Appendix D

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WestConnex M4 Widening

TRAFFIC AND TRANSPORT WORKING PAPER – WORKING PAPER 4

AUGUST 2014

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WestConnex Delivery Authority

WestConnex M4 Widening

Traffic and transport working paper – working paper 4

August 2014

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Glossary of terms and acronyms

Term	Meaning
BTS	Bureau of Transport Statistics
CBD	Central business district
CCTV	Closed circuit television
CEMP	Construction Environmental Management Plan
DGRs	Director-General's Environmental Assessment Requirements
DMSS	(Draft) Metropolitan Strategy for Sydney to 2031
EIS	Environmental impact statement
EMME	Strategic travel modelling software
EPA	Environmental Protection Authority
GEC	Global Economic Corridor
HCV	Heavy commercial vehicle
HFV	Heavy freight vehicle
ITS	Intelligent Transport Systems
JTW	Journey to Work
LCV	Light commercial vehicle
LGA	Local government area
LinSig	Multi-intersection modelling software for corridor or small network analysis
LoS	Level of Service – An index of the operational performance of traffic on a given traffic lane, carriageway or road when accommodating various traffic volumes under different combinations of operating conditions. It is usually defined in terms of the convenience of travel and safety performance.
LTTMP	NSW Long Term Transport Master Plan
PCU	Passenger car unit
RMS	(NSW) Roads and Maritime Services
SAMP	Sydney Airport Master Plan 2033
SIS	State Infrastructure Strategy
SMBSC	Sydney Metropolitan Bus Service Contract
STM	Sydney Strategic Travel Model
TfNSW	Transport for NSW
TMC	Transport Management Centre
TMP	Traffic Management Plan
UAP	Urban Activation Precinct
VoC	Volume over capacity
VTTS	Value of Travel Time Savings
WDA	WestConnex Delivery Authority
WRTM	WestConnex Road Traffic Model

Executive summary

The overall purpose of this report is to identify and assess the traffic and transport issues related to the M4 Widening project. WestConnex is a program of works designed to provide 33 kilometres of tolled motorways, linking Sydney's west, south-west, central business district (CBD), Sydney Airport and the Port Botany precinct.

The WestConnex scheme will:

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

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 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 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 is located approximately 13 kilometres to the west of the Sydney CBD and generally follows the alignment of the existing M4 Motorway. **Figure 1-4** 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 M4 Motorway is currently one of the most congested motorway links in Sydney. It is approaching its practical capacity, where unstable flow can result in stop-start conditions. This section of the WestConnex scheme, the subject of this report, is predominantly a road widening project, which will generate significant improvements in travel time by reducing congestion on the M4 Motorway.

The WestConnex Delivery Authority (WDA) is proposing to widen and upgrade approximately 7.5 kilometres of the M4 Motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush (the M4 Widening project). The core objectives of the M4 Widening project are to:

- Relieve road congestion so as to improve the speed, reliability and safety of travel in the M4 Motorway between Church Street and Homebush Bay Drive.
- Cater for the diverse travel demands along the M4 Motorway corridor that are best met by road infrastructure.
- Enhance the productivity of commercial and freight generating land uses strategically located near the M4 Motorway corridor.
- Improve access to the M4 Motorway from Sydney Olympic Park.
- Improve access to M4 Motorway from Homebush Bay Drive.

These objectives are consistent with the core objectives of the WestConnex scheme. An additional specific objective of the M4 Widening project is to enable integration with the subsequent stages of WestConnex while not significantly impacting on the surrounding environment in the interim period.

The study area adopted for the M4 Widening project covers approximately 7.5 kilometres of the M4 Motorway between the Pitt Street overpass, Parramatta and Homebush Bay Drive, Homebush, as shown in **Figure 3-1**. The Victoria Road corridor to the north and the Main Western Rail Line to the south have been adopted as the northern and southern boundaries of the study area. The study area includes the suburbs of Merrylands, Parramatta, Holroyd, Granville, Silverwater, Auburn, Lidcombe, Sydney Olympic Park, Homebush and Homebush West.

The M4 Motorway is a core component of Sydney's extensive road network. Any changes to the M4 Motorway will have impacts across the network as drivers adjust their preferred routes. An assessment of existing traffic conditions in the M4 Motorway corridor and on alternative routes was undertaken to establish the current operational performance of the road network within the study area. The impacts of the removal of the M4 Motorway toll in February 2010 and various policy changes that occurred when the toll was in operation, between 1992 and 2010, are also examined to help understand what may happen when a toll is reintroduced.

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) which was developed to forecast road traffic demands for the WestConnex scheme including the M4 Widening project. The WRTM has two elements:

- The base demand model – which 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 can account for changes in land use, trip distribution and mode choice as well as producing vehicle traffic demand forecasts for peak and off peak periods.
- The toll choice assignment model – models the range of driver behaviour to toll strategies and forecasts the traffic choosing to use 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 the Value of Travel Time Surveys (VTTS). Future demand was forecast by applying the model with future year traffic growth assumptions from the STM.

The WRTM was developed to forecast traffic patronage and assess the most likely range of future traffic patronage across the WestConnex scheme network for the proposed franchise period. In considering the future traffic patronage, several scenarios need to be considered, reflecting the timeframe under which the infrastructure can be delivered and the extent of other infrastructure developments. Five scenarios have been explored through development of specific modelled scenarios, reflecting various future travel demands.

The scenarios comprised differing levels of infrastructure provision within the model for the various modelled demand years. The scenarios examined were modelled in the WRTM by combining future year demands with future networks. Traffic was assigned using the calibrated road assignment model, suitably accounting for changes in toll choice behaviour over time.

2021 is used as the project case year for the Base 'do minimum' and M4 Widening scenarios (refer 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 impact at the completion of the M4 Widening in 2017.

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).

The Base 'do minimum' scenario was used to assess the need for the M4 Widening project and to act as a baseline to measure the impact of the project in the future. The Base and Future 'do-minimum' scenarios identified a significant increase in network congestion between the Existing case and Future 'do minimum' scenarios with many roads exceeding practical operating capacity in the future. The analysis also showed a substantial deterioration in travel times between the Existing case and Base 'do minimum scenarios, and an even more significant deterioration between Base 'do minimum' and Future 'do minimum' scenarios. While westbound morning peak traffic is relatively uncongested in the Existing case and Base 'do minimum' scenarios, travel times deteriorate significantly between Base 'do minimum' and Future 'do minimum' scenarios. In both directions, reduced travel speeds are concentrated between Silverwater Road and Church Street.

In the morning peak under the Future 'do minimum' scenario, high levels of congestion on the M4 Motorway would result in the eastbound trip between Church Street and Homebush Bay Drive taking 19 minutes. Under both the proposed M4 Widening and Full WestConnex scenarios, this trip time reduces to approximately five minutes. There would also be travel time savings in the westbound direction. The westbound trip takes 15 minutes in the Future 'do minimum' scenario compared to nine minutes with the Full WestConnex scenario.

The completion of the WestConnex scheme maintains the travel time savings generated by the widening of the M4 Motorway and would also generate travel time savings on other parts of the WestConnex scheme and the road network more generally. The assessment has found that under the distance based tolling regime to be adopted by the WestConnex scheme, traffic volumes could rise on parallel routes such as Parramatta Road despite the widening of the M4 Motorway.

Diversion of traffic from the M4 Motorway due to the previous single point based tolling regime (gauged by the change in traffic after the toll was removed in early 2010) was less than the amount that the WRTM is predicting under similar conditions. This was influenced by the effects of the cashback scheme that was applied to the previous tolling regime that will not apply to the widened M4 Motorway tolling regime. Furthermore, the road users most likely to avoid the toll will be those whose perception of the value of travel time is lower and from markets that are better served by other modes of transport or are not a target market of the WestConnex scheme.

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 comprises the first stage in the delivery of the WestConnex scheme. Access to and from the M4 Motorway would also be significantly improved at Homebush Bay Drive and Hill Road. The investment in the M4 Widening project and subsequent stages of the WestConnex scheme would 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 the WestConnex scheme which also includes the M4 East project. 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. Future stages of the WestConnex scheme will link Stage 1 with Sydney's south west, CBD, Sydney Airport and the Port Botany precinct.

As part of the broader WestConnex scheme, the M4 Widening project would 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 would support Sydney's Global Economic Corridor and Western Sydney, both of which are 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 will 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 *NSW Long Term Transport Master Plan* (Transport for NSW 2012) (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. 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 the WestConnex scheme 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.

Construction activity for the M4 Widening project would largely be confined to the M4 Motorway corridor itself and the existing number of trafficable lanes will be maintained during normal working hours. Some minor delays are anticipated as a result of reduced road works speed limits. Some local residential streets are anticipated to experience a noticeable increase in vehicle movements due to construction traffic accessing the work areas; however these are expected to be minor. Overall, the impact of the construction of the M4 Widening project is anticipated to be minor and appropriate management plans would be applied to mitigate the impact.

1 Introduction

1.1 Purpose of this report

The overall purpose of this report is to identify and assess the traffic and transport impacts related to the M4 Widening project. This assessment's focus is on the traffic and transport part of the Director-General's Requirements (DGRs), as detailed in **Table 1-1**.

Table 1-1: Traffic and transport DGRs

Director General's Requirements	Where addressed
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:	
• The preferred alignment and design.	Chapter 7 and section 9.1
• The proposed widening of the M4 Western Motorway between the Pitt Street underpass at Parramatta, and Homebush Bay Drive, Homebush.	
• The proposed interchange upgrades and augmentation.	
• 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.	Chapter 7
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.	Chapter 7
Impacts on cyclists and pedestrian access and safety and consideration of opportunities to integrate cycleway and pedestrian elements with surrounding networks.	Section 7.5
Construction traffic and transport impacts of the project (including ancillary facilities) and associated management measures, in particular:	
• 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).	Sections 8.4 and 8.5
• Route identification and scheduling of transport movements,	Section 8.3.2
• The number, frequency and size of construction related vehicles (both passenger, commercial and heavy vehicles).	Section 8.3.1
• The nature of existing traffic on construction access routes (including consideration of peak traffic times), and 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 8.2
Details of how the project meets the objectives of the overall WestConnex Scheme.	Chapter 2

1.2 The WestConnex scheme

WestConnex is a program of works designed to provide 33 kilometres of tolled motorways, linking Sydney's west, south-west, central business district (CBD), Sydney Airport and the Port Botany precinct. The overall scheme comprises a number of projects staged over a period of 10 years. WestConnex is the next priority in the evolution of Sydney's motorway network as shown in **Figure 1-1**. The scheme brings together previous proposals for the M4 Motorway and M5 Motorway corridors that have been in development for over a decade. WestConnex will be a major investment in Sydney's road infrastructure that is intended to transform urban travel and reshape the localities through which it passes.

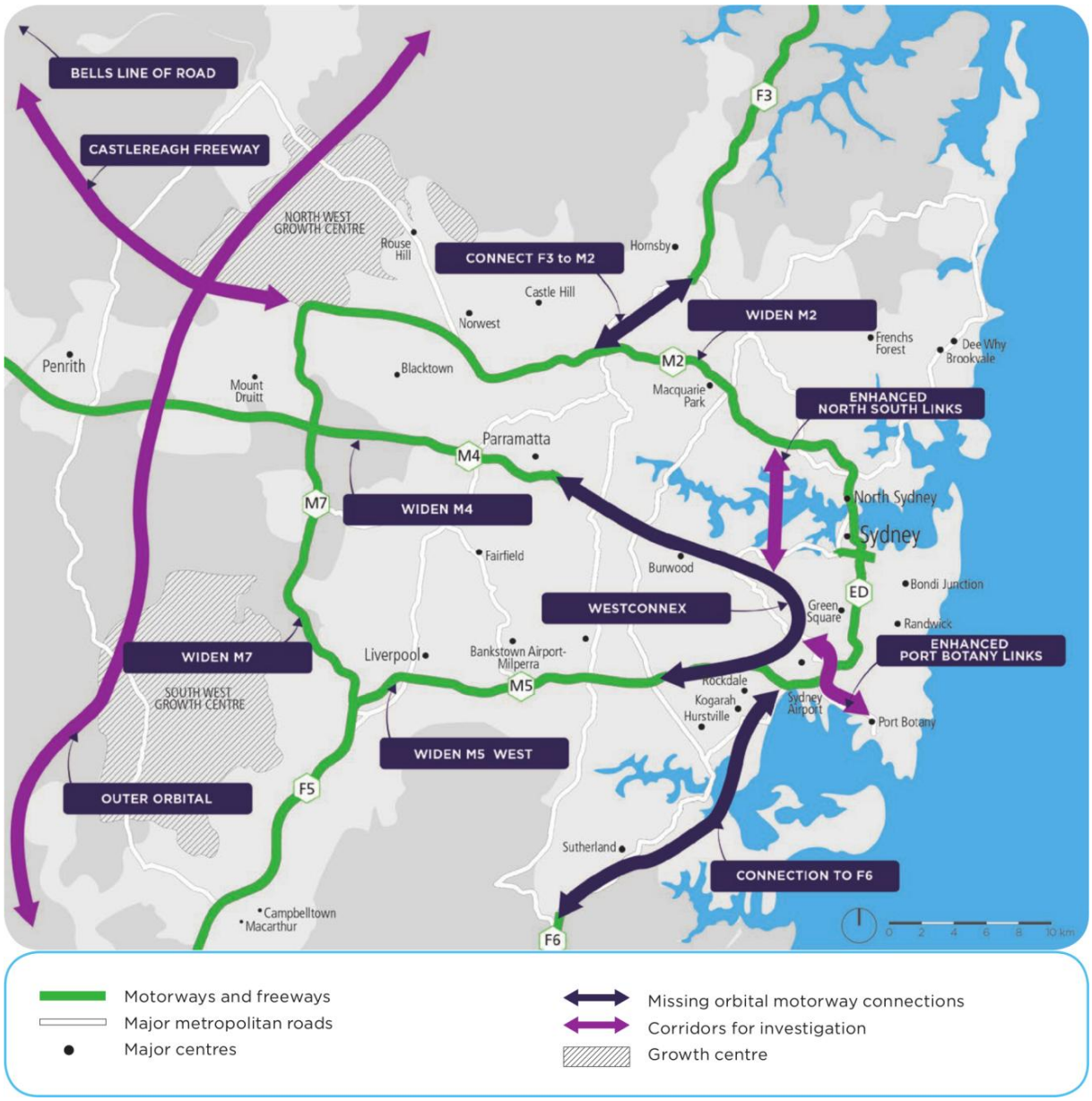

Figure 1-1: WestConnex as a key element of Sydney's motorway network

Source: Transport for NSW (TfNSW), *NSW Long Term Transport Master Plan,* 2012a p.140

The development of WestConnex has been guided by a set of objectives consistent with the strategic challenges and transport needs assessment. These scheme objectives also reflect the reality that there are limited government funds available for infrastructure investment. As such, a balance is needed between responsible spending of state wide taxpayer funds and a user pay system to cover the cost of the project. The scheme will:

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

The NSW Government has established the WestConnex Delivery Authority (WDA) to deliver the WestConnex scheme. WDA is an independent subsidiary agency of the (NSW) Roads and Maritime Services (Roads and Maritime).

WestConnex comprises a number of component projects, to be delivered in stages as shown in **Figure 1-2**. Further refinement of component projects will be required as the program progresses. The M4 Widening project is the first stage of this major infrastructure program. Other components of the WestConnex scheme include:

- M4 East – Extension of the M4 Motorway from Homebush to Haberfield.
- M4 South – Construction of a further stage from Haberfield to St Peters via Camperdown.
- M5 – Construction of a new link from St Peters to the M5 East as well as duplication of the M5 East.

These components will be assessed separately as each stage is developed further.

Figure 1-2: WestConnex project staging

Source: WDA, 2014

1.3 History of the M4 Motorway and the development of WestConnex

The M4 Motorway was originally constructed in several stages as the F4 Western Freeway between the late 1960s and the mid-1980s and is a key piece of transport infrastructure in Western Sydney. It is a 40 kilometre urban motorway class road connecting the Blue Mountains in the west with Parramatta Road near Concord Road in the east. There are 16 major interchanges along the route, including a connection to the Westlink M7 at Eastern Creek.

The M4 Motorway has been upgraded on a number of occasions since its first days of operation. The two main upgrades are detailed below:

- 1988 to 1992: The six kilometre length of motorway from Homebush Bay Drive to James Ruse Drive was widened from four lanes to six lanes with shoulders to increase traffic capacity. The existing areas from North Strathfield to Homebush Bay Drive and from Church Street, Parramatta to Coleman Street, Mays Hill, were repaired and overlaid with open grade asphalt and the "missing link" from Mays Hill to Prospect was constructed. This section was approximately 10 kilometres of four lane carriageway incorporating interchanges at Cumberland Highway, Prospect Highway and Reservoir Road, with connections to the existing motorway at each end.
- 1996 to 1998: The motorway was upgraded and widened along the length from Parramatta to Penrith. This involved the construction of additional lanes to widen the road from four to six lanes, and in some areas eight lanes.

The M4 Motorway became Sydney's first tolled motorway in 1992. In line with the toll collection technology available at the time, the M4 Motorway toll was implemented as a single-point, cash only toll plaza located immediately west of the Silverwater Road interchange. This type of tolling strategy collects tolls at a single point and does not collect tolls at off-ramps upstream of the toll point nor on-ramps downstream of the toll point.

Eastbound users of the M4 Motorway choosing to avoid the toll would exit the motorway at either Church Street or James Ruse Drive. Some of this diverted traffic would then re-enter the motorway via the Silverwater Road eastbound on-ramp. This led to congestion and delays during the morning peak on the surface road network connecting those interchanges particularly Church Street, the Great Western Highway, Parkes Street and Hassall Street on the southern perimeter of the Parramatta CBD.

Westbound users of the motorway choosing to avoid the toll would exit at Silverwater Road and utilise Parramatta Road to re-join the motorway at the Church Street on-ramp. This diversion of traffic from the motorway caused increased traffic volumes on Parramatta Road through Auburn and Granville in the afternoon peak.

The NSW Government M4 Motorway Cashback Scheme introduced on 1 January 1997 allowed NSW residents to claim back the value of tolls (excluding GST) paid while using a vehicle registered in NSW for private, pensioner or charitable use on the M4 Motorway. The scheme is still in place on the M5 Motorway and broad revenue information for the M5 Motorway Cashback Scheme indicates, in combination with traffic composition data, that around 66.5 per cent of M5 Motorway private vehicle patrons claim cashback for their tolled trip. The Cashback Scheme on the M4 Motorway operated under the same rules and had a similar participation rate.

On 16 February 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.

As the motorway network expanded and traffic demand changed, the M4 Motorway's central role has become pivotal in moving Sydney. While its termination at North Strathfield was relevant when opened, due to the ability of Parramatta Road to perform the downstream connection to the CBD at that time, the need to extend it to the inner city has been developing since the M4 Motorway first opened.

The strategic concept for WestConnex set out in the *State Infrastructure Strategy* (SIS) (Infrastructure NSW 2012) built upon a decade of studies into options to augment the M4 Motorway and M5 Motorway corridors. It was developed by a joint project team comprising representatives from Roads and Maritime, TfNSW and Infrastructure NSW.

1.4 What is the needs case for WestConnex and the M4 Widening project?

Sydney's transport network faces complex challenges now and in the next 20 years. As part of a multimodal network-wide effort to tackling Sydney's transport challenges, a major investment in road capacity and efficiency in the eastern half of Sydney is required to address network underperformance, and support Sydney's long term economic growth.

The solution to Sydney's complex challenges is in identifying the right strategic investments to provide long term network capacity, including modern road infrastructure, freight and passenger rail, and public and active transport, consistent with the *NSW Long Term Transport Master Plan* (LTTMP) (TfNSW 2012a). This means that the M4 Widening project and WestConnex alone will not solve all transport problems for Sydney, or respond to identified transport problems in isolation of other actions in the LTTMP.

WestConnex, including the M4 Widening project, would help alleviate transport problems as follows:

- WestConnex would address major underperformance of the road network – along critical demand corridors, ageing, narrow or lower order roads perform a traffic function that is better suited to motorway infrastructure, reducing amenity and resulting in congestion, growing travel times and higher numbers of traffic incidents.
- WestConnex would provide critical land transport network capacity to international gateways and their surrounds – Port Botany and Sydney Airport are major trip generators, and economically critical to Sydney and the NSW economy. Even with the NSW Government's target to double the share of freight transported on rail, major new road capacity is needed to connect the gateways to markets and customers across Sydney.
- WestConnex would serve Sydney's wider, highly diverse freight and business travel task – Sydney's broader freight and commercial task is significantly larger than our port-related task, and is heavily reliant on the M4 Motorway and M5 Motorway corridors and on north-south roads to connect freight to employment lands and population centres.

- WestConnex would serve natural growth in demand from Sydney's growing population and economy – population and employment growth are major drivers of transport demand. Over the next 20 years, average weekday trips in Sydney will grow in line with the population by around 30 per cent, while freight trips in Sydney will grow with gross state product by around 70 per cent. Much of both types of growth will occur within the WestConnex areas of influence.
- WestConnex would better serve the fragmented land use patterns across Sydney by supporting efficient transport connections for trips that are not well served by other transport modes due to uneven or fragmented economic or residential development. WestConnex would support employment growth opportunities in Western Sydney through improved freight connections from that region to Sydney's ports. WestConnex would also support improved access from Western Sydney, where public transport choice is limited, to employment opportunities in Sydney's east connecting residents across Sydney.

1.4.1 Travel demand from economic growth

The Port Botany/Sydney Airport precinct includes two of Australia's main international gateways and together with the surrounding industrial and commercial activities is collectively the largest and most important economic zone in Australia, generating an estimated $11 billion per annum to the NSW gross domestic product.

The efficiency of operation of the economic zone is vital to the wellbeing not only of the NSW economy but also to the many businesses that rely on the precinct's effective development. WestConnex would significantly improve access to Sydney's international gateways and enable more efficient road freight movement to the airport/port and contribute to higher productivity.

The M4 Widening project, as part of the WestConnex scheme, would also support more effective and efficient movement of people and freight to and from Western Sydney to the Inner West, the Eastern Suburbs and the Sydney CBD. The WestConnex scheme would enable major opportunities to establish improved connectivity of other existing and potential future transport links over a wide area of Sydney.

Growth of Sydney Airport

Passenger throughput at Sydney Airport is currently about 27 million passengers of which about 55 per cent are domestic traffic. The airport is a significant employment zone in its own right and large volumes of journey to work trips and commercial trips servicing the airport precinct and its activities are made each day. The *Sydney Airport Master Plan 2033* (SAMP) (Sydney Airport Corporation Limited 2014) states that passenger throughput at the airport is predicted to double to 60 million passengers by 2031; the *Joint Study on Aviation Capacity for the Sydney Region* (Australian and NSW Governments 2012) predicts 67 million passengers by 2035, effectively doubling the airport related traffic volumes on the arterial and motorway networks over the next 20 years. For the purpose of the current investigation, it is assumed that actions from the SAMP would proceed. Even though a recent announcement regarding a future second Sydney airport indicated that it would be in operation by 2026, it is not yet an approved project and, consequently, is not included in the Sydney Strategic Transport Model (STM). Undoubtedly if a second airport were to proceed there would be resultant changes to employment and residential land use which would generate changes to trip distribution across the Sydney road network. These changes are not reflected in the traffic forecasts generated by the WestConnex Road Transport Model (WRTM) for the reasons stated above and described in more detail in **Chapter 5**.

The LTTMP recognises the investment needed to progress options to improve public transport services to the airport and to manage the growing traffic congestion in the airport precinct in the short and medium term. WestConnex would enable surface traffic changes to better manage congestion and facilitate the potential for new and dedicated bus services and routes serving the airport.

Commercial and freight growth at Port Botany

Container throughput at Port Botany is expected to increase to twice the current volumes by 2031 (TfNSW 2013a). Current planning indicates that major changes to freight distribution and rail infrastructure and services are likely to be implemented by 2021. This includes new freight facilities at Cooks River, Enfield and Moorebank by 2018, affecting freight distribution on the road and rail networks. The freight mode share at Port Botany is also likely to change once the freight rail improvements, including the Southern Sydney Freight Line and Northern Sydney Freight Corridor, are fully operational by 2021.

Currently the primary north-south freight route from the eastern end of the M4 Motorway at Parramatta Road to the Port Botany/Sydney Airport precinct relies on the surface arterial and sub-arterial road network. This route includes West Street, Sydenham Road, Livingstone Road, Stanmore Road, Edgeware Road, Canal Road and Gardeners Road. These inner city roads, with narrow lane widths, largely undivided carriageways without adequate turning lanes to accommodate heavy vehicles, are not suited to carrying high volumes of heavy vehicles. The result is that heavy vehicles have difficulty navigating these roads, with traffic incidents causing significant disruption.

Due to the poor north-south connectivity in the inner west, the M7 Motorway, M5 Motorway and A3 corridor bear a heavier load with traffic from the M4 Motorway travelling south via the A3 corridor and onto the M5 East to head east towards the Port Botany/Sydney Airport precinct. This is not an efficient movement for traffic and increases congestion, wear and tear, and safety risks.

WestConnex creates an additional route to the Port Botany/Sydney Airport precinct, relieving current freight routes such as the M5 Motorway, the A3 corridor and Sydenham Road. Some heavy vehicles are expected to switch from these routes to WestConnex to continue west on the M4 Motorway. This means more route options for freight and commercial vehicles, improving flexibility and the resilience of the road network to respond to incidents. It also provides a level of network redundancy for freight connections into the Port Botany/Sydney Airport precinct, as heavy vehicles could be diverted north via WestConnex to the M4 Motorway corridor if there were significant delays or traffic incidents on the M5 Motorway corridor.

Travel to jobs at non-centre locations

Fragmented economic development across Sydney has meant that, many jobs are in non-centre locations that are poorly served by public transport. There are more jobs in Sydney's east compared to Sydney's west, generating a net flow of journey to work (JTW) trips from west to east. Furthermore, many jobs in the east are also out of centre jobs not in Sydney CBD (eg. the southern part of the Global Economic Corridor). Strategic centres hold 41 per cent of jobs within Sydney's east. These areas are not well served by public transport, particularly from Sydney's west and WestConnex would support travel to these out of centre jobs.

The strategic centres in Sydney's west, such as the regional cities of Parramatta, Penrith and Liverpool, hold only 20 per cent of the jobs in Sydney's west. As such, 80 per cent of employment is not in major centres and therefore is less efficiently served by public transport. **Figure 1-3** shows the existing distribution of Sydney's employment in non-centre locations across the west and east.

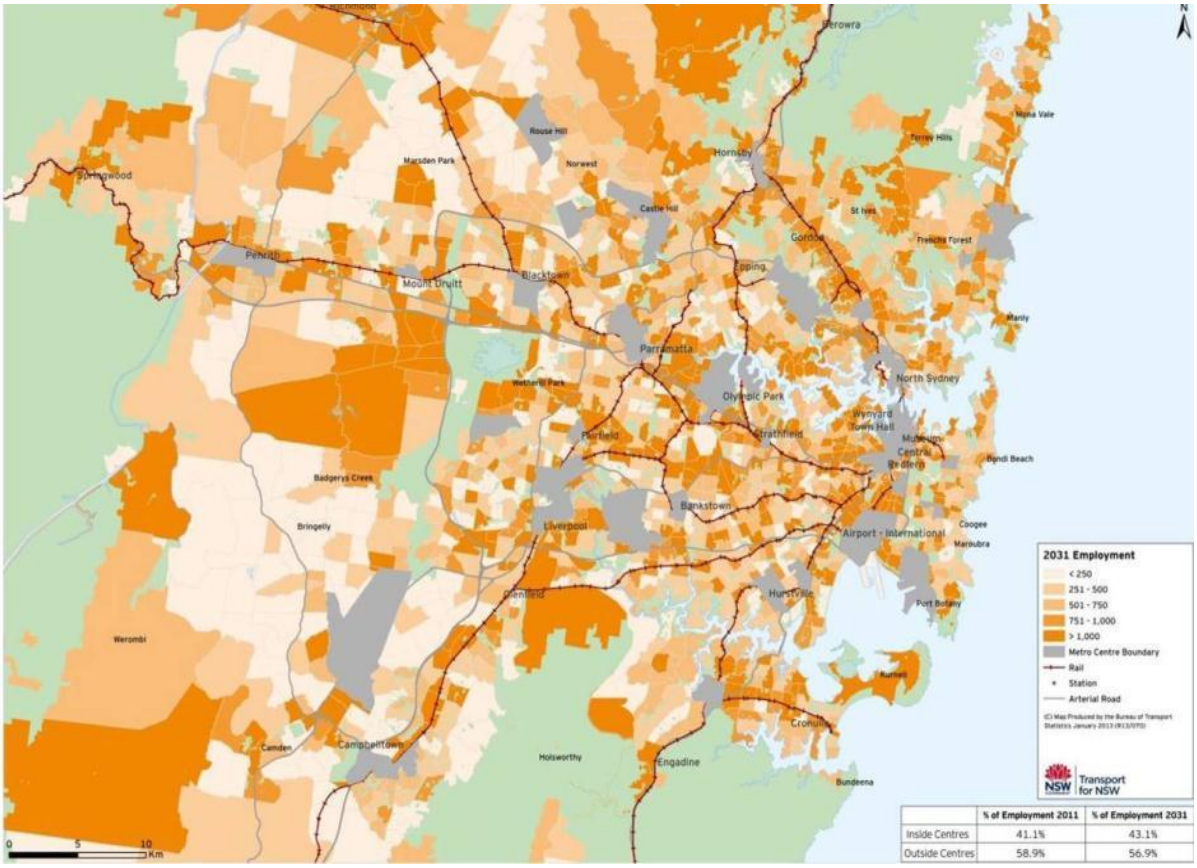

Figure 1-3: Sydney employment not located in major centres in 2031

Source: BTS, *Employment Forecasts 2006-2046*, 2012b

Consequently, around 85 per cent of people travelling to work from Sydney's west travel by car, compared to around 55 per cent of people travelling to work in Sydney's east. Residents in Sydney's west are more car dependent, with for example, a Campbelltown resident, on average driving two and half times the vehicle kilometres of an inner Sydney resident.
Table 1-2 demonstrates the imbalance in car usage for travel to and from Sydney's east and west.

Table 1-2: Trips between Western Sydney and Eastern Suburbs, 2011

From	To	2011 journey to work trips		
		Total	Car	Car %
Western Sydney	Eastern Suburbs	205,257	112,383	54.8
Western Sydney	Western Sydney	490,398	419,032	85.4
Eastern Suburbs	Eastern Suburbs	796,435	439,391	55.2
Eastern Suburbs	Western Sydney	88,798	75,088	84.6
Total		1,580,888	1,045,894	66.2

Source: BTS, *2010/11 Household Travel Survey,* 2012a

It has been estimated that by 2031 (SIS 2012) a combined total population growth of around 235,000 people and employment growth of 160,000 in the combined M4 Motorway and M5 Motorway corridors will generate significant additional demand for travel on an already constrained network (BTS 2012a, 2012b). This represents about one-quarter of Sydney's expected population growth and nearly one third of new jobs.

1.5 M4 Widening project description

WDA is proposing to widen and upgrade approximately 7.5 kilometres of the M4 Motorway generally between Pitt Street, Parramatta and Homebush Bay Drive, Homebush (the M4 Widening project).

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 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 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 is located approximately 13 kilometres to the west of Sydney CBD and generally follows the alignment of the existing M4 Motorway. **Figure 1-3** 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.

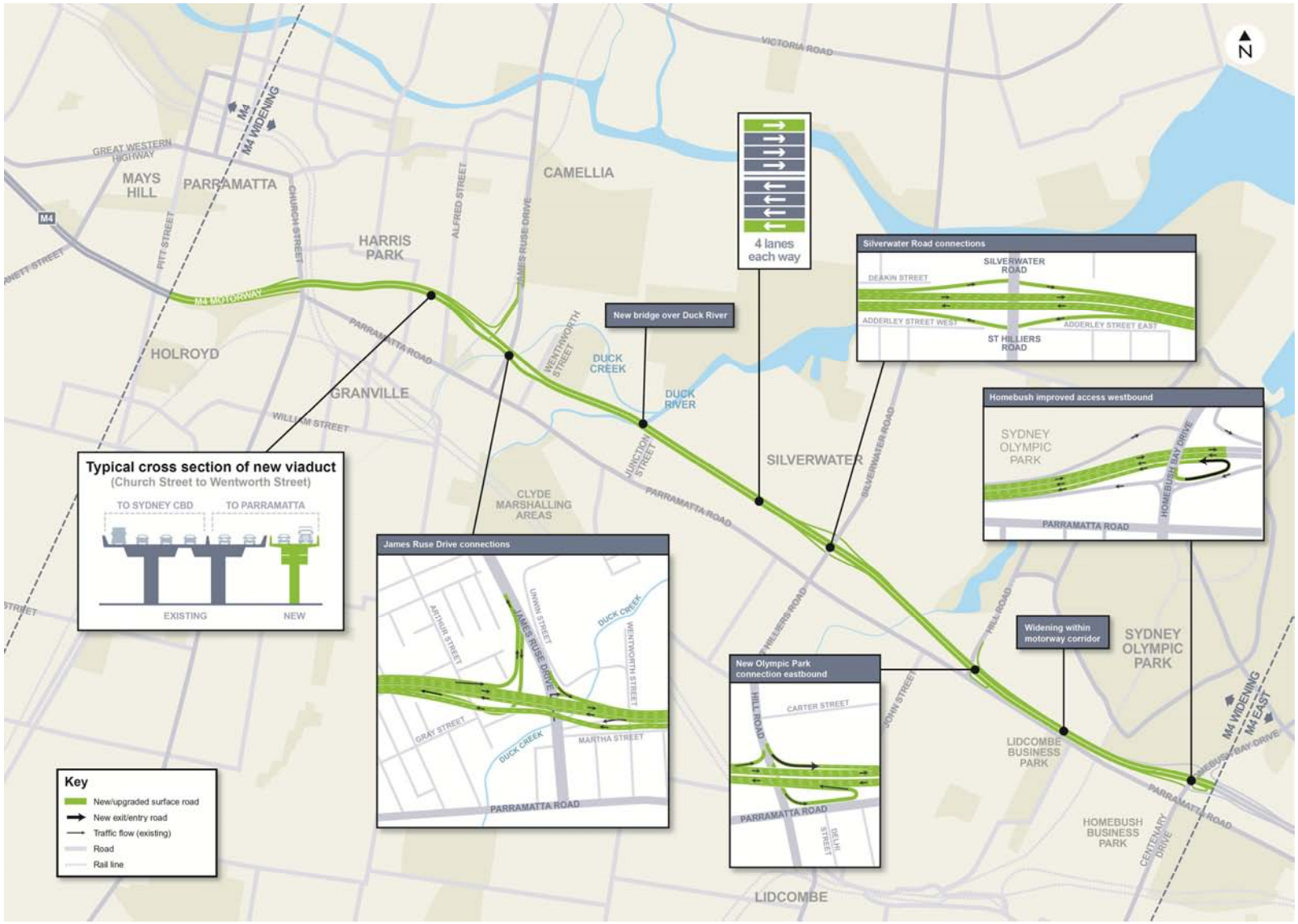

Figure 1-4: Location of the project

Source: WDA, 2014

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

1.6 Objectives of the M4 Widening project

The core objectives of the M4 Widening project are to:

- Relieve road congestion so as to improve the speed, reliability and safety of travel in the M4 Motorway between Church Street and Homebush Bay Drive.
- Cater for the diverse travel demands along the M4 Motorway corridor that are best met by road infrastructure.
- Enhance the productivity of commercial and freight generating land uses strategically located near the M4 Motorway corridor.
- Improve access to the M4 Motorway from Sydney Olympic Park.
- Improve access to M4 Motorway from Homebush Bay Drive.

These objectives are consistent with the core objectives of the WestConnex scheme. An additional specific objective of the M4 Widening project is to enable integration with the subsequent stages of WestConnex while not significantly impacting on the surrounding environment in the interim period.

1.7 Project development and alternative options

This section 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.

1.7.1 Introduction

Five scenarios have been explored through the development of specific modelled scenarios, reflecting various future travel demands.

The scenarios comprised differing levels of infrastructure provision within the model for the various modelled demand years. The scenarios examined were modelled in the WRTM by combining future year demands with future networks. Traffic was assigned using the calibrated road assignment model, suitably accounting for changes in toll choice behaviour over time.

2021 is used as the project case year for the Base ‘do minimum’ and M4 Widening scenarios (refer 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 impact at the completion of the M4 Widening in 2017.

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).

The merits of this 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 one – the base case or 'do nothing/do minimum'.
- Alternative two – improvements to the existing arterial road network.
- Alternative three – investment in public transport improvements.
- Alternative four – investment in rail freight improvements.
- Alternative five – demand management.

These alternatives are described below.

1.7.2 Alternative one – 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' ('do minimum') option.

Future transport demand in the M4 Motorway 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.

The anticipated growth in overall demand on Sydney's road network will have large impacts on overall network performance. The WRTM predicts that the combined distance travelled by all vehicles on a weekday will grow by 35 per cent over the period between the Existing case and the Future 'do minimum' scenarios, equating to 1.6 per cent per annum growth over the period, The model indicates that this will bring about a 35 per cent reduction in network speed (the combined distance travelled by all vehicles in the network divided by the combined amount of time spent travelling by those vehicles) during peak periods, comprising a 2.0 per cent per annum fall between the Existing case and the Base 'do minimum' scenarios, and accelerating to a 2.4 per cent per annum fall over the Base 'do minimum' to Future 'do minimum' period. Network speeds during business hours are expected to fall by 19 per cent between the Existing case and the Future 'do minimum' scenarios.

Use of the M4 Motorway between Church Street and Homebush Bay Drive is expected to grow at a slower pace than the network as a whole, with the combined distance travelled by all vehicles on a weekday expected to grow by 17 per cent between the Existing case and the Future 'do minimum' scenarios, equating to growth of 0.8 per cent per annum. With the motorway already experiencing congestion this is expected to have a large impact on travel times as summarised in **Table 1-3**.

Table 1-3: M4 Motorway travel times between Homebush Bay Drive and Church Street without WestConnex

Time period	Travel time (minutes)		Change (%)
	Existing case (2012)	Future 'do minimum' (2031)	
Morning peak – eastbound	12	19	57
Morning peak – westbound	5	15	172
Business hours – eastbound	5	8	77
Business hours – westbound	5	5	1
Evening peak – eastbound	5	11	123
Evening peak – westbound	7	11	64

The growth in travel times presented in **Table 1-3** show that the 'do minimum' option is highly undesirable. The performance of this section of the M4 Motorway will deteriorate even further if the other components of the WestConnex scheme are built without the M4 Widening project.

Travel times along Parramatta Road would deteriorate to proportionally the same extent under the 'do minimum' scenario, refer to **Figure 4-6**, which demonstrates that there is also no spare capacity within the corridor as a whole to provide an alternative to the M4 Motorway.

1.7.3 Alternative two – improvements to the existing arterial road network

Infrastructure NSW recognised 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). Fundamentally, 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 an 'access' route to the broader road network rather than a '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 road network to alleviate the current traffic challenges faced by the M4 Motorway corridor (refer **section 6**). 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 short sections of Parramatta Road, where it runs in parallel with the M4 Motorway, are relatively free of congestion, it generally experiences high levels of congestion during much of the day including weekends. Therefore 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. More substantial improvements to these arterial road networks would have an unacceptable level of traffic impact during construction. Improvements of this nature would still only be able to manage current congestion issues rather than catering for the future traffic demands expected in these corridors.

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 local access function and provides for shorter distance 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 be limited in addressing current and future traffic issues on the M4 Motorway, and generally benefit its function as an 'access' route rather than a 'through' route.

Victoria Road

Victoria Road provides an alternative transport corridor from Parramatta to the Sydney CBD via Anzac Bridge. 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 significant challenges to providing increases in road capacity.

Improvements to the Victoria Road corridor would not meet the M4 Widening project objectives, for example, improved motorway access and connections linking Sydney's international gateways and Western Sydney. Nor would they relieve road congestion on the M4 Motorway and its parallel arterial roads to improve the speed, reliability and safety of travel in the corridor.

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 and changes in land use.

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 would have significant construction impacts or require the construction of new infrastructure.

1.7.4 Alternative three – investment in public transport improvements

WestConnex is a key component of the LTTMP (2012), SIS (2012) and (*Draft) Metropolitan Strategy for Sydney to 2031* (DMSS) ((NSW) Department of Planning and Environment 2013a). 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.

Increased bus services

The Great Western Highway/Parramatta Road corridor is paralleled by the Main Western Rail Line. Trains provide the main public transport service in this corridor, connecting Western Sydney and centres in the corridor to Sydney CBD. The NSW Government's *Sydney's Rail Future Modernising Sydney's Trains* (TfNSW 2012b), identifies the need for service improvements on the Main Western Rail Line, including up to 14 additional trains in peak times.

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.

Unlike the Great Western Highway corridor, the Victoria Road corridor has no parallel alternative mass transit system. Consequently, buses satisfy the public transport demand along Victoria Road. Commercial and retail development along this corridor is limited to 'strip' development along Victoria Road, rather than at nodes supported by train stations. The bus services on Victoria Road serve the needs of commuters to the city, as well as workers, shoppers and other visitors to business centres along the corridor.

Western Sydney light rail network

Parramatta City Council has released a feasibility report for a Western Sydney light rail network (Parramatta City Council 2013). 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 network comprising four routes. The most relevant of these to the M4 Widening project would be the route connecting Parramatta to Rhodes via Sydney Olympic Park. However, it should be noted that this route has a lower priority than other proposed routes and is unlikely to be constructed within the timeframes considered in this report.

Infrastructure NSW considers the Western Sydney light rail concept in the SIS (2012). 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. Infrastructure NSW does recommend 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 project is a valid project which aims to deliver new and improved regional public transport links which in turn will drive employment and facilitates residential growth along corridors and in centres. However, the M4 Widening project (as part of WestConnex) provides better connectivity for Parramatta and Western Sydney with the southern part of Sydney's Global Economic Corridor and Sydney's international gateways. The M4 Widening project also provides improved connections between Global Sydney and key employment lands including Parramatta, the Westmead health precinct and Sydney Olympic Park compared with a Western Sydney light rail network.

Summary

Passenger trips including for work, education, health, recreation and personal business are recognised as a key customer market for WestConnex. A majority of these trips are by private vehicle. Commuting and education trips typically occur in the morning and evening 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. Public transport is not the most effective way of servicing a majority of these trips.

Some passenger trips are concentrated on centres and these types of trips are more appropriately served by public transport. However, due to Sydney's fragmented development there are more jobs in Sydney's east compared to Sydney's west, generating a net flow of journey to work trips from west to east. Many jobs in the east are not in Sydney CBD (eg the southern part of the Global Economic Corridor). Long distance trips to dispersed non-centre locations are poorly served by public transport (particularly from Sydney's west to Sydney's east) and as a result require efficient connections by road in order to be accessible. 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 the WestConnex scheme more broadly, best address the diverse travel demands to and from the corridor.

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 WestConnex scheme.

1.7.5 Alternative four – investment in 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 (2012) 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 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 requires 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 SAMP 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 WestConnex scheme would provide a robust freight solution.

1.7.6 Alternative five – demand management

Demand management can be defined as policy, planning and operational approaches 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 'centre' policies (land use planning) to reduce the need for travel.
- Other planning control policies such as limitations to parking provisions.
- 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 use by private vehicle for trips that can be served by public transport.

The DMSS 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. 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 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.

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 system). A smart motorway system seeks to enhance travel reliability through improved and more consistent traffic flow using controlled access management.

In addition to technology requirements, a smart motorway system 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.

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

A smart motorway system, as with other demand management measures, would be complementary to the widening of the M4 Motorway. A smart motorway system 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.

1.7.7 Preferred strategic alternative

The preferred option has evolved from a series of concept developments and evaluations which have been ongoing since 2003. **Chapter 6** demonstrates the need for the M4 Widening project and **Chapter 2** provides detail on the project's strategic context. The preferred option best meets the identified needs and objectives, which include supporting Sydney's long term economic growth through improved motorway access and connections; and relief of road congestion so as to improve the speed, reliability and safety of travel in the M4 Motorway corridor and parallel arterial routes such as Parramatta Road.

The preferred option supports the physical delivery, and to some extent the financial delivery, of the WestConnex scheme, specifically the subsequent delivery of the M4 East project. Risk and value management workshops have been undertaken to develop the appropriate options for the M4 Motorway. Traffic modelling has been undertaken to determine demand levels for proposed ramps and vehicle forecasts for the M4 Motorway (refer to **Chapter 5**).

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.

1.7.8 Earlier options development

There has been ongoing scheme development over the last decade. This section discusses the earlier motorway widening options considered over that time.

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.

1.8 Structure of the report

This remainder of the report is structured in the following manner:

- **Chapter 2** describes the strategic planning context of the WestConnex scheme
- **Chapter 3** details the existing land use and transport environment
- **Chapter 4** assesses the existing road network performance.
- **Chapter 5** describes the approach to traffic forecasting.
- **Chapter 6** assesses the future performance of the existing road network.
- **Chapter 7** assesses the operational performance and impacts of the project.
- **Chapter 8** addresses the traffic impacts of construction of the project.
- **Chapter 9** provides a conclusion to the report.

2 Strategic planning context

This chapter summarises the strategic planning considerations for the M4 Widening project, including its contribution to achieving the overall objectives of the WestConnex scheme.

Historically, the vision for a Sydney Orbital was first articulated in the plan known as *Roads 2000 Sydney* ((NSW) Department of Main Roads 1987). This orbital vision was delivered as eight incremental projects which were realised in 2007, with the opening of the Lane Cove Tunnel. The Sydney Orbital is now a vital part of Sydney's transport network, and is ultimately the result of more than 20 years of strategic effort in NSW.

The *State Infrastructure Strategy* (SIS) (Infrastructure NSW 2012) identified the need for Sydney's next motorway priority to be part of a holistic network solution, not an isolated road project, and one that delivers on both liveability and productivity outcomes.

As a consequence, WestConnex addresses the most urgent and strategically important elements of the *NSW Long Term Transport Master Plan* (LTTMP) (TfNSW 2012a). The LTTMP highlights the importance of improving integrated transport connections between Sydney's west, Sydney Airport and Port Botany. WestConnex has been identified as the first part of the long term vision for the Sydney motorway network to be delivered in Sydney. Consequently, it is proposed to be the strategic focus for motorways in NSW over the next 10 years.

Section 4.2.1 of the LTTMP identifies the six most highly constrained strategic transport corridors in Sydney, three of which are served by WestConnex: Parramatta to Sydney via Strathfield, Sydney Airport to Sydney City, Liverpool to Sydney Airport. WestConnex has been driven by a series of ideas that have sought to address issues constraining motorway development in Sydney. It has been five years since completion of Sydney's last motorway project and schemes for the M4 Extension have been under development for over 10 years. Schemes for the M5 East Duplication have been under development for almost 10 years.

Community and stakeholder engagement has been part of this development process, and local communities are well versed in the critical issues around motorway development in their local areas. WestConnex seeks to address the challenges that road users and the community encounter on a daily basis, including:

- The missing link in the Sydney motorway network's east-west spine created by the M4 Motorway terminating at North Strathfield – constraining movements between Sydney's west, its international gateways and key places of business in Sydney's east.
- Congestion, low travel speeds and unreliable travel times on the M4 Motorway, M5 East Motorway, Parramatta Road and in the Sydney Airport/Port Botany precinct that delay freight, public transport and add cost to business.
- Poor urban amenity along Parramatta Road due to heavy traffic volumes and congestion throughout weekdays and on weekends.

The impacts of these challenges are significant given around 30 per cent of Sydney's population (1.2 million people) and around 30 per cent of its employment (600,000 jobs) is located within the broader M4 Motorway and M5 Motorway corridors, as stated in the *WestConnex Business Case Executive Summary* (Sydney Motorways Project Office 2013). These corridors comprise highly urbanised and complex communities with local concerns

and issues which need to be incorporated into the detail of the transport solutions for the area.

WestConnex also responds to future strategic challenges pertinent to Sydney's economic productivity and liveability, including:

- Population growth of around 235,000 people and jobs growth of 160,000 by 2031 in the combined M4 Motorway and M5 Motorway corridors generating significant demand for travel on an already constrained network. This represents almost one-quarter of Sydney's population growth and around one-third of new jobs. Those figures are drawn from the NSW Bureau of Transport Statistics data (2012) based on a five kilometre width spanning from Penrith through to Parramatta to Glebe, Sydney Airport, Port Botany, Bexley, Liverpool and Campbelltown, excluding Sydney central business district (CBD). Growth is from a 2011 base.
- Urban revitalisation, liveability and growth centres along the Parramatta Road corridor, identified in the (Draft) Metropolitan Strategy for Sydney to 2031 (DMSS) ((NSW) Department of Planning and Environment 2013a) as a 'City Shaper'. The Parramatta Road corridor connects Global Sydney and Parramatta via Sydney Olympic Park. The WestConnex scheme will provide opportunities to transform the local centres that exist alongside the corridor and better connect them. The Parramatta Road corridor offers prime revitalisation opportunities to create lively, well-designed centres with improved north-south and east-west linkages currently limited by the busy Parramatta Road.
- An additional 40.3 million passengers forecast at Sydney Airport by 2035, resulting in significant vehicle trip generation on a heavily constrained and complex part of the road network according to the Joint Study on Aviation Capacity for Sydney Region (Australian Government, NSW Government 2012) (p.12). Those figures assume unconstrained growth at Sydney Airport and based on a 2010 growth base. Traffic in the Sydney Airport precinct is a mixture of airport traffic and through traffic destined for Port Botany, Sydney CBD and Sydney's north.
- Trade at Port Botany is growing at a faster rate than previously forecast. Given available capacity at the port itself, it is assumed that Port Botany will remain the primary container facility for NSW if landside access is improved. While freight rail will play an increasing role in the future, the majority of this growth is expected to be accommodated by road due to the dispersed nature of the freight.
- In line with population and employment growth, non-containerised freight and commercial trips are also forecast to grow across a wide range of sectors all of which by their nature will be road based trips.

2.1 Project objectives

As the M4 Widening is a component project of the WestConnex scheme, it is important to consider the overall core objectives of WestConnex:

- 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.

As identified in the *WestConnex – M4 Widening State Significant Infrastructure Application Report* (Roads and Maritime 2013), the M4 Widening project-specific objectives are consistent with the core objectives of the WestConnex scheme.

The core 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 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.

2.2 M4 Widening – the first component in the WestConnex scheme that will transform Sydney's transport network

The WestConnex scheme is a public commitment and priority project in the LTTMP. WestConnex will complete one of the missing links in Sydney motorway network, as shown in **Figure 1-1**. The M4 Widening project is an important part of the WestConnex scheme and contributes to achieving its overall objectives. Therefore, this road project will help transform and contribute to defining the success of the future urban structure and transport network in the M4 Motorway/Parramatta Road corridor.

The *WestConnex Business Case* (SMPO, 2013a) outlines the benefits of the WestConnex scheme and identifies the M4 Widening as the first project in that scheme.

2.3 Consistency with Government policy and objectives

The M4 Widening project, as part of the full WestConnex scheme, addresses broader government objectives set in *NSW 2021*: *A plan to make NSW number one* (NSW 2021) (NSW Department of Premier and Cabinet 2011) and is recognised in strategic plans including:

- *NSW Long Term Transport Master Plan* (LTTMP) (Transport for NSW (TfNSW) 2012a).
- *State Infrastructure Strategy* (SIS) (Infrastructure NSW 2012).
- *NSW Freight and Ports Strategy* (TfNSW 2013a).
- *(Draft) Metropolitan Strategy for Sydney to 2031* (DMSS) ((NSW) Planning and Infrastructure 2013).

2.3.1 NSW 2021

Within the context of NSW 2021, the M4 Widening project, as part of 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 road corridors including Parramatta Road and M4 Motorway and the link from Sydney's CBD to Sydney Airport and Port Botany.

2.3.2 State Infrastructure Strategy

The SIS identifies that the most pressing investment needs to occur on the M4 Motorway and M5 Motorway corridors due to their importance to the freight and business transport tasks and connections to Global Sydney and the international gateways. WestConnex is identified in the SIS 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 along the M5 Motorway corridor.

2.3.3 NSW Long Term Transport Master Plan

The M4 Widening project, as part of WestConnex, is aligned to the strategic objectives in the LTTMP:

- Improve the quality of service – The project is a key component in a multimodal solution to Sydney's transport network and offers the opportunity to meet the needs of existing and future customers. The widening has the potential to reduce travel times and improve reliability for freight, commercial and passenger markets.
- Improve liveability – The project, when considered as part of the full WestConnex scheme, could reduce traffic on lower order roads, improving liveability particularly in the Parramatta to Sydney CBD corridor.
- Support economic growth and productivity – The project will support more efficient freight and commercial movements, reducing the cost of congestion to the NSW economy.
- Support regional development – The project, as part of the existing M4 Motorway corridor and the future WestConnex, would improve connections between the city and regional NSW, particularly with the international gateways at Sydney Airport and Port Botany.
- Improve safety and security – The project could improve road safety by reducing congestion on this part of the M4 Motorway, ease traffic on the surrounding arterial roads, and reduce impacts on other road users such as pedestrians and cyclists.
- Reduce social disadvantage – The project, when considered as part of the full WestConnex scheme, would improve access to job opportunities across Sydney through reduced travel times between homes and jobs.
- Improve sustainability – The project could reduce congestion in a major part of the Sydney's road network and the impact of that congestion on the environment.
- Strengthen transport planning processes – WestConnex is an outcome of a long term transport planning framework to address the transport needs of NSW over the next 20 years.

2.3.4 NSW Freight and Ports Strategy

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.

2.3.5 (Draft) Metropolitan Strategy for Sydney to 2031

The WestConnex scheme is described in the DMSS as a key element of the Parramatta Road 'City Shaper'. The overall WestConnex scheme adds to the Parramatta Road corridor 'City Shaper' and provides a strong link between Parramatta, Sydney and the Global

Economic Corridor (GEC). WestConnex will link Parramatta and Global Sydney with key centres and precincts including Burwood, Sydney Olympic Park and Rhodes Business Park.

2.4 Strategic planning consideration – serving the right markets

By supporting the appropriate markets, the performance of WestConnex can be optimised, resulting in improved productivity of the freight task, improved travel times and increased amenity and business investment opportunities for centres.

2.4.1 Target markets for the WestConnex scheme

WestConnex has adopted a market based approach, consistent with the LTTMP which places a strong emphasis on identifying customers and meeting their needs. The corollary of this is that WestConnex should also support existing markets best served by other transport modes rather than compete with them.

The market analysis for WestConnex is supported by best practice nationally and internationally on motorway function and design, which treats motorways as best serving longer distance and inter- regional trips connecting to or bypassing major urban centres. The *Guide to Road Design* (Austroads 2010) likewise states that motorways have an exclusive function to carry traffic within cities and ensure the continuity of the national or regional primary road system. These functions particularly the continuity of the regional road system indicate that motorways are aimed at the long distance and inter-regional trips connecting to or bypassing major urban centres.

The WestConnex scheme has been designed to serve customer needs that are well suited to road-based and private vehicle-based travel on a motorway. Serving the right trips on the right mode will mean that WestConnex does not undermine important objectives for the wider network, and that it optimally performs its own role.

There are eight target markets for WestConnex, defined by trip purpose:

- Passenger and freight movements to and from the airport, involving dispersed levels of demand across metropolitan Sydney, and strong east-west air travel for low volume, high-value freight such as fresh food imports and exports.
- Container freight from Port Botany, involving longer metropolitan freight trips to freight hubs and employment lands along the M4 Motorway and M5 Motorway corridors, and just-in-time empty container movements.
- Heavy freight movements, involving moderately dispersed trips across metropolitan Sydney to areas of production, consumption, construction, transport and logistics.
- Light freight movements to highly dispersed locations, including employment lands, major centres, localised centres, specialised precincts such as the Westmead health precinct or Bankstown Airport, and even households.
- Commercial service vehicles, again to highly dispersed locations including major centres, localised centres, specialised centres and households.
- Commercial business vehicles, which tend to be moderately dispersed across major centres, specialised precincts and employment lands.
- Long distance personal trips to non-centre locations, involving diffuse origins and destinations where locations are set away from public transport trunk lines and interchanges.

- Interregional and interstate personal trips, including trips between Sydney's east and the Southern Highlands, Goulburn, Canberra, Blue Mountains, and trips from diffuse areas to high value recreational, cultural or other services and events.

2.4.2 Non-target markets for the WestConnex scheme

The WestConnex scheme should complement the function of the wider transport network. This means it should not serve those markets that are better served by other modes of transport or are not a target market of WestConnex.

There are four non-target markets for WestConnex:

- Personal travel within the area surrounding the WestConnex scheme to centres are trips to highly concentrated areas of activity accessible from WestConnex and are better served by passenger rail. These are short to medium trips seeking access to work, education and personal business.
- Personal travel between centres in Sydney's west and Sydney's east are relatively longer trips between centres which can be efficiently served by passenger rail. A large part of this travel is concentrated in the morning and evening peak during the week as people travel to and from work.
- Short to medium length personal trips to non-centre based locations should not require the use of the motorway and instead can be efficiently served by local and arterial roads. These are trips seeking access to work, education and personal business from highly dispersed locations to non-centre locations that are not well served by public transport.
- Long haul freight movements to regional and interstate areas can be efficiently served by freight rail. These trips have a relatively higher value than personal travel, and occur at all times of the day, notwithstanding curfews in metropolitan areas.

To varying degrees, these markets may use WestConnex depending on the performance of the rest of the network. However, it is not desirable for the motorway to serve these trips, and if it were to do so, the productivity and performance of the new motorway would be impaired.

2.5 Conclusion

Sydney's transport network faces complex challenges now and in the next 20 years. As part of a multimodal network-wide effort to tackling Sydney's transport challenges, a major investment in road capacity and efficiency in the eastern half of Sydney is required to address network underperformance, and support Sydney's long term economic growth.

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 comprises the first stage in the delivery of the WestConnex scheme. Access to and from the M4 Motorway would also be significantly improved at Homebush Bay Drive and Hill Road. 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 is being developed as the first project of Stage 1 of the WestConnex

scheme which also includes the M4 East project which will provide a full motorway connection between Parramatta in the west and Ashfield in the east. Future stages of the WestConnex scheme will link Stage 1 with Sydney's south west, Airport and Port Botany precinct.

As part of the broader WestConnex scheme, the M4 Widening project would 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 *NSW Long Term Transport Master Plan* (Transport for NSW 2012) (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. 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 the WestConnex scheme 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.

3 Existing land use and transport

3.1 Study area

The study area adopted for the M4 Widening project covers approximately 7.5 kilometres of the M4 Motorway between the Pitt Street overpass, Parramatta and Homebush Bay Drive, Homebush, as shown in **Figure 3-1** overleaf. The Victoria Road corridor to the north and the Main Western Rail Line to the south have been adopted as the northern and southern boundaries of the study area. The study area includes the suburbs of Merrylands, Parramatta, Holroyd, Granville, Silverwater, Auburn, Lidcombe, Sydney Olympic Park, Homebush and Homebush West.

3.2 Land use

Figure 3-2 overleaf shows the generalised land uses within the M4 Motorway corridor. These are described in detail below.

3.2.1 Demographics

The project is located within the local government areas (LGAs) of Holroyd, Parramatta, Auburn and Strathfield. The 2011 census showed that the LGAs had a combined population of 402,674 people (Australian Bureau of Statistics 2012). Compared to NSW as a whole, the LGAs generally comprise a younger population, with a median age of 34 years. Auburn and Holroyd LGAs have a high proportion of people aged under 14 (about 20 per cent). The main occupations comprise professionals, clerical and administrative workers and managers with many technicians and trades workers as well as labourers. About 60 per cent of the population is employed in full-time work. The LGAs are ethnically diverse with large Chinese, Indian, Lebanese, English, Italian and Irish-born populations.

3.2.2 Commercial and industrial land use

The study area includes Parramatta central business district (CBD); industrial areas in Camellia, Rosehill (currently tenanted by Shell), Clyde, Silverwater and Lidcombe; business parks in Silverwater, Lidcombe and Newington; a retail precinct along Parramatta Road in Auburn that is dominated by low-density, high volume retail uses such as car yards, bulky goods and large-lot retailing; 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.

