Transport Master Plan* (Transport for NSW 2012) and the *State Infrastructure Strategy Update 2014* (*State Infrastructure Strategy*) (Infrastructure NSW 2014) identified the need to plan and invest in the future of Sydney's motorway network, which provides vital infrastructure connections within and between travel demand corridors. Any investment in motorway infrastructure must be aligned with supporting public and active transport initiatives, while aiming to reduce the reliance on and demand for private vehicles on the future road network.

The WestConnex program of works is one part of a broader solution to these growing pressures. While public transport is also part of the overall transport plan for Sydney, it is recognised that not all trips across Sydney can be served by public transport, especially trips to dispersed destinations, commercial trips requiring the movement of large or heavy goods/materials, or trade and service-related journeys. In addition, Sydney is home to two-thirds of NSW's manufacturing sector, with the many of the state's major aviation, pharmaceuticals, biotechnology, electronics and automotive industries based in western Sydney. These businesses rely heavily on the road network and its connectivity to the port and airport precincts.

A congested road network also affects road-based public transport, resulting in increased bus travel times and journey time variability. Providing a tunnel alternative to sections of the arterial road network will improve road-based public transport travel times on surface roads and provide opportunities for new rapid transit options.

For these reasons, the NSW Government is investing in light rail, metro rail, bus, rapid-transit and motorways to provide a multi-modal response to current and future transport challenges. In this context, the project supports the actions and recommendations from the *NSW Long Term Transport Master Plan* and the *State Infrastructure Strategy*. The project would also act as an enabler of integrated transport and land use planning, supporting the development of initiatives including those outlined in *The Bays Precinct Transformation Plan* (UrbanGrowth NSW 2015b) and the *Parramatta Road Corridor Urban Transformation Strategy* (UrbanGrowth NSW 2016).

## What are the project objectives?

The specific objectives of the project include:

- Linking the M4 East and New M5 motorways so that further benefits of, and opportunities arising from, WestConnex can be realised
- Improving traffic conditions and reducing congestion on key arterial roads in proximity to the project
- Improving accessibility and reliability for commercial vehicle movement in the M4 and M5 motorway corridors to economic centres, including to the Sydney Airport and Port Botany precincts
- Facilitating urban renewal in areas where the project would reduce traffic
- Minimising impacts associated with acquisition of residential and commercial properties
- Delivering a project with a beneficial urban design outcome
- Enabling long-term motorway network development by providing a connection to the proposed future Western Harbour Tunnel and Beaches Link project to the north.

The objectives of the project are consistent with those of the WestConnex program of works, as stated in the *WestConnex Updated Strategic Business Case* (Sydney Motorway Corporation 2015).

## How would the project satisfy project objectives?

The project would provide a motorway standard tunnel connection between the M4 and M5 motorways, as an alternative to congested arterial roads. By connecting these two motorways, the project would help to link major employment centres that are critical in supporting the creation of jobs and businesses.

The project would also support the Western Sydney Employment Area, which is outside the Global Economic Corridor. This would support Greater Sydney Commission's metropolitan priority of enhancing access to a broader range of jobs and services within 30 minutes of home, which would reduce commuting times, in turn improving the quality of life for residents and supporting business growth.

Improved network productivity on the metropolitan network is also forecast as a result of the addition of a motorway standard tunnel alternative, with more trips forecast to be made or longer distances travelled on the surface road network in a shorter time. Reduced traffic is forecast on sections of major arterial roads including City West Link, Parramatta Road, Victoria Road, King Street, King Georges Road and Sydenham Road. Almost 2,000 heavy vehicles are forecast to be removed from Parramatta Road, east of the M4 East Parramatta Road ramps, each weekday. Non-motorway roads in the Inner West LGA are forecast to experience faster trips with the daily average speed increasing by about 10 per cent. Similarly, the vehicle distance travelled on non-motorway roads is forecast to reduce by about 12 per cent.

As part of the WestConnex program of works, the project would enable future opportunities for improved connectivity in Sydney's transport network to be realised by allowing for connections to proposed motorway projects, including the Western Harbour Tunnel and Beaches Link project to the north, the Sydney Gateway project (via the St Peters interchange) and the F6 Extension (via the New M5 Motorway) to the south.

The project, as part of the WestConnex program of works, would also act as a catalyst for urban renewal along parts of Parramatta Road and Victoria Road and would support the development of The Bays Precinct, as outlined in *The Bays Precinct Transformation Plan* (UrbanGrowth NSW 2015b).

In addition, the project would improve connectivity for pedestrians and cyclists around Rozelle by delivering new and upgraded east–west and north–south connections to Lilyfield, Balmain, Annandale, Glebe, Leichhardt and the Sydney CBD. The project would also deliver significant new open space and passive recreational facilities at Rozelle, including within the Rozelle Rail Yards and along Victoria Road near Iron Cove Bridge.

## What is the approval process for the project?

The project is State significant infrastructure under the State Environmental Planning Policy (State and Regional Development) 2011 and the EP&A Act. The project requires assessment and approval of the NSW Minister for Planning under Part 5.1 of the EP&A Act.

An application for project approval was made by Roads and Maritime. The purpose of the application was to assist the formulation of the Secretary's Environmental Assessment Requirements (SEARs) by the NSW Department of Planning and Environment (DP&E) and inform the preparation of an EIS for the project. SEARs for the project were issued by DP&E on 3 March 2016, and were revised on 9 November 2016 and on 3 May 2017 to respond to amendments made to the SSI application. A request has been made for the NSW Minister for Planning to specifically declare the project to be State significant infrastructure and critical State significant infrastructure.

Public exhibition of the EIS gives the community, government agencies and stakeholders, and other interested parties an understanding of, and the opportunity to comment on, the project. Roads and Maritime will consider this feedback in the further development of the project and will respond to issues raised in a Submissions and Preferred Infrastructure Report which will then be submitted to DP&E. The Secretary of DP&E will prepare an assessment report which will be provided to the NSW Minister for Planning who will then determine whether or not to grant the approval under Part 5.1 of the EP&A Act and, if so, the conditions to be imposed on the approval.

## What alternatives and options were considered?

In the context of the WestConnex program of works, the M4-M5 Link project concept was first described in the *State Infrastructure Strategy 2012-2023* (Infrastructure NSW 2012) (*State Infrastructure Strategy*). The M4-M5 Link project concept was further developed in the *State Infrastructure Strategy Update 2014* (Infrastructure NSW 2014), the *WestConnex Business Case Executive Summary* (Sydney Motorways Project Office 2013) and updated in the *WestConnex Updated Strategic Business Case* (Sydney Motorway Corporation 2015).

### Strategic alternatives

The merits of the M4-M5 Link were considered in the context of a range of other strategic alternatives, based on the extent to which they could meet the project objectives and how well they performed with reference to other transport, environmental, engineering, social and economic factors.

The following strategic alternatives were considered:

- Alternative 1 – improvements to the existing arterial road network
- Alternative 2 – investment in alternative transport modes
- Alternative 3 – demand management (reducing the number of vehicle kilometres travelled on the network)
- Alternative 4 – the 'do nothing'/'do minimum' case
- Alternative 5 – development of the M4-M5 Link.

Improvements to the arterial road network (such as improving intersection performance and implementing traffic calming measures, lane closures or clearways) would only provide incremental change in the efficiency of the road network, and would not support the additional capacity required for regional traffic growth, which is associated with the forecast increase in Sydney's population and subsequent increases in vehicle kilometres travelled.

As part of a broader integrated transport solution, WestConnex supports a coordinated approach to the management of freight and passenger movements, and is complementary to other modes of transport including rail, bus, ferries, light rail, cycling and walking. However, Sydney's freight, commercial and services tasks require distribution of goods and services across the Sydney basin, which relies on diverse and dispersed point-to-point transport connections that are most efficiently provided by the road network.

While the NSW Government is investing \$41.5 billion (2016–2017 NSW Budget) in transport projects over the next four years (including roads and public transport) there are no feasible strategic public

transport or freight alternatives to the project that, on their own, would meet the diverse range of needs for travel in the Sydney metropolitan area.

Public transport is best suited to providing concentrated, high volume flows of people to and from established centres. It is less suited to providing dispersed cross-city or local trips. In 2014, around 17.6 million trips were made each average weekday in Sydney, with around 75 per cent of these by road. Even with significant investment and high levels of patronage growth forecast for Sydney's public transport network, about 72 per cent of around 27.5 million journeys in 2031 are expected to be made on the road network each weekday by private vehicles, equal to an additional 4.3 million new trips compared to 2014 (Infrastructure NSW 2014).

Population growth, combined with the increasing road freight task in the Sydney metropolitan area, will result in a continued demand for use of roads providing east-west and north-south connections such as the M4 Motorway, M5 Motorway, M1 Motorway and A3 and A6 corridors. Without infrastructure investment and significant changes to how people travel, the continued demand and use of these corridors will result in additional, prolonged congestion.

The project would provide:

- Additional motorway capacity through a new, motorway standard north-south tunnel connection between the M4 East and New M5 motorways to support Sydney's freight, commercial and passenger needs
- More reliable trips, both in terms of travel time and safety, between south-western and western Sydney and the inner west
- Faster trips on non-motorway roads in the Inner West LGA, with the daily average speeds increasing by around 10 per cent
- New and upgraded pedestrian and cyclist infrastructure around Rozelle, making trips safer and more efficient and linking disconnected communities
- An urban design and landscaping outcome that would integrate motorway infrastructure with the existing landscape and activate residual spaces
- Forecast reductions in two-way future year average weekday traffic demand along sections of City West Link and Parramatta Road (east of the M4 East Parramatta Road ramps), Victoria Road (east of the Iron Cove Link portals), King Street at Newtown, Stanmore Road at Stanmore, Lyons Road at Russell Lea, Southern Cross Drive and the Sydney Harbour Tunnel.

Following selection of the preferred alignment, a number of options were considered in development of the preferred design including different approaches to the tunnel corridor; interchange locations; ventilation system design and locations; excavation methods; and construction ancillary facility locations. The preferred design provides a combination of benefits compared with other options assessed, including improved access, minimised impacts on properties and minimised impacts on future development potential.

## How did the community participate in selecting the preferred project?

Engagement on WestConnex started with early consultation during the development of the original WestConnex Strategic Environmental Review (Sydney Motorways Project Office 2013b) and the WestConnex Business Case in 2012. The Strategic Environmental Review and an executive summary of the business case (Sydney Motorways Project Office 2013a) were published on the WestConnex website.

During development of the WestConnex program of works since 2012, the focus of communication and engagement was to articulate the local and broader regional and state-wide benefits of WestConnex. The aims were to build awareness and understanding of the program, identify key issues and community and stakeholder concerns and develop design solutions to mitigate impacts on local communities.

Project-specific consultation with stakeholders began following the lodgement of the SSI application report in January 2016. Stakeholders (including the community) have been provided with project specific information and opportunities to raise questions and provide suggestions and feedback.

Consultation and feedback received on both the project and the WestConnex program of works has informed project development, the environmental assessment activities and ongoing communications. The consultation process for the M4-M5 Link project to date has included:

- Targeted stakeholder discussions and briefings with NSW Government agencies, local councils, advocacy groups, elected representatives and peak bodies
- Roundtable discussions with stakeholders such as councils, the freight industry and business groups
- Information sessions and one-on-one meetings/briefings with community members and stakeholders in key communities
- Two rounds of community information sessions, comprising:
  - Between August and September 2016: consultation on early design to inform the design development
  - Between May and June 2017: early consultation on the draft design prior to the EIS exhibition phase, and in response to feedback from the community
- Discussions with individual stakeholders, landowners and community members
- Business impact surveys with potentially affected business owners adjacent to the project footprint
- Presentations to key regulatory agencies during the preparation of key technical assessments
- Regular interactive sessions with Inner West Council and City of Sydney Council during the preparation of the urban design and active transport concepts for the project
- Community updates via the WestConnex website, social media and newsletters
- Research groups involving residents, professional road users and business operators.

Permanent communication channels have been established for the WestConnex program of works and the project, to seek input from stakeholders and communities and to support ongoing engagement.

## What are the environmental issues associated with the project?

### Traffic and transport

The project would provide a motorway standard tunnel connection between the M4 and M5 motorways, as an alternative to congested arterial roads. An assessment of the potential traffic and transport impacts of the project during construction and operation has been carried out. The study area for the operational assessment was informed by the forecast traffic and transport changes from the WestConnex Road Traffic Model (WRTM) version 2.3. The WRTM is a strategic traffic model that covers the Sydney metropolitan area and includes land use forecasts for current and planned development, including along Parramatta Road and around The Bays Precinct and Mascot town centre.

Traffic modelling assessed the following scenarios:

- Existing traffic conditions (2015)
- Construction (2021, representing the peak construction traffic from the project)
- 2023 and 2033 with and without the project
- 2023 with all WestConnex projects, NorthConnex, and the proposed future Western Harbour Tunnel and Sydney Gateway projects
- 2033 with all WestConnex projects, NorthConnex, and the proposed future Western Harbour Tunnel and Beaches Link, Sydney Gateway and F6 Extension projects.

### *Construction impacts*

To minimise construction traffic impacts, the project's construction ancillary facilities that provide tunnelling support (and would therefore generate the most construction traffic) have been strategically located to provide direct access to and from major arterial roads where possible and the M4 East Motorway (when opened). Only limited on-site parking for construction personnel would be provided at the more constrained construction ancillary facilities. Opportunities to provide additional parking and minimise impacts on on-street parking around construction sites would be investigated during detailed design and construction planning.

The roadway level of service analysis carried out for the project indicates that construction traffic is forecast to reduce mid-block traffic level of service (LoS) at four locations:

- At two locations – Wattle Street at Haberfield, east of Parramatta Road, and Darley Road Leichhardt, west of James Street – the mid-block level of service drops but remains at an acceptable LoS C or LoS D
- On City West Link, west of Darley Road at Leichhardt, the eastbound mid-block level of service is forecast to decrease from LoS E to LoS F in the PM peak hour
- On City West Link, west of The Crescent at Lilyfield, the westbound mid-block level of service is forecast to decrease from LoS D to LoS E in the PM peak hour.

The levels of service at intersections are not expected to be significantly impacted, with the exception of the Wattle Street/Ramsay Street, Dobroyd Parade/Timbrell Drive, City West Link/James Street and City West Link/The Crescent intersections. This is due to City West Link and Wattle Street being one of the key routes for construction traffic. Impacts due to temporary lane closures and speed reductions, particularly during traffic staging, would also occur.

### *Management of potential impacts – construction*

Prior to the commencement of construction, a Construction Traffic and Access Management Plan (CTAMP) would be prepared as part of the Construction Environmental Management Plan (CEMP). It would set out the approach that will be adopted to minimise delays and disruptions, and identify and respond to any changes required to ensure road safety. The CTAMP would propose a car parking strategy for construction staff at the various worksites, developed in consultation with relevant local councils and stakeholders and would identify measures to manage the movements of construction-related traffic to minimise traffic and access disruptions in the public road network.

