Appendix D

Traffic and Transport Assessment

Prepared for
Transport for NSW
ABN: 18 804 239 602

Traffic and Transport Assessment

Technical Report

19-Jul-2022
Westlink M7 Widening

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Traffic and Transport Assessment

Client: Transport for NSW

ABN: 18 804 239 602

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Glossary and abbreviations

Key terms	Description
95th percentile	95th percentile is a number that is greater than 95 per cent of the numbers in a given set. This often used to describe maximum expected queue lengths at an intersection.
Approved project	The Westlink M7 (previously referred to as Western Sydney Orbital) is an existing 39-kilometre-long toll road connecting the M5 South Western Motorway at Prestons, The Hills M2 Motorway at Baulkham Hills and the M4 Western Motorway at Eastern Creek.
Capacity	The nominal maximum number of vehicles which has a reasonable expectation of passing over a given section of a lane or roadway in one direction during a given time period under prevailing roadway conditions.
Conditions of Approval (CoA)	These are the current conditions that apply to the approved project. Found here: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSI-663-MOD-5%2120190718T013836.398%20GMT
Construction footprint	The area required for construction of the proposed modification.
Corridor	A substantial segment of the transport network, in which parallel, possibly competing, transport routes (and modes, where appropriate) operate between two locations.
Drainage	Natural or artificial means for the interception and removal of surface or subsurface water.
Entry ramp	A ramp by which one enters a limited-access highway/tunnel.
Exit ramp	A ramp by which one exits a limited-access highway/tunnel.
Heavy vehicles	A heavy vehicle is classified as a Class 3 vehicle (a two axle truck) or larger, in accordance with the Austroads Vehicle Classification System.
Impact	Influence or effect exerted by a project or other activity on the natural, built and community environment.
Lane	A portion of the carriageway allotted for the use of a single line of vehicles.
Mid-block	Section of road between two intersections.
Mitigation	Actions or measures to avoid or reduce the impacts of a project.
Modification	Proposed changes to be made to the conditions of approval for the approved project.
Modification application	This report forms part of an application seeking to modify an SSI development consent under section 5.25 of the EP&A Act.
Operational footprint	The area required for operation of the proposed modification.
Proposed modification	The addition of a trafficable lane in both directions within the existing median of the Westlink M7, from about 140 metres south of the Kurrajong Road overhead bridge at Prestons (southern end) to the Westlink M7 Bridge at Richmond Road in Oakhurst/Glendenning (northern end), excluding widening through the M4/Westlink M7 Light Horse Interchange.
Transport	The proponent seeking approval for the modification.
Westlink M7	M7 Motorway or formerly known as Western Sydney Orbital.
WSO Co	WSO Co Pty Limited

Acronym	Definition
100MVKT	100 million vehicle kilometres travelled
CBD	Central Business District
CEMP	Construction Environmental Management Plan - A site specific plan developed for the construction phase to ensure that all contractors and sub-contractors comply with the environmental conditions of approval and that the environmental risks are properly managed.
CSI	Crash Severity Index
DPE	NSW Department of Planning and Environment
EDC	Elizabeth Drive Connections
EIS	Environmental Impact Statement
EMS	Environmental management system
EP&A Act	*Environmental Planning and Assessment Act 1979* (NSW). Provides the legislative framework for land use planning and development assessment in NSW
EP&A Regulation	*Environmental Planning and Assessment Regulation 2021* (NSW)
EPA	NSW Environment Protection Authority
EPBC Act	*Environment Protection and Biodiversity Act 1999* (Commonwealth)
EPL	Environment protection licence
FSI	Fatal and serious injury
GMA	Greater Metropolitan Area
GSC	Greater Sydney Commission
iRAP	international Road Assessment Programme
km	kilometres
km/h	kilometres per hour
LEP	Local Environmental Plan
LGA	Local Government Area
LoS	Level of service. A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
m	metres
MUARC	Monash University Accident Research Centre
PCU	Passenger Car Unit
PCU/km/ln	passenger car units per kilometre per lane
SCATS	Sydney Coordinated Adaptive Traffic System
SEARs	Secretary's Environmental Assessment Requirements
SRS	Star Rating Score
TCS	Traffic Control Signal
Transport	Transport for NSW
TUSTM	Transurban's Strategic Traffic Model
vehicles/km	Vehicles per kilometre

Acronym	Definition
VHT	Vehicle hours travelled
VKT	Vehicle kilometres travelled
WSO Co	WSO Co Pty Limited

Executive Summary

The Westlink M7 is an existing 39-kilometre-long toll road connecting the M5 Motorway at Prestons, The Hills M2 Motorway at Baulkham Hills and the M4 Motorway at Eastern Creek. Transport for NSW (Transport) is seeking a modification to the approved project to widen part of the Westlink M7 into the existing median. This is proposed in response to recent and forecast traffic growth, to improve motorway efficiency, travel time performance and safety. If approved, it is expected to open in 2026.

Strategic context

The purpose of this report is to identify and assess the traffic and transport issues related to the proposed modification to the approval of the Westlink M7, which would enable the following key changes (referred to as 'the proposed modification'):

- Widening into the existing median of the Westlink M7 from about 140 metres south of the Kurrajong Road overhead bridge at Prestons (southern end) to the Westlink M7 at Richmond Road in Oakhurst/Glendenning (northern end), excluding at the M4 Motorway/Westlink M7(Light Horse) Interchange
- Widening the exit from the Westlink M7 northbound onto the M4 Motorway westbound from one lane to two lanes
- Widening of some existing Westlink M7 bridges within the median alignment (centre of bridges)
- Upgrades, additions and modifications to noise walls
- Utility works and upgrades to drainage
- Intelligent Transport System (ITS) installations, adjustments and relocations to cover the new lane configurations
- Use of temporary construction ancillary facilities along and near to the Westlink M7.

Figure 1-1 to Figure 1-5 show the key features of the proposed modification.

The Westlink M7 is approaching the limit of its practical capacity, where unstable flow can result in stop-start peak hour travel conditions. The proposed modification would increase the capacity for part of the Westlink M7, between the M5 South Western Motorway and Richmond Road, with the following key objectives in relation to traffic and transport:

- *Provide additional capacity on the Westlink M7 to meet future traffic growth, reduce congestion and improve connectivity and reliability*
- *Avoid and minimise impacts on the road network, the community and environment during construction*
- *Integrate with the new M12 Motorway, minimising disruption during construction and providing safe and efficient connectivity in the operations phase.*

These objectives are consistent with objectives of NSW's strategic land-use and transport planning strategies, which recognise the need for efficient transport infrastructure to support the planned growth of Sydney's South West and North West growth areas, the Western Sydney International (Nancy-Bird Walton) Airport and associated employment areas, as well as the Western Parkland City, more broadly.

Study area

The study area for this assessment was informed by forecast traffic and transport changes from Transurban's Strategic Traffic Model (TUSTM), that covers the Sydney metropolitan area. The extent of the study area and the areas requiring operational modelling assessment were determined through analysis of strategic model 'difference plots' between the 'with modification' and 'without modification' scenarios. The plots indicate that the anticipated off-motorway 'impact' of the proposed modification would be restricted largely to the immediate interchanges between the M5 South Western Motorway and Richmond Road.

Therefore, the study area for this assessment broadly encompasses an area extending along the Westlink M7 from Camden Valley Way to Richmond Road, as well as the immediate or adjacent intersections and interchanges as shown in Figure 4-1.

Methodology

The assessment of operational traffic and transport impacts of the proposed modification were evaluated using traffic demand data from the TUSTM. The TUSTM was also used to assess the wider network impact of the proposed modification.

Transurban's Operational Model (operational model), a microsimulation model was used to assess the impact of the proposed modification on the operational performance of the Westlink M7 mainline, ramps and interchanges with other motorways. Subsequently network intersection modelling was completed to assess the proposed modifications impact on the immediate road network, specifically the adjacent intersections.

The operational traffic model was developed and calibrated to 2021 traffic and network conditions. 2026 and 2036 were used as the future years in which the 'without modification' and 'with modification' conditions were compared.

Existing traffic and transport environment

The Westlink M7 Motorway provides a key link in Sydney' motorway network linking with the M5 South Western Motorway and M31 Hume Motorway to the south, the M4 Western Motorway and The Hills M2 Motorway. The Westlink M7 is a key freight route that facilitates access to surrounding industrial precinct and therefore up to 25 per cent of total traffic volumes are heavy vehicles.

Traffic volumes vary along the Westlink M7 with the largest volume occurring between The Horsley Drive and Elizabeth Drive with a two-way average daily traffic volume of about 87,000 vehicles per workday.

The Westlink M7 shared path runs parallel and traverses the Westlink M7 providing an off-road facility cyclists and pedestrians. Just under 40 kilometres long, it connects with the surrounding cycleway and footpath network. Cyclists are also permitted to use the Westlink M7 shoulder.

No bus facilities are provided along the Westlink M7, with many bus routes using the surrounding road network including roads that also facilitate access to/from the Westlink M7 ramps.

Hourly average speed recordings along the Westlink M7 were obtained from permanent traffic detectors. The daily speed profiles show significant speed reductions along the Westlink M7 during the AM and PM peak periods at most locations within the study area. For northbound traffic, average travel speeds dropped to nearly 40 kilometres per hour in the AM peak period and 60 kilometres per hour in the PM peak period. Similarly, for southbound traffic, average travel speeds dropped to nearly 60 kilometres per hour in the AM peak period and 30-40 kilometres per hour in the PM peak period.

Based on the existing traffic volume data available from the toll gantries, it is estimated that several segments along the Westlink M7 currently operate at or near capacity, with a level of service E or F (level of service A, representing optimum and free-flow operating conditions, to level of service F, representing breakdown in flow) during the workday AM and PM peak hours.

Most of the study area intersections currently operate with an overall level of service D of better. However, the minor roads at each intersection generally operate with higher delays and lengthy vehicle queuing, this includes the Westlink M7 ramps at several locations. The Great Western Highway/Rooty Hill Road South/Wallgrove Road intersection currently operates at Level of Service E, suggesting that traffic demands currently exceed the available intersection capacity.

An analysis of the severity of crashes on Transurban roads, conducted by the Monash University Accident Research Centre (MUARC) in 2020 showed a crash severity index for the Westlink M7 of 1.28 during the 2017-18 period, compared to an average on similar non-Transurban roads of 1.35. The study also found that the Westlink M7 had a fatal and serious injury (FSI) crash rate of 19 per billion VKT in the period 2017-18, compared to an FSI crash-rate of 104.7 per billion VKT for similar non-Transurban roads. Therefore the crash risk along the Westlink M7 is lower than other similar roads.

Construction impact assessment

An additional 2,000 vehicles per day or 200 vehicles per hour would be expected to use each of the Westlink M7 segments during construction to access the proposed ancillary facility sites located in the median. Most of the Regional and local roads used by construction vehicles to access the adjacent ancillary facilities are expected to carry approximately an additional 50 vehicles per hour. Most of these roads are in industrial areas, and therefore the additional construction related traffic volumes and minor increases to heavy vehicles would be expected to have minimal impact on the operation and safety of these roads. Construction vehicles accessing the construction ancillary facilities via residential streets would be minimised, as practical, to limit adverse impacts on the adjacent residents. The minor increase to traffic volumes on these streets are expected to have minimal impact on the operation and safety of these streets.

Bridge widening works would require temporary lane closures and traffic detours on the Westlink M7. In addition to the Westlink M7 closures, the construction of pier abutment widening structures at bridge widening locations would require temporary lane closures and full road closures. These temporary road closures would typically be for short durations, at workday nights or on weekends to minimise safety risks to workers and disruptions to motorists on the Westlink M7. Temporary road closures would require vehicles to take detours along alternative routes for the duration of the closure. The road closures would be managed by the Contractor and are subject to approval of a Construction Traffic and Access Management Plan, such that impacts to the transport network are minimised as much as practical.

Construction of the proposed modification would require temporary closures of sections of the existing Westlink M7 shared path. The identified detours would result in increased travel distances ranging between 200 meters and 1.3 kilometres for each closure. If multiple shared path closures occur simultaneously, travel distances would increase accordingly. A pedestrian and cyclist management plan will be prepared by the construction contractor in consultation with stakeholders, councils and Transport and implemented to manage potential impacts during construction.

It is planned that the proposed widening of the Westlink M7 would be undertaken concurrently with the new interchange for the M12 Motorway by a single design and construct contractor. Therefore, the construction works would be coordinated and cumulative traffic and transport impacts minimised as much as practical.

Operational impact assessment

Based on the operational modelling, mid-block traffic volumes along the Westlink M7 are forecast to increase from approximately 80,000 vehicles per workday in 2021 to approximately 90,000 vehicles per workday in 2026 (average across the corridor) and 100,000 vehicles per workday in 2036. With the proposed modification, an additional 2,000 to 8,500 vehicles would be accommodated along the Westlink M7 per direction in 2026 and an additional 3,000 to 14,500 vehicles per workday in each direction 2036.

The forecast traffic volumes along the Westlink M7 would increase as a result of the proposed modification. However, the Westlink M7 performance within the study area would improve, congestion would improve, vehicle speeds would generally increase, average travel times would decrease and the segment densities would also decrease.

However, the increased traffic volumes along the Westlink M7 due to the proposed modification could result in slower vehicle speeds at the northern and southern extents outside the proposed widening areas. Potential impacts to vehicle speeds beyond the proposed modification extents should be investigated by Transport during detailed design.
Most of the assessed intersections would continue to operate with the same level of service in both 2026 and 2036 with and without the proposed modification. However, there are some exceptions. The Leve of Service at seven intersections would decline from a satisfactory level (Level of Service A to D) to an unsatisfactory level (Level of Service E or F) due to the proposed modification. Five of these seven intersections would operate unsatisfactorily in either the AM or PM peak hour in 2026 and/or 2036 without the proposed modification due to population and employment growth. Therefore, the widening would bring forward the need to consider solutions for these areas.

No operational changes are proposed to the location and overall alignment of the Westlink M7 shared path as part of the proposed modification. However, at the M4 Western Motorway interchange, the proposed modification would create a dual lane exit to the M4 Western Motorway on the northbound carriageway. Therefore, cyclists would no longer be able to safely cross the northbound exit ramp to the M4 Western Motorway (due to the two lane arrangement). To address potential safety risks to cyclists, the proposed modification would introduce restrictions which would prohibit cycling on the Westlink M7 mainline between the M5 South Western Motorway and Richmond Road during construction and operation. Cyclists would need to use the existing shared path.

Current transport strategies do not identify the need for the central median of the Westlink M7 as a public transport corridor. Alleviating capacity constraints on Greater Sydney's road network and the public transport system through the provision of public transport infrastructure has moved away from the Westlink M7. Instead, increasing the road capacity of this key north-south motorway, in conjunction with the development of the network of public transport infrastructure projects in Greater Sydney and Western Sydney in particular, would support the objectives of the strategic metropolitan and transport documents shaping Sydney's growth.

Mitigation and management measures

The following mitigation measures would be required to manage the construction traffic and transport impacts of the proposed modification:

- A Construction Traffic and Access Management Plan (CTAMP) will be prepared as part of the Construction Environmental Management Plan (CEMP) in consultation with Transport, relevant local councils and in accordance with relevant guidelines
- Temporary changes to bus routes and bus stops will be implemented in consultation with Transport, local councils and bus operators.
- Movements of haulage vehicles will be planned to minimise movements on the road network during the AM and PM peak periods where practicable.
- An active transport strategy will be developed to document planned shared path detours and recommend upgrades to the surrounding shared path/footpath network to safely accommodate shared path users.

The proposed modification would generally present significant benefits to the users of the Westlink M7. However, the following mitigation and management measures were identified to address the notable operational traffic and transport impacts of the proposed modification as well as general traffic demand increases expected due to population and employment growth in the region:

- Potential impacts to vehicle speeds outside the proposed modification extents should be investigated
- The proposed modification will bring forward the need to consider solutions for intersections that exceed available capacity to cater for forecast traffic volumes associated with population and employment growth and to some degree the proposed modification.

1.0 Introduction

The Westlink M7 is an existing 39-kilometre-long toll road connecting the M5 South Western Motorway (M5 Motorway) at Prestons, The Hills M2 Motorway at Baulkham Hills and the M4 Western Motorway at Eastern Creek ('the approved project'). Transport for NSW (Transport) is seeking a modification to the approved project to widen part of the Westlink M7 (referred to as 'the proposed modification') in response to current and forecast traffic growth, and to improve motorway efficiency, travel time performance and safety.

This technical assessment has been prepared to support the application for this modification.

1.1 Overview of proposed modification

Transport, as the proponent for the proposed modification, is requesting that the Minister for Planning and Homes modify the planning approval for the Western Sydney Orbital (now referred to as Westlink M7) under section 5.25 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The approved project (DPE reference number SSI-663) was for the construction and operation of the four-traffic lane motorway, with a wide central median which could be used to provide additional traffic lanes or public transport facilities in the future. The proposed modification would provide an additional trafficable lane in both directions within the existing median of the Westlink M7. The motorway would be widened from about 140 metres south of the Kurrajong Road bridge at Prestons (southern end) to the intersection with Richmond Road in Oakhurst/Glendenning (northern end), excluding at the M4 Motorway/Westlink M7 Motorway (Light Horse) interchange. The key components for the proposed modification are shown in Figure 1-1 to Figure 1-5.

