Transport for NSW

M4 East Road Network Performance Review Plan

October 2023

NSW GOVERNMENT

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Acknowledgement of Country

Transport for NSW (Transport) acknowledges the traditional custodians of the land on which we work and live.

We pay our respects to Elders past and present and celebrate the diversity of Aboriginal people and their ongoing cultures and connections to the lands and waters of NSW.

Many of the transport routes we use today – from rail lines, to roads, to water crossings – follow the traditional Songlines, trade routes and ceremonial paths in Country that our nation's First Peoples followed for tens of thousands of years.

Transport is committed to honouring Aboriginal peoples' cultural and spiritual connections to the lands, waters and seas and their rich contribution to society.

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Document control

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Branch	Planning and Programs
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Versions

Version	Amendment notes
1	Draft
2	Updated based on stakeholder feedback
3	Updated based on Council feedback

Executive Summary

Introduction

WestConnex M4 East (Stage 1B) opened in July 2019. The project involved the construction of 5.5 kilometre tunnels with three lanes in each direction between Homebush and Haberfield. The project was delivered to improve connectivity between Western Sydney and the Inner West and reduce traffic on surface roads by allowing drivers to bypass up to 22 sets of traffic lights along Parramatta Road. The M4 East project was approved by the Department of Planning and Environment (DPE), previously the Department of Planning, Industry and Environment (DPIE), provided that the Conditions of Approval (CoA) are satisfied. As per CoA E36, the project is required to be reviewed 12 months after opening and this report fulfills that requirement through traffic modelling and analysis.

Background & purpose

The M4 East Road Network Performance Review Plan (M4 East RNPRP) has been prepared by Transport for NSW (Transport) to address Condition E36, which forms part of the Conditions of Approval for the M4 East and states the following:

- ***E36*** *CoA – Requires the preparation of a RNPRP at 12 months and 5 years after the completion of the M4 East project.* This RNPRP addresses the requirement for the 12-month post-opening assessment.

Assessment scope

This report considers and compares traffic volumes and road user safety metrics before and after the opening of the M4 East project. The comparison identifies the change in traffic patterns and any increases in usage of the surface road network, as well as any significant reduction in safety, highlighting key areas that are deemed to have been highly impacted by the M4 East project. Potential mitigation options are provided for those locations that are considered to be operating with deficiencies in performance or safety as a result of the M4 East. These options are for further consideration and implementation by Transport, in consultation with local Councils and the community.

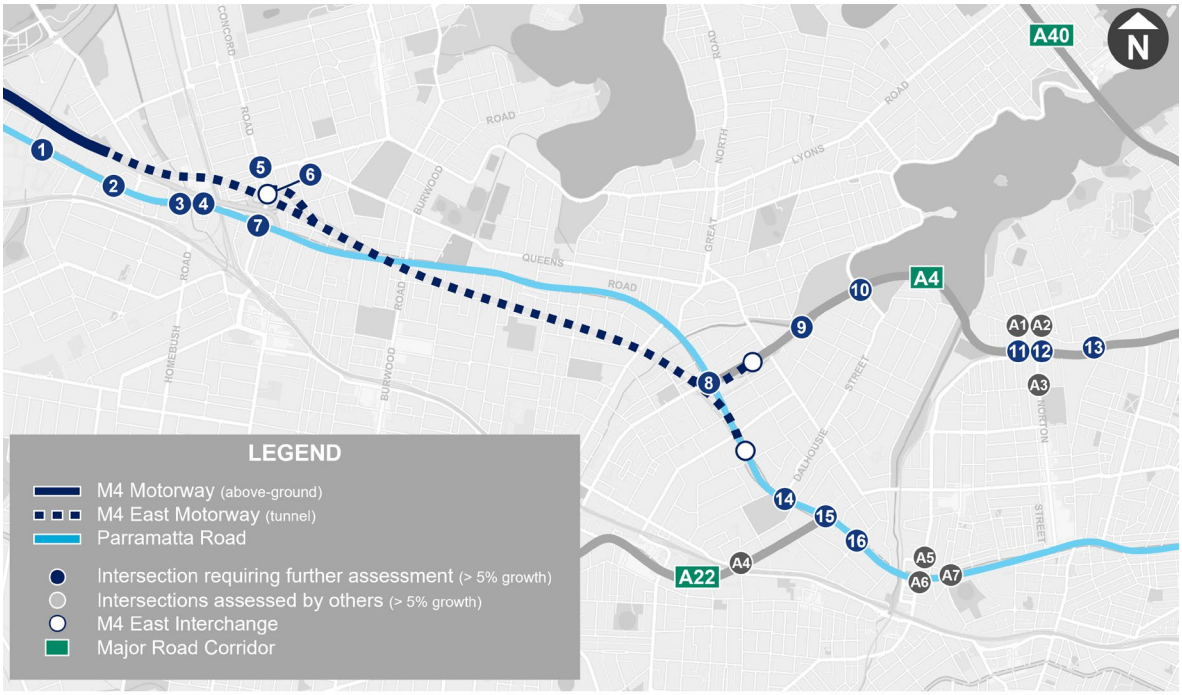
The study area for the M4 East RNPRP extends along key surface road corridors within the study area including Parramatta Road, City-West Link Road/ Dobroyd Parade/ Wattle Street, Concord Road and Homebush Bay Drive.

Summary of assessments

Intersections

Figure E-1 illustrates the intersections within the study area that experienced growth in traffic volumes post-opening (2019 and/ or 2020) by greater than five per cent of pre-opening volumes (2018).

Figure E - 1 Intersections assessed as part of the M4 East RNPRP



1. Parramatta Road / Potts Street
2. Parramatta Road / Park Road
3. Parramatta Road / M4 Motorway On-Ramp
4. Parramatta Road / George Street / Nipper Street
5. Concord Road / Patterson Street
6. Concord Road / Sydney Street
7. Parramatta Road / Concord Road / Leicester Avenue
8. Parramatta Road / Frederick Street / Wattle Street
9. Dobroyd Parade / Waratah Street
10. Dobroyd Parade / Timbrell Drive / Mortley Avenue
11. City-West Link Road / James Street
12. City-West Link Road / Norton Street
13. City-West Link Road / Balmain Road
14. Parramatta Road / Dalhousie Street
15. Parramatta Road / Liverpool Street
16. Parramatta Road / Sloane Street

A1. James Street / Lilyfield Road
A2. Norton Street / Lilyfield Road
A3. Norton Street / William Street
A4. Hume Highway / Carlton Crescent
A5. Tebbutt Street / Hathern Street
A6. Parramatta Road / Tebbutt Street
A7. Parramatta Road / West Street

Intersection analysis

Intersection performance was assessed at each site identified in Figure E -1 to compare pre-opening (2018) and post-opening (2019 and/ or 2020) performance. Most of these intersections experienced a traffic growth of greater than five per cent in both the 2019 and 2020 post-opening years, with the following exceptions:

- For intersections 2, 3, and 4, the increase in traffic volumes were observed to be less than five per cent during 2019 and, as such, only the 2020 scenario was reviewed.
- For intersection 13, the increase in traffic volumes were observed to be less than five per cent during 2020 and, as such, only the 2019 scenario was reviewed.
- Traffic volumes at intersection 8 did not increase more than five per cent during either post-opening scenarios when compared to pre-opening volumes; however, due to the crash history on Frederick Street, the 2020 scenario was reviewed.

In 2020, during the AM peak, overall performance remained the same or improved from pre-opening at all sites, with the exception of intersections 3, and 9 to 14 where performance degraded. During the PM peak, overall performance remained the same or improved at most intersections, with the exception of intersection 9, 12 and 16 where performance degraded.

Travel time analysis

Analysis of vehicle travel speeds along Parramatta Road was undertaken for both pre-opening and post-opening scenarios. The analysis utilises HERE travel data from Transport for the weekday periods in March 2018 representing pre-opening conditions, and in August 2020 representing post-opening conditions. Travel speeds from September 2019 were also assessed for reference conditions without the impact of the COVID-19 pandemic. The following segments along Parramatta Road were assessed between:

- Potts Street and Concord Road
- Concord Road and Wattle Street
- Wattle Street and Flood Street.

The analysis found that travel speeds improved post-opening, particularly between Concord Road and Wattle Street where the M4 East provides a direct alternative route. The analysis indicates travel time savings of between 10 and 20 minutes in each direction across the AM and PM peak periods, between Potts Street and Flood Street.

Bus performance analysis

Analysis of the weekday bus performance along Parramatta Road (between Burwood Road and West Street) was undertaken for both pre-opening and post-opening scenarios. The bus data was assessed for the weekday periods in March 2018 representing pre-opening conditions, and in August 2020 representing post-opening conditions.

Bus travel times and travel speeds generally improved by approximately one to four minutes during the AM peak (6-10am) and PM peak (3-7pm) in both directions on Parramatta Road between pre-opening and post-opening. The reduction in bus travel time is lesser than general traffic due to a shorter segment assessed (noting that there are no standard bus routes that travel west of Burwood Road on Parramatta Road) and bus stopping patterns and dwell times.

Road safety performance

Crash data was reviewed on key road corridors within the study area to assess road safety performance for pre-opening and post-opening. Based on this review, the following key findings were made:

- **Parramatta Road:** 15 per cent overall reduction in crashes between Homebush West and Haberfield; new/ increased crash clusters at Dalhousie Street, Sloane Street and between Tebbutt Street/ Old Canterbury Road and Flood Street.
- **Frederick Street/ Wattle Street/ City-West Link Road:** Number of crashes remained the same between pre-opening and post-opening, with approximately 38 per cent associated with rear end crashes across the assessed periods.
- **Homebush Bay Drive/ Centenary Drive:** Reduction in crashes from eight to three at the M4 Motorway interchange; the cause of each crash was generally unique.

- **Liverpool Road/ Hume Highway:** Increase from eight crashes pre-opening to nine crashes post-opening; most common cause of crashes changed from rear-end (38%) pre-opening to right through and out of control on carriageway (both 22%).

In general, the frequency and type of crashes have remained similar or reduced for the assessed corridors, indicating that, overall, the opening of the M4 East did not significantly impact road safety.

Community and stakeholder feedback

Transport received community and stakeholder feedback relating to impacts experienced from the opening of the M4 East motorway through the Haberfield, Ashfield and Leichhardt improvement project (HAL) in 2020, as well as Council consultation as part of the development of this report. Key issues and suggestions raised within these submissions included:

- concerns and suggestions regarding traffic light operations
- local road safety impacts and suggested speed limits
- general operations on Parramatta Road and Hawthorne Parade
- concerns with intersections on Parramatta Road and Dobroyd Parade/ Wattle Street/ City-West Link Road
- use of local roads as through-routes to avoid Parramatta Road.

A detailed response has been prepared by Transport for each of these key topics in Section 7.

Potential mitigations

Based on intersection performance and safety analysis as well as feedback received from the community and other stakeholders, several sites within the study area for this assessment were identified as potential locations for mitigation measures to minimise the impacts of the M4 East on the surrounding road network. These potential locations include the intersections of:

- City-West Link Road/ Balmain Road
- City-West Link Road/ James Street
- City-West Link Road/ Norton Street
- Dobroyd Parade/ Timbrell Drive/ Mortley Avenue
- Dobroyd Parade/ Waratah Street
- Parramatta Road/ Dalhousie Street
- Parramatta Road/ George Street/ Nipper Street
- Parramatta Road/ Liverpool Road
- Parramatta Road/ M4 on-ramp (Powell's Creek).

Subject to ongoing assessments and design developments to confirm feasibility, potential mitigations considered at some sites included the reconfiguration of intersections and traffic lanes, adjustments to signal phasing and the introduction of movement restrictions.

1. Introduction

1.1 Background

On 11 February 2016, the New South Wales (NSW) Minister for Planning granted approval to the State Significant Infrastructure (SSI) application for the WestConnex M4 East project ("the project"). The infrastructure approval, which is regulated under Section 115ZB of the *Environmental Planning and Assessment Act 1979*, is subject to the Minister's conditions of approval for the SSI.

The conditions of approval are administered by the NSW Department of Planning and Environment (DPE) (previously the NSW Department of Planning, Industry and Environment) and delivered by the Proponent – Transport for NSW (previously NSW Roads and Maritime Services).

Part E of the conditions of approval outlines conditions for environmental management, reporting and auditing during operations of the project. Condition E36 lists the requirement for the preparation of a Road Network Performance Review Plan as per the following requirements:

"At both 12 months and 5 years after the commencement of operation of the SSI, or as otherwise agreed to by the Secretary, the Proponent must prepare a Road Network Performance Review Plan in consultation with relevant councils that includes:

(a) an updated analysis, including modelling of traffic impacts to the adjoining road network (including impacts on local roads and rat running), as a consequence of the SSI. This must include a review of new information available about potential land use changes, including those associated with the Draft Parramatta Road Urban Transformation Strategy (Transport for NSW, 2015, or as updated), and any traffic changes as a result of other major road projects within the project area;

(b) further detailed investigations at the following intersections or sections of the road network:

- *(i) potential 'pinch-points' at the Parramatta Road and Wattle Street Interchanges where merging of tunnel exit traffic and surface traffic would occur,*
- *(ii) Parramatta Road/George Street,*
- *(iii) George Street/Pomeroy Street,*
- *(iv) Parramatta Road/Frederick Street/Wattle Street,*
- *(v) Parramatta Road/Concord Road,*
- *(vi) Concord Road/Patterson Street/Sydney Street,*
- *(vii) the intersection of the Concord Road off-ramps and Parramatta Road, and*
- *(viii) the intersection of the Pomeroy Street on-ramp and Parramatta Road;*

(c) updated consideration of potential mitigation measures to manage any predicted traffic performance deficiencies, particularly on Parramatta Road and in association with the investigations undertaken within E36(b);

(d) details on bus priority measures;

(e) the predicted traffic performance improvements from these measures, including any cumulative improvements;

(f) justification of why the predicted 'do minimum' performance of any intersection on the adjoining road network cannot be maintained (if necessary); and

(g) an updated description and proposed timing of potential mitigation measures. The Proponent is responsible for the implementation of the identified measures, if required.

The Road Network Performance Review Plan must be submitted to the Secretary, Transport for NSW (in relation to impacts on bus services) and to relevant council(s) within 60 days of its completion and made publicly available.

The purpose of the Road Network Performance Review Plan is to optimise road network performance including public transport access and times, and manage the performance impacts of the SSI on the adjoining road network by identifying or confirming mitigation improvements that could be required in areas where traffic performance may be unsatisfactory at time of completion of construction."

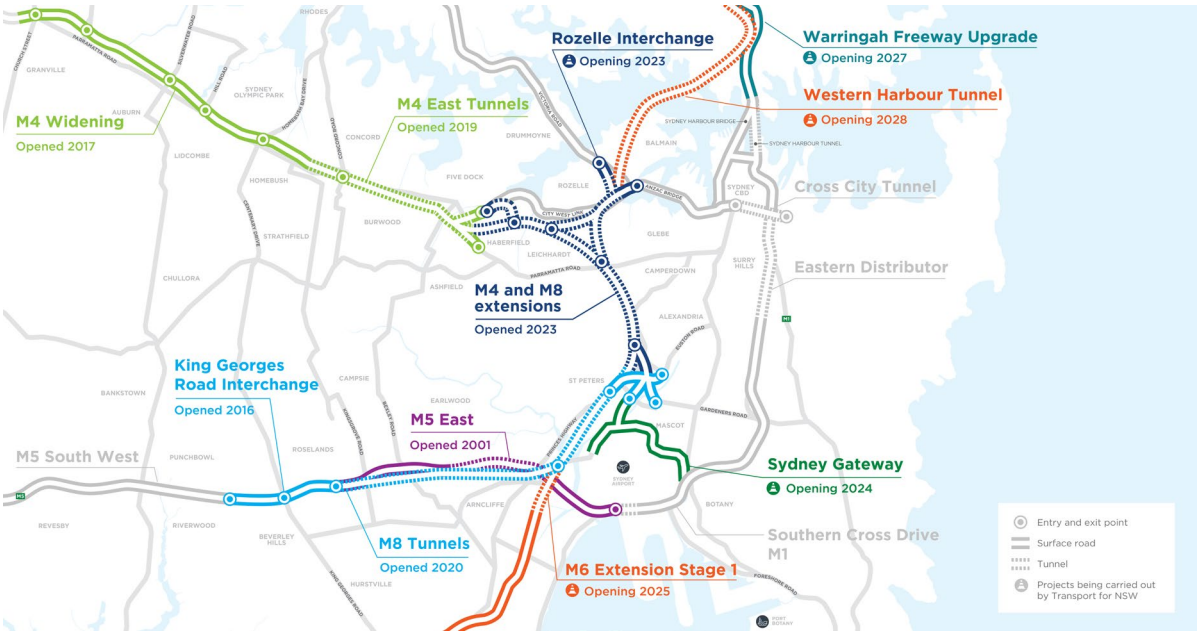
1.2 Overview of the project

1.2.1 WestConnex

WestConnex is a significant investment in Sydney's Road infrastructure by the NSW and Australian governments. It is the largest urban road project currently underway in Australia and comprises a series of interconnected motorways and road upgrades to increase the capacity of the M4 and M5 Motorways and provide a vital underground link between the two motorways.

WestConnex is 33 kilometres in length, which includes capacity improvements on existing motorways as well as new sections of motorway. It aims to better link Sydney's west with its international gateways and key places of business. WestConnex will act as a catalyst to renew and transform parts of Sydney, creating urban renewal and public transport improvement opportunities. An overview of the WestConnex project is shown in Figure 1-1.

Figure 1-1 Overview of WestConnex



Source: Transport for NSW (2023)

Efficient and reliable access to and from these gateways supports some of the state's most important economic journeys and is a critical element in sustaining the future productivity and global competitiveness of Sydney and NSW.

With more than two-thirds of WestConnex being built in underground tunnels, the project will ease congestion on surface roads and improve productivity and efficiency for all road users, including buses, freight and light commercial vehicles.

WestConnex is being delivered in three stages. Stage 1, comprising the M4 Widening and the M4 East, and Stage 2, comprising the M8 Motorway, are complete and open to traffic. Stage 3, comprising the M4-M5 Link and Rozelle Interchange is currently in delivery. The schedule for WestConnex is indicated in Figure 1-1.

1.2.2 M4 East

The M4 East was delivered to improve connectivity between Western Sydney and Sydney's Inner West.

The key features of the project included the delivery of 5.5 kilometres in tunnels between Homebush and Haberfield, four interchanges, seven new bridge structures, ancillary facilities and buildings, and improvements to the arterial road network, as follows:

- Widening of the existing motorway between Homebush Bay Drive, Homebush and the new M4 East entrance, west of Underwood Road, Homebush, to provide up to five lanes in each direction and connect with the widened M4 Motorway.
- Construction of new westbound on-ramp from Parramatta Road, west of George Street, North Strathfield, onto the widened M4 Motorway towards Parramatta.
- Construction of new on-ramp from Concord Road onto the widened M4 Motorway towards Parramatta, and new on/ off-ramps to access the M4 East.
- Construction of a new portal for the M4 East on Parramatta Road at Chandos Street, Ashfield.
- Construction of a new portal for the M4 East on Wattle Street at Ramsay Street, Haberfield.
- Provision of intelligent transport systems for motorway operations.
- Provision of road infrastructure and complementary technology services to support the future implementation of smart motorway operations.
- Provision of tolling infrastructure such as gantries and control systems.

The M4 East project was approved by the DPE provided that the Conditions of Approval (CoA) are satisfied. As per CoA E36, the project is required to be reviewed 12 months after opening. The project was opened to traffic on 13 July 2019 and is considered the date of the project opening for the purpose of this report.

1.3 Purpose of this report

The M4 East Road Network Performance Review Plan (M4 East RNPRP) has been prepared to address the requirements of Condition E36 discussed in Section 1.1. This report assesses the impacts of the project on the performance and safety of the road network 12 months following start of operations on 13 July 2019 (post-opening) with the performance of the road network prior to opening of the project (pre-opening). The report also identifies locations where road network performance and safety on the adjoining road network has been impacted by the M4 East, as well potential mitigation measures to improve impacted locations and support the integration of the M4 East into the broader transport network.

Table 1-1 describes the alignment of the mitigation measures developed out of the M4 East RNPRP with the relevant NSW outcomes or initiatives. The report also provides responses to feedback received from the community and other stakeholders.

Table 1-1 Project mitigation measures alignment with relevant NSW strategic policies

Strategic policy	Description	Alignment with mitigation measures
Future Transport 2056	• Outlines the NSW Government's strategy for creating and maintaining a 'world-class, safe, efficient and reliable transport system over the next 40 years. • Safe, healthy, sustainable, accessible and integrated journeys in NSW. • Stabilise Greater Sydney's traffic.	Customer-centric principles will inform the development of project mitigation measures, including ways of optimising the road network through managing demand and performance.
2026 Road Safety Action Plan	Aims to ensure safety is designed into the transport network as NSW grows.	Will inform the design of project mitigation measures, in the context of road safety.
Movement and Place Framework	To create successful streets and roads by balancing the movement of people and goods with the amenity and quality of places.	Customer-centric principles will inform the development of project mitigation measures.
Active Transport Strategy	Prioritising walking, bike riding and personal mobility for short trips and a viable, safe and efficient option for longer trips.	Consideration of active transport requirements to inform design of project mitigation measures.
Providing for Walking and Cycling in Transport Projects Policy	The policy outlines that every transport project funded by Transport for NSW must include provision for walking and cycling within the core scope of the project. Walking and cycling components of a project must be incorporated from the outset and followed through to delivery and maintenance.	Consideration of active transport requirements to inform design of mitigations.
Road User Space Allocation Policy and Procedure	When allocating road user space based on the network vision and road functions, consider all road users in order of: walking (including equitable access for people of all abilities);	Will inform the design of project mitigation measures, in the context of road users.

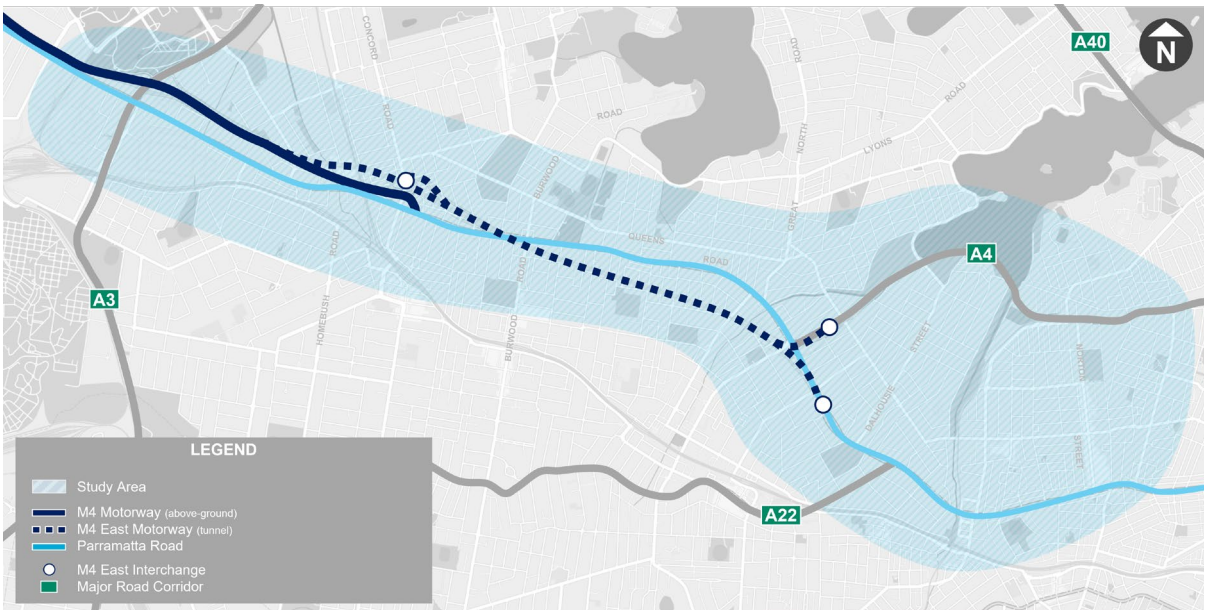
Strategic policy	Description	Alignment with mitigation measures
	cycling (including larger legal micro-mobility devices); public transport; freight and deliveries; and point to point transport ahead of general traffic and on-street parking for private motorised vehicles.	

1.4 Extent of this review

The extent of the M4 East RNPRP has been identified based on the intersections assessed during the Environmental Impact Statement (EIS) prepared for this project, intersections with concerns raised by the community and stakeholders, intersections where safety concerns have been identified. Figure 1-2 illustrates the study area for the M4 East RNPRP. In addition to the M4 Motorway and M4 East, key road corridors within the study area include:

- Parramatta Road
- City-West Link Road/Dobroyd Parade/Wattle Street (A4)
- Concord Road
- Homebush Bay Drive/Centenary Drive (A3)
- Liverpool Road/Hume Highway (A22).

Figure 1-2 M4 East RNPRP study area



1.5 Structure of this report

Table 1-2 presents the sections of this document relevant to the E36 conditions of approval.

Table 1-2 Report structure and relevant items addressed from Condition E36

Condition E36 item	Item requirements	Relevant report sections
A	*"an updated analysis, including modelling of traffic impacts to the adjoining road network (including impacts on local roads and rat running), as a consequence of the SSI. This must include a review of new information available about potential land use changes, including those associated with the Draft Parramatta Road Urban Transformation Strategy (Transport for NSW, 2015, or as updated), and any traffic changes as a result of other major road projects within the project area"*	Sections 3 – 7
B	*"further detailed investigations at the following intersections or sections of the road network –* *(i) potential 'pinch-points' at the Parramatta Road and Wattle Street Interchanges where merging of tunnel exit traffic and surface traffic would occur,* *(ii) Parramatta Road/George Street,* *(iii) George Street/Pomeroy Street,* *(iv) Parramatta Road/Frederick Street/Wattle Street,* *(v) Parramatta Road/Concord Road,* *(vi) Concord Road/Patterson Street/Sydney Street,* *(vii) the intersection of the Concord Road off-ramps and Parramatta Road, and* *(viii) the intersection of the Pomeroy Street on-ramp and Parramatta Road;*	Section 4
C	*"updated consideration of potential mitigation measures to manage any predicted traffic performance deficiencies, particularly on Parramatta Road and in association with the investigations undertaken within E36(b)"*	Section 8
D	*"details on bus priority measures"*	Section 5
E	*"the predicted traffic performance improvements from these measures, including any cumulative improvements"*	Section 4
F	*"justification of why the predicted 'do minimum' performance of any intersection on the adjoining road network cannot be maintained (if necessary); and"*	Section 4
G	*"an updated description and proposed timing of potential mitigation measures. The Proponent is responsible for the implementation of the identified measures, if required."*	Section 8

2. Methodology

As outlined in Section 1.3, this report considers and compares traffic volumes and safety metrics of the network before and after the opening of the M4 East project. The comparison identifies the change in traffic patterns and any increases in usage of the road network as a result of the project.

