Australian Government

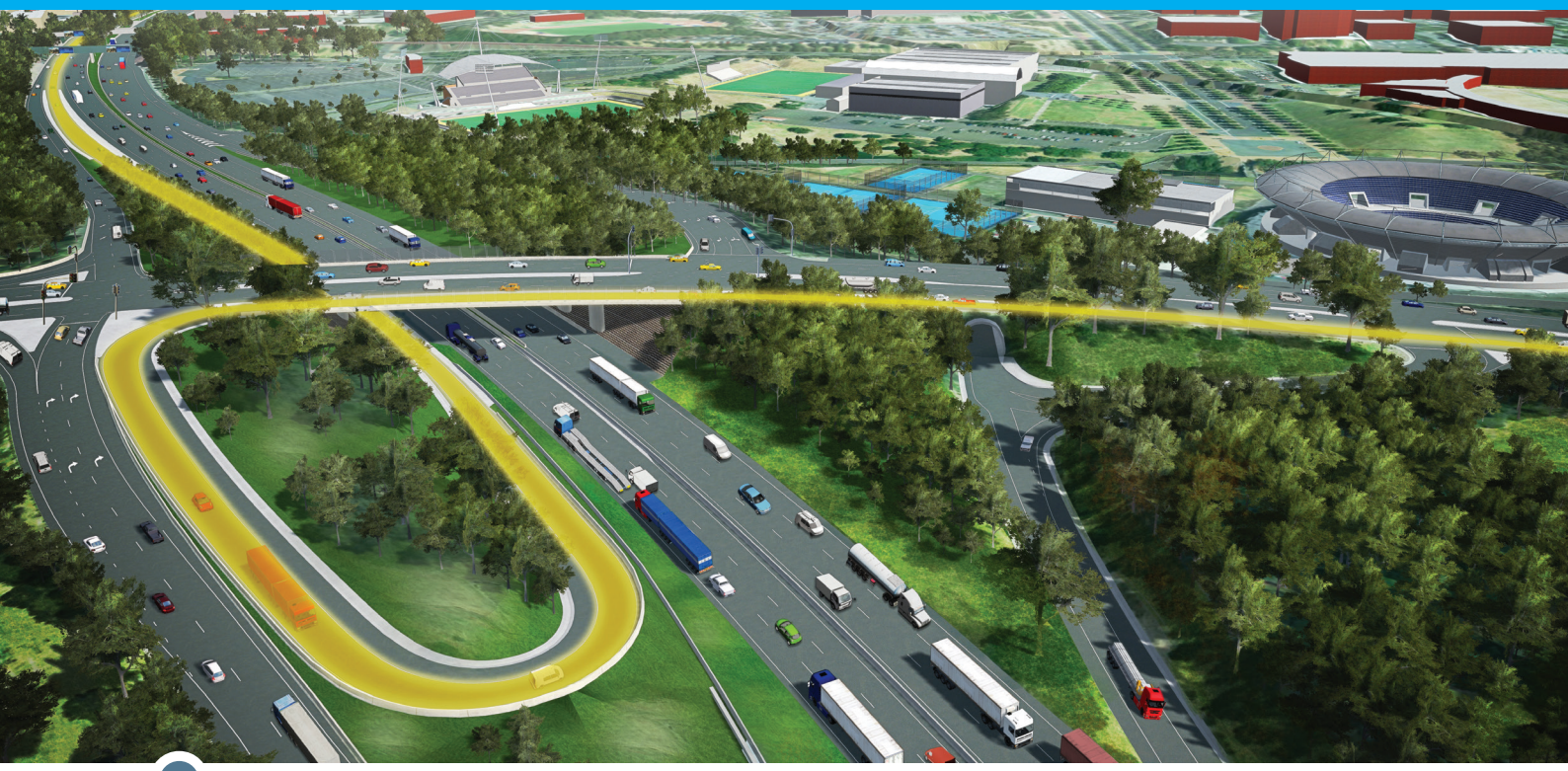
NSW NOW The new state of business

WestConnex

M4 Widening Environmental Impact Statement

Volume 1

August 2014



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WestConnex Delivery Authority

WestConnex – M4 Widening

Environmental impact statement

August 2014

Prepared by SMEC Australia

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Executive Summary

More than 12 million trips are taken every day by cars and trucks in Greater Sydney. This compares to around 753,000 trips by rail, 737,000 by bus and 4,000 by light rail. The NSW Government's Long Term Transport Master Plan (Transport for NSW 2012) estimates road congestion currently costs the NSW economy $5.1 billion annually, adversely impacting business productivity and city liveability.

Sydney's population is expected to increase by more than 1.5 million people by 2031 and road congestion will become an increasingly critical issue requiring on-going improvements to the road network to meet increased demand. Cars are expected to make up 74 per cent of all growth in daily travel demand over the next 20 years. The cost of road network congestion to the NSW economy is anticipated to rise to $8.8 billion annually by 2020 if measures are not taken to improve the situation.

Addressing congestion is also critical to the on-going competitiveness of Greater Sydney as a global city in regional competition with other global business centres such as Hong Kong, Singapore and Shanghai.

The NSW Government's *Long Term Transport Master Plan* sets out a number of projects to meet Sydney's transport challenge. WestConnex is the largest integrated transport and urban revitalisation project in Australia. It will link Parramatta to the central business district (CBD), Sydney Airport and the Port Botany precinct and the M5 in south-west Sydney via a 33 kilometre tolled motorway completely free of traffic signals. When completed, WestConnex would save 40 minutes on a typical journey between Parramatta and Sydney Airport, bypassing up to 52 sets of traffic signals.

The NSW Government will deliver WestConnex in a series of project stages, with a commitment for completion by 2023. When complete, it is expected that about 400,000 vehicles per day will use the WestConnex motorway.

WestConnex is made up of the following stages:

- The M4 West Widening (M4 Widening) from Parramatta to Homebush.
- The M4 East from Homebush to Haberfield.
- The M4 South from Haberfield to St Peters via Camperdown.
- The M5 from St Peters to the M5 East as well as duplication of the M5 East.

Each stage will be subject to its own environmental assessment, consultation and planning approval process.

The M4 Widening is the first WestConnex project. It involves converting the existing M4 Western Motorway (M4 Motorway) generally from three lanes to four lanes in each direction between Parramatta and Homebush.

This environmental impact statement (EIS) considers the environmental, social and economic impacts of the M4 Widening project. Volume 1 describes the project and why it is needed, assesses the impacts of the project and identifies measures that would be implemented to avoid and minimise those impacts. Volumes 2, 3 and 4 contain the technical papers used to inform the preparation of this assessment.

As proposed in the *WestConnex Business Case Executive Summary* (Sydney Motorways Project Office 2013a), a toll will be re-introduced on the widened M4 Motorway on opening in 2017. The proceeds of this toll would be applied to help fund the remaining WestConnex projects. The NSW Government is contributing $1.8 billion to fund WestConnex, while the Australian Government is contributing $1.5 billion with a further $2 billion through a concessional loan to the NSW Government.

When completed, the widened M4 Motorway would save motorists up to nine minutes in a morning peak eastbound journey from Church Street, Parramatta to Homebush Bay Drive, Homebush. When WestConnex is completed, this will convert to a saving of 14 minutes during the morning peak on an eastbound journey from Church Street to Homebush Bay Drive, cutting future travel times from 19 minutes (if nothing is done) to only five minutes. This equates to a travel time saving of 74 per cent.

When completed, the widened M4 Motorway would save motorists around one minute on an evening peak westbound journey from Homebush Bay Drive to Church Street, reducing travel time from six minutes to five minutes. When WestConnex is completed, this will convert to a saving of six minutes during the evening peak on a westbound journey for the same section of road, cutting travel times from 11 minutes (if nothing is done) to only five minutes. This equates to a travel time saving of 55 per cent. Faster travel times on this section of the M4 Motorway would provide economic and social benefits to Sydney.

Future WestConnex project stages would include new tunnel sections between Homebush and Camperdown. When these sections are completed they would ease congestion along Parramatta Road east of North Strathfield through to Camperdown, as there is currently no motorway alternative along that section of Parramatta Road.

When the fully completed WestConnex is operational, modelling shows that an average of around 4,500 fewer trucks and 20,000 fewer cars per day are expected to travel on the section of Parramatta Road between Concord Road and Camperdown.

Why is the M4 Widening and WestConnex needed?

The M4 Motorway is a vital artery in Sydney's road network. It is one of Sydney's key transport corridors servicing Western Sydney which is the third biggest economy in Australia after the Sydney CBD and South East Queensland. On the M4 Motorway, congestion is currently concentrated between some of Sydney's key jobs centres, which include Parramatta CBD and Sydney Olympic Park.

Congestion occurs mainly during the morning and evening peaks when many people are commuting to and from work. However, it is not only commuter traffic creating congestion on the M4 Motorway with freight vehicles, tradespeople and others making multiple daily trips which also significantly contributes to this congestion. The *State Infrastructure Strategy 2012-2032* (Infrastructure NSW, 2012) identifies that the M4 Motorway currently experiences periods of congestion (traffic travelling at lower than 'design speed' and experiencing periods of queuing) for up to 13 hours per day.

Congestion delays adversely impact on business productivity, and ultimately push up the price of goods and services. Uncertainty about how long a journey will take, due to variable travel times on a congested network, also has a negative impact on business productivity and freight efficiency.

The M4 Widening project would provide greater certainty to travel times on the M4 Motorway between Parramatta and Homebush due to increased lane capacity provided by the project, resulting in a smoother traffic flow and reducing the stop/start conditions currently experienced.

The M4 Widening project would also benefit businesses and industry using the widened motorway through improved access and travel time savings, improved certainty of travel times and savings in vehicle operating costs. Overall, the fully completed WestConnex will also improve liveability and amenity for residents and businesses within the region, by improving travel and accessibility to work, business and leisure.

Future transport demand in the M4 corridor represents a significant challenge for Sydney and NSW. The current road network has inadequate capacity to support a growing population that needs to reliably access dispersed employment areas and services. The M4 Motorway east of Church Street, Parramatta is a known constraint on the road network due to the motorway effectively reducing to two lanes in each direction at the James Ruse Drive interchange. Without the M4 Widening and the WestConnex project, congestion on this section of the M4 Motorway will continue to impact on the NSW economy.

Modelling indicates that without the M4 Widening or the WestConnex project, morning peak travel times in the eastbound direction would increase from around 12 minutes to 19 minutes between Church Street and Homebush Bay Drive. In the westbound direction in the same section of road, travel times would increase from about five minutes to 15 minutes.

In addition to slow average peak hour speeds, congestion also leads to unreliable travel times forcing motorists to plan for longer travel times than they may need. This can impact on motorist's quality of life, business productivity and freight efficiency, pushing up the cost of goods and services for consumers. Congestion presents particular challenges in the M4 corridor due to the high volume of freight needing to be transported from Port Botany to Western Sydney where many of the freight distribution centres are based. These goods are then distributed to dispersed points across the entire metropolitan area.

Efficiency of freight and logistics is important to freight and economic activity. Sydney's freight, commercial and services industries rely on distribution of goods and services across Sydney, through diverse and dispersed point-to-point transport connections. Around 60 per cent of import containers from Port Botany are delivered to areas serviced by the M4, M5 and M7 corridors.

Modelling by the Bureau of Freight Statistics estimates that the average number of weekday freight trips in the Sydney Metropolitan Area would increase by almost 40 per cent between 2011 and 2031. This includes:

- An increase in the number of trips made by rigid trucks on an average weekday from 271,000 to 355,000, an increase of around 30 per cent.
- A more rapid increase in articulated truck trips from 95,000 to 157,000, an increase of around 65 per cent.

Even minor incidents on a congested road network can have an immediate and serious impact on travel times. Congestion also reduces safety on the road network and can lead to more frequent vehicle crashes and traffic incidents that impact personal safety, property and road network performance.

What are the M4 Widening project objectives?

The objectives of the M4 Widening project are to:

- Enable integration with the subsequent stages of WestConnex while not significantly impacting on the surrounding environment in the interim period.
- Relieve road congestion so as to improve travel times and safety of travel on the M4 Motorway between Church Street, Parramatta and Homebush Bay Drive, Homebush.
- Improve access to the M4 Motorway from Sydney Olympic Park.
- Improve access to the M4 Motorway from Homebush Bay Drive.
- Improve road safety on the M4 Motorway and connections.
- Protect natural and cultural resources and enhance the environment.

How would the M4 Widening and WestConnex meet the need and project objectives?

The M4 Widening comprises the first project in the delivery of WestConnex.

Once completed, the M4 Widening project would provide immediate operational benefits in relieving congestion on the M4 Motorway between Church Street and Homebush Bay Drive, delivering reductions in travel times and improvements in the level of road safety on the motorway.

Access to and from the M4 Motorway would also be improved at Homebush Bay Drive and Hill Road, particularly in the evening peak period. The investment in the M4 Widening project and subsequent WestConnex stages would facilitate a fundamental change in network performance, enabling delivery of major city shaping improvements and delivering economic growth.

While the M4 Widening will provide improvements to Sydney's road network, the maximum benefits would occur when the entire 33 kilometre WestConnex project is completed, providing a seamless motorway standard journey from Parramatta to the CBD, Sydney Airport, the Port Botany precinct and the M5 in south-west Sydney, free of traffic signals.

When fully constructed, WestConnex will:

- Cut forecast travel times between Parramatta and Sydney Airport by up to 40 minutes.
- Effectively halve bus travel times between the Inner West and the CBD.
- Create 10,000 jobs during the construction phase, including hundreds of apprenticeships.
- Bypass up to 52 sets of traffic signals.
- Remove around 4,500 trucks a day from Parramatta Road and put them underground, leading to revitalised neighbourhoods on the surface.
- Improve north-south times across Parramatta Road for public buses accessing the Western Rail line at Burwood and other stations.
- Allow for the creation of 25,000 new jobs and 25,000 residences over the next 20 years along Parramatta Road.
- Deliver more than $20 billion in economic benefits to NSW.

By providing a fast motorway standard route, the fully completed WestConnex will also deliver average network speed improvements of one kilometre per hour across the Sydney network. With more than 15 million car and truck trips predicted on the network by 2031, the cumulative benefit of this average network speed improvement would be substantial.

In particular, the M4 Widening project, as part of WestConnex, supports NSW's key economic generators and provides a strategic response to the currently inadequate, and highly congested, road network.

As part of WestConnex, the M4 Widening project would support the freight transport task by improving access to, and reliability of, the motorway network. When complete, WestConnex would also provide a continuous high quality road connection linking the key regional cities of Parramatta and Penrith and other key centres in the Global Economic Corridor. Positive changes anticipated include improved travel time reliability on the motorway network, assisting business productivity and contributing to improved liveability and urban amenity.

What alternatives were considered?

A number of different alternatives to the project were considered. These include:

- A 'base case' (or 'do nothing/do minimum') option. This option assumes that the NSW Roads and Maritime Services (Roads and Maritime) will continue to deliver regular road network improvements over time to improve capacity and cater for traffic growth, but it does not include the M4 Widening or other WestConnex projects.
- Improving the existing arterial road network.
- Improving public transport provision.
- Investment in public transport and freight rail improvements.
- Demand management.

In the context of the substantial identified congestion and transport challenges facing Sydney, the 'base case' option is not considered viable if Sydney is to maintain global competiveness and remain an attractive and liveable city. In particular, congestion is already a significant issue on this section of the M4 Motorway and will continue to get worse as both population and the freight task increases. Therefore doing nothing was not considered an option.

The other alternatives are desirable and complementary to the project, but none were considered to provide an adequate and stand-alone response to the identified strategic need and project objectives.

In particular, the public transport and rail freight improvements and demand management alternatives alone would not address the diverse and dispersed point-to-point transport connections required that can only be provided by the road network.

In addition to these alternatives, a number of interchange design options, viaduct, bridge and motorway widening options were also considered in development of the preferred concept design described in this EIS. This concept design best meets the identified need and objectives of the project, which include improving access to the M4 Motorway from Sydney Olympic Park and Homebush Bay Drive, and relieving road congestion so as to improve travel time and safety of travel on the M4 Motorway between Parramatta and Homebush.

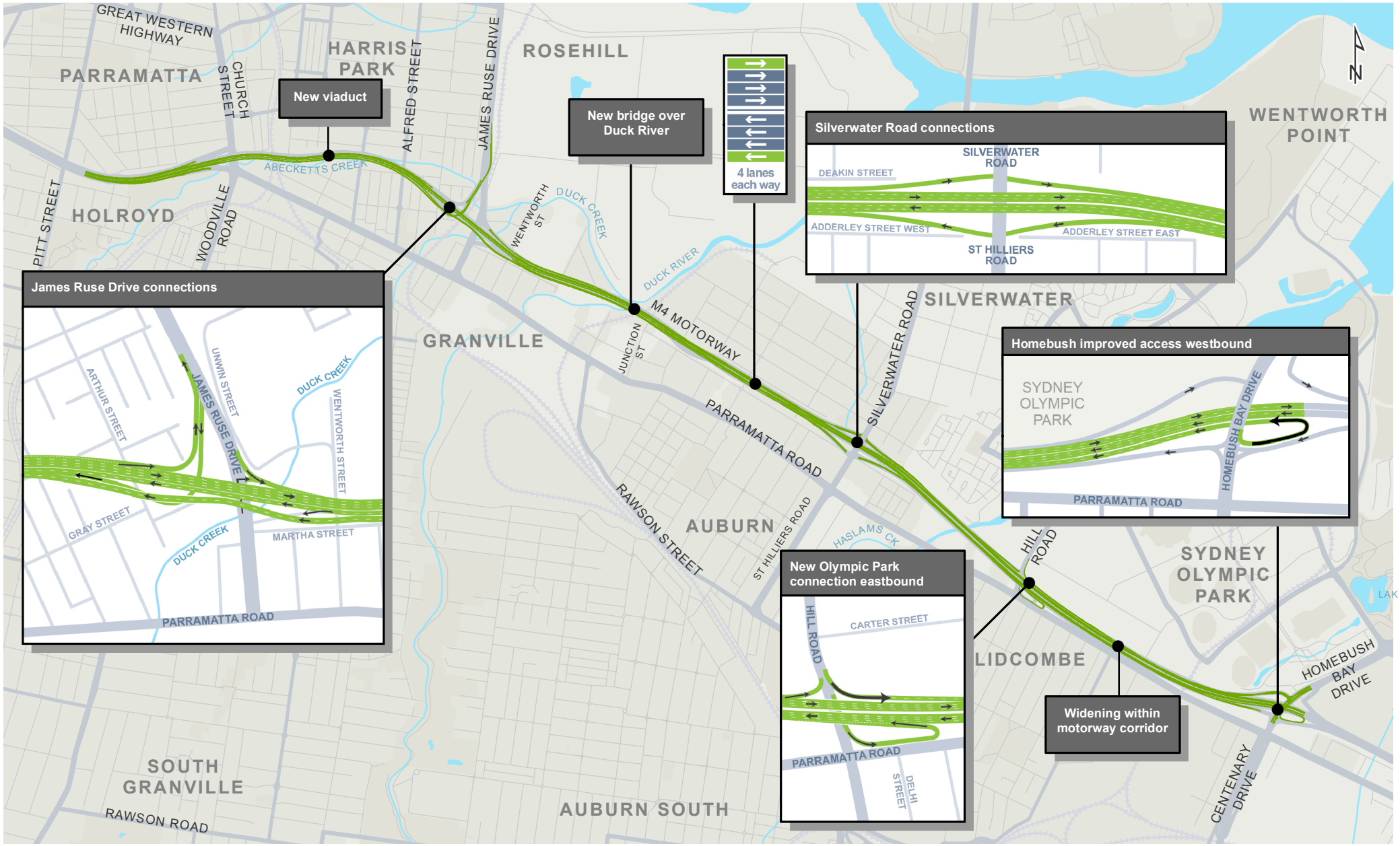
M4 Widening key features

The NSW Government is proposing to widen and upgrade approximately 7.5 kilometres of the M4 Motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush as part of WestConnex.

The M4 Widening project includes the following key features:

- Construction of a new two lane viaduct for westbound traffic, on the southern side of the existing viaduct structure between Church Street, Parramatta and Wentworth Street, Granville.
- Reconfiguration of traffic lanes on the existing viaduct structure (to make four lanes in each direction).
- Construction of a new bridge/viaduct over Duck River at Auburn.
- Widening of the existing motorway to the south of the westbound carriageway between Wentworth Street, Granville and Duck River, Auburn.
- Widening of the at-surface carriageway of the motorway predominantly within the existing motorway corridor (utilising both the existing median and verge areas), between Junction Street, Auburn and Homebush Bay Drive, Homebush to provide four traffic lanes westbound and four traffic lanes eastbound.
- Construction of a new westbound G-loop on-ramp to the M4 Motorway from Homebush Bay Drive, Homebush.
- Construction of a new eastbound on-ramp to the M4 Motorway from Hill Road, Lidcombe.
- Provision of Intelligent Transport Systems infrastructure for motorway operations.
- Provision of road infrastructure and complementary technology services to support the future implementation of smart motorway operations.
- Widening and/or lengthening of existing ramps at Church Street, James Ruse Drive, Silverwater Road, Hill Road and Homebush Bay Drive.
- Provision of tolling infrastructure such as gantries and control systems.
- Provision of new and modified noise barriers.
- Provision of new asphalt wearing surface to the existing M4 Motorway.

Roads and Maritime is the project proponent. The NSW Government has established the WestConnex Delivery Authority (WDA) to manage delivery of the WestConnex projects. WDA has been established as a public subsidiary corporation of Roads and Maritime.



KEY

- New/upgraded surface road
- New ramp
- Road
- Rail line

Project location and key features

0 0.5 1
Km

What are the main benefits expected?

While the M4 Widening would deliver standalone benefits, its full benefits would be realised when the WestConnex project is fully completed.

As part of WestConnex, the M4 Widening project would contribute to delivering long-term economic benefits outweighing the initial upfront construction cost and ongoing operational cost, and creating the potential for realisation of wider economic benefits. An economic appraisal was undertaken for the fully completed WestConnex as reported in the WestConnex Business Case Executive Summary. The economic appraisal identified a benefit-cost ratio (BCR) of 2.55:1, including wider economic impacts reflecting the benefits of WestConnex across the Sydney road network. Based on the concept design, the M4 Widening project would support around 2,000 construction jobs as well as a number of operational jobs.

The main traffic benefit of the M4 Widening project is the operational improvement in relieving congestion along the M4 Motorway between Church Street and Homebush Bay Drive, including reductions in travel times and improvements to road safety. The M4 Widening project would also improve access to and from the M4 Motorway at key locations such as Homebush Bay Drive and Hill Road.

Typical morning peak travel time improvements along the section of the M4 Motorway between Church Street, Parramatta and Homebush Bay Drive, Homebush, when WestConnex is completed, are shown below.

Year	Scenario	Travel time (minutes) eastbound on M4 Motorway	Travel time (minutes) westbound on M4 Motorway
2031	No WestConnex	19	15
2031	WestConnex complete	5	9
	WestConnex saves	14 minute saving	6 minute saving
	% time saving	74%	55%

The fully completed WestConnex will also deliver amenity benefits, helping Sydney cope with expected population growth, improve traffic flow along key corridors, deliver improved average travel speed across the network and provide an important catalyst for urban renewal in areas of Sydney that currently experience poor amenity due to excessive traffic on local and arterial roads.

In 2013, the NSW Government announced an urban activation precincts program as an important component of a package of wider housing delivery and employment initiatives. Through consultation with local communities and councils, urban activation precincts aim to deliver more homes in places with access to infrastructure, transport, services and jobs. The benefits to the community will include greater housing choices, increased amenities, services and improved public spaces. Two of these precincts are located along the M4 corridor, at Wentworth Point and Carter Street, Lidcombe, and will benefit from improvements to the M4 corridor.

What are the main adverse outcomes expected?

During construction of the project, adverse impacts would include:

- Noise and vibration, including potential night time disturbance associated with out-of-hours work.
- Dust and construction vehicle emissions.
- Traffic and access impacts.
- Impacts on three threatened ecological communities (Swamp Oak floodplain forest, Shale gravel transition forest and Freshwater wetlands on coastal floodplains). This would be limited to a total of approximately 0.17 hectares of moderate condition vegetation and 0.35 hectares of low condition habitat.

Construction impacts would be minimised through further consideration during detailed design and construction planning, application of appropriate management and mitigation measures, and consultation with affected residents.

During operation, adverse impacts would include:

- Traffic noise requiring new noise barriers and property treatments.
- Visual impacts associated with new viaducts and bridges.
- Increased traffic on Parramatta Road and other roads due to toll avoidance.
- Potential minor flooding impacts along A'Becketts Creek.

While substantial travel time benefits are expected along the motorway, the WestConnex Road Traffic Model has indicated that the M4 Widening project is expected to increase travel times on Parramatta Road between Church Street and Homebush Bay Drive due to drivers seeking to avoid the toll. However, even with more than 1.5 million extra people living in Sydney by 2031, there would be fewer people using Parramatta Road during the morning and afternoon peak periods than it had in 2008 when the M4 Motorway previously had a toll.

How will the impacts be managed?

Project development and concept design investigations have sought to avoid and minimise impacts on the community. For each key issue, the existing environment is described in the EIS, the potential impacts (both direct and indirect) of the project during construction and operation are assessed and the influence of relevant planning matters is considered. The assessment of key issues presented in this EIS is supported by detailed investigations. These are documented in the working papers in Volumes 2, 3 and 4 of this EIS.

The EIS also identifies comprehensive mitigation and management measures that would be implemented to avoid, manage, mitigate, offset and/or monitor impacts during construction and operation of the project. These include best practise construction environmental planning and management techniques, urban design and landscaping treatments, noise mitigation measures and consideration of options to offset biodiversity impacts. During further detailed design and construction planning, some impacts identified within this EIS are likely to be able to be further mitigated.

The design, construction and operation of the project would be undertaken in accordance with extensive environmental management commitments identified in this EIS, as well as any additional measures identified in conditions of approval for the project.

To assist in further mitigating traffic impacts on the wider road network, Roads and Maritime will continue to prioritise improvements to the overall network including works to address intersection congestion where required. In addition, the NSW Government's Long Term Transport Master Plan commits to the development of an integrated package of transport improvements to renew the Parramatta Road corridor in conjunction with the delivery of WestConnex. The medium- to long-term benefits of these improvements, along with the completion of WestConnex, would assist to reduce the adverse impact of additional vehicles on the section of Parramatta Road between Parramatta and Homebush.

How has the community been engaged?

Consultation activities undertaken specifically for the M4 Widening project began in September 2013 following announcement of the project and the commencement of EIS preparation.

Community feedback was sought on the WDA concept design for the M4 Widening with community information sessions and meetings also held, including:

- Publication and unaddressed distribution of approximately 95,000 WestConnex factsheets (September 2013).
- Publication and unaddressed distribution of more than 50,000 Urban Revitalisation factsheets (September 2013).
- Nine staffed community display sessions.
- Six 'drop in' community information sessions.
- Nineteen static displays in libraries, motor registries, council chambers and government offices.
- Briefings with industry groups, councils, chambers of commerce, clubs and organisations.
- Publication and distribution of approximately 75,000 M4 Widening project community update brochures (October 2013).

These sessions provided information about the project and the opportunity for the community and other stakeholders to comment. A range of other consultation activities were also adopted including door knocking, newsletters, advertisements and community updates seeking feedback and input on the project.

Extensive community feedback was received which has informed the preparation of this EIS. WDA will continue to provide opportunities for the community to participate in the ongoing refinement of the design and construction process to further minimise project impacts.

How can I comment?

The NSW Department of Planning and Environment (DP&E) will make the EIS publicly available for a minimum period of 30 days. During this period, it will be available for inspection at the DP&E's website: http://majorprojects.planning.nsw.gov.au/, at selected local council and Roads and Maritime offices, and at various staffed displays in the region. A link will also be provided on the WestConnex website: www.westconnex.com.au.

WDA will continue conducting community information sessions. A project information line (1300 660 248) will also be available throughout the exhibition period to answer questions from the community relating to the project.

To provide feedback on the project, a person may make written submissions to the Secretary of DP&E during the exhibition period, quoting the project number (SSI 13-6148). All submissions received will be placed on the DP&E website.

Written submissions may be made online at http://majorprojects.planning.nsw.gov.au or may also be directed to:

SSI 13-6148
NSW Department of Planning and Environment
GPO Box 39
Sydney NSW 2001

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Appendix H Technical working paper: Hydrology and flooding

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Certification

Submission of environmental impact statement

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

Environmental impact statement prepared by:

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Proposed development:

WestConnex M4 – Widening

Address of the land on which the infrastructure to which the statement relates:

M4 Western Motorway (M4 Motorway) between Pitt Street, Parramatta/Holroyd and Homebush Bay Drive, Homebush. Holroyd, Parramatta, Auburn and Strathfield local government areas.

Description of the infrastructure to which the statement relates:

Widening and upgrading of the M4 Motorway between Pitt Street, Parramatta/Holroyd and Homebush Bay Drive, Homebush.

Environmental impact statement:

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

Declaration:

I certify that I have prepared the contents of this environmental impact statement in response to the Director-Generalôs environmental assessment requirements dated 4 November 2013 and the relevant provisions of Schedule 2 of the (NSW*)* Environmental Planning and Assessment Regulation 2000. To the best of my knowledge the information contained in the environmental impact statement is not false or misleading.

Signature:



Name: Braith Gilchrist

Date: 7 August 2014

Glossary of terms and abbreviations

Term	Meaning
ABS	Australian Bureau of Statistics
Acid sulfate soils (ASS)	The acidic soils that result from the disturbance or drainage and subsequent oxidation of previously waterlogged potential acid sulfate soils.
Acute noise levels	Road traffic noise levels received at private dwellings that are predicted to be greater than 65dB(A)Leq(15hr) (day) and 60dB(A)Leq(9hr) (night), as presented in Practice Note IV, Step 3, Part (2) of the Roads and Maritime Environmental Noise Management Manual.
Afflux	An increase in water level resulting from a constriction in the flow path
AHIMS	Australian Bureau of Statistics.
Annual average daily traffic (AADT)	The total traffic in both directions at a specified location calculated from mechanically obtained axle counts.
Annual exceedance probability (AEP)	The probability of a rainfall or flood event exceeding a nominated level in a year. A one percent AEP is the probability of an event exceeding a nominated level in 100 years.
Australian Height Datum (AHD)	The standard reference level used to express the relative height of various features. A height given in metres AHD is essentially the height above sea level.
Alignment	The general route (eg of a roadway) in plan and elevation.
Alluvium	Unconsolidated deposit of gravel, sand or mud formed by water flowing in identifiable channels. Commonly well sorted and stratified.
AM peak period	6.00–10.00am weekdays.
AMU	Archaeological management unit.
ANZECC	Australian and New Zealand Environment and Conservation Council. A Ministerial Council operating between 1991 and 2001 that provided a forum for member governments to develop coordinated policies about national and international environment and conservation issues.
Aquifer	Geologic formation, group of formations, or part of a formation capable of transmitting and yielding quantities of water.
Archaeological site	A site with any material evidence of past Aboriginal activity that remains within a context or place that can be reliably related to that activity.
ARI	Annual recurrence interval. Used to describe the frequency or probability of floods occurring. (eg a 100 year ARI flood is a flood that occurs or is exceeded on average once every 100 years).
Asphalt or asphaltic concrete	A dense, continuously graded mixture of coarse and fine aggregates, mineral filler and bitumen usually produced hot in a mixing plant.
Background noise level	The underlying level of noise present in the ambient noise when extraneous noise is removed and excluding the noise source under consideration. This is described using the LA90 descriptor.
Batter	The side slope of embankments and cuttings which is usually expressed as a ratio of horizontal distance to vertical height value of one.
Bank protection	Devices for reducing scour by sea or river such as mattresses, groynes, pegged down brushwood, plantings etc.
BCR	Benefit-cost ratio
Bedrock	Solid rock underlying loose deposits such as soil or alluvium.
Benefit–cost ratio	The ratio of the present value of benefits to the present value of costs of a project.

Term	Meaning
Borehole	A cylindrical hole sunk into the ground for water extraction or monitoring, or for the investigation and assessment of soil and rock profiles.
BTS	Bureau of Transport Statistics
Carriageway	The portion of a roadway devoted to vehicular traffic generally delineated by kerbs, a verge or a median.
Cast in situ	Concrete which is cast directly into its final position.
Catchment	The area drained by a stream or body of water, or the area of land from which water is collected
CBD	Central business district
CEMP	Construction Environmental Management Plan A site specific plan developed for the construction phase of a project to ensure that all contractors and sub-contractors comply with the environmental conditions of approval for the project and that environmental risks are properly managed
Chainage	Any point on a control line selected to provide more detailed information about the cross-section or any other feature mentioned in the drawings. Also known as a station.
Clearing	The removal of vegetation or other obstacles at or above ground level
CNVMP	Construction Noise and Vibration Management Plan
CO	Carbon monoxide
$CO_{2\text{-}e}$	A metric measurement used to compare the emissions from various greenhouse gases based upon their global warming potential.
Colluvial soils	Stony clays that have been moved downslope by soil creep and slopewash but may include a proportion of windblown red clay (parna) and higher terrace alluvium.
Concentration (air quality)	Pollutants emitted to the air from various sources are transported and diluted resulting in a volume of pollutant per volume of ambient air. Ambient air quality goals are expressed in terms of concentrations, which are measured in parts per million or micrograms per cubic metre.
Concept design	Initial functional layout of a road/road system or other infrastructure. Used to facilitate understanding of a project, establish feasibility, and provide a basis for estimating and to determine further investigations needed for detailed design.
dBA	Used as a measure of A–frequency weighted sound levels. The A-frequency weighting is an adjustment made to sound level measurement, by means of an electronic filter, in line with international standards. This approximates the response of the human ear at lower sound pressure levels.
Decibel	A scale unit used in the comparison of powers and levels of sound energy.
DECC	NSW Department of Environment and Climate Change (formerly DEC and now OEH and EPA).
DECCW	NSW Department of Environment, Climate Change and Water (formerly DEC, DECC and now OEH and the EPA).
Dioxin	A group of halogenated organic compounds, significant because they act as environmental pollutants.
DP&E	(NSW) Department of Planning and Environment
Design speed	A nominal speed used for the design of geometric features of the road, such as curves.

Term	Meaning
DGRs	Director-General's Requirements (now known as Secretary's Environmental Assessment Requirements). Requirements and specification for the environmental assessment prepared by the Director-General (now known as the Secretary) of the (NSW) Department of Planning and Environment under the (NSW) *Environmental Planning and Assessment Act 1979.*
DPI	Department of Primary Industries
EIS	Environmental impact statement
ESD	Ecologically sustainable development.
Ecology	The relationship between living things and the environment.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
EEC	Endangered ecological community. An ecological community identified by relevant legislation as having endangered status.
EMP	Environmental management plan
Environment	A term for all the conditions (physical, chemical, biological and social) in which an organism or group of organisms, including humans, exists.
Environmental impact statement (EIS)	An environmental impact statement is a focussed analysis undertaken for the purposes of Part 5.1 of the (NSW) *Environmental Planning and Assessment Act 1979*, written generally to comply with the requirements issued by the Director-General of the (NSW) Department of Planning and Environment.
EP&A Act	(NSW) *Environmental Planning and Assessment Act 1979* (NSW).
EPA	(NSW) Environment Protection Authority.
EPBC Act	*(Commonwealth) Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth).
GHG	The NSW Department of Primary Industries, which includes Fisheries NSW, Agriculture NSW and NOW.
Grade separation	The separation of road, rail or other traffic so that crossing movements, that would otherwise conflict, are at different levels.
Groundwater	Water contained within rocks and sediments below the ground's surface in the saturated zone.
Haul road	A designated road, often temporary, used for moving materials (often used when new infrastructure is being constructed).
Hydrocarbon	Any organic compound – gaseous, liquid or solid – consisting only of carbon and hydrogen.
Hydrology	The study of rainfall and surface water runoff processes
Interchange	A grade separation of two or more roads with one or more interconnecting carriageways
ISCA	Infrastructure Sustainability Council of Australia
ITS	Intelligent Transport Systems. The application of computer and communication technologies to manage transport problems. ITS infrastructure and can include the traffic monitoring cameras, variable message signs and variable speed limit signs.
LA10	The noise level that is exceeded for 10% of the sample period. During the sample period, the noise level is below the LA10 level for 90 per cent of the time. The LA10 is a common noise descriptor for environmental noise and road traffic noise.
LA90	The noise level that is exceeded for 90 per cent of the sample period. During the sample period, the noise level is below the LA90 level for 10 per cent of the time. This measure is commonly referred to as the background noise level.

Term	Meaning
LAeq	The equivalent continuous sound level. This is the energy average of the varying noise over the sample period and is equivalent to the level of constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.
LALC	Local Aboriginal Land Council.
Landscape character	The aggregate of built, natural and cultural aspects that make up an area and provide a sense of place. Includes all aspects of a tract of land – built, planted and natural topographical and ecological features
Local road	A road or street used primarily for access to abutting properties.
Longitudinal section	The section drawn along the length of the route showing vertical elevation.
LoS	Level of service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
Lot	A parcel of land defined by measurement as a lot in a deposited plan (DP) or as a Crown portion or allotment.
LGA	Local Government Area
LTTMP	NSW Long Term Transport Master Plan
Managed Motorways	Also known as “smart motorways”, is a project to introduce intelligent technology for Sydney's M4 Motorway. The project brings together complementary technologies to maximise the performance of road infrastructure.
NCA	Noise catchment area
NOx	Oxides of nitrogen.
OEH	(NSW) Office of Environment and Heritage.
PACHCI	Procedure for Aboriginal Cultural Heritage Consultation and Investigation (Roads and Maritime Services, 2011).
PAD	Potential archaeological deposit – any location considered to have a moderate to high potential for subsurface archaeological material.
PAH	Polyaromatic hydrocarbons.
PASS	Potential acid sulfate soils.
PEA Act	NSW *Protection of the Environment Administration Act, 1999*
pH	A measure of acidity or alkalinity of a solution, numerically equal to seven for neutral solution, increasing with increasing alkalinity and decreasing with increasing acidity.
Piling – bored	A method of inserting piles using a drilling or boring motion.
Piling – driven	A method of inserting piles using a driving or hammering motion.
PM_{10}	Particulate matter less than 10 microns in diameter
POEO Act	(NSW) *Protection of the Environment Operations Act 1997*.
Proponent	The person or organisation that proposes carrying out a project or activity.
RBL	Rating background level. This is the median noise value of the assessment background levels values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night-time.
Receptor/receiver	An environmental modelling term used to describe a map reference point where the impact is predicted. A sensitive receptor is a home, workplace, school or other place where people spend some time. An elevated receptor is a point above ground level.
Roads and Maritime	(NSW) Roads and Maritime Services.

Term	Meaning
Shared path	An area open to the public that is designated for, or has as one of its main uses, use by both the riders of bicycles and pedestrians.
SMPO	Sydney Motorways Project Office
Smart motorways	Also known as “Managed Motorways”, is a project to introduce intelligent technology for Sydney's M4 Motorway. The project brings together complementary technologies to maximise the performance of road infrastructure.
Spoil	Surplus excavated material.
STM	Sydney Strategic Transport Model operated by the Bureau of Transport Statistics (BTS) and used for projecting travel patterns in Sydney, Newcastle and Wollongong under different land use, transport and pricing scenarios.
Stockpile	Temporarily stored materials such as soil, sand, gravel and spoil/waste.
Swale	A shallow, grass-lined drainage channel.
Threatened	As defined under the (NSW) *Threatened Species Conservation Act 1995*, a species, population or ecological community is threatened when it is likely to become extinct or is in immediate danger of extinction.
TRAQ	Roads and Maritime Tool for Roadside Air Quality model. The model has been specifically developed for roadside air quality impact assessments and uses a conservative approach to estimate the concentrations of air pollutants near to roadways.
TSC Act	The (NSW) *Threatened Species Conservation Act 1995* is an Act to conserve threatened species, populations and ecological communities of animals and plants.
TSP	Total suspended particulates.
Typical cross section	A cross section of a carriageway showing typical dimensional details, furniture locations and features of the pavement construction.
Turbidity	A measure of light penetration through a water column containing particles of matter in suspension.
UAP	Urban Activation Precinct
Urban design	The process and product of designing human settlements, and their supporting infrastructure, in urban and rural environments
VENM	Virgin excavated natural material.
Viaduct	A long bridge, generally composed of a series of spans over land, which carries a road or railway
VTTS	Value of Travel Time Surveys.
Water table	The surface of saturation in an unconfined aquifer at which the pressure of the water is equal to that of the atmosphere.
WDA	WestConnex Delivery Authority.
Wetland	A swamp or marsh in which the soil is frequently or permanently saturated with water, or under water.
WRTM	WestConnex Road Traffic Model which was developed to forecast road traffic impacts for WestConnex including the M4 Widening project

1 Introduction

This chapter introduces the project, providing a brief outline of its need, scope, and location. It also outlines the structure of this environmental impact statement (EIS).

1.1 Overview of WestConnex project

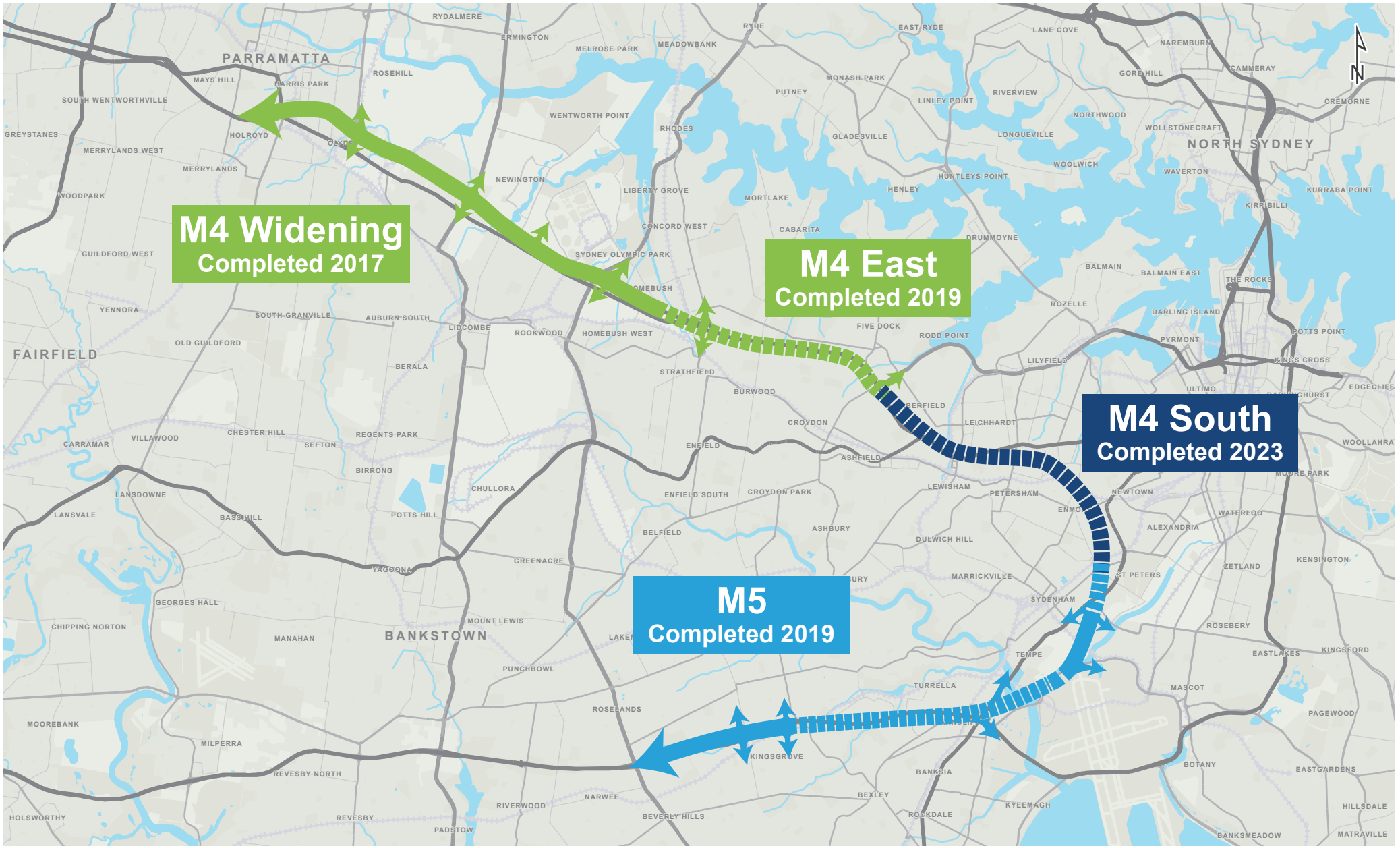
The M4 Widening is a component of the WestConnex project which is the largest integrated transport and revitalisation project in Australia. The WestConnex project will link Parramatta to the central business district (CBD), Sydney Airport and the Port Botany precinct and the M5 in south-west Sydney via a 33 kilometre tolled motorway completely free of traffic signals. As shown in Figure 1.1, WestConnex is made up of the following stages:

- Widening of the M4 Western Motorway (M4 Motorway) between Parramatta and Homebush (this project).
- M4 East - Extension of the M4 Motorway from Homebush to Haberfield, due for completion in 2019.
- M4 South - Construction of a further stage from Haberfield to St Peters via Camperdown, due for completion in 2023.
- M5 - Construction of a new link from St Peters to the M5 East, as well as the duplication of the M5 East, due for completion in 2019.

Currently, the M4 Motorway finishes at North Strathfield at which point traffic continues along Parramatta Road encountering multiple traffic signals generally every few hundred metres leading into the Sydney CBD. This leads to traffic congestion and unreliable travel times. When complete, the M4 Widening project and future M4 East project would together extend the M4 Motorway beyond Parramatta Road at North Strathfield to the City West Link near Haberfield. When constructed, these improvements will help by removing traffic, including heavy vehicles, from Parramatta Road and easing congestion for local travel, particularly east of North Strathfield. As a result, WestConnex will be the trigger for urban revitalisation and provide new opportunities for residential and commercial development along the Parramatta Road corridor, particularly between North Strathfield and Camperdown, making it a more attractive place to live, work and socialise. WestConnex aims to accommodate the growing transport needs of greater Sydney, strengthen access for industry to commercial centres and improve growth opportunities for local businesses.

When completed, WestConnex will save 40 minutes on a typical journey between Parramatta and Sydney Airport by bypassing up to 52 sets of traffic signals, helping the city cope with an expected population increase of more than 1.5 million by 2031.

WestConnex 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. WestConnex is also identified as a key element of Sydney's road future in the *NSW Long Term Transport Master Plan* (Transport for NSW 2012) (LTTMP).



M4 Widening project in a regional context with the WestConnex scheme **Figure 1.1**

The WestConnex Delivery Authority (WDA) was established by the NSW Government to deliver the WestConnex series of projects. The WDA is a public subsidiary corporation of the (NSW) Roads and Maritime Services (Roads and Maritime). Its role and functions are set out in Part 4A of the (NSW) Transport Administration (General) Regulation 2013. Roads and Maritime is the M4 Widening project proponent.

1.2 Project overview

The M4 Widening project comprises the first stage in the delivery of WestConnex. It includes widening and upgrading approximately 7.5 kilometres of the M4 Motorway generally between Pitt Street, Parramatta and Homebush Bay Drive, Homebush (noting that the Pitt Street overpass borders the four suburbs of Granville, Holroyd, Merrylands and Parramatta).

As a result of the project, access to and from the M4 Motorway would be substantially improved at Homebush Bay Drive, Homebush and Hill Road, Lidcombe (at Sydney Olympic Park). By providing an extra lane each way for motorists using this section of the motorway, it will also help alleviate congestion around the James Ruse Drive ramps and provide quicker and more reliable journeys for motorists and freight. The investment in the M4 Widening project and subsequent WestConnex stages would facilitate a step change in network performance, enabling delivery of major city shaping improvements and delivering economic growth.

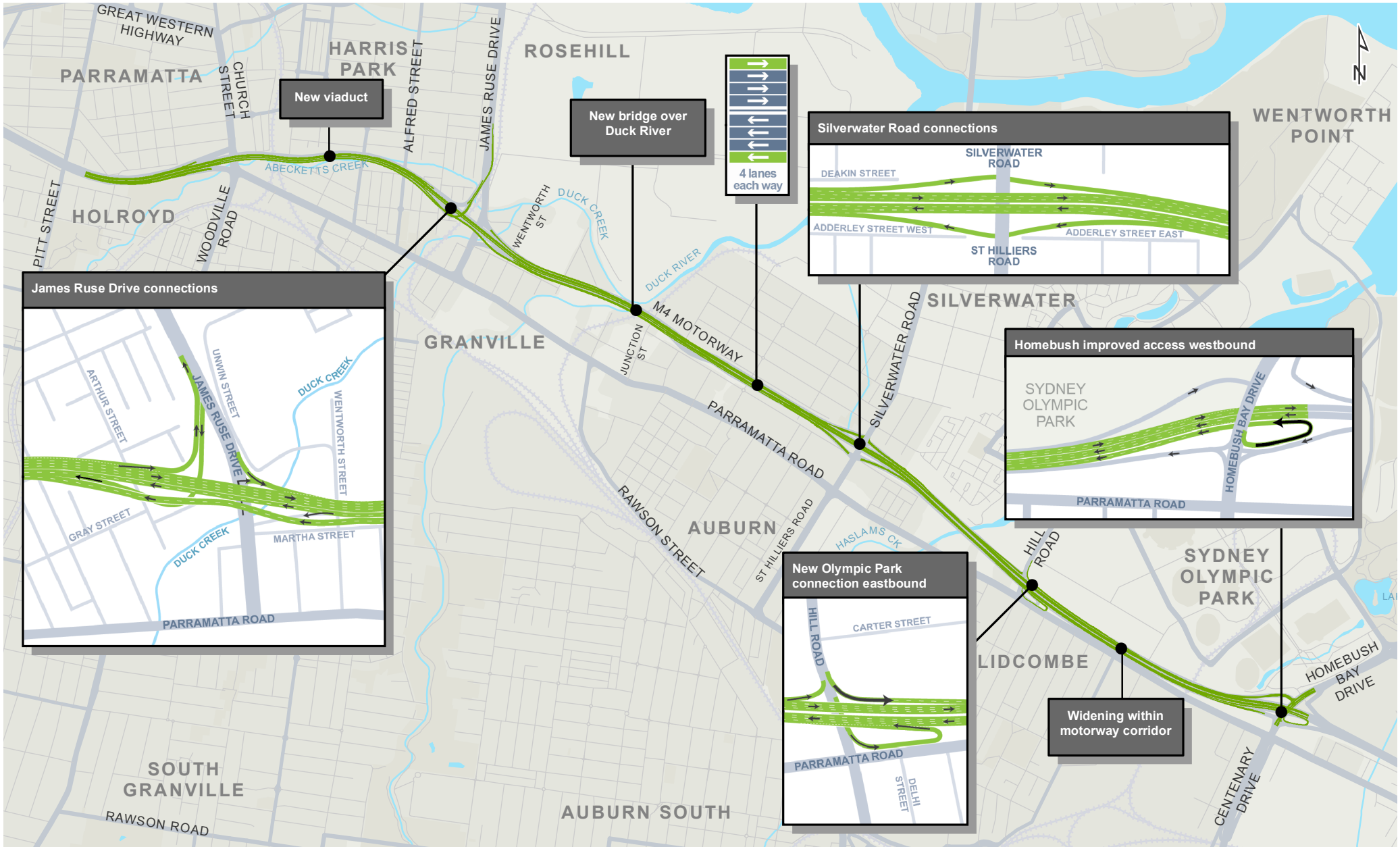
The M4 Widening project would include the following key features:

- Construction of a new two lane viaduct for westbound traffic, on the southern side of the existing viaduct structure between Church Street, Parramatta and Wentworth Street, Granville.
- Reconfiguration of the traffic lanes on the existing viaduct structure to four lanes eastbound and two lanes westbound (making a total of four lanes in each direction).
- Construction of a new bridge/viaduct over Duck River at Auburn.
- Widening of the existing motorway to the south of the westbound carriageway between Wentworth Street, Granville and Duck River, Auburn.
- Widening of the at-surface carriageway of the motorway predominantly within the existing motorway corridor (utilising both the existing median and verge areas), between Junction Street, Auburn and Homebush Bay Drive, Homebush to provide four traffic lanes westbound and four traffic lanes eastbound.
- Construction of a new westbound G-loop on-ramp to the M4 Motorway from Homebush Bay Drive, Homebush.
- Construction of a new eastbound on-ramp to the M4 Motorway from Hill Road, Lidcombe.
- Provision of Intelligent Transport Systems (ITS) infrastructure for motorway operations.
- Provision of road infrastructure and services to support the future implementation of smart motorway (Managed Motorway) operations.
- Widening and/or lengthening of existing ramps at Church Street, James Ruse Drive, Silverwater Road, Hill Road and Homebush Bay Drive.
- Provision of tolling infrastructure such as gantries and control systems.
- Provision of new and modified noise barriers.
- Provision of new asphalt wearing surface to the existing M4 Motorway.

1.3 Project location

The project is located approximately 13 kilometres to the west of the Sydney CBD and generally follows the alignment of the existing M4 Motorway. Figure 1.1 shows the regional context while Figure 1.2 shows the project location and key features. The project extends from Pitt Street, Parramatta in the west to east of the Homebush Bay Drive interchange at Homebush in the east.

The project traverses the suburbs of Merrylands, Parramatta, Holroyd, Granville, Silverwater, Auburn, Lidcombe, Sydney Olympic Park, Homebush and Homebush West. The project spans four local government areas (LGAs) being Holroyd, Parramatta, Auburn and Strathfield.



KEY

- New/upgraded surface road
- New ramp
- Road
- Rail line

Project location and key features **Figure 1.2**

0 0.5 1
Km

1.4 EIS structure

This EIS has been prepared to address the requirements issued by the Secretary (formerly Director-General) of the (NSW) Department of Planning and Environment (DP&E) (formerly (NSW) Department of Planning and Infrastructure) on 4 November 2013 and the relevant provisions of Schedule 2 of the (NSW) Environmental Planning and Assessment Regulation 2000.

The EIS is divided into three volumes.

Volume 1 has the following structure:

- Introduction — provides a broad overview of the project and where it is located (Chapter 1).
- Assessment process – outlines the statutory requirements and explains the steps in the assessment and approval process (Chapter 2).
- Strategic justification and project need — provides the strategic context, explains the need for the project and identifies the project objectives (Chapter 3).
- Project development and alternatives — reviews the alternatives and options considered in developing the project including the consequences of not proceeding (Chapter 4).
- Project description — provides a detailed description of the project including the route alignment, design standards and key design features (Chapter 5).
- Project construction – includes construction methodologies, construction staging, equipment and site compounds (Chapter 6).
- Consultation – outlines the consultation activities undertaken, issues raised and how these have been addressed (Chapter 7).
- Assessment of key issues— identifies the key environmental issues, assesses the impacts and proposes environmental management measures (Chapter 8).
- Assessment of other issues – identifies other environmental issues, assesses the impacts and proposes environmental management measures (Chapter 9). Climate change, greenhouse gases and cumulative impacts are considered in this chapter.
- Sustainability – discusses the sustainability framework within which WestConnex will be delivered and considers the M4 Widening project against the principles of ecologically sustainable development (ESD) (Chapter 10).
- Environmental risk analysis – Details the risk analysis process by which the potential environmental issues for assessment were identified (Chapter 11).
- Summary of environmental management measures – collates all of the environmental management measures for the project identified through the impact assessment (Chapter 12).
- Project justification and conclusion — presents the justification for the project, including consideration of the principles of ecologically sustainable development and the objects of the (NSW) *Environmental Planning and Assessment Act 1979* (EP&A Act) (Chapter 13).
- References.
- Appendix A Director-General's environmental assessment requirements and checklist
- Appendix B (NSW) Environmental Planning and Assessment Regulation 2000 checklist
- Appendix C Concept design drawings

Volume 2 contains the following appendices to the EIS:

- Appendix D Technical working paper: Traffic and transport
- Appendix E Technical working paper: Noise and vibration

Volume 3 contains the following appendices to the EIS:

- Appendix F Technical working paper: Urban design concept, landscape character and visual
- Appendix G Technical working paper: Soils, water and waste
- Appendix H Technical working paper: Hydrology and flooding

Volume 4 contains the following appendices to the EIS:

- Appendix I Technical working paper: Biodiversity
- Appendix J Technical working paper: Aboriginal heritage
- Appendix K Technical working paper: Historic heritage
- Appendix L Technical working paper: Air quality
- Appendix M Technical working paper: Socio-economic and Draft Community Consultation Framework

2 Assessment process

This chapter describes the planning approval process for the project as well as other relevant environmental and statutory approval requirements.

2.1 Approval framework

2.1.1 (NSW) *Environmental Planning and Assessment Act 1979*

Clause 94 of the State Environmental Planning Policy (Infrastructure) 2007 (the Infrastructure SEPP) provides that development for the purpose of a road or road infrastructure facilities may be carried out by or on behalf of a public authority without consent on any land. The project comprises development for the purposes of a 'road' and for associated 'road infrastructure facilities' under the Infrastructure SEPP.

Clause 14 of the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP) declares development as State significant infrastructure if the development is permissible without consent under Part 4 of the EP&A Act and is specified in Schedule 3.

Clause 1 of Schedule 3 of the SRD SEPP specifies infrastructure or other development that would be an activity for which the proponent is also the determining authority and would, in the opinion of the proponent, require an EIS to be obtained under Part 5 of the EP&A Act.

An EIS is required under Part 5 of the EP&A Act where the activity is likely to significantly affect the environment. Roads and Maritime has formed the opinion that the project, specifically its impact on noise and vibration, traffic and transport, socio-economic, land use and property and urban design considerations, is likely to significantly affect the environment and would require an EIS to be obtained under Part 5 of the EP&A Act. Accordingly, the project falls within Clause 1 of Schedule 3 of the SRD SEPP and is declared by Clause 14 of the SRD SEPP as State significant infrastructure.

As a result, Part 5.1 of the EP&A Act applies and Roads and Maritime seeks approval for the M4 Widening project under Part 5.1 of the EP&A Act. The approval process under Part 5.1 of the EP&A Act is illustrated in Figure 2.1. Further information on the assessment process is available on DP&E's website (www.planning.nsw.gov.au).

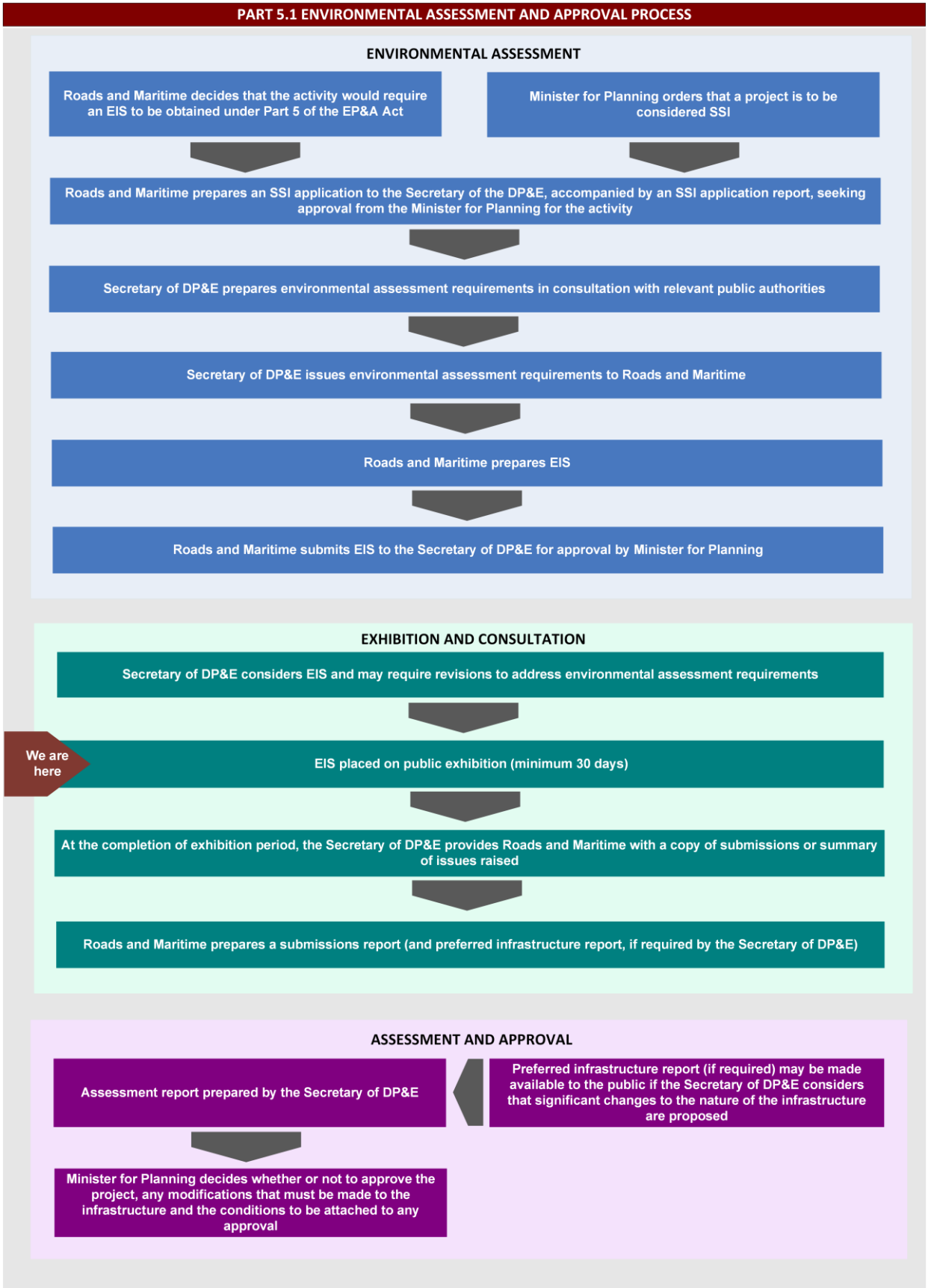


Figure 2.1 State significant infrastructure assessment and approval process

2.2 Other NSW approvals required

A number of approvals, which might otherwise be required, are not required for a project approved under Part 5.1 of the EP&A Act (EP&A Act s.115ZG). Relevantly, these are:

- Permits under sections 201, 205 and 219 of the (NSW) *Fisheries Management Act 1994*.
- Approvals under Part 4 and excavation permits under section 139 of the (NSW) *Heritage Act 1977*.
- Aboriginal heritage impact permits under section 90 of the (NSW) *National Parks and Wildlife Act 1974*.
- Authorisations under the (NSW) *Native Vegetation Act 2003* to clear native vegetation or State protected land.
- Various approvals under the (NSW) *Water Management Act 2000*, including water use approvals under section 89, water management work approvals under section 90, and activity approvals (other than aquifer interference approvals) under section 91.

Approvals under other NSW legislation that will be required are:

- An environment protection licence under Chapter 3 of the (NSW) *Protection of the Environment Operations Act 1997* (POEO Act). In accordance with section 115ZH of the EP&A Act, such a licence cannot be refused for an approved project and is to be substantially consistent with the Part 5.1 approval.
- An approval under the (NSW) *Crown Lands Act 1989* to grant a relevant interest (ie licence, permit, easement or right of way) over a Crown Reserve.

Other legislation that may apply to the project includes:

- An aquifer interference approval under the (NSW) *Water Management Act 2000* if construction requires intersection of a groundwater source.
- (NSW) *Land Acquisition (Just Terms Compensation) Act 1991* – likely to apply to the acquisition of any land required for the project. Acquisition is further discussed in section 5 of this report.
- (NSW) *Contaminated Land Management Act 1997* – outlines the circumstances in which notification of the (NSW) Environment Protection Authority (EPA) is required in relation to the contamination of land.

2.3 Commonwealth legislation

Under the (Commonwealth) *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) proposed 'actions' that have, will have or are likely to have a significant impact on matters of national environmental significance, the environment of Commonwealth land, or the environment inside or outside the Australian jurisdiction where the action will be carried out carried out by the Commonwealth or a Commonwealth agency must be referred to the Australian Government Department of the Environment under Part 9 of the EPBC Act. If the Minister for the Environment determines that the action is a 'controlled action', the approval of the Minister is required before the action can be carried out.

Based on the results of the environmental investigations carried out for this EIS, it is considered that no matters of national environmental significance or areas of Commonwealth land would be significantly impacted by the project. Accordingly, a referral is not required.

3 Strategic justification and project need

This chapter outlines the relationship between the project and the strategic planning framework. It also identifies the need for the project and the project objectives. A statement of strategic need concludes the chapter.

Director-General's Requirements	Where addressed in EIS
…a statement of the objectives of the project,	Section 3.5
including a description of the strategic need, justification, objectives and outcomes for the project,	Section 3.3 & Chapter 13
taking into account existing and proposed transport infrastructure and services within the adjoining subregions,	Section 3.3 & Section 7.1
and as relevant the outcomes and objectives of relevant strategic planning and transport policies, including, but not limited to, NSW 2021, NSW Government State Infrastructure Strategy, NSW Long Term Transport Master Plan (December 2012), draft Metropolitan Strategy for Sydney (March 2013), and any other relevant plans…	Section 3.2

3.1 Overview

The M4 Motorway is one of Sydney's key transport corridors. Currently, the M4 Motorway finishes at North Strathfield about 12 kilometres west of the Sydney CBD where it joins Parramatta Road, resulting in the lack of a high quality link through the inner west part of Sydney. The M4 Motorway currently experiences heavy congestion, slow speeds and unreliable travel times especially in the morning and afternoon peak, and increasingly at other times of the day and also on weekends.

Sydney's population expected to increase by more than 1.5 million people by 2031 and without major investment in road network infrastructure this growth will result in worsening road congestion. This congestion will in turn affect Sydney's economic competitiveness as a global city in light of competition from other cities in the region.

To meet these challenges, the NSW Government is proposing to widen and upgrade approximately 7.5 kilometres of the M4 Motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush as part of WestConnex.

The M4 Widening project is a component of Stage 1 of WestConnex. WestConnex is a program of works designed to provide 33 kilometres of tolled motorways linking Parramatta to the CBD, Sydney Airport and the Port Botany precinct and the M5 in south-west Sydney. Future stages of WestConnex would include an extension of the M4 Motorway from Homebush to Haberfield (M4 East project), a further stage from Haberfield to St Peters via Camperdown (M4 South project) and a new link from St Peters to the M5 East, as well as duplication of the M5 East.

Western Sydney is the third biggest economy in Australia after the Sydney CBD and South East Queensland.

The *WestConnex Business Case Executive Summary* (Sydney Motorways Project Office (SMPO) 2013a) (WestConnex Business Case Executive Summary) identifies that a high proportion of demand for travel to the port and the airport precinct originates in either the CBD/Sydney Airport/Port Botany corridor or Western Sydney and about 60 per cent of import containers are delivered to areas serviced by the M4, M5 and M7 corridors.

As identified in the *WestConnex Strategic Environmental Review* (SMPO 2013b) (Strategic Environmental Review), the WestConnex project will deliver significant long-term benefits to the economic growth and development of NSW and to Australia.

The WestConnex project will deliver substantial amenity benefits, improve the function of the city, improve traffic flow along key corridors and provide an important catalyst for urban renewal in areas of the city that currently experience poor amenity due to excessive traffic on local and arterial roads. Importantly, it will also improve economic competitiveness allowing people (including tradespeople, builders, service provides etc.) and goods (including supplies to factories, warehouses, shops, cafes, restaurants etc.) to move around the city in a more efficient and cost effective way. Figure 3.1 identifies a number of the benefits and key factors relevant to WestConnex.



Figure 3.1 Benefits and key factors relevant to WestConnex

Parramatta Road and the M4 Motorway provide an important link between people living in Western Sydney and jobs located in Sydney's east within the Sydney CBD and surrounding suburbs. Further detail on the need for the project is provided in section 3.3.

3.2 Strategic planning and policy framework

3.2.1 NSW 2021

NSW 2021: A plan to make NSW number one (NSW Department of Premier and Cabinet 2011) (NSW 2021) 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 NSW 2021 Performance Report* (NSW Department of Premier and Cabinet 2012) sets baselines and provides information on how the NSW Government intends to measure and deliver on the goals, targets and measures outlined in NSW 2021.

NSW 2021 emphasises investing in and delivering an efficient and effective transport system including delivering road infrastructure that will relieve congestion, improve travel times, improve road safety and enhance and expand capacity on key road corridors.

Within the context of the goals identified in NSW 2021, the M4 Widening project, and the full WestConnex, will help to achieve priority actions within NSW 2021 by delivering key road infrastructure identified by the NSW Government which will enhance and expand capacity on the M4 Motorway. Specifically, the M4 Widening and the full WestConnex project will help achieve the following NSW 2021 goals:

- Goal 1 - Improve the performance of the NSW economy.
- Goal 4 - Increase the competitiveness of doing business in NSW.
- Goal 5 - Place downward pressure on the cost of living.
- Goal 7 – Reduce travel times.
- Goal 10 – Improve road safety.
- Goal 19 – Invest in critical infrastructure.

3.2.2 State Infrastructure Strategy

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

The State Infrastructure Strategy recognises the scale and complexity of the problems along the M4 and M5 corridors and identifies these corridors as having the most pressing investment needs due to their importance for freight and business transport as well as being important connections to Global Sydney and to the international gateways of Port Botany and Sydney Airport. WestConnex (including the M4 Widening project) is identified in the State Infrastructure Strategy as a critical program of work with a range of benefits including reducing congestion, providing opportunities for urban renewal along Parramatta Road, providing improved access to the major

international gateways of Sydney Airport and Port Botany, and improving industrial access and business efficiency, including along the M4 corridor.

The State Infrastructure Strategy identifies the key deliverables and next steps in implementing WestConnex. It also discusses design considerations to be reflected in individual project stages.

3.2.3 NSW Long Term Transport Master Plan

The *NSW Long Term Transport Master Plan* (Transport for NSW 2012) (LTTMP) provides a framework for delivering an integrated, modern transport system by identifying NSW's transport actions and investment priorities for the next 20 years. Under the LTTMP, WestConnex is identified as a critical link in Sydney's motorway network and an immediate priority for the NSW Government. Figure 3.2 identifies the widening of the M4 Motorway and WestConnex more broadly as key connections for the Sydney motorway network to 2031.



Figure 3.2 Potential connections to bridge gaps in the Sydney motorway network by 2031 (Transport for NSW 2012)

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 and Port Botany and Western Sydney and employment areas across Sydney. Furthermore, it establishes that the program will relieve road congestion and thereby improve the speed, reliability and safety of travel, including in the M4 corridor.

The LTTMP identifies the need for progressive delivery of WestConnex. It recognises the widening of the existing M4 Motorway as a key component of WestConnex, which will increase the motorway's capacity to accommodate commercial vehicles and freight demand in this part of the corridor. In this way, the M4 Widening project assists the broader WestConnex in catering for the diverse travel demands and trip purposes (including freight and business travel) along key transport corridors that are best met by road infrastructure.

The LTTMP committed the NSW Government to develop integrated land use and transport outcomes to renew the Parramatta Road corridor in conjunction with the delivery of WestConnex. This included action to deliver an integrated package of transport improvements with WestConnex, including complementary enhancements to the existing road network (such as surface street changes, bus priority measures, heavy vehicle access improvements, redesign of bus services and facilities, improved access to rail stations and upgrades to rail stations and cyclist and pedestrian facilities).

3.2.4 Draft Metropolitan Strategy for Sydney to 2031

The *Draft Metropolitan Strategy for Sydney to 2031* (NSW Government 2013a) (Draft Metropolitan Strategy) 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.

The Draft Metropolitan Strategy is being delivered in conjunction with the LTTMP and State Infrastructure Strategy to fully integrate planning for housing and employment with the delivery of transport and infrastructure. The Draft Metropolitan Strategy envisions that the city of Sydney will be highly networked, with more frequent connections into and through the Global Economic Corridor, and between Sydney CBD and Parramatta, Liverpool and Penrith. Accessibility and connectivity as defined in the Draft Metropolitan Strategy is illustrated in Figure 3.3.

WestConnex supports the economic growth in the Global Economic Corridor which extends northward from Sydney Airport and Port Botany, through the CBD and on to Macquarie Park. The corridor provides for some 700,000 jobs, generates over 50 per cent of NSW's total economic output (Infrastructure NSW 2012b) and attracts investment and people from around the region and the world (NSW Government 2013).

The Draft Metropolitan Strategy has identified a number of policies, objectives and actions that are of particular relevance to WestConnex, and specifically the M4 Widening project. Objective 10 is to provide capacity for jobs growth and diversity recognising the role of global Sydney as the basis for the success of the NSW economy. Objective 16 emphasises productivity outcomes through investment in critical and enabling infrastructure, including freight networks. Objective 25 focusses on improving access to major employment hubs and global gateways, while Objective 27 seeks to deliver efficient freight connections.

The Draft Metropolitan Strategy for Sydney aims to unlock capacity constraints in transport corridors to Global Sydney, the Global Economic Corridor and Parramatta as a priority. It also recognises that the transport network between Port Botany, the major clusters of industrial land in Western Sydney and destinations beyond the Sydney Metropolitan Area will see a dramatic increase in freight movements related to the expected increase in Sydney's population by more

than 1.5 million people by 2031. This increased demand will need to be accommodated by both freight rail network improvements and an upgraded road network.

The Draft Metropolitan Strategy presents a vision for Sydney as a strong global city and the nation's economic and financial powerhouse. In this context it emphasises the need to improve access to major employment hubs and global gateways. WestConnex will support connections to Sydney Airport and Port Botany which will assist with growth in air travel and freight movements.

The Parramatta Road corridor is identified as a key 'city shaper' and will connect Global Sydney and Parramatta via Sydney Olympic Park more efficiently. Priorities for the Parramatta Road corridor include delivering improved road connections through WestConnex, which will provide opportunities to transform the local centres that exist alongside Parramatta Road and provide better connections to enable major urban renewal to occur in these areas.

To support appropriate amenity and urban place requirements, it is desirable to reduce the high volumes of long distance and heavy vehicle through traffic from the key arterial surface roads in these precincts

West Central and North West Subregion

The Draft Metropolitan Strategy guides subregional planning by identifying the metropolitan priorities for each of the subregions across Sydney. Subregional planning will demonstrate how the growth of the city will be closely integrated with long-term transport and infrastructure planning, as major renewal and growth programs capitalise on existing and planned transport.

The Draft West Central Subregional Strategy (NSW Government 2013b) includes a number of 'metropolitan priorities'. The M4 Widening project is consistent with the following key 'metropolitan priorities':

- Extend the Global Economic Corridor to connect with Parramatta CBD and Castle Hill and Norwest.
- Strengthen Sydney Olympic Park's connection to Parramatta and Global Sydney through the redevelopment of the Parramatta Road corridor.
- Plan for improved transport connections to Parramatta and its wider catchment in line with the LTTMP.
- Plan for transformational change of the Parramatta Road corridor through major urban renewal of centres along the corridor supported by the State Infrastructure Strategy.

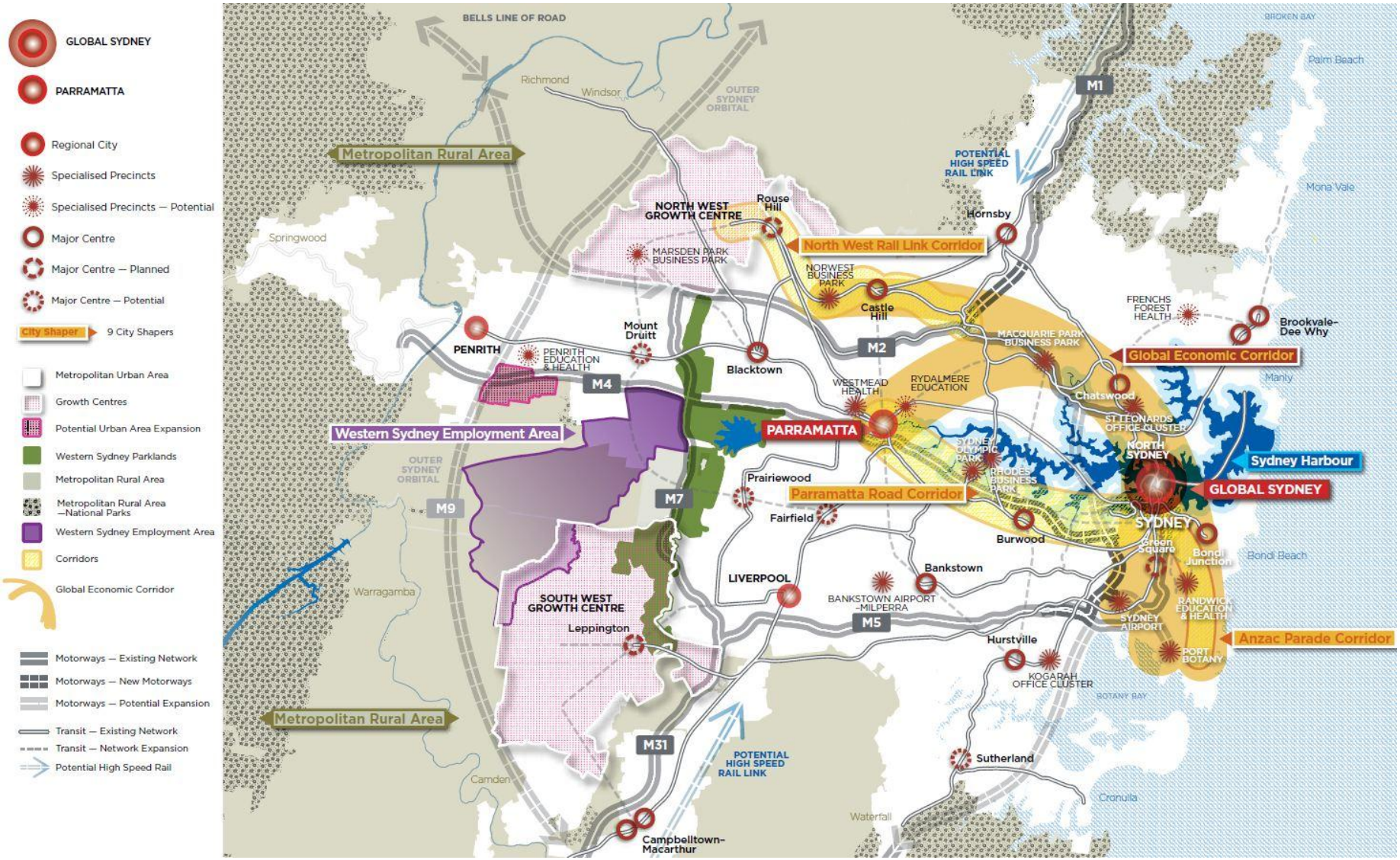


Figure 3.3 Accessibility and connectivity as defined in the Draft Metropolitan Strategy (NSW Government 2013a)

3.2.5 WestConnex Business Case

WestConnex is the largest integrated transport and urban revitalisation project in Australia. It comprises two main components being a 33 kilometre tolled motorway and a 20 kilometre urban renewal corridor between Camperdown and Parramatta. The Business Case for WestConnex was endorsed 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, including the M4 Widening as the first project of the WestConnex projects.

The overall core objectives of WestConnex were identified in the Business Case as follows:

- 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 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 renewal, 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 a way that is affordable and equitable.

The WestConnex project is expected to significantly reduce the growth in congestion on many parts of the corridor that will inevitably increase with population growth if there are no road capacity improvements. This investment in Sydney's road network would facilitate an urban revitalisation opportunity of the Parramatta Road corridor, particularly between North Strathfield and Camperdown, an example of which is shown across Figures 3.4 and 3.5. This forms the focus of the urban revitalisation program being coordinated by Urban Growth NSW in partnership with DP&E and Transport for NSW.



Figure 3.4 Existing Parramatta Road and Burwood Road intersection



Figure 3.5 Example of urban revitalisation opportunity of the Parramatta Road corridor at Parramatta Road and Burwood Road intersection

The basis of this program will be the formation of an integrated Land Use and Transport Concept Plan which would provide a vision for the Parramatta Road corridor for the next 20 years. The plan would integrate land use and transport solutions whilst identifying key opportunities and constraints within the corridor. It would also identify strategically important nodes or areas which would form the basis for revitalisation. The urban revitalisation program would also provide a review of potential capacity of the corridor to support future growth and development in line with the delivery of infrastructure and services. Part of the program is the funding for targeted improvements to the urban domain.

Funding of WestConnex as proposed in the Business Case assumes a distance based toll would be implemented on operation of the M4 Widening project. WDA assumes for the purposes of assessing impacts of the project, a toll for cars and light commercial vehicles would comprise a $1.00 flag-fall plus an additional charge of $0.37 per kilometre travelled. The toll for heavy commercial vehicles would be three times this rate. Based on this tolling strategy the total amount payable by cars and light commercial vehicles travelling the full length of the M4 Widening would be $3.90 ($2013). The proceeds of this toll would be applied to help fund the remaining WestConnex projects. The NSW Government is contributing $1.8 billion to fund WestConnex, while the Australian Government is contributing $1.5 billion with a further $2 billion through a concessional loan to the NSW Government.

3.2.6 Alignment with other strategic planning documents

National Infrastructure Plan

A new national infrastructure priority list is recommended to the Infrastructure Australia Council by the National Infrastructure Coordinator each year.

Action 6 of the *National Infrastructure Plan* June 2013 (Infrastructure Australia 2013) (National Infrastructure Plan) is to 'create a complete national freight network'. A number of long term directions are identified in the National Infrastructure Plan that are recommended for incorporation into the national freight network; including progress towards connection from the designated National Land Transport Network by road to all nationally significant container and bulk freight ports.

The National Infrastructure Plan identifies WestConnex under the national freight network theme.

National Land Freight Strategy

The *National Land Freight Strategy Discussion Paper* (Infrastructure Australia 2011) identifies an 'improvement in the efficiency of freight movements across infrastructure networks' as a key objective of the strategy, with priority actions to effect this objective including 'freight infrastructure improvement and access'. For roads, this includes relevant highway level of service standard, access for high productivity weight-dimension vehicle configurations and compatibility of freight transfer with rail freight and international shipping. Identified goals include the completion of urban motorway networks. The M4 Widening project is therefore considered consistent with this strategy.

National Road Safety Strategy 2011-2020

Working towards safer roads is a major component of the *National Road Safety Strategy* 2011-2020 (Australian Transport Council, 2011) (National Road Safety Strategy). The National Road Safety Strategy indicates that infrastructure improvements can have a major influence in preventing crashes or minimising the consequences of a crash; and given that road infrastructure has a life of 25 years or more, the investment in infrastructure improvement will continue to save lives and avoid serious injuries well into the future. By relieving road congestion (and thereby

improving the speed, reliability and safety of travel on the M4 Motorway), the delivery of the M4 Widening project is consistent with the overarching road safety directions identified in the National Road Safety Strategy.

Urban Activation Precincts

There are two Urban Activation Precincts (UAPs) in the vicinity of the M4 Motorway corridor including Wentworth Point and Carter Street, Lidcombe. UAPs were announced by the NSW Government in 2013 as an important component of a package of wider housing delivery and employment initiatives. The rezoning for the Wentworth Point UAP was finalised in June 2014.