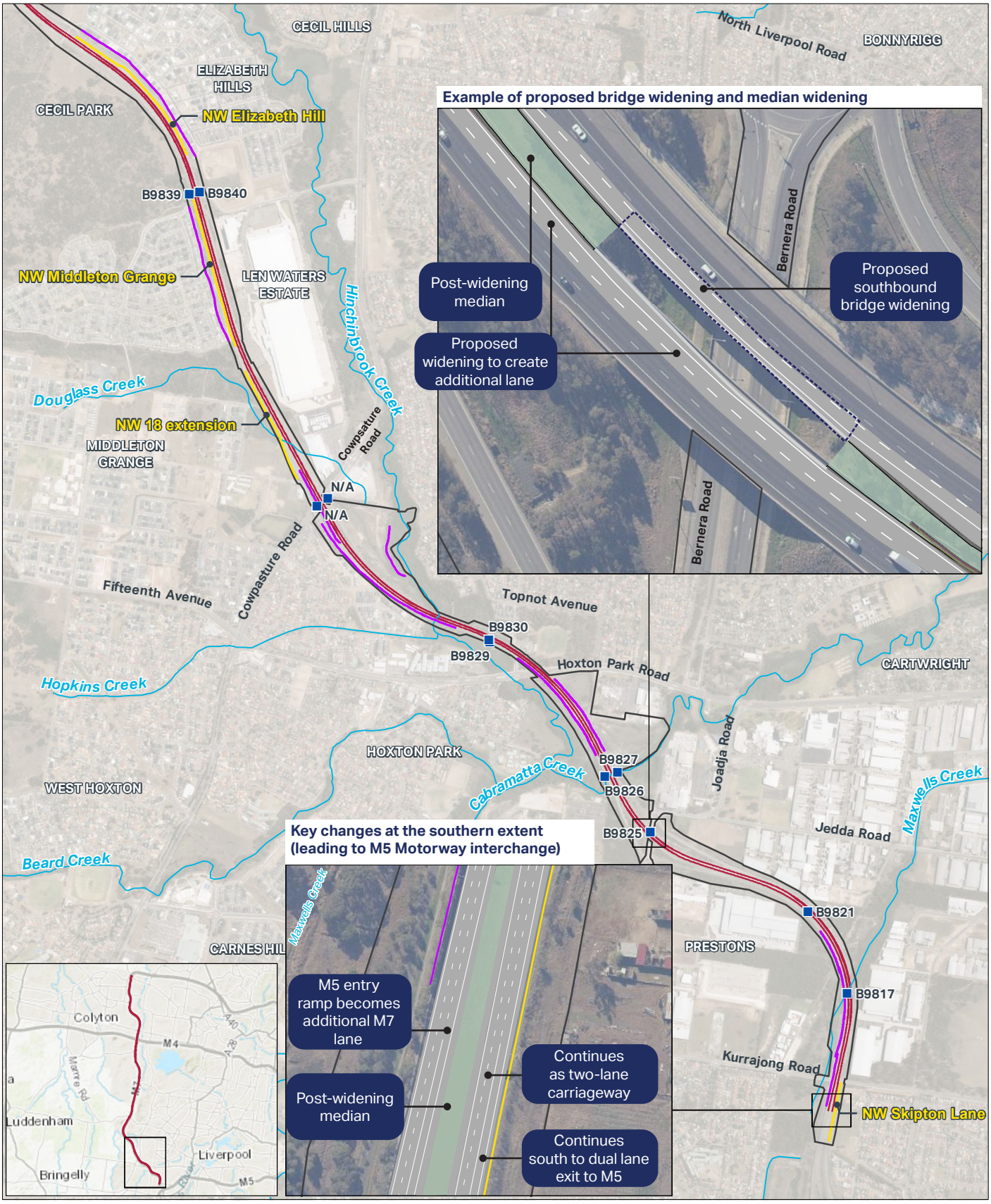

FIGURE 1-1: KEY FEATURES

0 400 800 m

Legend

- Proposed widening
- Operational footprint
- Watercourse
- Existing noise wall
- New noise wall (NW####)
- Transport for NSW bridge number B9#### proposed to be widened

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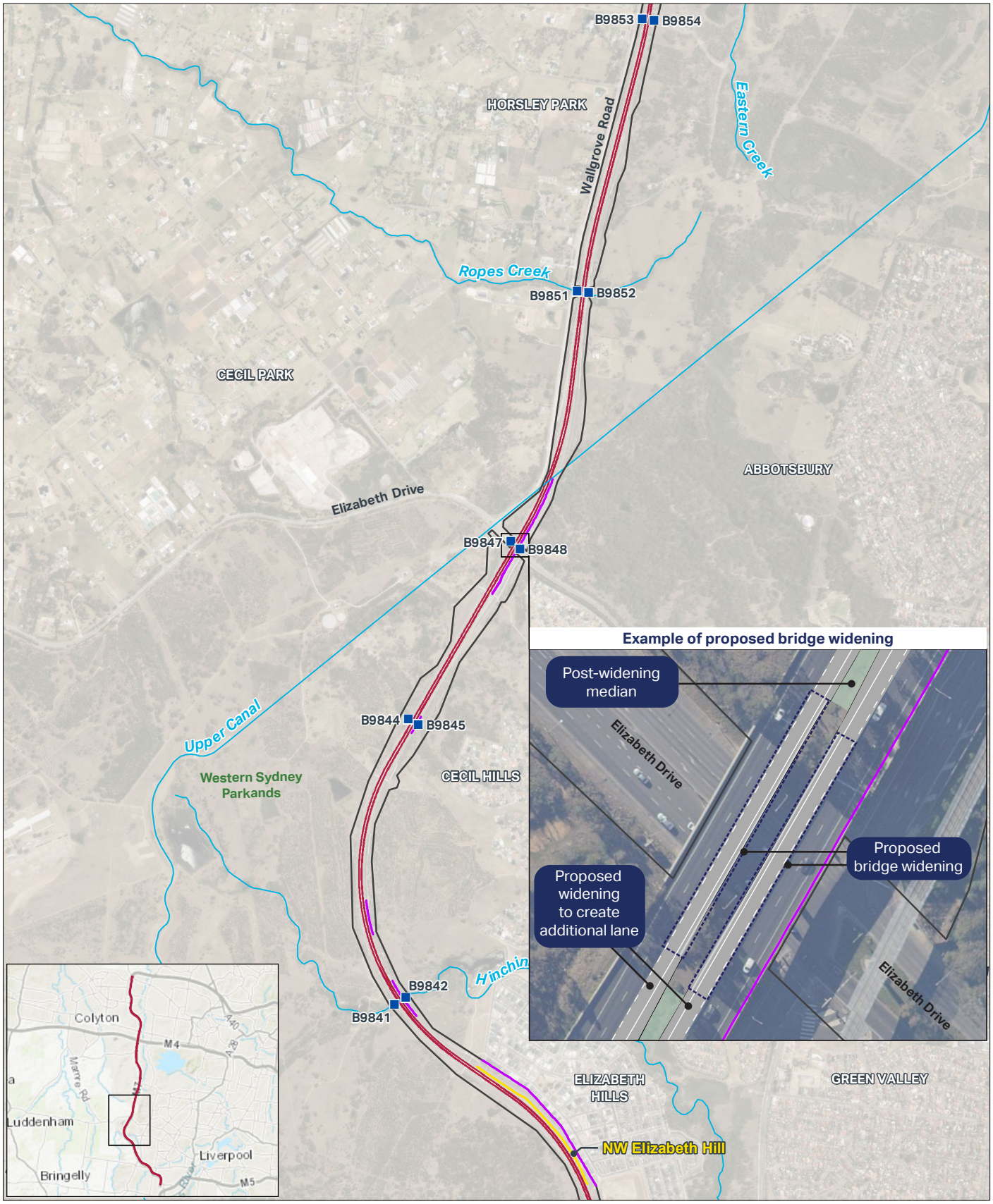

FIGURE 1-2: KEY FEATURES

0 400 800 m

Legend

- Proposed widening
- Operational footprint
- Watercourse
- Existing noise wall
- New noise wall (NW####)
- Transport for NSW bridge number B9#### proposed to be widened

FIGURE 1-3: KEY FEATURES

N 0 400 800 m

AECOM

Legend

- Proposed widening
- Operational footprint
- Watercourse
- Existing noise wall
- Trransport for NSW bridge number B9#### proposed to be widened

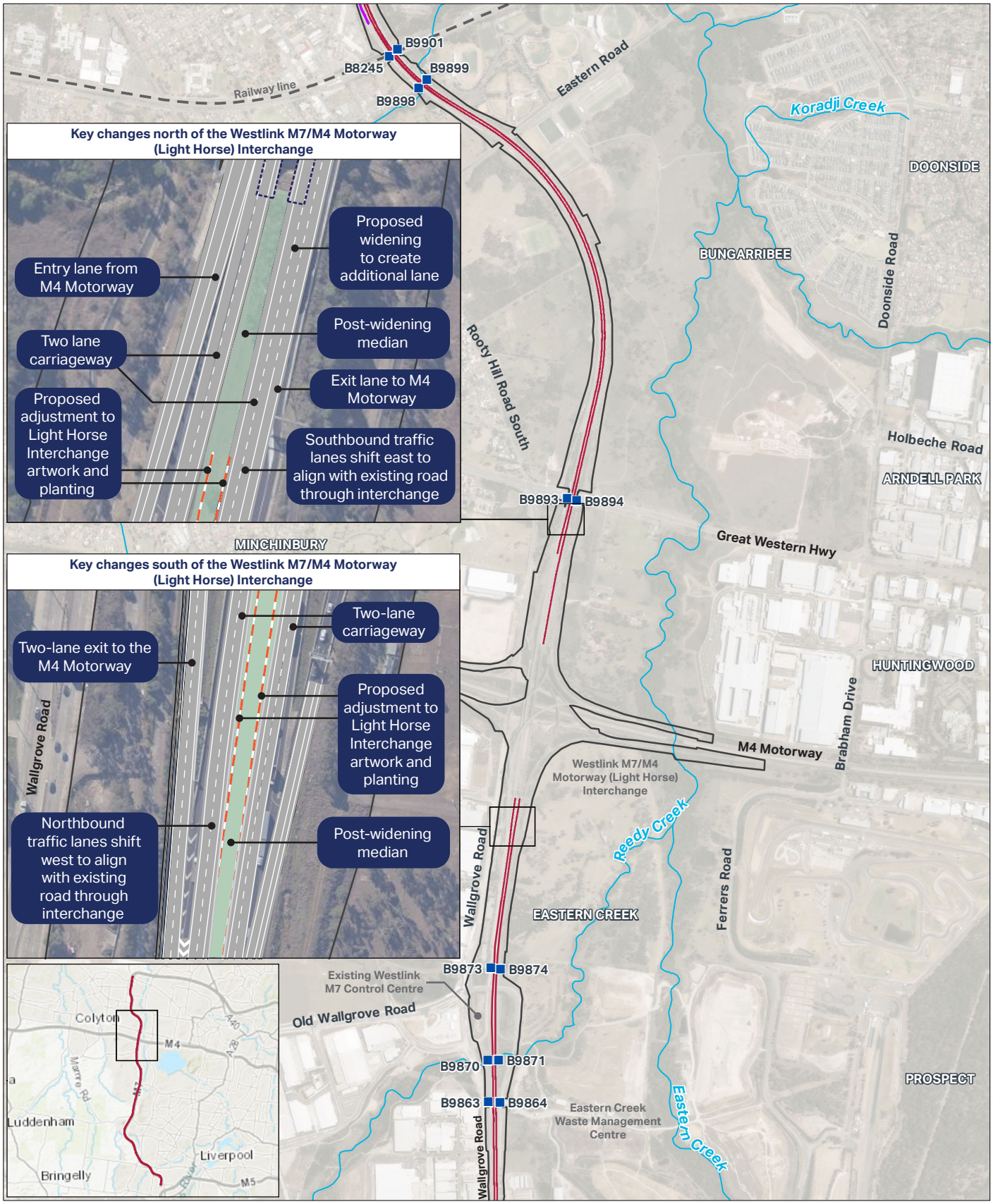

FIGURE 1-4: KEY FEATURES

N 0 400 800 m

AECOM

Legend

- Proposed widening
- Operational footprint
- Watercourse
- Existing noise wall
- Artwork potentially impacted by proposed modification
- Transport for NSW bridge number B9#### proposed to be widened

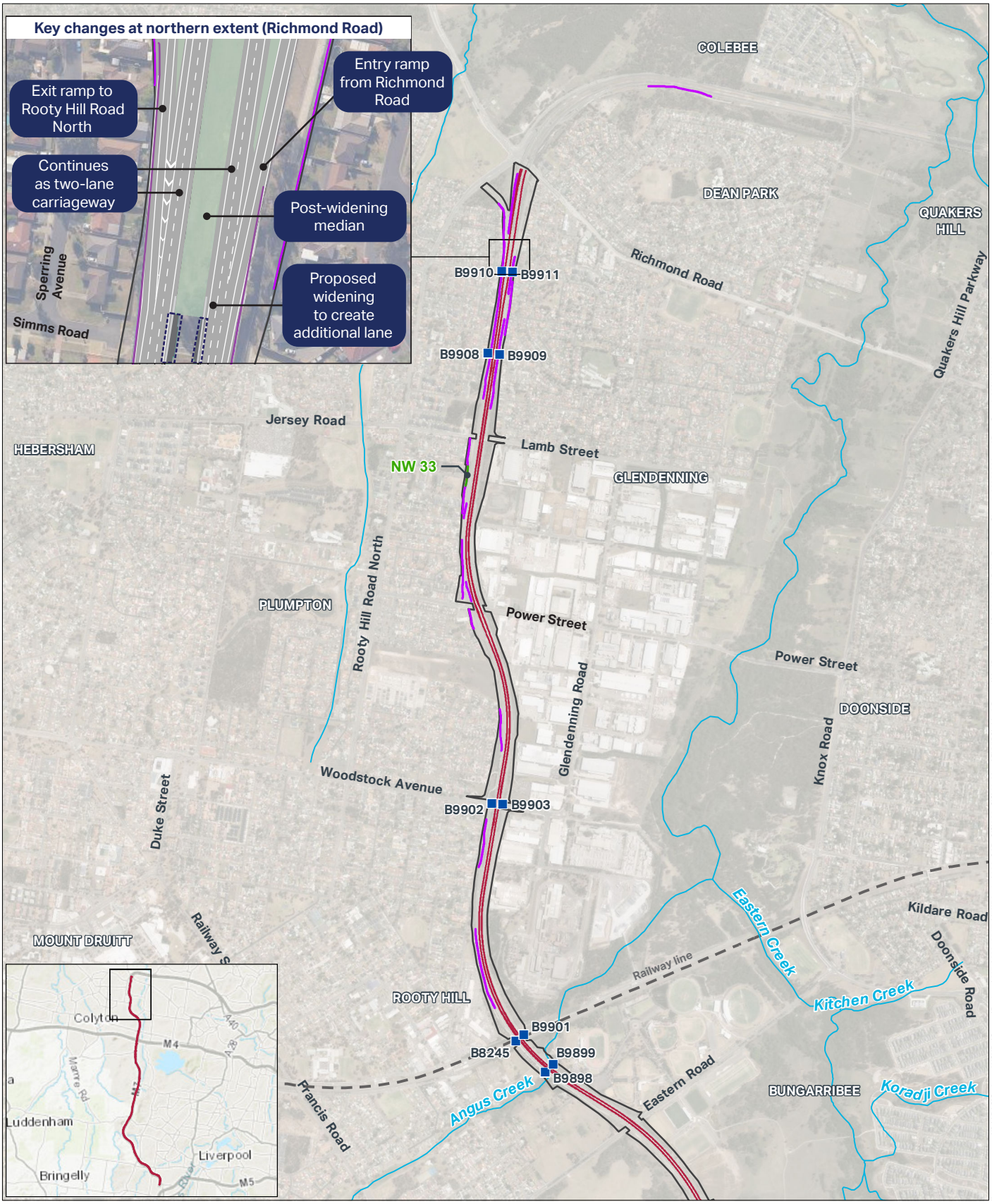

FIGURE 1-5: KEY FEATURES

Legend

- Proposed widening
- Operational footprint
- Watercourse
- Existing noise wall
- Existing noise wall height increase (NW####)
- Transport for NSW bridge number B9#### proposed to be widened

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1.2 Purpose of this technical report

This technical report provides an operational traffic and transport assessment of the proposed modification and has been prepared to inform the Modification Report. The aim of the Modification Report is to address the relevant Secretary's Environmental Assessment Requirements (SEARs) for the modification, provided by the NSW Department of Planning and Environment (DPE) (Application number SSI 663).

1.2.1 Secretary's Environmental Assessment Requirements

The relevant traffic and transport SEARs are presented in Table 1-1.

Table 1-1 SEARs – traffic and transport

Desired Performance Outcome	SEARs	Where addressed within this report
1. Transport, Traffic and Movement Network connectivity, safety, and efficiency of the transport system in the vicinity of the project are managed to minimise impacts. The safety of transport system customers is maintained. Impacts on network capacity and the level of service are effectively managed. Works are compatible with existing infrastructure and future transport corridors. The project is well-designed and enhances the environment where it is located, including improved accessibility and connectivity for communities and public spaces. The project contributes to greener places through the	1. Construction transport and traffic (vehicle, pedestrian, and cyclists) impacts, including, but not necessarily limited to:	
	(a) a considered approach to route identification and scheduling of construction vehicle movements;	Section 6.1.3.3
	(b) the indicative number, frequency and size of construction related vehicles (passenger, commercial and heavy vehicles, including spoil management movements), including the indicative number and route of heavy vehicle movements outside of standard construction hours;	Section 6.1.3.3
	(c) construction worker parking, including the location and capacity of proposed parking facilities;	Section 6.1.3.2
	(d) the nature of existing traffic (types and number of movements) on construction access routes (including consideration of peak traffic times and sensitive road users, pedestrian and cyclist activities and on-street parking arrangements);	Section 6.3.1
	(e) access constraints and impacts on public transport (infrastructure and services), pedestrians and cyclists;	Section 6.4 and Section 6.5
	(f) the need to close, divert or otherwise reconfigure elements of the road, pedestrian and cycle network associated with construction of the project and the duration of these changes; and	Section 6.3.3 and Section 6.3.4
	(g) impacts to on-street parking, including to residents and businesses.	Section 6.6 and Section 6.7

Desired Performance Outcome	SEARs	Where addressed within this report
enhancement and provision of green infrastructure.	2. Operational transport related impacts of the project, including: (a) forecast travel demand and traffic volumes for the project and the surrounding road, cycle and public transport network;	Section 7.1.1
	(b) travel time analysis;	Section 7.1.3
	(c) performance of key interchanges and intersections by undertaking a level of service analysis at key locations;	Section 7.1.5
	(d) wider transport interactions (local and regional roads, cycling, public and freight transport);	Section 7.3, Section 7.4 and Section 7.5
	(e) induced traffic and operational implications for public transport (particularly with respect to strategic bus corridors and bus routes) and consideration of opportunities to improve public transport; and	Section 7.4
	(f) impacts on cyclists and pedestrian access and safety; and	Section 7.3 and Section 7.5
	(g) an explanation of the scope of the modelled area, including justification of the nominated boundaries.	Section 4.3
	Note: The Traffic assessment must include consideration of changes to traffic volumes that would occur as a result of current and future strategic land use changes and road projects/upgrades within the road catchment which feeds into the project alignment.	Section 7.1.1
	3. Identify Movement (accessibility and connectivity) principles, outcomes and actions for the project that facilitate improvements to movement, including in relation to: (a) how the project considers the relationship between movement and place [including any issues and opportunities identified];	Section 7.3
	(b) how the project contributes to more walking, cycling and public transport use including journey time comparisons for public and active transport for general traffic journey time improvements made, and the matters set out in the Healthy Urban Development Checklist TC1 and TC2 (NSW Health, 2009);	Section 7.3 and Section 7.4

Desired Performance Outcome	SEARs	Where addressed within this report
	(c) how any walking, cycling or public transport improvements provided by the project integrates with wider active and public transport networks; and	Section 7.3 and Section 7.4
	(d) Opportunities for refinements and improvements to the existing pedestrian and cycle routes adjacent to and across the M7 Motorway corridor, including in response to land use changes/development since the opening of the M7 Motorway (including access between key community focal points such as public transport nodes, public open space and community facilities).	Section 7.3 and Section 7.4

1.3 Structure of this technical report

This technical report is structured as follows:

- **Section 1.0 – Introduction**: This section introduces features of the proposed modification
- **Section 2.0 – Proposed modification**: This section provides a description of the proposed modification including construction and operational activities
- **Section 3.0 – Strategic transport planning context:** This section outlines strategic planning considerations for the proposed modification for the Westlink M7
- **Section 4.0 – Method of Assessment:** This section outlines the methods used to assess the proposed modification as it relates to technical area
- **Section 5.0 – Existing environment**: This section describes the existing environment as it relates to technical area
- **Section 6.0 – Construction impact assessment:** This section assesses the impacts of the proposed modification during construction as it relates to technical area
- **Section 7.0 – Operational impact assessment:** This section assesses the impacts of the proposed modification during operation as it relates to technical area
- **Section 8.0 – Mitigation and management measures:** This section documents environmental management measures that are proposed to mitigate the identified impacts of the proposed modification (taking into account the existing conditions of approval for the approved project)
- **Section 9.0 – Conclusion:** This section summarises the construction and operational impacts of the proposed modification as it relates to technical area and briefly describes the recommended mitigation and management measures.

2.0 Proposed modification

The proposed modification would permit the addition of a trafficable lane in both directions within the existing median of the Westlink M7. A full description of the construction activities and operational features are provided in detail in Chapter 4 (Proposed modification) of the Modification Report.

The proposed modification to the approval for the Westlink M7 would include the following key operational components:

- Widening of the motorway into the existing median for a length of about 26 kilometres along the Westlink M7, from about 140 metres south of the Kurrajong Road overhead bridge at Prestons (southern end) to Richmond Road interchange in Oakhurst/Glendenning (northern end), excluding at the M4 Motorway/Westlink M7(Light Horse) Interchange
- Widening the exit from the Westlink M7 northbound onto the M4 Motorway westbound from one lane to two lanes
- Widening of 43 existing northbound and southbound bridges on the Westlink M7 at 23 locations within the centre median, and widening on outside of the bridges on the approach to the M4 Motorway from Old Wallgrove Road
- Upgrades, additions and modifications to noise walls
- Utility works and upgrades to drainage
- Intelligent Transport System (ITS) installations, adjustments and relocations to cover the new lane configurations.