Traffic volume surveys were performed at a number of sites within the study area which have been compared and analysed to determine the change in traffic volumes between pre-opening and post-opening. A percentage measure has been used to allow comparison of results across the study area.

Anything with a five per cent increase or less is considered within normal growth ranges or part of the normal day to day traffic volume variance for this project area. Anything with an observed traffic volume increase of more than five per cent was treated as a change and further assessed with SIDRA Intersection modelling software (SIDRA), as further discussed in Section 4.1.

Safety metrics including crash data and observed collisions and near misses were also assessed using data between 2018 and 2020 to determine whether road safety has reduced from the opening of M4 East. Crash data was also reviewed between 2016 and 2018 to determine if the trends during the period assessed were generally consistent with previous years.

The mitigation options were then proposed by considering the benefits of implementing these options in the road network and their alignment with local council improvement works and future road network plans. A summary of potential mitigation options for locations that are impacted by the project is provided in Section 8.

Due to changes in travel behaviours as a result of the COVID-19 pandemic (declared in March 2020), traffic volumes have been reviewed for both 2019 and 2020 to review and determine the associated impacts of the M4 East, with and without the potential impacts of COVID-19. As further discussed in Section 3.3, 2020 traffic volumes were generally higher than 2019, therefore 2020 traffic volumes were selected as the reference for traffic analysis and modelling to provide a more conversative assessment.

Figure 2-1 illustrates the process flow diagram adopted for the post-opening M4 East RNPRP.

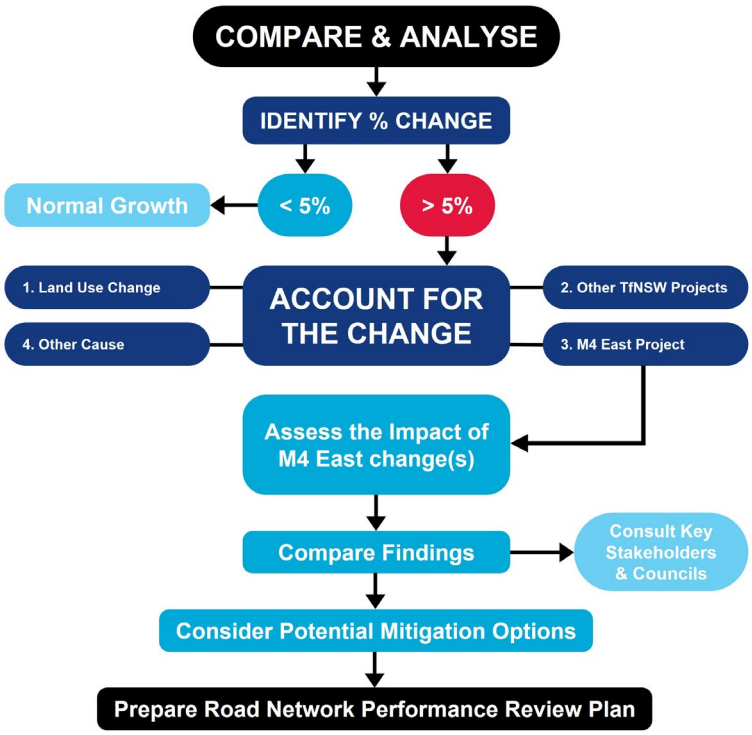


Figure 2-1 M4 East Road Network Performance Review Plan methodology

3. Traffic volume analysis

3.1 Intersections analysed

Table 3-1 presents the intersections where traffic volumes have been analysed for pre-opening and post-opening as part of this review.

Table 3-1 Intersections analysed for the M4 East RNPRP

Primary road: City-West Link Road/ Dobroyd Parade		
Balmain Road	James Street	Norton Street
Waratah Street	Timbrell Drive/ Mortley Avenue	Ramsay St
Primary road: Concord Road		
Patterson Street	Sydney Street/ M4 Off-Ramp	
Primary road: Parramatta Road		
Birnie Avenue	Bland Street	Bold Street*
Bombay Street/ Hill Road*	Bridge Street	Broughton Street
Burwood Road	Concord Road/ Leicester Avenue	Dalhousie Street
Duck Street/ Rawson Street*	Frederick Street/ Wattle Street	George Street/ Nipper Street
Good Street*	John Street*	Knight Street
Liverpool Road	Marlborough Avenue	Mosely Street
M4 On and Off-Ramp	M4 On-Ramp (Powell's Creek)	Park Road
Potts Street	Shaftesbury Road	Sloane Street
Underwood Road	Wentworth Road	
Primary road: Homebush Bay Drive		
M4 Eastbound On-Ramp	M4 Westbound Off-Ramp	M4 On and Off-Ramps
Primary road: George Street		
Pomeroy Street		

*Intersections are located outside of the M4 East RNPRP study area; volumes were reviewed based on stakeholder feedback.

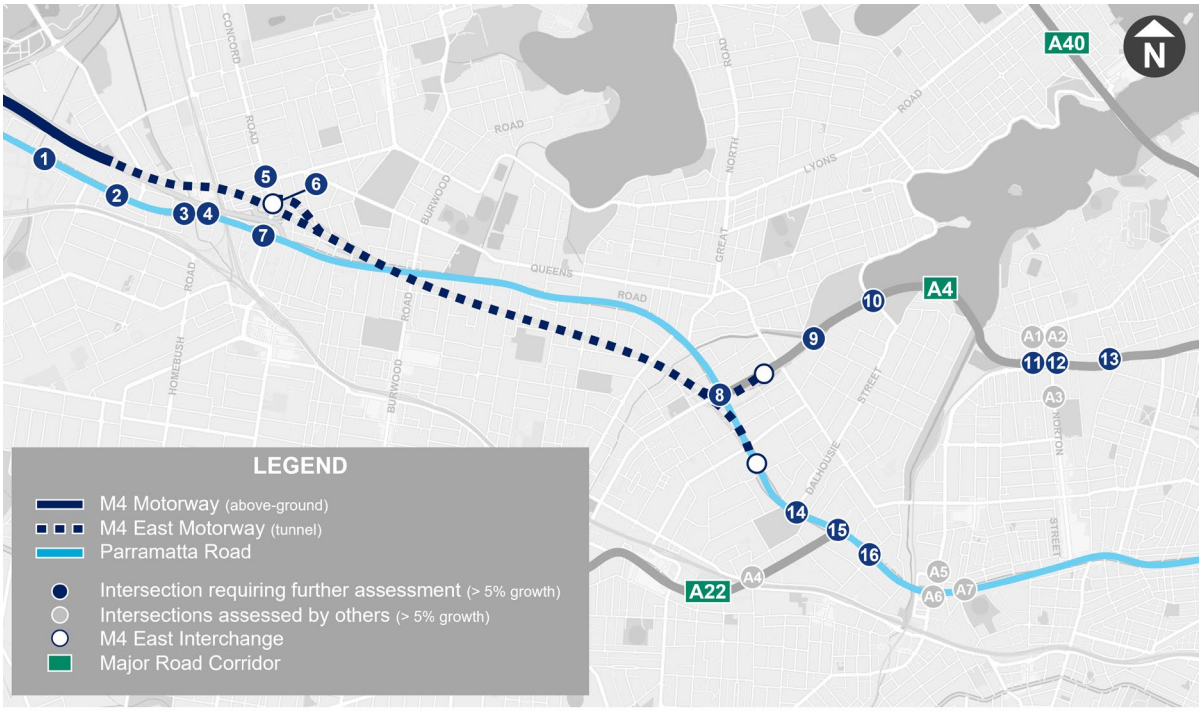
The traffic volume data used for the analysis were based on a combination of traffic surveys and Sydney Coordinated Adaptive Traffic System (SCATS) detector data. The pre-opening baseline surveys were carried out in March 2018. This was done to provide a true representation of the network performance before the M4 East's completion. The post opening surveys used in this analysis were carried out in September 2019 and August 2020.

3.2 Intersections identified for modelling

Figure 3-1 illustrates the intersections within the study area that demonstrated an increase greater than five per cent during the AM and/ or PM peak hours between pre-opening (2018) and post-opening (2019 and/ or 2020), with the exception of the following:

- Intersections 2, 3 and 4 – over five per cent increase was observed between 2018 and 2020 only
- Intersection 8 – less than five per cent increase was observed; however, 2020 was included for further assessments due to crash history at Frederick Street
- Intersection 13 – over five per cent increase was observed between 2018 and 2019 only.

Figure 3-1 Intersections identified for traffic modelling



1. Parramatta Road / Potts Road
2. Parramatta Road / Park Road
3. Parramatta Road / M4 Motorway On-Ramp
4. Parramatta Road / George Street / Nipper Street
5. Concord Road / Patterson Street
6. Concord Road / Sydney Street
7. Parramatta Road / Concord Road / Leicester Avenue
8. Parramatta Road / Frederick Street / Wattle Street
9. Dobroyd Parade / Waratah Street
10. Dobroyd Parade / Timbrell Drive / Mortley Avenue
11. City-West Link Road / James Street
12. City-West Link Road / Norton Street
13. City-West Link Road / Balmain Road
14. Parramatta Road / Dalhousie Street
15. Parramatta Road / Liverpool Street
16. Parramatta Road / Sloane Street

A1. James Street / Lilyfield Road
A2. Norton Street / Lilyfield Road
A3. Norton Street / William Street
A4. Hume Highway / Carlton Crescent
A5. Tebbutt Street / Hathern Street
A6. Parramatta Road / Tebbutt Street
A7. Parramatta Road / West Street

3.3 Traffic volume comparison

As noted in Section 2, traffic volumes were reviewed for 2019 and 2020 to assess the impact of the M4 East post-opening, with and without the potential impacts of COVID-19.

Figure 3-2 presents a comparison of traffic volumes between 2018, 2019 and 2020 during the AM peak for the intersections identified for further analysis.

Figure 3-2 Comparison of traffic volumes for 2018, 2019 and 2020 – AM peak hour (8-9am)

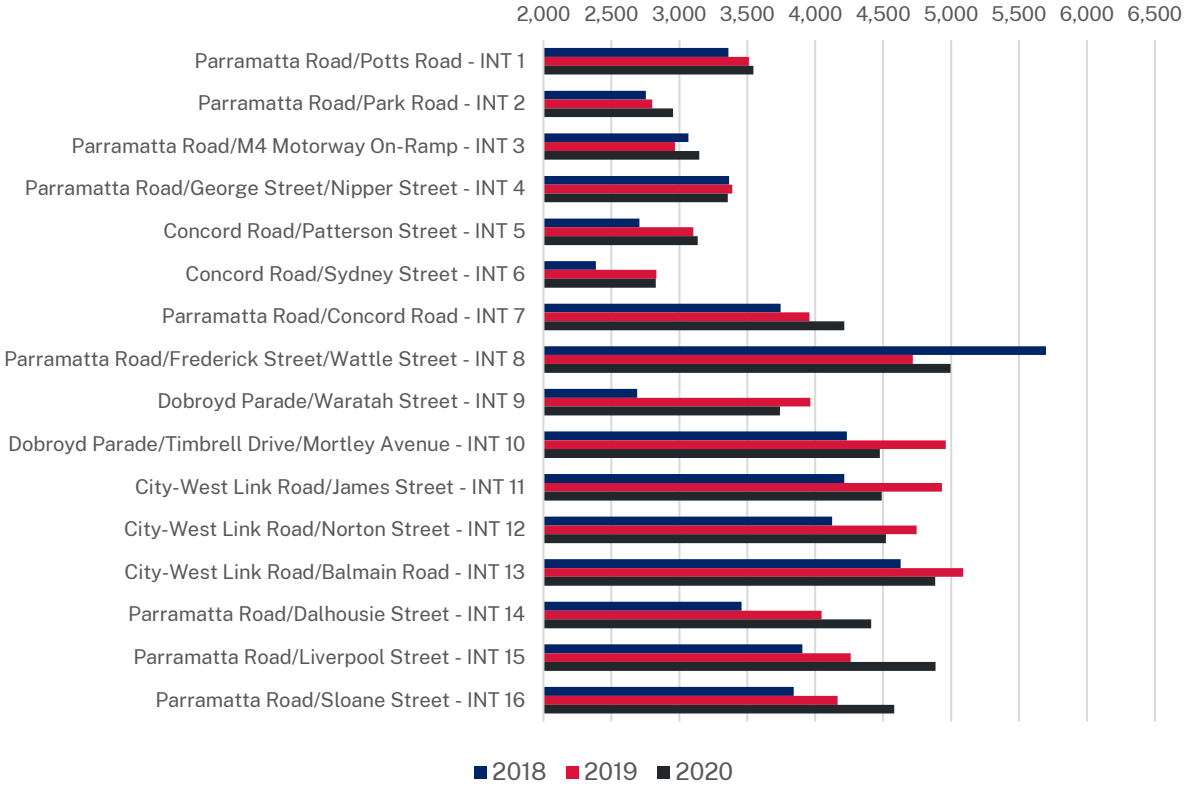
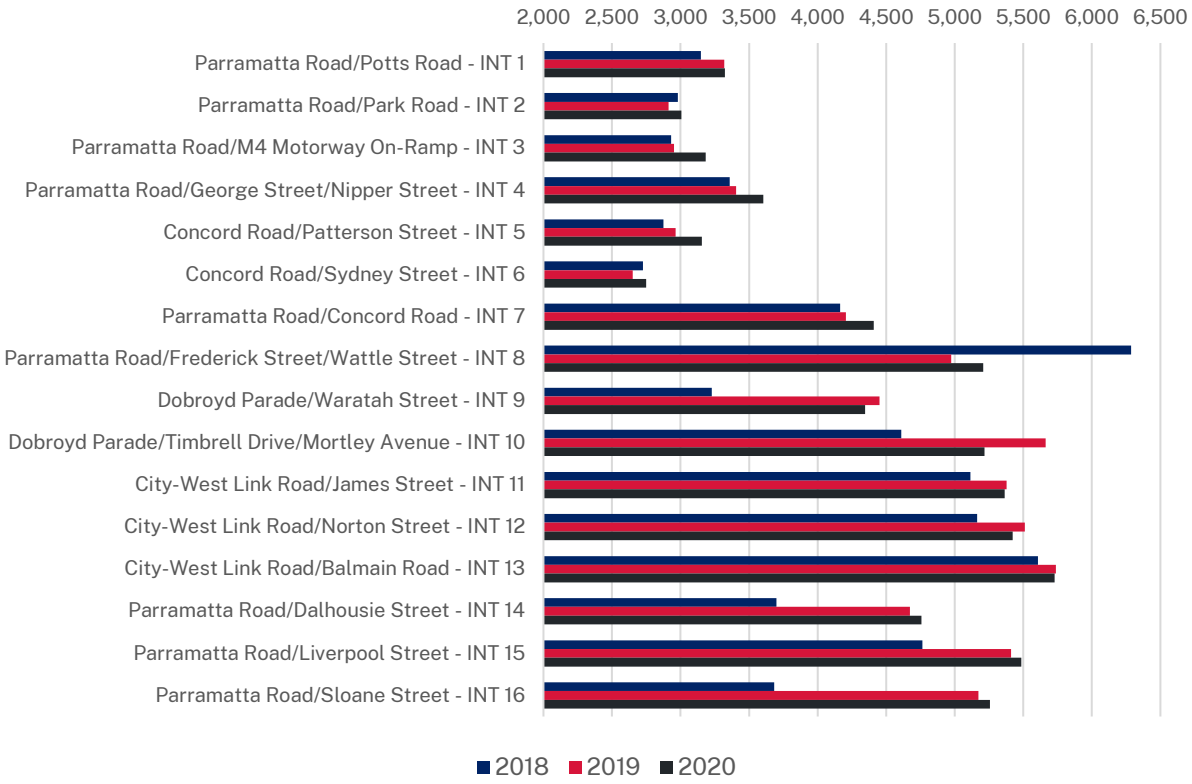


Figure 3-3 presents a comparison of traffic volumes between 2018, 2019 and 2020 during the PM peak for the intersections identified for further analysis.

Figure 3-3 Comparison of traffic volumes for 2018, 2019 and 2020 – PM peak hour (5-6pm)



As illustrated in Figure 3-2 and Figure 3-3, traffic volumes were higher in 2020 for the majority of intersections during the AM and PM peak periods compared to 2019. It is acknowledged that traffic volumes may be higher for 2020 due to changes in travel behaviour as a result of the COVID-19 pandemic, where private vehicle use increased and public transport use decreased. Therefore, the post-opening assessments based on the 2020 data were selected to be used as a conservative reference for traffic analysis and modelling in Section 3.4 and Section 4.

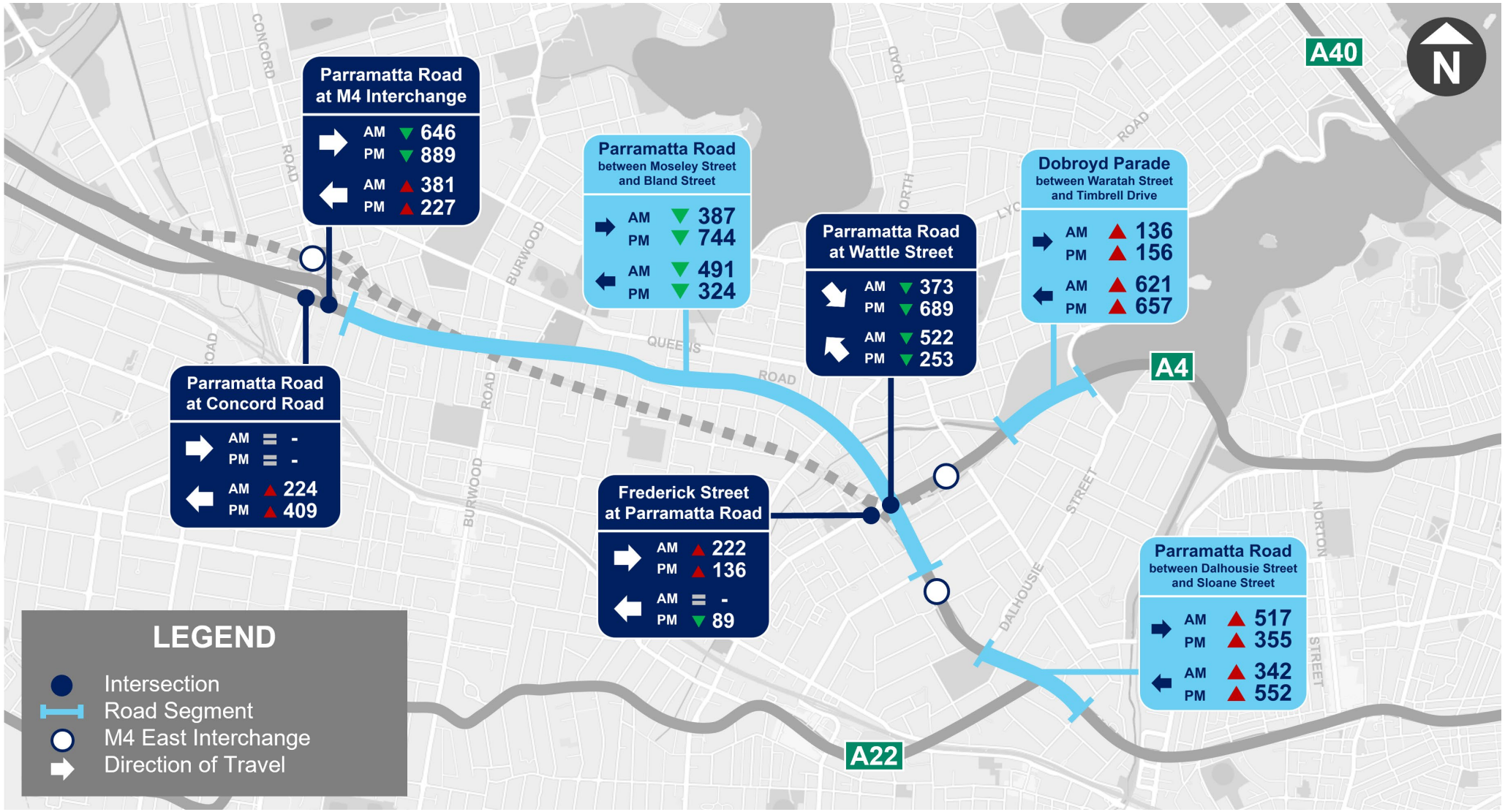
In order to assess road network performance without the impacts of COVID-19, intersection assessments were also completed for all sites using 2019 traffic volumes, with the exception of Intersection 13 (as noted in Section 3.2). Intersections 2, 3 and 4 were assessed for 2020 only as traffic volumes did not increase by more than five per cent in 2019.

Intersection assessments using 2019 traffic volumes for all sites (excluding Intersections 2, 3, 4, 8 and 13) are included in Appendix A.

3.4 Key observations

Figure 3-4 illustrates the key observations of traffic volumes on key road corridors within the study area between pre-opening (2018) and post-opening (2020) of the M4 East.

Figure 3-4 Key traffic volume observations between pre-opening and post-opening of M4 East



3.4.1 AM peak (8-9am)

Key observations from the comparison of pre-opening (2018) and post-opening (2020) traffic volumes for the AM peak are as follows:

Parramatta Road

- From Mosely Street to Bland Street (eastbound on Parramatta Road between M4 East interchanges) – an average **decrease** of 387 vehicles (18%).
- From Bland Street to Mosely Street (westbound on Parramatta Road between M4 East interchanges) – an average **decrease** of 491 vehicles (24%).
- From Dalhousie Street to Sloane Street (eastbound on Parramatta Road) – an average **increase** of 517 vehicles (29%) during the AM peak due to additional vehicles exiting the M4 East tunnels onto Parramatta Road.
- From Sloane Street to Dalhousie Street (westbound on Parramatta Road) – an average **increase** of 342 vehicles (24%) during the AM peak due to additional vehicles travelling on Parramatta Road to access the M4 East.
- At Concord Road (eastbound on Parramatta Road) – **similar** traffic to pre-opening; heavy vehicles **decreased** by 33 vehicles (33%).
- At Concord Road (westbound on Parramatta Road) – **increase** of 224 vehicles (22%); heavy vehicles **decreased** by three vehicles (4%).
- At M4 Motorway Interchange (eastbound on Parramatta Road) – **decrease** of 646 vehicles (28%); heavy vehicles **decreased** by 71 vehicles (31%).
- At M4 Motorway Interchange (westbound on Parramatta Road) – **increase** of 381 vehicles (64%); heavy vehicles **decreased** by two vehicles (5%).
- At Wattle Street (eastbound on Parramatta Road) – **decrease** of 373 vehicles (21%); heavy vehicles **decreased** by 57 vehicles (40%).
- At Wattle Street (westbound on Parramatta Road) – **decrease** of 522 vehicles (25%); heavy vehicles **decreased** by 88 vehicles (47%).
- In general, there has been a notable reduction in traffic volumes on Parramatta Road between the M4 East interchanges associated with the opening of the M4 East tunnels which provides an alternative route for drivers. Some increases in traffic volumes are observed for movements into and exiting the tunnel portals and ramps, such as the westbound right turn from Parramatta Road onto Concord Road to enter the eastbound M4 East tunnel on-ramp.

Dobroyd Parade

- From Waratah Street to Timbrell Drive/ Mortley Avenue (eastbound on Dobroyd Parade) – an average **increase** by 136 vehicles (9%); heavy vehicles **increased** by 87 vehicles (89%) on average.
- From Timbrell Drive/ Mortley Avenue to Waratah Street (westbound on Dobroyd Parade) – an average **increase** by 621 vehicles (56%); heavy vehicles **increased** by 51 vehicles (41%) on average.

Frederick Street (near southern M4 East interchanges):

- Towards Parramatta Road (northbound on Frederick Street) – **increase** of 222 vehicles (22%); heavy vehicles **increased** by three vehicles (5%).
- From Parramatta Road (southbound on Frederick Street) – **similar** traffic to pre-opening; heavy vehicles **decreased** by four vehicles (6%).

3.4.2 PM peak (5-6pm)

Key observations from the comparison of pre-opening (2018) and post-opening (2020) traffic volumes for the **PM peak** are as follows:

Parramatta Road

- From Mosely Street to Bland Street (eastbound on Parramatta Road between M4 East interchanges) – an average **decrease** of 744 vehicles (32%).
- From Bland Street to Mosely Street (westbound on Parramatta Road between the M4 East interchanges) – an average **decrease** of 324 vehicles (16%).
- From Dalhousie Street to Sloane Street (eastbound on Parramatta Road) – an average **increase** of 355 vehicles (20%) during the AM peak due to additional vehicles exiting the M4 East tunnels onto Parramatta Road.
- From Sloane Street to Dalhousie Street (westbound on Parramatta Road) – an average **increase** of 552 vehicles (30%) due to additional vehicles travelling on Parramatta Road to access the M4 East.
- At Concord Road (eastbound on Parramatta Road) – **similar** traffic to pre-opening; heavy vehicles **increased** by six vehicles (29%).
- At M4 Motorway Interchange (eastbound on Parramatta Road) – **decrease** of 889 vehicles (35%); heavy vehicles **decreased** by 27 vehicles (35%).
- At Wattle Street (eastbound on Parramatta Road) – **decrease** of 689 vehicles (38%); heavy vehicles **decreased** by 17 vehicles (44%).
- At Concord Road (westbound on Parramatta Road) – **increase** of 409 vehicles (42%); heavy vehicles **decreased** by three vehicles (6%).
- At M4 Motorway Interchange (westbound on Parramatta Road) – **increase** of 227 vehicles (35%); heavy vehicles **decreased** by four vehicles (13%).
- At Wattle Street (westbound on Parramatta Road) – **decrease** of 253 vehicles (12%); heavy vehicles **decreased** by 46 vehicles (44%).

Dobroyd Parade

- Waratah Street to Timbrell Drive/ Mortley Avenue (eastbound on Dobroyd Parade) – an average **increase** of 156 vehicles (9%); heavy vehicles **increased** by 13 vehicles (9%) on average.
- Timbrell Drive/ Mortley Avenue to Waratah Street (westbound on Dobroyd Parade) – an average **increase** of 657 vehicles (48%); heavy vehicles **increased** by 14 vehicles (31%) on average.

Frederick Street (near southern M4 East interchanges)

- Towards Parramatta Road (northbound on Frederick Street) – **increase** of 136 vehicles (14%).

- From Parramatta Road (southbound on Frederick Street) – **decrease** of 89 vehicles (8%).