The UAPs aim to deliver more homes in places with access to infrastructure, transport, services and jobs. The Wentworth Point UAP is 18.6 hectares in area and adjoins Sydney Olympic Park to the north. The activation of the precinct will include:

- A bridge across Homebush Bay to provide walking and cycling access to Rhodes Railway Station.
- A new 3.9 hectare peninsula park and three new smaller parks.
- Foreshore cycling and walking paths at least 20 metres wide.
- An 18-classroom school with playing fields by 2017.
- Upgrades to Hill Road and Bennelong Road to accommodate the increased population.
- A range of low, mid and high-rise residential buildings.
- New maritime uses adjacent to Homebush Bay including a rowing/kayaking facility, dry boat storage and supporting retail businesses.

The Carter Street UAP is located in Lidcombe and adjoins the Sydney Olympic Park to the south west. The precinct is 52 hectares in area and is currently zoned for employment purposes. The activation of the precinct will provide a mix of housing, office-based employment and retail services close to public transport, sporting facilities, entertainment venues and recreational areas including:

- More than 5,500 new homes with a mix of townhouses and apartments.
- Buildings of mainly four to six storeys along east-west streets, six to eight storeys along main streets and parks, and up to 20 storeys on five sites.
- A new 1.8 hectare park with recreation uses as well as stormwater management features.
- Publicly accessible foreshore along Haslams Creek with pedestrian and cycle paths linking to the existing network throughout Sydney Olympic Park.
- A retail centre with up to 12,000 square metres of shops and services along Uhrig Road focussing on a village square where residents and workers can meet and socialise, and a village park with an adjacent community centre.
- Corporate offices and a business and technology park on 11.4 hectares of highly accessible land along the M4 corridor.

3.3 Project need

3.3.1 Regional context

The Sydney Metropolitan Region economy is that part of the Australian economy most integrated into the global economy with approximately 70 per cent of the regions product being derived from finance and business services as well as those services sustaining the 4.5 million people now living in Sydney. The Sydney economy represents approximately 66 per cent of the Gross State Product and about 20 per cent of Australia's Gross Domestic Product (GDP) and is worth $306.2 billion per annum (2012). Metropolitan Sydney covers an area greater than the state of Singapore. Delivering food, various goods, construction and maintenance people and their materials, all of which can only be effectively delivered by roads, is therefore a critical for Sydney to remain economically competitive.

Heavy freight activity precincts are concentrated in Western Sydney and land use changes are reinforcing this situation, including development of the North and South West Growth Centres and proposed intermodal terminals at Moorebank and in greater western Sydney near the Western Sydney Employment Area. The importance of a well-connected motorway network that facilitates the major east-west movements will increase as the freight task increases.

The M4 corridor extends from the Blue Mountains to North Strathfield, within the 'West Central and North West' and 'West' subregions of Sydney as defined in the Draft Metropolitan Strategy. These subregions have a combined population of about 1.2 million people, representing roughly 25 per cent of Sydney's population and a combined 21.2 per cent of Gross Regional Product (GRP) for the Sydney Metropolitan Region ($61.5 billion for 2010-11) (NSW Government 2013a). There are around 500,000 jobs within the corridor and based on information published in the Draft West Central Subregional Strategy and the Draft West Subregional Strategy (NSW Government, 2013b and 2013c), these subregions are targeting a combined population exceeding 1.6 million and employment of 687,000 people by 2031.

The M4 Motorway plays a key role in Sydney's transport system, as shown in Figure 3.2 and Figure 3.3. Other major transport elements around the M4 Motorway include the Great Western Highway, Parramatta Road, James Ruse Drive, Silverwater Road, Homebush Bay Drive and the Western, Cumberland and Carlingford rail lines. The M4 Motorway connects directly with the M7 Motorway at Light Horse Interchange and, together with the Great Western Highway/Parramatta Road, forms the core east-west corridor in Sydney's urban road network connecting Western Sydney with the inner west and Global Sydney.

The existing rail network surrounding the M4 Motorway services regional public transport demand. Sections of the rail network including the South West Rail Link and the Richmond Line have been upgraded in recent years and there has been a focus on rail freight improvements through construction of the Southern Sydney Freight line and components of the Northern Sydney Freight Corridor.

Bus services are focussed on delivering a connected system that gives customers a wider choice of services to reach more destinations more often, including the new Bus Head Start program to provide bus services for the North West and South West Growth Centres as those areas develop, and a redesigned bus network in Sydney's urban area that covers more areas and improve service reliability on inner Sydney's congested corridors, including Parramatta Road (Transport for NSW 2012).

3.3.2 Existing road network conditions

As highlighted in section 3.2, the NSW and Australian Governments have long recognised that investment in transport infrastructure that supports movements to and around the Global Economic Corridor (and Sydney's international gateways) is necessary and will have substantial economic benefits.

Current and emerging pressures

Emerging pressures on the road network include population growth, employment growth and an ever-increasing freight, commercial and business services task. These aspects are discussed further in sections 3.3.3, 3.3.4 and 3.3.5.

Congestion

Forecasted strong growth in traffic over the next 20 years means that road congestion on the motorway network and on the arterial road network will increase unless action is taken (Transport for NSW 2012). Congestion occurs mainly during the morning and evening peak hours when many people are commuting to and from work. This congestion is concentrated on the main arteries leading to employment centres.

While traffic on the M4 Motorway exhibits a traditional peak period profile with maximum flow in the morning peak exceeding 5,400 vehicles per hour at the former toll plaza, the State Infrastructure Strategy indicates that the M4 Motorway currently experiences periods of congestion for up to 13 hours per day.

The LTTMP notes that the average AM peak travel speed on the M4 Motorway between Eastern Creek and Clyde is approximately 35 kilometres per hour. A Travel Speed Survey for the M4 Widening project undertaken in 2012 shows congestion in the morning peak in the eastbound direction, particularly between Church Street and James Ruse Drive. The survey also found low travel speeds in the evening peak in the westbound direction between Silverwater Road and James Ruse Drive.

A few sections of Parramatta Road, where it runs parallel with the M4 Motorway, are relatively free flowing, however many sections experience traffic congestion, with average speeds during each peak hour being about 21 kilometres per hour (Roads and Maritime 2013a).

In addition to slow average peak hour speeds, congestion also leads to travel time variability, resulting in reductions in business productivity and freight efficiency and impact quality of life factors for all road users. Even minor incidents on a congested road network can have an immediate and serious impact on travel times. The LTTMP notes that road congestion currently costs the economy around $5.1 billion each year and by 2020, the costs of congestion are expected to rise to $8.8 billion a year due to increases in demand associated with population growth.

Traffic modelling indicates without the M4 Widening or the WestConnex project, morning peak travel times in the eastbound direction on the motorway would increase from around 12 minutes to 19 minutes between Church Street and Homebush Bay Drive. In the westbound direction, over the same section, travel times would increase from around five minutes to 15 minutes, respectively.

Within the M4 Motorway/Parramatta Road corridor, many critical intersections affect local traffic, cross regional traffic operation, Parramatta Road and accessibility to the M4 Motorway. The level of service (LoS) of key intersections identifies those intersections that are operating satisfactorily (LoS A to C) and those where there is a large average delay per vehicle and the intersection is operating at near capacity (LoS D), at capacity (LoS E) or above capacity (LoS F). Of the 29

intersections that were analysed, nine are operating at LoS D, three are operating at LoS E and two are operating at LoS F during the morning peak. During the evening peak, six of the intersections are performing at LoS D, three at LoS E and three at LoS F.

Congestion also reduces safety on the road network. Congestion can lead to more frequent vehicle crashes and traffic incidents that impact personal safety, property and road network performance. Throughout inner Sydney, many lower order roads are very often required to accommodate high traffic volumes and long distance through trips that should be accommodated by higher order motorway networks. Rear end crashes from stop-start conditions is a symptom of road congestion. The road network surrounding the corridor exhibits proportionately higher road congestion than the Sydney network average.

Since 2010, the M4 Motorway/Parramatta Road corridor between Homebush Bay Drive, Homebush and Parramatta has averaged 372 crashes per year, with 244 crashes on the M4 Motorway and 128 crashes on Parramatta Road. The crash rate on the M4 Motorway (19 crashes with casualties per 100 million vehicle kilometres travelled) is less than that for Parramatta Road (84 crashes with casualties per 100 million vehicle kilometres travelled).

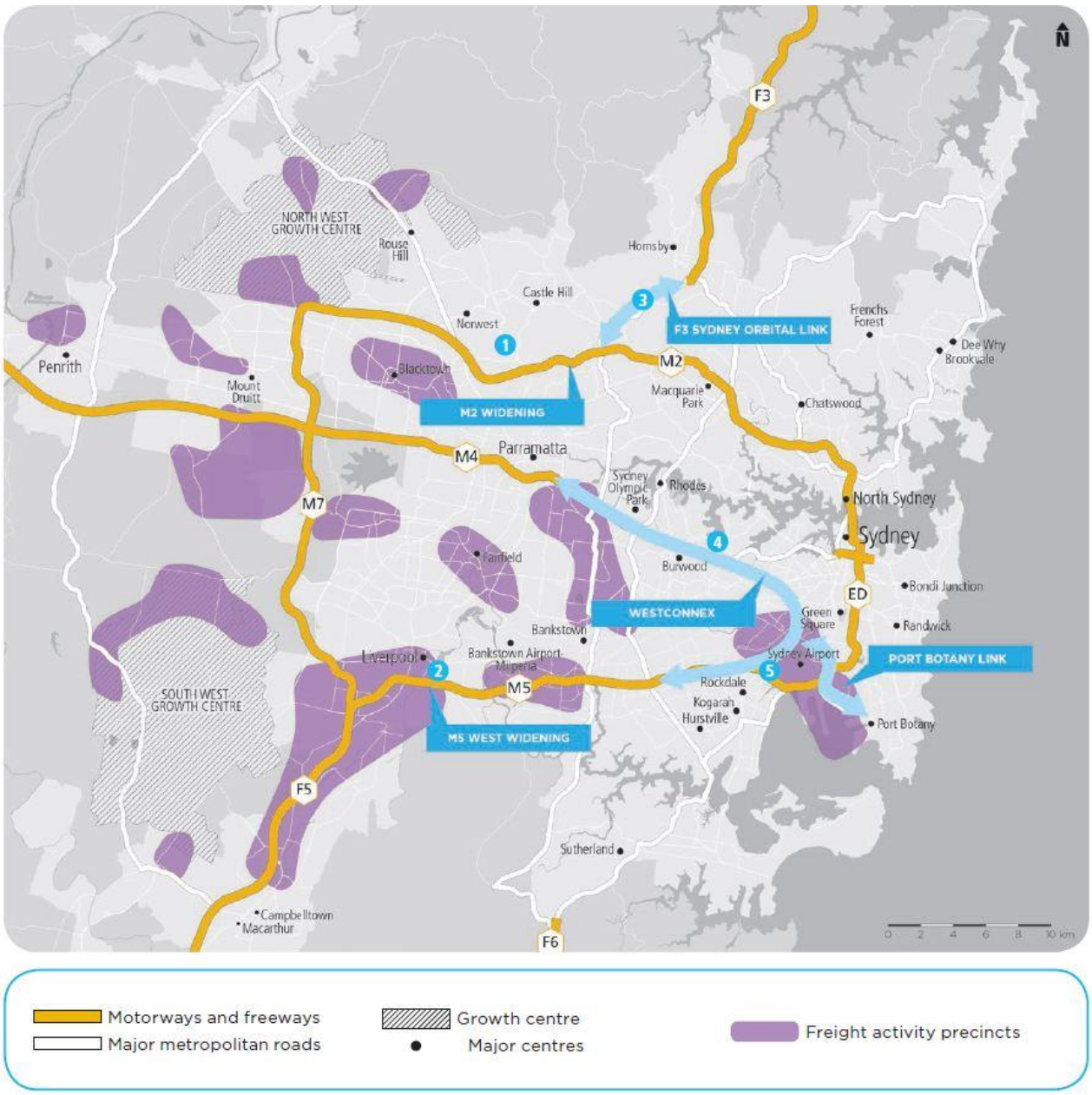
3.3.3 Freight, commercial and business services

Sydney's freight, service and business task is large and significant. *The Trade and Logistics Report 2011-12* (Sydney Ports Corporation 2012) indicates that some 98 per cent of imported containers through Port Botany and over 60 per cent of exported containers have their origin or destination within Greater Sydney.

There are opportunities to shift more freight onto rail and this remains a priority for the NSW Government. However, assuming the target of doubling the share of container freight moved by rail is achieved by 2020, more than 70 per cent of Port Botany's trade would still be required to be moved by road, requiring investment to improve efficiencies of the road network to support the port and airport precincts.

In managing the freight task, heavy commercial vehicles require a primary network with high quality connections between major freight hubs, whereas light commercial vehicles depend on a multi-layered network with many connections to service more diverse and dispersed end-markets across Sydney. The Bureau of Transport Statistics (September 2012) identify that there are currently around 280,000 heavy commercial vehicle trips per day across Sydney, of which only a small proportion are port related, and around 976,000 light commercial vehicle trips per day.

Figure 3.6 is an extract from the *NSW Freights and Ports Strategy* (Transport for NSW, 2013) which states that besides the port and Sydney Airport in the east, heavy freight activity precincts are concentrated in Western Sydney (Transport for NSW 2012). Land use patterns will only reinforce this situation, including development of the north and south west growth centres and proposed intermodal terminals at Moorebank and in greater western Sydney near the Western Sydney Employment Area. As such, the reliance on a well-connected motorway network that facilitates the major east-west movements within the Global Economic Corridor will increase as the freight task increases.



[1] Please note that since preparation of the NSW Freights and Ports Strategy the F3 Freeway has been renamed the M1 Motorway and the F3 Sydney Orbital Link is now NorthConnex

Figure 3.6 Major freight activity precincts in the NSW Freights and Ports Strategy (Transport for NSW, 2013)[1]

The NSW Freight and Ports Strategy is a core component of NSW's overall strategic planning framework and supports the goals identified in NSW 2021. One of the objectives of the strategy includes delivering a freight network that efficiently supports the projected growth of the NSW economy.

WestConnex is a key component in the strategy to connect and complete Sydney's motorway network including priority freight movement and expanding capacity on NSW roads which will provide benefits for freight movement, particularly around major freight activity centres including

Sydney's international gateways, Port Botany and Sydney Airport, which are concentrated around the M4 Motorway and M5 Motorway corridors.

The *Sydney Airport Master Plan 2033* (Sydney Airport Corporation Limited 2014) (Sydney Airport Master Plan) highlights that currently Sydney Airport handles 48 per cent of Australia's international air freight, 76 per cent more than any other Australian airport. The volume of freight handled by Sydney Airport is projected to double over the period to 2033 to over one million tonnes.

Air freight exports from Australia are dominated by fresh, chilled or frozen perishables such as meat, seafood, fruit, vegetables, flowers, livestock and manufactured goods. A key point for supply and re-distribution of fresh, chilled or frozen perishables is the Sydney Markets in Flemington, adjacent to the M4 Motorway at Homebush West. These are time-critical exports that rely on productive, efficient and effective landside and airside logistics that are best met by road freight rather than rail freight.

3.3.4 Job creation in Western Sydney

The Draft Metropolitan Strategy (NSW Government 2013a) notes that about 50 per cent of Gross State Product is generated from over 700,000 jobs located in the Global Economic Corridor and that total jobs are forecast to grow from 2.2 million today to 2.8 million by 2031.

The LTTMP (Transport for NSW 2012) highlights that western Sydney is currently home to 47 per cent of Sydney's residents but only 37 per cent of Sydney's jobs. This disparity is due to a number of factors that include greater housing affordability in Sydney's west, and clusters of industry and infrastructure that support stronger business investment (and therefore location decisions) having built up in Sydney's east more generally to take advantage of proximity and connection to Sydney's CBD and the international gateways of Port Botany and Sydney Airport.

The State Infrastructure Strategy (Infrastructure NSW 2012) indicates that transport infrastructure improvements can increase employment participation rates by increasing access to employment areas for people who may not otherwise join the labour force, or increasing access for people seeking higher order job opportunities. Infrastructure NSW's view is that a fundamental constraint (to greater employment growth in Parramatta) is the connectivity of Parramatta to Global Sydney, and, more broadly, Sydney's West to Sydney's international gateways.

In the M4 Motorway corridor, pockets of significant jobs growth are expected around Parramatta CBD, Sydney Olympic Park, and Rhodes. The M4 Widening project, together with the overall WestConnex will improve accessibility to jobs in Sydney's east, but more significantly, will encourage business and industry investment (and therefore employment opportunities) in Sydney's regional cities including Parramatta and Penrith.

3.3.5 Connecting communities

NSW 2021 seeks to strengthen local communities as a priority. The consultation process during development of the Draft Metropolitan Strategy identified that residents want affordable housing choices located close to jobs and services, good transport connections and a healthy and sustainable environment.

The Draft Metropolitan Strategy indicates that strong population growth is forecast across Sydney, with the population expected to grow from 4.3 million today to 5.6 million in 2031. In part, the Draft Metropolitan Strategy seeks to meet this challenge through the encouragement of a greater range of housing types to support more balanced growth across Sydney.

Based on forecast population and jobs growth, the total number of trips made in Sydney will increase from 16 million now to 21 million in 2031. In terms of the Global Economic Corridor, the LTTMP indicates that about 500,000 people access Sydney's CBD and 100,000 passengers travel through Sydney Airport per day. These statistics clearly indicate a strong net growth in demand for road travel on a network that is already heavily constrained.

Passenger trips including for work, education, health, recreation and personal business are recognised by government as a key customer market. A majority of these trips are by private vehicle. Commuting and education trips typically occur in the AM and PM travel peaks, whereas other passenger trips are more discretionary and can occur in inter-peak times and on weekends. These trips are typically highly dispersed and travel patterns are complex.

A comprehensive network strategy is required to sustainably cater for the forecasted road network demand. This will require a whole of transport response and any strategy will rely on a combination of initiatives including better use of existing assets, redesigning bus-based travel services, coordination of transport service types (including rail, light rail, bus), delivering pinch point upgrades and investing in major capital investments such as WestConnex.

WestConnex, including the M4 Widening project, is a key component of an integrated transport solution and is critical to the delivery of an efficient road network that caters for the diversity and complexity of Sydney's transport user demands.

3.4 Economic appraisal

Economic appraisal assists decision-makers to understand the economic worth of a proposal in monetary terms. It helps determine what is 'value for money' and allows the economic worth of a particular initiative to be considered in the context of other potential benefits and impacts.

An economic appraisal was undertaken for WestConnex as reported in the WestConnex Business Case Executive Summary. The economic appraisal identified a benefit-cost ratio (BCR) of 2.55:1, including wider economic impacts reflecting the benefits of WestConnex across the Sydney road network.

The economic appraisal for WestConnex has been undertaken in accordance with the *Transport for NSW Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives* (also known as 'Economic Evaluation Manual' and released in March 2013) and the Austroads Guide to Project Evaluation 1. In addition to these two technical guidelines, the economic appraisal is also consistent with the NSW Treasury Guidelines for Economic Appraisal and the ATC National Guidelines for Transport System Management in Australia.

The approach requires appraisal of projects on an incremental basis, which compares the economic benefits with and without the project by considering the following parameters:

- The direct costs of a project to the community, which include:
  - Capital costs, including construction costs.
  - The costs of temporary traffic management and diversions during construction.
  - Operating and maintenance costs.
- The direct benefits of a project, which include:
  - Travel time saved by freight and passenger users.
  - Travel time reliability improvements

  - Reductions in vehicle operating costs.
  - Reductions in road accident costs.
  - Externalities reductions including air pollution, greenhouse gas emissions, noise pollution.
  - Foregone local road maintenance.
- The indirect benefits of a project to the community. These external benefits include:
  - Benefits that other transport users derive from an expansion in the road network.
  - Reductions in travel times and congestion costs on surrounding road links used by other users.
  - Benefits that neighbouring businesses derive from better access to their businesses.
  - Reductions in accident costs.

The economic analysis found that WestConnex would create benefits, realised by the general community, which would outweigh the initial upfront construction cost and ongoing operational costs.

For the M4 Widening project, the traffic model predicts that some vehicles would initially divert away from the motorway in the early years. However, it is important to understand that the benefits of WestConnex as a whole are much greater than the benefits of the parts when considered altogether. This is because the full network benefits are only fully realised when all stages are complete.

The M4 Widening is also expected to support around 2,000 construction jobs as well as numerous operational jobs

3.5 Project objectives

The objectives of the M4 Widening project are to:

- Enable integration with the subsequent stages of WestConnex while minimising impacts on the surrounding environment in the interim period.
- Relieve road congestion so as to improve the travel time and safety of travel in the M4 Motorway between Church Street and Homebush Bay Drive.
- Improve access to the M4 Motorway from Sydney Olympic Park.
- Improve access to M4 Motorway from Homebush Bay Drive.
- Improve road safety on the M4 Motorway and connections
- Protect natural and cultural resources and enhance the environment.

The latter will be met through the following key approaches:

- Manage noise in accordance with the *NSW Road Noise Policy* (EPA 2011) and realise opportunities to reduce or mitigate noise impacts.
- Minimise impacts on natural systems including biodiversity.
- Minimise impact on Aboriginal and European cultural heritage.
- Protect surface and groundwater sources and water quality including management of contaminated areas.

- Minimise impact on flooding.
- Minimise construction and operational energy use.
- Integrate sustainability considerations throughout the design, construction and operation of the project including consideration of the Infrastructure Sustainability Council of Australia (ISCA) Sustainability Rating tool scorecard.
- Provide for improvement of social and visual amenity.

3.6 Statement of strategic need

Once completed, the M4 Widening project would provide immediate operational benefits in relieving congestion along the M4 Motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush including reduction in travel times and improvements in the level of road safety on the M4 Motorway. The M4 Widening project also comprises the first stage in the delivery of WestConnex. Access to and from the M4 Motorway will also be significantly improved at Homebush Bay Drive and Hill Road. The investment in the M4 Widening project and subsequent WestConnex stages will facilitate a step change in network performance, enabling delivery of major city shaping improvements and delivering economic growth.

The M4 Widening project is being developed as the first project of Stage 1 of WestConnex which also includes the M4 East project. On completion of both components of Stage 1, WestConnex will provide a full motorway connection between the Blue Mountains in the west and Haberfield in the east. Future stages of WestConnex will link Stage 1 with Sydney's south west, Sydney Airport and the Port Botany precinct.

As part of the broader WestConnex, the M4 Widening project will thereby support NSW's key economic generators and provide a strategic response to the currently inadequate, and highly congested, road network. Critically, this includes a targeted response to current failures in the motorway network that support Sydney's Global Economic Corridor and Western Sydney, both of which are so important to the economic development of NSW and Australia. Improvements to the transport network, including the M4 Widening project, will support the Global Economic Corridor and Western Sydney by enabling domestic and international trade and therefore underpin a sustainable NSW economy and Sydney's role as a global city.

Integrated land use and transport planning initiatives are a key factor in developing a future where Sydney's growing population can reliably access jobs and services. The M4 Widening project complements a number of other transport and freight based infrastructure initiatives identified in the LTTMP, and ultimately it is a combination of these initiatives that best address Global Sydney's needs.

Sydney's freight, commercial and services task requires distribution of goods and services across the Sydney Basin, which relies on more diverse and dispersed point-to-point transport connections that can only be provided by the road network. The M4 Widening project supports this task by improving access to, and reliability of, the motorway network. The project also provides a high quality road connection between the key regional cities of Parramatta and Penrith with other key centres in the Global Economic Corridor.

As a key early stage in WestConnex and in conjunction with the planning and development of the future M4 East project, the M4 Widening project would help address congestion issues by improving traffic flow on the M4 Motorway. Positive changes anticipated on other congestion-related issues include travel time reliability and business productivity.

4 Project development and alternatives

This chapter describes the various alternatives to the project that were considered as part of the project development process and explains how and why the project was selected as the preferred option. Design refinements for particular elements of the project are also addressed.

Director-General's Requirements	Where addressed in EIS
An analysis of feasible alternatives to the carrying out of the project and project justification, including:	Chapter 4
• an analysis of alternatives/options considered having regard to the project objectives (including an assessment of the environmental costs and benefits of the project relative to alternatives and the consequences of not carrying out the project), and	Sections 4.2, 4.3 & 4.4
• the provision of a clear discussion of the route development and selection process, the suitability of the chosen alignment and whether or not the project is in the public interest, and	Sections 4.1, 4.2 & Chapter 10
• justification for the preferred project taking into consideration the objects of the Environmental Planning and Assessment Act 1979.	Chapter 10

4.1 History of the M4 Motorway and the WestConnex project development

The M4 Motorway was originally constructed in several stages as the F4 Western Freeway between the late 1960s and the mid-1980s. It was first opened to traffic in 1971 and now comprises a 40 kilometre urban motorway class road connecting North Strathfield with the Blue Mountains, having been upgraded on a number of occasions since its first days of operation. The two main upgrades were undertaken from 1988 to 1992 and from 1996 to 1998.

The first main upgrade involved widening the (then) six kilometre length of motorway from Homebush Bay Drive to James Ruse Drive from four lanes to six lanes with shoulders to increase traffic capacity. The 'missing link' from Mays Hill to Prospect was constructed providing around 10 kilometres of four lane carriageway and incorporated interchanges at Cumberland Highway, Prospect Highway and Reservoir Road. The second main upgrade involved upgrading and widening from four to six lanes (and in some areas eight lanes) along the length from Parramatta to Penrith.

Between 2003 and 2004 a preferred option for the eastern extension of the M4 Motorway to the Sydney CBD was developed and was publicly exhibited. This option proposed extending the motorway to the City West Link and Parramatta Road at Ashfield as well as widening the existing M4 Motorway.

More recently, WestConnex was set out in the State Infrastructure Strategy as a strategic concept, developed as a response to a series of strategic challenges faced by Sydney and NSW. The WestConnex strategic concept built upon a decade of studies into options to augment the M4 and M5 corridors. It was developed by a joint project team comprising representatives from Roads and Maritime, Transport for NSW and Infrastructure NSW. The WDA has subsequently been established to further develop and deliver the WestConnex projects.

The LTTMP sets out how transport projects will be planned and developed in NSW. The principles used in developing the integrated approach to transport planning for the state of NSW include:

- Putting customers first.
- Integrating transport with land use planning.
- Identifying corridors of demand.
- Defining performance required from the transport infrastructure, using a network hierarchy approach.
- Moving towards a connected and integrated system.

The transport planning principles adopted for WestConnex align with the broader principles identified in the LTTMP and are as follows:

- Serves key market and customer needs.
- Integrates with the existing transport system.
- Transforms the city and reshapes local travel.
- Future proofs for long term growth and change.

The WDA has involved industry partners, which comprised of key construction and engineering consultancies, in the development of options and design solutions and to ultimately identify a feasible, affordable and functional design solution for the WestConnex project. The focus of industry partners' involvement has been on developing improved design and construction solutions for specific sections of the project. Notwithstanding, industry partners were not required to investigate the M4 Widening project due to the high level of development and design investigation previously undertaken for this part of WestConnex.

4.2 Alternatives

The merits of the M4 Widening project were considered in the context of a range of other alternatives. The alternatives considered are consistent with those considered for other recent motorway upgrade and enhancement projects. Alternatives to the project were considered based on the extent to which they could meet the project objectives and how well they performed with reference to other transport, environmental, engineering, social and economic factors.

The following alternatives to the project were considered:

- Alternative 1 – the base case or 'do nothing/do minimum' ('do minimum').
- Alternative 2 – improvements to the existing arterial road network.
- Alternative 3 – investment in public transport and freight rail improvements.
- Alternative 4 – demand management.

These alternatives are described below.

4.2.1 Alternative 1 – the base case or 'do nothing/do minimum'

The base case option would involve retaining the M4 Motorway (in combination with Parramatta Road), in essentially its current configuration, as the main east-west motorway and arterial route between Western Sydney and Parramatta Road, North Strathfield. The M4 Motorway would be

maintained as an un-tolled motorway as part of the 'do nothing/do minimum' option ('do minimum') with only minimal new infrastructure provided over time to improve capacity.

Future transport demand in the M4 corridor represents a significant challenge for Sydney and NSW. Without upgrading, the M4 Motorway would continue to operate at and over capacity in peak hours. The current network does not support a growing population that needs to reliably access dispersed employment areas and services. Without upgrading, congestion on the M4 Motorway will continue to impact on the NSW economy through impacts on delivery and transport times in Sydney and in particular, for businesses in Western Sydney.. Traffic modelling under the 'do minimum' scenario indicates morning peak travel times in the eastbound direction would increase from around 12 minutes to 19 minutes between Church Street and Homebush Bay Drive in the future, as discussed further in section 8.1. In the westbound direction on the same section of road travel times would increase from around five minutes to 15 minutes.

In the context of the identified transport challenges, a 'do minimum' option is considered unrealistic and would not address key NSW 2021 goals (see section 3.2.1). It would also not meet the project objectives.

4.2.2 Alternative 2 – improvements to the existing arterial road network

Infrastructure NSW recognises that the wider road network, including major arterials, will also require improvement and that some of the highest value infrastructure investments come from pinch point relief that addresses road congestion 'hotspots' (Infrastructure NSW 2012). Improvements to the existing arterial road network are seen as complimentary to the M4 Widening project objectives, reinforcing the function of the arterial road network as high order 'access' routes to the broader road network rather than a long distance 'through' route function performed by Sydney's motorway network.

Great Western Highway/Parramatta Road

A range of improvements would need to be made to the Sydney arterial road network to alleviate the current traffic challenges faced by the M4 corridor (refer section 4.2.3). These works would likely include multiple improvements to roads and intersections along the Great Western Highway and Parramatta Road corridors in an attempt to maintain an acceptable level of traffic operation.

While some short sections of Parramatta Road, where it runs in close parallel with the M4 Motorway, are relatively free of congestion, it generally experiences high levels of congestion during much of the day including weekends. As such, only localised intersection improvements, refinements to traffic signal timing and/or phasing, road safety measures or similar small scale works would have an acceptable level of traffic impacts during their construction phase. More substantial improvements to these arterial road networks would likely necessitate grade separation of intersection which would have substantial traffic impacts during construction. These would still only manage current congestion issues rather than catering for the future traffic demands expected in these corridors. Further, construction would likely necessitate considerable private property acquisition along the length of Parramatta Road to accommodate additional lanes.

West of Concord Road, the Great Western Highway/Parramatta Road corridor and the M4 Motorway perform different functions. The M4 Motorway provides a through route for longer distance east/west traffic movements, linking the inner west with greater western Sydney, whereas the Great Western Highway/Parramatta Road corridor performs a more intermediate regional access function and provides for shorter distance local east/west movements, linking the arterial road network with the broader road network and adjacent land uses. Any improvements

along the Great Western Highway/Parramatta Road corridor would therefore mainly benefit its function as an ‘access’ route rather than a ‘through’ route.

The WestConnex Road Traffic Model has indicated that the M4 Widening project is expected to increase travel times on Parramatta Road within the project corridor as a result of toll avoidance. From a quality of life and business efficiency perspective, it is preferable to have a motorway that provides efficient and timely transportation, rather than an arterial road that is already at near capacity. For example, the speed limit on this section of Parramatta Road is 60 kilometres per hour with traffic signals compared to 90 kilometres per hour on the M4 Motorway which is free of traffic signals.

Western Sydney Regional Ring Road

Parramatta City Council has proposed a ‘ring road’ concept, with an inner city ring road and outer regional ring road (Parramatta City Council 2012). These ring roads would utilise existing roads, but would have improved flows as a result of a series of upgrades at key intersections including along the M4 Motorway, James Ruse Drive and Cumberland Highway. The objective of these intersection upgrades is to create free flowing arterial roads and allow traffic to circumnavigate Parramatta and Westmead quickly and efficiently. The State Infrastructure Strategy recognises the need for further improvements to address growing road congestion issues around Parramatta and indicates that some of the proposed improvements could form part of WestConnex.

While this may be the case, as the Western Sydney Regional Ring Road project, in its entirety, would serve different traffic movements to the M4 Widening project and WestConnex, it is seen as a complementary initiative and the M4 Widening project has considered improvements to key intersections identified in the Western Sydney Regional Ring Road concept, as discussed in section 4.3.1. The Western Sydney Regional Ring Road is focussed on movements into and around Parramatta, whereas the M4 Widening project supports Sydney’s long-term economic growth through improved motorway access and connections linking Sydney’s international gateways with Western Sydney and places of business across the city.

Victoria Road

Victoria Road provides an alternative transport corridor from Parramatta to the Sydney CBD north of Parramatta River. The character of this route differs from the Great Western Highway/Parramatta Road corridor because its topography is much more varied with steeper slopes and tight bends. The Victoria Road corridor passes through a number of established centres and crosses major natural features and service/transport infrastructure, which presents major challenges for providing increases in road capacity.

Improvements to the Victoria Road corridor would not meet the M4 Widening project objectives. For example, improvements to the Victoria Road corridor would not provide improved access to the M4 Motorway from Sydney Olympic Park or Homebush Bay Drive; nor would they relieve road congestion so as to improve travel time and safety of travel in the M4 Motorway between Church Street and Homebush Bay Drive.

The above arterial road improvement alternatives are considered inadequate responses to the significant transport challenges on the M4 Motorway corridor. Localised road corridor improvements would only provide an incremental change to the network, and would typically be implemented in response to growth in traffic levels associated with local developments.

Similar to the option to improve the Great Western Highway/Parramatta Road corridor, substantial improvements to Victoria Road would likely necessitate grade separation of intersections which would have substantial traffic impacts. Construction would also likely necessitate removal of bus

lanes and/or considerable private property acquisition along the length of Victoria Road to accommodate additional general traffic lanes.

The options considered must be options broadly capable of accommodating the identified transport task and challenges being addressed by WestConnex. These can only be met by major arterial road improvements that will have significant construction impacts or require the construction of new infrastructure. These options would therefore not meet the project objectives.

4.2.3 Alternative 3 – investment in public transport and rail freight improvements

As discussed in Chapter 3, WestConnex is a key component of the LTTMP, the State Infrastructure Strategy and the Draft Metropolitan Strategy. As part of a broader integrated transport solution, the M4 Widening project supports the coordinated approach to the management of freight and passenger movements, as well as all modes of transport including road, rail, bus, ferries, light rail, cycling and walking. There is, however, recognition that Sydney's freight, commercial and services tasks require distribution of goods and services across the Sydney Basin, which relies on more diverse and dispersed point-to-point transport connections that can only be provided by the road network.

Public transport

The Great Western Highway/Parramatta Road corridor is paralleled by the Main Western Rail Line. Trains provide the trunk public transport service in this corridor, connecting Western Sydney and centres in the corridor to the Sydney CBD. The NSW Government's *Sydney's Rail Future, modernising Sydney's trains* (Transport for NSW 2012b) (Sydney's Rail Future), identified the need for service improvements on the Main Western Rail Line which are being considered separately by Government.

Commercial and retail centres have developed around the railway stations along the line, including at Westmead, Parramatta, Auburn, Lidcombe and Strathfield. Consequently, most bus services on and around the Great Western Highway/Parramatta Road corridor act as feeder services to train stations and centres rather than act as east/west trunk services.

Public transport options such as rail/light rail or bus would be a potential feasible alternative if the M4 Widening project, as part of WestConnex, was primarily concerned with transporting people to and from centres. In addition to dispersed and longer distance passenger movements, the key customer markets identified for WestConnex include heavy and light freight and commercial services and businesses whose travel patterns are highly dispersed and diverse in nature. These customers have highly diverse requirements when it comes to the transfer of goods and services that include transport of containerised freight, use of rigid and articulated trucks through to small trucks, vans utility vehicles and cars.

Public transport would only partially address these customer demands. There are no feasible strategic transport alternatives such as heavy or light rail options or bus corridor enhancements that will meet the diverse range of customer needs for travel in this corridor and address the project objectives as effectively as the M4 Widening project and WestConnex more broadly. Notwithstanding, a number of these public transport alternatives would be complementary to the M4 Widening project and the broader WestConnex project.

Combined transport options

A 'park and ride' scenario, supplemented with a light rail line along Parramatta Road or express heavy rail services to Central Station, has been identified. This transport alternative, as proposed

by a group known as Eco-Transit, would introduce a ‘park and ride’ and bus-rail interchange in Olympic Park; an additional railway station on the Olympic Line near its crossing of the existing M4 Motorway; and an express service linking the new station with Central Station via the Main Western Line. The park and ride facility would be supplemented with a light rail line from this new station, along Parramatta Road to Central Station.

Passenger trips including for work, education, health, recreation and personal business are recognised as a key customer market on the M4 Motorway. A majority of these trips are by private vehicle, as many destinations for these trips are located outside of centres. Commuting and education trips typically occur in the AM and PM travel peaks, whereas other passenger trips are more discretionary and can occur in inter-peak times and on weekends. These trips are typically highly dispersed and travel patterns are complex.

Therefore, public transport is not the most effective way of servicing a majority of these trips. It also does not address demand for the movement of freight. Public transport options are seen as complementary services supporting, but not wholly able to address, the road user demands that are best addressed by the M4 Widening project and the broader WestConnex.

Should an option such as this ‘park and ride’ scenario be adopted, the M4 Widening project would still be required to accommodate travel by cars to this new park and ride location from the west.

Western Sydney Light Rail Network

Parramatta City Council (May 2013) has released a feasibility report for a Western Sydney Light Rail Network. The report examines the feasibility of a Western Sydney Light Rail Network centred on Parramatta and covering the central area of Sydney. The proposed Western Sydney Light Rail Network aims to deliver new and improved regional public transport links which drives employment and facilitates residential growth along corridors and in centres, improving economic productivity and the liveability of Western Sydney and Sydney as a whole. The Western Sydney Light Rail Network is proposed as a viable, quick-to- build solution for Western Sydney; an interim mode between bus and heavy rail options.

The proposed Western Sydney Light Rail Network, as defined in the *Western Sydney Light Rail Network Part 2: Feasibility Report* (Parramatta City Council 2013) includes:

- A Macquarie Park Line, connecting Westmead to Macquarie Park via Parramatta, Rydalmere, Dundas and Eastwood.
- A Castle Hill Line, extending the Macquarie Park Line from North Parramatta to Castle Hill via Baulkham Hills.
- A future connection from Parramatta to Rhodes.

Infrastructure NSW considers the Western Sydney Light Rail concept in the State Infrastructure Strategy. Infrastructure NSW’s view is that a more fundamental constraint (to greater employment growth in Parramatta) is the connectivity of Parramatta to Global Sydney, and, more broadly, Sydney’s West to Sydney’s international gateways. It recommends action to address the slow, indirect and/or infrequent bus services north and south of Parramatta by re-routing bus services to follow a more direct route, with less frequent stops, and then improving speeds through bus priority measures (Infrastructure NSW 2012).

The Western Sydney Light Rail would not serve as an alternative to the M4 Widening project. As part of WestConnex, the M4 Widening project would provide improved connectivity for Parramatta and Western Sydney with the southern part of Sydney’s Global Economic Corridor and Sydney’s international gateways. The additional connections proposed as part of the M4 Widening project

would provide improved access between Global Sydney and key employment lands including Parramatta, the Westmead health precinct and Sydney Olympic Park. While the Western Sydney Light Rail Network would also have major benefits in terms of access (as a new mode along a new route) it would serve the passenger market only.

As discussed for other public transport alternatives, most passenger trips are highly dispersed and travel patterns are complex. This is the same for other key customer markets including heavy and light freight and commercial services and businesses, which have highly diverse travel requirements when it comes to the transfer of goods and services. These diverse trips are not well served by public transport, which are designed for moving people and goods between distinct origins and destinations with a common trip purpose. As such the M4 Widening project, and WestConnex more broadly, best address project objectives including addressing the diverse travel demands to and from the corridor

Rail freight improvements

Apart from moving passengers, Sydney's rail network plays a significant role in moving freight between Sydney's ports and destinations within Sydney, regional NSW and other states. The *Trade and Logistics Report 2011-12* (Sydney Ports Corporation 2012) indicates that some 98 per cent of imported containers through Port Botany and over 60 per cent of exported containers have their origin and destination within Greater Sydney.

The LTTMP identifies a number of current and future freight-related projects that complement the existing freight network. These include:

- Development of an intermodal terminal at Enfield (under construction).
- Development of an intermodal terminal at Moorebank.
- Completion of the Southern Sydney Freight Line (under construction).
- Stage one of the Northern Sydney Freight Corridor Program (under construction)
- A Western Sydney Freight Line (future proposal).
- Western Sydney Intermodal Terminal (future proposal).

There are opportunities to shift more freight onto rail and this remains a priority for the NSW Government. However, assuming the target of doubling the share of container freight moved by rail is achieved by 2020, more than 70 per cent of Port Botany’s projected trade would still be moved by road, requiring investment in an efficient road network to support the port and airport precincts.

Rail freight transport is more effective for long distance transport of goods to regional centres. However, Sydney’s freight, service and business task requiring distribution within the Sydney Basin, relies on dispersed point-to-point transport connections to their customers. Predominantly freight rail serves the first leg of the freight journey, with containerised freight broken down at distribution nodes and further distributed across the Sydney basin. In managing the freight task, heavy commercial vehicles require a primary network with high quality connections between major freight hubs, whereas light commercial vehicles depend on a multi-layered network with many connections to service more diverse end-markets across all of Sydney.

This arrangement means that there are around four times as many light commercial vehicle trips on Sydney’s road network as heavy commercial vehicle trips, and this trend is forecast to continue. A key reason for this trend is that heavy freight activity precincts are concentrated in a few key locations in the vicinity of the port and across Western Sydney, and this land use pattern is also set to continue into the future.

The Sydney Airport Master Plan highlights that currently Sydney Airport handles 48 per cent of Australia's international air freight, 76 per cent more than any other Australian airport. The volume of freight handled by Sydney Airport is projected to double over the period to 2033 to over one million tonnes. Air freight exports from Australia are dominated by fresh, chilled or frozen perishables such as meat, seafood, fruit, vegetables, flowers, livestock and manufactured goods. A key supplier/consumer of fresh, chilled or frozen perishables in Sydney is Flemington Markets, adjacent to the M4 Motorway at the intersection of Centenary Drive and Parramatta Road, Homebush. These are time-critical exports that rely on productive, efficient and effective landside and airside logistics that are best met by road freight rather than rail freight.

In combination with the freight-related projects identified above, the M4 Widening project and the broader WestConnex would provide a robust freight solution and would best address the project objectives.

4.2.4 Alternative 4 – demand management

A package of demand management initiatives

Demand management can be defined as a policy, planning and operational approach to the movement of goods or people. Demand management encompasses policies intended to reduce individual trip lengths and make various mode options more viable. These policies include:

- Urban consolidation and 'centres' policies (land use planning) to reduce the need for travel.
- Other planning control policies such as restricting parking provisions in new developments.
- Road network management and network connectivity policies; including implementation of intelligent transport systems to improve public transport operation, management of clearways and transit lanes, and to provide greater priority over general traffic.
- Transport pricing to reduce travel demand; including demand based, tolling or transport pricing to discourage discretionary travel by private vehicle for trips that can be served by public transport.

The Draft Metropolitan Strategy indicates that strong population growth is forecast across Sydney, with the population expected to grow from 4.3 million today to 5.6 million in 2031 (NSW Government 2013a). Jobs are also forecast to grow from 2.2 million today to 2.8 million by 2031.

The LTTMP highlights that western Sydney is currently home to 47 per cent of Sydney's residents but only 37 per cent of Sydney's jobs. This disparity is due to a number of factors that include greater housing affordability in Sydney's west, and the existing agglomerations and infrastructure that support stronger business investment (and therefore location decisions) in the Global Economic Corridor and Sydney's east more generally.

For a demand management option to achieve relevant outcomes, it needs to reduce the overall level of demand for travel, as well as create a shift to more sustainable transport modes. A demand management option can take many years to achieve changes in travel behaviour, as existing customer practices need to be modified and existing investment priorities changed. In the context of this project, travel demand management is about modifying travel decisions and reducing dependence on travel by cars, especially during peak periods.

While demand management could help to spread the demand for peak travel to less congested time periods, its effectiveness would be limited by other constraints, such as availability of other travel modes at the user's origin and destination and flexibility of working arrangements to take advantage of 'time of day' tolling or transport pricing benefits.

Demand management measures are seen as complementary initiatives rather than a viable stand-alone alternative to the project. To have a major impact on road traffic, demand management measures would also require major changes in social attitudes, travel behaviour and government policy.

Maximising the performance of existing infrastructure

Maximising the performance of the existing M4 Motorway could be achieved through the introduction of a system that brings together complementary technologies to create a fully managed road environment (a smart motorway or Managed Motorway system). A smart motorway system seeks to enhance travel reliability and traffic efficiency through improved and more consistent traffic flow using controlled access management.

A smart motorway system would require the installation of various technologies both along the motorway, at interchanges and traffic signals. Required technologies include ITS for tolling, vehicle detection devices, variable message signs, closed circuit television, emergency telephones, variable speed limit signs, cabling and fixed signage.

In addition to technology requirements a smart motorway scheme would require improvements to motorway on- and off-ramps to support the traffic management and on-road traffic information systems. A smart motorway system primarily manages congestion on the main motorway alignment and there is limited scope for a smart motorway system to improve congestion on the road network surrounding the motorway.

As with other demand management measures, a smart motorway solution is seen as complementary to the widening of the M4 Motorway. A smart motorway solution alone would not meet the project objectives and is not proposed as part of the M4 Widening project; however provision for road infrastructure and services to support the future implementation of a smart motorway solution has been incorporated into the M4 Widening project such as widening of on-ramps.

4.2.5 Preferred strategic alternative

The preferred option has evolved from a series of concept developments and evaluations which have been on-going since 2003. Chapter 3 demonstrates the need for the M4 Widening project and provides detail on the project's strategic context. The preferred option best meets the identified needs and objectives, which include improving access to the M4 Motorway from Sydney Olympic Park and Homebush Bay Drive, and relieving road congestion so as to improve travel time and safety of travel in the M4 Motorway between Church Street, Parramatta and Homebush Bay Drive, Homebush.

The preferred option supports the WestConnex project. Risk and value management workshops have been undertaken to develop appropriate options for the M4 Motorway (refer section 4.3 to section 4.4 below). Traffic modelling has been undertaken to determine demand levels for proposed ramps and vehicle forecasts for the M4 Motorway.

The preferred option comprises widening and upgrading the existing M4 Motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush and upgrades to a number of existing interchanges within this section of the M4 Motorway.

4.3 Motorway widening options

4.3.1 Earlier options development

As identified in section 4.1, there has been ongoing scheme development over the last decade. This section discusses the earlier motorway widening options considered over that time.

M4 Widening – 2004

A number of options were considered during the development of the proposed M4 East Motorway. While the preferred option in 2003-2004 extended the motorway, by tunnel, from approximately Concord Road to the City West Link, it also included widening of, and associated works to, the existing M4 Motorway from about 500 metres west of Homebush Bay Drive to Parramatta Road at North Strathfield.

The preferred option included a new three lane eastbound carriageway to the north of the existing motorway, including the duplication of the existing bridge over Underwood Road and the viaduct over George Street and the Main Northern Rail Line.

Adjustments to the eastbound ramp from Homebush Bay Drive and the revised connection to/from Concord and Parramatta Roads were also proposed.

M4 Widening near James Ruse Drive – 2010/2011

The westbound traffic lanes on the M4 Motorway currently merge from three to two lanes prior to the James Ruse Drive on-ramp. The merging of the on-ramp to the motorway in the westbound direction relies on terminating one lane to provide a designated lane for the on-ramp. This results in a reduction in capacity at this location which can cause substantial queuing during the weekly afternoon peak period.

In the period from 2010 to 2011, Roads and Maritime investigated a number of options to provide three lanes in the eastbound and westbound directions on the M4 Motorway in the vicinity of the James Ruse Drive on-ramp including the use of intelligent transport systems and road widening. Options included lane marking, on-ramp metering and a heavy vehicle priority lane on the on-ramp.

4.3.2 Length-of-corridor options

‘Length of corridor options’ refers to the start and end points of current M4 Widening project options along the M4 Motorway corridor. All current widening options commence at Pitt Street, Parramatta and Holroyd in the west with differing widening ‘end points’ in the east.

Widening from Pitt Street to Concord Road

A decision on the extent to which the M4 Motorway is widened at its eastern end is primarily driven by the nominated tunnel portal locations for the proposed future M4 East project. Consideration was given to widening the M4 Motorway from Pitt Street, Parramatta through to Concord Road, North Strathfield, which reflected positioning of the proposed M4 East tunnel portals to just west of Concord Road. Widening of the motorway near George Street, North Strathfield and the Main Northern Rail Line would require a new viaduct structure located to the north of the existing alignment due to constraints within the motorway corridor immediately to the west of Concord Road.

This option would require complex construction staging arrangements and construction in relatively confined space and under traffic.

Widening from Pitt Street to Homebush Bay Drive

The M4 East concept reference design has proposed tunnel portals to be located near Powell Street, Homebush. Homebush Bay Drive provides a suitable location to end the M4 Widening project as it is a major interchange for traffic. This limits the scope of the M4 Widening project to approximately Homebush Bay Drive. The upgrade to the M4 Motorway east of Homebush Bay Drive, Homebush would then become part of the M4 East upgrade component of WestConnex.

Locating the eastern extent of the M4 Widening project at approximately Homebush Bay Drive provides flexibility for the siting of the proposed M4 East tunnel portals at any point in the motorway corridor between approximately Homebush Bay Drive and Concord Road. There are also traffic benefits associated with this arrangement as traffic conditions improve to the east of Homebush Bay Drive, reducing the impact associated with construction of tunnel portals 'under traffic'.

Limiting the extent of widening works to approximately Homebush Bay Drive further improves the efficiency of tunnel construction because there is more space within the existing motorway corridor to facilitate 'off line' construction of the tunnel portals and associated approaches. This, allows for easier construction of the proposed M4 East project 'under traffic', by retaining current traffic lanes (and capacity) on the M4 Motorway.

Widening to approximately east of Homebush Bay Drive also provides for clear separation of any M4 Widening project construction site (and M4 Widening project construction contractor) from what could be a major construction site (and different construction contractor) for proposed M4 East tunnel works.

4.3.3 Viaduct widening

Widening of the M4 Motorway viaduct in the vicinity of the James Ruse Drive westbound on-ramp merge has been considered for a number of years. The existing westbound merge from three to two lanes just east of the James Ruse Drive westbound on-ramp creates considerable congestion during peak periods.

Options for widening of the M4 Motorway section between Church Street and Junction Street (just east of Duck River) require the widening to integrate with, or complement, the existing viaduct structure. The following options were considered:

- Option 1 – improvements to existing infrastructure.
- Option 2 – widening by construction of a new viaduct north of the existing viaduct.
- Option 3 – widening by construction of a new viaduct south of the existing viaduct.

These options are discussed below.

Option 1 – improvements to existing infrastructure

Consideration was given to widening the M4 Motorway via augmentation of the existing viaduct structure between Church Street and Junction Street. There are two possible methodologies for augmentation of the existing viaduct structure, being connection using a longitudinal joint or 'stitching' the new structure to the existing viaduct. Both options require discrete piers to support the additional structure.

There are a number of constraints likely to be associated with these options that include:

- The demolition of the existing viaduct parapet to attach the new section would have substantial impacts including closing the viaduct to traffic for extended periods as well as amenity impacts such as noise and dust emissions.
- Complexity of the construction process, such as the removal of existing barriers and structural impacts such as the integrity of the existing viaduct, would require an extended construction period due to the intensity of works required.
- Safety issues for motorcyclists associated with positioning of longitudinal joints within lane areas. Motorbikes are more likely to slip on longitudinal joints. Reflection of metal utilised in longitudinal joints have also previously resulted in motorist uncertainty and interpretation of the reflection as lane marking.
- Construction 'under traffic' would cause unacceptable traffic delays on the motorway and the surrounding arterial road network, especially for the 'stitching' method, where motorway shutdown is required while new deck concrete sets into place.
- There is limited flexibility when positioning additional piers required by an augmented viaduct structure. A lack of flexibility results in greater property impacts and direct impacts on the surrounding road network where pier placement in a local road would occasionally be required.
- High direct project costs and indirect economic costs associated with traffic delays attributed to extended periods of construction under traffic.

Option 2 – widening by construction of a new viaduct north of the existing viaduct

Widening of the M4 Motorway to the north of its existing alignment was considered. There are a number of constraints likely to be associated with this option that include:

- The majority of available space within the M4 corridor is located to the south of the existing viaduct.
- The introduction of a new viaduct to the north of the existing structure would require a greater number of partial and/or total property acquisitions when compared with the introduction of a new viaduct to the south of the existing viaduct.
- A large number of residential properties concentrated in the area between Arthur Street and Harris Street would be impacted.
- The overall project costs would be greater given the requirement for a large number of property acquisitions.
- The provision of a new viaduct on the northern side of the existing alignment would require substantial reconstruction of the James Ruse Drive eastbound off- ramp to enable access from both the existing and proposed viaduct.
- A new viaduct on the northern side of the existing alignment would impact Junction Street due to potential positioning of the piers for the new viaduct which may require closure of the street. Alternative access arrangements would also need to be provided for existing residents.
- Greater noise, visual and amenity impacts a large number of medium density residential properties, particularly those located on Junction Street and near the Main Western Rail Line.

Option 3 – widening by construction of a new viaduct south of the existing viaduct

The general alignment of the new viaduct has been driven primarily by horizontal and vertical alignment requirements, including height clearances over rail lines and arterial roads, and a need to align the structure as closely as possible to the existing motorway. This option has been used as the basis for the WDA concept design.

The main considerations for the southern viaduct alignment are outlined in Table 4.1.

Table 4.1 Southern viaduct alignment considerations

Aspect	Consideration
Horizontal alignment	The viaduct's horizontal alignment has been influenced by the desire to keep the new viaduct structure as close as possible to the existing motorway. This limits property impacts and minimises the overall bulk and scale of the structure within the corridor. In some instances separation of the new viaduct from the existing motorway is required to provide adequate clearance from other adjacent roads, rail lines and existing interchange on- and off-ramps and other existing infrastructure.
Vertical alignment	Similarly, the vertical alignment of the new viaduct has been influenced primarily by the existing motorway structure, and where required, has deviated from the existing motorway's vertical alignment in order to ensure minimum vertical clearance requirements are achieved where the motorway passes over major roads and rail lines.
Pier locations	The location of viaduct piers has been driven by the desire to limit property impacts, minimise the need for works within waterways and impacts on A'Becketts Creek and minimise impacts on the shared pedestrian/cyclist path.
Viaduct width	The width of the viaduct has been influenced by the need to meet design guide requirements for lane widths. The existing viaduct does not meet the current lane width requirements and augmentation of the existing structure to achieve design guide requirements is not proposed as this would require the construction of a new four lane viaduct. A four lane viaduct is not considered a reasonable alternative given the extensive property and amenity impacts and substantially increased cost. Viaduct width has also been influenced by the decision as to whether to include a motorway shoulder. The inclusion of a shoulder/breakdown bay would require additional viaduct width with corresponding property and cost implications and constructability challenges. A narrow shoulder is proposed for the new viaduct, with extra width incorporated into the viaduct design to accommodate sight distance requirements where needed. As such no breakdown bays would be incorporated on the viaduct structure. An analysis of crashes 'on viaduct' compared with off-viaduct sections of the M4 Motorway indicates the viaduct sections have fewer crashes, even with current lane widths. A possible future smart motorway system would provide for a more proactive management approach to the motorway to address issues such as breakdown. Traffic incident detection and management systems, including CCTV, emergency telephones and lighting would be installed on the new viaduct as required.

4.3.4 Bridge over Duck River

The M4 Widening project requires construction of a new bridge over Duck River. Options are limited to the introduction of a new bridge either to the north or to the south of the existing bridge structure.

Introduction of a new bridge to the south of the existing bridge has been used as the basis for the WDA concept design because, when compared with a new bridge to the north of the existing bridge, it enables widening to the southern side of the carriageway west of Duck River, which has limited to no impact on the operation at the existing James Ruse Drive westbound off-ramp during construction. The area of wetland and mangrove habitat impacted by widening to the north of the

existing viaduct would be greater than widening to the south of the existing viaduct. The area of mangrove to the north is of better quality than to the south as the area to the south is a narrower strip and is impacted by the shared path and other cleared areas.

4.3.5 Number of lanes

As identified in Table 4.1 above, viaduct width is a product of required lane width and lane numbers. To minimise the extent of impacts associated with the width of viaducts, retention of six lanes on the existing viaduct with an additional two lanes on the new viaduct has been adopted.

Analysis of future demand, inclusive of tolling, has indicated that the main carriageway alignment requires four lanes in each direction to accommodate forecast traffic volumes.

A four lane each way arrangement is also consistent with the requirements of the broader WestConnnex project.

4.3.6 Preferred motorway widening option

For the basis of the WDA concept design, widening to the south of the existing viaduct via the introduction of a new two lane viaduct between Church Street and Junction Street (just east of Duck River) has been identified as the preferred motorway widening option for the section between Church Street, Parramatta and Wentworth Street, Granville. This option has:

- Fewer construction phase amenity impacts.
- Less acquisition, including fewer commercial properties impacted.
- Fewer construction (constructability) and traffic management issues and therefore shorter construction duration.
- Fewer traffic impacts at interchanges, including removing the need for reconstruction works on existing on- and off-ramps at some interchanges.
- More cost effective solution based on the ability to construct the independent viaduct ‘under traffic’ and within normal construction.

At grade widening of the motorway is proposed predominantly within the existing motorway corridor, between Junction Street, Auburn and Homebush Bay Drive, Homebush to provide four traffic lanes westbound and four traffic lanes eastbound (refer section 5.3.1 for further information on the scope of at grade widening proposed for the project).

4.4 Interchange design options

This section describes various design options considered at key interchanges along the M4 Motorway. These design options were considered in response to ideas raised by councils and the community during consultation. WDA's investigations have included both strategic and operational modelling. This work has indicated network integration issues with these options and the preliminary outcomes suggest that they would not deliver satisfactory improvements to traffic conditions for the indicative costs nor offer value for money. This process included considering cost, expected traffic demand and potential benefits such as travel time savings.

The WDA concept design (the subject of this EIS) does not include all of these options, as outlined below. Notwithstanding, these options may be investigated in the future in partnership with local councils and the community. The WDA concept design does not preclude these future connections being developed. The NSW Government has committed to provide funding to further develop the Parramatta ring road concepts to ease congestion around the Parramatta CBD and enable connectivity to WestConnex, in partnership with the local councils. This work will examine options such as improved access to the M4 corridor from James Ruse Drive and other priorities identified in the *Western Sydney Regional Ring Road* (Parramatta City Council, 2012).

4.4.1 Westmead connection – eastbound off-ramp

A number of options were considered to facilitate the introduction of a new eastbound off-ramp from the M4 Motorway to the Great Western Highway near Bridge Road. It was considered that further investigation of issues including property impacts, cost and broader impacts to the local road network would be required before progressing the feasibility of these Westmead connections.

Option 1 – west of Bridge Road

This option would involve provision of an eastbound off-ramp from the M4 Motorway, connecting with the Great Western Highway approximately 250 metres west of Bridge Road. It would provide access for eastbound traffic from the motorway to the Great Western Highway and would allow westbound and eastbound turning movements onto the Great Western Highway.

This option would form part of the proposed Parramatta regional ring road and provide a more direct access from the west to Westmead and the western end of Parramatta CBD via the M4 Motorway and Great Western Highway. Due to the reasons outlined above, the option was not considered further as part of the WDA concept design.

Option 2 – Bridge Road

This option includes provision of a new eastbound off-ramp connection at the existing intersection with the Great Western Highway and Bridge Road and the relocation of the existing Coleman Street eastbound motorway on-ramp. Similar to Option 1 above, this option would also form part of the proposed Parramatta regional ring road and would provide access from the west to Westmead and Parramatta CBD via the M4 Motorway and Great Western Highway. This option was not considered further due to being outside the scope of this project. Due to the reasons outlined above, the option was not considered further as part of the WDA concept design.

Option 3 – Burnett Street eastbound off-ramp

This option would include provision of an eastbound off-ramp from the M4 Motorway to Burnett Street. There is currently a half diamond interchange at Burnett Street with westbound off- and

eastbound on-ramps. The eastbound off-ramp from the M4 Motorway would provide a connection to Westmead and also provide an additional connection to Parramatta's CBD from the west.

Due to the reasons outlined above, the option was not considered further as part of the WDA concept design.

4.4.2 Parramatta connection – westbound on-ramp

Three options were considered to facilitate westbound access to the M4 Motorway from the Parramatta CBD and are presented below. It was considered that further investigation of issues including property impacts, cost and broader impacts to the local road network would be required before progressing the feasibility of these Parramatta connections.

Option 1 – Church Street – intersection upgrade

This option would provide a new right turn for southbound traffic on Church Street to access the westbound on-ramp to the M4 Motorway.

It would involve provision of a dedicated right turn bay on Church Street, widening Church Street from Rosehill Street to Parramatta Road, widening Woodville Road from Crescent Street to Parramatta Road and widening Parramatta Road from Church Street to just west of the Main Western rail line. The widening would provide additional north-south lanes on Church Street and Woodville Road and two dedicated left turn lanes from Church Street to Parramatta Road.

In addition to the reasons outlined above, this option was not considered further as part of the WDA concept design based on the following issues:

- The Church Street/Parramatta Road/Woodville Road intersection is currently operating near its capacity. Modelling of the intersection has shown that it would operate above its capacity by 2021 and performance would deteriorate further with increased traffic by 2031. The Church Street/Parramatta Road/Woodville Road intersection would require infrastructure upgrades to operate satisfactorily regardless of WestConnex or the proposed right turn movement onto the M4 Motorway.
- The M4 Widening would increase traffic demands at the Church Street eastbound off-ramp – adversely impacting the operation of the Church Street/Parramatta Road/Woodville Road intersection. The introduction of a new right turn movement from Church Street onto the M4 Motorway would exacerbate the situation.
- To facilitate a new right turn movement from Church Street onto the M4 Motorway an existing traffic movement at the Church Street/Parramatta Road/Woodville Road intersection needs to be removed. This would necessitate removing the existing right turn from Woodville Road to Parramatta Road, removing the existing right turn from Parramatta Road to Church Street or by providing grade separated access ramps. Each would have significant traffic impacts and restrict route choices for drivers.
- Widening of Church Street would have considerable property impacts on the eastern side of Church Street between Rosehill Street to Parramatta Road, including property acquisitions.
- Upgrading the intersection of Woodville Road and Parramatta Road would impact on a heritage property on the south-east corner of the intersection.

Option 2 – Church Street – grade separated access ramps

A number of grade separated options that would provide access between the M4 Motorway and Church Street were investigated. These included direct access from Church Street to travel west or east on the M4 Motorway, in addition to westbound access from the M4 Motorway to Church Street.

These options were not considered further as part of the WDA concept design based on the following and the reasons outlined above:

- The proximity of the Western Rail Line to Church Street, making the interchange unsuitable for a traditional full diamond layout. Instead, loop-style ramps would likely be required to ensure appropriate grades on the ramps.
- Substantial property acquisition would be required to construct the grade separated access ramps.
- Loop-style ramps would be expensive to construct.

Option 3 – Burnett Street – westbound on-ramp

This option would include provision of a westbound on-ramp from Burnett Street to the M4 Motorway. There is currently a 'half diamond' interchange at Burnett Street with a westbound off-ramp and eastbound on-ramp. The westbound M4 Motorway on-ramp would provide westbound access to the M4 Motorway from Parramatta via the Great Western Highway and Burnett Street. For the reasons outlined above, this option was not considered further as part of the WDA concept design.

4.4.3 James Ruse Drive

Westbound off-ramp to James Ruse Drive

Two options were considered for the westbound off-ramp to James Ruse Drive based on the need to accommodate both the off-ramp and the introduction of a new viaduct structure to the south of the existing motorway. The options considered were:

- The reconstruction of the existing westbound off-ramp further to the south to make it possible to align the new viaduct structure immediately adjacent to the existing viaduct structure.
- Align the new viaduct further to the south of the existing viaduct structure to limit reconstruction works to the existing westbound off-ramp.

Aligning the new viaduct further to the south of the existing viaduct structure was identified as the preferred option for the WDA concept design as it resulted in negligible impacts to the operation of the existing westbound off-ramp. It is able to be constructed under traffic and has limited impacts on traffic operations on the motorway and the off-ramp during the construction phase. However, either option could be feasible if traffic operations could be maintained.

4.4.4 Hill Road

Eastbound on-ramp to the M4 Motorway

The project provides for an eastbound on-ramp from Hill Road onto the M4 Motorway. No other options for the alignment or location of this on-ramp were available given the substantial existing properties north of the M4 Motorway to the east of Hill Road.

Westbound off-ramp to Hill Road

A number of options to provide westbound access from the M4 Motorway to Hill Road were considered. These included:

- A direct connection from the M4 Motorway to Hill Road via an overpass ramp.
- Access to Hill Road via Parramatta Road with a new connection from the M4 Motorway to Parramatta Road to the east of the existing Hill Road westbound on ramp.
- Access to Hill Road via Parramatta Road with a new M4 Motorway westbound off ramp connecting to Parramatta Road at Nyrang Street (near Haslams Creek).

A range of issues, including cost and property impacts, were identified during preparation of the WDA concept design. A westbound off-ramp to Hill Road is not considered further in this EIS. Cost effective options are being investigated as part of the detailed design.

4.4.5 Homebush Bay Drive

Homebush Bay Drive and M4 Motorway interchange

The M4 Motorway interchange at Homebush Bay Drive is functioning slightly above capacity in the AM peak period, operating at a LOS F. The performance of the A3 principal arterial north/south route (Homebush Bay Drive/Centenary Drive) is also influenced by performance at intersections with two key east/west arterials (Parramatta Road and Arthur Street).

Freight movements associated with the Sydney Markets at Flemington is a key contributor to the proportion of heavy and other commercial vehicles utilising the road network in this area. A number of options have been considered to improve network performance in this area:

- Improvements to the Centenary Drive and Arthur Street intersection (with a primary focus on improving east/west movement).
- Introduction of a southbound off-ramp from Homebush Bay Drive to Parramatta Road providing for eastbound and westbound turning movements.
- Introduction of a direct access westbound on-ramp to the M4 Motorway for southbound traffic on Homebush Bay Drive.
- A combination of the above options.

The preferred option is to introduce a westbound on-ramp from Homebush Bay Drive to the M4 Motorway. This option will improve intersection performance at both the interchange with the M4 Motorway and also at the Centenary Drive/Arthur Street intersection. Provision of a new direct access westbound on-ramp to the M4 Motorway for southbound traffic on Homebush Bay Drive would ease demand on the existing westbound on-ramp. This would reduce northbound queue lengths along Centenary Drive and allow Centenary Drive traffic to flow more efficiently through Arthur Street.

Other options identified above (or a combination of those options) may also be considered in the future by Roads and Maritime as part of broader network improvements.

5 Project description

This chapter describes the proposed scope of work, including the design criteria, the motorway alignment and other project elements such as drainage, noise barriers, signage and lighting. Details of proposed property acquisition are also provided.

Director-General's Requirements	Where addressed in EIS
A detailed description of the project, including:	Chapter 5
• proposed route, and road treatments, • design of the viaducts, interchanges (including on- and offramps), and road user, pedestrian and cyclist facilities (including street furniture and lighting), • land use changes, including resumption of residential and industrial lands, and impacts to Crown land, • location and operational requirements of construction ancillary facilities and access tracks, and • relationship and/or interaction with existing public and freight transport services (including rail, bus and waterbased traffic, and rail and bus stops);	Sections 5.1 & 5.3 Section 5.3 Section 5.3.12 & Section 8.10 Section 6.4 Sections 8.1

5.1 Project scope

The WDA is proposing to widen and upgrade approximately 7.5 kilometres of the M4 Motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush. Figure 1.2 in Chapter 1 shows the extent of the project and its main features.

The M4 Widening project would include the following key features:

- Construction of a new two lane viaduct for westbound traffic, on the southern side of the existing viaduct structure between Church Street, Parramatta and Wentworth Street, Granville.
- Reconfiguration of the traffic lanes on the existing viaduct structure to four lanes eastbound and two lanes westbound.
- Construction of a new bridge/viaduct over Duck River at Auburn.
- Widening of the existing motorway to the south of the westbound carriageway between Wentworth Street, Granville and Duck River, Auburn.
- Widening of the at-surface carriageway of the motorway predominantly within the existing motorway corridor (utilising both the existing median and verge areas), between Junction Street, Auburn and Homebush Bay Drive, Homebush to provide four traffic lanes westbound and four traffic lanes eastbound.
- Construction of a new westbound G-loop on-ramp to the M4 Motorway at Homebush Bay Drive, Homebush.
- Construction of a new eastbound on-ramp to the M4 Motorway from Hill Road, Lidcombe.
- Provision of ITS infrastructure for motorway operations.
- Provision of road infrastructure and services to support the future implementation of smart motorway operations.
- Widening and/or lengthening of existing ramps at Church Street, James Ruse Drive, Silverwater Road, Hill Road and Homebush Bay Drive.

- Provision of tolling infrastructure such as gantries and control systems.
- Provision of new and modified noise barriers.
- Provision of new asphalt wearing surface to the existing M4 Motorway.

The project description presented in this EIS is based on the WDA concept design. That design will be refined during detailed design. It may also be modified in response to any submissions received following the exhibition of the environmental impact statement or to further minimise environmental impacts. The final design of the M4 Widening project that is built could therefore vary from its description in this chapter.

5.2 Design criteria

5.2.1 Design standards

New works will be designed generally in accordance with Australian Standards, Austroads Design Standards, Guides and Codes and the Roads and Maritime supplements. Existing roads and structures will not be modified to meet current standards.

The posted speed for the main carriageways would be 90 kilometres per hour. Lane widths, shoulder widths and crossfall would be variable. Details are shown on the design drawings included in Appendix C.

5.2.2 Urban design objectives and principles

A number of project specific urban design objectives have been developed for the project. These objectives are consistent with the Draft WestConnex Motorway Urban Design Framework (Roads and Maritime, 2013) and are listed below:

- Integrate sustainable principles into the planning, design and construction and ensure that a natural systems approach to planning and design is adopted.
- Create a strong, simple, legible and inspiring integrated engineering, urban design, and environmental solution.
- Minimise impacts upon the local community and respond to their concerns and issues through developing a responsive design outcome.
- Transform spaces into places and encourage improved lifestyle opportunities.
- Create a strong, simple, legible and inspiring integrated engineering, urban design, and environmental solution.
- Create a bold language that provides identity to the motorway with a high quality design.

5.3 Project elements

Elements for the M4 Widening project are discussed in further detail in the sections below. The proposed widening of the M4 Motorway is first described, followed by detail on major intersections and interchanges, bridges and viaducts. Other project elements such as pavements and drainage are then described. As identified in section 5.1, the project as described is based on the WDA concept design which may be refined during detailed design.

5.3.1 Motorway widening

The widening of the M4 Motorway is proposed between Pitt Street, Parramatta and Holroyd and Homebush Bay Drive, Homebush. The proposed widening is described below and is shown by Figure 5.1, Figure 5.2 and Figure 5.3.

Section one: Pitt Street overpass, Parramatta to Wentworth Street, Granville

The M4 Motorway currently provides three traffic lanes in each direction over the 2.7 kilometre section between the Pitt Street overpass in Parramatta (at the project's western extent) and Wentworth Street, Granville to the east. Over much of this section the motorway is positioned on a viaduct, with opposing traffic streams separated by a concrete barrier.

In this section, the M4 Widening project involves the construction of a new viaduct to provide two additional through traffic lanes, resulting in a total of four traffic lanes in each direction. The new viaduct would be constructed to the south of the existing viaduct generally between Church Street, Parramatta and Wentworth Street, Granville (just east of James Ruse Drive) and would carry two westbound traffic lanes. The new viaduct would be about two kilometres long and generally positioned adjacent to the existing viaduct, except in the vicinity of the James Ruse Drive interchange, where it would deviate to the south. The six lane capacity of the existing viaduct would then be reconfigured to provide four lanes eastbound and two lanes westbound.

The westbound on-ramps at both Church Street and James Ruse Drive would be widened and lengthened to provide additional capacity and to support the future implementation of smart motorway operations.

Figure 5.4 shows a cross section near Good Street, Granville. Further information on the Church Street interchange and the James Ruse Drive interchange is provided in section 5.3.2.

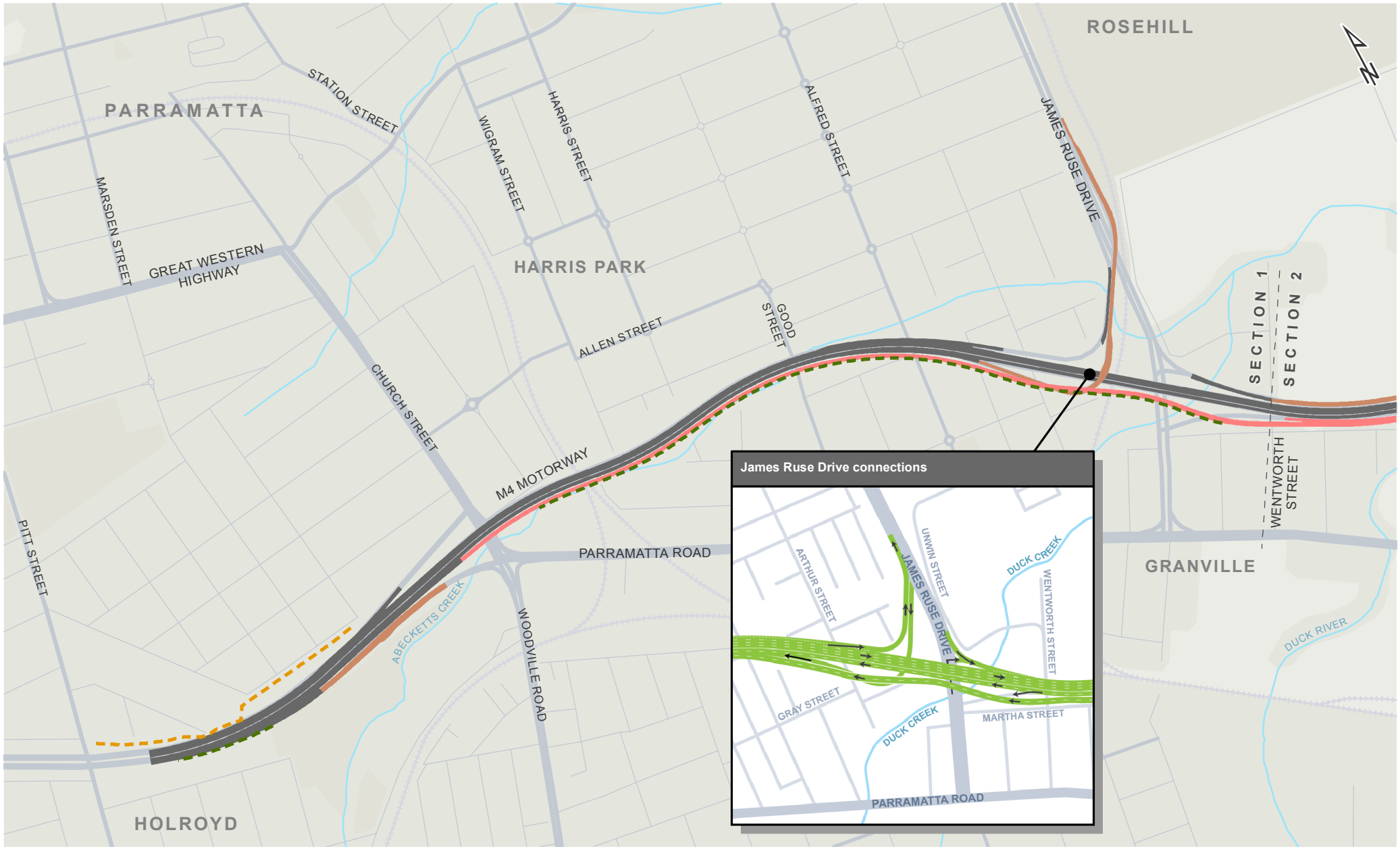
Section two: Wentworth Street, Granville to Junction Street, Auburn

The section between Wentworth Street, Granville and Junction Street, Auburn is about 900 metres long. Currently the motorway merges from three eastbound lanes to two lanes immediately to the west of Wentworth Street. A third eastbound lane returns with the no-merge eastbound on-ramp from James Ruse Drive. Three westbound traffic lanes are provided over this section.

The M4 Widening project involves the provision of an additional traffic lane and variable width sealed road shoulders on each carriageway, resulting in a total of four through traffic lanes in each direction divided by a central barrier. A westbound exit to James Ruse Drive would continue to be provided from the westbound carriageway.

The eastbound on-ramp at James Ruse Drive would be widened and lengthened to provide additional capacity and to support the future implementation of smart motorway operations. A new bridge over Duck River would be constructed to accommodate two westbound traffic lanes.

Figure 5.5 shows a cross section near Deniehy Street. Further information on the James Ruse Drive interchange and the bridge over Duck River is provided in section 5.3.2 and section 5.3.3 respectively.

