WestConnex

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New M5
Amended State Significant Infrastructure Application Report

October 2015

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WestConnex Delivery Authority for and on behalf of Roads and Maritime Services

The New M5

Amended State significant infrastructure application report

October 2015

Prepared for

WestConnex Delivery Authority on behalf of Roads and Maritime

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Document controls

Title	The New M5 State significant infrastructure application report

Approval and authorisation	
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Executive summary

The NSW Government is proposing the construction and operation of the New M5 (the project); which would comprise a new, tolled multi-lane road link between the M5 East Motorway east of King Georges Road and St Peters. The project would also include an interchange at St Peters and connection to the existing road network.

The project is one component of the WestConnex program of works. WestConnex is a 33 kilometre motorway that is intended to link Sydney's west with the airport and the Port Botany precinct. The WestConnex program of works is proposed to be delivered as a series of projects, each of which would be subject to a stand-alone planning assessment and approvals process in accordance with the requirements of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and other relevant legislation. The project forms part of WestConnex Stage 2, which also includes the King Georges Road interchange upgrade project.

RMS is the proponent for the project.

Key components of the project include:

- Twin motorway tunnels between the existing M5 East Motorway (between King Georges Road and Bexley Road) and St Peters. Each tunnel would be around nine kilometres in length and would be configured as follows:
    - Between the western portals and Arncliffe, the tunnels would be built to be three lanes wide but marked for two lanes as part of the project. Any change from two lanes to three lanes would be subject to future environmental assessment and approval.
    - Between Arncliffe and St Peters, the tunnels would be built to be five lanes wide but marked for two lanes as part of the project. Any change from two lanes to any of three, four or five lanes would be subject to future environmental assessment and approval.
- The location of the western portals along the M5 East Motorway would be between King Georges Road and Bexley Road with the actual location to be determined during the design phase. The location of the eastern portals at St Peters would be in the vicinity of land generally bounded by the Princes Highway, Campbell Road, Burrows Road and Canal Road with the actual location also to be determined during the design phase.
- Tunnel stubs to allow for a potential future connection to Stage 3 of the WestConnex program of works and a potential future connection to southern Sydney, being the Southern Connector.
- Surface road widening works along the M5 East Motorway between east of King Georges Road and the new tunnel portals.
- A new road interchange at St Peters, which would initially provide road connections from the new tunnels to Campbell Road and Euston Road, St Peters and via bridges over Alexandra Canal to Gardeners Road, Mascot.
- Closure and remediation of the Alexandria landfill site, to enable the construction and operation of the new St Peters interchange.
- Ancillary infrastructure and operational facilities for electronic tolling, signage (including electronic signage), ventilation structures and systems, fire and life safety systems, and emergency evacuation and smoke extraction infrastructure.
- A motorway control centre that would include operation and maintenance facilities.
- New service utilities and modifications to existing service utilities.
- Works to enhance and upgrade local roads near the St Peters interchange.
- Temporary construction facilities and temporary works to facilitate the construction of the project.

- Infrastructure to introduce tolling on the existing M5 East Motorway.
- Possible surface road upgrade works within the corridor of the M5 East Motorway and/or the M5 South West Motorway.

The project would be delivered through a design and construct contract aimed at delivering an innovative, cost effective and environmentally responsive design for the project. The design and construct tender process is being undertaken concurrently with the environmental impact assessment process for the project. The alignment of the project would be located within the project corridor, which forms the basis for the assessment within this document.

Roads and Maritime has formed the view that the impact of the project is likely to significantly affect the environment. On this basis, the project is State significant infrastructure under section 115U(2) of the *Environmental Planning and Assessment Act 1979* by reason of the operation of clause 14 and clause 1 of Schedule 3 of the *State Environmental Planning Policy (State and Regional Development) 2011*. Accordingly, the project is subject to Part 5.1 of the *Environmental Planning and Assessment Act 1979* and requires the approval of the Minister for Planning and Infrastructure.

A preliminary environmental risk analysis and investigations indicate that the following environmental issues would require further detailed assessment and may require project-specific safeguards and management measures:

- Traffic and transport.
- Air quality and human health.
- Noise and vibration.
- Biodiversity.
- Visual impacts and urban design.
- Social and economic.
- Land use and property.
- Hydrology and flooding.
- Geology, soils and water quality.
- Non-Aboriginal heritage.
- Resource management and waste minimisation.

A number of other environmental issues have also been identified. These issues are outlined in this report and are considered to be of lesser consequence taking into consideration the project scope, the existing environment and the implementation of standard safeguard and management measures.

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Glossary of terms and abbreviations

Term	Meaning
AHD	Australian height datum.
AHIMS	Aboriginal Heritage Information Management System.
Alluvial material	Relatively recent deposits of sedimentary material within river / creek beds, floodplains, lakes or at the base of mountain slopes.
Aquifer	Underground layer of water-bearing permeable rock or unconsolidated materials (such as gravel, sand and silt) from which groundwater can be usefully extracted.
Carriageway	Section of a roadway used for vehicular traffic. Generally delineated by kerbs, a verge or a median.
CBD	Central business district.
Community severance	Reduced access to local amenities and disruption of local social networks caused by the introduction of a physical barrier, such as a major road, or through significant increases in traffic volumes on a road that was not originally regarded as a barrier.
EP&A Act	*Environmental Planning and Assessment Act 1979.*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999.*
Environmental assessment process	A part of the decision-making process where the environmental impact of a development, proposal or activity is considered in detail, in conjunction with other aspects of the development, proposal or activity.
GDEs	Groundwater dependent ecosystems.
Interchange	A grade separated junction or overpass to separate road, rail or other traffic that cross each other, so that crossing movements do not conflict.
LGA	Local government area.
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation.
Roads and Maritime	Roads and Maritime Services
SEPP	State Environment Planning Policy.
SMPO	Sydney Motorways Project Office.
Threatened	As defined under the *Threatened Species Conservation Act 1995*. A species, population or ecological community that is likely to become extinct or is in immediate danger of extinction.
Tunnel portal	The entry / exit structures at each end of a tunnel.
WDA	WestConnex Delivery Authority.

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1 Introduction

1.1 Overview of WestConnex

The WestConnex program of works is the largest integrated transport and revitalisation project in Australia. It is intended to link the M4 Motorway to the central business district (CBD), Sydney Airport and the M5 East Motorway in south-west Sydney via a 33 kilometre tolled motorway completely free of traffic signals. The WestConnex program of works as shown on **Figure 1-1** is intended to be delivered in three stages. Within each stage, a number of projects are proposed and will be assessed as separate projects as follows:

- **Stage 1**, which consists of two projects:
  - The M4 Motorway Widening.
  - The M4 East Motorway (Homebush Bay Drive to Haberfield).
- **Stage 2**, which consists of three components:
  - The M5-King Georges Road interchange.
  - This project (the subject of this State significant infrastructure application report).
  - The Sydney Gateway (linking the St Peters Interchange with Sydney Airport).
- Stage 3:
  - The M4 South Motorway (Haberfield to St Peters via Camperdown).

Each project is subject to approval.

1.2 The Proponent

Roads and Maritime is the proponent for this project. RMS is proposing to carry out development comprising the infrastructure described in this application report.

The WestConnex Delivery Authority (WDA) was established by the NSW Government to manage the delivery of the WestConnex series of projects for Roads and Maritime Services (Roads and Maritime) on behalf of the State. The WDA is a public subsidiary corporation of the Roads and Maritime. Its role and functions are set out in Part 4A of the (NSW) *Transport Administration (General) Regulation 2013*. WDA is project managing the planning approval process for the project on behalf of Roads and Maritime.

1.3 Overview of the project

The NSW Government is proposing the construction and operation of the New M5 (the project); which would comprise a new, tolled multi-lane road link between the M5 East Motorway east of King Georges Road and St Peters. The project would also include an interchange at St Peters and connection to the existing road network.

The project would span six local government areas including: Canterbury, Hurstville, Rockdale, Marrickville, Botany Bay and Sydney. It would include widening of the existing M5 Motorway between King Georges Road and the new tunnel portals, twin motorway tunnels, both around nine kilometres in length and local road connections in St Peters.

The project would be delivered through a design and construct contract aimed at delivering an innovative, cost effective and environmentally responsive design for the project. The design and construct tender process is being undertaken concurrently with the environmental impact assessment process for the project. The alignment of the project would be located within the project corridor, which forms the basis for the assessment within this document. A description of the project is provided in **Section 3**. The local context of the project is shown in **Figure 1-2**.

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Figure 1-1: Overview of the WestConnex scheme

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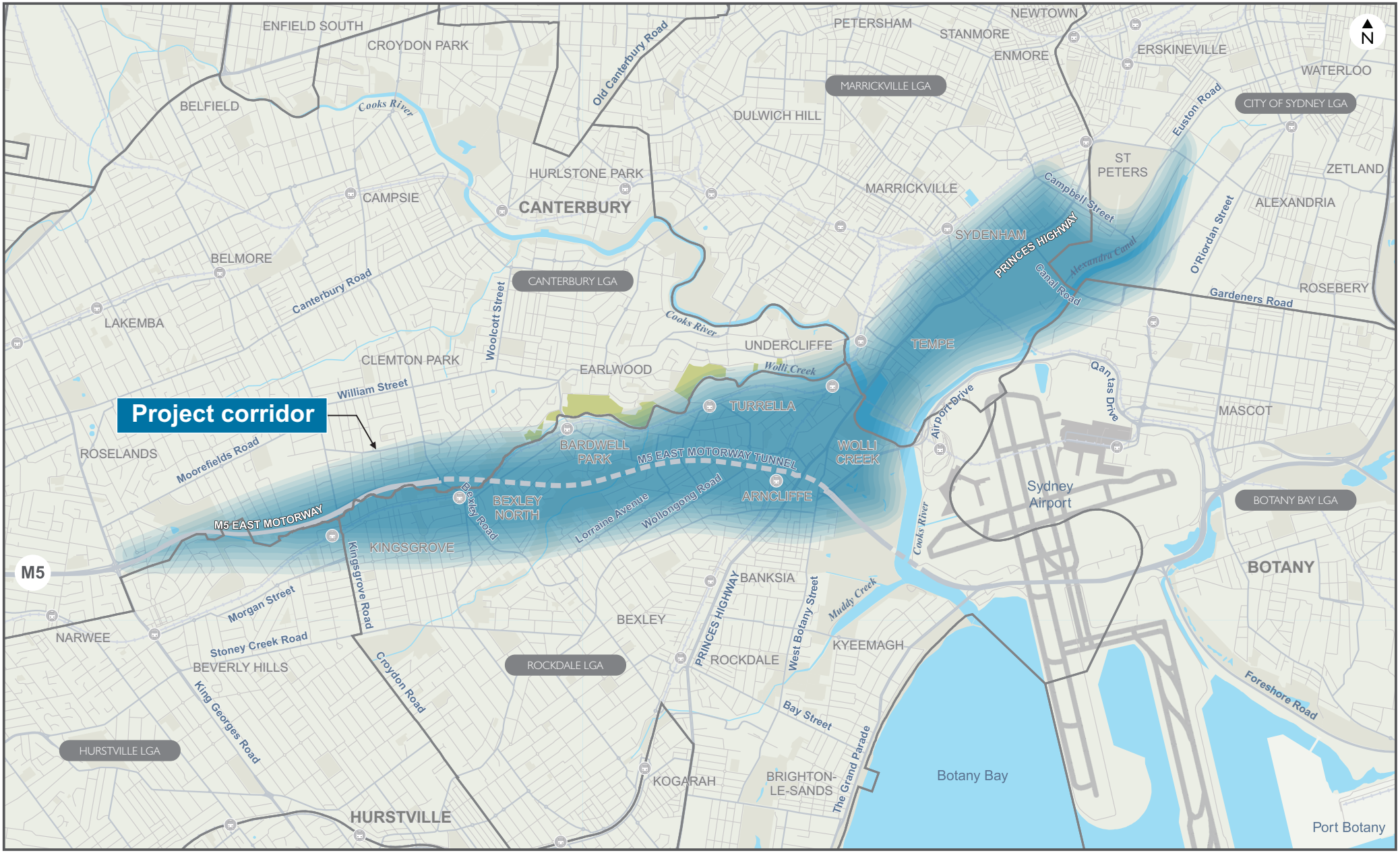

KEY

- Wolli Creek Regional Park
- Parks, reserves and private recreation
- Road
- Rail
- Watercourse
- Local government area boundary

Figure 1-2: Local context of the project

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1.4 Purpose of this document

This report has been prepared to support a State significant infrastructure application under section 115X of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The application has been amended with the approval of the Secretary.

Roads and Maritime has formed the opinion that the project is likely to significantly affect the environment and requires the preparation of an environmental impact statement under the EP&A Act. The project does not require development consent under Part 4 of the EP&A Act. Accordingly, as per clause 14 and Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011*, the project is declared to be State significant infrastructure under Part 5.1 of the EP&A Act and requires the approval of the Minister for Planning.

The requirements of clause 192(1) of the *Environmental Planning and Assessment Regulation 2000* for applications seeking approval of the Minister administering the *Environmental Planning and Assessment Act 1979* to carry out State significant infrastructure are addressed in Attachment A to this report.

The purpose of this application report is to assist the formulation of environmental assessment requirements by the Secretary of the Department of Planning and Environment under section 115Y of the EP&A Act.

This application report:

- Describes the project.
- Considers the potential environmental issues for the project.
- Identifies key environmental issues for the project.

The application report and Secretary's environmental assessment requirements would inform the preparation of an environmental impact statement for the project. The form and content of the environmental impact statement would be in accordance with clauses 6 and 7 of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*.

This application report was amended in July 2015 to incorporate changes relating to some aspects of the project including the proponent, works at the Alexandria landfill site and changes to local road connections at St Peters interchange and an additional bridge across Alexandra Canal.

The application report was amended again in October 2015 to clarify the project description, amend the maps within the application to better describe the project corridor and remove modifications and adjustments to utilities from the preliminary works scope.

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2 Background

2.1 Strategic context and project need

Sydney's strategic road network, which includes Sydney's motorway network, supports economic growth across the Sydney metropolitan area by connecting people to jobs, and allowing businesses to trade with one another (Infrastructure NSW, 2012). It carries the bulk of the State's container freight and acts as a feeder and distributor for other modes of transport, including rail, sea and air transport (Infrastructure NSW, 2012).

The Sydney transport network currently services a population of 4.2 million people with about 15.5 million trips on a normal weekday. The complex transport network needs to meet increasingly complex travel demands. This is the result of the diversification of places of employment, urban infill, higher density residential development within existing areas, as well as the ongoing spatial expansion of Sydney's fringe (Sydney Motorways Project Office, 2013).

Sydney's road network serves 93 per cent of passenger journeys and 86 per cent of road freight movements. Traffic on key corridors has grown by 50 per cent in the last 20 years, and investment in new roads has struggled to keep up with demand. Travel by road is the dominant transport mode in Sydney, and is predicted to continue to be the most dominant over the next 20 years (Infrastructure NSW, 2013). New road capacity is urgently required to meet the challenge of population growth and substantial increases in freight volumes.

Congestion on the road network has an impact on the NSW economy, which has been estimated at around $5.1 billion each year (Sydney Motorways Project Office, 2013). Around half of these costs are associated with light commercial and heavy vehicles due to losses in productivity due to travel delays and increased vehicle operating costs. Congestion also has societal implications due to longer commuter times and associated environmental impacts.

The need for additional capacity on the strategic road network becomes increasingly apparent with the projected growth at Sydney Airport and Port Botany. The Sydney Airport and Port Botany precinct is also the largest employment centre in Sydney after the Sydney Business District (Ernst and Young, 2011). Together, Sydney Airport and Port Botany currently generate around $10.5 billion of economic activity and handle close to $100 billion worth of freight each year.

By 2033, passenger growth at Sydney Airport is projected to increase from around 37 million to around 74 million passengers per year, and will handle over one million tonnes of freight by 2033 (SACL, 2014). Only a small proportion of travel to/from the airport is completed by public transport, with the majority of travel completed via the road network.

Freight demands over the next 20 years will more than triple for port container freight in Sydney, and double for bulk freight. The greater demand for imported goods would drive significant growth in port container traffic and result in increased land transport needs, particularly around Port Botany and along major arterial routes. Sydney Ports forecasts container trade through Port Botany to nearly quadruple by 2031, reaching seven million containers per year by 2031 (Infrastructure NSW, 2013).

Most of the freight leaving Port Botany travels by heavy vehicles along the M5 East Motorway and the M5 South West Motorway (M5 corridor), towards Sydney's employment centres in Sydney's west and south-west (Ernst and Young, 2011). Shifting freight from road onto rail remains a priority for the NSW Government. However, assuming the modal share of rail freight doubles by 2020, more than 70 per cent of Port Botany's trade would still be transported by the road network (Sydney Motorways Project Office, 2013).

The Sydney Airport and Port Botany area also forms part of the Economic Global Corridor, an arc that extends northwards through the CBD to Macquarie Park. Around 50 per cent of the NSW Gross State Product is concentrated within the corridor, and the strengthening of this corridor will influence the expansion of Sydney's economy (NSW Government, 2013). The NSW Government's priority is to create at least 173,000 additional jobs within the corridor (NSW Government, 2013). To facilitate this, the draft Metropolitan Strategy recognises the need to implement works to relieve major congestion around Sydney Airport and Port Botany, as well as improve public transport access to the airport.

Increased residential and employment growth in the suburbs neighbouring the M5 Motorway corridor or further afield (such as the Western Sydney Employment Hub and the South West Growth Centre) will place further pressure on the road network.

The M5 Motorway corridor (the M5 East Motorway and the M5 South West Motorway) is the main passenger, commercial and freight corridor between Port Botany, Sydney Airport and south-west Sydney. Traffic demand on the M5 East Motorway is currently exceeding the design capacity of the roadway, and as a result, presents a significant bottleneck to the M5 Motorway corridor.

Each day, the M5 East Motorway carries over 100,000 vehicles, of which 16 per cent are heavy vehicles. An analysis of the destinations of eastbound AM peak traffic using the main-line tunnels of the M5 East Motorway indicates that almost half of all traffic that exits at Marsh Street and the Princes Highway is bound for south Sydney and the airport, with 56 per cent of traffic continuing towards the Eastern Distributor. The significant demand for the M5 East Motorway has resulted in the following outcomes:

- Peak spreading on the M5 Motorway corridor as motorists change travel behaviours to avoid traditional peak hours to improve travel times.
- Increased demand on the surrounding road network. Travel demand within the M5 East Motorway and immediately surrounding surface road network is around 209,000 vehicles. Given that the M5 East Motorway is exceeding its design capacity, significant traffic flows occur on the surrounding road has resulted in congestion along alternative routes. As some sections of the surrounding road network have poor alignments, narrow lanes and uncontrolled access, the alternative routes are prone to disruption due to traffic incidents.
- Unreliable journey times, given the increased congestion during peak periods.

Freight productivity is further constrained on the M5 Motorway corridor and the surrounding road network due to height or mass restrictions which require heavy vehicles to take longer, less direct routes. A steep gradient within the M5 East Motorway also contributes to reductions in travel speeds (and therefore road capacity) within the tunnel.

WestConnex is one of the NSW Government's major infrastructure priorities. The project is one component of the WestConnex program of works and according to the current schedule for works it would be the fourth project to be delivered. WestConnex seeks to respond to the challenges of M5 Motorway corridor and the surrounding road network by:

- Providing quicker, more reliable trips between Western Sydney and the Sydney Airport / Port Botany precinct to support Sydney's urban freight movements by providing additional motorway capacity within the M5 Motorway corridor.
- Reducing demand and congestion on alternative routes on the surface road network, which in turn will improve connectivity and amenity for communities along these routes.
- Providing better connections between employment and population centres along the M5 Motorway corridor and beyond to cater for existing and future demand. This includes a direct connection to employment zones near Sydney Airport and Port Botany via the St Peters interchange.

If the total WestConnex program of works is completed, it would provide the missing link in the Sydney motorway network, linking the M4 and M5 corridors. This would improve access to the wider Sydney road network for vehicles with either origins or destinations in the Sydney CBD, Sydney Airport, Port Botany, south Sydney, inner west and eastern suburbs as well as the north-western and south-western suburbs. It would also provide enhanced connectivity to Sydney Airport and Port Botany through the delivery of the Sydney Gateway.

Opportunities to incorporate a southern connection to WestConnex would also have the potential to relieve congestion along existing arterial roads in the southern Sydney suburbs, and to cater for growth in key centres include Kogarah and Sutherland.

2.2 Strategic planning and policy context

There are a number of key strategic planning documents and policies which align with the need for the project, as discussed below.

2.2.1 NSW 2021 – A plan to make NSW number one

NSW 2021: A plan to make NSW number one (NSW 2021) (NSW Department of Premier and Cabinet, 2011) is the NSW Government's 10-year strategic business plan, which sets priorities for action and guides resource allocation to deliver economic growth and critical infrastructure throughout NSW.

The plan emphasises the investment and delivery of an efficient and effective transport system, including road infrastructure that will relieve congestion, improve travel times, improve road safety and enhance and expand capacity on key road corridors.

The project would involve the delivery of key road infrastructure identified by the NSW Government that would enhance and expand capacity on the M5 corridor, which would help to achieve priority actions outlined in NSW 2021, including goal 7 (reduce travel times), goal 10 (improve road safety) and goal 19 (invest in critical infrastructure).

2.2.2 NSW Long Term Transport Master Plan

The NSW Long Tern Transport Master Plan (LTTMP) (Transport for NSW, 2012) provides a framework for the delivery of an integrated, modern transport system by identifying NSW's transport actions and investment priorities over the next 20 years. WestConnex is identified in the LTTMP as an immediate priority for the NSW Government.

The LTTMP recognises that WestConnex will support Sydney's long term economic growth through improved motorway access and connections linking Sydney's international gateways including Sydney Airport, Port Botany, Western Sydney and employment areas across Sydney. It also notes that WestConnex would relieve road congestion, and thereby improve the speed, reliability and safety of travel, including in the M5 corridor.

The LTTMP identifies the need to progressively deliver WestConnex and recognises that upgrading the M5 corridor is a key component of the WestConnex program of works, as it would increase the capacity of the Motorway to accommodate commercial vehicles and freight demand.

The project would comprise a multi-lane road link between the M5 East Motorway east of King Georges Road, and St Peters. The project would help deliver the benefits of WestConnex by improving traffic efficiency and level of service for freight and public transport on the road network through the relief of road congestion to improve the speed, reliability and safety of travel along the M5 corridor and parallel arterial roads.

2.2.3 NSW State Infrastructure Strategy

The NSW State Infrastructure Strategy 2012-2032 (SIS) is a 20 year strategy developed by Infrastructure NSW. It identifies and prioritises the delivery of critical public infrastructure to enhance productivity and economic growth, Infrastructure NSW's assessment of the State's existing infrastructure has highlighted critical deficiencies in urban road capacity and provides strategic options for delivery, required to meet the challenges of population growth and substantial increases in freight volumes.

The SIS identifies that the most pressing investment needs to occur on the M4 and M5 corridors, due to their importance to freight and business transport, as well as their connections to 'global Sydney' and the international gateways of Sydney Airport and Port Botany. WestConnex is identified in the SIS as a critical program of work that would provide a range of benefits, including reducing congestion, improving access to the major international gateways of Sydney Airport and Port Botany and improved industrial access and business efficiency along the M5 corridor.

The project would duplicate the existing capacity of the M5 East Motorway through the provision of a multi-lane road link between the M5 East Motorway east of King Georges Road, and St Peters and would also include an interchange at St Peters which would eventually provide access to Sydney Airport and Port Botany, thereby contributing to the delivery of critical public infrastructure to enhance productivity and economic growth, as outlined in the SIS.

2.2.4 Draft Metropolitan Strategy for Sydney to 2031

The *Draft Metropolitan Strategy for Sydney to 2031* (Draft Metropolitan Strategy) (NSW Government 2013) was released for public comment in March 2013 and sets the framework and strategic planning foundation for Sydney's housing and job growth to 2031 to inform the final Metropolitan Strategy.

The Draft Metropolitan Strategy is being delivered in conjunction with the LTTMP and SIS to fully integrate planning for housing and employment with the delivery of extensive transport and infrastructure. The draft Metropolitan Strategy envisions Sydney as being highly networked, with more frequent connections into and through the 'global economic corridor'. It also recognises that the transport network between Port Botany, industrial land in Western Sydney and destinations beyond the Sydney metropolitan area will see a likely increase in freight movements, requiring upgrades to transport infrastructure including road networks.

The project is consistent with the draft Metropolitan Strategy as it would improve freight performance along the M5 corridor and provide connections between Port Botany and industrial land in Western Sydney.

2.2.5 NSW Freight and Ports Strategy 2013

The NSW Freight and Ports Strategy 2013 (Freight and Ports Strategy) (Transport for NSW, 2013) is a core component of NSW's overall strategic planning framework and supports the goals identified in NSW 2021.One objective of the draft Freight and Ports Strategy is the delivery of an efficient freight network that supports the projected growth of the NSW economy.

One of the actions identified in the Freight and Ports Strategy is to connect and complete Sydney's motorway network, including priority freight movements. It recognises that WestConnex is a key component in expanding capacity on NSW roads, which would provide benefits for freight movement, including around major freight activity centres including Port Botany and Sydney Airport, which are concentrated along the M4 and M5 corridors.

The project is consistent with the Freight and Ports Strategy as it would enhance freight movements along the M5 corridor and would contribute to improving access from the M5 corridor to Sydney Airport and Port Botany in the longer term.

2.3 Project objectives

The WestConnex program of works is a key recommendation of the State Infrastructure Strategy 2012-2032 (Infrastructure NSW 2012) (State Infrastructure Strategy) and was the subject of a Business Case approved by the NSW Government in September 2013. The Business Case outlines the need for action and identifies the process for delivering this major infrastructure initiative, with a Benefit Cost Ratio of 2.55 for the WestConnex program of works, which is strong for an infrastructure program of this scale. WestConnex is also identified as a key element of Sydney's road future in the LTTMP.