Some heavy vehicle increases on Dobroyd Parade is likely attributable to construction vehicles using this road for subsequent WestConnex stages and other state transport infrastructure projects, as per approved construction haulage routes.

Key observations regarding road safety performance at the intersections assessed within the study area are detailed in Section 6.

3.5 Heavy vehicle traffic generated by other major projects

The completion of the WestConnex construction will lead to a decrease in heavy vehicle movements along Parramatta Road, Wattle Street, Dobroyd Parade, and City-West Link Road. However, it is expected that these roads will still have a temporary excess of heavy vehicle movements due to construction activities associated with other major projects nearby, such as the Sydney Metro West. The EIS documents related to the Sydney Metro West project includes detailed information related to the proposed construction vehicle haulage routes.

4. Intersection performance

Using the intersections listed in Section 3.2 of this report, traffic modelling using SIDRA was undertaken to capture the performance of each of these intersections during pre-opening and post-opening.

It is noted that this modelling exercise was developed based on historical data including SCATS, site understanding and feedback from stakeholders. Traffic modelling was undertaken to confirm the extent of network performance impacts since the completion of the M4 East project. Limited calibration data was available as the project base year of 2018 was prior to the commencement of this assessment and limited modelling specific data could be captured or retrieved from this period.

The standard measure of intersection performance is **vehicle delay**. SIDRA determines the average delay that vehicles encounter at the intersection and provides a measure of the **level of service** (LoS). Table 4-1 indicates the criteria that SIDRA adopts in assessing the LoS, in line with Transport's traffic modelling guidelines.

Table 4-1 Intersection LoS criteria

Level of Service (LoS)	Average delay per vehicle (s/veh)	Traffic signals, roundabouts	Give way and stop sign
A	Less than 14	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	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity, at signals incidents will cause excessive delays	At capacity, requires other control mode
F	Greater than 70	Extra capacity required	Extreme delay, major treatment required

Signalised intersections generally experience queueing of vehicles due to signal phasing and opposing traffic and/or pedestrian demands. SIDRA provides a queue length for all approaches of an intersection and the movements permitted from each of them (e.g., left turn).

The **Percentile Queue** parameter is used for the percentile queue length value to be included in output reports and displays. The default value is Percentile Queue = **95 %**. The 95th percentile queue length is the value below which 95 per cent of all observed cycle queue lengths fall, or five per cent of all observed queue lengths may exceed.

The summary tables present traffic volumes, queue lengths (worst performing approach of each intersection during the pre-opening scenario compared with the performance of the same approach in the post-opening scenario), average delay and intersection LoS.

Traffic Volumes

Queue Lengths
95th percentile (metres)

Average Delay
(seconds)

Intersection LoS

4.1 Summary of intersection performance

Table 4-2 presents a summary of the intersection LoS for the AM and PM peak periods during the pre-opening (2018) and post-opening (2020) scenarios.

Table 4-2 Summary of intersection performance

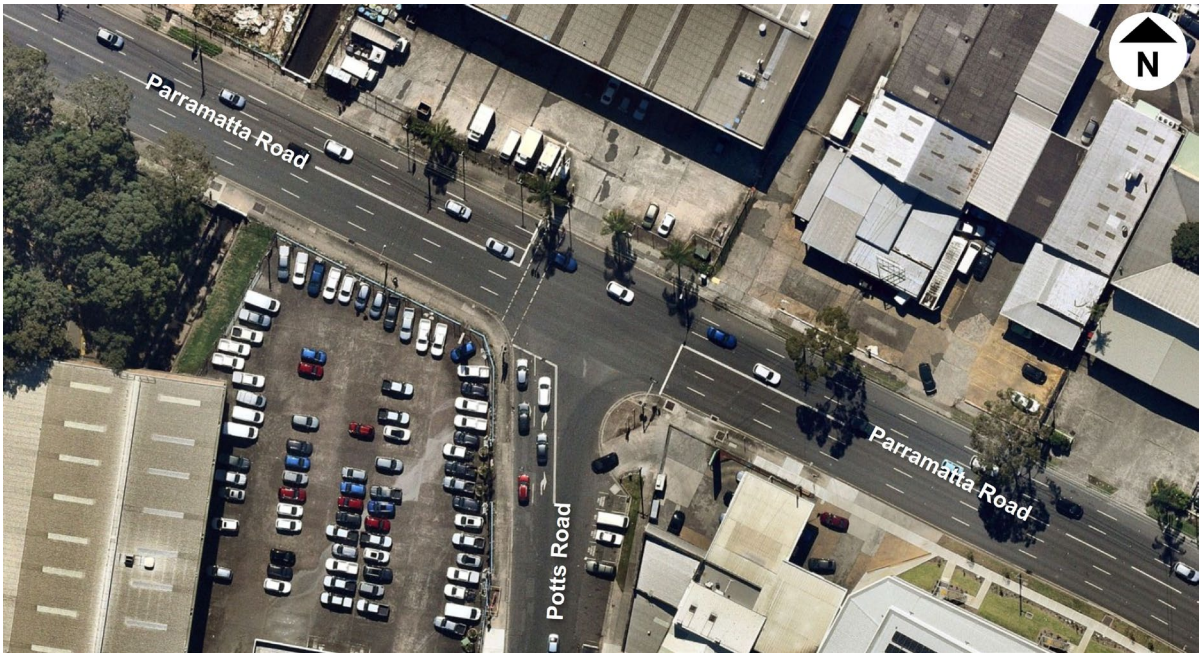
Intersection	AM peak			PM peak		
	Pre	Post	▲▼	Pre	Post	▲▼
1 – Parramatta Road/ Potts Street	A	A	=	A	A	=
2 – Parramatta Road/ Park Road	A	A	=	A	A	=
3 – Parramatta Road/ M4 Motorway On-Ramp	B	B	=	A	B	▼
4 – Parramatta Road/ George Street/ Nipper Street	D	D	=	E	E	=
5 – Concord Road/ Patterson Road	C	C	=	D	D	=
6 – Concord Road/ Sydney Road	B	A	▲	B	B	=
7 – Parramatta Road/ Concord Road/ Leicester Avenue	E	E	=	F	F	=
8 – Parramatta Road/ Frederick Street/ Wattle Street	E	D	▲	E	E	=
9 – Dobroyd Parade/ Waratah Street	A	B	▼	A	B	▼
10 – Dobroyd Parade/ Timbrell Drive/ Mortley Avenue	C	F	▼	D	C	▲
11 – City-West Link Road/ James Street	C	D	▼	C	C	=
12 – City-West Link Road/ Norton Street	C	C	=	C	D	▼
13 – City-West Link Road/ Balmain Road	C	E	▼	F	F	=
14 – Parramatta Road/ Dalhousie Street	C	C	=	B	C	▼
15 – Parramatta Road/ Liverpool Road	C	C	=	C	C	=
16 – Parramatta Road/ Sloane Street	A	B	▼	A	B	▼

In general, most intersections experience minor increase in delays and maintain a similar LoS compared to pre-opening. However, it is noted that some intersections on City-West Link Road experience increased delays associated with traffic generation from the M4 East project. Detailed discussion on each intersection is provided in the sections below.

4.2 Intersection 1 – Parramatta Road/ Potts Street

This is a three-way signalised intersection between Parramatta Road and Potts Street. Potts Street facilitates access to Paddy's Markets Flemington for general customers and heavy vehicles. In the eastbound direction, Parramatta Road widens to three lanes on approach to the intersection before narrowing back to two lanes approximately 150 metres from the exit of the intersection. All movements are permitted at this intersection. A pedestrian crossing is provided on the western approach of Parramatta Road. Figure 4-1 illustrates the intersection.

Figure 4-1 Intersection of Parramatta Road/ Potts Street



Imagery Source: Nearmap (post-opening)

The layout of this intersection has remained consistent between pre-opening and post-opening. The performance of this intersection has been assessed post-opening for 2020 which saw an overall increase in traffic volumes by approximately five per cent during the AM peak and six per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-3 presents a performance summary of this intersection.

Table 4-3 Summary of performance at Parramatta Road/ Potts Street

Parramatta Road/ Potts Street – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	3,537	3,314	3,725	3,499	+188	+185
Queue Length (m) Approach	212.0	233.9	292.3	232.5	+80.3	-1.4
	West	West	West	West		
Average Delay (sec)	9.2	6.1	9.5	6.4	+0.3	+0.3
Intersection LoS	LoS A	LoS A	LoS A	LoS A	=	=

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM and PM peak periods.

Key changes in performance observed at this intersection are as follows:

- There is minimal increase in queuing and delay at the intersection.
- Road safety remained consistent with two crashes occurring at this intersection before and after the opening of the M4 East.

Given the satisfactory performance of the intersection (as evidenced by LoS A), no mitigation measures have been proposed.

4.3 Intersection 2 – Parramatta Road/ Park Road

This is a three-way signalised intersection between Parramatta Road and Park Road. All movements are permitted at this intersection. Pedestrian crossings are provided on Park Road and the eastern approach of Parramatta Road. Figure 4-2 illustrates the intersection.

Figure 4-2 Intersection of Parramatta Road/ Park Road

Imagery Source: Nearmap (post-opening)

The layout of this intersection has remained consistent between pre-opening and post-opening. The performance of this intersection has been assessed post-opening for 2020 which saw an overall increase in traffic volumes by approximately seven per cent during the AM peak and one per cent during the PM peak when compared to pre-opening volumes. Traffic volumes did not increase more than five per cent from pre-opening volumes in 2019. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-4 presents a performance summary of this intersection.

Table 4-4 Summary of performance at Parramatta Road/ Park Road

Parramatta Road/ Park Road – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	2,899	3,137	3,109	3,164	+210	+27
Queue Length (m) Approach	116.6 South-East	128.7 South-East	118.5 South-East	118.9 South-East	+1.9	+3.2
Average Delay (sec)	7.9	7.9	7.2	6.9	-0.7	-1.0
Intersection LoS	LoS A	LoS A	LoS A	LoS A	=	=

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM and PM peak periods.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on Park Road during the AM peak, due to increased green time on Parramatta Road to facilitate increased traffic volumes as a result of the M4 East. During the PM peak, average delays have marginally decreased on all approaches.
- Vehicle queue lengths have marginally increased on Park Road during the AM peak and marginally decreased on all approaches during the PM peak, despite an increase in traffic volumes on both approaches of Parramatta Road due to traffic signal optimisation.
- Based on a review of crash data for 12 months before and after the opening of the M4 East, no crashes occurred at this intersection pre-opening and one crash occurred post-opening.

Given the satisfactory performance of the intersection (as evidenced by LoS A), no mitigation measures are proposed.

4.4 Intersection 3 – Parramatta Road/ M4 Motorway On-Ramp (Powell's Creek)

This is a three-way signalised intersection between Parramatta Road and M4 Motorway on-ramp. The M4 on-ramp is a one-way access only and the westbound through movement is a continuous flow. All other movements are permitted at this intersection. A pedestrian crossing is provided on the M4 Motorway on-ramp. Figure 4-3 illustrates the intersection.

Figure 4-3 Intersection of Parramatta Road/ M4 Motorway On-Ramp (Powell's Creek)

Imagery Source: Nearmap (post-opening)

The layout of this intersection has remained consistent between pre-opening and post-opening. The performance of this intersection has been assessed post-opening for 2020 which saw an overall increase in traffic volumes by approximately three per cent during the AM peak and eight per cent during the PM peak when compared to pre-opening volumes. Traffic volumes did not increase more than five per cent from pre-opening volumes in 2019. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-5 presents a performance summary of this intersection.

Table 4-5 Summary of performance at Parramatta Road/ M4 Motorway On-Ramp

Parramatta Road/ M4 Motorway On-Ramp – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	3,219	3,067	3,300	3,324	+81	+257
Queue Length (m) Approach	236.5 West	204.3 West	278.1 West	197.8 West	+41.6	-6.5
Average Delay (sec)	16.5	12.9	24.1	15.3	+7.6	+2.4
Intersection LoS	LoS B	LoS A	LoS B	LoS B	=	▼

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM peak but marginally degraded during the PM peak.

During the AM peak:

- Overall intersection volumes have increased compared to pre-opening. The westbound through movement on Parramatta Road is a continuous flow, resulting in minimal queue lengths or average delays.
- Average delays and queue lengths for the right turn movement onto the M4 Motorway on-ramp have reduced due to altered traffic signal phasing allowing vehicles to turn right more frequently during each cycle; however, queuing is still experienced beyond the turning lane which may impact upon through traffic.
- The altered signal phasing has resulted in an increase in the average delay on the western approach of Parramatta Road; however, queue lengths have slightly decreased.

During the PM peak:

- Both approaches along Parramatta Road have experienced increases in vehicle trips.
- Similar to the AM peak, signal phasing has been altered to allow vehicles to turn right from the eastern approach more frequently onto the M4 on-ramp, allowing a reduction in average delays and queuing.
- Despite the changes to signal phasing, queue lengths and average delays on the western approach have remained similar to pre-opening.
- Queuing between George Street/ Nipper Street and the M4 on-ramp has also been observed to occur in both directions during the PM peak. The LoS on both approaches has remained the same as pre-opening.
- The overall intersection performance during the PM peak has degraded slightly from LoS A to LoS B, as it is skewed by the continuous westbound through movement which generally operates with limited delay.

As discussed above, a review of the detailed model results indicates that the right turn onto the M4 on-ramp typically queues out of the available short right turn bay onto Parramatta Road. As this change is directly related to the M4 East project, mitigations are proposed at this intersection.

Based on a review of crash data for 12 months before and after the opening of the M4 East, no crashes occurred at this intersection pre-opening or post-opening.

4.5 Intersection 4 – Parramatta Road/ George Street/ Nipper Street

This is a four-way signalised intersection between Parramatta Road, George Street and Nipper Street. George Street facilitates travel north towards North Strathfield, and Nipper Street facilitates travel south towards Homebush. All movements are permitted at this intersection. Pedestrian crossings are provided on all approaches. Figure 4-4 illustrates the intersection.

Figure 4-4 Intersection of Parramatta Road/ George Street/ Nipper Street

Imagery Source: Nearmap (post-opening)

The layout of this intersection has remained consistent between pre-opening and post-opening. The performance of this intersection has been assessed post-opening for 2020 which saw an overall increase in traffic volumes by approximately six per cent during the AM peak and seven per cent during the PM peak when compared to pre-opening volumes. Traffic volumes did not increase more than five per cent from pre-opening volumes in 2019. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-6 presents a performance summary of this intersection.

Table 4-6 Summary of performance at Parramatta Road/ George Street/ Nipper Street

Parramatta Road/ George Street/ Nipper Street – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	3,530	3,536	3,743	3,792	+213	+256
Queue Length (m) Approach	362.8	398.0	393.7	511.7	+30.9	+113.7
	West	West	West	West		
Average Delay (sec)	52.4	59.4	52.9	60.0	+0.5	+0.6
Intersection LoS	LoS D	LoS E	LoS D	LoS E	=	=

Since the opening of the M4 East, overall performance at this intersection remained similar during the AM and PM peak periods. It is noted that the intersection was operating close to capacity prior to opening, with a LoS E during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on all approaches during the AM and PM peak periods, with the exception of the western approach of Parramatta Road where the averages delays have decreased. This is likely due to additional green time on Parramatta Road to support additional traffic accessing the M4 East, further east at Concord Road. The LoS has degraded on the eastern approach of Parramatta Road during the PM peak and degraded on Nipper Street and George Street during the AM and PM peak periods.
- Vehicle queue lengths have increased on all approaches during the AM and PM peak periods, with the exception of the western approach of Parramatta Road
- Based on a review of crash data for 12 months before and after the opening of the M4 East, three crashes occurred at this intersection pre-opening and four crashes post-opening.

While the performance of this intersection remains the same compared to pre-opening, it is noted that during peak hours, the downstream right turn onto the M4 westbound on-ramp often queues out beyond the available storage. This may impact the safety and performance of the intersection, noting an increased number of crashes post-opening. Given the close proximity of the M4 westbound on-ramp and associated queueing, it is recommended at this stage of assessment that both intersections are considered for mitigations. Potential mitigation measures at this location have been considered and included in Section 8.

4.6 Intersection 5 – Concord Road/ Patterson Street

This is a three-way signalised intersection located north of Parramatta Road. Concord Road facilitates travel north towards Rhodes and south towards the M4/ M4 East access ramps and further towards North Strathfield, with Patterson Street facilitating travel east towards Five Dock. All movements are permitted at this intersection. Pedestrian crossings are provided on the southern approach of Concord Road and eastern approach of Patterson Street. Figure 4-5 illustrates the intersection.

Figure 4-5 Intersection of Concord Road/ Patterson Street

Imagery Source: Nearmap (post-opening)

The layout of this intersection has changed between pre-opening and post-opening with the addition of a right-turn lane from Concord Road (northbound) onto Patterson Street, relocation of the east-west pedestrian crossing to the northern intersection leg, and additional lanes for the new M4/ M4 East access ramps to the south. Figure 4-6 illustrates Concord Road/ Patterson Street pre-opening of M4 East.

Figure 4-6 Intersection of Concord Road/ Patterson Street prior to opening of M4 East

Imagery Source: Nearmap (pre-opening)

The performance of this intersection has been assessed post-opening for 2019 and 2020 which saw an overall increase in traffic volumes by approximately 16 per cent during the AM peak and 11 per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-7 presents a performance summary of this intersection.

Table 4-7 Summary of intersection performance at Concord Road/ Patterson Street

Concord Road/ Patterson Street – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	2,841	3,048	3,299	3,434	+458	+350
Queue Length (m) Approach	166.8 South	254.2 South	166.5 South	169.9 South	-0.3	-84.3
Average Delay (sec)	34.0	44.6	33.8	48.4	-0.2	+3.8
Intersection LoS	LoS C	LoS D	LoS C	LoS D	=	=

Since the opening of the M4 East, overall performance at this intersection has been maintained during the AM and PM peaks.

- During the AM peak, average delays have been reduced on both approaches of Concord Road, increasing on Patterson Street. Queue lengths remain relatively similar, with the exception of the northern approach on Concord Road which has increased. The LoS has improved on both approaches of Concord Road from LoS C to LoS B degrading on Patterson Street from LoS C to LoS D.

- During the PM peak, queue lengths have increased on the northern approach of Concord Road and on Patterson Street, reducing on the southern approach of Concord Road which also experienced a reduction in average delay. The average delay on Patterson Street and the northern approach of Concord Road have increased.

The overall intersection performance during the AM peak has remained at a LoS C, and at LoS D in the PM peak and as such no mitigations are proposed at this location. This is likely due to the balancing of increased traffic volumes resulting from the M4 East with additional green time on Concord Road, as well as additional capacity on the southern approach of Concord Road.

4.7 Intersection 6 – Concord Road/ Sydney Street

This is a three-way signalised intersection between Concord Road, Sydney Street and the on/ off-ramps for the M4 and M4 East. Concord Road facilitates travel north towards Rhodes and south towards North Strathfield, with the M4 East facilitating travel east towards Haberfield and the M4 facilitating travel west towards Parramatta. Movement restrictions apply at this intersection. Pedestrian crossings are provided on the southern approach of Concord Road and Sydney Street/ M4 off-ramp. Figure 4-7 illustrates the current layout of the intersection.

Figure 4-7 Intersection of Concord Road/ Sydney Street

Imagery Source: Nearmap (post-opening)

The layout of this intersection has changed between pre-opening and post-opening with the addition of the new M4 and M4 East access ramps. Figure 4-8 illustrates Concord Road/ Sydney Street pre-opening of the M4 East.

Figure 4-8 Intersection of Concord Road/ Sydney Street prior to opening of M4 East

Imagery Source: Nearmap (pre-opening)

The performance of this intersection has been assessed post-opening for 2019 and 2020 which saw an overall increase in traffic volumes by approximately 68 per cent during the AM peak and four per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-8 presents a performance summary of this intersection.

Table 4-8 Summary of performance at Concord Road/ Sydney Street

Concord Road/ Sydney Street – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	1,813	2,834	3,049	2,939	+1,236	+105
Queue Length (m) Approach	92.1 North	140.3 North	59.0 North	71.4 North	-33.1	-68.9
Average Delay (sec)	18.7	21.2	13.5	16.1	-5.2	-5.1
Intersection LoS	LoS B	LoS B	LoS A	LoS B	▲	=

Since the opening of the M4 East, overall performance at this intersection has improved during the AM peak and remained similar during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on Sydney Street during the AM and PM peak periods. This is likely due to increased green time on Concord Road to accommodate vehicles entering and exiting the M4 East. The LoS of Sydney Street has degraded from LoS C to LoS E during the AM peak and LoS D to LoS E during the PM peak.
- Vehicle queue lengths have increased on Sydney Street during the AM peak and the southern approach of Concord Road during the AM and PM peak periods, likely due to the removal of one northbound lane at the intersection to accommodate vehicles exiting the M4 East.

Given the satisfactory performance of the intersection (as evidenced by LoS A during the AM peak and LoS B during the PM peak), no mitigation measures are proposed.

4.8 Intersection 7 – Parramatta Road/ Concord Road/ Leicester Avenue

This is a four-way signalised intersection between Parramatta Road, Concord Road and Leicester Avenue. Parramatta Road facilitates travel east towards Ultimo and west towards Holroyd. Concord Road facilitates travel north towards Rhodes, and Leicester Avenue facilitates travel south towards Strathfield. All movements are permitted at this intersection. Pedestrian crossings are provided on all approaches. Figure 4-9 illustrates the intersection.

Figure 4-9 Intersection of Parramatta Road/ Concord Road/ Leicester Avenue

Imagery Source: Nearmap (post-opening)

The layout of this intersection has changed between pre-opening and post-opening with an additional right turn lane from Parramatta Road onto Concord Road and the removal of a dedicated left turn lane and reallocation as a right turn lane from Concord Road onto Parramatta Road. Figure 4-10 illustrates Parramatta Road/ Concord Road/ Leicester Avenue pre-opening of the M4 East.

Figure 4-10 Intersection of Parramatta Road/ Concord Road/ Leicester Avenue prior to opening of M4 East

Imagery Source: Nearmap (pre-opening)

The performance of this intersection has been assessed post-opening for 2019 and 2020 which saw an overall increase in traffic volumes by approximately 13 per cent during the AM peak and eight per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-9 presents a performance summary of this intersection.

Table 4-9 Summary of performance at Parramatta Road/ Concord Road/ Leicester Avenue

Parramatta Road/ Concord Road/ Leicester Avenue – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	3,918	4,349	4,440	4,706	+522	+357
Queue Length (m) Approach	200.5 South	369.3 North	195.7 South	286.8 North	-4.8	-82.5
Average Delay (sec)	59.6	72.7	62.9	76.1	+3.3	+3.4
Intersection LoS	LoS E	LoS F	LoS E	LoS F	=	=

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM and PM peak periods. It is noted that the intersection was operating close to capacity prior to opening, with a LoS E during the AM peak and LoS F during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on Concord Road during the AM peak, with the LoS degrading from LoS E to LoS F.
- During the PM peak, average delays have reduced on Concord Road and the eastern approach on Parramatta Road due to phase time optimisation, with average delays increasing on Leicester Avenue and the western approach on Parramatta Road. The western approach on Parramatta Road has degraded from LoS E to LoS F and Leicester Avenue has degraded from LoS D to LoS E.
- Vehicle queue lengths have increased on Leicester Avenue and Concord Road during the AM peak. The northern approach right turn improves due to provision of dual right turn bays by reallocation of the existing through lane to right turn only. Consequently, the through and left turn movements from Concord Road degrade in performance. During the PM peak, all approaches experienced increase in queue lengths, except for Concord Road.
- Based on a review of crash data for 12 months before and after the opening of the M4 East, 1 crash occurred at this intersection pre-opening, with no crashes post-opening.

While this intersection continues to operate at LoS E and LoS F in the AM and PM peaks respectively, the operation of this intersection has not significantly declined and has remained fairly similar to pre-opening as evidenced by the marginal increase in delay and as such no mitigation measures are proposed.

4.9 Intersection 8 – Parramatta Road/ Frederick Street/ Wattle Street

This is a four-way signalised intersection located close to the eastern access and entry ramps of the M4 East. Parramatta Road facilitates travel towards Holroyd in the west and Ultimo in the east. Wattle Street facilitates travel north-east towards Haberfield, and Frederick Street facilitates travel south-west through Ashfield. Movement restrictions apply at this intersection. Pedestrian crossings are provided on Wattle Street, Frederick Street and the southern approach of Parramatta Road. Figure 4-11 illustrates the intersection.

Figure 4-11 Intersection of Parramatta Road/ Frederick Street/ Wattle Street

Imagery Source: Nearmap (post-opening)

The layout of this intersection has changed between pre-opening and post-opening on the eastern approach. The right turn lanes from Wattle Street onto Parramatta Road have been extended to full length lanes and separated from the through-lanes towards Frederick Street. Figure 4-12 illustrates Parramatta Road/ Frederick Street/ Wattle Street pre-opening of the M4 East.

Figure 4-12 Intersection of Parramatta Road/ Frederick Street/ Wattle Street prior to opening of M4 East

Imagery Source: Nearmap (pre-opening)

As described in Section 3.2, the increase in traffic volumes at this intersection during the post-opening scenario (2020) has been observed to be less than five per cent compared to pre-opening volumes (2018). However, due to the crash history on Frederick Street it has been included in this assessment. Based on a review of available crash data for 12 months before and after the opening of the M4 East, 17 crashes occurred at this intersection pre-opening, with nine crashes recorded post-opening.

Traffic volumes did not increase more than five per cent from pre-opening volumes in 2019. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening. Table 4-10 presents a performance summary of this intersection.

Table 4-10 Summary of performance at Parramatta Road/ Frederick Street/ Wattle Street

Parramatta Road/ Frederick Street/ Wattle Street – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	6,212	6,831	5,333	5,559	-879	-1,272
Queue Length (m) Approach	364.9 North-West	419.2 North-West	180.8 North-West	156.8 North-West	-184.1	-262.4
Average Delay (sec)	65.8	59.0	54.5	61.4	-11.3	+2.4
Intersection LoS	LoS E	LoS E	LoS D	LoS E	▲	=

Since the opening of the M4 East, overall performance at this intersection has improved during the AM peak and remained similar during the PM peak. It is noted that the intersection was operating close to capacity prior to opening, with a LoS E during the AM and PM peak periods.