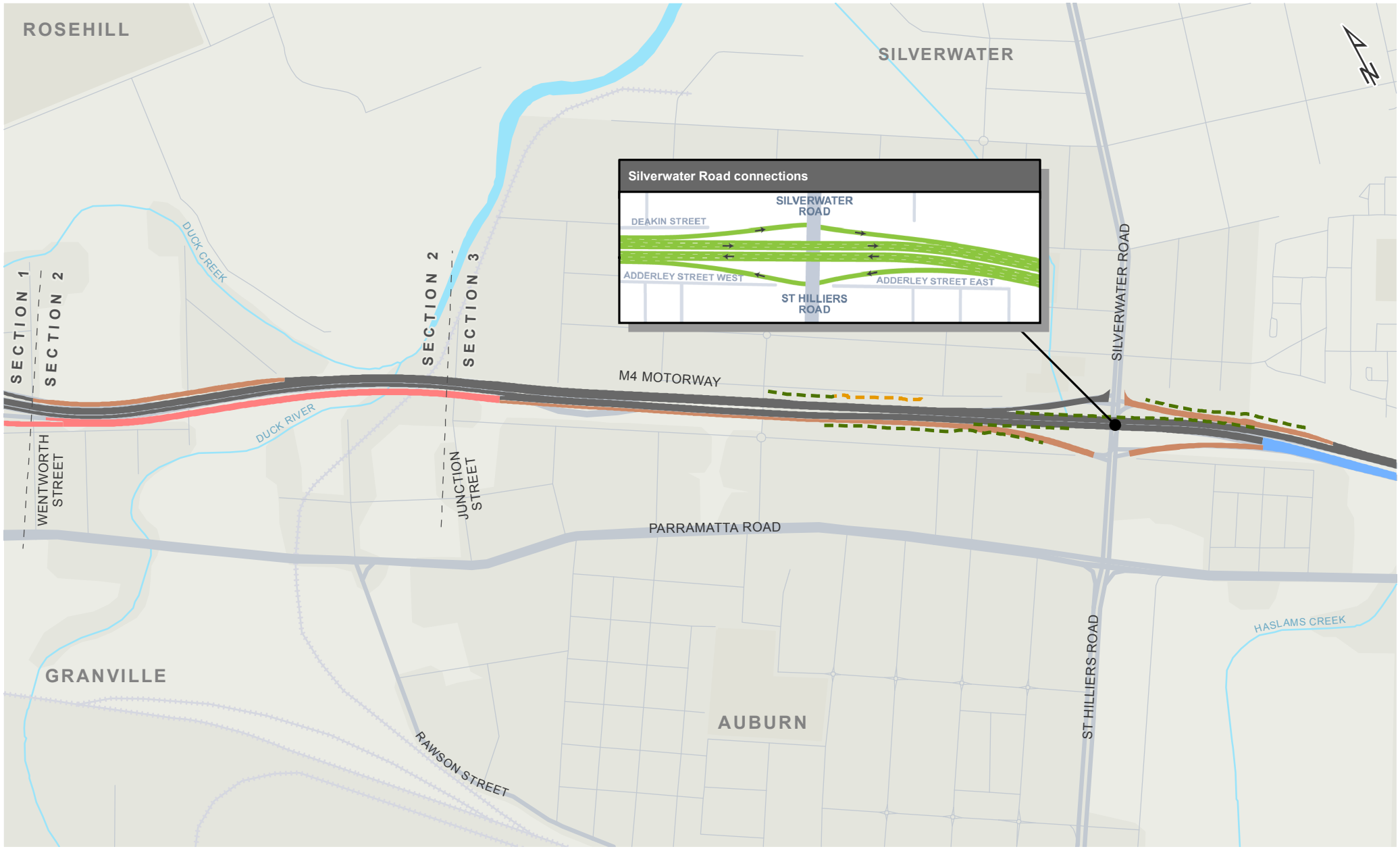


KEY

- New pavements and linemarking
- New viaduct
- Widening by median
- Widening by pavement
- New noise barriers
- Supplement existing noise barriers

M4 Widening alignment - Pitt Street, Parramatta to Deniehy Street, Clyde **Figure 5.1**

0 50 100 200 300 400
Metres

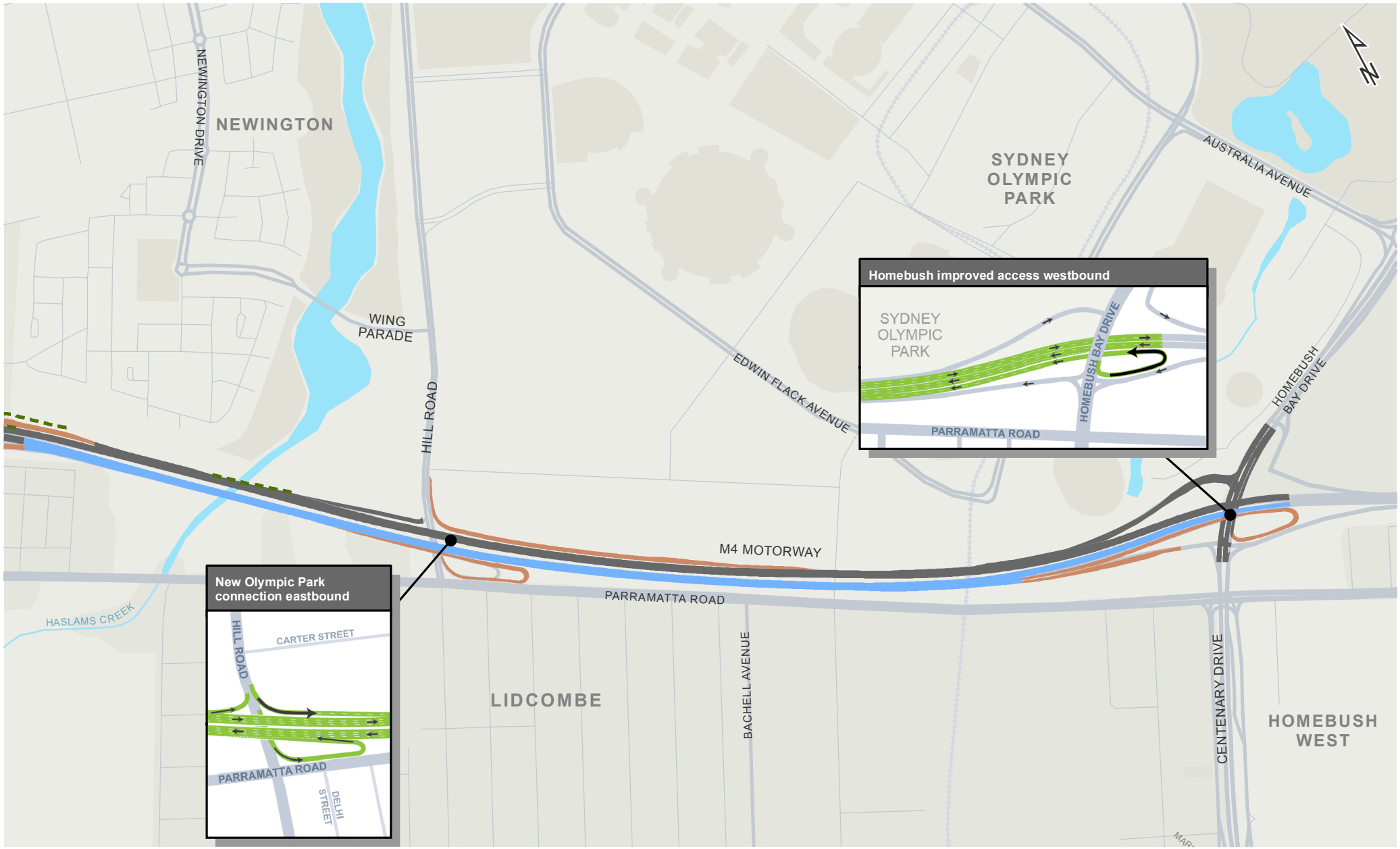


KEY

- New pavements and linemarking
- New viaduct
- Widening by median
- Widening by pavement
- New noise barriers
- Supplement existing noise barriers

M4 Widening alignment - Deniehy Street, Clyde to Haslams Creek **Figure 5.2**

0 50 100 200 300 400
Metres



KEY

- New pavements and linemarking
- New viaduct
- Widening by median
- Widening by pavement
- New noise barriers
- Supplement existing noise barriers

M4 Widening alignment - Haslams Creek to Homebush Bay Drive, Homebush **Figure 5.3**

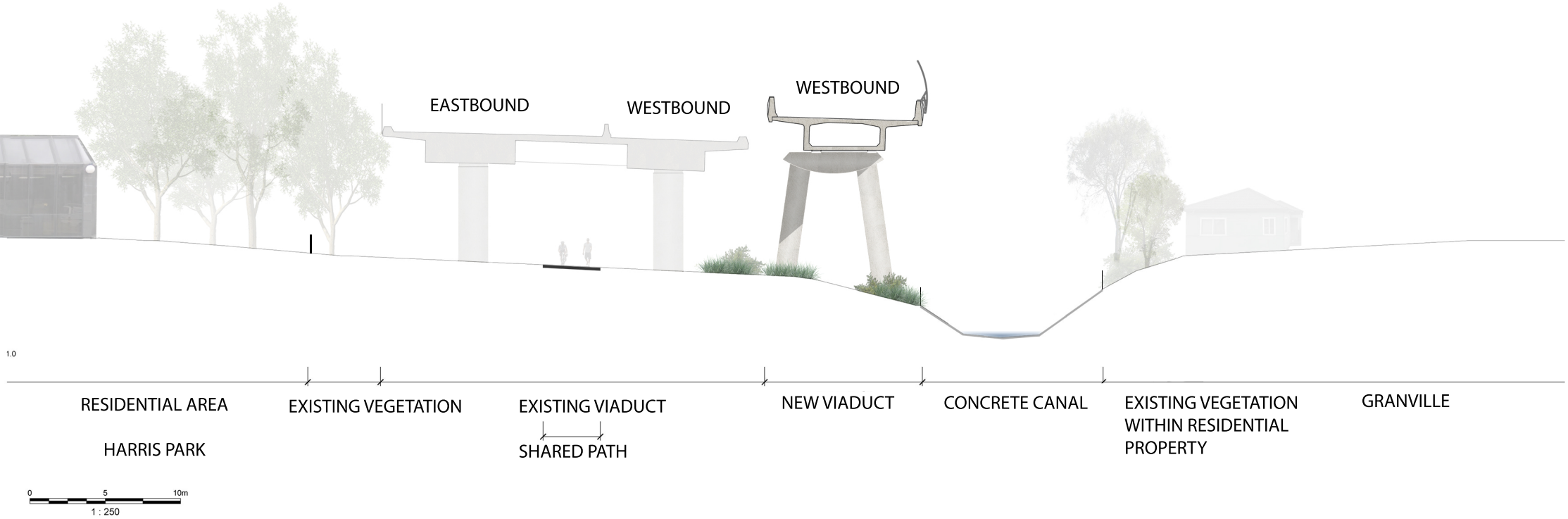
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Metres

Section three: Junction Street, Auburn to Homebush Bay Drive, Homebush

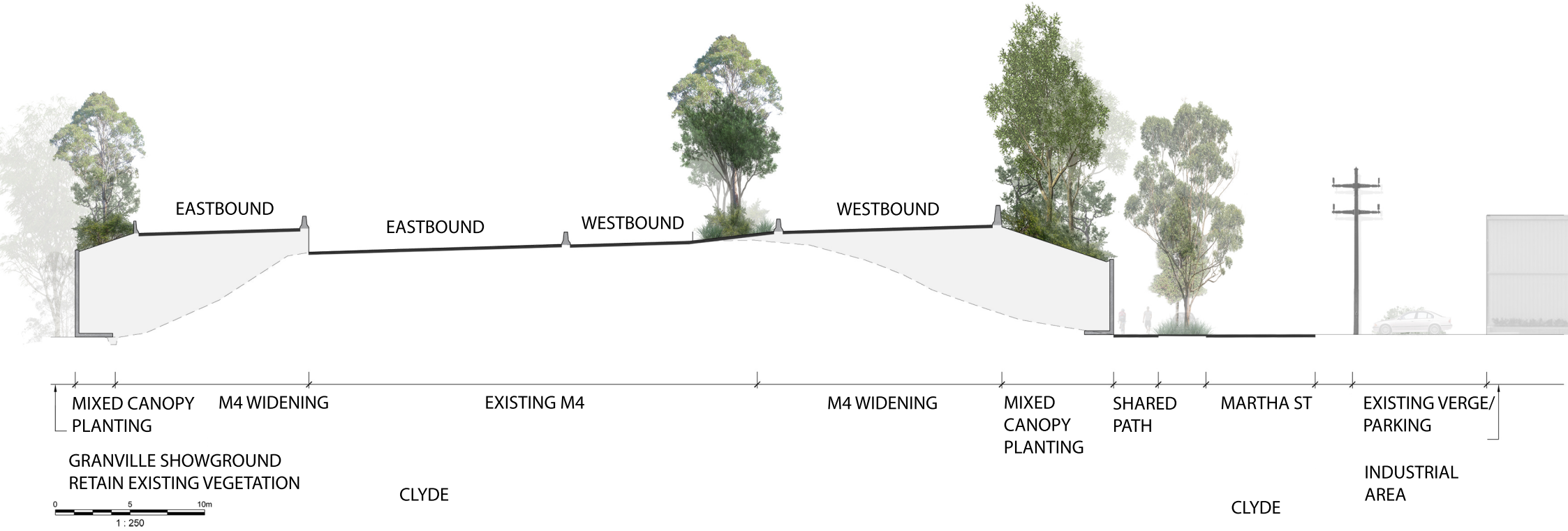
The 4.5 kilometre section of the M4 Motorway between Junction Street, Auburn and Homebush Bay Drive, Homebush is at-grade and currently provides three through traffic lanes in each direction. This section would be widened (utilising both the existing median and verge areas) with two additional lanes to provide a total of four traffic lanes with variable width sealed road shoulders. Between Newton Street and Stubbs Street, which is the location of the former tolling booths, the road geometry would be improved by straightening the horizontal alignment.

The westbound and eastbound on-ramps at Silverwater Road would be widened and lengthened to provide additional capacity and to support the future implementation of smart motorway operations. At the Hill Road interchange the westbound on-ramp would be lengthened and a new eastbound on-ramp would be constructed.

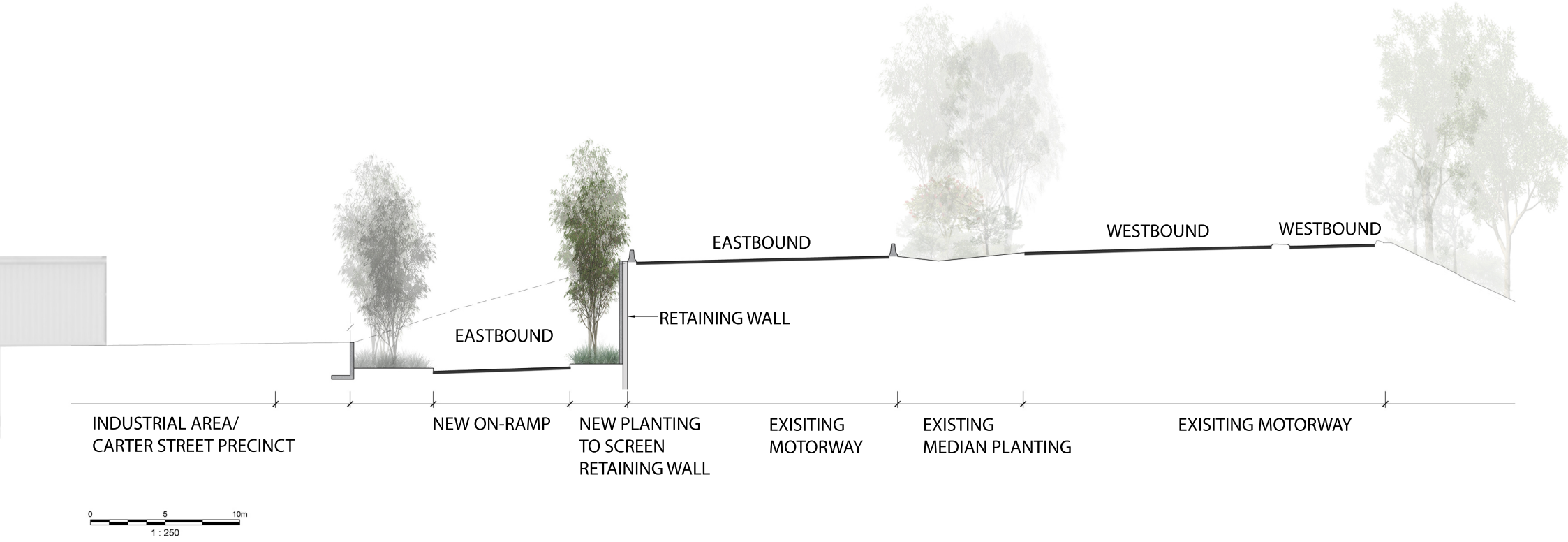
Figure 5.6 shows a cross section near Hill Road. Further information on the Silverwater Road, Hill Road and Homebush Bay Drive interchanges is provided in section 5.3.2.



Cross section near Good Street, Granville **Figure 5-4**



Cross section near Deniehy Street **Figure 5-5**



Cross section near Hill Road **Figure 5-6**

5.3.2 Intersections and interchanges

James Ruse Drive

The James Ruse Drive interchange currently accommodates all movements, except from James Ruse Drive northbound to the motorway westbound. The M4 Widening project would retain the existing interchange movements.

The project includes the widening and lengthening of the westbound and eastbound on ramps to the motorway at the James Ruse Drive interchange (refer to Figure 5.1). For traffic joining the motorway to travel westbound, a merge with the central lanes of the motorway would occur about 600 metres to the west of James Ruse Drive. For traffic joining the motorway to travel eastbound, the on-ramp would become the outer eastbound lane of the motorway and no merge with motorway traffic would be required, similar to the current arrangement.

Silverwater Road

The Silverwater Road interchange is currently a full diamond interchange configuration that accommodates all turning movements, with access between the ramps and Silverwater Road regulated by traffic control signals. The existing interchange movements would be retained.

Widening and lengthening of the westbound on-ramp, the westbound off-ramp and the eastbound on-ramp are proposed as part of the project. The westbound on-ramp to the motorway currently does not require a merge with through lanes on the motorway and the project would retain this arrangement.

The westbound off-ramp from the motorway currently commences about 400 metres east of Silverwater Road. The project proposes to extend this by a further 150 metres to the east with the outside lane becoming the exit lane. The eastbound on-ramp currently requires a merge with motorway traffic about 300 metres to the east of Silverwater Road. The project proposes that the on-ramp become the outside motorway lane with no merge required with through lanes on the motorway (refer to Figure 5.3).

Hill Road

The Hill Road interchange currently accommodates eastbound traffic exiting the motorway to travel north on Hill Road and southbound traffic on Hill Road entering the motorway to travel westbound.

The project would reconfigure and lengthen the existing westbound on-ramp by about 160 metres and introduce a new eastbound on-ramp that can be accessed by southbound traffic on Hill Road. Both of these improvements would facilitate the management of traffic leaving the Sydney Olympic Park precinct and are designed for future smart motorway operations. Figure 5.7 presents a model view of the extended on-ramp.

Homebush Bay Drive

The Homebush Bay Drive interchange is currently a modified full diamond configuration interchange that accommodates all traffic movements, with access between the M4 Motorway ramps and Homebush Bay Drive regulated by traffic control signals.

As part of the project, a G-loop on-ramp would be constructed for southbound traffic on Homebush Bay Drive to access the motorway and travel west. The new loop ramp would be positioned between the existing westbound off-ramp and the westbound carriageway of the motorway. This new westbound loop on-ramp would replace the existing signalised right turn for southbound Homebush Bay Drive traffic.

This would improve through movement capacity at this intersection and allow for free flowing left turn access to the motorway for northbound traffic from Centenary Drive. It would also assist future smart motorway operations.

Figure 5.8 presents a model view of the proposed new G-loop on-ramp.



Figure 5.7 Model view of the extended Hill Road on-ramp



Figure 5.8 Model view of the new G-loop on-ramp at Homebush Bay Drive

5.3.3 Bridges and viaducts

The main bridge and viaduct structures are described below. The *Urban Design, Landscape Character and Visual Working Paper* (KI Studio 2014) (Volume 3 – Working Paper F) provide further information on the design and appearance of these structures.

Viaduct – Church Street, Parramatta to Wentworth Street, Granville

The proposed viaduct between Church Street, Parramatta and Wentworth Street, Granville would provide two westbound lanes with a minimum one metre shoulder and 3.5 metre wide traffic lanes. The new structure would generally match the alignment of the existing viaduct but would not be attached. The design of the viaduct maintains existing clearances over Church Street, James Ruse Drive, Silverwater Road, local roads, railway crossings and waterways.

The viaduct superstructure would typically utilise pre-cast concrete and/or steel girders with typical spans of about 30 to 40 metres, however this would be varied near railway and road crossings to address span length, access, clearance and construction requirements however this is subject to detailed design. Single piers similar to the adjacent viaduct are proposed, however pier locations may not align with the existing piers. Where there are conflicts with existing infrastructure an A-frame pier type or similar would be used to clear any existing infrastructure.

Bridges over Deniehy Street

It is anticipated that two new three span bridges would be constructed over Deniehy Street. The westbound bridge would carry three lanes and a shoulder. The eastbound bridge would carry two lanes and a shoulder.

Duck River bridge

The Duck River bridge is proposed to be a multi-span structure with three westbound lanes. The superstructure of the bridge would be similar to the viaduct structure further to the west with typical spans of approximately 30 to 40 metres. Blade piers similar to the adjacent existing bridge are proposed, although new pier locations may not align with existing piers.

5.3.4 Pavement and line marking

Over the length of the project the existing M4 Motorway surface would be removed and replaced to improve the ride quality, reduce noise and allow new line markings to be effectively implemented. The finished surface would be an open-grade asphalt or similar for the full length and width of the project, including the viaduct with dense graded asphalt wearing course on ramps.

5.3.5 Drainage and operational water quality

Drainage

WDA's concept drainage design for the project has aimed to meet design standards while minimising the number of pipes crossing under the existing pavement, the total length of pipes and number of pits required. Table 5.1 shows the annual recurrence interval (ARI) criteria for key elements of the drainage system.

Table 5.1 Selected drainage design criteria

Drainage infrastructure	ARI
Open drains (surface drains including channels, table drains, bench drains, catch drains, contour banks, drop downs, basin inflows and basin outflows)	5 years
Piped systems (including pits)	10 years
Culverts and structures designed for surcharge	50 years
Culverts and structures not designed for surcharge	100 years
Pavements – nil width of flow spread onto traffic lanes	10 years
Pavement – wearing surface	10 years
Gross pollutant traps	1 year
Transverse culverts outlet channels	100 years
Cycleways	1 year

The pavement drainage system would consist of gutters, pits, channels and pipes which collect and convey stormwater from the road pavement before discharge into receiving waterways.

Along the main carriageway the proposed alignment changes are minor and generally consist of a lateral shift in the placement of the dividing traffic barrier together with drainage structures to suit. In the median, where practical, the existing drainage network would be retained and new drainage pits would connect to the existing pits. Where this solution is not practical (such as due to a lack of cover) a new drainage line would be provided and the former drainage network would be made redundant by either filling with grout or completely removing.

The new viaduct would include scuppers and carrier pipes to collect the stormwater from the scuppers. The carrier pipes would discharge down the viaduct piers, where at some locations vegetated swales would be provided. To address drainage on the existing viaduct with relocated median barriers, additional scuppers similar to the existing ones are proposed. Redundant median scuppers would be blocked.

Water quality controls

The need for water quality controls was assessed having regard to the moderate sensitivity of Duck River and the minimal sensitivity of Duck Creek, Haslam Creek and A'Becketts Creek. The need for spill containment was assessed by reference to waterway sensitivity and a traffic risk assessment.

While permanent water quality ponds are not proposed due to space limitations, water quality treatment may be provided through vegetated swales with rock check dams and spill management basins where space permits. Table 5.2 lists the indicative water quality control locations while Table 5.3 lists indicative spill containment locations. The need for, and locations of, these treatments would be refined during detailed design and may differ from those shown below.

Table 5.2 Indicative water quality control locations

Discharge chainage[1]	Source	Receiving waterway	Control	Side of motorway
600	Road	Duck Creek	Gross pollutant trap (GPT) and existing concrete channel	South
850	Proposed viaduct	Duck Creek	Swale and existing concrete channel	South
900	Proposed viaduct	Duck Creek	Swale and existing concrete channel	South
1150	Proposed viaduct	Duck Creek	Swale and existing concrete channel	Beneath viaduct
1550	Proposed viaduct	Duck Creek	Swale and existing concrete channel	South
1650	Proposed viaduct	Duck Creek	Swale and existing concrete channel	South
1875	Proposed viaduct	Duck Creek	Swale and existing concrete channel	South
3050	Road	Duck River	Swale	North
3200	Road	Duck River	Swale	North
3600	Merge of westbound on-ramp	Duck River	GPT	South
5575	Road	Haslams Creek[2]	Swale	North
6035	Road	Haslams Creek[2]	Swale	North
6200	Road	Haslams Creek[2]	Swale	North
6425	Road	Haslams Creek[2]	Swale	North
6500	Road	Haslams Creek[2]	Swale	North
6600	Road	Haslams Creek[2]	Swale	North
6750	Road	Haslams Creek[2]	Swale	North
6940	Road	Haslams Creek[2]	Swale	North
7040	Road	Haslams Creek[2]	Swale	North
7800	Road	Parramatta River via Badu Mangroves	Existing basin	North

[1] *Refer to design drawing in Appendix C for chainages*

[2] *Existing floating boom located to the north of the proposed project which provides water quality control*

Table 5.3 Indicative spill containment locations

Discharge chainage[1]	Risk potential	Risk of accident	Receiving waterway	Measure	Constraints
400	Multiple lane merges and final merge of westbound on-ramp	High	A'Becketts Creek	Potential for spill basin	Land ownership
6900	Merge of eastbound on-ramp	Medium	Haslams Creek	Vegetated channel, existing floating boom	Space
7400	Merge of westbound on-ramp	Medium	Parramatta River	Existing basin	Disturbance to existing surrounding network

[1] *Refer to design drawing in Appendix C for chainages*

5.3.6 Pedestrians and cyclist facilities

Cyclists currently use the 2.5 metre outside shoulders of the motorway to travel both eastbound and westbound, except between Church Street, Parramatta and Silverwater Road, Auburn where cyclists are prohibited from the motorway and a dedicated off-road cycleway is provided. The project would retain these arrangements and no additional facilities are proposed.

Pedestrian crossings of the motorway are available via cross street overbridges, underbridges and the Melton Street pedestrian bridge to the west of the Silverwater Road interchange. There is currently no pedestrian access along the motorway and none is proposed as part of the project.

5.3.7 Utility services, adjustments and protection

Adjustment and protection requirements for utilities and services would be confirmed as part of the detailed design process. The following requirements have been identified during WDA's concept design development:

- Between Church Street and Good Street in Granville there is a sewer that runs in and around the existing creek bed. Piers for the viaduct would be positioned so as to avoid this sewer. Some protection or relocation works may be required.
- Between Duke Street and Arthur Street in Granville there is an Optus fibre optic cable that runs through the project site. The cable may require protection or relocation during the construction of the viaduct.
- An Optus optic fibre cable runs along the northern side of the corridor near Hill Road, Lidcombe. The cable may require protection or relocation during the construction of new eastbound on-ramp at Hill Road.
- Two high pressure lines cross the corridor in a north-south direction on the eastern side of Hill Road, Lidcombe. These lines may require protection or relocation during the construction of new eastbound on-ramp at Hill Road.

5.3.8 Provision for smart motorway infrastructure

The M4 Widening project includes widening and/or lengthening of existing on-ramps at Church Street, James Ruse Drive, Silverwater Road, Hill Road and Homebush Bay Drive.

It is proposed that these ramps be widened and/or lengthened to provide sufficient vehicle storage capacity for smart motorway operations. The project also includes a new ITS cableway along the M4 corridor which can be used to support the future implementation of a smart motorway solution.

5.3.9 Emergency and incident management facilities

There are twelve emergency stopping bays along the section of the motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush (five westbound and seven eastbound). Where currently provided, the bays are typically spaced at intervals of between 500 metres and 1.9 kilometres with some of the eastbound/westbound bays positioned opposite each other. Emergency telephones are provided at each emergency stopping bay and at a number of other locations.

Existing bays and emergency telephones would be either retained or suitably relocated. New emergency stopping bays are not proposed. Incident detection capability, including in-pavement traffic detectors, would be maintained.

Current emergency access is provided to the motorway consistent with public access. This access would be maintained and additional lanes and access ramps would provide improved access for emergency vehicles.

5.3.10 Lighting, roadside furniture and signage

The project includes the provision or replacement of Type F concrete barriers at various locations. This would include replacing existing wire rope barriers with concrete barriers, east of the Duck River crossing.

All existing ITS devices would be either retained or if required by the works, replaced in their current location. Similarly, directional signage would be largely unchanged. Some additional signage is proposed including new signs to indicate changes to the on ramp at Homebush Bay Drive (westbound) and the operation of the new on ramp at Hill Road (eastbound). Signs advising of the toll would be placed on the M4 Motorway, Parramatta Road and other arterial roads as required.

Lighting is currently provided at interchanges, ramps and other selected locations along the motorway. Some changes to lighting may be required to accommodate new structures and widening works. Any new lighting or modifications to existing lighting would be design consistent with AS4282-1997 Control of the Obtrusive Effects of Outdoor Lighting.

5.3.11 Noise barriers

Additional and extended noise barriers are proposed at a number of locations along the project corridor, where reasonable and feasible (refer to Figure 5.1 to Figure 5.3). Proposed locations and indicative heights are based on noise modelling undertaken for the concept design, as described in Section 8.2. Indicative heights range from 3.5 to 7.5 metres (refer to 5.3.11).

Table 5.4 Noise barrier details

Location	Length	Height	Comment
Northern side of motorway, east of Pitt Street	335 m	6.5 m	Supplement existing barrier
Northern side of motorway, east of Pitt Street	318 m	7.5 m	Supplement existing barrier
Southern side of motorway, east of Pitt Street	218 m	4.0 m	New barrier
Southern side of motorway, east of Church Street to west of James Ruse Drive	1,565 m	3.5 m	New barrier
Southern side of motorway, west of Silverwater Road (north of westbound on-ramp)	476 m	4.5 m	New barrier
Southern side of motorway, west of Silverwater Road (south of westbound on-ramp)	219 m	4.5 m	New barrier
Northern side of motorway, west of Silverwater Road	600 m	4.5 m	Retain existing barrier at eastern end. Supplement height in central section and add new barrier at western end
Northern side of motorway, east of Silverwater Road (south of eastbound on-ramp and eastbound off-ramp)	535 m	6.0 m	New barrier
Northern side of motorway, east of Silverwater Road	351 m	6.0 m	New barrier
Northern side of motorway at Haslams Creek	188 m	4.2 m	New barrier which extends existing barrier at same height

5.3.12 Property access and acquisition

Access to a number of private properties would be required during within the identified construction site for plant and machinery, establishment and operation of compound and ancillary facilities. Where access to private property is required during the construction period for the M4 Widening project, this would occur by negotiation with the relevant landowners where possible. In the case of proposed construction compound sites, leases would be negotiated.

The project would ensure access to properties maintained throughout construction.

Property acquisitions, as identified by the concept design, would be required for the project as detailed in Table 5.5.

Table 5.5 Property acquisition details

Lot number	Acquisition type	Existing use
Lots 1 and 2 DP 1056064	Total acquisition	Commercial
Lot 101 DP 1077494 Lot 1 DP 1030856	Partial acquisition	Rail Corridor
Lot 50 DP 632565	Total acquisition	Residential
Lot 60 DP 632569	Total acquisition	Residential
Lot 20 DP 632496	Total acquisition	Residential
Lot 1 DP 1052519	Total acquisition	Industrial
Lots 16 and 22 806495	Partial acquisition	Commercial
Lot 1 DP 1023100	Partial acquisition	Commercial
Lot 1 DP 1083388	Partial acquisition	Industrial
Lot 1 DP 883068	Partial acquisition	Commercial
Lot 47 DP 225351	Partial acquisition	Commercial
Lot 2 DP 560429	Partial acquisition	Commercial
Lot 1 DP 560429	Partial acquisition	Commercial
Lots 43 and 44 DP 225351	Partial acquisition	Commercial
Lot 42 DP 225351	Partial acquisition	Commercial
Lot 41 DP 225351	Partial acquisition	Commercial
Lot 53 DP 825637	Partial acquisition	Vacant
Lot 48 DP 225351	Partial acquisition	Reserve
Lot 1 DP 775425	Partial acquisition	Creek channel

Temporary leases for construction access would be negotiated in accordance with the requirements of the site access schedule. Details of properties to be temporarily leased are outlined in in Table 5.6.

Table 5.6 Properties subject to temporary leases

Lot number	Type	Existing use
Lot 53 DP 825637	Lease	Vacant
Lot 101 DP 1077494 Lot 1 DP 1030856 Lot 11 DP 836871	Licence	Rail Corridor
Lot 1 DP 1083388 Lot C DP 179389	Partial lease	Industrial
Lot 48 DP 225351	Lease	Reserve
Lot 10 DP 858520	Partial lease	Commercial
Lot 16 DP 806495 Lot 21 DP 806495 Lot 22 DP 806495	Partial lease	Commercial
Lot 1 DP 1023100	Partial lease	Commercial
Lot 12 DP 836871	Partial lease	Commercial
Lot 1 DP 876255	Lease	Commercial
Lot 1 DP 7754425	Lease	Creek channel

Lot number	Type	Existing use
Lot 1 DP 840154	Lease	Vacant/temporary storage
Lot 11 DP 1117543 Lot 12 DP 1117543 Lot 1 DP 248869	Lease	Residential
Lot 18 DP 806495 Lot 24 DP 806495 Lot 25 DP 806495	Licence	Creek channel

Final acquisition requirements would be confirmed through detailed design in consultation with landowners. All property valuations and acquisitions would be carried out in accordance with the Land Acquisition Information Guide (Roads and Maritime, 2012) and the (NSW) *Land Acquisition (Just Terms Compensation) Act 1991*.

6 Construction

This chapter describes the proposed approach to construction of the project including indicative or likely staging, early works, construction methods, earthworks, material, equipment, working hours and temporary construction facilities. Detailed construction planning would occur prior to construction commencing and details of construction would be finalised at that time and detailed in a Construction Environmental Management Plan (CEMP).

6.1 Construction strategy

The construction strategy for the M4 Widening project would ensure that construction occurs in a safe and efficient manner while at the same time, manages identified constraints and minimises environmental impacts. Detailed construction planning would occur prior to construction commencing, however some general principles of the construction strategy are as follows:

- Achieve safe and convenient access for construction vehicles, plant and equipment along the length of the project and to and from public roads while at the same time minimising impacts. Considerations include the impacts to road users, the effect on urban amenity and the suitability of local road pavements.
- Manage risks to existing infrastructure including roads, railways, utilities and services.
- Recognise that modifications to existing infrastructure come with increased risk to road user and construction personnel safety and result in more constraints to construction productivity including the need to undertake work at night, to implement traffic switches and to work within agreed periodic rail corridor closures.
- Manage community and environmental issues including noise, access, amenity and general disruption.

A key element of the construction strategy is the utilisation of traffic switches to allow safe construction. It is expected that work in the central medians and verges would generally be undertaken in separate traffic management phases, although some work on the medians may be undertaken at night with the implementation of lane closures. The main traffic switches are likely to be:

- Switching westbound traffic onto the new viaduct generally between Wentworth Street, Clyde and Deniehy Street, Clyde. This would allow the median works between the western extent of the project and Wentworth Street to be completed.
- Switching westbound traffic on to the widened section of the M4 Motorway to the south at Silverwater Road, Auburn. This would allow all the median works between Silverwater Road and Deniehy Street to be completed.

It is expected that eastern sections of the project between Silverwater Road and Homebush Bay Drive, Homebush can be constructed at any time during the construction period. Construction planning would however need to take into account the events schedule at Sydney Olympic Park precinct.

6.2 Construction program

Construction of the M4 Widening project is expected to take about 22 months, with an indicative commencement of construction in early 2015, subject to approvals. Figure 6.1 shows an indicative construction program.

The program shown in Figure 6.1 is an example of how the project may be delivered. The final program would be subject to further development during contract procurement and the detailed design stage. Other factors that may influence the timing and duration of construction activities include wet weather periods, changes to construction methods and/or materials, night works and respite periods, unexpected environmental and/or community issues and the agreed approach to the management of traffic.

6.3 Construction methodology

6.3.1 Construction area

Figure 6.2 to Figure 6.4 show the proposed construction area. The construction area includes the area required for road works, bridge/viaduct works, access for construction vehicles and plant, drainage infrastructure, utilities/services adjustments, temporary stockpiles and construction site compounds.

6.3.2 Enabling works

Enabling works are those works that need to occur prior to construction of the new infrastructure, in order to facilitate the construction process. For the project, these works would include:

- Installation of construction signage and advisory signs.
- Installation of environmental controls.
- Surveys or acquisitions.
- Investigative drilling or excavation, or salvage.
- Minor clearing (except where heritage, threatened species, populations or endangered ecological communities would be affected).
- Implementation of traffic management measures, including the placement of temporary concrete barriers and any necessary adjustments to line marking.
- Implementation of temporary pedestrian and/or cyclist diversions.
- Establishment of ancillary facilities and construction site compounds including hardstand areas, demountable buildings, fencing, and services connections.

Section 6.4 covers the establishment and operation of construction site compounds. Section 6.5 considers traffic management and construction access arrangements in more detail.

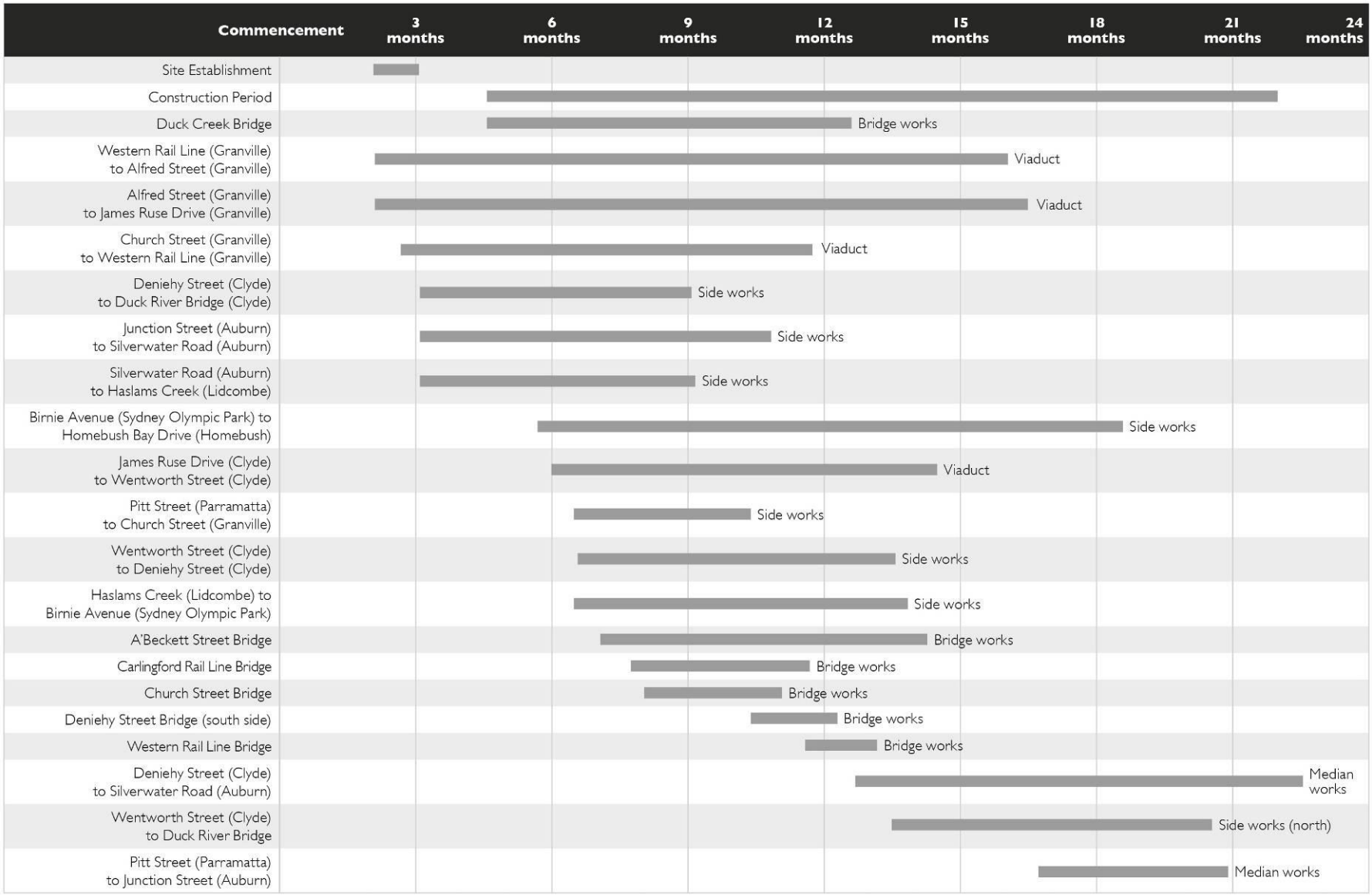
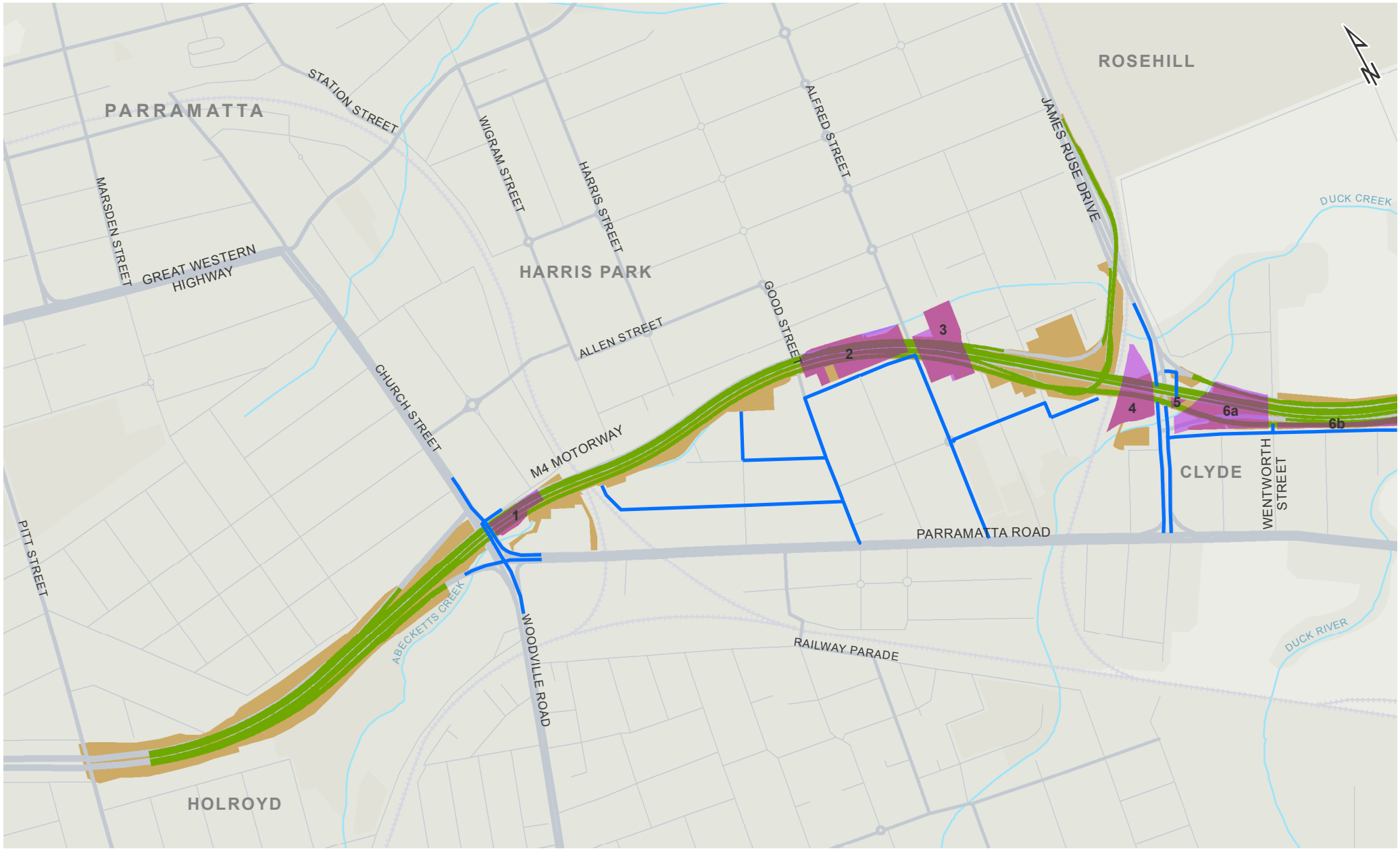


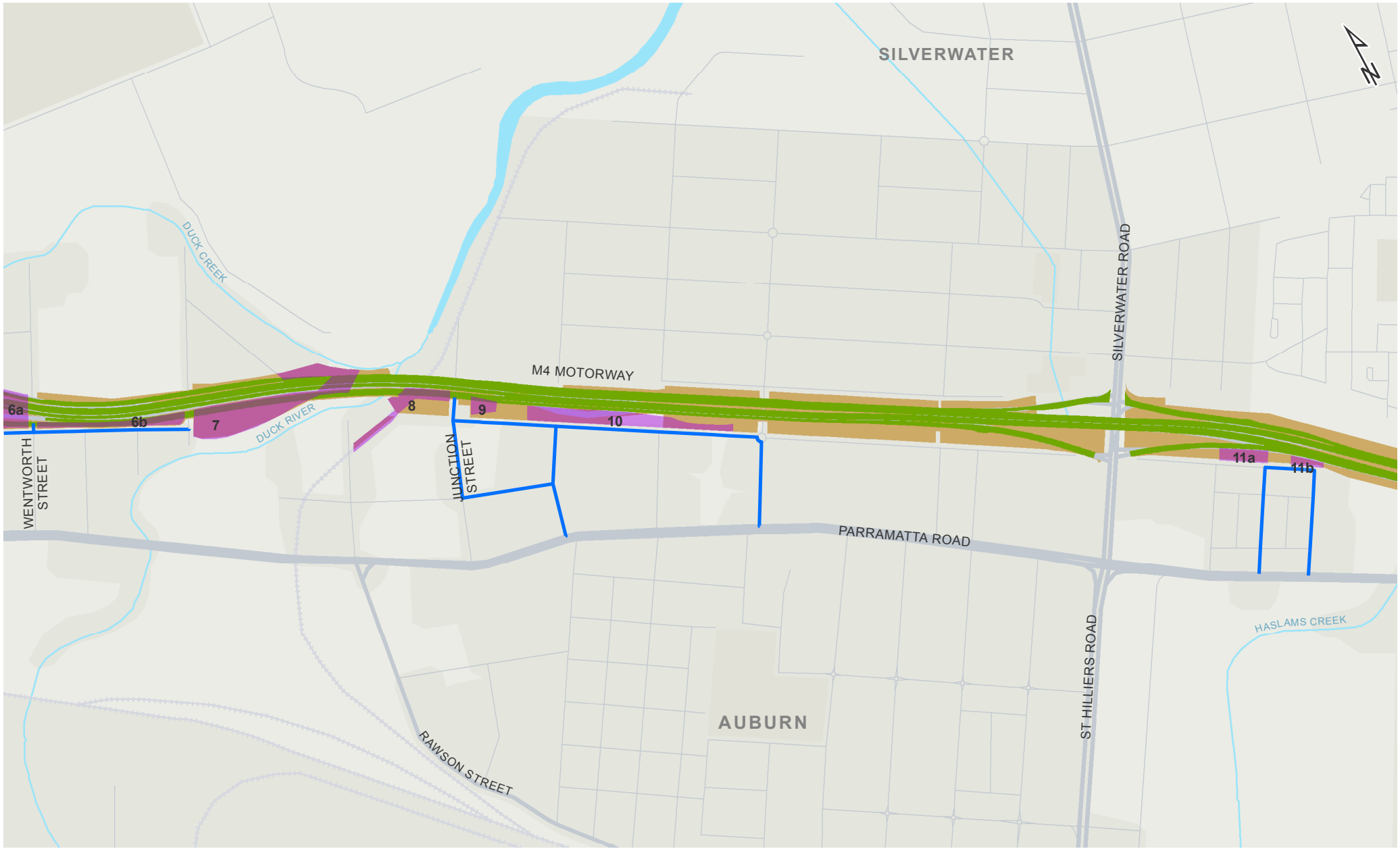
Figure 6.1 Indicative construction program



KEY

- Potential haulage routes
- Project design
- Potential site compounds
- Construction work area

Project construction area and haulage routes - Pitt Street, Parramatta to Deniehy Street, Clyde **Figure 6.2**

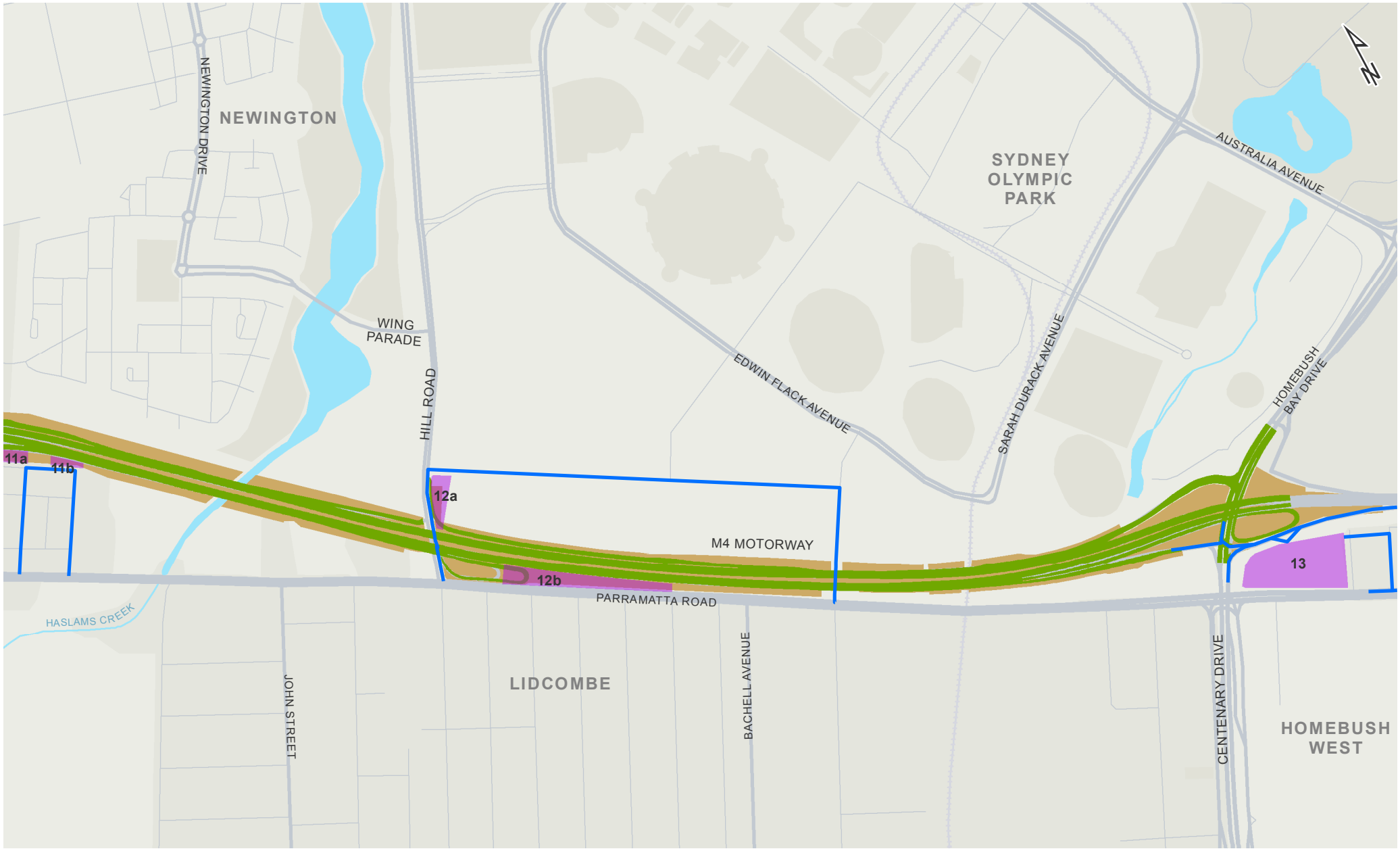


KEY

- Potential haulage routes
- Project design
- Potential site compounds
- Construction work area

Project construction area and haulage routes - Deniehy Street, Clyde to Haslams Creek **Figure 6.3**

0 50 100 200 300 400
Metres



KEY

- Potential haulage routes
- Project design
- Potential site compounds
- Construction work area

Project construction area and haulage routes - Haslams Creek to Homebush Bay Drive, Homebush **Figure 6.4**

6.3.3 Road widening works

Road widening is proposed at a number of locations along the M4 Widening project corridor and includes widening into the motorway verges (side works) as well as median widening (median works). Based on preliminary designs, the proposed construction works required for these road widening sections are described below.

West of Church Street, Parramatta

Works include widening both the M4 Motorway and the westbound on-ramp. Works in this section would include clearing and grubbing, benching into the roadside batters, backfilling and construction of new road pavements.

Wentworth Street, Granville to the bridge over Duck Creek

A reinforced earth wall may be constructed along the southern boundary to accommodate widening in this section. This would first involve excavation of the existing batter down to a level suitable for the foundations of the wall with the batter excavated back about as far as the wall is high. Alternatively, this section could be constructed as an extension of the new viaduct and connecting to the bridge over Duck Creek.

East of Deniehy Street, Clyde it is expected that cutting into the existing embankment and extending the batter to the south (using reused material where possible) would occur instead of a reinforced earth wall. Minor retaining walls may be needed in some places along this section. Installation/lifting of drainage pipes and pits and construction of new pavements would also occur along this section.

On the northern side of the M4 Motorway at the on-ramp from James Ruse Drive, Clyde, clearing and grubbing of vegetation on the roadside batter is required (between chainage 2700 and 2940). A retaining wall would be built between chainage 2700 and chainage 2820.

Junction Street, Auburn to Haslams Creek

Work proposed in this section includes:

- Clearing and grubbing as required.
- Removal or back filling of the access tunnel under the old toll plaza. This may involve pumping sand mixed with cement into the tunnel leaving a void just under the roof of the tunnel. The crown of the tunnel would then be grouted and drill holes would be sealed.
- Widening of the motorway alignment under the bridge at Stubbs Road and the pedestrian bridge at Melton Street (without structural modification to the bridges).
- Widening of the westbound and eastbound on-ramps at Silverwater Road, Auburn and general widening to the south of the motorway. Construction activities would include excavation, backfilling, drainage, laying of concrete pavements, line marking and installation of guard rails where required.
- Road widening would occur in the existing median where required. This would involve stripping existing topsoil/fill to a depth of approximately one metre, drainage works, importation of new fill, construction of pavements line marking and installation of new guardrails.
- Relocation of the central median barrier.
- Drainage modifications.

Haslams Creek to Homebush Bay Drive, Homebush

Work proposed in this section includes:

- A new eastbound on-ramp for Hill Road, Lidcombe. Construction would involve initially cutting into the existing batter. The eastern section of the new on-ramp would require a new retaining wall positioned on the outside of the ramp to contain the elevated road. A retaining wall between the ramp and motorway and between the elevated ramp and the property boundary is the most likely approach, although an alternative approach may be developed during detailed design that achieves a similar outcome.
- Extension/modification to westbound on-ramp from Hill Road.
- Widening of motorway alignment under the Sydney Olympic Park Line railway bridge and the Homebush Bay disused railway bridge.
- Widening of the existing westbound on-ramp at Homebush Bay Drive.
- Construction of a new westbound on-ramp from Homebush Bay Drive extending from southbound lanes on Homebush Bay Drive, beneath the bridge.
- Road widening would occur in the existing median where required. This would involve stripping existing topsoil/fill to a depth of approximately one metre, drainage works, importation of new fill, laying of pavements line marking and installation of new guardrails.
- Relocation of central median barrier.

6.3.4 Bridge/viaduct works

Crossing Church Street, Parramatta

The bridge over Church Street would likely be constructed using steel or concrete beams. The beams would be erected separately and an in situ concrete slab would then be poured.

Beams would be erected using cranes on Church Street. Delivery of bridge elements would generally be via the motorway or Parramatta Road and Church Street, and a partial closure of these roads may be needed.

Following the erection of the beams, steel reinforcement would be placed for the deck. Safety rails and boards would be installed along the outside of the beams followed by completion of the concrete bridge deck.

Bridge over the Western Rail Line

Similar to the Church Street bridge, the proposed bridge over the Western Rail Line would also be constructed using bridge beams.

The erection of the bridge deck would likely take place over a weekend within a track possession. Cranes would need to be positioned to lift the girders into place over the track.

A'Beckett Street and Alfred Street intersection, Granville

Work at this location would include foundations either side of Alfred Street and the erection of girders over Alfred Street and the approach spans either side.

Site compounds may be established on both sides of Alfred Street. Construction of the western approach span would likely be from A'Beckett Street, requiring the closure of A'Beckett Street.

Bridge over Carlingford Rail Line

Construction of a bridge at this location would require cranes to lift bridge elements into place over the Carlingford Rail Line. This would likely require closure of the rail corridor within a track possession.

James Ruse Drive, Clyde

A bridge is required over James Ruse Drive, with the bridge beams erected separately and an in situ concrete slab then poured. The beams would likely need to be placed with cranes positioned on James Ruse Drive with the road to be closed for a short period if this occurs.

Following the erection of the beams, steel reinforcement would be placed for the deck. Safety rails and boards would be installed along the outside of the beams followed by completion of the concrete bridge deck.

Bridge over Duck River

The bridge over Duck River would require approximately nine spans with piled footings. It is expected that most materials would be supplied from the Martha Street and Junction Street compounds.

A temporary work platform would be required to be built across the river to provide access and a safe working environment during construction of the bridge. Where both the temporary and the permanent piles are required, mangroves would need to be cleared. Traffic controllers would be used where construction works temporarily affect the cycleway (ie trucks crossing or girders being erected overhead).

6.3.5 Drainage works

Constructing drainage would involve localised excavation, compaction and installation of drainage pipes and pits, and construction of drainage swales and basins. On the existing viaduct, new scuppers would be installed where required.

Retaining walls, gross pollutant traps and water dissipation devices may also be required at some locations. The typical equipment required for drainage works would include concrete pumps, concrete trucks, excavators, jackhammers and boring machines.

6.3.6 Pavements

Where new pavements are being constructed this would typically involve:

- Placement of select material (usually crushed rock, natural gravels or suitable soils).
- Placing, compacting and finishing of concrete to form pavements.
- Placing, compacting and finishing of open grade or dense grade asphalt wearing course.

The typical equipment required for this work would be excavators, trucks, concrete trucks, graders, vibratory rollers, water carts, compactors, concrete and asphalt pavers, profilers and concrete saws.

As noted in Chapter 5, the existing M4 Motorway surface, within the M4 Widening project area, would need to be re-surfaced as part of the M4 Widening project. These works would involve milling of the existing surface first or just re-sheeting (relaying the asphalt) over the road surface followed by line marking. The finished surface would be an open grade asphalt or similar for the full length and width (within the M4 Widening project boundary), including the viaduct and ramps to ensure a consistent surface.

6.3.7 Tolling infrastructure

The M4 Widening project tolling system involves approximately 15 tolling point locations, at either end and on all existing motorway ramps. At each location a tolling gantry, equipment base (with equipment cabinets) and a maintenance parking bay would be constructed. This would involve:

- Clearing of small areas and excavation for gantry footings, conduit and equipment bases.
- Formwork and concrete pours.
- Installation of power and communications cables.
- Erection of gantries and installation of general requirements such as lighting, generators, security fencing, signage.

6.3.8 Operational noise mitigation

Noise walls would be constructed (or, if required, demolished and rebuilt) in accordance with the noise modelling outcomes described in Section 8.2 and the M4 Widening Construction and Operational Road Traffic Noise and Vibration Impact Assessment (Working Paper E) . Where practicable, noise walls would be constructed as early as practicable in the construction sequence to provide attenuation during construction. The introduction of new noise walls would typically require vegetation removal, piling, construction of reinforced concrete footings and steel posts, and installation of panels manufactured from concrete or other material. The removal and reinstatement of existing noise walls would require some demolition works prior to commencement of the construction activities outlined above.

6.3.9 Utilities and services

As described in Chapter 5, a number of utilities and services may be impacted by the project. The extent of impacts cannot be confirmed until the detailed design is finalised. Strategies to address impacts may include protection or relocation of the utility, or adjustments to the project design to avoid any impacts. Either the construction contractor or the relevant utility provider would undertake utility adjustments. A management plan would be prepared for the utility adjustments.

6.4 Temporary compounds and ancillary sites

Temporary site compounds and ancillary sites would provide support to the construction of the project.

As the M4 Widening project would need to be constructed under traffic, there are limited opportunities to locate compounds and ancillary sites within the M4 corridor. Compounds and ancillary sites would therefore be established at locations as close as possible to the M4 corridor. They would comprise:

- Hardstand. The whole area would be covered in hardstand.
- Temporary buildings (generally prefabricated) with:
  - Offices and meeting rooms.
  - Reception and general administration area.
  - Amenity, first aid and toilet facilities.
- Parking areas.

- Materials laydown and storage areas (refer to section 6.7.2). These would include purpose-built temporary structures as required.
- Perimeter fencing, including visual screening of compounds where necessary.

The locations of compounds and ancillary sites, together with details of their size, proposed uses and access points are yet to be finalised, but potential locations are outlined in Table 6.1 and in Figure 6.2 through Figure 6.4. These figures also show roads that may be used for access to the site, deliveries and for haulage of materials.

Proposed activities that would be undertaken for each of the identified uses in Table 6.1 are identified in Table 6.2.

Table 6.1 Potential compounds and ancillary sites

Compound	Proposed use	Approximate Area (m^2)	Proposed access/egress
1 Church Street Compound	Construction compound	6,800	Access for construction plant and materials from Church Street (southbound), egress for trucks onto Junction Street Access and egress from Victoria Street /Duke Street, Prince Street /Harris Street and/or Good Street
2 A'Beckett Street Compound	Construction compound	15,500	Access and egress from A'Beckett Street via Good Street or Alfred Street
3 Alfred Street Compound	Construction compound	13,700	Access from Alfred Street, egress onto Alfred Street or Arthur Street
4 James Ruse Drive Centre Compound	Construction and storage facility	10,000	Access and egress from James Ruse Drive (northbound)
5 James Ruse Drive East Access	Construction and storage facility	450	Access and egress from James Ruse Drive eastbound on-ramp
6a Martha Street West Compound and 6b Martha Street Centre Compound	Construction and storage facility	15,600 (west) 4,500 (centre)	Access from Wentworth Street, egress onto Martha Street
7 Deniehy Street Compound	Construction and storage facility	19,800	Access and egress from Martha Street
8 Junction Street Compound	Construction site	5,200	Access and egress from Junction Street
9 Adderley Street West Compound	Construction site	1,600	Access and egress from Adderley Street West
10 Adderley Street Main Compound	Construction compound	11,460	Access and egress from Adderley Street West
11 Adderley Street East Compound 1 and 2	Construction compound	2,700 1,200	Access from Adderley Street East, egress onto Day Street South

Compound	Proposed use	Approximate Area (m^2)	Proposed access/egress
12a Hill Road G-loop compound and 12b Hill Rd North Compound	Construction compound	3,570 10,200	Access and egress from Hill Road
13 Homebush Bay Drive East	Main project site office	21,400	Access and egress from M4 Motorway westbound off-ramp to Homebush Bay Drive and Flemington Road

Table 6.2 Compound site uses and proposed activities

Proposed use	Proposed activities
Main project site office	• Staff amenities and parking • Large scale demountable offices and facilities including ablutions • Light vehicles • Minor equipment storage
Construction and storage facility	• Staff amenities, sheds and parking • Large plant and equipment • Material storage • Stockpiles
Construction compound	• Staff amenities and sheds • Parking • Minor plant & equipment • Limited storage
Construction site	• Staff amenities & ablutions • Small and large plant and equipment

Further assessment of the compounds and ancillary sites would be undertaken during detailed design and when construction methods have been confirmed. Preliminary community consultation was undertaken for properties surrounding the potential compound sites identified in Table 6.1 (refer to section 7.4.1 for further details). Some additional minor ancillary sites shown in the figures are not described in the table below however they would be used for minor construction activities such as laydown activities.

The compound and ancillary sites identified above, as well as any additional or alternative compound sites that are identified during detailed design, would be assessed against the following criteria. If a criterion is not met, further mitigation measures will be identified to manage impacts. The compound sites would aim to:

- Be located more than 50 metres from a waterway unless best practise erosion and sedimentation measures are implemented and minimal clearing of vegetation is required.
- Have ready access to the road network or direct access to the construction corridor.

- Be located in areas of low ecological significance and require minimal clearing of native vegetation (not beyond that already required by the project).
- Be located on relatively level land.
- Be separated from the nearest residences by at least 200 metres (or at least 300 metres for a temporary batching plant).
- Be above the 20 ARI flood level unless a contingency procedure to manage flooding is prepared and implemented.
- Not unreasonably affect the land use of adjacent properties.
- Operate in a manner that minimises out-of-hours disturbance, including by providing sufficient area for the storage of raw materials to minimise, to the greatest extent practical, the number of deliveries required outside standard construction hours.
- Be located in areas of low heritage conservation significance (including identified Aboriginal cultural value) and not impact on heritage sites beyond those already impacted by the project.

Assessment of the potential impacts of construction traffic on local access roads during the construction period, especially in the areas surrounding proposed site compounds, is included in section 8.1 of this EIS. As well as being assessed against the above criteria, consultation with potentially affected community would be undertaken in accordance with the Draft Community Consultation Framework (refer to Appendix M).

All compounds determined to be required through the detailed design and construction planning process would typically be utilised for the duration of the construction period. There may be a need for a concrete batching plant or casting yard within the site compounds. The need for these facilities would be considered and assessed further once a construction contractor commences.

6.5 Traffic management and access

A traffic management and access plan would be prepared for the project during detailed design and construction planning. It is expected that there would need to be a series of traffic changes and management measures to allow the widening works to be carried out with minimum disruption to the traffic flows on M4 Motorway.

Construction sites would be accessed via local roads and the motorway. Table 6.3 summarises the proposed access arrangements. Refer also to the potential haulage routes shown by Figure 6.2 to Figure 6.4.

Table 6.3 Construction site access arrangements

Work site type	Vehicle access arrangement
Sites located adjacent to the motorway	Left-in left-out from the M4 Motorway where possible
Compounds	As per Table 6.1
Laydown areas	Left-in left-out from the M4 Motorway with some local road access if necessary
Local road work sites	Access and egress via local roads
Truck call-up areas	Left-in left-out from the M4 Motorway where possible

6.6 Workforce and construction work hours

6.6.1 Workforce

The workforce for construction of the project is expected to peak at about 600 workers. Table 6.4 shows the estimated workforce for each of the main work sections along the project corridor.

Table 6.4 Construction workforce

Section	Workforce (no. of workers)
West of Church Street	Between 6 and 30
Church Street crossing	Between 10 and 50
Bridge over the Western Rail Line	Between 8 and 30
Bridge over the Western Rail Line to A'Beckett Street	Between 12 and 50
A'Beckett Street/Alfred Street intersection	Between 12 and 40
A'Beckett Street to Carlingford Rail Line	Between 12 and 50
Carlingford Rail Line crossing and section west to James Ruse Drive	Between 12 and 35
James Ruse Drive crossing	Between 12 and 35
James Ruse Drive to Wentworth Street	Between 12 and 45
Wentworth Street to Deniehy Street	Between 12 and 50
Bridge over Deniehy Street	Between 12 and 45 or 12 and 60 for extended bridge
Deniehy Street to the western abutment of Duck Creek crossing	Between 12 and 24
North side of motorway between James Ruse Drive and Duck Creek	Between 15 and 45
Bridge over Duck Creek	Between 15 and 50
Junction Street to Silverwater Road	Between 15 and 60
Silverwater Road to Haslams Creek	Between 15 and 60
Haslams Creek to Burnie Avenue	Between 15 and 50
Burnie Avenue to Homebush Bay Drive	Between 15 and 60

6.6.2 Construction hours

Standard working hours

As identified in the *Interim Construction Noise Guidelines* (DECC, 2009) the standard working hours on site would be between 7.00 am and 6.00 pm, Monday to Friday and 8.00 am to 1.00 pm on Saturdays. A number of construction activities would need to be undertaken outside of standard working hours for reasons including safety, design and quality considerations, and to avoid substantial traffic delays on the M4 Motorway and surrounding road network. Night time works would generally commence after the evening peak once traffic volumes have reduced.

Works undertaken outside of standard hours are expected to be subject to relevant conditions of a POEO Act environment protection licence for the project. Refer below and to Chapter 2. Requirements are likely to include community notifications for out-of-hours work and procedures for recording and addressing complaints.

Work outside standard hours

Work outside of normal working hours would be required for a variety of activities to ensure safety and efficiency of the motorway and the network is maintained as far as possible throughout the construction period. Typical activities that would likely be undertaken outside standard working hours could include but are not limited to:

- Installation of traffic controls, such as concrete barriers.
- Some bridge and underpass works, including piling, installing structures such as girders, concrete decking and drainage.
- Re-surfacing of the existing asphalt pavement.
- Removal of existing static signage and installation of new signs.
- Ramp tie-in works.
- Removal of existing traffic barriers and installation of temporary and permanent traffic barriers.
- Installation of safety barriers to create an area for both construction personnel and road users so that works can be undertaken during the daytime that would otherwise need to be undertaken at night.
- Removal of existing lane marking and application of new lane marking.
- Use of some construction site compounds to support night works.
- Delivery of plant and materials that is required outside these hours as requested by police or other authorities for safety reasons.
- Installation of lighting and CCTV.
- Any works that do not cause noise emissions to be audible at any sensitive receptor.
- Emergency work to avoid the loss of lives, property and/or to prevent environmental harm.

Night time construction activities would typically be required for construction of additional lanes in the median (median works) and construction of new and modified ramps. For these construction activities, work in any given one kilometre construction section of the project could take between three to six months to complete.

Night time and weekend work would also be required for some construction activities associated with the new bridge and viaduct sections, primarily when lifting pre-cast structures into place. This is because road closures and rail possessions would be required. These would typically be undertaken over full weekends.

Night time construction activities would be supported by out-of-hours operation of construction compounds. The exact timing of out-of-hours works would depend on construction technique and would be subject to requirements from the construction contractor.

Where works are required outside standard working hours, measures would be implemented to minimise noise and other types of disturbance to residents and sensitive receivers including, but not limited to, the following:

- Notification to residents and sensitive receivers of any out-of-hours work at least five working days in advance.
- Minimising the amount of night works in any one area to ensure regular scheduled respite periods prior to works re-commencing in the same area.

- Minimising the out-of-hours work in residential areas where possible.
- Using noise shielding for any noisy equipment where feasible.
- Undertaking noisy activities during daytime hours where feasible.

Refer to Section 8.2.7 for further management measures for works outside standard working hours.

Rationale for work outside standard hours

There are two key reasons to undertake work outside standard hours:

- To minimise impacts on traffic.
- To protect public safety.

These reasons are discussed below.

To minimise impacts on traffic and transport
As discussed in Chapter 3, the M4 Motorway is one of the busiest roads in Sydney. Constructing the project under traffic is a complex task that would inevitably involve lane closures for activities such as asphalting works. Closing lanes during peak periods would result in significant traffic disruption at the worksite and along the entire motorway. In addition, congestion on the motorway increases the risk of traffic incidents and often has a flow-on effect of causing congestion on the orbital network, increasing the risk of secondary incidents.

It is therefore considered inappropriate to undertake these works in circumstances where a large number of people would be affected by daytime traffic disruption.

Similarly, construction activities in proximity to the rail network would require track possession which would disrupt rail operation and would therefore impact on commuters – particularly during peak periods.

To protect public safety
In addition, working on busy roads such as the M4 Motorway can pose safety risks to both construction personnel and the road users if appropriate measures are not put in place. Construction works associated with roads often require temporary modification to existing lane alignments and other traffic control measures which are different to the usual conditions experienced by road users at these locations. This increases the potential for traffic incidents that could affect the safety of construction personnel and other road users.

Noise impacts
An assessment of the potential noise impacts associated with construction of the project (including potential impacts from out-of-hours construction) is included in section 8.2. This assessment has been undertaken in accordance with the Interim Construction Noise Guidelines and feasible and reasonable noise management measures have been identified as part of this assessment. Noise management measures would be further refined during the detailed design phase in consultation with the EPA. Further, the need for an environment protection licence under the POEO Act would also provide for the appropriate management of construction noise impacts.

6.7 Construction resource use and management

6.7.1 Construction energy use

All construction activities associated with the M4 Widening project would consume energy. Activities with high energy demands include:

- Excavation.
- Removal, relocation and compaction of excavated material in fill embankments.
- Clearing of vegetation.
- Transport of raw materials.
- Construction of pavement, major bridges and structures.
- Demolition of existing structures.
- Operation of electronic signage and lighting.

Equipment and vehicles on the construction site would consume a large quantity of fuel. It is estimated up to four million litres of fuel (diesel and petrol) would be used to construct the project.

Electricity needs on the site would be minor; and connecting the offices to the local power grid would be sufficient. Some generators may be necessary for emergency power supply.

6.7.2 Construction water use

Construction of the project is estimated to require up to 50 megalitres of water (non-potable and potable). Water would be available along the M4 Motorway from the existing filling points (potable water requiring metered standpipes) or the wet detention basins.

6.7.3 Earthworks

Earthworks would be required across the M4 Widening project including for road widening, bridge construction and drainage. Table 6.5 shows the indicative earthworks quantities for the project.

Table 6.5 Indicative earthworks quantities

Type	Approximate amount
Clear and grub	55,900 square metres
Topsoil removal	5,600 cubic metres
Imported fill	110,000 cubic metres
Excavate to disposal	56,600 cubic metres
Select layer	20,000 cubic metres
Unsuitable material	4,300 cubic metres
Loosen and recompact	72,000 square metres
Removal of existing wearing course	10,800 cubic metres

Where possible, material excavated from the corridor would be re-used in the widening works or placed on site to stabilise batters (or for noise mounds if possible. Potential for spoil re-use would be confirmed during the detailed design phase.

6.7.4 Construction materials

In addition to the fill, water and energy requirements described above, construction of the project would require the use of many other materials, including concrete, asphalt and structural steel.

Materials would be sourced from within the local area where possible, with the quantities and source determined throughout the detailed design phase prior to commencement of construction. As discussed in section 6.4, there may be a need for a concrete batching plant or casting yard within the construction site compounds. The need for these facilities would be considered further once a construction contractor commences.

7 Consultation

This chapter describes the consultation process and activities undertaken for the project prior to and during preparation of the EIS. It also presents a summary of issues raised by community and government stakeholders. The chapter addresses the Director-General's Requirements (DGRs), identified below.

Director-General's Requirements	Where addressed in EIS
During the preparation of the EIS, you must consult with the relevant local, State or Commonwealth Government authorities, service providers, community groups and affected landowners.	Section 7.4
• local, State and Commonwealth government authorities, including the: – Environment Protection Authority, – Office of Environment and Heritage (including Heritage Division), – The Heritage Council of NSW, – Department of Primary Industries, – NSW Office of Water, – NSW Health, – Auburn Council, – Holroyd City Council, – Parramatta City Council, and – Strathfield Council;	Section 7.4.2
• specialist interest groups, including Local Aboriginal Land Councils, Aboriginal stakeholders, and pedestrian and bicycle user groups;	Section 7.4.3
• utilities and service providers;	Section 7.4.3
• the public, including community groups and adjoining and affected landowners	Section 7.4.4
The EIS must describe the consultation process and the issues raised, and identify where the design of the project has been amended in response to these issues. Where amendments have not been made to address an issue, a short explanation should be provided.	Chapter 7

7.1 Consultation objectives

The objectives of the community and stakeholder consultation for the M4 Widening are to:

- Increase community and stakeholder awareness of the need for the project.
- Increase community and stakeholder awareness of the environmental assessment process and opportunities for participation.
- Identify issues raised by stakeholders and the community at an early stage in the development and design process.
- Ensure the views of the community are taken into account, particularly at critical times and when consultation will add the greatest value (for example during the concept design development and during preparation of the EIS).

- Ensure appropriate consultation tools are used, taking into account demographics such as language, literacy and access to the internet.
- Provide timely feedback to the community related to environmental assessment outcomes.

7.2 Overview of consultation to date

As discussed in section 4.1, planning work to upgrade sections of the M4 Motorway has been underway since 2003, accompanied by community consultation activities such as those for the proposed M4 East project in 2003-2004. More recently, consultation commenced for WestConnex in September, 2012. These consultation activities are discussed in section 7.3, as activities undertaken prior to the commencement of the EIS.

Consultation activities undertaken specifically for the M4 Widening project began in September 2013 following project announcement and the commencement of the EIS, as discussed in section 7.4.

A graphic illustration of the key periods of consultation associated with the project and its earlier forms, as well as future consultation, is provided in Figure 7.1.

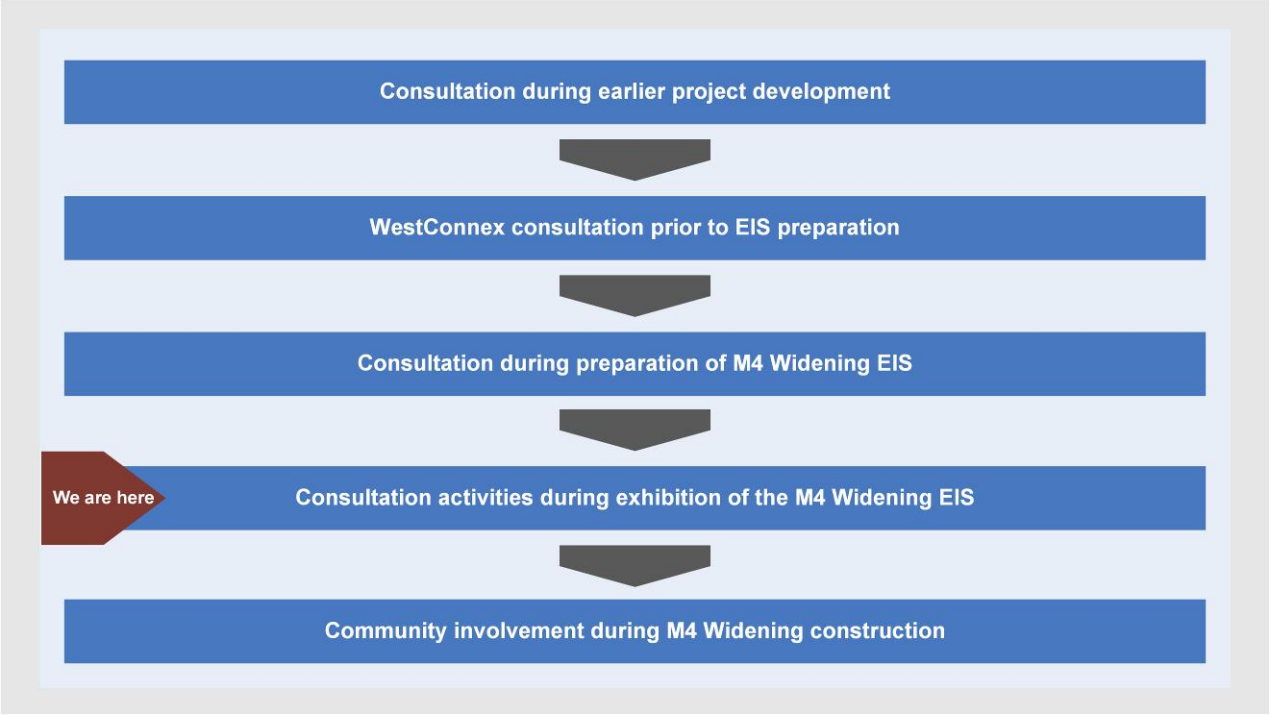


Figure 7.1 Consultation overview

7.3 Consultation activities undertaken prior to EIS preparation

The NSW Government announced WestConnex as Sydney's next motorway priority project in October 2012 and subsequently established the WDA to develop the project and funding solutions.

A key element of project planning was the preparation of the WestConnex Strategic Environmental Review, a non-statutory high-level strategic document that identifies potential

environmental issues for the WestConnex series of projects. The Strategic Environmental Review was prepared by WDA and was intended to provide early engagement with the community on the likely key environmental challenges associated with WestConnex.

During preparation of the Strategic Environmental Review, WDA consulted with key regulatory agencies on the likely key issues for this State significant urban infrastructure. The Strategic Environmental Review identified strategic issues to be avoided, managed and mitigated during delivery of the WestConnex series of projects. The Strategic Environmental Review was published on the WestConnex website in September 2013.

The following five main issues identified in the Strategic Environmental Review that relate to the M4 Widening project are:

- Congestion and delays on the M4 Motorway, at interchanges and on alternative toll-free routes in the future.
- Air quality.
- Noise and vibration.
- Socio-economic productivity, community health and safety, amenity, access to community facilities and connectivity.
- Construction impacts.

Research surveys and 'Have Your Say' campaigns were conducted with residents in the Penrith, Parramatta, Alexandria and St Peters areas, business owners, road users and stakeholders. Feedback from these communities has informed project development, environmental assessment activities and ongoing communications.

A range of consultation methods were utilised to seek input and identify issues, including:

- A website (www.westconnex.com.au), which provides background information, maps, videos, opportunities to provide feedback and register for ongoing project updates.
- A feedback and information telephone line (1300 660 248).
- A project email address to notify registered stakeholders, obtain comments and respond to community feedback.
- A postal address to contact key stakeholders and receive correspondence.
- Advertising in major metropolitan publications such as the Sydney Morning Herald and the Daily Telegraph, the Parramatta Advertiser and online advertising targeting road users.
- Media announcements that were widely covered in metropolitan television news, radio print and digital news outlets along with advocacy publications such as NRMA's Open Road magazine.
- Research groups involving residents, professional road users and business operators.
- An ongoing process of motorway industry engagement held at Sydney Olympic Park in October 2013 and M4 Widening project discussions with shortlisted construction companies which began in August 2013.
- Targeted stakeholder discussions with advocacy groups, local councils, elected representatives and peak bodies.
- Consultation with stakeholders such as local councils, the freight industry and business groups.
- Meetings with local and state government agencies.

- Individual meetings with community groups such as cycling groups.
- Staffed displays in local shopping centres and community events.
- Other awareness raising activities such as including information on WestConnex in local council publications and on websites of related Roads and Maritime projects.

7.4 Consultation activities undertaken and issues raised during EIS preparation

This section provides an overview of the key consultation activities undertaken during the preparation of the EIS and summarises the main issues raised and where these have been addressed in the relevant sections of the EIS.

7.4.1 Overview of key consultation activities

Consultations carried out during the preparation of this EIS include, but are not limited to, the following key consultation activities:

Project information line (ongoing)

A 1300 number was established to receive calls about WestConnex and respond to community questions and concerns about the M4 Widening project.

The National Telephone Interpreter Service for WestConnex was established in September 2013 and is advertised to the community in eight key languages on key publications.

Project website (ongoing)

The WestConnex website (www.westconnex.com.au) continues to be updated regularly at key milestones with the latest information on the M4 Widening project such as project reports, community updates, project team contact details, WestConnex fact sheets and community updates.

WestConnex Factsheets (September 2013)

A factsheet providing information about the project was sent to residents and businesses in areas surrounding the M4 corridor (approximately 95,000 factsheets were distributed). The factsheet directed recipients to the WestConnex website and the free call telephone number for more information about the project.

M4 Widening project community update (October 2013)

A community update inviting feedback on WDA's concept design for the M4 Widening project and advising of locations of information sessions was sent to residents within the general location of the project (approximately 75,000 residents in total). The community update provided further information on the project and directed recipients to the WestConnex website and free call telephone number for more information and to provide feedback (produced in eight languages).

Community information sessions (October – November 2013)

Six 'drop-in' community information sessions and nine staffed community displays were held at locations along the M4 corridor. These sessions were attended by the WestConnex project team representing a variety of different project areas and disciplines. This included members of the WestConnex design team and environmental assessment team, as well as representatives from Urban Growth NSW and Transport for NSW.

Material such as WDA's concept design maps, digital animation videos, artist impressions of the project and informative publications were provided at the sessions. Multilingual information was also available.

Static displays (October – November 2013)

Static displays were set up in 19 locations in areas that were considered readily accessible for the community. These were permanent, unmanned displays comprising project information such as WDA's concept design figures and a project timeline.

Meetings and briefings (October 2013 – April 2014)

Meetings and briefings have been held with key government agencies, local councils and industry stakeholders to explain specific details of the project and gather feedback. Opportunities for meetings and briefings with stakeholders will continue throughout the life of the project.

Letterbox delivery (December 2013 – April 2014)

The project team delivered 331 notification letters to residents and businesses likely to be directly and indirectly affected by the M4 Widening project, such as those close to field investigations, construction site compounds, upgrades to bridges and underpasses or new viaduct structures.

One-on-one meetings (October 2013 – May 2014)

Meetings with residents and property owners directly affected, positively or negatively, by property acquisition and noise mitigation were undertaken. Businesses and residents whose properties stood to be partially or totally acquired were also consulted.

Door knocking was also undertaken at around 70 residences in Granville, Auburn and Homebush West at locations surrounding proposed construction sites and compounds. The team conducted face-to-face talks with almost half of those door knocked.

Media and newspaper advertising (September 2013 – June 2014)

The following media announcements and advertisements in newspapers have been issued for the M4Widening project:

- Press releases announcing the WDA concept design display period and public exhibition of the EIS and providing details of the information sessions and displays.
- Newspaper advertising in metropolitan and local newspapers to inform the community about the M4 Widening project, WDA's concept design displays and the EIS exhibition information sessions and displays.

7.4.2 Issues raised by government agencies and councils

Meetings and briefings were held with key state and local government agencies, including government agencies identified in the DGRs. These meetings were designed to ensure agency issues and concerns were understood, documented and addressed, and that attendees had an opportunity to discuss any aspect of the M4 Widening project. Additionally phone calls, emails and various correspondence has been ongoing for the project.

Table 7.1 provides a summary of the consultation undertaken and issues raised by respective government agencies and local councils and where these issues have been addressed in the EIS.

Table 7.1 Summary of Local, State and Commonwealth agency consultation

Stakeholder	Issues raised	Addressed in EIS section
Environment Protection Authority	• Soil, water, waste and contaminated land impacts • Construction and operational air quality impacts • Noise and vibration impacts	Section 8.4 Section 8.9 Section 8.2
Office of Environment and Heritage	• Management of floodplain impacts during and after construction	Section 8.5
	• Impacts on biodiversity and habitats in the A'Becketts Creek, Duck Creek and Duck River waterways	Section 8.6
	• Management of Aboriginal heritage impacts	Section 8.7
The Heritage Council of NSW	• Management of heritage impacts on 35 heritage items • State Heritage listed sites are outside the M4 Widening project area	Section 8.8
Department of Primary Industries (Fisheries)	• Minimise impact on key fish and mangrove habitats at Duck River and Haslams Creek	Section 8.6
Department of Primary Industries (Crown Lands Division)	• The Crown Lands Division is to be kept informed of any design impact on the property boundary between the Parramatta Speedway and M4 Motorway corridor	Section 7.4 and Appendix L
NSW Office of Water	• Ensure watercourse crossings, culverts, construction compounds and access track designs minimise impact on watercourse and riparian land • Rehabilitate watercourses and riparian land disturbed by the M4 Widening project • Locate water treatment basins outside riparian corridors • Develop a Vegetation Management Plan	Section 8.6
NSW Health	• Requested community health be considered in detailed design of outdoor space which provides for active movement	Section 8.3
NSW Land & Housing Corporation	• Concerned about assets and amenity of residents which may be impacted by further congestion created by the proposed Westmead exit • Concerned that the proposed Westmead connection links to Bridge Road and Hawkesbury Road will increase traffic flows, impact on assets in these streets and on the amenity of tenants	Section 4.4.1
RailCorp (Sydney Trains)	• Impact of project on asset and operational impacts • Agreed to adopt Master Access Deed (MAD)	Section 8.1 and Appendix D

Stakeholder	Issues raised	Addressed in EIS section
Auburn City Council	• Concerned about the impact of future development in Wentworth Point, Carter Street and Sydney Olympic Park precincts on existing local network congestion as it relates to access to and from the M4 Motorway	Section 8.1 and Appendix D
	• Concerned the M4 Widening project does not provide a westbound off-ramp to Hill Road from the M4 Motorway	Section 4.4.4
	• Requested cyclepath upgraded with additional north-south connections	Section 8.1 and 0
	• Concerned that the proposed project may increase the volume of surface water runoff. Recommend a design diverting runoff into landscape areas under the viaduct not straight into creek or water catchment area	Sections 8.3.5 and 8.5
	• Concerned that increased traffic may impact air quality in the recreation space below and near the M4 Motorway	Section 8.9
	• Concerned that the viaduct pier design may impact on water movement, flooding and mangrove habitat in A'Beckett's Creek	Section 8.5
Holroyd City Council	• Concerned there may be increased traffic on Bridge Road, which may affect resident amenity, noise and road safety	Sections 8.1 and 8.2
	• Key developments near the proposed project need to be considered	Section 9.2 (cumulative)
	• The proposed on-ramp at Church Street may increase traffic on residential streets between Pitt and Church Streets. Will funding or mitigation be provided to manage avoidance of the proposed ramps?	Section 4.4.2
	• Requested a westbound off-ramp at Church Street	Proximity of M4 Motorway, Parramatta Road and the Western Railway would discount this option due to lack of space
Parramatta City Council	• Requested additional access be provided from/to Parramatta CBD and the M4 Motorway to align with ring road strategy for Parramatta	Section 4.4.2
	• Requested dedicated access to/from Rosehill Racecourse be included	WestConnex, including the M4 Widening, aims to provide connection between western Sydney and the airport. This does not include connections to local area facilities beyond this scope

Stakeholder	Issues raised	Addressed in EIS section
	• Requested landscaping in front of new wall at Martha Street where possible	Section 8.3
	• Requested improved lighting needed in areas under the viaduct and for the shared path for safety	Section 5.3.10 and Appendix F
	• Recommended improving the existing separated cycle path and opportunities for improvement in Martha Street and prohibiting cycling from the M4 Motorway between Cumberland Highway and North Strathfield	Sections 5.3.6 and 0
	• Requested construction contractors keep the local community informed	Section 7.4 and Appendix L
	• Suggested cross section diagrams of viaduct design to aid communication with community	Section 5.3.1
	• Further consultation requested when project scope is finalised	Appendix F
	• Suggested toll discount option for hybrid vehicles.	Section 8.5
	• Requested that flooding studies take into account previous flooding issues at Duck River and A'Beckett's Creek	Section 7.5
Strathfield Council	• Concerned that increased capacity on the widened M4 Motorway may impact negatively on local network congestion	Section 8.1
	• Concerned about the operation of Centenary Drive between Arthur St and the M4 Motorway – Arthur St intersection is operating at a very low level of service.	Section 4.4.5
	• Requested more detailed information in order to consider environmental and economic impacts during construction and operation	Chapters 3, 8 and 9

7.4.3 Consultation undertaken with special interest groups, utilities and industry stakeholders

The WDA has undertaken a range of consultation including meetings, staffed information displays, phone calls, emails and other correspondence with a range of special interest groups and relevant industry stakeholders that have a specific interest in the M4 Widening project and the broader WestConnex. Consultation activities undertaken during preparation of the EIS are summarised in Table 7.2 and Table 7.3 respectively.