### *Operational impacts*

The road network in the study area currently functions under high levels of traffic demand that often exceeds the operational capacity, especially citybound during the AM peak period. The four main travel demand corridors mentioned above include some of the most highly congested road corridors in Sydney. Major routes in the study area, such as Parramatta Road, City West Link, Victoria Road, Anzac Bridge/Western Distributor, Southern Cross Drive, Princes Highway and King Street, all experience significant congestion with resultant increase in travel time and variability, which can cause typical morning and evening peak hours to spread over longer periods, and extend the peak period.

The M4-M5 Link motorway is forecast to operate at a good level of service in the 2023 and 2033 'with project' scenarios, with levels of service between LoS A and LoS D (depending on the section of the motorway) during the AM and PM peak periods.

The addition of the M4-M5 Link would provide a significant improvement to the traffic network, with an overall increase in daily vehicle kilometres travelled (VKT) and a forecast reduction in daily vehicle hours travelled (VHT) on the road network. This means that more trips could be made or longer distances travelled on the network in a shorter time, mainly due to traffic using the new motorway, with reductions in daily VKT and VHT forecast on the non-motorway roads. This indicates the additional network capacity provided by the project would assist in accommodating the forecast growth in population and travel demand that would otherwise contribute to worsening road network and traffic conditions without the project.

Where the project would connect to the existing road network, increased congestion is forecast in parts of Mascot, along Frederick Street at Haberfield, Victoria Road north of Iron Cove Bridge, Johnston Street at Annandale and on the Western Distributor. Many of these areas would be improved when the full WestConnex program of works and the proposed future Western Harbour Tunnel and Beaches Link and Sydney Gateway projects, if approved, are completed.

Key benefits forecast for the Sydney metropolitan road network as a result of the M4-M5 Link project include:

- Existing non-motorway (arterial and local) roads in the Inner West LGA are forecast to experience faster trips with the daily average speed increasing. Similarly, the vehicle distance travelled on non-motorway roads is forecast to reduce. This indicates that on average, these trips would be fewer in number and faster
- Reduced travel times are forecast on key corridors, such as between the M4 Motorway corridor and the St Peters interchange
- Reduced traffic forecast on sections of major arterial roads including City West Link, Parramatta Road, Victoria Road (Rozelle), King Street (Newtown), Sydenham Road and King Georges Road.

As a result of the additional road network capacity provided by the project, the two-way future year average weekday traffic demand compared to a 'without project' scenario is predicted to significantly decrease on:

- City West Link and Parramatta Road at Haberfield, east of the M4 East Wattle Street and Parramatta Road ramps respectively, by about 25 per cent in the 2023 and 2033 'with project' and 'cumulative' scenarios
- King Street at Newtown by about 20 per cent in the 2023 and 2033 'with project' scenarios
- Stanmore Road at Stanmore by about 15 per cent in the 2023 and 2033 'with project' and 'cumulative' scenarios
- Lyons Road at Russell Lea by about 15 per cent in the 2023 and 2033 'with project' scenarios, and about 20 per cent in the 2023 and 2033 'cumulative' scenarios
- Southern Cross Drive and the Sydney Harbour Tunnel by about 20 per cent and 25 per cent respectively in the 2023 and 2033 'cumulative' scenarios.

There are significant reductions in forecast daily traffic volumes along Victoria Road (south of the proposed Iron Cove Link), King Georges Road, Stanmore Road, Addison Road and Sydenham Road compared to the 'without project' scenario. A decrease in the daily volume of heavy vehicles on surface roads is also forecast, as heavy vehicles shift onto the M4-M5 Link. Daily heavy vehicle volumes on Parramatta Road and City West Link are forecast to drop by 40 to 50 per cent, and on roads in the Inner West, such as Stanmore Road, Sydenham Road, Marrickville Road and King Street, are forecast to drop by 20 to 50 per cent.

The project would enhance the benefits of the WestConnex program of works for travel between western Sydney and the Sydney CBD. For example, a person driving a car in 2017 from Penrith to the Sydney CBD currently has the option of travelling along the M4 Motorway, which ends at Concord, and then would need to travel on the congested surface road network to the Sydney CBD. An alternative route between Penrith and the Sydney CBD using the M4 Motorway, WestLink M7, the Hills M2 Motorway, Lane Cove Tunnel and the Sydney Harbour Bridge or the Sydney Harbour Tunnel would cost around \$22.00 in tolls (\$2017) and is a distance of around 55 kilometres. After opening in 2023, the project would provide a journey using the M4 Motorway straight through to Anzac Bridge, via the M4-M5 Link, for a toll capped at \$8.60 (\$2017) and a distance of around 40 kilometres. This would provide significant time and cost savings for motorists.

### *Management of potential impacts – operational*

The management of operational traffic and transport impacts would be focused around the interchanges at Wattle Street, Rozelle and St Peters. Roads and Maritime would carry out an Operational Road Network Performance Review, in consultation with Transport for NSW and relevant councils. This would confirm the operational traffic impacts of the M4-M5 Link on surrounding arterial roads and major intersections at both 12 months and five years after the commencement of operation

of the project. The assessment would be based on future updated traffic surveys taken during operation and the methodology used would be comparable with that used in this assessment.

Specific measures would be identified as investigations progress and their implementation would depend on their complexity and appropriate timing to minimise impact on the community. Roads and Maritime would carry out these investigations in consultation with councils and the DP&E to develop a program of works.

## Air quality

### *Construction impacts*

The potential impacts of the construction of the project on ambient air quality have been assessed using guidance published by the UK Institute of Air Quality Management<sup>2</sup>. The UK guidance was adapted for use in NSW, taking into account differences between the two locations. This included, for example, differences in ambient concentrations of airborne particulate matter with a diameter of less than 10 micrometres (PM<sub>10</sub>).

The main risks during construction would be associated with dust soiling and the effects of airborne particles on human health and amenity. Several 'high risk' activities were identified. For example, the assessment found that there would be a high risk of dust impacts associated with activities in Rozelle, in particular demolition works. A range of mitigation measures are outlined below.

### *Management of potential impacts - construction*

A wide range of management measures has been recommended to mitigate the effects of construction works on local air quality at the nearest receptors, including carrying out spoil handling within acoustic sheds or the cut-and-cover tunnels, stabilising disturbed ground and exposed soils, and using water to suppress dust. Most of the recommended measures are routinely employed as standard practice on construction sites.

### *Operational impacts*

#### In-tunnel air quality

The tunnel ventilation system would be designed to maintain in-tunnel air quality within applicable criteria for all scenarios. The assessment of in-tunnel air quality used modelling scenarios that reflected the potential modes of operation of the tunnel ventilation system, and a worst case trip scenario for exposure to nitrogen dioxide (NO<sub>2</sub>). This pollutant has become the critical vehicle exhaust pollutant for tunnel ventilation design and management and therefore for the design and operation of the tunnel ventilation system. The NO<sub>2</sub> criterion used was as prescribed in the NSW Government *In-Tunnel Air Quality (Nitrogen Dioxide) Policy* (February 2016). Consideration was given to peak in-tunnel concentrations of carbon monoxide (CO) and NO<sub>2</sub>, as well as the peak extinction coefficient (for visibility).

#### Ambient air quality

Two types of scenarios have been considered for ambient air quality, comprising:

- Expected traffic scenarios

The expected traffic scenarios used for the ambient air quality assessment of the operation of the project were the same as those used for the traffic assessment

- Regulatory worst case scenarios

These scenarios assessed emissions from the ventilation outlets only, with pollutant concentrations at the ventilation outlets fixed at the regulatory limits 24 hours a day, seven days a week. The scenarios represented the theoretical maximum changes in air quality for all potential traffic operations in the tunnel, including unconstrained and worst case traffic conditions from an emissions perspective, as well as vehicle breakdown situations. The assumptions

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<sup>2</sup> Institute of Air Quality Management (2014). *Guidance on the assessment of dust from demolition and construction*, London

underpinning these scenarios are very conservative, and resulted in predicted contributions from project ventilation outlets that are much higher than those that could occur under foreseeable operational conditions in the tunnel.

For the expected traffic scenarios, the predicted changes in pollutant concentrations were generally a result of changes in the traffic volumes on the surface roads, with very small contributions from the tunnel ventilation outlets.

For some air quality metrics (1-hour NO<sub>2</sub> and 24-hour PM<sub>10</sub> and PM<sub>2.5</sub>), exceedances of the criteria were predicted to occur both with and without the project. However, where this was the case the total numbers of receptors with exceedances decreased slightly with the project and in the cumulative scenarios. That is, the project resulted in a better outcome than the 'without project' scenario. In the case of PM<sub>2.5</sub>, the background levels are at or slightly above the criterion for both the annual and 24-hour means. However, in many locations there is a decrease with the project because of the reduction in surface road traffic.

The spatial changes in local air quality as a result of the project reflect the changes in traffic on the road network. For example:

- Marked reductions in pollutant concentration were predicted along Dobroyd Parade/City West Link and Parramatta Road to the south-east of the Parramatta Road ventilation facility at Haberfield. In the 2023 Do Minimum scenario, the traffic to and from the M4 East tunnel would access the tunnel using these roads. In the 'with project' scenarios, the M4-M5 Link tunnel connects to the M4 East tunnel, reducing emissions of pollutants from those surface roads
- A substantial reduction in pollutant concentrations was predicted along the Victoria Road corridor south of Iron Cove in Rozelle, due to surface traffic being diverted through the Iron Cove Link tunnel
- There would also be reductions in pollutant concentrations along General Holmes Drive, Princes Highway and the M5 East Motorway
- However, there would be an increase in pollutant concentrations on Victoria Road to the north of the Iron Cove Link and near Anzac Bridge as a result of the general increase in traffic due to population growth and the project at that location
- Pollutant concentrations were also predicted to increase along Canal Road, which would be used to access the St Peters interchange, and other roads associated with the proposed future Sydney Gateway project, as it is expected to be a surface road.

Modelling of the changes in air quality for elevated receptors (such as apartment buildings) showed that there would not be any substantial impact on existing buildings.

### *Management of potential impacts - operation*

#### In-tunnel air quality

The project would be designed to reduce concentrations of emissions in the tunnel by:

- Designing tunnels to achieve minimal gradients to reduce vehicle emissions. The tunnels would generally have a gradient of less than four per cent. However, isolated locations connecting to the surface road network may require short lengths of steeper grades of up to eight per cent. Opportunities to avoid or minimise these sections of steeper grades would be investigated during detailed design
- Including large mainline tunnel cross-sectional area to allow for a greater volume of airflow, to dilute emissions within the tunnel. The mainline tunnels would have widths varying between 10.5 and 16 metres and be higher than most previous tunnels in Sydney
- Increased height of the tunnels to reduce the risk of incidents involving high vehicles blocking the tunnel and disrupting traffic. This would reduce the risk of higher pollutant concentrations associated with breakdown in traffic flow
- The project ventilation system has been designed and would be operated so that it would achieve some of the most stringent standards in the world for in-tunnel air quality, and would be effective at maintaining local and regional ambient air quality.

### Ambient air quality

The design of the ventilation system would ensure zero portal emissions during normal operations. The ventilation outlets would be designed to effectively disperse the emissions from the tunnels and are predicted to have negligible impact on local air quality. The heights of the ventilation outlets have been optimised to provide the most effective dispersion within the constraints of height limitations imposed by air safety requirements.

Planning controls would need to be developed in the vicinity of St Peters to ensure future developments at heights of 10 metres or higher are not adversely impacted by emissions from the ventilation outlets. Development of planning controls would need to be supported by detailed modelling addressing relevant pollutants and averaging periods.

### Noise and vibration

A noise and vibration assessment was carried out to evaluate and predict the potential impact of the construction and operation of the project.

#### *Construction noise and vibration*

Where possible, proposed ancillary facilities and construction sites have been located and designed to minimise noise and vibration impacts to sensitive receivers. This includes, wherever possible, selection of ancillary facility locations and positioning of exits and entrances to allow quick access to arterial roads to minimise traffic noise impacts to residential and other noise sensitive receivers.

In accordance with the *Interim Construction Noise Guidelines* (NSW Department of Environment and Climate Change 2009), the majority of surface construction would be carried out between 7.00 am and 6.00 pm Monday to Friday and 8.00 am and 1.00 pm Saturdays. Some surface works would need to be conducted out-of-hours to minimise traffic disruptions or for safety or operational reasons, such as design and quality requirements. Tunnelling activities and tunnel support activities, including spoil removal, would be conducted 24 hours a day, seven days a week.

Construction noise levels would exceed the relevant goals in most of the noise catchment areas (without additional mitigation) for work activities undertaken including earthworks, demolition of existing structures, site establishment road tie-in works, road and intersection modifications and utility adjustments. The most affected receivers are located around the Iron Cove Link study area at Rozelle, the Rozelle interchange study area and around the Parramatta Road West civil and tunnel site and Parramatta Road East civil site at Haberfield and Ashfield. For most construction activities, it is expected that the actual construction noise levels would generally be lower than the worst-case levels as predictions are representative of the highest noise level inclusive of all plant operating simultaneously at the closest location to each receiver. In reality, at any particular location the potential construction noise impacts can vary greatly depending on factors including the following:

- The position of the works within the site and distance to the nearest sensitive receiver
- The overall duration of the works
- The intensity of the noise levels
- The time at which the works are undertaken
- The character of the noise.

It is anticipated that the tunnels would be progressively excavated using a heading-and-bench construction methodology, which involves use of roadheaders to excavate the top part of the main alignment tunnels and then relatively small scale blasting or rock-breaking to remove the lower part of the tunnels (or bench).

The roadheader excavation would typically progress at around 20 to 25 metres per week subject to local geology and confirmation of the tunnel excavation methods. Ground-borne noise from roadheader activity is expected to impact about 494 properties, mostly where the tunnel entry and exit ramps would approach the surface road network around the Wattle Street interchange, the Rozelle interchange, the Iron Cove Link and on the approach to the St Peters interchange. It is likely that the excavation by the roadheaders may be perceptible in the evening and during the night for up to about

20 days at each affected receiver as the roadheader passes them, with exceedances of ground-borne noise goals at affected receivers during these periods.

Roadheaders used for tunnelling are also expected to result in temporary vibration above the preferred vibration dose value for human amenity during the night time, with no exceedances of the maximum vibration dose value. While vibration may be perceptible to some individuals, the vibration levels are predicted to be well below the level that could result in structural damage to property.

### *Management of potential impacts - construction*

Construction noise impacts would be managed using measures including scheduling of works, noise reduction measures for plant and equipment and provision of respite periods for sensitive receivers. Construction contractors would be required to minimise time and duration of impacts to sensitive receivers and keep them proactively informed of likely timing and impacts of noisy activities.

Temporary noise walls or solid hoardings would be used for construction ancillary facilities where required to minimise noise impacts to residential receivers. Acoustic sheds would be installed over the temporary access tunnel portals and spoil stockpile areas within the Parramatta Road West civil and tunnel site (C1b), Darley Road civil and tunnel site (C4), Rozelle civil and tunnel site (C5), Pyrmont Bridge Road tunnel site (C9) and the Campbell Road civil and tunnel site (C10). In addition, spoil stockpiling and management would occur within cut-and-cover tunnel structures at the Wattle Street civil and tunnel site (C1a), at the eastern end of the Rozelle civil and tunnel site (C5) and the Campbell Road civil and tunnel site (C10), and within the M4 East stub tunnels at Haberfield.