Key changes in performance observed at this intersection are as follows:

- During the AM peak, average delays have decreased on all approaches. Traffic volumes on all approaches have reduced except for Frederick Street, likely due to vehicles on Parramatta Road and Wattle Street bypassing this intersection via the M4 East. As Frederick Street does not have direct access to the M4 East and traffic volumes have decreased on all other approaches, additional green time has been allocated to this approach.
- During the PM peak, average delays have increased on Wattle Street and Frederick Street.
- Vehicle queue lengths have decreased on all approaches during the AM peak and increased on Wattle Street and Frederick Street during the PM peak.
- Based on a review of crash data for 12 months before and after the opening of the M4 East, 17 crashes occurred at this intersection pre-opening (three of which involved a pedestrian) and nine crashes post-opening (none of which involved a pedestrian).

The overall performance has slightly improved the AM peak and maintained in the PM peak. Therefore, no mitigations are proposed at this intersection. Transport is currently undertaking a separate road safety assessment of Frederick Street to identify potential measures to improve road safety along this corridor, as detailed in Section 6.2.

4.10 Intersection 9 – Dobroyd Parade/ Waratah Street

This is a four-way signalised intersection including a temporary access road. Dobroyd Parade facilitates travel north-east towards City-West Link Road and south-west through Haberfield. Waratah Street facilitates travel south-east through Haberfield. The temporary access road facilitates movement of WestConnex construction vehicles. Movement restrictions apply at this intersection. A pedestrian crossing is provided on the eastern approach of Dobroyd Parade. Figure 4-13 illustrates the intersection.

Figure 4-13 Intersection of Dobroyd Parade/ Waratah Street

Imagery Source: Nearmap (post-opening)

The layout of this intersection has changed between pre-opening and post-opening with the addition of a right turn lane from Dobroyd Parade (eastbound) onto Waratah Street and the reconfiguration of the temporary access road on the northern side of the intersection to be used by WestConnex construction vehicles only. Figure 4-14 illustrates Dobroyd Parade/ Waratah Street pre-opening of M4 East.

Figure 4-14 Intersection of Dobroyd Parade/ Waratah Street prior to opening of M4 East

Imagery Source: Nearmap (pre-opening)

The performance of this intersection has been assessed post-opening for 2019 and 2020 which saw an overall increase in traffic volumes by approximately 29 per cent during the AM peak and 36 per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-11 presents a performance summary of this intersection.

Table 4-11 Summary of performance at Dobroyd Parade/ Waratah Street (2018 v 2020)

Dobroyd Parade/ Waratah Street – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	2,927	3,419	3,765	4,647	+838	+1,228
Queue Length (m) Approach	217.4 South-West	339.2 South-West	93.6 South-West	109.1 South-West	-123.8	-230.1
Average Delay (sec)	12.3	13.4	26.7	15.8	+14.4	+2.4
Intersection LoS	LoS A	LoS A	LoS B	LoS B	▼	▼

Note: The queue length reported for the south-west approach post-opening in the AM and PM peak is for Dobroyd Parade only; the M4 East off-ramp is separated from Dobroyd Parade at Waratah Street.

Since the opening of the M4 East, overall performance at this intersection has degraded during the AM and PM peak periods. It is noted that two lanes on the south-western approach directly exit the M4 East tunnels which are separated from Dobroyd Parade at this intersection.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on all approaches during the AM peak with additional vehicles entering and exiting the M4 East.
- During the PM peak, the average delay has increased on the north-eastern approach on Dobroyd Parade. The LoS for Waratah Street has improved from a LoS F to LoS E due to a slight increase in green time. The north-eastern approach on Dobroyd Parade degraded from a LoS A to LoS B due to a reallocation of green time to the south-western approach to accommodate vehicles exiting the M4 East onto Dobroyd Parade. The western approach on Dobroyd Parade remained at LoS A due to the increased capacity.
- Vehicle queue lengths have increased on most approaches during the AM peak with additional vehicles entering and exiting the M4 East. Site observations have indicated that the queues on the south-west approach along Dobroyd Parade often extend into the M4 East tunnel portal. This is primarily due to queues from the Dobroyd Parade/ Timbrell Drive/ Mortley Avenue intersection extending to this intersection, resulting in reduced downstream capacity for the northbound through movements. During the PM, queue lengths have increased on most approaches, likely due to increased demand generated by the M4 East interchange immediately south-west of this intersection, except for the south-western approach on Dobroyd Parade.

- Based on a review of crash data for 12 months before and after the opening of the M4 East, one crash occurred at this intersection pre-opening and two crashes post-opening.
- There have been records of several vehicles colliding with the pedestrian fence in the centre median of this intersection. Since the pedestrian crossing is in two phases, pedestrians are regularly situated nearby the pedestrian fence in the centre median. This has cause for concern and further assessment as outlined in Section 6.

While the intersection continues to operate at LoS B across both peak periods, mitigations are proposed at this location due to the occurrence of queues on the south-west approach that often extend into the M4 East tunnel portal as well as the safety concerns outlined in Section 6.

4.11 Intersection 10 – Dobroyd Parade/ Timbrell Drive/ Mortley Avenue

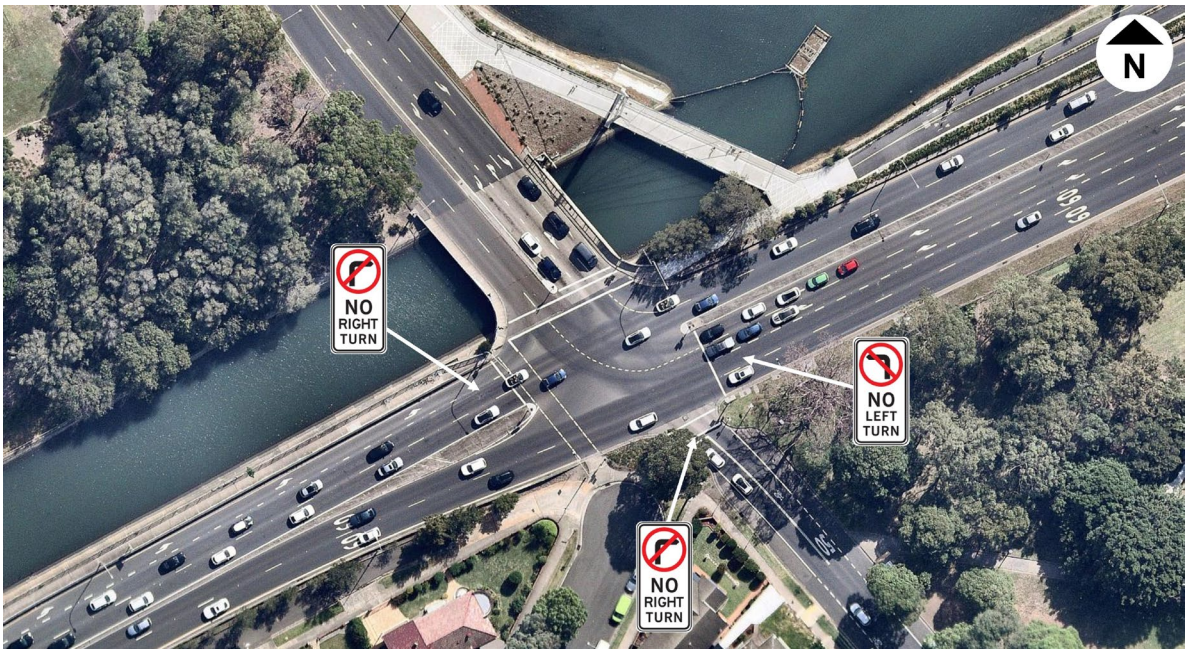
This is a four-way signalised intersection located north-east of the M4 East ramps and the intersection at Dobroyd Parade/ Waratah Street. Dobroyd Parade facilitates travel towards City-West Link Road in the east and west through Haberfield. Timbrell Drive facilitates travel north towards Rodd Point. Mortley Avenue facilitates travel south through Haberfield. Movement restrictions apply at this intersection. Pedestrian crossings are provided on Timbrell Drive, Mortley Avenue, and the western approach of Dobroyd Parade. Figure 4-15 illustrates the intersection.

Figure 4-15 Intersection of Dobroyd Parade/ Timbrell Drive/ Mortley Avenue

Imagery Source: Nearmap (post-opening)

The layout of this intersection has changed between pre-opening and post-opening through the provision of an additional eastbound through lane on Dobroyd Parade. Figure 4-16 illustrates Dobroyd Parade/ Timbrell Drive/ Mortley Avenue pre-opening of M4 East.

Figure 4-16 Intersection of Dobroyd Parade/ Timbrell Drive/ Mortley Avenue prior to opening of M4 East



Imagery Source: Nearmap (pre-opening)

The performance of this intersection has been assessed post-opening for 2019 and 2020 which saw an overall increase in traffic volumes by approximately six per cent during the AM peak and 20 per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-12 presents a performance summary of this intersection.

Table 4-12 Summary of performance at Dobroyd Parade/ Timbrell Drive/ Mortley Avenue

Dobroyd Parade/ Timbrell Drive/ Mortley Avenue – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,471	4,721	4,732	5,662	+261	+941
Queue Length (m) Approach	341.2 South-West	460.0 South-West	517.4 South-West	290.2 South-West	+176.2	-169.8
Average Delay (sec)	39.5	51.7	72.5	41.7	+33.0	-10.0
Intersection LoS	LoS C	LoS D	LoS F	LoS C	▼	▲

Since the opening of the M4 East, overall performance at this intersection has degraded during the AM peak and improved during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on Timbrell Drive and the south-western approach of Dobroyd Parade during the AM peak. The LoS has degraded on these two approaches.

- During the PM peak, average delays have increased on Timbrell Drive and the south-eastern approach of Dobroyd Parade. The LoS for the south-western approach on Dobroyd Parade has improved from LoS F to LoS C through the provision of an additional approach lane.
- Vehicle queue lengths have increased on the south-western approach on Dobroyd Parade during the AM peak. Site observations have indicated that queues often extend along this approach into the Dobroyd Parade/ Waratah Street intersection. This is primarily due to downstream queuing, green time for right turn from Timbrell Drive towards Dobroyd Parade, and pedestrian movements at this intersection.
- During the PM peak, queue lengths have increased on Timbrell Drive and the south-eastern approach of Dobroyd Parade. There has been a significant increase in queue length on the north-eastern approach of Dobroyd Parade. This may be due to additional vehicles travelling on Dobroyd Parade towards the M4 East
- Based on a review of crash data for 12 months before and after the opening of the M4 East, two crashes occurred at this intersection pre-opening, increasing to four crashes post-opening.

As the performance of this intersection has deteriorated to LoS F (during the AM peak), with significant increase in delays and queuing into adjacent intersections, mitigation measures to minimise the impacts at this intersection are proposed, as detailed in Section 8.

4.12 Intersection 11 – City-West Link Road/ James Street

This is a four-way signalised intersection connecting the suburbs of Leichhardt, Lilyfield and Rozelle. City-West Link Road facilitates travel east towards the Sydney Central Business District (CBD) and west towards Haberfield, Parramatta Road and the M4 East access ramps. James Street facilitates travel north through Lilyfield and south towards Leichardt. Movement restrictions apply at this intersection. Pedestrian crossings are provided on both approaches of James Street and the western approach of City-West Link Road. Figure 4-17 illustrates the intersection.

Figure 4-17 Intersection of City-West Link Road/ James Street

Imagery Source: Nearmap (post-opening)

The layout of this intersection has remained consistent between pre-opening and post-opening of the M4 East. The performance of this intersection has been assessed post-opening for 2019 and 2020 which saw an overall increase in traffic volumes by approximately three per cent during the AM peak and eight per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-13 presents a performance summary of this intersection.

Table 4-13 Summary of performance at City-West Link Road/ James Street

City-West Link Road/ James Street – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,531	5,353	4,655	5,791	+124	+438
Queue Length (m) Approach	206.8 South	218.3 East	109.4 South	467.4 East	-97.4	+249.1
Average Delay (sec)	31.0	33.3	51.9	36.3	+20.9	+3.0
Intersection LoS	LoS C	LoS C	LoS D	LoS C	▼	=

Since the opening of the M4 East, overall performance at this intersection has degraded during the AM peak and remained similar during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have marginally increased on the northern approach of James Street and significantly increased on the western approach of City-West Link Road during the AM peak. The LoS on the western approach of City-West Link Road degraded from LoS B to LoS F. This significant reduction in performance is likely due to increased demand on City-West Link Road from the M4 East. Green time has been reallocated from James Street to City-West Link Road, reducing the number of vehicles passing through the intersection from James Street.
- During the PM peak, average delays have reduced on James Street and increased on City-West Link. Similar to the AM peak, green time has been reallocated from James Street to City-West Link Road.
- Vehicle queue lengths have increased on City-West Link Road during the PM peak.
- Based on a review of crash data for 12 months before and after the opening of the M4 East, two crashes occurred at this intersection pre-opening and post-opening.

Overall, the intersection performs satisfactorily at LoS D or better during the peak hours, post opening. However, compared to the pre-opening, delays have increased notably, particularly on the western approach of City-West Link Road in the AM peak, which has degraded in performance from LoS B to LoS F. As such, mitigation measures are proposed at this intersection given the notable deterioration in performance for this key movement and its proximity to the Norton Street intersection, approximately 70 metres east which also operates with increased congestion post-opening of M4 East.

4.13 Intersection 12 – City-West Link Road/ Norton Street

This is a four-way signalised intersection located immediately east of the intersection at City-West Link Road/ James Street (Intersection 11). City-West Link Road facilitates travel east towards the Sydney CBD and west towards Haberfield. Norton Street facilitates travel north through Lilyfield and south towards Leichhardt. Movement restrictions apply at this intersection. Pedestrian crossings are provided on all approaches. Figure 4-18 illustrates the intersection.

Figure 4-18 Intersection of City-West Link Road/ Norton Street

Imagery Source: Nearmap (post-opening)

The layout of this intersection has remained consistent between pre-opening and post-opening. The performance of this intersection has been assessed post-opening for 2019 and 2020 which saw an overall increase in traffic volumes by approximately seven per cent during the AM peak and five per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-14 presents a performance summary of this intersection.

Table 4-14 Summary of performance at City-West Link Road/ Norton Street

City-West Link Road/ Norton Street – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,469	5,395	4,792	5,672	+323	+277
Queue Length (m) Approach	214.5 North	355.9 South	216.7 North	615.6 South	+2.2	+259.7
Average Delay (sec)	29.9	32.2	31.4	53.5	+1.5	+21.3
Intersection LoS	LoS C	LoS C	LoS C	LoS D	=	▼

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM peak but degraded during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on Norton Street during the AM peak. This is likely due to green time reallocation from Norton Street to City-West Link Road to accommodate additional traffic generation from the M4 East. During the PM peak, average delays have increased on the south-eastern approach of City-West Link Road. The LoS for this approach has degraded from LoS C to LoS F, which may be due to additional vehicles using this approach to access the M4 East further west on Dobroyd Parade.
- Vehicle queue lengths have increased on Norton Street during the AM peak. During the PM peak, queue lengths have increased on all approaches, with the exception of the north-western approach of City-West Link Road, and a significant increase was observed on the south-eastern approach of City-West Link Road.
- Based on a review of crash data for 12 months before and after the opening of the M4 East, one crash occurred at this intersection pre-opening and post-opening.

As the performance of the intersection has deteriorated notably on the south-eastern approach of City-West Link Road from LoS C to LoS F due to significant queuing into adjacent intersections, mitigation measures to minimise the impacts at this intersection are proposed as detailed in Section 8.

4.14 Intersection 13 – City-West Link Road/ Balmain Road

This is a four-way signalised intersection connecting the suburbs of Leichhardt, Lilyfield and Rozelle. City-West Link Road facilitates travel east towards the Sydney CBD and west towards Haberfield, Parramatta Road and the M4 East access ramps. Balmain Road facilitates travel north through Lilyfield and south towards Leichardt and Parramatta Road. Movement restrictions apply at this intersection. Pedestrian crossings are provided on both approaches of Balmain Road and the western approach of City-West Link Road. Figure 4-19 illustrates the intersection.

Figure 4-19 Intersection of City-West Link Road/ Balmain Road

Imagery Source: Nearmap (post-opening)

The layout of this intersection has remained consistent between pre-opening and post-opening. The performance of this intersection has been assessed post-opening for 2019 which saw an overall increase in traffic volumes by approximately 14 per cent during the AM peak and two per cent during the PM peak when compared to pre-opening volumes. Traffic volumes did not increase more than five per cent from pre-opening volumes in 2020. New warehouses were constructed between pre-opening and post-opening to the east of the intersection, near Catherine Street, however this land use change would be anticipated to have a minimal impact on the performance of this intersection.

Table 4-15 presents a performance summary of this intersection.

Table 4-15 Summary of performance at City-West Link Road/ Balmain Road (2018 v 2019)

City-West Link Road/ Balmain Road – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,680	5,926	5,357	6,041	+677	+115
Queue Length (m) Approach	367.0 West	771.6 West	826.9 West	872.1 West	+459.9	+100.5
Average Delay (sec)	32.9	65.2	64.6	78.6	+31.7	+13.4
Intersection LoS	LoS C	LoS F	LoS E	LoS F	▼	=

Since the opening of the M4 East, overall performance at this intersection has degraded during the AM peak but remained similar during the PM peak. It is noted that the intersection was operating at capacity prior to opening during the PM peak with LoS F.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on Balmain Road during the AM peak. This is due to increased green time on both approaches of City-West Link Road to accommodate additional traffic generation from the M4 East.
- Vehicle queue lengths have increased on Balmain Road during the AM peak. During the PM peak, queue lengths have increased on the northern approach of Balmain Road and both approaches of City-West Link Road.
- Based on a review of available crash data for 12 months before and after the opening of the M4 East, three crashes occurred at this intersection pre-opening, with two crashes recorded post-opening.

As the performance of this intersection has deteriorated from LoS C to LoS E (during the AM peak), mitigation measures to minimise the impacts at this intersection are proposed as detailed in Section 8.

4.15 Intersection 14 – Parramatta Road/ Dalhousie Street

This is a three-way signalised intersection located just east of the M4 East access ramps to/ from Parramatta Road in Ashfield. Parramatta Road facilitates travel towards Holroyd in the west and Ultimo in the east. Dalhousie Street facilitates travel north into Haberfield. All movements are permitted at this intersection. Pedestrian crossings are provided on all approaches. Figure 4-20 illustrates the intersection.

Figure 4-20 Intersection of Parramatta Road/ Dalhousie Street

Imagery Source: Nearmap (post-opening)

The layout of this intersection has changed between pre-opening and post-opening on the eastern approach with the left through-lane marked for Parramatta Road or M4 East, and right through-lane marked for the M4 East only. On the western approach, the left through-lane has also been extended to a full-length lane, noting vehicles exit directly into the middle and right through-lanes immediately west of the intersection. Figure 4-21 illustrates Parramatta Road/ Dalhousie Street pre-opening of M4 East for reference.

Figure 4-21 Intersection of Parramatta Road/ Dalhousie Street prior to opening of M4 East

Imagery Source: Nearmap (pre-opening)

The performance of this intersection has been assessed post-opening for 2019 and 2020 which saw an overall increase in traffic volumes by approximately 26 per cent during the AM peak and 33 per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection.

Table 4-16 presents a performance summary of this intersection.

Table 4-16 Summary of performance at Parramatta Road/ Dalhousie Street

Parramatta Road/ Dalhousie Street – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	3,754	3,848	4,727	5,107	+973	+1,259
Queue Length (m) Approach	334.7	319.4	426.6	525.6	+91.9	+206.2
	North-West	North-West	North-West	North-West		
Average Delay (sec)	29.2	26.3	37.3	38.0	+8.1	+11.7
Intersection LoS	LoS C	LoS B	LoS C	LoS C	=	▼

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM peak but reduced during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on all approaches during the AM peak due to notable increases in traffic volumes, likely due to additional vehicles using Parramatta Road to access the M4 East immediately north-west of this intersection.
- Signal cycle lengths have been adjusted to provide additional green time for Parramatta Road which provides direct access to the M4 East. The LoS on the north-west approach of Parramatta Road has reduced from LoS C to LoS D.
- During the PM peak, average delays have increased on all approaches. The north-west approach of Parramatta Road has degraded from LoS B to LoS C, while Dalhousie Street has degraded from LoS C to LoS E.
- Vehicle queue lengths have increased on all approaches during the AM and PM peak periods. Site observations have indicated that the queues on the north-west approach along Parramatta Road often extend into the M4 East tunnel portal. This is likely due to queuing back to Dalhousie Street from the right-turn lane at Parramatta Road/ Liverpool Road intersection. This has been observed to occur during the AM and PM peaks, resulting in reduced downstream capacity for the eastbound through movements, thereby resulting in queues extending until the tunnel portals.
- Based on a review of crash data for 12 months before and after the opening of the M4 East, no crashes occurred at this intersection pre-opening. Five crashes were recorded post-opening.
- Based on observations from Transport, Council and community, there have been several near misses reported between vehicles exiting the M4 East tunnel portals and pedestrians crossing at Dalhousie Street to and from Ashfield Park. There is low visibility of drivers

exiting the tunnel (unable to see the pedestrian crossing beyond the crest in the road), coupled with the proximity of the pedestrian crossing to the tunnel portal exits has caused concerns for pedestrian safety at this intersection.

While the intersection operates at LoS C during both peak periods, mitigations are proposed at this location due to the occurrence of traffic queues from Parramatta Road extending into the tunnel portal and the safety concerns outlined in Section 6.

4.16 Intersection 15 – Parramatta Road/ Liverpool Road

This is a three-way signalised intersection connecting the A22 (also known as Hume Highway) with Parramatta Road. Parramatta Road facilitates travel north-west towards Holroyd and south-east towards Ultimo. Liverpool Street (Hume Highway) facilitates travel towards Liverpool and is a key west-east connection. All movements are permitted at this intersection. Pedestrian crossings are provided on Liverpool Road and the western approach of Parramatta Road. Figure 4-22 illustrates the intersection.

Figure 4-22 Intersection of Parramatta Road/ Liverpool Road

Imagery Source: Nearmap (post-opening)

The layout of this intersection has remained consistent between pre-opening and post-opening. The performance of this intersection has been assessed post-opening for 2019 and 2020 which saw an overall increase in traffic volumes by approximately 20 per cent during the AM peak and 18 per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection.

Table 4-17 presents a performance summary of the existing site.

Table 4-17 Summary of performance at Parramatta Road/Liverpool Road

Parramatta Road/Liverpool Road – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,211	4,889	5,058	5,778	+847	+889
Queue Length (m) Approach	286.3 South-East	305.3 South-East	402.3 South-East	363.5 South-East	+116.0	+58.2
Average Delay (sec)	29.2	32.1	40.5	31.0	+11.3	-1.1
Intersection LoS	LoS C	LoS C	LoS C	LoS C	=	=

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM and PM peak periods.

Key changes in performance observed at this intersection are as follows:

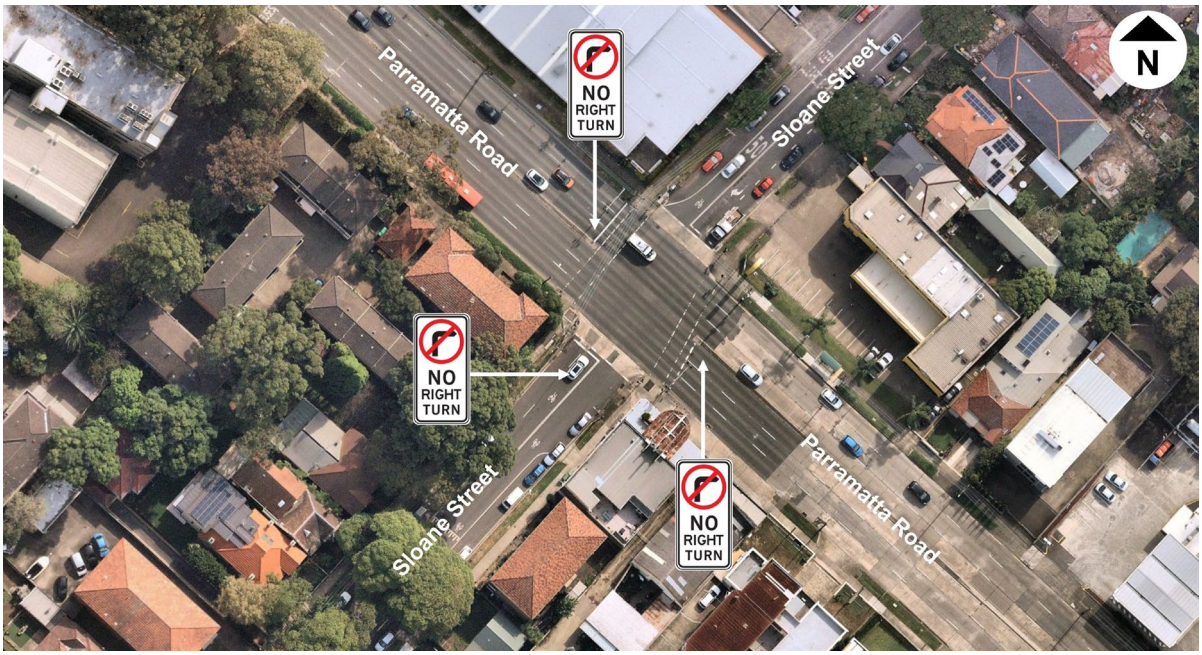
- Average delays have increased on all approaches during the AM peak. Additional green time is provided to Parramatta Road at Dalhousie Street (Intersection 14) further north to accommodate additional vehicles entering and exiting the M4 East, however green time and signal timing for vehicles on Parramatta Road at Liverpool Street has remained relatively similar to pre-opening conditions. Despite this, the LoS has remained the same on the western approach of Parramatta Road with LoS B, degrading from LoS B to LoS C on the eastern approach.
- It is noted that the right-turn movement from Parramatta Road onto Liverpool Road experiences considerable delays, worsening post-opening of the M4 East. Liverpool Road has also degraded from LoS E to LoS F with left turning vehicles more than doubling; this is likely due to vehicles using Parramatta Road to access the M4 East entrance further north-west.
- Vehicle queue lengths have increased on all approaches during the AM peak.
- During the PM peak, average delays have decreased on the eastern approach due to a reallocation of green time to Parramatta Road, whilst slightly increasing on the western approach. The LoS on the western approach of Parramatta Road degraded from LoS B to LoS C. Liverpool Street maintains a LoS E due to a decrease in right-turning vehicles while vehicles turning left towards the M4 East increased.
- During the PM peak, queue lengths have increased on both approaches of Parramatta Road and Liverpool Road.
- Site observations have also indicated that during the AM and PM peaks, right turn vehicles on the western approach of Parramatta Road often overflow into the through lanes resulting in longer queues and reduced capacity for the eastbound through vehicles along Parramatta Road, resulting in the safety issue of through-moving vehicles weaving across.
- Based on a review of crash data for 12 months before and after the opening of the M4 East, two crashes occurred at this intersection pre-opening and post-opening.