Table 7.2 Summary of consultation with specialist interest groups

Stakeholder	Issues raised	Addressed in EIS section
Deerubin Local Aboriginal Land Council Metropolitan Local Aboriginal Land Council	• No specific issues were raised by this stakeholder group	Section 8.7
Bicycle NSW and cycling groups (BayBUG, Dulwich Hill Bicycle Club, Lidcombe Auburn Cycling Club, Western Sydney BUG	• Requested that the shared path remain open throughout construction for commuter cyclists, recreational cyclists and organised club rides	Section 8.1
	• Recommended proactive consultation and more effective signage for detours.	Section 8.1
	• Requested upgrade of uncontrolled road crossings	Section 8.1
	• Suggested improved lighting under the viaduct	Section 5.3.10
	• Raised issue of increasing numbers of recreational and lifestyle cyclists using cycle networks in the region	Section 8.1
	• Club activity includes group training rides on the M4 Motorway shoulder	Section 8.1
	• If shoulder access is removed, concerned that viable cycleway is provided along similar route Requested upgraded uncontrolled road crossings at Granville	Section 5.3
Pedestrian groups (Heart Foundation Walking Group Coordinators Auburn, Holroyd, Parramatta, Strathfield)	• Requested to be consulted during construction phase of the M4 Widening project	Section 7.4 and Appendix M

Table 7.3 Summary of consultation with utilities and service providers

Stakeholder	Issues raised	Addressed in EIS section
Utilities (Telstra, Optus, Jemena, Sydney Water, Ausgrid, NBN Co, Savcor)	• Requested opportunity to comment in the early stages of detailed design • Identified essential infrastructure locations	Section 7.4 and Appendix M
Westmead Hospital and The Children's Hospital at Westmead	• Specialists need to access the hospital via the M4 Motorway at all times	Section 8.1
Emergency services (Ambulance Service NSW, Fire & Rescue NSW, NSW Rural Fire Service, NSW Police)	• Concern about existing congestion around Westmead medical precinct which affects critical spinal patient transport to Westmead Spinal Unit in particular.	Section 8.1
	• Identified high risk and accident rates at James Ruse Drive intersection.	Section 8.1
	• Requested ongoing consultation	Section 4.4
University of Western Sydney, Parramatta Campus and Westmead College	• Concerned potential construction impacts may constrain student and faculty movement between Westmead College, Parramatta City Campus and Rydalmere Campus.	Section 8.1
	• Raised heavy congestion issues at Bridge Road and Great Western Highway intersection with M4 Motorway ramps	Section 8.1
Auburn North Public School	• Requested to be kept informed of construction planning and for close consultation to be maintained.	Section 7.5 and Appendix M
Parramatta West Public School	• Concerned about potential construction related impacts on student wellbeing • Requested ongoing information about the construction of the project in a format that can be shared with parents.	Section 7.5 and Appendix M

7.4.4 Consultation undertaken and issues raised by the community

To date, over 110 comments and suggestions have been received through WDA's concept design consultation process that occurred between September and November 2013.

Consultation with approximately 180 residents has also taken place through the M4 Widening project website, project email and community information line. Numerous meetings, briefings and presentations have also been held with a wide range of individuals, groups and interested parties.

A summary of the community's most frequently raised issues is listed in Table 7.4, which also describes where each issue is considered in the EIS. A large number of issues have been raised by the community and have been recorded in a project database, and addressed by the project team as part of the environmental assessment.

Table 7.4 Summary of consultation with the public, community groups, adjoining and affected landowners

Stakeholder	Issues raised	Addressed in EIS section
Residents in surrounding suburbs of the M4 Motorway, including, Parramatta, Holroyd, Granville, Auburn, Newington, Lidcombe, Wentworth Point, and Sydney Olympic Park	Options and alternatives: • Concerned that the proposed Westmead connection at Bridge Road would make local road congestion worse. • Preference for more capacity to the M4 Motorway and congested intersections at Church St, Woodville Road, James Ruse Drive, Hill Road, Centenary Drive and Homebush Bay Drive. • Support for the M4 Widening project, the proposed G-loop on-ramp at Homebush Bay Drive and the benefit to north/south bound traffic.	Chapter 3
	Traffic and transport: • Concerned about traffic congestion and road closures during construction. • Concerned about impacts to the cycle path during construction. • Concerned about increased congestion on local roads caused by increase in traffic numbers and traffic trying to avoid tolls. • Concerned about existing safety of the M4 Motorway due to dangerous driving and the need for this to be improved by the M4 Widening project. • Concerned at the level of current congestion on the M4 Motorway and arterial road intersections which is seen as unsafe, costs time and money. • Requested improved capacity at access and exit ramps. • Suggested that a toll should not be re-introduced or not be introduced until after completion of the M4 Widening and M4 East projects • Suggested that the tolls be used to complete the project more quickly. • Suggested that discounted toll structures should be offered.	Section 8.1 and Appendix D
	Project funding and economic cost/benefit: • Concerned about the source of funding for the project. • Concerned about potential delays to the project due to economic conditions. • Concerned about the future of later stages if the earlier stages do not attract users as forecast. • Question whether the same level of economic benefits would be possible from other modes of transport.	Chapter 3 and Chapter 4

Stakeholder	Issues raised	Addressed in EIS section
	Noise and vibration: • Concerned about existing noise levels on the motorway and that noise will increase due to more traffic. Preference for additional noise monitoring and new/improved noise walls.	Section 8.2
	Air quality: • Concerned that the M4 Widening project will increase pollution, including from new viaducts.	Section 8.9
	Socio-economic: • Concerned about the M4 Motorway coming closer to properties due to widening activities. • Concerned that property values would be impacted by the project.	Section 8.10
	Project inclusions and enhancements • Would like to see improvement to shared path considered.	Section 5.3
	Urban design, landscape character and visual: • Suggested improvement of the areas underneath viaduct structures for community use. • Would like to see dedicated busway and motorcycle path included. • Would like to see the M4 Motorway widened to at least four lanes each direction.	Section 8.1
	Strategic justification and project need: • Suggested that motorists go to the CBD not the airport or Port Botany. • Would like the government to adopt long term vision integrated infrastructure plans.	Chapter 3
	Consultation: • Suggested that Roads and Maritime should be engaging with Transport for NSW about the WestConnex series of projects.	Chapter 7
Sydney Markets – Flemington	• Concerned by dangerous pedestrian crossing and traffic weave on Centenary Drive, Homebush • Concerned that introduction of a toll would create heavy congestion on Parramatta Road and Centenary Drive access points to and from the Flemington market site. • Concerned that the proposed Urban Revitalisation does not reflect Flemington Market operations • Requested additional westbound on-ramp to the M4 Motorway westbound	Section 8.1
Australia Post International Mail Centre Granville Letter Centre Lidcombe	• Supports better access between the airport and Western Sydney • Concerned by potential construction and congestion impacts on freight movement in Granville, Lidcombe and Chullora areas • Requested close consultation to provide transport planners with local, arterial and motorway options	Section 8.1

Stakeholder	Issues raised	Addressed in EIS section
Sydney Olympic Park Authority (and event operators)	• Concerned by impact of increased capacity on congested local network	Section 8.1
	• Requested improved access to new precincts at Carter St and Wentworth Point via Hill Road westbound off-ramp	Section 4.4
Sydney Olympic Park Major Events Committee	• Concerned about construction impacts on major event access	Section 8.1
	• Requested close consultation throughout project	Section 7.5
• NRMA Motoring and Services • Road Freight Industry Council	• Requested additional information about M4 Motorway tolling strategy and impacts	Section 8.1
	• Requested consultation on the matter of traffic management and delivery schedule	Section 7.5
• NSW Taxi Council • Taxi operators	• Requested close consultation to mitigate construction impacts and keep members informed via printed and digital publications	Section 7.5
Local area bus service providers	• Requested to be kept informed	Section 7.5.4
Australian Driver Trainers Association (NSW) Ltd	• Concerned by construction impacts on local road congestion and suitability of driver training and testing courses	Section 8.1

7.5 Consultation ï the next steps

The ongoing community consultation process for the project is outlined below. The M4 Widening project team would continue to consult with the community during the assessment and approval process and, if the project is approved, during its construction.

7.5.1 Exhibition of the EIS and display locations

The EIS will be on exhibition for a minimum of 30 days. During the exhibition period all stakeholders can review the EIS and will have a chance to make a written submission to DP&E for consideration in its assessment of the M4 Widening project. The consultation activities and tools during the public exhibition period are outlined below.

DP&E will advertise the dates and venues of the public exhibition period in the local and metropolitan newspapers, and provide links to the EIS on the website.

The EIS will be displayed at the following locations:

- DP&E, 23-33 Bridge Street, Sydney.
- Parramatta City Council, 30 Darcy Street, Parramatta.
- Holroyd City Council, 16 Memorial Avenue, Merrylands.
- Auburn City Council, 1 Susan Street, Auburn.
- Strathfield Municipal Council, 65 Homebush Road, Strathfield.
- Roads and Maritime, 101 Miller Street, North Sydney.
- Nature Conservation Council, Level 2, 5 Wilson Street, Newtown.
- Merrylands Central Library, Newman Street, Merrylands.
- Wentworthville Library, 2 Lane Street, Wentworthville.
- Greystanes Library, 732 Merrylands Road, Greystanes.
- Parramatta City Library, Civic Place (off Macquarie Street), Parramatta.
- Granville Branch Library, 8 Carlton Street, Granville.
- Auburn City Library, Civic Place, 1 Susan Street, Auburn.
- Lidcombe Library, Bridge Street, Lidcombe.
- Newington Library, Cnr Avenue of Europe and Avenue of Asia, Newington.
- Strathfield Library, 65 Rochester Street, Homebush.

7.5.2 Community information sessions

A series of community information sessions are proposed to be held during the public exhibition period at the following locations:

- Newington Community Centre, Cnr Avenue of Europe and Avenue of Asia, Newington.
- Granville Town Hall, 10 Carlton Street, Granville.
- Auburn Centre for Community, 44A Macquarie Road, Auburn.
- Parramatta Town Hall, 182 Church Street, Parramatta.
- Strathfield Library, 65 Rochester Street, Homebush.

The sessions will provide information describing the M4 Widening project, impacts and issues raised during the assessment. During this time, WDA will provide opportunities for the community to discuss the EIS with key members of the project team and learn about the submissions process.

7.5.3 Submissions report

At the completion of the public exhibition period, DP&E will collate and provide WDA with a copy of all submissions received during the exhibition period. After reviewing the submissions, WDA will prepare a submissions report on behalf of Roads and Maritime that will respond to relevant issues raised. The report will be made publicly available through the DP&E website. Key stakeholders will also receive notification of the submissions report via a letter.

If changes are required to the M4 Widening project through the EIS consultation or to minimise its environmental impact, a preferred infrastructure report may be required. Where this is required, WDA on behalf of Roads and Maritime would prepare the report to address the changes of the design to minimise impacts and submit this for review to DP&E. This report may be available for public review and comment prior to determination of the project.

7.5.4 Community involvement during construction

During construction the project team would continue to work with the community to ensure they are informed about the project and have opportunities to provide feedback to the project team. Key involvement activities and tools would include:

- Development and implementation of a detailed construction communications plan.
- Notification of works (including targeted letterbox drops).
- 24-hour project information phone line.
- Transport Management Centre (TMC) communication channels; radio crosses and interviews, Variable Message Signs throughout the metropolitan network.
- Live Traffic and Transport NSW Info websites and TMC 24-hour Traffic Information Line (132 701).
- Complaints management process.
- Regular updates to the WestConnex website.
- Newsletters, information brochures and fact sheets.
- Clear signage at construction sites.
- Media releases and project advertisements in local and metropolitan papers.
- Construction updates (including for councils, emergency services and bus operators).

A more detailed description of the consultation activities that would be undertaken during construction can be found in the Draft Community Consultation Framework (SMEC 2014) in Appendix M.

8 Assessment of key issues

This chapter provides an assessment of the key environmental issues for the project as identified in the DGRs and as per the relevant requirements of Schedule 2, Part 3 of the (NSW) Environmental Planning and Assessment Regulation 2000.

For each key issue the existing environment is described, the potential impacts (both direct and indirect) of the project during construction and operation are assessed, the influence of relevant planning matters are considered and proposed management and mitigation measures are described. The proposed management and mitigation measures in this chapter are collated in Chapter 12.

The assessment of key issues is supported by detailed investigations, which have been documented in the working papers in Volumes 2, 3 and 4. To the extent of any inconsistency between this main volume of the EIS and the working papers, the former prevails.

8.1 Traffic and transport

This section considers potential traffic and transport impacts of the project. Full details of the assessment undertaken are presented in the *WestConnex M4 Widening Traffic and Transport Working Paper – Working Paper 4* (Jacobs AECOM, 2014) (Volume 2 – Working Paper D) with a summary provided below. The assessment has been prepared to address relevant DGRs as documented in the table below.

Director-General's Requirements	Where addressed in EIS
• Traffic and transport – including but not limited to: • details of how the following meet the traffic and transport objectives of the project, taking into account adjacent sensitive land uses, future growth areas (including but not limited to Urban Activation Precincts at Wentworth Point and Carter Street, Lidcombe), approved and proposed infrastructure projects, and traffic (vehicular, cyclist and pedestrian needs):	Section 8.1.5 Chapter 13
– the preferred alignment and design	
– the proposed widening of the M4 Western Motorway between the Pitt Street underpass and Parramatta and Homebush Bay Drive, Homebush	
– the proposed interchange upgrades and augmentation, and	
– associated road infrastructure facilities	
• an assessment and modelling of operational traffic and transport impacts on the local and regional road network, Parramatta Road, and the Sydney motorway network;	Section 8.1.5
• induced traffic and operational implications for public transport (particularly with respect to strategic bus corridors and bus routes) and consider opportunities to improve public transport patronage;	Section 8.1.5
• impacts on cyclists and pedestrian access and safety and consideration of opportunities to integrate cycleway and pedestrian elements with surrounding networks;	Section 8.1.5

Director-General's Requirements	Where addressed in EIS
• construction traffic and transport impacts of the project (including ancillary facilities) and associated management measures, in particular:	Section 8.1.4 Section 8.1.6
– impacts to the road network (including safety and level of service, pedestrian and cyclist access, and disruption to public transport services and access to properties),	Section 8.1.4
– route identification and scheduling of transport movements,	Section 8.1.4
– the number, frequency and size of construction related vehicles (both passenger, commercial and heavy vehicles),	Section 8.1.4
– the nature of existing traffic on construction access routes (including consideration of peak traffic times), and	Section 8.1.4
– the need to close, divert or otherwise reconfigure elements of the road network associated with construction of the project, having reference to the cumulative construction impacts of other infrastructure preparing for or commencing construction;	Section 8.1.4
– details of how the project meets the objectives of the overall WestConnex scheme.	Chapter 13

8.1.1 Assessment methodology

A detailed specialist assessment of the traffic and transport assessment methodology is provided in the traffic and transport working paper included at Appendix D (Volume 2).

Construction traffic

The assessment of construction traffic impacts involves a review of the types of construction activities proposed, staging of works, working hours and the need for temporary periods of road occupancy to allow for construction. Potential impacts on general traffic, localised traffic and access issues, impacts on bus operations and the potential for diversionary effects during construction have been assessed and mitigation and management measures described to minimise impacts where possible.

Operational traffic and transport

The assessment of operational traffic and transport impacts of the project on road transport were evaluated using traffic demand data from the WestConnex Road Traffic Model (WRTM). This is a project specific model developed to forecast road traffic demands for the WestConnex projects including the M4 Widening project. The WRTM has two elements:

- The base demand model: This model is based on the Sydney Strategic Transport Model (STM) operated by the Bureau of Transport Statistics (BTS) and used for projecting travel patterns in Sydney, Newcastle and Wollongong under different land use, transport and pricing scenarios. The base demand model includes the capability to address changes in land use, trip distribution and mode choice as well as producing vehicle traffic demand during peak and off peak periods.
- The toll choice assignment model: This models the range of anticipated driver behaviour to toll strategies and forecasts traffic choice between toll and non-toll routes during peak and inter-peak periods.

The WRTM model was developed and calibrated to current observed travel behaviour, then validated against 2012 Sydney-wide travel behaviour. It was then adjusted to reflect driver behaviour on toll roads observed in Value of Travel Time Surveys (VTTS). Future demand was forecast by applying the model with future year traffic growth assumptions from the STM.

2021 is used as the project case year for the Base 'do minimum' and M4 Widening scenarios (described below) as it is consistent with the BTS data available. It includes the expected additional traffic that will result from population growth out to 2021 and therefore presents a conservative scenario for predicting traffic impacts at the completion of the M4 Widening in 2017.

Accordingly, impacts have been considered both for the M4 Widening as a standalone project and in the broader context of the fully completed WestConnex projects as appropriate. Opportunities for improvement to the network have been described.

The modelled scenarios are:

- **Existing case (2012)**: Current road network with no new projects or upgrades.
- **Base 'do minimum' (2021)**: The Base 'do minimum' case assumes that the M4 Widening and the remainder of the WestConnex projects are not built. It is called 'do minimum' rather than 'do nothing' as it assumes that on-going improvements will be made to the broader transport network including some new infrastructure and intersection improvements to improve capacity and cater for traffic growth but does not include the M4 Widening or other WestConnex projects.
- **M4 Widening (2021)**: A widened M4 Motorway but without any other WestConnex projects.
- **Future 'do minimum' (2031)**: A future network including some upgrades to the broader transport network over time to improve capacity and cater for traffic growth but does not include the M4 Widening or other WestConnex projects. The Future 'do minimum' case is at a time ten years later than the Base 'do minimum' case.
- **Full WestConnex (2031)**: With all WestConnex projects completed (Note: The NSW Government has committed to achieving completion of all WestConnex projects by 2023).

8.1.2 Existing environment

Land use

There is a wide variety of land uses in the vicinity of the M4 Widening corridor. Parramatta CBD lies to the north of the M4 Motorway at the western end of the project. Parramatta is designated as a Regional City (NSW Government, 2013a) and is often recognised as the second CBD of Sydney. It has large areas of commercial and retail land uses and includes the Parramatta Transport Interchange, a major rail and bus hub providing public transport access to large areas of Sydney.

Other town centres include Merrylands, Granville, Auburn and Lidcombe (all located to the south of the M4 Motorway). These town centres are located on railway lines and are dominated by retail land uses with some commercial and medium-density housing. A retail precinct along Parramatta Road in Auburn is dominated by low-density retail uses such as car yards, bulky goods and large-lot retailing.

Industrial areas are located at Camellia, Rosehill, Clyde, Silverwater and Lidcombe. There are three business parks at Silverwater, Lidcombe and Newington. Other industrial and commercial facilities include a waste transfer station; rail marshalling yards in Clyde; and Sydney Markets at Flemington.

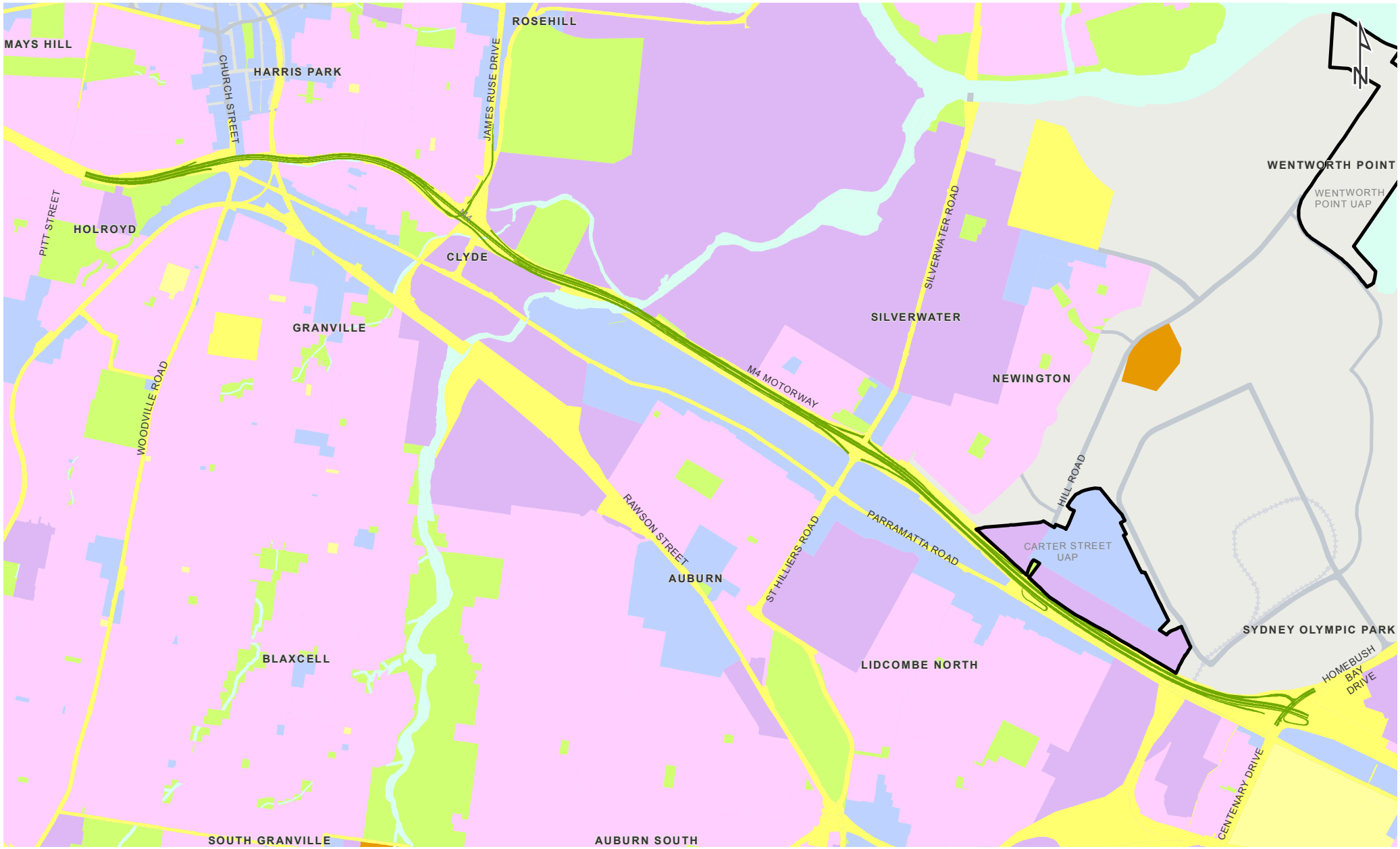
The Chullora and Enfield Intermodal Terminals, which are a significant generator of freight traffic on the M4 Motorway, are located five kilometres south of the M4 Motorway.

The area also contains a range of tourist and recreational facilities including Sydney Olympic Park, Blaxland Riverside Park, Sydney Speedway in Granville and Rosehill Racecourse. Local parks in the area include Wallawa Reserve at Granville, Holroyd Sports Ground at Holroyd, Deakin Park at Silverwater and Hume Park at Silverwater.

Community facilities including places of worship, community halls and scout/guide halls are located within the Merrylands, Parramatta, Granville, Auburn and Lidcombe town centres. There are major health facilities nearby, namely the Westmead health precinct and Concord Hospital. The Westmead health precinct is accessed from the M4 Motorway via the Coleman Street ramps and Hawkesbury Road, and Concord Hospital is accessed via Concord Road.

Suburbs along the M4 Motorway corridor within the study area that are dominated by residential land uses include Merrylands, Harris Park, Granville, Auburn, Newington, Lidcombe, Homebush and North Strathfield.

As discussed in section 3.2.6, there are two UAPs in the vicinity of the M4 Motorway corridor being Wentworth Point and Carter Street, Lidcombe. UAPs were announced by the NSW Government in 2013 as an important component of a package of wider housing delivery and employment initiatives. The UAPs aim to deliver more homes in places with access to infrastructure, transport, services and jobs.



KEY

- Project design
- Urban activation precincts (UAP)

LEP zone

- Commercial
- Environmental
- Industrial
- Residential
- Recreation
- SP1 Special Activities
- SP2 Infrastructure
- Waterways

Land uses in the M4 Motorway corridor **Figure 8.1**

0 0.5 1
Km

Corridor road network

The M4 Motorway is a 40 kilometre urban motorway class road currently connecting the Blue Mountains in the west with Parramatta Road near Concord Road in the east. From Concord Road at North Strathfield, motorists can access the Sydney CBD and Sydney's inner western and eastern suburbs via Parramatta Road.

The existing M4 Motorway can be divided into three sections:

- Glenbrook to M7 Motorway – approximately 21.5 kilometres in length with seven interchanges. In the eastbound direction two lanes are provided between Glenbrook and Mulgoa Road and three lanes are provided between Mulgoa Road and the M7 Motorway. The westbound lane configuration is the same as eastbound, with the exception of an additional lane between Russell Street and Glenbrook (to provide for slow-moving vehicles ascending the steep grade).
- M7 Motorway to Cumberland Highway – approximately 10.5 kilometre road in length with three lanes in each direction and including three interchanges.
- Cumberland Highway to Parramatta Road – approximately 14 kilometres in length with seven interchanges. In the eastbound direction, four lanes are provided between Cumberland Highway and Church Street/Woodville Road, three lanes are provided between Church Street/Woodville Road and Homebush Bay Drive/Centenary Drive, and two lanes are provided between Homebush Bay Drive/Centenary Drive to Parramatta Road. The westbound lane configuration is the same as eastbound, with the exception of the segment between Coleman Street and Cumberland Highway, where there are three lanes instead of four. At the James Ruse Drive interchange, the mainline in both directions narrows to two lanes on approach to the merge with the entry ramps that restore the third lane. This narrowing is one of the major constraints to travel along this corridor.

Principal arterial road routes parallel to the M4 Motorway include:

- Great Western Highway (A44).
- Parramatta Road (A44, A4 and A22).
- Victoria Road (A40).

Major north-south routes include:

- Woodville Road.
- James Ruse Drive.
- Silverwater Road (A6).
- Hill Road.
- Homebush Bay Drive/Centenary Drive (A3).

Parramatta Road runs adjacent to the M4 Motorway for approximately 9.5 kilometres, from its intersection with the M4 Motorway in Strathfield to its intersection with Woodville Road and Church Street in Granville. This section of Parramatta Road serves the local town centres of Homebush, Homebush West (Flemington), Lidcombe, Auburn, Granville, Lidcombe, and Silverwater.

Parramatta Road also serves the Auburn and Granville industrial areas, Sydney Markets, and offers access to Sydney Olympic Park. Parramatta Road continues for 16 kilometres from the east of Strathfield to its intersection with City Road and Broadway in Camperdown. Beyond Camperdown, the road continues to the CBD as Broadway.

Freight network

Sydney's heavy vehicle freight task is highly dependent on the motorway network. More than 37 per cent of all heavy freight vehicle (HFV) kilometres travelled in the Sydney Metropolitan Area are on the motorway and highway network, even though the network represents less than 17 per cent of the arterial road network. A key reason for this is that while strategic centres have largely grown up around the rail network, the location of industrial activity since the second world war has largely been linked to the motorway and highway networks.

Modelling by the Bureau of Freight Statistics estimates that the average number of weekday freight trips in the Sydney Metropolitan Area would increase by almost 40 per cent between 2011 and 2031. This includes:

- An increase in the number of trips made by rigid trucks on an average weekday from 271,000 to 355,000, an increase of around 30 per cent.
- A more rapid increase in articulated truck trips from 95,000 to 157,000, an increase of around 65 per cent.

The M4 Motorway is a key component of the primary freight network within the Sydney road freight hierarchy. It performs a strategic role of serving the freight routes between Port Botany/ Sydney Airport, freight and intermodal terminals and industrial hubs. The M4 Motorway also offers an arterial route, free of traffic signals, to time sensitive vehicles.

Rail freight (primarily bulk commodities such as coal, minerals and grains) are carried on the Main Western Rail Line as well as dedicated freight rail tracks connecting Lidcombe/Homebush West with Port Botany, running via Enfield and Marrickville.

Rail freight to/from the NSW Central West, primarily coal trains between mines in the Lithgow area and Port Kembla, use the same tracks as the Main Western Rail Line passenger trains west of Flemington Junction. These lines are at capacity. Rail-borne freight for Brisbane and northern NSW leaves the dedicated freight network at North Strathfield and joins passenger services on the Main Northern Rail Line.

Commercial

Business and commercial trips are an important part of the transport task, with the majority of these trips being undertaken by private vehicles or taxis.

This market segment includes a wide range of trip purposes and vehicle types, with origins and destinations being network-wide. Light commercial vehicles (LCV) are a broad range of vehicles that are used for direct movements of goods for commercial purposes (light goods vehicles), and to support tools of trade (service vehicles).

Business and commercial trips are relatively more focused on centres of activity than heavy vehicle freight trips, and may include white-collar workers travelling on work business (not commuting) and other mobile workers such as district nurses, tradesmen, sales personnel and others whose workplaces are not static. Both business and commercial trips rely heavily on the east-west distributor function that the M4 Motorway plays, and rely on lower order roads for north-south connections within and to the Global Economic Corridor.

The M4 Motorway corridor carries more than double the proportion of work-related business trips compared to other parts of the rest of the wider Sydney network.

Passenger

The M4 Motorway/Parramatta Road corridor will serve natural growth in Sydney's transport demand that results from a growing population and economy. The number of jobs in Sydney is expected to grow from 2.3 million in 2011 to 2.9 million in 2031 (BTS, 2012a) and any change in the spatial distribution of employment will have a large impact on Sydney's transport task. Much of the forecast employment growth by 2031 will occur in the Global Economic Corridor. However, outside the Global Economic Corridor, pockets of significant jobs growth are expected along the M4 Motorway corridor, around Parramatta CBD, Sydney Olympic Park and Rhodes.

Public transport

The Main Western Rail Line is broadly parallel to the M4 Motorway and Parramatta Road through this corridor. The M4 Motorway crosses over the railway between Harris Park and Granville stations. West of Harris Park the rail line is located north of the M4 Motorway. East of Granville the rail line is south of the M4 Motorway. The Harris Park Y-link western arm is used by Sydney CBD – Liverpool – Campbelltown trains on the Main Southern Rail Line and Cumberland Line trains (Blacktown – Parramatta – Liverpool – Campbelltown).

The Carlingford Rail Line leaves the Main Western Rail Line at Clyde and heads north, passing under the M4 Motorway at Rosehill. Lidcombe is the Main Western Rail Line station furthest away from the M4 Motorway – almost two kilometres to the south. The Sydney Olympic Park Rail Line leaves the Main Western Rail Line at Lidcombe. East of Lidcombe the Main Western Rail Line continues to Sydney CBD. Main Northern Rail Line services branch off the Main Western Rail Line at Strathfield. Between Strathfield and Sydney there are six tracks carrying an intensive level of commuter service.

There is an extensive network of bus services within the local area. Bus routes in this area provide connections to town centres, retail and employment areas, residential areas and railway stations. The use of Parramatta Road rather than the M4 Motorway supports multi- functional bus routes with stops at regular intervals.

There are over 50 daytime bus routes around the M4 Motorway corridor between Parramatta and Homebush provided by five separate bus operators. These services are delivered as part of five Transport for NSW Sydney Metropolitan Bus Service Contracts (SMBSC).

Cross regional bus routes cross or operate along sections of Parramatta Road. These include:

- Route M91 – Parramatta to Hurstville.
- Route M92 – Parramatta to Sutherland.
- Route 401 – Lidcombe to Sydney Olympic Park.
- Route 525 – Parramatta to Burwood.
- Route 526 – Burwood to Sydney Olympic Park.
- Route 544 – Auburn to Macquarie Centre.

There are also five NightRide bus routes that operate hourly between midnight and 5:00 am along the M4 Motorway corridor:

- N60 – Fairfield to Town Hall.
- N61 – Carlingford to Town Hall.
- N70 – Penrith to Town Hall (uses M4 Motorway).
- N71 – Richmond to Town Hall (uses M4 Motorway).

- N80 – Hornsby to Town Hall.

There are 11 Sydney Olympic Park special event bus routes, which pass through the M4 Motorway/Parramatta Road corridor en route to and from Sydney Olympic Park. These services operate at high frequencies before and after major events held at Sydney Olympic Park.

Apart from the major bus/rail interchanges at Parramatta and Granville, facilities for bus passengers in the M4 Motorway corridor are limited. Where bus routes intersect (for example at the Parramatta Road/Newton Street South/Hampstead Road intersection north of Auburn) there is often very little specific provision for interchanging passengers.

Within the area likely to be impacted by the M4 Widening project, there are several bus priority measures in place. The most notable bus priority measures are:

- Liverpool – Parramatta Transitway, with a 24 hour dedicated bus lane on the Great Western Highway entering Parramatta from the west via Pitt Street and Argyle Street.
- North West Transitway, with a 24 hour dedicated bus lane entering Parramatta from Westmead via Park Road and Argyle Street.
- Holker Street 24 hour bus-only lane between Hill Road and Sydney Olympic Park.
- Peak period bus and transit lanes on Victoria Road, Ermington.

There are also two bus only roads entering Sydney Olympic Park between Silverwater Road and Newington Road in the north-west and a link road off Homebush Bay Drive, passing under Homebush Bay Drive in the south-east. With the exception of a very short length of westbound bus lane approaching the Church Street traffic signals, there are no bus priority lanes or transit lanes on Parramatta Road between Granville and Concord.

Cyclists and pedestrians

The pedestrian network along the M4 Motorway corridor consists mainly of kerbside footpaths along local and arterial roads. There are a number of pedestrian paths through reserves, some of them shared with cyclists. These include:

- A path parallel to the M4 Motorway between Beaconsfield Street, Silverwater and Teal Pond.
- A shared path adjacent to and underneath the M4 Motorway viaduct between Ledger Road and Haslams Creek, which also provides linkages into neighbouring town centres and residential areas.
- A footpath connecting Railway Street, Granville with Church Street through a reserve north of the M4 Motorway.
- A footpath through a reserve connecting the Harris Park and Granville sections of Harris Street.

Grade separated pedestrian access across the M4 Motorway is available at:

- Pitt Street, Merrylands.
- Shared path underpass linking Fox Street, Holroyd to the south of the M4 Motorway and Railway Street, Granville to the north of the M4 Motorway.
- Church Street.
- Good Street, Granville.
- Alfred Street, Granville.
- Harris Street, Granville.

- Arthur Street, Granville (west side only).
- James Ruse Drive (west side only).
- Wentworth Street, Clyde (west side only).
- Deniehy Street, Clyde.
- Junction Street, Auburn.
- Stubbs Street, Auburn.
- Overpass linking Melton Street South, Auburn to the south of the M4 Motorway and Melton Street North, Silverwater to the north of the M4 Motorway.
- Silverwater Road.
- Shared path underpass linking Adderley Street East, Lidcombe to the south of the M4 Motorway and Haslams Creek to the north of the M4 Motorway.
- Hill Road, Lidcombe (west side only).
- Birnie Avenue, Lidcombe.
- Overpass linking Park Road to the south of the M4 Motorway and Wentworth Road South/Pomeroy Street to the north of the M4 Motorway in Homebush.

The majority of signalised intersections on the arterial road network provide pedestrian crossing facilities. While pedestrians are generally well catered for at intersections, there is a lack of mid-block crossing facilities particularly along arterial roads such as Parramatta Road, Silverwater Road, James Ruse Drive and Homebush Bay Drive. Signalised pedestrian crossings, which are provided only at key intersections, are sometimes several hundred meters apart.

Concurrent transport projects

Other transport related projects that are currently proposed or underway include the M4 smart motorway system, M5 West Widening, NorthConnex and North West Rail Link – and the further stages of WestConnex.

The smart motorway system on the M4 Motorway is proposed by Roads and Maritime as a separate project for the section between Lapstone and Mays Hill. The system includes real time traffic and travel information delivered through enhanced variable message signs on the M4 Motorway and approach roads, a coordinated on ramp signals system, dynamic speed and incident management, enhanced network monitoring delivered by traffic sensors in the roadway and CCTV cameras, emergency telephones and stopping bays, and road improvements such as some widened and lengthened on- and off-ramps and nearby intersection improvements. The aim of the system is to improve travel time reliability, improve safety, provide real-time information, reduce vehicle emissions, and reduce journey times.

The M4 Widening project includes the provision of road infrastructure and services to support the future implementation of smart motorway operations within this section of the M4 Motorway.

The M5 West Widening project is currently under construction and expands the M5 South West Motorway from two to three lanes in each direction from King Georges Road in Beverly Hills to Camden Valley Way in Prestons. Construction is expected to be completed before M4 Widening road works commence. That project aims to reduce congestion on the M5 Motorway and improve reliability and travel time, provide relief to congestion on parallel routes, support forecast growth in Sydney's south west and key destinations such as inner Sydney, Port Botany and Sydney Airport, improve communications with a new control centre in Hammondville, provide early warning alerts

on the motorway and surrounding arterial networks, and improve incident response times with the installation of a new CCTV system.

The proposed NorthConnex project is a new tolled motorway linking the M1 Pacific Motorway (previously the F3 Freeway) at Wahroonga to the Hills M2 Motorway at West Pennant Hills. The new link features twin motorway tunnels, about eight kilometres in length, with two lanes in each direction and provision for future widening to three lanes and northern and southern interchanges. The project aims to reduce traffic congestion and the number of heavy vehicles, particularly along Pennant Hills Road. NorthConnex provides opportunities for improved public transport, improved freight movements and provides a motorway that integrates with the regional transport network.

The North West Rail Link is a 23 kilometre rail link between Epping and Rouse Hill. Construction commences in 2014 and the line is expected to be operational in 2019. It features a direct underground link to the existing Epping to Chatswood rail tunnels, eight new stations, a train stabling facility at Rouse Hill, 4,000 commuter car parking spaces, twin 15 kilometre tunnels between Epping and Bella Vista, a four kilometre viaduct between Bella Vista and Rouse Hill, and bus, taxi, kiss and ride, pedestrian and cycling facilities at all stations.

8.1.3 Performance of the existing road network

M4 Motorway travel speeds

To gain an understanding of travel speeds on the M4 Motorway, a survey was undertaken on 21 November 2012. The survey involved 100 trips along the M4 Motorway between Church Street and Parramatta Road. Congestion was apparent in the morning peak in the eastbound direction, particularly between Church Street and James Ruse Drive where average speeds were below 30 kilometres per hour. The eastbound segment between Homebush Bay Drive and Parramatta Road also had heavy delays (average speeds below 45 kilometres per hour). Also apparent was congestion during the day and in the evening peak period.

In the westbound direction low travel speeds were recorded in the evening peak between Homebush Bay Drive and James Ruse Drive (average speeds below 30 kilometres per hour). Westbound congestion in the morning peak between Silverwater Road and James Ruse Drive was also noted (averages speeds below 60 kilometres per hour).

M4 Motorway travel times

The travel speed surveys undertaken in November 2012 also provided information about travel times for M4 Motorway journeys. Travel times along the M4 Motorway between Church Street and Homebush Bay Drive were typically 15 minutes eastbound during the morning peak period, however increased up to 25 minutes with disrupted flow. Westbound traffic travel times were typically 23 minutes during the evening peak period and eight minutes during the inter peak period.

Network capacity and level of service

Network congestion occurs when demand exceeds capacity. The M4 Motorway, as well as a number of north-south arterial routes (such as Homebush Bay Drive, Silverwater Road and Hill Road) and their on-ramps and off-ramps, are currently congested. Eastbound travel along the M4 Motorway during the morning peak is dominated by this excessive congestion.

Interchange and intersection performance

Within the M4 Motorway/Parramatta Road corridor, many critical intersections affect local traffic, cross-regional traffic operation, Parramatta Road and accessibility to the M4 Motorway. Table 8.1 shows existing intersection performance in terms of average vehicle delay and level of service

(LoS). There are six levels of service, designated from A to F, with LoS A representing the best operating condition (being an average delay per vehicle of less than 15 seconds) and LoS F the worst (being an average delay per vehicle greater than 70 seconds).

Table 8.1 Existing intersection performance

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (secs)	Level of service	Average delay per vehicle (secs)
Granville				
Church Street/M4 Motorway eastbound off-ramp	D	43	D	51
Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp	D	43	E	63
Parramatta Road/Bold Street	D	56	C	38
Parramatta Road/Good Street	C	31	C	42
Clyde and Rosehill				
James Ruse Drive/Prospect Street	C	35	D	50
James Ruse Drive/M4 Motorway eastbound on-ramp	B	22	B	24
James Ruse Drive/M4 Motorway westbound off-ramp	C	30	B	22
James Ruse Drive/Parramatta Road/Berry Street	C	36	C	38
Auburn				
Parramatta Road/Rawson Street/Duck Street	D	43	F	82
Silverwater Road/Carnarvon Street	D	46	E	59
Silverwater Road/M4 Motorway eastbound ramps	D	44	D	48
Silverwater Road/M4 Motorway westbound ramps	D	46	D	49
Silverwater Road/Parramatta Road	D	53	D	56
Lidcombe and Sydney Olympic Park				
Parramatta Road/John Street	C	30	C	28
Parramatta Road/Hill Road/Bombay Street	D	54	D	46
Hill Road/M4 Motorway eastbound off-ramp	E	62	A	12
Hill Road/Carter Street	A	13	A	13
Hill Road/John Ian Wing Parade	B	19	B	20
Homebush West and Strathfield				
Homebush Bay Drive/M4 Motorway eastbound on-ramp	A	6	A	11
Homebush Bay Drive/M4 Motorway eastbound off-ramp	E	61	E	60
Centenary Drive/M4 Motorway westbound ramps	E	62	D	54
North Strathfield and Strathfield				
Parramatta Road/Concord Road/Leicester Avenue	F	72	F	75
Parramatta Road/M4 Motorway	E	70	F	74
Parramatta Road/Mosely Street	C	40	C	31
Concord Road/Sydney Street	B	22	B	27

Queuing of traffic exiting the motorway at interchanges is determined by the ability of the interchange to discharge traffic onto the surrounding road network. If the queue becomes longer than the storage capacity of the off-ramp, the back of the queue will affect the left hand through lane of the motorway. This impact would take the form of reduced capacity on the motorway and the potential to increase the number of rear-end type crashes. Observations indicate that queuing occurs at Hill Road eastbound in the morning peak and at Silverwater Road westbound and Church Street eastbound.

Motorway tolling history

As discussed in Section 4.1, the M4 Motorway became Sydney's first tolled motorway in 1992. The M4 Motorway toll was implemented at a single-point, with the toll plaza located immediately west of the Silverwater Road interchange. Users of the M4 Motorway that chose to avoid the toll would exit the motorway and use alternative routes such as Parramatta Road. This diversion of traffic from the motorway resulted in increased traffic volumes on Parramatta Road through areas such as Auburn and Granville.

In 2010, the concession on the M4 Motorway expired and ownership was transferred from Statewide Roads to the NSW Government. The toll on the M4 Motorway was removed at this time. The removal of the toll resulted in higher usage of the M4 Motorway and a reduction of traffic on the parallel section of Parramatta Road.

Further detail on traffic changes due to tolling can be found in section 8.1.5.

Road safety and crash history

Since the removal of the toll on the M4 Motorway, the M4 Motorway/Parramatta Road corridor between Homebush Bay Drive and Parramatta has averaged 372 crashes per year, with 244 crashes on the M4 Motorway and 128 crashes on Parramatta Road. The crash rate on the M4 Motorway (19 crashes with casualties per 100 million vehicle kilometres travelled) is less than that for Parramatta Road (84 crashes with casualties per 100 million vehicle kilometres travelled).

8.1.4 Assessment of potential construction traffic and transport impacts

Chapter 6 explains how the project would be constructed including the construction program, number and location of construction site compounds, access arrangements and working hours. Specific impacts on the road network and different modes of transport are considered below.

Construction vehicle movements

Table 8.2 details proposed construction activities, heavy vehicle movements and number of personnel at each work site for the entire construction period. These movements form the basis of the construction traffic assessment in this section. Potential haulage routes are shown in Figure 6.2 to Figure 6.4.

Table 8.2 Construction vehicle movements

Work site	Approximate number of daily heavy vehicle movements required during construction	Approximate number of daily light vehicle movements required during construction
Works between Pitt Street and Church Street west side	Up to 20	Between 6 and 30
Works east of Church Street	Up to 10	Between 10 and 50
Works between A'Beckett Street and eastern abutment of bridge over Main Western Rail Line	Up to 10	Between 12 and 50
Works at A'Beckett Street and Alfred Street intersection	Up to 10	Between 12 and 40
Works between A'Beckett Street and western abutment of bridge over Carlingford Rail Line	Up to 10	Between 12 and 50
Works at James Ruse Drive west side	Up to 10	Between 12 and 35
Works at James Ruse Drive east side	Up to 10	Between 12 and 45
Works between Wentworth Street and Deniehy Street (south)	Up to 50	Between 12 and 50
Bridge over Deniehy Street	Up to 10	Between 12 and 45
Works between Deniehy Street and western abutment of Duck River	Up to 10	Between 12 and 24
Works between Wentworth Street and Deniehy Street (north)	Up to 10	Between 15 and 45
Extended bridge over Deniehy Street	Up to 10	Between 12 and 60
Bridge over Duck River	Up to 10	Between 15 and 50
Works between Junction Street and Silverwater Road	Up to 50	Between 15 and 60
Works between Silverwater Road and Haslams Creek	Up to 30	Between 15 and 60
Works between Haslams Creek and Birnie Avenue	Up to 50	Between 20 and 60
Works between Birnie Avenue and Homebush Bay Drive	Up to 30	Between 15 and 50

Temporary road closures

Proposed temporary road closures to facilitate construction activities are detailed in Table 8.3. Details of any required detours and measures to reduce the impact of the road closures would be addressed during detailed construction planning and would be identified in the construction traffic management plan (refer to section 8.1.6). Additional temporary road closures may be identified when the construction method is confirmed.

Table 8.3 Temporary road closures

Road	Description of temporary closure
Church Street	• Erection of western approach span for Church Street bridge – closure of northbound lane required on weekend nights. • Erection of bridge span over Church Street – complete closure of Church Street required on weekend nights • Traffic switches for existing viaduct works.
M4 Motorway (main road)	• Erection of western approach span for Church Street bridge – partial closure of shoulder and nearside westbound lane on weekend nights • Church Street to Wentworth Street – two lanes westbound and three lanes eastbound traffic would be switched onto the new viaduct commencing at Wentworth Street, leaving one lane in each direction on the M4 Motorway. • Wentworth Street to Silverwater Road –two westbound lanes and three eastbound lanes would be switched onto the new Duck River bridge, leaving one lane in each direction on the M4 Motorway. Traffic would be switched just west of Silverwater Road. • Silverwater Road to Haslams Creek – median lane closures in both directions could be required to facilitate median works. • Haslams Creek to Birnie Avenue – median lane closures in both directions could be required to facilitate median works. • Birnie Avenue to Homebush Bay Drive – median lane closures in both directions could be required to facilitate median works. • Traffic switches for existing viaduct works and for mill and pavement works.
A'Beckett Street	• Construction of western approach span for Alfred Street bridge – full closure would be required between Alfred Street and Kemp Street on two occasions and a partial closure on other occasions.
A'Beckett Street/Alfred Street	• Construction of bridge span over the intersection would require a full closure of the intersection for periods over a weekend
James Ruse Drive	• Erection of bridge span over James Ruse Drive would require a full closure for periods over a weekend
Martha Street	• Erection of reinforced earth wall panels would require closure of the nearside eastbound lane currently used for parking.
Deniehy Street	• Construction of bridge substructure would require closure of the nearside northbound and southbound lanes. • Erection of beams for bridge deck over Deniehy Street would require a full closure for periods over a weekend

Impacts on M4 Motorway traffic

During the construction period, temporary reductions in speed limits on the M4 Motorway will be required for road and worksite safety. Between Pitt Street, Parramatta and Homebush Bay Drive, Homebush, a reduced speed limit of 80 kilometres per hour will be introduced with some sections requiring further temporary “road work” speed reductions during off-peak periods or night works.

The speed limit reductions will be required due to reduced lane widths, works in the median and other works that would be undertaken in close proximity to travel lanes. The implementation of an 80 kilometres per hour speed limit during the construction period would increase travel times on the motorway by up to one minute in free-flow conditions. However, average travel time in peak periods is not expected to change as existing congestion currently keeps peak period travel speed below 80 kilometres per hour.

During peak periods, the existing number of lanes would be maintained – four lanes from Pitt Street to Church Street and three lanes east of Church Street in both directions of travel.

However, as road shoulders will need to be used to accommodate realigned traffic lanes, there is the potential for extended delays in the event of incidents such as breakdowns or accidents. Where road shoulders are used to accommodate realigned traffic lanes, monitoring of the motorway and work sites would be undertaken using CCTV and mobile patrols used to assist management of incidents, including access for emergency services.

Impacts on local road traffic

During construction, some road users may choose to take an alternative route (diversion). This is expected to mainly occur in the off-peak periods when construction lane closures with lower “road works” speed limits occur. During these periods, alternative routes would have sufficient spare capacity to accommodate additional traffic that has diverted from the motorway.

Impacts due to construction vehicle movements are a further consideration. Based on existing local road traffic and predicted construction traffic volumes (refer to Table 8.2), it is expected that only the residential streets would see a noticeable increase in vehicle movements. Assessment of suitable routes and access points will be addressed during the preparation of the construction traffic management plan (refer to section 8.1.6) and communicated via the methods outlined in section 7.5.4.

Impacts on public transport

Bus services would be affected by the same delays as general traffic due to reduced speed limits or during manual traffic control, however no regular bus services operate on the M4 Motorway. Consultation with bus operators would occur through the traffic and transport liaison group (refer to section 8.1.6) to advise of potential traffic delays or roads closures and to identify how this could best be managed to minimise impacts on users (such as revised timetables or services).

Disruptions to rail services may occur during construction of the viaduct over the Main Western and Carlingford Rail Lines. Where practicable, construction of the viaduct over the Main Western and Carlingford Rail Lines would be planned to coincide with pre-planned Sydney Trains rail possession periods, which are typically between 2.00 am Saturday and 2.00 am Monday. Specific shutdowns outside the planned rail possession periods may also be required. However, this would be undertaken in consultation with Sydney Trains to ensure impacts to services are minimised.

Impacts on pedestrians and cyclists

Pedestrian and cyclist facilities that would be affected by construction activities are detailed in Table 8.4. Where there is possible interaction between construction traffic and pedestrians and cyclists (eg at work site/compound access points) traffic controllers or diversions would be used to ensure adequate protection is provided and/or risks minimised.

If a temporary diversion is required for cyclists using the M4 Motorway shoulder, the alternative routes would be outlined in the Construction Traffic Management Plan and communicated to the public, including users of the pedestrian and cyclist facilities, via the methods outlined in section 7.5.4.

Table 8.4 Construction impact on pedestrians and cyclists

Location	Facility type	Description of impact
Between Church Street, Parramatta and Junction Street, Granville	Shared path	The shared path may require relocation to ensure it can continue to operate during the construction works. Where it cannot be relocated, a suitable alternative route would be provided. The shared path may be crossed occasionally by construction vehicles which would be facilitated by a traffic controller.
Between Arthur Street, Granville and Martha Street, Granville	Shared path	Shared path may require relocation
Duck River	Shared path	The shared path may be crossed occasionally by construction vehicles which would be facilitated by a traffic controller.

8.1.5 Assessment of potential operational traffic and transport impacts

Overview of findings

Modelling indicates that under the Full WestConnex scenario motorists would save motorists 14 minutes on a journey on the M4 Motorway from Church Street to Homebush Bay Drive in the AM peak, reducing travel times from 19 minutes to five minutes. In the westbound direction on the same section of road the time saving would be 10 minutes - from 15 minutes to five minutes.

Under the M4 Widening scenario alone, the most substantial travel time savings over the same section of the M4 Motorway would be nine minutes in the eastbound direction in the AM peak, with more modest improvements at other times and in other directions.

Over these time periods, increases in Parramatta Road travel times between Church Street and Homebush Bay Drive are expected with the M4 Widening and the Full WestConnex scenarios due to drivers avoiding the toll. Conversely, this eases congestion on the M4 Motorway, for drivers willing to pay the toll on a road free of traffic signals. A similar diversion of traffic onto Parramatta Road was observed when the toll was formerly implemented on the M4 Motorway (before being removed in 2010). Modelling shows that peak hour volumes would be similar to the observed traffic volume in the years prior to the removal of the toll.

While the M4 Widening project would not address or alleviate congestion on Parramatta Road east of Concord Road, a cumulative benefit is expected with the M4 East project (when delivered a few years after the M4 Widening) alleviating congestion at the eastern end of the M4 Motorway along Parramatta Road.

The M4 Widening is expected to improve road safety. The overall number of crashes in the corridor is expected to be lower with the M4 Widening (four per cent less crashes with casualties) as a result of reduced vehicle kilometres travelled.

A more detailed analysis of the detailed findings of the traffic and transport assessment is described below.

Performance across the Sydney network

Modelling has been undertaken to understand the future performance of the Sydney road network with and without the M4 Widening (2021) and the fully completed WestConnex (2031).

The M4 Widening, and fully completed WestConnex project, will improve the Sydney motorway network, giving motorists greater choice of route and trip time options. Some motorists will be prepared to pay for a faster, simpler trip, and some will seek alternative routes or modes to avoid the toll. This would have wider implications for the Sydney transport network. Two of the strongest indicators of system-wide performance are the combined distance travelled by all vehicles on the network (network vehicle kilometres travelled) and the combined time spent travelling by all vehicles (network vehicle hours travelled). These indicators have been used to calculate an average network speed (network vehicle kilometres travelled divided by network vehicle hours travelled).

With the M4 Widening in 2021, total vehicle kilometres travelled across the network would be reduced by approximately one million kilometres per day compared to if the M4 Widening was not built. In 2031, the fully completed WestConnex would also provide a small reduction in the total vehicle hours travelled and an improvement in the average network speed from 27 kilometres per hour without WestConnex to 28 kilometres per hour with WestConnex. While a change of one kilometre per hour for average network speed may appear minor, when considering that the total number of car and truck trips on the network is estimated to be 15.1 million by 2031, the cumulative benefit of this travel speed improvement would be substantial.

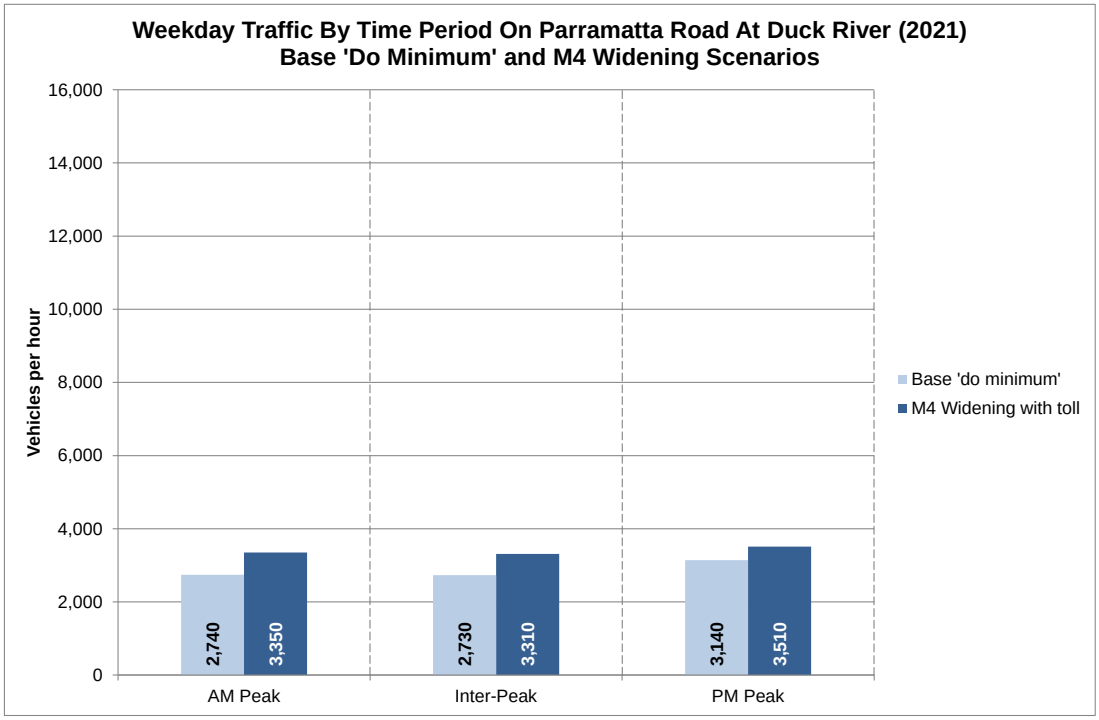
As an on-going traffic management measure, and as identified in section 8.1.6, an operational traffic review will be undertaken within 12 months of project opening to confirm the operational traffic impacts of the project on surrounding arterial roads and major intersections. Where necessary, the outcomes of the operational traffic review will be used to identify opportunities for any further operational refinement to optimise the performance of the project. This could include intersection treatments, changes to lane configuration or signal phasing.

The review will be based on actual traffic counts and will assess the level of service at major intersections between Pitt Street and Homebush Bay Drive along the M4 Motorway and on Parramatta Road

Changes to traffic volumes

Figure 8.2 shows the modelled number of vehicles passing over Duck River at Auburn on the M4 Motorway and Parramatta Road for the Base ‘do minimum’ and M4 Widening scenarios. Modelling indicates that the M4 Widening project is expected to reduce corridor traffic during the AM and PM peaks and the middle of the day (inter-peak) as some drivers will seek to use non-tolled routes.

With the M4 Widening project, Parramatta Road would account for 24 per cent of vehicles in the morning peak, 29 per cent in the evening peak, 33 per cent during the day and 44 per cent overnight. This can be interpreted as a diversion of toll avoiding drivers to Parramatta Road and other routes during periods of little or no congestion.



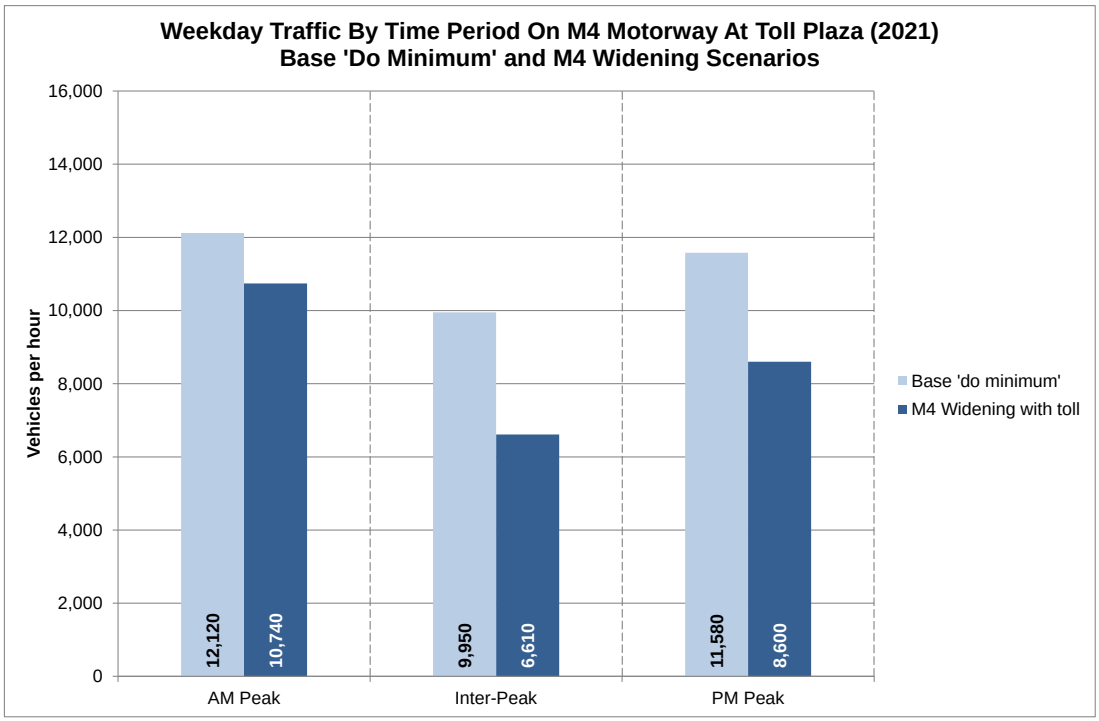
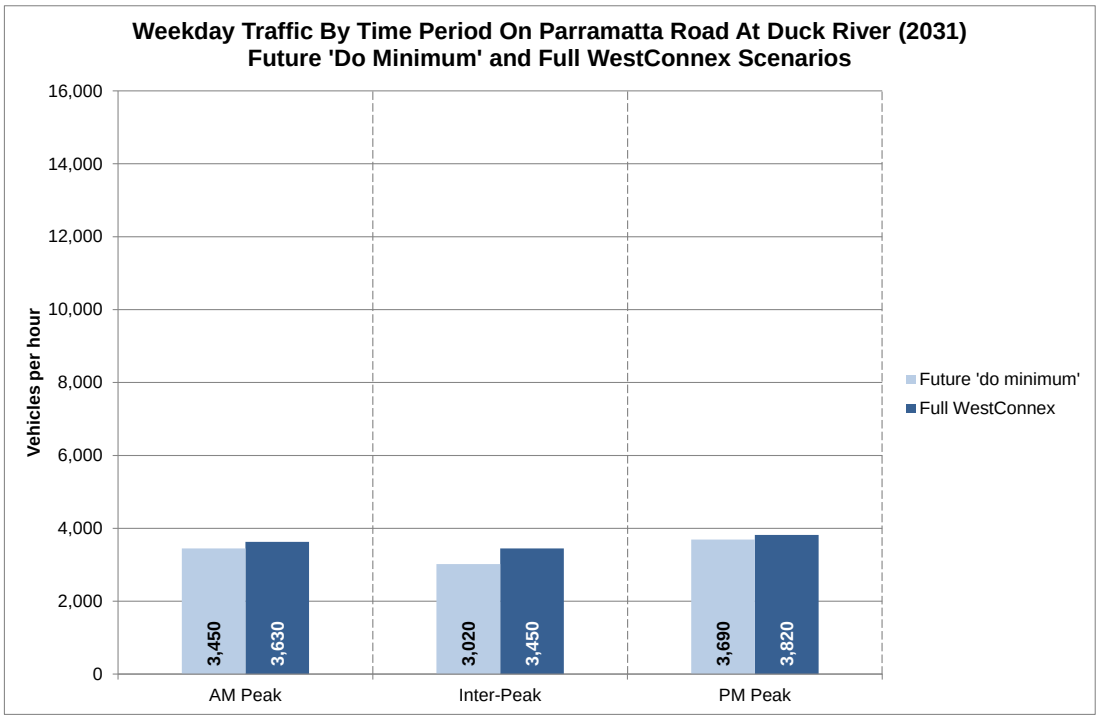


Figure 8.2 Parramatta Road and M4 Motorway traffic - Base ‘do minimum’ and M4 Widening scenarios (2021)

Figure 8.3 shows that in 2031 when all WestConnex projects are completed, the Full WestConnex would generate a net increase in corridor traffic in the AM peak. The net increase in corridor traffic compared to 2021 can be explained by vehicles returning to the corridor to take advantage of the faster more reliable and connected route provided by WestConnex. As congestion in other parts of the Sydney road network increases over time, vehicles using WestConnex will experience improved travel times compared to using other corridors in the network.



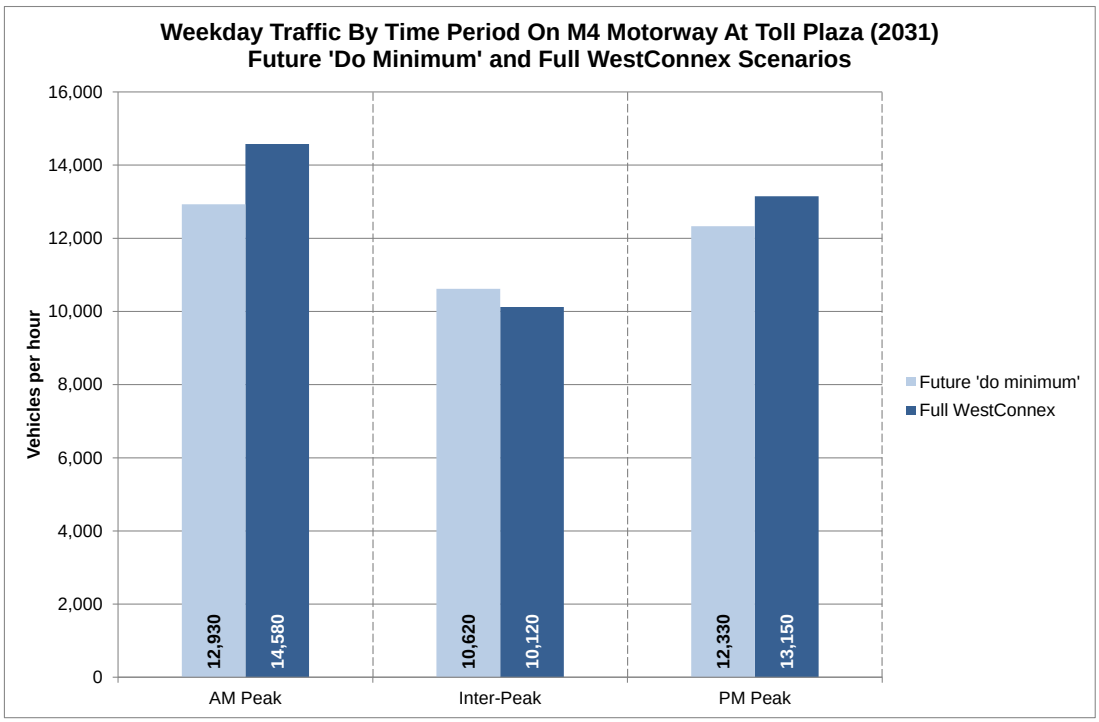


Figure 8.3 Parramatta Road and M4 Motorway traffic - Future ‘do minimum’ and Full WestConnex scenarios (2031)

Tolling Implications

This section presents the implications of the proposed toll on the widened M4 Motorway. The tolling assumptions for cars and light commercial vehicles adopted for this assessment has two components: a $1.00 flag-fall plus an additional charge of $0.37 per kilometre travelled; heavy commercial vehicles are to be tolled at three times this rate. Based on this tolling strategy the total amount payable by cars and light commercial vehicles travelling the full length of the M4 Widening would be $3.90 ($2013). As discussed in section 3.2.5, toll revenue from the M4 Widening would assist in funding the remainder of WestConnex.

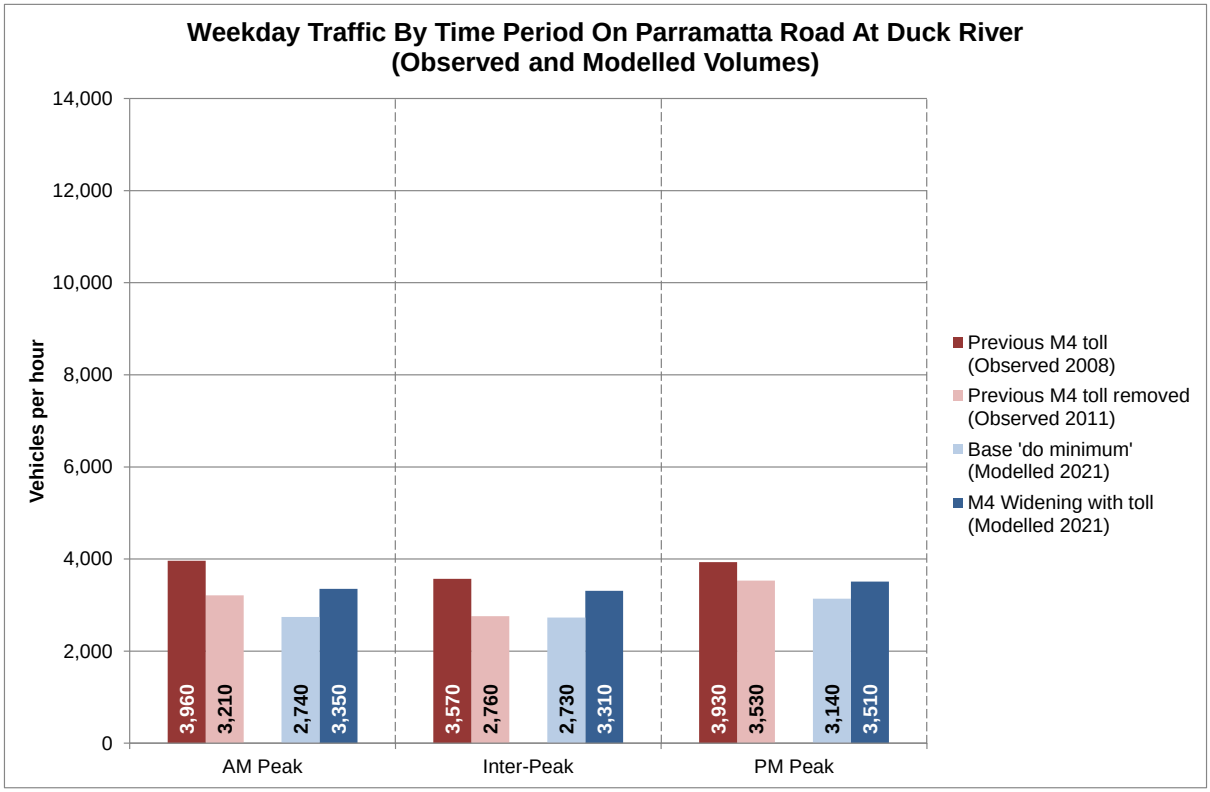
The M4 Motorway has previously operated with a single point toll. Overall weekday traffic on the M4 Motorway at the toll plaza was 23 per cent higher in 2010 after the removal of the toll than in 2009 with the toll. The M4 Motorway previously operated with a cashback scheme which would not apply when the M4 Widening project is tolled and open.

A comparison of the proportion of observed and modelled traffic volumes using the M4 Motorway and Parramatta Road under the previous and proposed tolling regime is shown in Figure 8.4.

A more simplified version showing the effects on Parramatta Road is presnted in Figure 8.5. As shown in this figure, the WRTM predicts that the M4 Widening would cause a 36 per cent reduction in M4 Motorway use at Duck River, whereas the previous M4 Motorway toll caused traffic at the toll plaza (equivalent to Duck River) to be reduced by approximately 23 per cent.

For Parramatta Road, traffic in the AM peak was 3,960 vehicles per hour in 2008 when the M4 Motorway was previously tolled and this reduced to 3,210 vehicles per hour in 2010 when the M4 Motorway toll was removed. The model predicts that with the reintroduction of a toll on the M4 Motorway, traffic numbers on Parramatta Road would increase to 3,350 vehicles per hour, which is less than when it was previously tolled.

For the PM peak, traffic on Parramatta Road was 3,930 vehicles per hour when the M4 Motorway was previously tolled in 2008 and reduced to 3,530 vehicles per hour when the toll was removed. The model predicts that with the tolled M4 Widening project, traffic numbers on Parramatta Road would increase to 3,510 vehicles per hour in the PM peak, which is again, less than it was with the previous toll.



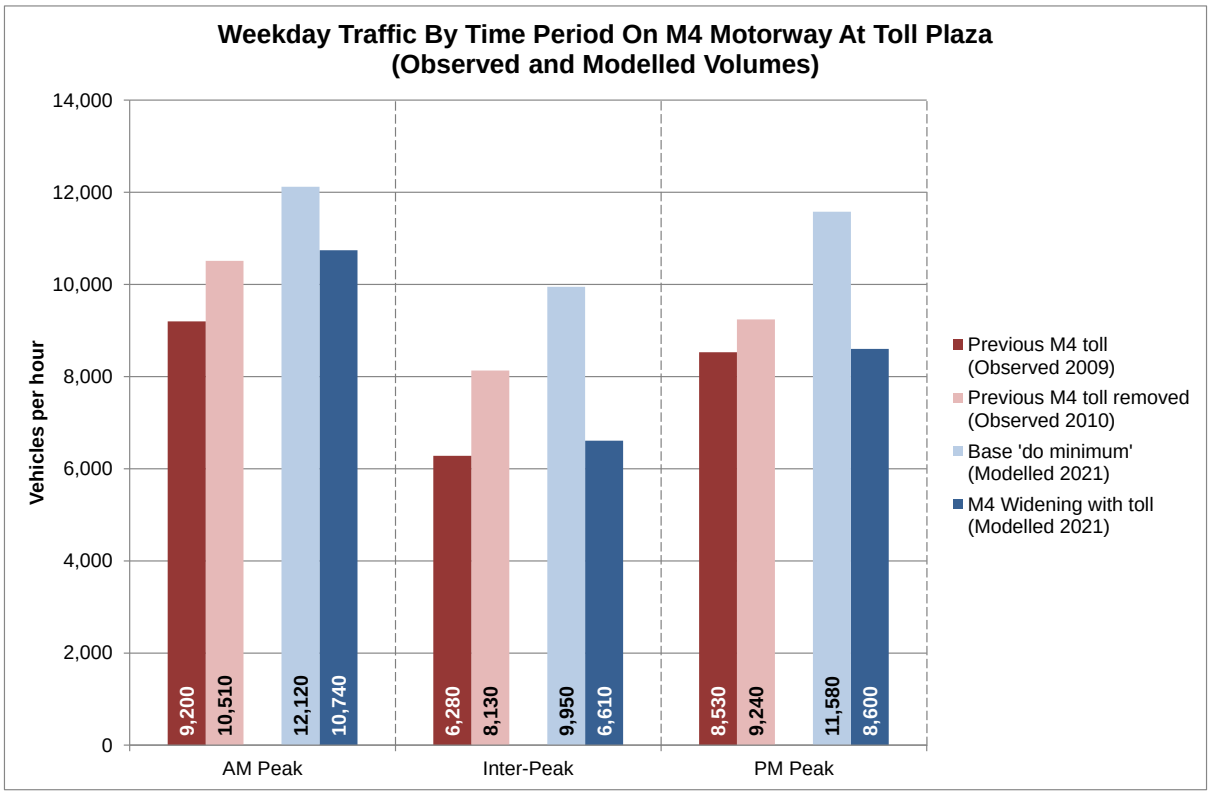
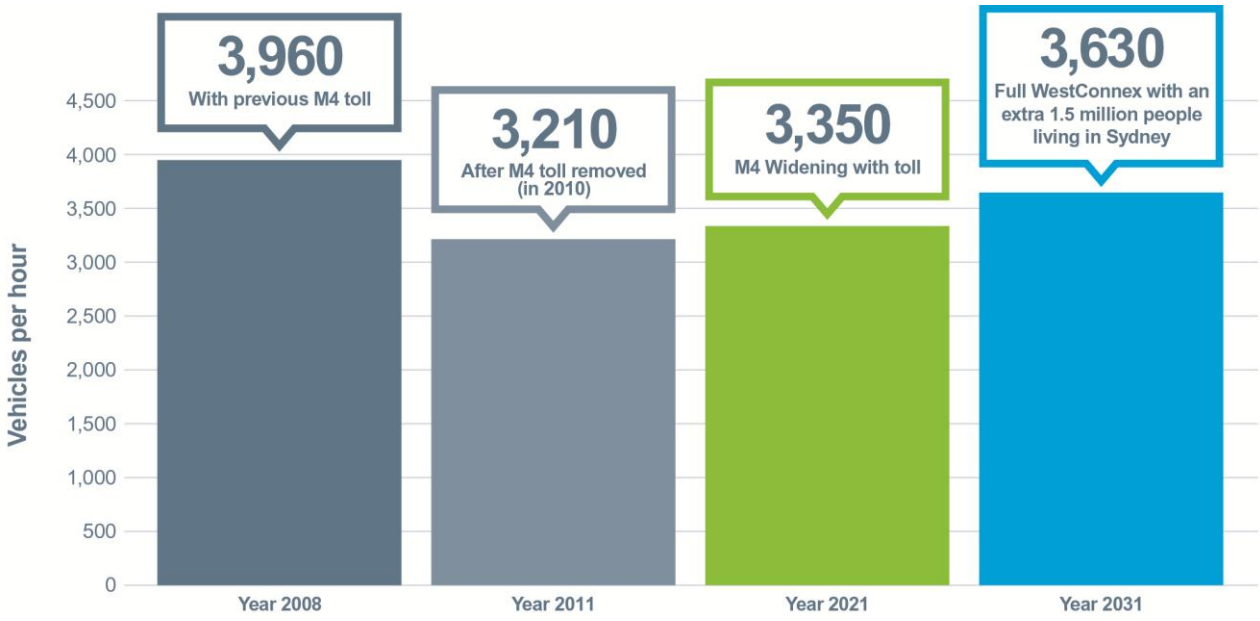


Figure 8.4 Response of weekday traffic volume to changing tolling scenarios

Weekday Traffic (AM) Parramatta at Duck River – Observed and modelled traffic volumes



Weekday Traffic (PM) Parramatta at Duck River – Observed and modelled traffic volumes



Figure 8.5 Comparison of hourly weekday traffic volume changes on Parramatta Road

While the analysis above presents hourly peak hour changes, Figure 8.6 shows a comparison of the average daily traffic volumes on Parramatta Road at Duck River and the M4 Motorway at the toll plaza over time. The figure illustrates the effect of the toll removal in 2010 when traffic volumes on Parramatta Road decreased. The figure also shows that with the M4 Widening and the reintroduction of the toll, average annual daily traffic volumes on Parramatta Road increase to a level similar to that experienced with the previous toll. Average annual daily traffic volumes on the M4 Motorway would increase as each stage of WestConnex is completed.

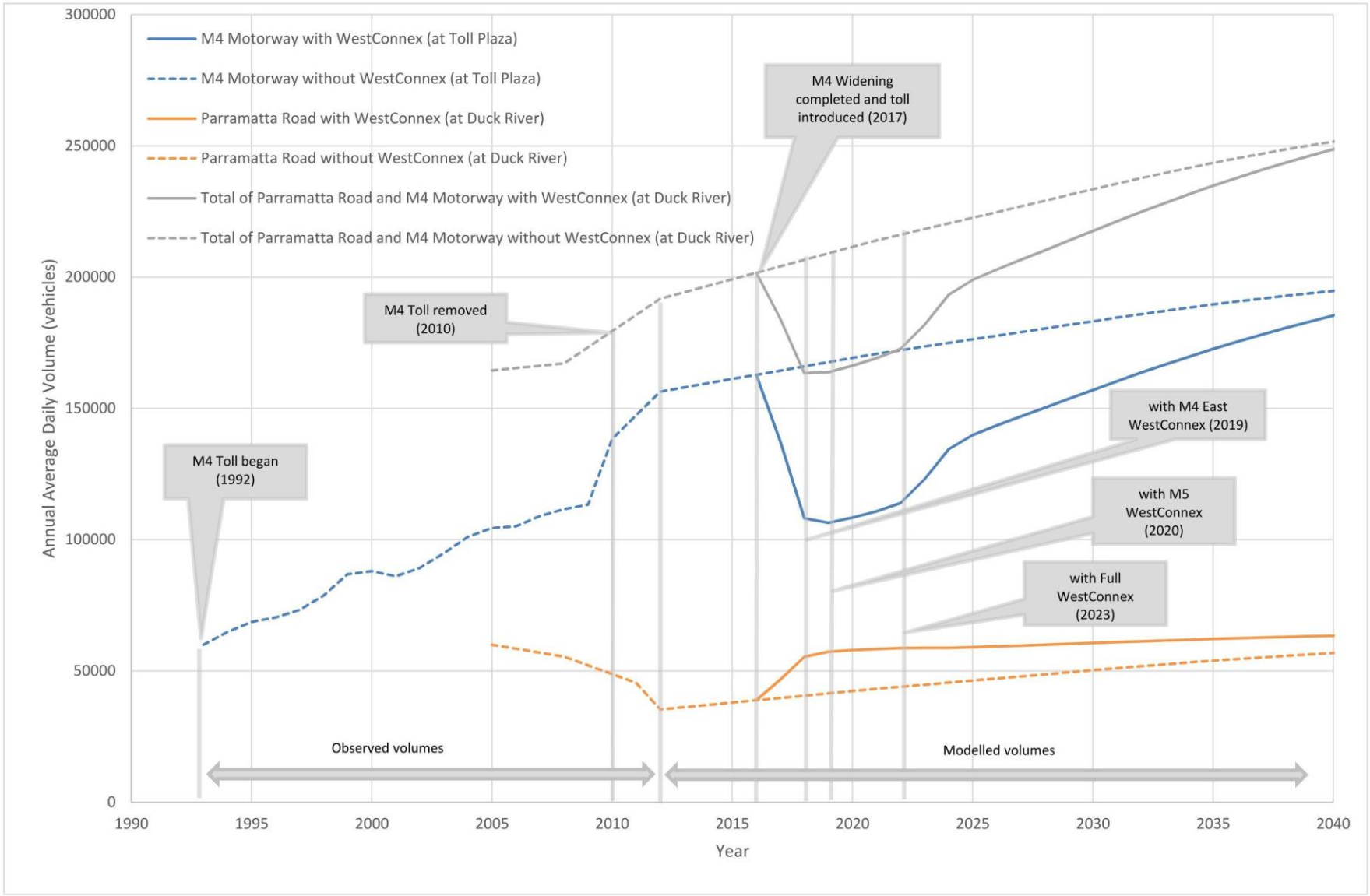


Figure 8.6 Comparison of traffic volumes on the M4 Motorway and Parramatta Road

Distribution of west-east traffic

The M4 Widening is expected to result in some growth in traffic on alternative west-east routes including Parramatta Road, Victoria Road and the M2 Motorway, primarily due to toll avoidance.