### *Operational noise*

The project has been designed to include traffic noise mitigation measures. Less than one per cent of receivers are predicted to experience an increase of more than 2 dB(A) due to the project. Marginal increases (1-2 dB(A)) are predicted on The Crescent and parts of Johnston Street, and also on some of the adjacent roads, such as Gordon Street, associated with increased volumes due to redistribution of traffic. In addition, significant reductions in noise (up to around -4 dB) are identified along sections of Victoria Road in Rozelle, where the project is forecast to significantly reduce traffic numbers.

Large increases in noise (up to around 15 dB(A)) are identified on Victoria Road near Iron Cove Bridge in the vicinity of the proposed tunnel portals and near the new Victoria Road bridge, where the project results in traffic lanes being moved closer to receivers, in combination with removing existing screening due to property acquisitions. These predicted increases are generally limited to the receivers that would have partial or direct line-of-sight to Victoria Road once the acquired buildings are demolished.

A total of 431 receivers (200 individual buildings) are predicted to have exceedances of the operational road traffic noise criteria for the project and are therefore eligible for consideration of additional noise mitigation. Forty-eight other sensitive receivers (27 individual buildings) are predicted to have exceedances of the operational road traffic noise criteria for the project and are therefore eligible for consideration of additional noise mitigation.

For residential buildings of two storeys or more, 64 per cent of the identified receivers are on the first two floors, with 15 per cent of the triggers being on level three, nine per cent being on level four, four per cent on level five, and eight per cent for all floors including and above level six. Noise emissions from fixed facilities in the Iron Cove area are predicted to exceed the criteria by up to 12 dB(A) at the most-affected receivers either side of Callan Street, Rozelle, adjacent to the substation. Proposed noise generating operational equipment would be reviewed at the detailed design stage of the project when specific plant selection is finalised and appropriate noise control measures can be determined to ensure compliance with relevant operational noise criteria.

### *Management of potential impacts - operation*

The operational assessment has identified the potential noise benefits associated with the use of low noise pavement, noise barriers and at-property treatment. However, due to engineering uncertainties and urban design considerations, a provisional noise mitigation option in the form of at-property treatment has been recommended.

A preferred noise mitigation option (low noise pavement, noise barrier, architectural treatments, a combination or other) would be determined during detailed design, taking into account whole-of-life engineering considerations and the overall social, economic and environmental effects. The preference will be given to selecting noise mitigation measures that reduce outdoor noise levels and the number of at-property treatments. Detailed investigations would be carried out for the area around Victoria Road near Iron Cove Bridge to develop an optimum suite of mitigation options, in consultation with the community, to address the large predicted increases in road traffic noise at that location.

## Human health risk

The human health risk assessment followed national guidelines and addresses requirements of key government agencies, such as NSW Health, in relation to air quality, noise and vibration, social aspects, public safety and the cumulative effects of construction.

In relation to air quality, dust emissions from construction activities need to be managed to ensure that impacts on local communities are minimised. As the larger part of the project alignment would be underground, the operation of the project is predicted to result in a decrease in total pollutant levels in the community. There would be a redistribution of vehicle emissions associated with redistribution of the traffic on surface roads. For much of the community this would result in no change or a small improvement (ie decreased concentrations and health impacts), however for some areas located near key surface roads, a small increase in pollutant concentration may occur. Potential health impacts associated with changes in air quality (specifically nitrogen dioxide and particulates) within the local community have been assessed and are considered to be acceptable.

The future development of land (including re-zonings) that may involve multi-storey residential buildings above 10 metres high in the vicinity of the St Peters interchange ventilation facilities would need to consider the dispersion performance of the ventilation facilities.

While concentrations of pollutants from vehicle emissions are higher within the tunnel (compared with outside the tunnel), and with the completion of a number of tunnel projects (approved or proposed) there is the potential for exposures to occur within a network of tunnels over varying periods of time, depending on the journey, exposure to nitrogen dioxide inside vehicles is expected to be well within the current health guidelines.

In congested conditions inside the tunnels, it is not considered likely that significant adverse health effects would occur due to the operation of the tunnel ventilation systems and the temporary nature of the potential exposure. Placing ventilation within vehicles on recirculation is also expected to minimise exposures to particulate matter during travel through the tunnels. For motorcyclists, where there is no opportunity to minimise exposures through the use of ventilation, there is the potential for higher levels of exposure to nitrogen dioxide. These exposures, under normal conditions, are not expected to result in adverse health effects.

In relation to noise and vibration, potential impacts during construction and operation have been considered. During construction, potential impacts from noise and vibration on the local community would require management and/or mitigation through the implementation of a range of measures. During operation of the project, a number of properties have been identified where specific mitigation measures are required to reduce impacts and protect the health of occupants. These mitigation measures include low noise pavement, noise barriers, and/or at-property acoustic treatment. The mitigation measures would ensure that the levels of road traffic noise experienced by residents would be reduced to as low as feasible and reasonable. No vibration impacts during operation are likely.

Changes in the urban environment associated with the project have the potential to result in a range of impacts on health and wellbeing of the community. Positive impacts include economic benefits, reduction in traffic volumes in some areas and increased public open space.

Management measures would be put in place to address temporary negative impacts that may occur as a result of traffic changes during construction, property acquisitions, visual changes, noise impacts and changes in access or loss of cohesion of local areas, which may result in increased levels of stress and anxiety.

## Land use and property

The need to reduce impacts on property has been balanced with maximising opportunities for beneficial re-use of the areas required for construction that would be surplus to the operational needs of the project. The majority of the project, including a large part of the Rozelle interchange and Iron Cove Link, would be constructed underground and has been designed to minimise the need for surface property acquisition. In addition, construction ancillary facilities at Haberfield and St Peters that are being used by the M4 East and New M5 projects would be used for the M4-M5 Link, to minimise additional property acquisition at these locations for construction. The project would also seek to maximise the use of use government owned land, including land already owned by Roads and Maritime.

Notwithstanding this, construction and operation of the project would result in temporary and permanent impacts on property. As of August 2017, the project would require 51 property acquisitions. In addition to the properties affected by surface activities, land (or interests in land, such as easements) below the surface of the ground would be acquired.

An Urban Design and Landscape Plan would be prepared for the project and would be the primary mechanism for identifying and describing the design and treatment of operational facilities, public open space uses (including active and passive recreation), community and social infrastructure and/or development that would be delivered as part of the project.

Subject to detailed design and the requirements of the project, parts of the project footprint not required for operational infrastructure and/or landscaping may be contemplated for separate future redevelopment. Where this is the case, the land would be rehabilitated at the end of construction and made suitable for potential development for permissible uses under land use zoning provisions and relevant urban renewal strategies. Future development would be subject to separate development assessment and approval, and the restrictions of the relevant consent authority.

### *Overshadowing impacts*

The project includes permanent buildings and structures that have the potential to result in overshadowing on neighbouring residential properties. Shadow diagrams for mid-winter (21 June) have been prepared for these buildings and structures. No assessment has been undertaken of overshadowing from potential noise barriers as no noise barriers are proposed as part of the concept design. Analysis of overshadowing impacts associated with noise barriers, if they are proposed, would be undertaken during detailed design. The shadowing analysis found that the only residential properties that would be overshadowed by any of the motorway infrastructure during operations would be adjoining residential properties on the west side of Callan Street at Rozelle which would be overshadowed by the Iron Cove link ventilation outlet for up to two hours on 21 June in the worst case scenario.

### *Settlement (ground movement)*

Settlement, induced by tunnel excavation, and groundwater drawdown, may occur in some areas along the tunnel alignment. Areas most likely to be affected by settlement are usually where tunnelling is closest to the ground surface (shallowest), around the tunnel portals and entry and exit ramps, and where soils are more likely to be compressible. This would include the estuarine and alluvial soils and fill material around the Rozelle Rail Yards.

Geotechnical and groundwater investigations have been carried out to inform the development of the concept design which has been assessed in the EIS and the assessment of potential settlement impacts. As a result of these investigations, a number of refinements to the project design have been made to minimise potential ground movement and groundwater impacts, including altering the horizontal and vertical alignment of the tunnels so that they are located in competent bedrock and dive beneath the palaeochannels (where feasible) and designing some localised sections of tunnel to be tanked to avoid groundwater ingress where the alignment intercepts alluvial soils and poor quality rock around the Rozelle Rail Yards.

For the majority of the proposed alignment the tunnels are located at depths of greater than 35 metres below ground level and in competent bedrock. As a result the risk of ground movement is limited. However, there are a number of discrete areas to the north and northwest of the Rozelle Rail Yards, to the north of Campbell Road at St Peters and in the vicinity of Lord Street at Newtown where ground

movement above 20 millimetres is predicted. These discrete areas generally coincide with areas of shallower tunnelling and/or where multiple tunnels are located close to each other.

### *Management of potential impacts - settlement*

Strict limits on the degree of settlement permitted would be imposed on the project. A range of design and construction measures would be adopted to meet relevant settlement criteria. Surveys of building condition would be undertaken in the zone of tunnel influence prior to construction and a settlement monitoring plan developed for construction and operation. Specific agreements would be developed with infrastructure and utility services providers to reduce risk to their infrastructure. In the event that damage occurs to a property as a result of the construction of the project, the damage would be rectified at no cost to the property owner.

### Urban design and visual amenity

Urban design and visual impacts differ during construction and operational phases of the project. Visual impacts during construction would result from the introduction of construction ancillary facilities into the existing landscape. Construction facilities could include noise walls, acoustic sheds and other temporary buildings. This would include fixed night lighting at sites that involve tunnelling activities or that support tunnelling activities.

Where feasible and reasonable, ancillary facilities would be developed and established to minimise visual impacts (eg location of visible structures and plant, perimeter treatments). Glare and light spill from construction ancillary facilities would be minimised through the use of cut-off and directional lighting, and site hoarding where required would be erected early within the site establishment phase to minimise noise impacts and provide visual screening.

The urban design and landscape component for the project would include new and upgraded footpath and cycleways and the creation of new open space and landscaping. The development of the concept design has been influenced by urban design principles that have been established for the project including integrating motorway infrastructure into the surrounding context, prioritising local and regionally significant connections and creating holistic and integrated design solutions. A detailed review and finalisation of architectural treatment of the project operational infrastructure, including ventilation facilities, would be undertaken during detailed design.

Urban design and landscaping for the project would be guided by location specific urban design master plans that would follow the principles outlined in the Urban design report, *WestConnex Motorway Urban Design Framework* (Roads and Maritime Services 2013) and *Beyond the Pavement: Urban Design Procedures and Design Principles* (Roads and Maritime Services 2014) and would be overseen by an independent Urban Design Review Panel. Completion of the project would also enable the full realisation of the urban design and landscape plans for the M4 East and New M5 projects at Haberfield and St Peters respectively.

### Social and economic aspects

#### *Construction impacts*

Construction of the project would directly benefit the economy, injecting economic stimulus benefits into the local, regional and state economies. The economic benefit of construction is multi-dimensional, including increased expenditure at local and regional businesses through purchases by construction workers, direct employment through on-site construction activities, direct expenditure associated with on-site construction activities and indirect employment and expenditure through the provision of goods and services required for construction.

It is estimated that over a five-year construction period, around 14,350 direct (onsite) job years would be created (between 2018 to 2023), which is equivalent to about 2,870 jobs per annum. Further, about 42,350 indirect (off-site) job years would be generated, equivalent to 8,470 jobs per annum based on a similar project period.

The economic multipliers also estimate that construction would generate a further \$5.8 billion of activity in production induced effects and \$7.7 billion in consumption induced effects. Total economic activity generated by the construction of the project would be approximately \$19.6 billion.

Impacts associated with property acquisition would be managed through a property acquisition support service. Potential access and visibility impacts to businesses due to construction would be

identified in consultation with the business owners and measures would be developed and implemented to manage those impacts. Although business clusters have heightened risk of being affected by construction, the significance of impact on businesses within the vicinity of the project footprint would be low. Although some construction impacts are negative (such as noise increases), the majority of higher risk business clusters have lower dependency on amenity and would not be noticeably affected beyond employee annoyance.

During construction, arterial roads are expected to experience impacts that would affect the efficiency of the regional road network. These would be minimised by planning and staging the works to minimise disruptions to the surface road network. The project may also result in alterations to parking availability and an increased demand for parking near project footprints and other work areas. This may affect the availability of parking for local residents, commuters, businesses and social infrastructure users, however impacts would be minimised through the development of a detailed construction car parking strategy as part of the CTAMP. The impact on active transport networks during construction would be minimised and safe alternative paths provided.

### *Operational impacts*

The project would improve intersection performance, reduce travel times and increase average speeds across the Sydney metropolitan road network. The traffic modelling indicates that by 2033, there would be an overall increase of 498,000 kilometres travelled and a reduction of 46,000 VHT on the network. This increase is largely due to the redirection of vehicles (in particular heavy vehicles) from surface roads to the new, faster M4-M5 Link.

Traffic volumes on some sections of the surface roads in the study area are projected to reduce. This reduction would potentially improve environmental amenity by reducing congestion, noise and air pollution. This may increase pedestrian and cyclist activity in the area, which may lead to an increase in trade and business revenue. This would be particularly true for the commercial areas along Parramatta Road, east of the M4 East entry and exit ramps, and Victoria Road at Rozelle.

As a result, the project is expected to have a positive impact on existing business amenity, which would lead to a moderate positive impact on the broader socio-economic environment. The operation of the project would provide increased access to open space and increased pedestrian and cyclist connections, which would provide increased opportunities for the community to meet and interact. Rozelle Rail Yards currently acts as a substantial physical barrier between the communities of Annandale, Rozelle and Lilyfield. On operation, areas around motorway infrastructure at Rozelle would be transformed into public open space integrated with a network of active and transport links (both north-south and east-west), which would improve community cohesion.

The project would provide pedestrian and cyclist bridges that would increase the opportunities for communities to connect and interact, contributing to community and social cohesion. A new pedestrian footpath and separated cycleway would be provided between Springside Street and the Bay Run at Byrnes Street on the western side of Victoria Road. A pedestrian and cycle 'land bridge' at Rozelle Rail Yards would provide a north-south connection between Bicentennial Park, the Rozelle Rail Yards and beyond to Easton Park benefitting the communities in Annandale/Glebe and Rozelle.

The delivery of a substantial area of open space at Rozelle would be a significant positive benefit to the social and economic environment.

### *Soil and water quality*

The project is located within the Sydney Harbour and Parramatta River and Cooks River catchments. Existing water quality in all waterways is generally poor, indicative of a highly urbanised catchment. However, a number of waterways are considered to be sensitive receiving environments, including Iron Cove at Rozelle, constructed wetlands along Whites Creek and Johnstons Creek and mapped Key Fish Habitat including at Rozelle Bay, White Bay, Alexandra Canal and downstream portions of Dobroyd Canal and Hawthorne Canal.

### *Construction impacts*

The potential for erosion of exposed soils, sedimentation of waterways and exposure of contaminated soils and groundwater during construction would be managed through implementation of standard

construction site mitigation measures including stabilising disturbed ground and exposed soils, water to suppress dust and using appropriate storage with secure bunding for chemicals and fuels.

During construction, temporary water treatment plants would be established at construction ancillary facilities that would support tunnelling, to treat water used during construction and groundwater encountered during tunnelling. With these controls in place, the project would not significantly impact on soils and surface water during its construction. A program to monitor potential surface water quality impacts would be developed that would commence prior to ground disturbance.