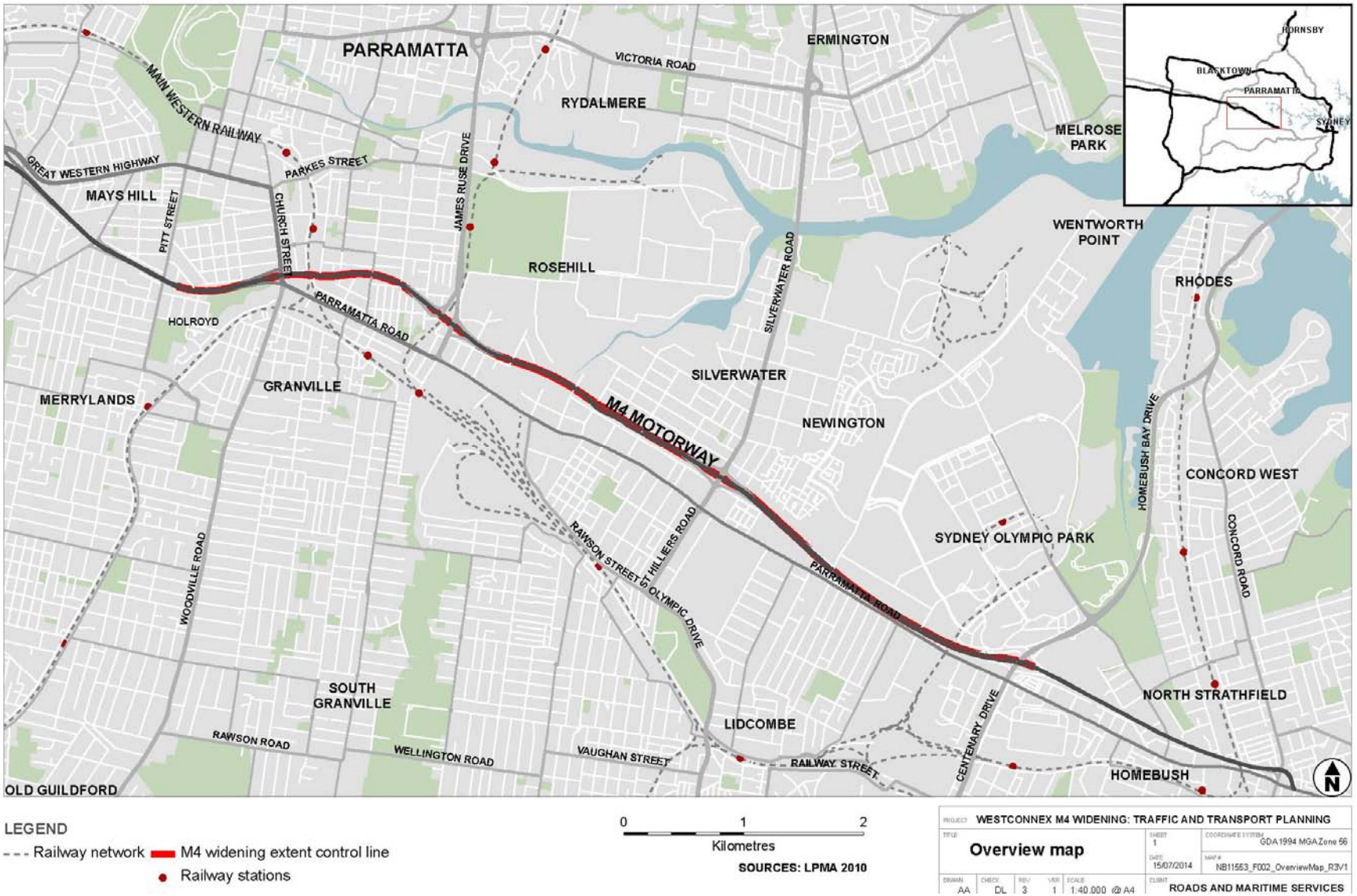

Figure 3-1: M4 Widening project study area

Source: Jacobs SKM, 2014

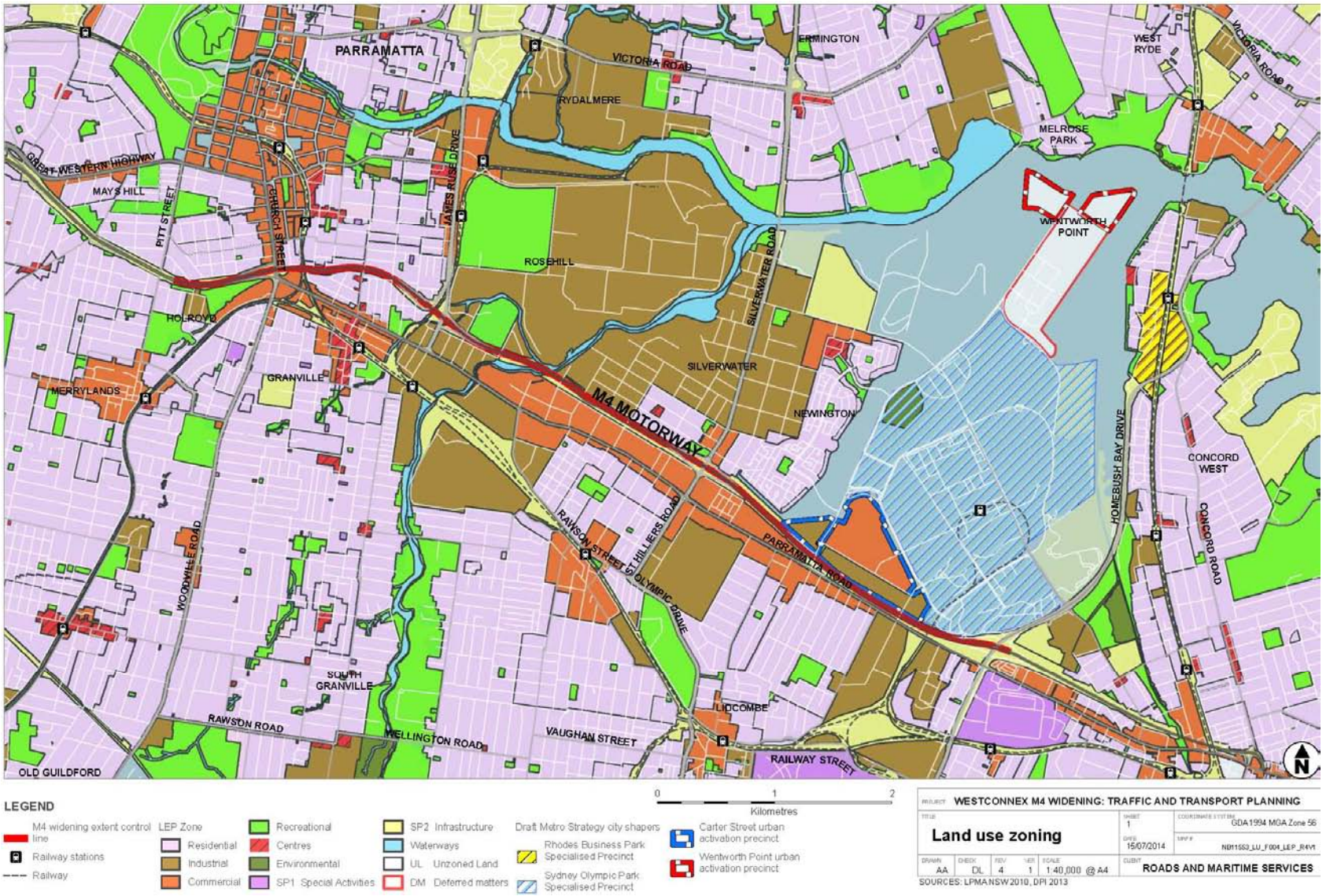

Figure 3-2: Land uses in the M4 Motorway corridor

Source: Jacobs SKM, 2014

3.2.3 Urban centres and residential areas

The study area includes the following urban centres:

- Parramatta, which is designated as a 'Regional City' ((NSW) Department of Planning and Environment 2013a), is located to the north of the M4 Motorway and is accessed via the Great Western Highway and Church Street (in the eastbound direction) and James Ruse Drive/Hassall Street (in the westbound direction). Parramatta is often recognised as the second CBD of Sydney, and has large areas of commercial and retail land uses. Parramatta Transport Interchange is a major rail and bus hub providing public transport access to large areas of Sydney.
- Merrylands, which is designated as a 'Town Centre' ((NSW) Department of Planning and Environment 2013a), is located to the south of the M4 Motorway and is accessed via Church Street/Woodville Road/Merrylands Road (in the eastbound direction) and Burnett Street/Merrylands Road (in the westbound direction). The town centre is located west of the railway station and is dominated by retail land uses with some medium-density housing.
- Granville, which is designated as a 'Town Centre' ((NSW) Department of Planning and Environment 2013a), is located to the south of the M4 Motorway and is accessed via Church Street/Parramatta Road/Bold Street (in the eastbound direction) and James Ruse Drive/Parramatta Road/Bold Street (in the westbound direction). The town centre is located south of the railway station and is dominated by retail land uses with some low and medium-density housing.
- Auburn, which is designated as a 'Town Centre' ((NSW) Department of Planning and Environment 2013a), is located to the south of the M4 Motorway and is accessed via Rawson Street (in the eastbound direction), Silverwater Road and St Hilliers Road (in the westbound direction). The town centre is located on both sides of the railway station with a mixture of retail and commercial land uses, and medium and high-density housing.
- Lidcombe, which is designated as a 'Town Centre' ((NSW) Department of Planning and Environment 2013a), is located to the south of the M4 Motorway and is accessed via Silverwater Road, St Hilliers Road, Rawson Street, Boorea Street and Olympic Drive (in the eastbound direction), and Arthur Street or Birnie Avenue (in the westbound direction). The town centre is located on both sides of the railway station with a mixture of retail, commercial and light industrial land uses, and medium-density housing.

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.

3.2.4 Tourist and recreational facilities

The study area includes a range of tourist and recreational facilities including:

- Sydney Olympic Park, which offers a range of sporting facilities including the State Sports Centre, Sydney Olympic Park Tennis Centre, Stadium Australia (currently known as ANZ Stadium) and Sydney International Aquatic Centre, as well as various leisure facilities such as walking and cycling trails, picnic areas and parks including Bicentennial Park.
- Blaxland Riverside Park which has the largest playground in Sydney.

- Sydney Speedway in Granville.
- Rosehill Racecourse.
- Local parks including:
  - Wallawa Reserve, Granville.
  - Holroyd Sports Ground, Holroyd.
  - Deakin Park, Silverwater.
  - Hume Park, Silverwater.

3.2.5 Community and health facilities

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 precinct is accessed from the M4 Motorway via the Coleman Street ramps and Hawkesbury Road, and Concord Hospital is accessed via Concord Road.

3.2.6 Major urban revitalisation projects

Parramatta Road Urban Renewal Program

An urban renewal program has been developed to facilitate urban renewal opportunities along the Parramatta Road corridor enabled by WestConnex. As part of the program, a land use and transport concept plan will provide a vision for the corridor for the next 20 years to integrate land use and transport planning whilst identifying key opportunities and constraints in the corridor.

The urban renewal program will also review the potential capacity of the corridor to support urban renewal and future growth and development coordinated with the delivery of infrastructure and services. The program forms part of the WestConnex scheme however is a separate project to the M4 Widening and will therefore be subject to separate strategic planning and environmental assessment processes.

Carter Street Urban Activation Precinct

In 2013, the NSW Government announced the 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.

The Carter Street Urban Activation Precinct, located in Lidcombe, is 52 hectares in area and adjoins Sydney Olympic Park. A large portion of the precinct 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. The activation of the precinct will include:

- 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.

The precinct is shown in **Figure 3-3**.

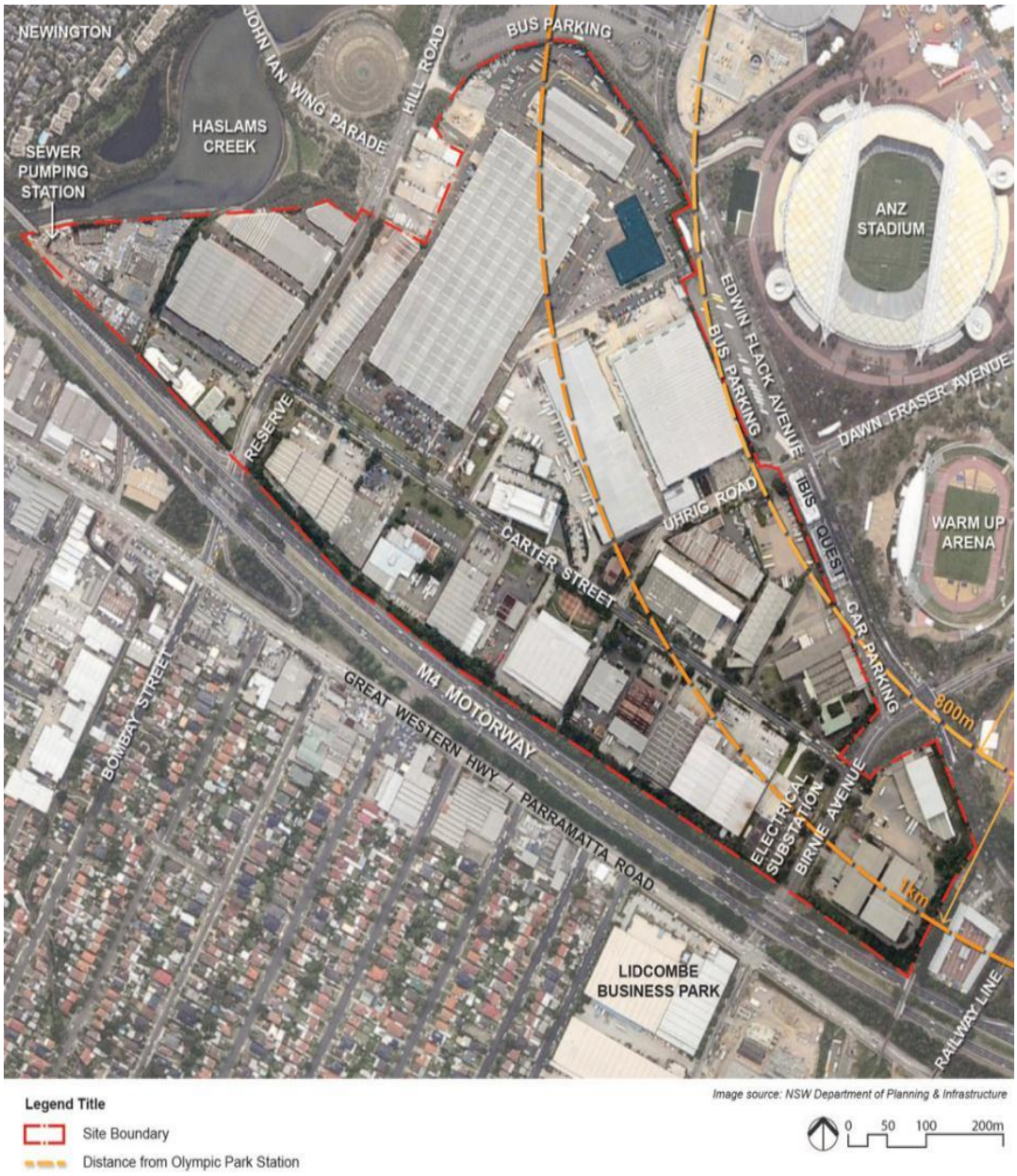

Figure 3-3: Carter Street Urban Activation Precinct

Source: (NSW) Department of Planning and Environment, *Urban Activation Carter Street, Lidcombe,* 2013b

Wentworth Point Urban Activation Precinct

The Wentworth Point Urban Activation Precinct 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 location of the Wentworth Point Urban Activation Precinct is shown below in **Figure 3-4**.

Figure 3-4 Wentworth Point Urban Activation Precinct

Source: Department of Planning and Environment, *Wentworth Point Urban Activation Precinct Proposal* (2013c) , p.3

3.3 Corridor road network

3.3.1 M4 Motorway

The M4 Motorway currently connects 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 M4 Motorway/Parramatta Road corridor is the main road freight, commercial and passenger route between Sydney CBD, inner-western suburbs, Parramatta, Greater Western Sydney and beyond to the Blue Mountains.

The M4 Motorway can be divided into three sections:

Glenbrook to M7 Motorway

This section extends for approximately 21.5 kilometres with interchanges at:

- Russell Street in Emu Plains (east and west-facing ramps).
- Mulgoa Road in Jamisontown (east and west-facing ramps).
- The Northern Road in South Penrith (east and west-facing ramps).
- Mamre Road in St Marys (east and west-facing ramps).
- Roper Road in Colyton (east-facing ramps).
- Wallgrove Road in Eastern Creek (east and west-facing ramps).
- M7 Motorway (full interchange).

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). The speed limit is 90 kilometres per hour between Glenbrook and Russell Street and 110 kilometres per hour between Russell Street and M7 Motorway interchange.

M7 Motorway to Cumberland Highway

This section extends for approximately 10.5 kilometres with interchanges at:

- Reservoir Road in Prospect (east and west-facing ramps).
- Prospect Highway in Prospect (east and west-facing ramps).
- Cumberland Highway in South Wentworthville (east and west-facing ramps).

Three lanes are provided in each direction. The speed limit is 100 kilometres per hour between the M7 Motorway interchange and the Ettalong Road overpass in Greystanes, and 90 kilometres per hour between the Ettalong Road overpass and the Cumberland Highway.

Cumberland Highway to Parramatta Road

This section extends for approximately 14 kilometres with interchanges at:

- Coleman Street, Merrylands (east-facing ramps).
- Burnett Street, Merrylands (east-facing ramps).

- Church Street/Woodville Road, Granville (west-facing ramps).
- James Ruse Drive, Clyde (east and west-facing ramps).
- Silverwater Road, Silverwater Road (east and west-facing ramps).
- Hill Road, Lidcombe (west-facing ramps).
- Homebush Bay Drive/Centenary Drive in Homebush West (east and west-facing ramps).

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.

In the eastbound direction, the speed limit is 90 kilometres per hour between Cumberland Highway and the Concord Road off-ramp, and 60 kilometres per hour between the Concord Road off-ramp and Parramatta Road. In the westbound direction, the speed limit is 60 kilometres per hour between Parramatta Road and the Concord Road on-ramp, 70 kilometres per hour between the Concord Road on-ramp and Powell Street, and 90 kilometres per hour between Powell Street and the Cumberland Highway.

3.3.2 Parallel west-east routes

Principal arterial roads parallel to the M4 Motorway are described below.

Great Western Highway (A44)

The Great Western Highway runs adjacent to the M4 Motorway for approximately 35 kilometres, from its intersection with Church Street and Parkes Street in Parramatta to the Russell Street/M4 Motorway interchange in Emu Plains. This section of Great Western Highway serves the regional centres of:

- Penrith
- St Marys
- Mount Druitt
- Blacktown
- Westmead
- Parramatta

Beyond Emu Plains, the highway traverses west through the Blue Mountains and beyond to Lithgow and Bathurst. Large sections of the highway between Westmead and Penrith are dual carriageway with a speed limit of 80 kilometres per hour. The highway shares a close relationship with the M4 Motorway, often acting as an alternative route during periods of congestion on the M4 Motorway.

Parramatta Road (A44, A4 and A22)

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:

- Granville
- Auburn
- Silverwater
- Lidcombe
- Homebush
- Homebush West (Flemington)

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

Victoria Road (A40)

Victoria Road extends east-west for approximately 20 kilometres, from its intersection with The Crescent in Rozelle to its intersection with O'Connell Street in Parramatta. Victoria Road passes through:

- Rydalmere
- Ermington
- West Ryde
- Ryde
- Gladesville
- Drummoyne

Along with the M2 Motorway and M4 Motorway/Parramatta Road corridors, Victoria Road is a major connector between Sydney's western and north-western suburbs and Sydney CBD.

3.3.3 Major north-south routes

Principal arterial roads intersecting the M4 Motorway are described below.

- Woodville Road extends north-south for approximately 7.5 kilometres between its intersection with Parramatta Road and Church Street in Granville to its intersection with the Hume Highway in Villawood, linking Villawood, Fairfield, Guildford and Merrylands with Parramatta. South of the Hume Highway, Woodville Road continues as Henry Lawson Drive to Hurstville via Milperra, East Hills and Peakhurst. Woodville Road/Henry Lawson Drive also serves as a major connector linking the M5 Motorway with Parramatta (in conjunction with the Hume Highway/Cumberland Highway corridor). Access between the M4 Motorway and Woodville Road is facilitated by west-facing ramps.

- James Ruse Drive extends north-south for approximately 6.5 kilometres between its intersection with Windsor Road and Briens Road in Northmead to its intersection with Parramatta Road and Berry Street in Clyde. Beyond Windsor Road, James Ruse Drive continues as Briens Road and Old Windsor Road to Kellyville, where it becomes Windsor Road again and continues to Windsor. James Ruse Drive provides access to the Clyde, Camellia and Rosehill industrial areas, and also forms part of one of the major links between Sydney's north-western suburbs and Sydney CBD. Access between the M4 Motorway and James Ruse Drive is facilitated by east and west-facing ramps.
- Silverwater Road (A6) extends north-south for approximately five kilometres between its intersection with Kissing Point Road and Stewart Street in Dundas to its intersection with Parramatta Road and St Hilliers Road in Auburn. Silverwater Road forms part of one of Sydney's major north-south corridors, linking the Illawarra region, Sutherland Shire and Bankstown to Sydney's northern suburbs and beyond to the Central Coast and Newcastle. Silverwater Road serves the Silverwater industrial area, and offers an alternate access to Sydney Olympic Park via Holker Street and Hill Road. Access between the M4 Motorway and Silverwater Road is facilitated by east and west-facing ramps.
- Hill Road extends north-south for approximately four kilometres between its intersection with Burroway Road in Wentworth Point to its intersection with Parramatta Road and Bombay Road in Lidcombe. Hill Road is one of the major thoroughfares to and from Sydney Olympic Park, and provides access to industrial premises located on Carter Street and Uhrig Road. Access between the M4 Motorway and Hill Road is facilitated by west-facing ramps.
- Homebush Bay Drive / Centenary Drive (A3) extends north-south for approximately 6.5 kilometres between its intersection with Concord Road in Concord West to its intersection with the Hume Highway and Roberts Road in Strathfield. These roads form part of one of Sydney's major north-south corridors, linking the St George region with Sydney Olympic Park, Ryde, Sydney's northern suburbs, the upper North Shore and the Northern Beaches. Access between the M4 Motorway and Homebush Bay Drive/ Centenary Drive is facilitated by east and west-facing ramps.

3.3.4 Key markets served by road

Background

Sydney has historically had a radial transport network, developed with Sydney CBD as the centre of activity. Over time this has evolved, with the Sydney Orbital Network, consisting of the M2, M5 and M7 Motorways, completed in 2007 providing a continuous motorway standard network.

With the population growing faster in Western Sydney, and many employment centres located towards the east in the Global Economic Corridor (GEC) spanning from Macquarie Park to Sydney Airport and Port Botany, more people are commuting further to access employment, leading to congestion and capacity constraints at certain times of day. This has implications for the economic development of Western Sydney and within the GEC itself.

The *NSW Long Term Transport Master Plan* (LTTMP) (Transport for NSW (TfNSW) 2012a) identified 46 strategic transport corridors. Of these 46 corridors, six were identified as highly constrained in their ability to meet forecast travel demand growth over the next 20 years.

These corridors connect activity centres such as CBDs, airports, ports or residential centres and reflect travel demand between them.

The M4 Motorway and Parramatta Road corridor is one of the most highly congested in Sydney, with sections already operating above capacity. This heavy congestion reduces travel speeds, and increases travel time variability. Peak travel times on a range of strategic routes in 2011 and 2031 were reported in the LTTMP and are shown below in **Figure 3-5**.

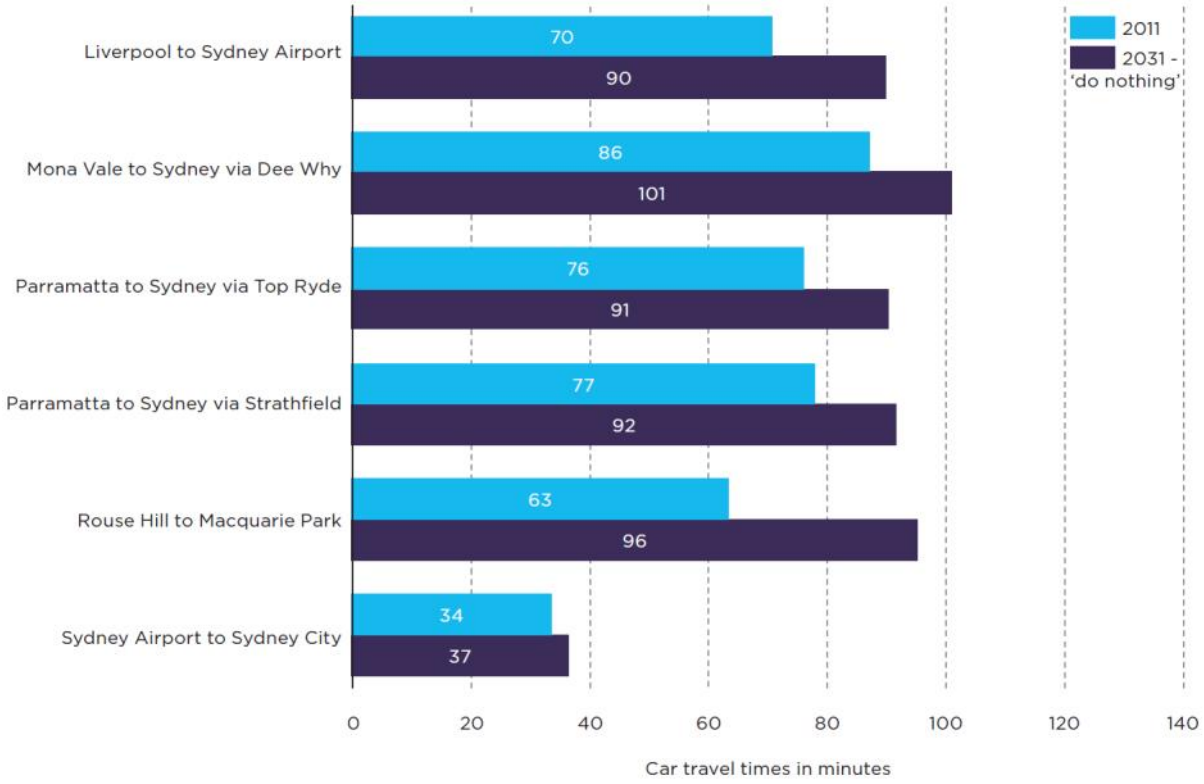

Figure 3-5: Peak travel times along strategic corridors for cars (in minutes), 2011 and 2031 'do nothing' scenario

Source: TfNSW, LTTMP, 2012a p.83

The primary cause of underperformance along the M4 Motorway/Parramatta Road and north-south corridors is that lower-order roads (such as Church Street, Woodville Road and Silverwater Road) are performing a higher transport workload than they were originally intended for, particularly for heavy vehicles. The result is increased congestion, travel time variability and a higher risk of traffic collisions. However, the full WestConnex scheme would provide the means for freight to reach destinations more directly relieving congestion on some of the lower order roads.

The M4 Motorway and Parramatta Road corridor (Parramatta to Sydney CBD) serves seven key markets as defined by their trip purpose:

- Passenger and freight movements to and from Sydney Airport, involving dispersed levels of demand across metropolitan Sydney, and strong east-west travel for low volume, high-value freight such as fresh food imports and exports.

- Container freight from Port Botany, involving longer metropolitan freight trips to warehousing and logistics centres and employment lands along the M4 Motorway corridor.
- Heavy freight movements, involving moderately dispersed trips across metropolitan Sydney to areas of production, consumption, construction, transport and logistics.
- Light freight movements to highly dispersed locations, including employment lands, major centres, localised centres, specialised precincts such as Westmead health or Sydney Olympic Park.
- Commercial business and service vehicles, again to highly dispersed locations including major centres, localised centres, specialised centres and households.
- Long distance personal trips to non-centre locations, involving diffuse origins and destinations where locations are set away from public transport trunk routes.
- Interregional and interstate personal trips, including trips between Sydney's east and the Southern Highlands, Goulburn, Canberra, Blue Mountains, and trips from diffuse areas to high value recreational, cultural or other services and events.

Freight

The *NSW Freight and Ports Strategy* (TfNSW 2013a) states that the NSW freight task is expected to almost double over the next 20 years. The 'miscellaneous' metropolitan freight volume, the largest freight commodity by volume after coal, is expected to grow from 70 million tonnes per annum in 2011 to over 130 million tonnes per annum by 2031. In the Sydney Statistical Subdivision, heavy freight vehicle (HFV) trips include a range of freight tasks including supermarket deliveries, deliveries to car yards, construction sites, fuel deliveries and waste removal. One reason for this is that for every import container, additional light commercial and freight trips are generated as containers are emptied and their goods distributed to their place of consumption.

Growth has immediate implications for the capacity of the road network. Over the next 20 years, strong growth in HFV movements is forecast on the M4 Motorway, M5 Motorway and M7 Motorway as shown in **Figure 3-6**. Without additional motorway capacity, it is estimated that the M4 Motorway will not be able to accommodate the additional traffic by 2031.

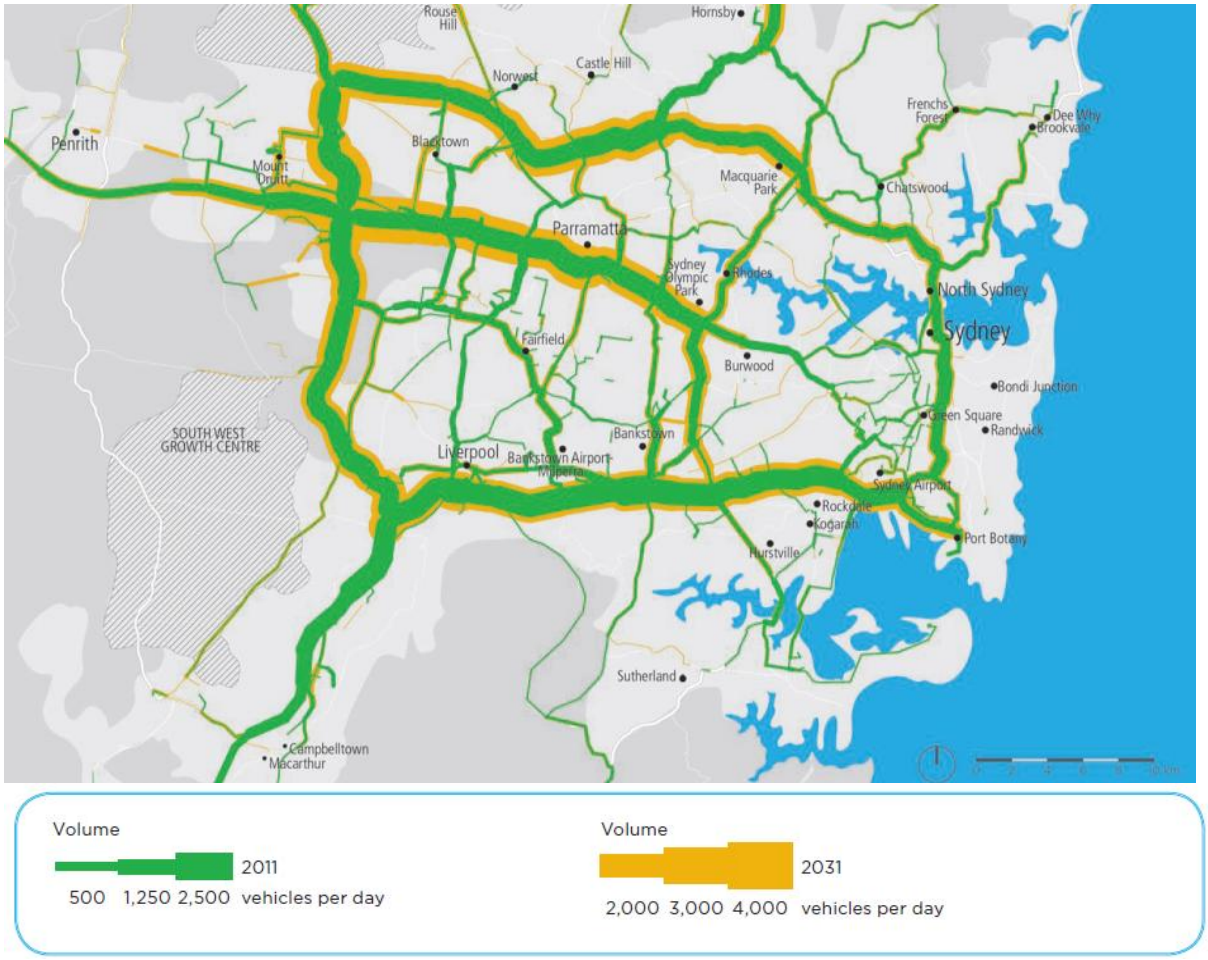

Figure 3-6: Heavy vehicle movements in Sydney, 2011 and 2031

Source: TfNSW, LTTMP, 2012a p.282

Sydney's heavy vehicle freight task is highly dependent on the motorway network. More than 37 per cent of all 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 post World War Two has largely been linked to the motorway and highway networks.

The M4 Motorway is a key component of the primary freight network within the Sydney road freight hierarchy (refer to **Figure 3-7**). It performs a strategic role of serving the freight routes between Port Botany / Sydney Airport, freight and intermodal terminals and industrial hubs.

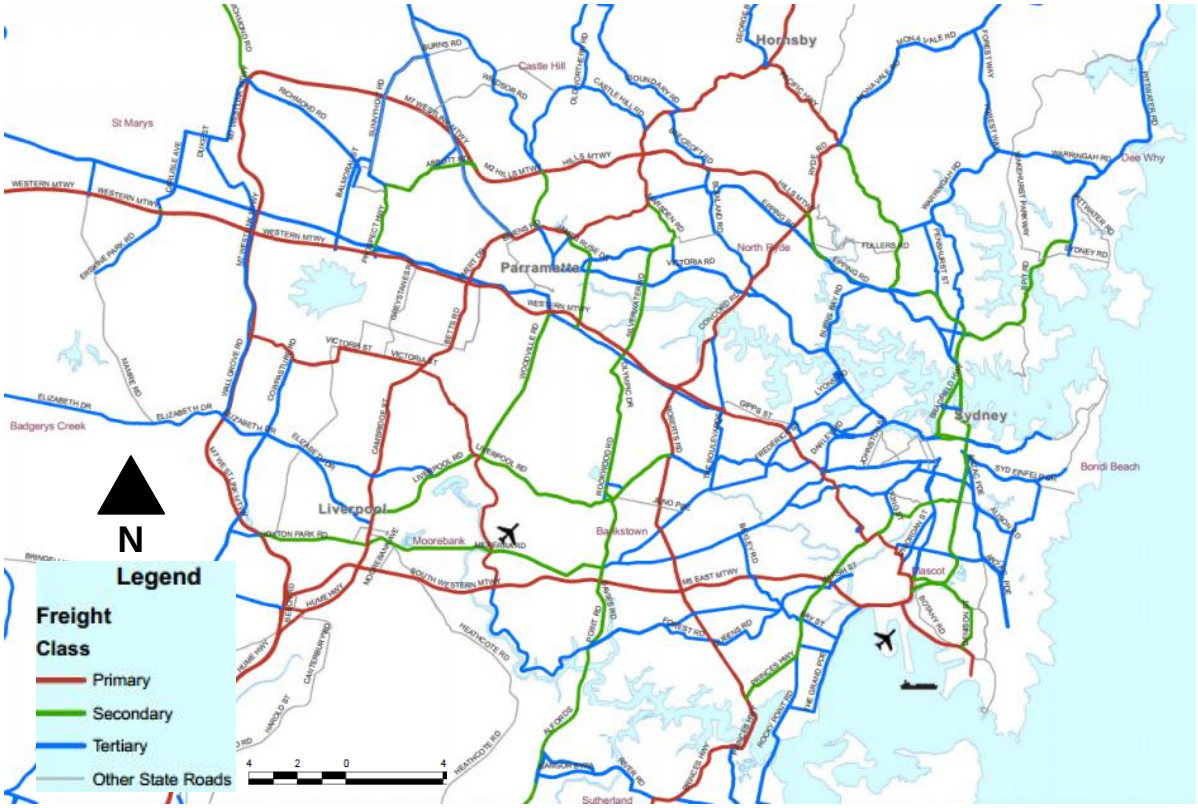

Figure 3-7: Sydney road freight hierarchy showing the M4 Motorway

Source: TfNSW, *Metropolitan Road Freight Hierarchy on the State Road Network Practice Note,* 2011

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 GEC.

The M4 Motorway corridor bears more than double the proportion of work-related business trips than the rest of the wider Sydney network, both in peak periods and at all times of day. **Table 3-1** shows the breakdown of work-related business trips as a percentage of all trips for wider Sydney and the M4 Motorway.

Table 3-1: Trip purpose by time period (work-related business trips)

	Morning peak	Business hours	Other	All day
All Sydney	14%	17%	10%	14%
M4 Motorway	30%	31%	22%	27%

Source: Bureau of Transport Statistics (BTS), *2010/11 Household Travel Survey,* 2012a

Nearly 50 per cent of all LCV trips in Sydney originate in five metropolitan Sydney regions. Three of these regions are heavily reliant on the M4 Motorway corridor including inner Sydney, central-western Sydney, and Fairfield-Liverpool, while the remaining two regions (lower and central-northern Sydney) rely on existing north-south corridors (primarily the eastern end of the Sydney Orbital Network). It is estimated that by 2031, 65 per cent of all LCV trips in Sydney will originate in the west and 18 per cent will originate in inner Sydney.

Sydney's broader freight and commercial task is heavily reliant on the M4 Motorway corridor and on north-south roads to connect freight and commercial vehicles to employment lands and population centres. By providing enhanced east-west and north-south connections, WestConnex will provide increased motorway-grade support for the dispersed and growing commercial and freight tasks. This will facilitate increased efficiency and economic activity across the Sydney metropolitan area.

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 GEC. However, outside the GEC, pockets of significant jobs growth are expected along the M4 Motorway corridor, around Parramatta CBD, Sydney Olympic Park and Rhodes.

3.4 Rail freight

3.4.1 Key markets served by rail

Background

Within the M4 Motorway corridor, the Main Western Rail Line is an important route for rail freight movement. Dedicated freight tracks connect Lidcombe/Homebush West with Port Botany, running via Enfield and Marrickville. The Main Western Rail Line is passenger only between Homebush and the Sydney CBD.

Existing freight network and volumes

Road freight accounted for 63 per cent of total freight tonnes carried in NSW in 2011. If the coal freight task is excluded, which is predominantly rail-borne, the road share of the freight task was 90 per cent in 2011 (TfNSW 2013a, p.23).

Current rail mode share of the whole NSW freight task is approximately 33 per cent by tonnage in 2011 (TfNSW 2012a). The key freight markets for rail are currently for bulk commodities such as coal, minerals and grains. To and from Port Botany, the current rail freight mode share is about 14 per cent.

Within Sydney there is a dedicated rail network for freight operations between Port Botany and the intermodal terminals at places such as Cooks River, Yennora, Chullora,

Leightonfield and Minto. To access this network, however, freight trains must negotiate the congested suburban passenger network as shown in Figure 2-8. As a consequence, freight train operations are severely constrained, operating on lines shared with commuter train services at peak periods.

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 the Main Northern Rail Line. There is considerable investment underway to upgrade rail freight infrastructure beyond the M4 Motorway corridor on Sydney's northern and southern approaches (further details are given in section 2.4.2) but there will still be considerable constraints on rail freight operations where they interface with the passenger network on the Main Western Rail Line.

The metropolitan freight network is shown in **Figure 3-8**.

3.4.2 Concurrent projects

The intermodal terminals at Chullora, Villawood and Enfield (refer to **Figure 3-8**), and the planned terminal at Moorebank, allow for freight to be redistributed from rail to road for onward distribution within metropolitan Sydney using the urban road network. In particular, trucks serving the Chullora and Enfield terminals (located just south of the eastern end of the M4 Widening project) will benefit from reduced travel times over this section when accessing locations in Western Sydney to the north and west of Parramatta.

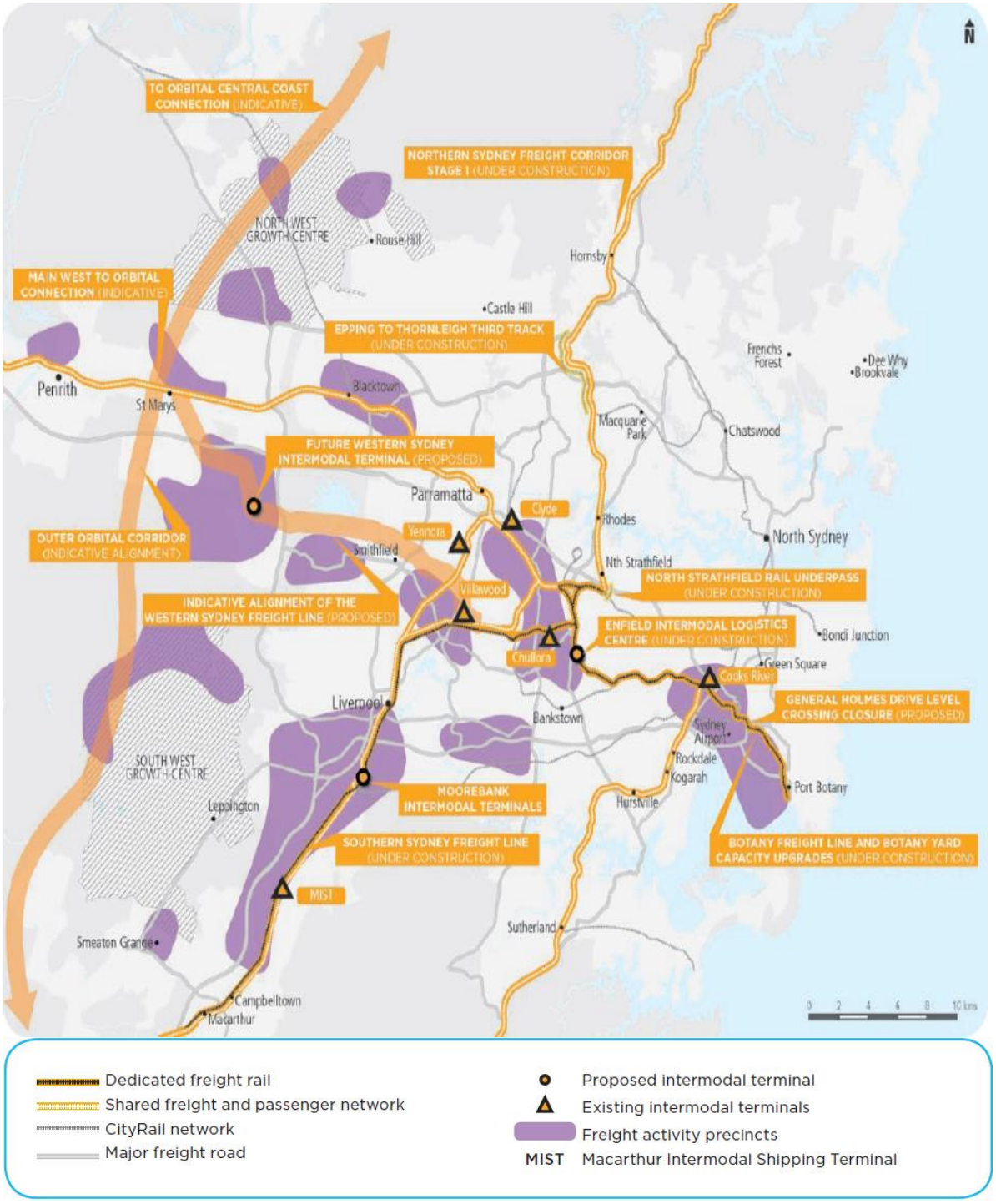

Figure 3-8: Metropolitan freight network including intermodal terminals

Source: TfNSW, *NSW Freight and Ports Strategy,* 2013a

3.5 Public transport

3.5.1 Travel mode share

Travel by car is the predominant travel mode for Western Sydney residents. **Figure 3-9** shows the Journey to Work (JTW) modal shares for the Western Sydney rail catchment area (Auburn to the Nepean/Hawkesbury) and, for comparison, the JTW modal shares for the Sydney metropolitan area (excluding the Blue Mountains, Central Coast and Southern Highlands).

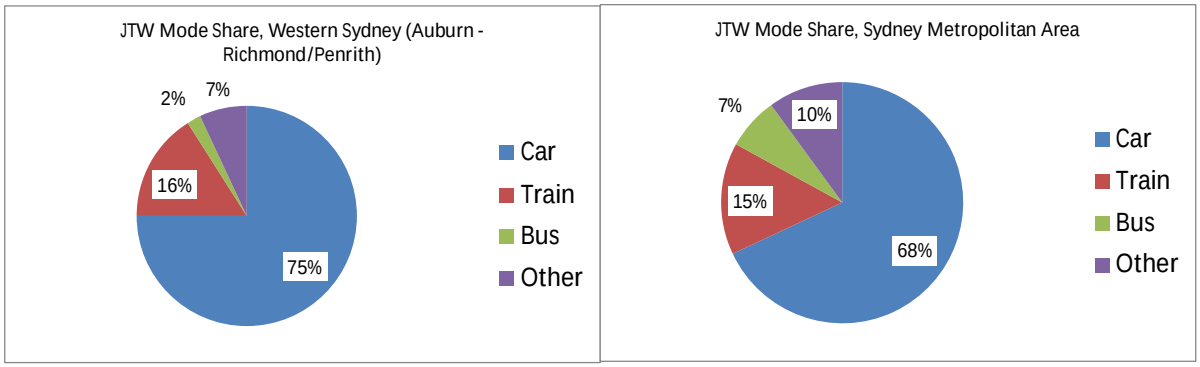

Figure 3-9: Journey to work mode shares

Source: BTS, *Compendium of Sydney Rail Statistics,* 2012b
Note (1): Data from the 2011 census was not available at the time of publication of the Compendium; therefore data from the 2006 census was used.
Note (2): "Other" includes walk, cycle and other non-motorised modes

The 2011 census shows that 59 per cent of all JTW trips by residents of the M4 Motorway corridor between Parramatta and Burwood are made by private vehicle as a driver or as a passenger. Public transport accounts for 33 per cent of work trips, with 30 per cent of all JTW trips made by train, predominantly for commuting to Sydney CBD (73 per cent of all trips to work in the CBD are by train). This data was sourced from the BTS website by selecting the origin zones in the M4 Motorway corridor between Burwood and Parramatta.

For travel into the corridor, 25 per cent of all trips to work in Parramatta CBD and 22 per cent of all trips to work in Burwood CBD are made by rail (BTS 2012b). This compares with 50 per cent of all trips to Sydney CBD and the Sydney metropolitan JTW rail mode share average of 15 per cent.

3.5.2 Bus services

There is an extensive network of bus and rail services within the local area, with some bus services likely to be impacted by the construction and operation of the M4 Widening project.

Bus routes in this area provide connections to 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 TfNSW Sydney Metropolitan Bus Service Contract (SMBSC) regions:

- Region 3 – Liverpool/Bonnyrigg/Smithfield/Guildford/Parramatta, operated by Transit Systems.

- Region 5 – Hurstville/Punchbowl/Strathfield and limited peak hour services into Sydney Olympic Park, operated by Punchbowl Bus Company.
- Region 6 – Inner-western and south-western suburbs, operated by State Transit Authority.
- Region 7 – North-western and lower North Shore, operated by State Transit Authority.
- Region 13 – Parramatta/Fairfield/Liverpool/Bankstown/Burwood, operated by Transdev.

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

- Route M91 – Parramatta to Hurstville, operated by Transdev.
- Route M92 – Parramatta to Sutherland, operated by Transdev.
- Route 401 – Lidcombe to Sydney Olympic Park, operated by State Transit Authority.
- Route 525 – Parramatta to Burwood, operated by State Transit Authority.
- Route 526 – Burwood to Sydney Olympic Park, operated by State Transit Authority.
- Route 544 – Auburn to Macquarie Centre, operated by State Transit Authority.

Table 3-2 lists the current bus routes which cross the M4 Motorway between Burnett Street, Parramatta and Concord Road, North Strathfield.

Table 3-2: List of bus routes crossing the M4 Motorway (current March 2014)

Crossing	Bus route(s)	Operator	Buses per weekday (bi-directional)
Burnett Street, Parramatta	810 and 811 – Parramatta to Merrylands via Pemulwuy	Transit Systems (Region 3)	61
Pitt Street, Parramatta	802, 804 and 806 – Parramatta to Liverpool via Bonnyrigg	Transit Systems (Region 3)	239
Church Street, Granville	M91 – Parramatta to Hurstville via Bankstown 907 – Parramatta to Bankstown via Villawood	Transdev (Region 13)	235
Good Street, Granville	906 – Parramatta to Fairfield via Guildford	Transdev (Region 13)	43
James Ruse Drive, Clyde	M92 – Parramatta to Sutherland via Bankstown	Transdev (Region 13)	139
Stubbs Street, Silverwater	540 – Auburn to Silverwater 544 – Auburn to Macquarie Centre via Silverwater	State Transit Authority (Region 7)	68
Hill Street, Lidcombe	401 – Lidcombe to Sydney Olympic Park	State Transit Authority (Region 6)	60

Crossing	Bus route(s)	Operator	Buses per weekday (bi-directional)
Underwood Road, Homebush	450 – Hurstville to Sydney Olympic Park via Strathfield	Punchbowl Bus Company (Region 5)	177
	525 – Parramatta to Burwood via Sydney Olympic Park 526 – Burwood to Sydney Olympic Park	State Transit Authority (Regions 6 and 7)	

There are also five NightRide bus routes that operate along the M4 Motorway corridor:

- N60 – Fairfield to Town Hall.
- N61 – Carlingford to Town Hall.
- N70 – Penrith to Town Hall.
- N71 – Richmond to Town Hall.
- N80 – Hornsby to Town Hall.

Routes N70 and N71 operate along the M4 Motorway between Concord Road and James Ruse Drive. Each NightRide service operates hourly between approximately midnight and 5.00 am.

There are 11 Sydney Olympic Park special event bus routes, all of which pass through the area likely to be impacted by the construction and operation of the M4 Widening project *en route* to and from Sydney Olympic Park. These services operate at high frequencies before and after major events held at Sydney Olympic Park.

3.5.3 Existing bus facilities

Apart from the major bus/rail interchanges at Parramatta and Granville, facilities for bus passengers in the M4 Motorway corridor are fairly basic. 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.

3.5.4 Bus priority facilities

Within the area likely to be impacted by the M4 Widening project, there are only limited bus priority measures in place and minimal bus priority is currently provided along Parramatta Road. Existing bus priority is shown in **Figure 3-10** overleaf.

The most significant bus priority measures already in place in the M4 Motorway corridor 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.

There are two significant lengths of bus lane on Victoria Road, between Parramatta and Ryde:

- Between Kirby Street and Park Road, Rydalmere (approximately 700 metres) – westbound evening peak only.
- Between Spurway Street and Kissing Point Road (approximately 1.1 kilometres) – eastbound morning peak only.

In addition, there are two short lengths of westbound bus lanes in Rydalmere on Victoria Road approaching the University of Western Sydney entrance and James Ruse Drive

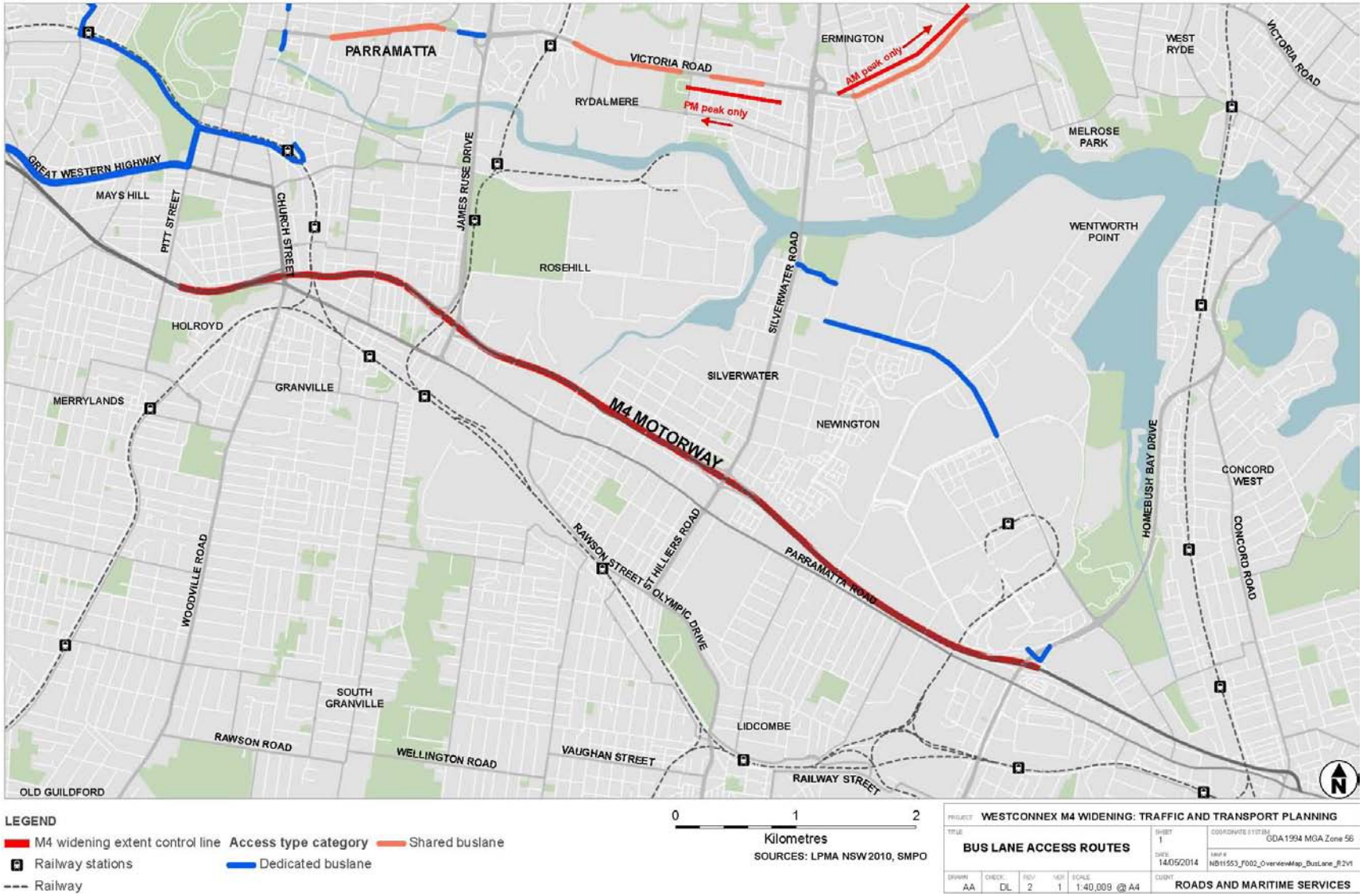

Figure 3-10: Bus priority facilities in the M4 Motorway corridor and adjacent routes

Source: Jacobs SKM, 2014

3.5.5 Rail network

The rail network in the M4 Motorway corridor is shown in **Figure 3-11** overleaf.

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.

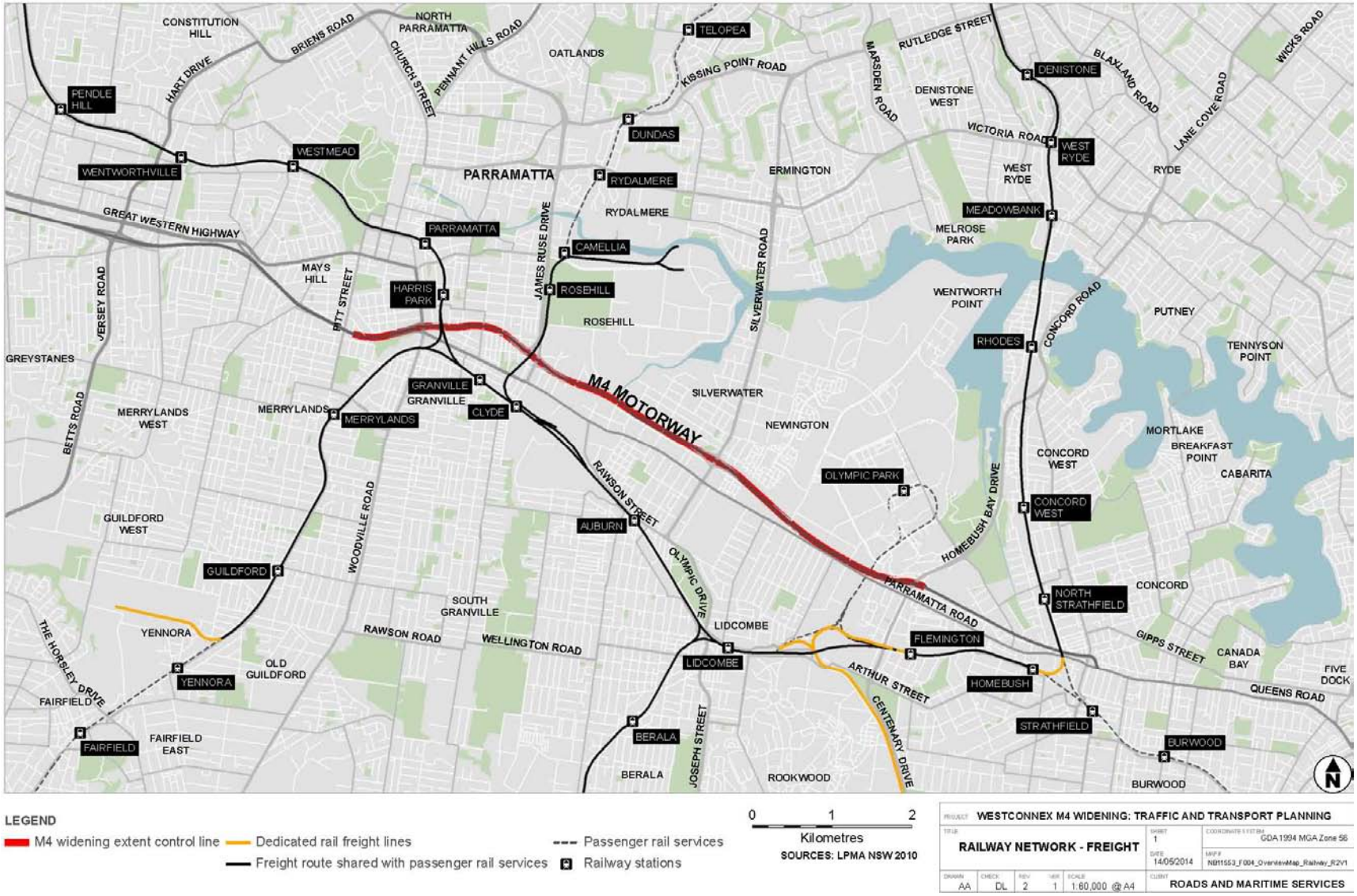

Figure 3-11: Rail network in the M4 Motorway corridor

Source: Jacobs SKM, 2014

The rail lines crossing the M4 Motorway corridor between Parramatta and Concord are listed in **Table 3-3**.

Table 3-3: Rail lines crossing the M4 Motorway

Crossing location and nature of crossing	Rail lines carried	Number of tracks at crossing
Harris Park, between Harris Street underpass and Church Street underpass on the M4 Motorway Bridge - road over rail	T1 – Emu Plains/Richmond to Central (continuing to the North Shore) T5 – Schofields to Campbelltown NSW Trains (InterCity) – Bathurst to Central NSW Trains (formerly CountryLink) – Dubbo/Broken Hill to Central Great Southern Railway – Perth to Central Freight	6
Immediately west of James Ruse Drive overbridge on the M4 Motorway Bridge – road over rail	T6 – Carlingford to Clyde	2
Sydney Olympic Park between Birnie Avenue and Sarah Durack Avenue Bridge – rail over road	T7 – Lidcombe to Sydney Olympic Park	2
250 metres west of Concord Road ramps on M4 Motorway Bridge – road over rail	T1 – Epping to Central (continuing to the North Shore) NSW Trains (InterCity) – Newcastle to Central NSW Trains (formerly CountryLink) – North Coast/New England to Central Freight (the dedicated Sydney freight network junction is immediately north of the M4 Motorway overbridge)	5

Overall, Sydney Trains commuter services all experience overcrowding during peak periods. The following table shows the passenger load as a percentage of the train seating capacity for morning peak trains approaching Redfern.

Table 3-4: Average load factors on peak hour trains approaching Redfern from the west

Line	Peak one hour		Peak period (6.00 am to 9.30 am)	
	Number of trains	Average load factor (%)	Number of trains	Average load factor (%)
Inner West	4	115	16	65
South via Granville	7	115	17	85
Western	16	130	41	100
Northern	4	145	13	90

Source: BTS, *Compendium of Sydney Rail Statistics*, 2012b
Note: Figures show average load factors. Individual services in the peak period will operate at higher load factors than the average shown in this table

Sydney Trains define a 'crush load' as a load factor of 135 per cent or higher. The target is for fewer than five per cent of trains to be operated at 'crush load' or higher (Sydney Morning Herald, *Train crush load limit set to triple*, 3 January 2009).

NSW Trains operate longer InterCity services from the Blue Mountains and Newcastle/Central Coast, and also former CountryLink services over these lines as follows:

- Melbourne and Canberra services four to five times per day along the Main Southern Rail Line.
- Griffith service weekly along the Main Southern Rail Line.
- Dubbo service daily and Broken Hill service weekly along the Main Western Rail Line.
- North Coast and New England services, four times per day along the Main Northern Rail Line.

Great Southern Railway operates the Indian Pacific service between Perth and Sydney, weekly in the winter and twice per week in the summer along the Main Western Rail Line.

Detailed analysis of rail services and frequencies is presented in **Table 3-5**.

Table 3-5: Scheduled passenger trains per weekday on rail lines passing through the M4 Motorway corridor between Parramatta and Homebush (March 2014)

Rail line	Trains per day (bi-directional)
T1 – Emu Plains/Richmond to Central (continuing to the North Shore)	296
T1 – Epping to Central (continuing to the North Shore)	144
T2 – Macarthur to City Circle via Granville (continuing to the Airport Line)	154
T2 – Homebush to City Circle (continuing to the Bankstown Line)	146
T5 – Schofields to Campbelltown	49
T6 – Carlingford to Clyde	50
T7 – Lidcombe to Sydney Olympic Park	206
NSW Trains (InterCity) – Bathurst to Central	66
NSW Trains (InterCity) – Newcastle to Central	88
NSW Trains (formerly CountryLink) – North Coast/New England to Central	8
NSW Trains (formerly CountryLink) – Dubbo/Broken Hill to Central	2-3
NSW Trains (formerly CountryLink) – Melbourne/Griffith/Canberra to Central	10-11

Railway stations

There are 11 rail stations in the vicinity of the project between Parramatta and Homebush. **Table 3-6** shows the passenger volumes at each of the stations, along the Main Western Rail Line plus the same data for the three stations immediately north of the M4 Motorway corridor ranked by daily passenger throughput. The busiest rail station within this area is Parramatta with over 66,000 passenger entries and exits on a weekday in 2011. Parramatta is the fourth busiest rail station on the Sydney Trains network and the busiest station outside Sydney CBD (BTS 2012b).

Table 3-6: Railway stations in the vicinity of the M4 Widening project

Station	Weekday entries and exits 2011	Number of weekday train services
Parramatta	66,440	413
Auburn	21,240	258
Lidcombe	20,580	466
Granville	10,940	322
Flemington	6,420	139
North Strathfield	4,900	142
Homebush	4,780	153
Olympic Park	4,460	210
Harris Park	3,160	157
Clyde	1,380	161
Rosehill	200	50

Source: BTS, *Compendium of Sydney Rail Statistics*, 2012b

3.6 Cyclists and pedestrians

3.6.1 Pedestrian network

The pedestrian network along the M4 Motorway corridor consists mainly of kerbside footpaths along local and arterial roads. In general, footpath widths range between 1.2 metres and 3.6 metres including share paths and generally footpaths are provided on both sides of the road.

In addition to the kerbside footpaths, there are a number of pedestrian paths through reserves, some of them shared with cyclists. These include:

- A path parallel to the M4 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 are located 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 (no footpaths).
- Junction Street, Auburn (no footpaths).
- 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. Whilst 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.

3.6.2 Cycling network

M4 Motorway corridor

The bicycle network in the study area (the M4 Motorway between Pitt Street and Homebush Bay Drive) contains a mixture of off-road and on-road facilities, providing access to Merrylands, Parramatta, Granville, Harrys Park, Clyde, Rosehill, Auburn, Lidcombe, Silverwater, Newington, Sydney Olympic Park and Sydney Markets. The bicycle network running parallel to the M4 Motorway between Cumberland Highway and Haslams Creek, Lidcombe is entirely off-road.

Bicycle network infrastructure along the M4 Motorway corridor includes:

- Shoulders on the M4 Motorway west of Church Street.
- Off road path that runs parallel to the south of the M4 Motorway between Cumberland Highway and Woodville Road. This extends to a shared path at the northern end of Woodville Road and along Railway terrace. Connections are also provided to the shared path along Parramatta Road between Woodville Road and James Ruse Drive including Bold Street.
- 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.

- Off-road path that runs underneath the M4 Motorway viaduct between Church Street and James Ruse Drive.
- Off-road path along the majority of Martha Street between James Ruse Drive and Deniehy Street, Clyde. Connection to Parramatta Road is provided via Kendall Street.
- Off-road path along the Duck River, including a crossing of the Duck River, between Deniehy Street, Clyde and Junction Street, Auburn. A connection and shared path extension is provided at Duck Street.
- Off-road path along the entire length of Adderley Street West, Auburn and Adderley Street East, Lidcombe to Haslams Creek. Partially shared with pedestrians.
- Shoulders on the M4 Motorway between Silverwater Road and Concord Road.
- Off-road path that runs parallel to the north of the M4 Motorway between Beaconsfield Street, Newington and Haslams Creek.
- Off-road path along Hill Road.
- Off-road path along Parramatta Road between Bachell Avenue and Birnie Avenue.
- Off-road path along Birnie Avenue.

Cyclists are prohibited from travelling on the M4 Motorway between Church Street and Silverwater Road as a result of the absence of suitable road shoulders on the viaduct.

Connections to the M4 Motorway corridor

Outside the M4 Motorway corridor the bicycle network is patchy and dominated by on-road cycling. There are significant gaps in north-south connections which are mainly caused by the lack of north-south links for Parramatta Road, the M4 Motorway, the Main Western Railway Line and the Parramatta River.

Some of the connections of the M4 Motorway corridor to major precincts and infrastructure include:

- Rees Street, Banks Street and Pitt Street to Parramatta, Parramatta Park and Westmead.
- Woodville Road and Randle Street to the Parramatta to Liverpool Rail Trail.
- Haslams Creek and Hill Road to Sydney Olympic Park
- Sydney Street, Concord Road, Patterson Street, Gipps Street and Queens Road to Sydney CBD via Iron Cove, Victoria Road and Anzac Bridge.

The bicycle network along the M4 Motorway corridor is shown in **Figure 3-12** and **Figure 3-13** overleaf.