While the intersection continues to operate at LoS C across both peak periods, mitigations are proposed at this location due to safety issues associated with queue spill back of the western approach right turn, resulting in weaving movements, noting its proximity to the tunnel portals.

4.17 Intersection 16 – Parramatta Road/ Sloane Street

This is a four-way signalised intersection located just east of Parramatta Road/ Liverpool Street. Parramatta Road facilitates travel north-west towards Holroyd and south-east towards Ultimo. Sloane Street facilitates travel north-east towards Haberfield and south-west towards Summer Hill. Movement restrictions apply at this intersection. Pedestrian crossings are provided on all approaches. Figure 4-23 illustrates the intersection.

Figure 4-23 Intersection of Parramatta Road/ Sloane Street



Imagery Source: Nearmap (post-opening)

The layout of this intersection has remained consistent between pre-opening and post-opening. The performance of this intersection has been assessed post-opening for 2019 and 2020 which saw an overall increase in traffic volumes by approximately 16 per cent during the AM peak and 21 per cent during the PM peak when compared to pre-opening volumes. No significant land use changes were observed to occur within the surrounding locality of the intersection between pre-opening and post-opening.

Table 4-18 presents a performance summary of this intersection.

Table 4-18 Summary of performance at Parramatta Road/ Sloane Street

Parramatta Road/Sloane Street – 2018 v 2020						
	Pre M4 East (2018)		Post M4 East (2020)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,145	4,682	4,809	5,666	+664	+984
Queue Length (m) Approach	170.6	137.1	179.0	139.1	+8.4	+2.0
	North-West	North-West	North-West	North-West		
Average Delay (sec)	13.6	13.4	15.1	14.6	+1.5	+1.2
Intersection LoS	LoS A	LoS A	LoS B	LoS B	▼	▼

Since the opening of the M4 East, overall performance at this intersection has marginally degraded during the AM and PM peak periods.

Key changes in performance observed at this intersection are as follows:

- During the AM peak, average delays have increased on all approaches. The LoS on the south-western approach on Sloane Street degraded from LoS E to LoS F due to increased priority for Parramatta Road to support additional traffic generation from the M4 East.
- During the PM peak, average delays have increased on all approaches, except for the north-west approach on Parramatta Road. The LoS for both approaches of Sloane Street has degraded due to increased priority of Parramatta Road to support traffic generated by the M4 East.
- Vehicle queue lengths have increased on all approaches during the AM and PM peak periods, with the exception of the north-west approach on Parramatta Road which only increased during the PM peak.
- Based on a review of crash data for 12 months before and after the opening of the M4 East, two crashes occurred at this intersection pre-opening, with four crashes recorded post-opening.

The overall intersection performance during the AM and PM peaks has changed marginally from LoS A to LoS B, which remains an acceptable LoS. The average delay and queue lengths have also remained stable compared to pre-opening, therefore no mitigation measures have been proposed.

4.18 Additional intersections

Traffic analysis was undertaken for additional intersections within Haberfield, Ashfield and Leichardt to assess potential locations requiring interventions or upgrades. A total of 11 intersections were assessed using the same assessment criteria detailed in Section 3.2. These 11 intersections are:

- Paramatta Road/ Tebbutt Street
- Paramatta Road/ West Street/ Flood Street
- Tebbutt Street/ Hathern Street
- Ramsay Street/ Wattle Street
- James Street/ Lilyfield Road
- Lilyfield Road/ Norton Street
- Darley Road/ Charles Street
- William Street/ Charles Street
- Norton Street/ William Street
- Lilyfield Road/ Balmain Road
- Hume Highway/ Carlton Crescent.

Of the 11 intersections assessed, seven intersections saw overall increases in traffic volumes greater than five per cent of pre-opening volumes in either 2019 or 2020, all of which are located within the study area for the M4 East RNPRP (as discussed in Section 3.2). These seven intersections are:

- James Street/ Lilyfield Road (A1)
- Norton Street/ Lilyfield Road (A2)
- Norton Street/ William Street (A3)
- Hume Highway/ Carlton Crescent (A4)
- Tebbutt Street/ Hathern Street (A5)
- Parramatta Road/ Tebbutt Street (A6)
- Parramatta Road/ West Street (A7).

Key findings during the AM peak are as follows:

- Average delays reduced or remained similar to pre-opening levels at all sites during both 2019 and 2020, with the exception of James Street/ Lilyfield Road where the average delay increased.
- Queue lengths increased at Tebbutt Street/ Hathern Street and James Street/ Lilyfield Road in 2019, reducing or remaining similar to pre-opening at the remaining sites.
- In 2020, queue lengths reduced or remained similar to pre-opening at all sites.

Key findings during the PM peak are as follows:

- Average delays decreased or remained the same or similar at all sites in both 2019 and 2020, with the exception of Parramatta Road/ Tebbutt Street where average delay increased.
- Queue lengths increased at Parramatta Road/ West Street in both 2019 and 2020.
- Queue lengths reduced or remained similar to pre-opening at all other sites for both years.

The LoS, queue lengths and average delays at these intersections have either improved or remained the same during the AM and PM peak periods for both 2019 and 2020, therefore no mitigations have been proposed. Traffic modelling outputs for these intersections are included in Appendix B.

5. Travel time performance

5.1 General traffic

Analysis of vehicle travel speeds along Parramatta Road was undertaken for both pre-opening and post-opening scenarios. Travel time data was sourced from HERE technologies, which provides GPS based movement metrics for the weekday periods in March 2018 representing pre-opening conditions, and in August 2020 representing post-opening conditions.

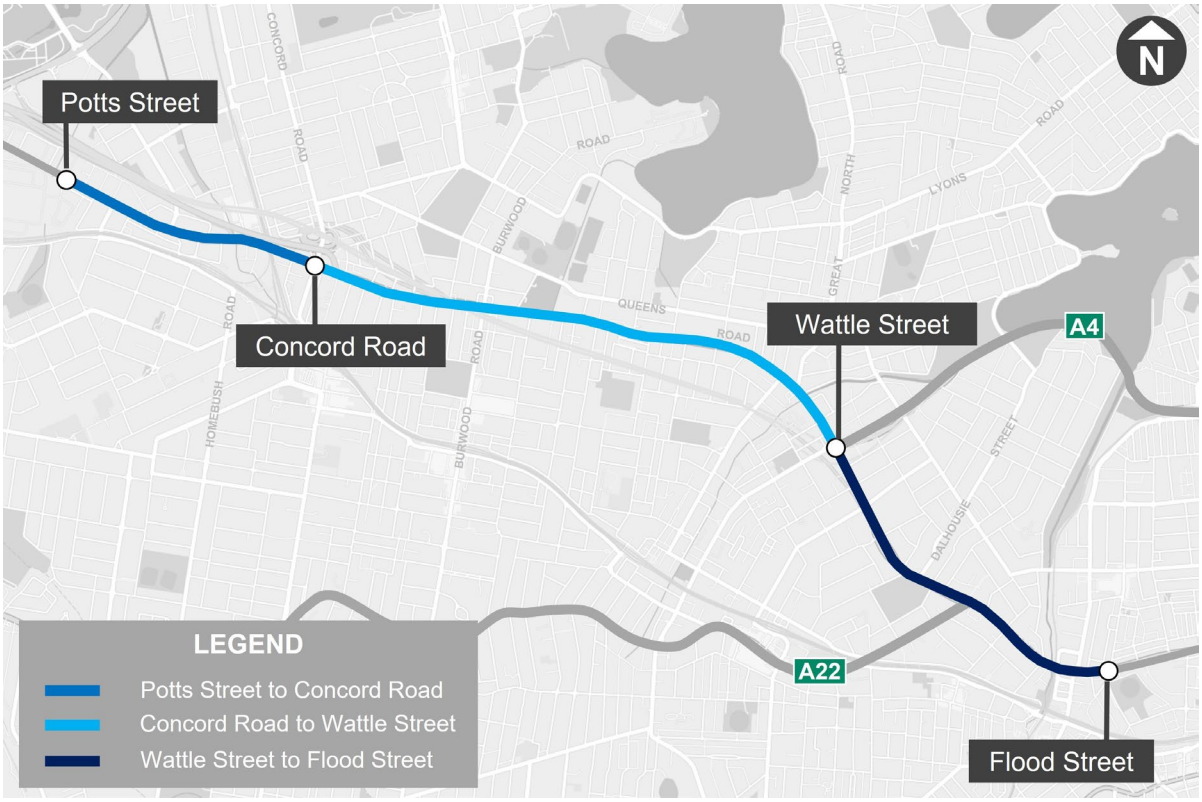
Travel times on Parramatta Road were assessed in three segments, between Potts Street and Flood Street, encompassing the extent of the M4 East RNPRP as presented in Figure 5-1. The assessed travel time data is reflective of typical traffic conditions experienced by vehicles on the corridor including cars, heavy vehicles and buses.

The following segments of Parramatta Road were assessed between:

- Potts Street and Concord Road
- Concord Road and Wattle Street
- Wattle Street and Flood Street.

Travel speeds from September 2019 were also assessed for reference conditions without the impact of the COVID-19 pandemic and is provided in Appendix C.

Figure 5-1 Assessed travel time segments

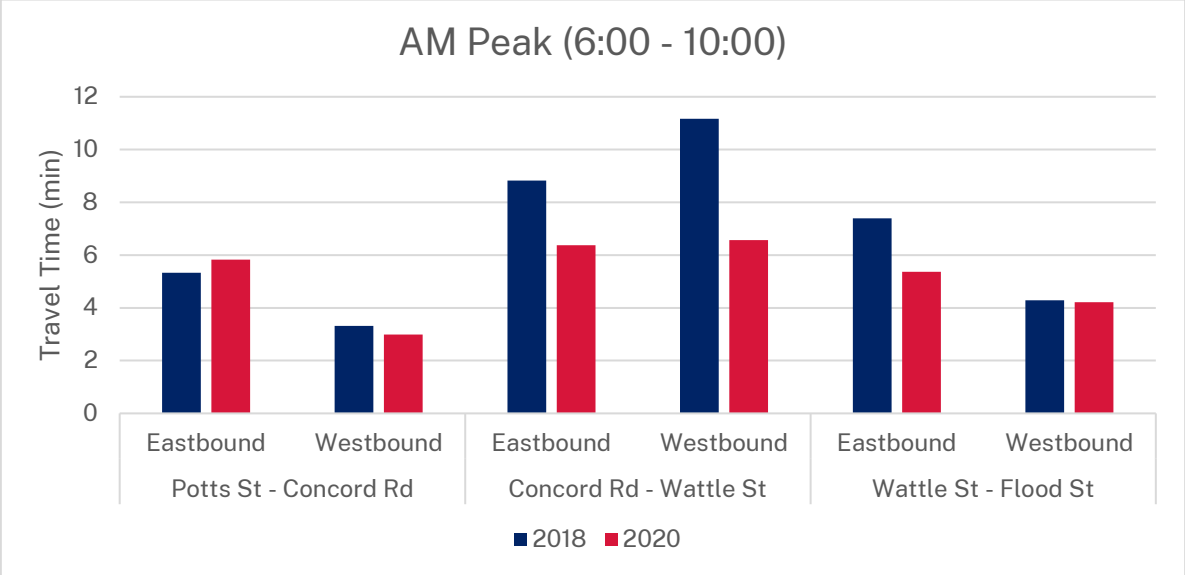


5.1.1 Parramatta Road – AM Peak

Figure 5-2 presents a comparison of the pre-opening and post-opening average travel time during a typical weekday morning (6-10am) in both directions on Parramatta Road between Potts Street and Flood Street. The key observations are noted below:

- Overall, travel times reduced on Parramatta Road by approximately 11 minutes in the eastbound direction and nine minutes westbound, for the full assessed length of the corridor, between Potts Street and Flood Street. This is likely due to the opening of the M4 East, which has resulted in reduction in traffic volumes on the corridor by providing a faster competing route for drivers.
- Travel times on the western segment, between Potts Street and Concord Road remain relatively similar between 2018 and 2020 in the westbound direction. However, travel times increased by approximately three minutes in the eastbound direction post opening.
- Substantial decrease in travel time between Concord Road and Wattle Street of approximately eight minutes eastbound and 16 minutes westbound.
- In the eastern segment, between Wattle Street and Flood Street, travel time decrease by approximately six minutes in the eastbound direction, while increasing by six minutes westbound. The increase in travel time in the westbound direction largely occurs between Flood Street and the tunnel portals and is likely due to increased eastbound right turning traffic from Parramatta Road onto Liverpool Road. This in turn, reduce the amount of phase time allocated to the opposing westbound movement on Parramatta Road at the Liverpool Road intersection.

Figure 5-2 Average travel times on Parramatta Road in the AM peak



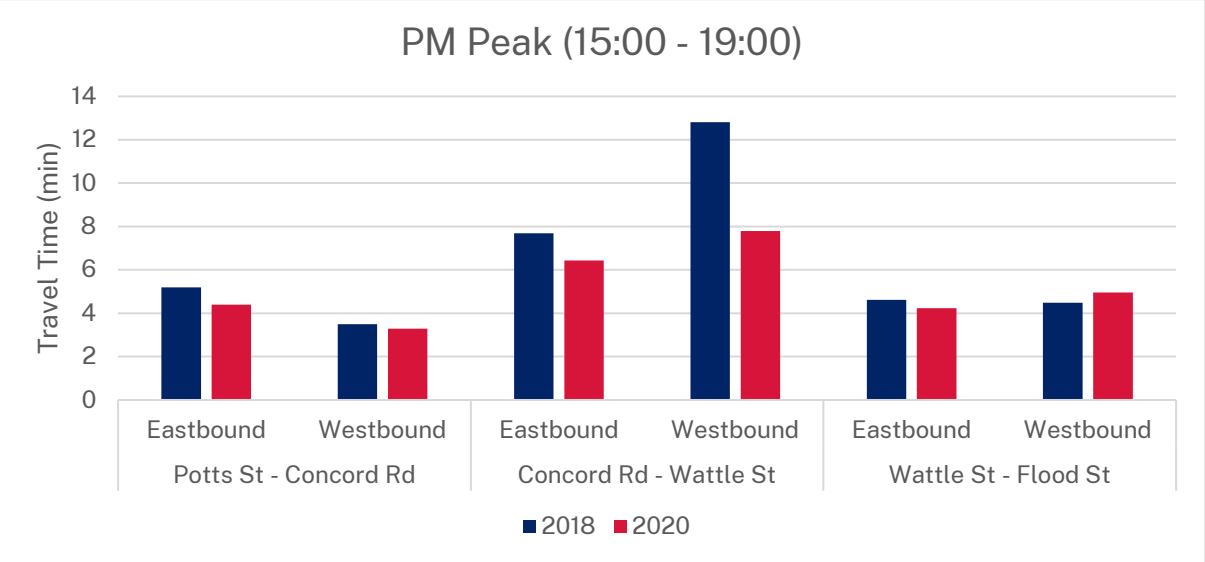
5.1.2 Parramatta Road – PM Peak

Figure 5-3 presents a comparison of the pre-opening and post-opening average travel time during a typical weekday afternoon/ evening in both directions on Parramatta Road between Potts Street and Flood Street. They key observations are noted below:

- A total travel time reduction of approximately eight minutes in the eastbound direction and 23 minutes in the westbound direction, noting that the westbound is the peak direction of travel in the evening associated with return to home journeys.

- The section between Concord Road and Wattle Street in the westbound direction experienced the largest reduction in travel time, likely due to the opening of the M4 East which provide an alternative route for motorists.
- The eastern segment between Wattle Street and Flood Street experienced an increase in travel time of approximately five minutes similar to the AM peak, in both directions.

Figure 5-3 Average travel times on Parramatta Road in the PM peak



5.2 Bus performance analysis

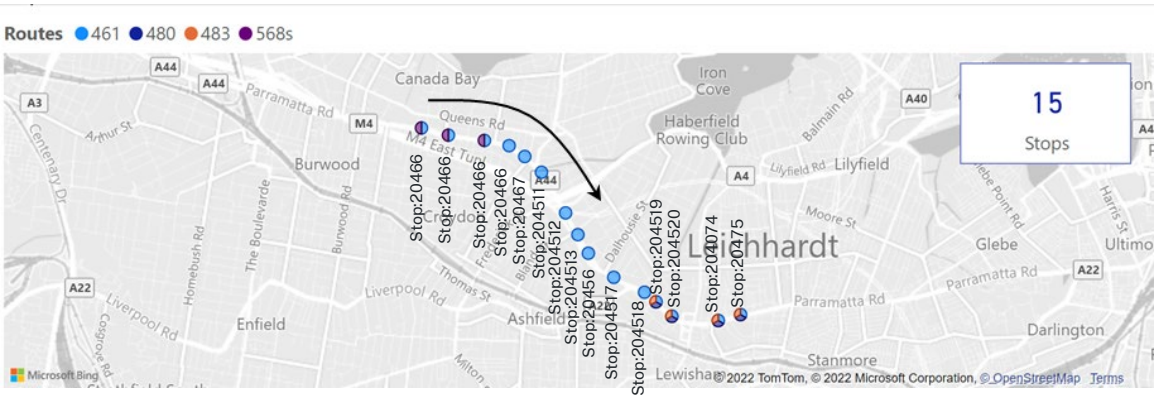
Analysis of bus performance along Parramatta Road was undertaken to determine the potential impacts due to the opening of the M4 East. Bus travel time data were analysed for the weekday periods in March 2018 representing pre-opening conditions, and in August 2020 representing post-opening conditions. Bus travel time data from September 2019 were also assessed for reference conditions without the impact of the COVID-19 pandemic.

Travel times are presented for the segments between individual bus stops in each direction on Parramatta Road during the AM and PM peak periods. A comparison of 2018 and 2019 travel times is provided in Appendix D.

5.2.1 Parramatta Road – Eastbound

Figure 5-4 illustrates the eastbound bus stop locations within the study area, between Burwood Road and Norton Street. There are no bus routes that travel west of Burwood Road on Parramatta Road within the M4 East RNPRP study area, except for Night Ride replacement services.

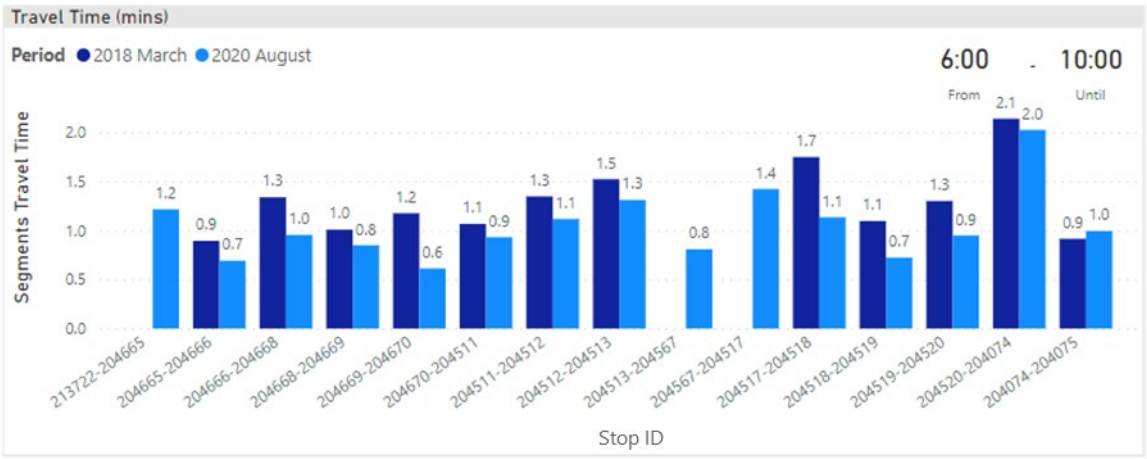
Figure 5-4 Eastbound bus stop locations and bus routes on Parramatta Road



Note: Bus travel times and travel speeds are presented from west to east.

Figure 5-5 presents a comparison of the pre-opening and post-opening bus travel times in the eastbound direction along Parramatta Road during the AM peak (6-10am). The assessments indicate that eastbound bus travel times during the AM peak have generally improved across most segments, indicating improve performance through the corridor. Travel time savings are generally with the range of five to 35 seconds (0.1 to 0.6 minutes) per segment, with a travel time saving of approximately three minutes and 20 seconds across the assessed stops.

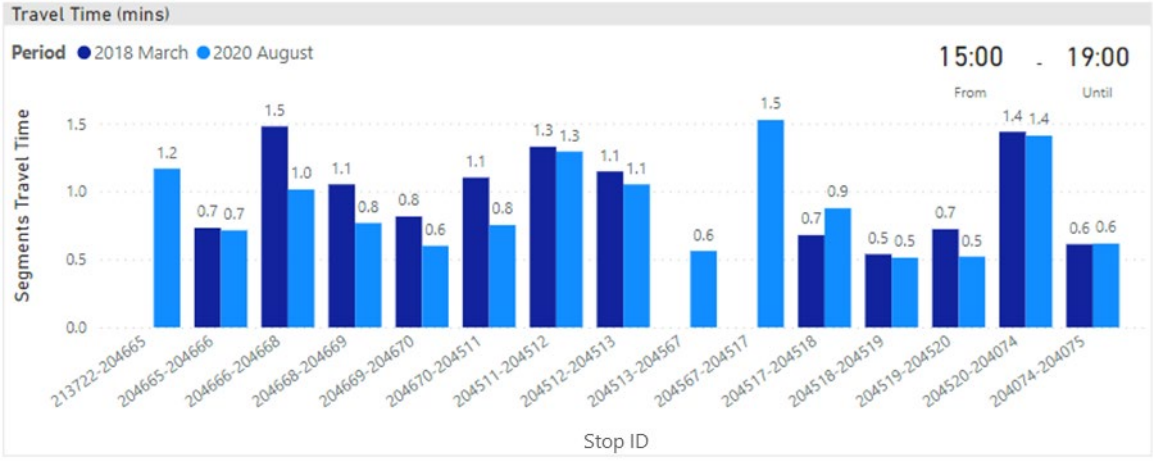
Figure 5-5 Comparison of eastbound bus travel times on Parramatta Road (AM peak)



Note: Travel time data was missing or incomplete on three-segments assessed in 2018. Average changes in travel time were taken from segments with 2018 and 2020 data only.

Figure 5-6 presents a comparison of the pre-opening and post-opening bus travel times in the eastbound direction along Parramatta Road during the PM peak (3-7pm). The assessments indicate that eastbound bus travel times during the PM peak have generally improved slightly across most stops, with stop-to-stop travel time savings of approximately of 10 to 30 seconds. In total, travel times have reduced by approximately one minute and 20 seconds across the assessed stops, with a larger proportion of travel time savings experienced on the western section of the corridor, west of Liverpool Road.

Figure 5-6 Comparison of eastbound bus travel times on Parramatta Road (PM peak)



Note: Travel time data was missing or incomplete on three-segments assessed in 2018. Average changes in travel time were taken from segments with 2018 and 2020 data only.

5.2.2 Parramatta Road – Westbound

Figure 5-7 illustrates the bus stop locations and bus routes using the westbound segments assessed, between Burwood Road and Norton Street. As noted previously, there are currently no bus routes that travel west of Burwood Road on Parramatta Road within the M4 East RNPRP study area, except for Night Ride replacement services.

Figure 5-7 Westbound bus stop locations and bus routes on Parramatta Road

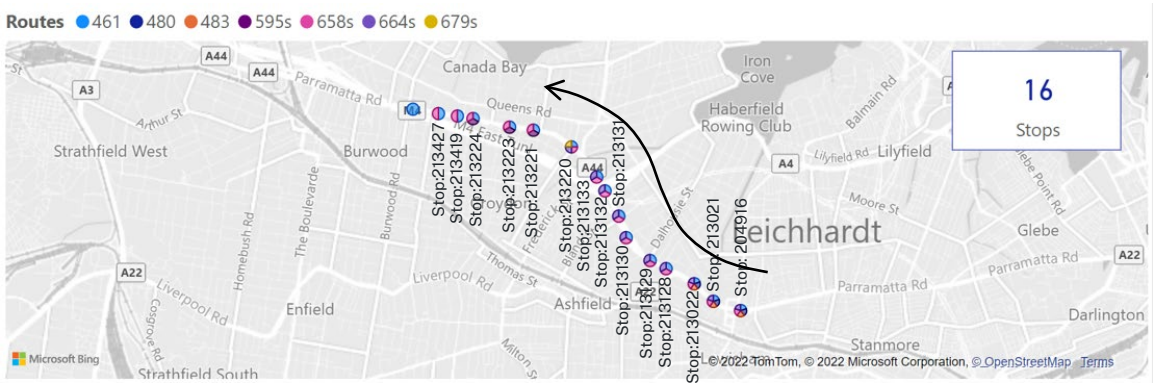
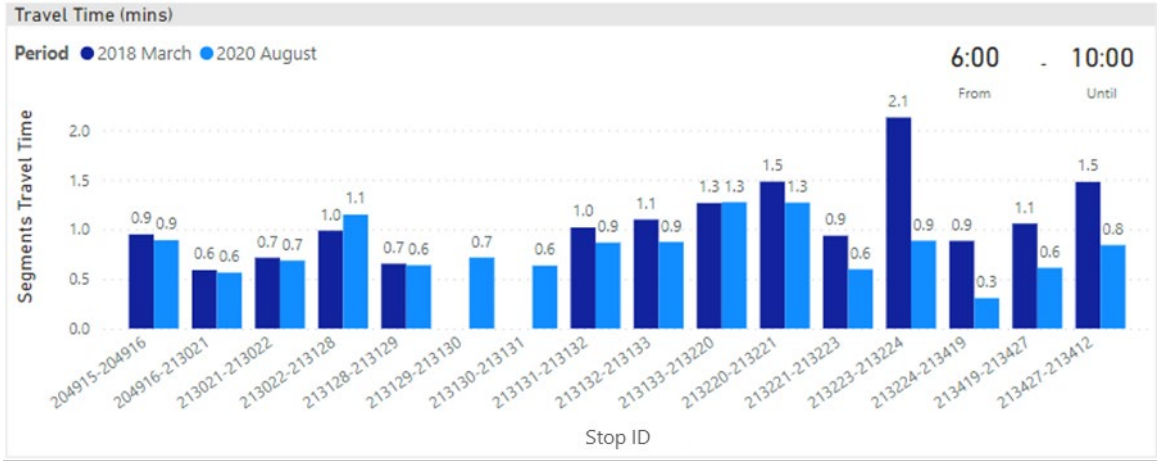


Figure 5-8 presents a comparison of the pre-opening and post-opening bus travel times in the westbound direction along Parramatta Road during the AM peak (6-10am). The assessments indicate that eastbound bus travel times during the AM peak have generally improved between Burwood Road and Frederick Steet/ Wattle Street, with travel time savings of up to a minute per segment. This accumulates to a total travel time saving of approximately three minutes and 40 seconds.