There is a high probability of encountering acid sulfate soils around Rozelle Bay, Manning Street at Rozelle and St Peters interchange. Further soil testing would occur during construction to confirm the presence of acid sulfate material. If acid sulfate soils are identified, they would be managed in accordance with the *Acid Sulfate Soil Manual* (Acid Sulfate Soil Management Advisory Committee 1998) which includes procedures for the investigation, handling, treatment and management of such soils.

### *Operational impacts*

Permanent water treatment plants would be established at the Rozelle interchange and Darley Road at Leichhardt to treat groundwater, stormwater run-off that enters the tunnels, and water used for washing tunnel walls, fire testing and hydrant and deluge water during operation of the tunnel. Depending on the source and quality of the water collected it would be treated and discharged to local stormwater systems and waterways or disposed to sewer.

A constructed wetland would be provided at Rozelle that would provide 'polishing' treatment to the treated groundwater flows. A bioretention facility would be constructed within a section of the informal car park in King George Park at Rozelle, adjacent to Manning Street. This bioretention facility would capture and treat stormwater runoff from a section of the Victoria Road catchment to the north. A section of the existing informal car park would also be upgraded, including sealing the car park surface and landscaping.

### Contamination

The contamination assessment included the area within the project footprint, which comprises the location of all operational infrastructure and areas where construction activities would occur. Emphasis has been given to those areas where historical land use activities have impacted soil, sediment and groundwater and which would require remediation and/or management during the construction and operation of the project.

Individual lots and areas located within or adjacent to the project footprint comprised a range of land uses including; residential, commercial/industrial, roadways, waterways and recreational open space.

There is potential for localised areas of soil, acid sulfate soil, sediment, fill and groundwater contamination associated with historically contaminating land uses to be encountered during construction, and further more detailed investigation may be warranted in some instances. The discovery of contaminated materials is considered most likely to occur during near surface excavation works associated with road and tunnel construction activities.

Potentially contaminated sites and activities that have the potential to generate and disturb existing contamination would be subject to detailed investigation (where warranted), and potentially remediation and/or management to ensure that risks to the environment, people and future land uses are minimised. In particular, the project may disturb contaminated sites at locations where construction ancillary facilities are proposed to be established, including within the Rozelle Rail Yards and adjacent to The Crescent.

Management measures would be implemented during the construction and operational phases of the project to achieve the desired performance outcome, which is to ensure that risks arising from the disturbance and excavation of land and disposal of soil are minimised, including disturbance to acid sulfate soils and site contamination. In addition, in the event of encountering unexpected finds of contamination (ie the observation of offensive odours, soil discoloration, buried waste or potential asbestos containing materials) during construction, work in the area would cease until an appropriately qualified environmental consultant can advise on the need for further assessment, remediation or other action (as appropriate).

## Flooding and drainage

The project footprint is located within the Sydney Harbour, Parramatta River and Cooks River catchments. The local stormwater drainage systems that control runoff from these catchments are of limited capacity. As a result, the project corridor is presently impacted by both mainstream flooding and overland flows.

Flood modelling was carried out for the project and considered a range of annual recurrence interval (ARI) design floods, the Probable Maximum Flood (PMF), situations such as a partial blockage of a bridge structure, and impacts predicted due to climate change.

### *Construction impacts*

The assessment found that a number of the construction ancillary facilities would be affected by flooding during relatively frequent storm events. The Rozelle civil and tunnel site is affected by both mainstream flooding from Whites Creek and major overland flows through the Rozelle Rail Yards.

Construction would have the potential to impact local overland flow paths and existing minor drainage paths. Disruption of existing flow paths could occur as a result of:

- Disruption of existing drainage networks during decommissioning, upgrade or replacement of drainage pits and pipes
- Interruption of overland flow paths by installation of temporary construction ancillary facilities and surface level alterations
- Sediment entering drainage assets and causing blockages
- Overloading the capacity of the local drainage system.

### *Operational impacts*

Inundation of the project by floodwater during its operation would have the potential to cause damage to infrastructure, impact on the safe operation of the motorway tunnels and pose a safety risk to road users and motorway operations staff.

A recommended level of flood protection to each project element has been identified with due consideration of the consequences of flooding. The main design criterion is to prevent flooding of the portals, tunnels, ancillary facilities and emergency response facilities for events up to the PMF or the 100 year ARI event plus 0.5 metres freeboard (factor of safety above design flood levels, typically used in relation to the setting of floor levels).

The project would have a minor impact on flood behaviour in adjacent developments for storms with ARI's up to 100 years. While it will be necessary to assess the detailed design, it is concluded that the minor nature of the changes in flood behaviour attributable to the project would not have a significant impact outside the project footprint.

Future climate change could lead to sea level rise and potential increase in rainfall intensity and frequency. Climate change scenarios were assessed, considering different combinations of design storm rainfalls and sea level conditions under 2050 and 2100 conditions. The assessment found that changes in the flood behaviour under future climate change conditions would not lead to a significant increase in the flood risk to the project or flood impacts to adjacent developments. The layouts of the different interchanges have been influenced by flood risk and drainage considerations.

### *Management of potential impacts*

Detailed hydrologic and hydraulic modelling would be undertaken during the development of the detailed permanent and temporary designs to confirm flood risks and the extent of works required to mitigate flood impacts.

## Biodiversity

The majority of the project footprint and surrounding area is modified and disturbed, and contains exotic species, weeds and planted native or non-indigenous species. The project footprint is considered to be in a poor ecological condition, with little ecological value and unlikely to have any native resilience or recovery potential. No plant community types defined as native vegetation by the Framework for Biodiversity Assessment (NSW Office of Environment and Heritage 2014) were recorded within the project footprint, and therefore no remnant native vegetation is considered to be present.

The Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), listed as vulnerable under state legislation, may be roosting intermittently in the cavities under the Victoria Road bridge. This and other bat species may also be using the area in the vicinity of the Rozelle Rail Yards as foraging habitat. The Grey-headed Flying Fox (*Pteropus poliocephalus*), listed as vulnerable under state and federal legislation, has been recorded adjacent to, and is considered likely to forage within, the project footprint.

### *Construction impacts*

There would be no direct impacts to native vegetation communities due to construction. Further investigation would be carried out prior to construction to confirm whether the Victoria Road bridge is a potential roost site for microbats. If confirmed, measures to manage potential impacts will be identified and implemented. No impacts on endangered ecological communities listed under either State or federal legislation are expected.

The project would not directly harm marine vegetation or habitat of threatened species, communities or populations. Works within and adjacent to waterways would be managed to minimise erosion and sedimentation and other potential water quality impacts. Significant impacts on aquatic habitat downstream of the project are not expected.

An arboricultural assessment has been carried out based on the concept design to identify trees that would be impacted by construction. The majority of potentially impacted trees are as a result of the proposed works in Rozelle. Further investigations would be carried out during detailed design to confirm if any trees could be retained. Compensatory tree planting would be included in the Urban Design and Landscape Plan that will be prepared for the project.

### *Management of potential impacts*

A Construction Flora and Fauna Management Plan will be developed during detailed design and will include measures to manage potential impacts on bats, aquatic habitats and trees.

## Groundwater

A groundwater model was developed to simulate existing groundwater conditions and predict future groundwater conditions to assess the potential impacts of the project, and cumulative impacts, on groundwater. Field investigations, including drilling boreholes, packer tests, groundwater gauging, groundwater sampling and hydrogeochemical analysis, were conducted across the study area between June 2016 and May 2017. Desktop studies were also undertaken to identify existing groundwater users and sensitive environmental receptors.

### *Construction impacts*

The groundwater modelling has predicted groundwater inflows to the tunnels during construction of between 0.45 megalitres per day and 2.87 megalitres per day. During construction, the lateral extent of drawdown impacts due to tunnel construction would be minimal, even though groundwater inflows are high.

During construction, groundwater that enters the tunnel excavations would be collected. Groundwater inflows are likely to be of poor quality due to elevated natural salinity and background metal concentrations. Wastewater from the tunnels would also have a high turbidity and pH and would be treated at construction water treatment plants prior to reuse or discharge.

### *Operational impacts*

The project tunnels are to be constructed predominantly through the Hawkesbury Sandstone and, to a lesser extent, through the Mittagong Formation and Ashfield Shale. Some areas of alluvium with high permeability would be encountered. The tunnels would be designed and constructed to ensure that groundwater inflow does not exceed one litre per second per kilometre for any kilometre length of tunnel during operations. This would require lining sections of the tunnels to minimise groundwater inflow.

Assuming a worst case scenario of a uniform groundwater inflow rate of one litre per second per kilometre for any kilometre length of the tunnel, a maximum groundwater inflow rate of around 45 litres per second (3.9 megalitres per day) would be expected. This represents less than one per cent of the annual recharge of groundwater across the Sydney Basin Central. Tunnel inflows during operations would be collected and conveyed to permanent water treatment plants at Darley Road, Leichhardt and Rozelle. The facilities would be designed so that treated groundwater would be of suitable quality for discharge to the receiving environment. Groundwater drawdown would contribute to ground settlement with the potential to impact existing buildings that are above areas of alluvium. Strict limits on the degree of settlement permitted would be imposed on the project.

### *Management of potential impacts*

Appropriate waterproofing measures would be identified during detailed design and installed to ensure that groundwater inflow into the tunnels does not exceed the design criterion. Groundwater monitoring would be carried out during construction. At the end of construction, six-monthly monitoring would occur for three years or as otherwise required by any project conditions of approval. The monitoring is likely to include measuring groundwater levels, groundwater quality and tunnel inflow volumes.

### **Non-Aboriginal heritage**

The built heritage and landscape assessment has focused on a broad area comprising an appropriate buffer around the project footprint. This is to ensure indirect impacts on heritage items and heritage conservation areas (HCAs) are appropriately assessed (ie visual impacts). The assessment also included consideration of potential vibration and settlement impacts on heritage items and HCAs above underground works.

### *Construction impacts*

The project has been designed to minimise impacts on heritage items, however some impacts have been unavoidable.

The project would directly affect five listed heritage items across the study areas, which are:

- Demolition of three statutory heritage items of local heritage significance, being:
  - Stormwater canal at Rozelle
  - ‘Cadden Le Messurier’ at Rozelle
  - Former hotel at Rozelle
- Partial demolition of one statutory heritage item of local heritage significance, being the Whites Creek Stormwater Channel No. 95
- The project temporarily encroaches into the south western boundary of the curtilage of the White Bay Power Station which is a State Heritage Register (SHR) listed item. The minor encroachment occurs during the construction phase of the project as a result of the alignment of the temporary Victoria Road bridge. However, the works would be some distance from the Power Station building itself and the building would not be physically impacted by the project.

Twenty-one other statutory heritage items of State or local heritage significance HCAs would be subject to indirect impacts through potential vibration, settlement and visual setting. The project would also directly affect nine individual buildings/structures assessed as being potential local heritage items which would be fully demolished and one landscape feature assessed as being a potential local heritage item which would be partially demolished.

One structure assessed as being a potential heritage item of State significance would be indirectly impacted through vibration. Six other individual buildings/structures assessed as being potential local heritage items would be subject to indirect impacts through potential vibration, settlement and visual setting changes.

### *Management of potential impacts*

A Construction Heritage Management Plan would be prepared and implemented to investigate potential archaeological feature at key locations that would be affected by the project. Heritage specialists would provide input into the development of the detailed design and construction methodologies as required to avoid or minimise potential impacts to features of heritage significance.

Photographic archival recording would be carried out for listed heritage items and sites of potential heritage significance to be demolished as part of the project. Historic fabric and features would be salvaged for distribution back to the former landowners and the local community. Key heritage values and stories of the heritage areas affected by the project would be interpreted in the final urban design and landscaping outcome.

### **Aboriginal heritage**

The Aboriginal heritage assessment study area falls within the traditional country of the Darug people. A significant portion of the project footprint is within disturbed terrain, being an area that has been impacted by past development or other human activity, limiting the potential for intact features of Aboriginal archaeological and cultural heritage significance to be present.

### *Construction impacts*

No surface Aboriginal objects or places were identified within the study area. A Metropolitan Local Aboriginal Land Council (MLALC) representative attended the site visit however did not identify any specific areas of Aboriginal cultural attachment or intangible cultural heritage values. No issues were raised by the MLALC representative regarding the proposed works having an impact on known or potential Aboriginal sites or deposits or intangible cultural heritage values. Part of King George Park at Rozelle within the project footprint is subject to an undetermined land claim from the Metropolitan Aboriginal Land Council under the *Aboriginal Land Rights Act 1983* (NSW). If necessary, the site would be avoided.

A site (rockshelter with midden) site recorded in the Aboriginal Heritage Information Management System database is located about 50 metres to the north of the Rozelle Rail Yards site. It was not possible to confirm the location and condition of the site due to property access restrictions. While no surface works are proposed at this location, tunnelling would occur in the vicinity. The site is outside the minimum safe working distance for vibration intensive plant and vibration impacts are expected to be negligible.

### *Management of potential impacts*

Any items of potential Aboriginal archaeological or cultural heritage conservation significance or human remains discovered during construction will be managed in accordance with an Unexpected Heritage Finds and Humans Remains Procedure. Attempts would be made to obtain access to the rockshelter with midden site to confirm and record its location and conditions. If the site is validated, an assessment would be carried out to confirm if any damage is likely and identify any required measures to manage potential impacts.

### **Greenhouse gas**

#### *Construction impacts*

Around 60 per cent of greenhouse gas (GHG) emissions generated during construction would be indirect upstream/downstream emissions associated with third party supply chains and indirect upstream emissions associated with transmission and distribution losses within the electricity network. Emissions generated by sources owned or controlled by the project would account for around 25 per cent of GHG emissions. Indirect emissions from the use of electricity to power project equipment and facilities would account for around 15 per cent of GHG emissions.

### *Operational impacts*

The GHG assessment demonstrates the benefits of road tunnel usage in urban areas, where travel along a more direct route at higher average speeds results in fewer GHG emissions being generated by road users, as reduced congestion and stop-start driving reduces the fuel used by vehicles. Despite increases to overall daily vehicle kilometres travelled on motorways and a reduction in performance of some non-motorway roads, a reduction in GHG emissions is estimated as a result of the project compared with the 'do minimum' traffic modelling scenario.

The results for 2023 indicate that the project is forecast to reduce annual GHG emissions by around 361,600 tonnes of carbon dioxide equivalent (t CO<sub>2</sub>-e) for the 'with project' scenario when compared with the 'do minimum' scenario for 2023.

The project is forecast to reduce annual GHG emissions by around 504,750 t CO<sub>2</sub>-e in 2033 for the 'with project' when compared with the 'do minimum' scenario. The predicted reduction in GHG emissions as a result of the project would be due to an improvement in vehicle fuel efficiency for some links within the study area as well as the operational efficiency of the project tunnels.