Table 8.5 shows modelled total number of vehicles on a typical weekday passing a specific 'screenline' point on key alternative west-east routes in 2021, with and without the M4 Widening project.

Table 8.5 Screenline volumes – Base 'do minimum' and M4 Widening scenarios

Road	Number of weekday vehicles	
	Base 'do minimum' (2021)	M4 Widening (2021)
M4 Motorway	179,620	114,890
Parramatta Road	43,990	59,370
M2 Motorway	118,050	123,940
Victoria Road	60,440	70,250

Table 8.6 is the future equivalent of Table 8.5. It shows a reduced impact on Parramatta Road and Victoria Road compared to the M4 Widening scenario as the broader network becomes more congested, increasing the travel time savings offered by M4 Motorway use.

Table 8.6 Screenline volumes – Future 'do minimum' and Full WestConnex scenarios

Road	Number of weekday vehicles	
	Future 'do minimum' (2031)	Full WestConnex (2031)
M4 Motorway	194,180	168,760
Parramatta Road	52,030	62,490
M2 Motorway	140,430	140,840
Victoria Road	68,250	75,770

These figures indicate that with the full WestConnex in 2031, the comparative diversion to Parramatta Road and Victoria Road is reduced, compared to with only the M4 Widening in 2021. As the population continues to grow and the broader network becomes more congested, the travel time savings offered by the M4 Motorway will become increasingly important and toll avoidance is expected to reduce.

Although the introduction of the toll with the M4 Widening causes some redistribution of trips to other roads in the network, the total number of vehicles using Parramatta Road in 2021 with the M4 Widening project (59,370) will be only marginally higher than the total number of vehicles using Parramatta Road in 2008 (55,477) when there was previously a toll on the M4 Motorway. This is despite the increase in population that will have occurred.

Modelling also indicates there would not be a significant increase in congestion on other parts of the network when compared with the 'do minimum' scenarios. For example, the same level of congestion is anticipated on Victoria Road in both the AM and PM peak periods with the full

WestConnex and without (Future 'do minimum' scenario). This indicates that the majority of trip redistribution to avoid the toll occurs outside of peak periods when the travel time on Victoria Road is lower and therefore the comparative benefit of using the M4 Widening is reduced.

Changes to travel times

Modelling indicates that there will be a 74 per cent travel time saving for motorists using the M4 Motorway when the full WestConnex is complete. Without the M4 Widening and remainder of the WestConnex projects, high levels of congestion would be experienced on the M4 Motorway in the future morning peak.

Modelling shows high levels of congestion on the M4 Motorway in the morning peak under the Base 'do minimum' scenario, with the eastbound trip from Church Street to Homebush Bay Drive taking 14 minutes. Under the M4 Widening scenario, this trip time reduces to approximately five minutes, a saving of approximately nine minutes. There would also be travel time savings in the westbound direction with this trip taking six minutes in the Base 'do minimum' scenario compared to five minutes in the M4 Widening scenario. The modelling shows that the M4 Motorway experiences much lower congestion in the evening peak than shown in the morning peak.

The model shows slight increases in Parramatta Road travel times with the M4 Widening scenario due to drivers avoiding the toll. For example, in the morning peak hour under the Base 'do minimum' scenario, the eastbound trip from Church Street to Homebush Bay Drive takes approximately 16 minutes. Under the M4 Widening scenario, this trip time increases to approximately 17 minutes. Similarly, in the westbound direction the average travel time in the morning peak on Parramatta Road increases from approximately 13 minutes under the Base 'do minimum' scenario to approximately 18 minutes under the M4 Widening scenario.

The increase in modelled travel times obtained for the morning peak remain consistent in the inter peak and evening peak periods.

The Future 'do minimum' scenario shows high levels of congestion on the M4 Motorway in the morning peak with the eastbound trip from Church Street to Homebush Bay Drive taking 19 minutes. This trip time reduces to about five minutes under the Full WestConnex scenario, a saving of 14 minutes or 74 per cent. There is also expected to be morning peak travel time savings in the westbound direction on the M4 Motorway. The westbound trip between Church Street and Homebush Drive is predicted to take 15 minutes under the Future 'do minimum' scenario compared to nine minutes under the Full WestConnex scenario.

In the evening peak under the Full WestConnex scenario, the M4 Motorway is expected to experience much lower congestion when compared to the morning peak. Beneficial travel time savings are also expected with the Full WestConnex operational. The eastbound trip from Church Street to Homebush Bay Drive is predicted to reduce from approximately 11 minutes under the Future 'do minimum' scenario to approximately five minutes under the Full WestConnex scenario. Similar travel time savings are expected for westbound travel.

In the future scenarios, increases in Parramatta Road travel times between Church Street and Homebush Bay Drive are likely to occur with, or without, implementation of the fully completed WestConnex. The modelling shows increases in Parramatta Road travel times with WestConnex due to drivers avoiding the M4 Widening toll. The most pronounced increase in travel time is predicted in the morning peak westbound journey with a six minute increase modelled.

As discussed in Section 8.1.3, a similar diversion of traffic onto Parramatta Road was observed when the toll was formerly implemented on the M4 Motorway, resulting in congestion through areas such as Auburn and Granville.

The NSW Government through the LTTMP is developing an integrated package of transport improvements with WestConnex including complementary enhancements to the existing road network including Parramatta Road. It is considered that the medium to long-term benefits of the improvements along with the completion of the full WestConnex would offset the short-term impacts for road users on Parramatta Road in this section.

Table 8.7, Table 8.8 and Table 8.9 present modelled travel times for the five scenarios presented above.

Table 8.7 Morning peak travel times between Homebush Bay Drive and Church Street

	Travel Time (minutes)			
	M4 Motorway		Parramatta Road	
Scenario	**Eastbound**	**Westbound**	**Eastbound**	**Westbound**
Existing case (2012)	12	5	14	12
Base 'do minimum' (2021)	14	6	16	13
M4 Widening (2021)	5	5	17	17
Future 'do minimum' (2031)	19	15	19	18
Full WestConnex (2031)	5	9	20	26

Table 8.8 Evening peak travel times between Homebush Bay Drive and Church Street

	Travel Time (minutes)			
	M4 Motorway		Parramatta Road	
Scenario	**Eastbound**	**Westbound**	**Eastbound**	**Westbound**
Existing case (2012)	5	7	12	13
Base 'do minimum' (2021)	6	7	14	14
M4 Widening (2021)	5	5	18	18
Future 'do minimum' (2031)	11	11	21	18
Full WestConnex (2031)	5	5	24	23

Table 8.9 Inter-peak travel times between Homebush Bay Drive and Church Street

	Travel Time (minutes)			
	M4 Motorway		Parramatta Road	
Scenario	**Eastbound**	**Westbound**	**Eastbound**	**Westbound**
Existing case (2012)	5	5	12	11
Base 'do minimum' (2021)	5	5	13	12
M4 Widening (2021)	5	5	16	16
Future 'do minimum' (2031)	8	5	16	13
Full WestConnex (2031)	5	5	18	18

In addition to the travel time savings discussed above, the M4 Widening project would also deliver improvements in travel time reliability. This benefit would generally result from:

- The increased lane capacity provided by the project would result in a smoother traffic flow without the stop / start conditions experienced currently.
- The additional lanes also provide spare capacity so that traffic is delayed to a lesser extent by minor incidents such as break downs and minor crashes (safety is discussed further below).

Interchange and intersection performance

A summary of interchange and intersection performance for sections of the project is provided below. Further detail on intersection performance indicators can be found in the *M4 Widening Traffic and Transport Working Paper* (Appendix *D*). The average delay assessed for signalised intersections is for all movements and is expressed in seconds per vehicle. It is generally accepted that in the long term (15 years plus), when future conditions have been taken into account, LoS should be D or better. In the short term, intersections should be operating at LoS C or better.

The traffic volumes used for the intersection analysis were taken from the WRTM. The analysis below is based on modelled traffic volumes as opposed to the actual traffic counts used to assess existing operations. The modelled trip distribution may differ from actual counts, within the tolerances allowed within the model, resulting in variations in operational performance from those obtained for the existing network assessment. The assessment of interchange and intersection performance using forecast future traffic volumes without the M4 Widening project (being the Future 'do minimum' scenario) is undertaken to provide a base case against which to evaluate the impact of the project under the same forecast future traffic conditions.

Roads and Maritime will continue to prioritise improvements to the overall network including prioritising works to address intersection congestion where required.

Granville

Modelling shows that with the M4 Widening, the morning peak would result in reduced performance at Parramatta Road intersections due to increased traffic volumes, with road users seeking to exit the tolled motorway to use Parramatta Road as an alternative.

The M4 Widening is not expected to result in a large change in intersection performance, with improved performance at the Parramatta Road/Bold Street intersection offsetting worse performance at the neighbouring Parramatta Road/Good Street intersection.

Modelling indicates that, with and without the full WestConnex, intersections are generally operating over capacity, although under the Full WestConnex scenario, further deterioration in level of services is expected at the Parramatta Road/Good Street intersection during the morning peak (from LoS D to F).

Clyde and Rosehill

Modelling indicates that with the M4 Widening in the morning peak, two of the four modelled intersections in Clyde/Rosehill operate under capacity with no significant performance issues when compared with the Base 'do minimum' flows. However, the intersection of James Ruse Drive and Prospect Street is expected to be operating at capacity with more congestion when compared to the situation without the project.

With the M4 Widening, in the evening peak the intersections of James Ruse Drive with Parramatta Road and Prospect Street are expected to be operating over capacity with the other intersections operating under capacity.

Modelling indicates that under the Full WestConnex scenario, in the morning peak three of the four modelled intersections would be operating above capacity. The intersection of James Ruse Drive/Prospect Street and James Ruse Drive/M4 Motorway westbound off-ramp are expected to be more congested with the full WestConnex than without.

Auburn

Modelling indicates that with the M4 Widening morning peak, performance would be similar with and without the M4 Widening at the intersections of Silverwater Road/M4 Motorway eastbound ramps and Silverwater Road/Parramatta Road. The intersection of Silverwater Road/Carnarvon Street is expected to operate at capacity and LoS D, which is better than the situation without the M4 Widening. The intersection of Silverwater Road/M4 Motorway westbound ramps intersection is expected to improve to LoS B compared to LoS D without the M4 Widening.

In the evening peak, the intersection of Silverwater Road/Carnarvon Street is expected to operate at capacity with a LoS C, which is better than the situation without the M4 Widening. The intersection of Parramatta Road/Rawson Street/Duck Street shows deterioration in performance when compared to the situation without the M4 Widening.

Under the Full WestConnex scenario, in the morning peak, four of the five intersections are expected to be operating above capacity, with the remaining intersection at capacity. There is minimal difference with and without WestConnex. In the evening peak the intersections of Silverwater Road/Carnarvon Street and Silverwater Road/Parramatta Road operate in excess of their theoretical capacity. Performance with and without WestConnex is expected to be similar.

Lidcombe and Sydney Olympic Park

With the M4 Widening in the morning peak, the intersection of Hill Road/Parramatta Road is expected to experience an increase in traffic when compared to the situation without the M4 Widening. This causes the intersection to operate at LoS F and well beyond capacity. Network issues at the M4 Motorway off-ramp and the Hill Road/Carter Street intersection would be further exacerbated with the M4 Widening due to an increase in traffic.

With the M4 Widening in the evening peak, the intersection of Hill Road/Parramatta Road is expected to experience an increase in traffic. As with the morning peak this causes the intersection to operate at LoS F and well beyond capacity. Network issues at the M4 Motorway off-ramp and the Hill Road/Carter Street intersection would be further exacerbated with the M4 Widening due to an increase in traffic.

Under the Full WestConnex scenario morning peak and evening peak, further increases in traffic yield are likely to mean poor performance in the Hill Road corridor, with minimal difference with and without WestConnex.

The M4 Motorway off-ramp after the WestConnex is complete is expected to improve in performance due to a reduction in off-ramp traffic. A reduction in traffic into and out of Carter Street with WestConnex is expected to see a substantial improvement in the performance of this intersection.

Homebush West and Strathfield
The inclusion of an additional on-ramp servicing the M4 Motorway and the removal of the right turn movement from Homebush Bay Drive southbound to the existing westbound M4 Motorway on-ramp would deliver significant improvements for the Centenary Drive/M4 Motorway westbound ramps. Similar improvements in performance are also expected under the Full WestConnex scenario.

North Strathfield and Strathfield
With and without the M4 Widening the morning peak and evening peak three of the four modelled intersections in Strathfield and North Strathfield operate under capacity. In both scenarios the Concord Road/Leicester Avenue/Parramatta Road intersection is expected to exceed capacity in both the morning peak and evening peak.

Under the Full WestConnex scenario, morning peak and evening peak is expected to see the Concord Road/Leicester Avenue/Parramatta Road remain over capacity at LoS F. The morning peak at the intersection of M4 Motorway/Parramatta Road is expected to see improved performance operating at LoS C which compares favourably with a LoS F without WestConnex.

Freight transport

Modelling indicates that without the M4 Widening there would be substantial heavy vehicle traffic on the M4 Motorway west of Westmead, and consistently high volumes along the M4 Motorway.

Table 8.10 presents the daily heavy commercial vehicle traffic volumes with M4 Widening and indicates a forecast redistribution of heavy vehicles to Parramatta Road and other network routes.

Table 8.10 Weekday heavy commercial vehicle distribution – Base 'do minimum' and M4 Widening scenarios

Road	Number of weekday heavy commercial vehicles	
	Base 'do minimum' (2021)	M4 Widening (2021)
M4 Motorway	27,060	13,138
Parramatta Road	1,408	3,517
M2 Motorway	12,542	13,984
Victoria Road	5,862	7,363

When all WestConnex projects are completed, there is expected to be less redistribution of heavy vehicle traffic away from the M4 Motorway than immediately after the M4 Widening's construction due to overall increasing network congestion as Sydney's population grows by more than 1.5 million people. This will over time make a quicker trip on a tolled road more attractive and there is expected to be a gradual drift of toll avoiding drivers back to using the motorway.

Road safety

The M4 Widening is likely to improve road safety, with up to 36 fewer crashes a year on the combined M4 Widening/Parramatta Road corridor.

Traffic modelling can be used to estimate the number of crashes on the M4 Motorway and Parramatta Road with and without the M4 Widening using an assumed number of crashes per

vehicle kilometre travelled. Table 8.11 presents modelled crash estimates for the Existing case, Base 'do minimum' and M4 Widening scenarios.

These figures show a decline in crashes on the widened M4 Motorway as a result of reduced vehicle kilometres travelled. There is a corresponding forecast relocation of traffic and therefore crashes to Parramatta Road as some motorists would use this road to avoid the toll. The overall number of crashes in the corridor is expected to be lower with the M4 Widening (four per cent less crashes with casualties).

Table 8.11 Crash estimates for the M4 corridor (including both Parramatta Road and the M4 Motorway) between Parramatta and Homebush Bay Drive

	Existing case (2012)	Base 'do minimum' (2021)	M4 Widening (2021)
Crashes with casualties	142	160	154
Crashes without casualties	230	257	227

Induced traffic

An assessment of 'induced demand' (ie additional traffic on the road network that might result from implementation of the project) was carried out by the BTS using the STM. The assessment showed that no significant increase in overall road traffic demand was anticipated as a result of the project.

Impacts on bus services

Tolling of the widened M4 Motorway is expected to lead to traffic volume increases on Parramatta Road between Granville and North Strathfield and also on Victoria Road. This additional traffic is expected to affect buses in a similar way to general traffic. Parramatta Road between Granville and Strathfield is not a priority bus route between Parramatta and Sydney CBD in the LTTMP. Buses either cross Parramatta Road or utilise parts of Parramatta Road to a limited extent.

Increased travel times of up to four minutes for buses using Parramatta Road are expected to be as follows under the M4 Widening scenario:

- Route M92: This Metrobus route has approximately nine minutes scheduled time for peak period trips on Parramatta Road between James Ruse Drive and John Street, Lidcombe. The additional journey time would be between 1.6 and 3.4 minutes per one way bus journey if the travel time impact for buses is proportional to the impact for general traffic.
- Route 909: This route has a scheduled peak period running time of 10 minutes on Parramatta Road between Alfred Street, Granville and Station Road, Auburn. The additional journey time would be up to four minutes per one way bus journey if the travel time impact for buses is proportional to the impact for general traffic.
- Route 450, 525 and 526: These routes deliver a combined peak frequency of 10 buses per hour over the one kilometre between Underwood Road and Leicester Avenue, Strathfield. Modelling shows that no substantial travel time increase over this section of Parramatta Road is expected.

For the bus routes crossing Parramatta Road, there are likely to be additional delays incurred due to the need to cross an increased east-west general traffic flow on Parramatta Road. However, there are also some small traffic reductions on roads elsewhere along these routes so the net impacts may be considered negligible.

Three Sydney Olympic Park special event routes are likely to incur some delays which will vary in severity according to traffic conditions on Parramatta Road at different times in the day.

With the M4 Widening there is a small diversion of general traffic from the M4 Motorway to Great Western Highway between the Cumberland Highway junction and Pitt Street, Parramatta. This section already has Transitway bus priority facilities which are sufficient to minimise the impact of the diverted traffic on bus service operations.

During the commuter peak periods there are currently 10 buses per hour on Church Street, Parramatta between Great Western Highway and Granville. There are limited bus priority measures currently provided on this road, but it does operate with peak period clearway conditions. The traffic flow is likely to increase with the M4 Motorway Widening in place and this is expected to affect traffic speeds and therefore service reliability for the four bus routes involved (M91, 810, 811 and 907).

Traffic volumes on Homebush Bay Drive are expected to fall following the opening of the M4 Widening. Only one existing regular bus route would benefit from this small change in traffic volume – the peak hours only route 533 from Chatswood to Sydney Olympic Park. These buses are allowed approximately eight minutes in the current timetable for travel between Rhodes and Underwood Road.

Five Sydney Olympic Park special event bus routes that use Homebush Bay Drive would also benefit from the slightly reduced traffic volumes during peak periods.

Leicester Avenue at Strathfield is the route used by cross regional services 450, 459, 525 and 526. Between 11 and 12 buses per hour currently travel over this section of road. Sydney Olympic Park special event bus route 4 also uses Leicester Avenue. Traffic levels on this stretch of road are expected to decline marginally following implementation of the M4 Widening project and this should help to improve bus service reliability on these routes. For route 459, traffic volumes on Concord Road north of Parramatta Road are likely to be lower with the M4 Widening, so this route is likely to benefit from some limited time savings.

Opportunities to improve public transport patronage would be considered as part of the urban revitalisation of Parramatta Road currently being developed by Urban Growth in partnership with Transport for NSW and DP&E. Opportunities could include priority bus measures at key intersections however these are not considered further as part of the M4 Widening project.

Impacts on rail services

While the project is not expected to induce travel demand, the M4 Widening would encourage a modal shift from road to rail for some travellers where rail offers a potential alternative.

Increased traffic volumes on the local road network may have some effect on access to rail stations by bus and car with about half of all rail passengers (across the rail network) accessing stations by these modes. However, station access is only one component of the overall passenger trip. Given the high frequency of train services at all stations in the area (with the exception of the Carlingford Line services) access delays are likely to have only a minimal impact on mode choice.

Overall the M4 Widening project is expected to have some marginal impacts on rail patronage but the net effect is unlikely to be significant.

Impact on pedestrians and cyclists

The redistribution of west–east traffic away from the M4 Motorway would increase traffic on alternative parallel routes, particularly Parramatta Road which is used by pedestrians and cyclists. The signalised intersections along Parramatta Road have controlled pedestrian crossings and these facilities would not be impacted by the project. Therefore, pedestrian ability to cross Parramatta Road would not be impacted by the increase in traffic volumes on the road. The M4 Widening project does not impact on local or arterial roads and their associated footpaths.

The off-road pedestrian and shared paths described in section 8.1.2 would be maintained and cyclists would continue to be able to use the shoulders of the M4 Motorway west of Church Street as is the case at present. Motorway ramp bicycle crossings would be provided in accordance with standard motorway design practice. Therefore, no operational impacts on cyclists and pedestrians are expected as a result of the M4 Widening project.

Cumulative traffic and transport impacts

The M4 Widening is expected to alleviate congestion on the M4 Motorway. On its own, widening of the M4 Motorway would allow improved traffic flows and faster travel times along its route, but will not address or alleviate congestion on Parramatta Road east of Concord Road. When the M4 East project is delivered a few years after the M4 Widening a cumulative benefit is expected with alleviated congestion at the eastern end of the M4 Motorway along Parramatta Road.

Strategic modelling also indicates that when all WestConnex projects are operational an average of around 4,500 fewer trucks and 20,000 fewer cars per day are expected to travel on the section of Parramatta Road between Concord Road and Camperdown. This strategic modelling was based on the same traffic assumptions as the M4 Widening traffic assessment.

Other developments in the Sydney motorway network are likely to affect and be affected by the M4 Widening. These include completion of the M5 Motorway widening and construction of NorthConnex. Under current motorway network operations, the existing M4 Motorway provides an untolled alternative to east-west travel, and attracts patronage from travellers for whom the M2 Motorway and M5 Motorway provide shorter tolled alternatives. Widening of these motorways makes them more attractive than the future widened and tolled M4 Motorway. These changes in the road network have been incorporated into the WRTM and are reflected in traffic forecasts.

The NSW Government's strategy for the rail network across Sydney is presented in Sydney's Rail Future, Modernising Sydney's Trains (Sydney's Rail Future) (TfNSW, 2012). The focus of the Government's approach is to modernise Sydney's rail network so that it is better able to meet forecast demand. A significant component of the approach is to provide customers with real alternatives to using their car or other transport modes.

Specific components of the strategy aim to address existing capacity constraints on the Main Western Rail Line in the M4 Motorway corridor:

- Operational pattern changes to facilitate the reliable operation of a 20 trains per hour peak service on the Main Western Rail Line.
- A greater focus on express services to/from the Sydney CBD for Parramatta, Blacktown and Penrith.
- Provision of a Lidcombe turnback for T3 Bankstown Rail Line services, releasing capacity for both T1 Western Rail Line and T2 Inner West and South Rail Line services.

- The introduction of high frequency metro-style services on the future North West Rail Link will give customers from the North West an attractive alternative service to the Main Western Rail Line for travel to and from the Lower North Shore and CBD.
- In the longer term, the second harbour crossing and new CBD rail line will significantly increase the capacity of the rail network with up to 14 additional trains per hour possible on the Main Western Rail Line.
- On the Blue Mountains Rail Line, signalling improvements will support faster journey times and rolling stock improvements, including potentially longer trains to meet growing demand, will deliver a more attractive rail service for longer distance customers in this corridor.

The cumulative effect of rail network improvements would result in a change to the use of rail and road travel in the M4 Motorway corridor.

8.1.6 Environmental management measures

Options development and concept design investigations described in Chapters 4 and 5 have sought to minimise traffic and transport impacts as far as possible.

Project-specific management and mitigation measures have been developed with the aim of minimising or mitigating, as far as practical, the traffic and transport impacts during construction and operation as described above. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential impacts and site-specific management measures identified to manage those impacts for implementation during the pre-construction, construction and operational phases are summarised in the table below.

Impact	REF#	Environmental management measures	Responsibility	Timing
Construction traffic and road safety impacts	TT-1	• A traffic and transport liaison group will be established prior to commencement of construction. The traffic and transport liaison group will be consulted during preparation of the construction traffic management plan to ensure impacts are minimised.	WDA Contractor	Pre-Construction
Construction traffic and road safety impacts	TT-2	• A construction traffic management plan will be developed, approved, implemented and monitored as part of the project. The construction traffic management plan would focus on maintaining general traffic flow and specifying appropriate site accesses and construction traffic routes. It would include: – Traffic Control Plans showing the access arrangements and the detail of required signs and devices – Vehicle Management Plans showing access to work sites and direction of travel – Pedestrian and Cyclist Management Plans	Contractor	Pre-construction

Impact	REF#	Environmental management measures	Responsibility	Timing
		– Management strategy for other road users – Management strategy for access to adjacent properties – Hours of operation, including prohibitions on queuing outside sites prior to commencement of working hours – Road safety audit requirements – Any localised improvements/adjustments to existing traffic management arrangements.		
Construction impacts on motorway traffic and local roads	TT-3	Construction staging and temporary works will be developed and implemented to minimise conflicts with the existing road network and to maximise the separation between work areas and travel lanes.	Contractor	Construction
Construction impacts on motorway traffic and local roads	TT-4	Lane occupancies will be planned with the aim of minimising the actual work area, limiting obstructions and restrictions, maximising road capacity and avoiding peak traffic periods.	Contractor	Construction
Construction impacts on motorway traffic	TT-5	Existing motorway capacity will be maintained during the morning peak and evening peak periods by maintaining the number of through lanes.	Contractor	Construction
Construction impacts on motorway traffic	TT-6	Monitoring of the motorway and work sites will be undertaken using CCTV and mobile patrols where required to assist management of incidents.	Contractor	Construction
Construction impacts on pedestrians and cyclists	TT-7	Access for bicycles along the motorway (where currently available) will be maintained or an alternative route provided and signposted, with the exception of times when work is being undertaken in the shoulder. This work will include temporary diversions or stop/go conditions under traffic control.	Contractor	Construction
Construction impacts on pedestrians and cyclists	TT-8	Access to existing shared paths will be maintained subject to the need for temporary diversions.	Contractor	Construction
Network performance	TT-9	An operational traffic review will be undertaken within 12 months of opening to confirm the operational traffic impacts of the project on the M4 Motorway and parallel road and their major intersections. The assessment will be based on actual traffic counts and will assess the level of service at major intersections between Pitt Street and Homebush Bay Drive along the M4	WDA / Roads and Maritime	Operation

Impact	REF#	Environmental management measures	Responsibility	Timing
		Motorway and on Parramatta Road. Where necessary, the outcomes of the operational traffic review will be used to identify opportunities for any further operational refinement to optimise the performance of the project. This could include intersection treatments, changes to lane configurations or changes to signal phasing.		

8.2 Noise and vibration

This section reviews the potential noise and vibration impacts of the project. Full details of the assessment undertaken are presented in the *WestConnex M4 Widening Construction and Operational Road Traffic Noise and Vibration Impact Assessment* (SLR, 2014) (Volume 2 – Working Paper E) with a summary provided below. The assessment has been prepared to address relevant DGRs as documented in the table below.

Director-General's Requirements	Where addressed in EIS
• An assessment of the noise impacts of the project during operation, consistent with the Road Noise Policy (Environment Protection Authority 2011). The assessment must include specific consideration of impacts to receivers (dwellings, child care centres, educational establishments, hospitals, motels, nursing homes, or places of worship), as relevant and identify reasonable and feasible mitigation measures.	Section 8.2.3
• An assessment of construction noise and vibration impacts, consistent with the Interim Construction Noise Guideline (Department of Environment, Climate Change and Water 2009), and Assessing Vibration: a technical guideline (Department of Environment and Conservation 2006).	Section 8.2.4 – 8.2.6

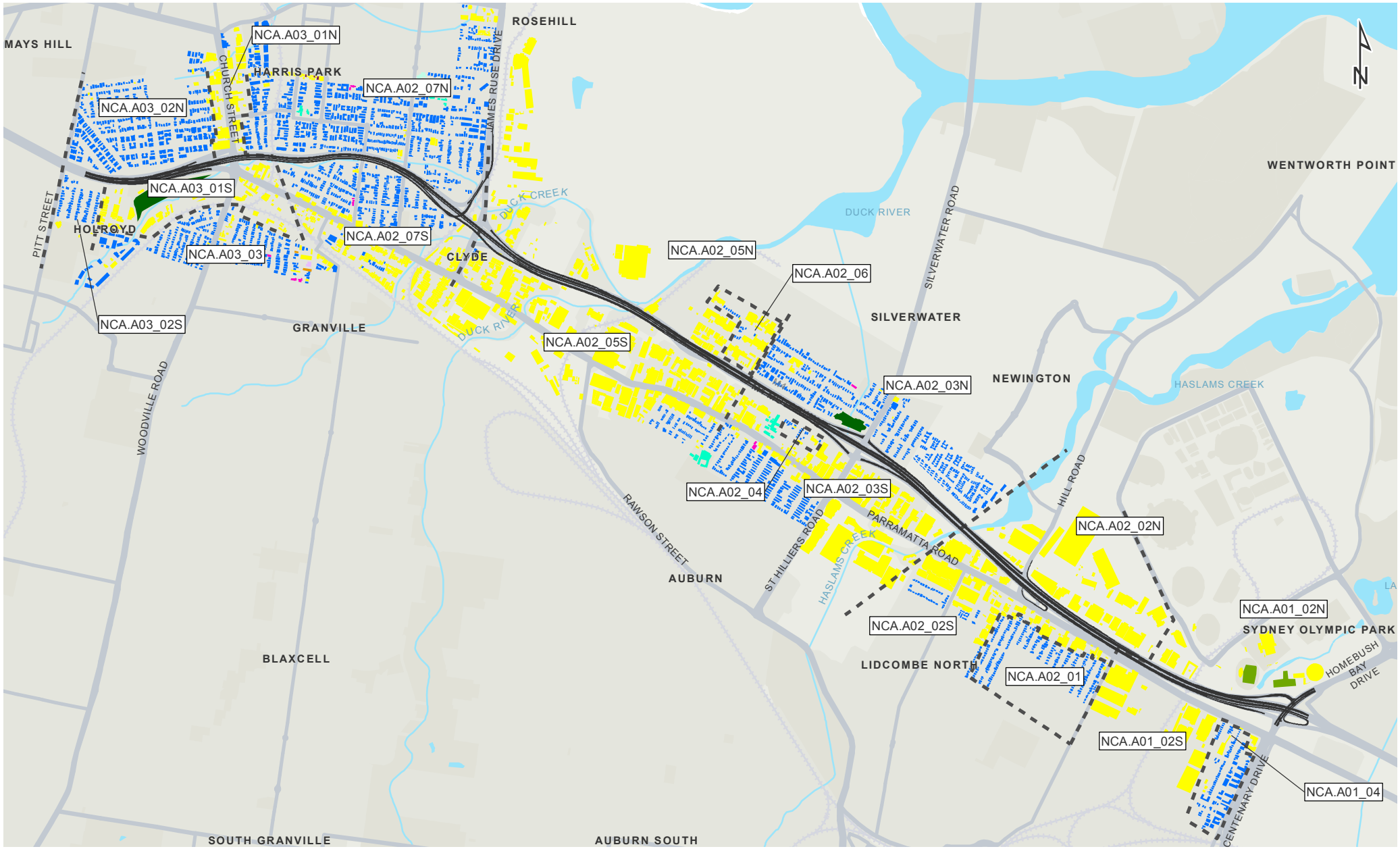
8.2.1 Existing environment

The existing ambient noise environment surrounding the project corridor is typical of urban and suburban areas where the ambient noise environment is primarily influenced by road traffic. Noise levels are typically lower at night when compared with daytime and evening periods. This is characteristic of urban and suburban areas where the ambient noise environment is primarily influenced by road traffic.

There are a range of noise sensitive receivers adjacent to the project corridor. All residences (such as hotels, hostels and apartments) are considered to be sensitive receivers during both construction and operation. All commercial receivers are considered to be sensitive to construction noise and vibration impacts and operational vibration impacts. Other nearby receivers sensitive to noise and vibration during both construction and operation include educational institutions, child care centres, hospitals, nursing homes, places of worship and open space.

Figure 8.7 shows the location of the various types of sensitive receptors as well as the noise catchment areas (NCA) (14 in total) that have been used for assessment.

To quantify and characterise the existing ambient noise environment across the proposal both unattended and attended noise monitoring was undertaken during February and March 2013. Figure 8.7 shows the locations where unattended noise monitoring occurred. The results of the noise monitoring are reported in section 4.5 and section 4.6 of the Noise and Vibration Working Paper.



KEY

- Project design
- Noise catchment areas

Sensitive receivers

- Commercial
- Open Space (Active)
- Open Space (Passive)
- Other (Childcare)
- Other (Educational)
- Other (Library)
- Other (Medical)
- Other (Place of Worship)
- Other (Public Building)
- Residential

Noise sensitive receivers and NCAs **Figure 8.5**

0 0.5 1 Km

8.2.2 Noise and vibration criteria

Road traffic noise

For traffic operating on public roads, the *NSW Road Noise Policy* (EPA, 2011) (RNP) provides criteria for assessing potential road traffic noise impacts. Table 8.12 shows the residential criteria while Table 8.13 provides the criteria for other land uses.

Table 8.12 RNP criteria – residential

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am – 10 pm)	Night-time (10 pm – 7 am)
Freeway/arterial/ sub-arterial roads	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads 3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	LAeq(15hour) 60 (external)	LAeq(9hour) 55 (external)

Table 8.13 RNP criteria – other sensitive land uses

Existing Sensitive Land Use	Assessment Criteria (dBA)		Additional Considerations
	Daytime (7 am – 10 pm)	Night-time (10 pm – 7 am)	
School Classrooms	LAeq(1hour) 40 (internal)	-	In the case of buildings used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian Standard 2107:2000 (Standards Australia 2000).
Places of Worship	LAeq(1hour) 40 (internal)	LAeq(1hour) 40 (internal)	The criteria are internal, ie the inside of a church. Areas outside the place of worship, such as a churchyard or cemetery, may also be a place of worship. Therefore, in determining appropriate criteria for such external areas, it should be established which activities in these areas may be affected by road traffic noise.
Open Space (Active Use)	LAeq(15hour) 60 (external) when in use	-	Active recreation is characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion.
Open Space (Passive Use)	LAeq(15hour) 55 (external) when in use	-	Passive recreation is characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, eg playing chess, reading.

In addition to the noise criteria in Table 8.12 and Table 8.13, the RNP describes a 'Relative Increase Criteria' of 12 dB above existing traffic noise. This criterion is primarily intended to protect existing quiet areas from excessive changes in noise. For a road in the same location, and with the same mix in traffic, a 12 dB increase in road traffic noise levels would require a 16-fold increase in traffic.

Sleep disturbance

Guidance for the assessment of sleep disturbance given in the RNP is reproduced as follows:

> *'Triggers for, and effects of sleep disturbance from, exposure to intermittent noise such as noise from road traffic are still being studied. There appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise. The NSW Roads and Traffic Authority's Practice Note 3 (NSW Roads and Traffic Authority 2008) outlines a protocol for assessing and reporting on maximum noise levels and the potential for sleep disturbance.'*

The *Environmental Noise Management Manual* (ENMM) – Practice Note III (Roads and Traffic Authority (RTA) 2001) protocol for assessing the potential for sleep disturbance is determined by performing LAFmax – LAeq(1hr) calculation on individual vehicle passby noise measurements. The number of night-time passby events where the LAFmax – LAeq(1hr) difference is greater than 15 dB is to be determined.

With regard to reaction to potential sleep disturbance events, the RNP gives the following guidance:

> *'From the research on sleep disturbance to date it can be concluded that:*
>
> - *maximum internal noise levels below 50–55 dB(A) are unlikely to awaken people from sleep*
> - *one or two noise events per night, with maximum internal noise levels of 65–70 dB(A), are not likely to affect health and wellbeing significantly.'*

It is generally accepted that internal noise levels in a dwelling, with the windows open are 10 dB lower than external noise levels. Based on a worst case minimum attenuation (windows open) of 10 dB, the first conclusion above suggests that short term external noises of 60 dBA to 65 dBA are unlikely to cause awakening reactions.

The second conclusion suggests that one or two noise events per night with maximum external noise levels of 75 dBA to 80 dBA are not likely to significantly affect health and wellbeing.

Construction noise

The *Interim Construction Noise Guideline* (DECCW 2009) requires project specific Noise Management Levels (NMLs) to be established for noise affected receivers. In the event construction noise levels are predicted to be above the NMLs, all feasible and reasonable work practices need to be investigated to minimise noise emissions.

NMLs for residential receivers are set at the overall single-figure background noise level (known as RBL) plus 10 dBA during recommended standard hours for construction, and RBL plus 5 dBA for construction outside the recommended standard hours. Receivers are considered to be highly noise affected if daytime $LA_{eq15minute}$ construction noise levels exceed 75 dB(A).

Table 8.14 shows the NMLs for residential receivers by NCA as well as the sleep disturbance screening criterion.

Table 8.14 Residential receiver NMLs for construction

NCA	Receiver Type	Standard Construction (RBL[1] + 10dBA)	Out of Hours (RBL[1] + 5dbA)			Sleep disturbance (RBL[1] + 15dbA)
		Day	Day[2]	Evening	Night	
East of project area (Welfare Street)	Residential	58	53	53	51	61
NCA.A01_04_RES	Residential	66	61	59	55	65
NCA.A02_01_RES	Residential	62	57	57	52	62
NCA.A02_03N_RES	Residential	65	60	57	54	64
NCA.A02_03S_RES	Residential	68	63	63	59	69
NCA.A02_04_RES	Residential	68	63	63	59	69
NCA.A02_06_RES	Residential	66	61	60	54	64
NCA.A02_07N_RES	Residential	62	57	57	51	61
NCA.A02_07S_RES	Residential	61	56	56	50	60
NCA.A03_02N_RES	Residential	68	63	63	56	66
NCA.A03_02S_RES	Residential	65	60	60	54	64
NCA.A03_03_RES	Residential	65	60	60	54	64

[1] RBL: Rating background level

[2] Saturday 1.00pm to 6.00pm and Sunday 8.00am to 6.00pm

Table 8.15 NMLs for other sensitive receptors

Land Use	NML LAeq(15minute) (Applied when the property is in use)
Classrooms at schools and other education institutions	Internal noise level 45 dBA
Hospital wards and operating theatres	Internal noise level 45 dBA
Places of Worship	Internal noise level 45 dBA
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, eg reading, meditation)	External noise level 60 dBA
Community centres	Depends on the intended use of the centre. Refer to the recommended 'maximum' internal levels in AS 2107 for specific uses.

For sensitive receivers such as schools and places of worship, the NMLs presented in Table 8.18 are based on internal noise levels. For the purpose of the assessment, it has been conservatively assumed that all schools and places of worship have windows that can be opened. On the basis that external noise levels are typically 10 dB higher than internal noise levels when windows are open, an external LAeq (15 minute) NML of 55 dBA has been adopted.

The Interim Construction Noise Guideline and AS2107 does not provide specific guideline noise levels for childcare centres. Childcare centres generally have internal play areas and sleep areas. For internal play areas an internal NML of LAeq (15 minute) 55 dBA has been adopted and for sleeping areas, an internal NML of LAeq (15 minute) 40 dBA (when in use) has been adopted.

For commercial premises, including offices, retail outlets and small commercial premises an external NML of LAeq (15 minute) 70 dBA has been adopted. An external NML of LAeq (15 minute) 75 dBA has been adopted for industrial premises.

Construction traffic noise

When trucks and other vehicles are operating within the boundaries of the various construction sites, road vehicle noise contributions are included in the overall predicted LAeq (15 minute) construction site noise emissions. When construction related traffic moves onto the public road network a different noise assessment methodology is applied, as vehicle movements would be regarded as 'additional road traffic' rather than as part of the construction site.

The Interim Construction Noise Guideline does not provide specific guidance in relation to acceptable noise levels associated with construction traffic. For assessment purposes, guidance is taken from the RNP. One of the objectives of the RNP is to apply relevant permissible noise increase criteria to protect sensitive receivers against excessive decreases in amenity. In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

On this basis, construction traffic NMLs set at 2 dB above the existing road traffic noise levels during the daytime and night-time periods are considered appropriate to identify the onset of potential noise impacts.

Construction vibration

Vibration damage goals

British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2 sets guide values for vibration based on the lowest vibration levels above which damage has been credibly demonstrated. Table 8.16 shows the recommended guideline limits.

Table 8.16 Transient vibration guide values – Minimal risk of cosmetic damage

Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
	4 Hz to 15 Hz	15 Hz and Above
Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note that where continuous vibration gives rise to magnification of vibration by resonance (specific conditions where the structure can readily store and transfer vibration energy), then the guide values in Table 8.16 may need to be reduced by up to 50 per cent.

For most sources of intermittent vibration during construction, such as rockbreakers, piling rigs, vibratory rollers and excavators, the predominant vibration energy occurs at frequencies usually

in the 10 Hz to 100 Hz range. On this basis a vibration damage screening level of 7.5 mm/s has been adopted for the purpose of assessing potential impacts.

In the lower frequency region below 4 Hz the guide values for building types are reduced as a high displacement is associated with relatively low peak component particle velocity. To minimise risk of structural damage a guide value of 3.7 mm/s has been adopted.

Human comfort goals for construction vibration
For most construction activities that generate perceptible vibration in nearby buildings, the character of the vibration emissions is intermittent. The publication *Assessing Vibration: a technical guideline* (DEC, 2006) nominates preferred and maximum vibration goals for critical areas, residences and other sensitive receptors. Refer to Table 8.17.

Table 8.17 Preferred and maximum vibration dose values for intermittent vibration

Location	Daytime ($m/s^{1.75}$)		Night time ($m/s^{1.75}$)	
	Preferred	Maximum	Preferred	Maximum
Critical areas (eg hospital operating theatres, precision laboratories)	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Table 8.18 shows indicative safe working distances for some construction activities (depending on specific type of plant and geotechnical conditions) (Transport for NSW, 2012)

Table 8.18 Recommended working distances for vibration intensive plant

Plant Item	Rating/Description	Working Distance	
		Cosmetic Damage BS 7385	Human Response BS 6472
Vibratory Roller	<50kN (Typically 1-2 tonnes)	5m	15 to 20m
	<100kN (Typically 2-4 tonnes)	6m	20m
	<200kN (Typically 4-6 tonnes)	12m	40m
	<300kN (Typically 7-13 tonnes)	15m	100m
	>300kN (Typically 13-18 tonnes)	20m	100m
	>300kN (>18 tonnes)	25m	100m
Small Hydraulic Hammer	300kg – 5 to 12 t excavator	2m	7m
Medium Hydraulic Hammer	900kg – 12 to 18t excavator	7m	23m
Large Hydraulic Hammer	1600kg – 18 to 34t excavator	22m	73m
Vibratory Pile Driver	Sheet piles	2 to 20m	20m
Pile Boring	≤800mm	2m (nominal)	N/A
Jackhammer	Hand held	1m (nominal)	Avoid contact with structure

8.2.3 Assessment of potential operational noise impacts

Approach to assessment

To assess road traffic noise impacts noise modelling of the project area was carried out. The modelling allows for traffic volume and mix, type of road surface, vehicle speed, road gradient, reflections off building surfaces, ground absorption and shielding from ground topography and physical noise barriers. The model calculates noise levels at receiver points for every ground and first floor facade of each noise sensitive receiver over the entire project area. The Noise and Vibration Working Paper includes further details on noise model inputs, assumptions and validation.

Noise modelling was undertaken using traffic modelling outputs based on the following scenarios. Predicted noise levels were then considered against RNP criteria.

- **Base 'do minimum' ('no build')** - forecast road traffic volumes assuming that the M4 Widening and the remainder of the WestConnex projects are not built (2017).
- **M4 Widening ('build')** - forecast road traffic volumes with the widened M4 Motorway, without any other WestConnex projects (2017).
- **Future 'do minimum' (10 years after project opening) 'no build' -** the road traffic volumes due to general traffic growth that would have occurred without the M4 Widening or other WestConnex project (2027).
- **Full WestConnex (10 years after project opening) 'build'** - the road traffic volumes based on worst-case traffic assuming all WestConnex project are operational (2027).

Predicted operational noise levels

Due to the forecast reduction in traffic volumes, the total road traffic noise at receivers adjacent to the M4 Motorway is generally predicted to reduce as a result of the project. Exceptions to this are adjacent to the new viaduct and at locations near to secondary roads that are forecast to see an increase in traffic due to the project, such as on certain parts of Parramatta Road.

Notwithstanding the general decrease in noise levels at receivers adjacent to the motorway, predicted noise levels for the 'build' scenarios are typically above the RNP noise goals at the majority of immediately adjacent receivers. This is because these receivers already experience a high level of traffic noise.

The forecast traffic numbers for the 'build' scenarios indicates an increase in vehicles along sections of Parramatta Road (predominantly between Church Street, Granville and Silverwater Road, Auburn). For receivers immediately adjacent to these sections of Parramatta Road, the change in vehicle numbers and composition (ie percentage of heavy vehicles) generally results in increases in predicted noise levels of more than 2 dB to the total road traffic noise. Table 8.22 provides a summary of the changes to numbers of receivers with predicted operational noise levels above the base criteria.

Table 8.19 Summary of operational noise predictions – RNP base criteria

		2017 Scenario				2027 Scenario			
		No Build		Build		No Build		Build	
Receiver	**Floor**	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**	**Day**	**Night**
Receivers with Predicted Noise Level above RNP Base Criteria[1]									
Residential	All	1608	1876	841	668	1715	2060	1457	1167
	1	801	972	401	291	871	1100	714	551
	2	533	608	266	220	562	651	483	378
	>2	274	296	174	157	282	309	260	238
Other (Educational)	All	25	n/a	25	n/a	25	n/a	25	n/a
Other (Worship)	All	18	18	18	14	18	18	18	15
Other (Active)	All	4	n/a	1	n/a	4	n/a	4	n/a
Other (Passive)	All	2	n/a	2	n/a	2	n/a	2	n/a

[1] Consistent with the RNP and Roads and Maritime policy, assessment locations at receivers are limited to the two most affected floors.

Feasible and reasonable noise mitigation will be considered in accordance with the *NSW Road Noise Policy* (EPA 2011) and the *Environmental Noise Management Manual* (RTA 2001). Specifically, noise mitigation (beyond the adoption of traffic management and other road design measures) will be considered in the following circumstances:

> *The predicted 'build' noise level exceeds the RNP base criteria for redeveloped roads and the noise level increase due to the project (ie the noise predictions for the 'build' minus the 'no build') is greater than 2 dB.*
>
> *OR*
>
> *The predicted 'build' noise levels are acute (≥65 dBA LAeq(15hour) or ≥60 dBA LAeq(9hour)) regardless of the incremental impact of the project.*

Where exceedances of the noise criteria are identified, the RNP describes noise mitigation measures to be considered in order of priority:

- Road design and traffic management.
- Low noise pavement surfaces.
- In-corridor noise barriers/mounds.
- At-property treatments or localised barriers/mounds.

The project includes use of a low noise pavement on the M4 Motorway (refer to Chapter 6) and has located the viaduct on the southern side - further away from sensitive receivers to the north.

Additional feasible and reasonable noise mitigation measures, including noise barriers and property treatments, are considered for receivers which qualify on the basis of predicted residual noise levels and/or a project related increase in noise above certain specified thresholds. Guidance for the reasonable and feasible assessment of additional noise mitigation is taken the Environmental Noise Management Manual.

Indicative locations and heights of proposed noise barriers are described in 5.3.11 and shown on Figure 5.1 to Figure 5.3. Indicative heights range from 3.5 metres to 7.5 metres and would comprise additional noise barriers and extended existing noise barriers.

Further to the inclusion of the optimised project noise barriers, a total of 186 sensitive 'receivers' are predicted to be eligible for consideration of property treatment as part of the M4 Widening project.

This number consists of:

- 159 residential receivers with noise levels less than 10 dB above the RNP base criteria
- 20 residential receivers with noise levels 10 dB or more above the RNP base criteria
- Four places of worship (part of Rodger Page Church)
- Three educational facilities (part of Auburn North Public School).

For individual residential receivers Roads and Maritime does not consider it reasonable to consider noise mitigation above the ground and first floor.

A number of residential receivers that have been identified exceeding the RNP criteria are multi-storey apartment buildings. A further feasible and reasonable review of architectural treatments at multi-storey apartments will be completed during detailed design. Receivers that are eligible for consideration of property treatment are listed in Appendix E of the Noise and Vibration Working Paper (Volume 2 – Working Paper E).

8.2.4 Assessment of potential construction noise impacts

Approach to assessment

To quantify noise levels from the construction activities a noise prediction model was developed. The concept designs for the project, local terrain, receiver buildings and structures were digitised in the noise model to develop a three-dimensional representation of the construction sites and surrounding environment.

Typical LAeq (15 minute) noise levels at the nearest noise sensitive receivers in each NCA were then calculated (at the worst-affected floor level) for the construction scenarios outlined in Table 8.20.

Consistent with the requirements of the Interim Construction Noise Guideline the construction noise impact predictions represent a worst-case assessment. They are representative of the 'noisiest' construction periods allowing for the simultaneous operation of noise intensive construction plant in proximity to adjacent receivers. For most construction activities, it is expected that the construction noise levels would frequently be lower than those that have been predicted at the most-exposed receiver.

Table 8.20 Summary of airborne construction noise scenarios

Construction activity	Locations	Scenarios	Scenario Sound Power Level (dBA)	Approximate duration of works at any locality[1]
Main Corridor/ Ramp Works	General carriageway and ramp footprint (concept design)	Site clearing and bulk earthworks	117	2-4 weeks
		Excavation and installation of drainage	105	2-4 weeks
		Pavement works including laying concrete and asphaltic surfaces	119	2-4 weeks
		Slope Stability and Retaining Wall Works	112	Up to 3 months
		Installation of Street Lighting and ITS Infrastructure	111	1-2 weeks
		Linemarking	102	1-2 week
		Landscaping	105	2 weeks
Construction Compounds	General footprint of compound	Establishment of construction compounds and worksites	104	Intermittent activity, up to 2 years at some locations
		Deliveries of demountable office facilities	105	
		Installation of temporary boundary fencing	99	
		Establishing stockpiles and materials storage areas	110	
Structures – Bridge & Viaduct Construction	Church St to James Ruse Drive Viaduct Church Street Bridge Bridge Over Western Rail Line Bridge over Carlingford Line Bridge over James Ruse Drive Bridge over Wentworth Street Bridge over Denihey Street Bridge Over Duck Creek	Laydown pad, temporary platforms and establishments	105	4 weeks
		Unloading of truss bridge and pre-assembly onsite	102	2-4 weeks
		Piling (Vibratory)	113	2-4 week
		Piling (Bored)	105	2-4 week
		Abutments	107	2-3 weeks
		Erection of bridge truss, Erection/dismantling of scaffolding & Erection of bridge decking	104	4-6 weeks

[1] Limited information is available on the approximate durations of the activities at this phase of the proposal, and hence, the key activities determined have only had high level assumptions made with respect to proposed duration, based on previous similar activity type.

Predicted construction noise levels

Table 8.21 summarises NML exceedances across all NCAs for each of the construction activity groups described in Table 8.20. The range of predicted exceedances represents the range of exceedances for different construction scenarios, with some scenarios being considerably more noise intensive than others.

Table 8.21 Summary of airborne construction NML exceedances across all NCAs

Construction activity	Receiver type	Worst-case NML exceedance at nearby receptors (dB) (least noise intensive scenario – most noise intensive scenario)	
		Standard Construction Hours	Out of Hours Works
Main Corridor/Ramp Works	Residential	2 – 32	1 – 43
	Commercial	1 – 26	1 – 26
	Other sensitive	0 – 12	0 – 6
Construction Compounds	Residential	8 – 49	2 – 60
	Commercial	11 – 41	11 – 41
	Other sensitive	-	-
Structures – Bridge & Viaduct Construction	Residential	23 - 34	28 - 45
	Commercial	9 - 32	9 - 32
	Other sensitive	-	-

Due to the proximity of works to receivers, the predicted noise levels indicate high worst-case exceedances of the NMLs of up to 48 dB (standard hours) and 59 dB (outside standard hours) for construction at the nearest residences. Commercial receivers are predicted to be subject to high NML exceedances of over 20 dB. Other sensitive receptors are predicted to be subject to high NML exceedances of over 20 dB. However, it should be noted that the predicted construction noise exceedances shown in Table 8.27 are not expected to be consistently high for the entire duration of the activity and would vary throughout the project corridor

The residential NCA most affected by noise from construction of the main corridor/ramp works is NCA.A02_07N. Around 23 properties are worst-affected in the NCA. Construction of bridges and viaducts would most affect NCA.A02_07S_RES with 16 properties worst-affected. These counts are based on the total number of receiver buildings predicted to be subject to worst-case daytime construction noise levels above the highly noise affected level (75 dBA) at any time in the entire construction schedule. This is generally limited to periods when noise intensive activities are located immediately adjacent to residences. It is therefore expected that the number of noise affected receivers on a typical day to day basis would be considerably less than these estimates.

The most noise intensive works are site clearing and pavement works which may require use of a rockbreaker. Impacts from each of these activities are expected to last for about two weeks in total at any single receiver during the Main Corridor/Ramp works (refer to Table 8.20).

Predicted LA1 (1minute) noise levels at the nearest noise sensitive receivers indicate that the sleep disturbance screening criterion is likely to be exceeded when night works are occurring adjacent to residential receivers for the majority of works scenarios. This level of noise is typical for construction works using noise intensive equipment in built up areas.

Construction noise mitigation and management measures would be implemented to minimise the extent of exceedances identified above and would be included in the Construction Noise and Vibration Management Plan (CNVMP) prepared for the project (refer to section 8.2.7). Table 8.25 identifies typical construction noise mitigation measures that would also be considered during the preparation of the CNVMP, with accompanying estimates of anticipated noise reduction that would typically be achieved by each measure.

Noise monitoring of construction activities would also be used to assess actual impacts against construction noise criteria and determine compliance.

Table 8.22 Summary of airborne construction NML exceedances across all NCAs

Typical construction noise mitigation and management measures	Potential noise reduction (dBA)
Schedule construction works within the standard construction hours	No reduction during standard construction hours Eliminates out-of-hours noise impacts
Temporary acoustic fencing/barriers	Typically around 5 to 10 dB
Portable temporary screens	Up to around 15 dB
Construct operational noise walls	5-10 dB
Install operational property treatments	Variable
Avoid the coincidence of noisy plant working simultaneously close together	Up to 3dB for halving the number of similar dominant plant items working together
Shut down equipment when not in use	Negligible reduction in comparison to worst-case predictions, however eliminates noise source during less noise intensive works
Maximise offset distance between noisy plant items and nearby noise sensitive receivers	Approximately 6dB reduction per doubling of offset distance
Loading and unloading should be carried out away from sensitive receivers	Approximately 6dB reduction per doubling of offset distance

8.2.5 Assessment of potential construction road traffic noise impacts

Assessment of construction road traffic noise levels assumed additional heavy construction vehicle movements on public roads would be mainly required during daytime hours, with some heavy vehicle movements required to support night time construction works (when required for safety reasons or to minimise disruption to the road network). It also assumed use of the haulage routes identified in Table 6.1 and used the maximum daily forecast number of heavy vehicle movements from Table 8.2 added to the existing vehicle volume data, where available.

The assessment found compliance with the 2 dB allowance at all locations where existing traffic volume data is available. This is generally where the proposed haulage routes are on arterial and sub-arterial roads that have significant existing traffic flows.

Noise impacts may be greater where heavy construction-related vehicles need to access site compounds via local roads. Opportunities to minimise construction road traffic noise impacts on local streets would be identified during the preparation of the CNVMP (refer to section 8.2.7). Principles include minimising night time traffic and using arterial and sub-arterial roads where possible.

Additional assessment for night time truck movements on public roads when required would be undertaken during CNVMP preparation when a finalised Construction Traffic Management Plan is available.

8.2.6 Assessment of potential construction vibration impacts

Approach to assessment

Construction vibration was assessed by reference to the proposed location of work areas, the location of vibration sensitive receivers and the recommended safe working distances shown in Table 8.18.

Cosmetic damage assessment

The separation distance(s) between the proposed works and the nearest receivers would generally be sufficient so that nearby buildings are unlikely to suffer 'Cosmetic Damage' for most of the proposed construction equipment. However, based on the general work zones, some items of construction equipment have the potential to be operated within 20 metres of residential receivers and within the recommended safe working distances. The required locations for vibration intensive equipment will be reviewed during detailed design when more specific information is available.

Attended vibration monitoring or vibration trials will be undertaken when proposed works are within the safe working distances to ensure that levels remain below the criterion. Building condition surveys will also be completed both before and after the works at any potentially affected properties to identify existing damage and any proposal related damage.

Human comfort vibration assessment

Vibration at the nearest receivers is likely to be perceptible at times during the works because some items of proposed construction equipment may need to be used within 20 metres of residential receivers and within the recommended safe working distances.

8.2.7 Environmental management measures

Options development and design refinements described in Chapters 4 and 5 and section 8.2.3 have sought to minimise noise and vibration impacts as far as possible.

Project-specific management and mitigation measures have been developed with the aim of minimising or mitigating, as far as practical, the noise and vibration impacts during construction and operation as described above. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential impacts and site-specific management measures identified to manage those impacts for implementation during the pre-construction, construction and operational phases are summarised in the table below.

Impact	REF#	Environmental management measures	Responsibility	Timing
Operational Road traffic noise	NV-1	• Implementation of new noise barriers and increased height of some existing noise barriers as identified in Table 5.4 and shown on Figure 5.1 to Figure 5.3, and subject to refinement during detailed design. • Where residual impacts remain after all feasible and reasonable approaches have been exhausted, noise mitigation in the form	WDA	Pre-Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
		of acoustic treatment of existing individual dwellings will be considered, where feasible and reasonable.		
Operational Road traffic noise	NV-2	Within 12 months of the commencement of operation of the project an operational noise review will be undertaken. This will include: • Monitoring to compare actual noise performance of the project against predicted noise performance. • An assessment of the performance and effectiveness of applied noise mitigation measures together with a review and if necessary, reassessment of all feasible and reasonable mitigation measures. • Identification of any additional feasible and reasonable measures that will be implemented with the objective of meeting the criteria in the NSW Road Noise Policy (EPA 2011), when these measures will be implemented and how their effectiveness will be measured and reported.	WDA	Operation
Construction noise and vibration	NV-3	• A Construction Noise and Vibration Management Plan (CNVMP) will be prepared for the project. The CNVMP will: – Assist in ensuring that the noise during construction complies where possible with the construction noise management levels set for the project. – Determine noise and vibration monitoring, reporting and response procedures. – Describe specific mitigation treatments, management methods and procedures to be implemented to control noise and vibration during construction such as those identified in Table 8.29 above. – Describe construction timetabling to minimise noise impacts including time and duration restrictions, respite periods and frequency. – Describe procedures for notifying residents of construction activities likely to affect their amenity through noise and vibration. – Define contingency procedures to be implemented in the event of non-compliances and/or noise complaints.	Contractor	Pre-Construction
Construction Vibration	NV-4	• The following vibration mitigation measures will be specifically considered during the preparation of the CNVMP: – Relocate vibration generating plant and equipment to areas within the site in order	Contractor	Pre-Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
		to lower the vibration impacts. – Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment. – Use lower vibration generating items of excavation plant and equipment eg smaller capacity rockbreaker hammers. – Minimise consecutive works in the same locality (if applicable). – Use dampened rockbreakers and/or 'city' rockbreakers to minimise the impacts associated with rockbreaking works. – If vibration intensive works are required within the safe working distances, conduct vibration monitoring or attended vibration trials to ensure that levels remain below the cosmetic damage criterion. – Conduct building condition surveys both before and after the works to identify existing damage and any damage due to the works.		

8.3 Visual amenity, built form and urban design

This section documents the visual aspects and impacts of the project including those relating to landscape character, views, built form and overshadowing. Full details of the assessment undertaken are presented in the *WestConnex M4 Widening Urban Design Concept, Landscape Character and Visual impact Assessment Report* (KI Studio, 2014) (Volume 3 – Working Paper F) with a summary provided below. The assessment has been prepared to address relevant DGRs as documented in the table below.

Director-General's Requirements	Where addressed in EIS
Visual Amenity, Built Form and Urban Design — including but not limited to:	
• development of urban design objectives, including consistency with existing (and desired) character of the area (and, where appropriate, the WestConnex Urban Revitalisation Project);	Section 5.2.2 Section 8.3.2 Working Paper F
• rationale for the overall design (length, height, width and appearance) and an assessment of the built form (materials and finishes) and urban design (bulk and scale) of the project, including:	Section 8.3.3 Working Paper F
– details of pedestrian and cyclist access (dedicated or shared-use), and public transport and emergency vehicle access, including integration of the project with existing M4 cycleway and future pedestrian and cycle network in the local, regional and metropolitan context,	Section 8.3.3 Section 5.3.9
– design relationship to the existing M4 Western Motorway and adjoining built forms and streetscapes, and	Section 8.3.3 Working Paper F
– views to and from the project alignment.	Section 8.3.5 Working Paper F
• consideration of design, and safety measures, for pedestrian and cycle access in vicinity of the project;	Section 8.3.3
• an assessment of the construction and operational visual and amenity impacts of the project (height, scale and/or lighting) on the local and regional area, particularly on:	Section 8.3.4 Section 8.3.5 Working Paper F
– existing and future residential properties adjacent to the project alignment,	
– adjoining commercial, industrial, cultural and recreational land uses, and	
– significant vantage points in the public domain;	
• overshadowing impacts of the viaducts and ramps on existing and proposed public domain, open space, and residential, and commercial land uses.	Section 8.3.5 Working Paper F

8.3.1 Assessment methodology

The approach to assessment has involved the following sequence of activities:

- Contextual analysis including establishing a study area and considering existing land use, connectivity and the natural features of the area.
- Landscape character analysis which identified the character and qualities of the motorway corridor and adjacent precincts.

- Review of the existing built form language of the various structures along the motorway.
- Setting of urban design vision, objectives and principles.
- Identification of key constraints and opportunities and development of WDA concept design strategies.
- Landscape character and visual impact assessment using the Roads and Maritime *Guideline for Landscape Character and Visual Impact Assessment, EIA-N04* (2013).
- Landscape character impact is based on the aggregate of an area's built, natural and cultural character and sense of place and is measured by the combination of the area's sensitivity and the magnitude (scale, character and distance).
- In order to determine the visual impact, sensitivity values were assigned to the various viewpoints. The selected viewpoints are representative of the various landscape character zones identified within the visual catchment of the project. Landscape character zones were omitted where there would be no exposure and therefore a negligible visual impact. Figure 8.8 illustrates how the level of sensitivity and magnitude are combined to achieve an overall level of impact for both the landscape character impact and the visual impact.
- Overshadowing assessment to quantify shadowing impacts on public domain, open space, and residential and commercial land uses.

Figure 8.8 Landscape character and visual impact grading matrix

Magnitude

Sensitivity	high	moderate	low	negligible
high	high impact	high- moderate	moderate	negligible
moderate	high- moderate	moderate	moderate-low	negligible
low	moderate	moderate-low	low	negligible
negligible	negligible	negligible	negligible	negligible

8.3.2 Existing environment

Existing landscape character

Seven landscape character zones were identified along the M4 Motorway corridor which primarily reflect the character of surrounding areas (refer to Figure 8.9). Within the motorway corridor, two distinct areas were identified. For the western section (landscape character zones 1 to 4), the motorway is generally above ground and does not have a green median, while in the eastern section (landscape character zones 5 to 7) the motorway is predominantly on ground or within a cutting, creating a more enclosed character. This enclosed character is contributed to by an established ribbon of vegetation along the verges.



Landscape character zone map **Figure 8.7**

Table 8.23 Landscape character zone descriptions

Zone	Description	Character
Zone 1 Parramatta/Holroyd	Northern side – High sensitivity	Predominantly residential
	Southern side – Moderate sensitivity	Predominantly commercial and open space
Zone 2 – Harris Park/Granville	Northern side – High sensitivity	Predominantly residential (various densities) Urban watercourse (A'Becketts Creek corridor)
	Southern side – High sensitivity	Residential
Zone 3 – Industrial/Speedway	Moderate sensitivity	Industrial
Zone 4 – Duck River Crossing	Moderate sensitivity	Green watercourse corridor (Duck River) Commercial industrial to the south of the motorway
Zone 5 – Duck River to Haslams Creek	Northern side – High sensitivity	Commercial/industrial Residential from Silverwater east to Newington
	Southern side – Low sensitivity	Commercial/industrial Small residential/education pockets
Zone 6 – Carter Street Precinct	Northern side – Low sensitivity	Commercial/industrial Identified for urban activation (housing, retail, office-based employment)
	Southern side – Low sensitivity	Commercial/industrial Remnant vegetation at entrance to Hill Road.
Zone 7 – Olympic Park	Northern side – Moderate sensitivity	Sydney Olympic Park Commercial
	Southern side – Low sensitivity	Commercial/markets Residential pockets

Built form and language

The form language of bridge structures within the motorway corridor is currently inconsistent. Circular forms tend to dominate the existing viaduct structure, yet angular shapes occur at a number of locations contributing to its incoherent character. Screens on local road overpasses and pedestrian bridges tend to express a common form language with the use of curved screens.

Retaining walls are located in the vicinity of Wentworth Street and consist of precast concrete panels with vertical ribbing. Precast interlocking concrete components are used along Martha and Junction Streets.

Four types of noise walls occur in the project corridor: transparent panels, precast concrete panels with artistic motifs, plain precast concrete panels and wavy concrete walls (along the on-ramp near Silverwater Road).

Land use and connectivity

The project interfaces with a number of land uses, including residential neighbourhoods, industrial and commercial precincts and recreation areas. There are varying levels of connectivity for pedestrians and cyclists along and across the motorway corridor. This includes:

- North-south routes from the residential areas of Granville, Holroyd, and further south from Merrylands to Parramatta.
- A shared-path running along the southern side of the motorway corridor between Church Street and Burnett Street.
- Links between the residential areas of Rosehill/Harris Park to the north and Granville to the south of the corridor including cycle routes to Granville and Clyde Rail Stations. The strong east-west route provided a shared-path is dominant.
- Links between residential areas of Silverwater to the north and Auburn to the south of the motorway corridor including to Auburn town centre and rail station. The strong east-west route along a shared footpath is again dominant.
- Links between the residential areas of Newington to the north and Lidcombe to the south of the motorway corridor.
- An interruption to east-west connectivity at Haslams Creek.
- Strong connections to Sydney Olympic Park from the west and south of the motorway corridor.
- Limited options on dedicated shared paths for users travelling east of Sydney Olympic Park along the motorway corridor.

Desired future character

Local plans and strategies often articulate the desired future character of neighbourhoods and include controls on development to achieve their stated aims. In this case, the relevant local plans generally recognise the role of the M4 Motorway as a regional transport corridor and include objectives, zoning and other controls consistent with that purpose. In general terms this means designating land for infrastructure and ensuring that any development that occurs does not adversely affect its operation.

The desired future character of the motorway corridor is also expressed through the urban design vision, objectives and principles that have been set for the project (refer to section 5.2.2 and to Appendix F). WestConnex also provides opportunities for urban revitalisation that could activate passive spaces for the community and rejuvenate existing green space.

8.3.3 Design rationale

The urban design concept has been developed consistent with the urban design objectives and principles that were introduced in section 5.2.2 and which are explained in detail in Chapter 6 of Urban Design, Landscape Character and Visual Working Paper (Appendix F). It is subject to refinement during detailed design.

The design focuses on limiting visual and landscape character impacts by retaining a compact footprint and proposing mitigation strategies to address identified impacts. Landscape strategies would be further developed to enhance the remnant ecological corridors, particularly in the western section, and reinforce the existing motorway parkland character in the eastern section.

It is envisaged that the cycle routes will remain as existing construction works are complete. Improvements to lighting beneath the viaduct and cycle underpasses would assist with safety and security where practical. Improvements to Martha Street would improve the pedestrian/cyclist experience by providing a consistent width of path.

Western section – Church Street, Granville to Duck River

The design of the western section of the project from Church Street, Granville to Duck River builds upon the existing built form language as far as practical and takes into account construction issues in order to minimise disruption and other impacts to the community. It aims to deliver a simple form language that utilises other roadside components to create a uniform, contemporary appearance. Key features of the design approach are referred to in Chapter 8 of the Urban Design, Landscape Character and Visual Working Paper (refer Appendix F).

Eastern section

The eastern section of the project extending from Duck River to the Homebush Bay Drive interchange involves widening the existing motorway carriageways at grade. The WDA concept design seeks to emulate the existing situation in this section and the urban design strategy focuses primarily on vegetative screening opportunities and consistency of built form elements. Key features of the design approach are referred to in Chapter 8 of the Urban Design, Landscape Character and Visual Working Paper.

8.3.4 Assessment of potential construction impacts

There are three main types of works likely to have visual impacts during construction – bridge/viaduct works, motorway widening works (central median and side works) and construction compounds.

Bridge and viaduct works

Bridge and viaduct works would involve construction works for abutments, piers and the bridge superstructure between Church Street, Granville and Wentworth Street, Clyde, at Deniehy Street, Clyde and at Duck River. Visually this would mean ground based construction activities as well as views of the bridge superstructure in various stages of completion as it is progressively built using cranes and other equipment.

The areas most affected by the bridge and viaduct works would be would be the residential streets in Granville located to the south of the motorway between the Western Rail Line and the Carlingford Rail Line. Areas to the north of the motorway would have less direct views of bridge construction due to screening by the existing viaduct, while areas to the east and west are generally less sensitive land uses (industrial and commercial).

Motorway widening works

The central median works would involve construction adjacent to the inside ('fast') lane of the motorway and would include excavation, pavement construction, drainage works and service utilities works. The side works would involve construction adjacent to the outside ('slow') lane and shoulder of the motorway, including drainage and excavation works, pavement widening in some locations, drainage works, service utilities, installation of signage, noise mound and wall construction and landscaping.

Median and side work site establishment would involve the placement of temporary concrete safety barriers and fencing to create a safe work zone. Screening fencing would be installed along the barriers where required.

The existing motorway sits generally on fill but with well-vegetated embankments and noise walls mostly screening the corridor from surrounding land uses. At locations where side works require the removal of vegetation, visual exposure to the corridor would be increased meaning short-term visual impacts for people adjacent to the corridor. There may also be some minor impacts on road users and those residences located adjacent to the motorway associated with light spill from night-time construction works.

While construction of the entire project is estimated to take about two years, construction works at any one location along the corridor would occur over a much shorter period (refer to Figure 6.1 in Chapter 6).

Although noticeable to road users and some surrounding residents, the visual impacts of construction works within the corridor would be short-term and generally rated as low to moderate. The provision of some screening fencing between the motorway and the construction sites would reduce the visual impact of construction and limit distractions for road users.

Construction site compounds

Given that the project would be constructed under traffic there would be no opportunity to locate construction site compounds between the two motorway carriageways, and limited opportunity to locate them within the motorway corridor (except in the bridge works sections). The project includes the establishment of construction site compounds at locations outside the motorway corridor but as close as possible to the motorway (refer section 6.4).

Construction site compounds would comprise offices and material laydown areas and be fenced and generally covered in hardstand. Offices would generally be prefabricated and material storage areas would include purpose-built temporary structures as required.

In some cases construction site compounds would be visible from surrounding land uses and from within the motorway corridor. Where construction site compounds are to be used at night the potential for light spill would need to be carefully managed to minimise impacts on adjacent residents.

The potential visual impacts associated with the introduction of construction site compounds are considered to be low to moderate.

8.3.5 Assessment of potential operational impacts

Landscape character assessment

Table 8.24 shows the outcomes of the landscape character assessment on the identified landscape character zones. The table indicates that the project would have a limited landscape character impact. This outcome is mainly driven by the existing nature of the motorway and the

limited scale of the expansion. The highest impact occurs within Zone 2, along the southern verge, and is due the sensitivity of the adjacent residential land use. In most other areas either the land use, or the minimal impact of the project outside the existing motorway corridor, limit the landscape character impact. Overall the project was assessed to have a moderate-low impact.

Table 8.24 Landscape character impacts

Zone	Sensitivity	Magnitude	Impact
Zone 1 (north)	High	Low	Moderate
Zone 1 (south)	Moderate	Low	Moderate-low
Zone 2 (north)	High	Negligible	Negligible
Zone 2 (south)	High	Moderate	Moderate-high
Zone 3 (north)	Moderate	Moderate	Moderate
Zone 3 (south)	Low	High	Moderate
Zone 4	Moderate	Low	Moderate
Zone 5 (north)	High	Low	Moderate
Zone 5 (south	Low	Low	Low
Zone 6 (north)	Low	High	Moderate
Zone 6 (south)	Low	Moderate	Moderate-low
Zone 7 (north)	Moderate	Negligible	Negligible
Zone 7 (south)	Low	Low	Low

Visual impact assessment

Visual impact was assessed by reference to visual catchment of the project and key viewpoints as defined by either by topographical features, built form elements or screening vegetation (refer to Chapter 9 of the Urban Design, Landscape Character and Visual Working Paper). A total of 22 viewpoints outside the corridor and four viewpoints within the corridor were considered. Table 8.25 summarises the outcomes of the visual impact assessment. It shows that eight viewpoints were assessed as having a moderate-high or high impact.

Table 8.25 Visual impact assessment outcomes

Viewpoint	Location	Sensitivity	Magnitude	Impact
Outside corridor				
1	Holroyd Sportsground – view east	Moderate	Low	Moderate-low
2	Karung Reserve – view east	High	Negligible	Negligible
3	Church Street – view east	Low	Moderate	Moderate-low
4	A'Beckett's Creek – view east	Low	Moderate	Moderate-low
5	Western Rail Line – view west	Low	High	Moderate
6	Parramatta Road – view north-east	Low	Moderate	Moderate-low
7	Prince Street – view north	High	Moderate	Moderate-high
8	A'Beckett Street – view east	High	High–moderate	Moderate/high-High
9	Arthur Street – view south	High	Negligible	Negligible
10	Arthur Street/A'Beckett Street – view south-west	High	Negligible	Negligible
11	Alfred Street – view north	High	Moderate	Moderate-high

Viewpoint	Location	Sensitivity	Magnitude	Impact
12	Arthur Street – view north	High	High	High
13	Hamilton Street – view north-east	High	Moderate	Moderate-high
14	Wentworth Street – view south-east	Moderate	Low	Moderate-low
15	Martha Street – view east	Moderate	High	Moderate-high
16	Harbord Street – view north	Moderate	Moderate	Moderate
17	Shared path at Duck River – view east	Low	Moderate	Moderate-low
18	Adderley Street West – view east	Low	Low	Low
19	Deakin Street – view east	High	Low	Moderate
20	Parkland near Newington – view west	Moderate	High	Moderate-high
21	Hill Road – view east	Moderate	High	Moderate-high
22	Pullman Hotel – view south	High	Negligible	Negligible
Within corridor				
A	At A'Beckett Street prior to intersection with Alfred Street – view east	Low	Low	Low
B	At Martha Street – view west	Low	High	Moderate
C	At Stubbs Street overpass – view west	Low	Moderate	Moderate-low
D	At Hill Road – view of the northern motorway verge	Low	High	Moderate

A detailed assessment of all viewpoints can be found in Chapter 9 of the Urban Design, Landscape Character and Visual Working Paper.

Figures 8.5 to 8.8 provide an indicative illustration of typical changes that would be associated with the project at a number of locations along the corridor.



Existing



Site photo with viaduct shown indicatively.

Figure 8.10 Existing view and indicative montage looking east along A'Beckett Street



Existing



Site photo with viaduct shown indicatively.

Figure 8.11 Existing view and indicative montage looking along the shared path west of the Cumberland Rail Line



Existing



Site photo with retaining wall and landscaping shown indicatively

Figure 8.12 Existing view and indicative montage looking west along Martha Street



Existing



Site photo with viaduct shown indicatively.

Figure 8.13 Existing view and indicative montage looking north east along Arthur Street

Overshadowing

Figure 8.14 illustrates the expected shadow impacts to the areas south of the viaduct, in the vicinity of Arthur Street. This location is where the viaduct is likely to have the highest overshadowing due to the height of the structure.

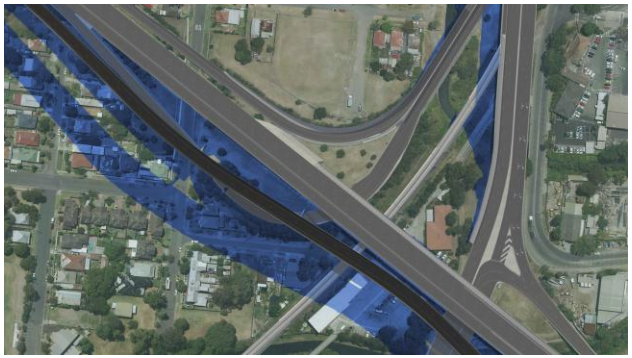
While the largest overshadowing would occur during the winter months early in the morning, there would be minimal impact in the afternoon. During the summer solstice, the overall overshadowing is fairly contained and impacts are limited.

Figure 8.15 illustrates the expected shadow impacts to the areas south of the viaduct, in the vicinity of Good Street.

Due to the orientation of the alignment, the overshadowing is more prominent compared to Arthur Street, even though the viaduct height is lower. The overshadowing mainly affects green areas and residual spaces with the exception of a few residences.

The largest overshadowing would occur during the winter months early in the morning and late afternoon. During the summer solstice, the overall overshadowing is negligible.

Figure 8.14 Overshadowing in the vicinity of Arthur Street



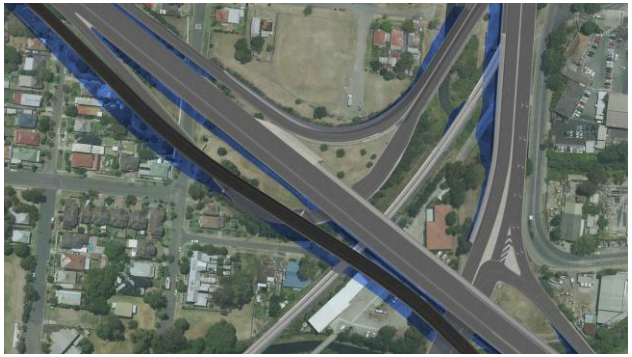
June 21 – 9:00am



June 21 – 12:00pm



June 21 – 3:00pm



December 21 – 9:00am

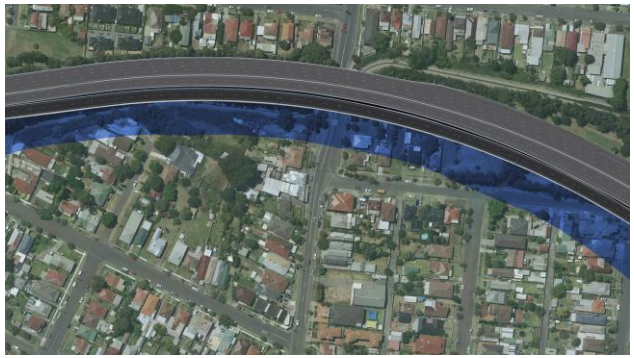


December 21 – 12:00pm

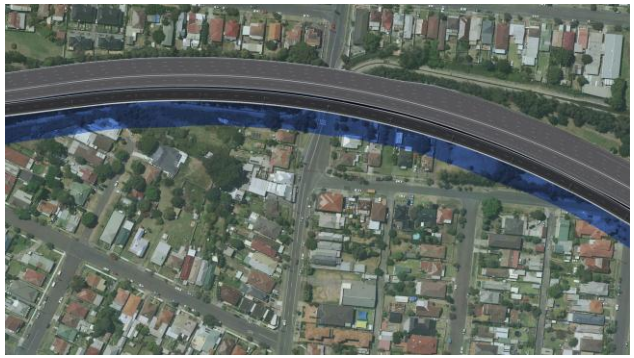


December 21 – 3:00pm

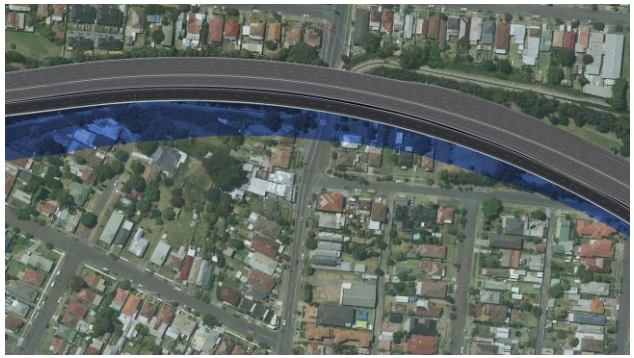
Figure 8.15 Overshadowing in the vicinity of Good Street



June 21 – 9:00am



June 21 – 12:00pm



June 21 – 3:00pm



December 21 – 9:00am



December 21 – 12:00pm



December 21 – 3:00pm

8.3.6 Environmental management measures

Options development and design refinements described in Chapters 4 and 5 have sought to minimise landscape character and visual impacts as far as possible.

Project-specific management and mitigation measures have been developed with the aim of minimising or mitigating, as far as practical, the landscape character and visual impacts during construction and operation as described above. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential impacts and site-specific management measures identified to manage those impacts for implementation during the pre-construction, construction and operational phases are summarised in the table below.

Impact	Ref#	Environmental management measures	Responsibility	Timing
Visual impacts	V-1	A detailed landscape plan will be prepared for the project. The landscape plan will build on the finding of the Urban Design, Landscape Character and Visual Working Paper and will include detailed set out, species and planting guides.	Contractor	Detailed design
Visual impacts	V-2	Where practicable, the height of retaining walls will be minimised allowing introduction of a batter and construction of reinforced soil wall to allow reinstatement of planting along verges.	Contractor	Detailed design
Visual impacts	V-3	Built elements, including noise walls will be further refined consistent with the urban design vision, objectives and principles for the project.	Contractor	Detailed design
Construction visual impacts	V-4	The visual impact of construction site compounds on adjacent residential areas will be minimised through the careful planning and positioning of temporary offices, other plant and material laydown areas, and specific management of lighting and potential for light spill within the identified construction site compounds.	Contractor	Construction
Construction visual impacts	V-5	Vegetation, mature or otherwise, currently located between construction site compounds and adjacent residential areas will be retained where practicable to screen views.	Contractor	Construction
Construction visual impacts	V-6	Vegetation clearance will be limited to that required to construct the project. Where practicable landscaping would be progressively introduced to provide screening between adjacent residences and the motorway corridor.	Contractor	Construction
Construction visual impacts	V-7	Where possible, some screening fencing will be introduced between the motorway carriageways and the work sites in the median and to the sides of the motorway to reduce the visual impact of construction and limit distractions for road users.	Contractor	Construction

8.4 Soils, water and waste

This section documents the potential impacts of the project on soils and water, and in relation to waste generation. Full details of the assessment undertaken are presented in the *WestConnex M4 Widening Soils, Water and Waste Technical Study* (SMEC, 2014) (Volume 3 – Working Paper G). The assessment has been prepared to address relevant DGRs as documented below.