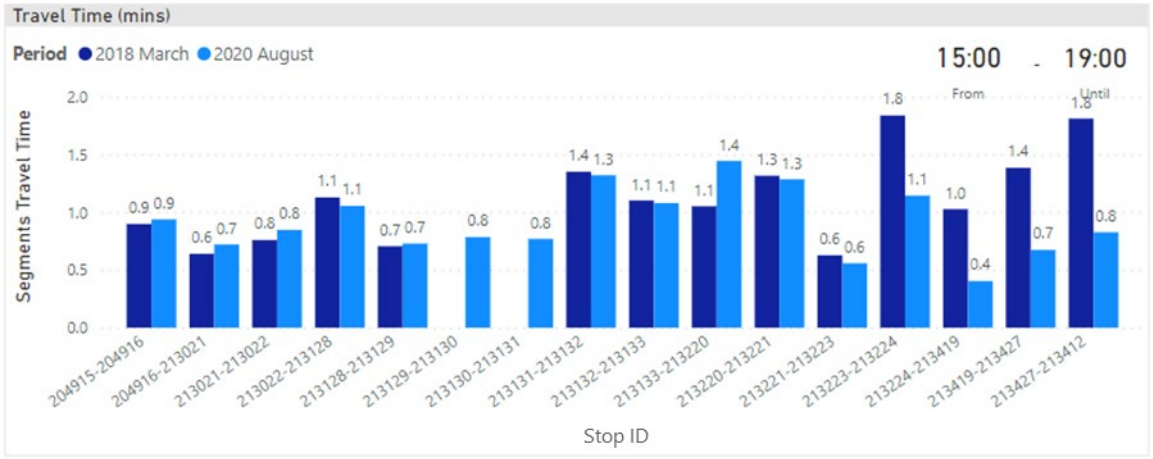
Figure 5-8 Comparison of westbound bus travel times on Parramatta Road (AM peak)



Note: Travel time data was missing or incomplete on two-segments assessed in 2018. Average changes in travel time were taken from segments with 2018 and 2020 data only. Bus travel times and travel speeds are presented from east to west.

Figure 5-9 presents a comparison of the pre-opening and post-opening bus travel times in the westbound direction along Parramatta Road during the PM peak (3-7pm). The assessments indicate that eastbound bus travel have generally remained similar or improved in some segments, with travel time savings of up to a minute per segment. Most time-savings were observed further west on Parramatta Road, of approximately three minutes.

Figure 5-9 Comparison of westbound bus travel times on Parramatta Road (PM peak)



Note: Travel time data was missing or incomplete on two-segments assessed in 2018. Average changes in travel time were taken from segments with 2018 and 2020 data only.

5.2.3 Summary

Bus travel times have generally improved on Parramatta Road for most stop-to-stop segments in each direction, across the weekday peak periods. Bus travel times have generally reduced in the range of one to four minutes, with most of these savings experienced on the western section of the corridor, west of Liverpool Road. This is likely associated with reductions in traffic volumes since the opening of the M4 East. Travel time for buses along the corridor have been improved, therefore the assessment has not identified any significant impact to bus operations due to the opening of the M4 East, and bus priority measures have not been proposed as part of this report.

In comparison, the analysis of general traffic travel times presented in Section 5.1 indicated a greater extent of travel time savings of 10 to 20 minutes on Parramatta Road based on bus stopping patterns and dwell times. This is because the general traffic analysis encompasses longer section of Parramatta Road (noting there no standard services that continue to travel west of Burwood Road on Parramatta Road) in comparison to the bus performance analysis undertaken.

6. Road safety performance

Crash data was reviewed along key road corridors within the study area to assess road safety performance for the 12 months pre-opening and post-opening of the M4 East. Crash data was also reviewed between 2016 and 2018 to determine if the trends during the period assessed were generally consistent with previous years.

6.1 Parramatta Road

Road safety performance along Parramatta Road between Centenary Drive in Homebush West and Flood Street in Leichhardt demonstrated an overall improvement with the opening of the M4 East project, with crash analysis indicating an overall reduction of 15 per cent in crashes when comparing the time periods 12 months prior to and post-opening. The reduction in the number of crashes along Parramatta Road corresponds to an overall decrease in traffic volumes along most sections of Parramatta Road before and after the opening of M4 East.

Crash trends along Parramatta Road within this period include:

- A total of 93 crashes occurring during the 12 months pre-opening of the M4 East, including one fatality.
- A total of 79 crashes occurring during the 12 months post-opening of the M4 East.
- The most common type of crash was rear end crashes accounting for 38 per cent and 34 per cent of overall crashes before and after opening respectively, followed by lane-changing or sideswiping incidents accounting for 15 per cent and 10 per cent of all crashes respectively
- The number of pedestrian-related crashes reduced from five pedestrian-related incidents before the M4 East opening compared to four incidents post-opening.

The intersection of Parramatta Road/ Frederick Street/ Wattle Street was previously identified by Transport as a safety concern. Between pre-opening and post-opening, crashes at this location have reduced from four to three. There is no clear correlation between the types of crashes at this intersection. Traffic volumes on Parramatta Road at this location reduced by 21 per cent for travel towards the City and 25 per cent towards Parramatta during the AM peak, reducing by 38 per cent for travel towards the City and 12 per cent towards Parramatta in the PM peak.

Overall crashes have either reduced or remained the same along Parramatta Road, with the exception of:

Parramatta Road/ Dalhousie Street intersection

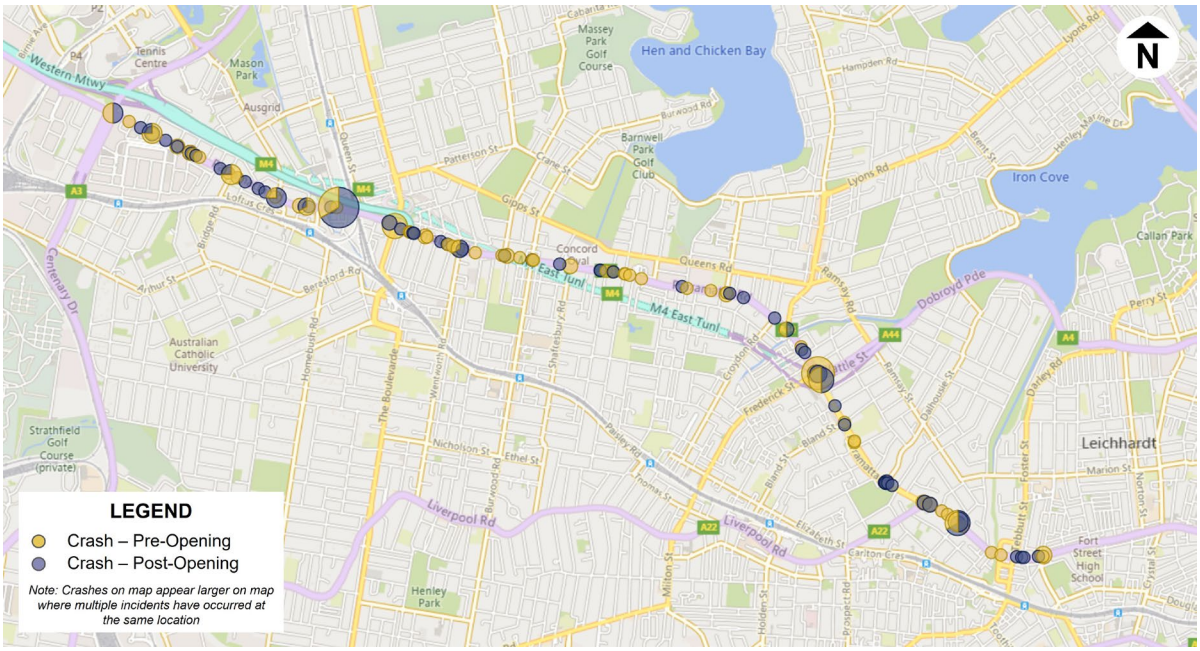
- During the 12 months prior to opening, there were zero recorded crashes at the location. Post-opening, five crashes were recorded, notably higher than crash data for previous years (2016 and 2017) where a maximum of two crashes were recorded per year. The nature of crashes at this location varied and did not show a discernible pattern including one lane sideswipe, one rear end crash, one avoiding vehicle, and one proceeding in lane. The appearance of the cluster of crashes post M4 East opening may be attributed to the marked increase in traffic volumes at this intersection, with a 21 per cent increase in intersection volumes post M4 East opening compared to pre-opening. The intersection is located close to the M4 East ramps, near high volumes of merging vehicles.
- No incidents involving pedestrians occurred during the 12 months pre-and post-opening; however, there have been several near miss occurrences. Based on observation from Transport, Council and community, there have been several near miss incidents between vehicles exiting the M4 East tunnel portals and pedestrians crossing at Dalhousie Street to

and from Ashfield Park. There is low visibility of drivers exiting the tunnel (unable to see the pedestrian crossing beyond the crest in the road), coupled with the proximity of the pedestrian crossing to the tunnel portal exits has caused concern for pedestrian safety at this intersection.

- **Parramatta Road/Sloane Street intersection** – during the 12 months pre-opening, there were two recorded crashes at the location, consistent with crash data for previous years (2016 and 2017). Post-opening, four incidents occurred, of which all were rear-end crashes. This intersection is located further south-east of Dalhousie Street and has experienced similar increases in traffic volumes.
- **Parramatta Road between Tebbutt Street/ Old Canterbury Road and Flood Street** – during the 12 months pre-opening, there were no recorded crashes on this segment, lower than previous years where a maximum of three incidents occurred (2017). Post-opening, four incidents occurred within this segment. No incidents involving pedestrians occurred during the 12 months pre-opening or post-opening. Traffic volumes on Parramatta Road at Tebbutt Street/ Old Canterbury Road increased by 111 vehicles (1.8%) and 498 vehicles (13.1%) post-opening during the AM and PM peak periods respectively.
  There is no clear correlation between the cause of each crash. It is also unlikely that this can be directly attributed to the opening of the M4 East given it is over one kilometre away from the tunnel entrance on Parramatta Road.

Figure 6-1 illustrates crash locations during the 12 months pre-opening and post-opening on Parramatta Road between Centenary Drive in Homebush West and Flood Street in Leichhardt.

Figure 6-1 Crash locations on Parramatta Road



6.2 Frederick Street, Wattle Street, Dobroyd Parade and City-West Link Road

Frederick Street, Wattle Street, Dobroyd Parade and City-West Link Road form the north-east/ south-west corridor travelling perpendicularly to Parramatta Road. Road safety performance remained consistent along this corridor between John Street in Ashfield and Balmain Road in Leichardt, with the number of overall crashes remaining similar when comparing the time periods 12 months prior to and following the opening of the M4 East.

Frederick Street has been previously identified as a location of concern by Transport, Council and the local community. Between John Street and Parramatta Road, two crashes were recorded pre-opening, increasing to six crashes post-opening. There is no clear correlation between the types of crashes on this road. On Frederick Street, during the AM peak, traffic volumes have remained similar to pre-opening levels for travel towards Hume Highway and increased by 222 vehicles (22%) towards City-West Link Road. During the PM peak, traffic volumes decreased by 89 vehicles (8%) for travel towards Hume Highway and increased by 136 vehicles (14%) towards City-West Link Road.

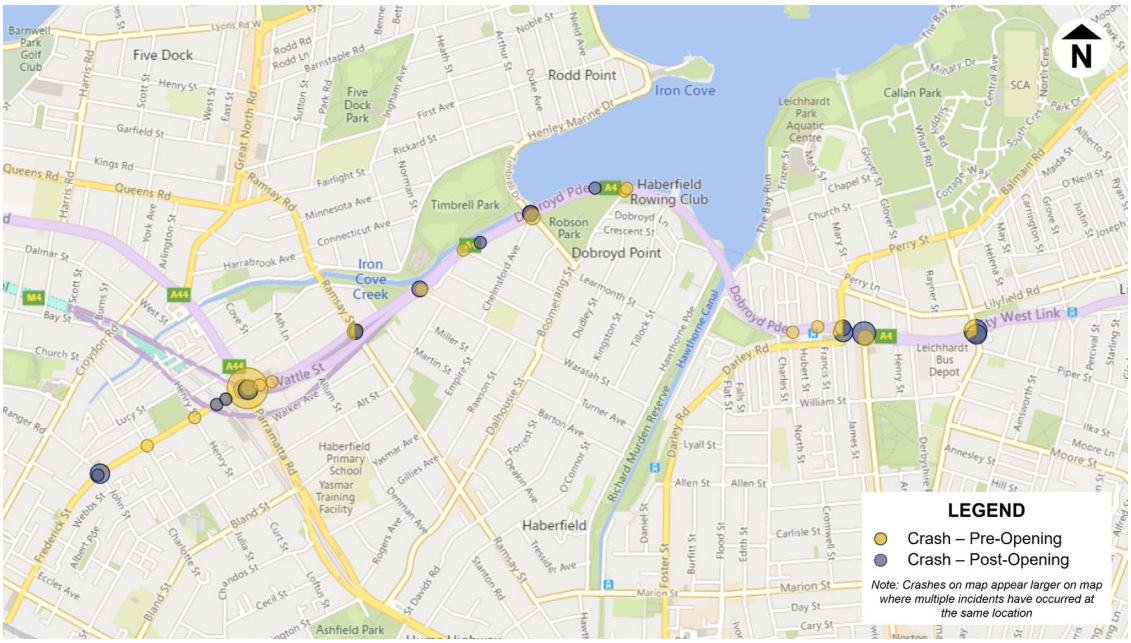
In early 2022, a fatal crash involving a pedestrian occurred at the intersection of Frederick Street and John Street. The incident occurred outside of peak times and unlikely to be related to the M4 East. Transport is conducting a separate road safety assessment of Frederick Street to identify potential measures to improve safety of the corridor.

Crash trends along this corridor between John Street, Ashfield and Balmain Road, Leichardt include:

- A total of 35 crashes occurred during the 12 months pre-opening of the M4 East, including one fatality.
- A total of 34 crashes also occurred during the 12 months post-opening of the M4 East, with no fatalities.
- The most common type of crash was rear end crashes accounting for 38 per cent of overall crashes before and after opening, followed by cross traffic incidents accounting for 12 per cent and 18 per cent of all crashes respectively.
- The number of pedestrian related incidents reduced with three pedestrian related crashes occurring before the M4 East opening and one occurring post-opening. Pre-opening, all incidents occurred at Parramatta Road/ Frederick Street/ Wattle Street; post-opening, the one incident occurred at Frederick Street/ John Street.
- Crashes occur at a higher frequency at the larger intersections of Parramatta Road/ Frederick Street/ Wattle Street and City-West Link Road/ Balmain Road due to various causes but is otherwise distributed along the corridor without great concentration at other locations.
- At the intersection of Parramatta Road/ Frederick Street/ Wattle Street, there were 17 crashes pre-opening, consistent with the number of crashes occurring in previous years (2016 and 2017). This significantly reduced to nine crashes post-opening, likely due to a reduction in traffic volumes.

Figure 6-2 illustrates crash locations during the 12 months pre-and post-opening on Frederick Street, Wattle Street, Dobroyd Parade and City-West Link Road between John Street, Ashfield and Norton Street, Lilyfield.

Figure 6-2 Crash locations on Frederick St, Wattle St, Dobroyd Parade and City-West Link Road



6.3 Homebush Bay Road and Centenary Drive

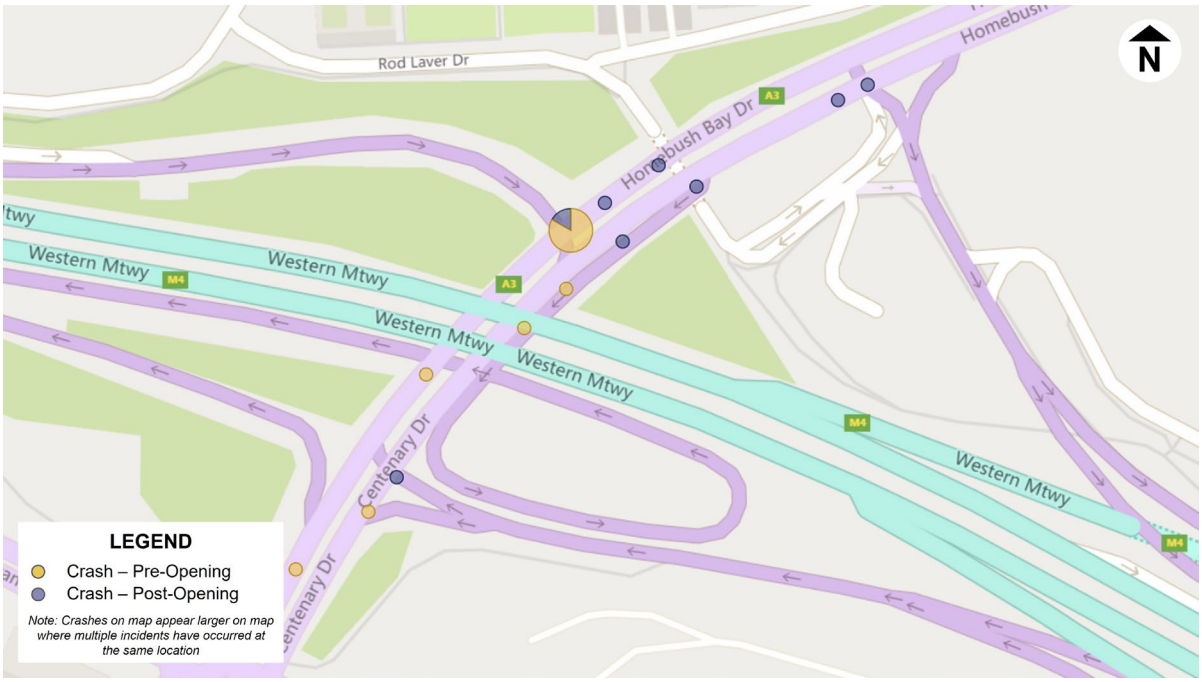
Homebush Bay Road and Centenary Drive form part of a major north-south arterial road (A3) between the Northern Beaches and Princes Highway at Kogarah. The M4 Motorway intersects with Homebush Bay Road and Centenary Drive in Homebush West over three intersections, connecting with an eastbound on-ramp at the northern-most intersection, westbound off-ramp in the middle and eastbound off-ramp and westbound on-ramps at the southern-most intersection.

Road safety performance between the northern and southern intersections slightly improved overall, with the number of crashes reducing by 20 per cent when comparing the time periods 12 months prior to and following the opening the of the M4 East. Further crash trends along this corridor within this period include:

- A total of 10 crashes occurred during the 12 months pre-opening of the M4 East. The same number of crashes were recorded in 2017; however, this is notably lower than in 2016 when 17 crashes were recorded.
- A total of eight crashes also occurred during the 12 months post-opening of the M4 East.
- The cause of each crash was generally unique for pre-opening and post-opening.
- Road safety performance notably improved at the M4 westbound off-ramp intersection with crashes reducing from five crashes pre-opening to two crashes post-opening.

Figure 6-3 illustrates crash locations during the 12 months pre-opening and post-opening on Homebush Bay Road and Centenary Drive at the M4 Motorway Interchange.

Figure 6-3 Crash locations on Homebush Bay Drive and Centenary Drive at M4 Motorway Interchange



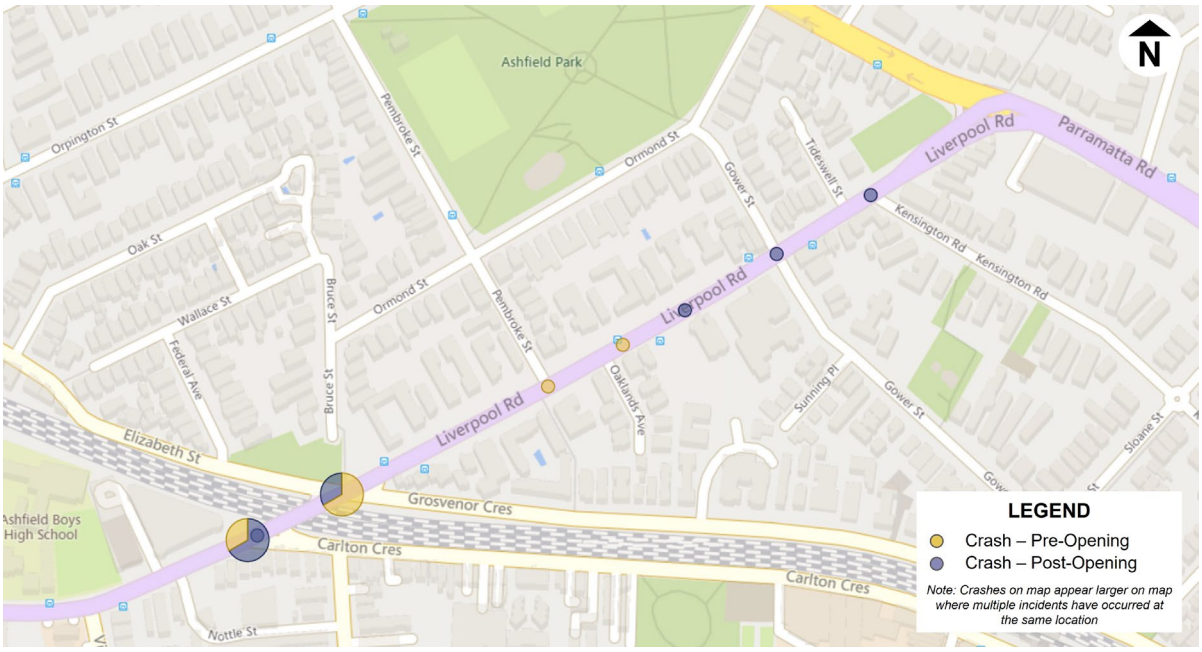
6.4 Liverpool Road (Hume Highway)

Liverpool Road forms part of a major north-east/ south-west arterial road (A22) between Haberfield and Casula. Liverpool Road intersects with Parramatta Road, south-east of the eastern tunnel portals for the M4 East. Road safety performance on the segment between Parramatta Road and Carlton Crescent remained relatively similar, with the number of crashes increasing from eight to nine following the opening of the M4 East. Further crash trends along this corridor within this period include:

- A total of eight crashes occurred during the 12 months pre-opening of the M4 East.
- A total of nine crashes also occurred during the 12 months post-opening of the M4 East.
- The most common type of crash for pre-opening was rear end crashes (38%) and vehicles turning right colliding with vehicles travelling through an intersection (25%).
- The most common type of crash for post-opening was vehicles turning right colliding with vehicles travelling through an intersection and vehicles losing control and crashing, both representing 22 per cent of all crashes.
- The number of pedestrian-related incidents reduced from one pedestrian-related crash occurring before and zero after the M4 East opening.

Figure 6-4 illustrates crash locations during the 12 months pre-and post-opening on Hume Highway between Parramatta Road and Carlton Crescent, Ashfield.

Figure 6-4 Crash locations on Liverpool Road (Hume Highway)



6.5 Dobroyd Parade/ Waratah Street intersection

The pedestrian crossing at Dobroyd Parade and Waratah Street connects Haberfield with Timbrell Park and is a two-stage pedestrian crossing with a centre median between the westbound and eastbound carriageways of Dobroyd Parade to store pedestrians.

Safety concerns for pedestrians and cyclists have been raised following several vehicle collisions with the centre median where there are often people waiting to cross, including children from the local public school on Waratah Street.

7. Community and stakeholder feedback

Transport has received several community and stakeholder correspondence relating to network impacts post-opening of the M4 East project.

Various submissions related to concerns or suggestions about the operation or configuration of existing intersections. A review of the correspondence and communication records identified feedback on the following key operational issues and concerns, as presented in Table 7-1.

Table 7-1 Community and stakeholder feedback

Feedback	Response
Traffic light operations	
Limited green time from local roads, limiting access to corridors such as City West Link and Parramatta Road	Changes to phasing and improvements to operating efficiency are always reviewed and considered prior to any proposed physical changes to the network like the M4 East. Transport recognises the existing phasing of traffic lights at locations within the study area is not always sufficient to clear traffic queues. Traffic light phasing and timings are not fixed and vary throughout given days including peak periods depending on several factors including local conditions, traffic volumes, queue lengths and pedestrian crossing frequency.
Time of day movement restrictions at signalised intersections	Time of day restrictions often cause several operational and safety concerns. Traffic lights where specific phases are used generally have dedicated lanes for those movements, such as a right turn arrow accompanied by a dedicated right turn lane. Time of day restrictions would remove the ability for traffic to legally use those lanes at certain times; however, they do not fully prevent drivers from using lanes illegally. At traffic lights, these behaviours can create larger safety issues and are therefore not further considered.
Local Road Safety Impacts	
Road safety impacts on various local streets around the study area	Transport recognises the existing traffic issues around the study area and is proposing changes to prevent the need for drivers to make illegal and poor decisions.
Illegal driver behaviour around the study area	
Increased traffic and safety issues around school zones and areas with vulnerable road users	Transport will be working with Councils to review the safety of the local roads within the study area, particularly near schools and other areas with more vulnerable road users to identify opportunities to improve traffic management and safety for the benefit of the local community.
Parramatta Road – general	
Widen Parramatta Road between M4 East Tunnels and Liverpool Road to improve traffic flow and safety	While widening and upgrading Parramatta Road may deliver improvements for road users it would require substantial impact and change to nearby properties, utilities and streetscape around the M4 interchange and Ashfield Park. Considering previous community opposition to road widening into Ashfield Park, Transport would not consider this suggestion to be widely acceptable to the local community.