Existing operational features impacted by the proposed modification would include:

- Main road alignment, including median and bridge areas
- Interchanges, tie-ins and entry/exit ramps
- Fill embankments and cuttings
- Culverts and drainage structures
- Water quality control measures, including basins
- Landscaping
- Existing public art and landscaping at the M4 Motorway/Westlink M7(Light Horse) Interchange
- Maintenance access
- Security fencing
- Noise barriers
- Shared path
- Other associated elements required during operation (for example, intelligent transport systems (ITS), utilities and variable message signs (VMS)).

The following activities would be required to facilitate construction of the proposed modification:

- Establishment of several construction ancillary facilities within and adjacent to the Westlink M7 and the M12 Motorway construction area. These would be used for stockpiling, construction support at bridge and median widening locations, project offices and compounds. The precise number and location of construction ancillary facilities would be determined by the construction contractor in accordance with the environmental approval
- Vegetation clearing within the median/widening areas and construction ancillary facilities (including for construction accesses)
- Demolition of existing structures and infrastructure within the construction footprint

- Provision of temporary water management infrastructure including the maintenance of stormwater drainage and establishment of waterway crossings and diversions
- Utility works within Westlink M7 and adjoining roads, particularly around existing motorway bridge substructures
- Earthworks for bridge and road widening within the existing median, and placement and compaction of fill material likely to result in a net amount of cut material
- Bridge widening works including establishment of substructures such as piles, abutments, piers and headstocks and superstructures including beams, girders, decks and barriers
- Pavement widening works within the road median
- Finishing works including asphalting the carriageway surface, line marking, signage, permanent barriers and median infill, adjustments to noise walls, installation of communications infrastructure and landscaping treatments.

Temporary motorway network changes would be required including a reduction in speed limits of the Westlink M7 within the project limits, temporary traffic diversions and lane closures. Two lanes in each direction on the Westlink M7 would be maintained during peak traffic periods. Temporary lane and full local road closures, as well as temporary off-motorway detour routes, would be required to predominantly support the construction of widened bridges. Construction access and haulage routes would primarily utilise the Westlink M7, however would also include roads adjacent to the Westlink M7. The existing Westlink M7 shared path would also be closed in places during construction, however appropriate detours would be provided to maintain full north-south connectivity.

Construction would likely commence in 2023 and continue through to the end of 2025. The construction program for the M12 Motorway, and how this interfaces with the Westlink M7, has been considered in the development of this program. It is proposed to construct the proposed modification at this interchange at the same time as the M12 Motorway project works to minimise disruption and achieve efficiencies during construction.

3.0 Strategic transport planning context

This chapter summarises the strategic planning considerations for the proposed modification for the Westlink M7.

3.1 Background

The Westlink M7 is a strategic movement corridor that forms the western portion of Sydney's motorway ring that provides motorway access from across Greater Sydney to Parramatta, the Sydney Central Business District (CBD) and centres across Greater Sydney. The Westlink M7 is located about 40 kilometres west of the Sydney CBD.

Thirty-nine kilometres in length, the Westlink M7 extends between the M5 Motorway and M31 Hume Motorway (M31 Motorway) in Casula to the south and The Hills M2 Motorway in Baulkham Hills to the north. The Westlink M7 also interchanges with the M4 Western Motorway (M4 Motorway) in Eastern Creek, as shown in Figure 3-1.

Access to/from the Westlink M7 is by grade-separated interchanges with arterial and local roads.

Source: Transport, 2021

Figure 3-1 Sydney's existing motorway network

3.2 Strategic context

Future Transport 2056 sets out the NSW Government's 40-year vision for the transport network and customer mobility in NSW. Sydney's vision was developed to support the Greater Sydney Commission's (GSC) vision for Greater Sydney as a metropolis of three cities, where all communities would have access to jobs and services within 30 minutes.

The Greater Sydney Services and Infrastructure Plan responds to Future Transport 2056 by identifying the policy, service and infrastructure initiatives required to support the metropolis of three cities' vision. The focus of the plan is to enable people and goods to move safety, efficiently and reliably around Greater Sydney.

As a north-south movement corridor in the Western Parkland City, the Westlink M7 forms a critical role as part of the Greater Sydney strategic road network and the Greater Sydney strategic freight network. The Greater Sydney Services and Infrastructure Plan recognises that as the Western Parkland City grows, the strategic road network and freight network will need to support growth in traffic volumes, helping to reduce pressure on local roads and improving the efficiency of the overall transport network. Other relevant planned transport network changes identified in the Plan are discussed in Section 3.3. In addition, relevant planned land-use changes for the Western Parkland City are discussed in Section 3.3.

The proposed modification to the Westlink M7 is expected to have the following traffic and transport benefits:

- *Provide additional capacity on the Westlink M7 to meet future traffic growth, reduce congestion and improve connectivity and reliability*
- *Avoid and minimise impacts on the road network, the community and environment during construction*
- *Integrate with the new M12 Motorway, minimising disruption during construction and providing safe and efficient connectivity in the operations phase.*

The benefits align with the objectives of the abovementioned strategic plans, but also align with several other strategic planning documents prepared by, and on behalf of, state government authorities, as summarised in Figure 3-2. The relevant themes from these key documents include:

- Supporting population and employment growth, particularly in the Western Parkland City
- Improved movement and place outcomes
- Improved road safety outcomes
- More efficient freight movements.

The benefits of the proposed modification are discussed further throughout Section 7.0 of this report.

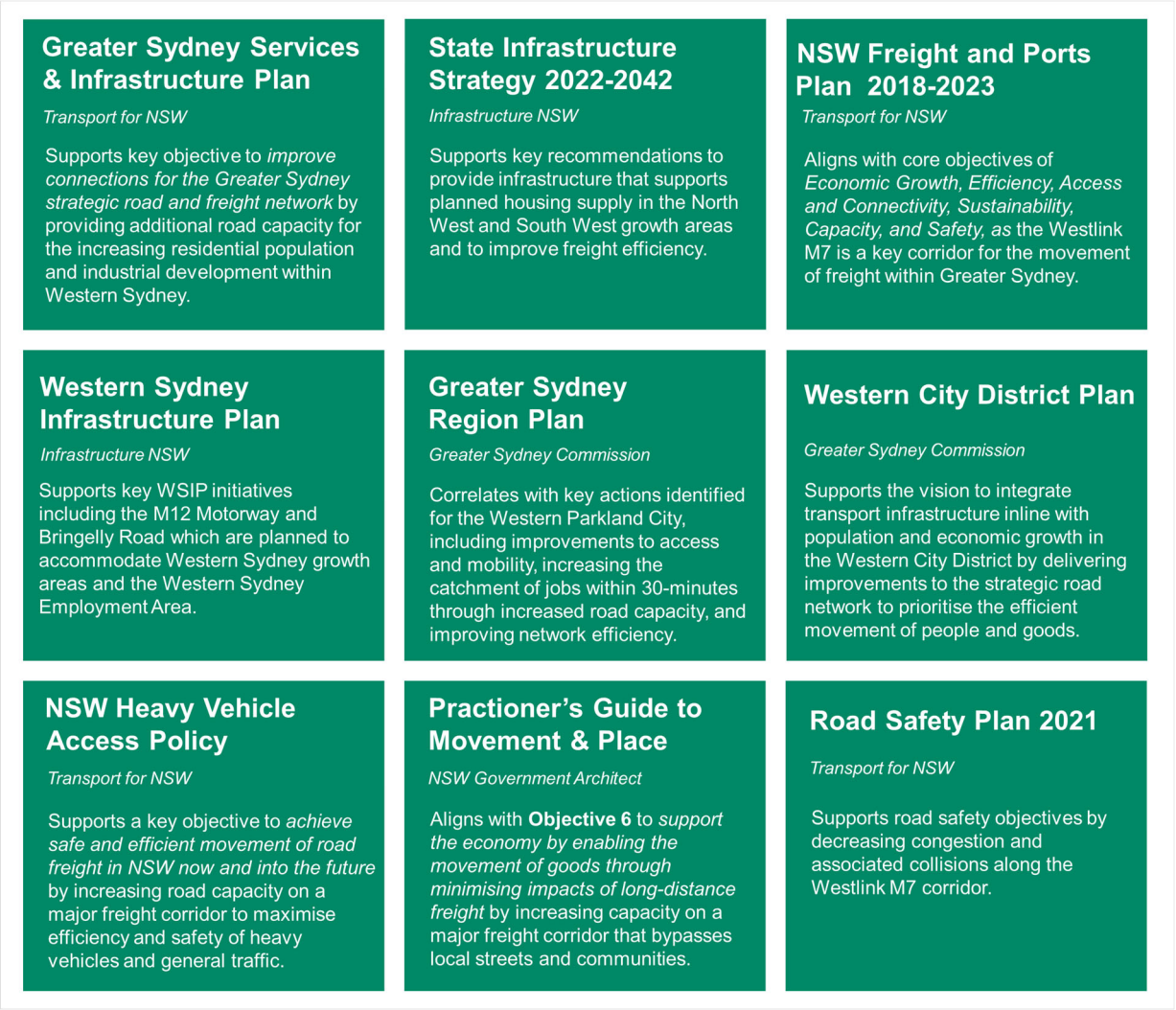
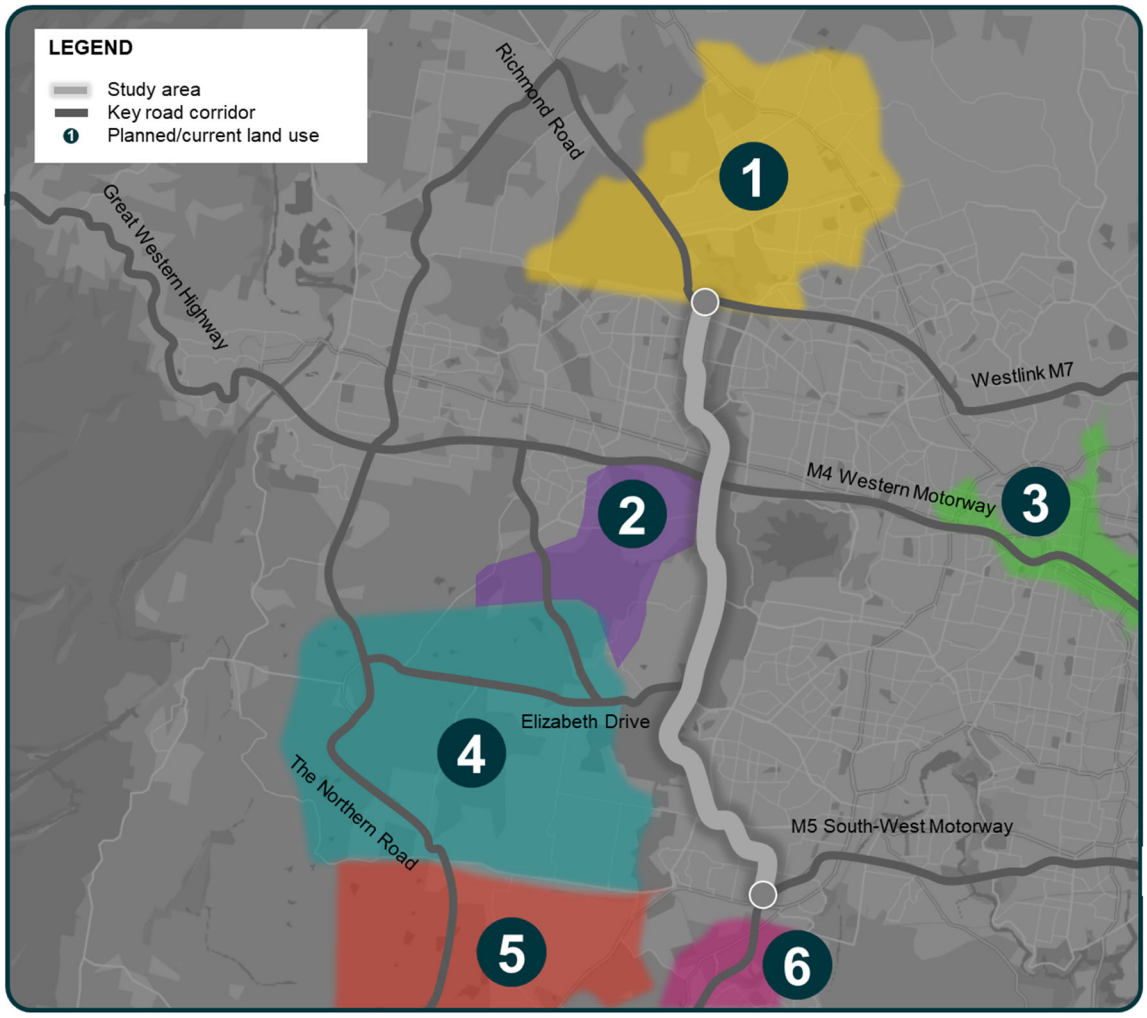


Figure 3-2 The proposed modification's alignment with key strategic planning documents

3.3 Planned land use changes

Figure 3-3 shows the location and briefly describes of key land use changes surrounding the study area (see Section 4.3), as referenced in the strategic plans discussed in Figure 3-2. The Westlink M7 is a key movement corridor linking these key growth areas directly or indirectly via the connecting arterial road network. The proposed modification would help facilitate trips between the population and employment planned for these areas.



1 North West Growth Area
Approximately 10,200 hectares of new release areas in northern western Sydney, approximately 30km from Parramatta. The precinct will facilitate the supply of 33,000 homes by 2026, as well as investigations into new land uses along major infrastructure corridors.

2 Western Sydney Employment Area
The precinct becomes a warehousing industrial hub providing around 17,000 new jobs in Western Sydney, with over 50 hectares of open space, recreation areas, cycle and walking paths, as well as preservation of critical transport corridors for an intermodal terminal.

3 Greater Parramatta Growth Area
The 6000-hectare Greater Parramatta to Olympic Peninsula (GPOP) corridor is fast emerging as the heart of Greater Sydney's Central City, with the area set to grow and change significantly over the next 20 years. There are 26 precincts to be delivered within the area.

4 Western Sydney Aerotropolis
An 11,200 hectare area surrounding the Western Sydney International (Nancy-Bird Walton) Airport and Bradfield City Centre located within the Western Parkland City, supporting up to 71,000 jobs and 24,000 residents by 2056, well connected by new transport corridors.

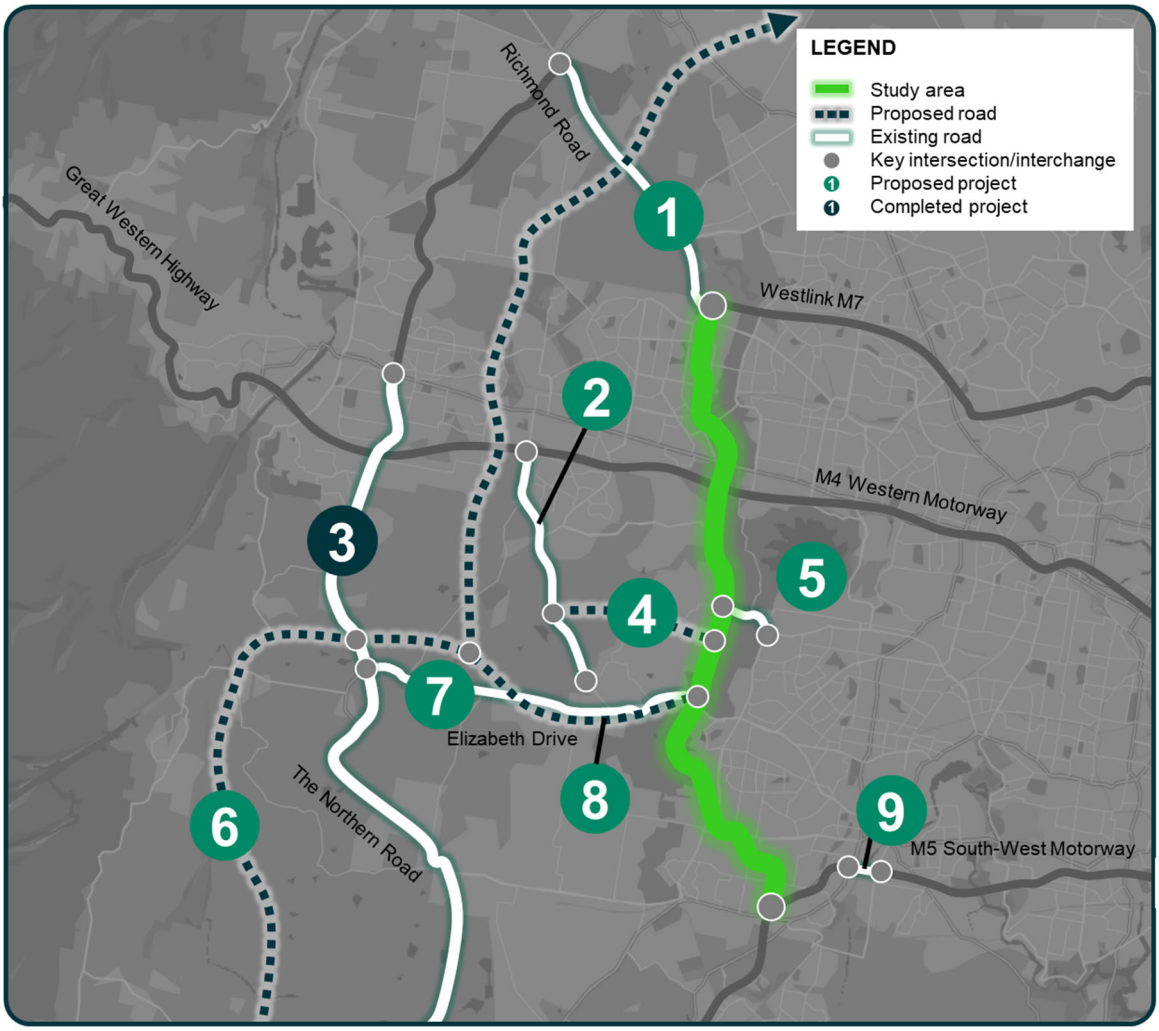
5 South West Growth Area
Approximately 17,000 hectares of greenfield land identified by the NSW Department of Planning and Environment (DPE) for future urban development compriseing16 precincts across the Camden, Campbelltown and Liverpool Local Government Areas.

6 Greater Macarthur Growth Area
Incorporates Glenfield to Macarthur urban renewal precincts and the land release precincts to the south of Campbelltown, including Gilead, North Appin and Appin, providing new homes and local centres, jobs, improved transport connections and open space.

Figure 3-3 Key land use changes surrounding study area

3.4 Adjacent infrastructure projects

Figure 3-4 shows the location and briefly describes relevant current and future infrastructure upgrade projects that would interface with the proposed modification. Some key projects are discussed in more detail in the following sections.



1 Richmond Road upgrade
Planned widening to six lanes between Westlink M7 and Marsden Park, and widening to four lanes north of Elara Boulevard.

2 Mamre Road upgrade
Planned upgrade between M4 Motorway and Kerrs Road, including widening to four lanes and signalisation of intersections. Investigations started in 2020.

3 The Northern Road upgrade
Upgrades to 35km corridor between The Old Northern Road, Narellan and Jamison Road, South Penrith. **Completed November 2021.**

4 Southern Link Road
Potential new road connection under investigation between Mamre Road and Westlink M7 in Horsley Park, to service emerging industrial precincts.

5 The Horsley Drive upgrade
Future upgrade between Westlink M7 and Cowpasture Road, Horsley Park to four lanes with future provision for six lanes inline with industrial growth.

6 Outer Sydney Orbital
Long-term multi-modal transport corridor connecting existing and planned road and rail networks north and south of Sydney.

7 Elizabeth Drive upgrade
Future upgrade between Westlink M7 and The Northern Road including widening and signalised intersections to support planned development.

8 M12 Motorway
Planned motorway connection between Westlink M7 and The Northern Road with direct access to Western Sydney Aerotropolis, to be completed by 2026.