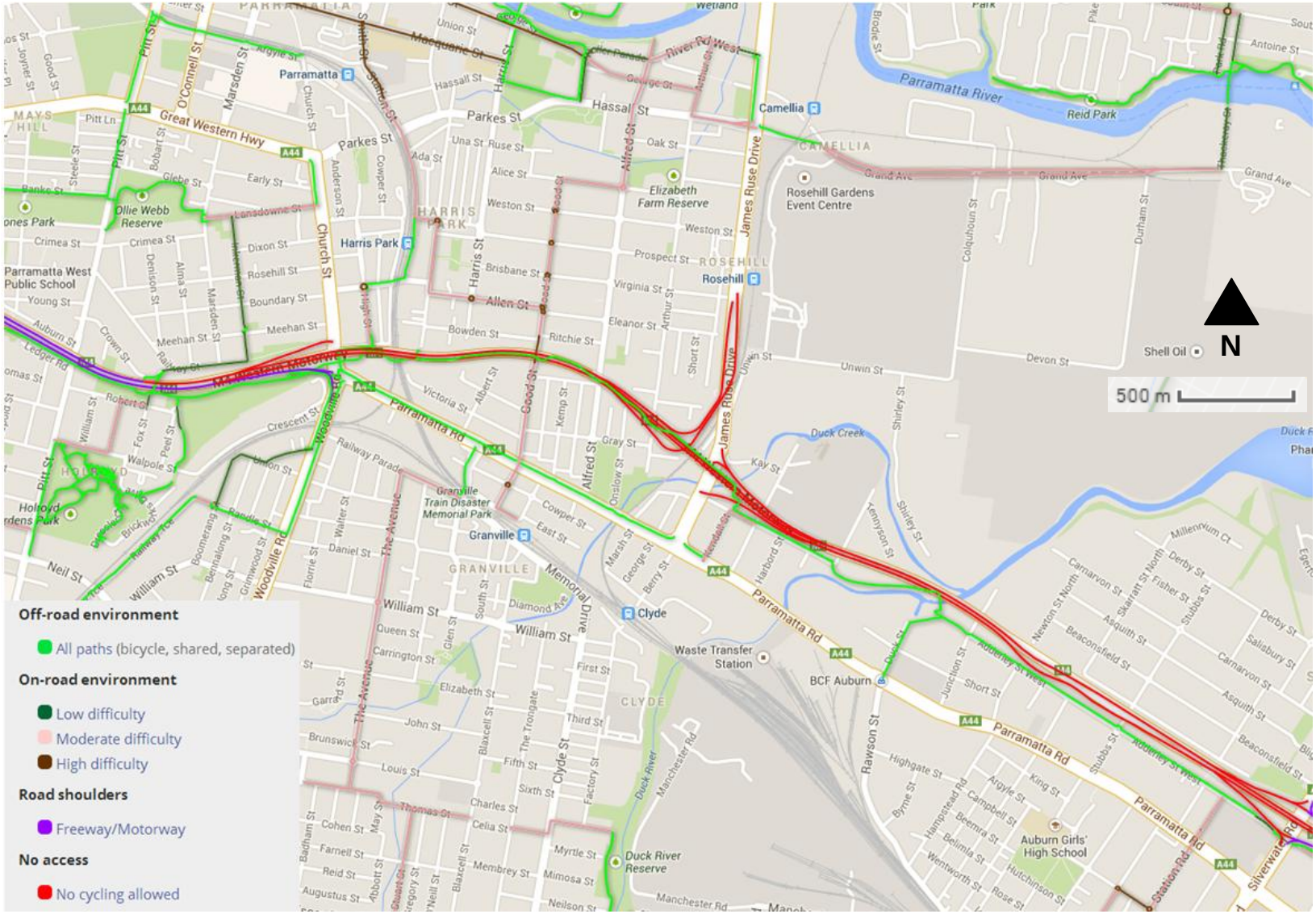

Figure 3-12: M4 Motorway corridor bicycle routes, Pitt Street to Silverwater Road

Source: NSW Government, Bicycle information for NSW Cycleway Finder v2.0, 2014

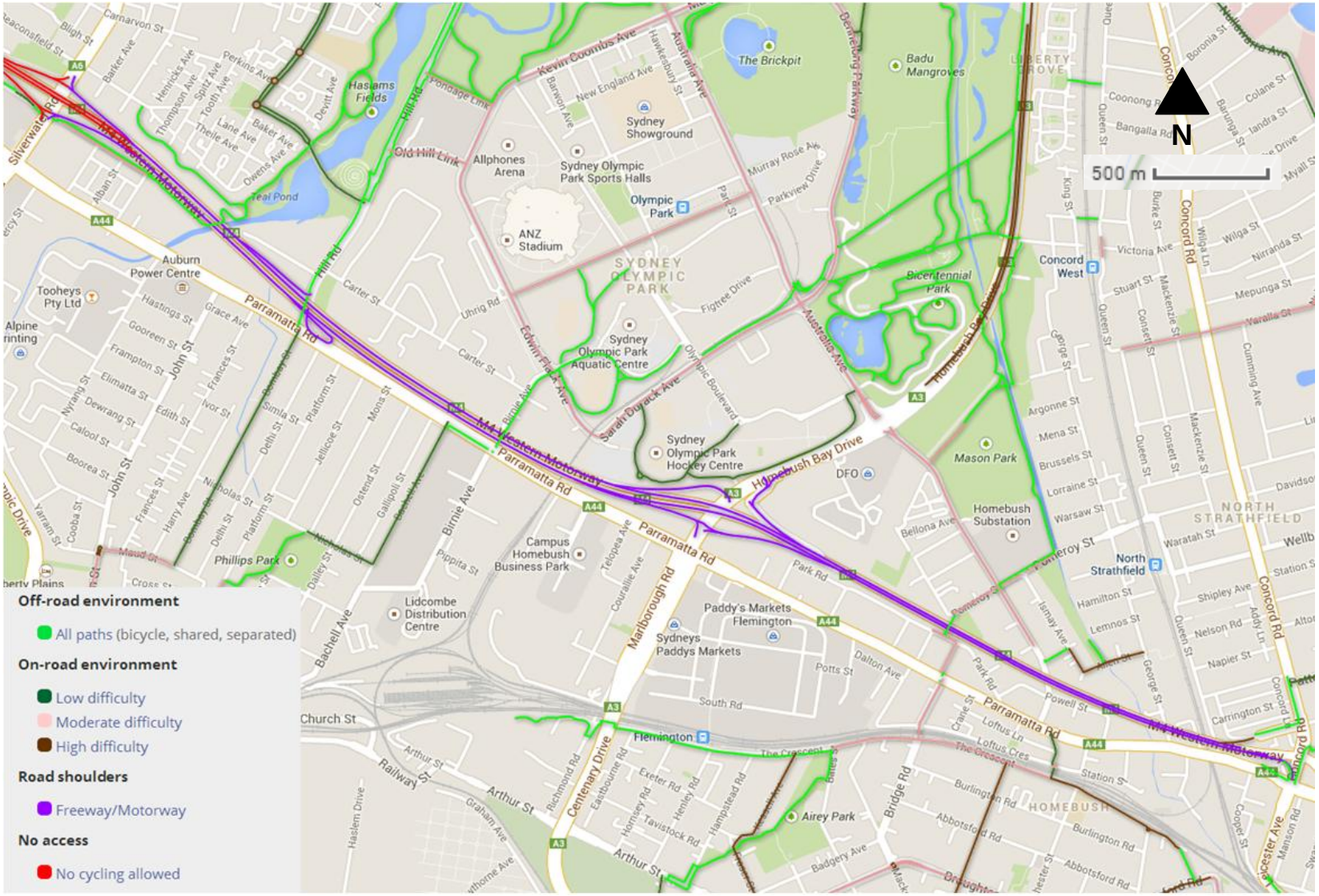

Figure 3-13: M4 Motorway corridor bicycle routes, Silverwater Road to Homebush Bay Drive

Source: NSW Government, Bicycle information for NSW Cycleway Finder v2.0, 2014

3.7 Concurrent transport projects and proposals

3.7.1 Smart motorway system

(NSW) Roads and Maritime Services (Roads and Maritime) is proposing to implement a smart motorway system on the M4 Motorway between Lapstone and Concord. Roads and Maritime has a separate smart motorway project for the section between Lapstone and Mays Hill. Smart motorway systems aim to:

- Improve travel time reliability.
- Improve safety.
- Provide real-time information about traffic conditions, travel times and traffic incidents for drivers on the M4 Motorway and on approach roads. Drivers would be able to make informed decisions about which route to take.
- Reduce vehicle emissions.
- Reduce journey times.

The smart motorway systemfor the M4 Motorway would include the following features:

- Real-time traffic and travel information delivered through enhanced variable message signs on the M4 Motorway and on approach roads.
- A coordinated entry ramp signals system.
- Dynamic speed and incident management through advanced lane use management and variable speed sign systems.
- Enhanced network monitoring delivered by traffic sensors in the roadway and closed circuit television (CCTV) cameras.
- Emergency telephones and stopping bays to provide drivers with improved safety in the event of a breakdown or if there is an emergency stop required.
- Road improvements such as some widened and lengthened on- and off-ramps and nearby intersection improvements.

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 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 future 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 Managed Motorway solution.

3.7.2 M5 West Widening

The M5 West Widening will expand 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 commenced in August 2012 and is expected to be completed before M4 Widening road works commence. The project aims to:

- Reduce congestion on the M5 South West Motorway and improve reliability and travel times
- Provide relief to existing 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 between road users and motorway traffic controllers with a new control centre in Hammondville.
- Improve safety and provide early warning alerts for drivers on the motorway and arterial networks by providing additional variable message signs.
- Improve incident response times with the installation of a new CCTV system.

3.7.3 NorthConnex

Roads and Maritime, Transurban and Westlink M7 shareholders are proposing to construct and operate a tolled motorway, NorthConnex, linking the M1 Pacific Motorway (previously the F3 Freeway) at Wahroonga to the Hills M2 Motorway at West Pennant Hills. The preferred route is shown in **Figure 3-14**.

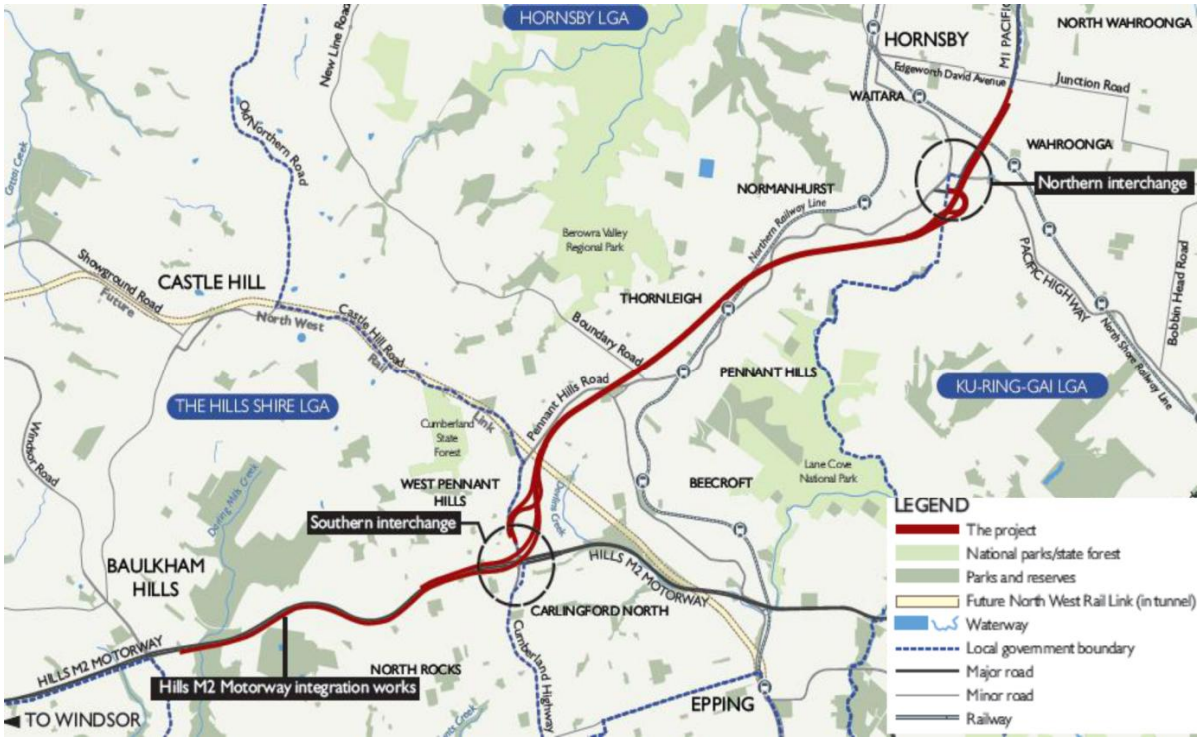

Figure 3-14: NorthConnex preferred route

Source: Transurban, *Community Presentation,* March 2014

The new link will feature:

- Twin motorway tunnels with two lanes in each direction and provision for future widening to three lanes.
- The twin motorway tunnels would be about eight kilometres in length and have a minimum posted speed limit of 80 kilometres per hour.

- Northern interchanges connecting with the M1 Pacific Motorway, the Pacific Highway and Pennant Hills Road.
- Southern interchange connecting with the Hills M2 Motorway and Pennant Hills Road.

The project aims to:

- Reduce traffic congestion, particularly along Pennant Hills Road, providing reduced travel times for road users.
- Reduce the number of heavy vehicles along Pennant Hills Road, and as a result improve safety, local air quality and noise amenity along the corridor.
- Provide opportunities for improved public transport in the area around Pennant Hills Road.
- Improve the efficient movement of state and national freight.
- Provide a high standard access-controlled motorway that integrates with the regional transport network.

3.7.4 North West Rail Link

The North West Rail Link is a 23 kilometre rail link between Epping and Rouse Hill. Construction is proposed to commence in 2014 and the line is expected to be operational in 2019. Its features include:

- A direct underground link to the existing Epping to Chatswood rail tunnels.
- Eight new stations at Cherrybrook, Castle Hill, Hills Centre, Norwest, Bella Vista, Kellyville, Rouse Hill and Cudgegong Road.
- A train stabling facility at Tallawong Road, Rouse Hill.
- 4,000 commuter car parking spaces at Cherrybrook, Hills Centre, Bella Vista, Kellyville and Cudgegong Road stations.
- Twin tunnels 15 kilometres in length between Epping and Bella Vista.
- A viaduct four kilometres in length between Bella Vista and Rouse Hill.
- Bus, taxi, kiss and ride, pedestrian and cycling facilities at all stations.

The alignment is shown in **Figure 3-15**.

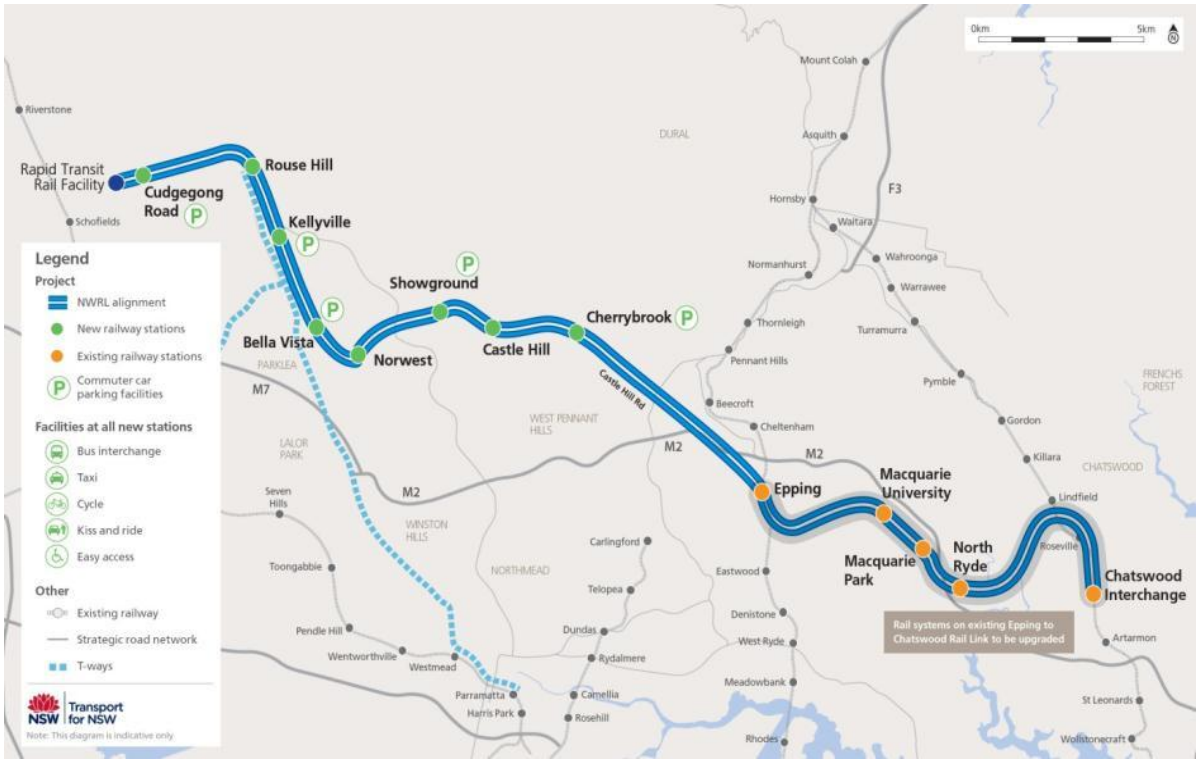

Figure 3-15: North West Rail Link alignment

Source: TfNSW, *North West Rail Link Project Overview,* 2012c

The new rail link will provide:

- Approximately 300,000 people living in Sydney's north-west with rail access to Epping, Macquarie Park, Chatswood, St Leonards, North Sydney and Sydney CBD.
- Increased service capacity to Sydney CBD.
- New rail services to existing suburbs in the Hills District as well as new areas that are planned for residential and commercial development.
- Frequent, regular rail services and improved travel time reliability compared with bus and private car.
- Travel time savings from many areas of the north-west region to Sydney CBD and Macquarie Park, and within the region, including to the Rouse Hill Town Centre.
- An increase in train services to Macquarie University and Macquarie Park.
- Reduced bus congestion in Sydney CBD in the longer term.

The North West Rail Link, when operational, will reduce the level of overcrowding on the Main Western Rail Line. In the longer term, the construction of a second Sydney Harbour rail crossing and a new CBD rail line, and improved operational use of the Main Western Rail Line tracks will increase service capacity to the CBD by 35 per cent. Improvements on the line will allow more express trains per hour from Blacktown and Penrith to the CBD, with all-day frequent and reliable Cumberland Line services, providing better connections from Parramatta to Liverpool and the south-west.

3.7.5 Bus network changes

The NSW Government's *Sydney's Bus Future* (TfNSW 2013b) is a long-term plan to redesign the bus network to cater for future growth. A three-tiered network is proposed with each level delivering a defined level of service consistency and reliability:

- 'Rapid' service routes would form the foundation of the new bus network, offering fast and reliable bus travel between major centres. Rapid routes would provide customers with mass transit level services between centres which are not linked by trains or light rail. Features would include frequent 'turn up and go' services without the need for consulting a timetable, stops every 800 metres to one kilometre, and investment in bus priority infrastructure.
- 'Suburban' service routes and 'Local' service routes would supplement the Rapid service routes to improve access to local, neighbourhood destinations. Features of Suburban service routes would include a mix of frequent 'turn up and go' and timetabled services, stops every 400 metres and bus priority targeted at key pinch points. Features of Local service routes would include timetabled services; local shopping services, CBD shuttles and peak expresses; stops every 400 metres; peak express services with variable stop spacing; the use of local streets and roads; and bus priority for peak express connections.

The current route 525 service between Parramatta and Burwood via the University of Western Sydney, Rydalmere, Ermington, Silverwater, Newington, Sydney Olympic Park and Strathfield would be converted to a Suburban service route.

4 Existing road network performance

The M4 Motorway is a core component of Sydney's extensive road network. Any changes to the M4 Motorway will have impacts across the network as drivers adjust their preferred routes. This chapter focuses on existing traffic performance in the M4 Motorway corridor, and also reflects on current conditions on alternative routes that road users may choose. The impacts of the removal of the M4 Motorway toll in February 2010 are examined to help understand what may happen when a toll is reintroduced.

The M4 Motorway was the first tolled motorway in Sydney, operating with a toll between 1992 and 2010. The implementation of the toll and various policy changes during this time has had an impact on trip distribution within the corridor. These changes in trip distribution culminated in the removal of the toll in February 2010. **Section 4.1.1** of this chapter describes the history of tolling policy on the M4 Motorway and the implications that those changes have had on network performance within the corridor and broader road network.

4.1 M4 Motorway traffic

4.1.1 M4 Motorway toll history

The M4 Motorway became Sydney's first tolled motorway in 1992. The history of the development of the motorway and the introduction of a toll along with various policy changes over the years is described in **section 1.3**.

On 16 February 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. Immediately prior to its removal, the motorway toll was $2.75 for cars and $6.60 for trucks.

Vehicle counting equipment is maintained by (NSW) Roads and Maritime Services (Roads and Maritime) on the M4 Motorway at the site of the former toll plaza between the Silverwater Road and James Ruse Drive interchanges. The data presented in **Figure 4-1** and **Figure 4-2** is derived from the toll plaza count data collected in 61 day periods commencing on 1 June 2009 and again on 31 May 2010. These time periods are representative of the same time of year before and after the removal of the toll. Weekday values presented are calculated from school days since they most closely reflect a 'typical' weekday. Overall weekday traffic on the M4 Motorway at the toll plaza was 23 per cent higher in 2010 without the toll than in 2009 with the toll.

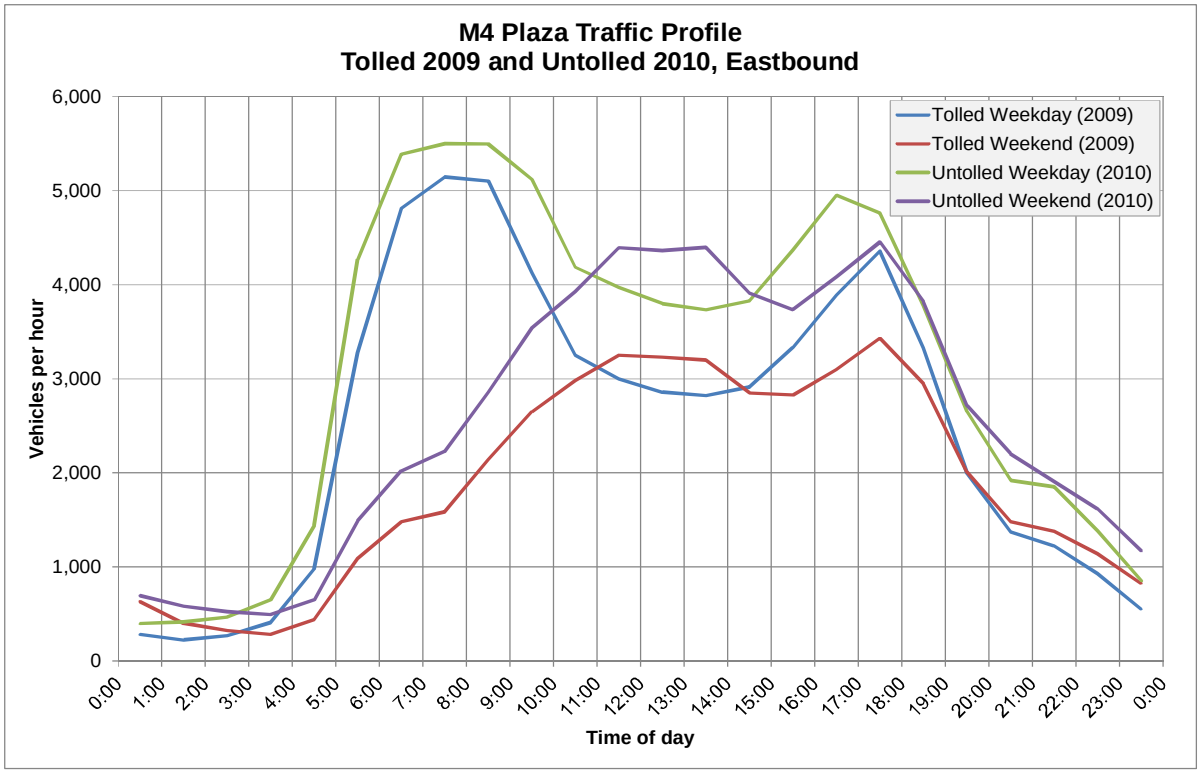

Figure 4-1: M4 Motorway plaza traffic profile, 2009 (tolled) and 2010 (untolled), eastbound

Source: WestConnex Delivery Authority (WDA), 2014

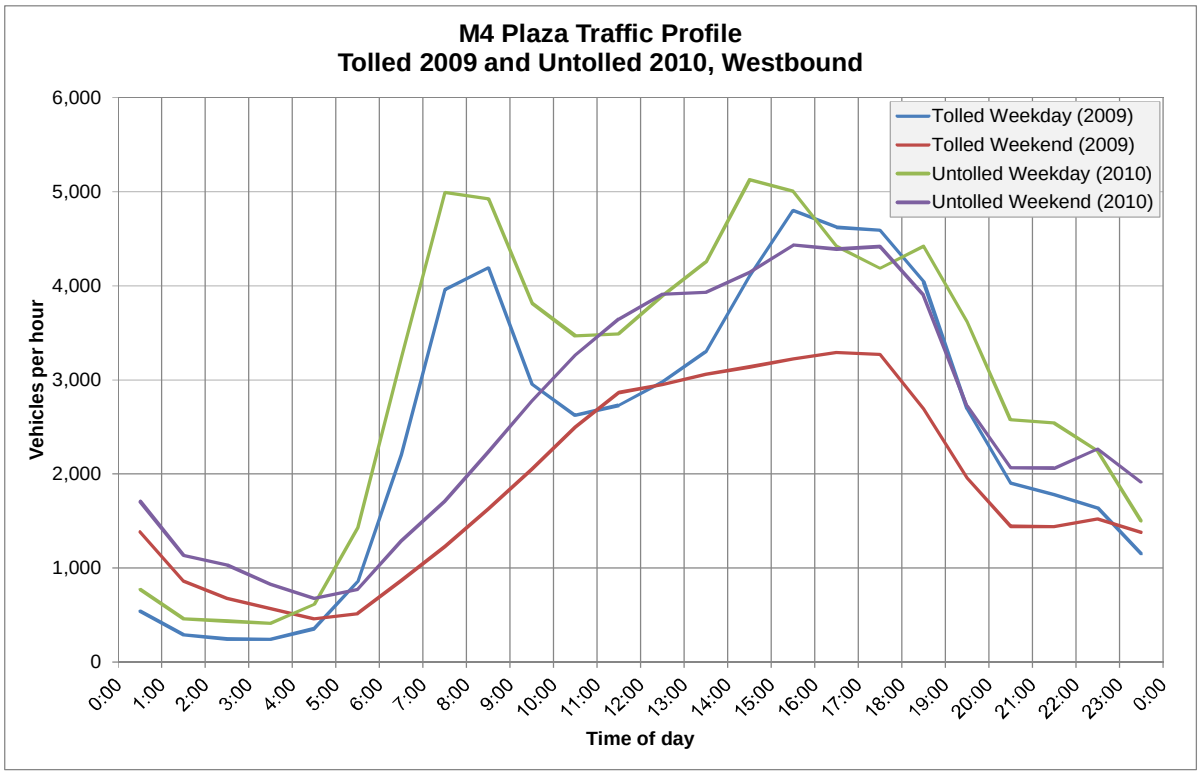

Figure 4-2: M4 Motorway plaza traffic profile, 2009 (tolled) and 2010 (untolled), westbound

Source: WDA, 2014

Figure 4-1 and **Figure 4-2** demonstrate that on weekdays, the M4 Motorway exhibits typical morning and evening demand peaks. On weekends, the eastbound direction exhibits midday and evening peaks. The busiest hour in the weekday eastbound morning peak is 7.00 am to 8.00 am both before and after the toll removal. Eastbound traffic in this hour grew by seven per cent following the removal of the toll. Removing the toll shifted the busiest hour in the evening peak from between 5.00 pm and 6.00 pm to between 4.00 pm and 5.00 pm with the number of eastbound vehicle movements in this hour rising by 27 per cent.

Of particular note in **Figure 4-2** is that traffic volumes in the two hours between 4.00 pm and 6.00 pm reduced following the toll removal. This indicates that traffic is at or near capacity on the M4 Motorway or the surrounding network at this time of day. On weekends, the westbound direction appears to have a single very long traffic peak (unlike the eastbound direction, which has a midday and evening peak).

Figure 4-3 shows changes in vehicle volumes on the M4 Motorway and Parramatta Road around the time the M4 Motorway toll was removed. **Figure 4-3** shows that traffic passing the M4 Motorway toll plaza grew by 19 per cent in the morning peak and by nine percent in the evening peak in the year following the removal of the M4 Motorway toll. Traffic nearby on Parramatta Road fell by 24 per cent in the morning peak and by 11 per cent in the evening peak. There are a range of factors contributing to these volume changes, including natural growth, however the toll removal is likely to be responsible for most of the change. It is likely that these changes would be greater outside peak times when there is less congestion on the M4 Motorway.

Figure 4-3 also shows changes in the combined M4 Motorway and Parramatta Road volumes in the year in which the toll was removed. The traffic passing the M4 Motorway toll plaza or nearby on Parramatta Road grew by nine percent in the morning peak and by four per cent in the evening peak. The toll seems likely to have influenced this outcome so it is reasonable to assume that the toll was causing vehicles that would have otherwise used the M4 Motorway or Parramatta Road to use alternatives such as Victoria Road.

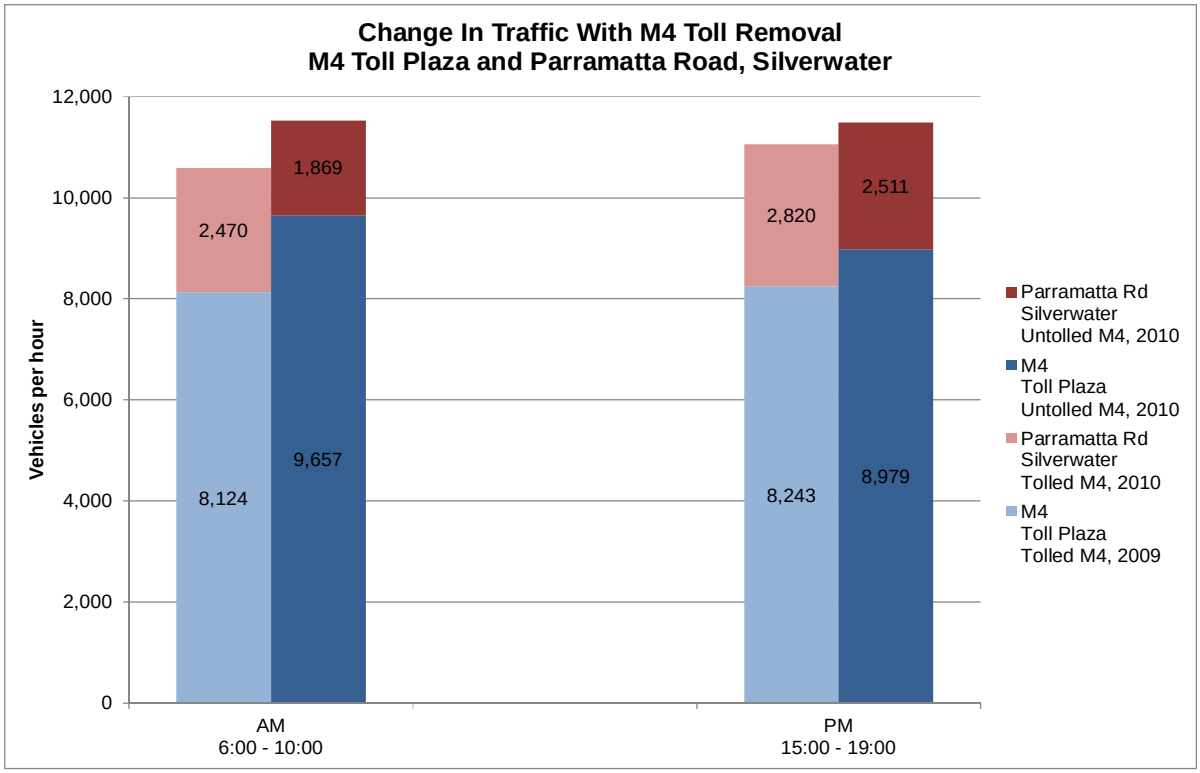

Figure 4-3: Change in M4 Motorway/Parramatta Road corridor traffic with the removal of the toll

Source: WDA, 2014
Note: The M4 Motorway data used for this figure is the same as that used for Figure 4-1 and Figure 4-2. The Parramatta Road data with the tolled M4 Motorway is an average for the week prior to the toll removal. The Parramatta Road data with the untolled M4 Motorway was obtained from seven school days dispersed between August and November 2010.

4.1.2 Road network and corridor performance

Five scenarios have been explored through the development of specific modelled scenarios, reflecting various future travel demands. The scenarios comprised differing levels of infrastructure provision within the model for the various modelled demand years. The scenarios examined were modelled in the WestConnex Road Traffic Model (WRTM) by combining future year demands with future networks. Traffic was assigned using the calibrated road assignment model, suitably accounting for changes in toll choice behaviour over time. The modelled scenarios are defined in **Section 1.7.1**.

Figure 4-4 is based on model data and shows the traffic on the M4 Motorway in the Existing case at the toll plaza and nearby on Parramatta Road at Duck River. It demonstrates that the M4 Motorway and Parramatta Road are busy thoroughfares throughout the day and that the morning and evening peaks are similar in size.

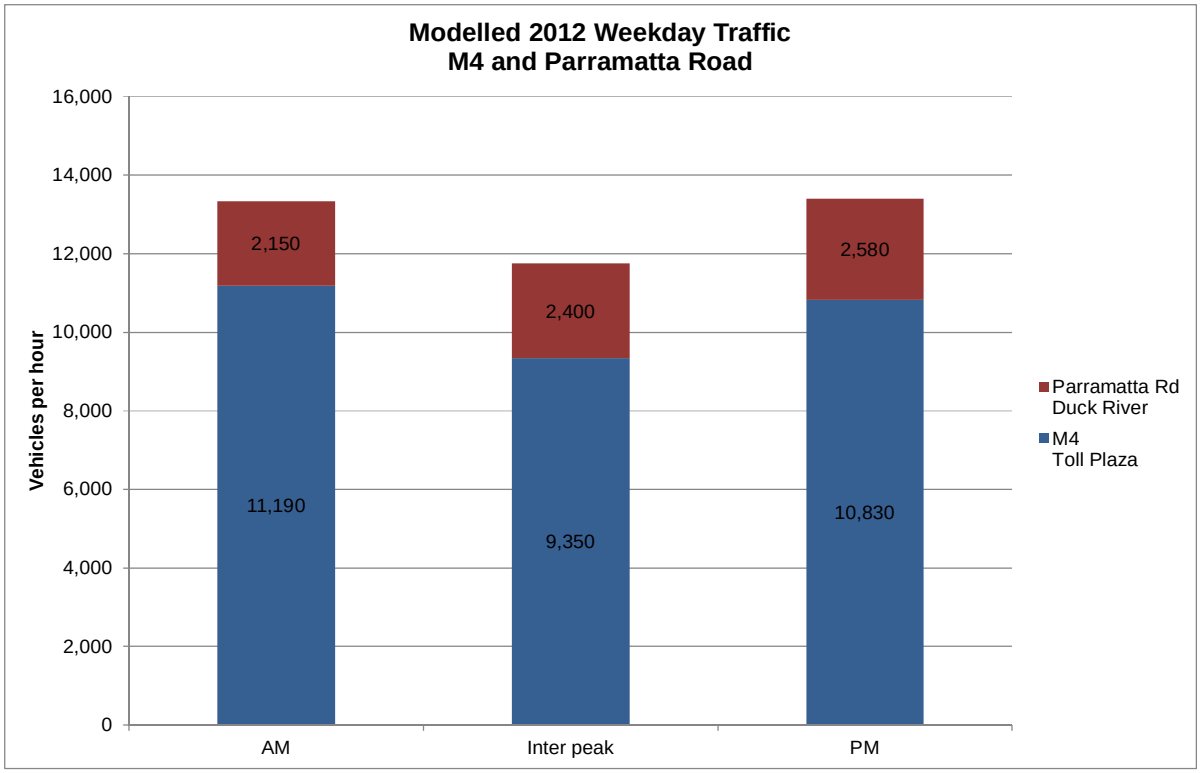

Figure 4-4: Weekday modelled traffic (2012) on the M4 Motorway and Parramatta Road

Source: Jacobs SKM WestConnex Road Traffic Model, 2014
Note: This figure is not directly comparable to Figure 4-3 as the historical data used in Figure 4-3 is aggregated into morning and evening peak time periods that are different to that used in the model.

Network performance

The existing and anticipated performance of the road network across Sydney and in the M4 Motorway corridor is detailed in this chapter and **Chapter 6** respectively. The performance of the Sydney road network as a whole is summarised in **Table 4-1**.

Table 4-1: Sydney road network performance, Existing case and 'do minimum' scenarios

'Do minimum' scenario	Vehicle kilometres travelled (millions)	Vehicle hours travelled (millions)
Existing case (2012)	93	2.7
Base 'do minimum' (2021)	108 (+16% from 2012)	3.5 (+30% from Existing case)
Future 'do minimum' (2031)	126 (+35% from 2012)	4.7 (+76% from Existing case)

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

Table 4-1 demonstrates that overall demand on the Sydney road network is set to continue to grow strongly. The impact of this on travel times is summarised in **Figure 4-5**.

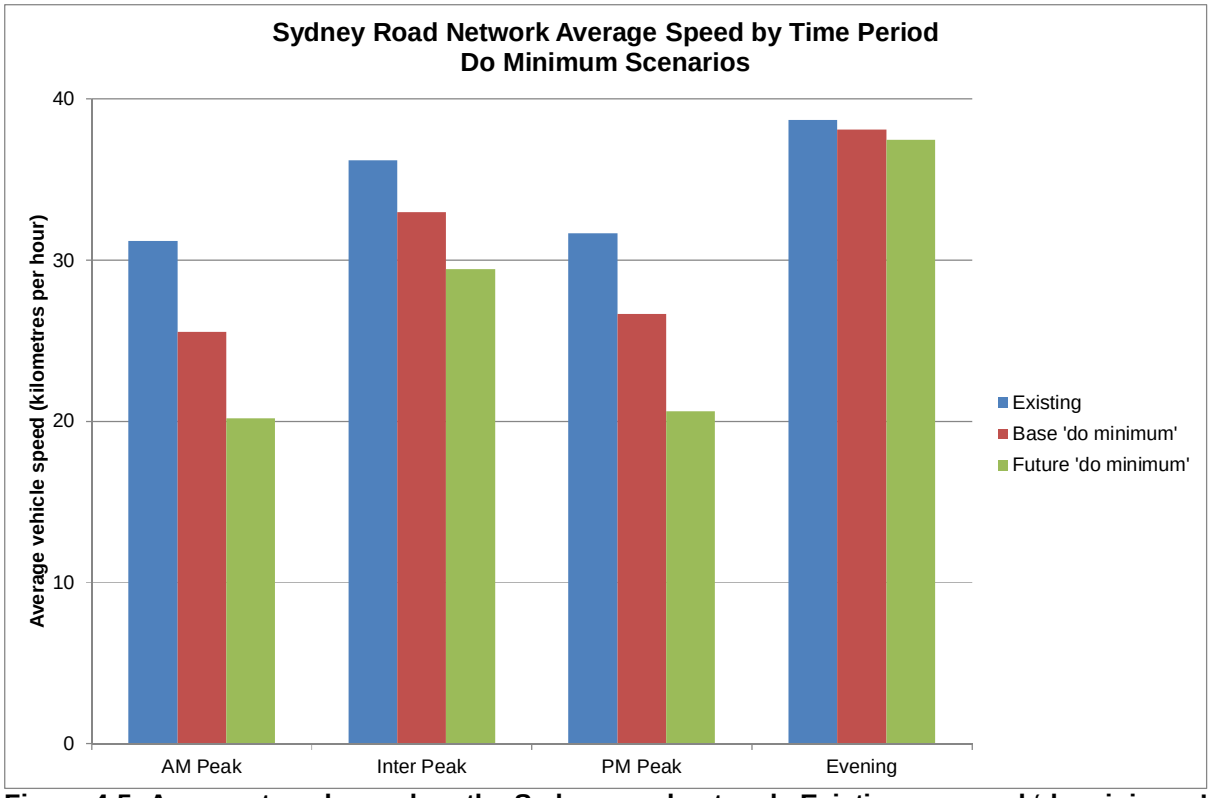

Figure 4-5: Average travel speed on the Sydney road network, Existing case and 'do minimum' scenarios

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

The values represented in **Figure 4-5** were calculated by determining the total number of kilometres travelled by all vehicles across the network and dividing that value by the total number of hours spent travelling. It shows a severe degradation in travel speeds on Sydney's road network. It should be noted that travel speeds in the inter peak period are anticipated to be slower in the Future 'do minimum' scenario than during peak periods in the Existing case.

Corridor performance

The growth in the use of the M4 Motorway corridor is summarised in **Table 4-2**.

Table 4-2: Annual vehicle kilometres travelled (millions) in the M4 Motorway corridor between Church Street and Homebush Bay Drive

Road	Existing case (2012)	Base 'do minimum' (2021)	Future 'do minimum' (2031)
M4 Motorway	413	447 (+8% from Existing case)	483 (+17% from Existing case)
Parramatta Road	67	81 (+20% from Existing case)	94 (+40% from Existing case)

Source: WestConnex Road Traffic Model, 2014

Parramatta Road is expected to experience much stronger growth than the M4 Motorway. While there would be a number contributing factors, including changing land use, the biggest factor would be congestion on the M4 Motorway. This is demonstrated in **Figure 4-6**, which shows growth in corridor travel times. Eastbound Parramatta Road and M4 Motorway travel times are near parity in the Future 'do minimum' scenario.

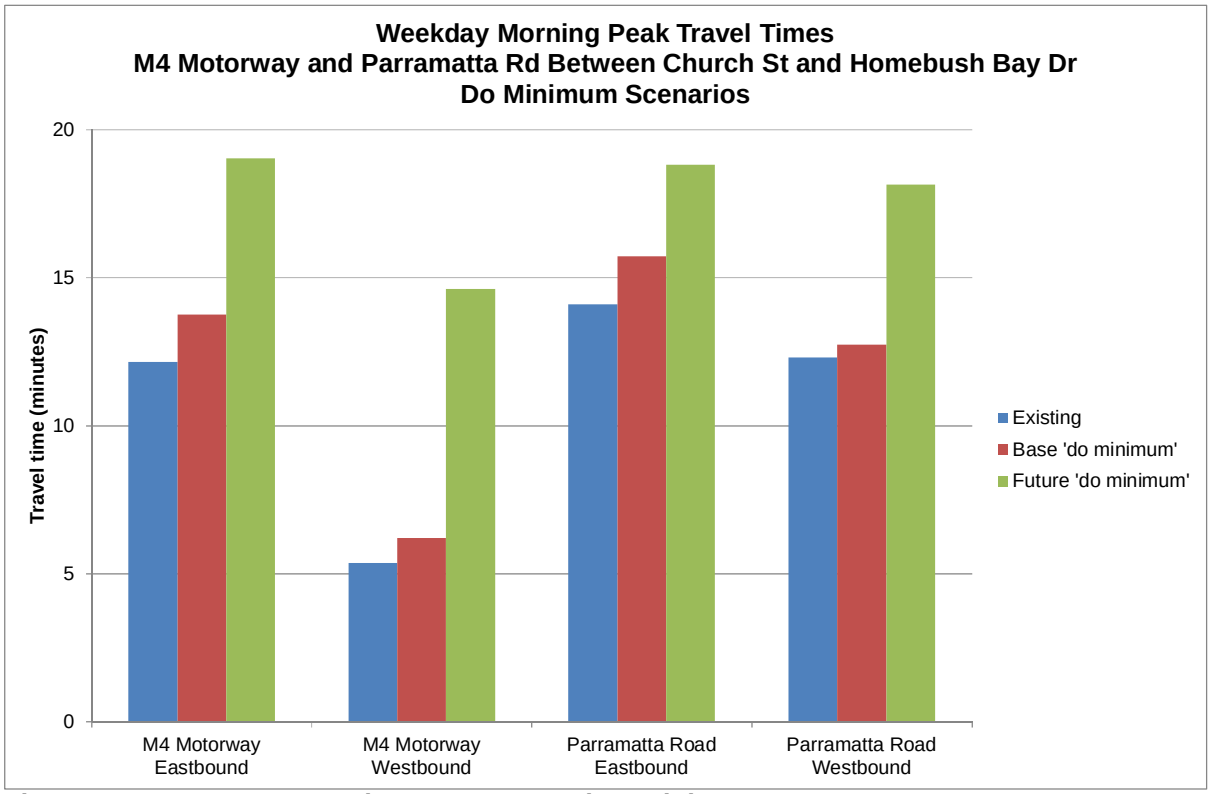

Figure 4-6: M4 Motorway and Parramatta Road travel times

Source: WestConnex Road Traffic Model, 2014

4.1.3 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 while recording location data with a global positioning system device. **Figure 4-7** and **Figure 4-8** show the average travel speeds recorded along various segments of the M4 Motorway during different time intervals.

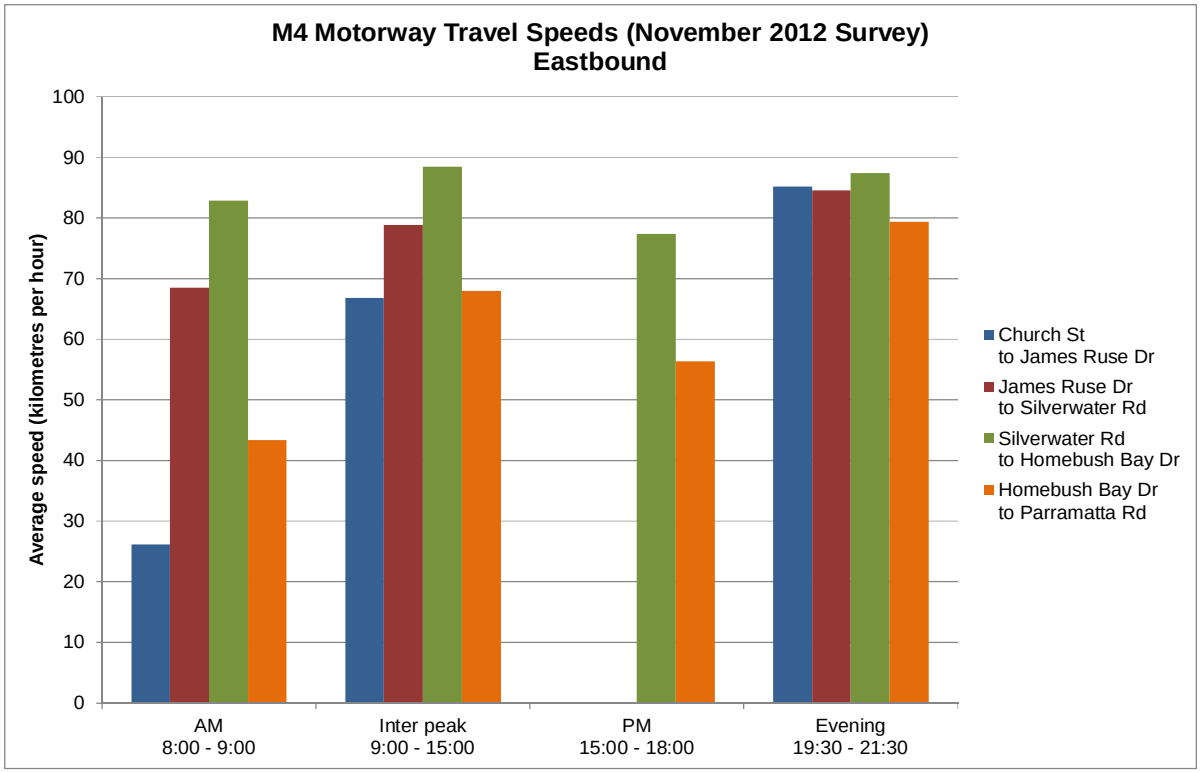

Figure 4-7: M4 Motorway travel speeds, eastbound

Source: Austraffic survey data, 2012

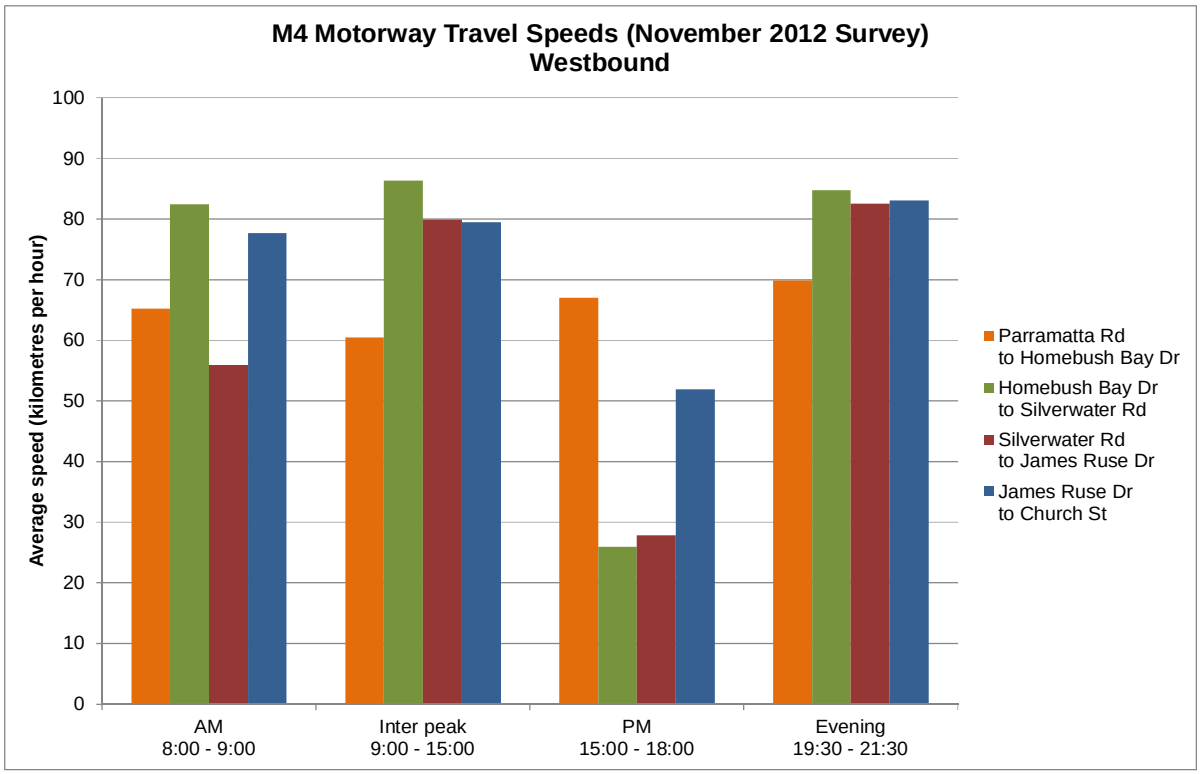

Figure 4-8: M4 Motorway travel speeds, westbound

Source: Austraffic survey data, 2012

The time periods that were used to aggregate the data are described in **Table 4-3**. These were chosen to reflect the model time periods and to take into account the following events that occurred during the survey:

- A breakdown on the M4 Motorway that affected eastbound traffic between 6.15 am and 6.42 am.
- A crash near the James Ruse Drive off-ramp between 4.29 pm and 4.53 pm
- Roadwork between Church Street and Silverwater Road with an associated reduced roadwork speed limit of 70 kilometres per hour between 9.30 pm and 9.43 pm.

Eastbound travel time observations between Church Street and Silverwater Road in the evening peak were omitted from the data shown in **Figure 4-7** due to the crash near James Ruse Drive off-ramp.

Table 4-3: Survey time periods

Time period	Hours
Morning peak	8.00 am to 9.00 am (eastbound), 7.00 am to 9.00 am (westbound)
Inter peak	9.00 am to 3.00 pm
Evening peak	3.00 pm to 6.00 pm
Evening	7.30 pm to 9.30 pm

Figure 4-7 shows congestion in the morning peak in the eastbound direction, particularly between Church Street and James Ruse Drive. The segment between Homebush Bay Drive and Parramatta Road shows heavy delays which are most likely attributable to congestion on Parramatta Road. Also apparent is congestion during the day and in the evening peak.

Figure 4-8 shows low travel speeds in the evening peak in the westbound direction between Silverwater Road and James Ruse Drive. It also shows that there is some congestion in the morning peak in the westbound direction.

4.1.4 Travel times

The travel speed surveys undertaken in November 2012 also provided information about travel times for M4 Motorway journeys. These are shown in **Figure 4-9** and **Figure 4-10** using the time periods detailed in **Table 4-3**.

Eastbound travel time observations between Church Street and Silverwater Road in the morning peak were omitted from the data shown in **Figure 4-9** due to the vehicle breakdown on the M4 Motorway that affected eastbound traffic between 6.15 am and 6.42 am.

Of note in **Figure 4-9** is the particularly large spike in the travel time in the evening peak from Homebush Bay Drive to James Ruse Drive.

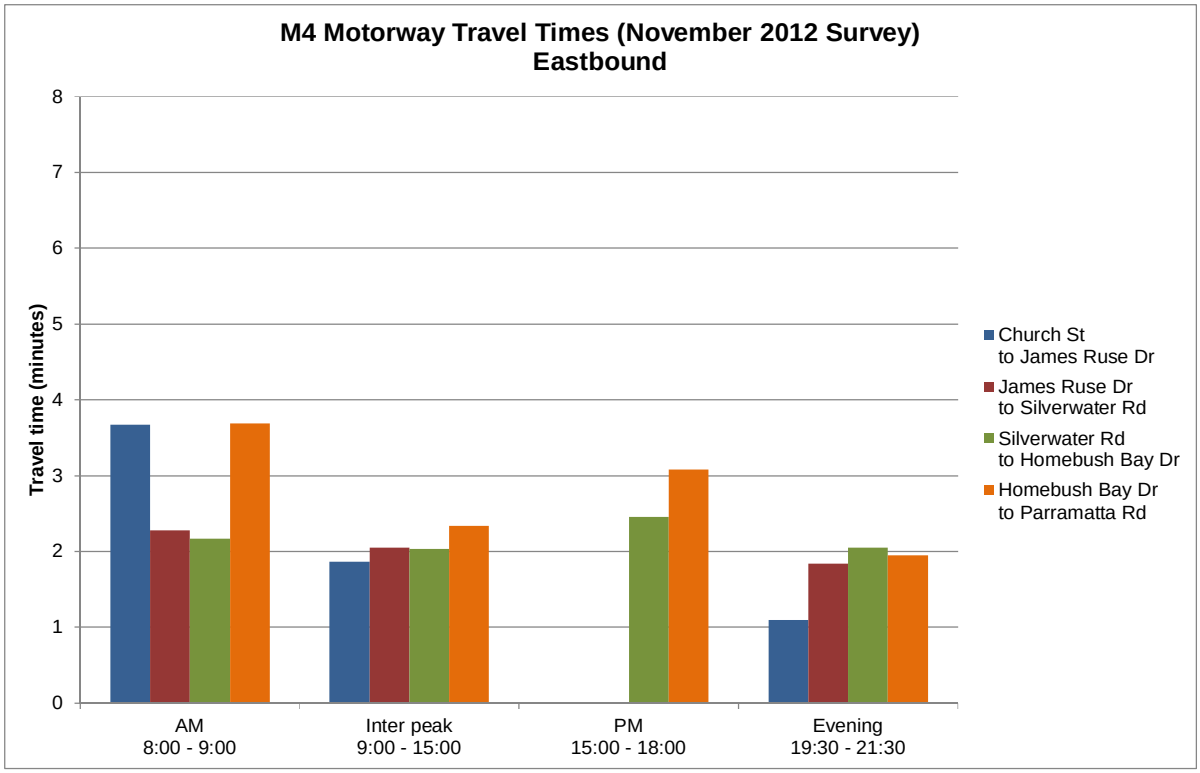

Figure 4-9: M4 Motorway travel times, eastbound

Source: Austraffic survey data, 2012

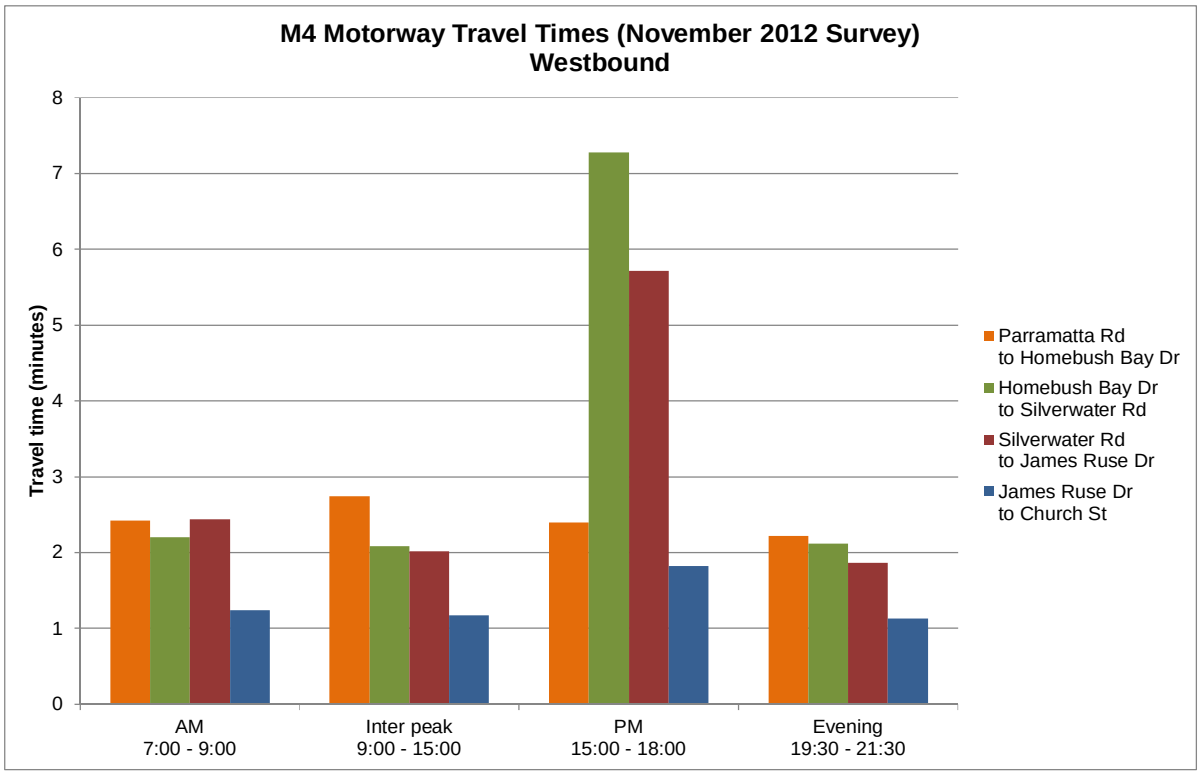

Figure 4-10: M4 Motorway travel times, westbound

Source: Austraffic survey data, 2012

4.1.5 Traffic summary

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. Travel speeds vary along the existing M4 Motorway, reflecting significant congestion points during the peak periods, particularly at James Ruse Drive and Homebush Bay Drive.

Travel times along the M4 Motorway between Church Street and Homebush Bay Drive are typically 15 minutes eastbound during the morning peak period, however can increase up to 25 minutes with disrupted flow. Westbound travel time is typically 23 minutes during the evening peak period and eight minutes during the inter peak period.

4.2 Network capacity and level of service

Network congestion can be defined as occurring when demand exceeds capacity, so the volume over capacity (VoC) ratio of a road segment can be used as a congestion indicator. A section of road is heavily congested when the VoC ratio is greater than 1.0 and is uncongested when the VoC ratio is less than 0.7.

The model has been used to compute the VoC ratio for various road segments in Sydney using theoretical lane capacities and computed segment volumes. This ratio is plotted on maps in **Figure 4-11** and **Figure 4-12**, where the most congested road segments (those with a VoC greater than 1.0) are coloured in red and relatively uncongested links (those with a VoC less than 0.7) are coloured in green. As can be seen in the figures below, 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 associated on- and off-ramps, are currently congested.

Eastbound travel along the M4 Motorway during the morning peak is dominated by this excessive congestion. The M2 Motorway also exhibits congestion; however, widening works have recently been completed to address this. The M5 East Motorway also exhibits congestion, which will be addressed by the M5 component of the WestConnex scheme.

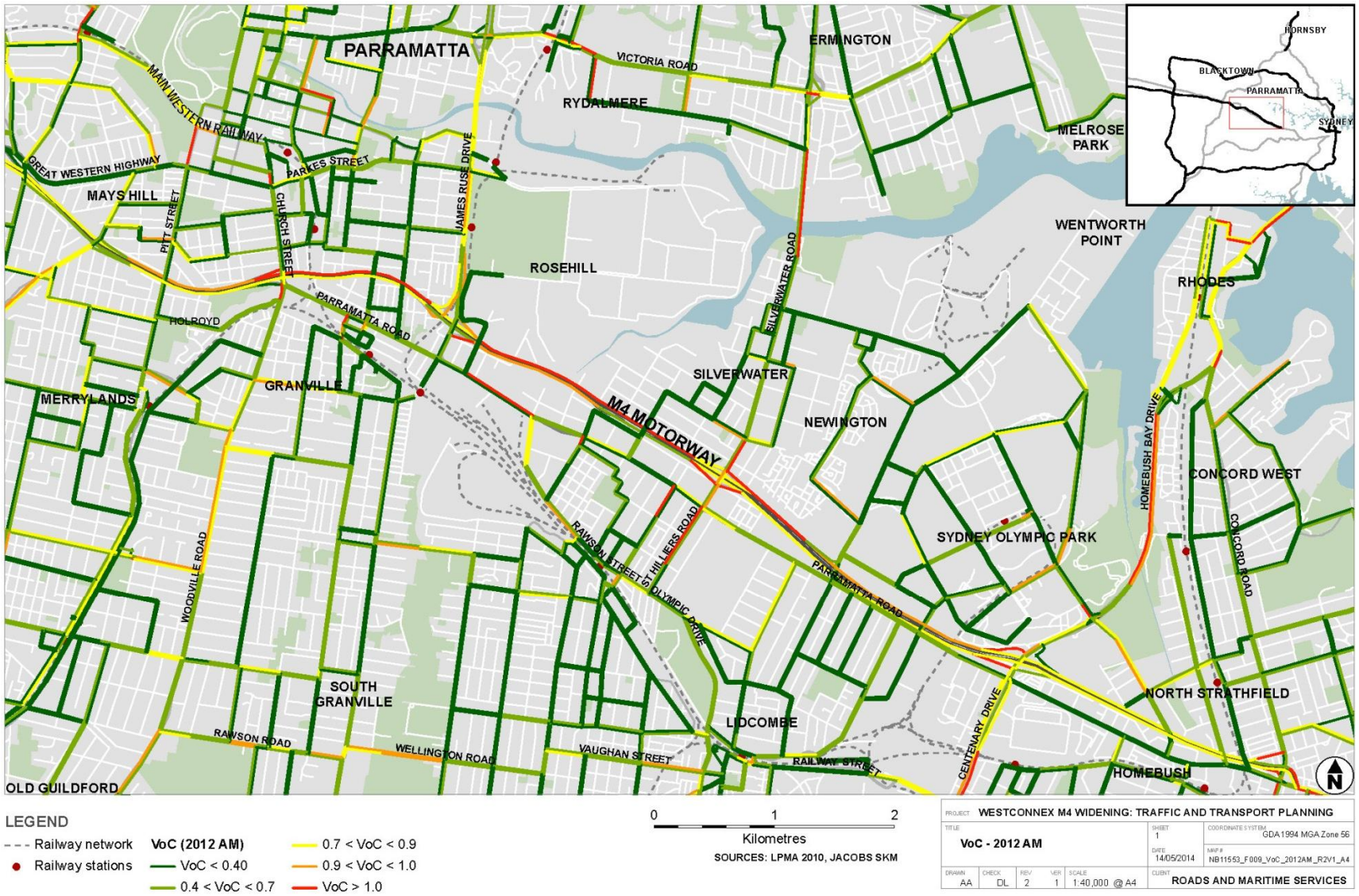

Figure 4-11: Volume over capacity map, morning peak

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

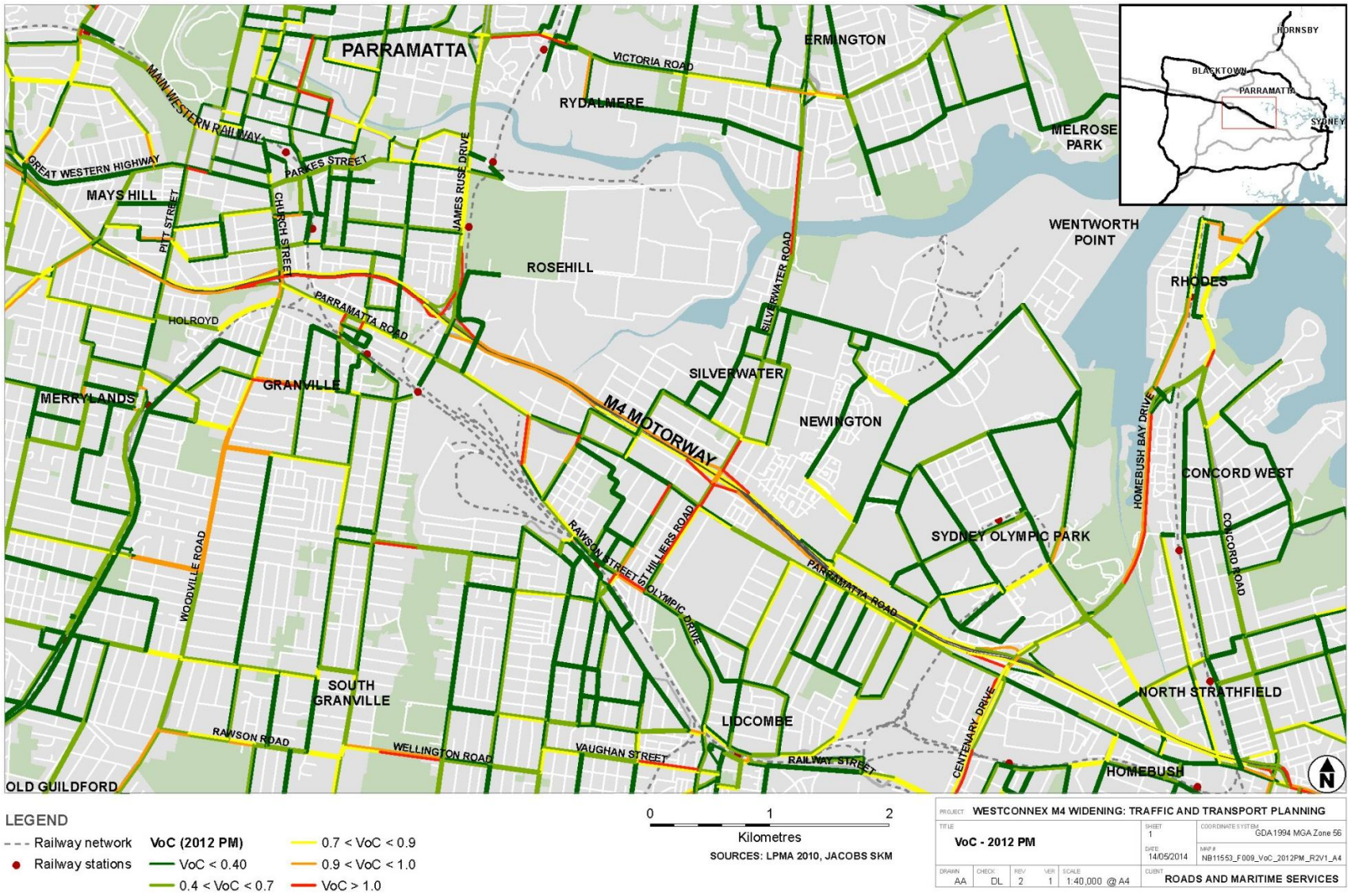

Figure 4-12: Volume over capacity map, evening peak

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

4.3 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. These have been analysed in the following sections. The purpose of assessing existing interchange and intersection performance was to develop a base line against which the impacts of the M4 Widening project on the adjacent road network could be compared.