Feedback	Response
Restrict left turn access from Parramatta Road eastbound into various local roads at Haberfield	This suggestion would be investigated further in consultation with Inner West Council. Options to completely restrict access from Parramatta Road need to consider the impacts to local access and connectivity. Removal of the left turn movements from Parramatta Road may increase traffic along certain corridors, opposing several concerns raised by other community members.
Removal of bus stops on Parramatta Road between Dalhousie Street and Liverpool Road be removed to improve safety and efficiency	Existing bus stops on Parramatta Road are not planned to be removed or relocated. Bus stops in this area were relocated as part of the M4 East. Further relocation or removal away from Ashfield Park would most likely increase walking distances beyond acceptable limits and impact existing bus commuters. The potential benefit of removing the two bus stops in this area is minimal given the 15-minute bus frequency during peaks and the limited stopping and dwell times for buses currently using these stops.
Hawthorne Parade	
Increased traffic on Hawthorne Parade and delays entering Marion Street	Based on previous travel time surveys and assessment, delays can vary at the Marion Street/ Hawthorne Parade intersection. Despite the existing right turn movement from Waratah Street onto City West Link, the opportunity to improve the left turn movement from Hawthorne Parade onto Marion Street is under consideration by Transport.
Restrict right turn out and left turn in access into Hawthorne Parade and from Marion Street to limit traffic entering the surrounding streets	This suggestion would be investigated further in consultation with Inner West Council. Options to restrict accesses need to consider the impacts to local connectivity, as this may increase traffic along other local road corridors.
Parramatta Road/ Liverpool Road	
Significant delays and congestion experienced at this intersection	The Parramatta Road/ Liverpool Road intersection operates at capacity and with significant congestion for extended periods of the day. Opportunities to improve the efficiency of this intersection are limited without increasing the intersection footprint; however, Transport is reviewing possible measures.
City West Link/ Timbrell Drive/ Mortley Avenue	
Insufficient storage for pedestrians and cyclists crossing between Timbrell Park and the Bay Run	This intersection has remained in its existing configuration since pre-M4 East opening. However, Transport will work with Inner West Council to assess options for improved pedestrian storage at this intersection.

Feedback	Response
Provide additional signalised crossing over Dobroyd Parade on the north-eastern approach	The signalised crossings at the Dobroyd Parade/ Timbrell Drive/ Mortley Avenue intersection were assessed by Transport in late 2018 as part of the recent improvement works on carried out on City-West Link Road. As part of that assessment, it was identified that an additional crossing on the northern side of the intersection would result in significant delays and impacts to the operation of the intersection, particularly for the left turn traffic out of Timbrell Drive. Extended vehicle queues on Timbrell Drive are particularly undesirable since they affect the crossing safety of pedestrians and cyclists near Henley Marine Drive.
Restricting through movements between Mortley Avenue and Timbrell Drive to improve right turn opportunities out of Timbrell Drive	The removal of the eastbound through movement from Timbrell Drive to Mortley Avenue would allow improved road space for a second right turn lane however would not provide any meaningful operational benefits to the majority of traffic at this intersection. The removal of the eastbound through movement would also cause a much larger volume of traffic to redistribute towards Ramsay Street or turning right towards Waratah Street instead of Mortley Avenue. The volume of through traffic is much higher than right turning traffic. For these reasons, removal of either through movement between Mortley Avenue and Timbrell Drive would not be considered.
Parramatta Road/ Chandos Street	
Restrict left turn in movements from Parramatta Road eastbound into Chandos Street	The removal of the left turn movement from Parramatta Road to Chandos Street would increase traffic along Bland Street and the connectivity of local streets. It is unlikely that this corridor would be used as a "rat run" for vehicles exiting Parramatta Road; however, this would be further investigated by Transport and/ or Council if reports of this nature are received.
Parramatta Road/ Sloane Street	
Addition of right turn movement from Parramatta Road westbound into Sloane Street	Providing a right turn into Sloane Street from Parramatta Road westbound would introduce footprint, property, traffic and efficiency impacts at this intersection. The right turn movement would require additional phasing which would limit the efficiency of the other movements at the intersections.
Introduce no right turn from Sloane Street into Lord Street to limit use of Sloane Street, north of Parramatta Road	This suggestion would be investigated further with Inner West Council. Options to restrict access need to consider the impacts to local access and connectivity, as this may increase traffic along other local road corridors.
Parramatta Road/ Wattle Street/ Frederick Street	
Allow right turn from Parramatta Road onto Wattle Street	The introduction of a new westbound right turn from Parramatta Road onto Wattle Street would not provide any additional opportunity to access the Haberfield area. For this reason, a new right turn at this location has not been considered.

Feedback	Response
Wattle Street/ Ramsay Street	
Delays and queue lengths at this intersection	The intersection has seen reductions in traffic of up to 20 per cent during peak periods since the opening of the New M4 Tunnels. This reduction along with the capacity enhancements completed as part of the M4 East should deliver improvements at the intersection with Wattle Street. However, it is noted that vehicles turning left into Ramsay Street (north) and left out of Ramsay Street (south) have increased during both peak periods. Given the proximity of the tunnel portals and length of the intersection there are limited opportunities to upgrade and provide additional capacity at this location. Transport will commission a review into the phasing and operation of this intersection to ensure it is operating as efficiently as possible with the revised traffic patterns in the area.
Remove left turn out restriction at Martin Street (north) to reduce delays and queues on Ramsay Street	The left turn out restriction was introduced at Martin Street to avoid introducing a significant volume of traffic from Ramsay Street onto Martin Street. The left turn movement from Ramsay Street west onto City West Link operates with improved efficiency since the opening of the M4 East. The right turn out of Waratah Street removes the need for eastbound Haberfield traffic to consider crossing City West Link and using Martin Street to turn around. For these reasons, removal of the left turn out restriction from Martin Street would not be considered.
City-West Link Road/ James Street	
Improvements to the left turn from City-West Link Road into James Street	Improvement measures such as widening of City-West Link Road in this area would require significant construction impacts and the acquisition of private property due to the limited available space in the existing road corridor. Widening may be of minimal benefit since the existing left westbound lane ends about 150 metres west of the intersection.
Increased crossings on William Street	Opportunities to increase crossings on William Street would be considered with Inner West Council.
City-West Link Road/ Balmain Road	
Upgrades be considered and included at the City West Link, Balmain Road intersection	Transport recognises traffic congestion and travel reliability is an issue on Balmain Road and particularly at the City West Link intersection. Monitoring of Balmain Road will continue to occur to gain an improved understanding of the potential options for improving conditions for all road users on Balmain Road.
Left lane must turn left condition along the eastbound approach to Balmain Road	Investigations are being carried out to address the undesirable driver behaviour and congestion issues on City-West Link Road, approaching Balmain Road.

Feedback	Response
Ramsay Street	
Rat running down side streets to access Ramsay Street, including Sloane Street, Marion Street and Hawthorne Street.	Transport recognises that traffic in these local roads have increased but is likely to improve with the WestConnex 3b opening. A review of HERE Travel Time data reveals that the opening of M4 East has had no significant impacts on the average speeds along Hawthorn Street. No significant impacts are similarly seen on Marion Street during the AM peak hour; however, average speeds have decreased by approximately three kilometres per hour since 2018 as shown in Table 7-2.
Cooper Street	
Increase in traffic on this road, which is used to bypass queues on Parramatta Road to access the M4	A review of HERE Travel Time data reveals that the opening of M4 East has had no significant impacts on the average speeds along Cooper Street. Further details of this analysis are provided in Table 7-2.
Concord Road/ Sydney Street	
Rat running down Concord Lane in violation of one-way restrictions in place from Sydney Street and M4 Off-Ramp	Transport recognises that traffic on Concord Lane has increased due to a new connection between Carrington Lane and Sydney Street. Transport shall investigate options to prevent violation of the one-way restriction from Sydney Road.

Based on feedback raised by the community and stakeholders in relation to increased congestion and rat running on certain road corridors, a review of travel speeds was completed using HERE Travel Time data.

In **Leichardt**, concerns were raised regarding rat running on local roads to bypass Parramatta Road. Travel speeds on local roads within Leichardt marginally decreased during the AM and PM peak periods, with no road upgrades completed on the roads reviewed between pre-opening and post-opening.

In **Strathfield**, similar concerns were raised regarding an increase in rat running on local roads to avoid Parramatta Road and access the M4 and M4 East. Travel speeds on local roads within Strathfield generally improved slightly during the AM peak, marginally increasing or decreasing during the PM peak. Other than the construction of a short median at Cooper Street/ Mosely Street, no other road upgrades have been completed between pre-opening and post-opening.

In **Haberfield**, concerns were raised regarding a potential increase of traffic on local roads due to the proposed permanent closure of local access to Parramatta Road at some locations. Travel speeds either remained the same or marginally decreased during the AM and PM peak periods. No road upgrades have been completed between pre-opening and post-opening.

Additional requests were raised to consider the impacts on local roads in nearby suburbs including **Petersham**, **Ashfield**, **Five Dock** and **North Strathfield.** Travel times for assessed roads in these suburbs generally improved after the opening of the M4 East tunnels, by typically one to two kilometres per hour during the peak periods.

Table 7-2 presents the results of a comparison between pre-opening (2018) and post-opening (2020) travel speeds for the AM and PM peak periods.

Table 7-2 Summary of pre-opening and post-opening travel speeds for AM and PM peak periods

Street name	Pre-opening v post-opening				
	Travel speed				Road upgrades
	AM peak		PM peak		
Leichardt					
Marion Street	=	-	▼	3km/h	No changes
Hawthorne Street	▼	< 1km/h	-	No data	No changes
Tebbutt Street	▲	1km/h	▼	2km/h	No changes
Petersham					
West Street	▲	2km/h	▲	1km/h	No changes
Haberfield					
Northcote Street	=	-	-	No data	No changes
Wolseley Street	▼	1km/h	=	-	No changes
Ramsay Street	▼	2km/h	▼	1km/h	No changes
Ashfield					
Liverpool Road	▲	2km/h	=	-	No changes
Five Dock					
Great North Road	▲	1km/h	▲	2km/h	No changes
Harris Road	▲	1km/h	=	-	No changes
Queens Road	▲	1km/h	▲	2km/h	No changes
Strathfield					
Cooper St	▲	1km/h	▼	1km/h	No changes
Mosely Street	▼	< 1km/h	=	-	Short median at Cooper St/ Mosely Street
Swan Avenue	▲	2km/h	▼	2km/h	No changes
Manson Road	▲	1km/h	▲	1km/h	No changes
Roberts Street	▲	1km/h	▲	1km/h	No changes
North Strathfield					
Leicester Avenue	▲	2km/h	▲	4km/h	Part of M4 East project upgrades
Wellbank Street	=	-	▲	1km/h	No changes
Concord					
Concord Road	▲	6km/h	▲	6km/h	Part of M4 East project upgrades
Gipps Street	▲	2km/h	▲	2km/h	No changes
Patterson Street	▼	1km/h	▲	1km/h	No changes
Homebush					

Underwood Road	=	-	▲	2km/h	No changes
Pomeroy Street	▲	2km/h	▲	1km/h	No changes

8. Potential mitigations

8.1 Mitigation measures

Table 8-1 details the potential mitigation measures to minimise the impacts of the M4 East on the surrounding road network. The locations below have been identified using desktop assessments only for the purpose of this report as these mitigations are subject to ongoing assessments to confirm feasibility. Selecting and delivering mitigations will follow the standard project lifecycle process which involves further traffic modelling, environmental impact assessment, design and consultation with Council and community. Infrastructure and non-infrastructure-based treatments would be considered at each site identified. These treatments may include, but are not limited to:

- reconfiguration of intersection layouts
- removal/ construction of additional traffic lanes
- adjustment of traffic signal phasing
- introduction of movement restrictions.

Intersections have been identified as requiring mitigation measures based on the following general criteria:

- intersection performance degrades to LoS E or worse
- road safety issues or significant crash trends and incidents
- occurrence of traffic queue spill back from surface road on the M4 East tunnels or to adjacent intersections that substantially impact the performance of the main corridor (i.e., Parramatta Road and City-West Link Road).

Table 8-1 Potential mitigation measures

Location	Potential mitigations	Predicted intersection performance improvements	Status/ Program
City-West Link Road/ James Street City-West Link Road/ Norton Street City-West Link Road/ Balmain Rd	• Shared path improvements • Movement restrictions • Localised widening • Signal phasing adjustments • Pedestrian refuge storage improvements	• Improved traffic flow and reduced congestion • Improved safety for pedestrians	Need for mitigation measures will be assessed following WestConnex Stage 3B opening.

Location	Potential mitigations	Predicted intersection performance improvements	Status/ Program
Dobroyd Parade/ Timbrell Drive/ Mortley Avenue	• Increase pedestrian storage at north-western end of intersection • Improve active transport amenity and connections between Timbrell Park and Bay Run • Movement restrictions on Timbrell Dr and Mortley Ave • Widening of Timbrell Drive • Improved pedestrian crossings at Timbrell Drive near Henley Marine Dr • Signal phasing adjustments	• Improved traffic flow and reduced congestion • Improved safety for pedestrians • Enhanced accessibility and connectivity for pedestrians and cyclists between Timbrell Park and Bay Run • Increased road capacity along Timbrell Drive	Need for mitigation measures will be assessed following WestConnex Stage 3B opening.
Dobroyd Parade/ Waratah Street	• Remove pedestrian crossing • Introduce pedestrian bridge • Restrict movements into Waratah Street	• Improved traffic flow and reduced congestion • Improved pedestrian safety through pedestrian and vehicle separation	Prioritised for delivery to mitigate safety issues.
Parramatta Road/ Dalhousie Street	• Restrict movements into and out of Dalhousie St • Remove pedestrian crossing(s) • Reduce lanes on Parramatta Road • Removal/ modification of zipper merge • Introduce pedestrian bridge • Improve shared paths • Reallocate westbound traffic lanes or bus stop on approach to the tunnel	• Improved traffic flow and reduced congestion • Improved pedestrian safety through pedestrian and vehicle separation • Provide improved bus reliability along Parramatta Road • Improved traffic flow by not obstructing westbound traffic movements near bus stops next to the tunnel portal	Need for mitigation measures will be assessed following WestConnex Stage 3B opening.
Parramatta Road/ Liverpool Road	• Extension and/or duplication of right turn bay • Changes to lane configuration on Parramatta Road	• Improved traffic flow and reduced congestion • Reduced delay and queue lengths for right-turning vehicles	Need for mitigation measures will be assessed following WestConnex Stage 3B opening.

Location	Potential mitigations	Predicted intersection performance improvements	Status/ Program
Parramatta Road/ M4 on-ramp (Powell's Creek) Parramatta Road/ George Street/ Nipper Street	• Extension of right turn bay by restricting movements into minor roads • Potential localised widening on Parramatta Road • Signal phasing adjustments	• Improved traffic flow and reduced congestion in specific areas or at certain times • Reduced delay and queue lengths for right-turning vehicles • Increased road capacity	Subject to stakeholder access requirements for Columbia Lane.

8.2 Timing

The timing for the assessment and implementation of the mitigations discussed in Section 8.1 will be as follows:

- Mitigations for safety issues will be prioritised for development and delivery.
- WestConnex Stage 3A was completed in early 2023, and Stage 3B is expected to be completed by the end of 2023. WestConnex Stage 3 is expected to reduce traffic demand and/ or change travel patterns of road users using some surface roads and intersections identified for mitigations as part of this assessment. The locations where this change may occur include along City West Link, Dobroyd Parade and Parramatta Road at the intersections with Dalhousie Street and Liverpool Road.
- Mitigations at locations where traffic demand is expected to reduce or travel patterns are expected to change upon opening of WestConnex Stage 3 will not be delivered before end 2023. This is to assess whether intervention is still required given the change at these locations and ensure investment is justified.
- Transport will assess traffic performance at the mitigation locations after the opening of WestConnex Stage 3B. The locations deemed still requiring mitigation work will be developed over a 3-4-year period prior to the commencement of construction. This timeframe will allow for additional investigation, design development, environmental approvals and consultation with key stakeholders including Councils and community.

8.3 Next steps

The potential mitigation measures identified in the above section will be investigated and progressed through existing programs within Transport, such as the Network Integration Program.

Development of initiatives for mitigation measures will include undertaking needs assessment, options development (including survey and traffic modelling), detailed costings, benefit analysis, environmental planning approvals, road safety audits/ reviews and community and stakeholder engagement.

The key risks with developing and delivering these initiatives include:

- community impacts, particularly in relation to changing existing movements and utilising alternative routes to and from local streets
- geometric constraints, including narrow lanes, footpaths and setbacks

- impacts to general traffic, which will require operational traffic modelling to assess the impacts of lane use changes
- funding and resource availability due to competing projects and priorities
- changing customer needs for various corridors, including focus on pedestrian and active travel amenity over traffic needs
- property acquisition and impacts on utilities that could increase cost, delivery timeframes and viability for some projects.

9. Summary and Conclusions

In line with CoA E36, a Road Network Performance Review was completed to report changes in traffic volumes and behaviour of motorists upon the completion of the M4 East. Based on the review the following findings were made:

- Traffic volumes generally increased at intersections within close proximity or facilitating direct connections with the M4 East interchanges on Concord Road, Parramatta Road and Wattle Street.
- Intersections where infrastructure upgrades were completed to support the M4 East generally saw LoS remain the same as pre-opening, through additional capacity for increased traffic volumes.
- Vehicle travel speeds generally improved during a typical weekday between pre-opening and post-opening on Parramatta Road between Potts and Flood Street, by approximately 10 to 20 minutes in each direction in both peak periods.
- Bus travel times and travel speeds generally improved during the AM peak (6-10am) and PM peak (3-7pm) in both directions on Parramatta Road between pre-opening and post-opening by approximately one to four minutes in each direction.
- Based on the traffic analysis, nine (9) intersections have been identified as potential locations for mitigation measures to reduce the impact of the M4 East on the road work, subject to detailed planning assessments and design development by Transport.

A review of road safety performance was also conducted as part of the performance review, with the following conclusions:

- Parramatta Road saw a 15 per cent reduction in total crashes post-opening, with four incidents involving pedestrians post-opening, compared with five pre-opening.
- Crashes on Frederick Street, Wattle Street and City-West Link Road reduced between pre-opening and post-opening, with three incidents involving a pedestrian pre-opening, compared with one post-opening. No incidents resulted in a fatality, compared to one fatality pre-opening.
- Rear-end crashes represented 38 per cent of overall crashes on Frederick Street, Wattle Street and City-West Link Road pre-opening and post-opening.
- Crashes occur at a higher frequency at the large intersection of Parramatta Road, Frederick Street and Wattle Street, due to various causes.

Appendix A – Intersection assessment summary for pre-opening (2018) and post-opening (2019)

For each site, AM and PM peak SIDRA Intersection models were developed to provide a comparison of intersection performance prior to and after the M4 East opening. These models were based on surveyed traffic volumes travelling through the intersections. The pre-opening baseline survey was carried out in March 2018. This was done to provide a true representation of the network performance before the M4 East's completion. The post-opening surveys used in this analysis were carried out in September 2019.

Intersection 1 – Parramatta Road/ Potts Street

Table A-1 presents a performance summary and comparison of the intersection, using traffic volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-1 Summary of intersection performance at Parramatta Road/ Pott Street

Parramatta Road/ Potts Street – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	3,537	3,314	3,692	3,493	+188	+185
Queue Length (m) Approach	212.0 North-West	232.8 North-West	324.6 North-West	254.0 North-West	+112.6	-0.5
Average Delay (sec)	9.2	6.1	11.2	7.3	+2.0	+1.2
Intersection LoS	LoS A	LoS A	LoS A	LoS A	=	=

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM and PM peaks.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased marginally by up to two seconds in general; however, the LoS of Potts Street improved from LoS E to LoS D during the AM peak. Average delays increased on the north-western approach of Parramatta Road during both the AM and PM peak but increased on the south-eastern approach during the PM peak only.
- Vehicle queue lengths have increased on the north-western approach of Parramatta Road and slightly increased on Potts Street during the AM peak. Queue lengths have increased on all approaches during the PM peak.

Given the satisfactory performance of the intersection (as evidenced by LoS A), no mitigation measures are proposed.

Intersection 5 – Concord Road/ Patterson Street

Table A-2 presents a performance summary and comparison of the intersection, using traffic volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-2 Summary of intersection performance at Concord Road/ Patterson Street

Concord Road/ Patterson Street – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	2,841	3,048	3,263	3,224	+422	+176
Queue Length (m) Approach	166.8 South	254.2 South	166.5 South	169.9 South	-0.3	-84.3
Average Delay (sec)	34.0	44.6	38.9	47.4	+4.9	+2.8
Intersection LoS	LoS C	LoS D	LoS C	LoS D	=	=

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM and PM peaks.

Key changes in performance observed at this intersection are as follows:

- Average delays have been reduced on the northern approach of Concord Road and increased on Patterson Street during the AM peak. This is due to increased green time on Concord Road to accommodate additional vehicles accessing the M4 East at Sydney Street. The LoS on both approaches of Concord Road has remained at LoS C, degrading on Patterson Street from LoS C to LoS E.
- Vehicle queue lengths have increased on all approaches during the AM peak and increased on Patterson Street and the northern approach of Concord Road during the PM peak.

Given the satisfactory performance of the intersection (as evidenced by LoS C and LoS D for the AM and PM peak respectively), no mitigation measures are proposed.

Intersection 6 – Concord Road/ Sydney Street

Table A-3 presents a performance summary and comparison of the intersection, using the volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-3 Summary of intersection performance at Concord Road/ Sydney Street

Concord Road/Sydney Street – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	1,813	2,834	3,056	2,833	+1,243	-1
Queue Length (m) Approach	92.1 North	140.3 North	59.0 North	71.4 North	-33.1	-68.9
Average Delay (sec)	18.7	21.2	14.9	17.9	-3.8	-3.3
Intersection LoS	LoS B	LoS B	LoS B	LoS B	=	=

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM and PM peak periods.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on Sydney Street, with LoS degrading from LoS C to LoS E during the AM peak and LoS D to LoS E during the PM peak. This is due to increased green time on Concord Road to accommodate vehicles entering and exiting the M4 East.
- Vehicle queue lengths have increased on Sydney Street during the AM peak, again due to increased green time on Concord Road. Queue lengths have increased on the southern approach of Concord Road during the AM and PM peaks, likely due to the removal of one northbound lane at the intersection to accommodate vehicles exiting the M4 East.

Given the satisfactory performance of the intersection (as evidenced by LoS B), no mitigation measures are proposed

Intersection 7 – Parramatta Road/ Concord Road/ Leicester Avenue

Table A-4 presents a performance summary and comparison of the intersection, using the volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-4 Summary of intersection performance at Parramatta Road/ Concord Road/ Leicester Avenue

Concord Road/ Sydney Street – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	3,918	4,349	4,169	4,490	+251	+141
Queue Length (m) Approach	200.5	369.3	195.7	298.5	-4.8	-70.8
	South	North	South	North		
Average Delay (sec)	59.6	72.7	54.9	74.2	-4.7	+1.5
Intersection LoS	LoS E	LoS F	LoS D	LoS F	▲	=

Since the opening of the M4 East, overall performance at this intersection has improved during the AM peak and remained similar during the PM peak. It is noted that the intersection was operating close to capacity prior to opening, with a LoS E during the AM peak and LoS F during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased for the western approach of Parramatta Road during the AM peak, with the LoS degrading from LoS D to LoS E. During the PM peak, average delays have reduced on both approaches of Parramatta Road due to additional green time, increasing on Leicester Avenue and Concord Road. Concord Road continues to perform at LoS F post-opening, with Leicester Avenue degrading from LoS D to LoS E.
- Vehicle queue lengths have slightly increased on Concord Road during the AM peak and increased on Leicester Avenue and the western approach of Parramatta Road during the PM peak.
- During the AM peak, the northern approach shows an improvement for the right turn following the reallocation of lanes in favour of that movement; however, the left turn movement from Concord Road has degraded.
- Based on a review of available crash data for 12 months before and after the opening of the M4 East, one crash occurred at this intersection pre-opening, with no additional crashes post-opening.

While this intersection operates at LoS F in the PM peak, the operation of this intersection has not significantly declined and has remained fairly similar to pre-opening as evidenced by the marginal increase in delay in the PM peak and as such no mitigation measures are proposed.

Intersection 9 – Dobroyd Parade/ Waratah Street

Table A-5 presents a performance summary and comparison of the intersection, using the volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-5 Summary of intersection performance at Dobroyd Parade/ Waratah Street (2018 v 2019)

Dobroyd Parade/ Waratah Street – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	2,927	3,419	4,176	4,692	+1,249	+1,273
Queue Length (m) Approach	217.4 South-West	339.2 South-West	436.2 South-West	109.1 South-West	+218.8	-230.1
Average Delay (sec)	12.3	13.4	27.3	14.2	+15.0	+0.8
Intersection LoS	LoS A	LoS A	LoS B	LoS A	▼	=

Since the opening of the M4 East, overall performance at this intersection marginally degraded during the AM peak and remained similar during the PM peak. It is noted that two lanes on the south-western approach directly exit the M4 East tunnels which are separated from Dobroyd Parade at this intersection.

Key changes in performance observed at this intersection are as follows:

- Traffic volumes on all approaches have increased, with the exception of the site access (northern approach). This is likely due to additional traffic generation from the M4 East interchange immediately west of this intersection.
- Average delays have generally increased on all approaches during the AM peak, with additional vehicles entering and exiting the M4 East. With the exception of Waratah Street, the LoS has slightly degraded on all other approaches. During the PM peak, increase in intersection delay is generally limited.
- Vehicle queue lengths have generally increased on all approaches during the AM peak, with additional vehicles entering and exiting the M4 East. Site observations have indicated that the queues on the south-west approach along Dobroyd Parade often extend into the M4 East tunnel portal. This is primarily due to queues from the Dobroyd Parade/ Timbrell Drive/ Mortley Avenue intersection extending till this intersection, resulting in reduced downstream capacity for the northbound through movements thereby resulting in queues extending till the tunnel portals. During the PM peak, queue lengths have increased on all approaches, likely as a result of increased generated by the M4 East interchange immediately south-west of this intersection, with the exception of the south-western approach on Dobroyd Parade where both have decreased.

While the intersection continues to operate at LoS B and LoS A in the AM and PM peaks respectively, mitigations are proposed at this location due to the occurrence of queues on the south-west approach that often extend into the M4 East tunnel portal.

Intersection 10 – Dobroyd Parade/ Timbrell Drive/ Mortley Avenue

Table A-6 presents a performance summary of the existing site, using the volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-6 Summary of intersection performance at Dobroyd Parade/ Timbrell Drive/ Mortley Avenue (2018 v 2019)

Dobroyd Parade/Timbrell Drive/Mortley Avenue – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,471	4,721	5,219	5,961	+748	+1,240
Queue Length (m) Approach	341.2 South-	460.0 South-	514.8 South-	427.2 South-	+173.6	-32.8
Average Delay (sec)	39.5	51.7	64.9	53.5	+25.4	+1.8
Intersection LoS	LoS C	LoS D	LoS E	LoS D	▼	=

Since the opening of the M4 East, overall performance at this intersection has degraded during the AM peak and remained similar during PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on all approaches during the AM peak, with the exception of Mortley Avenue. The LoS on the south-western approach of Dobroyd Parade has degraded. During the PM peak, average delays have increased on Timbrell Drive and the south-eastern approach of Dobroyd Parade. The LoS of the north-eastern approach of Dobroyde Parade has degraded from LoS C to LoS D; this may be due to increased demand generated by the M4 East.
- Vehicle queue lengths have increased on Dobroyd Parade during the AM peak. Site observations have indicated that the queues on the south-west approach along Dobroyd Parade often extend into the Dobroyd Parade/Waratah Street intersection. This is primarily due to downstream queuing, increase in green time for right turn from Timbrell Drive towards Dobroyd Parade, and increase in pedestrian movements at this intersection. During the PM peak, queue lengths have increased on Timbrell Drive and the south-eastern approach of Dobroyd Parade. There has been a significant increase in queue length on the north-eastern approach of Dobroyd Parade. This may be due to additional vehicles travelling on Dobroyd Parade towards the M4 East.
- Based on a review of available crash data for 12 months before and after the opening of the M4 East, one crash occurred at this intersection pre-opening and post-opening.