Director-General's Requirements	Where addressed
Construction and operational erosion and sediment and water quality impacts on Haslams Creek, Duck River, Duck Creek and A'Becketts Creek, including an assessment of:	
• potential water quality impacts and mitigation measures to manage water pollution, with reference to relevant public health and environmental water quality criteria, including those specified in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000), and any applicable regional, local or site-specific guidelines	Sections 8.4.3, 8.4.4
• proposed storm water management system and management measures for the containment of pollutants and minimisation of leachate and sediment mobilisation	Section 5.3.5 Section 8.4.5
• management of and disposal strategies for acid sulfate soils, in accordance with the Acid Sulfate Soils Manual (ASSMAC)	Section 8.4.5
• waste handling	Section 8.4.5
Management of waste, including:	
• classification of waste taking into account the Waste Classification Guidelines (Department of Environment, Climate Change and Water 2009)	Section 8.4.3
• waste handling, stockpiling and transportation	Sections 8.4.3, 8.4.4, 8.4.5
• quantification of bulk earthworks and spoil balance, and reuse or disposal of excess spoil	Section 8.4.3
• preliminary assessment and remediation strategies for contaminated land.	Sections 8.4.3, 8.4.4, 8.4.5

8.4.1 Assessment methodology

Contaminated land

Preliminary (Phase 1) and detailed (Phase 2) site assessments were undertaken by GHD (2013, 2014 respectively) to identify potential contamination and acid sulfate soils (ASS) that may be impacted by the project. The framework for the soil and land contamination assessment was developed in accordance with guidelines 'made or approved', by the EPA, under section 105 of the (NSW) *Contaminated Land Management Act 1997*.

Acid sulfate soils

ASS is the common name given to sediments and soils containing iron sulfides which, when exposed to oxygen generate sulfuric acid. The relatively specific conditions under which ASS are formed usually limit their occurrence to low lying parts of coastal floodplains, rivers and creeks.

Assessment of ASS comprised an initial review of ASS Risk Maps from the NSW Natural Resource Atlas with subsequent field testing and laboratory analysis.

Hazardous materials

The Phase 1 preliminary site assessment (GHD 2013) included consideration of the potential presence of hazardous materials within the project footprint. This involved:

- Searches of the EPA's environment protection licence register to identify sites licenced to handle hazardous materials.
- Dangerous goods searches with WorkCover NSW of the Stored Chemical Information Database and microfiche records held by WorkCover NSW.

This identified six sites that potentially contained hazardous materials.

Sediments

The Phase 2 detailed site assessment (GHD 2014) included collection of sediment samples in A'Becketts Creek, Duck River, Duck Creek and Haslams Creek at eight accessible locations using a stainless steel hand auger. Samples were collected at the surface and up to 0.4 metres below the estimated level of sediment. For subsurface samples, characteristics of the stratum were noted together with any obvious visual or olfactory evidence of potential sediment contamination. Sediment samples were submitted for analysis at a NATA certified testing laboratory for a range of analytes. Results were considered with reference to the Interim Sediment Quality Guideline detailed in Table 3.5.1 in the *Australian Water Quality Guidelines for Fresh and Marine Waters* (Australian and New Zealand Environment and Conservation Council (ANZECC) 2000).

Water quality

Assessment of likely and potential impacts of the project on surface water quality has included:

- Review of existing literature relating to the project, available water quality data and existing conditions using available non-project literature to obtain background information on catchment history and land use to aid in interpreting the existing conditions.
- Assessment of the impact of construction activities on water quality with reference to the ANZECC 2000 water quality guidelines with regard to aquatic ecosystems, visual; amenity, primary/secondary contact recreation, and aquatic foods (cooked).
- Review of water quality treatment measures that could be used to mitigate the impact of construction on water quality, following the principles of *Managing Urban Stormwater–Soils and Construction Volume 1* (Landcom 2004) and *Volume 2D* (DECC 2008).
- Assessment of the water impacts of the project during operation.
- Review of water quality treatment measures that could be used to mitigate the impact of the operation of the project on water quality following the principle of *Procedure for Selecting Treatment Strategies to Control Road Runoff*' (RTA 2003), *RMS Water Policy* (RTA, 1997), and *RMS Code of Practice, Water Management* (RTA 1999).

Field investigation, sample collection and analysis was undertaken consistent with the methodologies outlined above. The Phase 1 preliminary site assessment included searches of the NSW Groundwater Works website to identify licenced groundwater boreholes in or within close proximity to the project. Reviews were undertaken of drillers logs where available to ascertain the character of the underlying material and to identify the nominal depth to the watertable. Hydrogeological maps covering the project area were also reviewed.

The Phase 2 detailed site assessment comprised:

- Drilling of 13 groundwater boreholes.
- Groundwater sampling of these boreholes and 10 groundwater wells installed as part of the Roads and Maritime geotechnical investigation.
- Analysis of selected groundwater samples by a NATA accredited laboratory for a range of contaminants of potential concern.

Waste

The POEO Act covers the requirements for waste generators in terms of storage and correct disposal of waste and their responsibility for the correct management of waste, including final disposal. Under the POEO Act and its regulations, guidelines have been established for the classification of waste and these have been considered in the assessment of waste generated by the project and subsequent development of mitigation and management measures.

Quantities and types of wastes that would be generated from the project were identified from the project constructability review and were used as the basis for the preliminary classification in accordance with the *Waste Classification Guidelines* (DECCW 2009). Resource use for the project was assessed by reviewing existing information and estimating the resources required for construction and their likely sources.

8.4.2 Existing environment

Geology

The geology of the area is derived from the Wianamatta Group and is predominantly underlain by the Ashfield and Bringelly Shale formations, overlying the Hawkesbury Sandstone formation (Department of Mineral Resources and Energy 1991).

These geological units are overlain by Quaternary aged Alluvium (Qha) around the creek lines. This comprises quartz sand, silty sand, silt and clay.

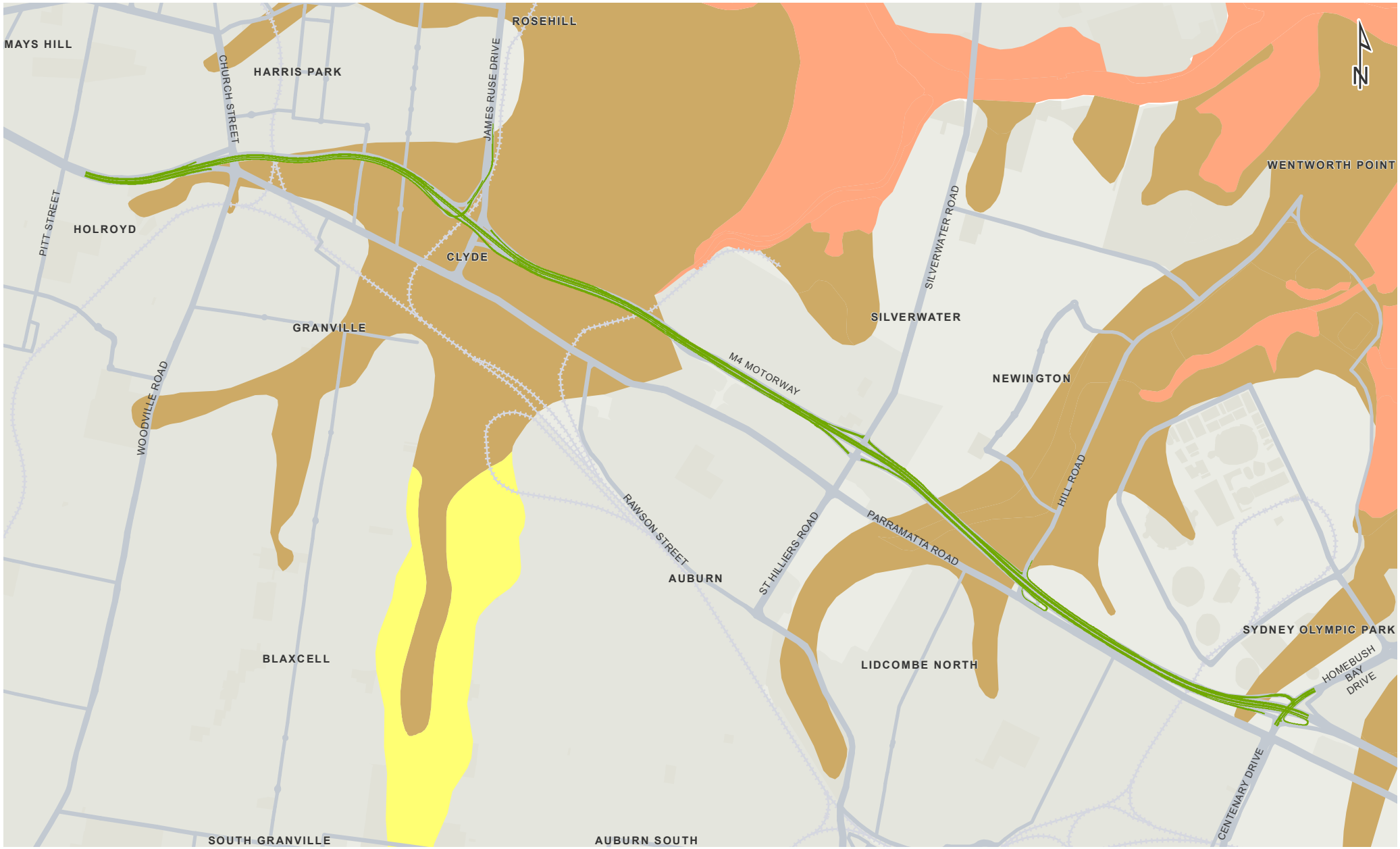
Soils

Four main soil landscapes have been identified within the project area in accordance with Soil Landscapes of Sydney (Soil Conservation Service of NSW 1989). These are:

- Birrong – high soil erosion hazard.
- Blacktown – generally moderate soil erosion potential ranging from low to high and poor soil drainage.
- Glenorie – high soil erosion hazard.
- Disturbed terrain (greater than four metres elevation) – including areas of fill or have heavy ground disturbance through general urban development.

Acid sulfate soils

The Phase 1 preliminary site assessment identified the potential for ASS to occur along the entire alignment. The Phase 2 detailed site assessment indicated that potential ASS (PASS) are present within the alluvial clay strata in areas mapped as potential ASS. Areas of PASS are shown in Figure 8.16.



KEY

Project design

Acid sulfate risk

- High probability of occurrence
- Disturbed Terrain
- No known occurrence

Areas of potential acid sulfate soils Figure 8.14

0 0.5 1
Km

Sediments

Sydney Harbour, including the Parramatta River, has a highly urbanised and industrialised catchment with a long history of contamination (Birch and Taylor 1999). Duck River, Duck Creek, Haslams Creek and A'Becketts Creek are located within the upper catchment.

Sediments in Sydney Harbour are known to be contaminated by a wide range of chemicals including metals, organochlorine compounds (Birch and Taylor 1999) and polycyclic aromatic hydrocarbons (McCready et al 2000). Sediments play a significant role in the storage and transport of contaminants and they are increasingly being used to identify sources of toxicants, to determine dispersion pathways and to locate contaminant sinks in aquatic systems (Birch et al 2000).

Stormwater runoff from urban catchments is widely recognised as a major source of contamination. In highly urbanised catchments, road surfaces have been shown to constitute up to 22 per cent of total catchment area and contribute up to 26 per cent of total runoff volumes with commensurate contributions of total 'heavy metal loads of 19 to 40 per cent (Davis and Birch 2009).

Urban stormwater and drainage systems provide pathways for contaminants to enter receiving waters, including metals bound to soils and consequently sediments of urban waterways frequently exhibit elevated metal concentrations (Birch et al 2001). Strong declining heavy metal trends away from canals discharging into the upper parts of many harbour embayments suggests that stormwater is a major source of contamination (Birch and Taylor 1999).

The Phase 2 detailed site assessment included collection of sediment samples from A'Becketts Creek, Duck River, Duck Creek and Haslams Creek (refer Appendix G for sample locations). Of the analytical results with concentrations above the laboratory limit of detection, metals, PAH, dieldrin, and asbestos recorded concentrations above the relevant screening criteria (Table 3.5.1 in the ANZECC 2000 guidelines).

Contaminated land

The M4 Widening project covers 7.5 kilometres of existing road network between the Pitt Street overpass at Parramatta and Homebush Bay Drive, Homebush. The route covers an area of diverse characteristics and is surrounded by a number of potentially contaminating land uses including industrial complexes, landfill sites and railway facilities. There is potential for contaminated land to occur within the vicinity of the project due to old industrial areas and numerous contaminated sites located along the Parramatta River.

The Phase 1 preliminary site assessment identified certain areas as having a high or high to moderate risk of contamination (refer to Table 8.26).

Table 8.26 Areas of high or high to moderate risk of contamination

Project section	Area
Pitt Street to Church Street	Near the battery recycling depot. There is potential for heavy metal contaminants and low pH.
Church Street to Deniehy Street	Cement bound asbestos fragments were observed beneath the M4 Motorway to the northern of A'Beckett Street and the corner of Alfred Street. On the eastern side of the James Ruse Drive Junction in a landscaped area beneath the M4 Motorway a grassed over stockpile (approximately 60 m by 20 m by 2 m) was observed in weathered portions of the stockpile to contain cement bound asbestos containing materials and potentially acid sulfate soils. Additionally the fill in these areas may contain other contaminants including hydrocarbons, pesticides and heavy metals, and possible acid sulfate soils (in the stockpile at James Ruse Drive).

Project section	Area
	A section of Duck Creek beneath the M4 Motorway and James Ruse Drive junction was observed to be heavily contaminated by rubbish as well as potential sewage/leachate. The source of this was not identified. There is potential for a range of contaminants including hydrocarbons, heavy metals, asbestos, polycyclic aromatic hydrocarbons and nutrient contaminants.
Junction Street to Silverwater Road	On the northern side of the M4 Motorway between Junction Street and Newton Street North is a soil and brick recycling facility; this was historically used as a landfill site. To the east of Stubbs Street there is evidence of fill materials (earth mounds, concrete rubble) along the vegetation strip. Waste odours were also noted in the eastern most portion of this area. Landfill and fill materials have the potential for a variety of contaminants including hydrocarbons, pesticides, heavy metals and asbestos, as well as explosive and toxic landfill and volatile organic fugitive gases.
Silverwater Road to Homebush Bay Drive	On the vegetation strip between Wetherill Street and Day Street South many of the mature trees are either distressed or have died. On the southern side of the M4 Motorway, to the east of Hill Road, between the M4 Motorway and Parramatta Road an area of open space has about 10 partially vegetated stockpiles over an area of approximately 50 m by 20 m. Fill materials included soils, brick, concrete and timber. On the southern side of the M4 Motorway between Birnie Street and Homebush Bay Drive, fill materials were observed in the vegetated strip between Parramatta Road and the M4 Motorway. To the east of Homebush Bay drive a portion of the open space area is used as a recycling centre (fill soils and trees). Fill materials have potential for a variety of contaminants including hydrocarbons, pesticides, heavy metals and asbestos.
	Two service stations occur to the south of the vegetation strip along Parramatta Road. These have potential for hydrocarbon and metals contamination.

Water quality

A review of existing and historic water quality in the Parramatta River estuary is provided in the *Parramatta River Estuary Coastal Zone Management Plan* (Cardno 2012). It notes that key water quality parameters of concern for management are dissolved oxygen (DO), pH, turbidity, nutrients (nitrogen, phosphorus), algal concentrations, and pathogens (faecal coliforms and enterococci).

With regard to human recreation, poor water quality has impacted on recreational usage of the estuary for activities such as swimming and fishing, with limited areas of the Parramatta River estuary considered suitable for primary and secondary contact recreational activities. Cardno Lawson Treloar (2008) note that dioxins in fish and prawns is a concern and that subsequent to an investigation undertaken by the NSW Food Authority, signage advising limiting consumption of fish and prawns was placed near popular recreational fishing spots around Sydney Harbour, including those in the Parramatta River estuary.

Analysis of monitoring data indicates that average concentrations of water quality parameters are in excess of the ANZECC (2000) aquatic ecosystem health guidelines for south-east Australian estuaries (Cardno, 2012). The exception is for pH for which the average values are in the acceptable range. Particular hotspots include Duck River and the Silverwater Bridge area. It is likely that these locations are impacted by sewer overflows due to the high concentrations of nutrients, faecal coliforms and enterococci, along with the low DO values. The high levels of nutrients at all sites indicate that nutrients entering the estuary via stormwater is a key issue and there is potential for algal blooms.

Groundwater

Groundwater is likely to be present in alluvium, shale and sandstone units associated with the study area. Based on a search of licensed groundwater boreholes in the vicinity of the project, groundwater is not used as a potable water source.

Groundwater levels vary across the project area. The Roads and Maritime (2014) geotechnical investigation recorded levels ranging from 0.1 metres AHD to 5.2 metres AHD between 7 and 11 March 2014. The Phase 2 detailed site assessment (GHD 2014) recorded levels ranging from 0.95 metres AHD to 13.48 metres AHD.

Groundwater parameters were observed to be reasonably consistent across the project site and within each of the strata as follows:

- Dissolved oxygen: results range from low to moderate oxygen levels typical of fresh/brackish groundwater.
- Electrical conductivity: results suggest that the groundwater is generally brackish to saline (1,298–24,759 µS/cm), which is expected for groundwater in the Ashfield Shale as this unit was formed in a marine environment.
- pH: readings were generally circumneutral which is typical for fresh/brackish groundwater.
- Oxidation-reduction potential indicated reducing conditions in many of the monitoring wells while some indicted potential oxidising conditions.

8.4.3 Assessment of potential construction impacts

Soils and sediments

Construction would involve the removal of existing vegetation and removal/modification of existing built features (eg paved surfaces) which would expose soils. Excavation would involve the stockpiling of spoil prior to reuse or removal from site. These and related construction activities would give rise to potential for erosion of unconsolidated material and entrainment by runoff and subsequent transport off site.

Soils transported into local waterways could have a number of impacts including:

- Reduced hydraulic capacity due to deposition of material within the channel.
- Degraded water quality including lower DO levels, increased nutrients (nitrogen (N), phosphorus (P)), increased turbidity, and altered pH.
- Increased levels of nutrients, metals and other pollutants transported via sediment and runoff to receiving waterways leading to increased potential for bioaccumulation of heavy metals in aquatic species.
- Increased sedimentation smothering aquatic life and affecting aquatic ecosystems.

Impacts from eroded material transported off the project site and deposited in terrestrial environments may include smothering of terrestrial vegetation and reduced visual amenity. Once dry, this material could form a source of dust emissions which could also impact on local amenity, particularly where deposition and occurred in proximity to residential areas, sensitive land uses such as schools and child care centres, and public open space.

A preliminary erosion and sedimentation assessment has been undertaken for the project in accordance with the Erosion and Sedimentation Risk Assessment Procedure (RTA 2004). This identified the project works to be low risk with reference to the following considerations:

- The size of the project and area of project corridor allows for maintenance and installation of controls.
- Slopes are less than five per cent grade and an R factor (rainfall erosivity) of 3500 for this area of Sydney presents as a low erosion hazard.
- Soils being exposed are generally within the existing road formation and adjacent to operational drainage networks.
- No SEPP 14 wetlands are located within the project area.

Construction of the bridge over Duck River would involve installation of up to four piers within the channel. Temporary access to the pier locations for construction would require the removal of vegetation including mangroves which presently assist in stabilising the channel bed and banks in turn reducing the potential for erosion/scour and mobilisation of sediments.

Duck River and its tributaries drain a heavily urbanised catchment with historical and current land use having a significant influence on sediment quality. As noted in section 8.4.2, previous investigations have identified trace metal concentrations in Duck River higher than reported background concentrations for the Port Jackson Estuary. Similar findings were made with regard to the sediment sampling and analysis undertaken as part of the Phase 2 detailed site assessment.

Duck River is tidal in this location and there are two tidal cycles daily. Tidal movement of water along the channel would have potential to entrain disturbed sediments and transport them both downstream to the Parramatta River estuary on the outward tide and upstream on the inward tide. The bidirectional movement of water in the channel would serve to limit the extent to which sediments were transported. Given the broader distribution of contaminated sediment within the wider Parramatta River estuary, the relatively limited works proposed within Duck River and the extensive management measures proposed in section 8.4.5, it is not anticipated there would be any material impacts associated with sediment disturbance. Disturbance of sediments would also have potential for localised short term increases in turbidity.

Water quality

Potential impacts on water quality from construction activities would be associated with:

- Disturbance/mobilisation of sediment associated with the clearing of riparian vegetation and removal of mangroves at Duck River associated with pier construction adjacent to and within the channel, and with providing access to the pier locations for construction.
- Exposure and mobilisation of exposed soils during construction such as from cleared areas and stockpiles.
- Accidental spills of chemical or hazardous materials.
- Inadequate management of runoff, sediment controls from the construction site.
- Potential disturbance and exposure of ASS to the air (oxidising conditions) resulting in potential for acidic runoff to reach receiving waterways.

Potential impacts could include:

- Degraded water quality including lower DO levels, increased nutrients, increased turbidity, and altered pH.
- Increased sedimentation smothering aquatic life and affecting aquatic ecosystems.

- Increased levels of nutrients, metals and other pollutants, transported via sediment and runoff to receiving waterways.
- Fuel, chemicals, oils, grease and petroleum hydrocarbon spills from construction machinery directly polluting the river and soils.
- Spills of concrete during concrete pours directly or indirectly polluting receiving waterways.
- Contamination from site compounds, chemical storage areas and washdown locations.
- Increased levels of litter from construction activities polluting receiving waterways.
- Contamination of receiving waterways as a result of disturbance of contaminated land.
- Acid runoff from disturbance of ASS during construction.
- Tannin leachate from cleared/mulched vegetation (this impact would likely be minor provided as vegetation clearance would be minimal and any cleared vegetation would be removed from site as soon as practicable after clearing.

The project is located on the southern side of the Parramatta River within the A'Becketts Creek, Duck Creek, Duck River, Haslams Creek and Powells Creek subcatchments, which all drain to the Parramatta River. These catchments are highly urbanised with large sections of open channels replaced with concrete-lined channels. Water quality is influenced by runoff from a diverse variety of sources, with the M4 Motorway drainage being only one of these.

As previously noted, existing water quality in the Parramatta River estuary is degraded with average concentrations of water quality management parameters (except for pH) being above the ANZECC (2000) aquatic ecosystem health guidelines for south-east Australian estuaries. Long term impacts on water quality in receiving waters are unlikely to be significant but given the increased motorway catchment area, there could be an incremental impact further reducing water quality.

Provided appropriate controls are implemented during construction, short term impacts are expected to be manageable and similarly have no material impact on receiving water quality.

Acid sulfate soils

The potential for ASS exists along the majority of the project, particularly in proximity to existing drainage channels. The principal risk is associated with disturbance and exposure of ASS to the air from excavation and construction works such as dewatering. If not appropriately managed, this could result in oxidation of ASS (over a period of weeks or months) with subsequent potential for highly acidic runoff that would impact groundwater, soils and waterways, as well as built environment elements.

The environmental impacts of acid drainage can include fish kills, fish disease, oyster damage and mortality, adverse effects on aquatic ecosystems, release of heavy metals from contaminated sediments, human and animal health impacts from polluted water, adverse impacts on soil structure and arability, and damage to built structures such as bridges (Ahern et al 1998). Within the context of the project, this could impact on water quality and aquatic ecosystems in both the immediate receiving waterways (A'Becketts Creek, Duck Creek, Duck River, Haslams Creek) and the broader Parramatta River estuary.

Contaminated land and hazardous materials

There is potential for contaminated land to be disturbed as a result of construction activities associated with excavation and other ground-engaging activities. Construction would also require

the temporary occupation of ancillary sites for use as construction compounds and/or materials storage area. Potential environmental impacts associated with the project include:

- Inappropriate handling/disposal of contaminated or hazardous waste.
- Adverse effects on human health (construction personnel, travelling public or nearby communities).
- Release of contaminants into underlying soils.
- Release of contaminants into groundwater.
- Movement of contaminated sediments into waterways.
- Adverse effects on flora and fauna.

The Phase 2 detailed site assessment identified the primary contamination issues with respect to human health and surface water/groundwater as being:

- Asbestos fragments as well as fibres in fill soils.
- PAHs in fill soils.
- Hydrocarbons (naphthalene) in groundwater.
- Lead, mercury, PAH and asbestos in sediments in A'Becketts Creek, Haslams Creek, Duck Creek and Duck River.
- PASS soils and sediments.
- Potential for hydrocarbon and landfill gas associated with a closed landfill to the north of the M4 Motorway.

The Phase 2 detailed site assessment identified three areas within the project area considered to represent a high risk to site users. These relate to the presence of asbestos at:

- The landscaped stockpile on the eastern side of the James Ruse Drive Junction.
- In land to the north of the M4 Motorway adjacent to the east and west of Deniehy Street.
- In an area of public access beneath the M4 Motorway to the east of Alfred Street.

Areas of high risk contamination will be further investigated prior to construction and appropriate remediation/mitigation measures will be implemented where required (refer section 8.4.5). Other contamination recorded in soil, such as PAHs and the potential risks associated with a former landfill, are not considered to present an imminent risk of harm to human health or the environment but would require appropriate management during construction.

The Phase 2 detailed site assessment concluded there was potential for latent contamination from hydrocarbons, heavy metals, asbestos, PAH contaminants associated with road usage; and hydrocarbons, pesticides, heavy metals and asbestos associated with illegal dumping or fill soils. This would also require appropriate management during construction.

Two commercial properties and three residential properties would be acquired for the project. Based on the age and the structure of buildings on these properties, there is potential for hazardous building materials to be present. Further assessment would be required prior to any demolition works that may be required as part of the construction in order to identify what management measures would be required during demolition to effectively manage risks to human health and environment.

Groundwater

The main potential impacts on groundwater associated with construction activities relate to:

- Interference to aquifers resulting in a decrease or change in groundwater levels impacting upon groundwater users and groundwater dependent ecosystems.
- Pollution of groundwater.

The risk of these impacts is considered to be low as, apart from piling, no construction activities would potentially interfere with any aquifers. No dewatering would be required for piling activities. Groundwater is not used as a potable water source within, or in proximity to, the project area and is therefore not expected to impact on the groundwater resource.

Exposure of ASS has potential for acid generation if not managed appropriately. Acidic runoff could impact on a range of environmental aspects including groundwater. Effective management of ASS is well understood and there are established guidelines to manage this risk. The likelihood of this impact is therefore considered to be low.

Waste

Waste generated during construction would primarily be from civil works associated with site preparation, relocation of utilities, and construction of road infrastructure and landscaping. Waste-generating activities would include:

- Vegetation clearance, generating green waste such as logs and mulched material.
- Construction of temporary construction compounds, construction roads, ancillary sites and alternative property access would require vegetation clearance, road surface grading, temporary drainage structure installation and the placement of gravel road base where required, generating general asphalt waste, pipe cuts and green waste.
- Installation of environmental controls, fencing, silt fences and lockable gates, generating material off-cuts.
- Demolition of kerbs, fencing, pavements, concrete noise walls, barriers, signage, lighting, parapets, existing toll plaza and gantries.
- Excavation of existing batters, for retaining walls, for drainage, piling for viaduct structure, piers and bridge abutments.
- Construction of the ultimate project involving earthworks, placement of pavement layers, drainage, piling and piers to viaduct footings, concrete pour, utilities placement and protection, installation of tolling infrastructure including gantries and control systems, lighting, fencing and road furniture.
- Installation of prefabricated bridge deck, prefabricated piers and viaduct units, precast barriers and guard rails, prefabricated culvert units, generating general construction waste.

Waste streams would include the following:

- Surplus spoil (excavated soil, sediment, rock) from bulk earthworks which is unable to be reused within backfilling or restoration.
- Contaminated soils that may be exposed during construction, and if exposed, would require offsite disposal.
- Concrete, pavement, steel and other materials from demolition of kerbs, fencing, pavements, concrete noise walls, barriers, signage, lighting, parapets, existing toll plaza and gantries.

- Surplus material from construction and general site reinstatement, such as fencing, sediment, concrete, steel, formwork, and sand bags.
- Packaging materials from items delivered to site, such as pallets, crates, cartons, plastics and wrapping materials.
- Vegetative waste from clearance and grubbing.
- Plant and vehicle maintenance waste, such as oil containers.
- General office wastes generated by onsite personnel, such as paper, cardboard, beverage containers and food wastes.
- Sewage waste generated through the use of personnel facilities.

Stockpiled materials can also cause impacts when materials are mixed. For example, mixing of topsoils with subsoils, mixing of suitable and unsuitable material or mixing contaminated material can lead to materials that would have ordinarily been reused being rendered as waste.

Earthworks would be required for across the project including for road widening, bridge construction and drainage. Based on estimates drawn from the concept design, it is predicted that about 110,000 cubic metres of imported fill would be required for construction of the project. It is predicted that there would be about 5,600 cubic metres of excavation material that could be beneficially reused as fill for the project. Imported fill would either be virgin excavated natural material (VENM) or would comply with the conditions attached to a relevant resource recovery exemption.

It is estimated that about 51,000 cubic metres of spoil material would be produced through excavation activities that would be unsuitable for reuse on site. This would be transported for beneficial reuse off-site in accordance with a relevant EPA resource recovery exemption or disposed of at a licensed waste facility.

The Phase 2 detailed site assessment included a preliminary waste classification for fill soils. Based on this, fill soils would be classified as general solid waste (where no asbestos is observed) or special waste (asbestos) (for the location at/near BH215). Further waste classification would be required during construction to determine appropriate soil management and disposal. The underlying natural soils have recorded concentrations that would be classified as general solid waste but if uncontaminated are likely to satisfy the criteria for VENM. Soils defined as PASS would require disposal in accordance with the NSW DECC (2009) guidelines for ASS.

8.4.4 Assessment of potential operational impacts

Soils and sediments

Following construction, cleared areas would be paved/landscaped and scour protection installed at drainage outlets. There would be no exposed areas of topsoil and therefore little or no risk of soil erosion and entrainment of unconsolidated material by wind or runoff.

The installation of piers in the Duck River channel would reduce the overall channel cross-section resulting in localised increases in flow velocities. This would give rise to potential for scour (increased through removal of mangroves), and entrainment and transportation of sediments. Over the longer term, the channel would adjust to a new equilibrium condition which would involve a wider and/or deeper channel.

As noted previously, the tidal nature of water movement would serve to limit the extent to which entrained sediments were transported. Increased turbidity would also be associated with

entrainment and transport of sediments. The potential for bank and bed scour can be reduced through provision of appropriate scour protection such as channel armouring (eg rip rap).

Water quality

Following completion of construction, including rehabilitation of exposed areas where vegetation and/or impervious surfaces had been removed, there would be minimal exposed areas of bare ground that could represent a potential source of unconsolidated material with potential for entrainment. As such, there would be little or no risk of soil erosion and transport of eroded sediments to receiving waterways.

Scour at drainage discharge points has potential for erosion and subsequent entrainment of material and transportation to receiving waterways. Provided this is adequately managed through appropriate design considerations such as incorporation of flow velocity reduction measures and scour protection, the likelihood of such impacts would be low.

Water quality risks during operation would largely be associated with the runoff of pollutants from the road surface. Typically, pollutants associated with road runoff are:

- Sediments from the paved surface from pavement wear and atmospheric deposition.
- Heavy metals such as lead, zinc, copper, cadmium, chromium and nickel attached to particles washed off the motorway pavement.
- Oil and grease and other hydrocarbon products.
- Rubber particles from wearing off tyres on the road pavement.
- Brake pad dust which could potentially include asbestos from older brake pads.
- Nutrients (N, P).

These deposits build up on road surfaces and pavement areas during dry weather and can be washed off and transported to waterways during rainfall periods.

Material deposited by motorists, such as non-biodegradable litter and food wastes, could also impact water quality, amenity and aquatic ecosystems if transported into receiving waterways.

During operation there would be a risk of accidental spillage of fuel, chemicals or other hazardous liquids as a result of vehicle leakage or road accidents on the motorway. While the likelihood of such potential spills would be low, the impact on the receiving environment could be considerable as spills of this nature would pollute receiving waterways if not adequately managed or mitigated.

Existing water quality in the Parramatta River estuary is degraded with average concentrations of water quality management parameters being above the ANZECC (2000) aquatic ecosystem health guidelines for south-east Australian estuaries. Polluted runoff would further degrade receiving water quality.

Acid sulfate soils

Negligible impact from ASS is expected once construction has been completed and disturbed areas have been stabilised.

Contaminated land and hazardous materials

Incidents such as vehicle accidents on the widened motorway could result in spillage of contaminants or hazardous materials on to the roadway. If not contained and/or cleaned up promptly, there would be potential for these to enter the drainage system and be discharged to

receiving waterways. This in turn could impact negatively on water quality and aquatic ecosystems.

Groundwater

There is unlikely to be any material impact on groundwater associated with operation of the project. In the event that it is necessary to dewater construction sites, further investigation would be undertaken with regard to treatment and disposal of groundwater.

Waste

During operation of the project, small quantities of waste would be generated and would potentially include spills and leakages from vehicles, litter generated by road users and sediment from the water quality control basin. In addition, small quantities of waste would be generated from road maintenance and repair activities. The volume of operational waste would be minor and would be classified and disposed of to an appropriately licensed landfill.

8.4.5 Environmental management measures

Options development and early construction planning, described in Chapters 4, 5 and 6, have sought to minimise soils, water and waste related impacts as far as possible.

Project-specific management and mitigation measures have been developed with the aim of minimising or mitigating, as far as practical, the soils, water and waste related impacts during construction and operation as described above. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential impacts and site-specific management measures identified to manage those impacts for implementation during the pre-construction, construction and operational phases are summarised in the table below.

Impact	Ref#	Environmental management measures	Responsibility	Timing
Managing impacts on soil and water in general	SWW-1	A Soil and Water Management Plan will be prepared for the project in accordance with: • *Managing Urban Stormwater–Soils and Construction, Volume 1 Managing Urban Stormwater, 4th edition* (‘the Blue Book’). • *Managing Urban Stormwater–Soils and Construction, Volume 2D Main Road Construction*.	Contractor	Pre-construction
Erosion risk – general	SWW-2	• Measures will be implemented during construction to minimise the risk of erosion, sedimentation and pollution. These measures may include: • Avoid disturbance where practicable, otherwise minimise the area of disturbance, particularly on and adjacent to river banks. • Designate of ‘no-go’ zones for construction plant and equipment. • Install upstream diversion channels to direct clean runoff from upstream	Contractor	Construction

Impact	Ref#	Environmental management measures	Responsibility	Timing
		catchments around or through disturbed areas (maintaining separation from runoff containing sediment). • Shape disturbed land to minimise slope lengths and gradients and improve drainage. • Install/line catch drains to carry any sediment laden runoff to appropriate sediment control measures. • Minimise stockpiling of material. • Remove cleared or excavated materials as soon as practicable after excavation and appropriately dispose of or stockpile off-site. • Locate stockpiles away from drainage lines and creek channels. • Seed disturbed areas for temporary soil stabilisation. • Employ appropriate measures to prevent/minimise wind-blown dust from leaving the site (eg watering). • Establish designated areas for plant and construction material storage within site compounds and other locations within the project area. • Store all chemicals and fuels associated with construction in secure roofed and bunded areas. • Retain erosion and sediment controls until disturbed areas are stabilised.		
Erosion from disturbed areas	SWW-3	• Measures will be implemented during operation to minimise the risk of erosion and sedimentation. These measures may include: • Undertake post-construction monitoring to ensure successful establishment of landscaping and vegetation cover. • Undertake remedial planting in locations where vegetation cover has not established or has only partially established.	Contractor	Operation
Erosion risk and mobilisation of sediment associated with Duck River bridge pier	SWW-4	• The following measures will be implemented to address erosion and sedimentation risk near the Duck River bridge works. • Minimise the area of mangroves to be cleared. • Install temporary coffer dams (sheet	Contractor	Construction

Impact	Ref#	Environmental management measures	Responsibility	Timing
construction		piling) or suitable alternative around pier construction locations. • Use silt curtain, subject to consideration of tidal flow velocities. • Program works likely to disturb aquatic sediments to 'slack water' periods. • Conduct water quality monitoring.		
Operational water quality impacts	SWW-5	• Detailed design would consider practicable measures to optimise pollution mitigation. This would include vegetated swales with rock check dams and spill management basins where space permits.	Contractor	Pre-construction
Disturbance of ASS	SWW-6	• An ASS Management Plan will be prepared in accordance with the *Acid Sulfate Soils Manual* and Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulfidic Black Ooze.	Contractor	Pre-construction
Disturbance of contaminated or potentially contaminated land	SWW-7	• A Contaminated Land Management Plan (including a Remediation Action Plan where required) will be prepared in accordance with relevant EPA guidelines.	Contractor	Pre-construction
	SWW-8	• Excavated material that is not suitable for on-site reuse or recycling will be transported to a site that may legally accept that material for reuse or disposal. • Soils leaving the site will be waste classified so that correct resource recovery and or off-site disposal occur.	Contractor	Construction
	SWW-9	• An Asbestos Management Plan will be developed for the construction of the project in accordance with the *National Environment Protection (Assessment of site contamination) Measure 1999*. • The Plan will include an unexpected finds procedure to address any previously unidentified asbestos contamination encountered during construction. • Further investigation of the area of public access beneath the M4 Motorway to the east of Alfred Street will be undertaken to assess the level and extent of asbestos in this area.	Contractor	Pre-construction
Inappropriate disposal of	SWW-10	• Where excavated material cannot be classified as virgin excavated natural	Contractor	Construction

Impact	Ref#	Environmental management measures	Responsibility	Timing
excavated material that cannot be reused in the project		material, it will be classified and disposed of to an appropriately licensed landfill in accordance with the *Waste Classification Guidelines–Part 1: Classifying Waste* and *Part 2: Immobilisation of Waste*.		
Disturbance of contaminated groundwater	SWW-11	• Further assessment of the extent and source of hydrocarbon contamination associated with BH101 (located at the junction of Church Street/Great Western Highway) will be undertaken to inform the requirements of any specific remediation or management measures during construction.	Contractor	Pre-construction
Disturbance of hazardous materials	SWW-12	• Assessment of the two commercial properties and the four residential properties being acquired will be undertaken for the presence of hazardous building materials.	Contractor	Pre-construction
Inappropriate handling and/or disposal of waste	SWW-13	• A project-specific Resource and Waste Management Plan (RWMP) will be prepared in accordance with the Roads and Maritime Waste Minimisation & Management Guidelines and applicable Roads and Maritime QA Specifications.	Contractor	Pre-construction
	SWW-14	• All wastes, including contaminated wastes, will be identified and classified in accordance with *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes*. • Disposal of any non-recyclable waste will be in accordance with the POEO Act and *Waste Classification Guidelines: Part 1 Classifying Waste*.	Contractor	Construction

8.5 Hydrology and flooding

This section documents the potential hydrology and flooding impacts of the project. Full details of the assessment undertaken are presented in the *WestConnex M4 Widening Hydrology and Flooding Technical Study* (SMEC, 2014) (Volume 3 – Working Paper H) with a summary provided as follows. The assessment has been prepared to address relevant DGRs as documented below.

Director-General's Requirements	Where addressed in EIS
Soils, water and waste – including but not limited to: • hydrological impacts, including an assessment, taking into account the *Floodplain Development Manual* (Department of Natural Resources 2005), of the following:	Section 8.5.3
– changes to existing flood regimes,	Section 8.5.3
– impacts to existing receivers and infrastructure and the future development potential of affected land,	Section 8.5.3
– identifying the potential impacts on surface water flow velocities and directions, and impacts on the bed and bank stability, with particular reference to construction of the new viaducts, and	Section 8.5.3
– an assessment of the effects of sea level rise as a result of climate change on the project.	Section 8.5.3

8.5.1 Assessment methodology

Modelling of catchments and the drainage network was undertaken to assess the existing stormwater flow regimes and to determine the potential impacts of the project. The models used were sourced from councils and then supplemented with additional survey details for existing waterways, bridges, drainage infrastructure and ground surface levels.

The main assessment considerations were:

- Changes in impervious area due to additional road pavement and consequential effects on surface flows.
- Addition of bridge/viaduct piers in the waterways and the potential effects to Duck River, Duck Creek and A'Becketts Creek.

Based on the *Practical Consideration of Climate Change – Floodplain Risk Management Guideline* (Department of Environment and Climate Change, 2007) the indicative change in extreme rainfall for the Sydney Metropolitan Catchments is between -7 per cent and +10 per cent by 2070. For assessment purposes, a 10 per cent increase in rainfall intensity has been adopted.

8.5.2 Existing environment

Catchments and waterways

The project crosses a number of waterways draining to Parramatta River. These waterways include A'Becketts Creek, Duck Creek, Duck River and Haslam's Creek. At the eastern end of the project near Homebush Bay Drive, a number of small tributaries drain across the M4 Motorway to Homebush Bay, east of Haslams Creek.

Duck Creek and A'Becketts Creek are tributaries of Duck River. The Duck River catchment has an area of about 41 square kilometres to its outlet at the Parramatta River, some 2.3 kilometres downstream of the existing M4 Motorway. The Duck River catchment is split between various LGAs including Bankstown, Parramatta, Auburn and Holroyd. A'Becketts Creek has a catchment area of seven square kilometres while Duck Creek has a catchment area of nine square kilometres.

The Duck River catchment is highly urbanised with a mixture of medium and high density residential, commercial and industrial land use. Duck River is an unlined vegetated channel in the vicinity of the M4 Motorway. Duck Creek is similarly an unlined vegetated channel where it crosses the M4 Motorway. A'Becketts Creek is lined over most of its length upstream of the Duck River confluence. The creek alignment follows the M4 Motorway alignment from the Church St interchange to Good Street to the east.

Haslams Creek is located to the east of Duck River and drains an area of 17 square kilometres. The catchment is heavily urbanised and much of the creek upstream of Parramatta Road is a lined concrete channel. The creek is unlined downstream of Parramatta Road, where it crosses the existing M4 Motorway. Channel restoration works were undertaken in association with the Homebush Bay redevelopment with the aim of restoring a riverine environment.

Existing flooding

Flood models were used to estimate the existing area covered by the project. Table 8.27 shows the modelled existing flood levels at the reaches that cross the project corridor while Figure 8.17 shows the location of watercourses. The table includes the five per cent, one per cent Annual Exceedance Probability (AEP) and Probable Maximum Flood (PMF) flood levels.

Table 8.27 Existing flood levels

Location	Watercourse	5%AEP	1%AEP	PMF
Ch 8610B	Reach A	4.53	4.89	5.69
Ch 7750B	Reach B	7.59	8.38	11.24
Ch 6950B	Reach C	10.51	10.87	12.11
Ch 6100B	Haslams Tributary	4.73	5.39	9.31
Ch 5500B	Haslams Creek	3.79	3.97	7.15
Ch 4950B	Reach D	8.46	8.67	11.06
Ch 4400B	Reach E	16.22	16.31	17.88
Ch 3500B	Reach F	-	-	-
Ch 3400B	Duck River	3.75	4.23	7.16
Ch 2500B	Duck Creek	4.77	5.10	7.77
		4.93	5.23	7.81
		5.07	5.42	7.96
Ch 1400B	A'Becketts Creek	5.13	5.52	7.97
		5.02	5.46	7.62
		6.47	7.01	10.96
		8.82	9.13	12.36
Ch 0600B	A'Becketts Creek inflow	8.65	8.91	12.47



KEY

Project design

Locations of watercourses Figure 8.15

8.5.3 Assessment of potential impacts

Flood levels

Table 8.28 shows the modelled impacts of the proposal on flood levels and velocities.

Table 8.28 Flood level and velocity impacts

Locn	Reach	Maximum Increase in Flood Level (m)				Maximum Increase in Velocity (m/s)			
		5% AEP	1% AEP	PMF	Climate Change Scenario	5% AEP	1% AEP	PMF	Climate Change Scenario
Ch 8610	Reach A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ch 7750	Reach B	0.01	0.01	0.00	0.00	0.01	0.02	0.00	0.01
Ch 6950	Reach C	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.02
Ch 6100	Haslams Creek Tributary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ch 5500	Haslams Creek	0.02	0.01	0.01	0.00	0.01	0.01	0.00	0.00
Ch 4950	Reach D	0.00	0.00	0.01	0.00	0.00	0.04	0.00	0.00
Ch 4400	Reach E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ch 3500	Reach F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ch 3400	Duck River	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Ch 2500	Duck Creek	0.01	0.01	0.03	0.02	0.04	0.04	0.09	0.06
Ch 1400	A'Becketts Creek	0.39	0.34	0.48	0.34	0.53	0.62	1.22	0.76
Ch 600	A'Becketts Creek Inflow	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Note: Refer to concept design drawing in Appendix C for chainage locations.

In all of the modelled crossings east of and including Duck Creek, the project has an impact of 0.01 metres or less on flood levels in the one per cent AEP event with the exception of Reach B where a 0.02 metres impact is predicted.

There are several locations where the project would result in more substantial flood level increases without mitigation measures. These impacts occur near A'Becketts Creek and are the result of the accumulated afflux resulting from viaduct piers placed in the waterway floodplain.

The spatial extent of these flood level increases is relatively localised due to the steep banks along the A'Becketts Creek channel, but it is predicted that two dwellings that are currently affected in the one per cent AEP event could be further affected by substantial flood increases. The modelling predicts a number of additional dwellings would experience more modest increases in the one per cent event, at properties already affected. At other properties, flood levels would rise within the property boundary but would not likely affect the dwelling.

A mitigation strategy will be developed to address flooding impacts at A'Becketts Creek. The strategy will develop and evaluate and range of feasible mitigation options, which may include widening or augmentation of sections A'Becketts Creek, or design modifications such as

relocation or changing the configuration of piers (refer to section 8.5.4). If necessary, these options would be subject to further environment assessment and community consultation, as appropriate.

In surrounding areas, other than along A'Becketts Creek, the project would not result in increased flooding of land that is currently flood free and therefore would not change the development potential of surrounding land in terms of flood affectation.

Surface flows

The proposal will result in minimal changes in velocities and these changes are not expected to increase the risk of scour and erosion of the downstream waterways. Velocity increases are less than 0.1 metre per second at all locations. Existing waterway alignments would be retained at all locations and there are no proposed changes in flow direction.

Changes in flows are the result of increased impervious area resulting from the proposed pavement widening. The predicted flow changes are generally negligible. A maximum increase of about two per cent in peak discharges is observed at some locations.

New pipe outlets have the potential to create localised scour unless erosion protection is provided and without appropriate measures to convey water down the creek banks, bank erosion and instability may occur. Further, turbulence associated with viaduct piers placed in the floodways could cause erosion and destabilisation of the waterway banks. Mitigation has been proposed to address these impacts.

Sea level rise

Potential climate change impacts on the project could be due to a combination of increased rainfall intensities and sea level rise.

High and low sea level rise predictions (0.21 metre and 0.91 metre) show that the project would not be directly affected by sea level rise. However rainfall intensity increases would affect the flood levels and flood immunity of the project.

8.5.4 Environmental management measures

Options development and concept design development, as described in Chapters 4 and 5, have sought to hydrology and flooding impacts as far as possible.

Project-specific management and mitigation measures have been developed with the aim of minimising or mitigating, as far as practical, the hydrology and flooding impacts during construction and operation as described above. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential impacts and site-specific management measures identified to manage those impacts for implementation during the pre-construction, construction and operational phases are summarised in the table below.

Impact	Ref#	Environmental management measures	Responsibility	Timing
Scour around pipe outlets and creek bank instability	HF-1	• Suitable protection measures will be provided at pipe outlets and at locations where there is a risk of creek bank instability due to discharges from the pavement drainage system.	Contractor	Detailed design

Impact	Ref#	Environmental management measures	Responsibility	Timing
Scour around viaduct piers	HF-2	• Rock protection will be provided to prevent scour where piers are placed in areas subject to inundation in the 1% AEP flood.	Contractor	Detailed design
Flood level increases	HF-3	• A mitigation strategy will be developed to address the predicted flood level increases in the vicinity of A'Becketts Creek. The strategy will develop and evaluate and range of mitigation options, which may include: – Widening or augmentation of A'Becketts Creek between Good Street and Woodville Road. – Enlargement of Good Street bridge waterway area. – Relocation of viaduct piers. – Streamlining of viaduct piers.	Contractor	Detailed design

8.6 Biodiversity

This section documents the potential ecological impacts of the project including those relating to terrestrial and aquatic flora and fauna and their habitats. Full details of the assessment undertaken are presented in the *WestConnex M4 Widening Biodiversity Assessment* (SKM, 2014) (Volume 4 – Working Paper I) with a summary provided below. The assessment has been prepared to address relevant DGRs as documented below.

Director-General's Requirements	Where addressed in EIS
Biodiversity — including but not limited to: • potential ecological impacts of the project, with specific reference to vegetation and habitat clearing, connectivity, edge effects, riparian and aquatic habitat impacts and soil and water quality impacts. The assessment of these impacts must:	Section 8.6.4
– make specific reference to impacts on threatened species and endangered ecological communities, including Miniopterus schreibersii oceanensis (Eastern Bentwing-bat) and Pteropus poliocephalus (Grey-headed Flying-fox),	Section 8.6.4
– consider impacts to adjoining waterways, riparian vegetation and aquatic habitats, including consideration of water quality, marine vegetation, fish passage, soil types (including salinity), erosion and sedimentation, and ongoing water management,	Section 8.6.4
– identify appropriate avoidance, mitigation and management measures, including details of alternative options considered, and proposed arrangements for long term management,	Section 8.6.5
– taking into account the Draft Guidelines for Threatened Species Assessment (Department of Environment and Conservation/Department of Primary Industries 2005), Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (Department of Environment and Conservation 2004), and the Guidelines for Aquatic Habitat Management and Fish	Section 8.6.2

Director-General's Requirements	Where addressed in EIS
Conservation (Department of Primary Industries 1999), and	
– include details of any offset of ecological impacts and native vegetation clearing, taking into account the Principles for the use of biodiversity offsets in NSW (Department of Environment, Climate Change and Water 2008).	Section 8.6.4

8.6.1 Assessment methodology

The ecological assessment was based on a literature/database review to establish the likelihood of threatened flora, fauna and/or endangered ecological communities occurring. This was followed by field investigations of the area likely to be affected by the project. For the purposes of the biodiversity assessment, the project study area is defined as per Figure 8.18 to Figure 8.14.

Literature review and database searches

Databases and other relevant sources considered included:

- NSW vegetation types database ((NSW) Office of Environment and Heritage (OEH) 2012).
- NSW threatened species profile database (OEH 2013).
- Native Vegetation of the Cumberland Plain – Final Edition (NPWS 2002).
- NSW BioNet (OEH 2013).
- DPI Threatened and Protected Species – Records Viewer.
- DPI Noxious Weed listings.
- Atlas of NSW Wildlife maintained by the NSW Office of Environment and Heritage (OEH April 2013).
- Australian Government Department of the Environment Protected Matters Search Tool (March 2013).

Database records as well as species and community profiles were used to undertake a 'likelihood of occurrence' assessment. This was then further refined following field surveys and assessment of habitat present.

Field surveys

Field surveys were conducted in early July 2013, comprising a total of three days fieldwork. The scope of field investigations, and assessment methodologies applied, are outlined in Chapter 2 of the Biodiversity Working Paper (Volume 4 – Working Paper I) and included:

- Vegetation surveys, classification and mapping.
- Vegetation and habitat condition assessment using the Biobanking Assessment Methodology (DECC 2008).
- Fauna field survey and habitat assessment including targeted searches were conducted for Eastern Bentwing-bat, Grey-headed Flying-fox, Cumberland Land Snail and diurnal birds, reptiles and amphibians.
- Aquatic habitat assessment at A'Becketts Creek, Duck Creek, Duck River and Haslams Creek, including waterways classification consistent with the *Policy and Guidelines for Fish Habitat Conservation and Management* (Department of Primary Industries 2013).

- Water quality measurements at Duck River, Haslams Creek and Duck Creek and results compared with ANZECC guidelines for estuarine waters in South East Australia.

Additional nocturnal survey work was conducted in February 2014. This survey targeted frogs and microbats over one afternoon and evening, with a particular focus on identifying potential habitat and populations of the Green and Golden Bell Frog (*Litoria aurea*).

Threatened species assessment

State and nationally listed threatened species identified from the literature/database reviews were considered in terms of their likelihood to occur based on their identified habitat requirements. All potentially occurring threatened species were targeted during the surveys with particular emphasis on those species with a high or moderate likelihood of occurrence. The likelihood of occurrence was classified according to the criteria identified in section 2.6 of the Biodiversity Working Paper.

Species with a high or moderate likelihood of occurrence were subject to assessments of significance under the relevant legislation ((NSW) TSC Act and/or (Commonwealth) EPBC Act).

Assessments were prepared consistent with the requirements of the *Draft Guidelines for Threatened Species Assessment* (Department of Environment and Conservation/Department of Primary Industries 2005) and *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (Department of Environment and Conservation 2004).

8.6.2 Existing environment

Vegetation communities

Planted vegetation dominates the study area and includes a wide range of species, both exotic and non-indigenous, as well as species representative of the original local vegetation. Small patches of remnant vegetation are also present, however a high level of disturbance from urban development has altered the species composition and vegetation structure of any remnant vegetation communities in the study area. Three threatened ecological communities were identified.

Key characteristics of the vegetation communities identified within the study area are provided in Table 8.29. The distribution of vegetation communities in the study area is shown by Figure 8.18 to Figure 8.19.

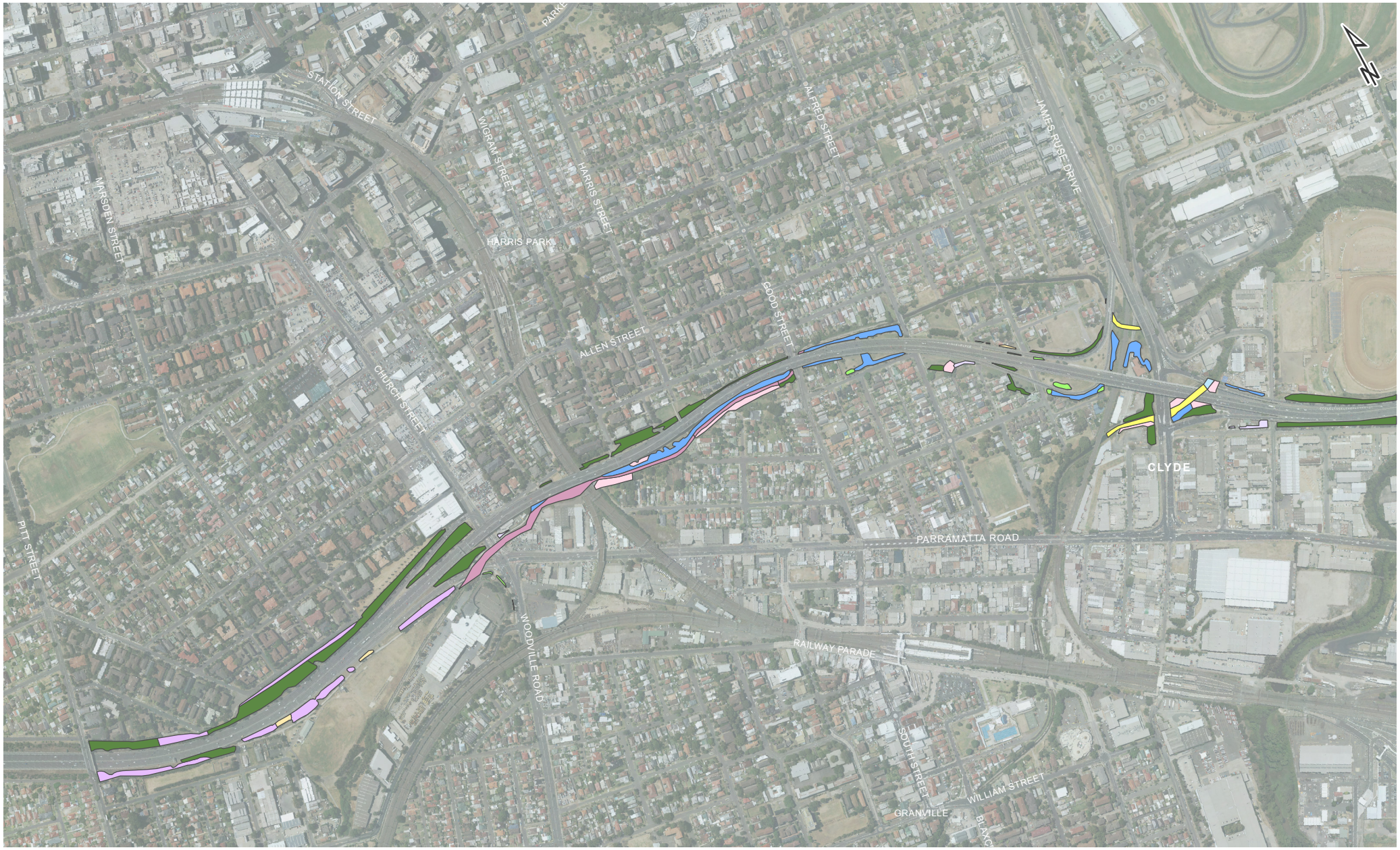
Table 8.29 Vegetation within the study area

Map Unit	Biometric Vegetation Type	Description	Status	Condition	Area in study area (ha)
Map Unit 1: Mangrove Forest	Mangrove forest in estuaries of the Sydney Basin and South East Corner	This community occurs on estuarine mudflats exposed to daily tidal inundation. In the study area this community occurs along Duck Creek between the James Ruse Drive and Silverwater Road intersections. This community is dominated by Grey Mangrove (*Avicennia marina subsp. australasica*). The understorey is generally dominated by areas of open water and muddy flats with abundant pneumatophores of Grey Mangrove protruding for the sediments. There are some saltmarsh associated species present including Creeping Brookweed (*Samolus repens*), Streaked Arrow-grass (*Triglochin striata*), Saltwater Couch (*Sporobolus virginicus* var. minor) and Austral Seablite (*Suaeda australis*). This community is in relatively good condition with only a light abundance of weed species on the edges of this community.	Fish habitat including mangroves are protected under the FM Act	High	0.6
Map Unit 2: Swamp Oak Floodplain Forest	Swamp Oak – Prickly Tea-tree – Swamp Paperbark swamp forest on coastal floodplains, Sydney Basin and South East Corner	Swamp Oak Floodplain Forest is restricted to a small area adjacent to Duck River in the study area. This community is dominated by Swamp Oak (*Casuarina glauca*) which includes planted and remnant trees. There is also a relatively large remnant Broad-leaved Ironbark (*Eucalyptus fibrosa*) present in this community possibly part of former natural woodland communities on higher elevated areas surrounding Duck River. The understorey is dominated by a mix of native and exotic species, with exotic species generally being dominant over the majority of the patch with several small patches dominated by native flora. Native species present include Basket Grass (*Oplismenus aemulus*), Wild Violet (*Viola banksii*) and Weeping Grass (*Microlaena stipoides*). Dominant exotic flora species include Paddy's Lucerne (*Sida rhombifolia*), Panic Veldt-grass (*Ehrharta erecta*), Madeira Vine (*Anredera cordifolia*) and Purple-top (*Verbena bonariensis*). This community has a moderate habitat condition based on the site values present.	Endangered, TSC Act	Moderate	0.1

Map Unit	Biometric Vegetation Type	Description	Status	Condition	Area in study area (ha)
Map Unit 3: Shale-Gravel Transition Forest	Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin	This vegetation type is restricted to several small patches and trees at the intersection of Hill Road and the M4 Motorway. This community is dominated by an open canopy of Woollybutt (*Eucalyptus longifolia)* and a small tree stratum of *Melaleuca decora*. A mid-storey layer of Prickly-leaved Paperbark (*Melaleuca nodosa*) is also present. The understorey is dominated by exotic flora species including Panic Veldt-grass, Moth Vine (*Araujia sericifera*), Paddy's Lucerne and Cobbler's Peg (*Bidens pilosa*). This community has a moderate habitat condition based on the site values present.	Endangered, TSC Act	Moderate	0.4
Map Unit 4: Freshwater Drainage Lines	(in part) *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin	This map unit occurs in natural and constructed freshwater drainage channels where there is continuous moisture. This community varies throughout the study area from areas of open water to areas with low to moderate densities of macrophyte vegetation and occurs mostly as thin strips along modified drainage lines. Riparian vegetation is generally absent or where present is dominated by exotic vegetation. These areas have a low habitat condition due to the highly modified nature of these areas. Common native species include Cumbungi (*Typha orientalis*), Common Rush (*Juncus usitatus*), *Schoenoplectus validus*, Common Reed (*Phragmites australis*) and Knotweeds (*Persicaria spp*.). There is also a high density of exotic flora usually present such as Umbrella Sedge (*Cyperus eragrostis*), Wandering Dew (*Tradescantia fluminensis*), Dock (*Rumex spp*.), Rhodes Grass (*Chloris gayana*) and Parramatta Grass (*Sporobolus africanus*).There are also colonising exotic trees and shrubs on the edges of drainage lines such as Privet (*Ligustrum spp*.) and Mulberry (*Morus alba*).	Endangered, TSC Act	Low	1.0
Map Unit 5: Estuarine Drainage Lines	N/A	This map unit comprises concrete lined tidal channels in the study area including Haslam's Creek and Duck Creek. There is generally no aquatic or riparian vegetation associated with these areas.	N/A	Low	0.5

Map Unit	Biometric Vegetation Type	Description	Status	Condition	Area in study area (ha)
Map Unit 6: Planted Monocultures	N/A	This map unit comprises monoculture plantings of various species including Swamp Oak and River Oak (*Casuarina cunninghamii*) (Map Unit 6a), Hill's Weeping Fig (*Ficus microcarpa* var. hillii) and Moreton Bay Fig (*Ficus macrophylla)* (Map Unit 6b), Spotted Gum (*Corymbia maculata*) (Map Unit 6c), native shrubs including Weeping Bottlebrush (*Callistemon viminalis*), Flax-leaved Paperbark (Melaleuca linariifolia) and Tallowwood (*Eucalyptus microcorys*). This map unit is distributed throughout the study area. The understorey is dominated by exotic flora including a wide range of environmental and noxious weed species.	N/A	Low	7.5
Map Unit 7: Mixed Plantings	N/A	This map unit consists of mixed plantings of Eucalypt species, Figs (*Ficus spp*.), She-oaks (*Casuarina spp*.) and various native shrub species including Wattles (*Acacia spp*.), Paperbarks and Bottlebrush (Callistemon spp.). This map unit is the most dominant in the study area and consists of planted native species, exotic weeds and horticultural species. The species composition varies and is based on planting mixes used in landscaping activities during the time of construction. Flora species include local native species and native flora not naturally occurring in local vegetation communities and native species from other regions of NSW. There are a number of different planted tree and native shrub species, including all those recorded in Map Unit 6. Further detail on species that make up this map unit can be found in Table 3-2 of the Biodiversity Working Paper. This map unit is distributed throughout the study area. The understorey is dominated by exotic flora including a wide range of environmental and noxious weed species.	N/A	Low	19.3

Map Unit	Biometric Vegetation Type	Description	Status	Condition	Area in study area (ha)
Map Unit 8: Exotic Vegetation	N/A	This map unit includes areas dominated by exotic trees, shrubs and groundcovers. Dominant species vary although common species include Camphor Laurel (*Cinnamomum camphora*), Jacaranda (*Jacaranda mimosifolia*), Privet species (Ligustrum spp.), African Olive (*Olea europaea* subsp. africana) Paddy's Lucerne (*Sida rhombifolia*), Green Cestrum (*Cestrum parqui*) and non-indigenous native species such as the Golden Wreath Wattle (*Acacia saligna*). Further detail on species that make up this map unit can be found in Table 3-2 of the Biodiversity Working Paper.	N/A	Very Low	1.0



KEY

- Map Unit 1: Mangrove Forest
- Map Unit 2: Swamp Oak Floodplain Forest
- Map Unit 3: Shale-Gravel Transition Forest
- Map Unit 4: Freshwater Drainage Lines
- Map Unit 5: Estuarine Drainage Lines
- Map Unit 6a: Planted Monocultures - Casuarina
- Map Unit 6b: Planted Monocultures - Figs
- Map Unit 6c: Planted Monocultures - Spotted Gum
- Map Unit 6d: Planted Monocultures - Native Shrubs
- Map Unit 6e: Planted Monocultures - Tallowwood
- Map Unit 7: Mixed Plantings
- Map Unit 8: Exotic vegetation

0 50 100 200 300 400
Metres

Vegetation and fauna habitats Figure 8.16

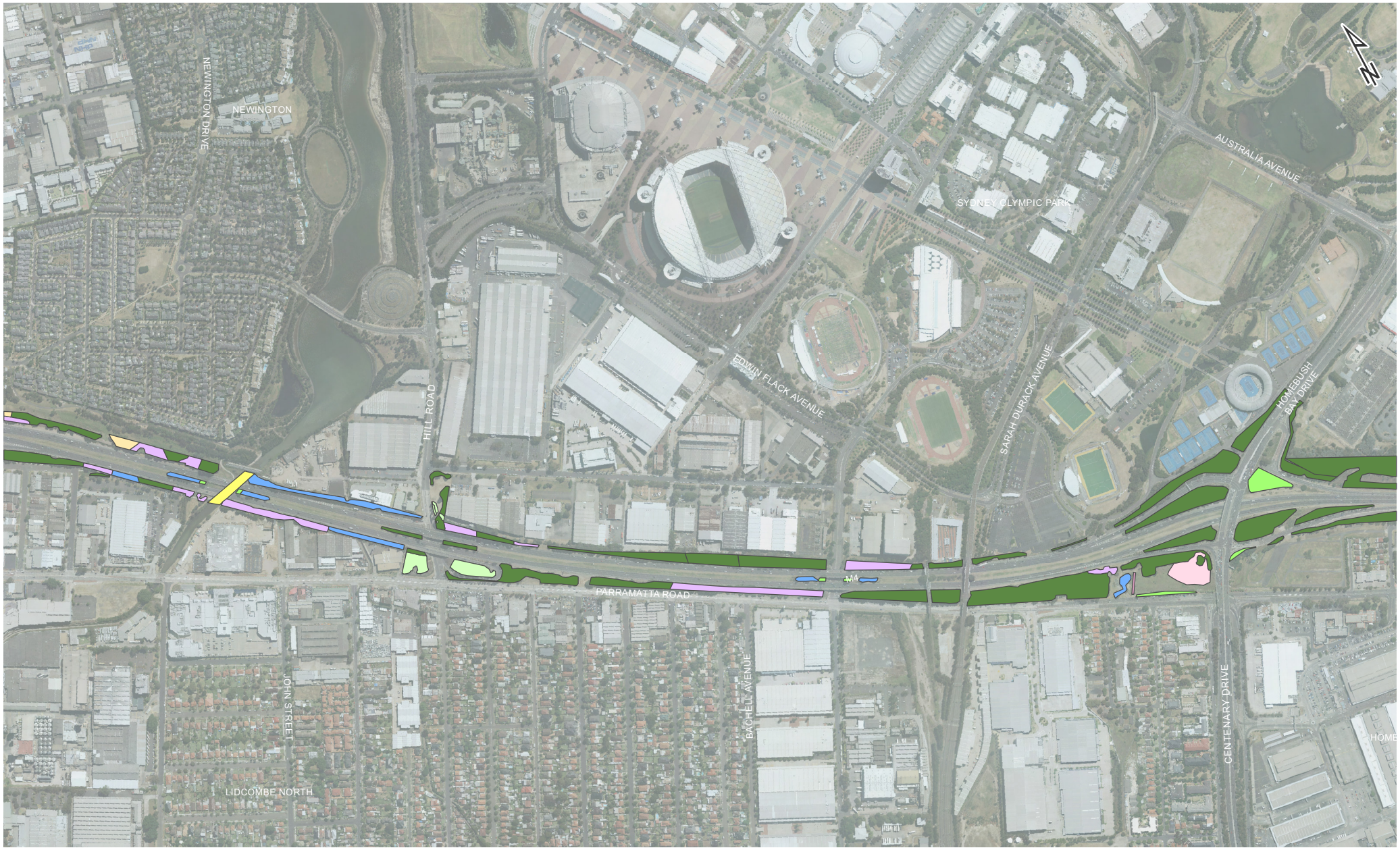


KEY

- Map Unit 1: Mangrove Forest
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- Map Unit 6c: Planted Monocultures - Spotted Gum
- Map Unit 6d: Planted Monocultures - Native Shrubs
- Map Unit 6e: Planted Monocultures - Tallowwood
- Map Unit 7: Mixed Plantings
- Map Unit 8: Exotic vegetation

0 50 100 200 300 400
Metres

Vegetation and fauna habitats Figure 8.17



KEY

- Map Unit 1: Mangrove Forest
- Map Unit 2: Swamp Oak Floodplain Forest
- Map Unit 3: Shale-Gravel Transition Forest
- Map Unit 4: Freshwater Drainage Lines
- Map Unit 5: Estuarine Drainage Lines
- Map Unit 6a: Planted Monocultures - Casuarina
- Map Unit 6b: Planted Monocultures - Figs
- Map Unit 6c: Planted Monocultures - Spotted Gum
- Map Unit 6d: Planted Monocultures - Native Shrubs
- Map Unit 6e: Planted Monocultures - Tallowwood
- Map Unit 7: Mixed Plantings
- Map Unit 8: Exotic vegetation

0 50 100 200 300 400
Metres

Vegetation and fauna habitats Figure 8.18

Groundwater dependent ecosystems

Areas of Mangrove Forest, Swamp Oak Forest and drainage lines were assessed as being wholly dependent on groundwater considering their presence in low-lying areas with direct access to groundwater resources. Shale Gravel Transition Forest was assessed having a potentially high-level of groundwater dependence. The remaining planted and exotic map areas of vegetation are unlikely to be dependent on groundwater.

Threatened flora

No threatened flora species were identified during field surveys. Habitat assessment confirmed the presence of potential habitat for four threatened flora species (refer Table 8.30), all of which were assessed as having moderate potential to occur. Potential habitat for these species in the study area comprises estuarine mud-flats on Duck River, aquatic and riparian habitats along creeks, and disturbed and planted vegetation.

Table 8.30 Threatened flora – likelihood of occurrence

Species	Status		Likelihood of occurrence
	EPBC Act	TSC Act	
Hypsela sessiflora	X	E	Moderate
Marsdenia viridiflora subsp. *viridiflora* (endangered population)	-	E2	Moderate
Tadgell's Bluebell (Wahlenbergia multicaulis)	-	E2	Moderate
Narrow-leaved Wilsonia (Wilsonia backhousei)	-	V	Moderate

V- vulnerable; E – endangered; E2 – endangered population.

Aquatic habitats

The sensitivity and functionality of aquatic habitats as fish habitat was assessed using Fisheries NSW Policy and *Guidelines for Fish Habitat Conservation and Management* (DPI, 2013) and the results are detailed in Table 8.31.

Table 8.31 Classification and sensitivity of fish habitat

Waterway	Type	Classification	Minimum recommended crossing type#
Haslams Creek	N/A^	Class 1 Major key Fish habitat	Bridge, arch structure or tunnel. Bridges are preferred to arch structures.
Duck River	Type 2 Moderately sensitive		
Duck Creek	Type 3* Minimally sensitive		
A'Becketts Creek	Type 3* Minimally sensitive	Class 3 Minimal key fish habitat	Culvert or ford (box culverts are preferred to fords and pipe culverts – in that order).

^ concrete lined waterway in the vicinity of, and within, the corridor and therefore not considered key habitat

** 'type' has been classified on the small areas of natural base near the corridor in an otherwise concrete lined waterway*

 # crossing type is based on waterway CLASS

The waterways were observed to be generally very turbid and two to four times higher than the upper threshold of ANZECC guidelines for estuarine waters in South East Australia. Dissolved oxygen was within the ANZECC guidelines at Haslams Creek only and was beneath the lower threshold value at Duck Creek and Duck River. Temperatures and salinities were higher in Duck River, presumably because it is (a) more tidally influenced and (b) there was greater infiltration of antecedent rainfall than the concrete lined channels.

The aquatic habitat assessment and water quality measurements indicate that the ecosystem health of the subject creeks is poor. The riparian zones are very fragmented, there is little in stream habitat and high levels of siltation. Mangroves provide the best aquatic habitat in the study area, but more generally creeks lacked habitat diversity and are unlikely to provide significant or important fish habitat.

Fauna habitat

Natural habitats for fauna have been extensively removed for commercial, industrial and residential development. Fauna habitats are mapped in Figure 8.18 to Figure 8.20 and include a small number of hollow-bearing trees and dead-standing trees. Remaining patches of habitat are relatively small and fragmented and comprise:

- Linear strips of Grey Mangrove (*Avicennia marina*) and Swamp Oak (*Casuarina glauca*) forests along the edges of Duck River.
- Riparian and aquatic habitats dominated by exotic vegetation.
- A small patch of remnant woodland.
- Planted vegetation.
- Cleared and modified landscapes.

Threatened fauna

The Grey-headed Flying-fox, which was observed flying over the study area at dusk, was the only threatened fauna species observed during surveys. Potential habitat for some wetland birds, microchiropteran bats and nectar-feeding birds was recorded along Duck River and in areas of planted/landscaped vegetation. Potential habitat has been highly modified and for threatened fauna species, is limited to planted vegetation and a thin strip of Grey Mangrove and Swamp Oak trees along Duck River. The list of threatened fauna species in the study area and their likelihood of occurrence is provided in section 4.1.2 (Table 4-3) of the Biodiversity Working Paper.

The threatened Green and Golden Bell Frog (*Litoria aurea*) was not positively detected during surveys within the M4 Motorway corridor or adjacent areas and no suitable habitat for this species was found to be present.

No threatened microchiropteran bat were recorded from the targeted survey of six sites.

Migratory species

One migratory species was recorded during surveys and a further 17 migratory species were assessed as having a moderate likelihood of occurring in the study area (refer section 3.8 of the Biodiversity Working Paper for further detail). The main area of potential habitat for migratory species is the estuarine habitats along Duck River comprising several small areas of mud-flats dominated by Grey Mangrove.

Wildlife connectivity corridors

Landscape connectivity in the study area is limited to aquatic habitat along creeks or narrow linear strips of riparian vegetation where present. These linear corridors may provide important links in the otherwise cleared landscape and connect larger habitat patches. Duck River constitutes the main intact fauna corridor within the study area linking habitats upstream to the south of the study area and downstream areas of habitat to the north.

Critical habitat

No areas of declared critical habitat under the TSC Act or EPBC Act are present in the study area.

8.6.3 Assessment of potential impacts

Loss of vegetation and habitat

The construction of the M4 Widening project would affect up to 9.32 hectares of planted and remnant vegetation in various condition states with the remaining areas affected already having been cleared and modified.

The estimated extent of impact includes approximately 0.38 hectares of remnant vegetation, 0.39 hectares of drainage lines that would be overshadowed and/or affected by pier construction, 8.55 hectares of planted and/or exotic vegetation.

Threatened ecological communities

Impacts on threatened ecological communities would be limited to approximately 0.17 hectares of moderate condition vegetation and 0.35 hectares of low condition habitat. These occur as highly disturbed remnants within an urban landscape and have minimal ecological importance in terms of floristic diversity, fauna habitat values and threatened flora habitat. The impacts to threatened ecological communities are summarised in Table 8.32.

Table 8.32 Impacts on threatened ecological communities

Threatened Ecological Community	Conservation Status	Condition	Affected area (ha)
Swamp Oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered, TSC Act	Moderate	0.08
Shale gravel transition forest in the Sydney Basin Bioregion	Endangered, TSC Act	Moderate	0.09
Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Endangered, TSC Act	Low	0.35
		Total	**0.52**

Impacts to Swamp Oak floodplain forest would be limited to several senescent remnant trees on the edge of Duck River and numerous planted Swamp Oak trees which would be beneath the proposed bridge over Duck River.

Impacts to Shale Gravel Transition Forest would be limited to the removal of several *Melaleuca decora* trees which are within the footprint of the proposed eastbound on-ramp at Hill Road. These trees are thought to be remnant due to their size and position and occur within a maintained landscape including planted trees and parkland areas.

Highly-disturbed areas of freshwater wetland would be affected by the project. Impacts would be restricted to those areas of A'Becketts Creek which run parallel to the M4 Motorway and would be limited to overshadowing from the viaduct structure and placement of several piers within A'Becketts Creek (overshadowing is assessed in further detail in section 8.3).

Potential impacts on the three subject threatened ecological communities was considered against the heads of consideration set out in section 5A of the EP&A Act. The assessment concluded that the project is not likely to have a significant impact on these ecological communities (refer Appendix E1 of the Biodiversity Working Paper).

Threatened species habitat
Impacts to threatened species would generally be limited to disturbance of potential foraging habitat. Affected threatened fauna potentially include highly mobile species which may forage in habitats of the study area including microbat species, waterbirds, and nectar-feeding bird and bat species such as Little Lorikeet and Grey-headed Flying-fox.

Potential impacts on threatened species with a moderate or higher likelihood of occurrence were considered against the heads of consideration set out in section 5A of the EP&A Act. The assessment concluded that the project is not likely to have a significant impact on these threatened species (refer Appendix E1 of the Biodiversity Working Paper).

Potential impacts on Commonwealth listed threated species were considered in accordance with relevant commonwealth guidelines including Significant Impact Guidelines 1.1 Matters of National Environmental Significance (Department of the Environment 2013). The assessment concluded that the project is not likely to have a significant impact on Commonwealth listed threatened species (refer Appendix E2 of the Biodiversity Working Paper).

Wildlife connectivity, habitat fragmentation and edge effects

Connectivity of aquatic habitats would be maintained along Duck River with impacts limited to areas of mangrove and swamp oak forest. It is expected that impacts to the mangrove canopy would extend edge effects due to direct impacts on vegetation and shading. Fragmentation associated with the existing bridges would increase by approximately 20 metres.

Injury and mortality

Fauna injury or death can occur during the clearing phase of construction when habitat trees are removed, as well as during road operation as a result of collision with vehicles. There is also potential for increased fauna injury and mortality as a result of further habitat fragmentation, degradation and loss.

During construction, the most vulnerable species are those who take refuge in trees (eg hollows, under bark, in nests, and in fallen logs) and in the ground, and/or have low agility. Mainly it is common species such as possums, reptiles, birds (particularly fledglings) and frogs are likely to be affected considering the highly urbanised environment and limited sheltering opportunities such as hollow trees and fallen timber.

The potential for increased risk of fauna injury or death during operation is limited due to the low abundance of fauna species and fact that the majority of the additional road capacity would be on viaduct structures above ground level. Impacts to mobile species such as Grey-headed Flying-fox and bird species would also not be substantially increased from existing levels.

Weeds

A variety of Class 4 noxious weeds were recorded within the motorway corridor during surveys. During construction there is potential for weed seeds and plant material to be dispersed into adjoining areas where weed species do not currently occur. The most likely causes of weed dispersal are associated with clearing of vegetation and stockpile of contaminated mulch and topsoil during earthworks, and movement of soil and attachment of seed (and other propagules) to construction vehicles and machinery.

Pests and pathogens

The following was noted in relation to pests:

- The removal of hollow-bearing trees would indirectly increase competition for hollows by native fauna because the loss of tree hollows via occupation by feral honeybees reduces the number of hollows available for native animals to breed and shelter.
- The M4 Widening project may contribute to increased levels of predation on native fauna from foxes and cats, through the impact of habitat removal leading to displacement of resident fauna.
- The clearing of vegetation may increase the value of the habitat for rabbits (*Oryctolagus cuniculus*) in the study area over the long-term. As rabbits tend to colonise more disturbed and modified open habitats, any increase in the population of this pest species is more likely to impact on native fauna tolerant of modified habitats.

While not observed during field investigations, the following pathogens may require management during construction:

- Phytophthora which causes root rot.
- Amphibian chytrid fungus which causes the disease chytridiomycosis (EPBC Act and TSC Act).
- Rust Fungi affecting plants of the family Myrtaceae.

Groundwater dependant ecosystems

Considering groundwater levels are unlikely to be altered as a result of the M4 widening project, potential groundwater-dependant ecosystems are unlikely to be impacted.

Aquatic impacts

Aquatic impacts are limited to potential impacts on aquatic habitats. Potential impacts on aquatic habitats during construction were identified as:

- Removal of mangroves at Duck River.
- Impacts to bank stability (where not already concrete lined) due to the clearing of riparian vegetation, and the construction of bridges.
- Erosion and sedimentation impacts due to the exposure and mobilisation of soils during construction.
- Impacts to water quality from accidental chemical or fuel spills.
- Potential for sulphuric acid to impact groundwater, soils and waterways as a result of acid sulfate soil exposure.
- Potential impact on salinity as a result of changes to the local landscape, which may affect the way salt and water move through the environment and where they concentrate.

- Potential for disruption to stream flow and isolation of pools as a result of in stream construction of bridge piers, particularly in A'Becketts Creek.

Potential impacts on aquatic habitats during operation were identified as:

- Loss off riparian and in-stream vegetation as a result of shading from bridge piers and the new viaduct.
- Indirect loss of mangroves at Duck River through increased shading by the new widened road.
- Contamination of local waterways as a result of any spills that may occur during operation from maintenance activities or vehicle crashes.
- Increase in sediment and pollution loads in stormwater due to the removal of buffer vegetation, increase in road surface and increase in vehicular traffic. This has the potential to impact on water quality through road runoff containing suspended solids, nutrients from atmospheric fallout and other pollutants from vehicle, tyre and pavement wear.
- Potential for changes to flow conditions from the in-stream bridge piers of Duck River which may result in (a) increased bank erosion, (b) collection of debris and sediment (c) disruption of flow (d) reduced water quality and (e) reduced fish passage.

8.6.4 Environmental management measures

Options development and early construction planning, described in Chapters 4, 5 and 6, have sought to minimise biodiversity impacts as far as possible.

Project-specific management measures and ecological management procedures have been developed with the aim of minimising or mitigating, as far as practical, biodiversity impacts during construction and operation as described above. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential impacts and site-specific management measures identified to manage those impacts for implementation during the pre-construction, construction and operational phases are summarised in the table below.