The assessment of interchange and intersection performance was undertaken using the following traffic modelling software:

- SIDRA Intersection (version 6) – SIDRA Intersection is a micro-analytical tool for the evaluation of intersection performance mainly in terms of capacity, level of service (LoS) and a wide range of other performance measures such as delay, queue length and stops for vehicles and pedestrians, as well as fuel consumption, pollutant emissions and operating cost. It can be used as an aid for design and evaluation of fixed-time/pre-timed and actuated signalised intersections, signalised pedestrian crossings, signalised single point interchanges, roundabouts, roundabout metering, two-way stop sign control, all-way stop sign control, and give-way/yield sign-control.
- LinSig (version 3) – LinSig is a macro-simulation model capable of modelling isolated or coordinated networks of traffic intersections. It is able to assess performance at individual intersections and at network level for existing or future year design options. To limit the level of complexity and to allow faster calculation of results, it uses a traffic flow model that considers platoons of vehicles rather than individual units. Provided all signalised intersections in a network operate on the same cycle time the pattern of traffic arrivals, departures and queues at an intersection stop line will be very similar during each cycle. LinSig is able to propagate these platoons of traffic through a road network to enable calculation of network performance statistics. LinSig is then able to optimise traffic signal timings for the network so that the level of delay is minimised or traffic capacity is maximised.

The critical elements of the assessment of existing conditions are intersection LoS and the traffic queue on the most affected leg of the intersection. Individual intersections have been assessed using SIDRA Intersection; however, wherever intersections form part of closely spaced networks and their operation is likely to be influenced by adjacent intersections the assessment has been undertaken using LinSig.

Detailed vehicle classification and turning count surveys were undertaken on 24 October 2012. This data was used to develop the intersection models of existing operational performance. The intersection models were calibrated and validated against observations of current operational performance demonstrated by the length of queues on the approaches to the intersections.

Some care is required in interpreting model results particularly in relation to reported queue lengths as these have been expressed as vehicles rather than passenger car units (pcus). Queue lengths should be increased at locations with a higher proportion of trucks in the overall traffic stream.

The models have relied upon measured traffic volumes at the stop line and have taken no account of actual demand attempting to make that movement which means that modelled queues may be lower than experienced in reality on the most congested approaches.

Only localised congestion is reflected in the existing models (so that models can be used for future assessment of localised congestion), these models have been established with no account for downstream blocking-back effects. This means that modelled queue lengths and delays are not impacted by these downstream congestion effects and will result in an apparent under-reporting of queue lengths and delays at affected locations when compared to on the ground observations.

The assessment of interchange and intersection performance is based on criteria outlined in **Table 4-4**, as defined by *Guide to Traffic Generating Developments* (Roads and Traffic Authority 2002). 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.

Table 4-4: Level of service criteria for intersections

Level of service	Average delay per vehicle (seconds)	Traffic signals	Roundabout, 'Give Way' and 'Stop' signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity. At signals, incidents will cause delays	At capacity, requires other control mode
F	Greater than 70	Demand exceeds capacity. Unstable traffic flow. Extra capacity required	Extreme delay, traffic signal or other major treatment required

Source: Roads and Traffic Authority, *Guide to Traffic Generating Developments,* 2002

4.3.1 Granville

The following intersections in Granville were assessed in determining existing interchange and intersection performance:

- Church Street/M4 Motorway eastbound off-ramp.
- Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp.
- Parramatta Road/Bold Street.
- Parramatta Road/Good Street.

These intersections are shown in **Figure 4-13**.

Figure 4-13: Intersections that have been assessed in Granville

Source: AUSIMAGE, 2011

Table 4-5 shows the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from a combination of intersection turning volume surveys and counts obtained from detectors at traffic signals.

The Parramatta Road/Good Street intersection operates satisfactorily in the morning peak and both the Parramatta Road/Bold Street and Parramatta Road/Good Street intersections operate satisfactorily in the evening peak. The longest queue during the morning and evening peaks occurs on the southern Woodville Road approach to the Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp intersection.

Table 4-5: Existing interchange and intersection operation, 2013

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
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

4.3.2 Clyde and Rosehill

The following intersections in Clyde and Rosehill were assessed in determining existing interchange and intersection performance:

- James Ruse Drive/Prospect Street.
- James Ruse Drive/M4 Motorway eastbound on-ramp.
- James Ruse Drive/M4 Motorway westbound off-ramp.
- James Ruse Drive/Parramatta Road/Berry Street.

These intersections are shown in **Figure 4-14**.

Figure 4-14: Intersections that have been assessed in Clyde and Rosehill

Source: AUSIMAGE, 2011

Table 4-6 shows the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from a combination of intersection turning volume surveys and counts obtained from detectors at traffic signals.

All intersections overall operate satisfactorily during the morning peak, however, the southbound left turn movement from James Ruse Drive to the eastbound on-ramp of the M4 Motorway is approaching capacity and experiences delays resulting in a LoS of D in both peaks. This delay is due to congestion on the motorway itself which inhibits the rate at which traffic can join the motorway from James Ruse Drive.

The James Ruse Drive/Prospect Street intersection is operating near capacity during the evening peak and has the longest queue in both peaks (northern approach).

Table 4-6: Existing interchange and intersection operation, 2013

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
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

4.3.3 Auburn

The following intersections in Auburn were assessed in determining existing interchange and intersection performance:

- Parramatta Road/Rawson Street/Duck Street.
- Silverwater Road/Carnarvon Street.
- Silverwater Road/M4 Motorway eastbound ramps.
- Silverwater Road/M4 Motorway westbound ramps.
- Silverwater Road/Parramatta Road.

These intersections are shown in **Figure 4-15**.

Figure 4-15: Intersections that have been assessed in Auburn

Source: AUSIMAGE, 2011

Table 4-7 shows the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from a combination of intersection turning volume surveys and counts obtained from detectors at traffic signals.

The results show that none of the intersections along Silverwater Road operate satisfactorily in either peak. The longest queue during the morning and evening peaks occurs on the southern approach to the Silverwater Road/Carnarvon Street intersection. The Parramatta Road/Rawson Street/Duck Street intersection has the longest queue in both peaks at the western approach.

Table 4-7: Existing interchange and intersection operation, 2013

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
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

4.3.4 Lidcombe and Sydney Olympic Park

The following intersections in Lidcombe and Sydney Olympic Park were assessed in determining existing interchange and intersection performance:

- Parramatta Road/John Street.
- Parramatta Road/Hill Road/Bombay Street.
- Hill Road/M4 Motorway eastbound off-ramp.
- Hill Road/Carter Street.
- Hill Road/John Ian Wing Parade.

These intersections are shown in **Figure 4-16**.

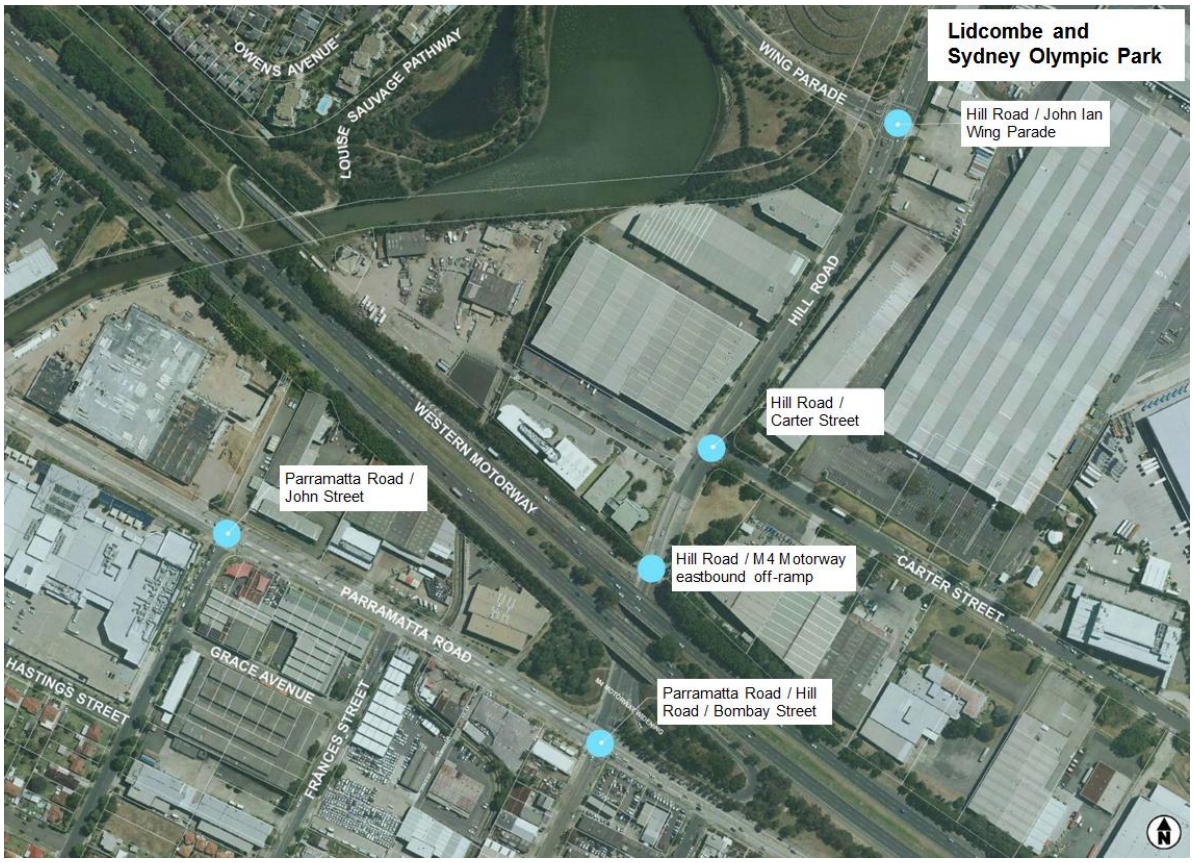

Figure 4-16: Intersections that have been assessed in Lidcombe and Sydney Olympic Park

Source: AUSIMAGE, 2011

Table **4-8** shows the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from a combination of intersection turning volume surveys and counts obtained from detectors at traffic signals.

The Hill Road/M4 Motorway ramps intersection operates at capacity in the morning peak indicated by its operational performance, LoS E. On-site observations show that the off-ramp queues back onto the main carriageway of the motorway in the morning peak. This queuing is a result of the off-ramp's inability to discharge left turning traffic into Hill Road due to traffic waiting to turn right from Hill Road into Carter Street which is in close proximity to the off-

ramp intersection. Both the Hill Road/M4 Motorway ramps and the Hill Road/Carter Street intersections are priority controlled requiring vehicles to give way to conflicting movements.

The Parramatta Road/Hill Road/Bombay Street intersection operates close to its capacity during both peaks. The longest queue during the morning peak occurs on the eastern Parramatta Road approach to the Parramatta Road/Hill Road/Bombay Street intersection. The longest queue during the evening peak occurs on the eastern approach to the Parramatta Road/John Street intersection with a queue of similar length occurring on the western approach to the Parramatta Road/Hill Road/Bombay Street intersection.

Table 4-8: Existing interchange and intersection operation, 2013

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
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

4.3.5 Homebush West and Strathfield

The following intersections in Homebush West and Strathfield were assessed in determining existing interchange and intersection performance:

- Homebush Bay Drive/M4 Motorway eastbound on-ramp.
- Homebush Bay Drive/M4 Motorway eastbound off-ramp.
- Centenary Drive/M4 Motorway westbound ramps.

These intersections are shown in **Figure 4-17**.

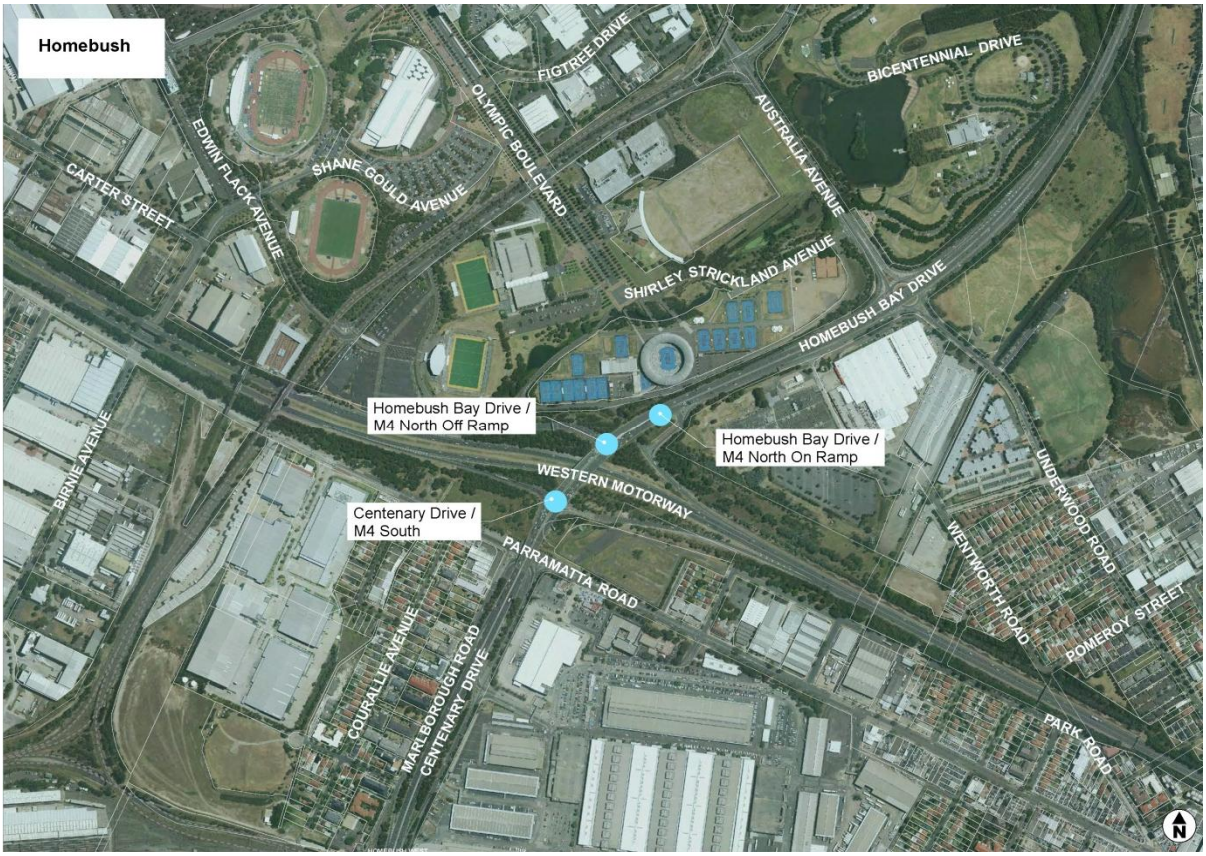

Figure 4-17: Intersections that have been assessed in Homebush West and Strathfield

Source: AUSIMAGE, 2011

Table 4-9 shows the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from a combination of intersection turning volume surveys and counts obtained from detectors at traffic signals.

The intersections of Centenary Drive/M4 Motorway westbound ramps and Homebush Bay Drive/M4 Motorway eastbound off-ramp are operating at or close to capacity during both peaks. In the morning peak the longest queue occurs on the southern approach to the Centenary Drive/M4 Motorway westbound ramps intersection. In the evening peak all three intersections experience similar queue lengths.

Table 4-9: Existing interchange and intersection operation, 2013

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
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

4.3.6 North Strathfield and Strathfield

The following intersections in North Strathfield and Strathfield were assessed in determining existing interchange and intersection performance:

- Parramatta Road/Concord Road/Leicester Avenue.
- Parramatta Road/M4 Motorway.
- Parramatta Road/Mosely Street.
- Concord Road/Sydney Street.

These intersections are shown in **Figure 4-18**.

Figure 4-18: Intersections that have been assessed in North Strathfield and Strathfield

Source: AUSIMAGE, 2011

Table 4-10 shows the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from a combination of intersection turning volume surveys and counts obtained from detectors at traffic signals.

The Parramatta Road/Concord Road/Leicester Avenue and Parramatta Road/M4 Motorway intersections are operating above capacity in both peaks. In the morning the longest queue is at the western approach to the Parramatta Road/Mosely Street intersection. In the evening peak the longest queue is at the eastern approach to the Parramatta Road/M4 Motorway intersection.

Table 4-10: Existing interchange and intersection operation, 2013

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
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

4.3.7 Queuing at M4 Motorway off-ramps

Further to the discussion in **Section 1.3**, relating to the effect of the toll on the M4 Motorway, and specifically the discussion around the effects of toll avoidance, the existing queue lengths of each of the motorway off-ramps has been evaluated reflecting the current situation with no toll in place. The results are presented in **Table 4-11**.

Queuing of traffic exiting the motorway is determined by the ability of the intersections that form the interchange to discharge traffic onto the surrounding road network and is a critical factor in the operational efficiency of any motorway. If the queue from the arterial road intersection becomes longer than the storage capacity of the off-ramp, the back of the queue will impact on the left hand through lane of the motorway. This impact will take the form of reduced capacity on the motorway leading to congestion and the potential to increase the number of rear-end type crashes.

The calculated queue lengths in **Table 4-11** indicate that the existing traffic volumes on the M4 Motorway do not generate queues which would extend beyond the storage capacity of the off-ramps. However, in reality the Hill Road eastbound off ramp queues back onto the main carriageway of the motorway most morning peaks. This is not reflected in the modelled values due to limitations in the software's ability to accurately reflect the interaction of closely spaced intersections. In this case the interaction between the left turn from the off-ramp and the right turn from Hill Road into Carter Street.

Notwithstanding the limitations in the analytical software described above, the same methodology will be employed to calculate the queue lengths of motorway off-ramps using future forecast demands so that a comparison with the calculated queue lengths reported in **Table 4-11** can be made and the relative impact assessed.

In addition, as discussed in **Section 1.3**, anecdotal evidence indicates that prior to the removal of the toll in 2010 a number of off-ramps, namely Silverwater Road westbound and Church Street eastbound did generate queues which were sufficiently long to exceed the available storage and extended into the through lanes of the motorway.

Table 4-11: Queue lengths at M4 Motorway off-ramps

Off-ramp	Morning peak queue length (metres)	Evening peak queue length (metres)
Cumberland Highway eastbound off-ramp	102	101
Cumberland Highway westbound off-ramp	87	96
Church Street eastbound off-ramp	96	220
James Ruse Drive eastbound off-ramp	263 (Ramp forms its own lane. Queue is measured from Prospect Street)	371 (Ramp forms its own lane. Queue is measured from Prospect Street)
James Ruse Drive westbound off-ramp	118	44
Silverwater Road eastbound off-ramp	124	70
Silverwater Road westbound off-ramp	75	46
Hill Road eastbound off-ramp	133	23
Homebush Bay Drive eastbound off-ramp	194	213
Homebush Bay Drive westbound off-ramp	74	52
End of the M4 Motorway at Parramatta Road	285	251

4.4 Road safety and crash history

This section presents an analysis of crashes that have occurred on the M4 Motorway or Parramatta Road between Parramatta and Homebush Bay Drive during the period July 2007 to June 2012. The data has been recorded by Roads and Maritime with all crashes conforming to the national guidelines for reporting and classifying road vehicle crashes. The main criteria for these crashes are:

- The crash was reported to police.
- The crash occurred on a road open to the public.
- The crash involved at least one moving vehicle.
- The crash involved at least one person being killed or injured or at least one motor vehicle being towed away.

Minor crashes where drivers exchange details are not required to be recorded and are not included in the crash data.

During the July 2007 to June 2012 period 946 crashes have been recorded on the M4 Motorway and 702 crashes on Parramatta Road.

4.4.1 M4 Motorway

Table 4-12 shows the number of crashes on the M4 Motorway by year. There was a sharp rise in crashes in 2010 as traffic increased following the removal of the toll in February 2010.

Table 4-12: Number of crashes on the M4 Motorway

Year	Number of crashes
2008	133
2009	152
2010	228
2011	244
Total	757

Table 4-13 shows the types of crashes that have occurred on the M4 Motorway during the period July 2007 to June 2012. Approximately two-thirds of crashes were rear end crashes, as is common on near-saturated roads where headways are relatively short. Most other crashes also occurred in traffic moving in the same direction, or from vehicles leaving the carriageway or losing control. This reflects the nature of limited-access dual carriageways, which largely prevents crashes involving pedestrians and traffic travelling in opposing directions.

Table 4-13: Types of crashes on the M4 Motorway

Type of crash	Number of crashes
Manoeuvring (parking, driveways, etc)	3
Object on path	30
Off-road or out of control	137
Opposing direction	2
Pedestrians	2
Rear end	650
Same direction (other than rear end)	133

Table 4-14 shows the severity of crashes that occurred on the M4 Motorway during the period July 2007 to June 2012. One fatal crash was recorded. Approximately two-thirds of reported crashes required towing only and injuries were involved in one-third. These results are indicative of a high standard, limited-access motorway which is engineered to ensure that the severity of crashes is limited.

Table 4-14: Severity of crashes on the M4 Motorway (July 2007 to June 2012)

Severity of crash	Number of crashes
Fatal	1
Injury	324
Non-casualty (tow-away)	621

Table 4-15 shows the location of crashes that occurred on the M4 Motorway during the period July 2007 to June 2012. Almost all crashes occurred mid-block, as would be expected due to the limited-access nature of the motorway.

Table 4-15: Location of crashes on the M4 Motorway

Location of crash	Number of crashes
Intersection	6
Mid-block	951

Table 4-16, **Figure 4-19** and **Figure 4-20** (refer below) are based on the subset of crash data for crashes that occurred in a two year period beginning 1 June 2010. This subset of data has been evaluated in order to reflect the operation of the M4 Motorway following the toll removal.

Table 4-16 shows crash rates along various sections of the M4 Motorway in a two year period beginning 1 June 2010.

The section of the M4 Motorway between Pitt Street and James Ruse Drive recorded 26 per cent more crashes with casualties per kilometre travelled than the other sections. This is likely to be due to the large number of vehicles entering and exiting the M4 Motorway through this section resulting in a significant amount of merging and weaving manoeuvres.

Table 4-16: Crash rates on each section of the M4 Motorway

Section	One-way length (kilometres)	Crashes per kilometre of road per year	Crashes with casualties per year	Crashes without casualties per year	Crashes with casualties per 100 million vehicle kilometres travelled	Crashes without casualties per 100 million vehicle kilometres travelled
Pitt Street to James Ruse Drive	1.9	39	26	47	23	41
James Ruse Drive to Silverwater Road	2.6	33	27	58	18	38
Silverwater Road to Homebush Bay Drive	3.0	29	31	55	18	32

Figure 4-19 and **Figure 4-20** show the temporal distribution of recorded M4 Motorway crashes on weekdays and weekends between Pitt Street and Homebush Bay Drive. Of note is that on weekdays there are substantially more crashes in the evening peak than the morning peak. On weekends crashes are most likely to occur between midday and 8.00 pm.

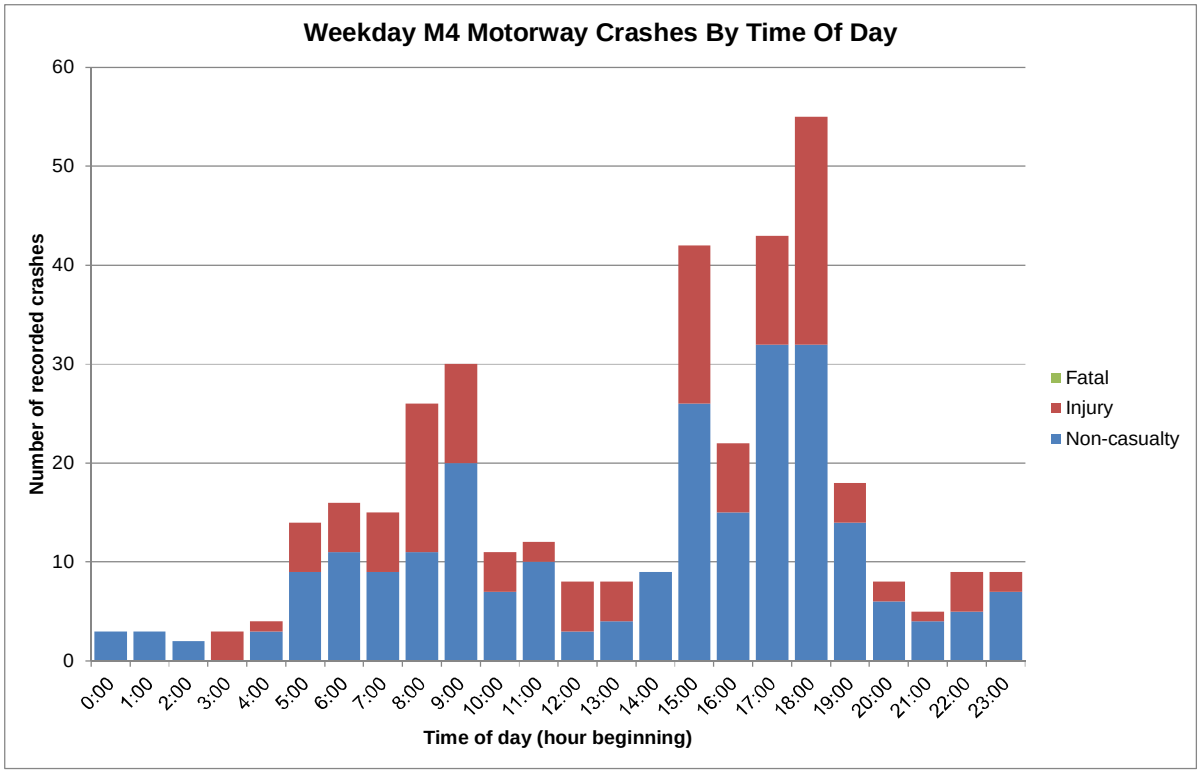

Figure 4-19: Weekday crashes on the M4 Motorway (Pitt Street to Homebush Bay Drive, 2010 to 2012)

Source: Roads and Maritime, 2013

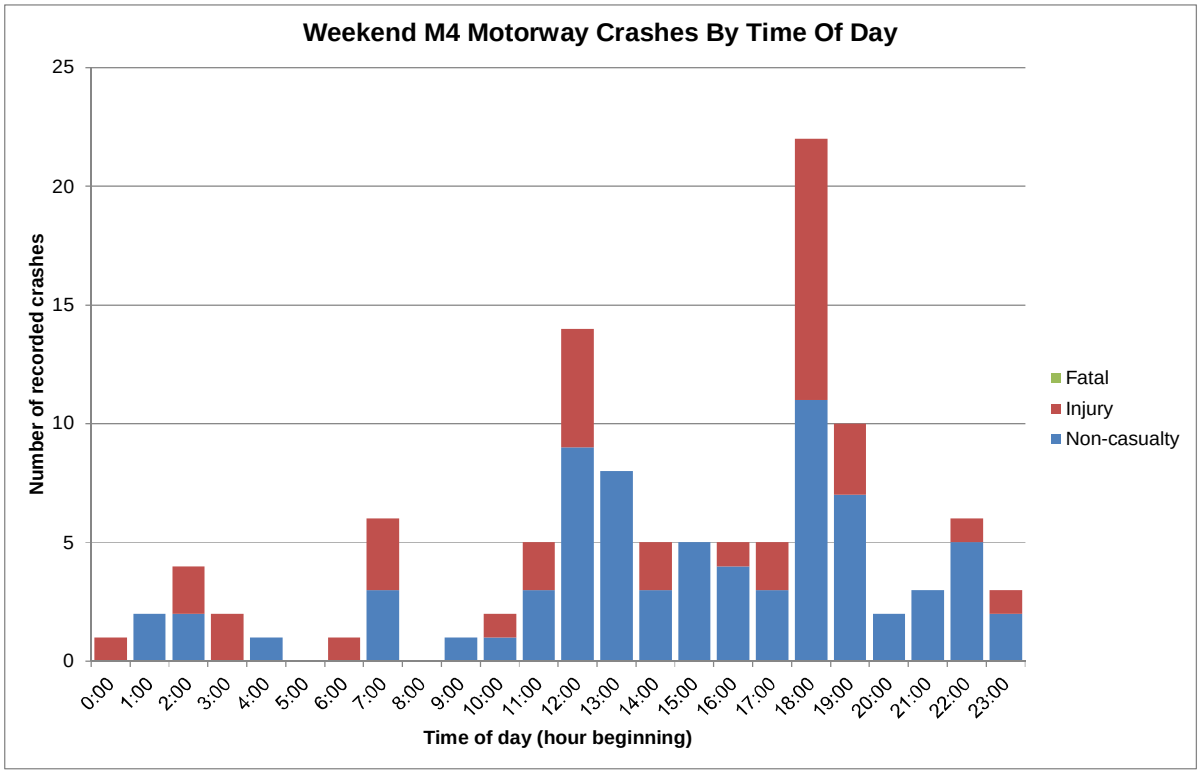

Figure 4-20: Weekend crashes on the M4 Motorway (Pitt Street to Homebush Bay Drive, 2010 to 2012)

Source: Roads and Maritime, 2013

4.4.2 Parramatta Road

Table 4-17 shows the number of crashes on Parramatta Road between Church Street and Homebush Bay Drive by year. There is a noticeable reduction in the number of crashes in 2010 following the removal of the toll on the M4 Motorway, which resulted in a reduction in traffic on Parramatta Road as motorists instead opted to use the motorway.

Table 4-17: Number of crashes on Parramatta Road (Church Street to Homebush Bay Drive)

Year	Number of crashes
2008	157
2009	158
2010	121
2011	122
Total	558

Table 4-18, **Figure 4-21** and **Figure 4-22** (refer below) are based off the subset of crash data for crashes that have occurred in a two year period beginning 1 June 2010. This has been done in order to reflect the operation of the M4 Motorway following the toll removal.

Table 4-18 shows crash rates along various sections of Parramatta Road.

The James Ruse Drive to Silverwater Road section of Parramatta Road recorded the greatest number of crashes. This section also recorded the highest crash rate. This section of Parramatta Road contains an at-grade rail level crossing controlled by traffic signals and boom gates. The operation of this rail level crossing adds to the congestion conditions through this section of the road.

Table 4-18: Crash rates on each section of Parramatta Road

Section	One-way length (kilometres)	Crashes per kilometres of road per year	Crashes with casualties per year	Crashes without casualties per year	Crashes with casualties per 100 million vehicle kilometres travelled	Crashes without casualties per 100 million vehicle kilometres travelled
Church Street to James Ruse Drive	1.4	37	25	28	126	144
James Ruse Drive to Silverwater Road	2.5	17	19	24	92	119
Silverwater Road to Homebush Bay Drive	2.9	11	15	18	51	61

Figure 4-21 and **Figure 4-22** show the temporal distribution of crashes on Parramatta Road between Church Street and Homebush Bay Drive on weekdays and weekends. Unlike the M4 Motorway, on weekdays the number of crashes involving injury is sustained throughout the day. On weekends, Parramatta Road experiences a peak in crashes and crash injuries between midday and 4.00 pm.

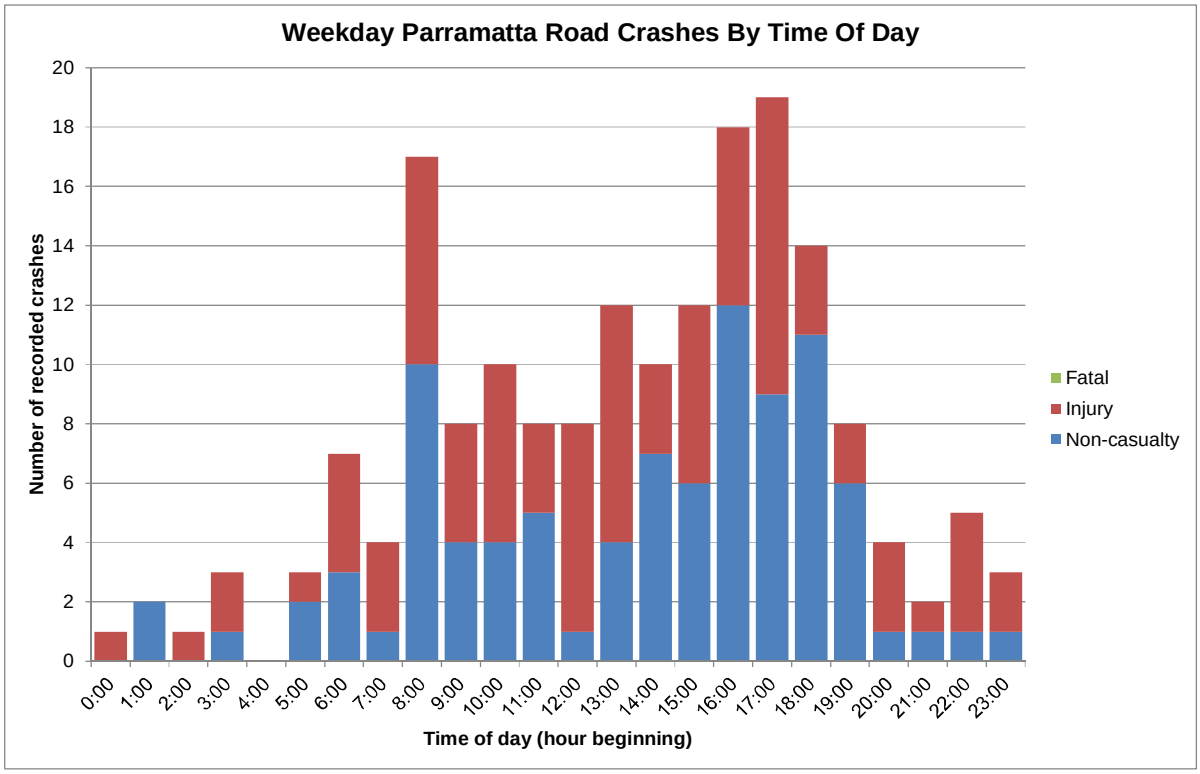

Figure 4-21: Weekday crashes on Parramatta Road (Church Street to Homebush Bay Drive, 2010 to 2012)

Source: Roads and Maritime, 2013

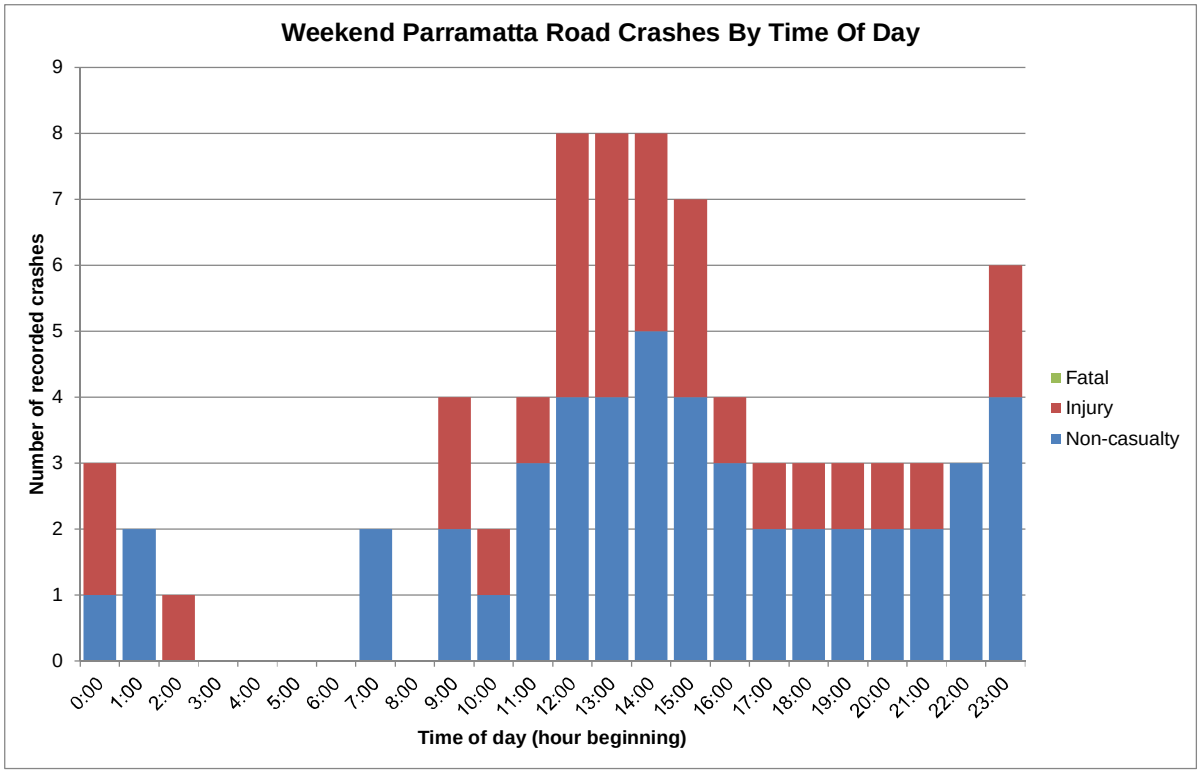

Figure 4-22: Weekend crashes on Parramatta Road (Church Street to Homebush Bay Drive, 2010 to 2012)

Source: Roads and Maritime, 2013

Table 4-19 shows the types of crashes that occurred on Parramatta Road during the period July 2007 to June 2012. The largest proportion of crashes were rear end crashes, due to heavy traffic, with other significant causes including vehicles colliding in opposing directions and from adjacent approaches at intersections. These types of crashes are typical for periodically congested urban arterial networks with relatively closely spaced signalised intersections.

Table 4-19: Types of crashes on Parramatta Road

Type of crash	Number of crashes
Adjacent approach at intersection	98
Manoeuvring (parking, driveways, etc)	17
Object on path	4
Off-road or out of control	28
Opposing direction	167
Pedestrians	20
Rear end	273
Same direction (other than rear end)	95

Table 4-20 shows the severity of crashes that occurred on Parramatta Road during the period July 2007 to June 2012. Similar to the M4 Motorway, one fatality was recorded, with 41 per cent involving an injury and the remainder requiring towing only.

Table 4-20: Severity of crashes on Parramatta Road

Severity of crash	Number of crashes
Fatal	1
Injury	291
Non-casualty (tow-away)	410

Table 4-21 shows the general location of crashes that occurred on Parramatta Road during the period July 2007 to June 2012. Unlike the M4 Motorway, most crashes occurred at intersections.

Table 4-21: Location of crashes on Parramatta Road

Location of crash	Number of crashes
Intersection	613
Mid-block	189

4.4.3 Summary

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).

5 Traffic forecasting approach

5.1 Introduction

The NSW Government, through the WestConnex Delivery Authority (WDA), engaged the Jacobs SKM-AECOM team to undertake the WestConnex traffic analysis study in support of the *WestConnex Business Case* (Sydney Motorways Project Office 2013a) process.

The purpose of this study was to develop a WestConnex Road Traffic Model (WRTM) to forecast traffic patronage and assess the most likely range of future traffic patronage across the WestConnex scheme network for the proposed franchise period. The WRTM is a regional strategic model considered suitable for demand analysis and future forecasting. It is not an operational model, therefore, to assess detailed impacts further analysis using operational modelling software is required (refer to **sections 4.3**, **6.7** and **7.4**). The WRTM was progressively developed as follows:

- Stream 1 of the WRTM was a fully functional toll choice model of similar design to the final WRTM however some parameters were adopted from recent studies undertaken in Brisbane as suitable data was not yet available for Sydney. This approach provided a functional model for use in the preliminary Business Case than would otherwise have been possible in the available time. The Stream 1 model was commenced in January 2013 and completed in April 2013 in time for use in the preliminary Business Case.
- The revisions made for the Stream 2 model essentially replaced the Brisbane parameters with Sydney data and refined transport networks and demands. Survey data for Sydney was collected between March and May 2013 to determine Sydney drivers' willingness to pay tolls (Value of Travel Time Surveys (VTTS)) and subsequently analysed to replace the Brisbane-based data initially used in Stream 1. Work was also undertaken to improve the model's performance with respect to matching observed traffic volume and travel times. The model is currently in the final stages of review by a Peer Review Committee that includes representatives from the WDA, transport planning specialists and academia. The reviewers have approved the use of the Stream 2 WRTM in this working paper. The Stream 2 model was used to produce the traffic and transport assessment as part of this working paper.

Traffic forecasts used for preparation of the M4 Widening Environmental Impact statement (EIS) were produced using the WRTM. The WRTM is a traffic model of metropolitan Sydney that has been specifically developed by (NSW) Roads and Maritime Services (Roads and Maritime) for the purpose of toll road traffic forecasting for the WestConnex scheme.

An integral part of the model development and application process was the involvement of independent expert peer reviewers providing review of model development, methodologies for the production of traffic forecasts and the traffic forecasts. The independent review committee included an independent expert Denis Johnston and Professor David Hensher of Sydney University Institute of Transport and Logistics Studies. These committee members are recognised experts in the field of toll road patronage forecasting and transport behavioural choice modelling.

The peer review committee were involved through the course of traffic model development and forecasting for M4 Widening, providing review and assurance for the traffic forecasting process.

5.2 Modelling approach

A sound approach to traffic demand modelling was undertaken for this study, including the following:

- A review of the currently available transport planning models and data was undertaken to determine the optimal models and data to provide an appropriate foundation for the WRTM.
- Available toll choice modelling techniques were assessed in the current Sydney context where multiple competing toll roads cover a substantial proportion of the developed Greater Sydney metropolitan area, known as the Sydney Statistical Division.
- Base and future population and employment data was sourced from the Bureau of Transport Statistics (BTS) (August 2012a release). The Sydney Strategic Transport Model (STM) data together with a previously developed model database provided by WDA have both been used as the starting point for the development of demand matrices using a matrix estimation process.
- Existing road infrastructure was reviewed for the base 2012 year and converted into a consistent format for representation in the WRTM. A set of future road infrastructure projects for the modelled Sydney metropolitan area for 2021 and 2031 was developed and agreed with Roads and Maritime and is consistent with its current funding and planning policies. These projects formed the basis for the base future networks modelled in WRTM.
- Project specific surveys of drivers' VTTS were undertaken to inform the toll choice modelling to enable the model best to reflect current driver behaviour in the specific context of the WestConnex scheme toll road facilities.
- The WRTM project model was developed and calibrated to current observed travel behaviour, then validated against 2012 Sydney-wide travel behaviour established in a series of traffic count and travel time surveys. It was then adjusted to reflect driver behaviour on Sydney's toll roads observed in the VTTS surveys. The model calibration and validation processes have maintained a specific focus and refinement in the WestConnex scheme study area. The WRTM comprises separate time period models for morning peak, evening peak, daytime off-peak and night-time off-peak.
- WestConnex scheme options, developed by WDA, were coded into the WRTM future year models.
- Future demands were developed by applying the WRTM with future year traffic growth assumptions sourced from the STM (that takes account of data like demographics and transport networks) to produce the most likely or Base Case scenario. Forecasts were produced by the WRTM for the years 2012, 2021 and 2031 to produce vehicle demands by toll class and time period for an average weekday at each year.

The WRTM patronage forecasting model developed for this project comprises two separate elements, the Base Demand Model (that is based on the STM with updates to incorporate more recent data) and the Toll Choice Assignment Model (an assignment module to incorporate toll choice behaviour). The role of each model element, and interaction between them, is discussed below.

The Base Demand Model has been developed using the STM with updated information used to produce improved travel demand matrices for detailed toll choice route assignment and project appraisal testing. This Base Demand Model provides the forecast capability to address changes in land use, trip distribution and mode choice and produces vehicle traffic demands for peak and off-peak periods for subsequent allocation to routes in the detailed toll choice assignment model.

The Toll Choice Assignment Model was developed to test impacts of toll and infrastructure strategies and provide infrastructure project traffic forecasts. The model is designed to forecast the traffic choosing to use toll and non-toll routes for the representative peak and inter-peak periods of the day.

Both models run in Emme, an internationally recognised transport modelling package, though much of the Base Demand Model development (i.e. the matrix estimation process) was undertaken using Cube software.

Available data was provided by WDA and Roads and Maritime and was initially used as primary inputs for the development of the WRTM including:

- Traffic volume counts provided by Roads and Maritime for screenlines and project specific counts.
- Road travel time surveys collected by Roads and Maritime for this project in December 2012. Travel times on the M4 have been discussed in **section 4.1.4**.
- Base 2011 and future years (2021 and 2031) vehicle demand matrices by travel purpose from the STM sourced from BTS in February 2013.
- Population and employment by small zone area provided by BTS consistent with demographics released by the (NSW) Department of Planning and Environment (August 2012 release).
- Toll plaza average day transaction data provided through WDA for many of the toll roads in Sydney, including the M5 Motorway, M7 Motorway, M2 Motorway and the Lane Cove Tunnel.
- Household travel survey data collected by BTS.
- Private car driver stated and revealed preference value of travel time survey data collected by Jacobs SKM for this study in early 2013.
- Commercial vehicle stated preference value of travel time survey data collected by Jacobs SKM in late 2012.
- Aerial photography collected in 2011 by Jacobs SKM for detailed auditing of road networks.
- Recently completed and future infrastructure project lists from WDA. The major projects assumed to be in place for the various years is given in **section 6.2**.
- Existing strategic models and data within the Sydney region from WDA.

The development of improved road traffic demand matrices was required for this study to provide a better performance for road traffic forecasting ability than the STM and particularly for the study area. The development of the base demand model included:

- Historical data analysis including collection of existing traffic volumes and existing travel time data across Sydney.
- VTTS analysis to investigate people's willingness to pay tolls to use toll roads based on project specific market research surveys.
- Annualisation and ramp-up assessments to develop the Average Annual Daily Traffic forecasts from the peak hour models.
- Development of improved road traffic demand matrices.
- Development of a Toll Choice Model for assigning road traffic to toll routes through the application of a toll choice diversion model, known as a distributed Value of Time (VOT) multi-class equilibrium assignment model.

To support the development of the WRTM, an investigation was undertaken into the various toll choice assignment methods in the Sydney and Australian context. Based on the assessment, it was determined that the WRTM toll choice model should adopt a distributed VOT multi-class equilibrium assignment methodology. The key reasons were:

- The methodology was considered a valid approach for the WRTM toll choice model for assessment of the WestConnex scheme. It would address the functional requirements of the project model with capabilities to consider a range of tolling strategies and scenario tests.
- Of the two methodologies considered, that approach would be more flexible as a multi-purpose approach for WDA and BTS to use in the assessment of the broader Sydney network.
- The approach appears to be emerging within the local market and has recently been used as the preferred modelling approach for a number of Australian toll roads.

Available data from a recent project in Brisbane for the Queensland Government was used for the private vehicle VTTS values for Stream 1. This data was supplemented by VTTS data from commercial vehicle surveys conducted by Jacobs SKM in Sydney in late 2012. The data collection and analysis methods were similar and compatible for these two VTTS studies.

To support the development of the WRTM toll choice model, further similar and compatible project specific VTTS surveys for private vehicles in Sydney were conducted in March and April 2013 to inform the toll choice modelling. Analysis of these surveys was not available for the Stream 1 delivery which was required for the Business Case in September 2013 but is included in Stream 2 modelling.

The WRTM toll choice model was constructed to directly model the range of driver behaviour and was adjusted to match the observed patronage on the existing toll facilities.

A series of validation checks was undertaken to verify the performance of both the base demand and toll choice models within the WRTM. Development of the Stream 2 model was undertaken in parallel to preliminary investigations using the Stream 1 model. The primary difference between the Stream 1 and Stream 2 model is the use of locally collected information on VTTS as opposed to the preliminary Brisbane information. Results from the Sydney private vehicle surveys showed that the toll choice parameters used were relatively similar to those used initially from the Brisbane data.

The data contained within this traffic and transport assessment has been taken from the Stream 2 model following assessment of the model calibration and validation by peer reviewers and agreement that the model is suitable for this purpose. At the time this assessment was undertaken, further work was being performed on the Stream 2 model to refine it further for use in final financial assessment and design.

5.3 Land use projections

This section summarises key demographic and land use inputs to the WRTM for both the base year 2012 (Existing case) models and each of the future year models (ie with and without M4 Widening and with and without the full WestConnex scheme). The WRTM is linked to the STM which includes the trip generation, trip distribution and mode choice modules and incorporates demographic data related to land uses including population, employment and education enrolment projections. For WRTM this data has been supplied by BTS as data extracts from the STM and is understood to have been based on the latest population and employment projections.

A summary of the policy context within which the demographic projections have been made is presented in **section 3.2**. A review of the demographic and land use inputs against these policies was then undertaken to test their integrity and suitability for use.

WDA established an Assumptions Review Group that has determined many of the basic parameters that have formed the basis of the development and forecasting process used by the WRTM. The Assumptions Review Group has prepared the *WestConnex Assumptions Book version 1.4* (WDA 2013) that presents the core assumptions and parameters adopted by the WRTM.

The WestConnex Assumptions Book confirmed the base demographic and land use information (Census year base) would be based on the December 2012 data release from BTS. This data has been projected from 2006 Census data and although a later release of the data was being prepared, it was not available for this assessment. The base vehicle demands from STM are consistent with this demographic assumption and therefore provide a consistent base for the future demands used in the WRTM.

It should be noted the BTS projections will be updated in future to reflect planning work being undertaken for the Carter Street and Wentworth Point Urban Activation Precincts and more broadly, concepts being developed through WestConnex revitalisation work on a land use and transport structure plan. This information was also not yet available for this assessment.

5.4 Induced demand and traffic assessment base case

An assessment of ‘induced demand’, ie additional traffic on the road network that might result from implementation of the project, was carried out by BTS using the STM that showed that no significant increase in overall road traffic demand was anticipated as a result of the project. Based on this assessment, the road traffic demands supplied earlier in the project were originally deemed suitable for use in future the project case modelling.

Subsequent investigations were undertaken using the Stream 2 WRTM to quantify the level of future road traffic growth in the M4 Widening/M4 East corridor as defined by modelled travel patterns of road traffic using the M4 Motorway and Parramatta Road at Duck Creek. The analysis indicated that the future road demands as sourced the STM showed no appreciable growth in this corridor in the period from 2012 to 2031.

Further investigations showed that the growth in transport demand in the M4 Motorway/Parramatta Road corridor over this period was forecast in STM to be carried by public transport resulting in little or no growth in car demand between 2012 and the 2021 and 2031 forecast years, despite growth in car travel demands across Sydney generally. While there were significant improvements assumed in public transport services in the M4 Motorway corridor for the future years within the STM the lack of road traffic demand was considered a counter-intuitive future demand case for assessment of the M4 Widening project.

For the purposes of this assessment, a demand case was constructed that adopted vehicle demand growth in the M4 Motorway/Parramatta Road catchment to match Sydney-wide growth at 1.6 per cent per annum compound growth between 2011 and 2021 and 1.2 per cent per annum compound growth between 2021 and 2031. This approach was agreed by the Peer Review Committee to be a suitable assumption and approach.

5.5 Examined scenarios

In considering the future, several scenarios need to be considered, reflecting the timeframe under which the project is likely to be delivered and the extent of other infrastructure developments. Five scenarios, as defined below in **section 5.5**, have been explored through development of specific modelled scenarios, reflecting various future travel demands.

Examined demand cases were represented by specific modelled forecast years:

- 2012 was adopted as the Existing case to correlate with the calibrated base year WRTM.
- 2021 was adopted as the project opening case for the widened M4 Motorway and was considered to allow for full ramp-up of traffic demand as travellers respond to the provision of the additional capacity and the toll.
- 2031 was adopted as the case for 10 years after opening.

The forecast demand for 2012, 2021 and 2031 reflects forecast land use and employment distribution changes across the Sydney conurbation. General growth was taken from the STM vehicle demand forecasts with an increase in vehicle demand to account for reasonable traffic demand growth in the M4 Motorway corridor (as described above in **section 5.4**).

The network cases comprised differing levels of infrastructure provision within the model for the various modelled demand years. The scenarios examined were modelled in the WRTM by combining future year demands with future networks. Traffic was assigned using the calibrated road assignment model, taking suitable account for changes in toll choice behaviour over time.

2021 is used as the project case year for the Base ‘do minimum’ and M4 Widening scenarios (refer 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 impact at the completion of the M4 Widening in 2017.

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).

5.6 Demand forecasting limitations

Traffic forecast modelling is highly complex. Reasonable variations in input parameters, data and assumptions result in variations in forecast traffic demand. Forecast traffic from models should therefore be considered as a range as opposed to absolute numbers. For the purposes of this traffic and transport assessment, the WRTM within its inputs and assumptions has been constructed to produce the best estimate of the future traffic demands given the constraints of time and data availability.

The future forecast traffic demands and the implied associated benefits and impacts of the project may vary from what has been presented in this assessment. Specifically, the following may logically cause variations to the future scenarios:

- Driver toll choice is a complex behaviour to simulate. The WRTM has been developed with a sophisticated toll choice component that is appropriate for this type of traffic assessment. Available information however indicates that the modelled reaction to tolls on the M4 Motorway may be more severe than has occurred in this part of the network in the past. Diversion of traffic from the M4 Motorway due to the previous toll arrangement (gauged by the change in traffic after the toll was removed in early 2010) was less than the model is predicting under similar conditions. This is complicated by the effects of cashback that will not apply when the project is tolled when widened.
- Land use and demographics projections change progressively from one release to the next. Revised projections currently under development by (NSW) Department of Planning and Environment are anticipated to change population and employment projections at the 2021 and 2031 years across Sydney. In addition to the broad changes to demographics planning for the Carter Street and Wentworth Point Urban Activation Precincts and more broadly concepts being developed through WestConnex revitalisation work may see localised changes in traffic demand that could change future traffic on and around the M4 Widening project. The anticipated changes in demographics planning for Carter Street

and Wentworth Point were not included in the STM data and, hence, not incorporated into the WRTM as these changes are not yet approved.

- The effectiveness of improvements to public transport services within the M4 Motorway corridor and the relative capacity of public versus private transport will affect the growth of private vehicle travel in the corridor. The adopted demand case used for this traffic and transport assessment was reasonable given the available information.

6 Future base case traffic conditions

6.1 Introduction

This chapter outlines future network performance assuming that no components of the WestConnex scheme are built (the Future 'do minimum' scenario). This will be used to assess the need for the M4 Widening project and to act as a baseline to measure the impact of the project in the future.

6.2 Future network assumptions

Future year network development is shown in **Table 6-1**. This has been based on the Strategic Travel Model assumptions (Bureau of Transport Statistics (BTS) 2012e). Some timing assumptions have been reviewed in consultation with (NSW) Roads and Maritime Services (Roads and Maritime) to reflect project assumptions. For the 'do minimum' scenarios it is assumed that there are no components of the WestConnex scheme included in the network.

Table 6-1: Strategic travel model network assumptions

By Year	Road	Rail / light rail	Bus
2006	Network version July 2009	Network version March 2007	Network version March 2007
2011	Lane Cove Tunnel Inner West Busway (Iron Cove Bridge duplication) F3 Freeway (M1 Pacific Motorway) widening Hume Highway widening	Enhanced 2009 timetable network Cronulla Rail Line duplication Epping to Chatswood Rail Line	Integrated bus networks phase one
2016	Hunter Expressway M2 Motorway widening M5 West widening Western Sydney employment hub Great Western Highway widening	A variety of rail projects to improve operability of the rail network South West Rail Link Inner West light rail extension to Dulwich Hill	Integrated bus networks completed Additional 1,000 buses Increased frequencies
2021		North West Rail Link Central business district (CBD) and South East Light Rail	Northern Beaches busway Bus network extensions and frequency adjustments aligned with changes in land use and rail network assumptions
2026	NorthConnex	Western Express	
2031	South West Growth Centre	Three tier railway plan – railway services based on three service types to meet different customer needs Parramatta to Epping Rail Line	

By Year	Road	Rail / light rail	Bus
2036	F6 Freeway (M1 Princes Motorway)	Three tier railway plan – railway services based on three service types to meet different customer needs	
(2041)	M2 Motorway extension via Gladesville Bridge to M4 East extension		

Source: BTS, *Strategic Travel Model assumptions*, 2012e

6.3 Network performance

This section examines the overall performance of the Sydney road network in the Existing case (2012), Base 'do minimum' (2021) and Future 'do minimum' scenarios (2031), including growth in use by vehicle type and the impact on travel speeds.

Figure 6-1 shows the total weekday distance travelled on the Sydney road network.

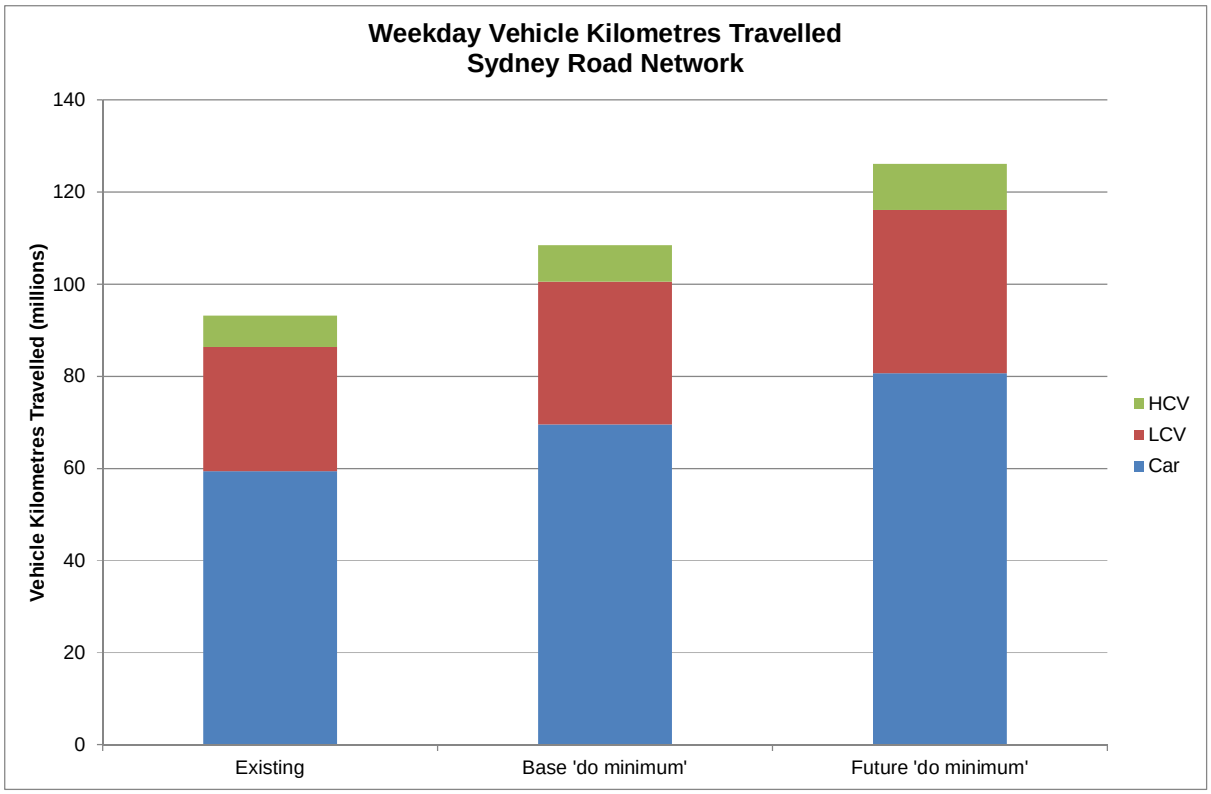

Figure 6-1: Total weekday distance travelled on the Sydney road network

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

Figure 6-2 shows the growth in vehicle kilometres travelled (VKT) across the Sydney road network for all cars, light commercial vehicles (LCVs) and heavy commercial vehicles (HCV) from the Existing case to the Base 'do minimum' and Future 'do minimum' scenarios.