As the performance of this intersection has deteriorated to LoS E (during the AM peak), mitigation measures to minimise the impacts at this intersection are proposed, as detailed in Section 5.

Intersection 11 – City-West Link Road/ James Street

Table A-7 presents a performance summary and comparison of the intersection, using the volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-7 Summary of intersection performance at City-West Link Road/ James Street (2018 v 2019)

City-West Link Road/ James Street – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,531	5,353	5,189	5,659	+658	+306
Queue Length (m) Approach	206.8 South	218.3 East	124.0 South	353.4 East	-82.8	+135.1
Average Delay (sec)	31.0	33.3	36.7	26.8	+5.7	-6.5
Intersection LoS	LoS C	LoS C	LoS C	LoS B	=	▲

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM peak and improved during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays increased on City-West Link Road during the AM peak and increased for the eastern approach on City-West Link Road during the PM peak. The increase in vehicles using City-West Link Road is likely due to vehicles using this corridor to access the M4 East at Haberfield. The LoS on City-West Link Road degraded from LoS B to LoS C on the western approach. Green time has been reallocated from James Street to City-West Link Road, reducing the number of vehicles pass through the intersection from James Street. During the PM peak, average delays have increased for the eastern approach on City-West Link Road.
- Vehicle queue lengths have increased on City-West Link Road during the AM and PM peak periods. Green time has been reallocated from James Street to City-West Link Road, reducing the number of vehicles passing through the intersection from James Street.
- Based on a review of available crash data for 12 months before and after the opening of the M4 East, two crashes occurred at this intersection pre-opening and post-opening.

The intersection performs with some increase in delay in 2018, while operating at LoS C or better indication overall satisfactory performance. However, by 2020, the performance of intersection degrades more noticeably, particularly on the western approach of City-West Link Road which operates at LoS F. As such, mitigation measures are proposed at this location.

Intersection 12 – City-West Link Road/ Norton Street

Table A-8 presents a performance summary of the existing site, using the volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-8 Summary of intersection performance at City-West Link Road/ Norton Street (2018 v 2019)

City-West Link Road/ Norton Street – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,469	5,395	4,996	5,801	+527	+406
Queue Length (m) Approach	214.5 North	355.9 South	216.7 North	607.8 South	+2.2	+251.9
Average Delay (sec)	29.9	32.2	30.0	49.6	+0.1	+17.4
Intersection LoS	LoS C	LoS C	LoS C	LoS D	=	▼

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM peak but degraded during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have remained relatively similar during the AM peak. During the PM peak, average delays have significantly increased for the south-eastern approach on City-West Link Road. The LoS for this approach has degraded from LoS C to Los F, which may be due to additional vehicles using this approach to access the M4 East further west on Dobroyd Parade. On Norton Street, average delays have increased on the northern approach due to an increase in vehicles.
- Based on a review of available crash data for 12 months before and after the opening of the M4 East, one crash occurred at this intersection pre-opening and post-opening.

As the performance of the intersection has deteriorated notably on the south-eastern approach of City-West Link Road from LoS C to LoS F due to significant queuing into adjacent intersections, mitigation measures to minimise the impacts at this intersection are proposed as detailed in Section 5.

Intersection 14 – Parramatta Road/ Dalhousie Street

Table A-9 presents a performance summary of the existing site, using the volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-9 Summary of intersection performance at Parramatta Road/ Dalhousie Street (2018 v 2019)

Parramatta Road/ Dalhousie Street – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	3,754	3,848	4,260	4,919	+506	+1,071
Queue Length (m) Approach	334.7 North-	223.7 North-	408.1 North-	639.6 North-	+73.4	+415.9
Average Delay (sec)	29.2	20.8	34.8	43.2	+5.6	+22.4
Intersection LoS	LoS C	LoS B	LoS C	LoS D	=	▼

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM peak but degraded during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have reduced for the north-western approach on Parramatta Road during the AM peak. This is likely due to the additional green time on Parramatta Road during the AM peak to support additional traffic exiting the M4 East onto Parramatta Road immediately north-west of this intersection. During the PM peak, all approaches have experienced an increase in average delays, with the exception of the south-eastern approach on Parramatta Road where average delays have reduced. The increase on the other approaches is likely due to additional vehicles using Parramatta Road to access M4 East immediately west of this intersection. The LoS of Dalhousie Street has degraded from LoS D to LoS E during the AM peak and LoS C to LoS F during the PM peak, likely due to increased priority on Parramatta Road.
- Vehicle queue lengths have increased on Dalhousie Street during the AM peak. During the PM peak, all approaches have experienced increases in queue lengths, with the exception of the south-eastern approach on Parramatta Road. This increases on the other approaches are likely due to additional vehicles using Parramatta Road to access the M4 East immediately west of this intersection.
- Based on a review of available crash data for 12 months before and after the opening of the M4 East, no crashes occurred at this intersection pre-opening. Five crashes were recorded post-opening.

While the intersection continues to operate at LoS D or better in 2019, mitigations are proposed at this location due to the occurrence of traffic queues from Parramatta Road extending into the tunnel portals as reflect by the substantial increase in queueing on the north-western approach of Parramatta Road.

Intersection 15 – Parramatta Road/ Liverpool Road

Table A-10 presents a performance summary and comparison of the intersection, using the volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-10 Summary of intersection performance at Parramatta Road/ Liverpool Road (2018 v 2019)

Parramatta Road/ Liverpool Road – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,211	4,889	4,486	5,695	+275	+806
Queue Length (m) Approach	286.3 South-East	402.3 South-East	342.3 South-East	507.2 South-East	+56.0	+104.9
Average Delay (sec)	29.2	40.5	42.1	45.1	+12.9	+4.6
Intersection LoS	LoS C	LoS C	LoS C	LoS D	=	▼

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM peak but degraded during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on all approaches during the AM and PM peak periods. During the AM peak, signal phases have been shortened by 15 seconds, with green time reduced on most approaches. As a result, the LoS on both approaches of Parramatta Road have degraded from LoS B to LoS C. Liverpool Road has remained at LoS E despite left turning vehicles more than doubling; this is likely due to vehicles using Parramatta Road to access the M4 East entrance further north-west. During the PM peak, green time has been significantly increased on Parramatta Road to increase priority for vehicles travelled towards and away from the M4 East. Despite this, the LoS has degraded on Parramatta Road from LoS B to LoS C on the north-west western approach and LoS B to LoS D on the south-eastern approach. Liverpool Road degraded from LoS E to LoS F, likely due to the large increase in left-turning vehicles, similar to the AM peak.
- Vehicle queue lengths have increased on all approaches during both the AM and PM peak periods.
- Based on a review of available crash data for 12 months before and after the opening of the M4 East, two crashes occurred at this intersection pre-opening and post-opening.

While the intersection continues to operate at LoS D or better, mitigations are proposed at this location due to increased queuing for the western approach right turn, which increases further by 2020, resulting in safety issues associated with weaving movements and potential for queueing back into the tunnel portals.

Intersection 16 – Parramatta Road/ Sloane Street

Table A-11 presents a performance summary of the existing site, using the volumes observed prior to and after the opening of the M4 East for 2018 and 2019.

Table A-11 Summary of intersection performance at Parramatta Road/ Sloane Street

Parramatta Road/ Sloane Street – 2018 v 2019						
	Pre M4 East (2018)		Post M4 East (2019)		Difference	
	AM	PM	AM	PM	AM	PM
Traffic Volumes	4,145	4,682	4,372	5,576	+227	+894
Queue Length (m) Approach	170.6 North-West	137.1 North-West	146.3 North-West	139.1 North-West	-24.3	+2.0
Average Delay (sec)	13.6	13.4	13.3	14.6	-0.3	+1.2
Intersection LoS	LoS A	LoS A	LoS A	LoS B	=	▼

Since the opening of the M4 East, overall performance at this intersection has remained similar during the AM peak but marginally degraded during the PM peak.

Key changes in performance observed at this intersection are as follows:

- Average delays have increased on Sloane Street during both the AM and PM peak periods, likely due to increased priority for Parramatta Road to support additional traffic generation from the M4 East. The LoS of the south-western approach on Sloane Street degraded during the AM peak and both approaches on Sloan Street degraded during the PM peak.
- Vehicle queue lengths increased on Sloane Street during the AM peak. During the PM peak, queue lengths increased on all approaches, with the except of the north-eastern approach of Parramatta Road which saw a slight decrease.
- Based on a review of available crash data for 12 months before and after the opening of the M4 East, 2 crashes occurred at this intersection pre-opening, with 3 crashes recorded post-opening.

Given the satisfactory performance of the intersection (as evidenced by LoS A during the AM peak and LoS B during the PM peak), no mitigation measures are proposed.

Appendix B – Haberfield, Ashfield and Leichardt Intersection Analysis Summary

Source: Technical Advice Operational Traffic Performance Review for Selected Intersections

A1 – James Street/ Lilyfield Road

	2018 Pre-M4E Opening Pre-Covid-19		2019 Post-M4E Opening Pre-Covid-19		2020 Post-M4E Opening Post-Covid-19		2019-2018		2020-2018	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Intersection Volume	1,047	1,277	1,202	1,141	1,049	1,146	155	-136	2	-131
Intersection Queue Length (m)	31.7	55.0	51.6	29.6	34.7	27.8	20	-25	3	-27
Approach with Longest Queue	South	East	East	South	South	North				
Intersection Delay (sec)	28.2	38.9	36.0	26.6	27.7	26.8	8	-12	-1	-12
Intersection Level of Service	B	C	C	B	B	B				

A2 –Norton Street/ Lilyfield Road

	2018 Pre-M4E Opening Pre-Covid-19		2019 Post-M4E Opening Pre-Covid-19		2020 Post-M4E Opening Post-Covid-19		2019-2018		2020-2018	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Intersection Volume	564	773	737	821	610	677	173	48	46	-96
Intersection Queue Length (m)	1.6	2.5	1.9	3.2	1.9	2.4	0.3	0.7	0.3	-0.1
Approach with Longest Queue	West	West	West	West	West	West				
Intersection Delay (sec)	3.6	4.1	3.8	4.4	3.7	4.3	0.2	0.3	0.1	0.2
Intersection Level of Service	A	A	A	A	A	A				

A3 – Norton Street/ William Street

	2018 Pre-M4E Opening Pre-Covid-19		2019 Post-M4E Opening Pre-Covid-19		2020 Post-M4E Opening Post-Covid-19		2019-2018		2020-2018	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Intersection Volume	843	1,135	944	1,126	855	1,060	101	-9	12	-66
Intersection Queue Length (m)	6	13	6	14	6	11	0.5	1.1	-0.1	-3.2
Approach with Longest Queue	North	North	North	North	North	North				
Intersection Delay (sec)	11	14	11	14	11	13	0.3	0.6	-0.2	-1.4
Intersection Level of Service	A	A	A	A	A	A				

A4 – Hume Highway/ Carlton Crescent

	2018		2019		2020		2019-2018		2020-2018	
	Pre-M4E Opening Pre-Covid-19		Post-M4E Opening Pre-Covid-19		Post-M4E Opening Post-Covid-19					
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Intersection Volume	2,671	2,887	2,630	2,835	2,813	2,798	-41	-52	142	-89
Intersection Queue Length (m)	63.2	96.0	48.0	82.8	65.1	81.1	-15	-13	2	-15
Approach with Longest Queue	South	North	South	North	South	North				
Intersection Delay (sec)	10.2	17.0	7.6	12.0	9.4	12.3	-3	-5	-1	-5
Intersection Level of Service	A	B	A	A	A	A				

A5 – Tebbutt Street/ Hathern Street

	2018		2019		2020		2019-2018		2020-2018	
	Pre-M4E Opening Pre-Covid-19		Post-M4E Opening Pre-Covid-19		Post-M4E Opening Post-Covid-19					
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Intersection Volume	1,612	1,927	1,764	1,837	1,680	1,886	152	-90	68	-41
Intersection Queue Length (m)	91	217	100	114	85	119	10	-102	-6	-98
Approach with Longest Queue	West	North	West	North	West	North				
Intersection Delay (sec)	30	30	30	25	28	25	-0.2	-6	-3	-6
Intersection Level of Service	C	C	C	B	B	B				0

A6 – Parramatta Road/ Tebbutt Street

	2018		2019		2020		2019-2018		2020-2018	
	Pre-M4E Opening Pre-Covid-19		Post-M4E Opening Pre-Covid-19		Post-M4E Opening Post-Covid-19					
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Intersection Volume	4,039	4,614	3,572	4,876	4,307	4,927	-467	262	268	313
Intersection Queue Length (m)	467	259	105	128	287	129	-362	-131	-179	-130
Approach with Longest Queue	West	West	West	East	West	East				
Intersection Delay (sec)	23	9	7	10	20	7	-16	1	-3	-2
Intersection Level of Service	B	A	A	A	B	A				

A7 – Parramatta Road/ West Street

	2018		2019		2020		2019-2018		2020-2018	
	Pre-M4E Opening Pre-Covid-19		Post-M4E Opening Pre-Covid-19		Post-M4E Opening Post-Covid-19					
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
Intersection Volume	4,170	4,744	3,906	5,007	4,640	5,056	-264	263	470	312
Intersection Queue Length (m)	200	220	149	235	200	252	-51	14	0	32
Approach with Longest Queue	West	East	West	East	West	East				
Intersection Delay (sec)	50	93	37	40	48	49	-13	-53	-2	-43
Intersection Level of Service	D	F	C	C	D	D				

Appendix C – General traffic performance analysis: 2018 and 2019 data

Parramatta Road

Figure C-1 and Figure C-2 present a comparison of the pre-opening and post-opening average travel time during a typical weekday morning and evening peaks respectively, in each direction on Parramatta Road between Potts Street and Flood Street.

The outcomes of this analysis are consistent with year 2020 as discussed in Section 5.1, with the following key observations:

- In the eastbound direction, total travel times (across the three segments) reduced by approximately 12 minutes in both the 2019 AM and PM peaks, consistent with 2020.
- In the westbound direction, total travel reduced by approximately eight minutes in the AM peak and remained similar to 2018, with the outcomes also consistent with 2020.
- The section of Parramatta Road between Concord Road and Wattle Street experienced the largest travel time saving due to the opening of the M4 East which provides a direct alternative route, bypassing the several traffic signals on the Parramatta Road corridor.

Figure C-1 Average travel times on Parramatta Road (AM peak)

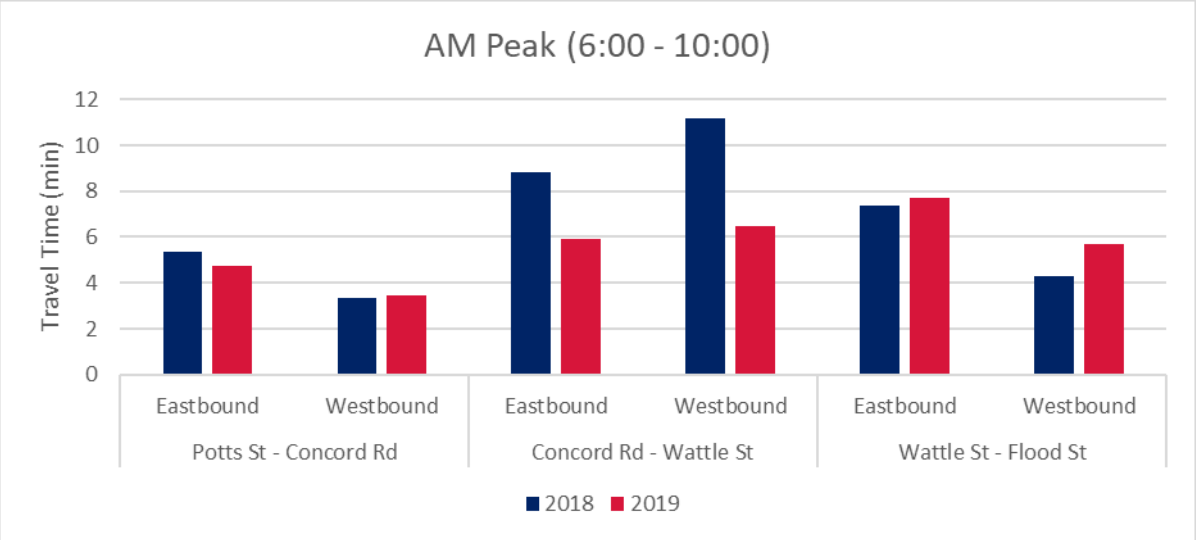
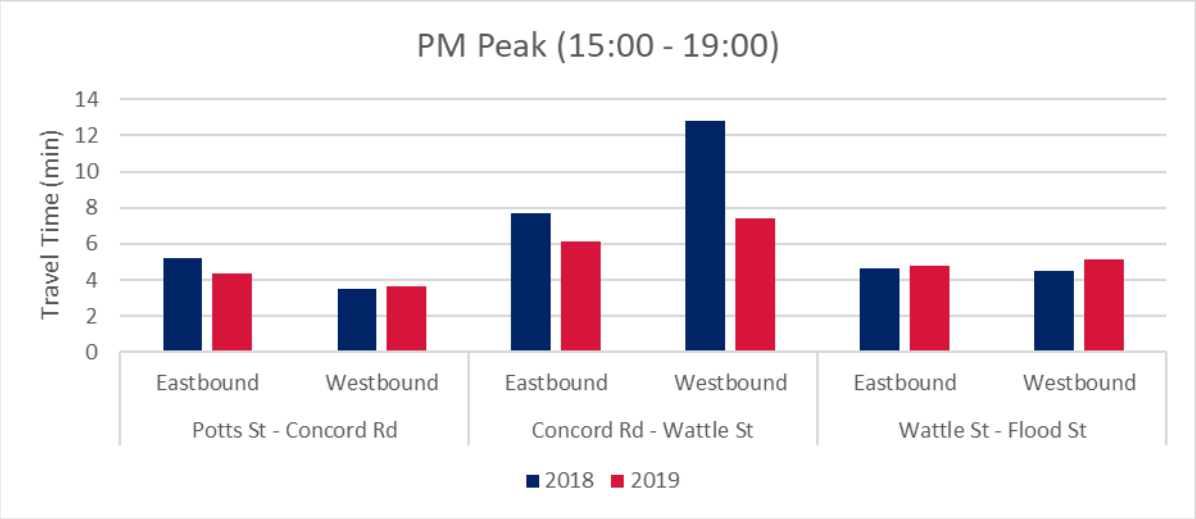


Figure C-2 Average travel times on Parramatta Road (PM peak)



Appendix D – Bus performance analysis: 2018 and 2019 data

Parramatta Road – Eastbound

Figure D-1 presents a comparison of the pre-opening and post-opening bus travel times in the eastbound direction along Parramatta Road during the AM peak period (6-10am).

Figure D-1 Comparison of eastbound bus travel times on Parramatta Road (AM peak)

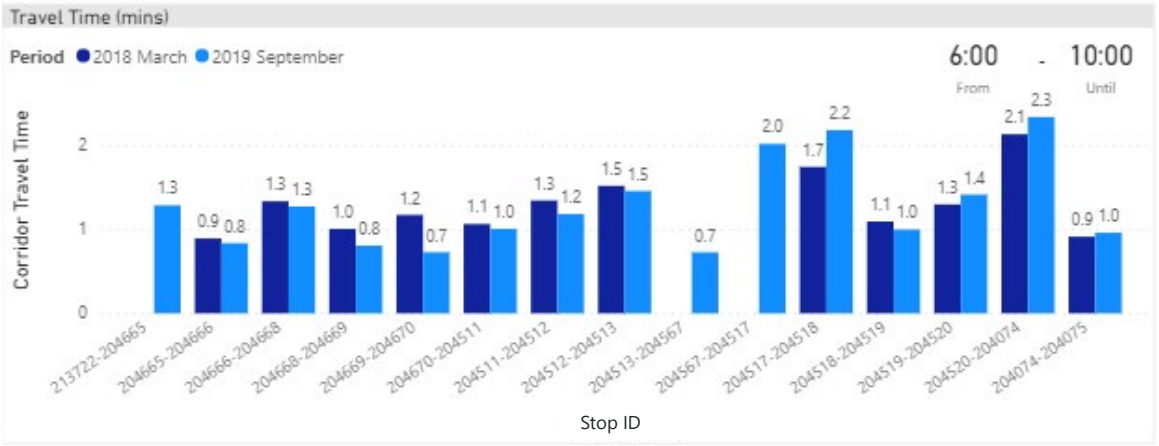
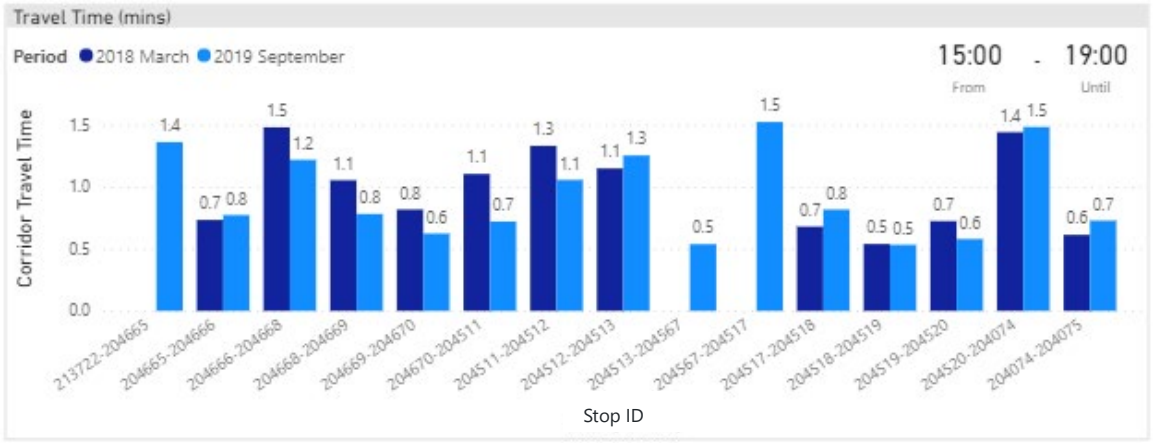


Figure D-2 presents a comparison of the pre-opening and post-opening bus travel times in the eastbound direction along Parramatta Road during the PM peak (3-7pm).

Figure D-2 Comparison of eastbound bus travel times on Parramatta Road (PM peak)



Parramatta Road – Westbound

Figure D-3 presents a comparison of the pre-opening and post-opening bus travel times in the westbound direction along Parramatta Road during the AM peak (6-10am).

Figure D-3 Comparison of westbound bus travel times on Parramatta Road (AM peak)

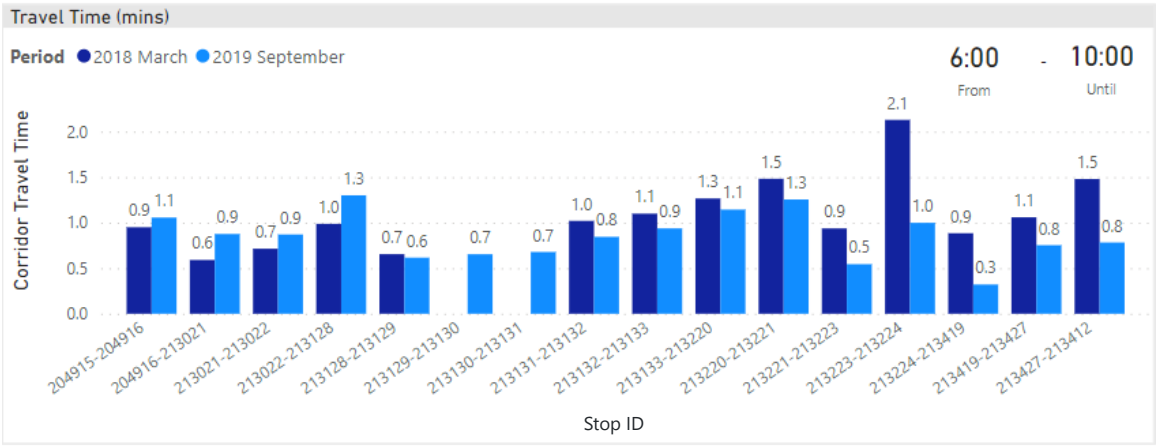
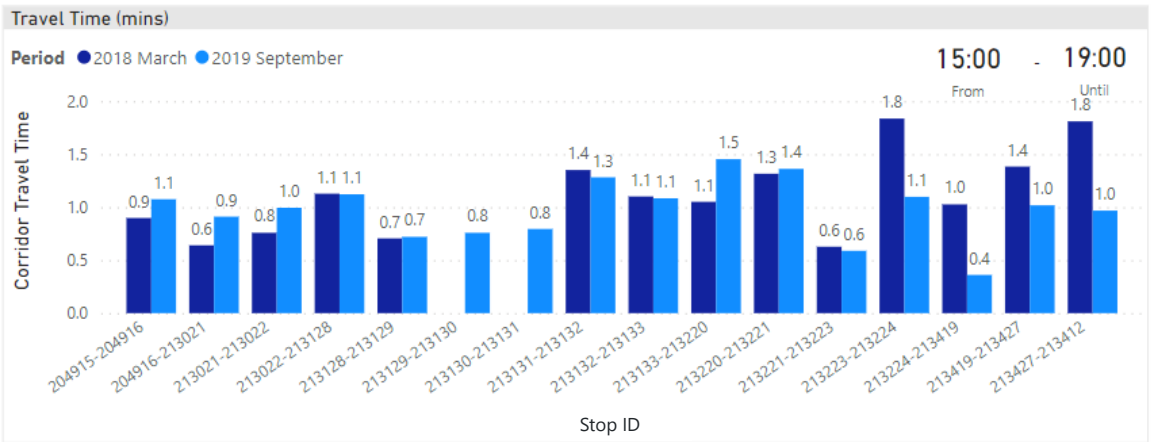


Figure D-4 presents a comparison of the pre-opening and post-opening bus travel times in the westbound direction along Parramatta Road during the PM peak (3-7pm).

Figure D-4 Comparison of westbound bus travel times on Parramatta Road (PM peak)



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