The core objectives of WestConnex are to:

- Support Sydney's long-term economic growth through improved motorway access and connections linking Sydney's international gateways and Western Sydney and places of business across the city.
- Relieve road congestion so as to improve the speed, reliability and safety of travel in the M4 and M5 corridor, including parallel arterial roads.
- Cater for the diverse travel demands along these corridors that are best met by road infrastructure.
- Create opportunities for urban revitalisation, improved liveability, and public and active transport improvements along and around Parramatta Road.
- Enhance the productivity of commercial and freight generating land uses strategically located near transport infrastructure.
- Fit within the financial capacity of the State and Federal Governments, in partnership with the private sector.
- Optimise user pays contributions to support funding in an affordable and equitable way.

An additional specific objective of the project is to provide for integration with other WestConnex projects while not significantly impacting on the surrounding environment in the interim period.

Additionally, the project, consistent with the WestConnex program of works, includes an objective to protect natural and cultural resources and enhance the environment through the following key approaches:

- Manage in-tunnel air quality so as to meet community visibility expectations.
- Manage tunnel ventilation emissions to ensure local air quality meets Environmental Protection Authority (EPA) standards.
- Maintain regional air quality.
- Minimise adverse impacts at a local level on air/noise quality.
- Minimise construction and operational energy use.
- Manage noise in accordance with the *NSW Road Noise Policy* and realise opportunities to reduce or mitigate noise impacts.
- Provide for improvement of social and visual amenity.
- Minimise impacts on natural systems including biodiversity.
- Minimise impact on Aboriginal and non-Aboriginal cultural heritage.

2.4 Consultation

Stakeholder consultation to date has been focused at raising community awareness of the WestConnex program of works, including the project through the website, a project information phone line, emails to registered stakeholders. A range of consultation methods have been utilised to seek input and identify issues from the community including:

- A website www.westconnex.com.au with background information, maps, videos, customer surveys and details for how to provide feedback.
- A centralised feedback telephone line 1300 660 248.
- A project email address info@westconnex.com.au to notify registered stakeholders, solicit comments and respond to community feedback.
- A postal address WestConnex Delivery Authority Locked Bag 928 North Sydney 2059 to contact key stakeholders and receive input.
- Broad advertising in major metropolitan publications such as the Sydney Morning Herald, the Daily Telegraph, local suburban publications and non-English speaking community papers as well as advertising targeting public transport users in mX magazine and online advertising targeting road users.
- Media announcements which have been widely covered in metropolitan television, radio, print and digital news outlets along with trade and advocacy publications such as National Roads and Motorists Associations' Open Road magazine.
- A brochure to explain the project which has been distributed widely along the corridor.
- Customer research groups involving residents, professional road users and business operators.
- Targeted stakeholder discussions with advocacy groups, local councils, elected representatives and peak bodies.
- Roundtable discussions with stakeholders such as councils, the freight industry and business groups.
- Meetings with Government agencies.
- Individual meetings with representatives and community members.

Consultation with a number of local councils, State Government agencies and elected representatives has also been undertaken. This consultation was focused around identifying key issues of potential concern to stakeholders, as well as identifying issues that these stakeholders are anticipating would be of concern to the local community based on previous motorway proposals in the area.

Issues identified during community consultation associated with the WestConnex program of works include:

- Air quality issues associated with ventilation facilities and tunnel portals.
- Implications associated with changes in air quality as a result of the project.
- Access and traffic impacts on local areas, particularly in the vicinity of tunnel portal locations.
- Safe accessibility to homes, schools and services.
- Construction impacts, including noise and vibration, dust, surface water, heritage and groundwater.
- Impacts on properties and perceived impacts on property values in the vicinity of tunnel portals and ventilation facilities.
- The need to consider alternative modes of transport, particularly public transport and cyclists.

2.4.1 Animations and website

A website has been set up at www.westconnex.com.au. Animations explaining the key concepts of the WestConnex program of works are including on the website and have been translated into eight community languages. The Strategic Environmental Review which provides an overview of the environmental impacts of the whole WestConnex program of works is also included on the website.

2.4.2 Stakeholder letter

A letter introducing the WestConnex concepts and encouraging stakeholders to view the animation and participate in the forum was sent to approximately 100 stakeholders (local government, councils, transport associations, emergency services) on Monday 27 August 2012.

2.4.3 Media releases

A comprehensive media campaign has been implemented for the WestConnex program of works. Advertisements in various media outlets, including the Sydney Morning Herald, Daily Telegraph, mX magazine, and local newspapers will be further enhanced by media coverage in newspapers, TV and radio in the Sydney metro area and suburban areas that are within proximity to the project. Media releases to date are available on the WestConnex project website.

2.4.4 Community consultation and Stakeholder Engagement Strategy

A community consultation and stakeholder engagement strategy will be adopted to guide consultation on the project. This would be implemented throughout the development of the project, including but not limited to the environmental assessment process. The strategy would detail the methods by which affected communities would be engaged regarding the project, and the proposed future stakeholder consultation.

2.5 Options considered

Strategic alternatives to the project have been considered against the WestConnex objectives, including:

- Base case ('do nothing').
- Construction and operation of public transport options.
- Construction and operation of the new motorway.

The base case or 'do-nothing' option would involve the continued operation of the M5 East Motorway in its current configuration. Traffic demand (passenger and freight) on the existing M5 East Motorway is currently exceeding the design capacity of the roadway and presents a significant bottleneck to the M5 Motorway corridor. The do-nothing option would mean that the motorway would continue to have safety, efficiency and capacity problems, which would have flow on effects to the economy and to users of the motorway with associated adverse amenity and environmental outcomes, The do-nothing option was therefore not considered further as it would not meet the WestConnex objective (refer to **section 2.3**).

Public transport options such as the construction and operation of heavy rail, light rail or bus as an alternative to WestConnex would contribute to relieving congestion along the M5 Motorway corridor by potentially reducing the number of passenger vehicles using the M5 Motorway corridor. However; the transport demands along the M5 corridor cater for a diverse range of needs, including freight movements, which would not be improved nor catered for should this option be implemented.

Although opportunities exist to shift more freight from the road network onto the freight heavy rail network, the need to transport freight by road will continue. The NSW Freight and Ports Strategy notes that dedicated freight rail corridors are being planned to ensure passenger and freight rail demand can be accommodated. However, assuming that the NSW Government's target of doubling the share of container freight moved by rail is achieved by 2020 (Transport for NSW, 2013), more than 70 per cent of Port Botany's trade would still be moved by road, requiring investment in an efficient road network to support the Port Botany and Sydney Airport precincts (Transport for NSW, 2013). The NSW Freight and Ports Strategy notes that road corridors, including WestConnex would be designed to reflect heavy vehicle access requirements as a key component.

The option to construct and operate a new motorway would respond to the diverse travel demands along the M5 corridor, and would relieve congestion on the M5 East Motorway by providing additional road capacity. This option could be achieved through the construction and operation of a new motorway that reflects the existing M5 East Motorway (in effect, duplicating that motorway), or the construction and operation of a new motorway that responds to other strategic road network projects under development (the Marrickville Tunnel and extension of the M4 Motorway).

Adherence to the current M5 East Motorway alignment, which was investigated by Roads and Maritime in 2009, would not provide the opportunity to have a direct connection between the M4 and M5 motorways. As such, the duplication of the M5 East Motorway would not fully achieve the broader economic and road network project objectives for the project, specifically the objective of improving motorway access and connections to link Sydney's international gateways, Western Sydney and places of business across the city. It was also considered to have potential impacts on land such as Tempe Reserve.

It is considered that a motorway following a new corridor would better provide and enhance connections to the M5 motorway corridor, Sydney Airport and Port Botany while also providing for future broader network connections. This corridor, as identified in **Figure 1-2**, is considered to best meet the WestConnex objectives and is the preferred option as it would:

- Support Sydney's long-term economic growth through improved motorway access and connections, linking Sydney' s international gateways and Western Sydney and places of business across the city.
- Relieve road congestion so as to improve the speed, reliability and safety of travel along the M5 corridor.
- Cater for diverse travel demands along the M5 corridor that are best met by road infrastructure.
- Contribute to enhancing the productivity of commercial and freight generating land uses strategically located near transport infrastructure.

2.6 Preferred route option

The preferred route option has evolved through a concept development process and evaluation of options which have been ongoing since 2009, following the public exhibition of the RTA program of works for the duplication of the M5 East Motorway in 2009.

Since the exhibition of the M5 East Motorway duplication, the program of works underwent further development including consideration of options to reduce impacts on some land, such as Tempe Reserve (Sydney Motorways Project Office, 2013).

In 2013, the work undertaken for the M5 East Motorway duplication was incorporated with two other projects under development (the Marrickville Tunnel and extension of the M4 Motorway) to form the WestConnex program of works (refer to **Figure 1-1**). To optimise the design and to reduce cost, two industry partners were appointed to review the existing design and earlier investigations for the southern corridor of the WestConnex program of works and to develop innovative solutions for different forms of alignment options.

As a result of these investigations, a broad corridor has been identified that would provide a connection from the M5 East Motorway east of King Georges Road to St Peters.

WestConnex Delivery Authority will be running a competitive design and construct tender process to identify an innovative, cost effective and environmentally-responsive design within the broad project corridor. Further design and refinement would be undertaken throughout this process to ensure that the final configuration of the project best meets both the WestConnex objectives and meets the environmental outcomes identified for the project. The refinement of the project would consider the outcomes and recommendations from previous investigations within the project corridor, particularly the M5 East Motorway duplication study. The Environmental Impact Statement would be presented on the preferred design.

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3 Description of the project

3.1 Overview

The NSW Government is proposing the construction and operation of the New M5 (the project); which would comprise a new, tolled multi-lane road link between the M5 East Motorway, east of King Georges Road, and St Peters. The project would also include an interchange at St Peters and connections to the existing road network. The design of the project will be developed through a competitive design and construct tender process.

Key components of the project would include

- Twin motorway tunnels between the existing M5 East Motorway (between King Georges Road and Bexley Road) and St Peters. Each tunnel would be around nine kilometres in length and would be configured as follows:
    - Between the western portals and Arncliffe, the tunnels would be built to be three lanes wide but marked for two lanes as part of the project. Any change from two lanes to three lanes would be subject to future environmental assessment and approval
    - Between Arncliffe and St Peters, the tunnels would be built to be five lanes wide but marked for two lanes as part of the project. Any change from two lanes to any of three, four or five lanes would be subject to future environmental assessment and approval.
- The location of the western portals along the M5 East Motorway would be between King Georges Road and Bexley Road with the actual location to be determined during the design phase. The location of the eastern portals at St Peters would be in the vicinity of land generally bounded by the Princes Highway, Campbell Road, Burrows Road and Canal Road with the actual location also to be determined during the design phase.
- Tunnel stubs to allow for a potential future connection to Stage 3 of the WestConnex program of works and a potential future connection to southern Sydney, being the Southern Connector.
- Surface road widening works along the M5 East Motorway between east of King Georges Road and the new tunnel portals.
- A new road interchange at St Peters, which would initially provide road connections from the new tunnels to Campbell Road and Euston Road, St Peters and via bridges over Alexandra Canal to Gardeners Road, Mascot.
- Closure and remediation of the Alexandria landfill site, to enable the construction and operation of the new St Peters interchange.
- Ancillary infrastructure and operational facilities for electronic tolling, signage (including electronic signage), ventilation structures and systems, fire and life safety systems, and emergency evacuation and smoke extraction infrastructure.
- A motorway control centre that would include operation and maintenance facilities.
- New service utilities and modifications to existing service utilities.
- Works to enhance and upgrade local roads near the St Peters interchange.
- Temporary construction facilities and temporary works to facilitate the construction of the project.
- Infrastructure to introduce tolling on the existing M5 East Motorway.
- Possible surface road upgrade works within the corridor of the M5 East Motorway and/or the M5 South West Motorway.

The project corridor is shown on **Figure 3-1**.

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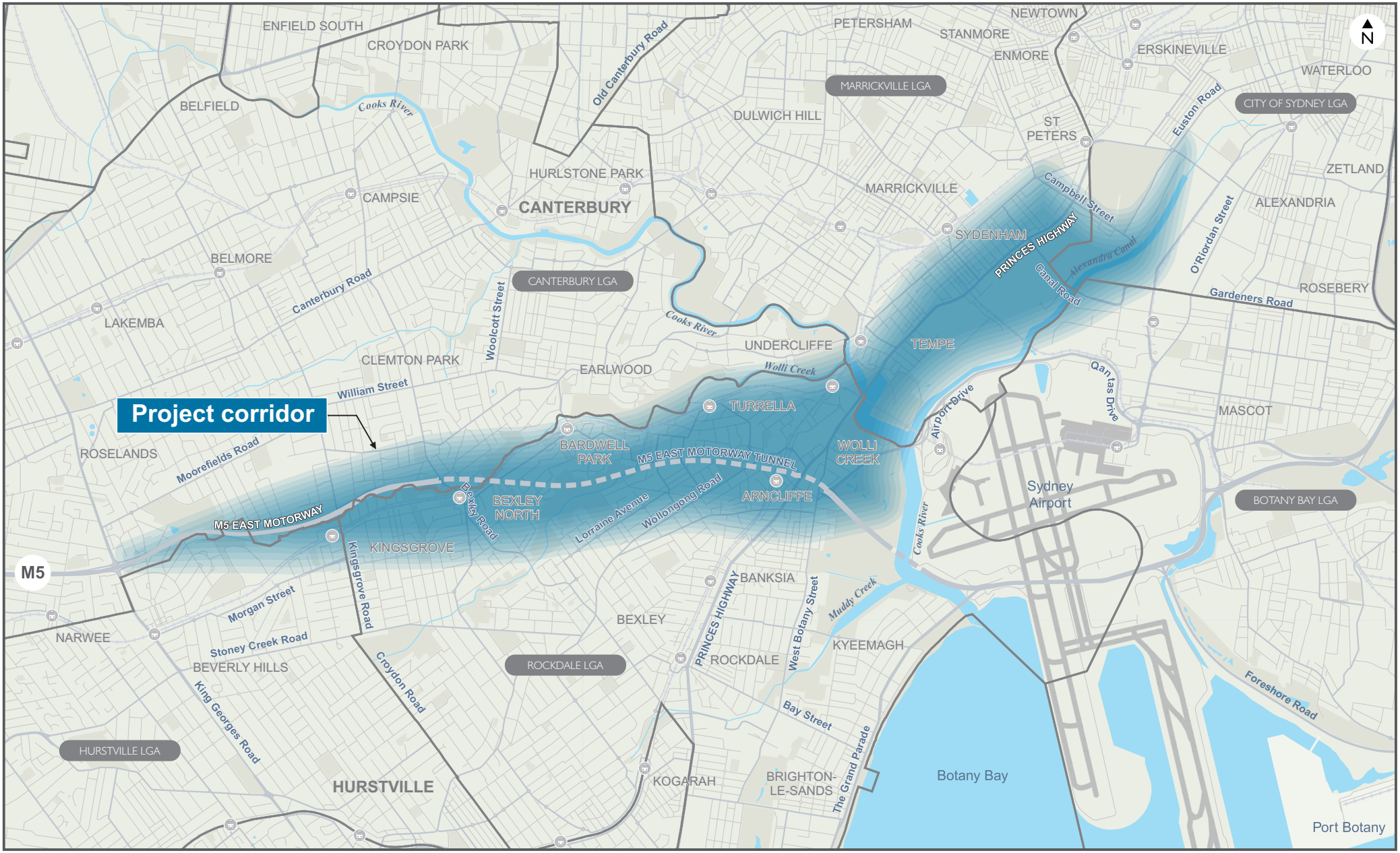

KEY

- Parks, reserves and private recreation
- Road
- Rail
- Watercourse
- Local government area boundary

Figure 3-1: The project corridor

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Km

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The final configuration of the twin main alignment tunnels, surface road connections and ancillary surface facilities would be determined as part of the design development process

3.2 Connection to M5 East Motorway

The western portals of the project would be located to the east of King Georges Road and west of Bexley Road to provide a direct connection to and from the M5 East Motorway. To connect the project with the M5 East Motorway, surface works would be required between the King Georges Road interchange and the western portals. This would require widening works along the motorway to provide four lanes in each direction from the King Georges Road interchange to the new western portals. The final layout of the surface road connections would be determined as part of the design development process. The works that will be undertaken for the project within the area currently approved for King Georges Road Interchange are works for line marking and erection of toll gantries.

As part of the project and to ensure appropriate traffic flows through the New M5 and existing M5 East Motorway corridor, a toll will be introduced on the M5 East Motorway as part of this project.

3.3 The motorway tunnel

The twin motorway tunnels between the existing M5 East Motorway (between King Georges Road and Bexley Road) and St Peters would be around nine kilometres in length and would be configured as follows:

- Between the western portals and Arncliffe, the tunnels would be built to be three lanes wide but marked for two lanes as part of the project. Any change from two lanes to three lanes would be subject to future environmental assessment and approval.
- Between Arncliffe and St Peters, the tunnels would be built to be five lanes wide but marked for two lanes as part of the project. Any change from two lanes to any of three, four or five lanes would be subject to future environmental assessment and approval.

The tunnels would have a minimum posted speed limit of 80 kilometres per hour.

On and off ramps at each end of the project would include sections of tunnel to provide direct connections from the main motorway tunnels to the M5 East Motorway and the proposed St Peters interchange.

The depth of the tunnel would vary depending on geological constraints and operational design requirements (such as road grade). The shallowest sections of the project are likely to be near the tunnel portals at the eastern and western ends of the project.

Tunnel stubs would be provided for possible future connections to the M4 South Motorway and a possible future connection to southern Sydney. The final tunnel alignment would be determined as part of the design development process.

3.4 St Peters interchange

The St Peters interchange would initially connect the New M5 to Campbell Road and Euston Road, St Peters and through to Gardeners Road, Mascot, to enable traffic to travel to and from the inner western suburbs of Sydney, the airport precinct and Port Botany via the existing surface road network.

Modifications to other local roads in the immediate vicinity of St Peters interchange may be required to cater for altered traffic conditions. Possible changes to pedestrian footpaths along the surface road network and bus stops along Canal Road as a result of the St Peters interchange would be reviewed as part of the preparation of the Environmental Impact Statement.

The WestConnex Stage 3 – M4 South Project and the Sydney Gateway, which do not form part of this

project, are under consideration to connect to the St Peters interchange at a later date. Works required at the interchange to provide these possible additional future connections would be subject to a separate environmental assessment and approvals process.

The St Peters interchange would be primarily located on the Alexandria landfill site and may also involve other land around the site. The site was originally established as a quarry but since at least 1988 has been used for the receipt, handling and disposal of various waste materials. Since around 2006, the site has also been used for recycling and resource recovery. Waste management activities on the site are subject to regulation through two separate environment protection licences (EPL 12594 and EPL 4627). The site has been acquired by WDA and will be vested in Roads and Maritime in due course.

Closure of the landfill and remediation is required for future beneficial use of the land as part of the WestConnex New M5 Project. WDA is conducting further investigations on the site to inform a landfill closure plan, which is being developed in consultation with the Environment Protection Authority. The landfill closure plan would detail how the Alexandria waste facility would be closed and remediated as part of the St Peters interchange, including:

- Closing landfill operations and ongoing compliance with environmental regulations including discharge from the site (ie groundwater, surface water, air).
- Long term management of leachate and gas, such that the site becomes stable over time.
- Rehabilitating and remediating the site to a standard consistent with the intended future use of the land.
- Capping and movement of materials to create a final landform.

3.5 Ancillary facilities

The project would require ancillary facilities during construction, including but not limited to: construction compounds, sedimentation basins, concrete batching plant, pre-cast yards and stockpiles. In determining the size and location of the ancillary construction facilities, existing land use activities, potential environmental impacts and amenity impacts on the surrounding community would be taken into account. At a minimum, ancillary construction facilities would be required close to the portals to provide tunnelling support. The location and size of the ancillary construction facilities would be developed as part of determining the preferred project design and would be assessed in the Environmental Impact Statement for the project.

3.6 Construction

Construction of the project would occur over a period of around four years and would include (but not be limited to) the following:

- Enabling and temporary works, including construction power, construction water supply, site establishment, demolition works, property and public transport modifications (if required).
- Construction of the road tunnels, interchanges, intersections and roadside infrastructure.
- Haulage of spoil generated during tunnelling and excavation activities.
- Fit-out of the road tunnels and support infrastructure, including ventilation and emergency response systems.
- Construction and fit-out of the tunnel control centre.
- Realignment, modification or replacement of surface roads, bridges, intersections and/or underpasses.
- Environmental management and pollution control facilities for the project.

Temporary works may be required during construction, such as temporary diversions for road traffic or pedestrians near work areas, or alternative arrangements where property accesses may be temporarily disrupted.

Road headers and/or tunnel boring machines may be used for the deeper parts of the alignment, while cut and cover construction methods may be required at shallower sections, such as near the tunnel portals. Other excavation activities likely to be undertaken include the creation of cross passages and caverns or shafts for other support infrastructure. If investigations into a southerly connection conclude that this infrastructure is feasible, stub tunnels would be constructed for connection to the project in the future.

The project would not include some preliminary works for the purpose of the design or assessment of the project which are intended to be conducted prior to approval of the project, including:

- Surveys.
- Test drilling and excavations.
- Test excavations.
- Geotechnical, contamination and environmental investigations.
- Site access ways and associated traffic management measures.
- Other tests, surveys, sampling or investigations.

The project would also not include some waste facility closure and remediation works and some other waste facility works at or around the Alexandria waste facility at St Peters such as:

- Ongoing operation, maintenance and some improvements to leachate, landfill gas, groundwater and stormwater systems
- Relocation, disposal or re-use of some material currently stockpiled within the site.

These excluded works are currently permitted under existing approvals, are required to comply with Environment Protection Authority requirements and/ or are subject to any necessary, separate environmental and planning approval processes.

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4 Key environmental issues

4.1 Overview

Key environmental issues are those which may have high or moderate impacts (actual or perceived) and assessment is necessary to determine the level of potential impact and to develop appropriate measures to avoid, manage and mitigate those impacts.

The outcomes of a preliminary risk assessment and investigations indicate that the following key environmental issues will require further detailed assessment and may require project specific safeguards and management measures:

- Traffic and transport.
- Air quality and human health.
- Noise and vibration.
- Biodiversity.
- Visual impacts and urban design.
- Social and economic.
- Land use and property.
- Hydrology and flooding.
- Geology, soils and water quality.
- Non-Aboriginal heritage.
- Resource management and waste minimisation.

A number of other environmental issues have also been identified. These issues are outlined in **Chapter 6** and are considered to be of lesser consequence taking into consideration the Project scope, the existing environment and the implementation of standard management and safeguard measures. It is expected these other environmental issues would not likely be key issues; however, the potential impact of these other environmental issues would be assessed further in any future Environmental Impact Statement for the project.

Preliminary consideration has been given to the provisions of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). A search of the EPBC Act online Protected Matters Search Tool has been conducted, which identified two Commonwealth listed threatened ecological communities which are likely to, or may occur within the project corridor. A further two Commonwealth listed threatened ecological communities have been previously mapped as occurring within the project corridor (refer **to Section 4.5.1** and **Figure 4-2**).

4.2 Traffic and transport

4.2.1 Overview

The western and central parts of the project corridor generally follow the alignment of the M5 East Motorway, with the northern part of the corridor generally following the alignment of the Princes Highway. The surrounding road network is shown in **Figure 4-1**.

The M5 East Motorway combined with the M5 South West Motorway (the M5 Motorway corridor) provides a key east-west road corridor between greater western Sydney and the Sydney central business district (CBD) as part of Sydney's strategic road network. The M5 Motorway corridor connects Sydney Airport and Port Botany to other key links within the wider road network including:

- The Westlink M7 Motorway which provides links to the employment areas of Western Sydney, and links to the broader Sydney Orbital Network.
- The Hume Motorway (M31), which provides links to Canberra and Melbourne.
- King Georges Road (A3), which provides links to northern, south western and southern suburbs of Sydney.
- The Princes Highway (A36), which provides links to the inner western and south-western suburbs of Sydney.
- Southern Cross Drive (M1), which provides links to the CBD, eastern suburbs and areas north of the CBD via the Pacific Highway.

Route A34 along Milperra Road and Canterbury Road (located to the north of the project corridor) provides an alternative east-west route to the M5 corridor. An additional route (comprising of Forest Road/Stoney Creek Road/Henry Lawson Drive), located to the south of the project corridor, also provides an alternative east-west route to the M5 Motorway corridor.

The WestConnex Strategic Environmental Review identified the following key operational constraints associated with the M5 Motorway corridor:

- Key arterial roads on the surrounding network are operating at or near capacity with limited opportunity for widening. This includes General Holmes Drive and Airport Drive.
- Other arterial roads, such as route A34, are also congested for substantial periods of the day, with little capacity to cater for diverted traffic during incidents on the M5 Motorway corridor.
- The steep grade leading to the exit of the westbound M5 East Motorway tunnel impacts on travel speeds, particularly heavy vehicles, which limits traffic capacity. Vehicles exiting to Kingsgrove Road generally travel in the right hand lane, further impacting on capacity.
- Traffic entering and merging onto the M5 Motorway corridor at major interchanges results in slow traffic and congestion, particularly at Marsh Street, Kingsgrove Road and King Georges Road.

The demand on the network is forecast to grow significantly as a result of population and employment growth in Sydney. This includes growth at Sydney Airport, Port Botany, the Sydney Global Economic Corridor, employment lands in the M5 Motorway corridor, the South-West Growth Centre, and the Western Sydney Employment Area. Combined with increased tourist visitation, congestion on the existing road network is expected to further worsen on the M5 Motorway corridor and alternative arterial routes.

The Princes Highway is the key arterial route within the northern part of the corridor, which provides connections to:

- The M5 East Motorway and surrounding suburbs to the south and south-west.
- Canal Road / Ricketty Street / Gardeners Road to the east, providing access to the Sydney Airport, Port Botany, industrial areas, the M1 and the eastern suburbs.
- Railway Road/Sydenham Road, Enmore Road and King Street, providing access to suburbs to the west and north.