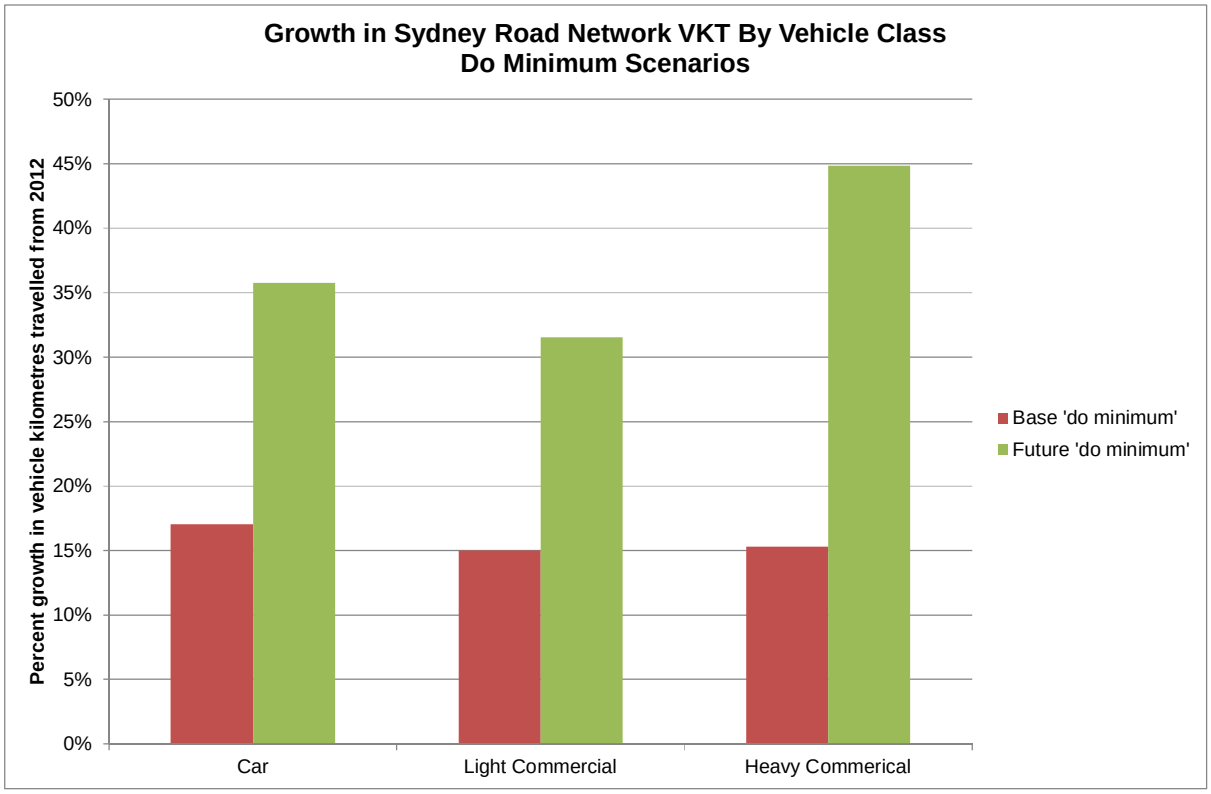

Figure 6-2: Sydney road network demand growth by vehicle class

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

Figure 6-2 shows that the combined weekday vehicle kilometres travelled by all cars is expected to grow by 36 per cent between the Existing case and Future 'do minimum' scenarios, which is equivalent to compound growth of 1.6 per cent per annum. Similarly, LCV traffic is expected to grow at 1.5 per cent per annum between the Existing case and Future 'do minimum' scenarios and HCV traffic is expected to grow at 2.0 per cent per annum over the period.

Figure 6-3 shows the growth in the total amount of time that all vehicles spend travelling in the Sydney road network on a weekday.

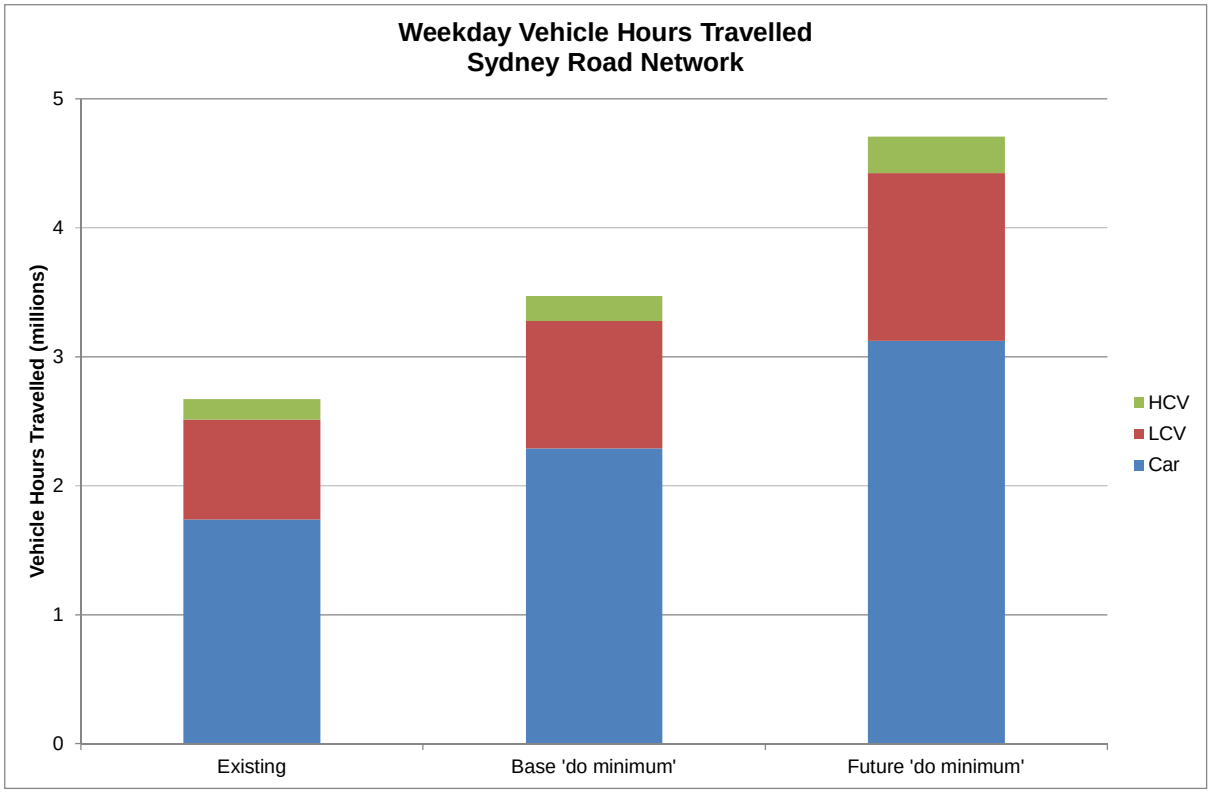

Figure 6-3: Total weekday hours travelled on the Sydney road network

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

The total hours spent travelling is expected to grow more quickly than the total number of kilometres travelled. The combined number of hours spent travelling on a weekday in Sydney is expected to grow by 3.1 percent per annum for cars, 2.8 per cent per annum for LCVs and 3.1 per cent per annum for HCVs. **Figure 6-4** shows the resulting reduction in vehicle speeds broken up by time of day.

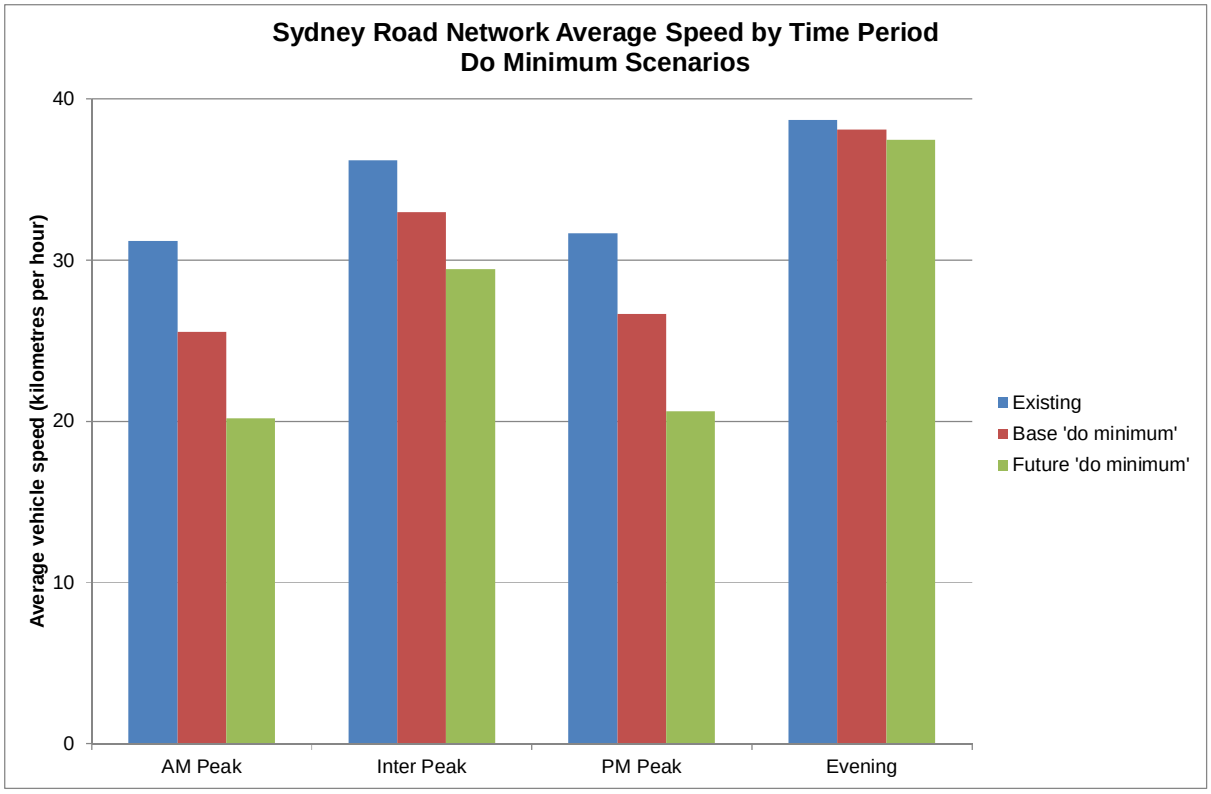

Figure 6-4: Travel speeds on the Sydney road network

Source: Jacobs SKM *WestConnex Road Traffic Model*, 2014

Figure 6-4 shows that the network speed in the Future 'do minimum' scenario inter peak period is slower than in the peak periods in the Existing case. Over the Existing case to Future 'do minimum' period, morning peak network speeds are decreasing by 2.3 per cent per annum, inter peak speeds are decreasing by 1.1 per cent per annum and evening peak speeds are decreasing by 2.2 per cent per annum.

6.4 'Business as usual' traffic growth

This section examines the modelled growth in usage of the M4 Motorway corridor between Church Street and Homebush Bay Drive. **Figure 6-5** shows the total distance travelled by all vehicles on a weekday on the M4 Motorway and Parramatta Road for the Existing case, Base 'do minimum' and Future 'do minimum' scenarios. Overall corridor traffic (combined M4 Motorway and Parramatta Road traffic) grows on average by approximately 1.0 per cent per annum during this period; however this is split unevenly with the M4 Motorway growing at 0.8 per cent per annum and Parramatta Road growing at 1.8 per cent per annum. The corridor growth rate slows from 1.1 per cent per annum between the Existing case and Base 'do minimum' scenario, to 0.9 per cent per annum between the Base and Future 'do minimum' scenarios.

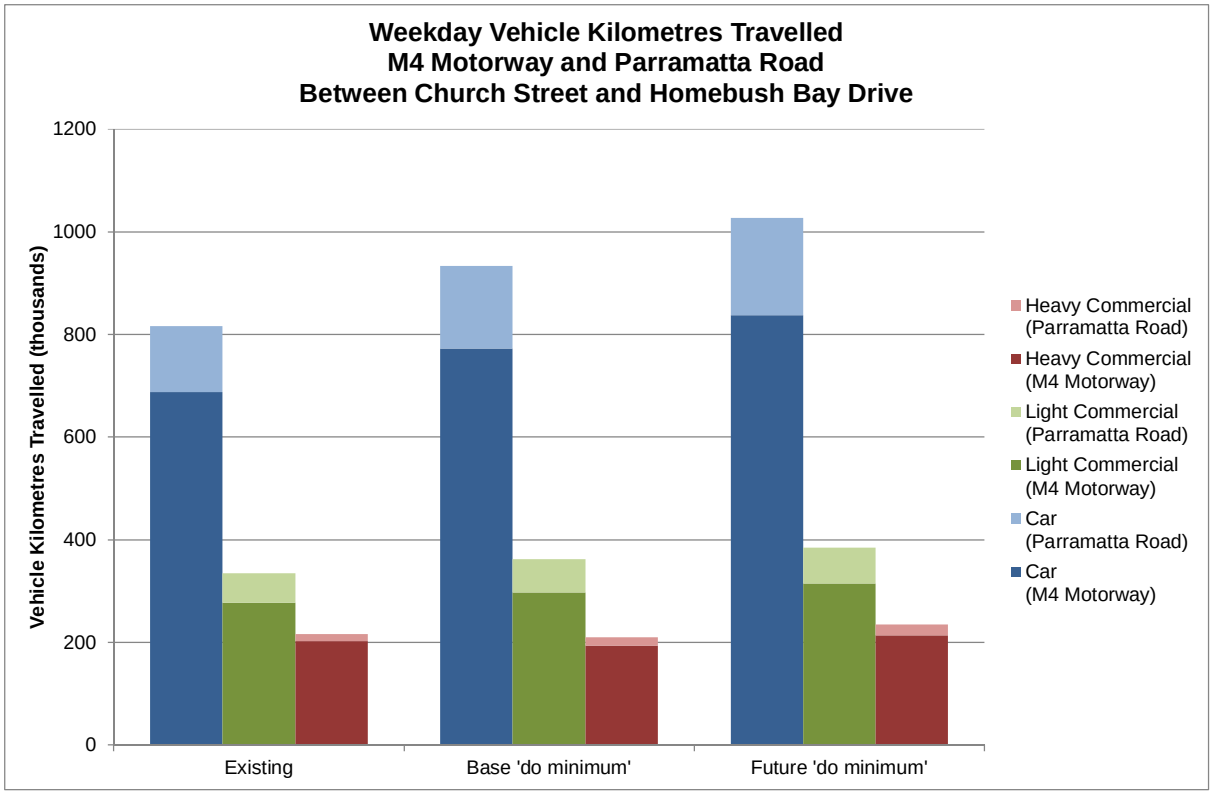

Figure 6-5: Future M4 Motorway and Parramatta Road usage

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

Figure 6-6 is derived from the same data as **Figure 6-5** and shows the growth in corridor use by vehicle type. The extent to which the M4 Motorway and Parramatta Road contribute to the growth is shown in each of the columns. The graph shows a 14 per cent increase in car use in the corridor between the Existing case and Base 'do minimum' scenario; nearly three quarters of that growth (10 per cent) is from the M4 Motorway and the remainder (four per cent) is from Parramatta Road.

A three per cent reduction in corridor use by HCVs between the Existing case and Base 'do minimum' scenario is shown in **Figure 6-6**. The graph shows that in this period increased HCV use of Parramatta Road adds one per cent to overall corridor use while reduced HCV use of the M4 Motorway subtracts four per cent from corridor use. Given that there is strong overall growth in HCV traffic on the Sydney road network during this time (see **Figure 6-2**), the most likely explanation is that the widening of the M2 and M5 Motorways is influencing HCV route decisions.

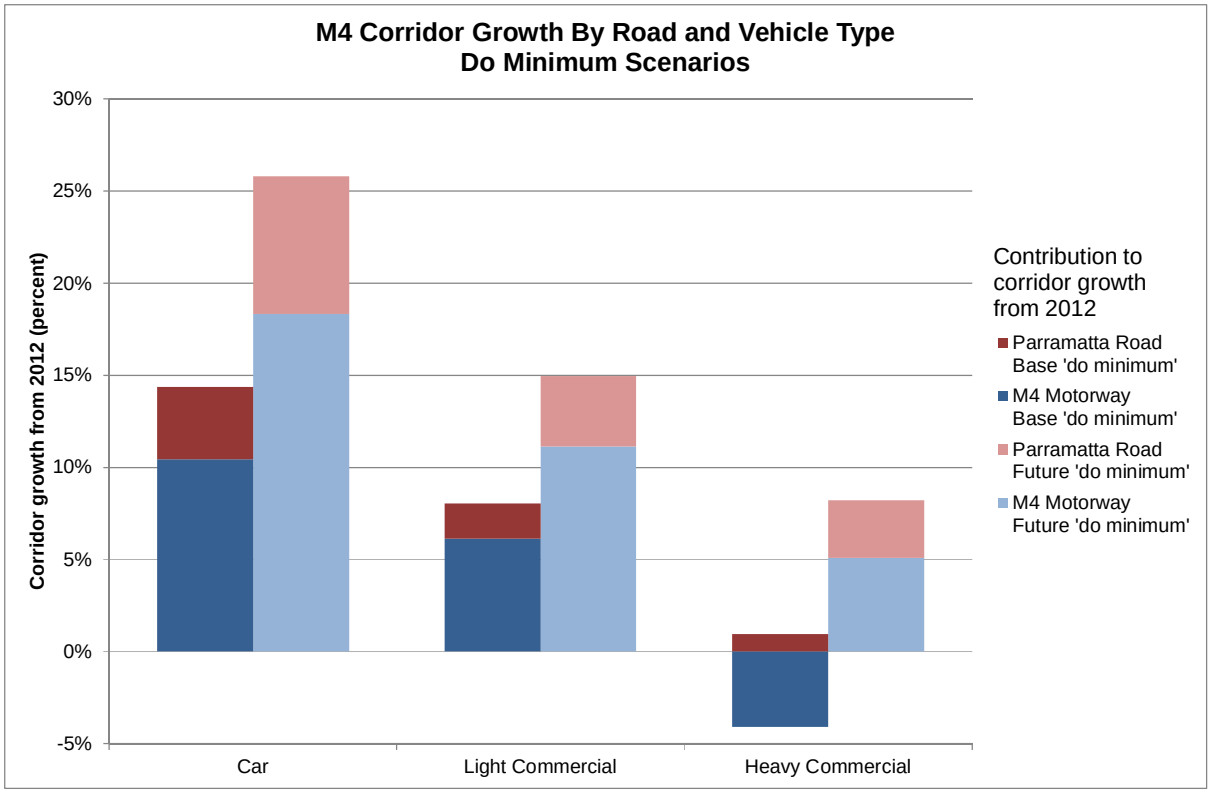

Figure 6-6: M4 Motorway corridor growth

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

The data presented in **Figure 6-6** can be used to make some general observations about annual growth in corridor use for each vehicle type. In particular, car traffic in the corridor will grow at 1.0 per cent per annum, LCV traffic will grow at 0.7 per cent per annum and HCV traffic will grow by 0.3 per cent per annum between the Existing case and Future 'do minimum scenario.

As previously mentioned in **section 4.2**, a common measure of road segment congestion is the volume over capacity (VoC) ratio. A section of road is heavily congested when the VoC ratio is greater than 1.0 and is uncongested when the VoC ratio is less than 0.7. Maps are presented in **section 4.2** showing the modelled VoC ratio of roads in the vicinity of the M4 Motorway for the Existing case morning and evening weekday peaks. **Figure 6-7** and **Figure 6-8** show the corresponding maps for the Future 'do minimum' scenario. Comparing the Existing case and Future 'do minimum scenario figures indicates a significant increase in network congestion over this period, with many roads exceeding practical operating capacity in the Future 'do minimum' scenario.

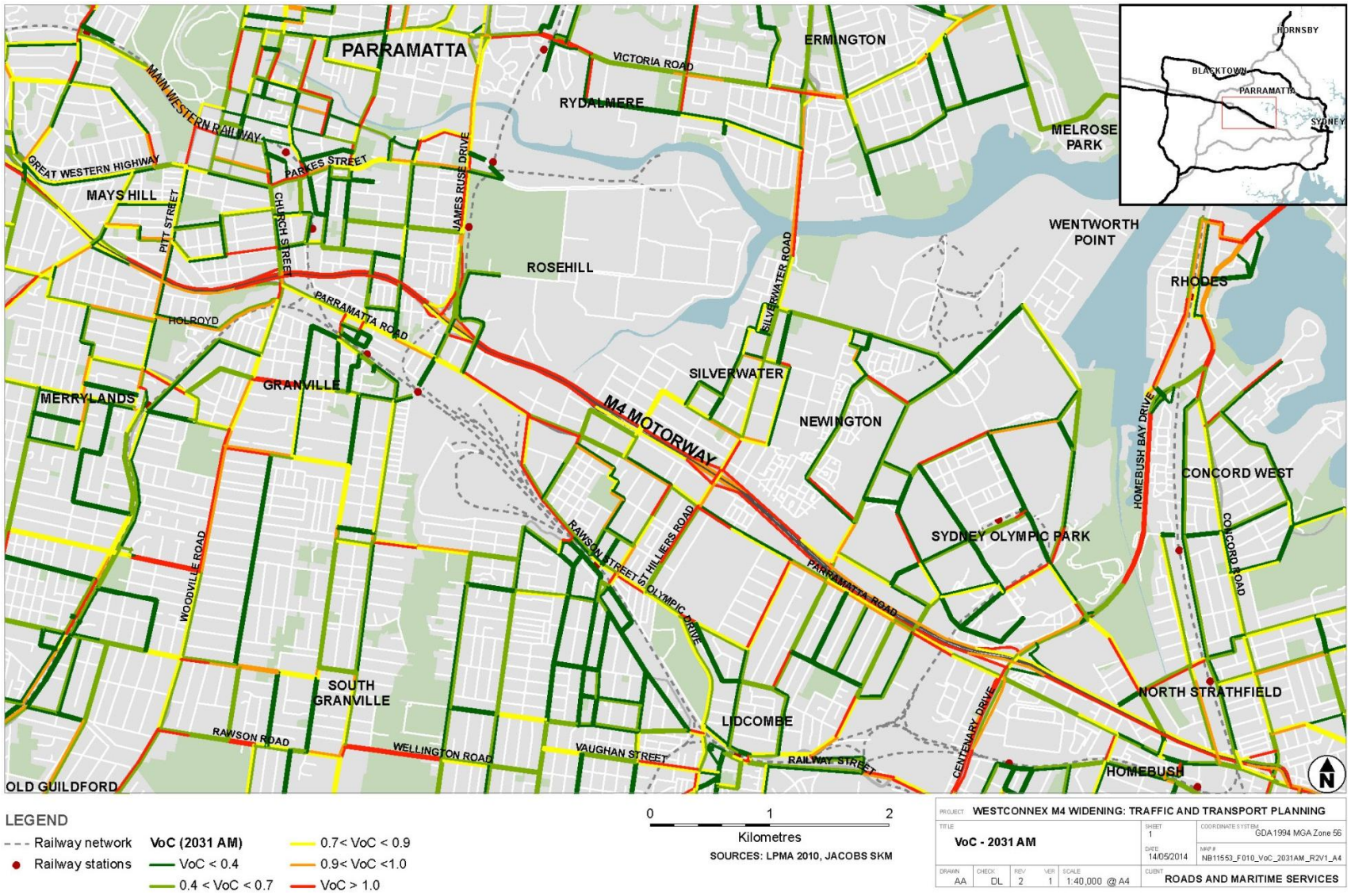

Figure 6-7: Volume over capacity ratio, morning peak, Future 'do minimum' scenario

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

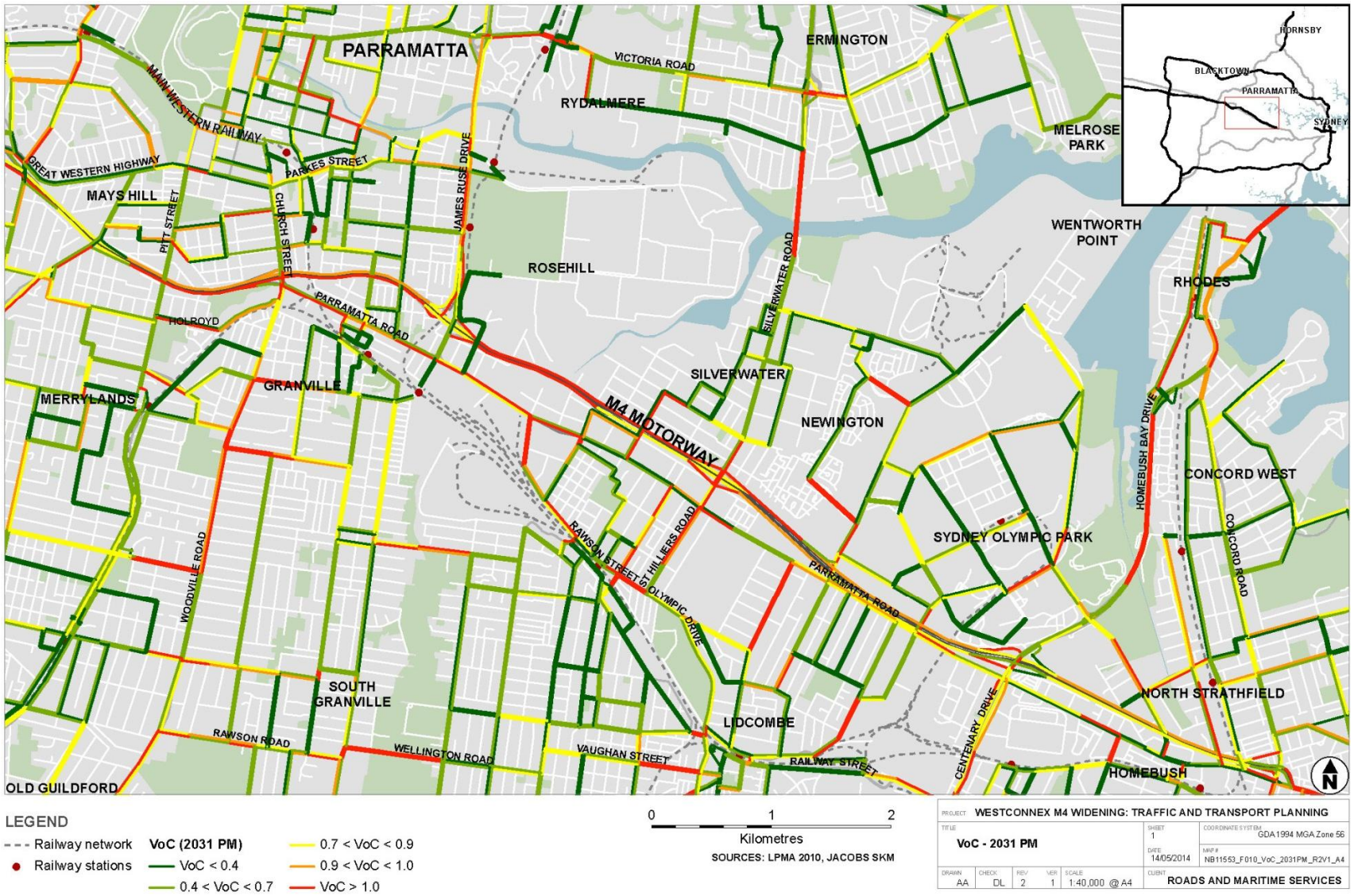

Figure 6-8: Volume over capacity ratio, evening peak, Future 'do minimum' scenario

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

6.5 Travel times

This section presents the modelled travel times on the M4 Motorway and Parramatta Road between Church Street and Homebush Bay Drive for the Existing case, Base 'do minimum' and Future 'do minimum' scenarios. The travel time graphs presented in this section are intended to show where delays occur by using the distance from Church Street (the western extent of the M4 Widening project) for the horizontal axis and time for the vertical axis. Consequently eastbound trips are represented by lines with a positive gradient (go up to the right) and westbound trips are represented by lines with a negative gradient (go up to the left). Steeper gradients correspond to slower speeds.

Figure 6-9 shows morning peak travel times on the M4 Motorway. Deterioration in travel times is shown between the Existing case and Base 'do minimum' scenario, and a further deterioration is apparent between the Base 'do minimum' and Future 'do minimum' scenarios. While westbound morning peak traffic is relatively uncongested in the Existing case and Base 'do minimum' scenario, travel times deteriorate significantly between the Base 'do minimum' and Future 'do minimum' scenarios. In both directions, reduced travel speeds are concentrated between Silverwater Road and Church Street.

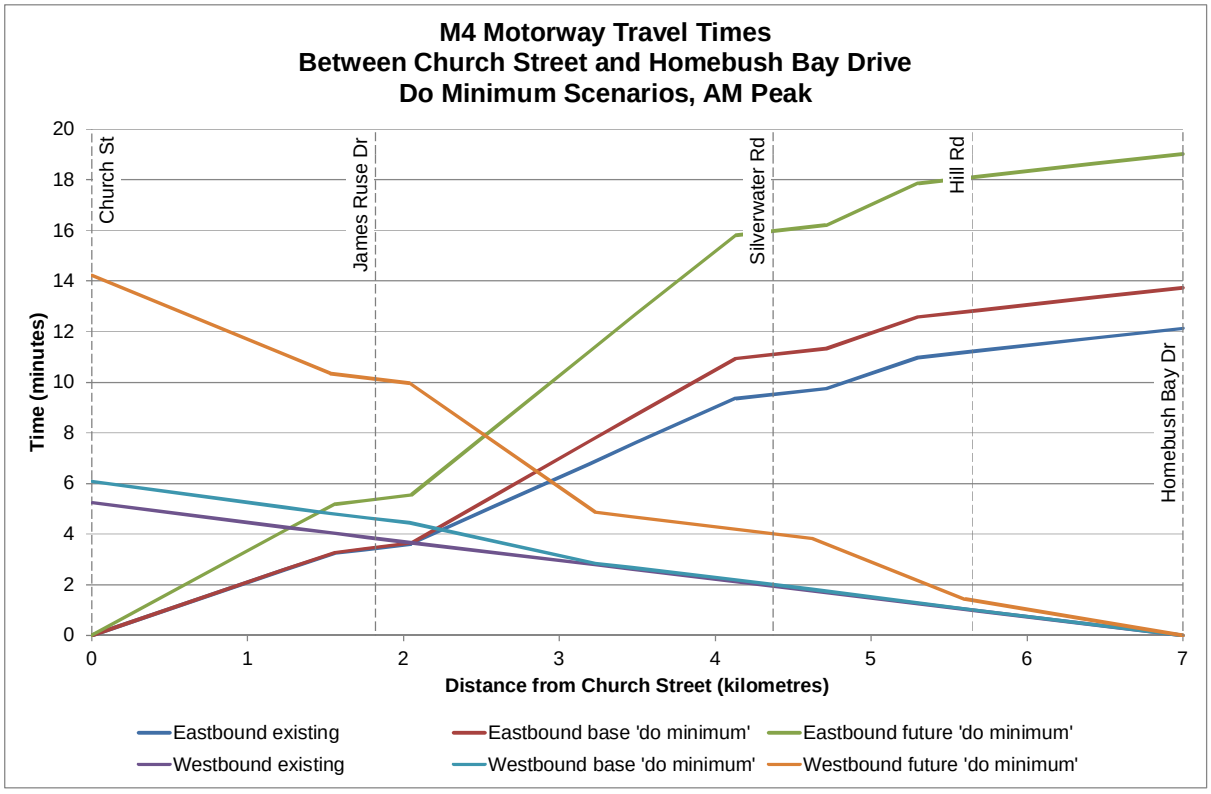

Figure 6-9: Morning peak travel times on the M4 Motorway in various scenarios

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

The evening peak equivalent of **Figure 6-9** is shown in **Figure 6-10**. As with the morning peak travel time graphs, there is a modest growth in travel times between the Existing case and Base 'do minimum' scenario, however there is rapid growth (ie reduced travel speed) between the Base 'do minimum' and Future 'do minimum' scenarios.

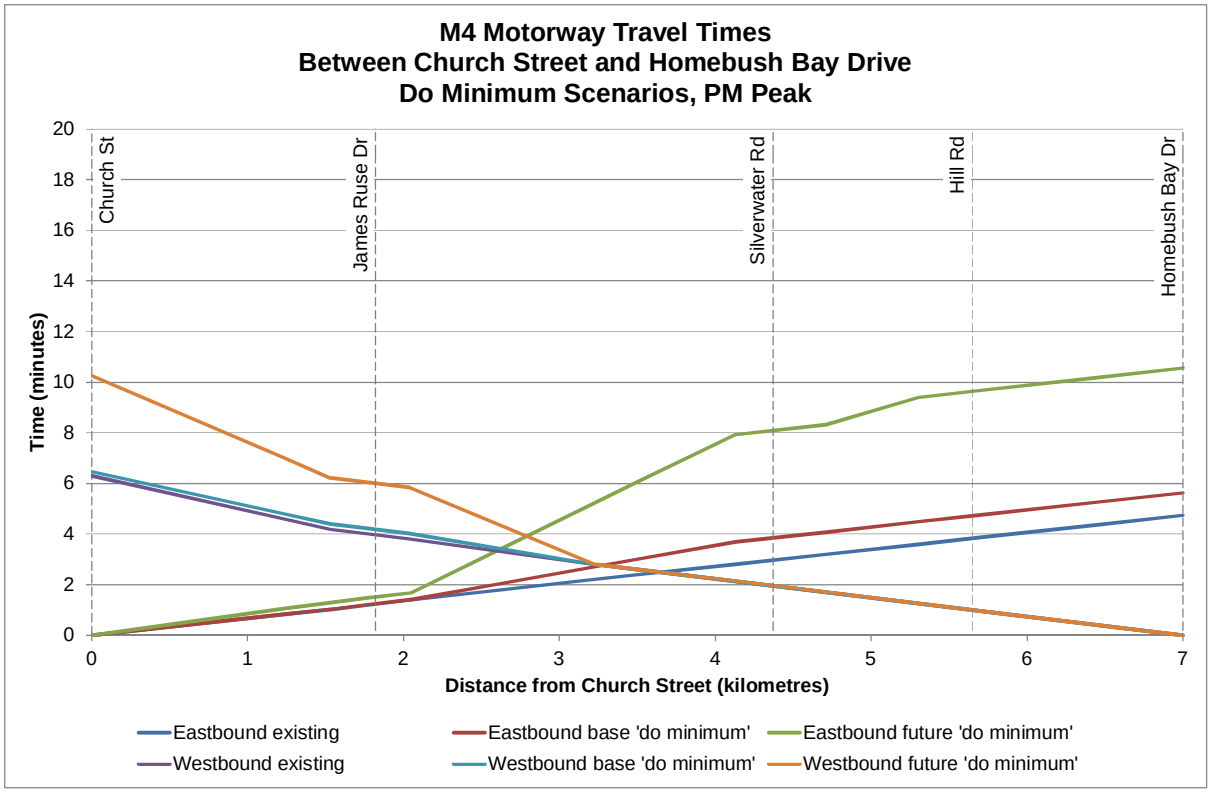

Figure 6-10: Evening peak travel times on the M4 Motorway in various scenarios

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

Figure 6-11 shows travel times in the inter peak period. The M4 Motorway is uncongested in this period until the Future 'do minimum' scenario, when congestion is apparent between Silverwater Road and James Ruse Drive.

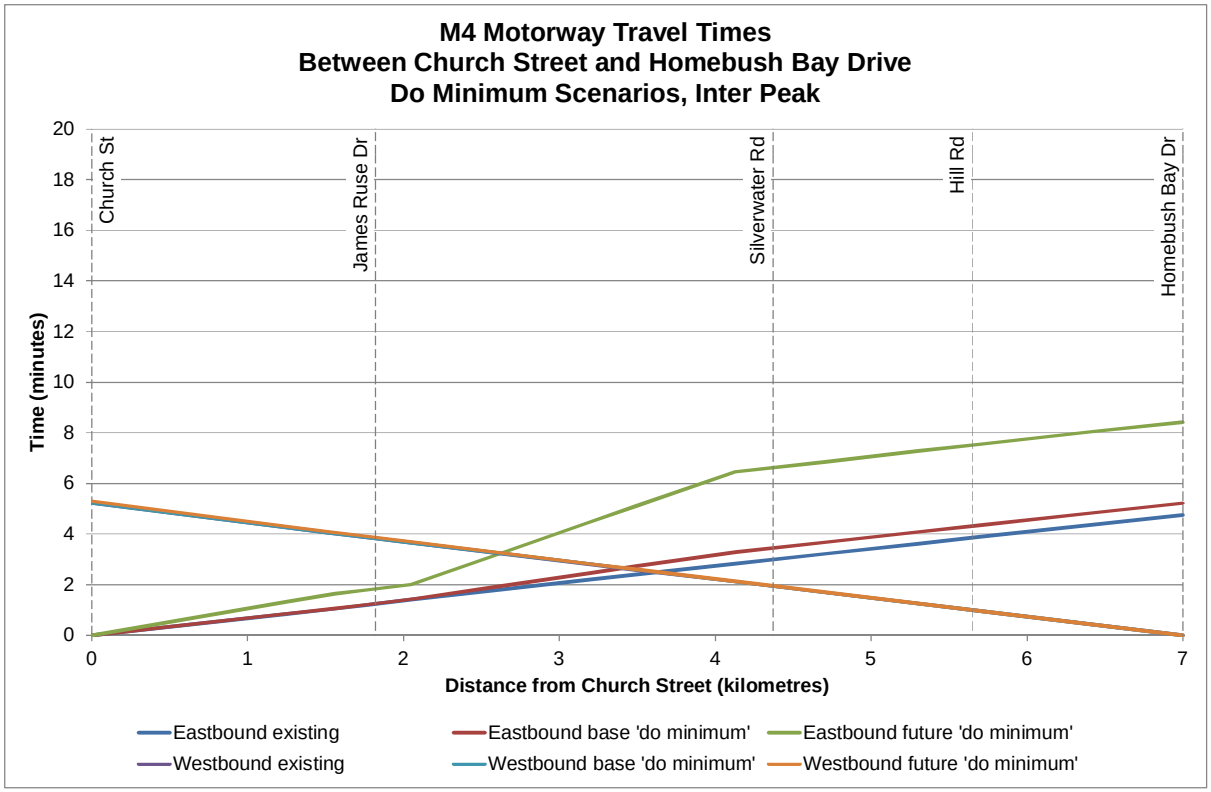

Figure 6-11: Inter peak travel times on the M4 Motorway in various scenarios

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

Parramatta Road travel times are shown in **Figure 6-12** and **Figure 6-13**. As with the M4 Motorway, travel times grow modestly in the period between the Existing case and the Base 'do minimum' scenario and grow rapidly in the period between the Base 'do minimum' and Future 'do minimum' scenarios as Parramatta Road becomes more congested. Parramatta Road and M4 Motorway travel times in the morning peak of the Future 'do minimum' scenario are similar.

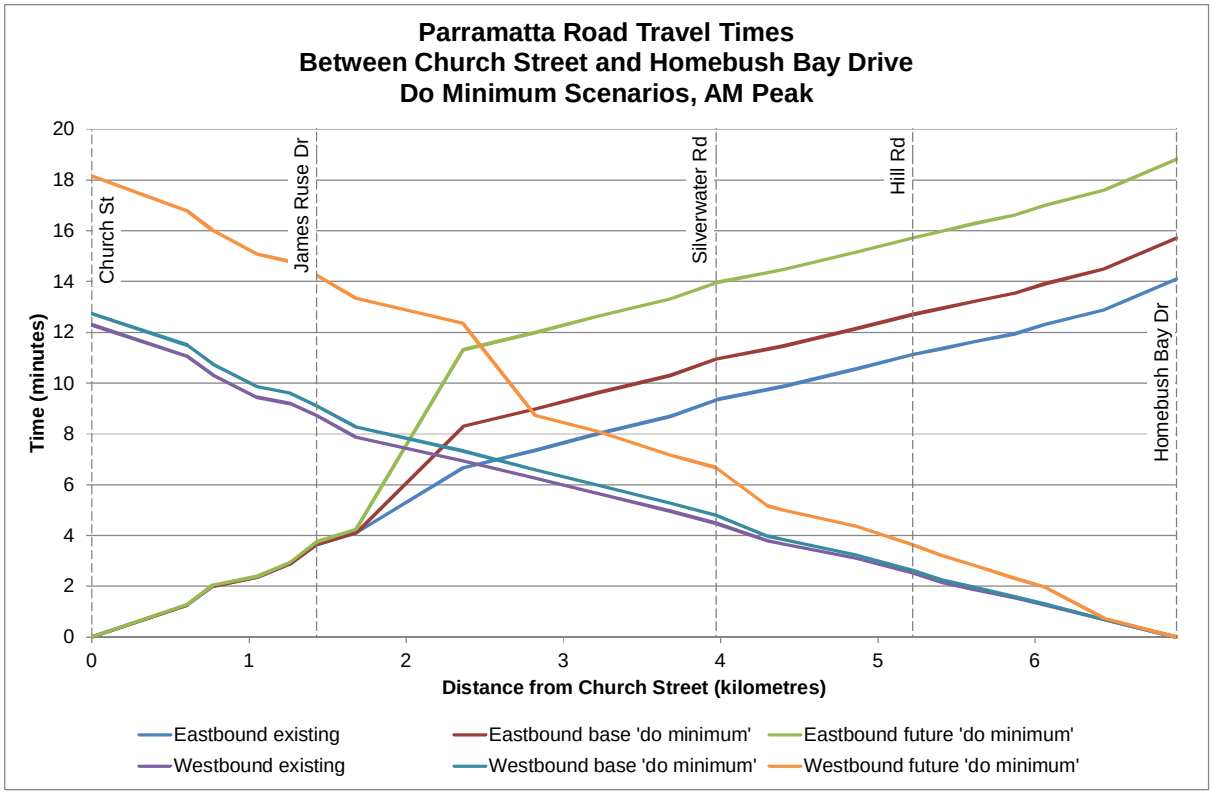

Figure 6-12: Parramatta Road morning peak travel times in various scenarios

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

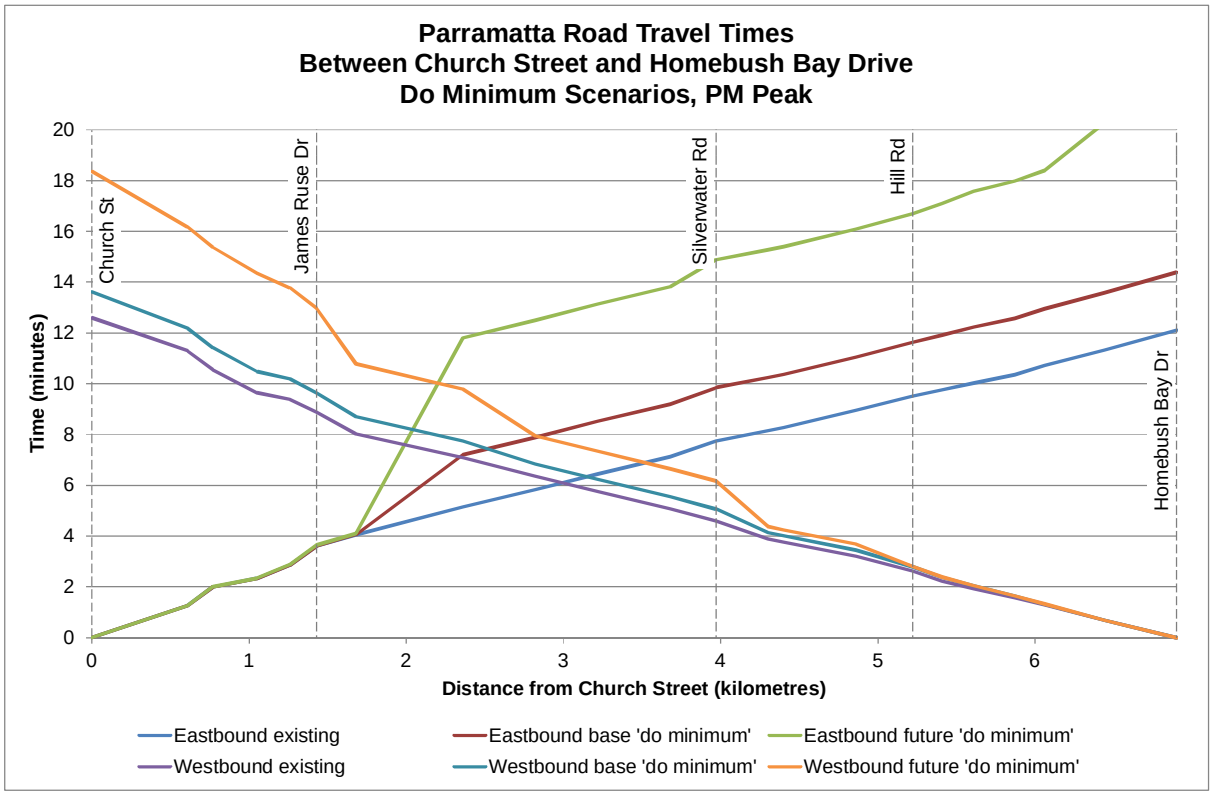

Figure 6-13: Parramatta Road evening peak travel times in various scenarios

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

6.6 Trip length distribution changes

The figures in this section show the trip distance distribution for trips using any part of the M4 Motorway between Church Street and Homebush Bay Drive. For any given length value on the horizontal axis these graphs show the number of trips per hour of that distance using the M4 Motorway. For example, **Figure 6-14** shows that in the morning peak of the Future 'do minimum' scenario there are 500 trips per hour of a distance of over 20 kilometres using the M4 Motorway.

Modelled results for the morning peak in the Existing case and the Future 'do minimum' scenario are shown in **Figure 6-14**.

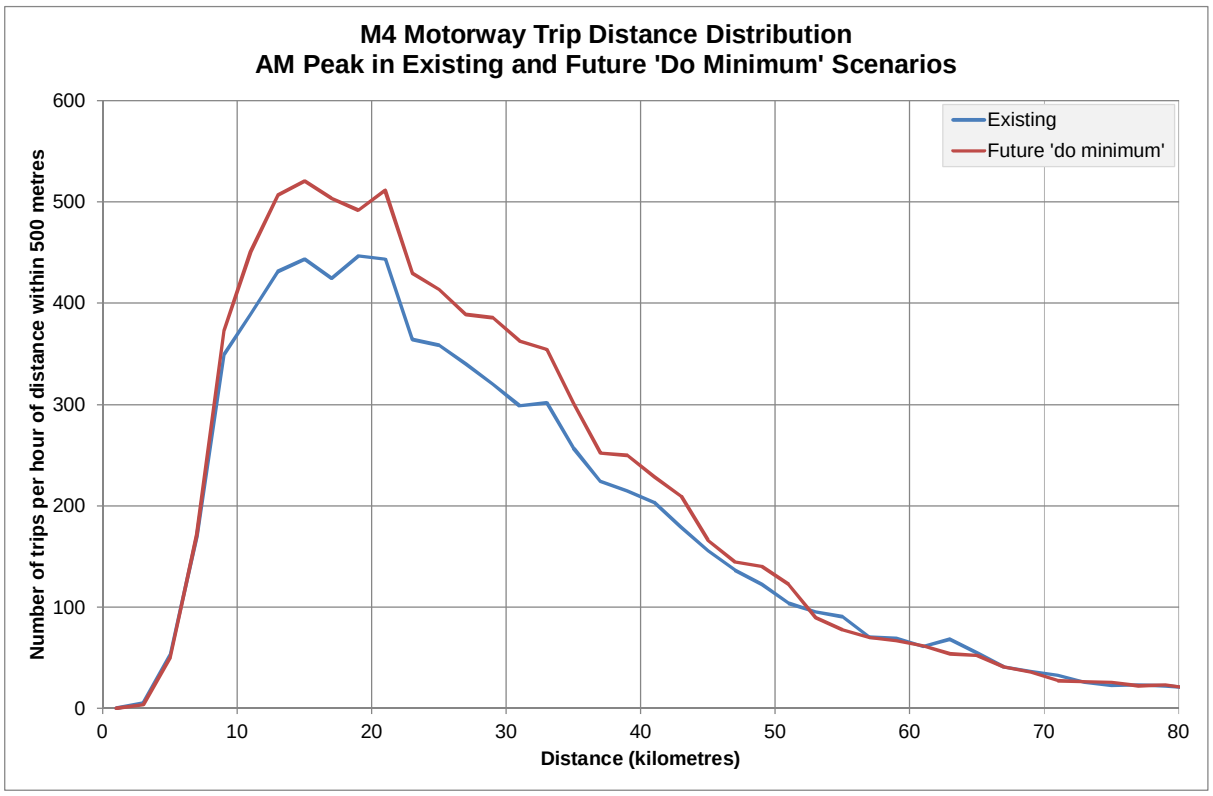

Figure 6-14: Morning peak trip distance distribution

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

Figure 6-14 shows strong growth in morning peak trips using the M4 Motorway with a distance between 10 and 35 kilometres. There is little or no growth in trips of a length greater than 50 kilometres or less than 10 kilometres. Reasons for the low growth in short trips may include alternatives such as Parramatta Road becoming more attractive due to M4 Motorway congestion. The M5 Motorway and M2 Motorway may be used for as alternatives for longer trips.

The next graph, **Figure 6-15**, shows the M4 Motorway trip distance distribution for the weekday inter-peak period. This shows fairly uniform growth in M4 Motorway usage across trips of varying distance, indicating that the area surrounding the M4 Motorway is not particularly congested during this time.

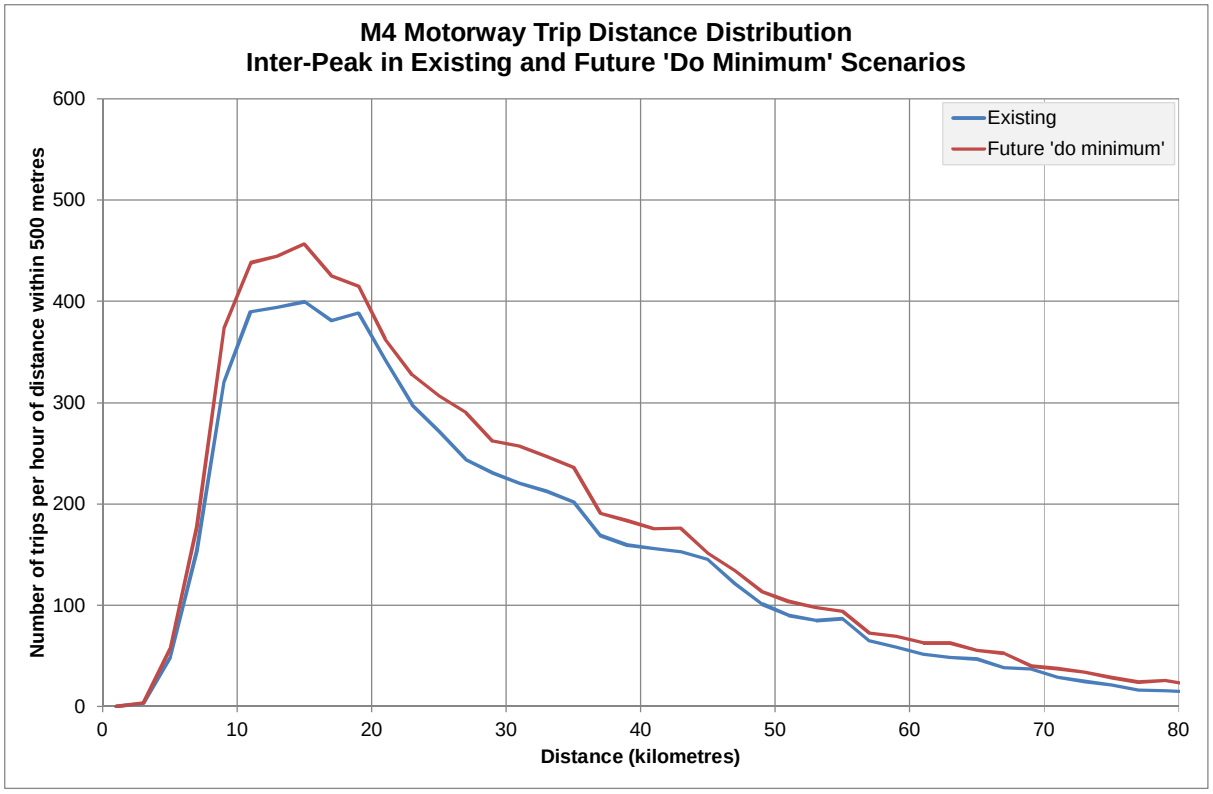

Figure 6-15: Inter-peak trip distance distribution

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

Figure 6-16 below shows that most growth in evening peak M4 Motorway usage is limited to trips of length between 10 and 20 kilometres, suggesting there are better alternatives for many longer trips.

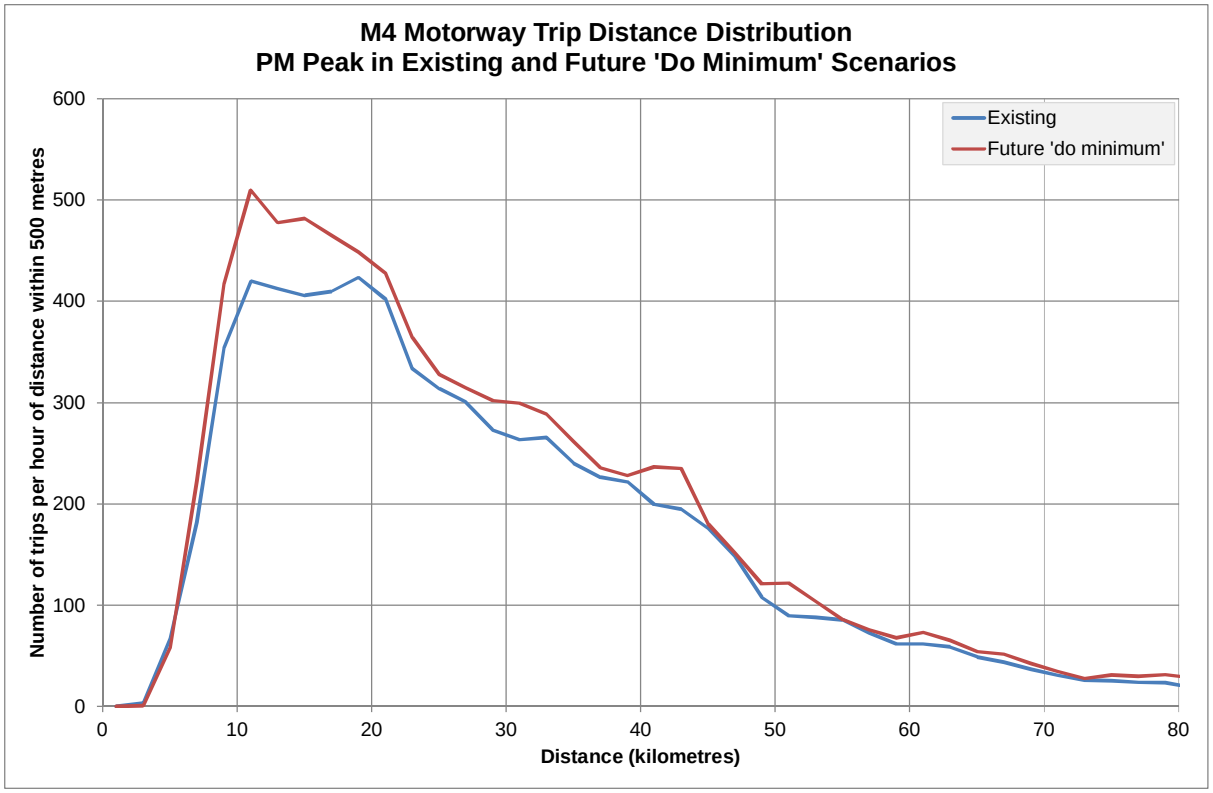

Figure 6-16: Evening peak trip distance distribution

Source: Jacobs SKM WestConnex Road Traffic Model, 2014

6.7 Interchange and intersection performance

The assessment of interchange and intersection performance is based on criteria outlined in **Table 4-4**, as defined by *Guide to Traffic Generating Developments* (Roads and Traffic Authority 2002). 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.

In these scenarios, the analysis is based on modelled traffic volumes as opposed to the actual traffic counts used to assess existing operations (refer to **section 4.3**). The modelled trip distribution may differ from actual counts, within the tolerances allowed in the modelling process, 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 project is undertaken to provide a base case against which to evaluate the impact of the project under the same forecast future traffic conditions.

6.7.1 Granville

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **Section 4.3.1** and are shown in **Figure 4-13**.

Table 6-2 and **Table 6-3** show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WestConnex Road Traffic Model (WRTM) for the Base ‘do minimum’ and Future ‘do minimum’ scenarios assuming that no components of the WestConnex scheme are built.

In the morning peak of the Base 'do minimum' scenario, the projected results show that the intersection of Parramatta Road/Church Street operates beyond theoretical capacity, with an average delay of approximately 67 seconds approaching a LoS F. The intersections of Parramatta Road/Bold Street and Parramatta Road/Good Street experience minor increases in traffic along the corridor, and modelling outputs indicates similar performance at both intersections in comparison to the existing scenario.

In the evening peak of the Base 'do minimum' scenario, the projected results show that the intersection of Parramatta Road/Church Street operates beyond theoretical capacity and operates at a LoS F. Modelling outputs for Parramatta Road/Good Street indicates similar performance in comparison to the existing scenario. However, the intersection of Parramatta Road/Bold Street operates with traffic volumes exceeding capacity and, consequently, operates at LoS F. This deterioration in performance can be attributed to an increase in the traffic volumes on the three critical opposing movements at the intersection, namely the westbound through movement on Parramatta Road, eastbound right turn from Parramatta Road to Bold Street and the northbound movement out of Bold Street.

Table 6-2: Future interchange and intersection operation, Base 'do minimum' scenario (2021)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Church Street/M4 Motorway eastbound off-ramp	D	49	C	35
Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp	E	67	F	>140
Parramatta Road/Bold Street	D	50	F	73
Parramatta Road/Good Street	C	32	D	51

As shown in **Table 6-3**, further degradation of performance is experienced in the Future 'do minimum' scenario with the increased traffic forecast at the intersection of Parramatta Road/Church Street which operates beyond its theoretical capacity at LoS F.

The projected Future 'do minimum' scenario shows an increase of approximately 900 passenger car units (PCUs) along the corridor when compared to the Base 'do minimum' scenario. Consequently, the intersection of Parramatta Road/Bold Street exceeds its theoretical capacity, operating at LoS F. The Parramatta Road/Good Street intersection has also deteriorated in performance and is approaching capacity, operating at LoS D in the morning peak.

In the evening peak of the Future 'do minimum' scenario there is an increase of approximately 700 PCUs along the corridor when compared to the Base 'do minimum' scenario. Consequently, the intersection of Parramatta Road/Good Street now exceeds its theoretical capacity, and operates at LoS F. The Parramatta Road/Bold Street intersection shows further deteriorated performance in comparison to the Base 'do minimum' scenario, operating at LoS F.

Table 6-3: Future interchange and intersection operation, Future 'do minimum' scenario (2031)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Church Street/M4 Motorway eastbound off-ramp	D	52	C	38
Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp	F	>140	F	>140
Parramatta Road/Bold Street	F	>140	F	91
Parramatta Road/Good Street	D	55	F	>140

6.7.2 Clyde and Rosehill

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **Section 4.3.2** and are shown in **Figure 4-14**.

Table 6-4 and **Table 6-5** show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios assuming that no components of the WestConnex scheme are built. The results indicate that the network operates below its theoretical capacity during the morning peak in the Base 'do minimum' scenario.

In the evening peak period of the Base 'do minimum' scenario the network operates under capacity although the James Ruse Drive/Prospect Street and James Ruse Drive/Parramatta Road intersections are approaching capacity with degrees of saturation of 93 per cent at both intersections.

Table 6-4: Future interchange and intersection operation, Base 'do minimum' scenario (2021)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
James Ruse Drive/Prospect Street	C	37	F	83
James Ruse Drive/M4 Motorway eastbound on-ramp	C	32	B	23
James Ruse Drive/M4 Motorway westbound off-ramp	C	29	B	26
James Ruse Drive/Parramatta Road/Berry Street	C	39	D	43

In the morning peak of the Future 'do minimum' scenario, the results indicate that the network is approaching its theoretical capacity and, in particular, the intersection of James Ruse Drive and Parramatta Road is significantly congested with extensive delays. Considerable queuing at the intersection of James Ruse Drive and Prospect Street is evident during the morning peak however as the downstream intersection is located 700

metres away the operation of the James Ruse Drive/M4 Motorway eastbound entry ramp intersection is unlikely to be affected.

In the evening peak period of the Future 'do minimum' scenario, both intersections have exceeded their theoretical capacities operating at LoS F. This can be attributed to a net gain in demand of 1,100 vehicles and 300 vehicles at the James Ruse Drive intersections with Prospect Street and Parramatta Road respectively.

Table 6-5: Future interchange and intersection operation, Future 'do minimum' scenario (2031)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
James Ruse Drive/Prospect Street	D	53	F	110
James Ruse Drive/M4 Motorway eastbound on-ramp	D	47	B	16
James Ruse Drive/M4 Motorway westbound off-ramp	C	33	B	26
James Ruse Drive/Parramatta Road/Berry Street	F	93	F	>140

6.7.3 Auburn

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **Section 4.3.3** and are shown in **Figure 4-15**.

Table 6-6 and **Table 6-7** show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios assuming that no components of the WestConnex scheme are built. In both peak periods of the Base and Future 'do minimum' scenarios the results indicate that the network will be overcapacity with three of the four intersections operating with a degree of saturation exceeding 100 per cent and extensive queuing, in excess of 400 metres, on approach to the intersections. Although the intersection of Silverwater Road/M4 Motorway westbound ramp appears to operate satisfactorily at LoS D during the morning peak and the Silverwater Road/M4 Motorway eastbound ramps at LoS C during evening peak of the Future 'do minimum' scenario, this is due to exit blocking elsewhere on the network which prevents vehicles from reaching these intersections. If vehicle throughput was not restricted at upstream intersections these intersections would also be over capacity.

The projected Base 'do minimum' results for the morning peak indicate that despite an increase in overall traffic at the intersection of Parramatta Road and Rawson Street, the intersection performs with a slight increase in average delay in comparison to the existing scenario, and operates at LoS D.

The further increase in traffic in the Future 'do minimum' scenario sees the intersection operate beyond theoretical capacity, at LoS F, in both peak periods. Significant queues are expected on Parramatta Road on both the eastern and western approaches to the intersection.

Table 6-6: Future interchange and intersection operation, Base 'do minimum' scenario (2021)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Parramatta Road/Rawson Street/Duck Street	D	46	F	101
Silverwater Road/Carnarvon Street	F	>140	F	73
Silverwater Road/M4 Motorway eastbound ramps	F	>140	D	46
Silverwater Road/M4 Motorway westbound ramps	D	46	D	46
Silverwater Road/Parramatta Road	D	54	F	120

Table 6-7: Future interchange and intersection operation, Future 'do minimum' scenario (2031)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Parramatta Road/Rawson Street/Duck Street	F	128	F	>140
Silverwater Road/Carnarvon Street	F	>140	F	117
Silverwater Road/M4 Motorway eastbound ramps	F	>140	C	37
Silverwater Road/M4 Motorway westbound ramps	D	49	F	104
Silverwater Road/Parramatta Road	F	73	F	>140

6.7.4 Lidcombe and Sydney Olympic Park

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **Section 4.3.4** and are shown in **Figure 4-16**.

Table 6-8 and **Table 6-9** show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios assuming that no components of the WestConnex scheme are built.

Modelling outputs from the Base 'do minimum' scenario show that the Hill Road/Parramatta Road intersection deteriorates in performance due to increased traffic, and is expected to operate at LoS F. Major delays are expected on the north and south approaches (Hill Road), as well as the east approach (Parramatta Road).

The performance of the M4 Motorway eastbound off-ramp is expected to deteriorate significantly, operating at LoS F with average delays in excess of 140 seconds. This priority intersection may require to be signalised, with additional capacity provided in order to accommodate the off-ramp traffic growth in all future scenarios.

In addition, significant delays are expected at the Hill Road/Carter Street priority intersection due to the northbound right turning traffic turning from Hill Road on to Carter Street. Under this scenario there is expected to be approximately 540 PCUs in the morning peak, and 300 PCUs in the evening peak, attempting to undertake the priority controlled movement. The intersection as a whole is below theoretical capacity, however, the right turn movement is well in excess of its theoretical capacity and experiences significant delay, resulting in an overall average intersection delay of approximately 140 seconds in the morning peak and in excess of 140 seconds in the evening peak.

Table 6-8: Future interchange and intersection operation, Base 'do minimum' scenario (2021)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Parramatta Road/John Street	C	39	D	44
Parramatta Road/Hill Road/Bombay Street	F	73	F	>140
Hill Road/M4 Motorway eastbound off-ramp	F	>140	D	56
Hill Road/Carter Street	F	>140	F	>140
Hill Road/John Ian Wing Parade	B	24	C	35

The issues described under the Base 'do minimum' scenario are further exaggerated under the Future 'do minimum' scenario, refer **Table 6-9**, due to the additional traffic growth throughout the corridor.

In the Future 'do minimum' scenario evening peak, the Hill Road/Parramatta Road and the Carter Street priority intersections operate at LoS F. In the same scenario, the M4 Motorway off-ramp traffic volume has decreased when compared to the Base 'do minimum' scenario, and as such this intersection improves to operate at LoS B.