### *Management of potential impacts*

The design of the project has been optimised such that measures to reduce energy and resource requirements, and therefore GHG emissions, are inherent in the design. These include (but are not limited to):

- Reducing the length of the mainline tunnels, thereby reducing the volume of spoil generated, materials used, lighting and ventilation required, and emissions generated from operational road use by vehicles
- Using roadheaders and drill and blast methodologies for tunnel excavation, as opposed to the use of a tunnel boring machine, which consumes more electricity, potable water and concrete, and generates more spoil
- Reduced power consumption through the design of the ventilation system, which incorporates low pressure fans that consume approximately 50 per cent less energy compared with a high pressure fan solution.

An Energy Efficiency and Greenhouse Gas Emissions Strategy and Management Plan would be prepared to identify initiatives to be implemented during construction and operation of the project to improve energy efficiency, reduce GHG emissions, energy use and embodied life cycle impacts.

## Resource use and waste minimisation

### *Construction impacts*

Resource requirements during construction may have an impact on resource availability within the local area.

#### Water

The total volume of water required for construction of the project is estimated to be around 6,000 kilolitres per day. Water would be sourced from various sources including:

- Stormwater harvesting (non-potable water)
- On-site construction water treatment and reuse (non-potable water)
- The mains supply (potable water).

Preference would be given to the use of non-potable water over potable water, in accordance with the *WestConnex Sustainability Strategy* (Sydney Motorway Corporation 2015). Non-potable water could be used during construction for dust suppression and end-of-project landscaping. It is anticipated that the local water supply network would have sufficient capacity to accommodate project construction water requirements.

## Power

It is estimated that the total energy requirements to construct the project would be around 100,000,000 kilowatt hours. At least 20 per cent of the electricity requirements would be met from renewable sources and/or accredited Green Power, as required by the *WestConnex Sustainability Strategy* (Sydney Motorway Corporation 2015). Discussions with power supply authorities suggest that local substations have the required capacity to supply the construction ancillary facilities for the project without affecting the local supply network.

## Waste

Various waste streams would be generated during construction of the project, including construction and demolition waste, vegetation waste, packaging materials and liquid wastes. All wastes would be managed using the hierarchy approach of waste avoidance and resource recovery before consideration of waste disposal.

All waste would be managed in accordance with the waste provisions contained within the *Protection of the Environment Operations Act 1997* (NSW) and, where reused off-site, would comply with relevant NSW Environment Protection Authority (NSW EPA) resource recovery exemptions and requirements. Spoil would be classified in accordance with the *Waste Classification Guidelines: Part 1 Classifying Waste* (NSW EPA, 2014) and reused on the project site where possible, reused at other approved developments or disposed of lawfully at an appropriate location.

The project would ensure that around 95 per cent of uncontaminated spoil generated is recycled or reused for beneficial purposes, either within the project footprint or at other locations, in accordance with the project spoil management hierarchy.

## Climate change risk assessment

The climate change risk assessment undertaken for the project considers the impact of future climate change on the project, rather than the impacts of the project on the future of climate change.

### *Construction impacts*

Climate change projections for the near future (2030) represent an average of projections for the period 2020–2039. Projections for the near future are considered relevant to the project's proposed construction timeframes, planned for the period between 2018 and 2023.

Potential climate change risks to project construction, with a risk rating of medium or higher, included an increase in the intensity and frequency of extreme rainfall and storm events, which could lead to localised flooding of construction ancillary facilities and unsuitable conditions for undertaking construction works. An increase in frequency and intensity of extreme heat events could also occur, resulting in increased work health and safety risks and potential delays to project program.

### *Operational impacts*

Seventeen climate change risks to the operation of the project were identified, including one extreme risk of flooding at Rozelle as a result of intense rainfall combined with sea level rise and an increase in extreme storm surges into Rozelle Bay. Four of the other risks to operation of the project were rated as high, including an increase in the intensity and frequency of extreme rainfall and an increase in frequency and intensity of extreme heat events.

Following the risk assessment, the design has been modified to reduce identified risks and a further detailed climate change risk assessment would be undertaken during the detailed design process to ensure the final design is adapted to the future (2030-2090) climate change scenarios.

### *Management of potential impacts*

A detailed climate change risk assessment will be undertaken during detailed design in accordance with AS 5334-2013 Climate change adaptation for settlements and infrastructure – A risk based approach. The assessment will identify and implement adaptation measures to address high and extreme risks. The decision to implement adaptation measures for medium risks will also be considered during detailed design.

## Hazard and risk

The project has been designed to minimise the likelihood of incidents and risks to public safety during construction. A Work Health and Safety Plan (WHSP) would be developed to support and augment the measures and procedures included in the CEMP. The WHSP would be supplemented by site-and activity-specific Safe Work Method Statements. An Incident Response Plan will also be developed and implemented in the event of an accident or incident.

The storage, transportation, handling and use of dangerous goods and hazardous substances would be undertaken in accordance with the *Work Health and Safety Act 2011* (NSW), the *Storage and Handling of Dangerous Goods Code of Practice* (Workcover NSW 2005), the *Dangerous Goods (Road and Rail Transport) Regulation 2014* (NSW) and relevant Australian Standards and codes.

## Cumulative impacts

When completed, the WestConnex program of works is expected to deliver beneficial cumulative impacts including significant increases in travel speeds through sections of the surface road network, increased reliability, and a reduction in average travel times.

Adverse cumulative impacts could be encountered during the construction phases of the different WestConnex projects. In particular:

- The New M5 project is expected to be finished in 2020, and may overlap the construction period of the M4-M5 Link project by around 12 months
- The M4 East project is expected to be finished in 2019, and may overlap the construction period of the M4-M5 Link project by around six months.

Construction of the project may also overlap construction of the proposed future Western Harbour Tunnel and Beaches Link project, which is anticipated to be carried out from an area within the Rozelle civil and tunnel site (C5) (when no longer needed for M4-M5 Link construction). Cumulative impacts from the concurrent construction of these two projects would predominantly comprise a minor worsening of the performance of the road network along City West Link as a result of spoil haulage and potential noise impacts on nearby receivers from concurrent construction activities.

Significant cumulative impacts with other planned developments in the area are not considered likely. However, consultation would be undertaken with local communities potentially affected by the impacts of multiple projects in addition to the M4-M5 Link project. Where relevant, proponents of other nearby developments would also be consulted to increase the overall awareness of project timeframes and impacts.

Consideration would also be given to the creation of a project working group, or equivalent, with the aim of managing project impacts and disruptions through the sharing of relevant project information (ie timing, duration and location of construction activities). The group mandate would also include how project information would be appropriately disseminated to stakeholders and communities to ensure transparency and adequate prior notification of work activities at a local level (street/suburb level).

## Sustainability

The *WestConnex Sustainability Strategy* (Sydney Motorway Corporation 2015) describes how sustainability initiatives are being integrated into the design, construction and operation of projects across the WestConnex program of works. The Sustainability Strategy outlines a sustainability vision, commitments, guiding principles, objectives and overarching targets across a range of sustainability themes, and was prepared to align with the *Transport for NSW Sustainability Framework* as well as other relevant government sustainability instruments.

The overarching sustainability objectives for the project would be met through the implementation of a Sustainability Management Plan and project specific sustainability initiatives. The implementation of these initiatives would contribute to the project achieving an Infrastructure Sustainability rating of 'Excellent'.

## How can I comment on the proposal and/or the environmental impact statement?

During the exhibition period, the EIS will be available for inspection at:

- The DP&E website (<http://www.majorprojects.planning.nsw.gov.au>)
- The WestConnex website (<http://www.westconnex.com.au>)
- Electronically at a NSW Service Centre located near you (<http://www.service.nsw.gov.au/service-centre/service-nsw>)
- The Roads and Maritime office in Milsons Point, selected local council offices and libraries in the Inner West, City of Sydney and Canada Bay LGAs as well as the Nature Conservation Council of NSW
- At various staffed displays in the region.

Details of the location and opening hours of staffed displays would be provided through a community update, letters to interest groups who have registered for the project, email notifications to registered stakeholders, information on the project website and advertisements in the local and metropolitan media. During the exhibition period, a project information line (1300 660 248) and email address ([info@westconnex.com.au](mailto:info@westconnex.com.au)) will be available to answer questions from the community relating to the project.

Feedback on the project during the exhibition period should be made via a written submission to the Secretary of DP&E, quoting the project number (SSI 16\_7485). All submissions received during the exhibition period will be placed on the DP&E website. Submissions can be made electronically through the DP&E website (<http://www.majorprojects.planning.nsw.gov.au>).

Written submissions may also be directed to:

Director Infrastructure Projects  
Planning Services  
Department of Planning and Environment  
Application number SSI 7485  
GPO Box 39  
Sydney NSW 2001

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## Volume 2B

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Appendix X – Climate change risk assessment framework

# Certification

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Submission of environmental impact statement

Prepared under Part 5.1 of the *Environmental Planning and Assessment 1979 Act* (NSW).

**Environmental impact statement prepared by:**

**Name:** Andrew Cook

**Qualifications:** Bachelor of Town and Regional Planning

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**Responsible person:** Philip Knudsen  
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**Address of the land to which the statement relates:**

Land within the Inner West and City of Sydney local government areas as described within the environmental impact statement.

**Description of the infrastructure to which this statement relates:**

Construction and operation of the WestConnex M4-M5 Link, which would comprise a new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange.

**Environmental impact statement:**

An environmental impact statement is attached addressing all matters in accordance with Part 5.1 of the *Environmental Planning and Assessment Act 1979* (NSW) and Schedule 2 of the Environmental Planning and Assessment Regulation 2000 (NSW).

**Declaration:**

I certify that I have prepared this environmental impact statement in accordance with the Secretary's Environmental Assessment Requirements as issued on 3 March 2016, and revised on 9 November 2016 and further revised on 3 May 2017. The environmental impact statement contains all available information that is relevant to the environmental assessment of the infrastructure to which the statement relates. To the best of my knowledge, the information contained in the environmental impact statement is neither false nor misleading.

**Signature:**



**Name:** Andrew Cook

**Date:** 16 August 2017

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# Glossary and terms of abbreviation

Term	Meaning
<b>A</b>	
AAQ NEPM	National Environment Protection (Ambient Air Quality) Measure
Aboriginal archaeological site	The present spatial extent of visible Aboriginal archaeological material(s) at a given location
Aboriginal cultural heritage	The tangible (objects) and intangible (dreaming stories, song lines and places) cultural practices and traditions associated with past and present day Aboriginal communities
Aboriginal object	Any deposit, object or material evidence (not being a handicraft made for sale), including Aboriginal remains, relating to the Aboriginal habitation of NSW
Aboriginal place	Any place declared to be an Aboriginal place under section 94 of the <i>National Parks and Wildlife Act 1974</i> (NSW)
ABS	Australian Bureau of Statistics
Abutment	A support structure at the end of a bridge
Acid sulfate soils	Naturally occurring soils, sediments or organic substrates (eg peat) that are formed under waterlogged conditions. These soils contain iron sulfide minerals (predominantly as the mineral pyrite) or their oxidation products. In an undisturbed state below the water table, acid sulfate soils are benign. However if the soils are drained, excavated or exposed to air by a lowering of the water table, the sulfides react with oxygen to form sulfuric acid
ACM	Asbestos containing material
Acoustic louvre	Equipment that provides ventilation and reduces noise from operational facilities
ACTAQ	Advisory Committee on Tunnel Air Quality
Acute exposure	Contact with a substance that occurs once or for only a short time (up to 14 days)
Adit	A temporary access tunnel
ADR	Australian Design Rule
ADT	Average daily traffic
AECOM	AECOM Australia Pty Ltd
AEP	Annual exceedance probability
Afflux	An increase in water level resulting from obstacles in the flow path
AHD	Australian Height Datum The standard reference level used to express the relative height of various features. A height given in metres AHD is the height above mean sea level
AHIMS	Aboriginal Heritage Information Management System A register of NSW Aboriginal heritage information maintained by the NSW Office of Environment and Heritage
AIP	NSW <i>Aquifer Inference Policy</i>
Airshed	A part of the atmosphere that shares a common flow of air and is exposed to similar influences
Alignment	The geometric layout (eg of a road) in plan (horizontal) and elevation (vertical)
Alluvium	Soil or sediment left by flowing water
ALRA	<i>Aboriginal Lands Right (Northern Territory) Act 1976</i> (Commonwealth)
AM peak hour	Unless otherwise stated, this refers to vehicle trips arriving at their destination during the average one hour peak in the AM peak period between 7.00 am and 9.00 am on a normal working weekday

<b>Term</b>	<b>Meaning</b>
ANSTO	Australian Nuclear Science and Technology Organisation
ANZECC	Australian and New Zealand Environment Conservation Council
AQM	Air quality management
Aquifer	A groundwater bearing formation sufficiently permeable to transmit and yield groundwater or water bearing rock
Aquitard	A low permeability unit that can store groundwater and also transmit it slowly from one aquifer to another
Archaeological potential	The likelihood of undetected surface and/or subsurface archaeological materials existing at a location
ARI	Average recurrence interval An indicator used to describe the frequency of floods. The average period in years between the occurrence of a flood of a particular magnitude or greater. In a long period of say 1,000 years, a flood equivalent to or greater than a 100 year ARI event would occur 10 times. The 100 year ARI flood has a one per cent chance (ie a one-in-100 chance) of occurrence in any one year. Floods generated by runoff from the study catchments is referred to in terms of their ARI, for example the 100 year ARI flood
ARTC	Australian Rail Track Corporation
Artefact	Any object which has been physically modified by humans
Arterial roads	The main or trunk roads of the state road network that carry predominantly through traffic between regions
AS	Australian Standard
Asphalt or asphaltic concrete	A dense, continuously graded mixture of coarse and fine aggregates, mineral filler and bitumen usually produced hot in a mixing plant
At-grade	A road at ground level, not on an embankment or in a cutting
ATC	Automatic traffic count
ATN	Active transport network
ATSIHP Act	<i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i> (Commonwealth)
AWS	Automatic weather station
AWT	Average weekday traffic
<b>B</b>	
Background concentration (air quality)	Describes all contributing sources of a pollutant concentration other than road traffic. It includes, for example, contributions from natural sources, industry and domestic activity
Background noise level	The ambient sound-pressure noise level in the absence of the sound under investigation exceeded for 90 per cent of the measurement period. Normally equated to the average minimum A-weighted sound pressure level
BAM	Beta attenuation monitor
Bank cubic metres	A measure of volume representing a cubic metre of unexcavated material. Once material is excavated, it expands to varying degrees depending on its constituents
BaP	Benzo(a)pyrene
BAR	Biodiversity Assessment Report
Benefit cost ratio	A measure of the magnitude of net benefit to society derived from the capital investment in the project
Biodegradation	Decomposition or breakdown of a substance through the action of micro-organisms (such as bacteria or fungi) or other natural physical processes (such as sunlight)
Bioretention facility	Landscaped depression designed to treat stormwater runoff to remove contaminants and sediment