The Princes Highway at this location caters for regional (or through movements) as well as local movements associated with residents and businesses accessing the surrounding suburbs.

Campbell Road, Burrows Road and Euston Road provide access to recreational, residential, commercial and industrial areas in St Peters, Alexandria and Mascot. They also provide connections between major roads, namely the Princes Highway, Canal Road, Gardeners Road and Botany Road.

Public transport network

Bus routes

The bus routes within the project corridor provide east-west and north-south connectivity. Routes follow major roads in the area, including the Princes highway, Canterbury Road and Bexley Road. No bus routes currently use the existing M5 East Motorway.

Cycling and pedestrian facilities

Within the project corridor there is currently a continuous cycle path from King Georges Road in the west to St Peters in the east. The cycleway comprises a mixture of separate dedicated bicycle paths and dedicated bicycle-friendly roads. Cycling is currently permitted on the shoulders of the M5 East Motorway until Bexley Road, where cyclists are diverted to use local and arterial roads. From the commencement of construction of the King Georges Road upgrade, cyclists will no longer be able to use the M5 East Motorway as a cycling route. There are also off road shared paths on either side of the motorway from west of King Georges Road to Bexley Road, as well as through recreational spaces along Cooks River.

Pedestrian footpaths are provided on all major roads within the project corridor, with the exception of the M5 East Motorway. Pedestrian crossings along major roads are, in the majority, restricted to signalised pedestrian crossings.

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KEY

- National Park/Regional Park
- Road
- Rail
- Watercourse
- M Route
- A Route

Figure 4-1: The road network

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Km

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4.2.2 Summary of issues

Construction

Construction of the project would require the use of heavy vehicles to deliver construction plant, equipment and materials as well as for the removal of waste, including general construction waste, office waste and spoil from tunnelling activities. Additional discussion on construction waste is provided in **Section 4.12** (Resource management and waste minimisation). Heavy vehicle movements during the tunnelling stage are expected to occur on a 24 hour basis.

It is anticipated that there would be an increase in the number of light vehicles on the surrounding road network during the construction of the project, associated with the construction workforce.

Surface construction works, including ancillary infrastructure, portal works and tie-ins to the surrounding road network, as well as the establishment of construction sites and associated entry / exit points may result in changes or modifications to:

- Existing property access.
- Exiting pedestrian and cyclist access and movements.
- Speed limits on the motorway and surrounding roads.

Additional heavy and light vehicle movements and surface construction works associated with the project have the potential to generate the following traffic and transport related impacts during construction:

- Deterioration in intersection and traffic performance along the local road network due to heavy vehicle movements associated with construction and spoil removal, narrowing of lanes, speed restrictions and temporary road closures.
- Changes in local traffic conditions as a result of traffic shifting from the motorway onto alternative routes while construction work is underway, such as during the surface integration works along the M5 East Motorway. These roads are currently congested and at capacity during peak periods.
- Potential safety risks for road users, including buses, pedestrians and cyclists during construction due to temporary road arrangements or the close proximity of construction activities to normal traffic.
- Temporary disruptions and delays to traffic and public transport services, including buses as a result of speed restrictions and / or potential temporary road closures.
- Temporary impacts on pedestrian and cyclist access on adjacent roads where modifications are required to accommodate access to construction areas.
- Impacts to local parking as a result of construction workforce.
- Temporary impacts to property access.

Operation

The operation of the project would alter traffic movements on the surrounding road network. In particular, the project would result in an increase in traffic movements immediately surrounding the St Peters Interchange which may have operational traffic impacts. These may include:

- Deterioration of individual intersection performance at existing intersections due to the introduction of new movements.
- Improved traffic efficiency and level of service for freight and public transport on the road network through the relief of road congestion to improve the speed, reliability and safety of the travel along the M5 corridor and parallel arterial roads.
- Enhanced productivity of commercial and freight generating land uses, including employment areas in the Sydney Airport and Port Botany area.
- Improved motorway access and connections linking Sydney Airport and Port Botany to greater western Sydney and places of business across the city in order to support Sydney's long-term economic growth.
- Improved road safety.
- A reduction in traffic volumes along existing road corridors, particularly heavy vehicles.
- Improved public transport options along surface roads that have the potential to experience reduced congestion.
- Modified pedestrian movements at existing intersections.
- Alterations to existing property accesses.

It is anticipated that the possible future completion of WestConnex Stage 3 and the complete WestConnex program of works would again alter traffic movements and traffic conditions around interchanges and along the local road network. Tolling would be introduced on each stage of WestConnex as it is developed (SMPO, 2012). There is the potential that introducing a tolling system as part of the WestConnex program of works would change the use of the existing and proposed M5 East Motorway as a result of some traffic switching off the motorway and onto alternate routes along local roads.

4.2.3 Proposed further assessments

The Environmental Impact Statement would include a construction and operational traffic and transport assessment to identify and assess potential impacts and management measures.

The construction traffic study would include identification and assessment of:

- Potential traffic and transport impacts on the road network, including consideration of public transport impacts, as well as pedestrian and cyclist access throughout construction of the project.
- Potential cumulative impacts with other stages of the WestConnex project.

The operational traffic study would identify and assess traffic impacts associated with the project, including an assessment of existing local and regional traffic volumes and traffic patterns against forecast volumes and potential changes to traffic patterns associated with the project. Traffic modelling to be undertaken as part of the operational traffic assessment would be undertaken for the opening year, being the year of completion of the project, and 10 years from the opening date, which would include the completion of WestConnex program of works. The operational traffic assessment for the project would also include:

- A description of intersection functionality.
- Quantification of
    - Anticipated benefits of improved intersection performance.
    - Travel times along the M5 East Motorway and M5 South West Motorway.
- Direct and indirect operational traffic implications on the local and regional road network, including freight movements.
- Identification and assessment of potential operational traffic impacts around interchanges and required modifications to the existing local road network.
- Identification and analysis of the performance of key intersections and interchanges during AM and PM peak periods.
- Traffic time analysis.
- An assessment of the impact of tolling on motorways and the surrounding road network based on the tolling strategy for the program of works.
- An assessment of impact of the project on road users, including motorists, public transport, pedestrians and cyclists.
- Road safety analysis.

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4.3 Air quality and human health

4.3.1 Overview

The NSW State of the Environment 2012 (EPA, 2012) provides a report on the status and condition of the major environmental resources in New South Wales (including the atmosphere) and examines the associated environmental trends. The report identifies that air quality within the Sydney metropolitan area consistently meets national air quality standards for four of the six major air pollutants (lead, CO, sulfur dioxide and nitrogen dioxide).

With regard to emissions from vehicles, the key air pollutants are:

- Carbon monoxide (CO).
- Oxides of nitrogen (NO_x), including nitrogen dioxide (NO_2).
- Particulate matter, including fine and ultra-fine particles (PM_{10} and $PM_{2.5}$).
- Air toxics, including benzene, toluene, xylenes, formaldehyde and polycyclic aromatic hydrocarbons (PAHs) which are predominately adsorbed to particulates.

These pollutants are potentially harmful to human health.

The NSW State of the Environment 2012 report states that transport emissions are the most important human-related source of air pollution in Sydney. In 2008, motor vehicles were the largest source of emissions of oxides of nitrogen (63 per cent of total emissions) and the second largest source of volatile organic compounds emissions (24 per cent of total emissions) in the Sydney Report.

The air quality in NSW is generally good when compared with international standards (EPA, 2012). Ambient concentrations of carbon monoxide, nitrogen dioxide and volatile organic compounds are all consistently below the respective national standards in most areas, and emission of these pollutants have decreased by 20 to 40 per cent since the early 1990's (EPA, 2012). These decreases have been attributed to initiatives to reduce air pollution associated with industry, businesses, motor vehicles and residential premises.

Exceedances of ozone and particulate matter (PM_{10}) standards have occurred between 1994 and 2011. However, recorded exceedances of particulate matter standards in Sydney are attributed to natural events such as bushfires and dust storms.

In NSW, measured $PM_{2.5}$ concentrations have generally been at or below the *National Environmental Protection Measure (NEPM) for Ambient Air Quality* 24-hour average advisory reporting standard but above the annual average advisory reporting standard (EPA, 2012). Measured $PM_{2.5}$ concentrations in the years 2000 to 2003 were above the reporting standard and in subsequent years were close to the standard, except for 2009 which had the highest peaks ever recorded due to dust storms (EPA, 2012).

The EPA undertook ambient monitoring of a number of air toxics between 1996 and 2001 at 25 sites (DEC, 2004). Of the 81 measured pollutants, only three required further investigation to ensure that they remained at acceptable levels in the future: benzene, 1,3-butadiene and benzo(a)pyrene. Additional testing conducted between 2008 and 2009 measured concentrations of a number of pollutants include benzene, toluene and xylenes at Turrella and Rozelle. Concentrations of all measured pollutants were recorded to be well below the monitoring investigation levels. As such, current concentrations of air toxics in the Sydney region are not an issue of concern.

The closest OEH air quality monitoring stations to the project are at Earlwood, Randwick and Chullora.

The OEH Air Quality Statement for 2013 noted that in 2013, air quality in NSW was poorer than previous years, which was mainly attributed to warmer and drier climatic conditions and severe bushfires. The OEH Air Quality Index (AQI) values, which standardises measurements of Ozone, CO, sulfur dioxide (SO_2), NO_2, air particles and visibility into one index were in the hazardous category (an AQI greater than 200) on a number of days in 2013. This reflected periods of bushfire activity. The recorded exceedances of ozone, PM_{10} and $PM_{2.5}$ at the Chullora and Earlwood OEH monitoring stations were similarly recorded during periods of high bushfire activity and during calm, hot weather conditions in 2013.

The M5 East Motorway ventilation facility is located in Turrella. As part of the approval of the M5 East Motorway, five monitoring stations have been installed to provide 24 hour air quality data to the Roads and Maritime to measure compliance with the air quality goals specified in the planning approval. Four of these stations monitor concentrations of carbon monoxide, nitrogen dioxide and PM_{10}, while one station monitors volatile organic compounds such as benzene and formaldehyde (which is aromatic). As part of the M5 East Motorway approval, exceedances of the conditions of approval need to be reported. Exceedances of the PM_{10} ambient goal, and one exceedance of the NO_2 ambient air quality goal, have been detected as a result of the monitoring. These exceedances were not attributable to emissions from the ventilation facility; rather they were associated with extreme weather events, bushfires, nearby construction activity or equipment failure.

4.3.2 Summary of issues

Construction

The construction of the project has the potential for the following air quality related impacts:

- Temporary increases in dust during earthworks, vegetation clearance, use of the ancillary concrete batching plant and construction activities. The potential impacts on air quality would be dependent on the scale of the activities, quantities of the material handled, and the proximity of sensitive receivers.
- Temporary increases in emissions associated with the use of the ancillary concrete batching plant vehicles, plant and machinery. This includes temporary ventilation systems within the tunnel during construction.
- Potential handling of odorous materials during the closure of the Alexandria landfill site and preparation for construction of the St Peters interchange.

Operation

During the operation of the project, the potential emissions to air are associated with vehicular fuel combustion. As discussed in **section 4.3.1**, the primary air pollutants of concern are CO, NO_2 and PM_{10} and $PM_{2.5}$.

In-tunnel air quality

The level of emissions from the project would be affected by the length of the tunnel(s), its grade and the mix of vehicles travelling through the tunnel. Maintaining a free flow of traffic in the tunnel(s) would also be a significant factor in minimising the emissions generated by vehicles using the project.

The design parameter for ventilation systems and the management of in-tunnel air quality for tunnels within NSW has been historically based on a CO limit. CO has also been used as a proxy for monitoring and management of all traffic related pollutants. In NSW, a 15-minute average CO in-tunnel limit is used, which since the 1990s has been based on the World Health Organisation (WHO) limit of 87 parts per million (ppm). Visibility limits are also adopted in many tunnels for the purposes of road safety.

The NSW Government has appointed an Advisory Committee on Tunnel Air Quality (the Advisory Committee) to review current international best practice and experience from Australian motorway tunnels. The committee will:

- Review and set performance standards for road tunnel emissions.
- Recommend appropriate monitoring, compliance and reporting mechanisms to support public confidence in the operation of road tunnels.
- Provide ongoing advice to the NSW Government on air quality issues.

WDA will consult with the Advisory Committee and other relevant agencies concerning appropriate in-tunnel air quality criteria.

Local air quality – surface roads

At a local level, air quality effects would be influenced by the emissions associated with vehicles on surface roads and in tunnels. The reduction in traffic congestion along surface roads has the potential to deliver air quality improvements to areas along key arterial roads. These local effects would be the subject of further investigation.

Local air quality – ventilation facilities

The project would require ventilation facilities for the tunnel. Well-designed ventilation facilities are very effective at dispersing tunnel emissions and are expected to be an important component of the final ventilation design solution.

The tunnel ventilation system would be designed and operated to meet in-tunnel air quality criteria, as well as to meet local and regional air quality criteria. The tunnel ventilation system would take account of in-tunnel ambient air quality, traffic conditions and external meteorological conditions. The tunnel ventilation design would be optimised to avoid unnecessary capacity and minimise operational energy use, while ensuring air quality outcomes are met.

The locations of ventilation facilities would be subject to further design development. Ventilation facilities would most likely be located close to the tunnel exit portals. Location of ventilation facilities near the tunnel exit portals would be the most cost effective and energy efficient location, given the reduced requirement for pushing tunnel air in the opposite direction to traffic flow. Subject to further design development, management of in-tunnel air quality may require construction of ventilation facilities at intermediate locations along the main alignment tunnels.

Air discharged from tunnel ventilation facilities would be subject to detailed investigations as part of the air quality assessment. The assessment would be based on the location and design characteristics of the facilities, emissions to air (based on in-tunnel emissions inventories), buildings and land use, prevailing meteorological and topographical effects to determine any changes in air pollutant concentrations at sensitive receivers.

Treatment of emissions

Air pollution control technology has been used in a limited number of tunnels in a few countries including Norway, Austria, Germany and Japan as well as the M5 East Motorway tunnel trial in Sydney. This technology includes the use of electrostatic precipitators to remove particles as well as catalytic and biological processes and adsorption technologies to remove nitrogen oxides. Evidence to date suggests that the benefits of such measures when applied to road tunnels are limited to specific situations (Advisory Committee on Tunnel Air Quality, 2014).

A range of solutions to manage in-tunnel air quality would be considered during the design of the project including, but not limited to ventilation (including number, size and position of outlets) and air treatment technologies.

Summary

The operation of the project has the potential for the following air quality impacts, and associated human health implications:

- Potential increase and decrease in near roadside air pollutant concentrations due to changes in traffic volumes on surface roads, or the introduction of new roads (such as the St Peters interchange).
- Potential increase in air pollutant levels near the ventilation facilities.
- Potential exposure to air pollutants for motorist using long tunnels.
- Potential generation of odours during closure and remediation of the Alexandria landfill site, and preparation for construction of the St Peters interchange.

4.3.3 Proposed further assessments

An air quality assessment would be undertaken to assess the construction and operation impacts of the project and to assist in developing air quality mitigation measures.

For construction, an assessment would be undertaken which would consider mitigation and management measures to reduce and minimise the emission of dust and other pollutants during construction. If odorous materials are proposed to be handled during closure of the Alexandria landfill site, appropriate odour management measures would be identified.

Emissions from concrete batching plants are predominantly particulate matter emissions, although relatively small quantities of combustion pollutants (carbon monoxide, oxides of nitrogen, oxides of sulphur and hydrocarbons) can also be emitted. Should a concrete batching plant be required, a quantitative assessment of particulate matter emissions would be undertaken.

For the assessment of air quality impacts during operation, an assessment of in-tunnel air quality would be undertaken to predict the levels of CO, NO_2 and particulates based on the proposed ventilation design, and to predict the potential exposure to motorists. As identified in **Section 4.3.2**, WDA will continue to consult with the Advisory Committee and other relevant agencies concerning appropriate in-tunnel air quality criteria to inform this assessment.

The operational air quality assessment would be undertaken in accordance with *Approved Methods for the Modelling and Assessment of Air Pollution in NSW* (DEC, 2005) to assess the potential impacts on surrounding sensitive receivers. The operational air quality assessment would apply modelling techniques endorsed in that guideline and relevant air quality criteria. The methodology applied to the assessment would be determined in consultation with Department of Planning and Environment and the Environment Protection Authority.

The assessment would consider local dispersion conditions, existing background levels of pollutants, managed air emissions, and changes in vehicle emissions on surface roads. Background monitoring data from the nearest existing air quality monitoring stations would be used in the assessment, in addition to data collected from project-specific air quality monitoring stations.

A human health risk assessment would also be undertaken to assess the potential human health implications of in-tunnel air quality as well as the implications of changes in air quality external to the project as a result of the project. This would be based on the results of the air quality modelling for the project. The methodology for the assessment would be determined in consultation with NSW Health.

4.4 Noise and vibration

4.4.1 Overview

The noise environment within the project corridor is characterised by noise generated by the major transport infrastructure located in the area, including the M5 East Motorway, the Princes Highway, Sydney Airport, and the suburban Sydney Trains railway network (T2, T3 and T4 rail lines). Industrial and commercial developments located in the project corridor, such as those located at Kingsgrove, Wolli Creek, Tempe, Sydenham, St Peters, Mascot and Alexandria, also contribute to the local noise environment.

A wide range of sensitive receivers are located within the project corridor, which include:

- Residential properties.
- Parks and recreational areas.
- Education facilities, including indoor and outdoor areas.
- Hospitals.
- Places of worship.
- Aged care facilities.

During construction, the project would result in localised noise and vibration impacts, particularly where surface works would occur for interchanges, tunnel portals and ancillary surface infrastructure. Tunnelling could also generate vibration and ground borne noise impacts on sensitive receivers located above the project alignment and in the vicinity of construction compounds.

With the majority of the project being in tunnel, potential operational noise impacts on sensitive receivers would be limited to where project infrastructure is located at the surface or where traffic volumes on surface roads would change. This would include potential reductions in traffic noise at sensitive receivers due to the shift of traffic from surface roads into the project tunnels.

4.4.2 Summary of issues

Construction

The construction of the project would likely result in the following noise and vibration issues:

- Airborne noise from surface works including at the interchange, the integration with the M5 East Motorway, construction ventilation systems, ancillary construction facilities and any open cut sections of the project.
- Ground-borne noise from tunnelling and piling.
- Potential vibration impacts on buildings near to surface works, or buildings above the tunnel alignment.
- Construction traffic noise from the use of heavy vehicles and construction equipment.
- Potential vibration impacts on buildings generated by blasting activities, which may be required depending on the geological conditions encountered.

Construction works during the evening and night time periods would be required, with the potential for tunnelling and associated above-ground support activities (including spoil haulage) to occur 24 hours a day, seven days a week. This is likely to result in impacts to sensitive receivers. There is also likely to be a requirement for some construction activities, such as integration works with the existing M5 East Motorway, to be conducted during the evening and night time periods for safety and operational reasons.

Operation

The project would result in the re-distribution of traffic around the project corridor, which would change the operational noise environment of existing surface roads. The project is likely to result in localised increases in road traffic noise from the following components:

- The widening of the M5 East Motorway to enable the integration of the project.
- The St Peters interchange and associated local road connections.
- Any open cut section(s) of the project
- The tunnel portals
- Other sources of operational noise emissions may include ventilation infrastructure, the tunnel control centre and other surface ancillary infrastructure.

4.4.3 Proposed further assessments

A detailed noise and vibration assessment would be undertaken to assess the construction and the operation impacts of the project and to assist in developing noise and vibration mitigation measures. The assessment would include:

- Identification of potentially affected noise and vibration sensitive receivers.
- Establishment of project specific construction noise management levels.
- Establishment of construction vibration goals.
- Identification of out of hours work required during construction.
- An assessment of noise (airborne and ground-borne) and vibration impacts from the construction of the project on identified residential and other sensitive receivers.
- An assessment of road traffic noise from the use of heavy vehicles during the construction of the project.
- An assessment of noise from the operation of the project on identified residential and other sensitive receivers.
- If required, recommendations for feasible and reasonable noise and vibration mitigation measures to be implemented during construction and operation.

The assessment of noise and vibration impacts for the construction and operation of the project would be undertaken in accordance with the following guidelines as relevant:

- NSW Road Noise Policy (DECCW, 2011).
- Environmental Noise Management Manual (RTA, 2001).
- Interim Construction Noise Guideline (DECC, 2009).
- Assessing Vibration: a Technical Guideline (DEC, 2006).
- German Standard DIN 4150 1999: Structural Vibration – Effects of Vibration on Structures.
- British Standard BS7385 1993: Evaluation and Measurement for Vibration in Buildings: Guide to Damage Levels from Ground-borne Vibration.
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZECC, 1990).

4.5 Biodiversity

4.5.1 Overview

Flora

Threatened flora

Database searches of the NSW BioNet Atlas of Wildlife and the EPBC Protected Matters Search Tool identified previous records of 22 listed threatened flora species or their habitat and one threatened flora population as occurring within 10 kilometres of the project corridor (refer to **Table B-1** in **Appendix B**).

Vegetation communities

Wolli Creek Regional Park

Wolli Creek Regional Park is reserved under the *National Parks and Wildlife Act 1974*. It comprises a linear corridor of bushland along Wolli Creek (identified as key fish habitat under the *Fisheries Management Act 1994* (FM Act)), and is considered a vital recreational and educational source for local and regional users containing important flora and fauna habitat and features of cultural and historical significance. A small portion of Wolli Creek Regional Park is located within the project corridor on the northern side of Wolli Creek (refer to **Figure 4-2**). The section of Wolli Creek Regional Park within the project corridor contains a number of native vegetation communities, including Coastal Sandstone Heath-Mallee, Coastal Sandstone Foreshores Forest, Estuarine Reedland and mapped weeds and exotic species.

Wetlands

Eve Street Marsh

Eve Street Marsh is situated within the project corridor west of the Cooks River at Arncliffe, about two kilometres west of Sydney Airport. The marsh is listed on the directory of important wetlands in Australia and covers an area of about two hectares. The Eve Street Marsh is situated on a low lying coastal floodplain and is subject to brackish tidal flows. It is identified as a marine and coastal wetland comprising intertidal mud, sand or salt flats as well as intertidal marshes.

The listing of the marsh notes that it is a wetland which is important as the habitat for animal taxa at a vulnerable stage on their life cycles, or provides a refuge when adverse conditions such as drought prevail. The wetlands are associated with the Green and Golden Bell Frog Lower Cooks River Key Population. Further, a number of threatened migratory species have been previously recorded in this area. The Eve Street Marsh provides habitat for six species listed on the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA), and is of special importance to four of these due to loss of habitat around Botany Bay. The six listed species for which this habitat is particularly significant includes:

- Great Egret (*Ardea alba*).
- Greenshank (Tringa nebularia).
- Curlew Sandpiper (*Calidris ferruginea*).
- Red-necked Stint (*Calidris ruficollis*).
- Sharp-tailed Sandpiper (*Calidris acuminata*).
- Bar-tailed Godwit (*Limosa lapponica*).

It is also considered to be nationally important as it is of outstanding historical or cultural significance. The Eve Street Marsh is a remnant of a once extensive brackish marsh and is considered to be a significant wetland as it is one of the first Australian examples of a rehabilitated tidal marsh that provides habitat for uncommon saltmarsh communities and for migratory wading birds and resident birds. Rehabilitation works have included major earthworks to establish appropriate gradients for tidal inundation, a mangrove lined channel connecting the wetland with the Cooks River and an enlarged tidal pond area in which water level is controlled by a weir. The weir constructed at the outlet of the wetland only permits some high tides from the Cooks River to enter the wetland.

Towra Point Wetlands

Towra Point Wetlands is a RAMSAR listed site and is an estuarine complex comprising a mixture of spits, bars, mudflats, dunes and beaches. It is the largest wetland of its type in the Sydney Basin bioregion and represents vegetation types that are now rare in the area. The wetland system comprises 60 per cent of the remaining saltmarsh communities and 40 per cent of the remaining mangrove communities in Sydney and is an important area for migratory and native bird species, with records in the area of more than 200 species. The Towra Point Wetlands is located about 6.8 kilometres south of the project corridor.

Threatened ecological communities

Searches of the Protected Matters Search Tool, BioNet Atlas of NSW Wildlife and examination of the DPI estuarine habitat maps identified 23 listed threatened ecological communities with the potential to occur within project corridor, as summarised in **Table 4-1**.

The search of the BioNet Atlas of NSW Wildlife was undertaken within the 10 kilometre minimum allowable search area centred on the Project corridor, the search of the Protected Matters Search Tool database was undertaken with about a one kilometre buffer around the Project corridor and the DPI estuarine habitat maps were examined within the Project corridor only.

The Native Vegetation of the Sydney Metropolitan Area dataset (NSW Office of Environment and Heritage, 2013) was also examined to identify any vegetation communities previously mapped within the Project corridor. A search of this dataset identified six threatened ecological communities which are mapped as occurring within the Project corridor, as summarised in **Table 4-1**. Mapped threatened ecological communities within the Project corridor are shown on **Figure 4-2**. Some areas of Sydney Turpentine Ironbark Forest and Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion mapped within the project corridor are within Beverly Grove Park, which is a biodiversity offset area which was set aside during the initial construction of the M5 East Motorway.

Other vegetation communities

The following vegetation communities have been mapped as part of the Native Vegetation of the Sydney Metropolitan Area dataset (NSW Office of Environment and Heritage, 2014) as occurring within the project corridor:

- Coastal enriched sandstone moist forest.
- Coastal sandstone foreshores forest.
- Estuarine reedland.
- Urban native and exotic cover.
- Coastal Sandstone Heath-Mallee.
- Weeds and exotic cover.

Noxious weeds

The *Noxious Weeds Act 1993* establishes control mechanisms to reduce the negative impacts of weeds on the economy, community and environment. Noxious and environmental weeds are known to be present across the project corridor. Under Section 13 of the *Noxious Weeds Act 1993*, WDA, as a public authority, is obliged to control noxious weeds on land that it owns and to prevent noxious weeds from spreading to adjoining properties.