Impact	Ref#	Environmental management measures	Responsibility	Timing
Fauna injury and mortality	FF-1	Project environmental management plans will include procedures for pre-clearance surveys that are consistent with the Roads and Maritime Biodiversity Guidelines (RTA 2011). Pre-clearing surveys will be undertaken by an experienced ecologist to identify any nesting/roosting animals present in the project area. This will include inspections of affected existing structures for microbats that may be present in cracks, fissures, scuppers, lifting holes or similar.	Contractor	Construction
Fauna injury and mortality	FF-2	If microbats are found during pre-clearing surveys, an appropriately qualified ecologist will be engaged and provide advice on work methods and timing to minimise impacts on the bats. If exclusions are required, these will be done in accordance with a Bat Management Plan prepared by an appropriately qualified ecologist.	Contractor	Construction

Impact	Ref#	Environmental management measures	Responsibility	Timing
Unexpected impacts on threatened species	FF-3	An unexpected threatened species finds procedure will be developed consistent with the Roads and Maritime Biodiversity Guidelines and incorporated into project environmental management documentation.	Contractor	Construction
Loss of native vegetation	FF-4	Exclusion zones will be established to avoid damage to native vegetation and fauna habitats identified for retention and prevent the distribution of weeds. The location of exclusion fencing to be installed will be identified by project environmental management plans and the function and importance of the exclusion zones will be communicated to construction personnel.	Contractor	Construction
Loss of native vegetation	FF-5	A detailed landscape plan will be prepared for the project. The landscape plan will build on the finding of the Urban Design, Landscape Character and Visual Working Paper and will include detailed set out, species and planting guides including for those areas disturbed during construction. Where areas of habitat are to be re-established, this will occur consistent with Guide 3 Re-establishment of Native Vegetation of the Roads and Maritime Biodiversity Guidelines (RTA 2011).	Contractor	Construction
Loss of threatened ecological communities	FF-6	Consistent with Principle 6 of the *OEH Offset Principles* the project will consider options to offset the loss of the small areas of TECs impacted by the project. These options will be detailed in the landscape plan and could include: – Enhancing habitat – Reconstructing habitat in strategic areas to link areas of conservation value – Increasing buffer zones	Contractor	Construction
Proliferation of weeds	FF-7	A weed management plan consistent with the Roads and Maritime Biodiversity Guidelines (RTA 2011) will be developed as part of the construction environmental management plan. The weed management plan will include descriptions and mapping of major weed infestations and appropriate management actions to be undertaken in relation to each infestation.	Contractor	Construction
Spread of pathogens	FF-8	Measures to prevent the spread of pathogens will be detailed in the construction environmental management plan. Measures will be consistent with	Contractor	Construction

Impact	Ref#	Environmental management measures	Responsibility	Timing
		Roads and Maritime Biodiversity Guidelines – Guide 7 Pathogen Management (RTA 2011).		
Impacts on riparian vegetation and wetlands	FF-9	The detailed design of the bridge over Duck River will be refined to reduce impact on riparian vegetation and wetlands where possible	Contractor	Detailed design
Impacts on riparian vegetation	FF-10	Riparian vegetation along the main wildlife corridor (Duck River) will be protected during construction works where possible with any affected areas to be rehabilitated.	Contractor	Construction
Impacts on aquatic habitat	FF-11	In stream structures such as bridges and culverts are to be designed and managed to minimise any potential impact to flow regimes and fish passage.	Contractor	Detailed design
Impacts on mangroves	FF-12	DPI would be consulted regarding an appropriate form of biodiversity offset for the proposed loss of 0.28 ha of mangroves.	WDA	Pre-construction

8.7 Aboriginal heritage

This section reviews the potential Aboriginal cultural heritage impacts of the project. Full details of the assessment undertaken are presented in the *WestConnex M4 Widening Aboriginal Archaeological Survey Report* (Kelleher Nightingale, 2014) (Volume 4 – Working Paper I) with a summary provided below. The assessment has been prepared to address relevant DGRs as documented in the table below.

Director-General's Requirements	Where addressed in EIS
• impacts to Aboriginal heritage (including cultural and archaeological significance), in particular impacts to Aboriginal objects and potential archaeological deposits (PAD), should be assessed. Where impacts are identified, the assessment shall:	Section 8.7 Appendix I
– outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the measures) generally consistent with the Draft Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation (Department of Environment and Conservation 2005),	Section 8.7.4 No impacts to Aboriginal heritage identified
– be undertaken by a suitably qualified heritage consultant(s),	Appendix I
– demonstrate effective consultation with Aboriginal communities in determining and assessing impacts and developing and selecting options and mitigation measures (including the final proposed measures),	Section 8.7.1 No impacts to Aboriginal heritage identified
– assess and document the archaeological and cultural significance of cultural heritage values of affected sites, and	Section 8.7.3 No impacts to Aboriginal heritage identified
– develop an appropriate assessment methodology, including research design, in consultation with the Department and the Office of	Section 8.7.3 No impacts to Aboriginal

Director-General's Requirements	Where addressed in EIS
Environment and Heritage, to guide physical archaeological test excavations of the sites and areas of PAD identified in a manner that establishes the full spatial extent and significance of any archaeological evidence across each site/area of PAD, and include the results of these excavations.	heritage identified

8.7.1 Assessment methodology

The Aboriginal archaeological assessment was based on the following:

- Review of databases including the Aboriginal Heritage Information Management System (AHIMS) and other heritage registers/databases (refer section 4.2 of the Aboriginal Archaeology Working Paper).
- Review of previous investigations.
- Analysis of the landscape context and flood modelling.
- Archaeological survey, which was undertaken in two sessions over four days with representatives from both the Deerubbin Local Aboriginal Land Council (19 July 2013 and 27 February 2014) and Metropolitan Local Aboriginal Land Council (22 July 2013 and 25 February 2014). This included inspection of any areas of surface exposure for artefacts, evidence of intact natural deposit and any old growth trees for evidence of Aboriginal bark removal. Assessments of soil disturbance were also made during the survey.

The Aboriginal archaeological assessment was undertaken in accordance with the OEH *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW, 2010) and the Roads and Maritime *Services Procedure for Aboriginal Cultural Heritage Consultation and Investigation* (PACHCI) (Roads and Maritime Services, 2011).

8.7.2 Existing environment

Background

The Sydney Basin has a rich indigenous heritage. Aboriginal occupation focused on accessing resources from diverse ecological areas, seasons and conditions. Smaller rivers, creeks and swamps remained constant and reliable places that attracted camping, fishing and inter-clan contact, as well as facilitating travel. Aboriginal occupation in the Sydney area is known to have extended beyond the last glacial maximum (about 20,000 years ago), when the environment was drier and significantly cooler and the permanent water sources even more critical to survival.

There is evidence of Aboriginal occupation throughout the wider region, with areas of plentiful food resources associated with shorelines, riparian zones and adjacent areas including Botany Bay, Cooks River, Wolli Creek, Haslams Creek, Homebush Bay, Parramatta River and Sydney Harbour. During urban development, many of these areas have been covered by fill, concealing original formations.

The project traverses the boundaries of the Metropolitan and Deerubbin Local Aboriginal Land Councils (LALC).

Landscape context

The western portion of the study area skirts along fine sandstone and humic sands associated with flood deltas related to the Duck River/Duck Creek system. These low lying lands have been largely filled, re-contoured and developed with virtually no natural land surfaces remaining. The eastern portion of the study area traverses shale and humic sands which also display high levels of urbanisation. Archaeologically the sands on the margins of waterway are good locations for archaeological material to survive, however the substantial modification to the landscape has virtually eliminated the heritage potential. The Duck River/Duck Creek junction displayed some archaeological sensitivity, while Haslams and Powells Creeks displayed no sensitivity due to impacts from infrastructure.

Flood modelling shows that the confluence of Duck River and Duck Creek, which geographically would have been advantageous to past Aboriginal people, can be subject to the movement of high energy flood water. The effect of this energy would be the total displacement of Aboriginal archaeological objects as energised water moves sediments down the system.

Site predictions

In highly urbanised landscapes Aboriginal archaeological objects will only survive in situ where the natural surface of the ground remains undisturbed. Aboriginal occupation is statistically more likely to have occurred where quality raw materials are found in close proximity to major waterways on defined topography such as terraces or creek junctions. Significant archaeological sites will exist where such deposits are situated on elevated (above the 1:100 year flood level), low gradient landforms. The study area exhibited no undisturbed archaeologically significant landforms. The junction point between Duck River and Duck Creek had some sensitivity, but existing development and past flooding have lowered the archaeological potential.

AHIMS search results

The AHIMS search identified 46 sites within and adjacent to a study area that included all existing on-ramps and off-ramps, arterial road approaches, intersections adjacent to the ramps, the proposed construction footprint and identified potential compound locations. Two of the sites are located within one kilometre of the study area. None are located within the study area. The most common site context within the locality was the open artefact scatter. The potential archaeological deposit, isolated find and modified tree (carved or scarred tree) site contexts were also present.

The absence of registered Aboriginal heritage items within the study area and the low number of items in the immediate surroundings is the result of the intensive modification of the landscape. Registered Aboriginal heritage items therefore likely represent residual pockets where the landform has not been as extensively modified.

Survey results

The field survey confirmed that the study area has low archaeological potential and no Aboriginal archaeological sites or objects were found. Surface visibility across the floodplain/flat landform was noted to be low due to high levels of modification affecting the ground surface (infrastructure, commercial and residential development, pavement, fill and landscaping). In many instances the ground surface was observed to be highly disturbed below the modification with levelling, cutting and filling visible in sample sections within the study area.

Evidence of high energy flood activity in the past was also evident at the Duck Creek crossing where homogenised soils displayed no long term structural integrity indicating poor archaeological survivability with the flood channel and plain.

Survey coverage across slopes also revealed similar levels of disturbance to the flats with landscaping and re-vegetation noticeable.

8.7.3 Assessment of potential impacts

No Aboriginal archaeological objects or Aboriginal places were identified within the study area and no impacts to Aboriginal sites/objects places are expected.

From an archaeological perspective, the project area is noted to be a highly disturbed and modified environment exhibiting little potential artefact survivability. The most sensitive Aboriginal archaeological locations are typically near the waterways and within the study area these locations display disturbance from flooding within the channels effecting a hydraulic movement of soils (and any potentially associated archaeology). The margins along the waterways, generally the best location for artefact survivability, were noted to be heavily urbanised with substantial disturbance from both development and past flood events.

Based on these findings no physical archaeological test excavations are required.

8.7.4 Environmental management measures

Project-specific management measures have been developed with the aim of minimising or mitigating, as far as practical, Aboriginal heritage impacts as described above. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential impacts and site-specific management measures identified to manage those impacts are summarised in the table below.

No specific measures are considered necessary for operation.

Impact	Ref #	Environmental management measures	Responsibility	Timing
Unexpected identification of Aboriginal objects	AH-1	Project environmental management plans will include procedures to guide the management of any previously unrecorded Aboriginal sites/objects within the project area. Management response would vary depending on the nature of the find, its significance and likely impacts.	Contractor	Construction
Unexpected identification of skeletal remains	AH-2	Project environmental management plans will identify procedures for management of any possible human skeletal remains. In the event that the project reveals possible human skeletal remains, work would cease in the affected area and the remains would be reported to the NSW Police, the Office of Environment and Heritage and Aboriginal stakeholders.	Contractor	Construction

8.8 Historic heritage

This section reviews potential historic heritage impacts of the project. Full details of the assessment undertaken are presented in the *Non-Indigenous Assessment and Statement of Heritage Impacts* (Artefact Heritage, 2014) (Volume 4 – Working Paper K) with a summary provided below. The assessment has been prepared to address relevant DGRs as documented in the table below.

Director-General's Requirements	Where addressed in EIS
Heritage – including but not limited to: • impacts to State and local historic heritage (including heritage items and archaeology) should be assessed. Where impacts to State or locally significant historic heritage items are identified, the assessment shall:	
– outline the proposed mitigation and management measures (including measures to avoid significant impacts and an evaluation of the effectiveness of the mitigation measures) generally consistent with the guidelines in the NSW Heritage Manual (Heritage Office and Department of Urban Affairs and Planning 1996),	Section 8.8.4
– be undertaken by a suitably qualified heritage consultant(s) (note: where archaeological excavations are proposed the relevant consultant must meet the NSW Heritage Council's Excavation Director criteria),	Section 8.8.1
– include a statement of heritage impact for all heritage items (including significance assessment),	Section 8.8.3 and Working Paper K
– consider impacts from vibration, demolition, archaeological disturbance, altered historical arrangements and access, landscape and vistas, and architectural noise treatment, and	Section 8.8.3 and Working Paper K
– develop an appropriate archaeological assessment methodology, including research design, in consultation with the Department and the Heritage Council of New South Wales, to guide physical archaeological test excavations and include the results of these excavations;	Working Paper K

8.8.1 Assessment methodology

The following databases, registers and statutory lists were searched in March 2013:

- World Heritage List.
- National Heritage List.
- State Heritage Register.
- (NSW) *Heritage Act 1977*, Section 170 Registers.
- *Holroyd Local Environmental Plan 2013*.
- *Parramatta Local Environmental Plan 2011*.
- *Auburn Local Environmental Plan 2010*.
- *Strathfield Local Environmental Plan 2012*.
- Register of the National Estate.
- Register of the National Trust.

A site survey was conducted to ground truth the desktop assessment. The site survey was undertaken by suitably qualified heritage practitioners in July 2013 and included physical inspections of all heritage listed items located near the study area (the works footprint with a surrounding buffer of 100 metres). A photographic record was kept, with photographs taken of all heritage items and potential archaeological sites.

Where existing statements of heritage significance were not available for the heritage items, statements of significance were prepared in accordance with the *NSW Heritage Manual* (NSW Heritage Office, 2001).

8.8.2 Existing environment

Historical context

Exploration to the west of Sydney Cove began soon after first settlement, as it was found that the sandstone soils of coastal Sydney were unsuited to cultivation and it was necessary to find more fertile land. In 1788, a government farm was established on the banks of the Parramatta River at Parramatta (initially named Rose Hill). A government house was built near the farm, which prompted the development of the town of Parramatta, which was laid out in 1790. Initially the river was the main form of transport to and from Parramatta, but an overland track between Parramatta and Sydney was cleared through the bush between 1789 and 1791. This track formed the basis for 'the road to Parramatta', which was laid out in 1797. By the early 19th century, Parramatta Road was a major thoroughfare for the colony.

A track leading west from Parramatta to the Nepean River was also developed during 1788 and 1789. In 1815, William Cox led the construction of the Great Western Road from the Nepean River through the Blue Mountains, with a ferry crossing of the river at Emu Plains. In December 1817, Cox also completed the construction of the section of the Great Western Road between Emu Plains and Parramatta, which was named the Great Western Highway in 1928.

During the early 19th century, scattered rural settlement developed at other locations along the route of the present-day M4 Motorway. Small land grants were made to former convicts in areas with better soils, such as at Prospect and along creeks and rivers, in order to establish steady food supplies for the colony. These small farms initially cultivated grain and other crops. Larger grants further from the rivers and creeks were made to prominent and wealthy individuals such as military officers, officials and merchants, who used some of their land for farming but most for grazing. Small villages began to develop along the main roads, including Parramatta Road and the Great Western Road.

The arrival of the railway in the 1850s prompted more rapid subdivision and development in areas along the route of the railway line. Between Strathfield and Parramatta, the rail line roughly followed a similar route to Parramatta Road and encouraged increased development in the area around the road and railway line; while to the west of Parramatta the railway line was located up three kilometres to the north of the Great Western Road and stimulated the development of town centres to the north of the main road.

The Sydney to Parramatta railway was completed in 1855, with stations built at various locations along the line in the following years.

Archaeological potential

The *Parramatta Historical Archaeological Landscape Management Study* (Godden Mackay Logan 2001) establishes Archaeological Management Units (AMUs) based on historical research and

land disturbance. The AMUs are designated as having a low, moderate, high or exceptional archaeological potential. They are also provided with a low, moderate or high significance rating.

AMU 2968 falls within the project area and was assessed to be of moderate research potential and local significance. The proposed new bridge over Duck River would traverse this AMU.

Historic heritage items

Figure 8.21, Figure 8.22 and Figure 8.23 show the locations of historic heritage items and conservation areas within the locality. Table 8.33 provides details of those items within or immediately adjacent to the area of the project giving a description and level of significance for each of item that has been determined in accordance with the NSW Heritage Manual (NSW Heritage Office, 2001). Full statements of significance for all items are included in Chapter 5 of the Historic Heritage Working Paper.



KEY

- Project design
- s170 Register Item
- State Heritage Register Item
- Conservation Area (LEP)
- Heritage Item (LEP)
- Archaeological Item (LEP)

Historic heritage items within the locality Figure 8.19

0 50 100 200 300 400
Metres



KEY

- Project design
- s170 Register Item
- State Heritage Register Item
- Conservation Area (LEP)
- Heritage Item (LEP)
- Archaeological Item (LEP)

Historic heritage items within the locality Figure 8.20

0 50 100 200 300 400
Metres



KEY

- Project design
- s170 Register Item
- State Heritage Register Item
- Conservation Area (LEP)
- Heritage Item (LEP)
- Archaeological Item (LEP)

Historic heritage items within the locality Figure 8.21

0 50 100 200 300 400
Metres

Table 8.33 Heritage items within or adjoining the area of the project

#Ref	Item	Description	Significance
I10	Federation Period cottage (14 Meehan Street, Granville)	The house is a small weatherboard cottage in the Federation style.	Local
I11	Vauxhall Inn	A hotel comprising a two-storey brick building with a streamlined circular tower on the corner of the two street frontages. The top of the tower is marked by a small 'cupola', which makes it a distinctive local landmark in a central intersection.	Local
I84	'Latalda' (20 A'Beckett Street, Granville)	'Latalda' is a single-storey Federation style weatherboard cottage.	Local
I85	Conjoined residences (22 and 24 A'Beckett Street, Granville)	The cottages are single-storey conjoined residences constructed of weatherboard and with a hipped, corrugated iron roof.	Local
I89	Conjoined residences (20 and 22 Albert Street, Granville)	The building is a pair of single storey conjoined residences of brick and rendered concrete construction, with little ornamentation.	Local
I90	Conjoined residences (24 and 26 Albert Street, Granville)	The item is a two storey conjoined Victorian Italianate terrace house, which originally had face brick facades in a Flemish bond pattern.	Local
I260	Conjoined residences (18 and 20 Bowden Street, Harris Park)	The building consists of a pair of single storey Victorian cottages of painted brickwork with a gabled corrugated iron roof, a central chimney, and a front verandah.	Local
I261	Single storey residence (22 Bowden Street, Harris Park)	The item is a single storey house of tuck pointed brick walls with a corrugated iron roof that has steep gabled to the front and side.	Local
I576	RTA Depot, Rosehill	The main building is a long brick structure with a corrugated fibro saw-tooth roof. It has a pedimented façade with 'Department of Main Roads 1944' inscribed on the pediment.	Local
I575	Capral Aluminium	The complex includes a multi-storey office building in the Moderne architectural style and a tall brick clad steel-framed workshop, with various plantings of shrubs, eucalyptus and Canary Island palms	Local
I1	Wetlands (Parramatta)	Wetlands that are located along Duck River and consist of remnant wetland vegetation, characterised by mangrove and saltmarsh complex.	Local
I4	Auburn North Public School	The original school building is a large two-storey brick building, running perpendicular to Adderley Street West and Parramatta Road. The Adderley Street façade of the building features the gable end of the main roof.	Local
I45	Dwelling (24 Silverwater Road)	The dwelling is an asymmetrical brick house built in the Victorian Italianate style.	Local
I1790	Electricity Substation No. 167	The substation is a large two-storey brick structure. The Municipal Council of Sydney logo and 'ELECTRICTIY SUBSTATION' are embossed in large Art Nouveau lettering on the façade of the building, which also features Art Nouveau and Art Deco detailing.	State

#Ref	Item	Description	Significance
I20	Stand of Eucalyptus longifolia	Group of remnant trees includes 10 trees which are around 10-15 metres in height	Local
I63	Former Ford Factory Building (brick façade)	The site was redeveloped as the Campus Homebush Business Park in c. 2004/5, and the façade of the former Ford Factory Building was retained as part of the development.	Local
C6	Welfare Street Precinct	The Welfare Street Precinct is a homogenous group of bungalow housing dating from c. 1920. The houses are single-storey brick cottages with asymmetrical facades and Marseilles tiled gables.	Local
I62	Wentworth Hotel	The Wentworth Hotel is a two-storey, symmetrical brick building.	Local

8.8.3 Assessment of potential impacts

Impacts on historic archaeological resources

Where works are proposed outside the existing road corridor they are largely limited to areas that have already been subject to significant disturbance through the construction of the motorway. As such, the M4 Widening project is unlikely to have any impacts on intact archaeological material.

While the project would traverse AMU 2968, it is considered unlikely that any substantial structures would have been built within this area and that any archaeological material would be of a low archaeological significance.

A section of road widening would also pass through the southernmost boundary of AMU 3094. The section of the study area within this AMU is unlikely to encounter archaeological remains, as this area has been disturbed during construction of the M4 Motorway.

Impacts on historic heritage items

The project would largely be confined to the existing M4 Motorway corridor or its immediate environs and would have no direct physical impacts on the majority of the adjacent heritage items and no visual impacts on those items. Table 8.34 identifies those historic heritage items where potential impacts could occur and summarises the scope of those impacts.

Table 8.34 Potential impacts on historic heritage items and conservation areas

#Ref	Item	Physical Impacts	Visual impacts
I10	Federation Period cottage (14 Meehan Street, Granville)	Potential vibration impacts	None
I84	Latalda' (20 A'Beckett Street, Granville)	Potential vibration impacts	None
I85	Conjoined residences (22 and 24 A'Beckett Street, Granville)	Potential vibration impacts	None
I89	Conjoined residences (20 and 22 Albert Street, Granville)	Potential vibration impacts	None
I90	Conjoined residences (24 and 26 Albert Street, Granville)	Potential vibration impacts	None
I260	Conjoined residences (18 and 20 Bowden Street, Harris Park)	Potential vibration impacts	None

#Ref	Item	Physical Impacts	Visual impacts
	Single storey residence (22 Bowden Street, Harris Park)	Potential vibration impacts	None
I261	Wetlands (Parramatta)	Potential impacts associated with the construction of the new bridge over the Duck River.	None
I20	Stand of eucalyptus longifolia	Possible impacts to trees along the northern edge of the eastern half of the item. However, these trees are immature and their removal would not have a negative heritage impact.	None
C6	Welfare Street Precinct	None	Temporary impact. There is a visual connection between the proposed compound site immediately to the west and the frontages of the properties. Partial screening is offered by wire mesh fencing and mature trees.

8.8.4 Environmental management measures

Options development and early construction planning, described in Chapters 4, 5 and 6, have sought to minimise historic heritage impacts as far as possible.

Project-specific management measures have been developed with the aim of minimising or mitigating, as far as practical, historic heritage and archaeological impacts during construction and operation as described above. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential impacts and site-specific management measures identified to manage those impacts for implementation during the pre-construction, construction and operational phases are summarised in the table below.

Impact	Ref#	Environmental management measures	Responsibility	Timing
Impacts on known heritage items	HH-1	The design and construction of the proposed new bridge over Duck River will aim to minimise impacts to the heritage listed wetlands adjacent to Duck River.	Contractor	Detailed design Construction
Impacts on known heritage items	HH-2	Potential impacts of construction vibration on adjacent heritage items will be managed in accordance with the project noise and vibration management plan.	Contractor	Construction
Impacts on known heritage items	HH-3	The proposed compound site located immediately to the west of Welfare Street would be screened to reduce the visual impact on the Welfare Street Precinct/Conservation area. Measures may include temporary barriers or suitable fencing.	Contractor	Construction

Impact	Ref#	Environmental management measures	Responsibility	Timing
Unexpected impacts on heritage values	HH-4	The project's construction environmental management plan will include 'unexpected finds' procedures to guide the management of any archaeological sites identified during construction. The management response will vary depending on the nature of the find, its significance and likely impacts.	Contractor	Construction

8.9 Air quality

This section documents the potential air quality impacts of the project. Full details of the assessment undertaken are presented in the *Air Quality Working Paper* (Todoroski Air Sciences, 2014) (Volume 4 – Working Paper L) with a summary provided as follows. The assessment has been prepared to address relevant DGRs as documented below.

Director-General's Requirements	Where addressed in EIS
Air quality — including but not limited to: • potential impacts on local and regional air quality, including sensitive receivers;	Section 8.9.3
• details of the proposed mitigation measures to prevent the generation and emission of dust.	Section 8.9.4

8.9.1 Assessment methodology

The EPA regulates emissions from the construction of roads, and generally traffic emissions are regulated via national motor vehicle and fuel standards that limit the emissions produced by vehicles. The EPA has set air quality assessment criteria through the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (DEC, 2005). These criteria generally relate to the total concentration of a pollutant in the air and not just the contribution from project-specific sources.

Table 8.35 summarises the air quality goals relevant to the M4 Widening project. Emissions of Total Suspended Particulates (TSP) and deposited dust have not been assessed for the motorway operations as these emissions would comprise small quantities and the impact would most likely be negligible. However, TSP has been considered in the evaluation of potential management options for the construction phase of the project, where such relatively coarse dust would arise, and may have potential for local effects.

Operational assessment methodology

Air quality dispersion modelling was undertaken to predict the concentrations of air pollutants from the change in vehicle traffic associated with the operational aspects of the project. Modelling scenarios were developed to represent current operational conditions with and without the project.

Dispersion modelling was undertaken using the Roads and Maritime Tool for Roadside Air Quality (TRAQ) model. The model has been specifically developed for roadside air quality impact assessments and uses a conservative approach to estimate the concentrations of air pollutants near to roadways.

TRAQ utilises the CALINE-4 line source air dispersion model which was developed by the Californian Department of Transportation. The model has been designed as a screening level model for estimating the dispersion of vehicle emissions from roads, particularly roads with free flowing traffic such as the project.

Table 8.35 EPA air quality assessment criteria

Pollutant	Averaging time	Criterion
Particulate matter ≤10 µm (PM_{10})	24 hours	50 µg/m^3
	Annual	30 µg/m^3
Particulate matter ≤2.5 µm ($PM_{2.5}$)	24 hours	25 µg/m^3
	Annual	8 µg/m^3
Nitrogen dioxide (NO_2)	1 hour	246 µg/m^3
	Annual	62 µg/m^3
Carbon monoxide (CO)	1 hour	30 mg/m^3
	8 hours	10 mg/m^3
Toluene	1 hour	360 µg/m^3
Xylene	1 hour	190 µg/m^3
Benzene	1 hour	29 µg/m^3
1,3-butadiene	1 hour	40 µg/m^3
Formaldehyde	1 hour	20 µg/m^3
Acetaldehyde	1 hour	42 µg/m^3
PAH (as benzo (a) pyrene)	1 hour	0.4 µg/m^3

The model is able to determine the concentration of pollutants as a function of distance away from the road. For the assessment, a number of road cross sections were selected along the length of the project. These were selected to represent areas before and after the major on/off ramps to show changes in vehicle emissions over the length of the project. It should be noted that impacts along the other sections of the roadway would be lower than the sections examined.

The TRAQ model was set up with meteorological conditions most likely to result in the worst case dispersion scenario for the worst case wind direction. This is a conservative approach to predicting the worst case pollutant concentrations in roadside locations.

It should also be noted that like any other screening model, the TRAQ model will inherently overestimate the likely emissions, however the model will accurately show the relative change that can occur when changes are made to a road. Thus the model will reliably determine whether traffic emissions will go up or down and by how much, (but it will overestimate the likely level of air pollutants.)

The methodology for this study is thus focused on determining whether there is any significant change in the existing levels of emissions from the road, where the change occur and the scale of the change.

The project may result in changes on other nearby roads. Accordingly, the effect of traffic along Parramatta Road was also examined when assessing the likely change in air quality at receptors alongside the widened motorway, both with and without the project. This was done where there was potential for a cumulative effect of the project and Parramatta Road.

Assessed scenarios

Four modelling scenarios were developed to represent the air quality impacts arising from vehicle emissions from the representative worst impacted road sections with and without the project under worst case conditions. The modelling was based on scenarios representing the maximum predicted traffic numbers, for the maximum impacting parts of each roadway section.

The maximum traffic volume scenarios are as follows:

- **Base 'do minimum'** (2017) - without the M4 Widening project or the remainder of the WestConnex projects.
- **M4 Widening** (2017) - project opening year with a widened M4 Motorway but without any other WestConnex projects.
- **Future 'do minimum'** (2027) - 10 years after the Base 'do minimum' but does not include the M4 Widening or any other WestConnex projects.
- **Full WestConnex** (2027) – development of the all WestConnex projects represented by adding all stages to the Future 'do minimum' case.

Vehicle emission estimates were calculated using the modelled project traffic scenarios and the TRAQ emissions database. The primary vehicle emissions of carbon monoxide (CO), particulate matter (PM_{10}) and oxides of nitrogen (NO_X) are included in the TRAQ emissions database. Appropriate adjustments were made for vehicle emissions travelling on different road grades. Emission estimations for the lesser air pollutants were derived from the NSW *OEH Air Emissions Inventory for the Greater Metropolitan Region of New South Wales* (EPA 2012). Vehicle emissions for the different scenarios with and without the project were adjusted to account for the future change in the fleet composition.

8.9.2 Existing environment

Land use and sensitive receivers

There is a diversity of land use in the study area. The western end is predominantly residential, comprising low density, suburban neighbourhoods, and the Parramatta CBD which contains high density residential and commercial development. The eastern end of the study area is characterised by newer, medium to high density residential suburbs, and major regional and state significant land uses such as the Sydney Olympic Park and Sydney Markets. The central section of the study area is characterised by a mix of low, medium and high density residential areas, large areas of commercial and industrial development, and large scale retail uses. The study area has experienced above average rates of population growth compared to NSW over recent years. This has been driven by redevelopment of former industrial areas and intensification of housing which is expected to continue.

Auburn North Public School is located within 100 metres of the motorway. There are also several childcare facilities in proximity to the motorway within the study area:

- Shiny Star Play Centre, George Street, Homebush.
- Auburn Preschool Kindergarten, off Adderley Street West, Auburn.
- Choice Childcare, off Adderley Street West, Auburn.

The study area contains a number of areas of public open space immediately adjacent to the M4 Motorway. These include Bill Boyd Reserve and Deakin Park at Silverwater, and Kurung Reserve, Holroyd Sports Ground, and Freame Park in the west of the study area.

Climate and meteorology

The Sydney region is characterised by mild to warm summers and cold winters. Climate data is collected by the Bureau of Meteorology (BoM) weather station at Sydney Olympic Park, about 400 metres north of the study area. January is the hottest month with a mean maximum temperature of 28.4ºC and July is the coldest month with a mean minimum temperature of 7.8ºC.

Mean temperatures exhibit variability and seasonal flux across the year. Mean 9.00 am temperature levels range from 22.3ºC in January to 11.2ºC in July. Mean 3.00 pm temperatures vary from 26.3ºC in January to 16.6ºC in July.

Mean relative humidity also displays variability over the year. Mean 9.00 am relative humidity levels range from 56 per cent in October to 72 per cent in February and March. Mean 3.00 pm relative humidity levels vary from 41 per cent in August to 55 per cent in February. February is the wettest month with an average rainfall of 109.8 millimetres over 7.7 days. September is the driest month with an average rainfall of 52.7 millimetres over 5.5 days.

Maximum wind speeds during the warmer months have a greater variation between the 9.00 am and 3.00 pm conditions compared to the colder months. Mean 9.00 am wind speeds range from 8.4 kilometres per hour in March to 11.9 kilometres per hour in September and mean 3.00 pm wind speeds range from 12.5 kilometres per hour in June to 19.4 kilometres per hour in December.

Local air quality

Sources of air pollution in the wider area include emissions from local anthropogenic activities such as motor vehicle exhaust and domestic wood heaters, urban activity and various other commercial and industrial activities, and natural emissions from wind erosion, dust storms, pollens and bushfires.

The nearest and most representative ambient air quality monitoring data for the study area are available from the EPA monitoring sites at Rozelle, Chullora and Prospect. Background monitoring data collected at these sites includes data for nitrogen dioxide (NO_2), carbon monoxide (CO, Rozelle and Chullora monitoring sites only) and PM10 (particulate matter with aerodynamic diameters of 10 µm or less). Data trends from each of these sites are discussed below.

NO_2

A summary of the NO_2 monitoring data collected from the monitoring sites from 2010 to 2013 inclusive is presented in Table 8.36. The data show that all annual average NO_2 concentrations at the monitoring sites were below the 62 micrograms per cubic metre annual average criterion for all years. The daily maximum 1-hour average NO_2 data show that all of the monitoring sites recorded levels below the 1-hour average NO_2 criterion of 246 micrograms per cubic metre at all times.

Levels of NO_2 are relatively low compared to the criterion level and with daily monitoring data exhibiting a seasonal fluctuation.

CO

A summary of the CO monitoring data collected from the monitoring sites in 2010 to 2013 is presented in Table 8.49. The daily maximum 8-hour average CO data show that all of the monitoring sites recorded levels below the 8-hour average CO criterion of 10 milligrams per cubic metre at all times.

Table 8.36 Summary of NO_2 monitoring from EPA monitoring sites (µg/m³)

Year	Rozelle		Chullora		Prospect		Criterion	
	Max 1hr average	Annual average	Max 1hr average	Annual average	Max 1hr average	Annual average	1hr average	Annual average
2010	92.1	21.1	107.2	23.8	80.8	21.7	246	62
2011	94.0	20.9	95.9	24.5	73.3	19.5	246	62
2012	116.6	22.0	110.9	25.1	94.0	19.4	246	62
2013	131.6	21.4	103.4	25.2	92.1	20.5	246	62

Table 8.37 Summary of CO monitoring from NSW EPA monitoring sites (mg/m³)

Year	Rozelle	Chullora	Prospect	Criterion
	Max 8hr average	Max 8hr average	Max 8hr average	8hr average
2010	2.1	2.6	2.2	10
2011	1.6	1.7	2.0	10
2012	2.5	2.3	2.1	10
2013	2.1	2.9	1.8	10

Daily monitoring data indicate that levels of CO are relatively low compared to the criterion level.

PM_{10}

A summary of the PM_{10} monitoring data collected from the monitoring sites in 2010 to 2013 is presented in Table 8.38. Annual average PM10 concentrations at all monitoring sites were below the 30 micrograms per cubic metre annual average criterion for all years.

Table 8.38 Summary of PM_{10} monitoring from NSW EPA monitoring sites (µg/m³)

Year	Rozelle		Chullora		Prospect		Criterion	
	Max 24hr average	Annual average	Max 24hr average	Annual average	Max 24hr average	Annual average	Max 24hr average	Annual average
2010	37.6	16.1	42.1	17.7	40.1	15.4	50	30
2011	39.4	16.6	65.2	19.8	41.5	15.8	50	30
2012	40.7	16.9	52.4	18.1	38.7	17.2	50	30
2013	58.5	18.3	69.4	18.3	81.8	19.2	50	30

Rozelle and Prospect recorded levels above the 24-hour average PM10 criterion of 50 micrograms per cubic metre between 2010 and 2012. Chullora recorded a number of 24-hour average PM_{10} levels above the criterion of 50 micrograms per cubic metre from 2011 onwards. These levels are likely to have been influenced by local sources.

All of the monitoring stations recorded 24-hour average PM_{10} levels above 50 micrograms per cubic metre, with notable elevated readings during Spring 2013. These readings were due to bush fire activity in the surrounding area.

8.9.3 Assessment of potential impacts

Construction

Construction would include activities with the potential to generate dust emissions. These will vary in intensity over the length of the project and would be influenced by the nature of construction activities occurring in specific locations. Assessment of the potential impacts of the project involved estimating the total quantity of dust likely to be emitted from the different construction areas during construction (including construction compounds).

Dust emissions may be generated from construction areas during earthworks activities including loading/emplacement, transport and shaping operations. Windblown dust may be generated from exposed areas and stockpiles during periods of high wind speed. Exhaust emissions from the operation of construction vehicles and plant would also generate particulate emissions.

Emissions of pollutants and odours generated associated with the operation of diesel powered machinery and plant equipment are generally considered to be too small, too infrequent or too widely distributed to generate any significant off-site pollutant concentrations. This notwithstanding, these emissions are generally included in the particulate emissions estimation equations for the overall activity. Table 8.39 provides a summary of the total estimated construction emissions for the project over the estimated 22 month construction period.

Table 8.39 Estimated TSP emissions for the project

Construction area	TSP emission (kg/construction period)
Ch0 to Ch1090	13,710
Ch1135 to Ch2300	10,406
Ch2300 to Ch2400	1,815
Ch2450 to Ch2700	2,863
Ch2700 to Ch3400	15,442
Bridge over Duck Creek	1,787
Ch3600 to Ch5000	8,620
Ch5000 to Ch5800	1,749
Ch5800 to Ch7100	11,795
Ch7100 to Ch8000	7,679
Total TSP emissions	75,866

The total amount of dust generated from the proposed construction earthworks activities would be comparable to a modest quarry operation, however, impacts would be less as construction activities would occur over a 7.5 kilometre length of roadway. The calculations assume that all reasonable construction dust controls would be implemented and that the site is managed via a construction dust management plan.

Emissions associated with construction activities would occur intermittently over the length of the project. This would also limit the potential for any significant off-site impacts.

Operation

Assessment of air quality at the sensitive receptor locations nearest to the project roadway has been undertaken individually for each of the modelled areas. The road section between Pitt Street

and Church Street was selected as the worst case road section on the basis of closest proximity to sensitive receptors and highest traffic numbers.

For all four scenarios considered, the modelling shows the greatest concentrations in emissions occurring in close proximity vicinity to the M4 Motorway and Parramatta Road. Even at a relatively small distance from either of the two roadways the concentrations of emissions are predicted to be substantially lower. Modelling shows the project would reduce traffic emissions along the M4 Motorway, and would also generally reduce emissions beside the motorway. Some small increase in emissions would occur where the widened motorway is closer to receptors. A small increase in emissions is also predicted along Parramatta Road.

The change in pollutant levels is small, and pollutant levels reduce rapidly with distance away from the motorway. The changes due to the project are small relative to the air quality criteria (generally improvements of a few per cent occur at receptor locations).

In 2017, the M4 Widening project would result in improved air quality in the vicinity of the motorway except very near to Parramatta Road. In 2027, WestConnex would result in improved air quality in the vicinity of the motorways along most of its length, except very near to Parramatta Road, and for road sections with increasing traffic flows under the full WestConnex project.

Overall, the assessment shows that the project would result in small changes of a few per cent in air quality near the project. In most cases the changes would lead to an improvement in air quality. The changes are limited to areas adjoining the widened motorway and would be unlikely to result in any discernable effects on regional air quality.

8.9.4 Environmental management measures

Project-specific management measures procedures have been developed with the aim of minimising or mitigating, as far as practical, air quality effects arising from the development of the project. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential construction impacts and site-specific management measures identified to manage those impacts for implementation during construction are summarised in the table below.

No specific measures are considered necessary for operation. As discussed above, operational motor vehicle emissions

Impact	Ref#	Environmental management measures	Responsibility	Timing
Emissions from general construction activities	AQ-1	• Activities will be assessed during adverse weather conditions and modified as required (for example, activities will cease where reasonable levels of dust cannot be maintained using available means). • Engines of on-site vehicles and plant will be switched off when not in use. • Where practicable, vehicles will be fitted with pollution reduction devices. • Vehicles will be maintained and serviced according to manufacturer's specifications. • Use lower vibration generating items of excavation plant and equipment eg smaller capacity rockbreaker hammers.	Contractor	Construction

Impact	Ref#	Environmental management measures	Responsibility	Timing
Dust emissions from exposed areas and stockpiles	AQ-2	• Minimise the area of exposed surfaces. • Employ appropriate measures to prevent/minimise wind-blown dust from leaving the site (eg water carts).. • Minimise stockpiling of material. • Stockpiles will be located away from sensitive receivers where practicable. • Apply barriers, covering or temporary rehabilitation. • Rehabilitation of completed sections will be undertaken as soon as soon as practicable.	Contractor	Construction
Dust emissions from hauling activities	AQ-3	• Watering of haul roads (fixed or mobile). • Roads or accesses with long term or heavy use will be sealed where required. • Sealed haul roads will be cleaned regularly. • Vehicle traffic will be restricted to designated routes which can be managed by regular watering and with appropriate speed limits. • Wheel wash or grids will be located near exit points to minimise mud/ dirt track out. • Street cleaning will be undertaken to remove dirt tracked onto sealed roads. • Vehicle loads will be covered when transporting material off site.	Contractor	Construction
Dust emissions from cutting, grinding or sawing equipment	AQ-4	Dust suppression activities will be undertaken for concrete cutting, grinding or sawing (eg water sprays)	Contractor	Construction

8.10 Socio economic

This section reviews potential socio-economic impacts of the project. Full details of the assessment undertaken are presented in the *WestConnex M4 Widening Socio Economic Assessment* (Jacobs, 2014) (Volume 4 – Working Paper M) with a summary provided below. The assessment has been prepared to address relevant DGRs as documented in the table below.

Director-General's Requirements	Where addressed in EIS
Socio Economic – including but not limited to: • social and economic impacts on the local community and community facilities directly impacted by the project;	Section 8.10.3
• a draft Community Consultation Framework identifying relevant stakeholders, procedures for distributing information and receiving/responding to feedback and procedures for resolving community complaints. Key issues that should be addressed in the draft Strategy should include:	Appendix M
– traffic management (including property access, pedestrian access),	Appendix M
– landscaping/urban design matters,	Appendix M
– construction activities including out of hours work, and	Appendix M
– noise and vibration mitigation and management.	Appendix M

8.10.1 Assessment methodology

Socio-economic assessment considers the social and economic consequences of a development. This includes changes to, or impacts on, communities, business and industry that are likely to occur from the construction or operation of a proposed development. The approach to this assessment involved four main stages:

- Scope socio-economic issues. This stage involved scoping the range of potential social and economic impacts for local and regional communities, business and industry that could result from the project.
- Establish a socio-economic baseline. This stage involved an investigation of the key social and economic characteristics and conditions. It included consideration of:
  - Government policy and strategy.
  - Population, demographic and housing indicators.
  - Industry, employment and income data.
  - Existing social infrastructure, including community services and facilities such as schools, child care, health and medical services, aged care, emergency services and support services.
  - Local community values, including those relating to local character, amenity, heritage, community health, safety, local access, connectivity and the natural environment. This was informed by the review of existing local and state government social policies, outcomes of community consultation, data analysis and observations made during fieldwork.
  - Existing transport and access, including the road networks, public transport and walking and cycling facilities.

- Assess potential impacts. This stage involved identifying and evaluating potential changes to existing socio-economic conditions as a result of the design, construction and operation of the project. Key considerations were:
  - Property impacts, including direct and indirect impacts associated with property acquisition.
  - Changes to local and regional population and demography.
  - Impacts on community values, such as those relating to the local character and amenity, community health and safety, local access and connectivity, local character and heritage, and the natural environment.
  - Impacts on local amenity, associated with changes in noise, air quality and the visual environment.
  - Impacts on social infrastructure and community facilities.
  - Impacts on local and regional businesses and industry.
  - Changes to local and regional access and connectivity, including for motorists, public transport users, pedestrians and cyclists.
- Development measures to avoid, manage or mitigate impacts. This stage involved the development of measures to address impacts on the local community, community facilities, business and industry, infrastructure, amenity, health and well-being, access and connectivity. Opportunities to maximise the benefits of the project were also explored.

The outcomes of consultation with key stakeholders including local communities, business representatives, local government officers and community service providers informed all of the assessment stages.

The study area adopted for the assessment is broader than the project corridor and is defined by Table 2-1 and Figures 2-1 in the Socio-Economic Working Paper. It comprises the Australian Bureau of Statistics (ABS) Statistical Area Level 2 (SA2) areas of:

- Merrylands-Holroyd at the western end of the project.
- Parramatta-Rosehill, Granville-Clyde, Auburn, Homebush Bay-Silverwater, and Lidcombe-Regents Park, near that section of the project involving widening of the existing M4 Motorway.
- Homebush and Strathfield, at the eastern end of the project.

It also considers at a broader level, regional impacts on communities and businesses in the LGAs of Holroyd, Parramatta, Auburn and Strathfield.

8.10.2 Existing environment

The regional policy and strategy framework relevant to the project is discussed in Chapter 3. Further detail regarding the strategic planning initiatives adopted by the City of Holroyd, the City of Parramatta, Auburn City, Strathfield City and the City of Canada Bay is provided in section 4.2 of the Socio-Economic Working Paper.

Demographic and socio-economic profile

The study area had a total resident population of about 194,026 people in 2012 and has experienced above average rates of population growth compared to NSW over recent years. This has been driven by redevelopment of former industrial areas and intensification of housing, which is expected to continue.

Communities in the study area are also diverse displaying high variance in levels of cultural diversity, socio-economic advantage/ disadvantage, age and residential mobility. Overall, communities within the study area are characterised by:

- Younger, more transient population in areas such as Parramatta and Homebush, reflecting the recent urban development occurring in these locations, with more stable residential populations in areas such as Granville.
- High levels of cultural diversity, with high proportions of people born overseas, high proportions of people who speak a language other than English at home and people who do not speak English well or at all. Areas with particularly high levels of cultural diversity include Auburn, Lidcombe and Parramatta.
- High levels of people with need for assistance with self-help, mobility or communication due to disability, health or old age, particularly in Auburn, Granville and Merrylands.
- Neighbourhoods with very high levels of socio-economic disadvantage, reflecting relatively low levels of income, educational attainment, employment and vehicle ownership, as well as low levels of economic resources, particularly in Auburn, Merrylands, Granville and Lidcombe.
- Relatively low levels of workforce participation and high levels of unemployment, particularly in Auburn and Granville, which are also characterised by very high levels of youth unemployment.

These groups may be more vulnerable to changes from the project, due to things such as potential communication challenges making access to information about the project more difficult, and access to fewer resources to cope with changes such as relocation or amenity impacts.

The study area also includes:

- High levels of access to local employment, including in the Parramatta CBD, and commercial and industrial areas located in Auburn, Granville, Homebush and Sydney Olympic Park.
- Large scale commercial and industrial development, which provide goods and services for communities in the study area, as well as those within greater Western Sydney and the wider Sydney region. These include the Sydney Markets, large scale home, furniture and home wares retail, motor dealerships and a motorcycle rider training facility.
- A wide range of local, regional and state level community services and social infrastructure, including education, sport, recreation and leisure facilities such as the Sydney Olympic Park, parklands, community cultural facilities and health and emergency services, including major hospitals.
- Good access to public transport facilities, particularly rail, which is reflected in the high level of train travel by residents to access employment.

Land use

Land use in the study area is diverse and varied and is described in detail in section 8.1 (refer also to Figure 8.1). The western end of the study area is predominantly residential, comprising low density, suburban neighbourhoods, apart from the Parramatta CBD, which provides a focus of high intensity residential and commercial development. At the eastern end, the study area is characterised by newer medium to high density residential suburbs as well as major regional and state significant land uses such as the Sydney Olympic Park and Sydney Markets. The central section of the study area is characterised by a mix of low, medium and high density residential areas, large areas of commercial and industrial development, and large scale retail uses.

8.10.3 Assessment of potential impacts

Property impacts

Total or partial acquisition of 15 private properties would be required for the project (refer to section 5.3.12 for details). Temporary leases of land would also be required for some properties to allow construction of the project.

Property directly impacted by the project would be acquired by Roads and Maritime. Property acquisition would be undertaken in accordance with the provisions of the (NSW) *Property Acquisition (Just Terms Compensation) Act 1991*.

Occupiers of the three residential properties and one commercial property at Granville that are to be wholly acquired would need to relocate prior to commencement of construction. Disruption caused by changes such as relocation can result in a number if impacts including:

- Anxiety and stress about changes as well as uncertainty regarding the acquisition process. Consequential effects on health and well-being.
- Disruption to social networks and community relationships, particularly if people need to move away from the local area and from existing social and support networks.
- Difficulties adjusting to relocation due to disadvantage, limited English, disability or otherwise higher levels of dependency on personal community networks.

These impacts are likely to be significant for the particular individual families affected. However, given the small number of residential properties affected the impacts are not expected to be significant in the context of the project.

Land use impacts

As identified in Chapter 6, some ancillary sites have been identified for use during construction of the project. Details of their size and proposed use would be confirmed during detailed design and when the construction method has been decided. Land use changes arising from the use of construction compounds would be temporary.

Most of the project would occur on land zoned SP2 – Infrastructure consistent with the objectives of that zoning. However, as noted above and in section 5.3.12, some land acquisition would be required and this would affect small areas of land used for residential, commercial, industrial, infrastructure (railway) and open space purposes. The small amount of acquisition required would result in a localised land use change but would not affect the broader distribution and supply of these land uses.

Population and demography

Given the small number of residential properties to be acquired for the project, there are not expected to be any impacts on population and demography as a result of property acquisition.

Indirectly, improvements in travel conditions such as travel-time savings and improved road safety are likely to make some areas more accessible and attractive for people looking to relocate to the area.

Business and industry

Directly affected businesses

The project would require the total or partial acquisition of a number of properties that currently accommodate commercial or industrial uses. These include:

- The total acquisition of two commercial properties at Junction Street, Granville, to allow construction of the viaduct. These properties are currently used for a car wash café and a car yard.
- The partial acquisition of an industrial property at Junction Street, Lidcombe, to allow for the construction of the viaduct. A temporary lease would also be required over part of this property.
- The partial acquisition of a strip of land at the rear of seven commercial properties at Carter Street, Homebush Bay, to allow for the construction of a new eastbound on-ramp to the motorway from Hill Road.

The M4 Widening project would also directly impact a property at Martha Street, Clyde, which is owned by Roads and Maritime and currently leased to a business providing motorcycle rider training.

The car wash café, car yard and motorcycle rider training centre would need to relocate prior to the start of construction. These businesses generally cater for broader customer catchments and have specific location and siting requirements, which may cause difficulties in finding alternative premises locally. If suitable alternative premises are not able to be found, these businesses may need to cease operations.

While acquisition would directly affect these individual businesses, residents of local and regional communities would not lose access to these types of services given there are a number of car yards locally as well as other car wash facilities within reasonable distance to Granville.

The acquisition of the subject commercial properties may result in a loss of local employment in Granville, particularly if alternative local premises are not found. Impacts would likely be limited to employees of affected businesses, and are not expected to significantly alter the diversity of employment options available in the locality. In the longer term, the project would facilitate improved access and connectivity to and between local centres thereby encouraging the redevelopment of local centres potentially attracting new investment.

The acquisition of a strip of land at the rear of seven commercial properties at Carter Street is not expected to adversely affect the operation or viability of these businesses.

The motorcycle rider training facility at Martha Street is one of about 20 Roads and Maritime accredited rider training facilities across NSW. A further six are located in the greater Sydney region. During consultation for the project, issues were raised about the potential relocation of the facility and the ability to find a suitable alternative location locally. It was noted that loss of the facility may particularly affect low income earners, including new migrants in the local area, who may rely on a motorcycle licence for access to an affordable means of transport and in turn allows them to access employment and other services. The nearest alternative facility is located about 25 kilometres from the locality.

Potential construction impacts

During construction, effects on business and industry have the potential to arise from:

- Increased expenditure on local goods and services through project procurement and the private spending by project personnel.
- Traffic disruptions and delays due to construction works (road work speed limits, lane closures) and increased construction traffic on the arterial and local road networks.
- Demand for on-street parking by construction workers in areas near construction compounds and other work areas.

- Noise and dust from construction activities, impacting on business amenity.
- Changes to access for businesses located near to surface works, construction compounds and other work areas.

The construction phase is likely to have a positive effect for some local businesses through increased demand for local goods and services. This includes those local shops and food outlets located nearby that are likely to benefit from increased expenditure on the day-to-day needs of construction personnel. Businesses supplying goods and services to construction are also likely to see benefits from increased construction activities locally.

The project would require the temporary closure of some roads for construction works associated with the viaduct, bridge structures and road widening. This includes the temporary full or partial closure of roads that provide important regional access for business and industry as well as local roads that provide access to commercial and industrial areas in the locality. Affected roads include:

- M4 Motorway including on and off-ramps (partial closure only).
- Church Street at Parramatta.
- James Ruse Drive at Granville, including James Ruse Drive westbound on-ramp.
- Local roads, including A'Beckett, Alfred and Martha streets at Granville and Wentworth Street and Deniehy Road at Clyde.

Where full-road closures are required, these would typically be undertaken at off-peak times, including weekends or night-time, which would assist in minimising impacts on local access.

Impact on regional roads may cause temporary disruptions for the movement of regional freight and commercial traffic, resulting in potential delays and increased travel times, as well as delays and disruptions for workers and customers.

Potential impacts during operation

Regionally, the project would have positive impacts for local and regional business and industry through improved access and connectivity, travel time savings, better travel time reliability and savings in transportation and vehicle operating costs.

Locally, the project would improve access to/from business and industry, improve access and connectivity to and between local centres to the north and south of the motorway, allowing for the redevelopment of local centres and attracting new investment.

In the short-term, the project is expected to increase traffic volumes on Parramatta Road, which may affect the business environment and ease of access to businesses on this road and adjoining areas. However, in the longer term, with the construction of other stages of WestConnex, the project is expected to provide opportunities to improve the commercial and business environment in some locations, such as Parramatta Road, through urban renewal associated with further WestConnex projects. This would provide opportunities for new investment and diversification of commercial uses along this corridor.

Impacts on amenity may also be experienced by some businesses located closest to the widened motorway through increased traffic noise as discussed in section 8.2.

Social infrastructure and community facilities

Potential construction impacts

During construction, changes in local access and increases in construction traffic, including heavy vehicles, may affect access to social infrastructure located near to construction compounds and work areas. This includes both regional and local level community services and facilities, such as:

- Childcare centres at Good Street and Alfred Street at Granville.
- Rosehill Gardens Racecourse, due to the temporary closure of Wentworth Street for the construction of the viaduct and upgrade works associated with on and off-ramps to James Ruse Drive.
- Sydney Speedway, due to the temporary closure of Wentworth Street and Deniehy Street for construction of the viaduct.
- Silverwater Fire Station, located at the intersection of Adderley Street West and Stubbs Road, due to works associated with the widening of the Motorway.
- Auburn North Public School and the Revival Christian Church ACC located on Adderley Street West, Auburn due to works associated with the widening of the Silverwater Road westbound on-ramp.
- Sport, recreation and leisure facilities located at Sydney Olympic Park due to widening works on the M4 Motorway, upgrade works for the proposed Homebush Bay Drive westbound on-ramp, and construction of the new eastbound on-ramp at Hill Road.

Construction works associated with the viaduct at Granville may affect the amenity of TwinkleStar Childcare Centre located on Good Street and Alfred Street Childcare Centre located on Alfred Street. In addition to noise, parking and general traffic impacts, the increase in construction traffic using these roads, if unmanaged, may present a safety risk for children accessing these centres. This is likely to be of particular concern for parents during drop-off and pick-up times (ie 7.30 am to 9.30 am and 4.00 pm to 6.00 pm weekdays).

While the distance between the child care centres and the nearest work areas is likely to minimise impacts associated with dust from construction activities, early consultation noted that any increase in dust from construction may be a concern for children who suffer asthma and other similar conditions. Air quality is discussed further in section 8.9.

Impacts on amenity may also be experienced by users of community facilities at Adderley Street West, Auburn, including Auburn North Public School and Revival Christian Church. In particular, impacts may be experienced from increased noise, dust and construction related parking demand associated with construction works.

Demand from construction workers for parking near to construction compounds may reduce available parking for users of nearby community facilities, with already high parking demand noted during investigations.

Potential impacts during operation

During operation, the project would improve access and connectivity to community services and facilities for both local residents and communities in the greater Sydney region, through travel time savings and improved travel time reliability.

However, adverse impacts may be experienced by users of some social infrastructure located near the project, through changes in local amenity and traffic volumes on surface roads.

Some facilities located near to the motorway such as Auburn North Public School and the Revival Christian Church may be subject to changes in traffic noise from the widened motorway as discussed in section 8.2.3. The removal of established trees and vegetation from within the motorway corridor is likely to reduce the visual screening in these locations, increasing visibility of motorway traffic from these facilities. This may affect community perceptions about the impacts of traffic noise.

Local amenity

Potential construction impacts

During construction, impacts on amenity within the study area are likely to result from:

- Noise and dust from construction activities for residents and businesses located near to construction compounds and construction works.
- Changes in visual amenity due to the viaduct structure and the removal of established vegetation within the Motorway corridor.
- Section 8.2 addresses potential noise impacts, section 8.9 addresses potential air quality impacts while section 8.3 addresses changes in visual amenity.

Residential areas that may experience changes to local amenity as a result of construction activities include:

- High Street at Parramatta, located near the proposed construction compound at Junction Street, and which may be impacted by works at the construction compound as well as night-time works associated with the construction of the viaduct over Church Street.
- Good Street, A'Beckett Street, Alfred Street, and Onslow Street at Granville, from the construction of the viaduct structure and night-time works associated with the reconfiguration of existing motorway lanes.
- Residential areas located north of the motorway between Stubbs Street and Haslams Creek at Silverwater, due to night-time works associated with the reconfiguration of existing motorway lanes and works on the bridge structure over Silverwater Road.
- Adderley Street West in Auburn, due to works associated with the construction of the Silverwater Road westbound on-ramp, and night-time construction activities may impact on the night-time amenity or sleeping patterns for some residents closest to the construction activities.

Potential impacts during operation

In the longer term, the project would provide opportunities to improve the urban amenity of some local centres within the study area, through the reduction of traffic, including on Parramatta Road. However, adverse impacts may be experienced for some areas due to increased traffic noise and changes to the visual environment.

Access and connectivity

Potential construction impacts

During construction, the project would require the temporary, partial or full-closure of some roads to allow construction of the viaduct and widening of the existing M4 Motorway. Changes to speed limits would also be required near construction works to ensure safety of construction works. This is likely to result in localised delays and disruptions for motorists as well as motorists from elsewhere who are accessing employment, services and facilities in the locality. Impacts of temporary road closures for local business are discussed above.

During construction, the project is likely to result in an increase in construction traffic on roads near the project. This would include increases in light vehicles as well as heavy vehicles associated with the delivery of materials and equipment. This may affect ease of access and safety for other road users, including pedestrians and cyclists, particularly on local streets.

Construction of the project would require the temporary closure (track possessions) of some rail lines to allow construction of the viaduct. These include:

- Western rail line, which cater for metropolitan, intercity and interstate passenger services as well as freight services.
- Carlingford rail line, which provides passenger services between Clyde and Carlingford.

Closure of the rail line would result in disruptions to passenger and freight rail services using these lines, potentially requiring passengers and freight operators to use alternate modes of transport. These effects would be potentially more pronounced given the generally lower levels of vehicle ownership, particularly in Auburn and Strathfield. Alternative bus services would need to be provided to address this impact.

During construction, impacts on bus services in the study area may result from delays and disruptions on the wider road network. In addition, changes may be required to local bus services near to construction works. This may include the temporary relocation of some bus stops located close to construction compounds and work areas, as well as changes in local routes due to temporary road closures. The services that may be affected by construction works are discussed in section 8.1.4.

During construction, impacts on pedestrian and cycle networks would include:

- Changes to the cycle path under the existing M4 Motorway viaduct.
- Changes to traffic volume on streets with uncontrolled cycle path crossings under the existing viaduct.
- Temporary closure of the footpath along the northern side of Martha Street at Auburn.
- Changes to pedestrian access near construction compounds and construction works.

Potential impacts during operation

The project will improve regional access and road connectivity, including to and between the Sydney and Parramatta CBDs, through improved driving conditions, reduced travel times, improved connections to the regional road network and improved road safety.

Locally, the project would improve access to/from the study area. This includes access and connectivity to and between local centres located to the north and south of the Motorway.

In the short-term, the project is expected to increase traffic volumes of Parramatta Road, which may impact on access and connectivity to land uses along this corridor. However, in the longer term, with the construction of other stages of WestConnex, the project is expected to reduce traffic volumes and provide opportunities for improved bus transport, and pedestrian and cycle access. In particular, this would provide safer access for pedestrians and assist in reducing barriers to local traffic movements.

Existing bus routes, including school bus routes and private bus services, are generally expected to be retained, although some bus operators may modify bus routes or add services in response to the project. Existing bus stops would be maintained, where practicable.

Community values

Potential construction impacts

Community values can be affected by property acquisition, loss of local amenity, changes to access, reduced connectivity and impacts on community facilities. These issues have been discussed above.

The proposed new bridge over Duck River at Auburn would affect the river environment and involve the removal of vegetation (refer section 8.6). The loss of this vegetation may be a concern for some groups given the catchment includes little remaining areas of remnant vegetation. This area also provides important amenity and landscape values for users of the cycleway under the M4 Motorway, helping to screen users from surrounding industrial development. Accordingly, any loss of vegetation is likely to be of concern for local communities.

Potential impacts during operation

Overall, the project will improve liveability and amenity for residents and businesses within the locality and region, by improving travel and accessibility to work, business and leisure.

At a regional level, improved access for regional travel and travel time savings is likely to provide benefits for community cohesion. Travel facilitates social interactions and economic transactions across the wider region. Where mobility on major routes is constrained by traffic congestion, people avoid making trips that have unacceptable travel times. The project would assist in decreasing travel times for these trips, helping to facilitate community interaction.

Locally, the project would improve access to and between centres and communities located to the north and south of the Motorway, reducing barriers to local movements. This would provide opportunities to improve social connections within the study area, through easier access between communities and to meeting places located within local centres. This would contribute to stronger community identities and assist community cohesion.

During consultation for the project, concerns were raised about the potential for an increase in already excessive noise levels and air quality for nearby communities. These issues have been addressed in detail sections 8.2 and 8.9.

The project would require the removal of existing established vegetation at Granville and Auburn. This vegetation provides an important visual buffer for surrounding residents, reducing the visual impacts and visibility of the Motorway, and helping to reduce community perceptions about traffic noise. Section 8.3 considers visual impacts in detail.

8.10.4 Environmental management measures

Options development and design refinement described in Chapters 4 and 5 have sought to minimise socio-economic impacts as far as possible.

Project-specific management measures have been developed with the aim of minimising or mitigating, as far as practical, socio-economic impacts as described above. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential impacts and site-specific management measures identified to manage those impacts for implementation during the pre-construction and construction phases are summarised in the table below.

No specific measures are considered necessary for operation.

Impact	Ref#	Environmental management measures	Responsibility	Timing
Community access and amenity	SE-1	• The draft Community Consultation Framework for the project (refer Appendix M) will be finalised following consideration of community submissions on the EIS. Consultation will then be undertaken consistent with the revised Community Consultation Framework, particularly in relation to: – Traffic management (including property access, pedestrian and cyclists access). – Landscaping and urban design. – Construction activities including work outside standard construction hours. – Noise and vibration mitigation and management.	Contractor WDA	Pre-Construction Construction
Property impacts	SE-2	• Early and on-going communication and consultation will occur with property owners, business owners and residents about the property acquisition process.	WDA	Pre-Construction
	SE-3	• Property acquisition will occur consistent with the requirements of the (NSW) *Land Acquisition (Just Terms Compensation) Act 1991*.	WDA	Pre-Construction
Business impacts	SE-4	• On-going communication and consultation will occur with the owners and operators of the motorcycle training centre at Martha Street, about potential project impacts and appropriate measures to manage impacts. Roads and Maritime will review the potential to relocate the training centre within the same general locality.	WDA	Pre-Construction
	SE-5	• On-going communication and consultation with the owners of the industrial property for partial acquisition at Junction Street, Lidcombe will occur. This will include working with the business owners to manage and plan Project construction activities and delivery to minimise impacts on their business operations.	WDA	Pre-Construction

9 Assessment of other issues

9.1 Greenhouse gas assessment

9.1.1 Assessment methodology

Greenhouse gas emissions are an important consideration for the project, as reducing greenhouse gas emissions is an important global concern and transport is a major contributor of emissions in Australia. Greenhouse gas emissions would be generated during construction and operational activities of the project.

Greenhouse gas emissions that would be generated during construction and operation can be categorised into three broad scopes:

- Scope 1 –direct greenhouse gas emissions generated by the project (eg fuel combusted by construction equipment onsite, vegetation permanently cleared).
- Scope 2 – indirect greenhouse gas emissions generated offsite to provide electricity to the project.
- Scope 3 – other indirect emissions generated offsite (eg embodied emissions embodied within the materials used for the project, emissions generated by vehicle road use, waste disposal).

Figure 9.1 provides an overview of greenhouse gas emissions during construction. Figure 9.2 provides an overview of greenhouse gas emissions during operation.

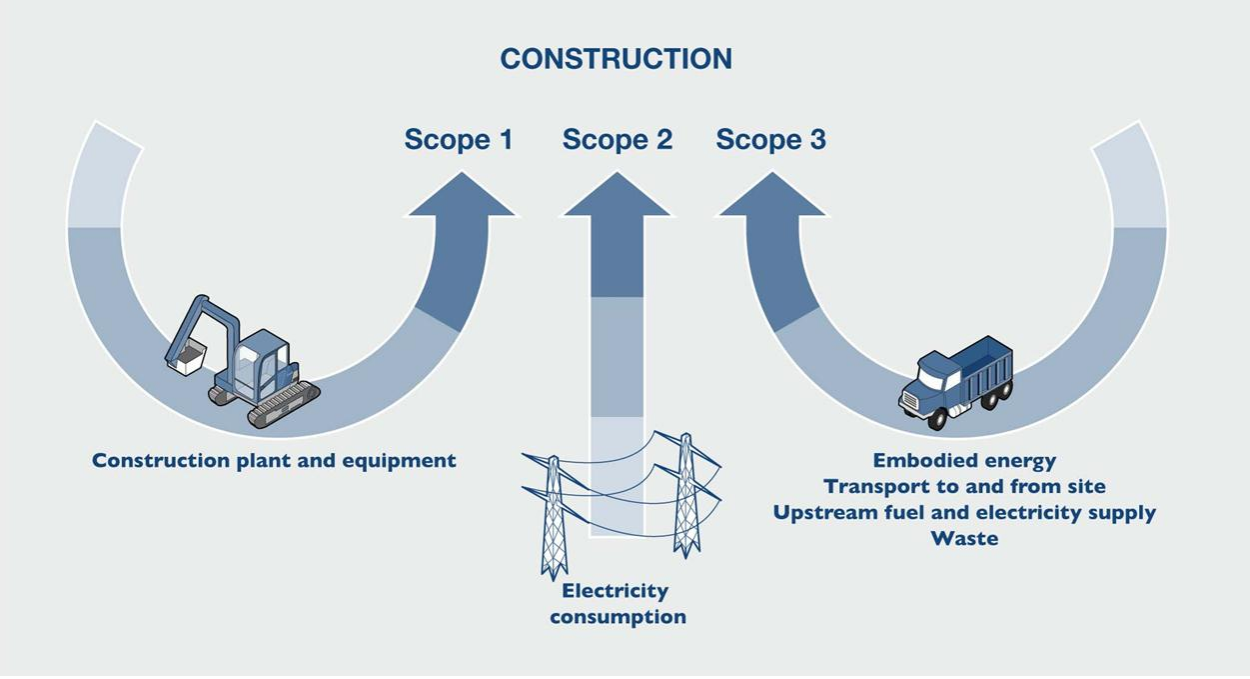


Figure 9.1 Typical greenhouse gas emissions generated during construction

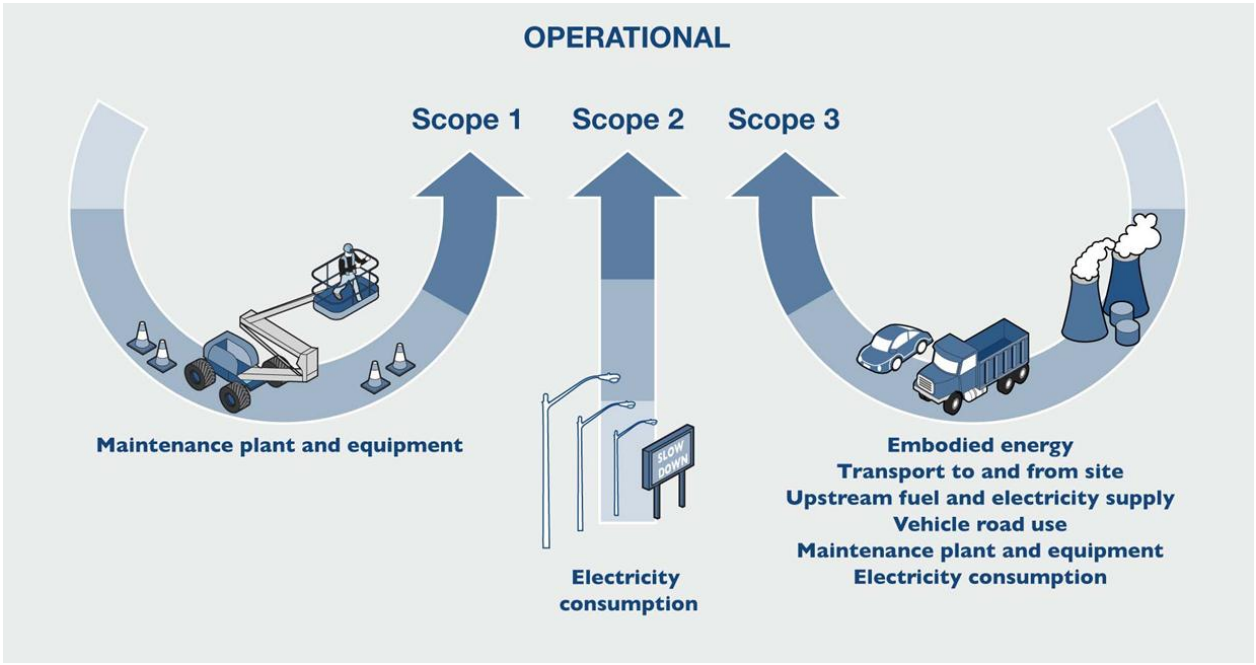


Figure 9.2 Typical greenhouse gas emissions generated during operation

This greenhouse gas assessment has been prepared with reference to the *Greenhouse Gas Assessment Workbook for Road Projects* (Transport Authorities Greenhouse Group, 2013) and the corresponding Greenhouse Gas Assessment Calculator for Road Projects calculation tool. The workbook is used to estimate construction, operation and maintenance stages of road projects but does not estimate the greenhouse emissions associated with operational vehicle road use (ie traffic). Specific details of the project were included in the calculations where these are known. Otherwise typically conservative assumptions were made in relation to the project and data to provide a worst-case assessment.

The TRAQ model was used to calculate greenhouse gas emissions associated with operational vehicle road used. A detailed explanation of TRAQ is provided in section 8.9.1. When estimating greenhouse gas TRAQ calculates:

- Exhaust emissions (CO, hydrocarbons (HC) and carbon dioxide (CO_2)).
- Fuel consumption by carbon balance.
- Estimated CO_2-e (carbon dioxide equivalent) emissions using Department of Climate Change and Energy (DCCE) emission factors.

Construction emission estimates for the project includes emissions from Scopes 1 and 3. Scope 2 emissions are not assessed as no imported electricity has been forecast. Emissions associated with maintenance are also not considered as this EIS assesses construction and operational impacts of the project, it does not assess the impacts of maintenance activities as these are beyond the scope of this project. Operational emissions for the project therefore only include estimates for Scope 2 and 3.

9.1.2 Assessment of potential impacts

Construction emissions

Emission sources during construction would include:

- Operation of construction equipment – which creates direct greenhouse gas emissions as fuel is combusted onsite.
- Use of construction materials – which contain varying levels of upstream indirect embodied emissions.
- Construction transport – where construction-related transportation creates greenhouse gas emissions from the consumption and burning of fossil fuels.
- Electricity use – which is generally consumed by site offices, for lighting, and for security.
- Vegetation clearing – where the breakdown of organic matter as waste material directly releases stored carbon dioxide to the atmosphere.

Table 9.1 provides a summary of the construction greenhouse gas emissions. Greenhouse gas emissions are measured as tonnes of carbon dioxide equivalents (tCO_2-e).

Table 9.1 Estimated project construction greenhouse gas emissions

Activity		Scope 1 (tCO_2e-)[1]	Scope 3 (tCO_2e-)[1]	Total Emissions (tCO_2e-)[1]
Site offices/general areas	Liquid fuel combustion – electricity generation (eg diesel generator)	260	20	280
Demolition and earthworks	Liquid fuel combustion – site plant and equipment Vegetation clearing	4,400	110	4510
Pavements	Liquid fuel combustion – site plant and equipment Upstream embodied emissions – material use	930	444,000	444,935
Structures	Liquid fuel combustion – site plant and equipment Upstream embodied emissions – material use	3,800	30,250	34,050
Drainage	Liquid fuel combustion – site plant and equipment Upstream embodied emissions – material use	460	580	1,040
Road furniture	Upstream emissions from the transport of materials	345	2,380	2,725
Total		**10,195**	**477,340**	**487,540**

[1] *tCO_2e- : tonnes of CO_2 equivalent*

The above estimates show that the construction of pavements would be the greatest contributor of construction greenhouse gas emissions to the project. This is due to the emissions embodied within the large quantities of construction materials such as concrete, heavy bound base material

and asphalt. As noted in section 9.1.1, the estimated amount of material used is expected to be a highly conservative estimate.

Operational emissions

Emission sources during operation relate to vehicles using the motorway, in addition to electricity used to power lighting, signals and signage.

Table 9.2 and Table 9.3 below provide an estimate of operational greenhouse gas emissions. Table 9.2 provides a summary of annual emissions resulting from electricity usage during operation of lighting, traffic signals and signage.

Table 9.3 estimates the operational emissions associated with vehicle road use in 2017 and 2027 with and without the project. It should be noted that the 2017 scenario assumes only the M4 Widening project is operational. The 2027 scenario assumes all WestConnex projects are operational and takes the worst case traffic numbers across each section of the motorway considered in the modelling.

Table 9.2 Estimated annual project operational greenhouse gas emissions due to electricity use

Activity	Scope 2 (tCO_2e-)[1]	Scope 3 (tCO_2e-)[1]	Total Emissions (tCO_2e-)[1]
Lighting	3,150	645	3,800
Traffic signals and signage	1,940	400	2,340
Total	5,090	1,045	6,140

[1] *tCO_2e- : tonnes of CO_2 equivalent*

Table 9.3 Estimated annual operational greenhouse gas emissions during 2017 and 2027 due to vehicles using the motorway

Activity	Emissions Source	Scenario	Annual GHG Emissions (tCO_2-e/yr) Scope 3		
			Without the project (Base 'do minimum')	With the project	Change in Emissions
Vehicle use of motorway	Liquid fuel combustion	2017 – M4 Widening project only	104,750	87,750	-17,000
		2027 – Full WestConnex	106,270	109,390	+3120

The above estimates show that vehicle road use would be the project's greatest contributor of operational greenhouse gas emissions. While this assessment focussed only on changes to emissions along the motorway and not alternative arterial roads, it also shows that while the introduction of the M4 Widening project in 2017 would lead to a reduction in emissions on the motorway, an increase in emissions is anticipated in 2027 when the entire WestConnex is operational. This is expected given traffic modelling shows an overall increase in traffic numbers in 2027 but an overall decrease in traffic numbers for the 2017 scenario.

9.1.3 Environmental management measures

Project-specific management and mitigation measures have been developed with the aim of minimising or mitigating, as far as practical, greenhouse gas emissions during construction and operation as described above. The management and mitigation measures draw on best management practice, government standards and guidelines, and specialist knowledge. Potential impacts and site-specific management measures identified to manage those impacts for implementation during the pre-construction, construction and operational phases are summarised in the table below.

Impact	Ref#	Environmental management measures	Responsibility	Timing
Energy consumption: construction	GHG-1	Assess energy (fuel/electricity) efficiency when selecting equipment	Contractor	Pre-construction
Re-use of excavated road materials	GHG-2	A waste management plan will be prepared to maximise re-use and recycling of construction and demolition waste. Reuse of excavated road materials would be maximised as far as possible where they are cost, quality and performance competitive to reduce use of materials (with embedded energy).	Contractor	Pre-construction
Embodied carbon in steel	GHG-3	Steel with recycled content would be specified where feasible where they are cost, quality and performance competitive. Contractors would be required to propose recycled content construction materials where they are cost, quality and performance competitive	Contractor	Construction
Energy consumption: construction	GHG-4	Assess opportunities to use local materials to reduce transport emissions	Contractor	Construction
Carbon stored in vegetation	GHG-5	Undertake vegetation planting and management that maximises opportunities to sequester carbon over the life of the project	Contractor	Construction
Energy consumption: construction	GHG-6	The feasibility of using biofuels (biodiesel, ethanol, or blends such as E10 or B80) would be investigated by the contractor, taking into consideration the capacity of plant and equipment to use these fuels, ongoing maintenance issues and local sources. Works would be planned to minimise fuel use.	Contractor	Construction
Energy consumption: operation	GHG-7	Assess opportunities to use renewable energy sources to power control systems, lighting and signage	WDA	Operation

9.2 Cumulative impacts and interactions

The assessment has been prepared to address relevant DGRs as documented below.

Director-General's Requirements	Where addressed in EIS
an analysis of the project including an assessment, with a particular focus on the requirements of the listed key issues, in accordance with clause 7(1)(d) of Schedule 2 of the Regulation (where relevant), including an identification of how relevant planning, land use and development matters (including relevant strategic and statutory matters) have been considered in the impact assessment (direct, indirect and cumulative impacts) and/or in developing management/ mitigation measures;	Cumulative impacts Section 8.1.5 Section 9.2.4

9.2.1 Nature of cumulative impacts

Cumulative impacts result from a number of projects being constructed or operated at the same time. They typically include:

- Impacts on local, regional and State traffic, transport and road users.
- Social and economic effects, including changes to land use, access, settlements, employment and businesses.
- Changes to local and regional amenity, including noise, vibration, visual quality and air quality.
- Environmental changes including effects on water quality, hydrology and biodiversity.

When considered in isolation, a particular impact from one project may be considered minor, but when the impact of multiple projects on the same receivers is considered, the impacts may be much more substantial.

Another type of cumulative impact is known as construction fatigue. This concept relates to sensitive receivers that experience construction impacts from a variety of projects over a long period of time with few or no breaks between construction periods. Construction fatigue typically relates to amenity impacts from projects that are constructed consecutively or 'back to back'.

The impacts associated with the construction and operation of the project and other relevant projects are the subject of this cumulative impact assessment. Prediction and evaluation of cumulative impacts is not a straightforward process. The following sections provide an assessment based on the most current and publicly available information.

9.2.2 Assessment methodology

This assessment of cumulative impacts focuses on the key environmental issues that are assessed in detail in Chapter 8.

Potential construction phase interfaces with other significant projects were also reviewed. The identification of projects for consideration was based on the following criteria:

- The project size – given the extent of development within Sydney, only major projects (as determined by DP&E) were considered.
- The project boundary – only projects located within suburbs intersected by or adjacent to the affected section of the M4 Motorway were considered. The suburbs considered within the catchment of the assessment therefore included Parramatta, Holroyd, Granville, Harris Park,

Clyde, Camellia, Silverwater, Newington, Auburn, Lidcombe, Sydney Olympic Park, Strathfield and Concord.

- The project timeframe – only projects likely to be undertaken at some point during the construction period of the M4 Widening were considered.

The operational relationship of the project with existing and planned transport infrastructure is considered in Chapter 3.

9.2.3 Existing environment

Based on the criteria explained in section 9.2.2, seven major projects were identified within suburbs intersected by or adjacent to the affected section of the M4 Motorway. Each is described further below, with a summary of these projects and their relevant impacts is provided in Tables 9.4 to 9.9.

Greystanes Southern Employment Lands – Dexus Industrial Park
The Greystanes Southern Employment Lands (SEL) site is situated on the former Prospect Quarry within the Greystanes Estate at Prospect in Western Sydney. It is located about 6.5 kilometres from the western end of the M4 Widening project.

The project comprises development of a 47 hectare site for warehousing and distribution facilities. It is understood that while some components of the development have been completed, construction is still ongoing. No details were available as to the timing of completion of construction.

Information on the project was sourced from *Environmental Assessment Dexus Estate Industrial Project* (Dexus Property Group 2009).

Table 9.4 Summary – Greystanes Southern Employment Lands

Environmental aspect	Comment
Traffic and transport	The traffic assessment concluded that the proposed road network and intersections both for the project and the wider Greystanes SEL would provide convenient and appropriate access for the proposed industrial development.
Noise and vibration	The assessment concluded that the development of the industrial land within the Greystanes SEL would comply with applicable noise criteria and would not have any significant noise impact on the Nelsons Ridge residential area. Given that the project is generally consistent with the approved concept plan, and involves only warehousing and distribution (as opposed to heavy industry) the project is unlikely to result in any operational or construction noise impacts.
Visual amenity, built form and urban design	In most respects, the project complies with the Greystanes SEL concept plan and is therefore not expected to result in any significant adverse visual impacts. The visual assessment concluded that there would be low visual impacts associated with the proposed amended building height controls, both on the existing and future surrounding context.
Soils, water quality and waste	As the site is relatively flat and self-contained, with stormwater flowing to the precinct detention basin at Widemere East, the project does not entail a significant risk of erosion and sedimentation during construction works. The project is not expected to entail any significant risk to groundwater resources by way of contamination. The project is not expected to entail any significant additional risk to stormwater quality, given the project involves general warehousing and distribution activities.

Environmental aspect	Comment
Hydrology and flooding	The project is not expected to entail any significant additional risk to stormwater, given that the project involves general warehousing and distribution activities. A Stormwater Management Strategy (and an accompanying Stormwater Maintenance Plan) forms part of the concept plan approval, and the construction of the estate stormwater infrastructure has been approved as part of the Greystanes SEL project approval.
Biodiversity	As a former quarry, the DEXUS Estate site is devoid of vegetation and has no significant fauna habitat. Accordingly, the project is not expected to have any impact on the flora and fauna values of the area.
Aboriginal heritage	As a former hard rock quarry, the DEXUS Estate site does not contain any Aboriginal sites or objects.
Historical heritage	A previous assessment concluded that the development of the Greystanes SEL would not have a significant impact on heritage items, although archival recording and an interpretation strategy were recommended to record and conserve the heritage values of the Prospect Quarry.
Air quality	Dust emissions during construction works would not be significant and would be managed using standard best practice controls. During operations, the main sources of air emissions would be vehicle, and to a lesser extent, plant emissions. Neither of these emissions sources are expected to be significant, and would be consistent with emissions from similar warehouse and distribution centres.
Socio-economic	The project would not result in any adverse economic impacts.

Clyde Terminal Conversion Project

The Clyde Terminal is located to the north of the M4 Motorway with the nearest part of the site being about 300 metres from the motorway. The eastern part of the site is bounded by Duck River.

The Clyde Terminal Conversion Project comprises conversion of the terminal and associated Shell-owned land to allow receipt, storage, dosing and distribution of finished petroleum products. The first stage comprises demolition of redundant infrastructure and would take place over a five to 10 year period. This would be followed by construction of new infrastructure. At the time of preparation of this EIS, planning approval had not been granted.

Information on the project was sourced from the *Clyde Terminal Conversion Project Environmental Impact Statement* (AECOM 2013).

Table 9.5 Summary – Clyde Terminal Conversion Project

Environmental aspect	Comment
Traffic and transport	The Traffic Impact Assessment concluded that the Project would result in increases to light vehicle and heavy vehicle numbers during the demolition and construction works. However, this increase in vehicles would not significantly impact the surrounding road network, and as such, the levels of service for impacted intersections are not predicted to change.
Noise and vibration	Demolition and construction works may result in minor exceedances of construction noise management levels of up to 4 dB(A) at three residential receivers. Noise associated with operation of the Clyde Terminal once the conversion works are completed is anticipated to be consistent with current operations at the Clyde Terminal and to be within acceptable noise criteria.

Environmental aspect	Comment
Visual amenity, built form and urban design	Demolition and construction components of the Project have the potential to result in minor temporary visual disturbances within the project area and to a lesser extent the surrounding road network associated with the movement of heavy vehicles and cranes. The continued use of the Clyde Terminal for the receipt, handling and distribution of finished petroleum products would be consistent with the industrial character and historic use of the project area.
Soils, water quality and waste	Demolition and construction have the potential to generate dust and sediment runoff impacting on surface water quality at the project area. However, it is anticipated that the proposed management measures would be adequate to mitigate any such impacts to a negligible level. The ongoing operation of the Clyde Terminal both during and after the conversion works are completed would generate similar waste streams as those currently generated and these would be managed in a similar manner as currently approved.
Hydrology and flooding	The project is also not anticipated to increase overall stormwater runoff from the Project area as the majority of the project area is already hardstand.
Biodiversity	Demolition and construction works would take place on sections of the Project area that have been subject to historical vegetation clearing and which no longer contain native vegetation. The project does not require the removal or direct disturbance to foreshore vegetation (including wetland habitat) within the project area.
Aboriginal heritage	Impacts on Aboriginal heritage are considered highly unlikely.
Historical heritage	An assessment of the proposed works found that the demolition of the old Clyde Refinery infrastructure would have a negative impact on the historical, rarity and representative significance of the project area. It would also have a moderately negative impact on the assessed local aesthetic, social, technical and research significance of the Project area.
Air quality	The project is not anticipated to result in residual air impacts provided the proposed mitigation measures are put in place during demolition and construction works.
Socio-economic	The project is not anticipated to result in detrimental residual social and economic impacts. Rather, it would provide a number of benefits to the locality, region and State.