<b>Term</b>	<b>Meaning</b>
Blasting	Rock blasting is the controlled use of explosives and other methods such as gas pressure blasting pyrotechnics or plasma processes, to excavate, break down or remove rock
BOD	Biological oxygen demand
BoM	Australian Government Bureau of Meteorology
Bore	Constructed connection between the surface and a groundwater source that enables groundwater to be transferred to the surface either naturally or through artificial means
BS	British standard
BTEX	Benzene, toluene, ethylbenzene and xylenes
BTEXN	Benzene, toluene, ethylbenzene, xylenes and naphthalene
BTS	NSW Bureau of Transport Statistics
Bund	A small embankment designed to retain water
Bus lane	A traffic lane dedicated to buses, but which can also be used by taxis, bicycles and motorcycles
<b>C</b>	
Campbell Road civil and tunnel site	A construction ancillary facility for the M4-M5 Link project at St Peters
Campbell Road motorway operations complex	An area where operational ancillary facilities are established. 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
Campbell Road ventilation facility	Ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels. Located at St Peters, within the St Peters interchange site
Capacity	The nominal maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or roadway in one direction during a given time period under prevailing roadway conditions
Carcinogen	A substance that causes cancer
Carriageway	The portion of a roadway used by vehicles including shoulders and ancillary lanes
CASA	Civil Aviation Safety Authority
Catchment	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location
CBD	Central business district
CCTV	Closed circuit television
CEEC	Critically endangered ecological community A threatened ecological community with a 'critically endangered' listing status under environmental legislation
CEMP	Construction Environmental Management Plan A plan developed for the construction phase of the project to ensure that all contractors and sub-contractors comply with the environmental conditions of approval for the project and that the environmental risks are properly managed
CFFMP	Construction Flora and Fauna Management Plan
Chronic exposure	Contact with a substance or stressor that occurs over a long time (more than one year) [compared with acute exposure and intermediate duration exposure]
CHL	Commonwealth Heritage List
City Centre Access Strategy	Sydney Centre Access Strategy (Transport for NSW 2013)
Climate change	A change in the state of the climate that can be identified (eg by statistical tests) by changes in the mean and/or variability of its properties, and that persists for an extended period of time, typically decades or longer (CSIRO and BoM 2015)

<b>Term</b>	<b>Meaning</b>
Climate projection	A climate projection is the simulated response of the climate system to a scenario of future emission or concentration of greenhouse gases and aerosols, generally derived using climate models. Climate projections are distinguished from climate predictions by their dependence on the emission/concentration/radiative forcing scenario used, which in turn is based on assumptions concerning, for example, future socio-economic and technological developments that may or may not be realised (CSIRO and BoM 2015)
CLM Act	<i>Contaminated Land Management Act 1997</i> (NSW)
CMA	Catchment management authority
CMP	Conservation Management Plan
CNVG	<i>Construction Noise and Vibration Guideline</i> (Roads and Maritime, 2016)
CNVIS	Construction Noise and Vibration Impact Statements
CNVMP	Construction Noise and Vibration Management Plan
CO	Carbon monoxide
CO <sub>2</sub>	Carbon dioxide A naturally occurring gas, also a by-product of burning fossil fuels from fossil carbon deposits, such as oil, gas and coal, of burning biomass, of land use changes and of industrial processes (eg cement production). It is the principle anthropogenic greenhouse gas that affects the Earth's radiative balance (CSIRO and BoM 2015)
CO <sub>2</sub> -e	Carbon dioxide equivalents
COAG	Council of Australian Governments
Coffer dam	Temporary enclosure built within a body of water to allow the enclosed area to be pumped out
COHb	Carboxyhaemoglobin
Concept design	Initial functional layout of a road/road system or other infrastructure. Used to facilitate understanding of a project, establish feasibility and provide basis for estimating and to determine further investigations needed for detailed design
Confluence	A point at which streams combine
Construction	Includes all physical work required to construct the project
Construction ancillary facilities	Temporary facilities during construction that include, but are not limited to construction sites (civil and tunnel), sediment basins, temporary water treatment plants, precast yards and material stockpiles, laydown areas, workforce parking, maintenance workshops and offices
Construction fatigue	Impact on receivers in the vicinity of concurrent and/or consecutive construction activities
Contributory item	Place within a Heritage Conservation Area that contributes to its heritage significance
CORTN	<i>Calculation of Road Traffic Noise</i> algorithms (UK Department of Transport 1988)
CPI	Consumer price index
CPTED	Crime Prevention Through Environmental Design
CSA	Cross-sectional area
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSELR	CBD and South East Light Rail
CSSI	Critical State significant infrastructure
CSWMP	Construction Soil and Water Management Plan
CTAMP	Construction Traffic and Access Management Plan
Cul-de-sac	A street or road that is open for vehicular traffic at one end only
Culvert	A structure that allows water to flow under a road

<b>Term</b>	<b>Meaning</b>
Cumulative impacts	Impacts that, when considered together, have different and/or more substantial impacts than a single impact assessed on its own
Cut-and-cover	A method of tunnel construction whereby the structure is built in an open excavation and subsequently covered
Cutting	Formation resulting from the construction of the road below existing ground level, the material is cut out or excavated
<b>D</b>	
Darley Road civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Leichhardt
Darley Road motorway operations complex	An area where operational ancillary facilities are established. Located at Leichhardt, 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
dB	Decibel - sound level measurement
dBA	A-weighted decibels A-weighting is applied to instrument-measured sound levels in effort to account for the relative loudness perceived by the human ear, as the ear is less sensitive to low audio frequencies
dBL	Linear weighted decibels
DCP	Development Control Plan
DE	Diesel exhaust
DEC	NSW Department of Environment and Conservation (now OEH and EPA)
DECC	NSW Department of Environment and Climate Change (now OEH)
DECCW	NSW Department of Environment, Climate Change and Water (formerly DECC, now OEH)
DEFRA	(UK) Department for Environment, Food and Rural Affairs
DEH	Australian Government Department of Environment and Heritage
DERM	(Queensland) Department of Environment and Resource Management
Design speed	A nominal speed which determines the geometric design features of a road
Detailed design	The phase of the project following concept design where the design is refined, and plans, specifications and estimates are produced, suitable for construction
Detection limit	The lowest concentration of a chemical that can reliably be distinguished from a zero concentration
Detour	An alternative route, using existing roads, made available to traffic
Deviation	An alteration to the alignment of a portion of a road
DEWHA	Australian Government Department of Environment, Water, Heritage and the Arts
DGA	Dense graded asphalt
DIN	German standard
DIRD	Australian Government Department of Infrastructure and Regional Development
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m <sup>3</sup> /s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving (eg metres per second (m/s))
Divided road	A road with a separate carriageway for each direction of travel created by placing a physical separation (eg median) between the opposing traffic directions
DLWC	NSW Department of Land and Water Conservation
Do minimum	A model scenario that does not incorporate the proposed project infrastructure

<b>Term</b>	<b>Meaning</b>
Do something	A model scenario that incorporates the proposed project infrastructure
Do something cumulative	A model scenario that incorporates the proposed project infrastructure and other relevant project infrastructure
DoEE	Australian Government Department of the Environment and Energy
DoP	NSW Department of Planning (now Department of Planning and Environment)
Dose	The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure
DP&E	NSW Department of Planning and Environment
DP&I	NSW Department of Planning and Infrastructure (now Department of Planning and Environment)
DPC	Department of Premier and Cabinet
DPF	Diesel particulate filter
DPI	NSW Department of Primary Industries
DPI-Fisheries	NSW Department of Primary Industries (Fisheries)
DPI-Water	NSW Department of Primary Industries (Water)
DPM	Diesel particulate matter
DPSW	NSW Department of Public Works and Services
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water
Drawdown	Reduction in the height of the water table caused by changes in the local environment
DRIS	Decision Regulation Impact Statement
DSEWPC	Australian Government Department of Sustainability, Environment, Water, Population and Communities
DSITIA	(Queensland) Department of Science, Information Technology, Innovation and the Arts
<b>E</b>	
Earthworks	All operations involved in loosening, excavating, placing, shaping and compacting soil or rock
EB	Eastbound
EC	Elemental carbon
Ecological community	An ecological community is a naturally occurring group of native plants, animals and other organisms that are interacting in a unique habitat
EDMS	(NSW) Emissions Data Management System
EF	Emission factor A quantity which expresses the mass of a pollutant emitted per unit of activity. For road transport the unit of activity is usually either distance (ie g/km) or fuel consumed (ie g/litre)
Egress	Exit
EHC Act	<i>Environmentally Hazardous Chemicals Act 1985</i> (NSW)
EIA	Environmental Impact Assessment
EIS	Environmental impact statement
Electrical conductivity	The measure of a material's ability to accommodate the transport of an electric charge
Embankment	An earthen structure where the road (or other infrastructure) subgrade level is about the natural surface
Emergency management	A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding
EMF	Electromagnetic field
Emission rate	A quantity which expresses the mass of a pollutant emitted per unit of time (eg g/second)

<b>Term</b>	<b>Meaning</b>
Emissions scenario	A plausible representation of the future development of emissions of substances that are potentially radiatively active (eg greenhouse gases, aerosols) based on a coherent and internally consistent set of assumptions about driving forces (such as demographic and socio-economic development, technological change) and their key relationships (CSIRO and BoM 2015)
Enabling works	Works which are required to enable the commencement of the main construction works
Endangered ecological community	A threatened ecological community with an 'endangered' listing status under environmental legislation
ENMM	Environmental Noise Management Manual
Entry ramp	A ramp by which one enters a limited-access highway/tunnel
Environment	As defined within the <i>Environmental Planning and Assessment Act 1979</i> (NSW), all aspects of the surroundings of humans, whether affecting any human as an individual or in his or her social groupings
EOI	Expressions of interest
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i> (NSW)
EP&A Regulation	Environmental Planning and Assessment Regulation 2000 (NSW)
EPA	NSW Environment Protection Authority
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Commonwealth)
EPHC	Environment Protection Heritage Council
EPL	Environment Protection Licence under the <i>Protection of the Environment Operations Act 1997</i> (NSW)
Erosion	A natural process where wind or water detaches a soil particle and provides energy to move the particle
ERS	Eastern Regional Sequence
ESP	Electrostatic precipitator
EU	European Union
Exit ramp	A ramp by which one exits a limited-access highway/tunnel
Extreme rainfall	There is no consistent global definition for extreme rainfall. It can be defined by either relative rainfall at a location (amount relative to averages), or absolute rainfall amounts (eg over 100 millimetres in a single day). In this report, an extreme rainfall event is defined as the wettest day in 20 years
Extreme temperature	Definitions vary, however this report refers to extreme temperature as hot days (days above 35°C) and very hot days (days above 40°C)
<b>F</b>	
F6 Extension (previously referred to as SouthLink)	A proposed motorway link between the New M5 at Arncliffe and the existing M1 Princes Highway at Loftus, generally along the alignment known as the F6 corridor. The project is being delivered by NSW Roads and Maritime Services and would be subject to separate assessment and planning approval
FBA	<i>Framework for Biodiversity Assessment</i> (Office of Environment and Heritage 2014)
Feasible and reasonable	Consideration of standard or good practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. 'Feasible' relates to engineering considerations and what is practical to build. 'Reasonable' relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community expectations and nature and extent of potential improvements
FFDI	Forest Fire Danger Index
Fill	The material placed in an embankment

<b>Term</b>	<b>Meaning</b>
Fire weather	Weather conditions conducive to triggering and sustaining wild fires, usually based on a set of indicators and combinations of indicators including temperature, soil moisture, humidity, and wind. Fire weather does not include the presence or absence of fuel load (CSIRO and BoM 2015)
Flash flooding	Flooding which is sudden and unexpected. It is often caused by sudden local or nearby heavy rainfall. It is often defined as flooding which peaks within six hours of the rain event
Flood	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami
Flood prone land	Land susceptible to flooding by the probable maximum flood. Note that the flood prone land is also known as flood liable land
Flood storage area	Those parts of the floodplain that are important for the temporary storage of floodwaters during the passage of a flood. The extent and behaviour of flood storage areas may change with flood severity, and loss of flood storage can increase the severity of flood impacts by reducing natural flood attenuation. It is necessary to investigate a range of flood sizes before defining flood storage areas
Floodplain	Area of land which is inundated by floods up to and including the probable maximum flood event (ie flood prone land)
Floodplain Risk Management Plan	A management plan developed in accordance with the principles and guidelines in the NSW Floodplain development manual (DIPNR 2005). Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives
FM Act	<i>Fisheries Management Act 1994</i> (NSW)
FMS	Flood management strategy
FPL	Flood planning level
Fracture	Cracks within the strata that develop naturally or as a result of underground works
Freeboard	A factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. It is usually expressed as the difference in height between the adopted flood planning level and the peak height of the flood used to determine the flood planning level. Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the floodplain, such as wave action, localised hydraulic behaviour and impacts that are specific event related, such as levee and embankment settlement, and other effects such as 'greenhouse' and climate change. Freeboard is included in the Flood Planning Level
Freight Strategy	NSW Freight and Ports Strategy (Transport for NSW 2013b)
FRNSW	Fire & Rescue NSW
<b>G</b>	
Gateway to the South	An accelerated pinch points program, the Gateway to the South Pinch Points Program aims to ease congestion and improve journey reliability on Sydney's key southern corridors. The NSW Government has committed \$300 million to address critical pinch points along the A1, A3 and A6 routes south of the M5 Motorway
GCCSA	Greater Capital City Statistical Area

<b>Term</b>	<b>Meaning</b>
GDE	Groundwater dependent ecosystem Refers to communities of plants, animals and other organisms whose extent and life process are dependent on groundwater, such as wetlands and vegetation on coastal sand dunes
Genotoxic carcinogens	Chemicals that alter the genetic material of target cells and could cause cancer
Geomorphology	Physical features of the earth's surface and their relation to its geological structures
Geotechnical investigation	Below ground investigation including soil and groundwater sampling and testing
GHG	Greenhouse gas
GI	Ground integrity
GIS	Geographical information system
GLC	Ground-level concentration
Global Sydney	As defined in A Plan for Growing Sydney (NSW Government 2014), Global Sydney includes the Sydney CBD, North Sydney CBD, Barangaroo, Darling Harbour, The Bays Precinct, Pyrmont-Ultimo, Broadway and Camperdown Education and Health Precinct, Central to Eveleigh, Surry Hills and City East
GMA	Greater Metropolitan Area
GMP	Groundwater monitoring program
GMR	NSW Greater Metropolitan Region
GPS	Global positioning system
Grade	The rate of longitudinal rise (or fall) with respect to the horizontal expressed as a percentage or ratio
Grade separation	The separation of road, rail or other traffic so that crossing movements at intersections are at different levels
GRAL	Graz Lagrangian (dispersion model) An air quality modelling package
GRAMM	Graz Mesoscale Model
Greenhouse gas	Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. Water vapour (H <sub>2</sub> O), carbon dioxide (CO <sub>2</sub> ), nitrous oxide (N <sub>2</sub> O), methane (CH <sub>4</sub> ) and ozone (O <sub>3</sub> ) are the primary greenhouse gases in the Earth's atmosphere (CSIRO and BoM 2015)
Groundwater	Water that is held in rocks and soil beneath the earth's surface
Groundwater aggressivity	The extent to which groundwater may corrode or degrade materials
Groundwater gauging	Obtaining data from groundwater wells
GSV	Ground surface visibility
GVA	Gross value add
GVM	Gross vehicle mass
<b>H</b>	
ha	Hectare
Haberfield civil and tunnel site/Haberfield civil site	Construction ancillary facilities for the M4-M5 Link project located at Haberfield
Habitat	An area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component (OEH 2014a)
HAMU	Historical archaeological management unit
HARD	Historical archaeological research design
Hazard	A source of potential harm or a situation with a potential to cause loss of human life or damage to physical assets
HCA	Heritage conservation area