Fauna

Threatened fauna and threatened fauna populations

Sixty-one threatened fauna species and three threatened fauna populations listed under the EPBC Act and / or the TSC Act or their potential habitat have been previously recorded within 10 kilometres of the project corridor (refer to **Table B-2** in **Appendix B**). Fauna species included:

- Forty bird species.
- One fish species.
- Four frog species.
- Ten mammal species.
- Six reptile species.

The three threatened fauna populations listed under the EPBC Act or TSC Act which have been previously recorded within 10 kilometres of the project corridor include:

- Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (SE mainland population) (*Dasyurus maculatus maculatus*), endangered under the EPBC Act.
- Long-nosed Bandicoot population in inner western Sydney (*Perameles nasuta*), an endangered population under the TSC Act.
- Koala – combined populations of QLD, NSW and ACT (*Phascolarctos cinerus*), a vulnerable population under the EPBC Act.

Other fauna populations

Green and Golden Bell Frog Lower Cooks River Key Population

The Green and Golden Bell Frog Lower Cooks River Key Population is located in the vicinity of the lower Cooks River delta immediately west of Sydney's Kingsford Smith Airport. The population consists of one main population within the wetlands and recreation corridor at Arncliffe, including the Eve Street Marsh.

The Green and Golden Bell Frog Lower Cooks River Key Population at Arncliffe is one of two key populations that fringe the shores of Botany Bay, and one of four that inhabit south-eastern Sydney. Habitat associated with this key population is largely comprised of modified natural or artificially created waterbodies which require ongoing active management. Green and Golden Bell Frogs inhabit wetlands, waterbodies and ponds throughout the wetlands and recreation corridor that are interspersed amongst green space, including golf courses and playing fields, residential development and along major transport and infrastructure routes.

Wolli Creek Regional Park Grey-headed Flying Fox Camp

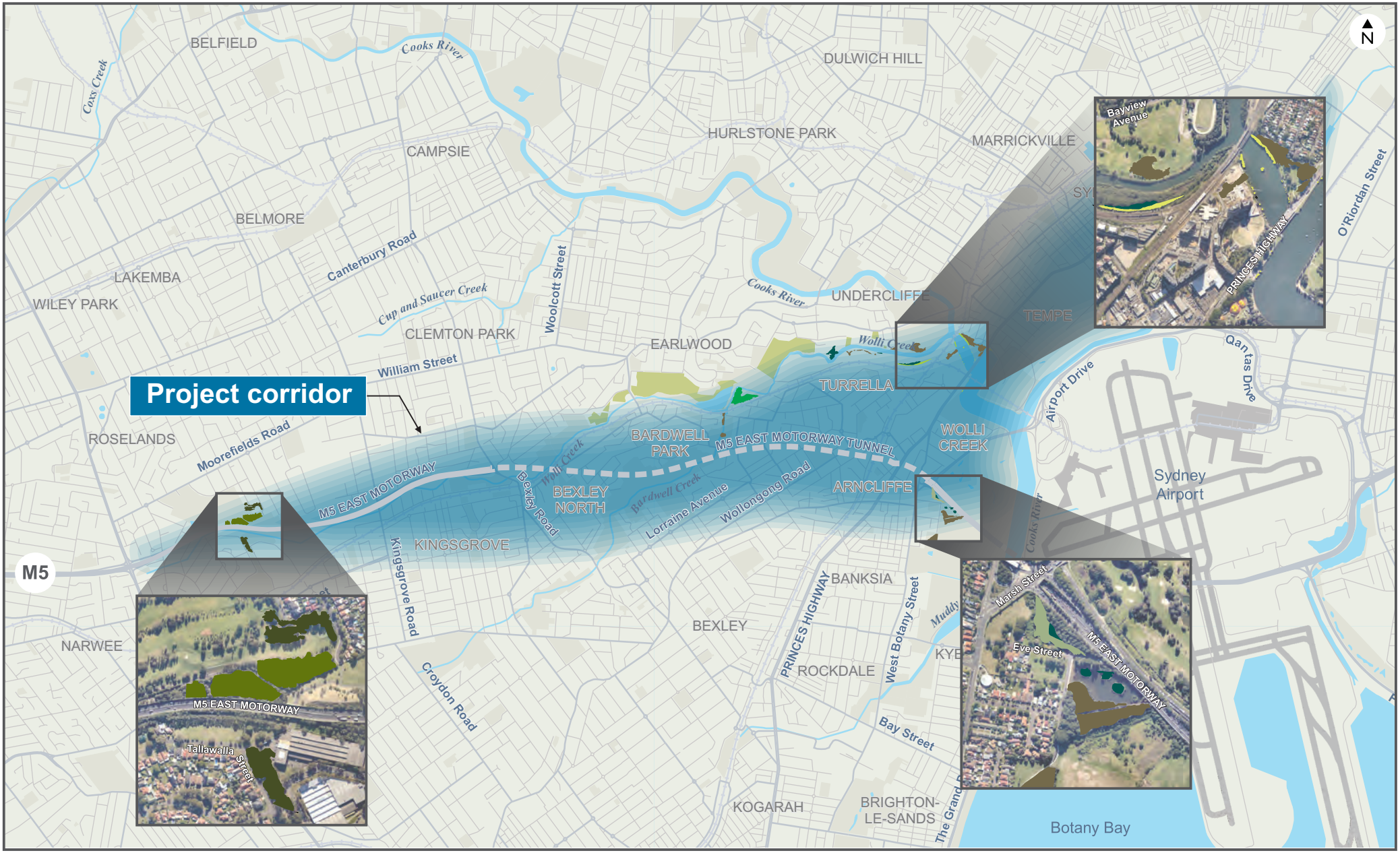
There is a known Grey-headed Flying Fox (*Pteropus poliocephalus*) population or 'camp' within Wolli Creek Regional Park. The camp is situated close to Wolli Creek within a canopy of Eucalypts and Casuarina trees which were planted in the early 1980s as part of a revegetation project. The camp is thought to have been established in mid-2007 and can include up to several hundred individual flying foxes during summer. The Grey-headed Flying Fox camp is considered seasonal, with the flying foxes heading north for the winter. However, in recent years the camp has continued to be occupied during the winter months, suggesting that it is possible that the camp has moved from being a seasonal camp to a permanent one (Wolli Creek Preservation Society, 2014).

Table 4-1 Threatened ecological communities within 10 kilometres of the project corridor

Ecological community	Commonwealth listing (EPBC Act)		NSW listing (TSC Act/FM Act)		Mapped within Project corridor
	Yes / No	Status	Yes / No	Status	
Bangalay Sand Forest of the Sydney Basin and South East Corner bioregions.	No	-	Yes	Endangered	×
Blue Gum High Forest in the Sydney Basin Bioregion.	Yes	Critically Endangered	Yes	Critically Endangered	×
Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion.	No	-	Yes	Vulnerable	×
Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	Yes	Vulnerable	Yes	Endangered	✓
Coastal Upland Swamp in the Sydney Basin Bioregion.	Yes	Endangered	Yes	Endangered	×
Cooks River / Castlereagh Ironbark Forest in the Sydney Basin Bioregion.	Yes	Endangered	Yes	Endangered	✓
Duffys Forest Ecological Community in the Sydney Basin Bioregion.	No	-	Yes	Endangered	×
Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion.	Yes	Endangered	Yes	Endangered	×
Estuarine Mangrove Forest.	No	-	Yes	Protected*	✓
Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	No	-	Yes	Endangered	×
Kurnell Dune Forest in the Sutherland Shire and City of Rockdale.	No	-	Yes	Endangered	×
Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	Yes	Critically Endangered	Yes	Endangered	×
Moist Shale Woodland in the Sydney Basin Bioregion.	Yes	Critically Endangered	Yes	Endangered	×
River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	No	-	Yes	Endangered	✓
Shale gravel Transition Forest in the Sydney Basin Bioregion.	Yes	Critically Endangered	Yes	Endangered	×
Shale / Sandstone Transition Forest.	Yes	Endangered	Yes	Endangered	×
Southern Sydney sheltered forest on transitional sandstone soils in the Sydney Basin Bioregion.	No	-	Yes	E3	×
Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	No	-	Yes	Endangered	✓
Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.	No	-	Yes	Endangered	×
Sydney Freshwater Wetlands in the Sydney Basin Bioregion.	No	-	Yes	Endangered	×
Sydney – Turpentine Ironbark Forest.	Yes	Critically Endangered	Yes	Endangered	✓

Ecological community	Commonwealth listing (EPBC Act)		NSW listing (TSC Act/FM Act)		Mapped within Project corridor
	Yes / No	Status	Yes / No	Status	
Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions.	No	-	Yes	Endangered	×
Western Sydney Dry Rainforest in the Sydney Basin Bioregion.	Yes	Critically Endangered	Yes	Endangered	×

*Protected under the Fisheries Management Act 1994



KEY

- Wolli Creek Regional Park
- Road
- Rail
- Watercourse
- Cooks River/Castlereagh ironbark forest
- Sydney turpentine-ironbark forest
- Swamp oak floodplain forest
- River-Flat Eucalypt forest on coastal flood plains
- Coastal saltmarsh
- Estuarine mangrove forest
- Swamp sclerophyll forest

Figure 4-2: Mapped threatened ecological communities within the project corridor

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Km

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Migratory species

Seventeen listed threatened marine migratory bird species listed under the TSC Act and / or EPBC Act have been previously recorded within the project corridor (refer to **Table B-2** in **Appendix B**). There is a large number of records of migratory birds within the Project corridor in the vicinity of the Eve Street Marsh wetlands system, which is recognised for the suitable bird habitat it provides (refer to **Figure 4-2**).

Aquatic habitat

The project corridor encompasses Wolli Creek, Alexandra Canal and the Cooks River. All waterways within the project corridor are declared as key fish habitat by the NSW Department of Primary Industries; being those aquatic habitats that are important to the sustainability of the recreational and commercial fishing industries, the maintenance of fish populations generally and the survival and recovery of threatened aquatic species.

Wildlife corridors

Wildlife corridors are connections across the landscape that link up areas of habitat, while supporting multiple land uses. Wildlife corridors generally comprise native vegetation and connect two or more areas of similar wildlife habitat. Corridors are critical for the maintenance of ecological processes, including allowing for the movement of animals and the continuation of viable processes. Landscape connections between larger areas of habitat through wildlife corridors enable migration, colonisation and breeding of flora and fauna.

Corridors can comprise either discontinuous areas of habitat, such as wetlands and roadside vegetation, continuous lineal strips of vegetation and habitat, such as riparian strips and ridge lines, or parts of a larger habitat area selected for its known or likely importance to local fauna.

Based on their ecological value, the following areas are considered to have potential functionality as wildlife corridors or part of wildlife corridors:

- Vegetation along Wolli Creek, including Wolli Creek Regional Park.
- Vegetation along the F6 reserved road corridor, including the Eve Street Marsh.
- Vegetation along Bardwell Creek, including Kingsgrove Park, Bardwell Valley Parklands, Broadford Street Reserve and Coolibah Reserve.
- Vegetation along the Cooks River north of its confluence with Wolli Creek, including parts of Wentworth Park and Gough Whitlam Park.

Groundwater dependent ecosystems

Groundwater dependent ecosystems (GDEs) are communities of plants, animals and other organisms whose extent and life processes are dependent on groundwater, such as wetlands and vegetation on coastal sand dunes. The project corridor is located within land that forms part of the Botany Sands Groundwater Source, subject to the provisions of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011*. The Botany Sands Groundwater Source extends to the Botany Wetlands, which includes high priority groundwater dependent ecosystem listed on Schedule 4 of the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources 2011.* The mapping of potential high priority groundwater dependent ecosystems in the Botany Sands Groundwater Source notes two potential GDEs about two kilometres south of the project corridor. A search of the National Atlas of Groundwater Dependent Ecosystems (Australian Bureau of Meteorology) did not identify any GDEs within the project corridor.

4.5.2 Summary of issues

The project has the potential to impact on biodiversity, including threatened and protected species, populations and communities. Impacts on biodiversity (direct and indirect) would be mostly associated with areas of surface disturbance. However, potential impacts could potentially occur as a result of surface water discharges, and groundwater drawdown could have impacts on GDEs. The mechanisms by which these impacts could occur include:

- Vegetation clearance at the locations of surface infrastructure and ancillary facilities resulting in habitat loss and edge effects.
- Potential loss of connectivity between habitat areas, resulting in habitat fragmentation.
- Mortality of individuals during both the construction and operation of the project.
- Introduction and / or spread of noxious weeds and other invasive species.
- Impacts to groundwater levels due to groundwater inflows during construction and operation.
- Mobilisation of sediments into waterways and potential pollution from materials used in the process of construction and operation, including discharges from water treatment plants.
- Potential changes to hydrology and geomorphology as a result of the project, including discharges from the water treatment plants.
- Loss of migratory species habitat.

While located within the project corridor, direct impacts to Wolli Creek Regional Park would be avoided through project design.

Further, there is potential for the project to result in alterations to natural surface water flows, loss of hollow bearing trees, and the removal of dead wood and dead trees which are considered to be key threatening processes under Schedule 3 of the *Threatened Species Conservation Act 1995*.

4.5.3 Proposed further assessments

Throughout the environmental assessment process, opportunities to avoid and / or minimise impacts to areas of ecological value would be investigated, where reasonable. A flora and fauna assessment would be prepared as part of the Environmental Impact Statement for the project. The flora and fauna assessment would include:

- Field surveys within the project corridor to determine the presence of endangered ecological communities and other vegetation communities.
- An assessment of impacts of the project on fauna habitat, including native vegetation loss, habitat fragmentation, wildlife corridors, loss of ecological connectivity and weed infestation.
- An assessment of the impacts on biodiversity, including impacts of the project on threatened species populations and ecological communities.
- Identification and management of key threatening processes associated with the construction and operation of the project.
- Recommended safeguards and management measures to minimise the impacts of the project on flora and fauna, in particular, threatened species, populations and communities and critical habitat.
- Assessment of matters of national environmental significance under the EPBC Act and preparation of a referral, if required, in accordance with the requirements of the EPBC Act.

4.6 Visual impacts and urban design

4.6.1 Overview

The project corridor covers a varied urban environment, comprising several distinct landscape character zones and visual catchments.

Kingsgrove to the Cooks River

To the west of the Cooks River, areas predominately consist of established low density residential development located along ridgelines with open spaces forming green corridors along the Wolli Creek and Bardwell Creek valleys. Increased residential densities, with commercial buildings, are located along major roads and within town centres focused around train stations. Pockets of light industrial areas, mostly consisting of large warehouse style buildings, are located at Kingsgrove, Arncliffe and Turrella. Older industrial areas, such as those at Arncliffe, are transitioning from an industrial to residential character. Major transport corridors intersect the area, including the M5 East Motorway and the Sydney Trains suburban rail lines.

The Cooks River

Along the Cooks River, open spaces dominate the low lying areas adjacent to the river, with significant landscape character changes occurring as part of the Wolli Creek redevelopment. Partially completed, this area has been transformed from industrial to a mixed use high rise development with associations with the historic Tempe House (a State Heritage item). Areas along the Cooks River have been re-shaped through reclamation associated with historic land uses and the development of Sydney Airport.

Tempe to St Peters

Moving north-east, the topography gently rises to the north. The urban landscape transitions from low-density and terrace-style residential areas located to the north-west of the Princes Highway, to large warehouse style commercial and industrial developments interspersed with container storage facilities, intermodal facilities and the Alexandria landfill to the south-east of the Princes Highway. Major transport corridors intersect the area, including the Princes Highway, the suburban railway and freight rail lines. Alexandra Canal, an item of State heritage significance under the *Heritage Act 1977* (refer to **Section 4.11.1** for additional information) also passes through the project corridor. The canal has been substantially modified and contains little to no natural features. The banks of the canal are inaccessible for most of its length within the project corridor, with industrial buildings backing onto the canal. Tempe Recreational Reserve, Tempe Wetlands and the Tempe Golf Driving Range are located north of the Cooks River on the eastern side of the Princes Highway, adjacent to the waterway.

Sydney Park

Sydney Park, located on a former industrial area and landfill at the northern extent of the project corridor, represents a large area of public open space. Smaller parks and pocket parks are interspersed within the residential areas to the north-west of the Princes Highway.

4.6.2 Summary of issues

Construction

Construction of the project has the potential for the following urban design and visual assessment related impacts:

- Visual impacts from active construction areas and the introduction of associated construction ancillary facilities. This includes lighting.
- Vegetation clearing within the project corridor.
- Construction traffic management measures such as road barriers and associated construction lighting.
- Construction management measures such as fencing and noise hoarding.

At the St Peters interchange, views of construction activities would be apparent from Sydney Park, to motorists on immediately surrounding roads, and from surrounding industrial and residential areas. Commercial buildings, located along the Princes Highway, would provide some screening for sensitive receivers to the north-west of the highway.

Where the project would be integrated with the M5 East Motorway, the corridor would be widened. Construction activities could be visible from open spaces along the motorway, as well as from residential and industrial areas where changes to motorway overbridges, embankments, noise walls or mounds, and vegetation are directly impacted or require modification.

Operation

Key visual aspects of the project to be addressed in the Environmental Impact Statement include:

- Visual impact of new infrastructure on existing views from residences and surrounding development including:
  - The interchanges and tunnel portals.
  - Surface infrastructure such as ventilation facilities.
  - Gantries and signs.
  - Noise mitigation measures, such as noise barriers and noise mounds, if required. The height and location of any new or modified noise walls (or mounds) would be informed by the future noise impact assessment and would be subject to consideration of the reasonableness and feasibility of such a noise mitigation approach. This would include the consideration of visual impacts.
- Impact to the motorist experience due to visual quality of new motorway infrastructure, structures and elements, and changes to the existing landscape, views and visual characteristics of existing roads.
- Impact on the landscape characteristics of existing open spaces adjacent to the project, and views from these spaces. The integration works associated with the M5 East Motorway may require additional land take within areas currently used for open space. The visual character of these spaces is already defined by the presence of the motorway. However, additional land take (if required) would need to consider any potential impacts on visual character and functionality of these spaces.

- The removal of mature trees and vegetation, if unavoidable through design.
- Overshadowing caused by surface infrastructure.
- Changes in light spill at St Peters interchange or at surface infrastructure.
- Impacts to existing pedestrian and cycle pathways adjacent to, along and across the corridor.
- Landscape character and visual impact associated with the possible creation of residual land areas adjacent to the project.

The visual impacts of the project would be dependent on the design features of the interchanges and other surface infrastructure, landscape treatments and the exploration of opportunities to integrate the surface infrastructure elements with the surrounding features of the area. Design of the portals, the interchange and surface infrastructure would take into consideration their visibility and presence within their context to ensure an appropriate design response. Integration works with the M5 East Motorway would also take into account visual integration with the design of the existing motorway to ensure an appropriate visual transition to and from the project. The design of the project would also be guided by the Urban Design Corridor Framework that is under development for the broader WestConnex program of works. This framework will ensure a consistent high quality design approach and outcome across all three stages.

4.6.3 Proposed further assessments

Further assessment of the potential for visual impacts and landscape character impacts along the project corridor would be conducted as part of the Environmental Impact Statement, which would include:

- Identification of the visual qualities present, including the existing landscape character of the region, sensitive locations, catchments and key viewpoints.
- An assessment of visual impacts from the construction and operational stages of the project on existing views and landscapes.
- An assessment of the urban design elements of the project.
- Identification of urban design mitigation measures, where required.

The design of the project would be in keeping with urban design principles for the project, the WestConnex Urban Design Corridor Framework and the Roads and Maritime guideline Beyond the Pavement: RTA urban design policy, procedures and design principles (RTA, 2009), which identifies the following urban design principles regarding road infrastructure:

- Contributing to urban structure and revitalisation.
- Fitting with the built fabric.
- Connecting modes and communities.
- Fitting with the landform.
- Responding to the natural pattern.
- Incorporating heritage and cultural contexts.
- Designing roads as an experience in movement.
- Creating self-explaining road environments.
- Achieving integrated and minimal maintenance design.

Additional guidelines would be considered, where applicable, during the design development process and the preparation of the Environmental Impact Statement:

- Bridge Aesthetics: Design guidelines to improve the appearance of bridges in NSW (RTA, 2012).
- Noise wall design guideline: Design guidelines to improve the appearance of noise walls in NSW (RTA, 2007).
- Landscape guideline: Landscape design and maintenance guidelines to improve the quality, safety and cost effectiveness of road corridor planting and seed (RTA, 2008).
- Shotcrete Design Guidelines: Design guidelines to avoid, minimise and improve the appearance of shotcrete (RTA, 2005).

4.7 Social and economic

4.7.1 Overview

Demographics

The project is located within the Canterbury, Hurstville, Rockdale, Marrickville, Botany Bay and Sydney Local Government Areas (LGAs). Key statistics of these combined LGAs are summarised in **Table 4-2** below.

Table 4-2 Key population statistics (Australian Bureau of Statistics, 2011)

Statistic	Description
Population	599,010
Median age	35 years
Main occupations	Professionals. Clerical and administrative workers. Technicians and trade workers. Managers.
Average motor vehicles per dwelling	1.3
Total in labour force	309,451
Main mode of travel to work	Marrickville LGA: Car (as driver or passenger) (35.8%), Train (20.5%) Canterbury LGA: Car (as driver or passenger) (58.7%), Train (15.1%) Hurstville LGA: Car (as driver or passenger) (55%), Train (20.8) Rockdale LGA: Car (as driver or passenger) (55.3%), train (18.2%) Botany LGA: Car (as driver or passenger) (56.9%), Bus (13.4%) Sydney LGA: Walk (25.3%), Car (22.8%)

Land use of high social value

Land uses of high social value within the project corridor comprises a mixture of facilities, including areas of for passive and active recreation, including parks, nature reserves, bushland, golf courses and sporting facilities, as well as churches, community halls, child care facilities, schools, medical centres and aged care facilities. A list of land uses of high social value are provided in **Appendix C**. Open spaces and recreational areas within the project corridor are shown on **Figure 4-3**.

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KEY

- Road
- Rail
- Watercourse
- Public Recreation
- Private Recreation

0 1 2 Km

Figure 4-3: Open space and recreational uses within the project corridor

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Economic context

Employment lands

The NSW Government defines employment lands as those lands which are zoned for industrial or similar purposes in planning instruments. The State Government established the Employment Lands Development Program for managing the supply of Employment Lands for the Sydney Region and assisting infrastructure coordination (refer to **Section 6.4** for additional information related to land use).

The draft *Metropolitan Plan for Sydney 2036* sets out employment capacity targets for key strategic employment centres. A summary of these targets for centres relevant to the Project corridor is provided in **Table 4-3**.

Table 4-3 Employment capacity targets of strategic centres relevant to the project

Strategic centre	2006 base employment	2036 long term employment capacity target	2006-2036 employment growth	2006-2036 employment growth (%)
Port Botany	12,000	16,000	+4,000	+33%
Sydney Airport	34,000	56,000	+12,000	+65%
Sydney	358,000	454,000	+96,000	+27%
Hurstville	10,000	17,000	+7,000	+70%
Kogarah	10,000	12,000	+2,000	+20%

Source: Metropolitan Plan for Sydney 2036

Areas of commercial and industrial land use

The M5 East Motorway is the main road freight, commercial and passenger route between Port Botany, the Sydney Airport, and south west Sydney. The motorway also provides access to the wider Sydney arterial and orbital network, including the M4 Motorway and Parramatta Road. The M5 East Motorway is also a key corridor for transport to and from freight intermodal terminals located at Cooks River, Enfield and Clyde.

Interchanges along the M5 East Motorway within the project corridor include intersections of the M5 East Motorway with King Georges Road, Bexley Road and the Princes Highway, as well as the intersection of West Botany Street with Marsh Street. These intersections provide access to areas of commercial and industrial land use within and surrounding the project corridor, including:

- King Georges Road provides a major link between the northern and southern parts of the Sydney orbital Motorway, and provides access to Roselands to the north and Beverly Hills to the south.
- Bexley Road provides access to commercial and retail precincts on Canterbury Road to the north and a number of public recreational spaces in Bardwell Valley to the south.
- Princess Highway provides access to the Sydney CBD to the north, Rockdale town centre to the south and industrial areas at St Peters, Alexandria, Marrickville and Tempe.
- West Botany/Marsh Street provides access to recreational facilities such as Arncliffe Base fields to the south and access to the Airport in the north.

4.7.2 Summary of issues

Construction

Construction of the project has the potential for the following social and economic related impacts:

- Impacts associated with property acquisition, including uncertainty for residents and business owners about the property acquisition process and potential need to relocate.
- Disruption to access to private properties, businesses and community facilities.
- Some increased trade during construction due to customers from the construction workforce.
- Impacts associated with acquisition (temporary and / or permanent) of areas of high social value.
- Temporary changes to access and potential for traffic delays and disruptions near to construction work, including for motorists, public transport users, pedestrians and cyclists, commercial and freight transport operators, and emergency services.
- Impacts on amenity for local residents, businesses and users of community facilities (including schools) located close to the construction compounds and proposed construction work, as a result of increased dust, noise and traffic from construction activities, including the haulage of spoil material and parking for construction workers.
- Temporary disruption to pedestrian and cycle access near construction work, including potential changes between King Georges Road and Bexley Road.
- Potential impacts on road safety for motorists, cyclists and pedestrians near to construction work and construction compounds, particularly at interchange upgrade locations.
- Potential impacts on the use of sections of Sydney Park, particularly along the edges close to Campbell Road. Barwon Park Road, the Princes Highway, Sydney Park Road and Euston Road.

Operation

There is the potential for operation of the project to have the following economic and amenity-related benefits:

- Improved access, connectivity and reliability for local and regional businesses, freight and communities.
- Improved amenity for residents, pedestrians and other users along major roads related to a reduction in road traffic noise and improved air quality.
- Increased road capacity to service growth in employment lands and residential developments.
- Improved travel times along local surface roads as a result of a reduction in congestion.
- Improved freight travel times for vehicles using the Project.
- Improved access to Sydney Airport and Port Botany.
- Improved accessibility for businesses.
- Community perceptions about increased severance, cohesion and access.
- Bypassing of suburbs, which would impact on businesses that rely on trade from passing vehicles.
- Amenity impacts to properties close to the project, due to changes in traffic noise, visual impacts of surface infrastructure and potential changes in air quality.
- Changes to local access and connectivity near surface roads.