Camellia Waste Recycling Project

This project is located at Veolia Environmental Services' existing site at Camellia, about two kilometres to the north/northwest of the M4 Motorway. The project comprises the construction of a Materials Recycling Facility capable of processing up to 200,000 tonnes per annum of general solid waste (non-putrescible) on the existing site in Camellia, including receiving up to 50,000 tonnes per annum of source separated material. This would come directly to the product area for baling and dispatch to secondary markets. The general solid waste (non-putrescible) would consist mainly of dry waste from the commercial and industrial sector.

Construction was anticipated to commence in 2014 with commissioning occurring in late 2014. At the time of preparation of this EIS, planning approval had not been granted.

Information on the project was sourced from the *Camellia Recycling Centre Environmental Impact Statement* (CH2M Hill 2013)

Table 9.6 Summary – Camellia Waste Recycling Project

Environmental aspect	Comment
Traffic and transport	The assessment concluded that the additional truck movements generated by the project during both construction and operation would not create a significant impact on the surrounding road network.
Noise and vibration	Construction and operational noise levels are likely to meet the recommended management levels.
Visual amenity, built form and urban design	The degree of character alteration to the visual environment as a result of the project would not be considered substantial and is less than significant.
Soils, water quality and waste	The site has elevated levels of hexavalent chromium (Cr (VI)) in the soil where the fill has been locally contaminated with imported Chrome Ore Processing Residue. The soil also contains asbestos materials and is classified as acid sulphate soil. Demolition and decommissioning of the existing Veolia facility is expected to produce a large volume of industrial waste. Much of this waste is expected to consist of decommissioned machinery.
Hydrology and flooding	The proposed development is likely to incur minimal changes in flood levels, flows and velocities.
Biodiversity	Impacts on biodiversity are considered highly unlikely.
Aboriginal heritage	Impacts on Aboriginal heritage are considered highly unlikely.
Historical heritage	Impacts on historical heritage are considered highly unlikely.
Air quality	There is the potential for minor dust generation and exhaust emissions from the construction and operation of the Camellia Recycling Centre.
Socio-economic	It is not expected that there will be any negative long-term socio-economic impacts from the project.

Westfield Shopping Centre Redevelopment, Parramatta

The Concept Plan for this project comprises an additional single level of retail uses over the existing shopping centre footprint, a 20 storey commercial tower above the retail podium, additional above ground car spaces, and street activation and public domain works on the corner of Church Street and Argyle Street. Initial works (Stage 1) would comprise the additional retail level and car park spaces.

Stage 1 is due for completion by 2016 and Stage 2 by 2021. Planning approval for Stage 1 was granted in February 2014. The project is located about 850 metres north of the M4 Widening project.

Information on the project was sourced from *Westfield Parramatta Development Concept Plan Application* (Ingham Planning (2012).

Table 9.7 Summary – Westfield Shopping Centre Redevelopment, Parramatta

Environmental aspect	Comment
Traffic and transport	Traffic impact assessment indicates that the proposed development will have minimal impact on the surrounding road network, and intersections will continue to function satisfactorily at their current service levels.
Noise and vibration	Construction noise and vibration levels would likely to meet the recommended management levels. Operational noise emissions would be minor.
Visual amenity, built form and urban design	The proposed development will have minimal impact on the natural environment or amenity of the area.
Soils, water quality and waste	The proposal would have minimal impacts on soils and water quality. Construction waste generation would not be significant and 80% would be reused or recycled.
Hydrology and flooding	The subject land is not identified as being flood prone. The existing stormwater management system has been designed in accordance with the relevant technical standards and to the requirements of the Upper Parramatta Catchment Trust.
Biodiversity	Impacts on biodiversity are considered highly unlikely.
Aboriginal heritage	Impacts on Aboriginal heritage are considered highly unlikely.
Historical heritage	Impacts on historical heritage are considered highly unlikely.
Air quality	The proposal will result in minimal odour impacts within the locality.
Socio-economic	The proposal will have positive social and economic impacts, particularly in terms of accommodating planned employment growth for the Parramatta CBD.

Enfield Intermodal Logistics Centre (ILC)

The ILC site is located on the former Enfield Marshalling Yards site at South Strathfield about 15 kilometres by road from the Sydney CBD and 3.5 kilometres from the eastern end of the M4 Widening Project. The ILC site covers an area of about 60 hectares and extends generally from the intersection of the Hume Highway and Roberts Road in the north to the intersection of Punchbowl Road and Cosgrove Road in the south. Current access to the site is via Cosgrove Road.

The ILC is part of a network of existing and planned intermodal terminal facilities in Sydney aimed at mitigating the growth in road-based freight truck numbers. Main construction works commenced in July 2011 and are expected to be completed by mid- 2014. The site is expected to be operational sometime between July and September 2014.

Information on the project was sourced from the *Intermodal Logistics Centre at Enfield Environmental Assessment* (Sydney Ports 2005).

Table 9.8 Summary – Enfield Intermodal Logistics Centre

Environmental aspect	Comment
Traffic and transport	The assessment found that the development of the ILC at Enfield would have a minimal impact on the road network during construction and operation.
Noise and vibration	Noise generated by construction activities may potentially exceed criteria set for construction noise, depending on the duration of construction activities. The major operational noise emissions from the site would be associated with the idling of trains and plant operating in the northern end of the site.

Environmental aspect	Comment
	The types of activities carried out on site during construction and operation would be unlikely to cause significant ground vibration beyond 25 metres from the source.
Visual amenity, built form and urban design	The immediate surrounds are largely industrial, with some residential areas in Greenacre, Belmore and Strathfield South. The site development would generally be in keeping with the existing character of the area. Some relatively high and/or bulky structures would, however, increase visibility of the site beyond its current levels. Most of the residential areas with potential views to the site would be subject to low impacts as the change to the landscape created by the development would be minimal.
Soils, water quality and waste	No negative impacts with respect to soils, contaminated land or groundwater are anticipated as a result of this proposal. Beneficial impacts are likely to result through remediation of contamination 'hotspots' and through site capping. During construction the potential would exist for sedimentation of receiving waters to occur. Water quality during operation of the site would be adequately managed through implementation of various controls.
Hydrology and flooding	The hydrological and hydraulic assessment demonstrated that the development would have little or no discernible impact on the environment, provided that the proposed mitigation measures were incorporated into the design.
Biodiversity	Due to the generally degraded nature of the site, the ILC proposal considered unlikely to affect, threaten or have an adverse impact on any of plants or animals listed under the TSC Act or EPBC Act. The ILC site does, however, provide marginal habitat for the Green and Golden Bell Frog. The creation of a Frog Habitat Area would minimise the impact of any further disturbance or habitat loss that may result from the development of the ILC site.
Aboriginal heritage	The site has been extensively disturbed through its use as the former Enfield Marshalling Yards and no natural soils are thought to remain on the site. As a result, there are no indigenous heritage constraints for development of the site.
Historical heritage	The assessment identified two items of State significance and three items of local significance. Options have been developed for the two items of State significance to be retained on the ILC site, where they will be subject to on-going maintenance.
Air quality	The construction air quality assessment showed that, with the prescribed mitigation measures in place, the ambient air quality criteria for particulate matter and deposited dust would be met around the site borders. The air quality assessment of the operations phase concluded that, with emissions from an at-capacity ILC site, the risk of air quality impacts is very low, from both off-site and on-site sources.
Socio-economic	The key issues raised by the local community were associated with the actual or perceived traffic increases on the local roads and the associated safety, noise and air quality impacts. Air quality and noise associated with truck and train movements and the 24 hour operation of the site were also raised regularly by community stakeholders.

Columbia Precinct

This project is located at Homebush to the south of the M4 Motorway on a three hectare area of land bounded by Parramatta Road to the north, the North Shore/Northern Railway Line to the east, the Western railway Line to the south and Powells Creek to the west. The project is located about 1.8 kilometres from the eastern end of the M4 Widening project.

The project comprises a redevelopment of the site for mixed use, commercial, residential and retail purposes. Planning approval was granted in May 2013.

Information on the project was sourced from the *Columbia Precinct Concept Plan Part 3A Environmental Assessment* (Colston Budd Hunt & Kafes Pty Ltd 2011).

Table 9.9 Summary – Columbia Precinct

Environmental aspect	Comment
Traffic and transport	The proposal would not have a material impact on traffic and transport. The new intersection would operate at a Level of Service C which is satisfactory.
Noise and vibration	Construction noise and vibration levels would likely meet the recommended management levels. Operational noise emissions would be minor subject to implementation of an appropriate acoustic design.
Visual amenity, built form and urban design	A peer review concluded that the proposal is a sensitive and thoughtful development with respect to urban design considerations. Visual impacts would be positive and in keeping with the surrounding area.
Soils, water quality and waste	Impacts on soils are considered highly unlikely. Water quality has been addressed through various controls and there is unlikely to be a material impact on receiving water quality.
Hydrology and flooding	The primary flood risk is associated with Powells Creek, however, the 100 year ARI flood level was deemed appropriate for development of the site.
Biodiversity	Impacts on biodiversity are considered highly unlikely.
Aboriginal heritage	Impacts on Aboriginal heritage are considered highly unlikely.
Historical heritage	Impacts on historical heritage are considered highly unlikely.
Air quality	Material impacts on air quality are considered highly unlikely and would be associated with construction activities.
Socio-economic	The redevelopment of the site which comprises obsolescent industrial and commercial buildings for mixed use commercial, residential, retail purposes is anticipated to be a positive socio-economic benefit.

Westmead Health Campus – various projects

The Westmead Health Campus (WHC) is co-located with Westmead Hospital in the suburb of Westmead within the Parramatta LGA. It is located about 1.5 kilometres north-west of the Parramatta CBD and about 2.4 kilometres from the western end of the M4 Widening project.

There are various developments either in planning or underway within the WHC and which could potentially overlap with the M4 Widening project. Specific impacts would depend on the nature of the respective developments, however, in general there is considered to be low potential for cumulative impacts with regard to the M4 Widening project.

9.2.4 Assessment of potential impacts

As part of the first stage of WestConnex, the M4 Widening project would have beneficial cumulative effects. It would deliver economic benefits that outweigh the initial upfront construction cost and ongoing operational cost, and would create the potential for the realisation of wider economic benefits. WestConnex will also deliver substantial amenity benefits such as, but not limited to, helping Sydney cope with expected growth, improving traffic flow along key corridors and provide an important catalyst for urban renewal in areas of Sydney that currently experience poor amenity due to excessive traffic on local and arterial roads.

Table 9.10 provides a high level assessment of the likelihood of the identified projects interacting with the M4 Widening project to produce cumulative impacts. The likelihood is based on the construction period of each project in relation to the M4 Widening project and the minimum separation distance from the affected section of the M4 Motorway. The table also includes future stages of WestConnex (refer Figure 1.1 for locations).

Table 9.10 Likelihood of project interactions with the M4 Widening Project

Existing or proposed projects	Likelihood of interaction	Timing of construction	Minimum distance to project
Greystanes Southern Employment Lands – Dexus Industrial Park	Low	Concurrent	6.5 kilometres
Clyde Terminal Conversion Project	High	Concurrent	300 metres
Camellia Waste Recycling Project	Medium	Consecutive (preceding)	2 kilometres
Westmead Health Campus – various projects	Low	Concurrent	1.5 kilometres
Westfield Shopping Centre Redevelopment	Low	Concurrent (Stage 1) Consecutive (following – Stage 2)	850 metres
Enfield Intermodal Logistics Centre (ILC)	Low	Consecutive (preceding)	3.5 kilometres
Columbia Precinct	Low	Concurrent	1.8 kilometres
M4 East (WestConnex Stage 1)	High	Consecutive (following)	0
WestConnex M4 South	Low	Consecutive (following)	5.6 kilometres
WestConnex M5	Low	Consecutive (following)	6 kilometres

The potential cumulative impacts of these projects are considered as follows in relation to:

- Concurrent impacts, ie potential cumulative impacts as a result of projects being constructed at the same time.
- Consecutive impacts, ie potential cumulative impacts as a result of a project being constructed before and after the construction of the M4 Widening project.

Concurrent impacts

Traffic and transport

Consideration of cumulative traffic and transport impacts is provided in section 8.1. This includes a consideration of the traffic and transport implications of the full WestConnex as well as potential interactions with other major transport projects including NorthConnex and various improvements to the rail network. Measures are also proposed to address potential interaction between the M4 Widening and other major projects during construction.

Noise and vibration

The potential for cumulative construction noise impacts would be limited to the Clyde Terminal Conversion Project which is the closest identified major project to the M4 Widening project where construction activities would be concurrent. The intervening land (north of the motorway) is largely given over to industrial and commercial land use, and there are few sensitive receivers. The noise assessment for the M4 Widening identifies a commercial building at the southern end of Shirley Street as a sensitive receiver. This receiver is also identified in the environmental assessment for the Clyde Terminal Conversion Project.

No cumulative operational noise impacts are expected.

Visual amenity, built form and urban design

Given the physical separation of the M4 Widening from the other identified projects the likelihood of cumulative impacts is considered low. It is noted that these would all be constructed entirely or largely within existing corridors or footprints and the cumulative effect would be at a landscape level and consistent with an urban environment in a large city.

While the proposed M4 East project (largely in tunnel) adjoins the M4 Widening project, the two sections would connect on the surface. Both sections would be accorded a consistent landscape design treatment and cumulative effects are therefore likely to be minor.

Water quality

Four of the identified projects are also located within the Parramatta River catchment and there is therefore potential for a cumulative impact on water quality in the upper Parramatta River. However, given the size of the catchment and the large number of other activities that influence receiving water quality, the cumulative effect of these projects and the M4 Widening is considered relatively minor.

Hydrology and flooding

As noted above, four of the identified projects are located within the Parramatta River catchment along with the M4 Widening. Of these, only the Clyde Terminal Conversion Project is located in the same subcatchment as the project. The subcatchment is drained by Duck River with the Clyde Terminal Conversion Project being broadly lower down the subcatchment from the project. There are no material hydrological impacts associated with this or the M4 Widening. As such, no cumulative impacts are anticipated.

Biodiversity

The project would impact on three threatened ecological communities:

- Swamp Oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions.
- Shale gravel transition forest in the Sydney Basin Bioregion.
- Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions.

None of the identified projects would affect these communities and accordingly, no material cumulative impact is anticipated.

While the Clyde Terminal Conversion Project is located in proximity to Duck River, the assessment indicates that no impact is anticipated on riparian or wetland vegetation. Cumulative impacts associated with removal of riparian/wetland vegetation is therefore expected to be minimal. The assessment for the Clyde Terminal Conversion Project notes that there have been sightings of the Grey-headed Flying-fox in the locality and a similar observation has been made for this project. The biodiversity assessment for the project noted that there is a permanent Grey-headed Flying-fox camp site on the Parramatta River, at Parramatta Park, and that the species is known to forage up to 50 kilometres from a camp site. As such, a cumulative impact on this species is considered low.

Aboriginal heritage
No Aboriginal archaeological objects or Aboriginal places were identified within the project area. Accordingly, no cumulative impacts to Aboriginal sites/objects places are anticipated.

Historical heritage
The project would largely be confined to the existing M4 Motorway corridor or its immediate environs and would have no direct physical impacts on the majority of the adjacent heritage items and no visual impacts on those items. None of the identified heritage items are associated with the other major developments. As such, no cumulative impacts to historical heritage items are anticipated.

Air quality
Dust and other emissions associated with construction activities would vary in intensity over the length of the project and would be influenced by the nature of construction activities occurring in specific locations. The greatest potential for cumulative effects would relate to those projects in close proximity to the M4 Widening, particularly where construction activities are concurrent. The closest project is the Clyde Terminal Conversion Project. Construction–related emissions from this project are not expected to be significant and accordingly, cumulative air quality impacts are considered unlikely.

The air quality assessment showed that in operation the project would result in small changes of a few per cent in air quality parameters and, in most cases lead to an improvement in air quality. The changes are limited to areas adjoining the widened M4 Motorway and would be unlikely to result in any discernable effects on regional air quality. As such, cumulative impacts are considered unlikely.

Consecutive impacts

Construction activities for the Camellia Waste Recycling Project and Enfield Intermodal Logistics Centre would likely be complete prior to commencement of construction of the M4 Widening. Given this and the separation distances from the M4 Widening, no material cumulative impacts are anticipated.

There may be some overlap with Stage 2 of the Westfield Parramatta Development which is scheduled for completion in 2021. At the time of preparation of the EIS, no development application had been lodged for this second stage.

Various developments are planned for the Westmead Health Campus with the latter likely following after the M4 Widening. However, given the separation distance (1.5 kilometres), no material cumulative impacts are anticipated.

In additional to the M4 East, further WestConnex stages include:

- M5 from St Peters to the M5 East, scheduled for construction from 2016 to 2020.
- M4 South from Haberfield to St Peters, scheduled for construction from 2018 to 2023.

The potential for cumulative construction impacts would largely be related to where each stage connects to the adjoining stage. However, given that these stages do not adjoin the M4 Widening project, the potential for cumulative impacts is considered unlikely.

9.2.5 Environmental management measures

The majority of the cumulative impacts would be mitigated and managed by the measures outlined in this chapter and in Chapter 8. Additional mitigation measures include:

Impact	Ref#	Environmental management measures	Responsibility	Timing
Cumulative impacts	CI-1	Consultation will be undertaken with local communities potentially affected by the impacts of multiple projects in addition to the M4 Widening.	WDA/Contractor	Construction
Cumulative impacts	CI-2	Where relevant, consultation will be undertaken with proponents of other nearby projects to increase the overall awareness of project timeframes and impacts	WDA/Contractor	Construction

10 Sustainability

This chapter explains how sustainability principles relate to the design, construction, and operation of the project. The assessment has been prepared to address relevant DGRs as documented in the table below.

Director-General's Requirements	Where addressed in EIS
The Environmental Impact Statement (EIS) must be prepared in accordance with, and meet the minimum requirements of, Part 3 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 (the Regulation), including… • detail how the principles of ecologically sustainable development will be incorporated in the design, construction and ongoing operation phases of the project.	Section 10.3 Section 10.4

10.1 What is sustainability?

The most common definition of sustainability, from the World Commission on Environment and Development report Our Common Future is 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland 1987). Other definitions vary depending on the perspectives and specific needs of users but most definitions recognise that social and economic well-being is invariably linked to maintaining ecosystem health and preserving natural resources.

Well-functioning infrastructure is essential for the sustained economic growth, international competitiveness, public health, and overall quality of life (Mirza 2006). Infrastructure sustainability has recently been defined by the Infrastructure Sustainability Council of Australia (ISCA) as 'infrastructure that is designed, constructed and operated to optimise environmental, social and economic outcomes over the long term' (ISCA 2012). However, this definition can only be made meaningful at the infrastructure project level by understanding and appreciating the specific project context. Considerations may include:

- The institutional setting and regulatory framework surrounding project development.
- Opportunities and constraints associated with the physical project site.
- The perspectives, needs and interests of key stakeholders.
- Project timeframes, targets and objectives.
- The life expectancy of the infrastructure asset.

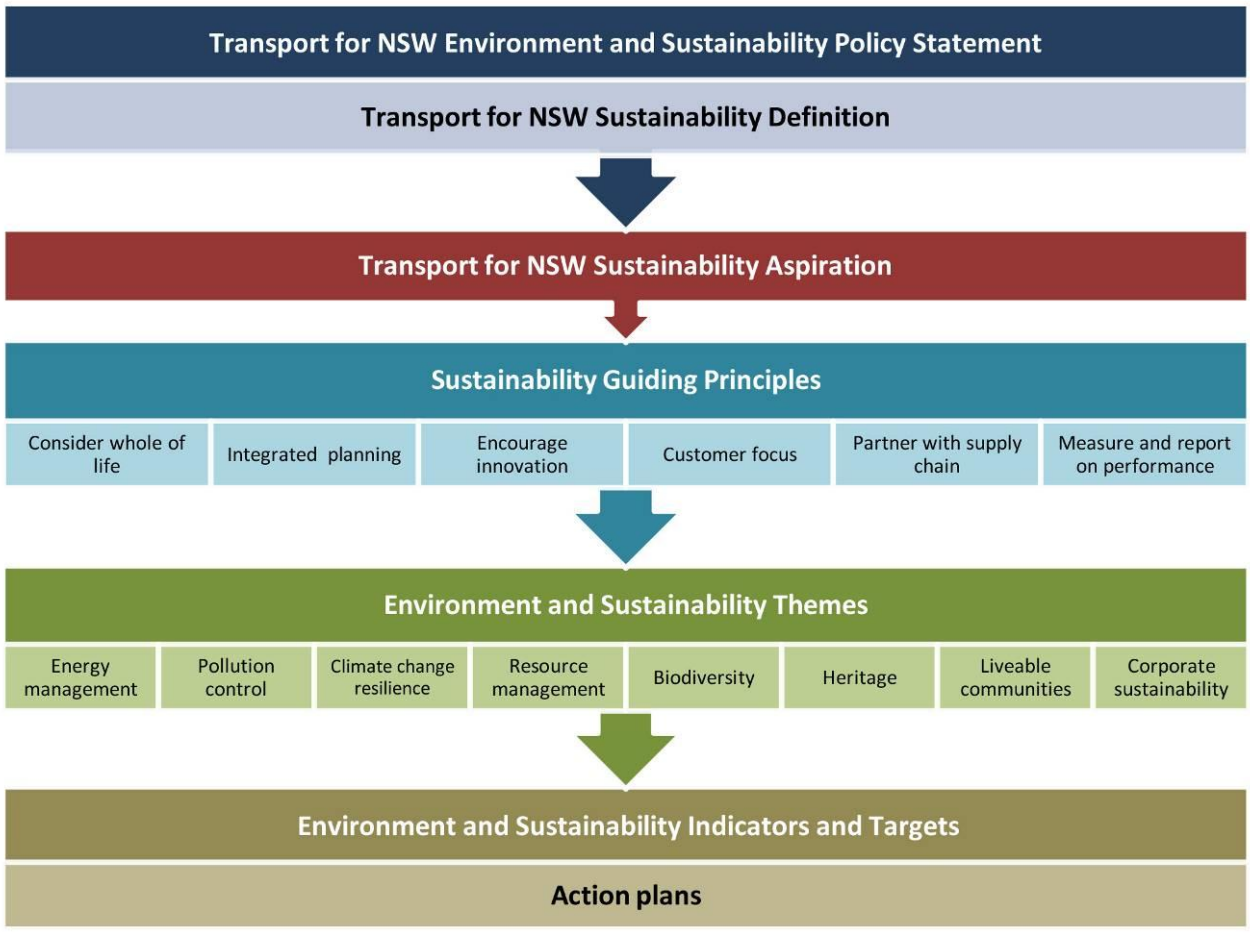
10.2 Sustainability framework

The *Transport Environment and Sustainability Policy Statement* (TfNSW, 2013) explains that NSW transport agencies are committed to delivering transport services, projects, operations and programs in a manner that balances economic, environmental and social issues to ensure a sustainable transport system for NSW. The statement indicates that this is to be achieved by:

- Ensuring that the development, expansion and management of the transport network is sustainable and resilient to climate change
- Minimising the impacts of transport on the environment, encompassing transport operations, infrastructure delivery and maintenance and corporate activities
- Enhancing the quality of life for transport customers by procuring, delivering and promoting sustainable transport options.

The companion *Transport Environment and Sustainability Policy Framework* (TfNSW, 2013a) presents a collective and coordinated approach to deliver the NSW Government's environmental and sustainability agenda across transport agencies. The framework includes sustainability principles, themes, targets and action plans as illustrated by Figure 10.1.

Figure 10.1 Transport Environment and Sustainability Policy Framework (TfNSW 2013a)



Consistency between the project and the Transport Environment and Sustainability Policy Framework is considered in Table 10.1.

Table 10.1 Project consistency with Transport Environment and Sustainability Policy Framework

Theme	Scope	Action	Project consistency
Energy management	Construction of major roads and other projects	Identify greenhouse gas emission sources at project planning stage and measures taken, where cost effective, to reduce these emissions through design and construction processes	Sources of greenhouse gas emissions during the construction and operation of the project have been identified and quantified (refer to section 9.2). Measures to minimise energy consumption associated with the proposal, have been proposed (refer to section 9.3).
Pollution control	Operations, maintenance and construction	Establish practices, where practicable to mitigate noise from transport	Measures to address construction and operational noise associated with the project are detailed in section 8.2.7. Water quality is considered in section 8.4.
Climate Change Resilience	Planning, construction and operations	High level analysis of climate change risks to transport operations and projects	The potential effects of sea level rise on the flooding regime and consequential effects for the project are specifically considered in the section 8.5.
Resource Management	Construction	Implement best resource management practices. Where practicable establish a water balance study to reduce water consumption	Resource management during the construction of the project, including opportunities for recycling and reuse, are considered in section 8.4. A water balance study has not been done at this early stage of the project.
Biodiversity	Planning, operations, maintenance and construction	Develop and implement practices that mitigate transport's impact on biodiversity	The potential impacts of the project on biodiversity has been considered (refer to section 8.6.4). Measures have been proposed to address identified impacts (refer to 8.6.4).
Heritage	Planning, operations, maintenance and construction	Develop and implement practices that mitigate transport's impact on heritage	The potential impacts of the project on Aboriginal and historic heritage have been considered (refer to sections 8.7 and 8.8 respectively).

In addition to the project level initiatives reviewed above, WDA has committed to registering the whole WestConnex project with ISCA and achieving a minimum rating of 'Excellent' for the design and as-built phases of the M4 Widening project. A Sustainability Strategy is being prepared to guide the implementation of sustainability across the entire WestConnex project and facilitate the ISCA process. The strategy is supported by the WestConnex environmental and sustainability policy, which includes a commitment to enhancing the project's environmental outcomes and proactively managing impacts.

The strategy will include clear commitments, objectives and targets across a range of sustainability issues such as sustainable procurement, climate change adaptation, energy use, greenhouse gas emissions, water, waste, materials use, land management, ecology, community health, urban and landscape design and innovation. The strategy has been developed to align with the *Sustainability Framework* (TfNSW 2013), the ISCA process and the WestConnex Urban Design Framework objectives.

The WestConnex Urban Design Framework provides design direction to achieve the following urban design vision:

> *WestConnex shall be a sustainable, high quality and transformational project for the people of Sydney and NSW. Exhibiting design excellence as a whole and in all constituent parts, it should be sensitively integrated into the natural and built environment, help build communities and contribute to the future liveability of the city – Australia's 'Global City'. (WestConnex Urban Design Framework, October 2013).*

10.3 Ecologically sustainable development

Ecological Sustainable Development (ESD) has been given statutory recognition in the EP&A Act (as defined in the EP&A Regulation) and (NSW) *Protection of the Environment Administration Act 1999* (PEA Act). Simply defined, ESD is development which aims to meet the needs of people today, while conserving our ecosystems so that future generations can meet their needs.

Both the EP&A Regulation and the PEA Act emphasise the need for effective integration of economic and environmental considerations in decision-making processes and set out the following ESD principles

- The precautionary principle.
- Inter-generational equity.
- Conservation of biological diversity and ecological integrity.
- Improved valuation and pricing and incentive mechanisms.

The way these four tenets of ESD have been recognised and applied during the development and assessment of the project is considered below.

10.3.1 Precautionary principle

The precautionary principle deals with certainty in decision-making. It provides that where there is a threat of serious or irreversible environmental damage, the absence of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation.

The threat of serious or irreversible environmental damage is one of the essential preconditions to the engagement of the precautionary principle. This EIS has identified a number of environmental risks associated with the project and the mitigation measures that will mitigate those risks. Implementation of the identified mitigation measures will result in acceptable residual risks and no significant risk of serious or irreversible environmental harm.

10.3.2 Inter-generational equity

Clause 7(4) of Schedule 2 of the EP&A Regulation 2000 provides that the principle of inter-generational equity is, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

Social equity is concerned with the distribution of economic, social and environmental costs and benefits. Inter-generational equity introduces a temporal element with a focus on minimising the distribution of costs to future generations.

For road projects, the environmental aspects that are most relevant are waste and resources, socio-economics, biodiversity, water quality, air quality, climate change and cumulative impacts. Table 10.2 considers these matters.

Table 10.2 Intergenerational equity considerations

Aspect	Comment
Waste and resources	The resource demand and waste generation associated with the project would be short-term (mostly limited to the construction phase) and are not of a scale that is likely to affect the access of future generations to resources or waste disposal sites.
Socio-economics	The project would require some property acquisition which would affect a small number of residents and businesses. Major land use changes are not expected (refer to section 8.10). During operation the project would provide improved access and connectivity, travel time savings, better travel time reliability and savings in transportation and vehicle operating costs. Future generations would not be affected by the small amount of property acquisition required. They would however benefit from the operation phase benefits of the project including the economic benefits and improved accesses for business.
Biodiversity	The proposal would not have a significant impact on species, populations ecological communities or their habitats. While some clearing of mangroves would be required these would be minor (refer to section 8.6).
Water quality	During operation the main risk to water quality would be spills and runoff from the road surface containing pollutants such as heavy metals, brake dust, hydrocarbons and rubber particles. To address these risks, water quality treatment through vegetated swales is proposed and spill management basins would be provided where space permits. Residual impacts would only have a minor effect on the quality of the environment for future generations (refer to section 8.4).

Aspect	Comment
Air quality	During operation the project would result in small changes to air quality, which in most cases would represent an improvement (refer to section 8.9). Future generations would benefit from these air quality improvements
Climate change	Sources of greenhouse gas emissions during the construction and operation of the project have been identified and quantified. Measures have been proposed to minimise these emissions (refer to section 9.2). The potential effects of climate change have been considered as part of the drainage design.
Cumulative impacts	Potential cumulative impacts of the project have been assessed (refer to section 9.2 and section 8.1.5). Major operation phase cumulative impacts are not expected.

10.3.3 Conservation of biological diversity and ecological integrity

The twin principles of biodiversity conservation and ecological integrity have been a consideration during the course of the design and assessment process with a view to identifying, avoiding, minimising and mitigating impacts.

The construction of the project would affect up to 9.32 hectares of planted and remnant vegetation in various condition states. Impacts on threatened ecological communities would be limited to approximately 0.17 hectares of moderate condition vegetation and 0.35 hectares of low condition habitat. These areas occur as highly disturbed remnants within an urban landscape and have minimal ecological importance in terms of floristic diversity, fauna habitat values and threatened flora habitat. Consequently, likely impacts on threatened flora and threatened ecological communities were not considered to be significant.

Potential impacts on threatened fauna were also assessed as not likely to be significant. These impacts would be limited to disturbance of potential foraging habitat.

The project would involve some impacts on aquatic habitat, including the removal of around 0.28 hectares of mangrove forest which is classified as important fish habitat under the FM Act. Measures, such as offsets for any cleared mangroves, have been proposed to minimise impacts on aquatic habitat (refer to section 8.6.4) which have been assessed as not significant.

10.3.4 Improved valuation and pricing and incentive mechanisms

Clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000 provides that the principle of inter-generational equity is, namely, that the present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

The principle of internalising environmental costs into decision making requires consideration of all environmental resources which may be affected by a project, including air, water, land and living things. While it is often difficult to place a reliable monetary value on the residual, environmental and social effects of a project, the value placed on environmental resources within and around the corridor is evident in the extent of environmental investigations, planning and design of impact mitigation measures to prevent adverse environmental impacts as identified in this EIS.

The project would include measures for the abatement, avoidance and/or containment of pollution and waste. Additionally the project would include tolling to ensure the polluter pays principle is implemented for the provision of the road. The polluter pays principle provides that those who generate pollution and waste should bear the cost of containment, avoidance or abatement.

11 Environmental risk analysis

This chapter explains how environmental issues for the project were identified and evaluated through an environmental risk analysis process. It also provides a summary of the environmental risk analysis results. The relevant DGRs for this chapter are in the table below.

Director-General's Requirements	Where addressed in EIS
Environmental Risk Analysis — notwithstanding the above key assessment requirement, the EIS must include an environmental risk analysis to identify potential environmental impacts associated with the infrastructure (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures. Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the EIS.	Chapter 11

11.1 Overview

Before lodging the *WestConnex – M4 Widening State Significant Infrastructure Application Report* (Roads and Maritime, 2013), Roads and Maritime and WDA reviewed outcomes of preliminary investigations during WDA concept design development and identified those environmental issues of most importance. The findings were documented in the preliminary environmental assessment and assisted DP&E formulate the 'key issues' for the project as outlined in the DGRs.

As required by the DGRs, the process of environmental risk analysis continued during the course of preparing the environmental assessment. Emphasis was placed on using the detailed information gathered during the assessment process to review the environmental aspects of the project. More specifically, the analysis:

- Identified environmental issues, including key issues in the environmental assessment requirements, and any other issues
- Examined potential impacts and proposed mitigation measures in relation to the identified issues.
- Identified the nature and extent of impacts likely to remain after mitigation measures are applied.

Based on this analysis, an environmental risk category was assigned to each potential impact. This enabled the identification of any matters that might be considered additional key issues and provided a basis for an appropriately detailed assessment of these additional key issues in this environmental assessment. The environmental risk categories assigned to each impact are described in Table 11.1.

Table 11.1 Environmental risk categories

Risk category	Description
Key issue	High or moderate impact (actual and perceived) requiring further investigation to identify specific management and mitigation measures.
Other issue	Moderate or low impact that can be managed effectively with standard and best practice management and mitigation measures

11.2 Environmental risk analysis results

A summary of the environmental risk analysis results is provided in Table 11.2. The results of the environmental risk analysis confirm that the DGRs included all key issues. None of the additional environmental issues assessed for the project were considered to constitute key issues.

Table 11.2 Environmental risk analysis

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
Traffic and transport	Yes			Key issue	Section 8.1
		Construction impact: Potential for safety impacts, due to temporary road arrangements or the proximity of construction activities to general traffic. *Mitigation:* Implement measures to address safety risks as part of the Construction Traffic Management Plan.	Safety measures will address safety risks for construction workers and motorists. With mitigation, residual safety risks are expected to be minor.		Section 8.1.4 Section 8.1.6
		Construction impact: Temporary disruptions and delays to traffic due to the narrowing of lanes, speed restrictions, additional spoil and truck movements and temporary road closures. *Mitigation:* Implement measures to construction related delays as part of the Construction Traffic Management Plan.	Periodic delays associated with lane occupancy. Additional travel time for M4 traffic of about one minute in free flow conditions due to reduced speed limit. No additional travel time in peak periods.		Section 8.1.4 Section 8.1.6
		Construction impact: Potential for a temporary shift of traffic from the motorway to alternative routes, such as Parramatta Road or Victoria Road, particularly during peak periods as motorists try to avoid congestion caused by road works. Mitigation: No specific mitigation required.	Diversion is expected mainly in the off-peak periods and particularly at night when the more substantial lane occupancies would occur. During these periods, alternative routes would have sufficient spare capacity to accommodate additional traffic that has diverted from the motorway.		Section 8.1.4 Section 8.1.6

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
		Construction impact: Temporary impacts on pedestrian and cyclist access due to shared-path diversions and localised changes to access. *Mitigation:* Implement measures (signage, controllers) as part of the Construction Traffic Management Plan to ensure impacts are minimised.	Minor delays for pedestrians and cyclists. Access will be maintained on key routes.		Section 8.1.4 Section 8.1.6
		Operational impact: During operation, increased travel volumes (including heavy vehicles) and travel times on alternative routes, including Parramatta Road. *Mitigation:* Conduct an operational traffic review and identify any opportunities for road safety and traffic management measures and/or project refinements.	Moderate increases in travel time for traffic using Parramatta Road. This would be offset by travel time savings for motorway traffic.		Section 8.1.5 Section 8.1.6
		Operational impact: Safety impacts associated with increased traffic on alternative routes, including Parramatta Road. *Mitigation:* Conduct an operational traffic review and identify any opportunities for road safety and traffic management measures and/or project refinements.	Overall number of crashes (including those resulting in casualties) is expected to be lower with the project.		Section 8.1.5 Section 8.1.6

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
Noise and vibration	Yes			Key issue	Section 8.2
		Construction impact: Noise from road construction activities within the corridor and from the operation of construction site compounds. *Mitigation:* Prepare a Construction Noise and Vibration Management Plan. Implement reasonable and feasible measures to address construction noise.	Mitigation will reduce impacts, but intrusive construction noise is still expected at some locations.		Section 8.2.4 Section 8.2.7
		Construction vibration: Building damage is unlikely due to separation distances. Some potential for vibration to be perceptible at times during works. *Mitigation:* Prepare a Construction Noise and Vibration Management Plan and implement measures to address construction vibration (including equipment selection, working distances and response to vibration related complaints).	With mitigation, residual construction vibration impacts are expected to be minor.		Section 8.2.6 Section 8.2.7
		Operational impact: Road traffic noise associated with changes to traffic and road geometry. *Mitigation:* Implement reasonable a feasible road traffic noise mitigation.	Noise affected residences would be eligible for noise mitigation treatments to minimise operation road traffic noise. Overall the project would result in a reduction in the number of noise affected properties.		Section 8.2.3 Section 8.2.7

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
Visual amenity, built form and urban design	Yes			Key issue	Section 8.3
		Construction impact: Visual changes due to motorway widening and bridge/viaduct construction. Visual impacts associated with construction site compounds. *Mitigation:* Organise, manage and screen site compounds and work areas to minimise visual impacts. Minimise vegetation clearance.	Construction activities would be visible from some locations. Construction visual impacts are temporary by nature.		Section 8.3.4 Section 8.3.6
		Operational impact: Impact of built structures and vegetation removal on sensitive receivers. *Mitigation:* Ensure built structures are designed consistent with the urban design vision for the project. Implement a landscape plan.	Moderate to high and high visual impacts are anticipated at some locations.		Section 8.3.5 Section 8.3.6
		Operational impact: Overshadowing associated with bridge/viaduct structures. *Mitigation:* Explore opportunities to minimise overshadowing during detailed design.	The overshadowing would mainly affect green areas and residual spaces, but also residences.		Section 8.3.5 Section 8.3.6

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
Soils, water, contamination and waste	Yes			Key issue	Section 8.4
		Construction impact: Impacts on water quality from erosion and sedimentation and accidental spills. Mitigation: Prepare a Soil and Water Management Plan to address erosion and sedimentation risks. Implement measures to reduce the likelihood of spills and the extent of impacts should they occur.	With mitigation, residual impacts are expected to be limited.		Section 8.4.3 Section 8.4.5
		Construction impact: Disturbance and exposure of acid sulfate soils. Consequential impacts on water quality and built structures. *Mitigation:* Prepare and implement an Acid Sulfate Soil Management Plan consistent with best practice guidelines.	With mitigation, residual impacts are expected to be limited.		Section 8.4.3 Section 8.4.5
		Construction impact: Disturbance of contaminated land. Consequential environmental and human health impacts. *Mitigation:* Prepare and implement a Contaminated Land Management Plan and Asbestos Management Plan consistent with best practice guidelines	With mitigation, residual impacts are expected to be limited.		Section 8.4.3 Section 8.4.5

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
		Construction impact: Generation and disposal of waste. *Mitigation:* Prepare and implement a Resource and Waste Management Plan consistent with best practice guidelines. Ensure all waste disposal occurs in accordance with its waste classification and associated legal requirements.	With mitigation, residual impacts are expected to be limited.		Section 8.4.3 Section 8.4.5
		Operational impact: Increase in the transport of road surface pollutants (brake dust, rubber, oils, fuels) to local waterways via the pavement drainage system. Risk of spills. *Mitigation:* Detailed design would consider practicable measures to optimise pollution mitigation.	Some remaining potential for polluted runoff to further degrade receiving water quality. Overall number of crashes is expected to be lower with the proposal.		Section 8.4.4 Section 8.4.5
Hydrology and flooding	Yes			Key issue	Section 8.5
		Operational impact: Increase in 1% AEP flood levels at A'Becketts Creek, potentially affecting a number of properties and two dwellings. *Mitigation:* Develop measures during detailed design to address predicted flood level increases.	With mitigation (to be developed), residual impacts are expected to be limited.		Section 8.5.3 Section 8.5.4
		Operational impact: Scour at pipe outlets and around bridge viaduct piers as well as impacts on creek bank stability. *Mitigation:* Identify measures (such as rock armour) during detailed design to address potential for scour and creek bank	With mitigation, residual impacts are expected to be limited.		Section 8.5.3 Section 8.5.4

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
		instability.			
Biodiversity	Yes			Key issue	Section 8.6
		Construction impact: Removal of 9.32 hectares of planted and remnant vegetation (0.54 hectares) in various condition states. *Mitigation:* Undertake pre-clearance surveys, minimise clearing, implement a landscape plan and implement a weed management plan.	With mitigation, residual impacts are expected to be limited. Impacts on threatened species, populations, endangered ecological communities and their habitats were assessed as not significant.		Section 8.6.3 Section 8.6.4
		Operational impact: Impacts on aquatic habitats including mangroves at Duck River. *Mitigation:* Design in-stream structures to minimise impacts on flow. Minimise clearance of mangroves and rehabilitate disturbed areas.	With mitigation, residual impacts are expected to be limited. Estimated loss of 0.28 hectares of mangroves.		Section 8.6.3 Section 8.6.4
Aboriginal heritage				Key issue	Section 8.7
		Construction impact: Disturbance or destruction of previously unidentified Aboriginal heritage artefacts in the road corridor or site compound locations. *Mitigation:* Develop and implement procedures for unexpected finds.	With mitigation, residual impacts are expected to be limited. The project corridor exhibited no undisturbed archaeologically significant landforms. The junction point between Duck River and Duck Creek had some sensitivity, but existing development and past flooding have reduced the archaeological potential.		Section 8.7.3 Section 8.7.4

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
Non-Aboriginal heritage				Key issue	Section 8.8
		Construction impact: Damage to nearby heritage buildings as a result of construction vibration. *Mitigation:* Prepare a Construction Noise and Vibration Management Plan. Implement measures to prevent construction vibration building damage (such as safe working distances).	Damage to nearby buildings (including heritage items) is not expected due to separation distances.		Section 8.8.3 Section 8.8.4 Section 8.2.6 Section 8.2.7
		Construction impact: Disturbance or destruction of previously unidentified historic heritage (relics) in the road corridor or site compound locations. *Mitigation:* Develop and implement a procedures for unexpected finds.	With mitigation, residual impacts are expected to be limited. Assessment found that works within the project corridor would be unlikely to have any impacts on intact archaeological material.		
Air quality				Key issue	Section 8.9
		Construction impact: Mobilisation of dust. *Mitigation:* Implement measures to minimise dust including minimising exposed surfaces, water suppression and covering of loads.	With mitigation, residual impacts are expected to be limited.		Section 8.9.3 Section 8.9.4
		Operational impact: Modelling shows the project would generally reduce vehicle emissions along and beside the M4 Motorway. Small localised increases in emissions would occur where the widened motorway is closer to receptors. A small increase in emissions is also predicted along Parramatta Road. *Mitigation:* No specific mitigation	Small increases in vehicle emissions at some locations.		Section 8.9.3 Section 8.9.4

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
		proposed.			
Social and economic	Yes			Key issue	Section 8.10
		Pre-construction impact: Impacts on residents and businesses as a result of the total or partial acquisition of 15 private properties. *Mitigation:* Early and on-going consultation. Undertake acquisition consistent with the requirements of the (NSW) *Land Acquisition (Just Terms Compensation) Act 1991*.	With mitigation, residual impacts are expected to be limited.		Section 8.10.3 Section 8.10.4
		Construction impact: Reduced amenity (traffic and access, temporary congestion, construction impacts).	With mitigation, there would still be a degree of construction related disruption. Affected people would be kept informed about the nature and duration of expected impacts.		Section 8.10.3 Section 8.10.4
		Mitigation: Undertake early and ongoing with affected people. Implement measures to reduce construction related disruption.			
		Operational impact: Benefits associated with travel time savings for motorway users. Corresponding impacts associated with increased travel time on the alternative route (Parramatta Road). *Mitigation:* Conduct an operational traffic review and identify any opportunities for road safety and traffic management measures and/or project refinements.	Moderate increases in travel time for traffic using Parramatta Road. This would be offset by travel time savings for motorway traffic and improved connectivity.		Section 8.1.5 Section 8.1.6

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
Climate change and greenhouse gas	No			Other issue	Section 9.1
		Construction impact: increase in greenhouse gas emissions from construction fuel use and energy embodied in construction materials. *Mitigation:* Maximise reuse and recycling. Implement energy efficiency measures. Source materials locally where possible to reduce transport emissions.	With mitigation, there would still be greenhouse gas emissions associated with the construction of the project. The amount of additional emissions has been estimated.		Section 9.1.2 Section 9.1.3
		Operational impact: Increased emissions from vehicle use. While the introduction of the M4 Widening project in 2017 would lead to a reduction in emissions on the motorway, an increase in emissions is anticipated in 2027 when the entire WestConnex project is operational. *Mitigation:* No specific mitigation.	At opening of the M4 Widening (2017) reduced emissions are expected at most locations near the motorway. A small increase is predicted along Parramatta Road.		Section 9.1.2
		Operational impact: Increased energy use (and associated emissions) due to the operation of the motorway (lighting, signals, and maintenance). *Mitigation:* Investigate opportunities to use renewable energy for motorway operation.	With mitigation, there would still be greenhouse gas emissions associated with the operation of the project. The amount of additional emissions has been estimated.		Section 9.1.2 Section 9.1.3

Issue	DGRs – Key issue?	Potential impacts and proposed mitigation	Potential residual impacts	Risk category following analysis	EIS reference
Cumulative impacts and interactions	No			Other issue	Section 9.2
		Construction impact: Additional impacts arising from interaction with other projects during the construction period (primarily construction traffic) *Mitigation:* Consult the proponents of other projects during the preparation of the Construction Traffic Management Plan and other environmental management documentation.	With mitigation, residual impacts are expected to be limited.		Section 9.2.4 Section 9.2.5
		Operational impact: Cumulative benefit in terms of reduced congestion when other stages of WestConnex are complete. *Mitigation:* Cumulative benefit. No mitigation required.	Cumulative benefit.		Section 8.1.5

12 Summary of environmental Management Measures

This chapter describes how the M4 Widening project will be managed to reduce potential environmental impacts throughout detailed design, construction and operation. A framework for managing the potential impacts is provided with reference to environmental management plans. A summary of site-specific environmental safeguards is provided as detailed in Chapters 8 and 9 of this EIS.

12.1 Environmental management plans (or systems)

A number of safeguards and management measures have been identified in order to minimise adverse environmental impacts, including social impacts, which could potentially arise as a result of the M4 Widening project. These management measures would be incorporated into the detailed design and applied during the construction and operation of the project.

A Contractors Construction Environmental Management Plan (CEMP) would be prepared to describe safeguards and management measures identified. The plan would provide a framework for establishing how these measures would be implemented and who would be responsible for their implementation.

The plan would be prepared prior to construction of the proposal and must be reviewed and certified by the WDA, prior to the commencement of any on-site works. The CEMP would be a working document, subject to ongoing change and updated as necessary to respond to specific requirements.

12.2 Summary of safeguards and management measures

Environmental safeguards outlined in Chapters 8 and 9 of this EIS would be incorporated into the detailed design phase of the project and during construction and operation. These safeguards would minimise any potential adverse impacts arising from the proposed works on the surrounding environment. All safeguards described in this EIS would be incorporated into the contractor's CEMP. Safeguards and management measures applicable to the project are summarised in Table 12-1.

Table 12-1 Summary of safeguards and management measures

Impact	REF#	Environmental management measures	Responsibility	Timing
Construction traffic and road safety impacts	TT-1	• A traffic and transport liaison group will be established prior to commencement of construction. The traffic and transport liaison group will be consulted during preparation of the construction traffic management plan.	WDA Contractor	Pre-Construction
Construction traffic and road safety impacts	TT-2	A construction traffic management plan will be developed, approved, implemented and monitored as part of the project. The construction traffic management plan would focus on maintaining general traffic flow and specifying appropriate site accesses and construction traffic routes. It would include: • Traffic Control Plans showing the access arrangements and the detail of required signs and devices • Vehicle Management Plans showing access to work sites and direction of travel • Pedestrian and Cyclist Control Plans • Management strategy for other road users • Management strategy for access to adjacent properties • Hours of operation, including prohibitions on queuing outside sites prior to commencement of working hours • Road safety audit requirements • Any localised improvements/adjustments to existing traffic management arrangements.	Contractor	Pre-construction
Construction traffic and road safety impacts	TT-3	Construction staging and temporary works will be developed and implemented to minimise conflicts with the existing road network and to maximise the separation between work areas and travel lanes.	Contractor	Construction
Construction traffic and road safety impacts	TT-4	Lane occupancies will be planned with the aim of minimising the actual work area, limiting obstructions and restrictions, maximising road capacity and avoiding peak traffic periods.	Contractor	Construction
Construction traffic and road safety impacts	TT-5	Existing motorway capacity will be maintained during the morning peak and evening peak periods.	Contractor	Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
Construction traffic and road safety impacts	TT-6	Monitoring of the motorway and work sites will be undertaken using CCTV and mobile patrols where required to assist management of incidents.	Contractor	Construction
Construction impacts on pedestrians and cyclists	TT-7	Access for bicycles along the motorway (where currently available) would be maintained or an alternative route provided and signposted, with the exception of times when work is being undertaken in the shoulder. This work would include temporary diversions or stop/go conditions under traffic control.	Contractor	Construction
Construction impacts on pedestrians and cyclists	TT-8	Access to existing shared paths would be maintained subject to the need for temporary diversions.	Contractor	Construction
Operational traffic management	TT-9	An operational traffic review will be undertaken to confirm the operational traffic impacts of the project on surrounding arterial roads and major intersections. The assessment will be based on actual traffic counts and will assess the level of service at major intersections between Pitt Street and Homebush Bay Drive along the M4 Motorway and on Parramatta Road. Where necessary, the outcomes of the operational traffic review would be used to identify opportunities for any further operational refinement to optimise the performance of the project.	WDA	Operation
Operational Road traffic noise	NV-1	Feasible and reasonable noise mitigation will be considered in accordance with the NSW Road Noise Policy (EPA 2011) and the Environmental Noise Management Manual (RTA 2001). Specifically, noise mitigation (beyond the adoption of traffic management and other road design measures) will be considered in the following circumstances: • The predicted 'build' noise level exceeds the RNP base criteria for redeveloped roads and the noise level increase due to the project (ie the noise predictions for the 'build' minus the 'no build') is greater than 2 dB. OR • The predicted 'build' noise levels are acute (≥65 dBA LAeq(15hour) or ≥60 dBA LAeq(9hour)) regardless of the incremental impact of the project.	Roads and Maritime	Pre-Construction
Construction noise	NV-2	A Construction Noise and Vibration Management Plan (CNVMP) will be	Contractor	Pre-Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
and vibration		prepared for the project. The CNVMP will: • Assist in ensuring that the noise during construction complies where possible with the construction noise management levels set for the project. • Determine noise and vibration monitoring, reporting and response procedures. • Describe specific mitigation treatments, management methods and procedures to be implemented to control noise and vibration during construction. • Describe construction timetabling to minimise noise impacts including time and duration restrictions, respite periods and frequency. • Describe procedures for notifying residents of construction activities likely to affect their amenity through noise and vibration. • Define contingency procedure to be implemented in the event of non-compliances and/or noise complaints.		
Construction Vibration	NV-3	The following vibration mitigation measures will be specifically considered during the preparation of the CNVMP: • Relocate vibration generating plant and equipment to areas within the site in order to lower the vibration impacts. • Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment. • Use lower vibration generating items of excavation plant and equipment eg smaller capacity rockbreaker hammers. • Minimise consecutive works in the same locality (if applicable). • Use dampened rockbreakers and/or ‘city’ rockbreakers to minimise the impacts associated with rockbreaking works. • If vibration intensive works are required within the safe working distances, conduct vibration monitoring or attended vibration trials to ensure that levels remain below the cosmetic damage criterion. • Conduct building condition surveys both before and after the works to identify existing damage and any damage due to the works.	Contractor	Pre-Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
Operational Road traffic noise	NV-1	Feasible and reasonable noise mitigation will be considered in accordance with the NSW Road Noise Policy (EPA 2011) and the Environmental Noise Management Manual (RTA 2001). Specifically, noise mitigation (beyond the adoption of traffic management and other road design measures) will be considered in the following circumstances: • The predicted 'build' noise level exceeds the RNP base criteria for redeveloped roads and the noise level increase due to the project (ie the noise predictions for the 'build' minus the 'no build') is greater than 2 dB. OR • The predicted 'build' noise levels are acute (≥65 dBA LAeq(15hour) or ≥60 dBA LAeq(9hour)) regardless of the incremental impact of the project.	WDA	Pre-Construction
Operational Road traffic noise	NV-2	Within 12 months of the commencement of operation of the project an operational noise review will be undertaken. This will include: • Monitoring to compare actual noise performance of the project against predicted noise performance. • An assessment of the performance and effectiveness of applied noise mitigation measures together with a review and if necessary, reassessment of all feasible and reasonable mitigation measures. • Identification of any additional feasible and reasonable measures that will be implemented with the objective of meeting the criteria in the NSW Road Noise Policy (EPA 2011), when these measures will be implemented and how their effectiveness will be measured and reported.	WDA	Operation

Impact	REF#	Environmental management measures	Responsibility	Timing
Construction noise and vibration	NV-3	A Construction Noise and Vibration Management Plan (CNVMP) will be prepared for the project. The CNVMP will: • Assist in ensuring that the noise during construction complies where possible with the construction noise management levels set for the project. • Determine noise and vibration monitoring, reporting and response procedures. • Describe specific mitigation treatments, management methods and procedures to be implemented to control noise and vibration during construction. • Describe construction timetabling to minimise noise impacts including time and duration restrictions, respite periods and frequency. • Describe procedures for notifying residents of construction activities likely to affect their amenity through noise and vibration. • Define contingency procedures to be implemented in the event of non-compliances and/or noise complaints.	Contractor	Pre-Construction
Construction Vibration	NV-4	The following vibration mitigation measures will be specifically considered during the preparation of the CNVMP: • Relocate vibration generating plant and equipment to areas within the site in order to lower the vibration impacts. • Investigate the feasibility of rescheduling the hours of operation of major vibration generating plant and equipment. • Use lower vibration generating items of excavation plant and equipment eg smaller capacity rockbreaker hammers. • Minimise consecutive works in the same locality (if applicable). • Use dampened rockbreakers and/or ‘city’ rockbreakers to minimise the impacts associated with rockbreaking works. • If vibration intensive works are required within the safe working distances, conduct vibration monitoring or attended vibration trials to ensure that levels remain below the cosmetic damage criterion. • Conduct building condition surveys both before and after the works to	Contractor	Pre-Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
		identify existing damage and any damage due to the works.		
Visual impacts	V-1	A detailed landscape plan will be prepared for the project. The landscape plan will build on the finding of the Urban Design, Landscape Character and Visual Working Paper and will include detailed set out, species and planting guides.	Contractor	Detailed design
Visual impacts	V-2	Where practicable, the height of retaining walls will be minimised allowing introduction of a batter and construction of reinforced soil wall to allow reinstatement of planting along verges.	Contractor	Detailed design
Visual impacts	V-3	Built elements, including noise walls will be further refined consistent with the urban design vision, objectives and principles for the project.	Contractor	Detailed design
Construction visual impacts	V-4	The visual impact of construction site compounds on adjacent residential areas will be minimised through the careful planning and positioning of temporary offices, other plant and material laydown areas, and specific management of lighting and potential for light spill within the identified construction site compounds.	Contractor	Construction
Construction visual impacts	V-5	Vegetation, mature or otherwise, currently located between construction site compounds and adjacent residential areas will be retained where practicable to screen views.	Contractor	Construction
Construction visual impacts	V-6	Vegetation clearance will be limited to that required to construct the project. Where practicable landscaping would be progressively introduced to provide screening between adjacent residences and the motorway corridor.	Contractor	Construction
Construction visual impacts	V-7	Where possible, some screening fencing will be introduced between the motorway carriageways and the work sites in the median and to the sides of the motorway to reduce the visual impact of construction and limit distractions for road users.	Contractor	Construction
Managing impacts on soil and water in general	SWW-1	A Soil and Water Management Plan will be prepared for the project in accordance with: • Managing Urban Stormwater–Soils and Construction, Volume 1 Managing Urban Stormwater, 4th edition (‘the Blue Book’). • Managing Urban Stormwater–Soils and Construction, Volume 2D Main Road Construction.	Contractor	Pre-construction

Impact	REF#	Environmental management measures	Responsibility	Timing
Erosion risk – general	SWW-2	Measures will be implemented during construction to minimise the risk of erosion, sedimentation and pollution. These measures may include: • Avoid disturbance where practicable, otherwise minimise the area of disturbance, particularly on and adjacent to river banks. • Designate of 'no-go' zones for construction plant and equipment. • Install upstream diversion channels to direct clean runoff from upstream catchments around or through disturbed areas (maintaining separation from runoff containing sediment). • Shape disturbed land to minimise slope lengths and gradients and improve drainage. • Install/line catch drains to carry any sediment laden runoff to appropriate sediment control measures. • Minimise stockpiling of material. • Remove cleared or excavated materials as soon as practicable after excavation and appropriately dispose of or stockpile off-site. • Locate stockpiles away from drainage lines and creek channels. • Seed disturbed areas for temporary soil stabilisation. • Employ appropriate measures to prevent/minimise wind-blown dust from leaving the site (eg watering). • Establish designated areas for plant and construction material storage within site compounds and other locations within the project area. • Store all chemicals and fuels associated with construction in secure roofed and bunded areas. • Retain erosion and sediment controls until disturbed areas are stabilised.	Contractor	Construction
Erosion from disturbed areas	SWW-3	Measures will be implemented during operation to minimise the risk of erosion and sedimentation. These measures may include: • Undertake post-construction monitoring to ensure successful establishment of landscaping and vegetation cover. • Undertake remedial planting in locations where vegetation cover has not established or has only partially established.	Contractor	Operation

Impact	REF#	Environmental management measures	Responsibility	Timing
Erosion risk and mobilisation of sediment associated with Duck River bridge pier construction	SWW-4	The following measures will be implemented to address erosion and sedimentation risk near the Duck River bridge works. • Minimise the area of mangroves to be cleared. • Install temporary coffer dams (sheet piling) or suitable alternative around pier construction locations. • Use silt curtain, subject to consideration of tidal flow velocities. • Program works likely to disturb aquatic sediments to 'slack water' periods. • Conduct water quality monitoring.	Contractor	Construction
Operational water quality impacts	SWW-5	Detailed design would consider practicable measures to optimise pollution mitigation. This would include vegetated swales with rock check dams and spill management basins where space permits.	Contractor	Pre-construction
Disturbance of ASS	SWW-6	An ASS Management Plan will be prepared in accordance with the Acid Sulfate Soils Manual and Guidelines for the Management of Acid Sulfate Materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulfidic Black Ooze.	Contractor	Pre-construction
Disturbance of contaminated or potentially contaminated land	SWW-7	A Contaminated Land Management Plan will be prepared in accordance with relevant EPA guidelines.	Contractor	Pre-construction
Disturbance of contaminated or potentially contaminated land	SWW-8	• Excavated material that is not suitable for on-site reuse or recycling will be transported to a site that may legally accept that material for reuse or disposal. • Soils leaving the site will be waste classified so that correct resource recovery and or off-site disposal occur.	Contractor	Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
Disturbance of contaminated or potentially contaminated land	SWW-9	• An Asbestos Management Plan will be developed for the construction of the project in accordance with the National Environment Protection (Assessment of site contamination) Measure 1999. • The Plan will include an unexpected finds procedure to address any previously unidentified asbestos contamination encountered during construction. • Further investigation of the area of public access beneath the M4 Motorway to the east of Alfred Street will be undertaken to assess the level and extent of asbestos in this area.	Contractor	Pre-construction
Inappropriate disposal of excavated material that cannot be reused in the project	SWW-10	Where excavated material cannot be classified as virgin excavated natural material, it will be classified and disposed of to an appropriately licensed landfill in accordance with the Waste Classification Guidelines–Part 1: Classifying Waste and Part 2: Immobilisation of Waste.	Contractor	Construction
Disturbance of contaminated groundwater	SWW-11	Further assessment of the extent and source of hydrocarbon contamination associated with BH101 (located at the junction of Church Street/Great Western Highway) will be undertaken to inform the requirements of any specific remediation or management measures during construction.	Contractor	Pre-construction
Disturbance of hazardous materials	SWW-12	Assessment of the two commercial properties and the four residential properties being acquired will be undertaken for the presence of hazardous building materials.	Contractor	Pre-construction
Inappropriate handling and/or disposal of waste	SWW-13	A project-specific Resource and Waste Management Plan (RWMP) will be prepared in accordance with the Roads and Maritime Waste Minimisation & Management Guidelines and applicable Roads and Maritime QA Specifications.	Contractor	Pre-construction
Inappropriate handling and/or disposal of waste	SWW-14	• All wastes, including contaminated wastes, will be identified and classified in accordance with Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes. • Disposal of any non-recyclable waste will be in accordance with the POEO Act and Waste Classification Guidelines: Part 1 Classifying Waste.	Contractor	Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
Scour around pipe outlets and creek bank instability	HF-1	• Suitable protection measures will be provided at pipe outlets and at locations where there is a risk of creek bank instability due to discharges from the pavement drainage system.	Contractor	Detailed design
Scour around viaduct piers	HF-2	• Rock protection will be provided to prevent scour where piers are placed in areas subject to inundation in the 1% AEP flood.	Contractor	Detailed design
Flood level increases	HF-3	A mitigation strategy will be developed to address the predicted flood level increases in the vicinity of A'Becketts Creek. The strategy will develop and evaluate and range of mitigation options, which may include: • Widening or augmentation of A'Becketts Creek between Good Street and Woodville Road. • Enlargement of Good Street bridge waterway area. • Relocation of viaduct piers. • Streamlining of viaduct piers.	Contractor	Detailed design
Fauna injury and mortality	FF-1	Project environmental management plans will include procedures for pre-clearance surveys that are consistent with the Roads and Maritime Biodiversity Guidelines (RTA 2011). Pre-clearing surveys will be undertaken by an experienced ecologist to identify any nesting/roosting animals present in the project area. This will include inspections of affected existing structures for microbats that may be present in cracks, fissures, scuppers, lifting holes or similar.	Contractor	Construction
Fauna injury and mortality	FF-2	If microbats are found during pre-clearing surveys, an appropriately qualified ecologist will be engaged and provide advice on work methods and timing to minimise impacts on the bats. If exclusions are required, these will be done in accordance with a Bat Management Plan prepared by an appropriately qualified ecologist.	Contractor	Construction
Unexpected impacts on threatened species	FF-3	An unexpected threatened species finds procedure will be developed consistent with the Roads and Maritime Biodiversity Guidelines and incorporated into project environmental management documentation.	Contractor	Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
Loss of native vegetation	FF-4	Exclusion zones will be established to avoid damage to native vegetation and fauna habitats identified for retention and prevent the distribution of weeds. The location of exclusion fencing to be installed will be identified by project environmental management plans and the function and importance of the exclusion zones will be communicated to construction personnel.	Contractor	Construction
Loss of native vegetation	FF-5	A detailed landscape plan will be prepared for the project. The landscape plan will build on the finding of the Urban Design, Landscape Character and Visual Working Paper and will include detailed set out, species and planting guides including for those areas disturbed construction. Where areas of habitat are to be re-established, this will occur consistent with Guide 3 Re-establishment of Native Vegetation of the Roads and Maritime Biodiversity Guidelines (RTA 2011).	Contractor	Construction
Loss of threatened ecological communities	FF-6	Consistent with Principle 6 of the *OEH Offset Principles* the project will consider options to offset the loss of the small areas of TECs impacted by the project. These options will be detailed in the landscape plan and could include: – Enhancing habitat – Reconstructing habitat in strategic areas to link areas of conservation value – Increasing buffer zones	Contractor	Construction
Proliferation of weeds	FF-7	A weed management plan consistent with the Roads and Maritime Biodiversity Guidelines (RTA 2011) will be developed as part of the construction environmental management plan. The weed management plan will include descriptions and mapping of major weed infestations and appropriate management actions to be undertaken in relation to each infestation.	Contractor	Construction
Spread of pathogens	FF-8	Measures to prevent the spread of pathogens will be detailed in the construction environmental management plan. Measures will be consistent with Roads and Maritime Biodiversity Guidelines – Guide 7 Pathogen Management (RTA 2011).	Contractor	Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
Impacts on riparian vegetation and wetlands	FF-9	The detailed design of the bridge over Duck River will be refined to reduce impact on riparian vegetation and wetlands where possible.	Contractor	Detailed design
	FF-10	Riparian vegetation along the main wildlife corridor (Duck River) will be protected during construction works where possible with any affected areas to be rehabilitated.	Contractor	Construction
Impacts on aquatic habitat	FF-11	In stream structures such as bridges and culverts are to be designed and managed to minimise any potential impact to flow regimes and fish passage.	Contractor	Detailed design
Impacts on mangroves	FF-12	DPI would be consulted regarding an appropriate form of biodiversity offset for the proposed loss of 0.28 ha of mangroves.	WDA	Pre-construction
Unexpected identification of Aboriginal objects	AH-1	Project environmental management plans will include procedures to guide the management of any previously unrecorded Aboriginal sites/objects within the project area. Management response would vary depending on the nature of the find, its significance and likely impacts.	Contractor	Construction
Unexpected identification of skeletal remains	AH-2	Project environmental management plans will identify procedures for management of any possible human skeletal remains. In the event that the project reveals possible human skeletal remains, work would cease in the affected area and the remains would be reported to the NSW Police, the Office of Environment and Heritage and Aboriginal stakeholders.	Contractor	Construction
Impacts on known heritage items	HH-1	The design and construction of the proposed new bridge over Duck River will aim to minimise impacts to the heritage listed wetlands adjacent to Duck River.	Contractor	Detailed design Construction
Impacts on known heritage items	HH-2	Potential impacts of construction vibration on adjacent heritage items will be managed in accordance with the project noise and vibration management plan.	Contractor	Construction
Impacts on known heritage items	HH-3	The proposed compound site located immediately to the west of Welfare Street would be screened to reduce the visual impact on the Welfare Street Precinct/Conservation area. Measures may include temporary barriers or suitable fencing.	Contractor	Construction
Unexpected impacts on heritage values	HH-4	The project's construction environmental management plan will include 'unexpected finds' procedures to guide the management of any archaeological sites identified during construction. The management	Contractor	Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
		response will vary depending on the nature of the find, its significance and likely impacts.		
Emissions from general construction activities	AQ-1	• Activities will be assessed during adverse weather conditions and modified as required (for example, activities will cease where reasonable levels of dust cannot be maintained using available means). • Engines of on-site vehicles and plant will be switched off when not in use. • Where practicable, vehicles will be fitted with pollution reduction devices. • Vehicles will be maintained and serviced according to manufacturer's specifications. • Use lower vibration generating items of excavation plant and equipment eg smaller capacity rockbreaker hammers.	Contractor	Construction
Dust emissions from exposed areas and stockpiles	AQ-2	• Minimise the area of exposed surfaces. • Employ appropriate measures to prevent/minimise wind-blown dust from leaving the site (eg water carts).. • Minimise stockpiling of material. • Stockpiles will be located away from sensitive receivers where practicable. • Apply barriers, covering or temporary rehabilitation. • Rehabilitation of completed sections will be undertaken as soon as soon as practicable.	Contractor	Construction
Dust emissions from hauling activities	AQ-3	• Watering of haul roads (fixed or mobile). • Roads or accesses with long term or heavy use will be sealed where required. • Sealed haul roads will be cleaned regularly. • Vehicle traffic will be restricted to designated routes which can be managed by regular watering and with appropriate speed limits. • Wheel wash or grids will be located near exit points to minimise mud/ dirt track out.	Contractor	Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
		• Street cleaning will be undertaken to remove dirt tracked onto sealed roads. • Vehicle loads will be covered when transporting material off site.		
Dust emissions from cutting, grinding or sawing equipment	AQ-4	Dust suppression activities will be undertaken for concrete cutting, grinding or sawing (eg water sprays)	Contractor	Construction
Community access and amenity	SE-1	The draft Community Consultation Framework for the project (refer Appendix M) will be finalised following consideration of community submissions on the EIS. Consultation will then be undertaken consistent with the revised Community Consultation Framework, particularly in relation to: • traffic management (including property access, pedestrian and cyclists access). • Landscaping and urban design. • Construction activities including work outside standard construction hours. • Noise and vibration mitigation and management.	Contractor WDA	Pre-Construction Construction
Property impacts	SE-2	• Early and on-going communication and consultation will occur with property owners, business owners and residents about the property acquisition process.	WDA	Pre-Construction
Property impacts	SE-3	• Property acquisition will occur consistent with the requirements of the (NSW) *Land Acquisition (Just Terms Compensation) Act 1991*.	WDA	Pre-Construction
Business impacts	SE-4	• On-going communication and consultation will occur with the owners and operators of the motorcycle training centre at Martha Street, about potential project impacts and appropriate measures to manage impacts. Roads and Maritime will review the potential to relocate the training centre within the same general locality.	WDA	Pre-Construction
Business impacts	SE-5	• On-going communication and consultation with the owners of the industrial property for partial acquisition at Junction Street, Lidcombe will occur. This will include working with the business owners to manage and plan Project construction activities and delivery to minimise impacts on their business operations.	WDA	Pre-Construction

Impact	REF#	Environmental management measures	Responsibility	Timing
Energy consumption: construction	GHG-1	• Assess energy (fuel/electricity) efficiency when selecting equipment	Contractor	Pre-construction
Re-use of excavated road materials	GHG-2	• A waste management plan will be prepared to maximise re-use and recycling of construction and demolition waste. Reuse of excavated road materials would be maximised as far as possible where they are cost, quality and performance competitive to reduce use of materials (with embedded energy).	Contractor	Pre-construction
Embodied carbon in steel	GHG-3	• Steel with recycled content would be specified where feasible where they are cost, quality and performance competitive. Contractors would be required to propose recycled content construction materials where they are cost, quality and performance competitive	Contractor	Construction
Energy consumption: construction	GHG-4	• Assess opportunities to use local materials to reduce transport emissions	Contractor	Construction
Carbon stored in vegetation	GHG-5	• Undertake vegetation planting and management that maximises opportunities to sequester carbon over the life of the project	Contractor	Construction
Energy consumption: construction	GHG-6	• The feasibility of using biofuels (biodiesel, ethanol, or blends such as E10 or B80) would be investigated by the contractor, taking into consideration the capacity of plant and equipment to use these fuels, ongoing maintenance issues and local sources. Works would be planned to minimise fuel use.	Contractor	Construction
Energy consumption: operation	GHG-7	• Assess opportunities to use renewable energy sources to power control systems, lighting and signage	WDA	Operation
Cumulative impacts	CI-1	Consultation will be undertaken with local communities potentially affected by the impacts of multiple projects in addition to the M4 Widening.	WDA/Contractor	Construction
Cumulative impacts	CI-2	Where relevant, consultation will be undertaken with proponents of other nearby projects to increase the overall awareness of project timeframes and impacts	WDA/Contractor	Construction

13 Project justification and conclusion

This chapter presents a justification of the project and a conclusion to the environmental impact statement. The justification considers how the project balances strategic and project needs against the protection of the environment and planning outcomes outlined in the objects of the EP&A Act, including ecologically sustainable development and community consultation. The relevant DGRs for this section are presented in the table below.

Director-General's Requirements	Where addressed in EIS
a statement of the objectives of the project, including a description of the strategic need, justification, objectives and outcomes for the project, taking into account existing and proposed transport infrastructure and services within the adjoining subregions, and as relevant the outcomes and objectives of relevant strategic planning and transport policies, including, but not limited to, NSW 2021, NSW Government State Infrastructure Strategy, NSW Long Term Transport Master Plan (December 2012), draft Metropolitan Plan for Sydney (March 2013) and any other relevant plans	This chapter and Chapter 3
project justification, including: • ……. whether or not the project is in the public interest, and • justification for the preferred project taking into consideration the objects of the *Environmental Planning and Assessment Act 1979*.	Section 13.1

13.1 Justification

13.1.1 Project justification

The M4 Widening is the first WestConnex project. WestConnex is the largest integrated transport and urban revitalisation project in Australia. It will link Parramatta to the CBD, Sydney Airport and the Port Botany precinct and the M5 in south-west Sydney via a 33 kilometre tolled motorway completely free of traffic signals.

WestConnex will deliver significant long-term benefits to the economic growth and development of NSW and to Australia. This strong economic benefit is supported by the economic analysis undertaken for WestConnex which identified benefits that would outweigh the initial upfront construction cost and ongoing operational costs resulting in a BCR of 2.55:1.

As a key corridor within WestConnex, the M4 Motorway/Parramatta Road corridor provides an important link between people living in Western Sydney and jobs located in Sydney's east within the Sydney CBD and surrounding suburbs. Future transport demand in the corridor represents a significant challenge for Sydney and NSW. The current network does not support a growing population that needs to reliably access dispersed employment areas and services.

Further, in managing the freight task, heavy commercial vehicles require a primary network with high quality connections between major freight hubs, while light commercial vehicles depend on a multi-layered network with many connections to service more diverse and dispersed end-markets across Sydney.

Modelling by the Bureau of Freight Statistics estimates that the average number of weekday freight trips in the Sydney Metropolitan Area would increase by almost 40 per cent between 2011 and 2031. This includes:

- An increase in the number of trips made by rigid trucks on an average weekday from 271,000 to 355,000, an increase of about 30 per cent.
- A more rapid increase in articulated truck trips from 95,000 to 157,000, an increase of around 65 per cent.

The M4 Motorway already operates at and over capacity in peak hours. Without upgrading, congestion on the M4 Motorway will continue to impact on the NSW economy and there will be an on-going misalignment between transport provision and land use planning in Sydney.

Modelling indicates that under the Full WestConnex scenario motorists would save 14 minutes on a journey on the M4 Motorway from Church Street to Homebush Bay Drive in the AM peak, reducing travel times from 19 minutes to five minutes. In the westbound direction on the same section of road the time saving would be six minutes - from 15 minutes to nine minutes.

Under the M4 Widening scenario alone, the most substantial travel time savings over the same section of the M4 Motorway would be nine minutes in the eastbound direction in the AM peak, with more modest improvements at other times and in other directions.

Over these time periods, some increases in Parramatta Road travel times between Church Street and Homebush Bay Drive are expected with the M4 Widening and the Full WestConnex scenarios due to drivers avoiding the toll. A similar diversion of traffic onto Parramatta Road was observed when the toll was formerly implemented on the M4 Motorway (before being removed in 2010). However, it is noted that even with more than 1.5 million extra people living in Sydney by 2031, there would be fewer people using Parramatta Road during the morning and evening peak periods than it had in 2008 when the M4 Motorway previously had a toll.

While the M4 Widening project would not address or alleviate congestion on Parramatta Road east of Concord Road, a cumulative benefit is expected with the M4 East project (when delivered a few years after the M4 Widening) alleviating congestion at the eastern end of the M4 Motorway along Parramatta Road. The NSW Government through the LTTMP is also developing an integrated package of transport improvements with WestConnex including complementary enhancements to the existing road network including Parramatta Road.

Strategic modelling also indicates that when the full WestConnex is operational an average of around 4,500 fewer trucks and 20,000 fewer cars per day are expected to travel on the section of Parramatta Road between Concord Road and Camperdown.

The M4 Widening is expected to improve road safety. The overall number of crashes in the corridor is expected to be lower with the M4 Widening (four per cent less crashes with casualties) as a result of reduced vehicle kilometres travelled.

The M4 Widening project would also improve access to the motorway at key locations such as Sydney Olympic Park and from Homebush Bay Drive. In particular, the inclusion of an additional on-ramp servicing the M4 Motorway and the removal of the right turn movement from Homebush Bay Drive southbound to the existing westbound M4 Motorway on-ramp would deliver significant improvements for the Centenary Drive/M4 Motorway westbound ramps.

A number of other interchange design options were considered as part of the options process, as well as viaduct widening options and alternatives to the project – such as investment in public transport and rail freight improvements. WDA selected the project as described in Chapter 5 as the preferred option which best achieves the project objectives.

The project objectives are outlined in section 3.5 and focus on relieving congestion, improving access, minimising impacts and improving safety. A summary of how the project addresses the project objectives is provided in Table 13.1.

Table 13.1 Assessment of the project against the project objectives

Project objectives	Assessment of the project against objectives
Enable integration with the subsequent stages of WestConnex while not significantly impacting on the surrounding environment in the interim period.	The location of the eastern extent of the project maximises flexibility for the siting of the proposed M4 East tunnel portals at any point in the motorway corridor between approximately Homebush Bay Drive and Concord Road. This location also reduces the potential impact associated with construction of tunnel portals 'under traffic' and further improves the efficiency of tunnel construction because there is more space within the existing motorway corridor to facilitate 'off line' construction. It also provides for clear separation of any M4 Widening project construction site from what would likely be a major construction site for M4 East tunnel works.
Relieve road congestion so as to improve travel speeds and safety of travel in the M4 Motorway between Church Street and Homebush Bay Drive.	The project would provide immediate operational benefits in relieving congestion along the M4 Motorway between Homebush Bay Drive and Church Street including reduction in travel times and improvements in the level of road safety on the motorway. Under the Full WestConnex scenario an eastbound trip from Church Street to Homebush Bay Drive reduces from a predicted 19 minute trip to about five minutes. Similar improvements are expected in the morning peak in the westbound direction.
Improve access to the M4 Motorway from Sydney Olympic Park.	The project provides for an eastbound on-ramp from Hill Road onto the M4 Motorway, improving access at this key access location for Sydney Olympic Park.
Improve access to M4 Motorway from Homebush Bay Drive.	The project would introduce a new westbound on-ramp from Homebush Bay Drive to the M4 Motorway which would improve intersection performance at the interchange with the M4 Motorway. It would also ease demand on the existing westbound on-ramp which would reduce northbound queue lengths along Centenary Drive and allow Centenary Drive traffic to flow more efficiently through Arthur Street.
Improve road safety on the M4 Motorway and connections	The project would result in a reduction in the overall number of crashes on the M4 Motorway, being four per cent less crashes with casualties.
Protect natural and cultural resources and enhance the environment.	Potential impacts on the environment have been assessed and a range of safeguards and mitigation measures are proposed.

The preferred option for the M4 Widening addresses the project objectives and potential impacts associated with the construction and operation of the project have been assessed and appropriate mitigation measures identified to avoid and mitigate impacts. The views of the

community have also been taken into account in consideration of the public interest. Community feedback was sought on the WDA concept design for the M4 Widening and community information sessions and meetings were held, providing information about the project and the opportunity to comment.

The degree to which the project addresses the objectives of the EP&A Act is presented in Table 13.2 below. The relationship of the project to ESD is described in section 10.4, which discusses how the principles of the four tenets of ESD have been recognised and applied during the development and assessment of the project.

Based on the above, the M4 Widening project, as a component of the WestConnex, is in the public interest. Without the project, congestion on the M4 Motorway will continue to impact on the NSW economy and there will be an on-going misalignment between transport provision and land use planning in Sydney.

13.1.2 Objects of the EP&A Act

The objects of the EP&A Act provide a framework within which the justification of the project can be considered. A summary of this assessment is provided in Table 13.2.

Table 13.2 Assessment of the project against the objectives of the EP&A Act

EP&A Act objective	Comment
To encourage the proper management, development and conservation of natural and artificial resources, including agricultural land, natural areas, forests, minerals, waters, cities, towns and villages for the purpose of promoting the social and economic welfare of the community and a better environment.	Overall the project would manage, develop and conserve natural and artificial resources appropriately and would result in social and economic benefits to the community. It promotes social and economic welfare by reducing congestion and improving transport efficiency on the M4 Motorway for both people and goods. The project also makes efficient use of urban land by utilising an existing transport corridor. A range of safeguards and mitigation measures are proposed to address potential environmental impacts.
To encourage the promotion and co-ordination of the orderly and economic use and development of land.	The project makes use of an existing transport corridor and, as a component of WestConnex, would create economic benefits.
To encourage the protection, provision and co-ordination of communication and utility services.	The project is designed to minimise impacts on communication and utility services identified within the corridor.
To encourage the provision and co-ordination of community services and facilities.	The project would improve an element of the transport network that currently experiences heavy congestion and on which the community relies.
To encourage the protection of the environment, including the protection and conservation of native animals and plants, including threatened species, populations and ecological communities, and their habitats.	The project would only have minor potential impacts on the natural environment. Impacts on threatened ecological communities would be limited to approximately 0.17 hectares of moderate condition vegetation and 0.35 hectares of low condition habitat. No threatened species or populations would be affected by the project. A range of safeguards and mitigation measures are proposed.

EP&A Act objective	Comment
To encourage ecologically sustainable development.	Ecologically sustainable development has been considered in the development of the project and is discussed in section 10.3.
To encourage the provision and maintenance of affordable housing.	Part of the NSW Government's approach to housing affordability has been to set goals for housing and land supply. While the project does not involve the provision or maintenance of affordable housing, it does improve access to new housing areas.
To promote the sharing of the responsibility for environmental planning between different levels of government in the State.	Not relevant to the project.
To provide increased opportunity for public involvement and participation in environmental planning and assessment.	The project development process has involved extensive consultation with relevant parties. Consultation undertaken and proposed is outlined in Chapter 7.

13.2 Conclusion

This EIS addresses the key issues identified in the DGRs issued under Part 5.1 of the EP&A Act and the relevant provisions of Schedule 2 of the EP&A Regulation. A checklist showing where the DGRs are addressed in this EIS is provided in Appendix A.

The M4 Widening project would address key elements of the project need and the project objectives by improving access to Olympic Park and Homebush Bay Drive, and relieving road congestion so as to improve the speed, reliability and safety of travel in the M4 Motorway.

As part of the first stage of the WestConnex project, it would deliver economic benefits that outweigh the initial upfront construction cost and ongoing operational cost, and would create the potential for the realisation of wider economic benefits. It would also enable integration with the subsequent stages of WestConnex while not significantly impacting on the surrounding environment in the interim period.

Potential adverse impacts associated with the project have been fully assessed and strategies to avoid, minimise and mitigate those impacts have been an integral part of the project development process. Substantial travel time savings are expected along the motorway, however, the M4 Widening is expected to increase travel times on Parramatta Road as a result of toll avoidance. Overall, the number of crashes in the M4 corridor is also expected to be lower with the M4 Widening.

Construction of the project would result in short-term impacts on noise, air quality, water quality, traffic and access. However, these impacts would be minimised through the development and implementation of construction environmental management plans and careful planning of the construction schedule and methodologies. Only minimal clearing of vegetation would be required and no significant impact on threatened species, ecologically endangered communities or habitat areas has been identified.

Operational impacts of the project such as noise and flooding would be further investigated during detailed design to confirm the need for appropriate mitigation measures or, where relevant,

design refinements. This EIS includes a suite of management measures that aim to ensure the best possible environmental outcomes are achieved during its construction and operation.

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