Table 6-9: Future interchange and intersection operation, Future 'do minimum' scenario (2031)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Parramatta Road/John Street	D	46	F	101
Parramatta Road/Hill Road/Bombay Street	F	>140	F	>140
Hill Road/M4 Motorway eastbound off-ramp	F	>140	B	23
Hill Road/Carter Street	F	>140	F	>140
Hill Road/John Ian Wing Parade	C	29	D	54

6.7.5 Homebush West and Strathfield

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **Section 4.3.5** and are shown in **Figure 4-17**.

Table 6-10 and **Table 6-11** show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios assuming that no components of the WestConnex scheme are built. The results indicate little change at the eastbound on-ramp between the Base and Future 'do minimum' scenarios; the morning peak at the eastbound off-ramp has improved slightly while all other ramps have deteriorated to LoS F from LoS D or E. However, it should be noted that both the Base and Future 'do minimum' scenario results are based on modelled demands rather than actual traffic counts and are, consequently, subject to the limitations of the strategic model described in **section 5.6**.

Table 6-10: Future interchange and intersection operation, Base 'do minimum' scenario (2021)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Homebush Bay Drive/M4 Motorway eastbound on-ramp	A	5	A	5
Homebush Bay Drive/M4 Motorway eastbound off-ramp	D	46	D	49
Centenary Drive/M4 Motorway westbound ramps	F	72	D	51

Table 6-11: Future interchange and intersection operation, Future 'do minimum' scenario (2031)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Homebush Bay Drive/M4 Motorway eastbound on-ramp	A	5	A	6
Homebush Bay Drive/M4 Motorway eastbound off-ramp	D	48	F	83
Centenary Drive/M4 Motorway westbound ramps	F	109	F	110

6.7.6 North Strathfield and Strathfield

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **Section 4.3.6** and are shown in **Figure 4-18**.

Table 6-12 and **Table 6-13** show the results of the interchange and intersection analysis. The analysis was based on traffic volumes from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios assuming that no components of the WestConnex scheme are built.

Under the Base 'do minimum' scenario, Concord Road/Parramatta Road intersection continues to operate with extensive queues and the average delay has increased to 141 seconds on Concord Road/Parramatta Road.

The operational performance at the intersection of the M4 Motorway/Parramatta Road appears to have improved when compared to the existing scenario. However, this is due to blocking back at the over capacity intersection of Concord Road/Parramatta Road preventing the full demand reaching this intersection.

In the evening peak of the Base 'do minimum' scenario, the intersection of Concord Road/Parramatta Road performs poorly, operating at LoS F. When compared to the existing situation, an increase in delays and extensive queuing along Parramatta Road and Concord Road is identified which is due to an increase in network flow over the existing situation.

Table 6-12: Future interchange and intersection operation, Base 'do minimum' scenario (2021)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Parramatta Road/Concord Road/Leicester Avenue	F	>140	F	>140
Parramatta Road/M4 Motorway	D	43	C	30
Parramatta Road/Mosely Street	B	20	B	17
Concord Road/Sydney Street	B	17	B	26

In the Future 'do minimum' scenario, the intersections of M4 Motorway/Parramatta Road and Concord Road/Parramatta Road perform poorly with increased delays and extensive queuing due to insufficient capacity to accommodate the forecast demand which is between 700 to 900 vehicles per hour greater than existing network flows. The remaining intersections continue to perform with satisfactory LoS similar to the existing conditions. However, an increase in delays and queue lengths are predicted at these intersections.

Table 6-13: Future interchange and intersection operation, Future 'do minimum' scenario (2031)

Intersection	Morning peak hour		Evening peak hour	
	Level of service	Average delay per vehicle (seconds)	Level of service	Average delay per vehicle (seconds)
Parramatta Road/Concord Road/Leicester Avenue	F	>140	F	>140
Parramatta Road/M4 Motorway	F	99	C	34
Parramatta Road/Mosely Street	B	26	C	42
Concord Road/Sydney Street	B	16	C	29

6.7.7 Queuing at M4 Motorway off-ramps

Queue lengths at the M4 Motorway off-ramps have been presented for the Existing case in **Table 4-11**.

Table 6-14 and **Table 6-15** below show the modelled queue lengths for the Base and Future 'do minimum' scenarios.

Table 6-14 Queue lengths at M4 Motorway off-ramps, Base 'do minimum' scenario (2021)

Off-ramp	Morning peak queue length (metres)	Evening peak queue length (metres)
Cumberland Highway eastbound off-ramp	201	92
Cumberland Highway westbound off-ramp	125	104
Church Street eastbound off-ramp	118	119
James Ruse Drive eastbound off-ramp	243 (Ramp forms own lane on James Ruse Drive. Queue is measured from Prospect Street)	558 (Ramp forms own lane on James Ruse Drive. Queue is measured from Prospect Street)
James Ruse Drive westbound off-ramp	109	51
Silverwater Road eastbound off-ramp	456	77
Silverwater Road westbound off-ramp	76	44
Hill Road eastbound off-ramp	876	113
Homebush Bay Drive eastbound off-ramp	194	171
Homebush Bay Drive westbound off-ramp	74	59
End of the M4 Motorway at Parramatta Road	186	231

Table 6-15 Queue lengths at M4 Motorway off-ramps, Future 'do minimum' scenario (2031)

Off-ramp	Morning peak queue length (metres)	Evening peak queue length (metres)
Cumberland Highway eastbound off-ramp	114	165
Cumberland Highway westbound off-ramp	190	157
Church Street eastbound off-ramp	122	108
James Ruse Drive eastbound off-ramp	243 (Ramp forms own lane on James Ruse Drive Queue is measured from Prospect Street)	817 (Ramp forms own lane on James Ruse Drive Queue is measured from Prospect Street)
James Ruse Drive westbound off-ramp	124	70
Silverwater Road eastbound off-ramp	594	68
Silverwater Road westbound off-ramp	70	30
Hill Road eastbound off-ramp	1318	45
Homebush Bay Drive eastbound off-ramp	205	286
Homebush Bay Drive westbound off-ramp	31	69
End of the M4 Motorway at Parramatta Road	138	300

In general queue length at the motorway off-ramps have increased when compared to those generated in the existing situation (refer to **Table 4-11**). This outcome is to be anticipated based on the overall growth in traffic demand within the corridor.

Of particular interest is the fact that the queue lengths at the Church Street eastbound ramp and at Silverwater Road westbound ramp have grown at a lower rate than the average growth throughout the M4 Motorway corridor. Church Street eastbound and Silverwater Road westbound were the traditional interchanges where motorists wishing to avoid paying the toll would do so under the previous single point tolling regime. The broader distribution of traffic exiting the motorway is indicative of the untolled scenarios being assessed and reflects trip distribution that is not affected by toll choice decisions.

7 Effects of the M4 Widening project

7.1 Network performance

The M4 Widening, and the fully completed WestConnex project, would have wider implications for the Sydney transport network leading to changed trip patterns. 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).

Table 7-1 indicates that 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. It also indicates that the fully completed WestConnex (in 2031) would provide a small reduction in the total vehicle hours travelled and an improvement in the average network speed. The average network speed across the entire Sydney road network increases from 27 kilometres per hour to 28 kilometres per hour. 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 trips by 2031, the cumulative benefit of this travel speed improvement would be substantial.

Table 7-1: Average weekday Sydney network performance

Scenario	Vehicle Kilometres Travelled (millions)	Vehicle Hours Travelled (millions)	Average Network Speed (kilometres per hour)
Base ‘do minimum’ (2021)	109	3.5	31
M4 Widening (2021)	108	3.5	31
Future ‘do minimum’ (2031)	126	4.7	27
Full WestConnex (2031)	126	4.6	28

Source: WestConnex Road Traffic Model, 2014

Volume over capacity (VoC) maps were presented in **chapters 4** and **6** to demonstrate network congestion in the Existing case (2012) , Base (2021) and Future 'do minimum' (2031) scenarios.

The following VoC maps demonstrate network congestion in the morning and evening peaks of the M4 Widening (2021) (refer **Figure 7-1** and **Figure 7-2**) and Full WestConnex (2031) scenarios (refer **Figure 7-3** and **Figure 7-4**). A section of road is considered to be heavily congested when the VoC ratio is greater than 1.0 and is considered to be uncongested when the VoC ratio is less than 0.7.

Although the introduction of the toll with the M4 Widening causes some redistribution of trips to other roads, the VoC maps do not demonstrate any significant increase in congestion on other parts of the network when compared with their 'do minimum' counterpart (refer **Figure 6-7** and **Figure 6-8**). For example, Victoria Road is shown as uncongested in both the morning (AM) and evening (PM) peak periods of the Full WestConnex scenario (refer **Figure 7-3** and **Figure 7-4**) which is the same condition as the Future 'do minimum' scenario (refer **Figure 6-7** and **Figure 6-8**). This indicates that the majority of trip redistribution to avoid the toll (refer **Table 7-3**) occurs outside of peak periods when the travel time on Victoria Road is lower than that during peak periods.

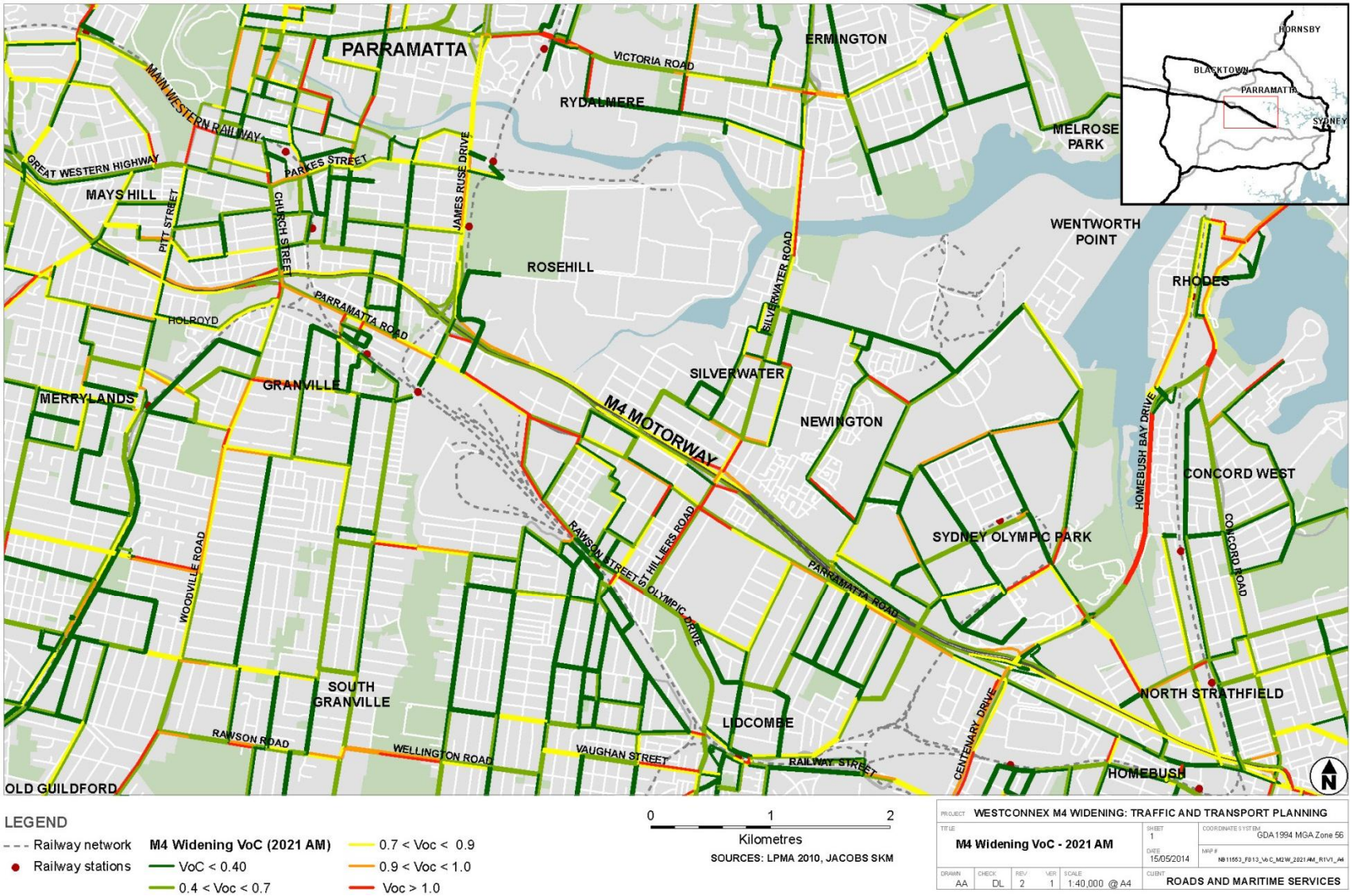

Figure 7-1: Volume over capacity ratio, morning peak, M4 Widening scenario (2021)

Source: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

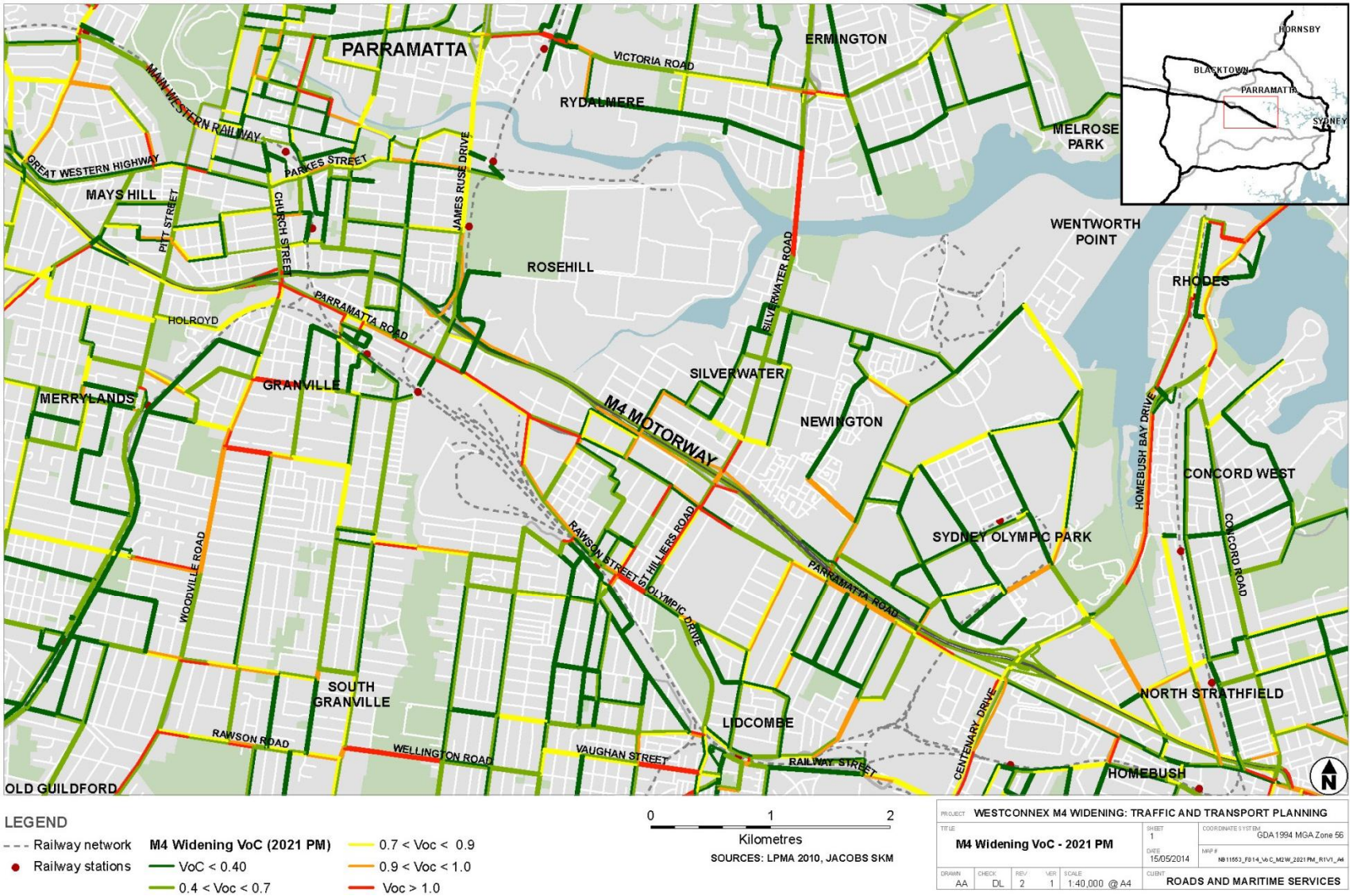

Figure 7-2: Volume over capacity ratio, evening peak, M4 Widening scenario (2021)

Source: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

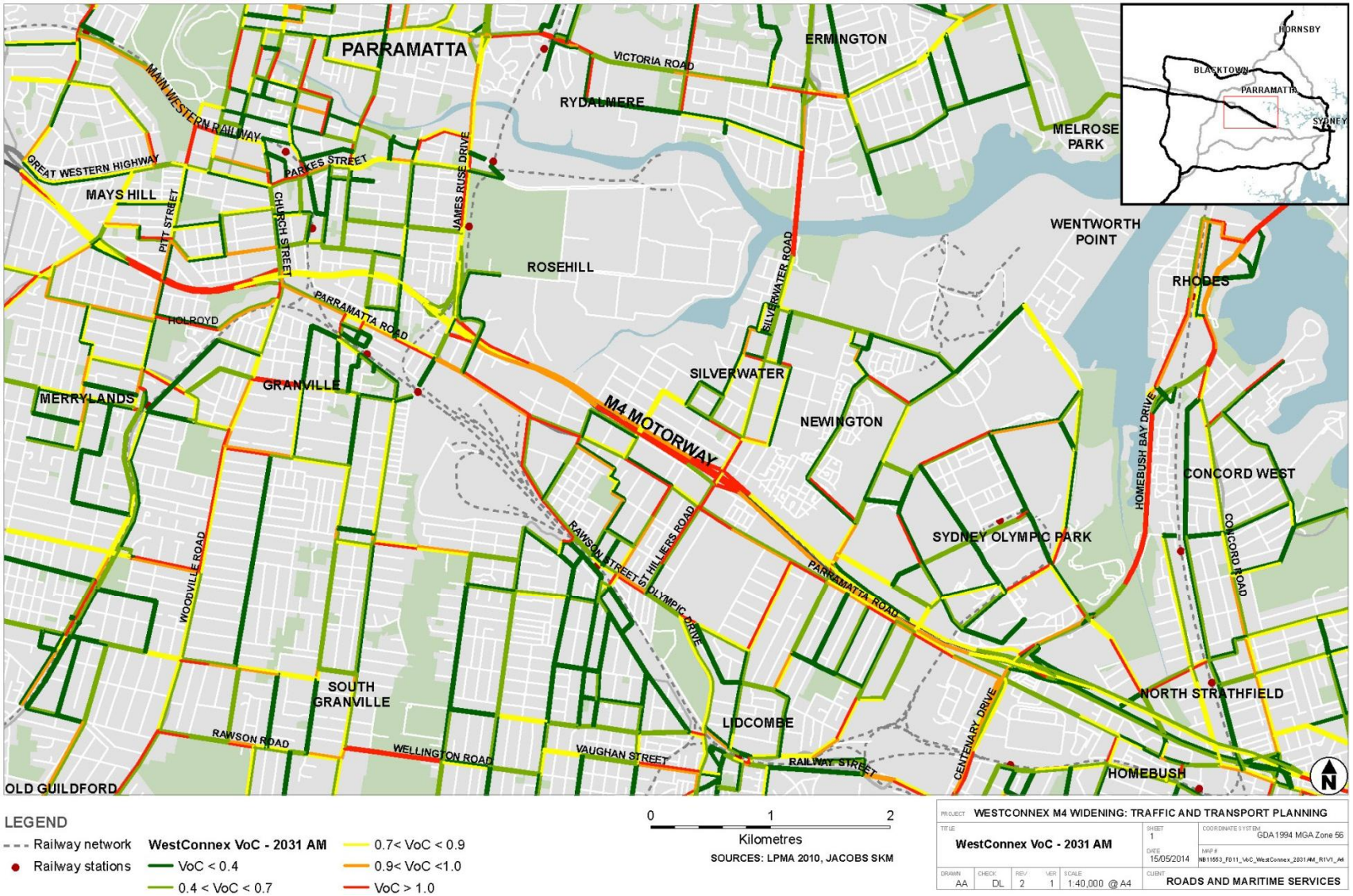

Figure 7-3: Volume over capacity ratio, morning peak, Full WestConnex scenario (2031)

Source: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

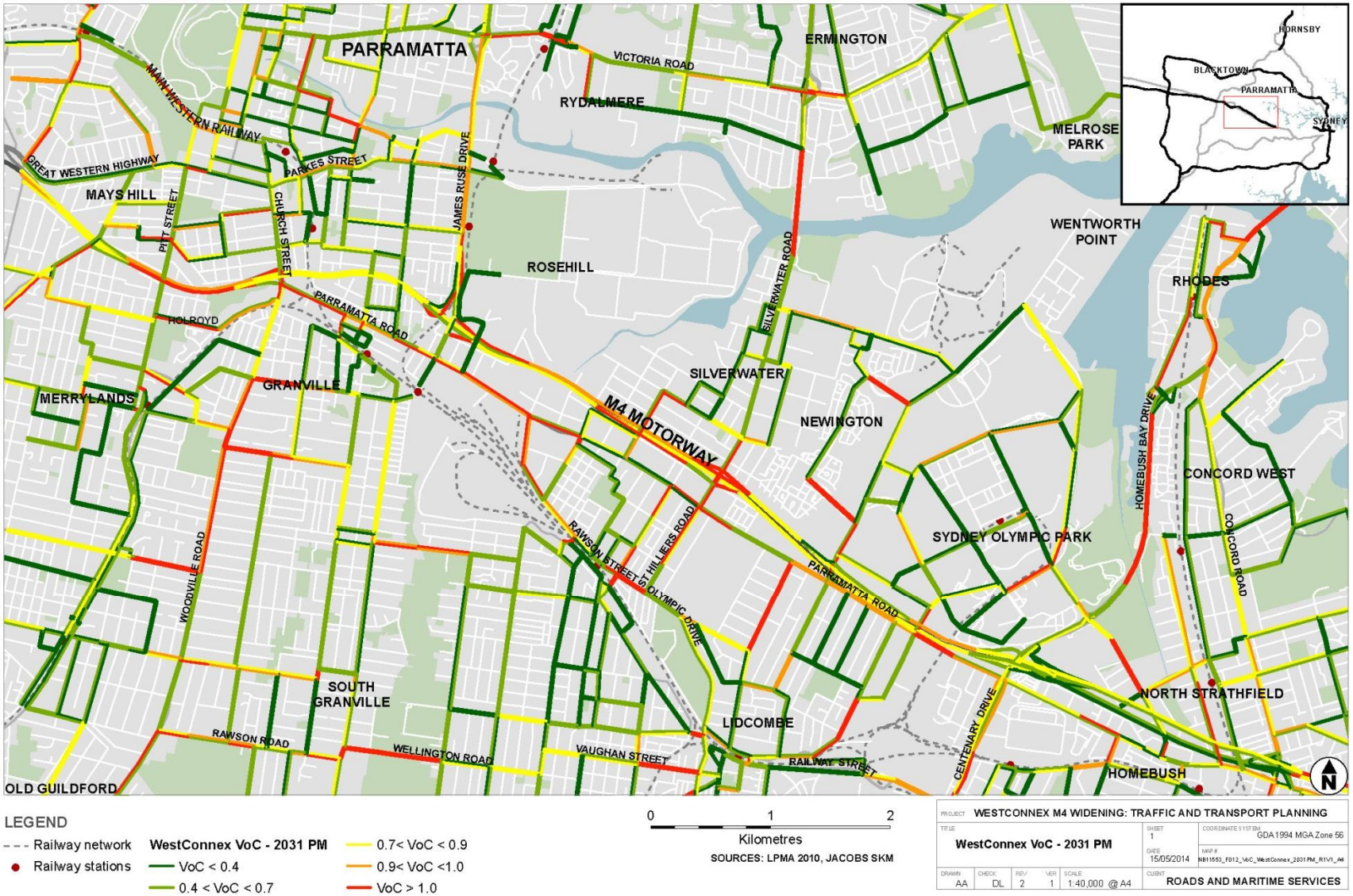

Figure 7-4: Volume over capacity ratio, evening peak, Full WestConnex scenario (2031)

Source: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

7.2 Traffic flows

7.2.1 M4 Motorway corridor performance

Figure 7-5 and **Figure 7-6** below show the modelled number of vehicles passing over Duck River at Auburn on the M4 Motorway and Parramatta Road in 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 7-7 and **Figure 7-8** 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.

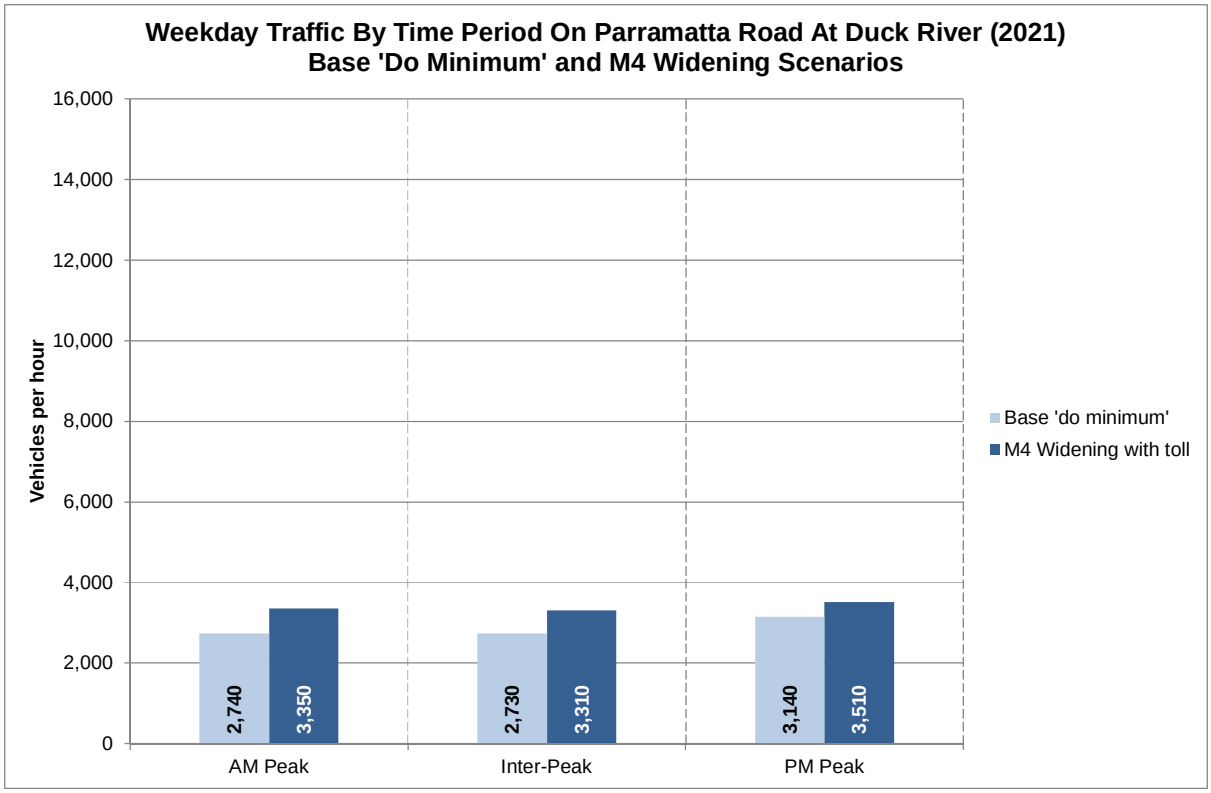

Figure 7-5: Parramatta Road traffic – Base 'do minimum' and M4 Widening scenarios (2021)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

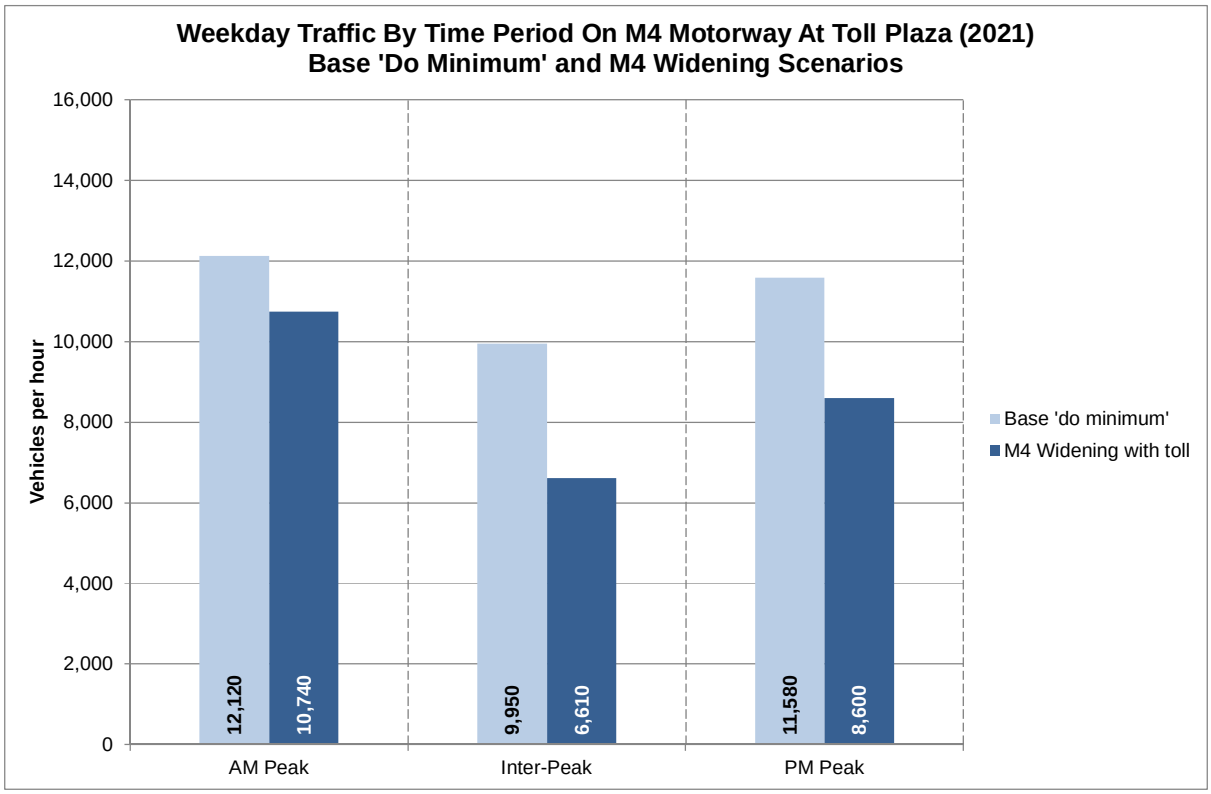

Figure 7-6: M4 Motorway traffic – Base 'do minimum' and M4 Widening scenarios (2021)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

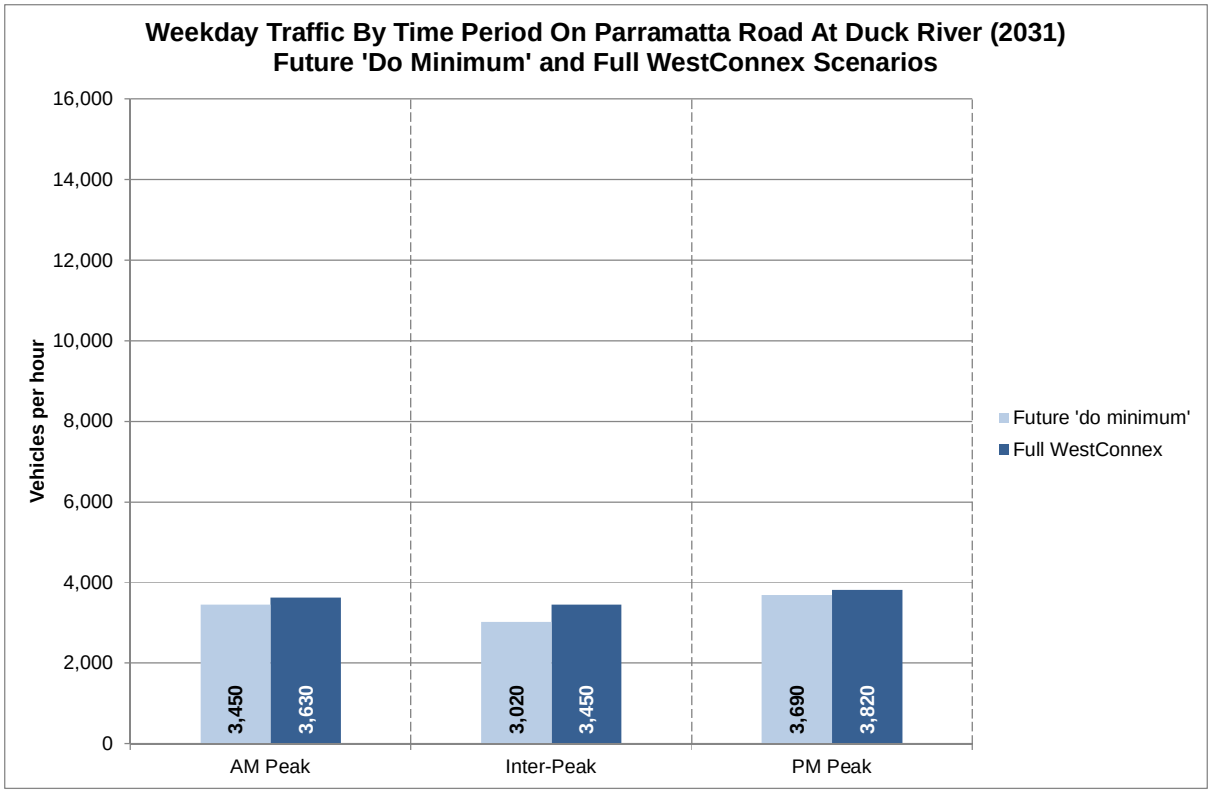

Figure 7-7: Parramatta Road traffic – Future 'do minimum' and Full WestConnex scenarios (2031)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

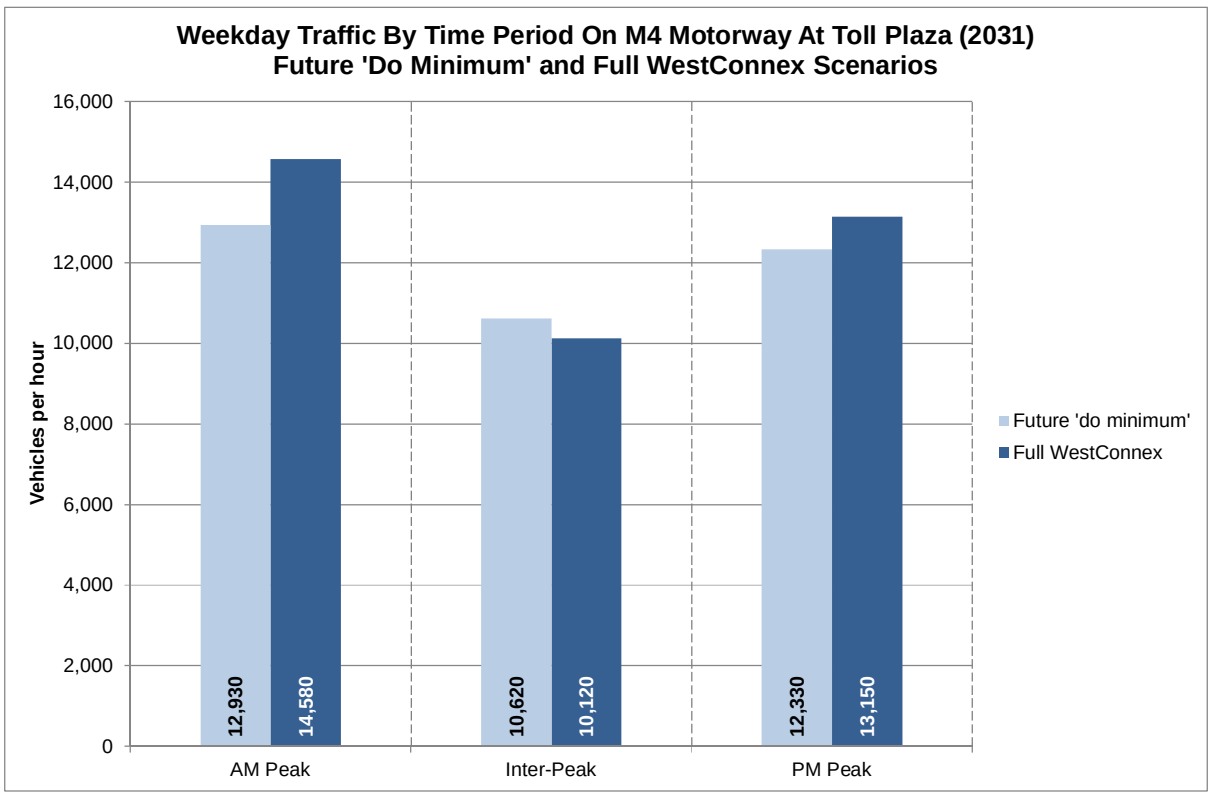

Figure 7-8: M4 Motorway traffic – Future 'do minimum' and Full WestConnex scenarios (2031)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

7.2.2 Distribution of east-west traffic

This section describes the distribution in East-West traffic and demonstrates how this distribution changes with the M4 Widening project. **Table 7-2** shows the number of times (in thousands) a vehicle passes the line (called a 'screenline') described below in **Figure 7-9** on a typical weekday.

Figure 7-9: Screenline to investigate changes in east-west traffic distribution

The change in traffic volumes detailed in **Table 7-2** shows that the M4 Widening would bring about some growth in traffic on Parramatta Road and Victoria Road. This is primarily due to users changing their travel routes to avoid paying the new toll. There is also anticipated growth in the use of the M2 Motorway. An analysis of the impact on intersection performance in the M4 Motorway corridor as a result of this redistribution is performed in **Section 7.4**.

Table 7-2: Screenline volumes, Base 'do minimum' and M4 Widening

Road	Number of weekday vehicles		
	Without M4 Widening (Base 'do minimum') (2021)	M4 Widening (2021)	Difference
M4 Motorway	179,620	114,890	-64,730
Parramatta Road	43,990	59,370	15,380
M2 Motorway	118,050	123,940	5,890
Victoria Road	60,440	70,250	9,810

Source: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

Section 4.1.1 gave an overview of the previous M4 Motorway toll (which was removed in 2010). The data presented in **Figure 4-1** shows that the toll removal coincided with a 23 per cent increase in typical weekday traffic volumes.

While overall Sydney road network congestion is anticipated to be significantly higher in 2021 than 2010, it is reasonable to expect that the impact of the new tolling arrangements would be higher due to the absence of a cashback scheme. The implications of the toll associated with the M4 Widening project are discussed in more detail in **section 7.9**.

Table 7-3 below shows the Full WestConnex scenario equivalent of **Table 7-2**. It shows a reduced impact on Parramatta Road and Victoria Road compared to the M4 Widening scenario as the broader network becomes more congested and WestConnex is completed, increasing the travel time savings offered by the M4 Widening project and the broader WestConnex scheme.

Table 7-3: Screenline volumes, Future 'do minimum' and Full WestConnex scheme

Road	Number of weekday vehicles		
	Without WestConnex (Future 'do minimum') (2031)	Full WestConnex (2031)	Difference
M4 Motorway	194,180	168,760	-25,420
Parramatta Road	52,030	62,490	10,460
M2 Motorway	140,430	140,840	410
Victoria Road	68,250	75,770	7,520

Source: Jacobs SKM, WestConnex Road Traffic Model, 2014

7.3 Travel times

This section describes the modelled travel times on the M4 Motorway and Parramatta Road between Church Street and Homebush Bay Drive for the morning peak, inter peak and evening peak time periods. The Base and Future 'do minimum' scenarios travel times are compared to those with M4 Widening and Full WestConnex scenarios travel times respectively.

As in **Chapter 6**, the travel time graphs presented in this section represent westbound trips with lines with a positive gradient (go up to the right) and eastbound trips are represented with lines with a negative gradient (go up to the left). It should be noted that vertical axis (time) values range from 0 to 20 minutes for the M4 Motorway graphs and from 0 to 30 minutes for the Parramatta Road graphs.

Figure 7-10 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. There would also be travel time savings in the westbound direction; the westbound trip takes six minutes in the Base 'do minimum' scenario compared to five minutes in the M4 Widening scenario.

Figure 7-11 indicates very low levels of congestion with similar travels speeds with and without the M4 Widening.

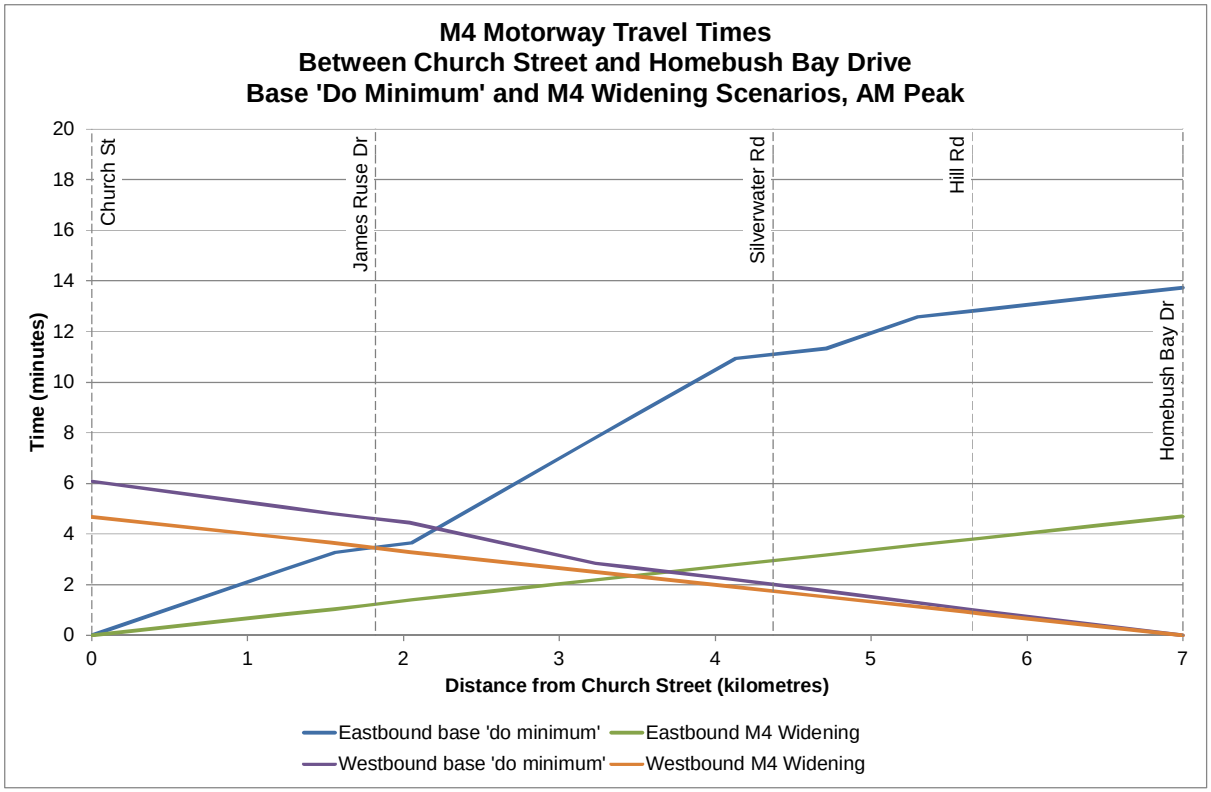

Figure 7-10: M4 Motorway, Base 'do minimum' and M4 Widening scenarios, AM peak (2021)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

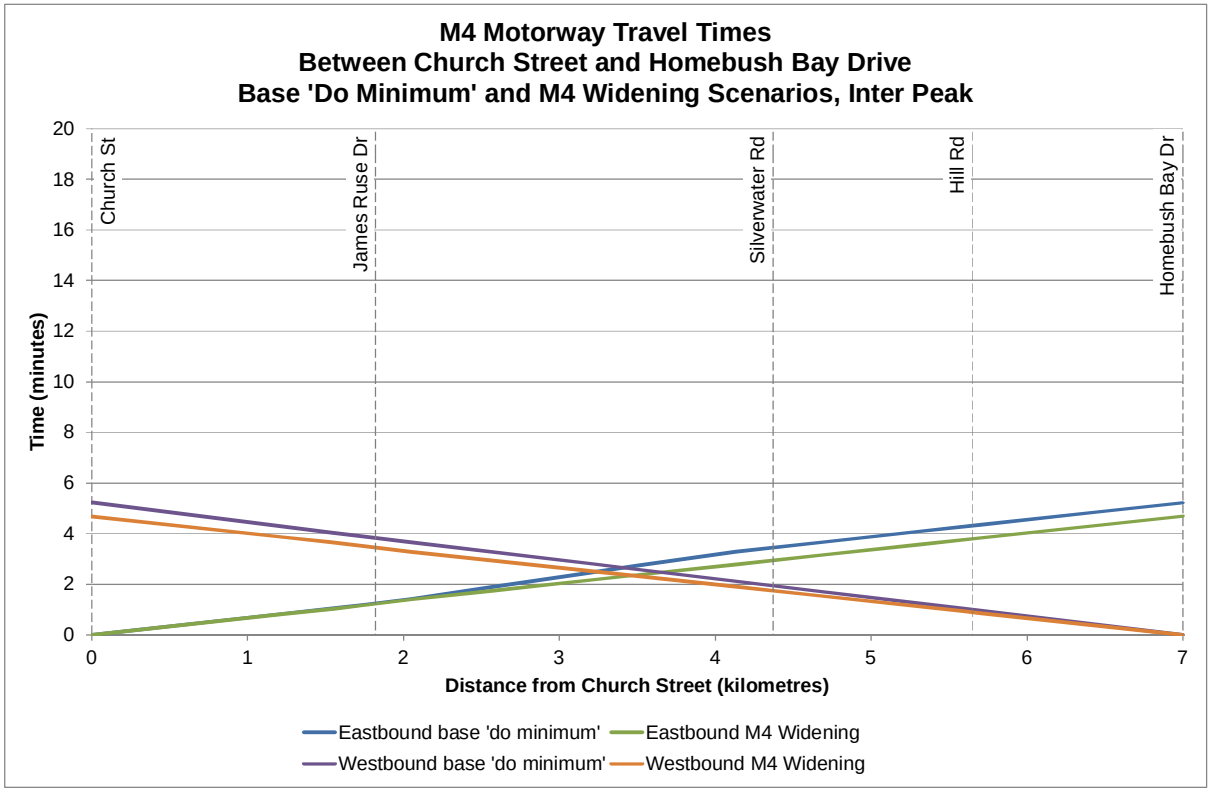

Figure 7-11: M4 Motorway, Base 'do minimum' and M4 Widening scenarios, Inter peak (2021)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

Figure 7-12 shows the M4 Motorway experiencing much lower congestion in the evening peak than shown for the morning peak in **Figure 7-10**.

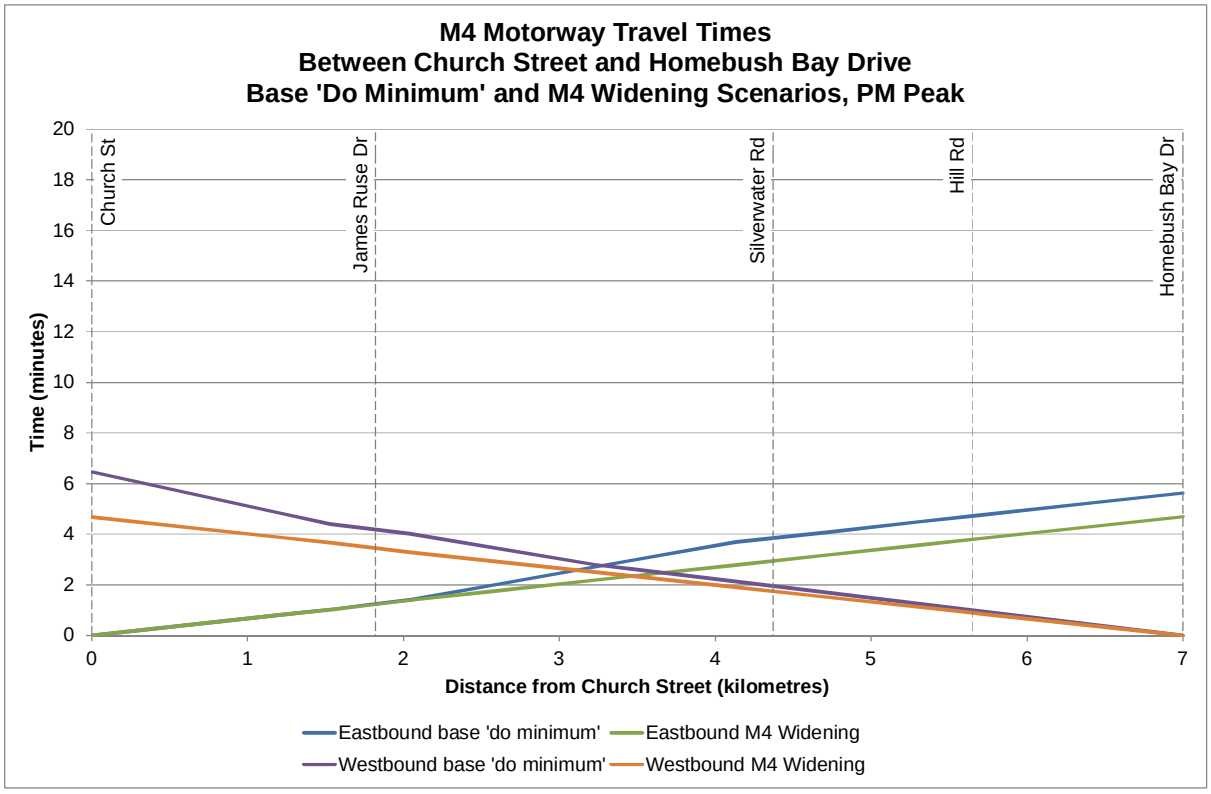

Figure 7-12: M4 Motorway, Base 'do minimum' and M4 Widening scenarios, PM peak (2021)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

Figure 7-13 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 of 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 18 minutes. Similarly, in the westbound direction the average travel time in the morning peak increases from approximately 13 minutes in the Base 'do minimum' scenario to approximately 17 minutes under the M4 Widening scenario.

The increase in modelled travel times indicated for the morning peak remain consistent in the inter peak and evening peak periods, as shown in **Figure 7-14** and **Figure 7-15**.

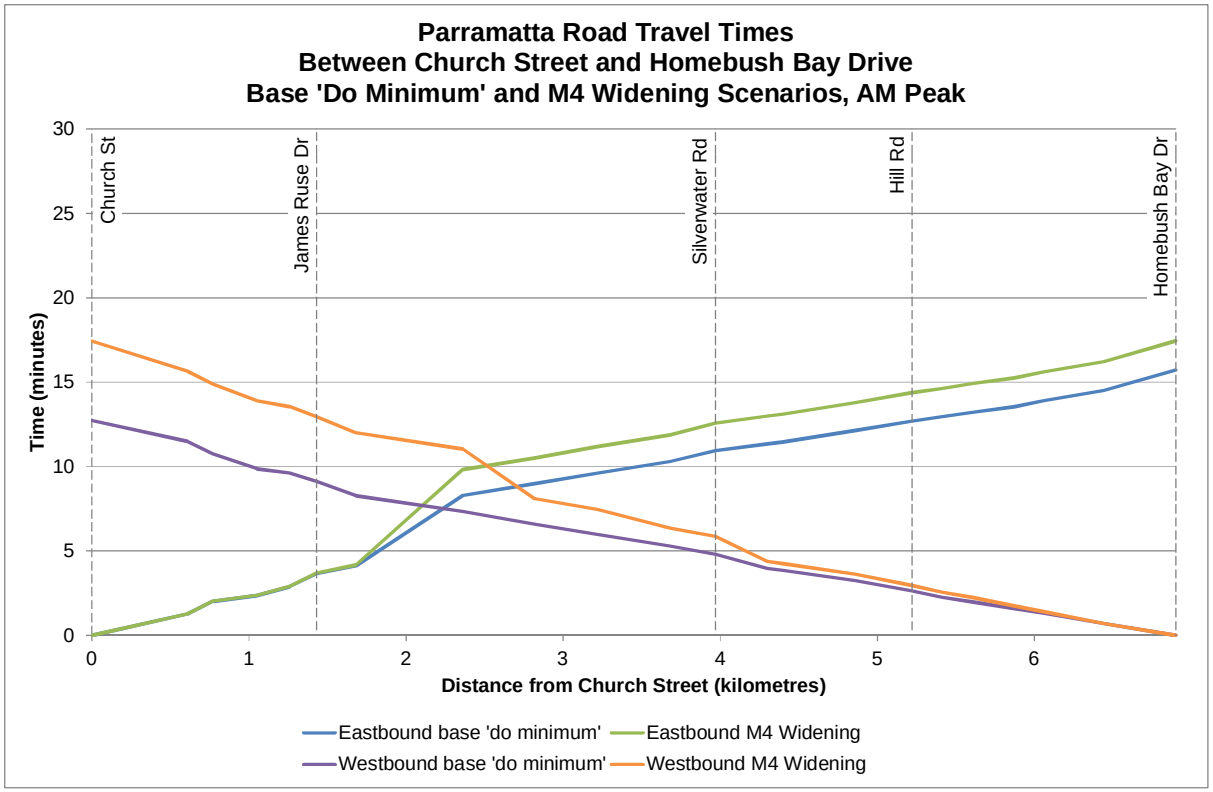

Figure 7-13: Parramatta Road, Base 'do minimum' and M4 Widening scenarios, AM peak (2021)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

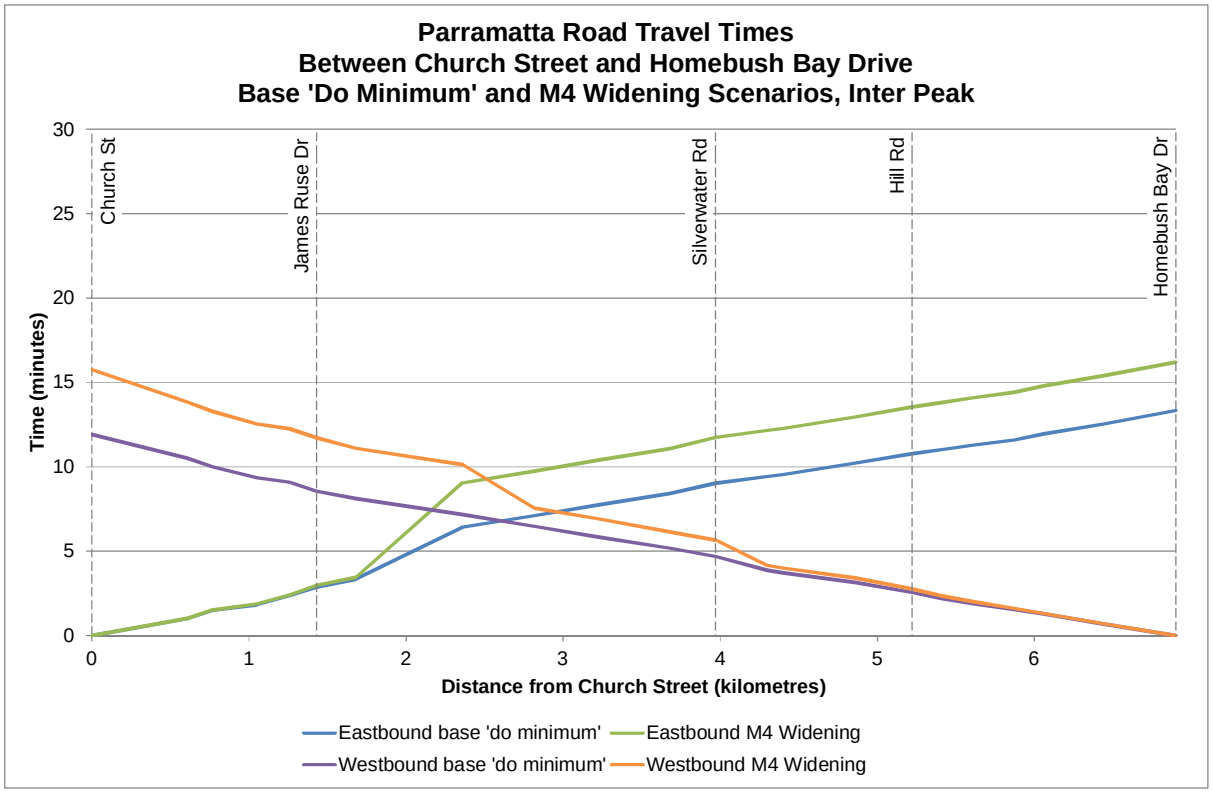

Figure 7-14: Parramatta Road, Base 'do minimum' and M4 Widening scenarios, Inter peak (2021)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

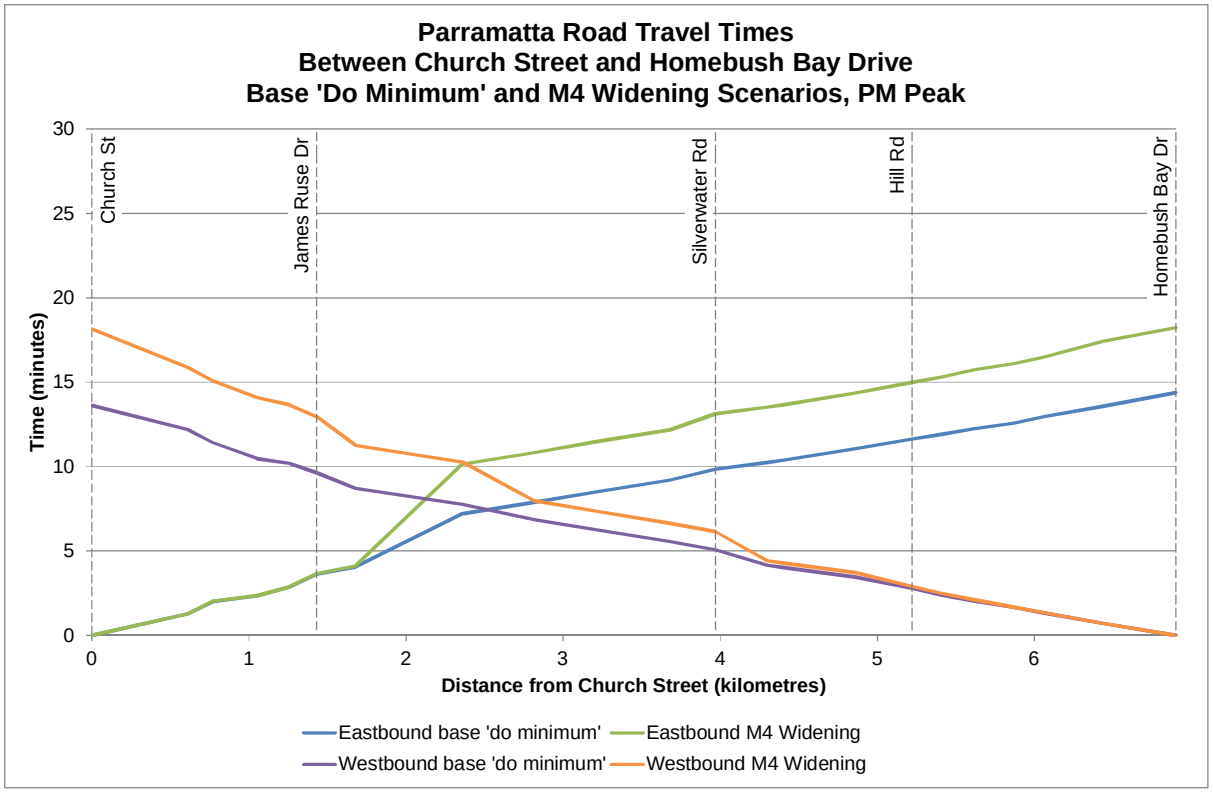

Figure 7-15: Parramatta Road, Base 'do minimum' and M4 Widening scenarios, PM peak (2021)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

Figure 7-16 shows high levels of congestion on the M4 Motorway in the morning peak under the Future 'do minimum' scenario, with the eastbound trip from Church Street to Homebush Bay Drive taking 19 minutes compared to 14 minutes in the Base 'do minimum' scenario. Under the Full WestConnex scenario, this trip time reduces to approximately five minutes which demonstrates that the travel time savings achieved in the M4 Widening scenario are maintained as the remainder of the WestConnex scheme is delivered.

There would also be travel time savings in the westbound direction; the westbound trip takes 15 minutes in the Future 'do minimum' scenario compared to approximately nine minutes with the Full WestConnex scenario which includes the M4 Widening project.

Lower levels of congestion are indicated in the inter peak (refer **Figure 7-17**) , under the Future 'do minimum' scenario, with the eastbound trip from Church Street to Homebush Bay Drive taking 9 minutes. This trip time again reduces to approximately five minutes with the Full WestConnex scenario.

In the evening peak Full WestConnex scenario (refer **Figure 7-18**), similar travel time savings as would be achieved in the morning peak period are again achieved with the eastbound trip between Church Street and Homebush Bay Drive reducing from approximately 11 minutes under the Future 'do minimum' scenario to approximately five minutes with the Full WestConnex scenario.