A reduction of heavy vehicle traffic on major arterials would allow traffic to flow more freely, increasing local accessibility and reducing travel times for motorists, pedestrians and cyclists. The project would also provide a continuous motorway-standard service for vehicles travelling to and from western Sydney and the Sydney Orbital Network, facilitating more efficient movement of freight between centres of important economic activity. This would likely generate productivity benefits for the State economy, as well as other less tangible benefits related to potential increases in regional development.

The potential for increased severance, cohesion and access is anticipated to be minor, as the majority of the project would be in tunnel. However, surface components may fragment land and alter accessibility for residents and other users of these areas. Such changes are not expected to result in a significant loss of community cohesion within the area.

In removing a portion of traffic from surface roads, the project may have an impact on some businesses that rely on trade from passing vehicles (for example, service stations and fast food outlets). Alterations to traffic flow throughout the local road network may have similar implications for businesses in other suburbs.

4.7.3 Proposed further assessments

A social and economic impact assessment would be undertaken which would consider the potential impacts of the project (beneficial and adverse, as well as direct and indirect), including:

- A description of the social and economic profile for the communities and businesses surrounding the project.
- An assessment of the potential positive and negative impacts of the project on the social and economic values of the area during construction and operation.
- Identification of appropriate management and safeguard measures.

The assessment would consider the Environmental Planning and Impact Assessment Practice Note – Socio-Economic Impact Assessment (RMS, 2013).

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4.8 Land use and property

4.8.1 Overview

The project corridor spans the Hurstville, Canterbury, Rockdale, Marrickville, Botany Bay and City of Sydney local government areas. Land use and existing development within and around the project corridor is predominately urban in nature, containing a mix of residential, commercial, industrial and open space uses. There are several major transport corridors and infrastructure located in or adjacent to the study area, including the M5 East Motorway, the Princes Highway, the Sydney Trains suburban rail network and Sydney Airport.

Land uses within the project corridor comprise a mix of the following:

- Residential land

  Predominately low density residential, with medium and high density residential land uses located in areas close to public transport and along major roads. Land use changes are occurring within the project corridor as older industrial areas are redeveloped for residential purposes. This includes the significant mixed use redevelopment at Wolli Creek within the Rockdale local government area.

- Open space

  Nature reserves, active recreational uses (such as golf courses and sports grounds) and passive recreational uses, are located throughout the project corridor. This includes the Wolli Creek Regional Park, Cahill Park, Barton Park, the Kogarah Golf Course, Tempe Recreation Reserve and Sydney Park. Continuous open space corridors, consisting of smaller open spaces, are located along Bardwell Creek and Wolli Creek.

- Industrial and commercial land

  Concentrated in the suburbs of Kingsgrove, Turrella, Wolli Creek, Arncliffe, Tempe, St Peters, Mascot and Alexandria. Commercial uses are typically concentrated along major roads (such as the Princes Highway) and at train stations, alongside medium and high density residential uses. Community facilities, churches, schools, medical and veterinary centres are located along the length of the project corridor.

Land zoning within the project corridor is set by the following environmental planning instruments:

- Sydney Regional Environmental Plan No. 33 – Cooks Cove.
- Hurstville Local Environmental Plan 2012.
- Canterbury Local Environmental Plan 2012.
- Rockdale Local Environmental Plan 2011.
- Botany Bay Local Environmental Plan 2013.
- Marrickville Local Environmental Plan 2011.
- Sydney Local Environmental Plan 2012.

The regional zoning context of the project and the land use zoning within the project corridor are shown on **Figure 4-4** and **Figure 4-5** respectively. The zoning generally reflects actual land uses within project corridor and includes:

- General and light industrial.
- Business (ie commercial) zones, including centres, enterprise corridors along major road and business parks.
- Residential zones, ranging from low to high density.
- Mixed use zones (commercial and residential).
- Special infrastructure zones, which align with major transport infrastructure and corridors, as well as drainage, electricity infrastructure and educational establishments.
- Recreational zones (private and public).
- Conservation and waterways zones, including national parks and nature reserves.

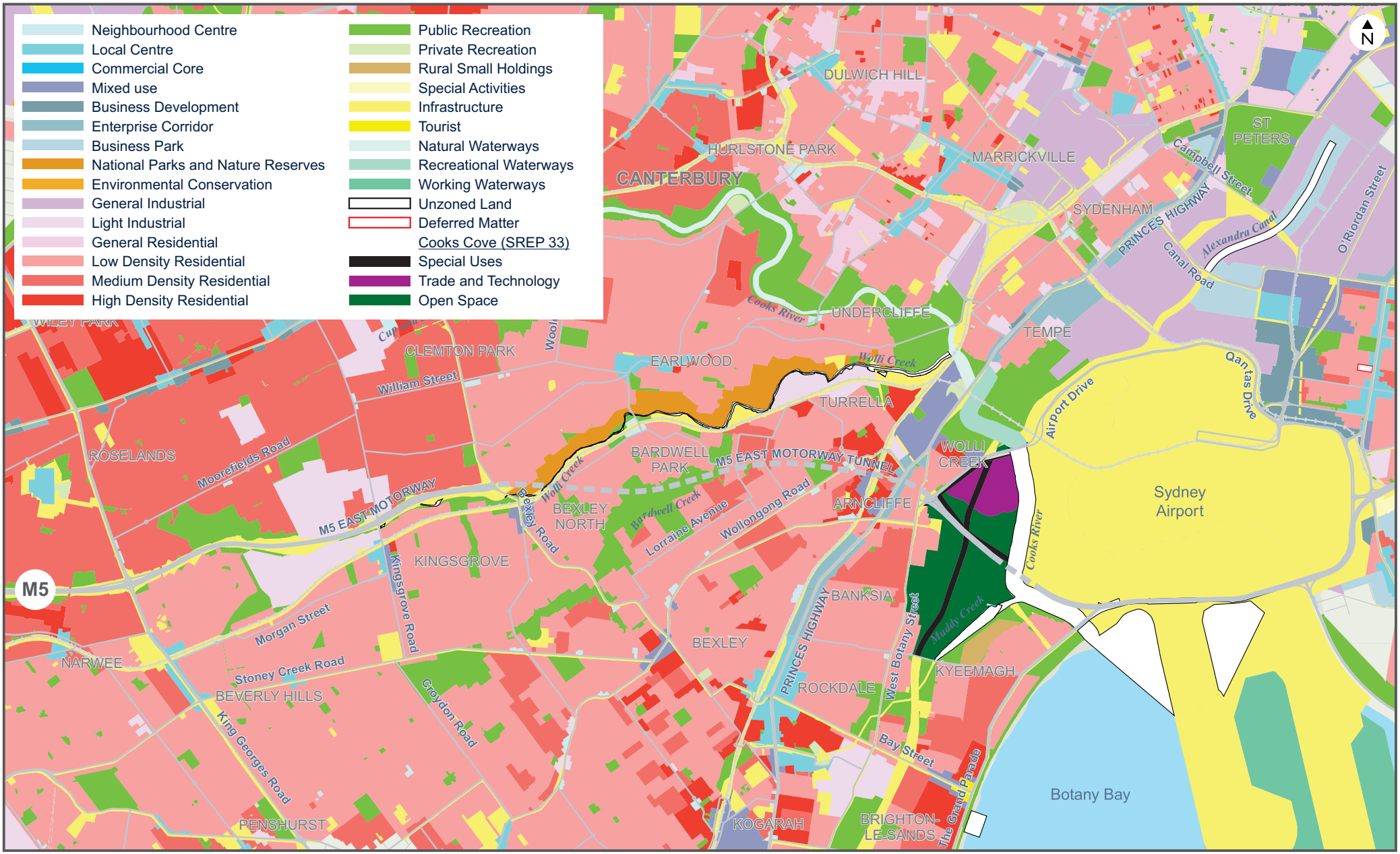
A number of strategic planning initiatives are also underway within the project corridor. This includes:

- The Princes Highway Corridor.
- Cooks Cove Precinct.
- The Mascot Station Town Centre Precinct (City of Botany Bay Council) and the Mascot Station Urban Activation Precinct (Department of Planning and Environment).
- Zoned and proposed employment lands.

The Princes Highway Corridor Strategy, an initiative of Rockdale City Council, was adopted by the Council in late 2013. The strategy focuses on revitalising the corridor within the Rockdale local government area for employment uses and growing the Arncliffe town centre. This strategy recommends the changes to the distribution of residential, mixed use and business zones, as well as increased densities.

The Cooks Cove Growth Centre is a 100 hectare precinct, which is bounded by the Cooks River and Muddy Creek, Marsh Street, West Botany Street and Bestic Street. It is subject to Sydney Regional Environmental Plan No. 33 – Cooks Cove. Preliminary strategies identified an area for employment uses near Marsh Street with the remainder of the site to be set aside for conservation, open space and recreational purposes. Planning for the site is now being handled by the Urban Growth Development Corporation.

The Mascot Station Town Centre Precinct, an initiative of City of Botany Bay Council, is centred on the Mascot railway station and is partially located within the project corridor. The area has been rezoned as part of the *Botany Bay Local Environmental Plan 2013*, and will allow for the intensification of residential and commercial land uses. The Department of Planning and Environment have also announced the Mascot Station Urban Activation Precinct, which also covers the area in the vicinity of the station. This strategic initiative would investigate the feasibility of increased residential and commercial uses in proximity to Mascot Station. These investigations are presently on hold to consider the interaction with WestConnex.



KEY

Road
Rail
Watercourse

Figure 4-4: Regional zoning context

0 1 2
Km

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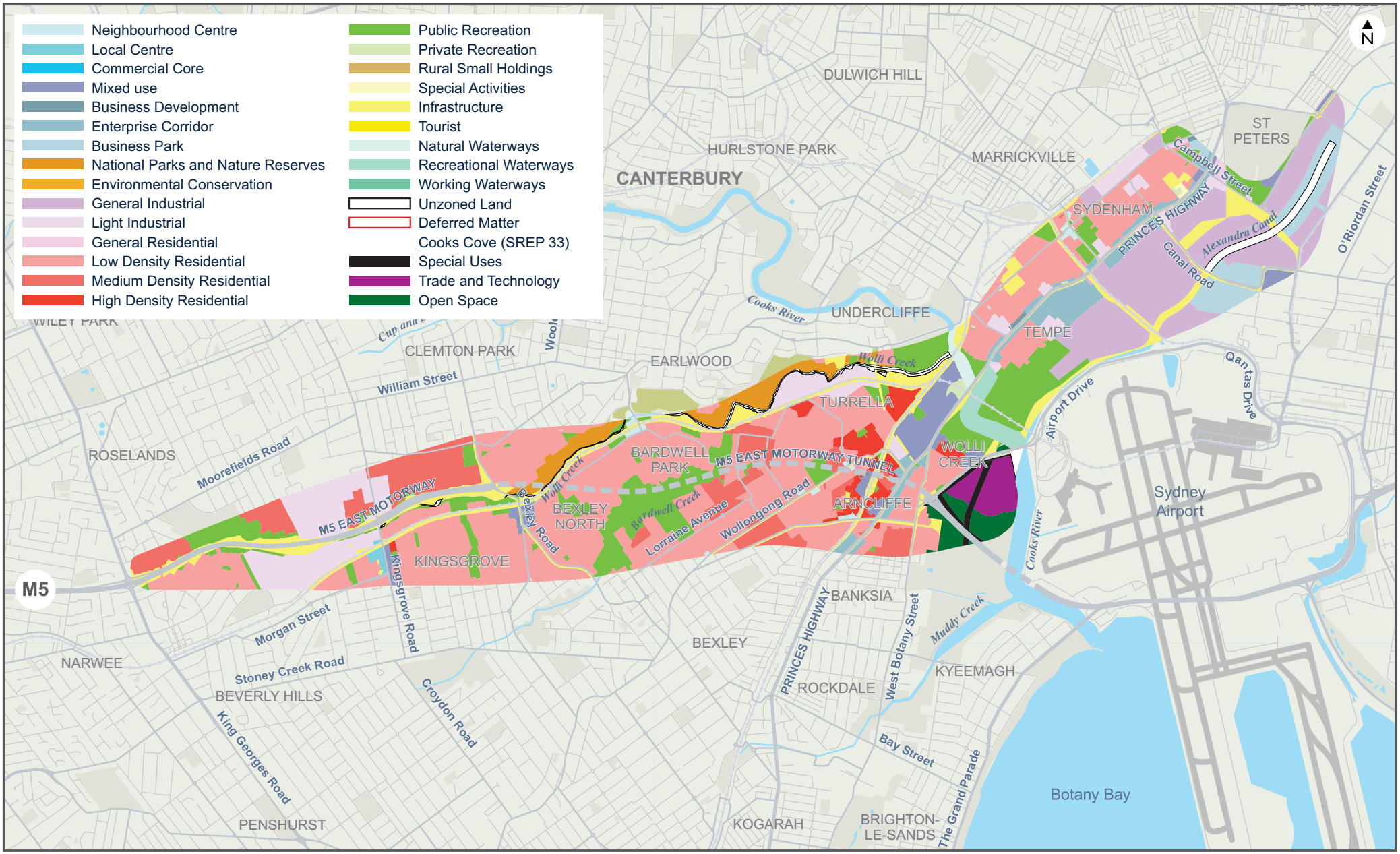

Figure 4-5: Land use zoning within the project corridor

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4.8.2 Potential impacts

Construction

During construction, potential impacts to land use and property issues could occur as a result of:

- Ancillary construction facilities, such as site compounds or construction sediment basins, if located outside of existing road reserves. This would potentially require full or partial land acquisition and a temporary change in land use.
- Temporary diversions for road construction, cyclists and pedestrians. Diversions of local roads, if required, would be identified in the Environmental Impact Statement, and would be managed in consultation with the relevant local Council and Roads and Maritime.
- Alteration and / or temporary disruption to property access. Alternative arrangements would be negotiated with the affected parties in order to enable continued access and to minimise disruption as much as reasonably possible.

Construction of the project also offers an opportunity to beneficially reuse the site for the St Peters interchange. Closure of the existing landfill will allow rehabilitation and landscaping associated with the motorway interchange.

The location and size of ancillary construction facilities would be developed during the design development process for the preferred project design and reflected in the Environmental Impact Statement. At a minimum, construction facilities would be required at the St Peters interchange and where the project would be integrated with the M5 East Motorway. Intermediate sites would also be required and would be dependent on the construction methodology for tunnelling and determining the location of ancillary operational facilities.

Existing land uses, site accessibility and potential opportunities to co-locate permanent operation facilities would be considered when determining the size and location of construction facilities. In the event that land is required that is not owned by the NSW Government, discussions would be held with the affected property owner concerning the purchase or lease of the land required during construction.

Operation

Impacts on land use and property could occur as a result of:

- Full or partial property acquisition to accommodate surface infrastructure and activities, such as at-surface roads, interchanges and ancillary infrastructure. The need for acquisition would be minimised, where possible, and the location of surface infrastructure would consider potential impacts on land uses.
- Severance and sterilisation of land. Options for incorporating sterilised or fragmented land into the future road corridor would also be investigated, or alternatively, suitability for the land to be consolidated and resold following the completion of construction would be explored.
- Changes in property access. In some cases, accesses would require permanent relocation to cater for new or widened road reserves. The extent of such changes, including the number of properties affected and whether access would be lost or relocated, would be assessed and identified in the Environmental Impact Statement.
- Changes to development potential of properties.
- Impacts on land uses along key surface roads within the project corridor due to the associated improvements to amenity and local network efficiencies. Improvements to travel times would also deliver benefits to businesses that would support the continued growth of key employment areas in the immediate vicinity of the project corridor (such as the Port Botany precinct).

- Full or partial property acquisition for the location of permanent operational ancillary facilities.

With the majority of the project being in tunnel, substantial direct land use impacts would generally be avoided for the majority of the project length in terms of acquisition, severance or sterilisation. As such, direct land use and property impacts are anticipated to be limited to areas where surface components are proposed that extend outside existing road corridors. This is anticipated to occur primarily in areas close to the southern and northern extents of the project and at other surface infrastructure locations.

The potential impacts on any relevant future strategic planning initiatives being progressed by the Department of Planning and Environment and the Urban Growth Development Corporation (as detailed earlier in this section) would be dependent on the preferred project design. These would be identified and assessed as part of the Environmental Impact Statement, supported by consultation with these agencies.

4.8.3 Proposed further assessment

A detailed assessment of the land use and property issues of the area would be undertaken. This would include:

- The identification of the local land uses, existing access arrangements and potential property acquisition for both public and private land adjacent to the project.
- Assessment of the potential impacts of the project on property, land use (including approved developments) and access arrangements during construction and operation of the project.
- Identification of appropriate management and safeguard measures to minimise these impacts.

4.9 Hydrology and flooding

4.9.1 Overview

The project corridor is located within the Cooks River catchment, which covers an area of about 10,200 hectares and flows for about 23 kilometres from Graf Park in Bankstown into Botany Bay at Kyeemagh (Cooks River Alliance 2013).

The River was stripped of its natural vegetation during early European settlement and has been subject to long term anthropogenic degradation. The landscape and natural function of the catchment has been impeded by dredging and artificial channel modifications, including re-alignment.

The eight tributaries of the Cooks River are:

- Greenacre Creek.
- Cox's Creek.
- Cup and Saucer Creek.
- Fresh Water Creek.
- Bardwell Creek.
- Wolli Creek.
- Muddy Creek.
- Sheas Creek / Alexandra Canal.

Water quality of the Cooks River catchment is discussed in **Section 4.10** (Geology, soils and water quality).

Wolli Creek and Alexandra Canal / Sheas Creek sub-catchments are located within the project corridor. The locations of key waterways within the project corridor are shown on **Figure 4-6**.

Wolli Creek is the largest tributary of the Cooks River. The creek runs through the Wolli Creek Valley in a north-easterly direction from Kingsgrove in the west, joining the Cooks River near Tempe.

Wolli Creek is a concrete channel for 3.5 kilometres, from its westernmost extent in the vicinity of the King Georges Road interchange to Bexley Road in the east, where the watercourse flows through a box culvert. East of Bexley Road, Wolli Creek comprises a natural streambed, which flows through Wolli Creek Valley and Wolli Creek Regional Park. Wolli Creek is joined by the Bardwell Creek tributary within Wolli Creek Regional Park on the northern side of the passenger rail line at Bardwell Park, before reaching its confluence with the Cooks River south of Wentworth Park, Wolli Creek.

Alexandra Canal is an adapted artificial waterway (formerly known as Sheas Creek), which extends for about four kilometres from Huntley Street, Alexandria in the north-west to its confluence with the Cooks River at Tempe. Alexandra Canal was built during the 1890s to provide access for water transport for the delivery of cargo (Heritage Branch 2014).

Sections of the project corridor in proximity to Wolli Creek, Alexandra Canal / Sheas Creek and the Cooks River are located within land which could potentially be affected by a one in 100 year Average Recurrence Interval flood event.

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KEY

- Wolli Creek Regional Park
- Road
- Rail
- Waterbody
- Named watercourse
- Drainage line

Figure 4-6: Key waterways within the project corridor

0 1 2 Km

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4.9.2 Summary of issues

Construction

Construction of the project has the potential to result in the following surface water:

- Changes to flooding regimes from construction work and / or from the positioning of temporary construction infrastructure within areas of flood prone land.
- Impacts to the geomorphology of creeks that receive treated groundwater discharges.
- Reduction in water quality from erosion and sedimentation and / or discharge of water into waterways.

Operation

Operation of the project has the potential to result in impacts to surface water from the following activities:

- Impact to the geomorphology of receiving watercourses due to the discharge of treated groundwater and other waste waters (such as tunnel wash or deluge system water). The discharge would likely be into a local watercourse, such as Wolli Creek, the Cooks River or Alexandra Canal. This could depend on the discharge volumes and the point of discharge.
- Increased impervious surfaces and/or changes to the total catchment area of existing drainage infrastructure due to surface work at tunnel portals and tie-ins to existing roads. This could lead to potential localised flooding. Considerable increases to runoff at these locations could potentially require upgrades to existing drainage infrastructure, and may require additional mitigation measures (such as stormwater drainage basins and the like).
- Potential obstruction to flood flows as a result of new infrastructure or a reduction in flood plain, which could have an impact downstream flooding behaviour or on nearby existing developments.

4.9.3 Proposed further assessments

The Environmental Impact Statement for the project would include an assessment of the potential construction and operational impacts on surface water and flooding, including identification of the following:

- Likely groundwater discharge volumes into local watercourses during construction and operation, and the potential impacts on geomorphology of those waterways. Associated impacts on biodiversity values are considered in **Section 4.5**.
- Potential flooding impacts during construction and / or operation of the project.
- Operational drainage infrastructure required to convey stormwater flows.
- Required alterations to existing road drainage infrastructure in the vicinity of surface work at tunnel portals and tie-ins to existing roads.
- Required connections to third party stormwater systems for operational surface ancillary facilities.
- Appropriate mitigation and management measures to safeguard the environment during construction and operation of the project.

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4.10 Geology, soils and water quality

4.10.1 Overview

Topography

Western areas of the project corridor are relatively flat, low lying, with gentle undulating hills ranging between 30 metres Australian height datum (AHD) and 40 metres AHD.

Wolli Creek and its southern tributary, Bardwell Creek have incised gullies through a subterranean (under the surface) sandstone and shale plateau, which is higher in elevation than in other parts of the Sydney basin. Wolli Creek flows to the east to join the Cooks River. The Wolli Creek and Cooks River valleys widen as they approach Botany Bay and the incised valley floors have been filled with alluvial sediment to create flat alluvial plains. The Wolli Creek and Cooks River channels have been modified over much of their length to improve drainage and control flooding.

The topography of the project corridor near the confluence of Wolli Creek and the Cooks River is relatively flat and low-lying (around five metres AHD to 10 metres AHD), and gradually declining towards Botany Bay. Land within and adjoining the central and north-eastern areas of the project corridor have been substantially modified over time due to land reclamation and industrial activities. This has resulted in large areas of low-lying flat land. Terrain in areas to the north-west of the Princes Highway is undulating following a gentle rise from the Cooks River.

Soils

Soils within the project corridor are identified from the Soil Landscapes of the Sydney 1:100,000 Sheet (Chapman, G.A and Murphy, C.L., 1989). The Gymea soil landscape covers the majority of the project corridor in the west, with smaller areas of the Hawkesbury, Blacktown, Birrong, Warriewood and Oxford Falls soil landscapes. The eastern extent of the project corridor is largely covered by land identified as being disturbed terrains, associated with Alexandra Canal and industrial land uses. Relevant characteristics of these landscapes are provided in **Table 4-4**.

Table 4-4 Soil landscapes within the project corridor

Soil Landscape	Limitations
Gymea (Gy)	• Undulating to rolling rises and low hills on Hawkesbury Sandstone. • Localised steep slopes. • High soil erosion hazard. • Rock outcrops. • Shallow, highly permeable soil. • Very low soil fertility.
Hawkesbury (Ha)	• Rugged, rolling to very steep hills on Hawkesbury Sandstone. • Extreme soil erosion hazard. • Mass movement (rock fall) hazard. • Steep slopes. • Rock outcrops. • Shallow, stony, highly permeable soil. • Low soil fertility.
Blacktown (Bt)	• Gently undulating rises on Wianamatta Group shales and Hawkesbury shale. • Moderately reactive highly plastic subsoil. • Low soil fertility. • Poor soil drainage.
Birrong (Bg)	• Level to gently undulating alluvial floodplain draining Wianamatta Group shales. • Localised flooding. • High soil erosion hazard. • Saline subsoil. • Seasonal waterlogging. • Very low soil fertility.
Oxford Falls (Of)	• Hanging valleys on Hawkesbury Sandstone. • Very high soil erosion hazard. • Perched water tables and swamps. • Highly permeable soil. • Very low to low soil fertility. • Localised rock outcrop.
Warriewood (Wa)	• Level to gently undulating swales, depressions and infilled lagoons on Quaternary sands. • Localised flooding and run-on. • High water table. • Highly permeable soil.
Disturbed (xx)	• Level plain to hummocky terrain, extensively disturbed by human activity, including complete disturbance, removal or burial of soil. • Dependent on nature of fill material. • Mass movement hazard. • Unconsolidated low wet-strength materials. • Impermeable soil. • Poor drainage. • Localised very low fertility. • Toxic materials.

Acid sulfate soils and potential acid sulfate soils are naturally occurring soils containing iron sulfides which, on exposure to air, oxidise and create sulfuric acid. This increase in acidity can result in the mobilisation of aluminium, iron and manganese from the soils. The project corridor is located on land classified as Class 1, 2, 3, and 5 acid sulfate soils. Definitions of the acid sulfate soils classes are provided in **Table 4-5** below.

Table 4-5 Acid sulfate soils class definition

Acid sulfate soils class	Work which would potentially expose acid sulfate soils
Class 1	Any work
Class 2	Work beyond the natural ground surface and work by which the watertable is likely to be lowered.
Class 3	Work beyond one metre below the natural ground surface and work by which the watertable is likely to be lowered beyond one metre below the natural ground surface.
Class 4	Work beyond two metres below the natural ground surface and work by which the watertable is likely to be lowered beyond two metres below the natural ground surface.
Class 5	Work within 500 metres of adjacent Class 1, 2, 3, or 4 land which are likely to lower the watertable below 1 metre AHD on adjacent Class 1, 2, 3 or 4 land.

Source: Acid sulfate soils assessment guidelines (Ahern C. R., Stone, Y. and Blunden, B., 1998)

A search of the Australian Soils Resource Information System indicated the majority of the project corridor has a low to extremely low probability of occurrence of acid sulfate soils. Land adjacent to watercourses, namely the Cooks River, Wolli Creek and Alexandra Canal were identified as having a high probability of acid sulfate soils occurring. These areas correspond to land identified as containing Class 1, 2 and 3 acid sulfate soils.