9 M5 Motorway Upgrade
Upgrade to westbound corridor between Moorebank Avenue and Hume Highway to reduce congestion and improve surrounding road network efficiency.

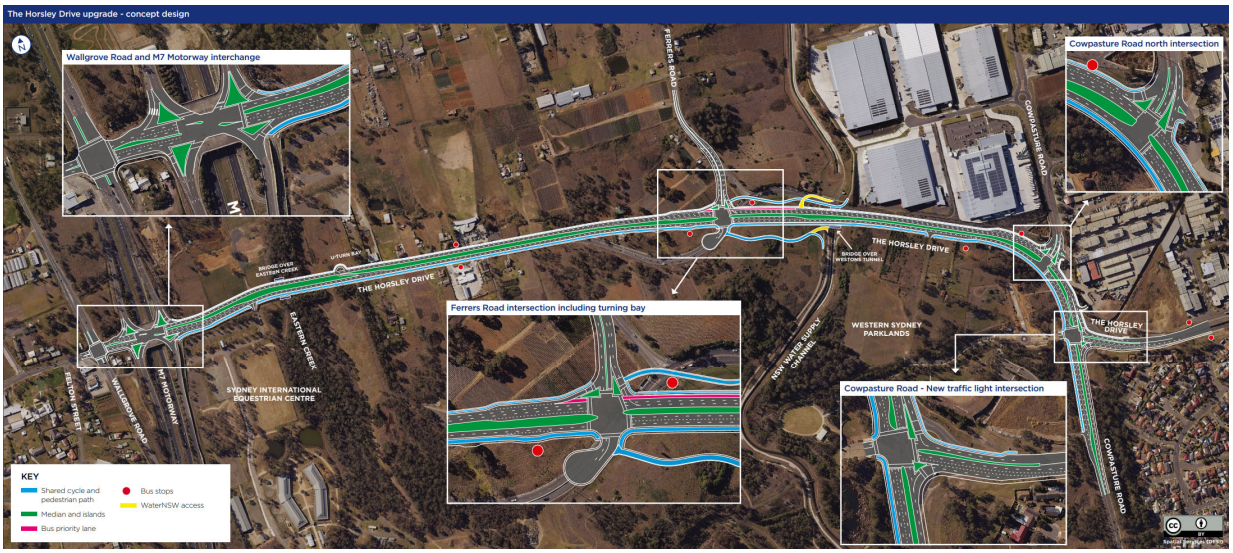
Figure 3-4 Road infrastructure upgrade projects interfacing with the proposed modification

3.4.1 The Horsley Drive upgrade

The NSW Government is planning a future upgrade of The Horsley Drive between the Westlink M7 and Cowpasture Road. The indicative layout is shown in Figure 3-5 and includes the following key features:

- A four lane divided road between the Westlink M7 and Cowpasture Road with a wide central median to allow for six lanes in the future
- An additional westbound right-turn lane on the east approach of the intersection of The Horsley Drive and Wallgrove Road, with potential for future works on the west approach
- An extra eastbound lane from west of Ferrers Road to Cowpasture Road
- Pedestrian and cyclist shared path along The Horsley Drive, which link to the Westlink M7 shared path
- An upgraded intersection at Ferrers Road and Cowpasture Road
- Replacement of the roundabout at The Horsley Drive and Cowpasture Road with a traffic light intersection.

The detailed design is expected to be completed by early 2022 and major construction could begin early 2023.



Source: Roads and Maritime, 2021

Figure 3-5 The Horsley Drive upgrade

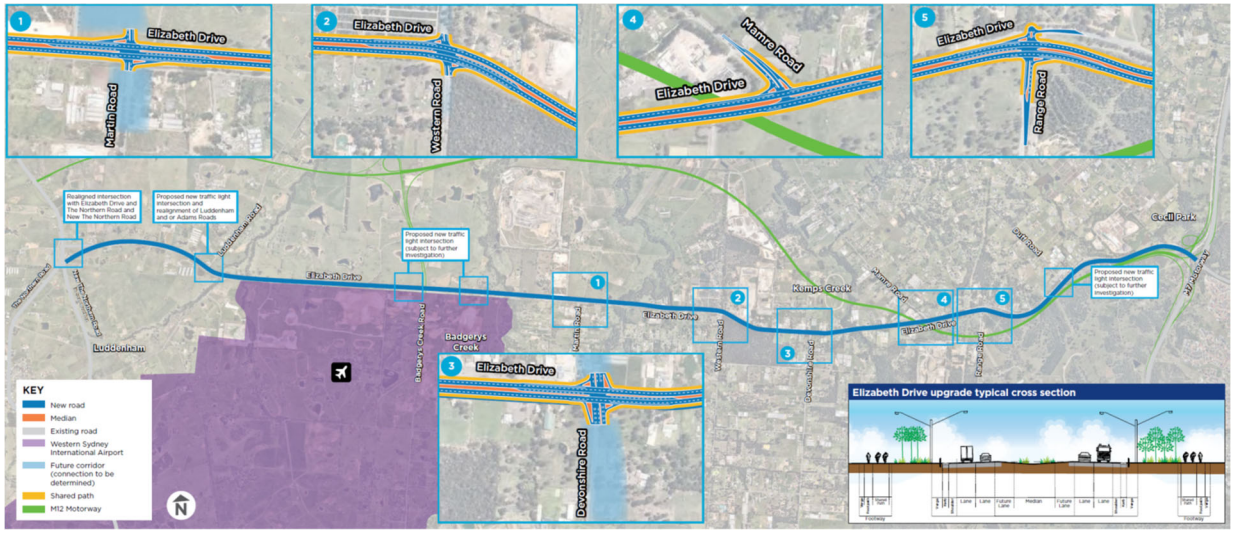
For the purpose of this assessment, The Horsley Drive upgrade has not been considered within the intersection performance assessment but has been considered with respect to cumulative construction impacts.

3.4.2 Elizabeth Drive upgrade

Transport for NSW (Transport) has allocated funding to investigate improvements to Elizabeth Drive between the M7 and The Northern Road with the aim of supporting the planned development in the region. The upgrade of Elizabeth Drive would support the delivery of the Western Sydney International (Nancy-Bird Walton) Airport and Western Parkland City. A community update released in March 2020 indicates the proposed upgrade of Elizabeth Drive as shown in Figure 3-6, which includes the following key features:

- Upgraded four-lane road (with future provision for up to six lanes) with a central median
- New traffic lights at multiple intersections
- Pedestrian, cycling and bus stop infrastructure along Elizabeth Drive
- A direct connection to Western Sydney International Airport and access across the Western Parkland City.

Transport is currently preparing a concept road design and environmental assessment for the proposed Elizabeth Drive project. Construction of the Elizabeth Drive upgrade is expected to be complete by 2030.



Source: Transport, 2020

Figure 3-6 Elizabeth Drive upgrade

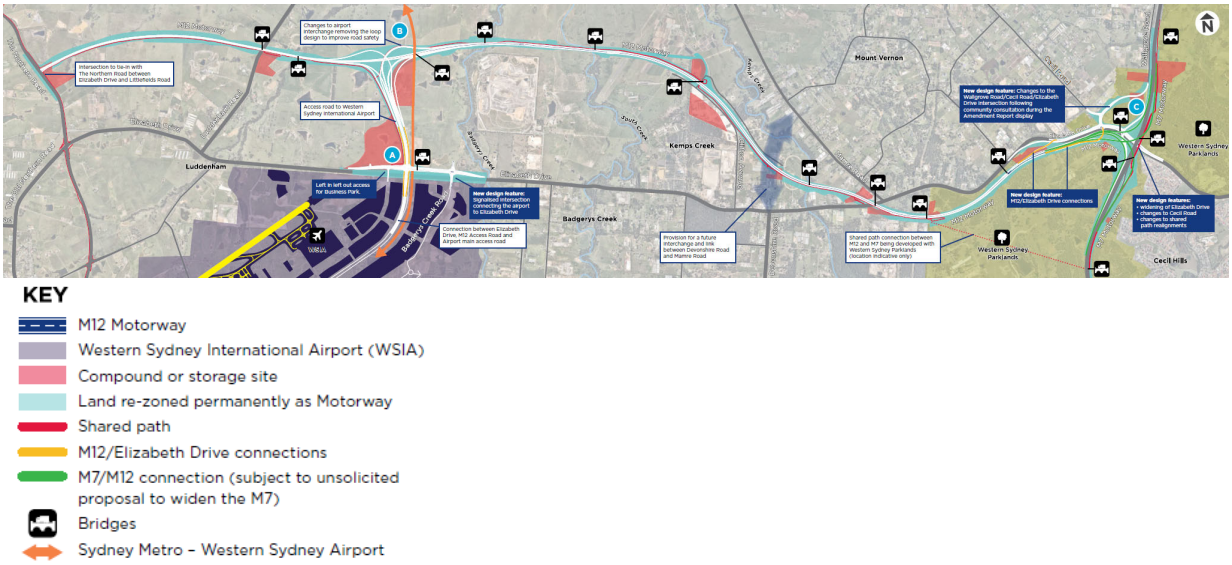
3.4.3 M12 Motorway

The approved M12 Motorway would connect the Westlink M7 to the approved Western Sydney International Airport. The M12 Motorway would extend west from the Westlink M7, at a new interchange near Elizabeth Drive at Cecil Park, as shown in Figure 3-7. The project also includes the Elizabeth Drive Connection (EDC), which would modify the existing intersections with the Westlink M7 at Elizabeth Drive to cater for the M12 Motorway connections with Elizabeth Drive.

This project was granted planning approval in April 2021. Construction is expected to start in early 2022 and be completed before the opening of the Western Sydney International Airport.

For the purpose of this assessment, it is assumed that M12 Motorway, Elizabeth Drive Connections and M7/M12 Motorway interchange would be completed by 2026 and are included in both the with and without modification scenarios, as discussed in Section 4.4.2.

It is planned that the proposed widening of the Westlink M7 would be undertaken concurrently with the new interchange for the M12 Motorway and EDC, by a single design and construct contractor. Therefore, the cumulative construction impacts of these projects are discussed in Section 7.7.



Source: Transport, 2021

Figure 3-7 M12 Motorway indicative alignment

4.0 Method of assessment

This section describes the method of assessment used in this technical assessment report, and outlines the legislation, guidelines and policy that are relevant to the assessment.

4.1 Relevant legislation, guidelines, and policy

The following guidelines were referenced in carrying out this assessment:

- *Motorway Design Guide – Capacity Flow Analysis* (Transport, 2017)
- *Guide to Traffic Management–Part 3 Traffic Studies and Analysis* (Austroads, 2020)
- *Guide to Traffic Generating Developments Version 2.2* (NSW Roads and Traffic Authority, 2002)
- *Cycling Aspects of Austroads Guides* (Austroads, 2014)
- *NSW Bicycle Guidelines v1.2* (RTA, 2005)
- *Planning Guidelines for Walking and Cycling* (DIPNR, 2004)
- *NSW Sustainable Design Guidelines Version 3.0* (Transport, 2013)
- *Traffic Modelling Guidelines* (Transport, 2013a)
- *Highway Capacity Manual* (Transportation Research Board, 2022).

4.2 Method of assessment

4.2.1 Overview

The multi-modal assessment methodology adopted in this technical assessment report includes the following process:

- Assess the existing transport conditions within the study area
- Predict the operational transport impacts of the proposed modification including cumulative impacts using a suite of traffic modelling tools including:
  - Transurban's Strategic Transport Model to provide traffic demands and to understand the wider network impacts of the proposed modification
  - Microsimulation modelling using the Aimsun Next software to assess the impacts on the M7 mainline, ramps and interchanges with other motorways
  - Intersection modelling using the SIDRA Intersection software to assess the operational impacts of the proposed modification on the intersections directly adjacent and/or interfacing with the Westlink M7.
- Assess the operational transport impacts of the proposed modification including cumulative assessment using the following key performance metrics:
  - Network performance criteria
  - Travel times
  - Roadway level of service
  - Intersection level of service
- Identify mitigation measures that manage and minimise the risk of the identified impacts.

4.3 Study area

As discussed in Section 2.0, the widening of the Westlink M7 within the existing median is proposed to occur over a length of about 26 kilometres, from about 140 metres south of the Kurrajong Road overhead bridge at Prestons (southern end) to the Richmond Road interchange in Oakhurst/Glendenning (northern end).

The study area for this assessment was informed by the forecast traffic and transport changes from Transurban's Strategic Traffic Model (TUSTM), that covers the Sydney metropolitan area. The extent of the study area and the areas requiring operational modelling assessment were determined through analysis of strategic model 'difference plots' between the 'with modification' and 'without modification' scenarios. The difference plots indicate that the anticipated off-motorway 'impact' of the proposed modification would likely be restricted largely to the immediate interchanges between the M5 Motorway and Richmond Road.

Therefore, the study area for this assessment broadly encompasses an area extending along the Westlink M7 from Camden Valley Way to Richmond Road, as shown in Figure 4-1. Specifically, the study areas include:

- Westlink M7 between the Camden Valley Way and Richmond Road and all immediate or adjacent intersections within this extent (generally one intersection from the mainline)
- Sir Roden Cutler VC Interchange - the interchange with the M5/M31 Motorways and Camden Valley Way
- M4 Motorway/Westlink M7 Light Horse Interchange.

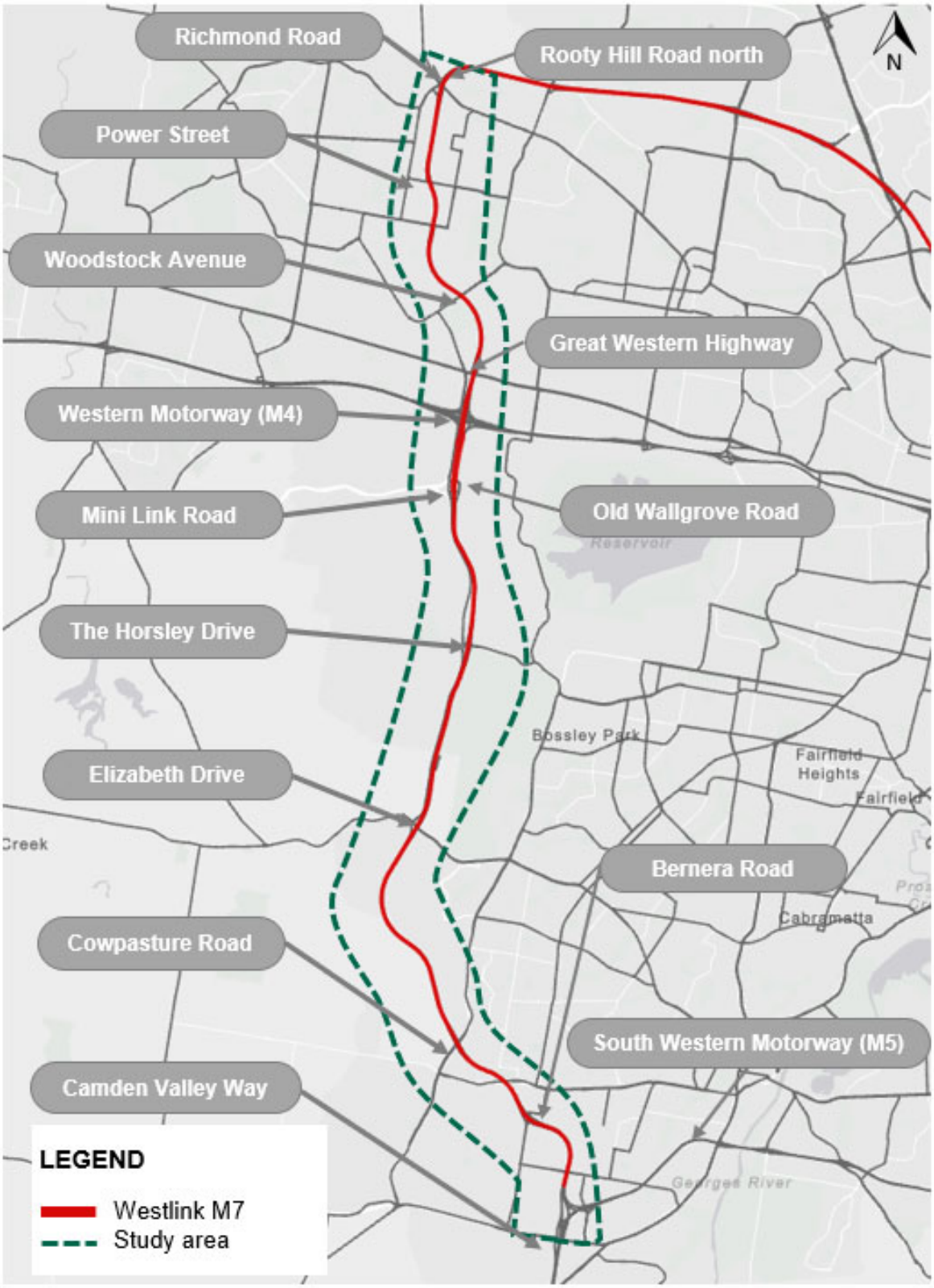


Figure 4-1 Operational traffic and transport technical study area

4.4 Road network performance assessment methodology

4.4.1 Methodology

The road network assessment and modelling methodology adopted for this project included the following three components:

- TUSTM to provide traffic demands and to understand the wider network impacts of the proposed modification
- Microsimulation modelling using the Aimsun Next software to assess the impacts on the M7 mainline, ramps and interchanges with other motorways
- Intersection modelling using the SIDRA Intersection software to assess the operational impacts of the proposed modification on the intersections directly adjacent and/or interfacing with the Westlink M7.

Further detail relating to each of these three modelling streams is included in the subsequent sections of this report.

4.4.2 Assessment scenarios

To assess the impacts of the proposed modification on the surrounding road network, the following scenarios were assessed:

- 2021 base year (model was calibrated to early 2021 traffic conditions and data)
- 2026 without modification – includes a future 2026 road network including the planned M12 Motorway project and EDC, as well as forecast 2026 traffic demands
- 2026 with modification – includes a future 2026 road network including the proposed modification, planned M12 Motorway project and EDC, as well as forecast 2026 traffic demands
- 2036 without modification – includes a future 2036 road network including the planned M12 Motorway project and EDC, as well as forecast 2036 traffic demands
- 2036 with modification – includes a future 2036 road network including the proposed modification, planned M12 Motorway project and EDC, as well as forecast 2036 traffic demands.

The planned road network changes assumed in each of the assessed scenarios are summarised in Table 4-1.

Table 4-1 Summary of road network changes included in each modelling scenario

Planned infrastructure	2021	2026		2036	
	Existing	Without modification	With modification	Without modification	With modification
M12 Motorway	×	✓	✓	✓	✓
Elizabeth Drive Connections	×	✓	✓	✓	✓
Westlink M7/M12 interchange	×	✓	✓	✓	✓
Westlink M7 proposed modification	×	×	✓	×	✓

All other planned road network upgrades as discussed in Section 3.4 have not been included in the traffic modelling assessment documented as part of this assessment due to factors such as project timing and limited data. However, their impacts have been qualitatively considered where relevant.

4.4.3 Strategic model and traffic forecasting methodology

Transurban has an in-house strategic traffic model, TUSTM, that is regularly used to forecast changes in traffic patterns resulting from major network improvements such as the Westlink M7 proposed modification.

The TUSTM was used to forecast traffic volumes along the Westlink M7 with and without the proposed modification. Percentage growth factors were also obtained from the TUSTM and used to develop changes to traffic turning volumes at the study intersections which were then assessed using the SIDRA Intersection modelling software.

TUSTM uses population and employment demand forecasts obtained from the NSW Government which are assigned using appropriate modules from the CUBE suite of transport planning software packages. Vehicle trips are assigned to three income groups where tolls are represented in path finding costs functions as equivalent travel times based on separate values of travel time savings for each income group.