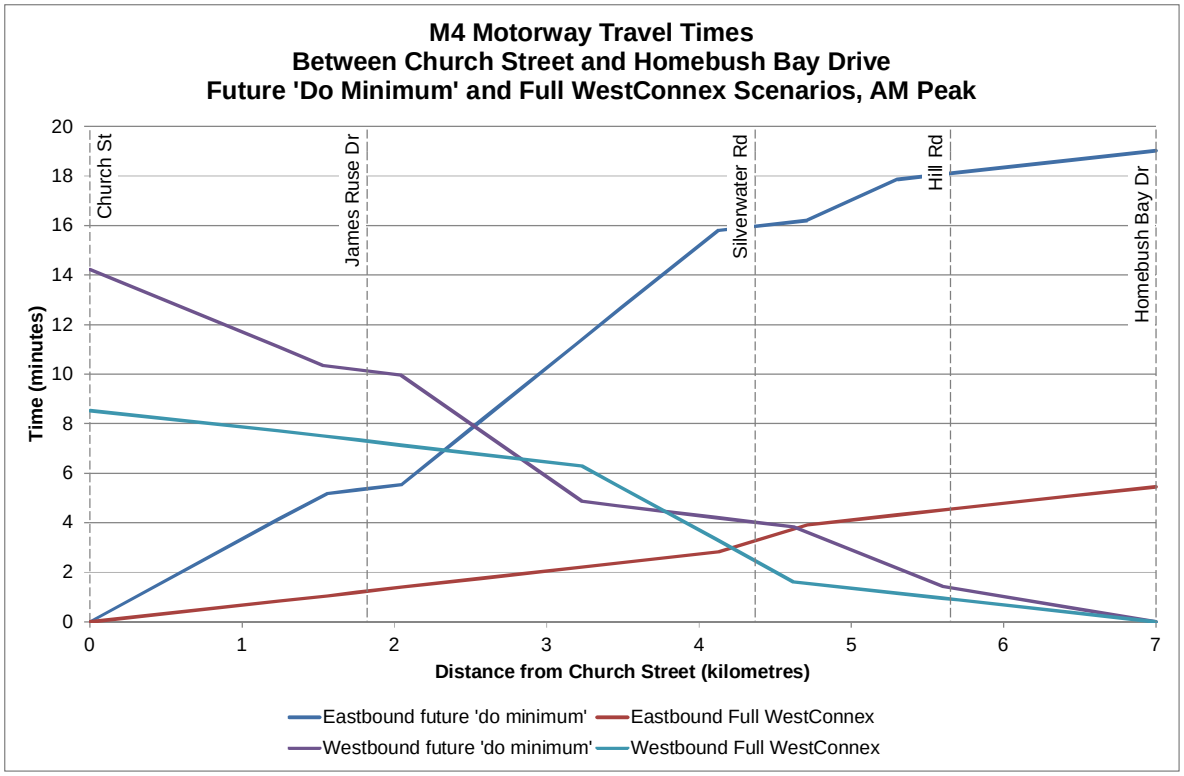

Figure 7-16: M4 Motorway, Future 'do minimum' and Full WestConnex scenarios, AM peak (2031)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

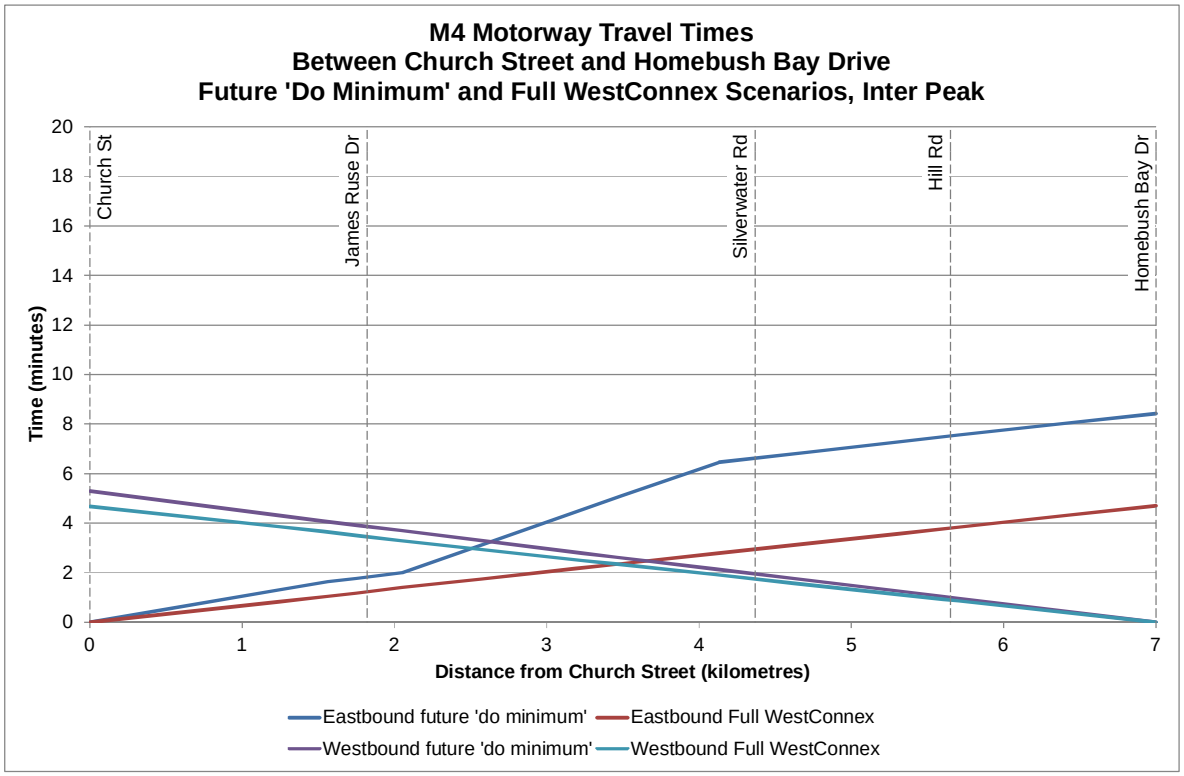

Figure 7-17: M4 Motorway, Future 'do minimum' and Full WestConnex scenarios, Inter peak (2031)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

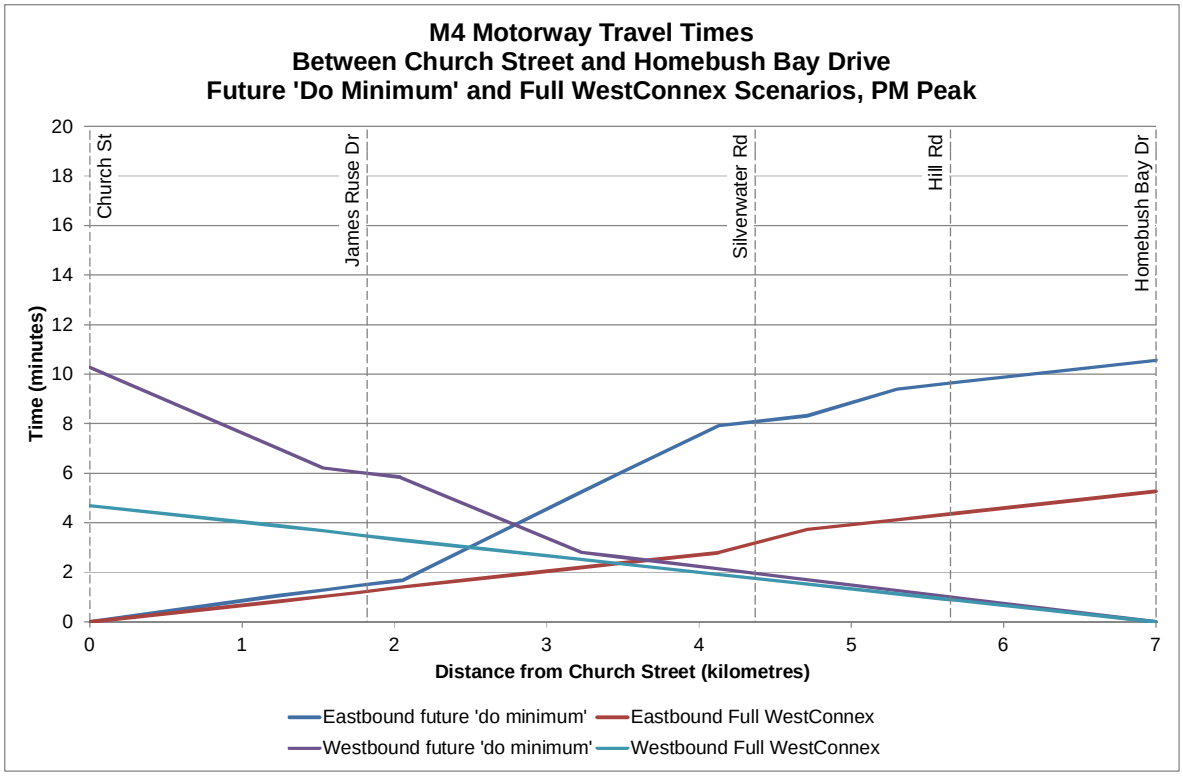

Figure 7-18: M4 Motorway, Future 'do minimum' and Full WestConnex scenarios, PM peak (2031)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

Figure 7-19, **Figure 7-20** and **Figure 7-21** show increases in Parramatta Road travel times with WestConnex due to drivers avoiding the toll. In the future scenarios there are further increases in Parramatta Road travel times since there are more vehicles in the corridor, however, the proportional increase between the Future 'do minimum' scenario and the Full WestConnex scenario remains the same. It is important to note that the increase in traffic, and therefore travel times, along Parramatta Road will generally return to numbers equivalent to Parramatta Road prior to the removal of the toll on the M4 Motorway in 2010.

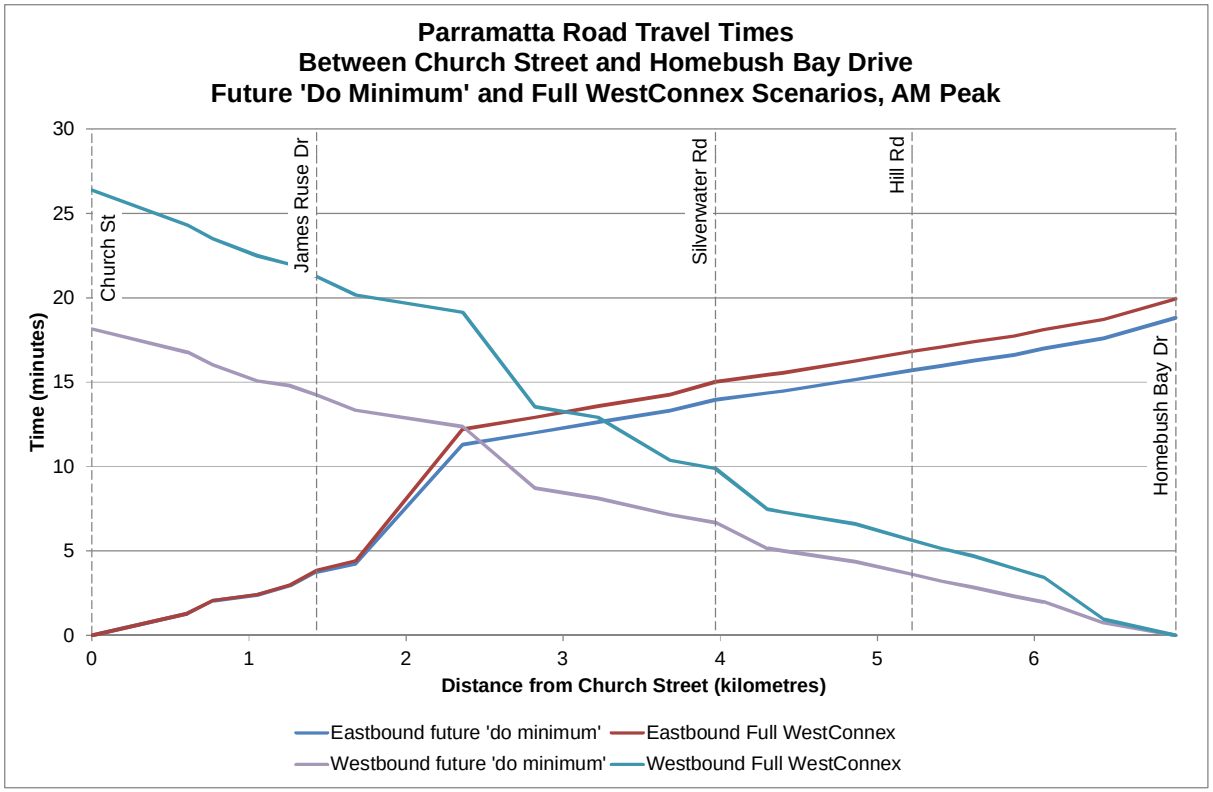

Figure 7-19: Parramatta Road, Future 'do minimum' and Full WestConnex scenarios, AM peak (2031)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

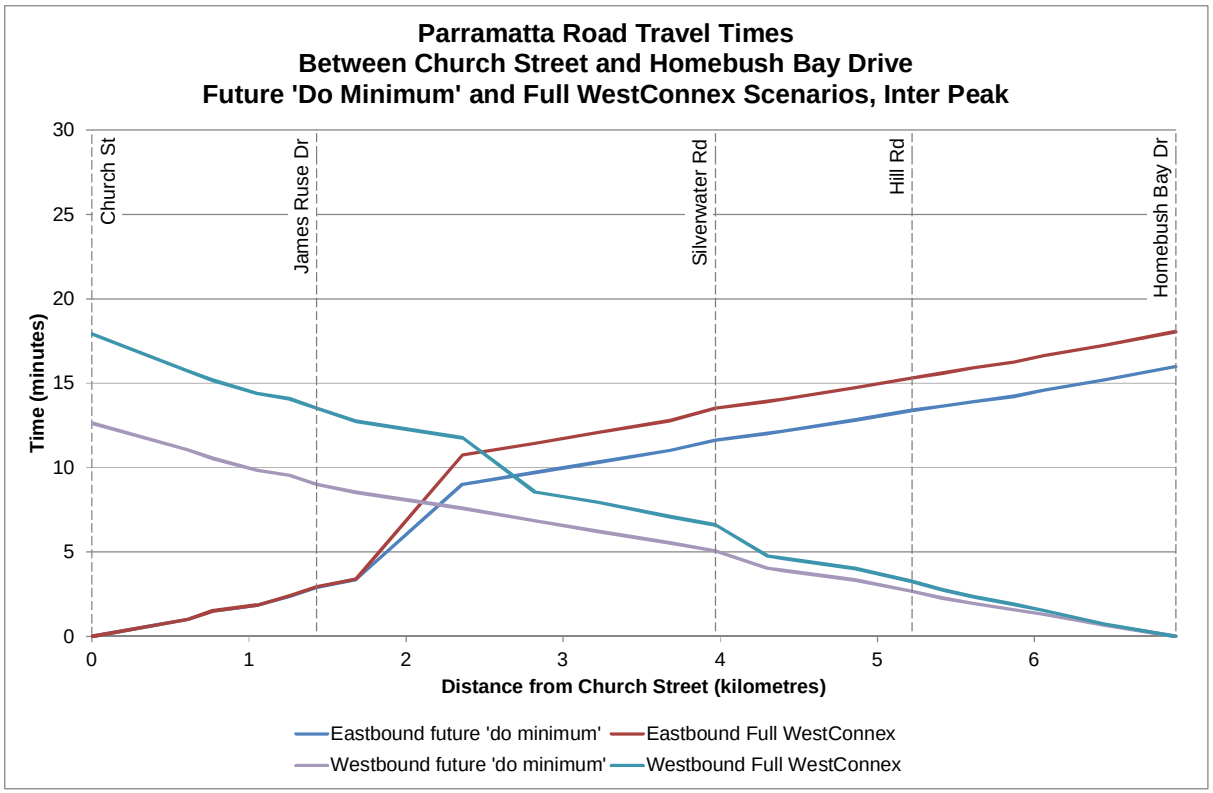

Figure 7-20: Parramatta Road, Future 'do minimum' and Full WestConnex scenarios, Inter peak (2031)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

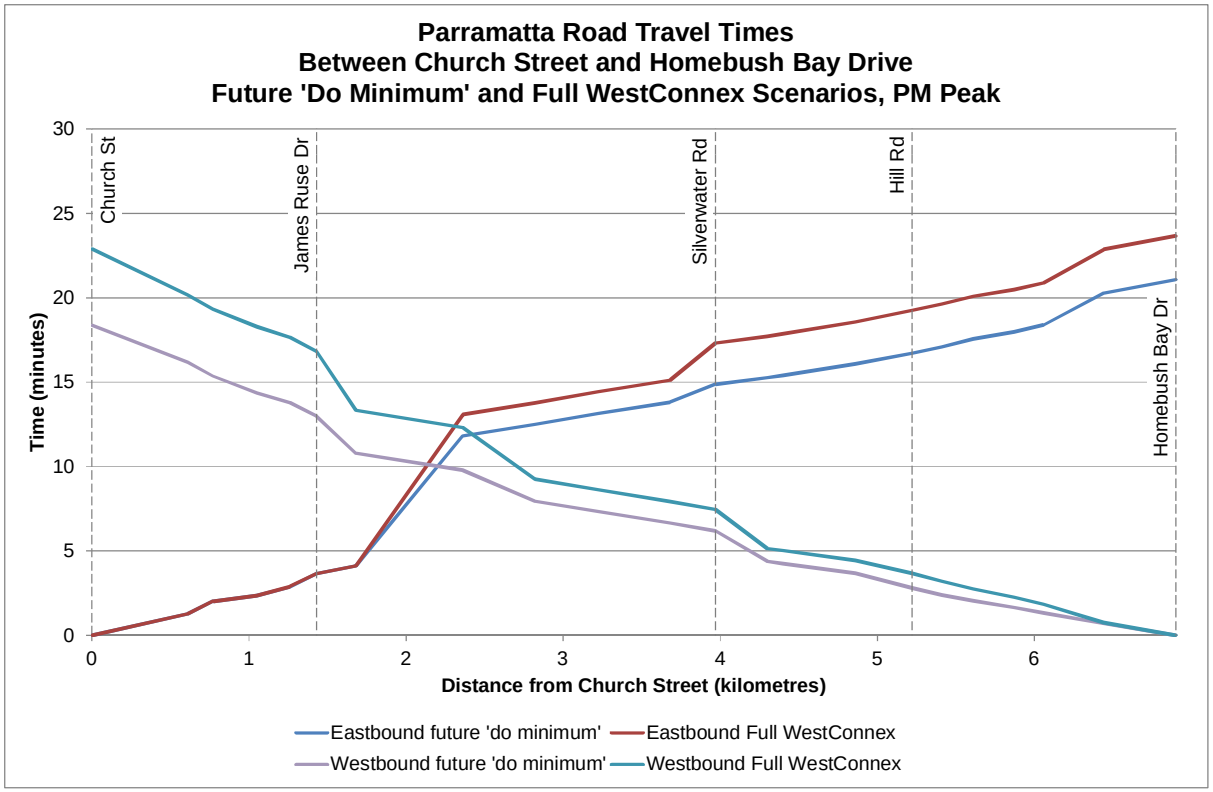

Figure 7-21: Parramatta Road, Future 'do minimum' and Full WestConnex scenarios, PM peak (2031)

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

Table 7-4, **Table 7-5** and **Table 7-6** present modelled travel times for the Existing case, Base and Future scenarios, including the travel times reported in the preceding figures.

Table 7-4: 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

Source: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

Table 7-5: 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

Source: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

Table 7-6: 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

Source: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

In addition to the travel time savings discussed above, the M4 Widening project would also deliver improvements in travel time reliability. This benefit will derived in two parts:

- The increased lane capacity provided by the project will 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.

The assessment as also demonstrated a reduction in the number of crashes that are likely to occur further increasing the reliability of travel time.

7.4 Interchange and intersection performance

The assessment of interchange and intersection performance is based on criteria outlined in **Table 4-2**, as defined by *Guide to Traffic Generating Developments* (Roads and Traffic Authority 2002). 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 in this section have been taken from the WestConnex Road Traffic Model (WRTM). Results are shown for the same interchanges and intersections as assessed in Chapters 4 and 6 for the Existing case and 'do minimum' scenarios, respectively.

In this scenario, the analysis is based on modelled traffic volumes as opposed to the actual traffic counts used to assess existing operations (refer to **section 4.3**). 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 project (refer to **section 6.7**) is undertaken to provide a base case against which to evaluate the impact of the project under the same forecast future traffic conditions.

7.4.1 Granville

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **section 4.3.1** and are shown in **Figure 4-13**.

Table 7-7 and **Table 7-8** below show the results of the interchange and intersection analysis for the Base 'do minimum' and M4 Widening scenarios.

The tables in this section show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios with the M4 Widening project and the full WestConnex scheme, respectively, built.

The Base 'do minimum' results for the morning peak show that the critical intersection of Parramatta Road/ Church Street operates beyond theoretical capacity with an average delay of approximately 67 seconds and is approaching LoS F.

Under the projected morning peak demands associated with the M4 Widening scenario, modelling outputs indicate deteriorating performance at the Parramatta Road intersections due to increased traffic volumes. This can be explained by road users seeking to use Parramatta Road as an alternative to the tolled M4 Motorway.

Similarly in the evening peak the forecast demand indicates an increase in traffic along Parramatta Road, with an additional approximately 700 PCUs (passenger car units) at the intersection of Parramatta Road/Good Street, and approximately 500 PCU at of Parramatta Road/Bold Street. Modelling of these intersections indicates improved performance at the Parramatta Road/Bold Street intersection offset by the deteriorating performance at the neighbouring Parramatta Road/Good Street intersection.

Table 7-7: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), morning peak

	Level of service		Vehicle delay (seconds)	
Intersection	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
Church Street/M4 Motorway eastbound off-ramp	D	D	49	47
Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp	E	F	67	>140
Parramatta Road/Bold Street	D	F	50	>140
Parramatta Road/Good Street	C	E	32	67

Table 7-8: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), evening peak

Intersection	Level of service		Vehicle delay (seconds)	
	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
Church Street/M4 Motorway eastbound off-ramp	C	C	35	39
Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp	F	F	>140	>140
Parramatta Road/Bold Street	F	D	73	53
Parramatta Road/Good Street	D	F	51	>140

Further degradation of performance is experienced in the morning peak of the Future 'do minimum' scenario with the increased traffic expected at the intersection of Parramatta Road/Church Street, refer to **Table 7-9,** resulting in LoS F. The results of the Full WestConnex scenario in the morning peak, indicates further deterioration of intersection performance due to further growth in traffic.

In the evening peak of the Full WestConnex scenario, refer to **Table 7-10**, the intersection of Parramatta Road/Church Street is expected to operate at LoS F, with long queues on the southern leg of Woodville Road and eastern leg of Parramatta Road. The results of the evening peak full WestConnex scenario show that both the Parramatta Road/Church Street and Church Street/M4 Motorway eastbound off-ramp intersections operate over capacity during the evening peak. This further decrease in intersection performance can be attributed to the additional demand in the network when compared to the Base 'do minimum and M4 Widening scenarios.

Both the morning and evening peak periods of the Full WestConnex scenario show that both Parramatta Road/Good Street and Parramatta Road/Bold Street operate in excess of their theoretical capacity. This further decrease in intersection performance can be attributed to the additional demand in the network when compared to the Base 'do minimum and M4 Widening scenarios.

Table 7-9: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), morning peak

Intersection	Level of service		Vehicle delay (seconds)	
	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
Church Street/M4 Motorway eastbound off-ramp	D	D	52	51
Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp	F	F	>140	>140
Parramatta Road/Bold Street	F	F	>140	>140
Parramatta Road/Good Street	D	F	55	124

Table 7-10: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), evening peak

Intersection	Level of service		Vehicle delay (seconds)	
	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
Church Street/M4 Motorway eastbound off-ramp	C	D	38	49
Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp	F	F	>140	>140
Parramatta Road/Bold Street	F	F	91	94
Parramatta Road/Good Street	F	F	>140	>140

7.4.2 Clyde and Rosehill

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **section 4.3.2** and are shown in **Figure 4-14**.

The tables in this section show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios with the M4 Widening project and the full WestConnex scheme, respectively, built.

Under the projected demands in the morning peak associated with the M4 Widening scenario, refer **Table 7-11**, it can be seen that two of the four modelled intersections 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 at capacity. This shift in intersection performance can be attributed to the increases in the traffic movements from the south and west over the projected flows in the Base 'do minimum' scenario.

The results for the M4 Widening scenario evening peak, refer **Table 7-12**, show that the intersections of James Ruse Drive with Parramatta Road and Prospect Street are operating over capacity with the other intersections operating under capacity. The over capacity operation of the James Ruse Drive/Parramatta Road intersection can be attributed to an increase in demand at this intersection of 1,700 vehicles over the Base 'do minimum' scenario. This increase in traffic demand is likely to be due to those vehicles choosing to avoid the toll on the M4 Motorway.

Table 7-11: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), morning peak

Intersection	Level of service		Vehicle delay (seconds)	
	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
James Ruse Drive/Prospect Street	C	F	37	111
James Ruse Drive/M4 Motorway eastbound on-ramp	C	B	32	28
James Ruse Drive/M4 Motorway westbound off-ramp	C	B	29	28
James Ruse Drive/Parramatta Rd/Berry Street	C	F	39	117

Table 7-12: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), evening peak

Intersection	Level of service		Vehicle delay (seconds)	
	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
James Ruse Drive/Prospect Street	F	F	83	110
James Ruse Drive/M4 Motorway eastbound on-ramp	B	B	23	28
James Ruse Drive/M4 Motorway westbound off-ramp	B	B	26	25
James Ruse Drive/Parramatta Road/Berry Street	D	F	43	83

The results for the morning peak Full WestConnex scenario show three of the four modelled intersections operating above capacity. The intersections of James Ruse Drive/Prospect Street and James Ruse Drive/Parramatta Road operate at level of service F during the morning peak and are over capacity. This further decrease in intersection performance can be attributed to an additional demand of between 500 and 1000 vehicles at these points during the morning peak.

The performance of the intersection of James Ruse Drive and Parramatta Road during the M4 Widening and Full WestConnex scenarios causes queuing, in excess of 300 metres, on the western Parramatta Road approach. It is likely that this queuing would affect the performance of downstream intersections.

Potential improvements can be made at the intersection of James Ruse Drive and Parramatta Road through the banning of the low demand right turn from Parramatta Road to Berry Street and providing access to this area at the downstream signalised intersection with Marsh Street. The removal of this right turn would allow the removal of a signal phase and free up additional green time for other critical movements. However, it is unlikely that this step alone would be sufficient to bring the intersection under capacity and further infrastructure improvements may be required.

Table 7-13: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), morning peak

Intersection	Level of service		Vehicle delay (seconds)	
	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
James Ruse Drive/Prospect Street	D	F	53	>140
James Ruse Drive/M4 Motorway eastbound on-ramp	D	B	47	27
James Ruse Drive/M4 Motorway westbound off-ramp	C	F	33	76
James Ruse Drive/Parramatta Road/Berry Street	F	F	93	117

Table 7-14: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), evening peak

Intersection	Level of service		Vehicle delay (seconds)	
	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
James Ruse Drive/Prospect Street	F	F	>140	>140
James Ruse Drive/M4 Motorway eastbound on-ramp	B	B	16	17
James Ruse Drive/M4 Motorway westbound off-ramp	B	D	26	45
James Ruse Drive/Parramatta Road/Berry Street	F	F	>140	>140

7.4.3 Auburn

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **Section 4.3.3** and are shown in **Figure 4-15**.

The tables in this section show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios with the M4 Widening project and the full WestConnex scheme, respectively, built.

Under the projected morning peak demands associated with the M4 Widening scenario, refer **Table 7-15**, modelling outputs suggest similar results to the Base 'do minimum' scenario 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 an improvement on the Base 'do minimum'. This can be attributed to a reduction in the volume of all four right turn movements at the intersection. In addition, the intersection of Silverwater Road/M4 Motorway westbound ramps intersection has improved to LoS B compared to LoS D in the Base 'do minimum' scenario. This can be attributed to a drop in the left turn give-way movement from Silverwater Road to the M4 Motorway westbound on-ramp of approximately 390 PCUs, which is the critical movement at the intersection.

In the evening peak the projected demands associated with the M4 Widening scenario, refer **Table 7-16**, the intersection of Silverwater Road/Carnarvon Street is expected to operate below capacity and LoS C, which is an improvement on the Base 'do minimum' scenario. This can be attributed to a drop in the left turn give-way movement from Silverwater Road to the M4 eastbound on-ramp of approximately 200 PCU. This movement is on the threshold of capacity in the Base 'do minimum' scenario; however the reduction in this volume results in improved average performance of the intersection under the M4 Widening scenario.

The intersection of Parramatta Road/Rawson Street/Duck Street shows deterioration in performance when compared to the Base 'do minimum' scenario. This can be attributed to an increase in overall traffic at the intersection of approximately 600 PCUs in the morning peak and 300 PCUs in the evening peak, resulting in the intersection performance deteriorating to LoS F. The increase in traffic on Parramatta Road could be attributed to the reinstatement of tolls on the M4 Motorway, causing a diversion of traffic on to Parramatta Road as an alternative route.

Table 7-15: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), morning peak

	Level of service		Vehicle delay (seconds)	
Intersection	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
Parramatta Road/Rawson Street/Duck Street	C	F	42	70
Silverwater Road/Carnarvon Street	F	D	>140	53
Silverwater Road/M4 Motorway eastbound ramps	F	F	>140	>140
Silverwater Road/M4 Motorway westbound ramps	D	B	46	26
Silverwater Road/Parramatta Road	D	D	54	48

Table 7-16: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), evening peak

	Level of service		Vehicle delay (seconds)	
Intersection	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
Parramatta Road/Rawson Street/Duck Street	F	F	101	108
Silverwater Road/Carnarvon Street	F	F	73	92
Silverwater Road/M4 Motorway eastbound ramps	D	C	46	33
Silverwater Road/M4 Motorway westbound ramps	D	D	46	56
Silverwater Road/Parramatta Road	F	F	120	122

The results of the AM peak Full WestConnex scenario (refer **Table 7-17**) also show four of the five intersections operating above capacity, with the remaining intersection at capacity. There is little difference between the results for the Future 'do minimum' and Full WestConnex scenarios.

Under the Full WestConnex scenario, with increased traffic, the intersection of Parramatta Road/Rawson Street/Duck Street is expected to operate poorly at LoS F. This is slightly improved when compared to the Future 'do minimum' scenario despite an additional approximately 100 PCUs at the intersection. However, the additional traffic in the Full WestConnex scenario is primarily on the through movements on Parramatta Road, with right turn volumes having decreased in comparison to the Future 'do minimum' scenario. This allows better optimisation of the signal timings at the intersection, resulting in improved performance in comparison to the Future 'do minimum' scenario.

The results of the PM peak Full WestConnex scenario (refer **Table 7-18**) show that the intersections of Silverwater Road/Carnarvon Street and Silverwater Road/Parramatta Road operate in excess of their theoretical capacity, with similar results to those of the Future 'do minimum' scenario.

The intersection of Silverwater Road/M4 eastbound ramps is expected to perform at LoS D, which is a slight worsening in performance in comparison to the Future 'do minimum' scenario, where it would operate at LoS C. This can be attributed to an increase in the right turn volume from Silverwater Road to the M4 Motorway eastbound on-ramp, which results in less green time to all other movements. In addition, the intersection of Silverwater Road/M4 Motorway westbound ramps has improved in performance to Los D, compared to LoS F in the Future 'do minimum' scenario. This can be attributed to a decrease in total volume at the intersection, of approximately 150 PCUs which allows better optimisation of the signal timings at the intersection.

The intersection of Parramatta Road/Rawson Street/Duck Street shows decreased performance in the evening peak Full WestConnex scenario, due to the increased volume of traffic attempting to traverse the intersection. Under this scenario, the intersection is expected to operate at Los F, with queuing particularly on the eastern and western approaches of Parramatta Road.

Due to the increased demands projected under all scenarios it is anticipated that infrastructure improvements would be required on the Silverwater Road corridor to bring the modelled network below capacity. These modifications could take the form of a revised lane configuration on Silverwater Road between the M4 Motorway and Parramatta Road.

Table 7-17: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), morning peak

Intersection	Level of service		Vehicle delay (seconds)	
	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
Parramatta Road/Rawson Street/Duck Street	F	F	128	98
Silverwater Road/Carnarvon Street	F	F	>140	108
Silverwater Road/M4 Motorway eastbound ramps	F	F	>140	>140
Silverwater Road/M4 Motorway westbound ramps	D	E	49	69
Silverwater Road/Parramatta Road	F	F	73	85

Table 7-18: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), evening peak

Intersection	Level of service		Vehicle delay (seconds)	
	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
Parramatta Road/Rawson Street/Duck Street	F	F	>140	>140
Silverwater Road/Carnarvon Street	F	F	117	124
Silverwater Road/M4 Motorway eastbound ramps	C	D	37	55
Silverwater Road/M4 Motorway westbound ramps	F	D	104	45
Silverwater Road/Parramatta Road	F	F	>140	>140

7.4.4 Lidcombe and Sydney Olympic Park

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **Section 4.3.4** and are shown in **Figure 4-16**.

The tables in this section show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios with the M4 Widening project and the full WestConnex scheme, respectively, built.

In the morning peak of the M4 Widening scenario, refer **Table 7-19**, the intersection of Hill Road/Parramatta Road experiences an increase in traffic of approximately 600 PCUs in comparison to the Base 'do minimum' scenario. This causes the intersection to operate well beyond theoretical capacity at LoS F. The network issues apparent in the Base 'do minimum' scenario at the M4 Motorway off-ramp and the Hill Road/Carter Street intersection are further exacerbated in the M4 Widening scenario due to an increase in traffic. The off-ramp is now expected to operate at LoS F, whilst the Hill Road/Carter Street intersection operates with an average delay in excess of 140 seconds and a LoS F.

In the evening peak of the M4 Widening scenario, refer **Table 7-20**, the intersection of Hill Road/Parramatta Road experiences an increase in traffic of approximately 500 PCUs in comparison to the Base 'do minimum' scenario. This causes the intersection to operate well beyond theoretical capacity at LoS F. The network issues apparent in the Base 'do minimum' scenario at the M4 Motorway off-ramp and the Hill Road/Carter Street intersection are improved in the M4 Widening scenario due to a decrease in off-ramp traffic and a decrease in the movements into and out of Carter Street. The off ramp is now expected to operate at LoS A, while the Hill Road/Carter Street intersection operates at LoS D.

Table 7-19: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), morning peak

	Level of service		Vehicle delay (seconds)	
Intersection	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
Parramatta Road/John Street	C	C	39	33
Parramatta Road/Hill Road/Bombay Street	F	F	73	>140
Hill Road/M4 Motorway eastbound ramps	F	F	>140	>140
Hill Road/Carter Street	F	F	>140	>140
Hill Road/John Ian Wing Parade	B	C	24	36

Table 7-20: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), evening peak

	Level of service		Vehicle delay (seconds)	
Intersection	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
Parramatta Road/John Street	D	E	44	67
Parramatta Road/Hill Road/Bombay Street	F	F	>140	>140
Hill Road/M4 Motorway eastbound ramps	D	A	56	11
Hill Road/Carter Street	F	D	>140	54
Hill Road/John Ian Wing Parade	C	F	35	101

In the morning peak of the Full WestConnex scenario (refer **Table 7-21**) further increases in traffic yield poor performance on the Hill Road corridor. The intersection of Hill Road/Parramatta Road is now expected to operate at LoS F. The M4 Motorway off-ramp is also expected to operate at LoS F, whilst the Hill Road/Carter Street intersection operates with an average delay of over 700 seconds and a LoS F.

In the evening peak of the Full WestConnex scenario (refer **Table 7-22)** further increases in traffic yield poor performance at the intersection of Hill Road/Parramatta Road, which is again expected to operate at LoS F. Similar to the M4 Widening scenario, under the Full WestConnex scenario, the M4 Motorway off-ramp is expected to improve in performance due to a reduction in off-ramp traffic, operating at LoS A. Furthermore, a reduction in traffic

into and out of Carter Street in comparison to the Future 'do minimum' scenario, results in this intersection performance improving to an average delay of approximately 80 seconds, compared to an average delay of 433 seconds in the Future 'do minimum' scenario.

Considering the above, it is expected that some infrastructure upgrades would be required along the Hill Road corridor in order to bring the corridor to capacity in the future year scenarios. This may involve signalising the priority intersections at the M4 Motorway off-ramp and Hill Road/Carter Street, as well as further capacity improvements.

Table 7-21: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), morning peak

	Level of service		Vehicle delay (seconds)	
Intersection	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
Parramatta Road/John Street	D	E	46	66
Parramatta Road/Hill Road/Bombay Street	F	F	>140	>140
Hill Road/M4 Motorway eastbound ramps	F	F	>140	>140
Hill Road/Carter Street	F	F	>140	>140
Hill Road/John Ian Wing Parade	C	C	29	42

Table 7-22: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), evening peak

	Level of service		Vehicle delay (seconds)	
Intersection	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
Parramatta Road/John Street	F	F	101	107
Parramatta Road/Hill Road/Bombay Street	F	F	>140	>140
Hill Road/M4 Motorway eastbound ramps	B	A	23	8
Hill Road/Carter Street	F	F	>140	80
Hill Road/John Ian Wing Parade	D	F	54	>140

7.4.5 Homebush West and Strathfield

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **Section 4.3.5** and are shown in **Figure 4-17**.

The tables in this section show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios with the M4 Widening project and the full WestConnex scheme, respectively, built.

The results of the M4 Widening scenario compared to the Base 'do minimum' scenario, presented in **Table 7-23** and **Table 7-24**, indicate that the inclusion of an additional on-ramp servicing the M4 Motorway westbound and the removal of the right turn movement from Homebush Bay Drive southbound to the existing westbound M4 on-ramp provides an increase in reserve capacity of between 16 per cent (morning peak) and 20 per cent (evening peak) at the critical intersection of Centenary Drive and the M4 Motorway westbound ramps through the provision of additional capacity at this location.

Table 7-23: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), morning peak

	Level of service		Vehicle delay (seconds)	
Intersection	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
Homebush Bay Drive/M4 Motorway eastbound on-ramp	A	B	5	18
Homebush Bay Drive/M4 Motorway eastbound off-ramp	D	D	46	45
Centenary Drive/M4 Motorway westbound ramps	F	B	72	16

Table 7-24: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), evening peak

	Level of service		Vehicle delay (seconds)	
Intersection	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
Homebush Bay Drive/M4 Motorway eastbound on-ramp	A	A	5	13
Homebush Bay Drive/M4 Motorway eastbound off-ramp	D	C	49	30
Centenary Drive/M4 Motorway westbound ramps	D	B	51	23

The results of the Full WestConnex scenario compared to the Future 'do minimum' scenario, presented in **Table 7-25** and **Table 7-26**, demonstrate similar improvements in performance in the morning peak at the intersection of Centenary Drive and the M4 Motorway westbound ramps through an increase of between 18 per cent (morning peak) and 30 per cent (evening) reserve capacity at this location. All intersections in this network would operate with low average delay and level of service between A and C under the Full WestConnex scenario.

Table 7-25: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), morning peak

Intersection	Level of service		Vehicle delay (seconds)	
	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
Homebush Bay Drive/M4 Motorway eastbound on-ramp	A	A	5	6
Homebush Bay Drive/M4 Motorway eastbound off-ramp	D	C	48	36
Centenary Drive/M4 Motorway westbound ramps	F	B	109	23

Table 7-26: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), evening peak

Intersection	Level of service		Vehicle delay (seconds)	
	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
Homebush Bay Drive/M4 Motorway eastbound on-ramp	A	A	6	6
Homebush Bay Drive/M4 Motorway eastbound off-ramp	F	C	83	34
Centenary Drive/M4 Motorway westbound ramps	F	A	110	14

7.4.6 North Strathfield and Strathfield

The interchanges and intersections assessed within this locality correspond to those assessed under existing conditions in **Section 4.3.6** and are shown in **Figure 4-18**.

The tables in this section show the results of the interchange and intersection analysis. The analysis was based on traffic volumes obtained from the WRTM for the Base 'do minimum' and Future 'do minimum' scenarios with the M4 Widening project and the full WestConnex scheme, respectively, built.

Based on the modelled traffic demands associated with the morning peak of the M4 Widening scenario, refer **Table 7-27**, it can be seen that three of the five modelled intersections operate under capacity with no significant performance issues when compared with the Base 'do minimum' flows. However the intersection of Concord Road/Leicester Avenue/Parramatta Road exceeds capacity with a degree of saturation of seven per cent and 13 per cent higher than their Base 'do minimum' peak. This shift in intersection performance can be attributed to the increases in the opposed traffic movements over the projected flows in the Base 'do minimum' scenario.

In the evening peak, refer **Table 7-28**, the modelled traffic demands associated with the M4 Widening scenario indicate that four of the five modelled intersections operate below capacity with no significant performance issues when compared with the Base 'do minimum' scenario flows. However the intersection of Concord Road/Leicester Avenue/Parramatta

exceeds capacity with a degree of saturation comparable to the Base 'do minimum' scenario.

In response to the changed traffic distribution arising from the reintroduction of the toll on the M4 Motorway, the configuration of the intersection of Parramatta Road and the M4 Motorway may need to be altered. The number of lanes allocated to the westbound through movement at the intersection is likely to be increased relative to the number of lanes allocated to traffic turning onto the motorway.

Table 7-27: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), morning peak

	Level of service		Vehicle delay (seconds)	
Intersection	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
Parramatta Road/Concord Road/Leicester Avenue	F	F	>140	>140
Parramatta Road/M4 Motorway	D	E	43	68
Parramatta Road/Mosely Street	B	B	20	18
Concord Road/Sydney Street	B	B	17	17

Table 7-28: Interchange and intersection performance, Base 'do minimum' and M4 Widening scenarios (2021), evening peak

	Level of service		Vehicle delay (seconds)	
Intersection	Base 'do minimum' (2021)	M4 Widening (2021)	Base 'do minimum' (2021)	M4 Widening (2021)
Parramatta Road/Concord Road/Leicester Avenue	F	F	>140	>140
Parramatta Road/M4 Motorway	C	B	30	28
Parramatta Road/Mosely Street	B	A	17	11
Concord Road/Sydney Street	B	B	26	23

In the morning peak of the Full WestConnex scenario, refer **Table 7-29**, the intersection of Concord Road/Leicester Avenue/Parramatta Road operates significantly over capacity at LoS F. This can be attributed to a large increase in the predicted traffic volume at this location. The intersection of M4 Motorway/Parramatta Road sees improved performance operating at LoS C which compares favourably with a LoS F in the Future 'do minimum' scenario. This performance increase can be attributed to the lower vehicle demands forecast at this intersection.

In the evening peak of the Full WestConnex scenario, refer **Table 7-30**, the intersection of Concord Road/Leicester Avenue/Parramatta Road again operates significantly over capacity at LoS F. This can be attributed to a large increase in the predicted traffic volume at this location with forecast volumes 200 vehicles per hour higher than in the Future 'do minimum' evening peak.

Table 7-29: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), morning peak

Intersection	Level of service		Vehicle delay (seconds)	
	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
Parramatta Road/Concord Road/Leicester Avenue	F	F	>140	>140
Parramatta Road/M4 Motorway	F	C	99	34
Parramatta Road/Mosely Street	B	B	26	25
Concord Road/Sydney Street	B	B	16	23

Table 7-30: Interchange and intersection performance, Future 'do minimum' and Full WestConnex scenarios (2031), evening peak

Intersection	Level of service		Vehicle delay (seconds)	
	Future 'do minimum' (2031)	Full WestConnex (2031)	Future 'do minimum' (2031)	Full WestConnex (2031)
Parramatta Road/Concord Road/Leicester Avenue	F	F	>140	>140
Parramatta Road/M4 Motorway	C	D	34	49
Parramatta Road/Mosely Street	C	A	42	11
Concord Road/Sydney Street	C	B	29	19

7.4.7 Intersection performance overview

Table 7-31 and **Table 7-32** present an overview of the previously discussed intersection performance indicators for the morning and evening peaks.

Table 7-31: Morning peak intersection performance overview

Area	Intersection	Without M4 Widening (Base 'do minimum' - **2021**)		M4 Widening **(2021)**		Without WestConnex (Future 'do minimum' - **2031**)		Full WestConnex **(2031)**	
		LoS	Delay	LoS	Delay	LoS	Delay	LoS	Delay
Granville	Church Street/M4 Motorway eastbound off-ramp	D	49	D	47	D	52	D	51
	Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp	E	67	F	>140	F	>140	F	>140
	Parramatta Road/Bold Street	D	50	F	>140	F	>140	F	>140
	Parramatta Road/Good Street	C	32	E	67	D	55	F	124
Clyde and Rosehill	James Ruse Drive/Prospect Street	C	37	F	111	D	53	F	>140
	James Ruse Drive/M4 Motorway eastbound on-ramp	C	32	B	28	D	47	B	27
	James Ruse Drive/M4 Motorway westbound off-ramp	C	29	B	28	C	33	F	76
	James Ruse Drive/Parramatta Road/Berry Street	C	39	F	117	F	93	F	>140
Auburn	Parramatta Road/Rawson Street/Duck Street	C	42	F	70	F	128	F	98
	Silverwater Road/Carnarvon Street	F	>140	D	53	F	>140	F	108
	Silverwater Road/M4 Motorway eastbound ramps	F	>140	F	>140	F	>140	F	>140
	Silverwater Road/M4 Motorway westbound ramps	D	46	B	26	D	49	E	69
	Silverwater Road/Parramatta Road	D	54	D	48	F	73	F	85
Lidcombe and Sydney Olympic Park	Parramatta Road/John Street	C	39	C	33	D	46	E	66
	Parramatta Road/Hill Road/Bombay Street	F	73	F	>140	F	>140	F	>140
	Hill Road/M4 Motorway eastbound ramps	F	>140	F	>140	F	>140	F	>140
	Hill Road/Carter Street	F	>140	F	>140	F	>140	F	>140
	Hill Road/John Ian Wing Parade	B	24	C	36	C	29	C	42

Area	Intersection	Without M4 Widening (Base 'do minimum' - **2021**)		M4 Widening **(2021)**		Without WestConnex (Future 'do minimum' - **2031**)		Full WestConnex **(2031)**	
		LoS	Delay	LoS	Delay	LoS	Delay	LoS	Delay
Homebush West and Strathfield	Homebush Bay Drive/M4 Motorway eastbound on-ramp	A	5	B	18	A	5	A	6
	Homebush Bay Drive/M4 Motorway eastbound off-ramp	D	46	D	45	D	48	C	36
	Centenary Drive/M4 Motorway westbound ramps	F	72	B	16	F	109	B	23
North Strathfield and Strathfield	Parramatta Road/Concord Road/Leicester Ave	F	>140	F	>140	F	>140	F	>140
	Parramatta Road/M4 Motorway	D	43	E	68	F	99	C	34
	Parramatta Road/Mosely Street	B	20	B	18	B	26	B	25
	Concord Road/Sydney Street	B	17	B	17	B	16	B	23
Strathfield and Burwood	Parramatta Road/Wentworth Road	F	127	F	108	F	>140	F	134
	Parramatta Road/Broughton Road	C	38	B	28	D	43	B	24
	Parramatta Road/Burwood Road	B	26	B	26	C	41	B	21
	Parramatta Road/Shaftesbury Road	C	35	C	37	D	43	B	27

Table 7-32: Evening peak intersection performance overview

Area	Intersection	Without M4 Widening (Base 'do minimum' - 2021)		M4 Widening (2021)		Without WestConnex (Future 'do minimum' - 2031)		Full WestConnex (2031)	
		LoS	Delay	LoS	Delay	LoS	Delay	LoS	Delay
Granville	Church Street/M4 Motorway eastbound off-ramp	C	35	C	39	C	38	D	49
	Church Street/Parramatta Road/Woodville Road/M4 Motorway westbound on-ramp	F	>140	F	>140	F	>140	F	>140
	Parramatta Road/Bold Street	F	73	D	53	F	91	F	94
	Parramatta Road/Good Street	D	51	F	>140	F	>140	F	>140
Clyde and Rosehill	James Ruse Drive/Prospect Street	F	83	F	110	F	>140	F	>140
	James Ruse Drive/M4 Motorway eastbound on-ramp	B	23	B	28	B	16	B	17
	James Ruse Drive/M4 Motorway westbound off-ramp	B	26	B	25	B	26	D	45
	James Ruse Drive/Parramatta Road/Berry Street	D	43	F	83	F	>140	F	>140
Auburn	Parramatta Road/Rawson Street/Duck Street	F	101	F	108	F	>140	F	>140
	Silverwater Road/Carnarvon Street	F	73	F	92	F	117	F	124
	Silverwater Road/M4 Motorway eastbound ramps	D	46	C	33	C	37	D	55
	Silverwater Road/M4 Motorway westbound ramps	D	46	D	56	F	104	D	45
	Silverwater Road/Parramatta Road	F	120	F	122	F	>140	F	>140
Lidcombe and Sydney Olympic Park	Parramatta Road/John Street	D	44	E	67	F	101	F	107
	Parramatta Road/Hill Road/Bombay Street	F	>140	F	>140	F	>140	F	>140
	Hill Road/M4 Motorway eastbound ramps	D	56	A	11	B	23	A	8
	Hill Road/Carter Street	F	>140	D	54	F	>140	F	80
	Hill Road/John Ian Wing Parade	C	35	F	101	D	54	F	>140

Area	Intersection	Without M4 Widening (Base 'do minimum' - 2021)		M4 Widening (2021)		Without WestConnex (Future 'do minimum' - 2031)		Full WestConnex (2031)	
		LoS	Delay	LoS	Delay	LoS	Delay	LoS	Delay
Homebush West and Strathfield	Homebush Bay Drive/M4 Motorway eastbound on-ramp	A	5	A	13	A	6	A	6
	Homebush Bay Drive/M4 Motorway eastbound off-ramp	D	49	C	30	F	83	C	34
	Centenary Drive/M4 Motorway westbound ramps	D	51	B	23	F	110	A	14
North Strathfield and Strathfield	Parramatta Road/Concord Road/Leicester Ave	F	>140	F	>140	F	>140	F	>140
	Parramatta Road/M4 Motorway	C	30	B	28	C	34	D	49
	Parramatta Road/Mosely Street	B	17	A	11	C	42	A	11
	Concord Road/Sydney Street	B	26	B	23	C	29	B	19
Strathfield and Burwood	Parramatta Road/Wentworth Road	C	32	C	31	D	56	F	79
	Parramatta Road/Broughton Road	E	69	E	60	F	>140	C	41
	Parramatta Road/Burwood Road	C	31	C	31	C	33	B	20
	Parramatta Road/Shaftesbury Road	D	47	D	47	F	70	C	33

7.4.8 Queuing at M4 Motorway off-ramps

Queue lengths at the M4 Motorway off-ramps have been presented for the Existing case in **Table 4-11** and for the Base and Future 'do minimum' scenarios in **Table 6-14** and **Table 6-15**.

Table 7-33 and **Table 7-34** below show the modelled queue lengths for the M4 Widening only and Full WestConnex scenarios.

Table 7-33: Queue lengths at M4 Motorway off-ramps, M4 Widening scenario (2021)

Off-ramp	Morning peak queue length (metres)	Evening peak queue length (metres)
Cumberland Highway eastbound off-ramp	163	124
Cumberland Highway westbound off-ramp	99	82
Church Street eastbound off-ramp	116	106
James Ruse Drive eastbound off-ramp	673 (Ramp forms its own lane. Queue is measured from Prospect Street)	603 (Ramp forms its own lane. Queue is measured from Prospect Street)
James Ruse Drive westbound off-ramp	103	49
Silverwater Road eastbound off-ramp	683	59
Silverwater Road westbound off-ramp	74	34
Hill Road eastbound off-ramp	1251	17
Homebush Bay Drive eastbound off-ramp	156	100
Homebush Bay Drive westbound off-ramp	44	64
End of the M4 Motorway at Parramatta Road	120	196

Table 7-34: Queue lengths at M4 Motorway off-ramps, Full WestConnex scenario (2031)

Off-ramp	Morning peak queue length (metres)	Evening peak queue length (metres)
Cumberland Highway eastbound off-ramp	275	230
Cumberland Highway westbound off-ramp	202	123
Church Street eastbound off-ramp	121	169
James Ruse Drive eastbound off-ramp	912 (Ramp forms its own lane. Queue is measured from Prospect Street)	845 (Ramp forms its own lane. Queue is measured from Prospect Street)
James Ruse Drive westbound off-ramp	323	131
Silverwater Road eastbound off-ramp	1264	66
Silverwater Road westbound off-ramp	109	33
Hill Road eastbound off-ramp	1780	9
Homebush Bay Drive eastbound off-ramp	116	103
Homebush Bay Drive westbound off-ramp	68	38
End of the M4 Motorway at Parramatta Road	74	163

In general queue lengths at the motorway off-ramps have increased when compared to those generated in the existing situation (refer to **Table 4-12**). This outcome is to be anticipated based on the overall growth in traffic demand within the corridor.

Of particular interest is the fact that the queue lengths at the Church Street eastbound ramp and at Silverwater Road westbound ramp have grown at a lower rate than the average growth throughout the M4 Motorway corridor. Church Street eastbound and Silverwater Road westbound were the traditional interchanges where drivers wishing to avoid paying the toll would do so under the previous single point tolling regime. The broader distribution of traffic exiting the motorway is indicative of the distance based tolling strategy that would be applied to both the M4 Widening and the full WestConnex scheme being assessed and reflects trip distribution that is not affected by a single point toll.

Both the Silverwater eastbound and westbound off-ramps are traffic signal controlled with the left turn movement operating as a “Give Way’ controlled slip lane. Operational constraints on Silverwater Road between the interchange and Parramatta Road are impacting on the ability of the exit ramp to effectively discharge the demand.

The storage provided on the ramp is insufficient to accommodate the anticipated maximum queue. This would potentially generate queues back onto the main carriageway of the motorway resulting in reduced operational performance and a potential increase in “rear end” type crashes. This situation could potentially occur despite the overall reduction in traffic on the M4 Motorway.

It is recommended that modifications to this section of Silverwater Road be investigated. These modifications could take the form of a revised lane configuration on Silverwater Road between the M4 Motorway and Parramatta Road to ensure that the efficiency of the intersection of Silverwater Road/Parramatta Road is optimised and the provision of traffic signal control for the left turn movement from the off ramp.

The Hill Road eastbound off-ramp is currently priority controlled and generates a queue well in excess of the available storage. This would generate queues back onto the main carriageway of the motorway resulting in reduced operational performance and a potential increase in “rear end” type crashes.

Modification of the ramp terminal to a signalised intersection would reduce the desirable storage length to approximately 350 meters. This could be accommodated within the confines of the exit ramp through the provision of an additional lane. Further improvement is possible by signalising the adjacent intersection of Hill Road and Carter Street which would relieve the congestion caused by vehicles waiting to filter turn right into Carter Street.

The operational traffic review to be undertaken 12 months after the opening of the M4 Widening will be used to verify that the actual demands reflect the modelled outcomes described above.

7.5 Pedestrian and cycling impacts

The redistribution of east-west traffic away from the M4 Motorway would increase traffic on alternative parallel routes, particularly Parramatta Road, used by pedestrians and cyclists. The pedestrian network along the M4 Motorway corridor consists mainly of kerbside footpaths along local and arterial roads. In general, footpath widths range between 1.2 metres and 3.6 metres including shared paths and generally footpaths are provided on both sides of the road. All signalised intersections along Parramatta Road incorporate controlled pedestrian crossings and these facilities would not be impacted by the project.

Consequently, the ability for pedestrians to cross Parramatta Road would not be impacted by the increase in traffic volumes on the road. The M4 Widening project would not impact on local or arterial roads and their associated footpaths.

The off-road pedestrian and shared paths described in **Section 3.6** 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.

7.6 Freight vehicle movements

Table 7-35 presents the daily heavy commercial vehicle traffic volumes with the M4 Widening. A redistribution of heavy vehicles to Parramatta Road is evident. However, there are other redistribution effects in response to the project. **Table 7-35** shows the number of heavy commercial vehicles passing the screenline identified in **Figure 7-9** broken down into major roads. In all cases, heavy commercial freight traffic on other roads increases relative to the 'do minimum' scenario.

Freight vehicles choosing to avoid the WestConnex toll are likely to be made up of those vehicles where the perceived value of travel time saving is less than the cost of the toll. This behaviour is incorporated into the WRTM based on the Value of Travel Time Savings surveys undertaken for heavy commercial vehicles in 2012 (refer **section 5.2**). An example of this behaviour would be where the vehicle operator could not recoup the cost of the toll from the fees payable for the trip.

Table 7-35 Weekday heavy commercial vehicle distribution: Base 'do minimum' and M4 Widening scenarios (2021)

	Number of weekday HCVs		
Road	**Without M4 Widening (Base 'do minimum') (2021)**	**M4 Widening (2021)**	**Difference**
M4 Motorway	27,060	13,138	-13,922
Parramatta Road	1,408	3,517	2,109
M2 Motorway	12,542	13,984	1,442
Victoria Road	5,862	7,363	1,501

Source: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

Table 7-36 presents the number of heavy commercial vehicles passing the screenline, identified in **Figure 7-9,** in the Future 'do minimum' scenario when compared to the Full WestConnex scenario.

In both future project scenarios there is less redistribution of heavy vehicle traffic away from the M4 Motorway than in the base project scenarios. This is likely to be due to the overall increase in network congestion which would make the benefits afforded by the M4 Widening project more attractive. In the case of the Full WestConnex scenario, the benefits of the increased capacity on the M4 Motorway are amplified due to the increased network connectivity that the full scheme brings to bear.

Table 7-36: Weekday heavy commercial vehicle distribution: Future 'do minimum' and Full WestConnex scenarios (2031)

Number of weekday HCVs			
Road	**Without WestConnex (Future 'do minimum') (2031)**	**Full WestConnex (2031)**	**Difference**
M4 Motorway	29,718	26,100	-3,618
Parramatta Road	1,918	3,491	1,572
M2 Motorway	14,913	15,922	1,009
Victoria Road	6,768	7,814	1,046

Source: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

The Base 'do minimum' scenario heavy commercial vehicle weekday volumes within the M4 corridor are shown in **Figure 7-22**. This shows significant heavy vehicle traffic on the M4 Motorway west of Westmead, and consistently high volumes along the M4 Motorway.

Heavy commercial vehicle weekday volumes within the M4 corridor with the M4 Widening scenario are shown in **Figure 7-23**. This shows a reduced volume of heavy vehicle traffic on the M4 Motorway east of Cumberland Highway, indicating some redistribution of traffic due to the introduction of the toll.

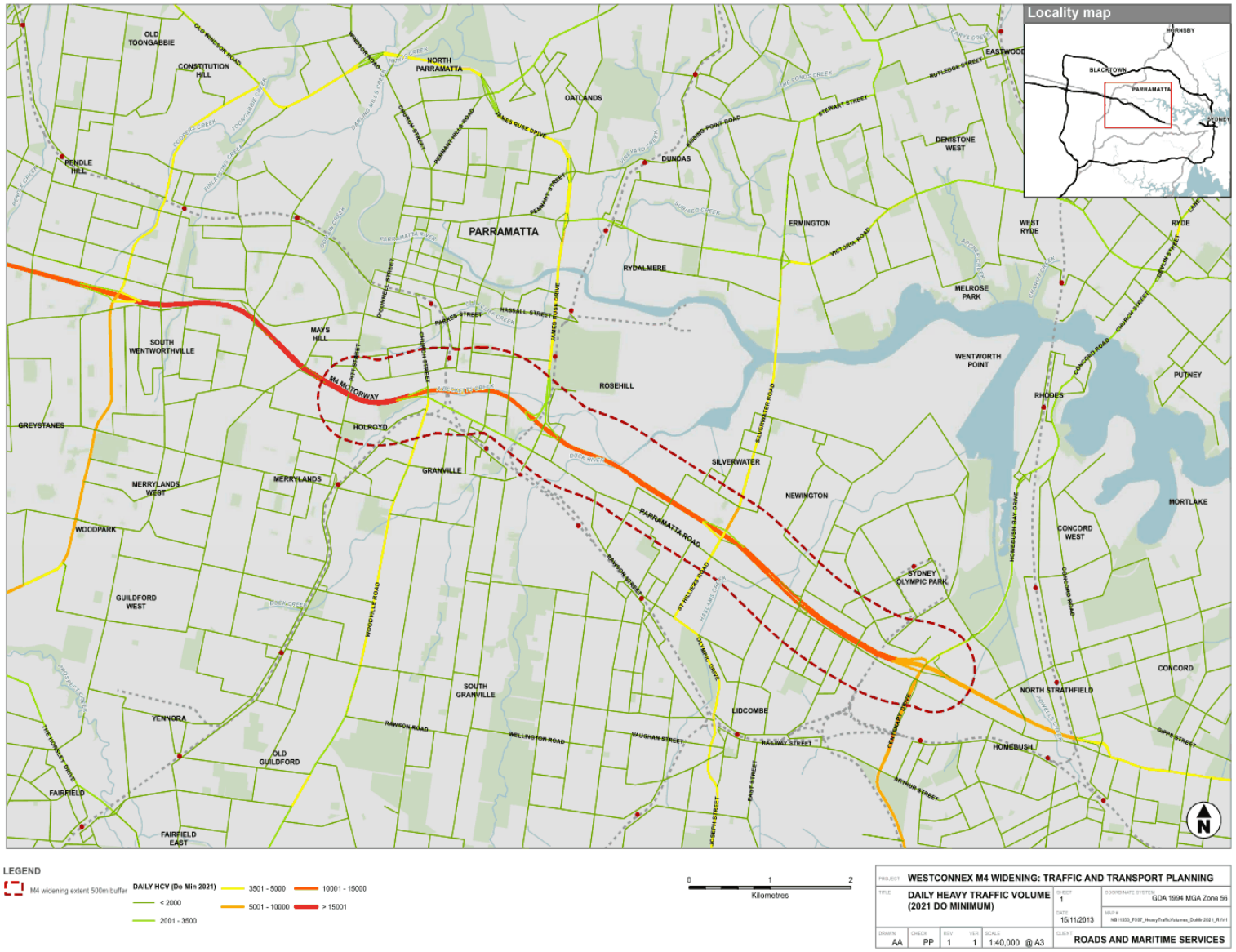

Figure 7-22 Heavy commercial vehicle daily traffic volumes in the Base 'do minimum' scenario (2021)

Source: WestConnex Road Traffic Model, 2014

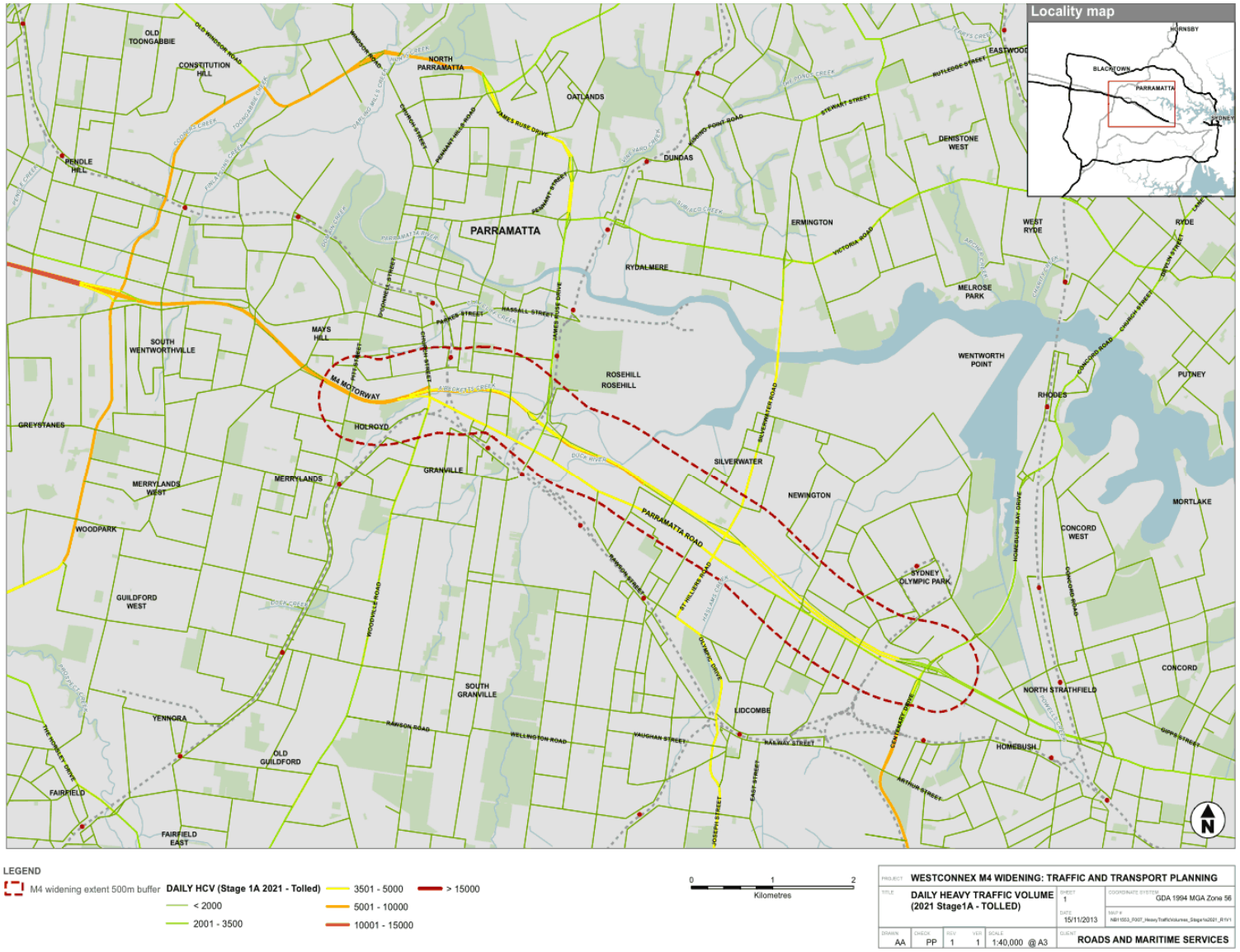

Figure 7-23: Heavy commercial vehicle daily traffic volumes in the M4 Widening scenario (2021)

Source: WestConnex Road Traffic Model, 2014

7.7 Road safety

The WRTM can be used to estimate the number of crashes in the M4 corridor (including Parramatta Road and the M4 Motorway) with and without the M4 Widening with the assumption that the number of crashes per vehicle kilometre travelled for each segment of road is the same as described in **Table 4-12** and **Table 4-17**

The findings of this analysis are presented below in **Table 7-37**.

Table 7-37: Crash estimates for the M4 Motorway and Parramatta Road between Homebush Bay Drive and Parramatta in 2021

Road	Statistic	Existing case (2012)	Base 'do minimum' (2021)	M4 Widening (2021)
Combined M4 Motorway and Parramatta Road	Crashes with casualties	142	160	154
	Crashes without casualties	230	257	227

These figures show a decline in crashes in the combined M4 corridor (4 per cent less crashes with casualties and 11 per cent less without casualties).