Geology

The geology along the project corridor has been interpreted using the Geology of the Sydney 1:100,000 Sheet 9130 (Herbert, C. 1983). A summary of the geological units present within the Project corridor is provided in **Table 4-6**. The geology of the project corridor relates to the Sydney Basin Stratigraphy, with Ashfield Shale (part of the Wianamatta Group) overlying Hawkesbury Sandstone. The Mittagong Formation separates the Ashfield Shale from the underlying Hawkesbury Sandstone over much of the Sydney Basin.

Ashfield Shale corresponds to ridgelines within the project corridor, and is present largely in the west and to the north of Sydney Airport. The Ashfield Shale is estimated to be around 60 metres to 70 metres in thickness, and consists of siltstone and laminate subgroup units.

The Mittagong Formation comprises fine grained sandstone and siltstone. The thickness of the formation is variable but is generally less than 10 metres.

Hawkesbury Sandstone is present towards the Cooks River within the project corridor, in areas of steeper topography. Hawkesbury Sandstone is a medium to coarse grained quartz sandstone deposited in beds one to three metres thick.

Hawkesbury Sandstone and Ashfield Shale are overlain by unconsolidated Quaternary sediments in areas adjacent to the Cooks River and Alexandra Canal.

Table 4-6 Geological units within the project corridor

Unit	Era	Period	Epoch	Environment / Palaeo-environment
Qha	Cainozoic	Quaternary	Holocene	Stream alluvial and estuarine sediment.
Qhs	Cainozoic	Quaternary	Holocene	Freshwater swamp.
Qhd	Cainozoic	Quaternary	Holocene	Transgressive dune.
Rwa	Mesozoic	Triassic	Middle Triassic	Potentially lacustrine (related to a lake).
Rh	Mesozoic	Triassic	Middle Triassic	Braided alluvial channel fill.

Source: Geology of the Sydney 1:100,000 Sheet 9130 (Herbert, C. 1983)

Sections of the project corridor in the vicinity of Tempe and St Peters are understood to be located beneath or proximal to the location of historical brick pits, quarries and disposal facilities, which are underlain by Pleistocene aged Botany Sands, comprising Aeolian sand and dune deposits with lenses of peat and clay.

Groundwater

Groundwater along the project corridor is present within the Ashfield Shale and underlying Hawkesbury Sandstone, although the Ashfield Shale is not always present along the project corridor.

Groundwater levels within the two main geological units are variable but typically the shape of the regional water table is a subdued reflection of the topography with the water table being deepest beneath hills and shallowest beneath creeks or gullies.

The quality of groundwater within the Ashfield Shale is generally saline and corrosive. Groundwater quality within the Hawkesbury Sandstone is generally of good quality and often of potable quality. Elevated concentrations of dissolved iron and manganese naturally occur within the Hawkesbury Sandstone which can cause iron staining when discharged. Groundwater quality in the upper part of the Hawkesbury Sandstone is sometimes poor due to leakage from the overlying Ashfield Shale.

Perched groundwater is also present within weathered sections of the Ashfield Shale. The perched groundwater typically forms isolated pockets of groundwater above the regional water table. Perched groundwater is not continuous and does not form an aquifer.

An alluvial and coastal sand bed aquifer, the Botany Sands Bed aquifer, is located in areas surrounding Botany Bay, and extends along the Cooks River and its tributaries, as well as north towards Centennial Park. There are two main groundwater systems operating within the Botany Sand Beds; the deeper, confined fractured / porous Triassic Hawkesbury Sandstone and upper Quaternary Botany Sand Beds (Ivkovic, K M, Marshall, S K et. al 2013). The upper Quaternary Botany Sands aquifer has a shallow water table and unconfined to semi-confined. The sediments within the sand beds are highly permeable, resulting in the semi-confined layers of the sand beds being highly vulnerable to contamination. For this reason, parts of the aquifer are under embargo for certain uses due to contamination. This is discussed later in this section.

The project corridor is also located within land under regulation by the Greater Metropolitan Region Groundwater Sources Water Sharing Plan.

Sixty-seven existing registered bores have been identified in close proximity to the project M5 Project corridor from a search of the NSW Natural Resource Atlas. These boreholes include:

- Fifty-one monitoring bores.
- Ten domestic bores.
- Five recreation bores.
- One test bore.

Water quality

The catchments located within the project are identified in **Section 4.9** (Hydrology and flooding). The Cooks River catchment is regarded as one of the most polluted urban river catchments in Australia. Water quality of the catchment has been affected historically by stormwater pollution, industrial and domestic wastewater discharge, rubbish dumping and modifications of the waterway. Present levels of pollutants, including nutrients, sediments, toxicants and faecal coliforms make the Cooks River unsafe for swimming, unsuitable for many aquatic species and a health risk for commercial fishing.

Sewage overflows, rubbish dumping and stormwater pollution continue to affect the water quality of the catchment. Detrimental impacts to the Cooks River catchment are further compounded by continued urbanisation within the catchment area, hindering opportunities to improve the management, environmental and recreational qualities of the Cooks River.

Contamination

Areas of known contamination

There are six contaminated sites within the project corridor listed on the Environment Protection Authority's Contaminated Land record (EPA, 2014). Details of these sites and the nature of their contamination are provided in **Table 4-7**.

The St Peters interchange would be located on land that includes a former quarry that has operated as a landfill since about 1988 (the Alexandria landfill site). It would be progressively made suitable for road infrastructure purposes. This may include removal of waste materials for disposal at an appropriately licensed waste facility, closure of the landfill including capping, upgraded pollution control systems, and rehabilitation and landscaping of the land.

The Botany Sands aquifer is highly vulnerable to contamination. Botany and its surrounding suburbs have been heavily used by industry for more than 100 years, including tanneries, metal platers, service stations and depots, landfills, dry cleaners and wool scourers. Industrial activity has been undertaken in this area largely before any environmental protection controls were in place, and as a result, heavy metals including chromium, nickel, lead and arsenic may have contaminated the aquifer.

Some of these industrial uses have led to contamination of the groundwater within the aquifer. Because of known or potential contamination, the NSW Government has taken a precautionary approach to ensure public health is not put at risk from exposure to potentially contaminated groundwater. Under the precautionary approach, the Botany Sand Beds aquifer is divided into four management zones; the known contaminated Orica exclusion area, and three other management zones. Domestic groundwater use is banned within all four management zones in order to minimise the risk to bore users and prevent the spread of contamination through pumping. Industrial bore users within all management zones are required to test their bore water annually and report the results of testing to the NSW Office of Water and the Office of Environment and Heritage. There has been an embargo in place since August 2003 on the acceptance of new licence applications to extract groundwater.

Areas of potential contamination

There are a number of current and former land uses within the project corridor which may have resulted in contamination. These include service stations and industrial facilities. As the development of the design progresses the likelihood that these areas would be affected would be known and approaches to mitigate impacts would be developed.

The bed of Alexandra Canal is declared as a remediation site under the *Contaminated Land Management Act 1997*. The bed sediments of Alexandra Canal have been identified as containing chlorinated hydrocarbons, including organochloride pesticides (chlordane, total DDT and dieldrin), polychlorinated biphenyls and metals. The contamination of the bed sediments has been found to present a significant risk of harm to human health and the environment (NSW Environment Protection Authority, 2000).

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Table 4-7 Land within the project corridor declared as significantly contaminated under the Contaminated Land Management Act 1997

Contaminated Site	Contaminants present	Nature of contamination
Pioneer Plating Work 25-29 Ricketty Street, Mascot. Part Lot K in DP356471 and Lot B in DP399409.	• Total petroleum hydrocarbons (TPH). • Benzene, toluene, ethyl benzene and xylene (BTEX). • Total cyanide. • Heavy metals, including cadmium, chromium (III and VI), copper, nickel and zinc.	• The contaminants have been introduced to the site from past activities and through the importation of contaminated fill. The contaminants are or may be exposed across the surface of the site and are impacting on groundwater beneath the site.
Former drum reconditioning facility 15 Campbell Street, St Peters. Lot 1 DP 223531.	• Polycyclic aromatic hydrocarbons (PAHs). • TPHs. • BTEX. • Napthalene.	• PAHs, TPH and BTEX are present in the soil on the site at levels significantly exceeding guideline levels for sensitive land use. • Napthalene is present in groundwater on the site at levels about relevant trigger values for the protection of aquatic ecosystems. • TPH is present in the groundwater at significant concentrations. • It is likely contaminated groundwater on the site is migrating off-site towards Alexandra Canal.
Former Tempe Tip. 2-14 Fisher Street, Petersham. Lot 1 DP 62963, Lot 1 DP124394, Lot 8 Sec 20 DP57638, Lot 7 DP63236, Lot 3 DP662867, Lot 1 DP124399, Lot C DP385209, Lot F DP385210, Lot A DP382059, Lot 40 DP 746918, Lot 3 DP 261958, Lot 723 and Lot 725 DP48012, Lot 19 and lot 20 DP 825649, Lot 2 DP869306.	• Ammonia	• Leachate containing ammonia is migrating offsite towards the adjoining Alexandra Canal via groundwater flow, further contaminating the watercourse. • Applicable guidance levels for ammonia in water have been markedly exceeded. • The ammonia migrating off site is causing harm to fresh water biota in contact with the contaminated groundwater and to water quality in Alexandra Canal as a receiving body of the contaminated groundwater.

Contaminated Site	Contaminants present	Nature of contamination
Alexandra Canal Off Swamp Road, Tempe. Lot 1 DP532493, Lot 1 DP749404 and Lot 3 DP 878489.	• Chlorinated hydrocarbons, including organochlorine pesticides (chlordane, total DDT and dieldrin). • Polychlorinated biphenyls (PCBs). • Metals.	• The contaminants within Alexandra Canal are present within the bed sediments in such a way as to present a significant risk of harm to human health and the environment. • Contamination at the site presents a significant risk of harm because harm is being caused to benthic biota in contact with contaminants in the sediments and to humans from increased risk associated with the consumption of contaminated fish. Disturbance of the sediments would mobilise the contaminants and increase the risk of harm.
Solvent Recycler and Distributor 61 Turella Street, Turella Lot 1 DP563180	• Tetrachloroethene (or perchloroethylene (PCE)). • Trichloroethene (TCE). • Cis-1, 2-dichloroethene (DCE). • Chloroethene (vinyl chloride (VC)). • Dichloromethane (DCM). • TPHs • BTEX	• Groundwater at the site is contaminated with high concentrations of chlorinated solvents and petroleum hydrocarbons exceeding human health and ecological guideline criteria. • Contaminated groundwater may be migrating offsite where there is the potential for exposure to occur.
Roads and Maritime Services Land Lot 3 Jackson Place, Earlwood Lot 1 DP557246	• Lead. • DDT (including breakdown products). • Asbestos.	• The Site is contaminated is contaminated with concentrations of primarily lead and organochlorine pesticides (OCP), as well as some polycyclic aromatic hydrocarbons (PAH). • Asbestos in bonded cement and fibre forms has been detected in soils on the Site.

4.10.2 Summary of issues

Construction

Construction of the project has the potential for the following soil, groundwater and contamination related impacts:

- Impacts to water and soils due to spills or leaks of fuels and / or oils from construction plant and equipment and / or from vehicle / truck incidents.
- Impacts to water and soils due to spills or leaks of other hazardous substances and dangerous goods from construction work and / or from vehicle / truck incidents
- Exposure of soils during construction resulting in direct erosion impacts. This may lead to dirty water runoff and sedimentation in local watercourses including Wolli Creek, the Cooks River, Alexandra Canal and / or Botany Bay or on adjacent land.
- Interception of groundwater, which may require treatment before re-use or disposal. The volumes of groundwater and treatment requirements would differ depending on the depth of the tunnel to be constructed, and the geological units through which it passes. It is expected as a minimum, treatment for suspended solids would be required, and further consideration would need to be given to the management of potentially contaminated groundwater, as well as elevated levels of salinity, iron and manganese.
- Discharge of treated groundwater from tunnel construction work. It is likely that groundwater encountered by tunnelling activities would be discharged to a local watercourse as surface water. Alternatively, groundwater may be discharged to sewer under a trade waste agreement.
- Generation of a net surplus of spoil as tunnelling would comprise of a large component of the project. Construction of a tunnel within the project corridor would likely occur within the Ashfield Shale and Hawkesbury Sandstone geological units.
- Interaction with quaternary aged sediments present within the project corridor may include soft clays and organic soils, loose silts and sands. These can pose a constraint to construction for reasons such as instability, low bearing capacity and settlement. These constraints are commonly encountered and established treatment options are available for structures, earthworks and pavements.
- Disturbance of contaminated soils, especially if surface work is undertaken within land known to be contaminated, or on land which has been identified as potentially contaminated based on current and historic activities. Disturbance of contaminated soils has the potential to result in offsite pollution.
- Potential disruption of contaminated bed sediments within Alexandra Canal from bridge construction.
- Exposure of soil containing acid sulfides to oxygen, resulting in the production of sulfuric acid, which may become bioavailable in the environment and affect local aquatic ecosystems, water quality and visual amenity.

Operation

Depending on the final design, the tunnel component of the project may either be drained or undrained. An un-drained tunnel precludes the inflow of groundwater into the tunnel. A drained tunnel allows ongoing groundwater inflow requiring groundwater collection, treatment and discharge during the operational phase.

If the final design of the tunnel component of the project is a drained tunnel (ie a tunnel allowing ongoing groundwater inflow), local groundwater in the vicinity of the tunnel may be drawn down to the tunnel invert level. This may impact the functionality of existing groundwater bores listed above and could have an impact on groundwater dependent ecosystems. Should the final design include a drained tunnel, there is the potential for contaminated groundwater to be intercepted as part of ongoing groundwater inflow. The extent of potential impact, if any, on existing bores, would be considered in the Environmental Impact Statement for the project.

Other potential impacts during operation would also include:

- Impact to water quality of receiving watercourses due to the discharge of treated groundwater and other waste waters (such as tunnel wash or deluge system water). The discharge would likely be into a local watercourse, such as Wolli Creek, the Cooks River or Alexandra Canal. This could have an impact on the water quality of the receiving waterway, depending on the discharge volumes, treatment and the point of discharge.
- Impact to water quality of receiving watercourses due to increased runoff from roads. This would typically contain oils and greases, petrochemicals and heavy metals as a result of vehicle leaks, operational wear, road wear and atmospheric deposition. Increased flows could also lead to increased potential for scouring of soils and watercourses.
- Spills or leaks of fuels and / or oils from vehicle accidents, or from operational plant and equipment.

4.10.3 Proposed further assessments

Geotechnical, groundwater preliminary contamination and environmental investigations are currently underway to inform the design and construct tender process and the Environmental Impact Statement. These investigations will identify the ground conditions for tunnelling and hydrogeological conditions across the project corridor, as well as provide preliminary contamination information. These investigations would include an assessment of the groundwater quality at monitoring well locations, anticipated groundwater flow rates.

Geotechnical investigations would inform the design of the tunnel and therefore the expected quantities of spoil from tunnelling activities (refer to **Section 5.5** for additional information related to resource management and waste). The quantity of spoil would also depend on the tunnelling technique adopted for the project. Spoil management is discussed further in **Section 4.11**.

The Environmental Impact Statement for the project would also include:

- Details of the landfill closure plan for the Alexandria landfill site, including how closure works would be consistent and coordinated with construction and operation of the St Peters interchange.
- Identification of waterways and groundwater systems that may be impacted by the construction and operation of the project.
- Assessment of the potential impacts to soil and water, including field investigations.
- Assessment of the risk of erosion and sedimentation in accordance with RMS Erosion and Sedimentation Management Procedure (RMS, 2008).
- Likely groundwater discharge volumes into local watercourses during construction and operation, and the associated impacts on water quality. Associated impacts on biodiversity values are considered in **section 4.5**.
- Assessment of potential settlement along the tunnel alignment and the potential impacts to structures and infrastructure.
- Identification of areas of known contamination or with potential contamination (soil and groundwater) that could be impacted by the project, and the potential impacts associated with the disturbance of these areas. This would be supported by investigations to identify, quantify and assess the contamination.

4.11 Non-Aboriginal heritage

4.11.1 Overview

The project corridor spans an area which was initially colonised soon after European settlement in 1788. Now known as Wolli Creek, the Cooks River swampland made early access from Sydney Cove difficult and was an inhibiting factor for early and intensive settlement. Land grants began in 1799 and were generally divided into areas of small farms and large estates which saw mansions such as Tempe House erected as retreats for their owners. By the later 19th century, particularly near the waterfront, older houses and mansions were being replaced by working class housing and industries. This saw the establishment of industrialisation in suburbs such as Arncliffe and Mascot (Thorp, 1994).

A preliminary non-Aboriginal heritage desktop assessment was performed in August 2014, which included a search of relevant statutory and non-statutory heritage databases and a review of the heritage listings within local environmental plans. These included:

- NSW State Heritage Register and Inventory.
- Section 170 Heritage and Conservation Registers administrated by Sydney Water, Department of Commerce, RailCorp, Roads and Maritime, Ausgrid and NSW Ports.
- Hurstville Local Environmental Plan 2012.
- Canterbury Local Environmental Plan 2012.
- Rockdale Local Environmental Plan 2011.
- Botany Bay Local Environmental Plan 2013.
- Marrickville Local Environmental Plan 2011.
- Sydney Local Environmental Plan 2012.
- Register of National Estate.
- National Trust of Australia.
- Australian Heritage Places Inventory.
- Commonwealth and National Heritage Lists.

A number of heritage items were identified within the project corridor (refer to **Figure 4-7**). Of these, nine items were identified as being of State significance, being:

- Sydenham Railway Station group.
- Alexandra Canal.
- Southern and Western Suburbs Ocean Outfall Sewer (SWSOOS)—Western Main Carrier.
- St Peter's Anglican Church.
- Cairnsfoot Special School.
- A Timber slab cottage, Tempe.
- Milford Haven.
- Tempe House and St Magdalene's Chapel.

The remaining items are of local significance and/or listed on Section 170 Heritage and Conservation registers.

The majority of items identified within the project corridor are:

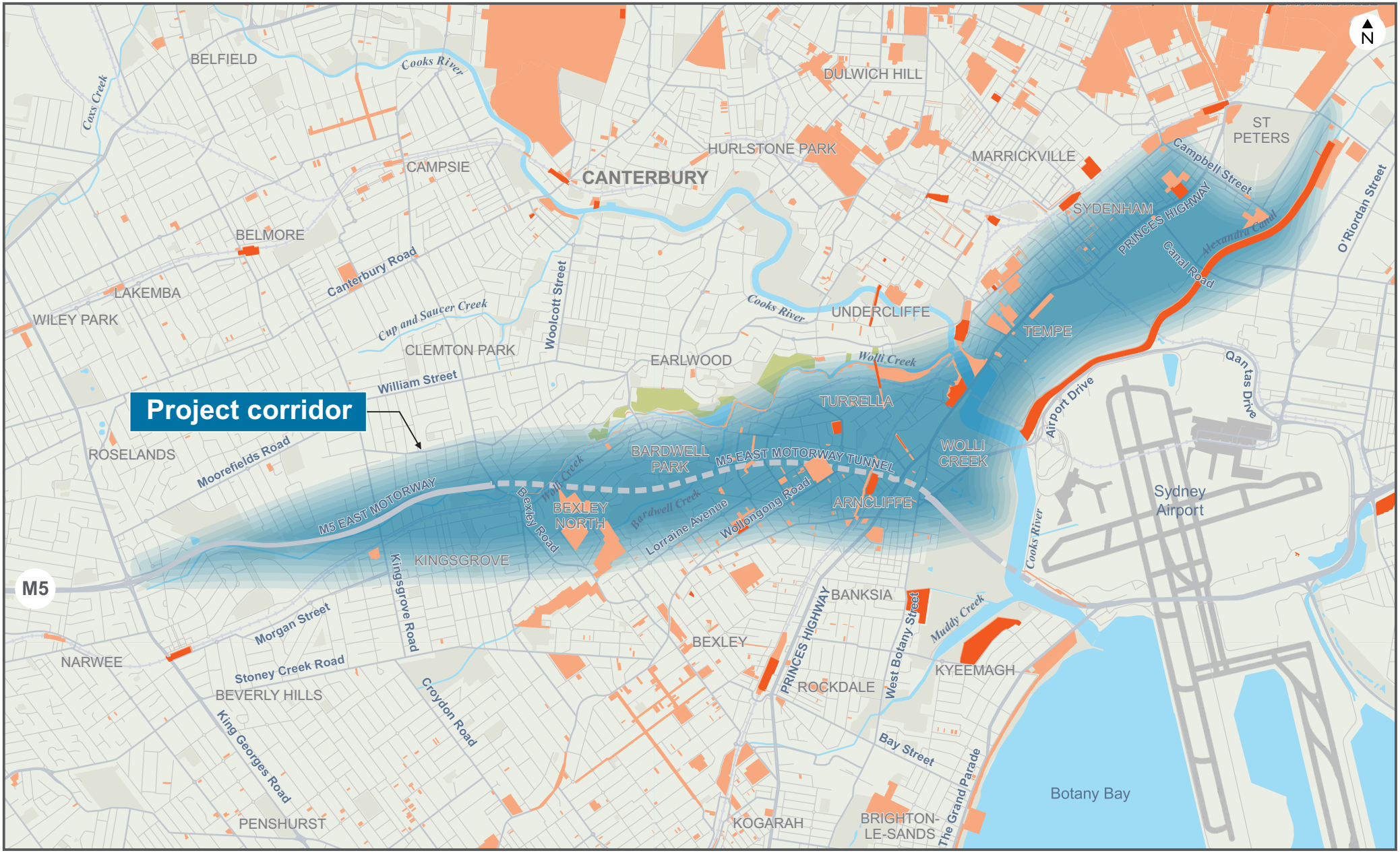
- Houses and structures (school, churches, cottages, brickwork). This includes the State Heritage listed Tempe House and St Magdalene's Chapel on the banks of the Cooks River, and the locally listed Rudders Bond Store at St Peters.
- Recreational areas, waterways and wetlands (for example, Wolli Creek and Alexandria Canal).
- Utility infrastructure, including the Southern and Western Suburbs Ocean Outfall Sewer (SWSOOS) aqueduct.
- Railway station groups.

Four heritage conservation areas are also located within the project corridor and within the Marrickville local government area. This includes:

- Collins Street Heritage Conservation Area.
- Wells Avenue Heritage Conservation Area.
- Stanley Street Heritage Conservation Area.
- Goodsell Estate Heritage Conservation Area.

There are no World Heritage, National Heritage or Commonwealth Heritage Places recorded within the project corridor.

In addition to being listed as a local heritage item under the Botany Bay Local Environmental Plan 2012, the Sydney (Kingsford-Smith) Airport Group (located immediately to the south east of the project corridor) is also identified as an indicative place on the Commonwealth Heritage List and is on the interim list of the Register of the National Estate (a non-statutory register).



KEY

- Wolli Creek Regional Park
- Road
- Rail
- Watercourse
- State heritage
- Local heritage

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Figure 4-7: Listed heritage items within the project corridor

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4.11.2 Potential impacts

There is the potential for direct and indirect impacts to non-Aboriginal heritage items and conservation areas to occur during the construction and operation of the project. Potential impacts would include:

- Physical impact on the item or within the curtilage of the item. This could include the demolition of the item or architectural treatment to buildings for operational noise attenuation.
- Structural damage due to vibration and settlement associated with tunnelling or surface works.
- Temporary and permanent changes to views to or from heritage items
- Permanent alteration to curtilage of a heritage listed item.

The majority of the potential impacts to non-Aboriginal heritage items would be associated with the construction of the project. Depending on the final location and design of surface infrastructure, there would be minimal potential for permanent operational impacts.

There is also the potential for non-Aboriginal heritage items in addition to those already identified to be discovered during the construction process. These are likely to be primarily archaeological remains of earlier habitation and industrial activities within sections of the project corridor.

4.11.3 Proposed further assessment

The project would be designed and constructed to avoid and/or minimise any impacts to areas of heritage value wherever feasible, and to avoid direct impacts to items listed on the State Heritage Register. Further investigation of the potential impacts on non-Aboriginal heritage items would be undertaken and presented in the Environmental Impact Statement. This would include:

- Updated searches of non-Aboriginal heritage databases and a review of literature relating to heritage within the project corridor.
- An assessment of significance for known State and local heritage items within the project corridor in accordance with the Burra Charter (ICOMOS, 1999) and the *Assessing Heritage Significance, NSW Heritage Manual 2, 2001* (NSW Heritage Office, 2001) and *Statements of Heritage Impact, 1996* (NSW Heritage Office, 1996).
- Pedestrian survey of areas around the surface elements, to identify additional building stock that may not have been included in LEP listings.
- Assessment of potential impacts to items of local and state heritage significance.
- An archaeological assessment, where required, to determine the presence of potential non-Aboriginal archaeological items and the potential impacts as a result of the project. The need for an archaeological assessment would be determined based on the outcomes of the literature review, the investigations detailed above and the nature of the potential impact. It may include archaeological test excavations.
- Consultation with the relevant stakeholders such as the Office of Environment and Heritage and local councils.
- Mitigation and management measures to minimise impacts to identified non-Aboriginal heritage values.

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4.12 Resource management and waste minimisation

4.12.1 Overview

Resource management and waste minimisation would be considered throughout various stages of the project from design and construction through to operation. Large quantities of materials would be required for the construction of the project such as concrete, asphalt, steel, gravel, sand, aggregate and road base. This would need to be sourced from quarries, manufactures and suppliers, which would be largely sourced from areas outside the project corridor.

Waste associated with the project would be generated from a number of streams including:

- Excavation waste.
- Demolition waste.
- Wastewater.
- Hazardous waste.
- Vegetation waste.
- Liquid waste.
- Construction waste.
- General waste.

All wastes would be managed using the waste hierarchy approach of waste avoidance, waste re-use before consideration of waste disposal. All wastes would be managed in accordance with the waste provisions contained within the *Protection of the Environment Operations Act 1997* and, where re-used off site, would comply with relevant NSW Environment Protection Authority resource recovery exemptions.