The TUSTM forecasting approach comprises[1]:

- *A strategic highway network model of the Sydney metropolitan area including all major roads within the network*
- *Representation of future years, 2026 and 2036 by including anticipated changes and upgrades to the network*
- *Representation of future demand for travel by both cars and trucks to model their varying travel patterns and behaviours*
- *Explicit modelling of all tolls, existing and future, on the network*
- *Inclusion of multiple user classes within the model to reflect which in turn affects drivers' willingness to pay the toll in order to save travel time*
- *Modelling of future land use which feeds into the production of future demand for travel for cars and trucks using transport and population data from the NSW Government.*

4.4.4 Corridor operational traffic modelling methodology

Transurban operates a "rapid" operational traffic model of the Westlink M7 core network which focuses on the areas within the tolled boundaries of the asset. For the purpose of this assessment, the operational traffic model is referred to as the operational model. The operational model was developed to supplement the TUSTM and provide simulated capacity constrained assessments of the future demand forecasts estimated by the TUSTM.

For the purpose of this assessment, the operational model was expanded to include the following:

- The Westlink M7 and Hills M2 Motorway Interface: specifically, to include the Abbot Road eastbound merge with the mainline
- The Westlink M7 and M4 Smart Motorway Interface: specifically, the M7 - M4 entry and exit ramps, where the M4 Smart Motorway currently meters traffic exiting Westlink M7 during peak periods
- The Westlink M7 and Elizabeth Drive/M12 Motorway Interface: where it is expected that improved access to the emerging Western Sydney International Airport Precinct provided by the M12 Motorway will significantly increase traffic demand on the Westlink M7
- The Sir Roden Cutler Victoria Cross Memorial Interchange: where the Westlink M7 interfaces with the M31 Motorway, M5 Motorway and Camden Valley Way.

The operational model was developed and calibrated to observed travel behaviour in early 2021. Future traffic demand was forecast by applying the model with future year traffic growth assumptions from the TUSTM.

[1] M2 Upgrade Environmental Assessment Traffic and transport assessment (Transurban, 2010)

The operational model has been developed to undertake 16-hour microsimulation between the hours of 4:00 am and 8:00 pm of a typical working week.

The extent of the operational model's network is shown in Figure 4-2. The model has been organised into two separate subnetworks:

- The extended Westlink M7 Core Subnetwork
- The Sir Roden Cutler Victoria Cross Memorial Interchange (VC Cutler Interchange) Subnetwork

Further information relating to the operational model base development and calibration and validation are documented in the Operational Modelling Traffic Assessment report included in Appendix A.

Figure 4-2 Operational model extent

4.4.5 Intersection assessment

4.4.5.1 Overview

The workday AM and PM operation of the intersections located directly adjacent and/or interfacing with the Westlink M7 within the study area (listed in Table 4-2 and shown in Figure 4-3) were assessed using the SIDRA Intersection software. SIDRA Intersection is a modelling micro-analytical software package, capable of analysing isolated and coordinated intersections.

The following information was used to inform the base year SIDRA Intersection modelling:

- Satellite imagery and Traffic Control Signal (TCS) plans obtained from Transport informed the intersection geometry and posted speed limits
- Sydney Coordinated Adaptive Traffic System (SCATS) detector counts provided by Transport for all signalised intersections in May 2021, supplemented by a range of historical traffic volume data, as summarised in Table 4-5, to account for and noting that at the time of the base year modelling, typical traffic conditions were affected by COVID-19 lockdowns
- Traffic signal phasing and timing data from SCATS provided by Transport
- Analysed TomTom speed data supplied by WSO Co which was used to estimate queue lengths by intersection approach based on the average workday data in May 2021 for model calibration and validation purposes.

Table 4-2 Study intersections

#	Intersection	TCS number	Scenario
1	Camden Valley Way/M7/M5 northbound entry ramp/M31 exit ramp	3055	All
2	Camden Valley Way/M5 southbound exit ramp	3054	All
3	Bernera Road/Yarrawa Street/M7 exit ramp/M7entry ramp	n/a	All
4	Jedda Road/Bernera Road/M7 exit ramp/M7 entry ramp	n/a	All
5	Cowpasture Road/M7 exit ramp/M7 entry ramp	3856	All
6	Elizabeth Drive/M7 exit ramp/Wallgrove Road	3859	2021 only
	Elizabeth Drive/northbound M7 entry ramp/M7 exit ramp		2026 and 2036 with and without proposed modification
7	Elizabeth Drive/southbound M7 on-ramp/M7 off-ramp	3860	All
8	Elizabeth Drive/M12 entry Ramp/Wallgrove Road	5125	2026 and 2036 with and without proposed modification
9	Wallgrove Road/Cecil Road	5126	2026 and 2036 with and without proposed modification
10	The Horsley Drive/Wallgrove Road	3862	All
11	The Horsley Drive/Wallgrove Road/M7 entry Ramp/M7 exit ramp	3863	All
12	Wallgrove Road/Mini Link Road/M7 entry ramp/M7 exit ramp	3866	All
13	Old Wallgrove Road/Wallgrove Road/M7 entry ramp/M7 exit ramp	3006	All
14	Great Western Highway/Rooty Hill Road South/Wallgrove Road	779	All
15	Great Western Highway/M7 entry ramp	3864	All

#	Intersection	TCS number	Scenario
16	Great Western Highway/M7 exit ramp	3865	All
17	Woodstock Avenue/M7 exit ramp	3867	All
18	Woodstock Avenue/M7 entry ramp	3868	All
19	Power Street/M7 entry ramp	3869	All
20	Power Street/M7 exit ramp	3870	All
21	Rooty Hill Road North/M7 exit ramp	3872	All
22	Rooty Hill Road North/Richmond Road/M7 entry ramp/M7 exit ramp	2721	All
23	Richmond Road/M7 entry ramp	3874	All

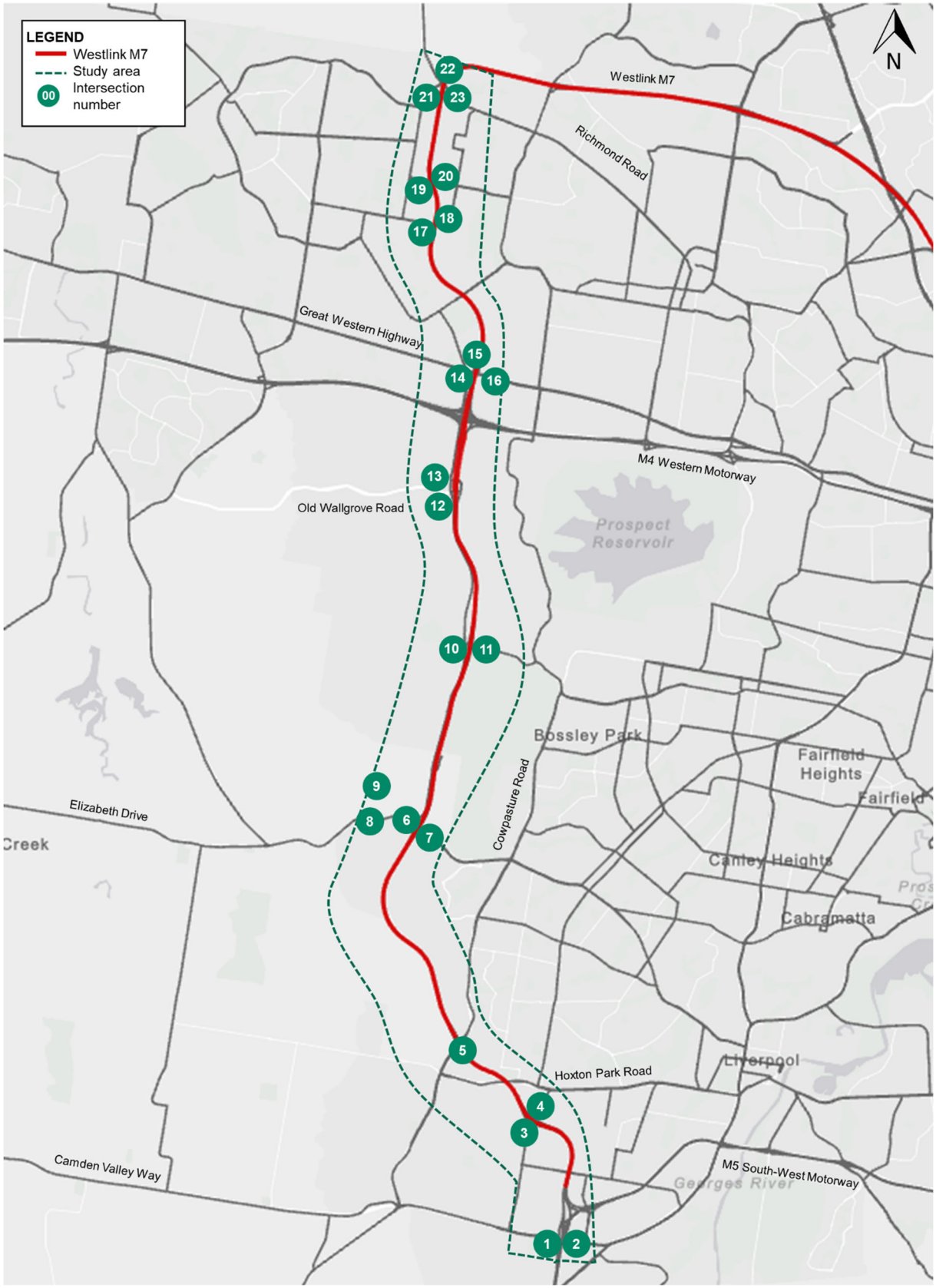


Figure 4-3 Location of study intersections

4.4.5.2 Peak hours

The SCATS detector counts indicated that the workday AM peak hour occurred at around 7:30-8:30 am for all intersection sites. The data suggested that the workday PM peak hour for each site varied between 3:00 pm and 5:00 pm. However, the average workday PM peak hour was determined to be 3:15-4:15 pm and the total traffic detector counts for all sites at this time were within five per cent of the total detector counts for each site's individual peak hour.

4.4.5.3 COVID-19 pandemic impacts

The 2021 SCATS detector counts were compared with SCATS detector counts for July 2019 to understand the potential impacts of the COVID-19 pandemic on local traffic patterns. The comparison indicated that the 2021 detector counts were higher than the 2019 detector counts for both the AM and PM peak period. This was also compared with observations from the toll gantries for the same periods. Based on the findings of the comparison, the 2021 SCATS detector counts were adopted to reflect the average workday traffic volumes at the study intersections.

4.4.5.4 Queue length validation

Precise queue length validation is difficult to achieve in traffic modelling, including SIDRA Intersection modelling, due to the volatility of queue lengths. Therefore, there are no set guidelines for quantitative queue length calibration and general growth/decay behaviour that should be replicated in modelling. In addition, counting queue lengths is a subjective exercise since the queueing vehicles will often still be moving slowly.

In order to better understand the queueing behaviour for this project, TomTom speed data has been reviewed and used to estimate typical workday AM and PM queueing conditions. This approach was selected given the particular difficulties in obtaining queue length observations for intersection approaches to the Westlink M7 and also noting that data collection was not possible due to COVID-19 restrictions.

TomTom speed data was supplied by WSO Co for the assessment peak hours adopting an average workday based on data from 10 to14 May 2021 to coincide with the traffic volume inputs from the SCATS detector counts.

4.4.6 Assessment criteria

4.4.6.1 Network performance statistics

To compare the operational impact of the proposed modification on the performance of the modelled road network, the following seven network performance statistics have been considered for each of the assessment scenarios:

- Vehicle kilometres travelled (VKT) – total distance travelled by vehicles travelling through the Westlink M7 Subnetwork. Generally, the higher the VKT, the better the network operates
- Total serviced demand – vehicles completing their trips through the Westlink M7 Subnetwork. Generally, the higher the demand, the better the network operates
- Vehicle hours travelled (VHT) – the total time taken by all vehicles to enter and drive through a network such as the Westlink M7 Subnetwork. Generally, for a given number of vehicles the lower the total travel time, the better the network operates
- Harmonic mean speed – the mean speed at which all vehicles travel through the Westlink M7 Subnetwork. Generally, the higher the speed, the better the network operates
- Network density – usually expressed in passenger car units per kilometre per lane, the network density is a measure of how many vehicles occupy a length of road i.e. it can be described as a measure of congestion. Generally, the lower the density, the better the network operates.
- Total stops – the number of stops that all vehicles make while travelling through the Westlink M7 Subnetwork, mostly due to congestion. Generally, the fewer stops, the less congested the network is.

4.4.6.2 Travel times

Travel times along key routes in the Westlink M7 Subnetwork have been used to determine the relative impacts or benefits of the proposed modification by comparing the change in travel times with and without the proposed modification. The key travel time route assessed considers most of the full extent of the study area along the Westlink M7 between the M5 Motorway and Richmond Road.

4.4.6.3 Roadway level of service

Level of service (LoS) is a measure to determine the operational conditions and efficiency of a roadway or intersection. The definition of Level of Service generally outlines the operating conditions in terms of speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience, and road safety.

The LoS for freeway or motorway sections where the design speed is greater than 70 kilometre per hour is calculated based on vehicle density. Density is measured in passenger car units per kilometre per lane (PCU/km/ln) and is calculated as the design flow rate divided by the average passenger-car speed.

Table 4-3 shows the six level of service definitions for a freeway ranging from LoS A, representing optimum and free-flow operating conditions, to LoS F, representing breakdown in flow. When a roadway performance is LoS D or worse, investigations are generally initiated to determine if suitable remediation can be achieved.

Table 4-3 Mid-block level of service definitions and criteria

Level of service	Definition	Freeway density (PCU/km/ln)
A	A condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high.	7.0 or less
B	In the zone of stable flow where drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort is a little less than with level of service A.	7.1 to 11.0
C	Also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience declines noticeably at this level.	11.1 to 16.0
D	Close to the limit of stable flow and approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.	16.1 to 22.0
E	Traffic volumes are at or close to capacity, and there is virtually no freedom to select desired speeds or to manoeuvre within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause breakdown.	22.1 to 28.0
F	In the zone of forced flow, where the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow breakdown occurs, and queuing and delays result.	Greater than 28.0

Where free flow speed is taken as 100 kilometres per hour
Source: Guide to Traffic Management – Part 3 Traffic Studies and Analysis, Austroads, 2020

4.4.6.4 Intersection level of service

Average delay is commonly used to assess the operational performance of intersections, with LoS used as an index. A summary of the intersection LoS criteria is shown in Table 4-4.

Similar to the mid-block performance measures, common practice suggests that when the intersection performance falls to LoS D, investigations should be initiated to determine if suitable remediation can be provided. However, limited road capacity and high demand mean that LoS E and F are regularly experienced by motorists at pinch points on the existing strategic road network in Sydney, generally during peak periods. It should also be noted that capacity constraint can be used as a demand management technique, which discourages car travel and that conversely, over-provision of capacity can encourage more car use.

Table 4-4 SIDRA Intersection level of service criteria

Level of service	Average delay (seconds per vehicle)	Criteria for signals/roundabouts
A	<14	Good operation
B	15 to 28	Good operation with acceptable delays and spare capacity
C	29 to 42	Satisfactory
D	43 to 56	Near capacity
E	57 to 70	At capacity, incidents at signals will cause excessive delays
F	>70	Extra capacity required

Source: Adopted from Guide to Traffic Generating Developments (Transport, 2002)

4.4.7 Data sources

A range of data has been used in the preparation of this operational traffic and transport assessment, as summarised in Table 4-5.

Table 4-5 Data sources

Data type[1]	Date covered	Use in assessment
Westlink M7 toll gantry counts (WSO Co)	10/05/2021 to 14/05/2021	Existing conditions assessment and also used to calibrate and validate the microsimulation model
Westlink M7 detector speed data (WSO Co)	25/02/2021 to 12/03/2021	Existing conditions assessment
SCATS detector counts (WSO Co)	08/07/2019 to 14/07/2019 10/05/2021 to 16/05/2021	Base year SIDRA Intersection modelling
Historical tube count data (AECOM/TTM Group)	Range of dates between February, March or April 2021 - depending on the site	Existing conditions assessment and also used to calibrate and validate the microsimulation model
Count station data (Transport)	2007 to 2021	Base year SIDRA Intersection modelling
2017 balanced counts from the Western Sydney Priority Growth Area Aimsun mesoscopic traffic model (Transport)	17/06/2017	Base year SIDRA Intersection modelling
Weigh in motion data (Transport)	February 2020	Existing conditions assessment
Crash history data within 250 metres of the Westlink M7 centreline (Transport)	1/10/2015 to 27/09/2020	Existing conditions assessment
Future year traffic volumes for Wallgrove Road and Cecil Road (Transport and WSP)	2026 and 2036	Future year SIDRA Intersection modelling
TUSTM forecast traffic growth rates (WSO Co)	2026 and 2036 with and without proposed modification	Future year SIDRA Intersection modelling
Operational model outputs and traffic volumes (WSO Con)	2026 and 2036 with and without proposed modification	Operational impact assessment
Westlink M7 cycle counts	11/06/2022 to 19/06/2022	Existing cycling demand

1 This table outlines the range of different data sources used to inform this Modification Report. With regards to the data used specifically for the Operational model, the traffic volumes and travel times were taken from consistent days in February 2021, as documented in Appendix A.

4.4.8 Cumulative impact assessment

A cumulative impact assessment has been undertaken for both the construction of the proposed modification and its operation to assess its potential cumulative impacts with other projects in the area. This was undertaken based on a screening of other nearby projects to determine those that have the potential to cause cumulative traffic and transport impacts. The screening took into account projects that have been approved but where construction has not commenced, projects that have commenced construction, and projects that have recently been completed. The screening process is described further in Section 7.18 (Cumulative impacts) of the Modification Report.

The cumulative impact assessment was based on the residual impacts of the proposed modification (i.e. those that are expected to exist after application of management and mitigation measures).

4.4.9 Assumptions and limitations

Forecasting future year traffic volumes is highly complex and involves sophisticated traffic modelling processes. Reasonable variations in forecast model input parameters, data and assumptions result in variations in forecast traffic demand. Forecast traffic volumes from models should therefore be considered as a range as opposed to absolute numbers. For the purposes of this technical assessment report, the TUSTM and operational models with their inputs and assumptions has been constructed to produce an estimate of the future traffic demands. The associated limitations and assumptions are documented in Appendix A.

In addition, the assessment of existing conditions and proposed modification operational impacts discussed in this report is largely based on information that has been provided to the authors, including the data sources discussed in Table 4-5. It is assumed that the provided information is reasonable and correct.

5.0 Existing environment

This section provides a description of the existing environment as it relates to traffic and transport.

5.1 Adjacent land use

The study area is located within the Liverpool Local Government Area (LGA) in the south, the Fairfield Council LGA through the middle and the Blacktown LGA in the north. The 2016 census showed that the LGAs had a combined population of approximately 740,000 people (Australian Bureau of Statistics, 2017). This represents about 15 per cent of the total Greater Sydney population.

Land uses within the study area mostly include residential and industrial land uses, recreational uses and green space including the Western Sydney Parklands, which is located adjacent to the Westlink M7 for most of the study area.

Key industrial and warehouse precincts located adjacent to the study area include:

- Eastern Creek
- Huntingwood
- Minchinbury.

5.2 Modes of travel

The *Household Travel Survey Data* (obtained from Transport's Open Data Portal), provides mode share details of the average workday travel demand for each LGA in NSW. Table 5-1 shows the average workday travel mode share for the study area LGAs as well as a comparison with the Sydney Greater Metropolitan Area (GMA).

On a typical workday, car-based travel equates for 75 to 83 per cent of trips generated by the study area LGAs compared to 41 per cent for the Sydney GMA. Overall, the three LGAs within the study area have a higher reliance on private vehicles than the Sydney GMA.

These travel patterns were generally consistent for each year that data was available (2016/17-2019/20).