<b>Term</b>	<b>Meaning</b>
HCV	Heavy commercial vehicle (interchangeable with HGV – see below)
HDV	Heavy-duty vehicle, which includes heavy goods vehicles, buses and coaches
Heavy vehicles	A heavy vehicle is classified as a Class 3 vehicle (a two axle truck) or larger, in accordance with the Austroads Vehicle Classification System
Heritage Act	<i>Heritage Act 1977 (NSW)</i>
Heritage Council	Heritage Council of NSW
Heritage item	Any place, building or object listed on a statutory heritage register
HGV	Heavy goods vehicle (truck)
HHRA	Human health risk assessment
HI	Hazard Index
HIA/HIS	Heritage impact assessment / heritage impact statement
HVAS	High volume air sampler
Hydraulic conductivity	A characteristic of soil that describes how easily water moves through it
Hydrogeochemical	Chemical characteristics of groundwater
Hydrogeology	The area of geology that deals with the distribution and movement of groundwater in soils and rocks
Hydrology	The study of rainfall and surface water runoff processes
Hz	Hertz. A measure of frequency
<b>I</b>	
IARC	International Agency for Research on Cancer
ICNG	<i>Interim Construction Noise Guideline (NSW DECC 2009a)</i>
IFD	Intensity-Frequency-Duration
ILCR	Incremental lifetime carcinogenic risk
ILUA	Indigenous Land Use Agreement
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment
In situ	In the natural or original position. Applied to a rock, soil, or fossil when occurring in the situation in which it was originally formed or deposited
Infiltration	The downward movement of water into soil and rock. It is largely governed by the structural condition of the soil, the nature of the soil surface (including presence of vegetation) and the antecedent moisture content of the soil
Infrastructure SEPP	<i>State Environmental Planning Policy (Infrastructure) 2007 (NSW)</i>
Ingress	Enter
Inner West Council	The amalgamation of the former local government areas of Ashfield, Leichhardt and Marrickville, proclaimed on 12 May 2016
Inner West subsurface interchange	A subsurface interchange at Leichhardt and Annandale that would link the mainline tunnels with the Rozelle interchange and the Iron Cove Link
INP	Industrial Noise Policy
Inside shoulder	The area of pavement outside the traffic lanes that is closest to the 'fast' lane
Interchange	A grade separation of two or more roads with one or more interconnecting carriageways
Intrusive item	Place within a heritage conservation area that detracts from its heritage significance
IPCC	Intergovernmental Panel on Climate Change
Iron Cove Link	Around one kilometre of twin tunnels that would connect Victoria Road near the eastern abutment of Iron Cove Bridge and Anzac Bridge

<b>Term</b>	<b>Meaning</b>
Iron Cove Link civil site	A construction ancillary facility for the M4-M5 Link project located at Rozelle
Iron Cove Link motorway operations complex	An area where operational ancillary facilities are established. 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
Iron Cove Link ventilation facility	Ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels. Located at Rozelle
ISCA	Infrastructure Sustainability Council of Australia
ITS	Intelligent Transport Systems Systems in which information and communication technologies are applied in the field of road transport, including infrastructure, vehicles and users, and in traffic management and mobility management, as well as for interfaces with other modes of transport
IVA	Industry value add
<b>J</b>	
Just Terms Act	<i>Land Acquisition (Just Terms Compensation) Act 1991 (NSW)</i>
<b>K</b>	
KFH	Key fish habitat
KGRIU	King Georges Road Interchange Upgrade A component of the WestConnex program of works. Upgrade of the King Georges Road interchange between the M5 West and the M5 East at Beverly Hills, in preparation for the New M5 project
kL	Kilolitre
kL/day	Kilolitres per day
Km	kilometres
kN	Kilonewton
KTP	Key threatening process
<b>L</b>	
L/s/km	Litres per second per kilometre
L <sub>Aeq</sub>	The 'energy average noise level'
L <sub>A90</sub>	The "background noise level" in the absence of construction activities. This parameter represents the average minimum noise level during the daytime, evening and night-time periods respectively. The LAeq(15minute) construction Noise Management Levels (NMLs) are based on the LA90 background noise levels
L <sub>AFmax</sub>	The maximum fast time weighted noise level from road traffic noise occurring at a particular location
LALC	Local Aboriginal land council
Landscape character	The aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. Includes all aspects of a tract of land – built, planted and natural topographical and ecological features
Landscape design	The design of the natural and built environment. Soft landscape design involves design using vegetative materials such as trees, shrubs, groundcovers. Hard landscape design involves design using hard materials such as pavement, walls and ramps
Lane	A portion of the carriageway allotted for the use of a single line of vehicles
LCV	Light commercial vehicle
LCZ	Landscape character zone
Leachate	Liquid that 'leaches' (drains) from a landfill or stockpile
LEP	Local environmental plan
LGA	Local government area

<b>Term</b>	<b>Meaning</b>
Licensed discharge point	A location where a licensed operation discharges water to the environment in accordance with conditions stipulated within the site environment protection licence (EPL)
LIDAR	Light Detection and Ranging
LOAEL	Lowest observed adverse effect level
Local road	A road or street used primarily for access to abutting properties
Localised flooding	Localised flooding occurs when components of the drainage system are undersized or blocked and cannot accommodate the incoming overland surface flows, resulting in the flooding of a localised area
LOR	Limit of reporting
LoS	Level of service
LTADEL	Long term average annual extraction limits
<b>M</b>	
m	Metres
m <sup>2</sup>	Square metres
m <sup>3</sup>	Cubic metres
M4 East mainline stub tunnels	Eastbound and westbound extensions of the M4 East mainline tunnel being built as part of the M4 East project (to connect with the M4-M5 Link)
M4 East mainline connection	The underground connection between the M4-M5 Link mainline tunnels and the M4 East mainline stub tunnels
M4 East Motorway/project	A component of the WestConnex program of works. Extension of the M4 Motorway in tunnels between Homebush and Haberfield via Concord. Includes provision for a future connection to the M4-M5 Link at the Wattle Street interchange
M4 Motorway	The M4 Motorway is a 40 kilometre motorway that extends from Concord in Sydney's inner west to Lapstone at the foothills of the Blue Mountains
M4 Widening	A component of the WestConnex program of works. Widening of the existing M4 Motorway from Parramatta to Homebush
M4-M5 Link	The project which is the subject of this EIS. A component of the WestConnex program of works
M5 East Motorway	Part of the M5 motorway corridor. Located between Beverly Hills and Sydney Airport (General Holmes Drive)
M5 motorway corridor	The M5 East Motorway and the M5 South West Motorway
M5 South West Motorway	Part of the M5 Motorway corridor. Located between Prestons and Beverly Hills
Mainline tunnels	The M4-M5 Link mainline tunnels connecting with the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters
Mainstream flooding	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam
Managed motorway	A managed motorway uses active traffic management to reduce congestion, improve reliability of travel times and inform travellers of real-time incidents and expected travel times to set destination along the motorway
MCA	Multi-criteria analysis
Mean rainfall	The arithmetically averaged total amount of precipitation recorded during a calendar month or year
Median	The central reservation which separates carriageways from traffic travelling in the opposite direction
mg/L	Milligrams per litre
microSiemens per centimetre (mS/cm)	A measure of electrical conductivity. Commonly used to measure the salinity of water
Mid-block	Section of road between two intersections
ML	Megalitre

<b>Term</b>	<b>Meaning</b>
MLALC	Metropolitan local Aboriginal land council
MNES	Matters of national environmental significance
MODFLOW	A three-dimensional finite-difference groundwater model
Motorway	Fast, high volume controlled access roads. May be tolled or untolled
MUSIC	Model for Urban Stormwater Improvement Conceptualisation
MVA	Megavolt-amp
MVKT	Million vehicle kilometres travelled
<b>N</b>	
NARCIiM	NSW/ACT Regional Climate Modelling
National Road Network	AusLink National Land Transport Network
Naturalisation works	Restoring the natural values of a river by works such as replacing concrete walls with natural looking banks made of rocks and native plants to improve health and natural character
NB	Northbound
NCA	Noise catchment area
NCG	<i>Noise Criteria Guideline</i> (Roads and Maritime, 2015)
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
New M5 Motorway/project	A component of the WestConnex program of works. Located from Kingsgrove to St Peters (under construction)
New M5 mainline stub tunnels	Northbound and southbound extensions of the New M5 mainline tunnel being built as part of the New M5 project (to connect with the M4-M5 Link)
New M5 mainline connection	The underground connection between the M4-M5 Link mainline tunnels and the New M5 mainline stub tunnels
NH <sub>3</sub>	Ammonia
NHL	National heritage list
NHMRC	National Health and Medical Research Council
NIWA	National Institute of Water and Atmospheric Research (New Zealand)
NLA	National Library of Australia
NMG	<i>Noise Mitigation Guideline</i> (Roads and Maritime, 2015)
NML	Noise management level
NMVOG	Non-methane volatile organic compound
NO	Nitric oxide
NO <sub>2</sub>	Nitrogen dioxide
NOAEL	No observed adverse effect level
Northcote Street civil site	A construction ancillary facility for the M4-M5 Link project located at Haberfield
NO <sub>x</sub>	Oxides of nitrogen
NoW	NSW Office of Water
NPI	National Pollutant Inventory
NPW Act	<i>National Parks and Wildlife Act 1974</i> (NSW)
NSW	New South Wales
NSW EPA	NSW Environment Protection Authority
NSW Health	NSW Department of Health
NT Act	<i>Native Title Act 1993</i> (Commonwealth)
NV Act	<i>Native Vegetation Act 2003</i> (NSW)
NW Act	<i>Noxious Weeds Act 1993</i> (NSW)
NWQMS	National Water Quality Management Strategy
NZ	New Zealand
<b>O</b>	
O <sub>3</sub>	Ozone
Obstruction Limitation Surface	An invisible level that defines the limits to which objects may project into the airspace around an aerodrome so that aircraft operations may be conducted safely

<b>Term</b>	<b>Meaning</b>
OC	Organic carbon
OCP	Organochlorine Pesticides
OEH	NSW Office of Environment and Heritage (Formerly DECCW)
OEMP	Operational Environmental Management Plan
OLS	Obstruction limitation surface
OOHW	Out-of-hours work
ONVR	Operational Noise and Vibration Review
OPP	Organophosphate Pesticides
Outcrop	Bedrock exposed at the ground surface
Outside shoulder	The area of pavement outside the traffic lanes that is closest to the 'slow' lane
Overbridge	Bridge that conveys another road, rail or pedestrians over the described road
Overland flooding	Inundation by local runoff rather than overbank discharge from a stream, river, estuary, lake or dam
<b>P</b>	
PACHCI	<i>Procedure for Aboriginal Cultural Heritage Consultation and Investigation</i> (Roads and Maritime 2011)
PAH(s)	Polycyclic aromatic hydrocarbon(s)
Palaeochannel/palaeovalley	Ancient river systems eroded deeply into the landscape and infilled with saturated alluvial sediments
PANS-OPS	Procedures for air navigation systems operations
Parcel of land	Refers to an individual lot number (lot) and deposited plan (DP)
Parramatta Road corridor	The area from Parramatta CBD to Sydney CBD, generally between the Main Western Rail line in the south and the Parramatta River to the north
Parramatta Road East civil site	A construction ancillary facility for the M4-M5 Link project at Haberfield
Parramatta Road Transformation Strategy	<i>The Parramatta Road Corridor Urban Transformation Strategy</i> (UrbanGrowth NSW 2016a)
Parramatta Road ventilation facility	A ventilation facility located on the south-eastern corner of the Parramatta Road / Wattle Street intersection (referred to as the Eastern ventilation facility in the M4 East project EIS). The facility is being built as part of the M4 East project. As part of the M4-M5 Link project, fitout works would be carried out on a section of this facility
Parramatta Road West civil and tunnel site	A construction ancillary facility for the M4-M5 Link project at Ashfield
PASS	Potential acid sulfate soils
Pavement	The portion of a carriageway placed above the subgrade for the support of, and to form a running surface for, vehicular traffic
PCB	Polychlorinated biphenyls
PCT	Plant community type
PCU	Passenger car unit
Peak discharge	The maximum discharge occurring during a flood event
Peak flood level	The maximum water level occurring during a flood event
Permeability	Ability of a material to transmit water
PFAS/PFOS/PFHxS	Per- and poly-fluoroalkyl substances
Photo-ionisation detector measurements	A measurement of the concentration of volatile organic compounds and other gases within the soil
pH	Numeric scale ranging from zero to 14 used to specify the acidity or alkalinity of an aqueous solution. Solutions with a pH less than seven are acidic and solutions with a pH greater than seven are alkaline. Pure water has a pH of seven and is neutral
PIARC	Permanent International Association of Road Congresses

<b>Term</b>	<b>Meaning</b>
Piezometer (monitoring well)	A non-pumping monitoring well, generally of small diameter that is used to measure the elevation of the water table or potentiometric surface. A piezometer generally has a short well screen through which water can enter
PM	(Airborne) particulate matter
PM <sub>10</sub>	Airborne particulate matter with an aerodynamic diameter of less than 10 micrometres (µm)
PM <sub>2.5</sub>	Airborne particulate matter with an aerodynamic diameter of less than 2.5 micrometres (µm)
PM peak hour	Unless otherwise stated, this refers to trips travelling on the network during the average one hour peak period between 3pm to 6pm on a weekday
PMF	Probable maximum flood The flood that occur as a result of the probable maximum precipitation on a study catchment. The probable maximum flood is the largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation coupled with the worst flood producing catchment conditions. Generally, it is not physically or economically possible to provide complete protection against this event. The probable maximum flood defines the extent of flood prone land (ie the floodplain)
ppb	Parts per billion
ppbv	Parts per billion by volume
PPV	Peak Particle Velocity
POEO Act	<i>Protection of the Environment Operations Act 1997</i> (NSW)
Pollutant	Any measured concentration of solid or liquid matter that is not naturally present in the environment
Portal	The entry and/or exit to a tunnel
Potential heritage item	Place identified in this report as potentially having heritage significance, which is not recognised on the heritage register
ppm	Parts per million
ppmv	Parts per million by volume
Pre-construction	All work prior to, and in respect of the State significant infrastructure, that is excluded from the definition of construction
Priority List	Infrastructure Australia's <i>Australian Infrastructure Plan: The Infrastructure Priority List</i>
Prescribed airspace	The airspace above any part of either an Obstruction Limitation Surface or a 'procedures for air navigation systems – aircraft operations' (PANS-OPS) surface for Sydney Airport. The obstacle limitation surface is an invisible level that defines the limits to which objects may project into the airspace around an aerodrome so that aircraft operations may be conducted safely
Probability	A statistical measure of the expected chance or likelihood of occurrence
Project	A new multi-lane road link between the M4 East Motorway at Haberfield and the New M5 Motorway at St Peters. The project would also include an interchange at Lilyfield and Rozelle (the Rozelle interchange) and a tunnel connection between Anzac Bridge and Victoria Road, east of Iron Cove Bridge (Iron Cove Link). In addition, construction of tunnels, ramps and associated infrastructure to provide connections to the proposed future Western Harbour Tunnel and Beaches Link project would be carried out at the Rozelle interchange
Project footprint	The land required to construct and operate the project. This includes permanent operational infrastructure (including the tunnels), and land required temporarily for construction
Property	Based on ownership, with the potential to contain more than one lot and DP