The most significant waste stream associated with the project is likely to be spoil generated from the excavation of the road tunnels that is in excess of project requirements. Spoil that is in excess of project requirements would be preferentially beneficially re-used in other road projects and any non-road development sites that may require engineered fill, or other land rehabilitation projects. This would be managed in accordance with the broader WestConnex spoil management strategy that is currently under development.

Where wastes are required to be removed from the Alexandria landfill site, they would be handled and transported to meet the requirements of the Environment Protection Authority, and would be transferred to a licensed facility permitted to accept the materials.

Water resources would be required during construction. Water resources would be required during tunnelling, as well as other construction activities such as compaction of pavement materials, dust suppression and concrete batching.

Water resources could be sourced from within or outside the project corridor. Higher quality water for some construction activities may be sourced from potable water supplies. Water from groundwater sources may also be used. The final volume, source and quality requirements for water supplied to the project would be determined through the design development process for the preferred project design and reflected in the Environmental Impact Statement.

4.12.2 Potential impacts

Construction

Impacts associated with resource use and waste generation are likely to be predominantly associated with the construction of the project. These include:

- Potential impact on resource availability as a result of resource use requirements for the project.
- Generation of waste during construction of the project, including:
  - Demolition wastes from existing structures that require removal.
  - Excavated wastes, such as soil and rock, primarily from tunnelling and cutting. Depending on the final locations of excavation activities, these wastes are expected to be largely characterised as Virgin Excavated Natural Material although contaminated spoil may be generated.
  - Vegetation waste from the removal of trees, shrubs and ground covers that are unable to be mulched and reused within the project.
  - Packaging materials such as crates, pallets, cartons, plastics and wrapping materials.
  - Site compound waste such as liquid wastes from cleaning, repairing and maintenance, waste from spillages, fuel or oil waste, effluent from site amenities and general office wastes.
  - Potential generation of wastes for off-site disposal as part of the closure of the Alexandria landfill site.

Operation

The operation of the project has the following resource use and waste management related impacts:

- Ongoing operation of leachate and landfill gas management systems on the Alexandria landfill site (St Peters interchange).
- Generation of wastes from operational maintenance and repair activities required over the lift of the project. The type and volume of wastes generated would be dependent on the nature of the activity, but would predominantly consist of green waste, oil, road materials, as well as contaminated waste resulting from potential fuel spills and leaks.
- Supply of water for the deluge system, which would form part of the fire and life safety system.
- Water used as part of the deluge system or for tunnel washing would be captured, and treated using the groundwater inflow water treatment plant, prior to being discharged into the environment. This is discussed in **Section 5.8** (Hydrology and flooding).
- Litter generated by road users.

With the implementation of standard work practices during routine maintenance and repair activities, the overall impact of operational waste streams and volumes would be minimal.

4.12.3 Proposed further assessment

The Environmental Impact Statement would provide further details on waste and resource management for the project, including:

- Details of the landfill closure plan for the Alexandria landfill site, including how closure works would be consistent and coordinated with construction and operation of the St Peters interchange.
- Estimates of the quantity of spoil that would be generated.
- Identification of a management hierarchy to reduce the volume of excess spoil generated by the project, such as through design, through use within the project, or use in other projects.
- Identification of the approximate resource requirements for the project, including estimation of the material and water requirements.
- Identification of available materials in the region including from quarries, potential material suppliers, and reuse of materials.
- Identification of available water supplies in the region and the locality (including recycled water).
- Identification of specific waste impacts of the project and the waste management approach.
- Identification of management and mitigation measures for resource use and waste across the project including potential spoil re-use and disposal sites and transport impacts. This includes strategies to minimising the export of excavated materials off-site, maximising re-use opportunities and minimising the volume of excavated material disposal to landfill.
- Identification of opportunities to use recycled materials provided they are fit for purpose and meet engineering requirements.

The impacts associated with the handling, storage and transport for spoil has been discussed in **Section 4.2** (Traffic and transport), **Section 4.3** (Air quality and human health), **Section 4.4** (Noise and vibration) and **Section 4.10** (Geology, soils and groundwater).

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5 Other environmental issues

5.1 Aboriginal heritage

5.1.1 Overview

The traditional owners of the land within the project corridor are the Gameygal (Eora) people. The Gameygal (or Camerigal) people are believed to have occupied the western edge of Botany Bay from the Cooks River to Georges River. Previous investigations in the area suggest Aboriginal people relied on the banks of the Cooks River for food and medicinal plants (Attenbrow 1992). The Cooks River Valley was originally covered in a network of tracks providing trade and social and ceremonial linkages which played a key role in the social and economic structure of Aboriginal society.

Since early European settlement, the project corridor has been subject to significant disturbance from agricultural uses, residential, industrial and infrastructure uses. Items and sites of Aboriginal heritage significance are most likely to occur in areas associated with water sources, especially swamps (Smith 1988). Therefore, it is likely there may be areas of Aboriginal heritage significance located along and areas adjoining the shorelines of the Cooks River and Wolli Creek. There is potential that areas of archaeological sensitivity are considerably inland and / or buried beneath fill material as a result of extensive historic disturbance and development in the area, including land reclamation and the realignment of the Cooks River, as well as sea level rise.

A search of the Aboriginal Heritage Information Management System (AHIMS) was undertaken in August 2014 which identified a number of previously recorded sites within or close to the project corridor (refer to **Figure 5-1**). Of the sites, seven AHIMS registered sites are located within the project corridor and located near to the Cooks River and Wolli Creek (refer to **Table 5-1**).

Table 5-1 AHIMS sites located within the Project corridor

AHIMS ID	Description
45-6-2414	Rockshelter with deposit
45-6-2415	Rockshelter with deposit
45-6-2416	Rockshelter with midden
45-6-2417	Rockshelter with midden
45-6-2418	Rockshelter with deposit
45-6-2198	Midden
45-6-2737	Potential Archaeological Deposit (PAD)

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KEY

- Wolli Creek Regional Park
- Road
- Rail
- Watercourse
- Open artefact site
- PAD
- Rockshelter with art and shell midden
- Rockshelter with deposit
- Rockshelter with midden
- Rockshelter with shell midden
- Shell midden

Figure 5-1: Listed AHIMS sites within and in proximity to the project corridor

0 1 2 Km

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5.1.2 Potential impacts

Potential direct or indirect impacts on previously recorded AHIMS sites would be dependent on the preferred project design, the location of surface infrastructure and construction activities. The potential impact on these sites would be determined during the preparation of the Environmental Impact Statement. The project would be designed and constructed to minimise the potential for direct and indirect impacts on the known Aboriginal heritage sites. Given the nature of the surface infrastructure required, it may be possible to avoid direct impacts to the sites.

There is also potential for unknown Aboriginal sites and / or artefacts to be impacted by the project and this would be taken into consideration during the preparation of the Environmental Impact Statement. The risk of significant impacts to Aboriginal sites and / or artefacts is likely to be low given that most of the project would be located below ground. This risk is further mitigated by the disturbed and highly urbanised environment along most of the project corridor.

5.1.3 Proposed further assessment

An Aboriginal cultural heritage assessment report would be prepared for the project, including completion of at least stage 2 of the Roads and Maritime Procedure for Aboriginal Cultural Heritage Consultation and Investigation (PACHCI). The Aboriginal cultural heritage assessment report would include but not be limited to:

- An archaeological survey of the project area to identify known and potential Aboriginal objects, places and cultural values.
- A review of relevant plans or diagrams showing the location of the project in relation to known and potential Aboriginal objects, places or cultural values.
- An assessment of significance of known and potential Aboriginal objects, places and cultural values.
- An assessment of known and potential impacts to Aboriginal objects, places and cultural values resulting from the construction and implementation of the project.
- If advancing to Stage 3 of the PACHCI, consultation with the Aboriginal community in accordance with that guideline. If advancing to Stage 3, consultation with the Aboriginal community would occur in accordance with the Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010).
- Identification of mitigation measures required to minimise impacts of the project on Aboriginal cultural heritage.

The Aboriginal cultural heritage assessment report would be prepared in accordance with the following policy documents and heritage guidelines:

- Procedure for Aboriginal Cultural Heritage Consultation and Investigation, (PACHCI) (Roads and Maritime Services, 2011).
- Aboriginal Cultural Heritage Consultation Requirements for Proponents (DECCW, 2010).
- Code of practice for archaeological investigation of Aboriginal Objects in NSW (DECCW, 2010).

5.1.4 Management and safeguard measures

Standard management and safeguard measures would be considered through the design development process for the preferred project design and preparation of the Environmental Impact Statement including the implementation of stop works and referral procedures in the event of unexpected finds of Aboriginal heritage items.

5.2 Energy efficiency

5.2.1 Overview

The transport sector is a key contributor to greenhouse gas emissions in Sydney, contributing 13 per cent of total greenhouse gas emissions in NSW in 2007 (DCCEE, 2009). Transport emissions produced from the use of fuels are currently the third fastest growing component of NSW-generated greenhouse gases after electricity generation and industrial processes (EPA, 2012). Investment in roads to improve the efficiency of the transport network in NSW is likely to have a positive impact on greenhouse gas emissions by easing congestion and reducing vehicle emissions.

Greenhouse gas emission sources listed in the Australian Government's reporting legislation include:

- Carbon dioxide (CO_2).
- Sulfur hexafluoride (SF_6).
- Methane (CH_4).
- Nitrous oxide (N_2O).
- Hydrofluorocarbons (HFCs).
- Perflurocarbons (PFCs).

Emissions of these greenhouse gas emissions sources can be categorised into three different scopes (1, 2 or 3) in accordance with the World Business Council for Sustainable Development and World Resources Institute Greenhouse Gas Protocol (2004), and the Australian Government greenhouse has accounting and reporting systems. Specifically:

- Scope 1 emissions, also referred to as direct emissions are emissions generated directly by the project, such as those from the combustion of fuels used to power plant, equipment and vehicles used on site and the clearing of vegetation.
- Scope 2 emissions, also referred to as indirect emissions are emissions generated from the consumption of electricity that is generated off-site and used by the project, such as the electricity used to power tunnel ventilation systems and lights.
- Scope 3 emissions, also referred to as indirect upstream emissions, includes emissions in the supply chain, or those from the use of a product. These include embodied energy in construction materials and vehicles travelling on the completed project. Examples of road project Scope 3 emissions include:
    - Emission associated with offsite mining and production of materials such as concrete, asphalt and aggregates used in the construction and maintenance of a road.
    - Emissions from the combustion of fuel when transporting materials.
    - Emission from the vehicles using the road.

5.2.2 Potential impacts

Construction

The construction of the project would contribute to greenhouse gas emissions, either directly or indirectly, as a result of:

- Fuel consumption for transporting materials to site and the operation of construction plant
- Vegetation clearing.
- Indirect GHG emissions such as through embodied energy of products used for construction works, and their supply chains (such as concrete, and steel), or through the generation of electricity for consumption by the project.

Operation

The key source of greenhouse gas emissions during the operation of the project would be associated with the use of fuel by vehicles travelling along the project route and in road maintenance activities, and the electricity used for tunnel systems (such as tunnel ventilation and lighting).

There is likely to be some offset due to a reduction in fuel used by vehicles that have been diverted to the project given the operational traffic efficiencies gained by the project as well as improved traffic conditions and road maintenance regimes along main surface roads.

Mechanical tunnel ventilation systems are anticipated to be a major contributor to GHG, given the energy associated with the pumping of in-tunnel air. Energy consumption by tunnel ventilation systems can be reduced by good road design and efficient ventilation design. The air quality approach for the project, and the selected ventilation infrastructure, would be a key component of determining the energy consumption for the project.

5.2.3 Proposed further assessments

A greenhouse gas assessment would be conducted for the construction and operation of the project in accordance with the following:

- The Greenhouse Gas Protocol: A corporate Accounting and Reporting Standard (World Council for Sustainable Business Development and World Resources Institute, 2005).
- The National Greenhouse and Energy Reporting Act 2007.
- Australian Standard AS ISO 14064.1:2006 Greenhouse Gas Part 1: Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals (Standards Australia, 2006).
- Australian National Greenhouse Accounts: National Greenhouse Accounts Factors (NGA Factors) (Department of Industry, Innovation, Climate Change, Science, Research and Tertiary Education (DIICCSRTE), 2013).
- Greenhouse Gas Assessment Workbook for Road Projects (the TAGG Workbook) (Transport Authorities Greenhouse Gas Group (TAGG), 2013).

It is anticipated that the greenhouse gas assessment would:

- Identify the assessment boundary and sources of greenhouse gas emissions associated with the construction, operation and maintenance of the project.
- Determine the quantity of each emissions source (such as fuel consumed, electricity, and construction materials) in line with the TAGG workbook.

- Quantify the greenhouse gas emissions associated with each greenhouse gas source using equations specified in the NGA factors (DIICCSRTE, 2013).
- Present the greenhouse gas emissions associated with the construction, operation and maintenance of the project.
- Identify opportunities (mitigation measures) which may be implemented to reduce greenhouse gas emissions associated with the project.

The design of the project would be prepared with consideration of the WestConnex sustainability strategy that is under development for the overall program of works. This strategy will reflect the ISCA's Infrastructure Sustainability Rating Tool Scorecard, which sets out specific requirements relating to energy and carbon for large infrastructure projects.

Project specific energy targets would be established, consistent with the NSW Government's 20 per cent renewable energy target by 2020 (identified as goal 22 in NSW 2021), and the Infrastructure Sustainability Council of Australia's (ISCA) Infrastructure Sustainability Rating Tool Scorecard. This would include:

- Implementation of identified energy reduction activities across all emission scopes including:
  - Energy and carbon reduction activities with a payback of less than four years.
  - At least one energy and carbon reduction activity with a payback of more than four years.
  - An assessment of feasibility of reductions in energy consumption during 'peak demand' periods.
- Investigating further opportunities for renewable energy use, such as providing 20-40 per cent of energy from renewable sources for the infrastructure lifecycle.

Further, it is anticipated that the design of the project would consider opportunities to utilise renewable energy technologies where possible.

5.2.4 Safeguards and management measures

Greenhouse gas and climate change issues are commonly encountered on road projects and can be managed and mitigated through the implementation of standard approaches. Standard management and safeguard measures have been identified below, which would be considered through the design development process for the preferred project design and identified as appropriate in the Environmental Impact Statement for the project. These may include:

- Consideration of the preferential selection of materials, vehicles and construction equipment with characteristics such as lower embodied energy and greater fuel efficiency, where feasible.
- Construction plant and equipment would be maintained to reduce energy efficiency losses associated with damaged or unmaintained equipment.
- Construction transport requirements would be reduced wherever reasonably possible, for example through use of local staff, resources, suppliers, and landfills.
- Vegetation clearance would be minimised wherever reasonably possible.
- Reductions in operational emissions would be achieved by developing an optimal design, including the vertical and horizontal alignments and reduction of stop start driving. These reductions would be cumulative over the design life of the project. Energy efficient ventilation and lighting system designs would also be key areas of consideration for achieving optimal energy efficiency outcomes during the operational phase.

5.3 Climate change risk and adaptation

5.3.1 Overview

An increase in the global concentration of greenhouse gases has led to an increase in the Earth's average surface temperature, contributing to the phenomenon of climate change. The State of the Climate 2012 (CSIRO and the Australian Bureau of Meteorology, 2012) confirms the long term warming trend over Australia's land and oceans, showing that in Australia, each decade has been warmer than the previous since the 1950s. Other observed trends include an increase in record hot days, a decrease in record cold days, ocean warming, sea-level rise and increases in greenhouse gas concentrations. Due to long lag times associated with climate processes, even if greenhouse gas emissions are mitigates and significantly reduced, the warming trend is expected to continue for centuries (Intergovernmental Panel on Climate Change, 2007).

The IPCC Fifth Assessment Report (IPCC, 2013) states with high confidence that Australia is already experiencing impacts from recent climate change, including a greater frequency and severity of extreme weather events. Certain current and predicted climate events and trend pose a risk to road infrastructure, by way of physical damage, accelerated deterioration of assets and reduced network capacity and road safety (Maddocks et al, 2010). As a result it is important to understand the most likely and 'worst case' implications of climate change on high-value infrastructure, such as the project.

The physical implications of climate change on major road infrastructure projects, such as roads and highways, are typically considered during the design and environmental assessment process for such projects.

An understanding of greenhouse gas emissions and their effect on climate change is essential in minimising potential impacts associated with the project.

NSW 2021 – A Plan to Make NSW Number One (NSW Department of Premier and Cabinet, 2011) includes targets to minimise the impacts of climate change by ensuring that 'NSW is ready to deal with major emergencies and natural disasters' (Goal 28). In addition, the NSW Long Term transport Master Plan (Transport for NSW, 2012) promotes the need to ensure that transport infrastructure is 'able to withstand the predicted impacts of changing climate'.

Using climate change projections produced by the Intergovernmental Panel on Climate Change, both the Commonwealth Scientific and Industrial Research Organisation and the Bureau of Meteorology have produced regional downscaled projections for Australia. In 2010 the then Department of Environment Climate Change and Water released the NSW Climate Impact Profile, which included projected climate change impacts in 2050 for each region in NSW. In summary, climate change projections for the Sydney/Central Coast region include:

- Higher average temperatures. The magnitude of projected increases ranges from 1.5–3 degrees Celsius.
- Higher rainfall in all seasons except winter.
- Greater evaporation in spring and summer.
- More extreme impacts associated with the El Niño-Southern Oscillation.

5.3.2 Potential impacts

Climate variables identified as potentially generating risks for the project include:

- Mean annual temperature change and extreme temperature events.
- Mean annual rainfall change and extreme rainfall events.
- Increased mean annual potential evaporation.

- Increased solar radiation.
- Extreme events, particularly storms (rainfall, hail, wind, dust, lightning), drought and bushfires.

Road infrastructure is particularly vulnerable to very high temperatures, changes in soil moisture and the ground stability of sloping land forms (Thorn et al, 2010) The increased frequency and intensity of extreme weather events, increased rainfall, bushfires and rising temperatures are already causing strain on existing road networks. Recent flood events and bushfire events in NSW have highlighted the susceptibility of the transport sector to extreme events (Thorn et al, 2010). More extreme weather events are likely to damage road infrastructure and by 2030, design criteria for extreme events are very likely to be exceeded more frequently Thorn et al, 2010).

The key climate change risks to road projects are associated with changes in rainfall intensity which may typically result in the following:

- Increased potential for localised flooding impacting on road infrastructure and potential increases in road maintenance activities and costs.
- Increased risk of road closures
- Drainage and stormwater impacts.
- Erosion impacts, resulting in sediment loss from the site.
- Watercourse impacts, including changes to channel structure and other characteristics resulting from changes in hydrological conditions.

Risks to infrastructure associated with climate change may also generate knock-on effects or additional risks such as (Maddocks et al, 2010):

- Risks to road user health and safety.
- Interruption or delays to commuter travel.
- Interruption or delays to commercial activities that depend on road transport.
- Increased maintenance and replacement costs.
- Increased liability resulting from damage to road infrastructure.
- Higher insurance costs for road authorities.

5.3.3 Proposed further assessment

A climate change-related risk assessment of the project would be undertaken which would include:

- Identification of key climate variables such as temperature, rainfall and extreme events.
- Identification of potential climate change scenarios, based on the latest climate science, that broadly identify how each climate variable may change over the design life of the project.
- Identification of climate-based risks that may impact on the project as a result of climate change.
- An assessment of potential impacts of priority climate change risks based on the consequence and likelihood of each risk.
- Recommendation of broad actions to mitigate climate risks.

Given the expected design life of road infrastructure, the proposed construction timeframe for the project and available climate data, it is assumed that the climate risk assessment would be undertaken for the years 2030 and 2070. Climate change projections for 2030 would be appropriate for short term impacts of climate change on the operation of the project (about 10 years after opening to traffic), and projections for 2070 would be relevant to the longer term operation and maintenance stages of the project. The climate change risk assessment would be undertaken using the most up-to-date emission scenarios available during the preparation of the Environmental Impact Statement for the project which are the most relevant to the years of assessment (2030 and 2070).

5.3.4 Safeguards and management measures

Construction of the project would aim to minimise greenhouse gas emissions, largely through:

- Regularly maintaining construction plant and equipment to reduce energy efficiency losses associated with damaged or unmaintained equipment.
- Reduce construction transport requirements wherever reasonably possible, for example through use of local staff, resources, suppliers, and landfills.

The management of risks associated with the impacts of climate change on the operation and maintenance of the project would be through undertaking a climate change risk assessment as described in Section 5.4.3 above, and discussion with project design engineers to adequately design and plan for predicted changes in climatic conditions.

Safeguards and management measures to minimise the emission of greenhouse gases associated with the operation and maintenance of the project would include:

- Consideration of the preferential selection of materials, vehicles and construction equipment with characteristics such as lower embodied energy and greater fuel efficiency, where feasible.
- The minimisation of vegetation clearance where reasonably possible.
- Development of an optimal design, including the vertical and horizontal alignments and reduction of stop start driving. These reductions would be cumulative over the design life of the project.

5.4 Hazard and risk

5.4.1 Overview

Hazard and risk impacts associated with the project have the potential to affect the surrounding environment and human health.

Potential impacts are likely to arise during the construction and operation of the project. Impacts are likely to evolve predominantly from the use of the tunnelling system. These potential impacts may involve leakage, spillage and accidental release from the incorrect handing or storage or hazardous materials.

Potential impacts arising from the operation phase would involve tunnel air quality and vehicle and personal safety.

5.4.2 Potential impacts

Construction

Potential impacts associated with the construction of the project may include:

- Environment and human health risks associated with the accidental release of hazardous materials due to improper handling or storage, or in the event of a traffic accident resulting in the release of hazardous material. All hazardous substances that may be required for construction would be stored and managed in accordance with the *Work Health and Safety Act 2011* and the Storage and Handling of Dangerous Goods Code of Practice (WorkCover NSW, 2005).
- There would also be the potential for the rupture or interference with underground services during construction.
- Occupational health and safety hazards, such as dangers to construction workers, road users and the general public may also occur during construction. This could include tunnel collapse or flooding and inundation during construction. Such risks would be managed through the implementation of an occupational health and safety plan and other management plans (such as construction traffic and an incident response plan).

Operation

Potential impacts associated with the operation of the project may include:

- Environment and human health risks associated with the accidental release of hazardous materials in the event of a traffic accident resulting in the release of hazardous material.
- Spills or leaks from minor vehicle accidents.
- Large fires or explosions from major vehicle accidents.
- Tunnel collapse or subsidence.
- Flooding and inundation during operation.

Contaminants associated with either a spill, fire suppression (including deluge system) or clean up would be contained and treated by the tunnel drainage system. At interchanges, contaminants have the potential to enter the environment from paved or unpaved surfaces. Water quality treatment measures would reduce the risk of contaminants discharging to the receiving environment.

5.4.3 Proposed further assessment

Hazards and risks would be considered in the Environmental Impact Statement. As part of this, a screening of dangerous goods and hazardous materials against the *Applying SEPP 33: Hazardous and Offensive Development Application Guidelines* (Department of Planning, 2011) thresholds would be undertaken. Design features of the project to manage risk and hazards during the operational stage of the project would also be outlined within the Environmental Impact Statement, which would include an assessment of the potential hazards associated with chemicals associated with clean-up activities or deluge systems.

5.4.4 Management and safeguard measures

To ensure the continued management of hazards and risks during the operation of the project, standard mitigation strategies would be implemented such as:

- Prohibition of dangerous goods within the project.
- Tunnel monitoring equipment to observe traffic conditions within the tunnel.
- Fire protection systems, which would include a fire suppression and firefighting system and would allow egress for pedestrians and access for emergency services.
- The ventilation system would be designed to ensure conditions are provided for the safe egress of passengers and to vent smoke in the event of a fire.
- Visual and audible communications systems would be used to also communicate incidents to motorists within and outside the tunnel.
- An Incident Response Plan to respond to accidents or spills.
- Appropriate design criteria for portal flood immunity and drainage infrastructure capacities.

In addition to the standard management and mitigation measures identified in the hazard and risk assessment in the Environmental Impact Statement, the following measures would be implemented:

- Occupational health and safety risks associated with construction would be managed through the implementation of an occupational health and safety plan.
- The risks associated with the use and storage of hazardous substances during construction would be managed through appropriate design, preparation of a construction environmental management plan and establishment of bunded areas.
- The final locations of construction site compounds where hazardous substances would be stored would be determined during detailed design based on specific environmental criteria.
- Construction stormwater control basins and operational water quality control measures would be designed to reduce the environmental effects of pollutant runoff from the road surface and to contain spills of chemicals and hazardous substances.

5.5 Cumulative impacts

5.5.1 Overview

A cumulative impact refers to the result of the impact of an action coinciding or interacting with other impacts during the same time period and in the same area. Cumulative impacts are likely to have an effect on the following areas:

- Traffic and transport.
- Air quality and human health.
- Noise and vibration.
- Biodiversity.
- Visual impacts and urban design.
- Social and economic.
- Land use and property.
- Surface water and flooding.
- Soils and geology.
- Non-Aboriginal heritage.
- Resource management and waste minimisation.

A desktop assessment has identified developments which have the potential to interact with the project. It is likely the majority of cumulative impacts would take place during the construction of the project which is expected to take place between mid-2016 to early 2020.

5.5.2 Potential impacts

Key developments that are expected to interact with the project include:

- The M5 West Widening Project. This project would expand the existing Southern West Motorway from two to three lanes from Camden Valley Road to King Georges Road. The construction of the M5 West Widening is expected to be completed in around December 2014.
- WestConnex Stage 1 (M4 East Motorway) and Stage 3 (M4 South Motorway). If they proceed, both projects are intended to feed into this project and would improve traffic flow to/from the project. Stage 3 would also connect the project with the M4 south and the Sydney Gateway via the St Peters interchange, requiring additional construction works to tie-in connections.
- WestConnex Stage 2 (Sydney Gateway) and other associated ground transport improvements identified by Sydney Airport Corporation within its Sydney Airport Master Plan 2033. Depending on the approval and scheduling of these works, this could result in cumulative construction traffic and construction noise impacts on the surrounding community. In the long term, these projects are expected to assist in improving traffic flows to/from WestConnex and the connections to employment areas in the Sydney Airport and Port Botany area.
- Southern Access Motorway. This project would involve extending the existing F6 corridor from Waterfall north to the M5 Corridor. Budget for the preparation of a business case for the Southern Access Motorway was announced by the NSW Roads Minister in June 2014 for the potential Project. Although the planning and assessment process is in its early stages, there is the potential that there may be some concurrent construction of the project and Southern Access Motorway, should this project proceed.