Table 5-1 Average workday travel mode share for Blacktown, Fairfield and Liverpool LGAs (2019/2020)

Local Government Area	Average workday travel mode share (percentage)						
	Private vehicles			Rail	Bus	Walk only	Other modes
	Driver	Passenger	Total private vehicles				
Blacktown	52%	23%	75%	6%	7%	11%	1%
Fairfield	52%	25%	78%	5%	4%	12%	1%
Liverpool	57%	26%	83%	5%	4%	7%	1%
Sydney GMA	47%	21%	68%	7%	6%	17%	2%

(Source: Transport Open Data portal)

5.3 Study area road network

5.3.1 Westlink M7

Within the study area, the Westlink M7 is configured with two lanes in each direction separated by a wide landscaped median. It has a posted speed limit of 100 kilometres per hour, albeit reduced speed limits are often used during peak periods and incidents.

Key features of the Westlink M7 include:

- Marked shoulders provided in both directions, which cyclists are permitted to use
- Vehicle access is generally provided by ramps with acceleration and deceleration lanes that link the motorway mainline with grade-separated interchanges, which are mostly signal controlled
- Motorway interchanges include:
  - VC Cutler Interchange with the M5 Motorway
  - M4 Motorway/Westlink M7 Light Horse Interchange
- Variable message signs are placed at regular intervals along the Westlink M7 to convey relevant messages to drivers
- Breakdown bays are also provided at regular intervals along the Westlink M7.

For the purpose of this assessment, the Westlink M7 has been split into nine segments (from south to north), as summarised in Table 5-2.

Table 5-2 Assessed Westlink M7 segments

#	Westlink M7 segments
1	Camden Valley Way to Bernera Road
2	Bernera Road to Cowpasture Road
3	Cowpasture Road to Elizabeth Drive
4	Elizabeth Drive to The Horsley Drive
5	The Horsley Drive to Old Wallgrove Road
6	Old Wallgrove Road to Great Western Highway
7	Great Western Highway to Woodstock Avenue
8	Woodstock Avenue to Power Street
9	Power Street to Richmond Road

5.3.2 Adjacent roads

The key Westlink M7 road crossings and interchanges within the study area include the following, listed from south to north:

- Camden Valley Way (A28) (in Prestons)
- M5 Motorway (in Prestons)
- Bernera Road and Jedda Road (in Prestons)
- Cowpasture Road (in Middleton Grange, Hinchinbrook and Hoxton Park)
- Elizabeth Drive (in Cecil Park and Abbotsbury)
- The Horsley Drive (in Horsley Park)
- Wallgrove Road at Old Wallgrove Road (in Eastern Creek)
- M4 Motorway/Westlink M7 Light Horse Interchange (in Eastern Creek)
- Great Western Highway (A44) (in Eastern Creek and Minchinbury)
- Woodstock Avenue (in Plumpton and Glendenning)
- Power Street (in Plumpton and Glendenning)
- Richmond Road (in the suburb of Dean Park).

Details of all roads within the study area are provided in Table 5-3.

Table 5-3 Key study area road characteristics

Road	Classification	Intersects with Westlink M7	Function	Approved B-double route	Posted speed limit
Camden Valley Way	State road	✓	Arterial road that links with the Hume Highway to the north and to the Camden LGA to the south.	✓	70km/h
Kurrajong Road	Regional road	✗	Collector road which links the Hume Highway to the east with Cowpasture Road to the west and facilitates access to the surrounding industrial park in Prestons.	✓	60km/h
Bernera Road/Jedda Road	State road/Regional road	✓	Arterial/collector road that links with Hoxton Park Road to the north and Camden Valley Way to the south and facilitates access to the surrounding industrial park in Prestons.	✓	50-60km/h
Hoxton Park Road	State road	✗	Arterial road that links with the Hume Highway to the east in Liverpool CBD, and Cowpasture Road to the west and facilitates access to the surrounding industrial park in Prestons.	✓	70km/h
Wilson Road	Local road	✗	Collector road that provides access to residential areas and links with Elizabeth Drive to the north and Hoxton Park Road to the south.	✗	50km/h
Cowpasture Road	State road	✓	Arterial road that links with Elizabeth Drive and The Horsley Drive to the north and Hoxton Park Road and Camden Valley Way to the south and facilitates access to large distribution centres in Hinchinbrook.	✓	70km/h
Elizabeth Drive	State road	✓	Arterial road that connects with Cowpasture Road and the Hume Highway in Liverpool CBD to the east and The Northern Road to the west, and facilitating access to the evolving Western Sydney Aerotropolis.	✓	70km/h
The Horsley Drive	State road	✓	Arterial road connecting with the Cumberland Highway to the east, facilitates access to industrial uses in Wetherill Park to the east and to Horsley Park to the west	✓	70km/h
Redmayne Road	Local road	✗	Local road in Horsley Park	✗	60km/h
Chandos Road	Local road	✗	Local road in Horsley Park	✗	60km/h
Wallgrove Road	State road	✓	North-south corridor that is located parallel to the Westlink M7 between Elizabeth Drive and Rooty Hill Road South at the Great Western Highway	✓	80km/h [2]

Road	Classification	Intersects with Westlink M7	Function	Approved B-double route	Posted speed limit
			and facilitates access to the Eastern Creek industrial uses and the Horsley Park area		
Mini Link Road	State road	✓	Arterial road facilitating access between the Westlink M7, Wallgrove Road and Old Wallgrove Road and the adjacent Eastern Creek industrial uses	✓	60km/h
Old Wallgrove Road	State road	✓	Arterial road facilitating access between the Westlink M7, Wallgrove Road and the adjacent Eastern Creek industrial precinct	✓	80km/h
M4 Western Motorway	State road	✓	East-west motorway that connects the inner western suburbs of Sydney to the east and the Great Western Highway at the foot of the Blue Mountains to the west	✓	100km/h
Great Western Highway	State road	✓	Arterial road that connects Sydney with the Blue Mountains and Central West Region to the west	✓	80km/h
Eastern Road/Francis Road	Regional road	✗	Collector road linking the Bungarribee and Doonside residential areas to the east with Rooty Hill and Mount Druitt to the west	✓	60km/h
Woodstock Avenue	State road/Regional road	✓	Facilitates access between the Westlink M7 and Rooty Hill including industrial uses to the east and residential areas to the west	✓	60km/h
Power Street	State road/Regional road	✓	Facilitates access between the Westlink M7 and Glendenning and Plumpton including industrial uses immediately to the east and residential areas to the west	✓	60km/h
Lamb Street	Regional road	✗	Facilitates access between the Westlink M7 and Glendenning and Oakhurst including industrial uses immediately to the east and residential areas to the west	✗	60km/h
Rooty Hill Road North	State road	✓	North-south corridor that is located parallel to the Westlink M7 between Richmond Road and Woodstock Avenue	✓	60km/h
Richmond Road	State road	✓	Arterial road connecting Blacktown to the east with Richmond to the north-west	✓	70km/h

[2] Partially 70 kilometre per hour northbound between south of The Horsley Drive and south of Mini Link Road

5.4 Traffic volumes

5.4.1 Westlink M7

Hourly traffic volume data from the Westlink M7 ramp gantries collected in May 2021 have been used to estimate the average workday traffic volumes per hour along the Westlink M7.

The average workday daily traffic volume profile is shown in Figure 5-1. The profile shows two spikes of nearly 6,000 vehicles per hour associated with the morning and afternoon peak periods at around 7:00 am and 3:00 pm. In addition, it is evident that the peak hour traffic volumes in both directions are similar, suggesting that the Westlink M7 doesn't necessarily have peak directional flows, which is a function of its north-south alignment.

The workday peak hour and daily traffic volumes for each of the nine Westlink M7 segments are summarised in Table 5-4. Traffic volumes are generally higher in segments 1 to 6 i.e. the southern sections of the study area, with segment 4 between Elizabeth Drive and The Horsley Drive carrying the highest traffic volumes, with approximately 87,200 vehicles per workday.

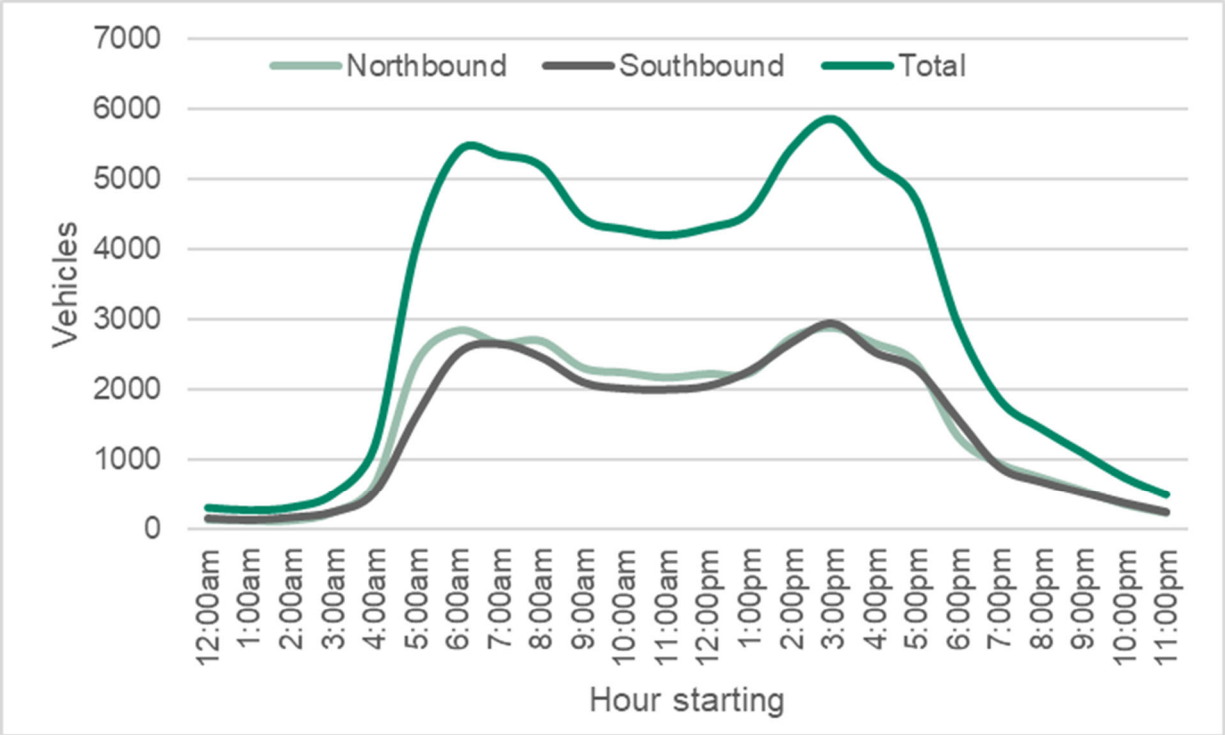


Figure 5-1 Westlink M7 average workday hourly traffic volume profile (May 2021)

Table 5-4 Workday traffic volumes on the Westlink M7 (May 2021)

#	Westlink M7 segments	Workday traffic volumes (vehicles)		
		AM peak hour	PM peak hour	Daily (workday)
1	Camden Valley Way to Bernera Road	6,130	6,520	84,340
2	Bernera Road to Cowpasture Road	6,110	6,450	84,680
3	Cowpasture Road to Elizabeth Drive	5,940	6,460	85,820
4	Elizabeth Drive to The Horsley Drive	6,080	6,330	87,140
5	The Horsley Drive to Old Wallgrove Road	6,120	5,990	86,230
6	Old Wallgrove Road to Great Western Highway	5,900	6,080	84,170
7	Great Western Highway to Woodstock Avenue	6,160	6,210	80,020
8	Woodstock Avenue to Power Street	4,970	4,970	65,390
9	Power Street to Richmond Road	5,550	5,460	71,250
Average		**5,880**	**6,050**	**81,000**

5.4.2 Surrounding road network

Traffic volume data was collected in February 2021 using automatic tube counters to understand the existing traffic volumes and patterns on the road network surrounding the Westlink M7. Specifically, classified hourly traffic volumes over a one-week period for the following locations were analysed:

- Kurrajong Road, at the Westlink M7 underpass
- Hoxton Park Road, at the Westlink M7 overpass
- Cowpasture Road, south of the Westlink M7
- Elizabeth Drive, south of the Westlink M7
- The Horsley Drive, east of Westlink M7
- Wallgrove Road, south of the Horsley Drive
- Great Western Highway, east of Westlink M7
- Francis Road, west of the Westlink M7
- Woodstock Avenue, east of the Westlink M7
- Power Street, west of the Westlink M7
- Lamb Street, at the Westlink M7 underpass
- Rooty Hill Road, west of the Westlink M7
- Richmond Road, north of the Westlink M7.

The AM peak hour, PM peak hour and average workday traffic volumes at each of these locations are summarised in Table 5-5. The traffic volumes show the following:

- Cowpasture Road and Richmond Road carry more than 30,000 vehicles per workday in each direction, having the highest traffic volumes of the adjacent roads
- Kurrajong Road, Hoxton Park Road, Elizabeth Drive, Great Western Highway, Francis Road, and Rooty Hill Road carry between 10,000 and 20,000 vehicles per workday in each direction
- The Horsley Drive, Wallgrove Road, Woodstock Avenue, Power Street, and Lamb Street all carry between 5,000 and 10,000 vehicles per workday in each direction.

Table 5-5 Workday traffic volumes at key locations surrounding the Westlink M7 (February 2021)

Location (adjacent to Westlink M7)	Direction	AM peak hour	PM peak hour	Average workday traffic	
		Vehicles	Vehicles	Vehicles	Heavy vehicle percentage
Kurrajong Road at Westlink M7	Eastbound	600	690	8,530	4%
	Westbound	700	1,020	11,280	4%
Hoxton Park Road	Eastbound	1,390	1,020	15,610	9%
	Westbound	1,280	1,790	19,100	8%
Cowpasture Road	Eastbound	2,780	2,020	34,220	12%
	Westbound	1,700	2,550	31,830	14%
Elizabeth Drive	Eastbound	1,470	1,160	15,870	16%
	Westbound	1,070	1,280	15,410	17%
The Horsley Drive	Eastbound	580	880	10,050	14%
	Westbound	490	570	7,470	14%
Wallgrove Road at The Horsley Drive	Eastbound	810	390	7,850	17%
	Westbound	350	920	8,060	16%
Great Western Highway	Eastbound	1,360	1,090	17,340	15%
	Westbound	910	1,650	18,200	19%
Francis Road	Eastbound	970	960	12,060	5%
	Westbound	940	1,100	12,980	4%
Woodstock Avenue	Eastbound	710	510	8,310	17%
	Westbound	530	750	8,200	18%
Power Street	Eastbound	650	410	6,400	5%
	Westbound	680	940	8,900	5%
Lamb Street	Eastbound	430	470	6,400	7%
	Westbound	310	490	5,430	8%
Rooty Hill Road	Eastbound	1,410	1,270	19,780	10%
	Westbound	1,140	1,480	19,200	8%
Richmond Road	Eastbound	2,190	2,590	35,260	13%
	Westbound	2,620	2,340	36,500	15%

5.5 Heavy vehicles

5.5.1 Classification

Weigh-in-motion detection devices are used on Sydney motorways to record axle weights and gross vehicle weights as vehicles drive over a measurement site. Two weigh-in-motion sites are positioned along the corridor at Prestons and Eastern Creek.

Using the number of axles and weights, the sites classify every recorded vehicle in accordance with Austroads standard types. The technical report “Austroads Automatic Vehicle Classification by Vehicle Length” outlines 12 standard vehicle types to ensure a uniform classification system across Australia.

The standard vehicle types include classes 1 and 2 representing light vehicles and classes 3-12 representing heavy vehicles of increasing length. The heavy vehicle classes can further be broken down into 4 sub-categories based on the functional description:

- Rigid trucks (Classes 3, 4, 5)
- Articulated trucks (Classes 6, 7, 8, 9)
- B-double trucks (Class 10)
- Road trains (and larger)(Classes 11, 12).

Vehicles up to B-Doubles are permitted on the Westlink M7, and these are anticipated to be the largest common vehicle. Vehicles larger than this would be classified as a restricted access vehicle and require appropriate permits for use.

Classification data was obtained from the weigh-in-motion site at Prestons for the period covering February 2022. A summary of key statistics is as follows:

- A total of 5,700 and 6,100 vehicles were recorded during the workday AM and PM peak hours
- About 75 per cent of recorded vehicles were light vehicles and light vehicles with trailers (Classes 1 and 2)
- More than five per cent of recorded vehicles were articulated trucks (up to 19 metres)
- Less than five per cent of recorded vehicles were B-double trucks (up to 26 metres)
- The split of vehicles between the outside and median side lanes is approximately 70 per cent and 30 per cent respectively.

Overall, a heavy vehicle percentage of about 20 to 25 per cent was recorded. This is expected considering the role that the Westlink M7 plays in providing a north-south freight corridor link.

Figure 5-2 presents the percentage of heavy vehicles in the study area during an average workday.

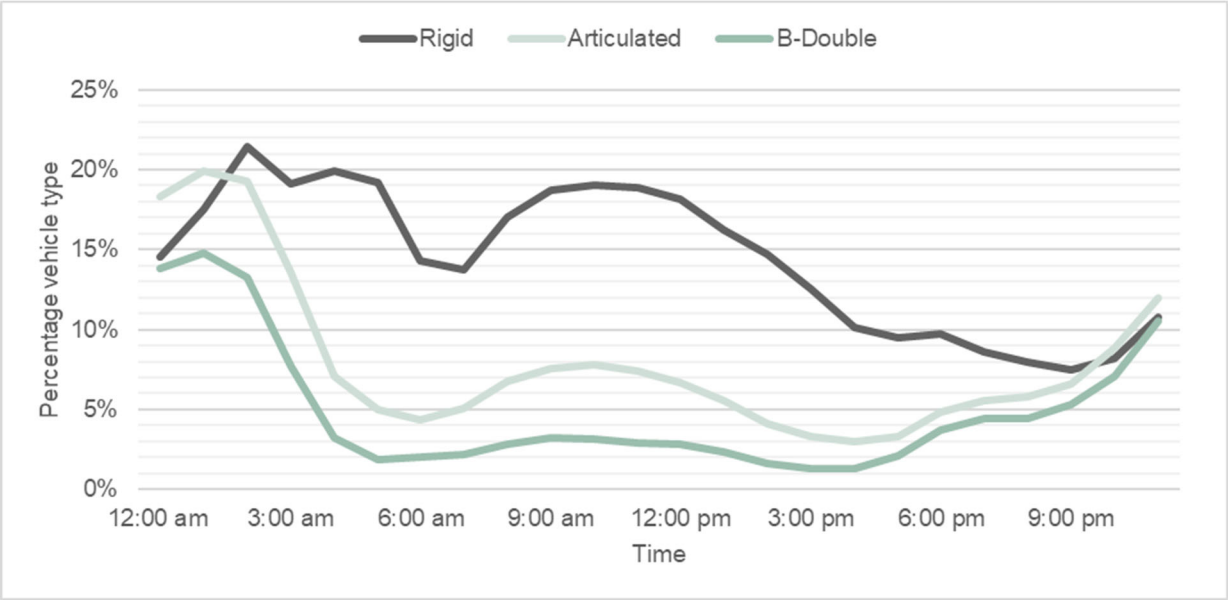


Figure 5-2 Weigh-in-Motion data daily profile (Prestons) - February 2020 average workday

5.5.2 Passenger car unit factors

Understanding the make-up of vehicle classifications on a particular road allows for a broader understanding of the impact of each vehicle in the flow of traffic. In standard traffic counts each vehicle is counted as one vehicle, not matter how large it is. This however does not take into consideration that a heavy vehicle would occupy a larger space than a car while traveling. As such, vehicle classifications are used to convert larger vehicles on the network into a Passenger Car Unit (PCU) value. The PCU aims to account for the different performance and physical characteristics of vehicle types in the network. It does this by assigning a higher conversion factor to larger, slower vehicles. When the PCU conversion factors and the number of vehicles are multiplied, this gives a truer representation for the flow and capacity of a road.

The Traffic Modelling Guidelines (Transport, 2013) provides reference values for PCU conversion factors to convert different vehicle types into PCUs. This is reproduced in Table 5-6.