7.8 Public transport

7.8.1 Bus services

The impact on bus services depends upon the extent to which any proposed bus priority facilities and bus network enhancements are implemented at the time of the M4 Widening. In particular, as discussed above, tolling of the M4 Widening would lead to traffic volume increases on Parramatta Road between Granville and North Strathfield and also on Victoria Road. Bus services travelling along, or crossing, Parramatta Road between Granville and North Strathfield would experience delays due to the additional congestion caused by the additional traffic flow. If bus priority measures are introduced on this section of road, bus service speeds and reliability would be improved while general traffic would be more constrained.

Great Western Highway, between Cumberland Highway and Church Street, Parramatta

Following the opening of the M4 Widening there will be 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 would be sufficient to minimise the impact of the diverted traffic on bus service operations.

Church Street, Parramatta between Great Western Highway and Granville

During the commuter peak periods there are 10 buses per hour on this section of Church Street under the existing timetables. This includes Metrobus M91 journeys between Parramatta and Bankstown. There are limited bus priority measures currently provided on this road, but the road does operate with peak period clearway conditions. The traffic flow is likely to increase with the M4 Widening. This would impact on traffic speeds and hence on bus service reliability for the four bus routes involved (M91, 810, 811 and 907).

Parramatta Road between Granville and Concord Road

This stretch of road is 9.3 kilometres in length and lies immediately to the south of the section of M4 Motorway to be widened. **Table 7-38** shows the existing bus routes which travel along Parramatta Road.

Table 7-38: Existing bus routes on Parramatta Road between Granville and Concord Road

		Bus Routes and Peak Frequencies			
Kilometres from Church Street	Parramatta Road location	Along Parramatta Road to next junction	Peak buses / hour	Across Parramatta Road	Peak buses / hour
0.0	Church Street	M91	4	M91, 907	2
0.6	Bold Street	M91, 906	6	nil	0
0.7	Good Street	906	2	nil	0
1.0	Alfred Street	909	2	nil	0
1.4	James Ruse Drive	909, M92	8	nil	0
2.8	Newton Street South/Hampstead Road	909, M92	8	540, 544	3 to 4
3.7	Station Road, Auburn	M92	6	nil	0
4.6	Nyrang Street, Lidcombe	M92 (& SOP 6)	6 (+ freq)	nil	0
4.9	John Street, Lidcombe	(SOP 6)	(freq)	nil	0
5.2	Hill Road, Lidcombe	401 (& SOP 7)	3 (+ freq)	nil	0
5.6	Mons Street, Lidcombe	(SOP 7)	(freq)	nil	0
6.9	Centenary Drive, Flemington	nil	0	nil	0
8.3	Underwood Road	450, 525, 526	9 to 10	nil	0
9.3	Leicester Avenue	nil	0	459 (& SOP 4)	2 (+ freq)
9.4	M4 Junction, Concord	nil	0	nil	0

Source: Published bus timetables

Note: SOP refers to Sydney Olympic Park Special Event bus routes. These services operate frequently before and after special events at Sydney Olympic Park

The bus routes operating along Parramatta Road would experience increased travel times as follows:

Route M92: This Metrobus route travels on Parramatta Road between James Ruse Drive and John Street, Lidcombe a distance of approximately 3.5 kilometres. 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 travels on Parramatta Road between Alfred Street, Granville and Station Road, Auburn a distance of approximately 2.7 kilometres. 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. The WRTM shows that there would be no substantial travel time increase over this section of Parramatta Road.

For the bus routes crossing Parramatta Road, there are likely to be additional delays incurred due to the need to cross a much heavier 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 are likely to be quite small.

The three Sydney Olympic Park special event routes are likely to incur some additional run time delays which would vary in severity according to traffic conditions on Parramatta Road at the time of day of their operation.

Homebush Bay Drive

Traffic volumes on this road 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 operating at peak hours that utilise Homebush Bay Drive, would also benefit from the slightly reduced traffic volumes.

Leicester Avenue, Strathfield

Leicester Avenue is the route used by cross regional routes 450, 459, 525 and 526. 11 to 12 buses per hour travel over this section of road in the current timetable. 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. The existing timetable allowance for this section of route is between one and two minutes. For route 459, traffic volumes on Concord Road north of Parramatta Road are likely to be lower with the M4 Widening project implemented so this route is likely to benefit from some limited time savings.

7.8.2 Rail services

The M4 Widening would encourage a modal shift from road to rail for some travellers where rail offers a potential alternative. However, the rail services between Parramatta, Strathfield and Sydney CBD are already overcrowded in the commuter peaks. In the peak hour, trains are currently carrying between 15 per cent and 45 per cent more passengers than the available capacity. Over the whole morning peak commuting period, many trains on this line are operated at capacity or higher (Train Loads Database, March 2012d, Bureau of Transport Statistics, TfNSW). As discussed above, some relief to this crowding is expected with the opening of the North West Rail Link, indicatively up to three extra train loads per peak hour.

Increased traffic volumes on the arterial road network may have a negative impact on access to rail stations by bus and car. Approximately half of all rail passengers (across the rail network) access stations by these modes (2010/11 Household Travel Survey, Bureau of Transport Statistics, TfNSW. (Table 17 in the Compendium of Sydney Rail Travel Statistics, 2012a)). 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 possible exception of the

Carlingford Line services) access delays are likely to have only a minimal impact on mode choice.

Overall the M4 Widening project would have some marginal impacts on rail patronage but the net effect is unlikely to be significant.

7.9 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).

The M4 Motorway has previously operated with a single point toll, an analysis of which is presented in **Chapter 4**. Overall weekday traffic on the M4 Motorway at the toll plaza was 23 per cent higher in 2010 after the removal of the toll (removed in February 2010) than in 2009 with the toll. The M4 Motorway previously operated with a cash back scheme which would not apply when the M4 Widening project is open and tolled.

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 7-24** and **Figure 7-25** below. Observed traffic data was sourced from the Roads and Maritime Services (Roads and Maritime) permanent counting station located on Parramatta Road at the Duck River Bridge, Granville (Station No. 49.002) and from counting stations on the M4 Motorway adjacent to the toll plaza.

As shown in **Figure 7-25**, 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.

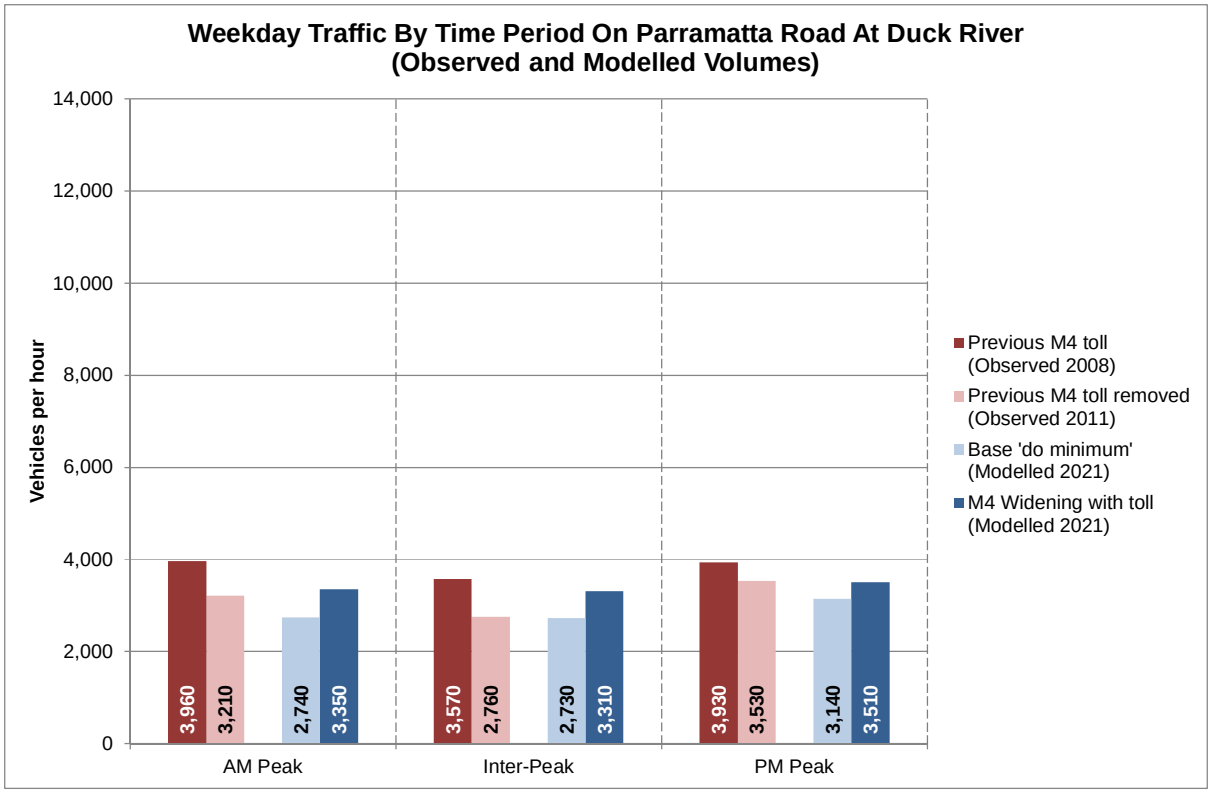

Figure 7-24: Response of weekday traffic volume on Parramatta Road to changing tolling scenarios

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

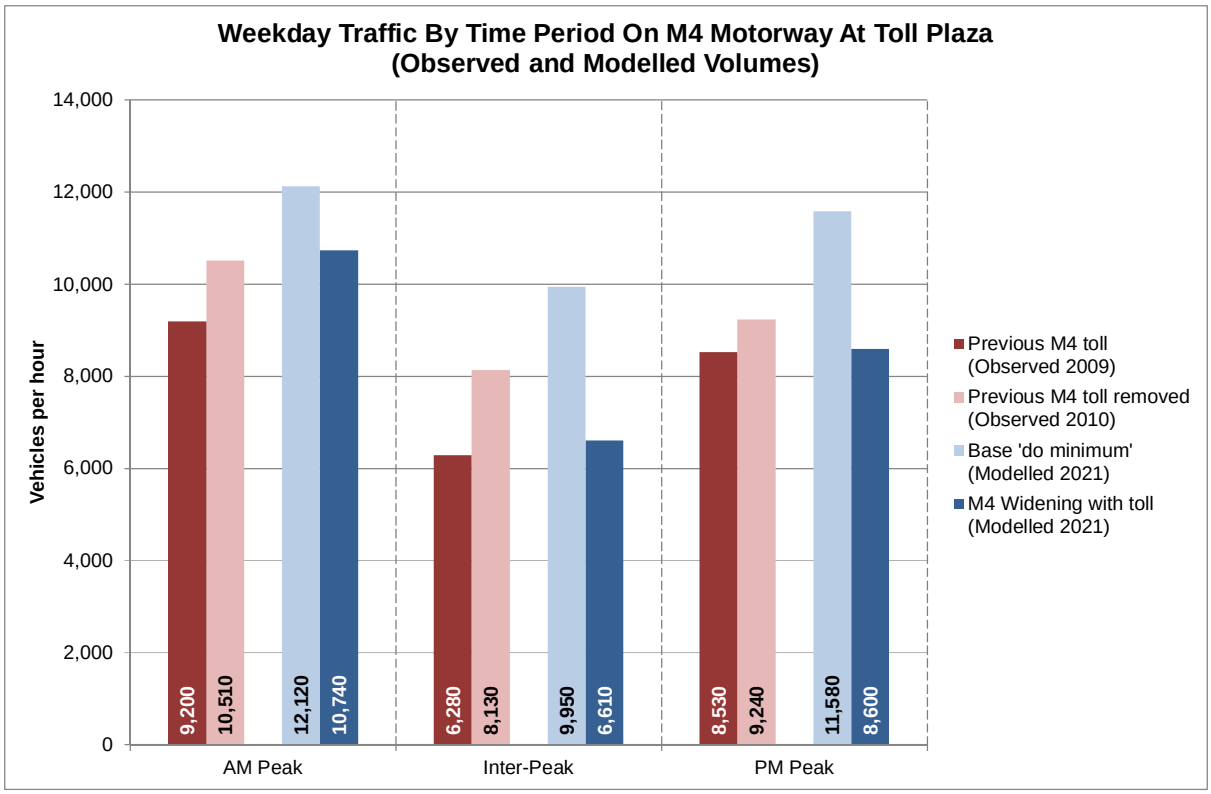

Figure 7-25: Response of weekday traffic volume on M4 Motorway to changing tolling scenarios

Data: Jacobs SKM, *WestConnex Road Traffic Model*, 2014

The additional capacity provided by the M4 Widening would significantly increase motorway travel speeds. The reduction in travel time would be valuable for commercial trips in Western Sydney. Upon the completion of the full WestConnex scheme, travel times between the Parramatta CBD and locations in Sydney's east including the Sydney Airport, the Port Botany precinct and parts of the Sydney CBD will improve significantly.

It is expected that motorists choosing to avoid paying the toll on the M4 Widening would increase traffic on alternative routes (see **Table 7-2)**. For example, the model predicts that the project would increase traffic during the day and the evening on Parramatta Road at Auburn and on Victoria Road at Rydalmere.

Decisions relating to toll road use change also depend on the time of day. During uncongested periods many motorists choose to avoid toll roads as the time savings are reduced while the toll remains the same. This effect is demonstrated in **Figure 7-24** and **Figure 7-25** where the proportion of traffic using Parramatta Road instead of the M4 Motorway increases in the Inter peak period.

A comparison of the average daily traffic volumes on Parramatta Road at Duck River and the M4 Motorway at the toll plaza over time is shown in **Figure 7-26**. 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. Conversely average daily traffic volumes on Parramatta Road remain relatively stable indicating that the WestConnex scheme is accommodating an increasing proportion of the future demand.

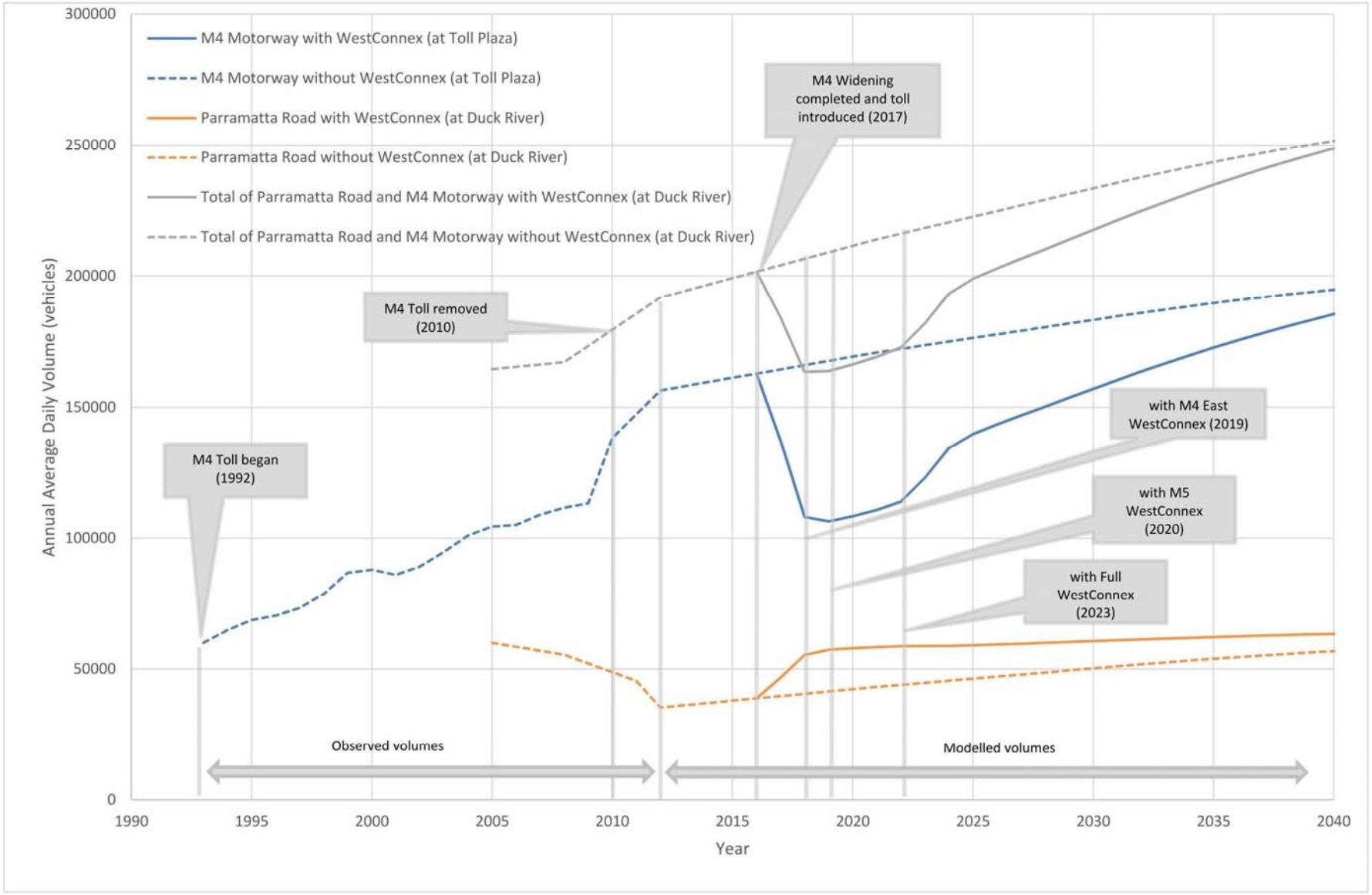

Figure 7-26: Comparison of traffic volumes on the M4 Motorway and Parramatta Road over time

7.10 Cumulative traffic and transport impacts

7.10.1 Introduction

Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. It is the combination of these effects, and any resulting impact on traffic and transport operations, that is the focus of the cumulative impact assessment.

7.10.2 WestConnex M4 East project

Increasing traffic capacity within the M4 Motorway corridor would 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 would not address or alleviate congestion on Parramatta Road east of Concord Road. The cumulative impact of the delivery of the M4 East project a few years after the M4 Widening project would alleviate congestion at the eastern end of the M4 Motorway along Parramatta Road.

7.10.3 Full WestConnex scheme

As indicated in the *NSW Long Term Transport Master Plan* (Transport for NSW (TfNSW) 2012a), the WestConnex scheme is a key project in providing a step change in Sydney's network. It is considered a critical link in Sydney's motorway network, particularly with respect to its function to improve access to international gateways and support urban revitalisation opportunities. WestConnex would ease congestion, connect communities and create jobs.

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.

The WestConnex scheme would be delivered within an integrated package of transport improvements across Sydney including complementary enhancements to the existing road network (including associated surface road changes, bus priority measures, heavy vehicle access improvements) redesign of bus services and facilities, improved access to rail stations and upgrades to cyclist and pedestrian facilities.

Similarly the (*Draft) Metropolitan Strategy for Sydney to 2031* ((NSW) Department of Planning and Environment 2013a) identifies WestConnex as essential to support major growth and urban revitalisation in the inner part of Sydney, with the Parramatta Road corridor in particular being identified in the Strategy as a key 'City Shaper'.

7.11 Future road network and Main Western Rail Line changes

7.11.1 Road network

Other developments in the Sydney motorway network would affect and be affected by the M4 Widening project. These include completion of the M5 Motorway widening and construction of NorthConnex. Under current motorway network operations, the 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 but less attractive and tolled alternatives. Widening of these motorways is likely to improve their operational performance and potentially make them more attractive than the future widened and tolled M4 Motorway.

These changes in the road network have been incorporated into the WestConnex Road Traffic Model and are reflected in traffic forecasts.

7.11.2 Rail network

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 2012b). 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 would 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 central business district (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 would 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 would 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 would support faster journey times and rolling stock improvements, including potentially longer trains to meet growing demand, would deliver a more attractive rail service for longer distance customers in this corridor.

The cumulative effect of transport network improvements would change the relative attractiveness of rail and road travel in the M4 Motorway corridor and this would be reflected in traffic forecasts undertaken for the M4 Widening project.

The rail passenger demand forecasts used in the development of Sydney's Rail Future (TfNSW 2012b) have recognised WestConnex however the detailed impact of, for example, the tolling strategy on the widened section of the M4 Motorway on modal split and therefore passenger demand for rail services would require further detailed analysis.

7.12 Mitigation measures

7.12.1 Operational traffic review

The assessment has identified a number of intersections where the operational performance would change under the forecast future traffic demands. This assessment has been based on modelled traffic demand and, consequently, the outcome may be affected by the limitations of the modelling process as described in **Section 5.6**.

The WDA would undertake an operational traffic review to confirm the operational traffic impacts of the project on surrounding arterial roads and major intersections 12 months after the commencement of operation of the project. The review would be undertaken by a suitably qualified traffic consultant that is independent of the design and traffic studies

undertaken as part of the environmental impact statement and Preferred Infrastructure Report (if required).

In undertaking the review, WDA would assess the level of service at the major intersections on the alternative route to the M4 Motorway, namely Parramatta Road and at the same intersections and interchanges adopted for this traffic and transport assessment.

The assessment would be based on actual traffic counts and the methodology used would be comparable with that described herein.

7.12.2 Infrastructure changes

Some minor intersection configuration works may be required, to reflect the anticipated changes in trip distribution that would occur as a result of the M4 Widening project. These minor works may comprise altering the lane movement allocation at key intersections at the western and eastern extents of the project. For example the number of lanes allocated to the westbound through movement at the intersection of Parramatta Road and the M4 Motorway at North Strathfield may be increased relative to the number of lanes allocated to traffic turning onto the motorway.

These minor reconfiguration works would be aimed at providing an appropriate movement capacity relative to the changed proportion of traffic demand for the affected movements at the key intersections on the network.

7.12.3 Urban revitalisation

The section of Parramatta Road between Parramatta and Strathfield was a major beneficiary of the original construction of the M4 Motorway, significantly reducing the volume of traffic that it carried. Since the removal of the toll in 2010, this section of Parramatta Road has carried an average daily traffic volume been 30,000 and 40,000 vehicles per day, much lower than sections of the road east of Strathfield.

UrbanGrowth NSW is leading a Parramatta Road Urban Renewal Program. A Concept Plan is currently being developed with stakeholders to guide the long-term renewal of the corridor. This program may result in changes to the configuration of intersections along Parramatta Road aimed at supporting other modes of transport. This could include bus priority, wider footpaths, or dedicated cycle facilities. Improved bus services along sections of Parramatta Road would improve the transport options of the new residents and employees and encourage the use of non-car modes.

8 Construction impacts

8.1 Introduction

The assessment of construction impacts is based on the WDA concept design of the M4 Widening project as at April 2014 and currently proposed land availability for compounds and access. This will be refined and updated as part of the detailed design.

The M4 Widening project comprises widening and upgrading the existing M4 Motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush and upgrades to existing interchanges.

A new viaduct is proposed to be located to the south of the existing viaduct between Church Street and Wentworth Street, Granville (just east of James Ruse Drive). The existing viaduct would be reconfigured to provide four lanes eastbound and two lanes westbound while the new viaduct would provide two additional westbound lanes. The existing M4 Motorway will be re-sheeted with new asphalt wearing surface.

The current ground level sections of the carriageway, between Pitt Street and Church Street and between Wentworth Street and Homebush Bay Drive, provide three eastbound and westbound lanes. These would be widened with two additional lanes, to provide a total of four traffic lanes and a shoulder on each carriageway on completion of the widening.

Widening of the M4 Motorway would require the upgrade and addition of grade separated interchanges at major arterial connections. All current connections to arterial roads along the M4 Motorway would be maintained. Upgrades to interchanges would include:

- Construction of a new eastbound on-ramp to the M4 Motorway from Hill Road, Lidcombe.
- Construction of a new westbound G-loop on-ramp to the M4 Motorway from Homebush Bay Drive, Homebush.
- Widening and/or lengthening of existing ramps at Church Street, James Ruse Drive, Silverwater Road, Hill Road and Homebush Bay Drive.

The M4 Widening project also includes:

- Provision of road infrastructure and services to support the future implementation of smart motorway operations.
- Provision of Intelligent Transport Systems (ITS) infrastructure for motorway operations.
- Provision of tolling infrastructure such as gantries and control systems.

The proposed construction methodology and program indicates that the proposed works can be completed by the first quarter of 2017.

Objectives

The objectives for managing the impact of the project construction activities on traffic are:

- Safety of all road users, including pedestrians and cyclists.
- Minimise disruption to all road users, including pedestrians and cyclists.

- Ensure the M4 Motorway and surrounding road network continues to function adequately.
- Limit impacts on public transport services.
- Minimise changes to traffic operations.
- Minimise access disruptions to adjoining properties.
- Minimise construction activities on local roads in residential areas wherever possible.
- Avoid heavy vehicle movements in peak traffic and outside of standard working hours.

8.2 Construction sites and access

8.2.1 Work sites and compounds

The M4 Widening project extends approximately 7.5 kilometres between Pitt Street, Parramatta and Homebush Bay Drive, Homebush. The project has been divided into three work zones, each with work sites for the purpose of planning and staging. The proposed work zones and work sites are detailed in **Table 8-1**.

Table 8-1: Proposed work zones and work sites

Work zones	Work sites
1 – Pitt Street overpass to Wentworth Street	Between Pitt Street and the western pier of the viaduct spanning the Main Western Rail Line Viaduct over the Main Western Rail Line Between the eastern pier of the viaduct spanning the Main Western Rail Line to the western pier of the viaduct spanning the Carlingford Rail Line Between the viaduct over the Carlingford Rail Line to the western side of James Ruse Drive Viaduct over James Ruse Drive Between James Ruse Drive and the western abutment of the bridge over Wentworth Street
2 – Wentworth Street to Junction Street	Between the eastern abutment of the bridge spanning Wentworth Street and the eastern abutment of the bridge spanning Duck River) Bridge over Duck Creek
3 – Junction Street to Homebush Bay Drive	Between Junction Street and Silverwater Road Between Silverwater Road and Haslams Creek Between Haslams Creek and Birnie Avenue Between Birnie Avenue and Homebush Bay Drive

These work sites would be serviced by a series of main compounds and ancillary sites, which are detailed in **Table 8-2**.

Table 8-2: Main compounds with proposed access

Work zone	Compound name	Proposed access and egress
1	Church Street Compound	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
1	A'Beckett Street Compound	Access and egress from A'Beckett Street via Good Street or Alfred Street
1	Alfred Street Compound	Access from Alfred Street, egress onto Alfred Street or Arthur Street
1	James Ruse Drive Centre Compound	Access and egress from James Ruse Drive (northbound)
1	James Ruse Drive East Access	Access and egress from James Ruse Drive eastbound on-ramp
1	Martha Street West Compound and Martha Street Centre Compound	Access from Wentworth Street, egress onto Martha Street
2	Deniehy Street Compound	Access and egress from Martha Street
2	Junction Street Compound	Access and egress from Junction Street
3	Adderley Street West Compound	Access and egress from Adderley Street West
3	Adderley Street Main Compound	Access and egress from Adderley Street West
3	Adderley Street East Compound (1 and 2)	Access from Adderley Street East, egress onto Day Street South
3	Hill Road G-loop Compound and Hill Road North Compound	Access and egress from Hill Road
3	Homebush Bay Drive East Compound	Access and egress from Parramatta Road and / or Homebush Bay Drive westbound off-ramp

The locations and access arrangements for the proposed compounds are shown in **Figure 8-1**, **Figure 8-2** and **Figure 8-3**.

8.2.2 Working hours and arrangements

Standard working hours for the sites would be between 7.00 am and 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturday.

Traffic Management Plans (TMPs) would be developed by the contractor to allow safe work sites to be created along the motorway and local roads. These work sites would be protected by temporary concrete barriers where applicable while maintaining the lane capacity on the road with the potential for changes to lane widths and realignment of lanes. The TMPs would consider the convenience and safety of all road users, including public transport, pedestrians and cyclists.

In some cases, works may be required to be undertaken outside standard working hours, subject to approval organisations including the Transport Management Centre (TMC) and agencies if the impacts on traffic flow as a result of daytime activities are considered unacceptable by WestConnex Delivery Authority (WDA). Works outside standard working hours are expected to include:

- Any works requiring lane closures.
- Removal of existing traffic barriers and installation of temporary and permanent traffic barriers.
- Removal of existing line marking and new line marking.
- Removal of existing static signage and installation of new signage.
- Road re-surfacing.
- Pavement tie-in works.
- Ramp tie-in works.
- Reconfiguration of traffic lanes, installation of additional pavement drainage and relocation of existing Type F barrier on the existing viaduct.
- Some bridge works including piling for abutments, construction of piers, and installation of structures such as girders and concrete deck works and drainage works.
- Some concreting works.
- Some Operation and Management Control System (OMCS) works including trenching which requires lane closures.
- Delivery of plant and materials which is required outside normal working hours as requested by the police or WDA for safety and / or traffic flow reasons.

Where there is a requirement for construction activities to be undertaken outside standard working hours, the Construction Environmental Management Plan (CEMP) would outline an Out of Hours Works procedure which would include communication and notification to local residents, businesses and sensitive receivers of the out of hours works required and a complaints line.

Access points in and out of the work sites would be designed to minimise the potential for disruption to traffic caused by the turning movements of construction vehicles.

8.2.3 Construction site access

Work sites would be accessed via local roads and the motorway, including at on- and off-ramps. Access route selection would consider the characteristics of the road, nature of traffic using the road, any restrictions on use, bus routes, schools etc. Access to work sites for delivery vehicles and staff for the project is summarised in **Table 8-3.** Access arrangements for the proposed compounds are shown in **Figure 8-1**, **Figure 8-2** and **Figure 8-3**.

Table 8-3: Construction site access arrangements

Work site type	Vehicle access arrangement
Sites located adjacent to the motorway	Left-in left-out from the motorway where possible
Compounds	As per **Table 8-2**
Laydown areas	Left-in left-out from the 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 motorway where possible

Table 8-4 lists the local roads that would be used to provide direct access to work sites and ancillary sites. Estimates of the number of heavy vehicle movements related to each work site are provided in **Table 8-5**.

Local roads in **Table 8-4** have been classified according to a hierarchy in order to determine their functional role within the road network. Roads are classified according to the role they fulfil and the volume of traffic they can appropriately convey. The guidelines for the functional classification of roads were developed by (NSW) Roads and Maritime Services (Roads and Maritime) and are detailed below:

- Arterial road – typically a main road carrying over 15,000 vehicles per day and fulfilling a role as a major inter-regional link (over 1,500 vehicles per hour).
- Sub-arterial road – defined as secondary inter-regional links, typically carrying volumes between 5,000 and 20,000 vehicles per day (500 to 2,000 vehicles per hour). These roads supplement arterial roads in providing for through movement, to an individually determined limit that is sensitive to both roadway characteristics and abutting land uses.
- Collector road – provides a link between local roads and regional roads, typically carrying between 2,000 and 10,000 vehicles per day (250 to 1,000 vehicles per hour). At volumes greater than 5,000 vehicles per day, residential amenity deigns to decline noticeably. Trunk collector and spine roads with limited property access can reasonably carry traffic flows greater than 5,000 vehicles per day.
- Local road – provides access to individual allotments, carrying low volumes, typically less than 2,000 vehicles per day (250 vehicles per hour).

Table 8-4: Local road access to work and ancillary sites

Work zone	Local roads used for access	Road characteristic
1	Church Street	Arterial
	Junction Street	Local
	Victoria Street	Local
	Duke Street	Local
	Prince Street	Local
	Harris Street	Local
	Good Street	Collector
	A'Beckett Street	Local
	Alfred Street	Collector
	Arthur Street	Local
	James Ruse Drive	Arterial
	Wentworth Street	Local
	Martha Street	Local
2	Martha Street	Local
	Junction Street	Local
	Deniehy Street	Local
3	Adderley Street West	Local
	Adderley Street East	Local
	Day Street South	Local
	Hill Road	Collector
	Parramatta Road	Arterial

Access points at each of the compound frontages would be provided with adequate sight distances relating to the posted road speed. This would allow vehicles on the main road to see vehicles egressing from the compound and would allow sufficient room to slow down and stop if necessary. Similarly it would allow vehicles waiting to egress from the compound adequate sight distance to see approaching vehicles and determine acceptable gaps.

8.2.4 Construction workforce travel

It is anticipated that the total on-site staff and workforce would consist of up to 800 people over the duration of the construction period. Construction staff would have limited parking available at the compounds and work sites. Personnel would be advised of suitable parking arrangements as part of the compulsory project induction and would be encouraged to car pool.

It is expected that a proportion of the workforce would use public transport to commute to and from the work sites (existing public transport provision is detailed in **section 3.5**). Public transport and therefore a reduction in work site-related vehicle movements and parking on local roads could be promoted via the use of shuttle services from designated points, collecting personnel and transporting them to site prior to the beginning of each shift and transporting them from the site at the end of each shift. An on-demand service could then operate during the shift. The collection and delivery points for the shuttle service would vary as activities and work sites change as construction progresses. This would be identified in the CEMP as part of management of site traffic and transport arrangements.

8.3 Proposed construction activity

8.3.1 Vehicle movements

Proposed construction activities, heavy vehicle movements and number of personnel at each work site are detailed in **Table 8-5**.

Table 8-5: Proposed construction activities, heavy vehicle movements and number of personnel

Work site	Construction activities	Total number of heavy vehicle movements required during construction	Estimated number of daily heavy vehicle movements	Estimated number of personnel and daily light vehicle movements
Works between Pitt Street and Church Street west side	Clearing and grubbing	15	Up to 20	Between 6 and 30
	Prepare site access including environmental controls	8		
	Piling to abutment and retaining wall	18-20		
	Abutment and wall	60-70		
	Backfill	150		
	Cut	100-160		
	Pavement	635		
	Sundry	50		
Works east of Church Street	Clearing and grubbing	5	Up to 10	Between 10 and 50
	Prepare site access including environmental controls	60-70		
	Temporary bridges	24		
	New cycleway track	15-20		
	Piling and piers to viaduct footings	216		
	Viaduct girders	131		
	Sundry	80		
Works between A'Beckett Street and eastern abutment of bridge over Main Western Rail Line	Piling and piers to viaduct footings	325	Up to 10	Between 12 and 50
	Viaduct deck	89		
	Sundry	210		

Work site	Construction activities	Total number of heavy vehicle movements required during construction	Estimated number of daily heavy vehicle movements	Estimated number of personnel and daily light vehicle movements
Works at A'Beckett Street and Alfred Street intersection	Piling and piers to viaduct footings	325	Up to 10	Between 12 and 40
	Viaduct deck	89		
	Sundry	10		
Works between A'Beckett Street and western abutment of bridge over Carlingford Rail Line	Clearing and grubbing	20-30	Up to 10	Between 12 and 50
	Prepare site access including environmental controls	32		
	Piling and piers to viaduct footings	344		
	Viaduct deck	286		
	Sundry	20		
Works at James Ruse Drive west side	Piling and piers to viaduct footings	99	Up to 10	Between 12 and 35
	Viaduct deck	67		
	Sundry	60		
Works at James Ruse Drive east side	Clearing and demolition	40-60	Up to 10	Between 12 and 45
	Piling and piers to viaduct footings	240		
	Viaduct deck	54		
	Sundry	40		
Works between Wentworth Street and Deniehy Street (south)	Clearing and grubbing	12	Up to 50	Between 12 and 50
	Environmental controls	5-10		
	Retaining wall	2,300		
	Drainage	10-15		
	Pavement	600		
	Sundry	50-80		
Bridge over Deniehy Street	Abutments	22	Up to 10	Between 12 and 45
	Piers	40		
	Deck	40		
	Sundry	25		

Work site	Construction activities	Total number of heavy vehicle movements required during construction	Estimated number of daily heavy vehicle movements	Estimated number of personnel and daily light vehicle movements
Works between Deniehy Street and western abutment of Duck River	Clearing and grubbing	40	Up to 10	Between 12 and 24
	Cut and fill embankment	120-150		
	Drainage	10-15		
	Pavement	310		
	Sundry	40		
Works between Wentworth Street and Deniehy Street (north)	Clearing and grubbing	40	Up to 10	Between 15 and 45
	Access road	100-140		
	Piled wall	348		
	Retaining wall	57		
	Backfill retaining walls	300-400		
	Sundry	50		
Extended bridge over Deniehy Street	Abutments	20	Up to 10	Between 12 and 60
	Piers	287		
	Deck	196		
	Sundry	60		
Bridge over Duck River	Clearing and grubbing	Unknown	Up to 10	Between 15 and 50
	Backfill access to first pier location	10-20		
	Piling	62		
	Pile caps and piers	32		
	Beams	242		
	Deck	70		
	Sundry	60		

Work site	Construction activities	Total number of heavy vehicle movements required during construction	Estimated number of daily heavy vehicle movements	Estimated number of personnel and daily light vehicle movements
Works between Junction Street and Silverwater Road	Clearing and grubbing	15-25	Up to 50	Unknown
	Compounds and access	100-200		
	Access along alignment	50-90		
	Westbound widening	4,000		
	Westbound on-ramp	40		
	Backfill tunnel	460		
	Median infill	Unknown		
	Sundry	150-250		
Works between Silverwater Road and Haslams Creek	Clearing and grubbing	5-10	Up to 30	Between 15 and 60
	Widening eastbound on-ramp	437		
	Median	760		
	Sundry	100		
Works between Haslams Creek and Birnie Avenue	Clearing and grubbing	80	Up to 50	Between 20 and 60
	Eastbound on-ramp	5-10		
	Eastbound on-ramp access road	1,025		
	Eastbound on-ramp batter	10-20		
	Eastbound on-ramp fill wall	2,050		
	Eastbound on-ramp pavement	1,025		
	Westbound on-ramp	260		
	Median	2,700		
	Sundry	250		

Work site	Construction activities	Total number of heavy vehicle movements required during construction	Estimated number of daily heavy vehicle movements	Estimated number of personnel and daily light vehicle movements
Works between Birnie Avenue and Homebush Bay Drive	Compound and access track	50	Up to 30	Between 15 and 50
	Median and ramp	1,180		
	Existing viaduct works – new asphalt wearing surface	Unknown		
	Retaining walls to pedestrian and railway bridges	40-60		
	Sundry	125		

The work sites located east of Wentworth Street would have the largest volume of vehicle movements associated with them. These would be predominantly located in the commercial and industrial areas of Auburn, Silverwater and Lidcombe with immediate access to major arterial roads (James Ruse Drive, Parramatta Road and Silverwater Road). Due to the early start and finish times (relative to commuter peak periods) it is anticipated that there would be minimal impacts on the surrounding road network.

On the non-viaduct sections of the motorway, construction vehicles would access the work sites from the motorway where possible. Access to viaduct work sites would be provided by the local and arterial road network. Truck haulage would generally avoid peak periods in peak directions for productivity reasons and to limit the impact of truck movements in and out of work sites.

Vehicle Management Plans would be developed to reduce the impact of construction vehicle movements on the motorway and local roads. Such methods include controlled access points, radio contact to drivers and off-motorway truck staging. Staging sites for delivery and haulage trucks would be selected as appropriate for the capacity required and location relative to residential areas and other sensitive land uses.

Impact due to local road access of work and ancillary sites

The estimated vehicle movements to work sites are provided in **Table 8-5**. While the preferred access is via the motorway there would be some construction vehicles using local roads. **Table 8-4** lists the local roads around the motorway corridor that would be used to various degrees by construction-related vehicles depending on the nature of the site.

Based on the existing volumes and proportion of heavy vehicles it is expected that only the residential streets would have a noticeable increase in vehicle movements due to construction traffic accessing the work areas. Assessment of suitable routes and access points would be made as part of the CEMP with TMPs developed to limit the impact as detailed in **section 8.6**.

Selection of construction traffic routes

Routes for construction vehicles to and from compounds and work sites would be developed in the context of minimising impacts on local roads and maximising use of arterial roads. The approach for development of the routes is to consider the following:

- Preference for the motorway network and arterial roads.
- Restrictions on size and load of vehicles.
- Sensitive land uses, for example schools.
- Hours of operation of sensitive land uses.
- Access needs for residents, pedestrians, emergency services and buses.
- Out of hours impact on residential areas.
- Consultation with the Traffic and Transport Liaison Group and local residents.
- Guidance from relevant documents and standards, for example the *RMS Traffic Control at Work Sites* manual and *AS1742.3: Manual of Uniform Traffic Control Devices – Traffic control for works on roads*.

8.3.2 Haulage routes

Potential haulage routes to and from each compound from the nearest arterial road are detailed in **Figure 8-1**, **Figure 8-2** and **Figure 8-3**.

Figure 8-1: Potential haulage routes in work zone 1

Figure 8-2: Potential haulage routes in work zone 2

Figure 8-3: Potential haulage routes in work zone 3

8.3.3 Night works

Vehicle movements during proposed night works, as outlined in **section 8.2.2**, would include:

- General light vehicles.
- Floats.
- Tipper trucks.
- Truck and dog combinations.
- Flatbed crane trucks.
- Concrete trucks.
- Asphalting.

Works undertaken at night would be dictated by allowable lane occupancies. These occupancies would be operated through TMPs approved by the TMC with suitable detours (where applicable) to minimise impacts on the local road network. Appropriate communication strategies would be implemented to ensure that road users and the adjacent community are informed prior to any works commencing that may affect local traffic conditions.

A more detailed construction methodology would be prepared in association with the detailed design prior to commencement of construction works as part of the CEMP.

8.3.4 Temporary road closures

Proposed temporary road closures to facilitate construction activities are detailed in **Table 8-6**.

Details of detours (where applicable) and measures to reduce the impact of the road closures would be addressed in the TMPs that are developed for the planning and staging of works.

Table 8-6: Proposed temporary road closures

Road	Description of temporary closure
Church Street (arterial)	Erection of western approach span for Church Street bridge – closure of northbound lane required between 11.00 pm and 6.00 am (Saturday night / Sunday morning) Erection of bridge span over Church Street – complete closure of Church Street required between late Saturday night and mid Sunday morning (to be confirmed) Traffic switches for existing viaduct works – timing to be confirmed
M4 Motorway (main road)	Erection of western approach span for Church Street bridge – partial closure of shoulder and nearside westbound lane between 1.00 am and 4.00 am on Sunday morning Church Street to Wentworth Street – two westbound lanes and three eastbound lanes would be switched onto the new viaduct commencing at Wentworth Street. Traffic would be switched between the eastern abutment of the Deniehy Street bridge and the western abutment of Wentworth Street. This is to facilitate median works including relocation of existing Type F barrier on the existing viaduct. There would also be traffic switches for mill and pavement works Wentworth Street to Silverwater Road – two westbound lanes and three eastbound lanes would be switched onto the new Duck River bridge. Traffic would be switched just west of Silverwater Road. This is to facilitate median works 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 – timing to be confirmed
A'Beckett Street (local road)	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 (collector road) intersection	Construction of bridge span over the intersection would require a full closure of the intersection for 12 hours on a Sunday
James Ruse Drive (arterial)	Erection of bridge span over James Ruse Drive would require a full closure for 12 hours
Martha Street (local road)	Erection of reinforced earth wall panels would require closure of the nearside eastbound lane currently used for parking
Deniehy Street (local road)	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 on a Sunday

8.3.5 Special loads

Special load deliveries for the project are anticipated for items such as large bridge beams, viaduct deck and structural elements and paving equipment. These movements would, in general, occur at night under escort to locations along the motorway corridor. Oversized loads would be restricted by the routes and access hours allowed by Roads and Maritime, the TMC and WDA. Deliveries to sites on the motorway or local roads would have minimal impact on traffic due to the low volumes experienced during the permissible hours of movement. Some deliveries on local roads would require stop and go procedures to facilitate access by oversized loads resulting in short term closures to assist in movement and unloading.

8.4 Impact on traffic flows

8.4.1 M4 Motorway

Construction activities would have a temporary impact on existing traffic flows along the M4 Motorway, arterial roads and various local roads in close proximity to the motorway corridor. Those arterial and local roads that would experience some additional traffic during the construction period are the same roads that are expected to experience long-term benefits as a result of additional capacity on the M4 Motorway following the widening. These are identified in **section 8.2.3**.

During construction, a series of TMPs would be developed by the construction contractor for approval by WDA, Roads and Maritime and the TMC. The TMPs provide the overall plan and staging for managing traffic through and around each work site. These would be in accordance with the *RMS Road Design Guide*, the *RMS Traffic Control at Work Sites* manual and *AS1742.3: Manual of Uniform Traffic Control Devices – Traffic control for works on roads*, and any other relevant standard, guide or manual and reviewed by the Traffic and Transport Liaison Group. The Traffic and Transport Liaison Group would include relevant stakeholders such as NSW Police, affected bus operators, Transport for NSW, Roads and Maritime, NSW Taxi Council and local councils.

Speed limits and capacity

During construction, the motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush would generally have a reduced daytime speed limit of 80 kilometres per hour with some sections reduced to 60 kilometres per hour during night works. The speed limit reductions are required to facilitate reduced lane widths, works in the median and other works that would be undertaken in close proximity to travel lanes. Lane and shoulder widths would be consistent with *AS1742.3: Manual of Uniform Traffic Control Devices – Traffic control for works on roads.*

The implementation of an 80 kilometres per hour roadwork speed limit between Pitt Street, Parramatta and Homebush Bay Drive, Homebush would increase travel times on the motorway by up to one minute in free-flow conditions.

During peak periods, the existing provision of lanes would be maintained during construction – four lanes from Pitt Street to Church Street and three lanes east of Church Street in both directions of travel. During peak periods on the M4 Motorway, the current operational vehicle speeds are below the proposed roadwork speed limit, therefore the average travel time in peak periods is likely to remain unchanged during construction.

Where road shoulders would be used to accommodate realigned traffic lanes, there is the potential for extended delays as a result of incidents such as breakdowns or accidents.

Monitoring of the motorway and work sites would be undertaken using CCTV and mobile patrols to assist management of incidents.

8.4.2 Impacts on local roads

Road users may choose to take an alternative route (diversion) due to the reduced benefit on the motorway as a result of reduced speed limits and lane closures. Diversion is expected predominantly in the off-peak periods and particularly at night when the most severe lane occupancies would occur. At times, the motorway would need to be closed. **Table 8-6** outlines the proposed temporary road closures. During these periods, alternative routes would have sufficient spare capacity to accommodate additional traffic that has diverted from the motorway and therefore limited impact is anticipated for local roads.

8.4.3 Emergency services

The M4 Motorway is used by emergency service vehicles for travel to and from incidents. Therefore, the emergency services could potentially be delayed in general traffic when responding to incidents. In off-peak periods travel time delays would be related to the speed limit reduction and therefore the impact on emergency services would be minimal.

The potential removal of road shoulders would restrict access to incidents on the motorway by emergency service vehicles. Management plans for incident response would be developed in consultation with the emergency services

Emergency services would be regularly informed on the staging and progress of works through briefings from the construction team.

8.5 Impact on other road users

8.5.1 Pedestrians and cyclists

Specific pedestrian and cyclist facilities that would be impacted by construction activities are detailed in **Table 8-7**. Where there is possible interaction between construction traffic and pedestrians (eg at work site/compound access points) traffic controllers would be employed to ensure that adequate protection is given. Measures to reduce the impact on pedestrians would be addressed in the TMPs that are developed for the planning and staging of works.

Table 8-7: Construction impact on pedestrians and cyclists

Location	Facility type	Description of impact
Between Church Street and Junction Street, Granville	Shared path	The shared path would 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 would be crossed occasionally by construction vehicles which would be facilitated by a traffic controller.
Between Arthur Street and Martha Street, Granville	Shared path	Shared path would require relocation – further
Duck River	Shared path	The shared path would be crossed occasionally by construction vehicles which would be facilitated by a traffic controller.

8.5.2 Buses

Bus services that could potentially be affected by the proposed temporary road closures are detailed in **Table 8-8**. Bus operators and Transport for NSW would be consulted in the planning phase of each construction activity that requires road closures. Buses would also be subjected to the same delays as general traffic due to reduced speed limits or during manual traffic control.

Table 8-8: Construction impact on bus services

Road	Bus route	Bus operator
Church Street	907 – Bankstown to Parramatta via Bass Hill and Villawood	Transdev NSW
	M91 – Hurstville to Parramatta via Padstow, Bankstown and Chester Hill	Transdev NSW
M4 Motorway	N70 – Penrith to Town Hall (NightRide)	Busways
	N71 – Richmond to Town Hall (NightRide)	Busways
Alfred Street	909 – Bankstown to Parramatta via Auburn and Harris Park	Transdev NSW
James Ruse Drive	M92 – Sutherland to Parramatta via Lidcombe and Auburn	Transdev NSW

8.5.3 Rail

Construction of the viaduct over the Main Western and Carlingford Rail Lines would be planned to be undertaken with pre-planned Sydney Trains rail possession periods, which are typically between 2.00 am Saturday and 2.00 am Monday. However, specific shutdowns outside the planned rail possession periods may also be required.

8.6 Traffic management and mitigation during construction

8.6.1 Traffic Management Plans

The construction contractor would be responsible for the development of all TMPs for all aspects of construction that would require temporary changes to the motorway and local roads using barriers or lane occupancies. These changes would be undertaken in accordance with the *RMS Road Design Guide*, the *RMS Traffic Control at Work Sites* manual and *AS1742.3: Manual of Uniform Traffic Control Devices – Traffic control for works on roads*, and any other relevant standard, guide or manual. Consultation with relevant stakeholders would be managed through the Traffic and Transport Liaison Group.

TMPs provide the overall staging for the traffic management and the detail of how sub-plans are managed. The content of the TMPs would include:

- Traffic Control Plans showing the detail of signs and devices required for each configuration.
- 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.

Communication of the proposed changes would vary depending on the nature and extent of the management scheme. The options and processes for advising road users and the

general public of the changes would be included in the Community and Stakeholder Consultation Plan and coordinated by the Traffic and Transport Liaison Group to include:

- Portable and permanent variable message signs.
- Other project signage as required to direct traffic
- Project-specific and Roads and Maritime web sites.
- Radio advertising.
- Metropolitan and local newspaper advertising.

8.6.2 Other mitigation strategies

It is expected that the construction contractor would take all reasonable measures to ensure that road user delays are kept to an absolute minimum and that access is maintained for all road users.

In addition to development of the TMPs, the following mitigation strategies would be implemented to manage and control traffic during construction:

- Identify potential road user delays during the planning and consultation phases.
- During the detailed design stage, develop construction staging and temporary works that avoid conflicts with the existing road network and maximises spatial separation between work areas and travel lanes.
- Maintain existing road network capacity during construction.
- Isolate work areas from general traffic using temporary safety barriers.
- Promote public transport and car pooling to personnel to reduce work site-related vehicle movements and parking on local roads.
- Develop alternative work methods to minimise impacts, for example utilising more efficient plant and equipment, and applying different design solutions.
- During construction, WDA to work with TMC to observe traffic flows and incidents from CCTV footage.
- Provide a mechanism for the community to report incidents and delays, for example a project phone number.
- Plan all lane occupancies with the aim to minimise the actual work area, limit obstructions and restrictions, maximise road capacity and avoid peak traffic periods.
- Analyse traffic volume data to identify capacity requirements, assess the potential impact of lane occupancies on traffic flows, and identify the best time to minimise inconvenience to road users.
- Provide clear and concise guidance and support amongst key stakeholders involved in the Traffic and Transport Liaison Group.
- Minimise impacts on the shared path and keep it operational during construction where practical and safe to do so.

9 Conclusion

The principal objective of the M4 Widening project is to alleviate existing peak congestion and provide additional motorway capacity for future traffic growth in the M4 Motorway corridor as part of the full WestConnex scheme. Its role would be to support population and employment growth (giving rise to this forecast traffic growth in the corridor) and to provide support to the policy of urban revitalisation along Parramatta Road.

9.1 Operational benefits

9.1.1 Increase road and improve network operational performance

The M4 Motorway is currently one of the most congested motorway links in Sydney. It is approaching its practical capacity, where unstable flow can easily result in stop-start conditions. This section of the WestConnex scheme is predominantly a road widening project, which would generate significant improvements in travel time by reducing congestion on the M4 Motorway.

Table 7-4 shows that in the morning peak under the Base 'do minimum' scenario there are high levels of congestion on the M4 Motorway, 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. There would also be travel time savings in the westbound direction; the westbound trip takes six minutes in the Base 'do minimum' scenario compared to five minutes under the M4 Widening scenario.

Congestion on the M4 Motorway increases further in the morning peak under the Future 'do minimum' scenario, with the eastbound trip from Church Street to Homebush Bay Drive taking 19 minutes compared to 14 minutes under the Base 'do minimum' scenario. Under the Full WestConnex scenario this trip time reduces to approximately five minutes which demonstrates that the travel time savings achieved in the M4 Widening scenario are maintained as the remainder of the WestConnex scheme is delivered.

The completion of the full WestConnex project maintains the travel time savings generated by the widening of the M4 Motorway and would also generate travel time savings on other parts of the WestConnex scheme and the road network more generally.

The assessment has found that under the distance based toll regime to be adopted by the WestConnex scheme, traffic volumes could rise on parallel routes such as Parramatta Road despite the widening of the M4 Motorway. Under the M4 Widening scenario, travel times on Parramatta Road increase slightly due to drivers avoiding the toll. In the future there are further increases to Parramatta Road travel times since there are more vehicles in the corridor, however, the proportional increase between the Future 'do minimum' and the Full WestConnex scenarios remains the same. It is important to note that the increase in traffic, and therefore travel times, along Parramatta Road will generally return to numbers equivalent to Parramatta Road prior to the removal of the toll on the M4 Motorway in 2010.

Diversion of traffic from the M4 Motorway due to the previous toll arrangement (gauged by the change in traffic after the toll was removed in early 2010) was less than the amount that model is predicting under similar conditions. This is complicated by the effects of cashback that would not apply when the project is tolled when widened.

Furthermore, the road users most likely to avoid the toll would be those customers whose perception of the value of travel time is lower than other road users and from markets that are better served by other modes of transport or are not a target market of WestConnex.

In addition to providing increased road capacity along the M4 Motorway corridor, the full WestConnex scheme would also attract traffic, including heavy vehicles, that currently use King Georges Road, Roberts Road, Centenary Drive and Homebush Bay Drive (route A3) as a north-south link between the M4 Motorway and M5 Motorway by provide continuous motorway access to Sydney's east and Sydney's ports. The resulting reduction in traffic volumes on the A3 route would improve safety and reliability along these important strategic routes.

9.1.2 Improve the freight network

The WestConnex scheme provides a significant opportunity to address freight and commercial business vehicle needs along the M4 Motorway and M5 Motorway corridors, the requirement for high quality links to the Port Botany/Sydney Airport and the connectivity of the broader strategic freight network of which it would form a critical part.

The WestConnex scheme would provide significant freight benefits by providing more efficient and higher standard access between critical freight generators. In addition to the step change in freight efficiency and accessibility that the WestConnex scheme would provide, there are also a range of complementary initiatives that would enhance the freight network more broadly post implementation, including:

- Better connectivity of the strategic freight network for restricted access vehicles such as higher productivity vehicles, higher mass limit vehicles and over-height vehicles.
- 'Last-mile' access to freight generators located close to the WestConnex scheme
- Priority freight access to strategic freight generators such as Port Botany, Sydney Airport and intermodal terminals.

In meeting these needs, the M4 Widening project would assist the WestConnex scheme to contribute to the broader strategic objectives of the *NSW Long Term Transport Master Plan* (LTTMP) (Transport for NSW (TfNSW) 2012) and strategic action areas in the *NSW Freight and Ports Strategy* (TfNSW 2013).

The M4 Widening project would provide improved travel times for freight vehicles using the M4 Motorway in line with the improvement in operational performance of the motorway and contributes to the overall benefit once the rest of the WestConnex scheme is operational. However, the reintroduction of the toll as part of the project would cause a redistribution of some heavy vehicles to Parramatta Road and other roads. Freight traffic on these roads would increase relative to the Base 'do minimum' scenario.

The M4 Widening project would specifically give improved freight efficiency to the Chullora and Enfield intermodal sites to the south of the project with more capacity in the corridor to accommodate road trips to/from the rail terminal.

The upgrade of the M4 Motorway/Homebush Bay Drive interchange through the introduction of an additional westbound on-ramp from the southbound carriageway of Homebush Bay Drive would improve traffic flow on the A3 which links the M4 and M5 Motorways and forms part of Sydney's primary road freight network.

9.1.3 Addresses a growing population and contributes to create jobs in the area and create efficient connections between homes and jobs

The M4 Widening project would better connect residential areas to employment areas especially in Parramatta central business district (CBD) but also in the Silverwater and Rosehill industrial areas.

Within the study area of the M4 Widening project, pockets of significant jobs growth are expected along the M4 Motorway corridor, particularly around Parramatta CBD, Sydney Olympic Park and Rhodes. The number of jobs is expected to grow by 55 per cent between 2006 and 2046 from 369,458 to 571,259. The population is expected to grow by 61 per cent between 2006 and 2046 from 693,840 to 1.119 million. The major growth areas are expected to be around Burwood, Strathfield, Rhodes and Sydney Olympic Park, where two Urban Activation Precincts are located at Carter Street, Lidcombe and Wentworth Point, *Urban Activation Carter Street, Lidcombe* and *Wentworth Point Urban Activation Precinct Proposal*, Department of Planning and Infrastructure (2013b and 2013c).

9.1.4 Enable possible improvements to the public transport network

In the future the WestConnex scheme would create opportunities to improve the public transport network, however, no public transport network enhancements are proposed as part of the M4 Widening project.

There is an extensive network of bus and rail services within the local area, with some bus services likely to be impacted by the construction and operation of the M4 Widening project. Bus routes in this area provide connections to 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.

Heavy rail along the Main Western Rail Line serves long distance east-west movements by public transport.

The impact on bus services is related to the increase in traffic volumes on Parramatta Road between Granville and North Strathfield as a result of the application of a toll on the widened M4 Motorway. Bus services travelling along, Parramatta Road between Granville and North Strathfield would experience delays due to the congestion caused by the additional traffic flow.

Parramatta is Sydney's second CBD and is a major centre for employment, education retail and health facilities. Parramatta is identified as a 'Regional City' in the (*Draft) Metropolitan Strategy for Sydney to 2031* (DMSS) ((NSW) Planning and Infrastructure 2013). Providing bus priority measures on this section of Parramatta Road supports the provision of reliable public transport to Parramatta from areas without direct rail connections, such as Bankstown, and the employment areas on and around the M4 Motorway and Parramatta Road.

When the WestConnex scheme is operational, traffic on the parallel section of Parramatta Road could reduce and trigger solutions to several issues observed in the study area:

- The need for improved public transport access between the major transport hubs at Burwood and Strathfield and the developing employment precincts at Sydney Olympic Park, and the Urban Activation Precincts at Carter Street, Lidcombe and Wentworth Point.

- The need to connect future employment areas at Camellia and Silverwater with Main Western Rail Line stations, to encourage public transport mode choice.
- The need to plan for increased public transport demand resulting from urban revitalisation and densification.

Opportunities could arise to incorporate targeted bus priority along, across and to/from Parramatta Road. This section of Parramatta Road serves a number of bus routes crossing the corridor, or operating along different sections, linking to surrounding centres, railway stations and employment areas. Introducing bus priority measures at key intersections for cross regional routes would improve operating conditions for those services providing connections to surrounding centres, railway stations and employment areas.

Improved traffic conditions resulting from a reduction in traffic levels may support the introduction of new or extended services using this part of the Parramatta Road corridor.

9.1.5 Enable possible improvements of the active transport network in the future

In its present form, the M4 Motorway provides a direct connection between major trip generating centres including Strathfield, Flemington Markets, Homebush Bay/Sydney Olympic Park/Carter Street precincts, Silverwater industrial area and Parramatta. All these destinations are within 10 kilometres of each other.

Currently within the M4 Motorway corridor between Concord Road and Silverwater Road cyclists are permitted to ride along motorway shoulders. In the section between James Ruse Dive and Silverwater Road, cyclists are prohibited from travelling on the motorway where the shoulders in both directions reduce to widths which are unsuitable for cyclists to operate safely. To offset this network deficiency, an off-road shared path has been provided east of James Ruse Drive to Haslams Creek at Newington.

The widening of the M4 Motorway would maintain the current arrangements and no new cycling facilities are proposed. However, when the WestConnex scheme is complete, there may be opportunities in the future to incorporate separated cycleway provisions with enhanced connections to north-south bicycle corridors and major intersecting roads.

9.2 Construction impacts

The M4 Widening project comprises widening and upgrading the existing M4 Motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush and upgrades to existing interchanges. The proposed construction methodology and program indicates that the proposed works can be completed by the first quarter of 2017.

Construction activities would have a temporary impact on existing traffic flows along the M4 Motorway, arterial roads and various local roads in close proximity to the motorway corridor. Those arterial and local roads that would experience some additional traffic during the construction period are the same roads that are expected to experience long-term benefits as a result of additional capacity on the M4 Motorway following the widening. These are identified in **section 8.2.3**.

During construction, the motorway between Pitt Street, Parramatta and Homebush Bay Drive, Homebush would generally have a reduced daytime speed limit of 80 kilometres per hour with some sections reduced to 60 kilometres per hour during night works. The speed limit reductions are required to facilitate reduced lane widths, works in the median and other works that would be undertaken in close proximity to travel lanes. Lane and shoulder widths

would be consistent with *AS1742.3: Manual of Uniform Traffic Control Devices – Traffic control for works on roads.* The implementation of an 80 kilometres per hour roadwork speed limit between Pitt Street, Parramatta and Homebush Bay Drive, Homebush would increase travel times on the M4 Motorway by up to one minute in free-flow conditions.

Routes for construction vehicles to and from compounds and work sites would be developed in the context of minimising impacts on local roads and maximising use of arterial roads. Based on the existing volumes and proportion of heavy vehicles it is expected that only the residential streets would have a noticeable increase in vehicle movements due to construction traffic accessing the work areas. Assessment of suitable routes and access points would be made as part of the Construction Environment Management Plan (CEMP) and associated Traffic Management Plans (TMPs) developed to limit the impact.

TMPs would be developed by the contractor to allow safe work sites to be created along the motorway and local roads. These work sites would be protected by temporary concrete barriers where applicable while maintaining the lane capacity on the road with the potential for changes to lane widths and realignment of lanes. The TMPs would consider the convenience and safety of all road users, including public transport, pedestrians and cyclists.

In some cases, works may be required to be undertaken at night or on weekends, subject to approval by Roads and Maritime and agencies if the impacts on traffic flow as a result of daytime activities are considered unacceptable by WDA.

9.3 Summary

The Traffic and Transport Assessment of the M4 Widening project has found that the project would meet its stated objectives and would

- Enable integration with the subsequent stages of the WestConnex scheme 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.

Further, the Traffic and Transport Assessment has found that:

- The project is consistent with NSW Government and Transport for NSW (TfNSW) policy in respect to the LTTMP, NSW 2021: A plan to make NSW number one (NSW Department of Premier and Cabinet 2011) and the State Infrastructure Strategy (Infrastructure NSW 2012).
- The project is an integral component of the full WestConnex scheme as outlined in the WestConnex Business Case (Sydney Motorways Project Office 2013).
- On traffic operational grounds, the existing M4 Motorway peak traffic volumes are at capacity and traffic growth is being constrained and peak periods extended. The M4 Widening project would cater for diverse travel demands (such as freight and associated services) by providing the capacity required to service the new motorway corridors along the M4 East (between Homebush Bay Drive and City West Link), then onto St Peters and

at Sydney Airport. These corridors would improve accessibility by providing new routes for through traffic and connection to a high standard road network for adjoining areas. The reduction in arterial traffic would improve accessibility for local journeys.

- Road freight operations in the corridor, especially the long distance heavy vehicle movements on the network to and from Port Botany/Sydney Airport from Western Sydney experience increasing trip delay and unreliability as a result of the general traffic congestion. The M4 Widening project would provide significant reductions in travel time along the M4 Motorway and would contribute to the overall benefit once the rest of the WestConnex scheme is operational
- Construction activity would largely be confined to the M4 Motorway corridor itself and during normal working hours the existing number of trafficable lanes would be maintained. Some minor delays are anticipated as a result of reduced road works speed limits. Some local residential streets are anticipated to experience a noticeable increase in vehicle movements due to construction traffic accessing the work areas however these are expected to be minor.
- Overall, the impact of the construction of the M4 Widening project is anticipated to be minor and appropriate management plans would be applied to mitigate the impact.

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