<b>Term</b>	<b>Meaning</b>
Proponent	The person or organisation that proposes to carry out the project or activity. For the purpose of the project, the proponent is NSW Roads and Maritime Services
Public transport	Includes train, bus (government and private), ferry (government and private) and light rail (government and private) services
PV	Passenger vehicle
Pyrmont Bridge Road tunnel site	A construction ancillary facility for the M4-M5 Link project at Annandale
<b>Q</b>	
<b>R</b>	
RAP	Remedial action plan
RAP	Registered Aboriginal parties
RBL	Rating background levels
RCBC	Reinforced concrete box culvert
RCP	Representative concentration pathways
REF	Review of environmental factors
Representative concentration pathways	Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases and aerosols and chemically active gases, as well as land use/cover (Dowdy et al 2015)
Residual land	Acquired land not required during operation of the project
Revegetation	Direct seeding or planting (generally with native species) within an area in order to re-establish vegetation that was previously removed from that area
RH	Relative humidity
Riparian	The part of the landscape adjoining rivers and streams that has a direct influence on the water and aquatic ecosystems within them
RNP	Road Noise Policy
Road reserve	A legally defined area of land within which facilities such as roads, footpaths and associated features may be constructed for public travel
Road Safety Strategy	National Road Safety Strategy for Australia 2011 – 2020
Roadheader	A commonly used machine for excavation in sandstone using picks mounted on a rotary cutter head attached to a hydraulically operated boom
Roads and Maritime	NSW Roads and Maritime Services
Roadside furniture	A general term covering all signs, street lights, protective devices for the control, guidance and safety of traffic and convenience of road users
Rozelle civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Lilyfield and Rozelle
Rozelle East motorway operations complex	An area where operational ancillary facilities are established. Located at the western end of the Rozelle Rail Yards on land occupied during construction by the Rozelle civil and tunnel site
Rozelle interchange	A new interchange at Lilyfield and Rozelle that would connect the M4-M5 Link mainline tunnels with City West Link, Anzac Bridge, the Iron Cove Link and the proposed future Western Harbour Tunnel and Beaches Link
Rozelle Rail Yards	The Rozelle Rail Yards is bound by City West Link to the south, Lilyfield Road to the north, Balmain Road to the west, and White Bay to the east. Note that the project only occupies part of the Rozelle Rail Yards site
Rozelle ventilation facility	Ventilation supply and exhaust facilities, axial fans, ventilation outlets and ventilation tunnels. Located at the Rozelle Rail Yards, the ventilation supply facility is located at the Rozelle West motorway operations complex and a ventilation exhaust facility at the Rozelle East motorway operations complex

<b>Term</b>	<b>Meaning</b>
Rozelle West motorway operations complex	An area where operational ancillary facilities are established. Located at the central/eastern end of the Rozelle Rail Yards, on land occupied during construction by the Rozelle civil and tunnel site
RPA Hospital	Royal Prince Alfred Hospital
RTA	NSW Roads and Traffic Authority (now NSW Roads and Maritime Services)
Runoff	The amount of rainfall that ends up as streamflow, also known as rainfall excess
RWR	Residential, workplace and recreational This term refers to all discrete receptor locations along the project corridor, and mainly covers residential and commercial land uses
<b>S</b>	
s	Second
S170	State Agency Section 170 Heritage and Conservation Register. Section 170 of the <i>Heritage Act 1977</i> (NSW) requires NSW Government agencies to keep a register of heritage items/assets owned, occupied or managed by that government agency
SA1	Statistical area level 1 district
SA2	Statistical area level 2 district
SACL	Sydney Airport Corporation Limited
Salinity	The concentration of dissolved salts in water
SB	Southbound
SCATS	Sydney coordinated adaptive traffic system
SCR	Selective catalytic reduction
Scour	Removal of sediment such as sand and gravel from around bridge abutments or piers caused by moving water
SEARs	Secretary's Environmental Assessment Requirements Requirements and specifications for an environmental assessment prepared by the Secretary of the NSW Department of the Planning and Environment under section 115Y of the <i>Environmental Planning and Assessment Act 1979</i> (NSW)
Sediment	Material, both mineral and organic, that is being or has been moved from its site of origin by the action of wind, water or gravity and comes to rest either above or below water level
Sedimentation basin	A stormwater detention system that promotes the settling of sediments through the reduction of flow velocities and temporary detention. Key elements include purpose designed inlet and outlet structures, settling pond and high flow, overflow structures
SEIA	Socio-economic impact assessment
SEIFA	Socio-Economic Index for Areas
Sensitive receiver/receptor	Includes residences, educational institutions (including preschools, schools, universities, TAFE colleges), health care facilities (including nursing homes, hospitals), religious facilities (including churches), child care centres, passive recreation areas (including outdoor grounds used for teaching), active recreation areas (including parks and sports grounds), commercial premises (including film and television studios, research facilities, entertainment spaces, temporary accommodation such as caravan parks and camping grounds, restaurants, office premises, retail spaces and industrial premises)
SEPP	State Environmental Planning Policy
SEPP 19	State Environmental Planning Policy No. 19 – Bushland in Urban Areas
SEPP 33	State Environmental Planning Policy No. 33 – Hazardous and Offensive Development
SEPP 55	State Environmental Planning Policy No. 55 – Remediation of Land
SER	Strategic Environmental Review
SF <sub>6</sub>	Sulfur hexafluoride

<b>Term</b>	<b>Meaning</b>
Settlement	Refers to how ground can move due to the construction of new infrastructure
SHI	NSW State Heritage Inventory database
SHFWDCP	Sydney Harbour – Foreshores and Waterways Area Development Control Plan: Ecological Communities and Landscape Characters and Wetlands Protection Map
SHPRC	Sydney Harbour and Parramatta River Catchment
SHR	State Heritage Register
SHWQIP	Sydney Harbour Water Quality Improvement Plan
Shotcrete	The spraying of concrete and mortar onto a surface at high velocity
Shoulder	The portion of the carriageway beyond the traffic lanes adjacent to and flush with the surface of the pavement
SLNSW	State Library of NSW
Smart motorway operations	A Smart Motorway uses technology to monitor, provide intelligence and control the motorway to ease congestion and keep traffic flowing more effectively. Technology, including lane use management signs, vehicle detection equipment, CCTV cameras and on-ramp signals, allows road operators to manage, in real-time, traffic entering, exiting and traversing the motorway
SMC	Sydney Motorway Corporation
SMCMA	Sydney Metropolitan Catchment Management Authority
SMPO	Sydney Motorways Project Office
SO <sub>2</sub>	Sulfur dioxide
SO <sub>x</sub>	Sulfur oxides
SOA	Secondary organic aerosol
Socio-economic	Involving combination of social and economic matters
Soil salinity	Salt content of soil
Span	The distance between the centres of adjacent supports of a bridge
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Species Profile Database
Spoil	Surplus excavated material
SREP	Sydney Regional Environmental Plan
SREP 26	<i>Sydney Regional Environmental Plan No. 26 – City West</i>
SSFL	Southern Sydney Freight Line
SSI	State significant infrastructure
SSIAR	State significant infrastructure application report
SSWAHS	City of Sydney and Sydney South West Area Health Service
St Peters interchange	A component of the New M5 project, located at the former Alexandria Landfill site at St Peters. Approved and under construction as part of the New M5 project. Additional construction works proposed as part of the M4-M5 Link project
Staging	Refers to the division of the project into multiple contract packages for construction purposes, and/or the construction or operation of the overall project in discrete phases
State and Regional Development SEPP	State Environmental Planning Policy (State and Regional Development) 2011
State Infrastructure Strategy	State Infrastructure Strategy 2012–2032 (Infrastructure NSW 2012)
STM	Strategic Traffic Model
Stockpile	Temporary stored materials such as soil, sand, gravel, spoil/waste
Storativity	The volume of water an aquifer releases from, or takes into storage, per unit surface area of the aquifer per unit change in head. It is equal to the product of specific storage and aquifer thickness. In an unconfined aquifer the storativity is known as the specific yield
Strata	Geological layers below the ground surface

<b>Term</b>	<b>Meaning</b>
Stream order	A classification system which assigns an 'order' to waterways according to the number of additional tributaries associated with each waterway, to provide a measure of system complexity
Structure (soil)	The way soil particles group together to form aggregates
Stub tunnel	Driven tunnels constructed to connect to potential future motorway links
Surface road concentration (air quality)	Describes the contribution of pollutants from the surface road network. It includes not only the contribution of the nearest road at the receptor, but also the net contribution of the modelled road network at the receptor
Surface water	Water flowing or held in streams, rivers and other wetlands in the landscape
Sustainable development	Development which meets the needs of the present, without compromising the ability of future generations to meet their own needs (Brundtland 1987)
SW	Water quality monitoring sample ID
SVOC	Semi Volatile Organic Hydrocarbons
Sydney Gateway	A high-capacity connection between the St Peters interchange (under construction as part of the New M5 project) and the Sydney Airport and Port Botany precinct
Sydney Harbour Catchment SREP	<i>Sydney Regional Environmental Plan (Sydney Harbour Catchment) 2005</i>
<b>T</b>	
T90	Distillation temperature where 90% of the fuel is evaporated
Target species	A species that is the focus of a study or intended beneficiary of a conservation action or connectivity measure
TBM	Tunnel boring machine
TEC	Threatened ecological community A naturally occurring group of native plants, animals and other organisms living in a unique habitat at risk of extinction and listed under the EPBC Act and/or <i>Threatened Species Conservation Act 1995 (NSW)</i>
TEOM	Tapered Element Oscillating Microbalance
TEOM-FDMS	TEOM with Filter Dynamic Measurement System
TEQ	Toxicity equivalent
TEUs	20-foot equivalent units
The Bays Precinct Transformation Plan	<i>Transformation Plan: The Bays Precinct, Sydney (UrbanGrowth NSW 2015)</i>
The Blue Book	<i>Managing Urban Stormwater – Soils and Construction Volumes 1 and 2 (NSW Government 2004 and 2006)</i>
The Crescent civil site	A construction ancillary facility for the M4-M5 Link project located at Annandale
THC	Total hydrocarbons
TMC	Transport Management Centre
Topography	Surface features in an area of land
Total concentration (air quality)	The sum of the background, surface road and ventilation outlet concentrations. It may relate to conditions with or without the project under assessment
Toxicity	The degree of danger posed by a substance to human, animal or plant life
TPA	Transport Performance Analytics
TPH	Total petroleum hydrocarbons
Transport for NSW	NSW Government Department Transport for NSW
TRAQ	Tool for Roadside Air Quality
TRH	Total recoverable hydrocarbons
Truck and dog construction vehicle	A vehicle with 20 cubic metre capacity and maximum length of 19 metres
TSC Act	<i>Threatened Species Conservation Act 1995 (NSW)</i>

<b>Term</b>	<b>Meaning</b>
TSP	Total suspended particulate (matter)
TSS	Total suspended solids
Tunnel boring machine	An excavation machine that 'bores' through soil or rock to create a tunnel with a circular cross section (as opposed to drilling and blasting methods)
Turbidity	A measure of light penetration through a water column containing particles of matter in suspension
Typical cross section	A cross section of a carriageway showing typical dimensional details, furniture locations and features of the pavement construction
<b>U</b>	
UDLP	Urban Design and Landscape Plan
UDLP land	Project land that has been identified as subject to the UDLP
UFP	Ultrafine particles
UK	United Kingdom
Ultrafines	Particulate matter below 0.1 microns in diameter
UN	United Nations
Urban design	The process and product of designing human settlements, and their supporting infrastructure, in urban and rural environments
US	United States
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
<b>V</b>	
V/C	Volume to capacity ratio
VDV	Vibration dose value
Ventilation facility	Facility for the mechanical removal of air from the mainline tunnels, or mechanical introduction of air into the tunnels. May comprise one or more ventilation outlets
VENM	Virgin excavated natural material
Ventilation outlet	The location and structure from which air within a tunnel is expelled
Ventilation outlet concentration	Describes the contribution of pollutants from tunnel ventilation outlets
VIA	Visual impact assessment
Victoria Road civil site	A construction ancillary facility for the M4-M5 Link project located at Rozelle
Visual amenity	Pleasantness or attractiveness of a place or area
VHT	Vehicle hours travelled
VKT	Vehicle kilometres travelled
VMS	Variable message signs
VOCs	Volatile organic compounds
VTTS	Value of travel time savings
Vulnerable	As defined under the <i>Threatened Species Conservation Act 1995</i> (NSW), a species that is facing a high risk of extinction in NSW in the medium-term future
VWP	Vibrating wire piezometers
<b>W</b>	
WARR Act	<i>Waste Avoidance and Resource Recovery Act 2001</i> (NSW)
Waste hierarchy	Approach of prioritising waste avoidance and resource recovery (including reuse, reprocessing, recycling and energy recover) before consideration of waste disposal
Water table	The surface of saturation in an unconfined aquifer at which the pressure of the water is equal to that of the atmosphere
Waterway	Any flowing stream of water, whether natural or artificially regulated (not necessarily permanent)
Wattle Street civil and tunnel site	A construction ancillary facility for the M4-M5 Link project located at Haberfield

<b>Term</b>	<b>Meaning</b>
Wattle Street interchange	An interchange to connect Wattle Street (City West Link) with the M4 East and the M4-M5 Link tunnels. Approved and under construction as part of the M4 East project. Additional construction works proposed as part of the M4-M5 Link project
Wayfinding	This refers to navigation signage or roadway markers such as in the tunnels or along surface roads
WDA	WestConnex Delivery Authority (now Sydney Motorway Corporation)
Western Harbour Tunnel and Beaches Link	The Western Harbour Tunnel component would connect to the M4-M5 Link at the Rozelle interchange, cross underneath Sydney Harbour between the Birchgrove and Waverton areas, and connect with the Warringah Freeway at North Sydney. The Beaches Link component would comprise a tunnel that would connect to the Warringah Freeway, cross underneath Middle Harbour and connect with the Burnt Bridge Creek Deviation at Balgowlah and Wakehurst Parkway at Seaforth. It would also involve the duplication of the Wakehurst Parkway between Seaforth and Frenchs Forest
WestConnex program of works	A program of works that includes the M4 Widening, King Georges Road Interchange Upgrade, M4 East, New M5 and M4-M5 Link projects
Wetland	Wetlands are areas of land that are wet by surface water or groundwater, or both, for long enough periods that the plants and animals in them are adapted to, and depend on, moist conditions for at least part of their lifecycle
WHO	World Health Organization
WM Act	<i>Water Management Act 2000</i> (NSW)
WQIP	Water quality improvement plan
WQPMP	Water quality plan and monitoring program
WRTM	WestConnex Road Traffic Model
WSROC	Western Sydney Regional Organisation of Councils Ltd
WSUD	Water sensitive urban design
WQO	Water quality objective
<b>Other</b>	
$\beta$ coefficient	Beta coefficient A measure of sensitivity
$\mu\text{g}$	microgram
$\text{mg}/\text{m}^3$	micrograms per cubic metre

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