- WestConnex enabling works around the Sydney Airport. This project would involve upgrades to roads around Sydney Airport, including widening Marsh Street to three lanes in each direction, widening Joyce Drive to six lanes, minor works and line marking to provide for six lanes along General Holmes Drive, a new underpass beneath Wentworth Avenue and associated works, minor upgrades to Mill Pond Road, and upgrades to bus, bicycle and pedestrian infrastructure. Potential upgrade works to O'Riordan Street may also be required. Roads and Maritime anticipates that initial construction works would commence in late 2015 and would continue for up to five years, depending on the timing of approvals and staging of construction works.
- Other Sydney Airport projects. The Sydney Airport Master Plan 2033 identifies a number of construction activities associated with its aprons, airfield and terminals over the next 19 years, including works within the first five years and 10 year periods. Depending on the scheduling of these works, this could result in cumulative construction traffic and construction noise impacts on the surrounding community. In the long term, WestConnex would deliver capacity to cater for increased traffic demand associated with growth at Sydney Airport.

Concurrent or consecutive construction of the project with one or a number of the abovementioned projects has the potential to result in some adverse cumulative construction impacts for sensitive receivers. Cumulative impacts would be largely related to air quality, noise and vibration and traffic and transport. The majority of cumulative construction impacts, should they occur, would be concentrated to areas where the projects have an overlapping impact on sensitive receivers, for example at the future tie in point of the project with WestConnex Stage 3.

There are also a number of approved or potential urban developments within or outside the project corridor, particularly around Mascot, Wolli Creek and Alexandria. Depending on the location of these developments relative to the project, there is potential for cumulative traffic and noise impacts on the surrounding community. However, comparative to the abovementioned major projects in the area, the cumulative effect of these potential developments with the project would unlikely be significant. Increased traffic demand generated by these urban developments would be considered within the traffic and transport assessment as part of forecast growth.

Operation of the project simultaneously with other large road infrastructure projects and residential developments has the potential to generate cumulative impacts. Such cumulative impacts would be localised and would be largely related to amenity impacts on local residents, the local community and users of recreational areas within and in the vicinity of the project corridor. This may potentially include impacts to local traffic conditions, noise and vibration, air quality and human health, social and economic impacts as well as impacts to visual amenity.

Operation of the WestConnex program of works in conjunction with other transport infrastructure projects such as the wider WestConnex program of works and the potential future Southern Access Motorway would produce a number of operational benefits, namely:

- Improved travel efficiency and reliability.
- Enhanced economic productivity.
- Improved road safety and road surface conditions, leading to improved liveability though public and active transport.
- Improvements to air quality by removing traffic from surface roads into a suitably designed ventilated tunnel.
- Improvements to local amenity, particularly through improved traffic conditions, air quality and noise and vibration.

5.5.3 Proposed further assessment

Project-specific assessments that would be completed for the project would consider the potential for cumulative impacts, including the potential cumulative impacts associated with the completed WestConnex program of works. The Environmental Impact Statement would consider the interrelationships between the project, the remainder of the WestConnex program of works and other major developments, understand the potential cumulative impacts associated with these interactions and establish mitigation strategies.

5.5.4 Management and safeguard measures

The mitigation and management of cumulative impacts associated with the WestConnex program of works would be overseen and managed by the WestConnex Delivery Authority. The cumulative impact resulting from other major developments would be dependent on the scheduling of those developments in the context of this project. Mitigation and management measures would be detailed in the Construction Environmental Management Plan, and through coordination between the relevant construction contractors (if required).

6 Conclusion

Roads and Maritime is proposing the construction and operation of the New M5 (the project); which would comprise a new, tolled multi-lane road link between the M5 East Motorway east of King Georges Road and St Peters. The project would also include an interchange at St Peters and connection to the existing road network.

The project would span six local government areas including: Canterbury, Hurstville, Rockdale, Marrickville, Botany Bay and Sydney. It would include widening of the existing M5 Motorway between east of King Georges Road, Beverly Hills and Bexley Road, twin motorway tunnels, both around nine kilometres in length and local road connections in St Peters.

The WDA is a public subsidiary corporation of the Roads and Maritime. Its role and functions are set out in Part 4A of the (NSW) *Transport Administration (General) Regulation 2013*. With respect to this project, WDA is project managing the carrying out of the proponent's functions on behalf of Roads and Maritime. Roads and Maritime is the proponent for this project.

Roads and Maritime, as the proponent, has formed the view that the project is likely to significantly affect the environment. On this basis, the project is declared to be State significant infrastructure (SSI) under section 115U(2) of the EP&A Act by reason of the operation clause 14 and clause 1 of Schedule 3 of *State Environmental Planning Policy (State and Regional Development) 2011*. Accordingly, approval from the Minister for Planning is required for the project.

The key environmental issues with the project are:

- Traffic and transport.
- Air quality and human health.
- Noise and vibration.
- Biodiversity.
- Visual impacts and urban design.
- Social and economic.
- Land use and property.
- Hydrology and flooding.
- Geology, soils and water quality.
- Non-Aboriginal heritage.
- Resource management and waste minimisation.

The Environmental Impact Statement would include the following:

- A description of the project, including its components and construction activities.
- An assessment of potential impacts on the key environmental issues, including a description of the existing environment and an assessment of potential direct and indirect impacts during construction and operation of the project.
- Consideration of the other potential environmental issues for the project.
- The identification of measures to be implemented to avoid, minimise, manage, mitigate, offset and/or monitor potential impacts of the project.
- The identification and consideration of issues raised by stakeholders.

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Appendix A

Requirements of the Environmental Planning and Assessment Regulation 2000

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Appendix A Requirements of the Environmental Planning and Assessment Regulation 2000

Clause 192(1) of the *Environmental Planning and Assessment Regulation 2000* requires that an application for approval of the Minister to carry out State Significant Infrastructure must include:

a) Details of any approvals that would, but for section 115ZG of the Act, be required for carrying out of the State Significant Infrastructure, and

b) Details of any authorisations that must be given under section 115ZH of the Act is the application is approved, and

c) A statement as to the basis on which the proposed infrastructure is State Significant Infrastructure including, if relevant, the capital investment value of the proposed infrastructure.

Approvals that would otherwise apply

Approvals that may be required to carry out the Project, if not for section 115ZG of the *Environmental Planning and Assessment Act 1979 (EP&A Act)* include:

- A permit under section 201, 205 or 219 of the *Fisheries Management Act 1994*.
- An approval under Part 4, or an excavation permit under section 139, of the Heritage Act 1977.
- An Aboriginal heritage impact permit under section 90 of the *National Parks and Wildlife Act 1974*.
- A water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the *Water Management Act 2000.* Section 115ZG does not remove the need to obtain an aquifer interference approval under the *Water Management Act* 2000, if that were to be otherwise required.

Authorisations if the application is approved

Authorisations that may be required for the Project under section 115ZH of the EP&A Act include:

- An environment protection licence under Chapter 3 of the *Protection of the Environment Operations Act 1997*.
- Consent under section 138 of the *Roads Act 1993* (if required).

State significant infrastructure application

Clause 14(1) of the *State Environmental Planning Policy (State and Regional Development) 2011* provides that development is declared, pursuant to 115U (2) of the EP&A Act, to be State significant infrastructure for the purposes of the Act if:

(a) The development on the land concerned is, by the operation of a State Environmental Planning Policy, permissible without consent under Part 4 of the Act, and

(b) The development is specified in Schedule 3.

Clause 94 of the *State Environment Planning Policy (Infrastructure) 2007* (ISEPP) permits development on any land for the purpose of a road or road infrastructure facilities to be carried out by or on behalf of a public authority without consent. As the Project is for a road and road infrastructure facilities, and is to be carried out on behalf of Roads and Maritime, the project is permissible without development consent under Part 4 of the EP&A Act.

Clause 1(1) of Schedule 3 of the *State Environmental Planning Policy (State and Regional Development) 2011* identifies as SSI, general public authority activities for infrastructure or other development (but for Part 5.1 of the Act and within meaning of Part 5 of the Act) would be an activity for which the proponent is also the determining authority and would, in the opinion of the proponent require an environmental impact statement to be obtained under Part 5 of the Act.

Roads and Maritime, as the proponent, has formed the view that the impact of the Project is likely to significantly affect the environment. On this basis, the project is declared to be State significant infrastructure (SSI) under section 115U (2) of the EP&A Act by reason of the operation of clause 14 and clause 1 of Schedule 3 of the *State Environmental Planning Policy (State and Regional Development) 2011*. Accordingly, the project is subject to Part 5.1 of the EP&A Act and required the approval of the Minister for Planning and Infrastructure.

Appendix B

Threatened flora and fauna species lists

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Table B-1 Listed threatened flora species with the potential to occur or previously recorded within the Project corridor

Scientific name	Common name	Commonwealth listing (EPBC Act)		NSW listing (TSC Act)	
		Yes/No	Status	Yes/No	Status
Flora (species)					
Acacia bynoeana	Bynoe's Wattle	No	-	Yes	Endangered
Acacia pubescens	Downy Wattle	Yes	Vulnerable	Yes	Vulnerable
Acacia terminalis subsp. terminalis	Sunshine Wattle	No	-	Yes	Endangered
Allocasuarina glareicola	Sunshine Wattle	Yes	Endangered	No	-
Caladenia tessellata	Thick Lip Spider Orchid	Yes	Vulnerable	Yes	Endangered
Cryptostylis hunteriana	Leafless Tongue-orchid	Yes	Vulnerable	No	-
Deyeuxia appressa	-	Yes	Endangered	No	-
Eucalyptus nicholii	Narrow-leaved Black Peppermint	No	-	Yes	Vulnerable
Genoplesium baueri	Yellow Gnat-orchid	Yes	Endangered	No	-
Maundia triglochinoides	-	No	-	Yes	Vulnerable
Melaleuca biconvexa	Biconvex Paperbark	Yes	Vulnerable	No	-
Melaleuca deanei	Deane's Paperbark	No	-	Yes	Vulnerable
Pelargonium sp. Striatellum	Omeo Stork's-bill	No	-	Yes	Endangered
Persoonia hirsuta	Hairy Geebung	No	-	Yes	Endangered
Pimelea curviflora var. curviflora	-	No	-	Yes	Vulnerable
Pimelea spicata	Spiked Rice-flower	Yes	Endangered	No	-
Pterostylis saxicola	Sydney Plains Greenhood	Yes	Endangered	No	-
Streblus pendulinus	Siah's Backbone, Sia's Backbone, Isaac Wood	Yes	Endangered	No	-
Syzygium paniculatum	Magenta Lilly Pilly	Yes	Vulnerable	Yes	Endangered
Tetratheca juncea	Black-eyed Susan	No	-	Yes	Vulnerable
Thesium australe	Austral toadflax	Yes	Vulnerable	No	-
Wilsonia backhousei	Narrow-leafed Wilsonia	No	-	Yes	Vulnerable
Flora (populations)					
Acacia prominens	Gosford Wattle, Hurstville and Kogarah Local Government Areas	No	-	Yes	Endangered population

Table B-2 Listed threatened fauna species and populations with the potential to occur or previously recorded within the project corridor

Scientific name	Common name	Commonwealth listing (EPBC Act)		NSW listing (TSC Act)	
		Yes/No	Status	Yes/No	Status
Fauna (species)					
Aves (Birds)					
Anthochaera Phrygia	Regent Honeyeater	Yes	Endangered	Yes	Endangered
Botaurus poiciloptilus	Australasian Bittern	Yes	Endangered	Yes	Endangered
Burhinus grallarius	Bush Stone-curlew	No	-	Yes	Endangered
Calidris alba	Sanderling	No	-	Yes	Vulnerable
Calidris ferruginea	Curlew Sandpiper	No	-	Yes	Endangered
Calidris tenuirostris	Great Knot	No	-	Yes	Vulnerable
Calyptorhynchus lathami	Glossy Black-Cockatoo	No	-	Yes	Vulnerable
Charadrius leschenaultii	Greater Sand-Plover	No	-	Yes	Vulnerable
Charadrius mongolus	Lesser Sand-Plover	No	-	Yes	Vulnerable
Dasyornis brachypterus	Eastern Bristlebird	Yes	Endangered	No	-
Diomedea epomophora epomophora	Southern Royal Albatross	Yes	Vulnerable*	No	-
Diomedea epomophora sanfordi	Northern Royal Albatross	Yes	Endangered*	No	-
Diomedea exulans antipodensis	Antipodean Albatross	Yes	Vulnerable*	No	-
Diomedea exulans	Wandering Albatross	Yes	Vulnerable*	Yes	Endangered
Diomedea exulans exulans	Tristan Albatross	Yes	Endangered*	No	-
Diomedea exulans gibsoni	Gibson's Albatross	Yes	Vulnerable*	No	-
Haematopus fuliginosus	Sooty Oystercatcher	No	-	Yes	Vulnerable
Haematopus longirostris	Pied Oystercatcher	No	-	Yes	Endangered
Hieraaetus morphnoides	Little Eagle	No	-	Yes	Vulnerable
Lathamus discolor	Swift Parrot	Yes	Endangered*	Yes	Endangered
Limicola falcinellus	Black-billed Sandpiper	No	-	Yes	Vulnerable
Limosa limosa	Black-tailed Godwit	No	-	Yes	Vulnerable
Macronectes giganteus	Southern Giant-Petrel	Yes	Endangered*	No	-
Macronectes halli	Northern Giant-Petrel	Yes	Vulnerable*	No	-
Neophema chrysogaster	Orange-bellied Parrot	Yes	Critically Endangered	No	-
Neophema pulchella	Turquoise Parrot	No	-	Yes	Vulnerable
Ninox strenua	Powerful Owl	No	-	Yes	Vulnerable

Scientific name	Common name	Commonwealth listing (EPBC Act)		NSW listing (TSC Act)	
		Yes/No	Status	Yes/No	Status
Ptilinopus superbus	Superb Fruit-Dove	No	-	Yes	Vulnerable
Rostratula australis	Australian Painted Snipe	Yes	Endangered	No	-
Sternula albifrons	Little Tern	Yes	Endangered*	No	-
Sternula nereis nereis	Australian Fairy Tern	Yes	Vulnerable	No	-
Thalassarche bulleri	Buller's Albatross, Pacific Albatross	Yes	Vulnerable*	No	-
Thalassarche cauta cauta	Shy Albatross	Yes	Vulnerable*	No	-
Thalassarche cauta salvini	Salvin's Albatross	Yes	Vulnerable*	No	-
Thalassarche cauta steadi	White-capped Albatross	Yes	Vulnerable*	No	-
Thalassarche eremita	Chatham Albatross	Yes	Endangered*	No	-
Thalassarche melanophris	Black-browed Albatross	Yes	Vulnerable*	No	-
Thalassarche melanophris impavida	Campbell Albatross	Yes	Vulnerable*	No	-
Tyto novaehollandiae	Masked Owl	No	-	Yes	Vulnerable
Xenus cinereus	Terek Sandpiper	No	-	Yes	Vulnerable
Fish					
Epinephelus daemelii	Black Rockcod, Black Cod, Saddled Rockcod	Yes	Vulnerable	No	-
Amphibia (Frogs)					
Crinia tinnula	Wallum Froglet	No	-	Yes	Vulnerable
Litoria aurea	Green and Golden Bell Frog	Yes	Vulnerable	Yes	Endangered
Heleioporus australiacus	Giant Burrowing Frog	Yes	Vulnerable	No	-
Litoria raniformis	Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog	Yes	Vulnerable	No	-
Mammals					
Arctocephalus pusillus doriferus	Australian Fur-seal	No	-	Yes	Vulnerable
Chalinolobus dwyeri	Large-eared Pied Bat, Large Pied Bat	Yes	Vulnerable	No	-
Dasyurus viverrinus	Eastern Quoll	No	-	Yes	Endangered
Dugong dugon	Dugong	No	-	Yes	Endangered
Isoodon obesulus obesulus	Southern Brown Bandicoot (Eastern)	Yes	Endangered	No	-
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	No	-	Yes	Vulnerable
Myotis macropus	Southern Myotis	No	-	Yes	Vulnerable
Pseudomys novaehollandiae	New Holland Mouse	Yes	Vulnerable	No	-
Pterogale penicillata	Brush-tailed Rock-wallaby	Yes	Vulnerable	No	-

Scientific name	Common name	Commonwealth listing (EPBC Act)		NSW listing (TSC Act)	
		Yes/No	Status	Yes/No	Status
Pteropus poliocephalus	Grey-headed Flying-fox	Yes	Vulnerable	Yes	Vulnerable
Reptiles					
Caretta caretta	Loggerhead Turtle	Yes	Endangered*	No	-
Chelonia mydas	Green Turtle	Yes	Vulnerable*	No	-
Dermochelys coriacea	Leatherback Turtle	Yes	Endangered*	No	-
Eretmochelys imbricata	Hawksbill Turtle	Yes	Vulnerable*	No	-
Hoplocephalus bungaroides	Broad-headed Snake	Yes	Vulnerable*	No	-
Natator depressus	Flatback Turtle	Yes	Vulnerable*	No	-
Fauna (populations)					
Dasyurus maculatus maculatus	Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (SE mainland population)	Yes	Endangered	No	-
Perameles nasuta	Long-nosed Bandicoot population in inner western Sydney	No	-	Yes	Endangered population
Phascolarctos cinereus	Koala – combined populations of QLD, NSW and ACT	Yes	Vulnerable	No	-

*notes that the species is also recorded as being migratory and marine under the EPBC Act

Appendix C

Sensitive land uses in the project corridor

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Table C-1 Sensitive land uses in the project corridor

Sensitive land use name
Private recreation
Canterbury Golf Course, Moorefields Road, Beverly Hills.
Bardwell Valley Golf Course, Hillcrest Avenue, Bardwell Valley.
Barton Park Driving Range, West Botany Street, Arncliffe.
Kogarah Golf Club, Marsh Street, Arncliffe.
Tempe Golf Driving Range, South Street Tempe.
Public recreation / open space
Beverly Grove Park, Kingsgrove
Smith Reserve, Morgan Street, Kingsgrove.
Kingsbury Reserve, Warejee Street, Kingsgrove.
Forrester Reserve, Forrester Street, Kingsgrove.
Kookaburra Reserve, Shaw Street, Kingsgrove.
Kingsgrove Avenue Reserve, Kingsgrove Avenue, Kingsgrove.
Beaumont Park, Poole Street, Kingsgrove.
Shaw Street Reserve, Shaw Street, Kingsgrove.
Carrisbrook Avenue Reserve, Carrisbrook Avenue, Bexley North.
Whitbread Park, Barnsbury Grove, Bexley North.
Gilchrist Park, Shaw Street, Bexley North.
Scotts Reserve, Slade Road, Bexley North,
Stotts Reserve, Churchill Street, Bexley North.
Slade Road Reserve, Slade Road, Bardwell Park.
Ron Gosling Reserve, May Street, Bardwell Park.
Coolibah Reserve, Darley Road, Bardwell Park.
Broadford Street Reserve, Bardwell Valley.
Charles Daly Reserve, Bardwell Valley
Silver Jubilee Park, Lorraine Avenue, Bardwell Valley.
Braeside Crescent Reserve, Braeside Crescent, Earlwood.
Girrahween Park, Hartill-Law Avenue, Earlwood.
Albert Park, Finlays Lane, Earlwood.
Turrella Reserve, Arncliffe Road, Earlwood.
Waterworth Park, Bayview Avenue, Earlwood.
Gough Whitlam Park, Bayview Avenue, Earlwood
Canterbury Velodrome, Bayview Avenue, Earlwood.
Illoura Park, Forrest Avenue, Earlwood.
Harrison Reserve, Bray Avenue, Earlwood.
Riverine Park, Eve Street, Banksia.
Arncliffe Park, Hirst Street, Arncliffe.
Ajax Reserve, Arncliffe.
Barton Park, West Botany Street, Arncliffe.
Banksia Playing Fields, West Botany Street, Arncliffe.
Beehag Reserve, Spring Street, Arncliffe.
Empress Reserve, Arncliffe.
Memory Reserve, Arncliffe.
Marinea Street Reserve, Marinea Street, Arncliffe.
Cahill Park, Levey Street, Wolli Creek.
Kendrick Park, Princes Highway, Wolli Creek.
Tillman Park, Unwins Bridge Road, Tempe.
Tempe Recreation Reserve, Holbeach Avenue, Tempe.
Simpson Park, Hutchinson Street, Tempe.
Tempe Park, South Street, Tempe
Sydenham Green, Railway Road, Sydenham.
Sydney Park, Sydney Park Road, St Peters.
Camdenville Park, May Street, St Peters.

Sensitive land use name
Places of worship
Our Lady of Fatima Church, Shaw Street, Kingsgrove.
Anglican Church of Australia, Paterson Avenue, Kingsgrove.
Uniting Church in Australia, Way Street, Kingsgrove
South-west Chinese Christian Church, Morgan Street, Kingsgrove.
St. Andrew's Presbyterian Church. Forest Road, Bexley.
Bexley North Anglican Church, Carrisbrook Avenue, Bexley North.
Uniting Church in Australia, Earlwood Crescent, Bardwell Park.
Arncliffe Uniting Church in Bardwell Valley, Hannam Street, Bardwell Valley.
Our Lady of Lourdes Catholic Church, Homer Street, Earlwood.
Earlwood Presbyterian Church, Collingwood Avenue, Earlwood.
St George Church, Minnamorra Avenue, Earlwood.
Uniting Church in Australia, Villiers Street, Rockdale.
St Mark Coptic Orthodox Church, Wollongong Road, Arncliffe.
Bay City Church, Hattersley Street, Arncliffe.
St David's Anglican Church, Forest Road, Arncliffe.
Uniting Church in Australia, Lymerston Street, Tempe.
St Peters Anglican Church, Princes Highway, St Peters.
Community facilities
Kingsrove Community Aid Centre, Morgan Street, Kingsgrove.
Kingsgrove Scout Hall, Shaw Street, Kingsgrove.
Kingsgrove RSL Club, Brocklehurst Lane, Kingsgrove.
Kingsgrove and Bexley North Community Centre, Shaw Street, Bexley North.
Bexley North Library, Shaw Street, Bexley North.
Bexley North Scout Hall, Shaw Street, Bexley North.
Earlwood-Bardwell Park RSL Club, Hartill-Law Avenue, Bardwell Park.
Earlwood Library, William Street, Earlwood.
Lydham Hall House Museum, Lydham Avenue, Rockdale.
Arncliffe RSL Club, Wollongong Road, Arncliffe.
Arncliffe Community Centre and Coronation Hall, Barden Street, Arncliffe.
Al Zahra Muslim Womens Association, Wollongong Road, Arncliffe.
Marrickville Council Libraries, Unwins Bridge Road, Sydenham.
Child Care
Cheeky Monkeys Day Care Centre, Homer Street, Kingsgrove.
Kingsrgrove World of Learning, Richland Street, Kingsgrove.
Kids Oasis, Wolli Street, Kingsgrove.
Hilltop Kids Lond Day Care Centre, Barnsbury Grove, Bardwell Park.
Lady Bugs Child Care, Alexandria Street, Turella.
Turella Childrens Centre, Walker Street, Turella.
Macedonian Community Child Care Centre, Firth Street, Arncliffe.
Busy Bee Long Day Child Care Centre, Marinea Street, Arncliffe.
Kinderoos, Dowling Street, Arncliffe.
Betty Spears Childcare Centre, Gannon Street, Tempe.
Tillman Park Child Care Centre, 79 Unwins Bridge Road, Tempe.
Education
Regina Coeli School, Tarrilli Street, Beverly Hills.
Kingsgrove Public School, Kingsgrove Road, Kingsgrove.
St Ursula's College, Caroline Street, Kingsgrove.
Bardwell Park Infants School, Crewe Street, Bardwell Park.
Earlwood Public School, Homer Street, Earlwood.
Earlwood Pre School, Joy Avenue, Earlwood.
Cairnsfoot Special School, Loftus Street, Turella.
Kingdom Culture Christian School, Dowling Street, Arncliffe.
Athelstane Public School, East Street, Arncliffe.

Sensitive land use name
Arncliffe Public School, Princes Highway, Arncliffe.
St Francis Xavier's Catholic Primary School, Forest Road, Arncliffe.
Al Zahra College, Wollongong Road, Arncliffe.
Arncliffe West Infants Public School, Loftus Street, Arncliffe.
Tempe Public School, Unwins Bridge Road, Tempe.
Tempe High School, Unwins Bridge Road, Tempe.
St Peters Public School, Church Street, St Peters.
Health care centre
Blue Cross Medical Centre, Kingsgrove Road, Kingsgrove.
Early Childhood Health Centre, Morgan Street, Kingsgrove.
Bexley North Medical Clinic, Shaw Street, Bexley North.
Life Medical Clinic, Bexley Road, Bexley North.
Bardwell Park Family Medical Practice, Hartill-Law Drive, Bardwell Park,
Arncliffe Early Childhood Health Centre, Firth Street, Arncliffe.
Arncliffe Dental Care, Wollongong Road, Arncliffe.
Arncliffe Family Health Clinic, Queen Street, Arncliffe.
Wolli Creek Dental Care, Brodie Spark Drive, Wolli Creek.
Tempe Family Medical, Princes Highway, Tempe.
Aged care facility
Bexley Gardens Retirement Village, Ellerslie Road, Bexley North.
Glen Village, The Glen Road, Bardwell Valley.
Earlwood Senior Citizens Centre, Earlwood
Macquarie Lodge Aged Care Plus Centre, Wollongong Road, Arncliffe.
The Salvation Army Aged Care Plus, Wollongong Road, Arncliffe.
Carinya Lodge, Fairview Street, Arncliffe.
Hospital
Kingsgrove Day Hospital, Kingsgrove Road, Kingsgrove.
Regional Park
Wolli Creek Regional Park

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Arabic

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