Table 5-6 Suggested PCU values for vehicle classification

Vehicle type	PCU conversion factor
Car	1
Rigid truck	1.9
Articulated truck	2.9
B-double	3.6

Source: Roads and Maritime Services, Traffic Modelling Guidelines, Table 13.2

These factors have been used to determine an average heavy vehicle to PCU conversion factor of 2.3 for the study area.

5.6 Active transport

A shared path for pedestrians and cyclists is separated from vehicular traffic and located alongside the Westlink M7. The shared path is just under 40 kilometres long and extends from Prestons in the south to Baulkham Hills in the north. Table 5-7 summarises the existing active transport facilities on the surrounding road network that link with the Westlink M7 shared path.

In addition, cyclists are permitted to use the Westlink M7 shoulder. Cycle counts were undertaken across nine days (11 June 2022 to 19 June 2022) to understand the cycling behaviour at three sections along the Westlink M7:

- between Richmond Road and Power Street
- between the M4 Motorway and Old Wallgrove Road
- between Elizabeth Street and Cowpasture Road..

Less than 20 cyclists per day were counted on a workday and a weekend, across the three sections.

Table 5-7 Existing active transport facilities

LGA	Road	Connectivity to surrounding areas
Liverpool	Hume Motorway	Shoulder lanes connecting to and from the south (e.g. Campbelltown)
	Camden Valley Way	Shared path providing east-west regional connectivity
	M5 Motorway	On-road shoulder bicycle lanes
	Kurrajong Road	On-road bicycle shoulder lanes and footpaths providing regional east-west connectivity
	Bernera Road and Jedda Road	Shared paths providing regional connectivity to and from the north
	Hoxton Park Road (future detour)	Shared paths providing regional east-west connectivity
	Wilson Road	Shared paths providing local north-south connectivity
	Cowpasture Road	Shared paths providing regional north-south connectivity
	Parklands Trak connections	Shared path connections including three bridges and one underpass
	Elizabeth Drive	Shared paths providing regional east-west connectivity
Fairfield	Villiers Road	Short section of footpath with no connectivity and no formal cycling facilities provided
	Saxony Road	Footpaths with limited connectivity and no formal cycling facilities provided
	The Horsley Drive	Shared paths providing regional east-west connectivity
	Redmayne Road	Short section of footpath with no connectivity and no formal cycling facilities provided.
	Chandos Road	Short section of footpath with no connectivity and no formal cycling facilities provided.
Blacktown	Old Wallgrove Road	Shared paths providing regional north-south connectivity parallel to the Westlink M7
	Wallgrove Road and	On-road bicycle shoulder lanes providing east-west connectivity
	Western Motorway	On-road bicycle shoulder lanes providing east-west connectivity.
	Great Western Highway	On-road bicycle shoulder lanes providing regional east-west connectivity. Westlink M7 shared path connects to Western Sydney Parklands
	Eastern Road	Shared paths providing regional east-west connectivity
	Woodstock Avenue	Mix of on-road bicycle shoulder lanes and shared paths providing regional east-west connectivity

LGA	Road	Connectivity to surrounding areas
	Power Street	Shared paths providing regional east-west connectivity
	Lamb Street	Shared path providing regional east-west connectivity
	Florence Street	Westlink M7 shared path connection to local streets
	Richmond Road and Rooty Hill Road North	Shared path providing regional connectivity

5.7 Public transport

Public transport services are a key method of transport for journeys to work in the area, particularly to/from the Sydney CBD.

5.7.1 Rail services

As shown in Section 5.2, rail use represents five to six per cent of workday travel in the Blacktown, Fairfield, and Liverpool LGAs (see Table 5-1).

Table 5-8 summarises the rail services and stations that service the study area.

Table 5-8 Rail services surrounding the study area

Line description	Nearby stations
T1 Western Line	Rooty Hill, Doonside, Blacktown
T2 Inner West and Leppington Line	Glenfield, Edmondson Park
T5 Cumberland Line	Glenfield, Edmondson Park

5.7.2 Bus services

Bus passengers represent four to seven per cent of workday travel in the surrounding Blacktown, Fairfield and Liverpool LGAs (see Table 5-1).

There are no bus facilities on the Westlink M7 in the study area, though a number of bus services operate in the vicinity of the motorway. The bus network connects Liverpool CBD to the western suburbs of the Liverpool LGA; Blacktown CBD to Mount Druitt; and Fairfield CBD to the Western Sydney Parklands and surrounds.

A total of 22 routes use the following roads to cross the Westlink M7:

- Camden Valley Way
- Kurrajong Road
- Elizabeth Drive
- The Horsley Drive
- Wallgrove Road/ Old Wallgrove Road
- Great Western Highway
- Eastern Road
- Power Street
- Lamb Street
- Richmond Road and Rooty Hill Road North.

Table 5-9 Bus routes that travel through the study area

Study area location	Route	Route description	Peak average frequency (minutes)	Off-peak Average frequency (minutes) [1]	Approximate total number of workday services
Camden Valley Way	867	Prestons to Glenfield	20	0	15
	864	Glenfield to Carnes hill via Horningsea Park	30	0	10
	857	Narellan to Liverpool	30	60	15
	856	Bringelly to Liverpool	50	0	10
	855	Rutleigh Park to Liverpool via Austral and Leppington Station	29	0	15
Kurrajong Road	869	Ingleburn to Liverpool via Edmondson Park and Prestons	30	0	75
	852	Carnes Hill Marketplace to Liverpool via Greenway Drive and Cowpasture Road	20-30	60	35
	851	Carnes Hill Marketplace to Liverpool via Cowpasture road	60	60	15
Hoxton Park Road	854	Carnes Hill to Liverpool via Greenway drive Hoxton Park Road	30	60	65
	853	Liverpool to Carnes Hill via Hoxton Park Road	10	60	60
Cowpasture Road	827	Carnes Hill to Liverpool	30	60	70
Elizabeth Drive	801	Badgerys creek to Liverpool	55-60		6
The Horsley Drive and Elizabeth Drive	813	Bonnyrigg and Western Sydney Parklands to Fairfield	30	60	45

Study area location	Route	Route description	Peak average frequency (minutes)	Off-peak Average frequency (minutes) [1]	Approximate total number of workday services
Wallgrove Road, Old Wallgrove Road, and The Horsley Drive	835	WSU Penrith to Prairiewood	18	30	30
Great Western Highway	729	Mount Druitt to Blacktown via Minchinbury	30	60	70
Great Western Highway	723	Mount Druitt to Blacktown via Eastern Creek	20	60	50
Eastern Road	728	Mount Druitt to Blacktown	30	30	55
Power Street	756	Mount Druitt to Blacktown via Plumpton and Woodcroft	25-30	30	70
Lamb Street	754	Blacktown to Mt Druitt via Hassall Grove	30-35	60	75
	745	Norwest Hospital to St Marys via Stanhope Gardens	25	30	50
Richmond Road	750	Mount Druitt to Blacktown via Bidwill	15-30	15-30	85

[1] Zero values indicate that services operate during peak periods only

5.8 Road network performance

5.8.1 Network performance

Table 5-10 displays the existing(2021) network performance results from the calibrated operational model for the whole modelled period of 5:00 am to 8:00 pm.

Table 5-10 Modelled network performance in 2021

Network measure	2021 operational model result
Total serviced demand (vehicles)	228,773
Vehicle kilometres travelled (millions)	3.1
Vehicle hours travelled (hours)	40,367
Harmonic mean speed (km/h)	70
Density (vehicles/km)	12
Total number of stops	168,860

5.8.2 Average travel speeds

The latest Key Road Performance Report from Transport[2] reported that traffic on the Westlink M7 between Camden Valley Way and the M4 Motorway was operating with an average speed of 70 to 75 kilometres per hour in the northbound direction in the AM peak period (6:30 am to 9:15 am) and about 75 kilometres per hour in the southbound direction in the PM peak period (3:00 pm to 6:45 pm). The report also noted that the travel time ranged between 12 and 31 minutes in the northbound direction in the AM peak period and between 12 and 37 minutes in the southbound direction in the PM peak period. The low speeds of about 25 kilometres per hour less than the 100 kilometres per hour posted speed limit and the large variance in travel time shows that the congestion currently experienced on the Westlink M7 causes considerable variability in speeds and travel times.

Hourly average speed recordings along the Westlink M7 were obtained from permanent traffic detectors, which are installed at regular intervals along the motorway. The location of the assessed loops is discussed in Table 5-11. The selected loops were generally located at mid-block locations away from any entry and exit ramps.

Figure 5-3 and Figure 5-4 show the average workday speed profile for northbound and southbound traffic along the Westlink M7 for a typical workday in early 2021.

As expected, the daily speed profiles show significant speed reductions during the AM and PM peak periods (about 6:00 am to 9:00 am and 2:00 pm to 6:00 pm) at most locations within the study area. For northbound traffic, average travel speeds dropped to nearly 40 kilometres per hour in the AM peak period and 60 kilometres per hour in the PM peak period. Similarly, for southbound traffic, average travel speeds dropped to nearly 60 kilometres per hour in the AM peak period and 30-40 kilometres per hour in the PM peak period.

[2] https://roads-waterways.transport.nsw.gov.au/documents/about/corporatepublications/key-roads-performance-report/key-roads-performance-report-2019-06.pdf

Table 5-11 Speed data locations

#	Westlink M7 segment	Detector location
1	Camden Valley Way to Bernera Road	Near the Kurrajong Road underpass
2	Bernera Road to Cowpasture Road	At the Hoxton Park Road overpass
3	Cowpasture Road to Elizabeth Drive	About 2.5km north of Cowpasture Road
4	Elizabeth Drive to The Horsley Drive	Near the Saxony Road overpass
5	The Horsley Drive to Old Wallgrove Road	Near the Chandos Road underpass
6	Old Wallgrove Road to Great Western Highway	About 350m north of Old Wallgrove Road
7	Great Western Highway to Woodstock Avenue	At the Eastern Road underpass
8	Woodstock Avenue to Power Street	About 250m south of Power Street
9	Power Street to Richmond Road	At the Lamb Street underpass

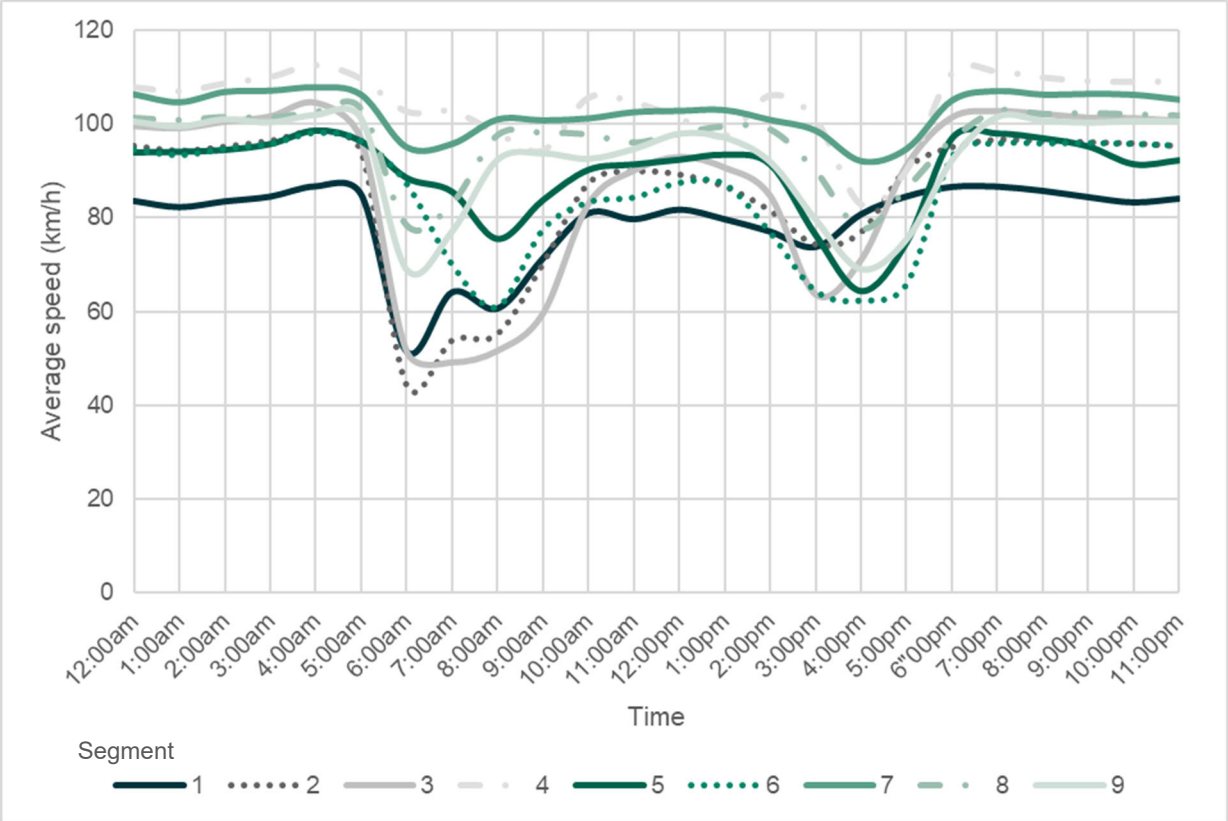


Figure 5-3 Westlink M7 average workday traffic speeds for northbound traffic (February 2021)

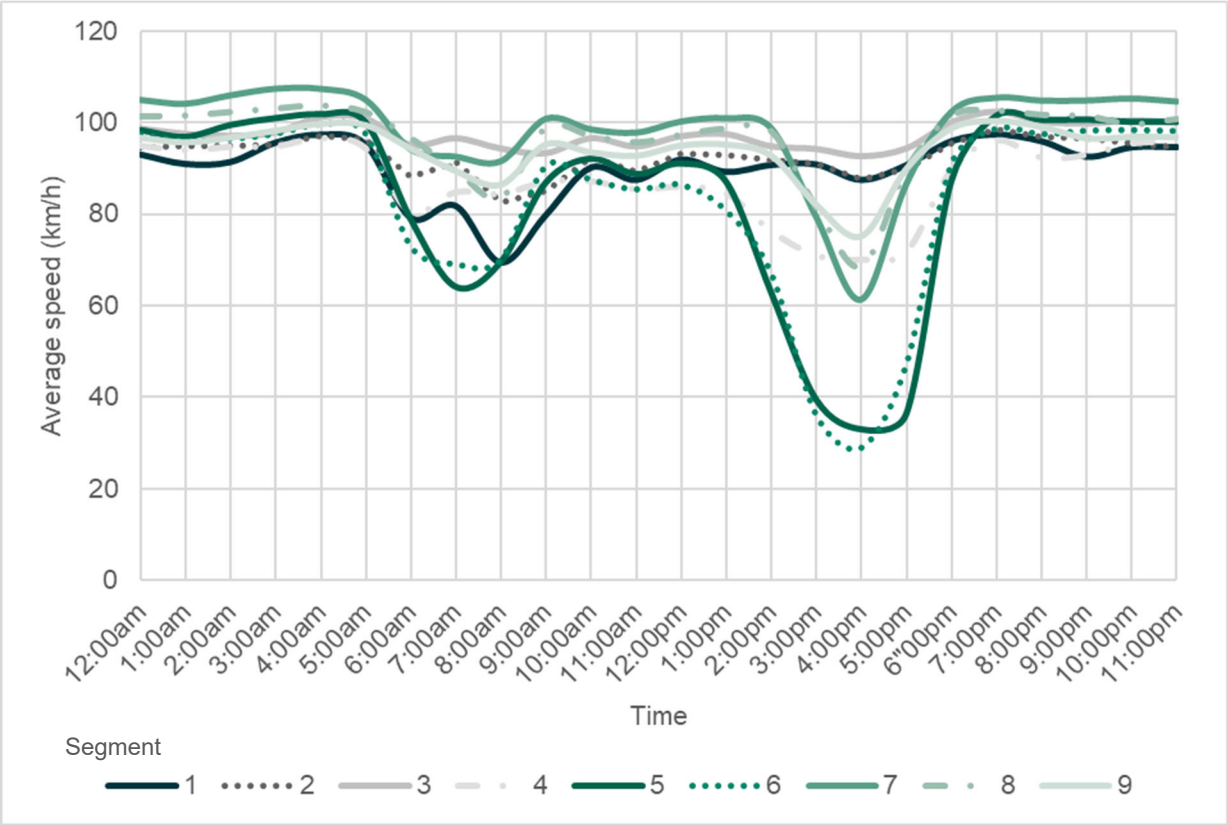


Figure 5-4 Westlink M7 average workday traffic speeds for southbound traffic (February 2021)

5.8.3 Travel times

2021 modelled travel times (average) were estimated by the operational model for the 15-hours of 5:00 am to 8:00 pm. Table 5-12 shows the modelled AM and PM peak hour travel times and average speeds for two routes.

Vehicles travelling between the M5 Motorway and Richmond Road (Route 1) experience travel times between 22 and 26 minutes and average travel speeds between 65 and 75 kilometres per hour. Vehicles travelling between the M5 Motorway and Old Wallgrove Road (Route 2) experience travel times between 15 and 20 minutes and average travel speeds between 55 and 75 kilometres per hour.

As Route 2 is around two thirds the length of Route 1, this suggests that travel speeds are generally lower in the southern part of the study area than the northern part.

Figure 5-5 shows the modelled travel times for the same two routes across the 15-hour period. Travel times for both routes are largely consistent across the AM peak period between 7:00 am and 9:00 am. In the PM peak hour, the longest travel times occur at 4:00 pm.

Table 5-12 Modelled AM and PM peak hour travel times - 2021

Route	Description	Peak hour	Direction	Travel time (minutes)	Average speed (km/h) [1]
1	Between M5 Motorway and Richmond Road	AM	Northbound	26	60-65
			Southbound	22	70-75
		PM	Northbound	25	65
			Southbound	25	65

Route	Description	Peak hour	Direction	Travel time (minutes)	Average speed (km/h) [1]
2	Between M5 Motorway and Old Wallgrove Road	AM	Northbound	19	55-60
			Southbound	15	70-75
		PM	Northbound	18	60
			Southbound	18	60

[1] Assuming Route 1 is 27km and Route 2 is 18km

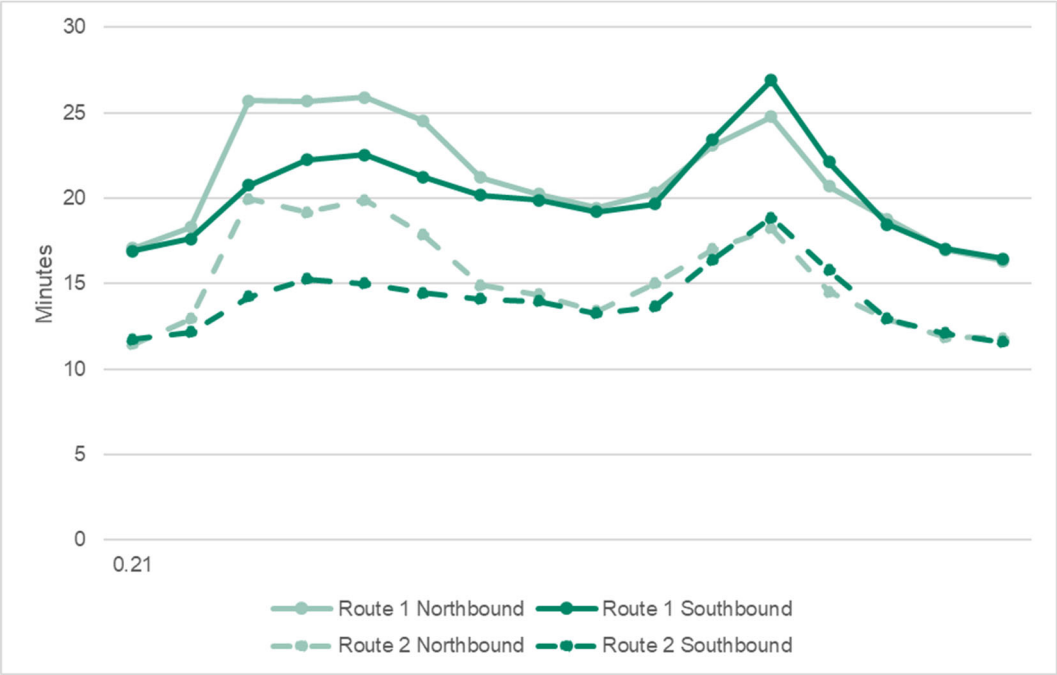


Figure 5-5 Westlink M7 modelled travel times between 5:00 am and 8:00 pm (2021)

5.8.4 Roadway level of service

Table 5-13 presents the level of service for the 2021 AM and PM peak hour for the nine assessed segments of the Westlink M7, adopting the definitions discussed in Section 4.4.6.3. Most of the assessed segments currently operate with a LoS E or F during either the workday AM or PM peak hours. However, segments eight and nine operate with a LoS D during the workday AM or PM peak hours.

Overall, the roadway level of service assessment suggests that the Westlink M7 corridor is approaching capacity and some segments are currently operating at capacity during the workday AM and PM peak hours.

Table 5-13 Mid-block level of service of the Westlink M7

#	Westlink M7 segment	Direction of travel	No of lanes	AM peak hour		PM peak hour	
				Density	Level of service	Density	Level of service
1	Camden Valley Way to Bernera Road	Northbound	2	37	F	21	D
		Southbound	2	22	E	19	D
2	Bernera Road to Cowpasture Road	Northbound	2	49	F	25	E
		Southbound	2	25	E	22	E
3	Cowpasture Road to Elizabeth Drive	Northbound	2	44	F	31	F
		Southbound	2	24	E	32	F
4	Elizabeth Drive to The Horsley Drive	Northbound	2	21	D	19	D
		Southbound	2	29	F	29	F
5	The Horsley Drive to Old Wallgrove Road	Northbound	2	20	D	21	D
		Southbound	2	41	F	57	F
6	Old Wallgrove Road to Great Western Highway	Northbound	2	20	D	26	E
		Southbound	2	39	F	55	F
7	Great Western Highway to Woodstock Avenue	Northbound	2	21	D	22	E
		Southbound	2	26	E	19	D
8	Woodstock Avenue to Power Street	Northbound	2	20	D	20	D
		Southbound	2	22	D	18	D
9	Power Street to Richmond Road	Northbound	2	20	D	19	D
		Southbound	2	21	D	16	D

Note: density values have been extracted from the operational model

5.8.5 Intersection performance

Table 5-14 and Figure 5-6 shows the existing (2021) intersection performance within the study area. Both the AM and PM peak hour average delay (seconds) and LoS is supplied for each intersection. Most intersections currently operate with an overall LoS D or better. However, the minor roads at each intersection generally operate with higher delays and lengthy vehicle queuing, this includes the Westlink M7 ramps at several locations.

The Great Western Highway/Rooty Hill Road South/Wallgrove Road intersection currently operates at LoS E, suggesting that traffic demands are currently at the available capacity.

Table 5-14 AM and PM peak hour intersection performance - 2021

ID	Intersection	AM peak hour		PM peak hour	
		Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
1	Camden Valley Way/M7/M5 northbound entry ramp/M31 exit ramp	33	C	31	C
2	Camden Valley Way/M5 southbound exit ramp	6	A	10	A
3	Bernera Road/Yarrawa Street/M7 exit ramp/M7entry ramp	47	D	17	B
4	Jedda Road/Bernera Road/M7 exit ramp/M7 entry ramp	20	B	16	B
5	Cowpasture Road/M7 exit ramp/M7 entry ramp	18	B	20	B
6	Elizabeth Drive/ M7 exit ramp/Wallgrove Road	38	C	42	C
7	Elizabeth Drive/ M7 entry ramp/M7 exit ramp	25	B	18	B
8	Elizabeth Drive/M12 entry Ramp/Wallgrove Road	Not applicable			
9	Wallgrove Road/Cecil Road				
10	The Horsley Drive/Wallgrove Road	46	D	48	D
11	The Horsley Drive/Wallgrove Road/M7 entry Ramp/M7 exit ramp	36	C	38	C
12	Wallgrove Road/Mini Link Road/M7 entry ramp/M7 exit ramp	32	C	44	D
13	Old Wallgrove Road/Wallgrove Road/M7 entry ramp/M7 exit ramp	35	C	29	C
14	Great Western Highway/Rooty Hill Road South/Wallgrove Road	59	E	63	E
15	Great Western Highway/M7 entry ramp	2	A	4	A
16	Great Western Highway/M7 exit ramp	12	A	9	A
17	Woodstock Avenue/M7 exit ramp	16	B	15	B
18	Woodstock Avenue/M7 entry ramp	8	A	9	A
19	Power Street/M7 entry ramp	2	A	1	A
20	Power Street/M7 exit ramp	10	A	10	A

ID	Intersection	AM peak hour		PM peak hour	
		Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
21	Rooty Hill Road North/M7 exit ramp	27	B	22	B
22	Rooty Hill Road North/Richmond Road/M7 entry ramp/M7 exit ramp	31	C	43	D
23	Richmond Road/M7 entry ramp	26	B	37	C

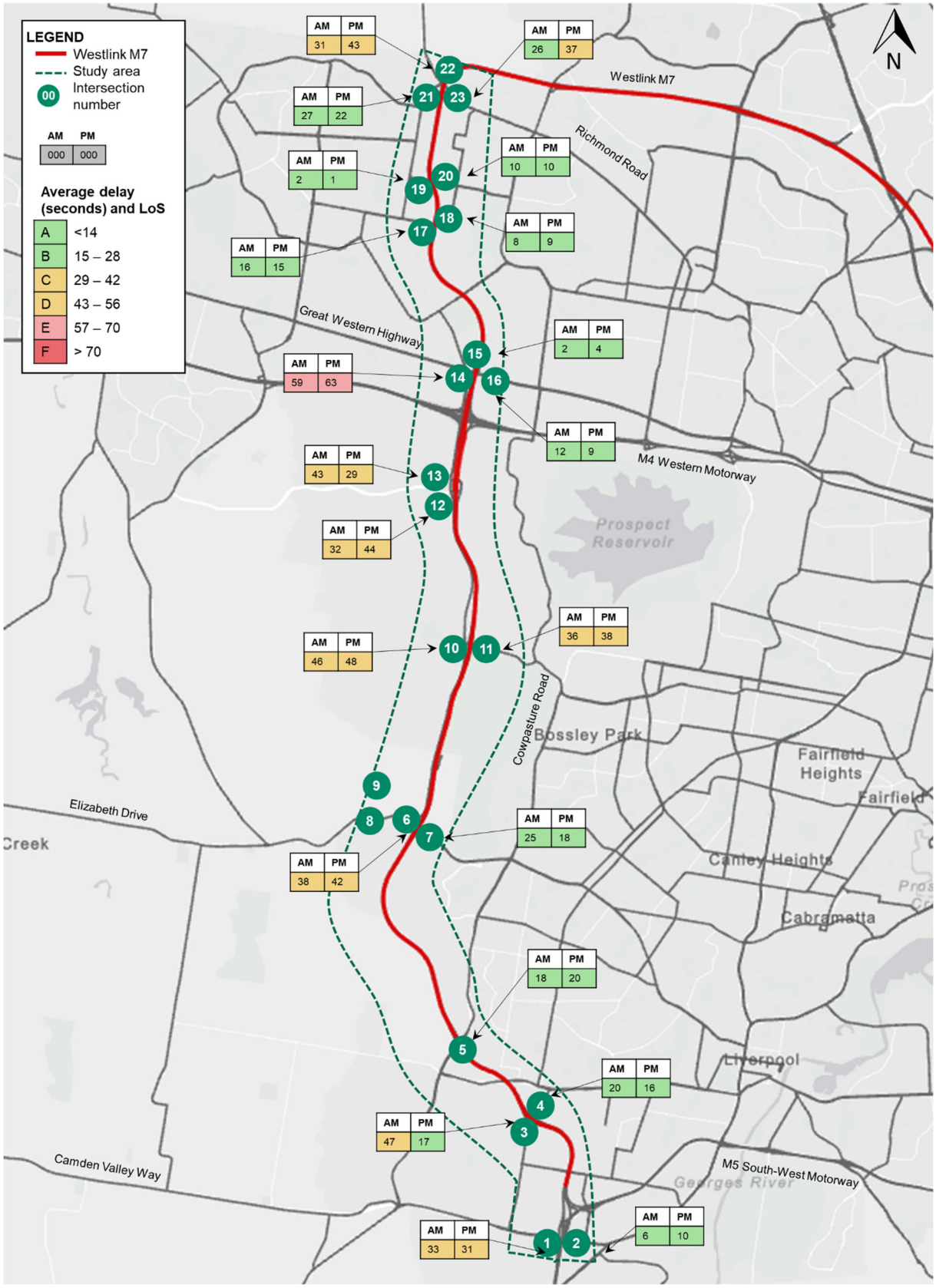


Figure 5-6 AM and PM peak hour intersection performance - 2021

5.9 Road safety and crash history

5.9.1 Westlink M7

Table 5-15 summarises the crash history for five years (1 October 2015 to 27 September 2020) along the Westlink M7 between Camden Valley Way and Richmond Road.

A total of 323 crashes were recorded along the Westlink M7, including:

- Four crashes resulting in a fatality (one per cent):
  - Two between Woodstock Avenue and Old Wallgrove Road
  - Two between The Horsley Drive and Cowpasture Road
- 181 crashes resulting in an injury (56 per cent)
- 138 crashes that did not result in an injury or fatality (43 per cent)
- The following common crash types occurred:
  - Nearly 46 per cent were rear end or same direction type crashes
  - Nearly 26 per cent were off road type crashes
  - Nearly 20 per cent were lane change or side-swipe type crashes.

In addition, approximately 30 per cent of crashes on the Westlink M7 involved at least one heavy vehicle.

Table 5-15 Westlink M7 historical crash data (October 2015 to September 2020)

#	Westlink M7 segment	Segment length (km)	Crashes by type			
			Fatal	Injury	Tow-away	Total
1	Camden Valley Way to Bernera Road	3.0	0	30	23	53
2	Bernera Road to Cowpasture Road	2.3	0	5	5	10
3	Cowpasture Road to Elizabeth Drive	5.4	1	30	19	50
4	Elizabeth Drive to The Horsley Drive	4.1	1	28	17	46
5	The Horsley Drive to Old Wallgrove Road	3.4	0	34	24	58
6	Old Wallgrove Road to Great Western Highway	2.5	1	20	20	41
7	Great Western Highway to Woodstock Avenue	3.7	1	11	9	21
8	Woodstock Avenue to Power Street	0.9	0	7	3	10
9	Power Street to Richmond Road	2.1	0	16	18	34
Total		**27.4**	**4**	**181**	**138**	**323**

Source: Data provided by Transport

iRAP rating

The international Road Assessment Programme (iRAP) provides a methodology to assess the safety potential of roads, including providing star ratings for roads based on this assessment. The star ratings provide a measure of the safety performance of the road infrastructure, and are derived from a Star Rating Score (SRS). The SRS and subsequent star rating are computed based on known relationships between road attributes and crash rates. This provides an objective measure of the relative likelihood of a crash occurring and its severity. A road awarded a 5-star rating would provide road users with the safest form of design standards regarding road cross-section, layout, roadside environment, and intersection design for the prevailing speed environment. A road with a 1-star rating would provide relatively poor road infrastructure design for the speed environment.

In 2021, Transurban carried out an assessment of all its road infrastructure in accordance with the iRAP methodology. For the Westlink M7, the review found that the motorway rating is:

- 5-star for 42 per cent northbound and 22 per cent southbound
- 4-star for 58 per cent northbound, 77 per cent southbound
- 3-star for two per cent southbound.

Crash severity index

Crash severity indices provide an assessment of road safety based on the type and number of crashes occurring on a route. Fatal, injury and tow-away crashes carry different weightings; they are determined independently of absolute traffic volumes and calculated to establish the average level of severity of crashes that occur. Figure 5-7 illustrates the formula used to calculate this index.

Crash Severity Index =

[(No. of fatal crashes * 3.0) + (No. of injury crashes * 1.5) + (No. of non-injury crashes)] / Total no. of crashes

Figure 5-7 Crash severity index formula

An analysis of the severity of crashes on Transurban roads, conducted by the Monash University Accident Research Centre (MUARC) in 2020 showed a crash severity index for the Westlink M7 of 1.28 during the 2017-18 period, compared to an average on similar non-Transurban roads of 1.35.

The study also found that the Westlink M7 had a fatal and serious injury (FSI) crash rate of 19 per billion VKT in the period 2017-18, compared to an FSI crash-rate of 104.7 per billion VKT for like non-Transurban roads. Therefore the crash risk along the Westlink M7 is lower than other similar roads.

5.9.2 Intersections

Table 5-16 summarises the crash history for five years (1 October 2015 to 27 September 2020) at the intersections within the study area. During the five-year period, a total 194 crashes were recorded at intersections within the study area.

The following four intersections each recording more than 20 crashes:

- Richmond Road and the Westlink M7
- Camden Valley Way and Westlink M7
- Great Western Highway and Wallgrove Road
- Cowpasture Road and Westlink M7.

The breakdown of the total number of crashes by type is as follows:

- 30 crashes resulted in serious injury (15 per cent)
- 43 crashes resulted in moderate injury (22 per cent)
- 52 crashes resulted in minor injury (27 per cent)
- 69 crashes resulted in no injury (36 per cent).

Of these crashes, the following common crash types occurred:

- Nearly 49 per cent were rear end type crashes
- Nearly 20 per cent have been classified as other type crashes
- Nearly 13 per cent were right through type crashes
- Nearly 10 per cent were off road type crashes
- Nearly 8 per cent were lane change or side-swipe type crashes.

Table 5-16 Historical crash data at adjacent intersections (October 2015 to September 2020)

Intersection	Crashes by type			
	Fatal	Injury	Tow-away	Total
Camden Valley Way and Westlink M7	0	21	7	28
Cowpasture Road and Westlink M7	0	14	9	23
Elizabeth Drive and Westlink M7	0	4	4	8
Elizabeth Drive and Wallgrove Road	0	5	1	6
The Horsley Drive and Westlink M7	0	2		2
The Horsley Drive and Wallgrove Road	0	4	4	8
Great Western Highway and Wallgrove Road	0	16	8	24
Great Western Highway and Westlink M7	0	5	3	8
Mini Link Road, Wallgrove Road and Westlink M7	0	5	4	9
Old Wallgrove Road, Wallgrove Road and Westlink M7	0	9	4	13
Woodstock Avenue and Westlink M7	0	7	6	13
Power Street and Westlink M7	0	6	3	9
Richmond Road and Westlink M7	0	20	11	31
Rooty Hill Road North and Westlink M7	0	7	5	12

6.0 Construction impact assessment

6.1 Construction strategy

Reference has been made to Chapter 4 (Proposed modification) of the Modification Report in preparing this report. Chapter 4 of that report describes an indicative approach to construction of the proposed modification, and outlines the proposed construction activities, working hours, ancillary facilities and requirements for potential road closures. A summary of the proposed modification's construction works is also discussed in the proposed modification description included in Section 2.0 of this report.

It is noted that the modification report has been prepared prior to the appointment of construction contractor(s). Therefore the construction strategy presented and assessed for the proposed modification provides an assessment of probable construction methodologies, while retaining flexibility for the construction contractor(s) to refine the construction methodology and detailed design following their appointment. This means that the detail of the design and construction approach presented in the modification report is indicative only and is subject to detailed design and construction planning.

6.1.1 Construction program

An indicative program of works for the proposed modification is provided in Table 6-1. The construction program shows construction activities commencing in 2023 and continuing through 2025.

The construction duration is driven primarily by the requirement to complete bridge widening works for select bridges to provide access for pavement widening.

Table 6-1 Indicative program of works for construction of the proposed modification

Key stage	Year		
	2023	**2024**	**2025**
Site establishment	X		
Utility works	X	X	
Bridge works	X	X	
Pavement works	X	X	X
Finishing works			X

The construction program for the M12 Motorway interface has been considered in the development of this program. As described in Section 4.3.14 of the modification report, it is proposed that the Westlink M7 widening works near the Elizabeth Drive and M12 Motorway interchanges would occur at the same time as the M12 Motorway project works to minimise disruption and potential construction fatigue associated with consecutive construction, as well as achieve efficiencies during construction.

6.1.2 Construction hours

Construction of the proposed modification would be undertaken during both standard and out of hours periods. Transport is also seeking approval for additional construction activity time at the start and end of each day (Monday to Friday) and Saturday afternoon, referred to as 'extended construction hours'.

The proposed extended construction hours are:

- Monday to Friday 6:00 am to 7:00 pm
- Saturday 8:00 am to 5:00 pm
- No work on Sundays or public holidays.

The exact timing of out of hours work would depend on construction activities, construction techniques, and constraints imposed by the affected communities or the relevant authorities and would be subject to the requirements of the construction contractor. The out of hours works could include:

- Monday to Friday 7:00 pm to 6:00 am
- Saturday 5:00 pm to 8:00 am
- All day Sunday
- No work on public holidays.

Any works that necessitate the closure of a carriageway, requiring off-motorway detours or contraflow traffic arrangements would occur out of hours.

It is proposed that construction occur up to seven nights a week (across different sections of the construction footprint). Where lane or carriageway closures are required, the closure would occur overnight.

Out of hours work would be expected to:

- Shorten the overall construction period. This would minimise the duration of construction activities and associated disruption to the surrounding communities and road network. Out of hours work would minimise adverse impacts on local and regional businesses during construction
- Reduce the public's exposure to changed traffic conditions during construction where the proposed modification interfaces with local roads and the existing motorway network, reducing the extent and duration of delays and potentially improving safety
- Minimise impacts on traffic flow and congestion, for example by limiting lane and carriageway closures and other temporary traffic impacts to periods of low traffic volumes (generally at night)
- Flexibility in working hours between various construction ancillary facilities would assist to minimise traffic entering ancillary facilities during peak periods. Appropriate communication with potentially affected community and stakeholders regarding out of hours works would be made.

For the purpose of this assessment, the following assumptions are made with regards to day shift and night shift activity:

- Worker arrival and departure hours would typically be:
  - Day shift arrivals between 6:00 am and 7:00 am
  - Day shift departures between 4:00 pm and 5:00 pm
  - Night shift arrivals between 5:00 pm and 6:00 pm
  - Night shift departures between 4:00 am and 5:00 am.
- Heavy vehicle activity would typically be spread out between:
  - Day shift - 7:00 am and 5:00 pm
  - Night shift – 8:00 pm and 12:00 am.

Further information relating to the proposed construction hours is included in Section 4.3.16 of the modification report.

6.1.3 Construction ancillary facilities

6.1.3.1 Overview

Construction ancillary facilities would be required at different locations across the construction footprint to support the construction of the proposed modification. These temporary facilities would include material and earthworks stockpiling areas, construction support areas for bridge widening locations, a main project office and compound areas, secondary offices and compounds located as needed along the length of the construction footprint, workshops for servicing plant and equipment, double-handling and laydown areas.

Construction ancillary facilities would include nine 'zone' and 67 'site' construction areas, the majority of which would be located within the median of the Westlink M7:

- 'Zone' construction ancillary facilities would likely serve as construction management offices for site-based personnel, and may also provide ablutions, change facilities, induction areas, material laydown and storage, car parking and shuttle bus pick up. Shuttle buses would be considered on an as needed basis based on staffing numbers to convey workers from the construction ancillary facilities to the construction sites, given most of the work would be within the median area.
- 'Site' construction ancillary facilities would be provided to accommodate ablutions, material laydown and storage areas and carparking for example. It is anticipated that these would be established within the median along the road widening and bridge construction areas. Larger site construction ancillary facilities would also be required at local road level for the larger multi-span bridge widening works.

A project management head office would also be established with central facilities for construction, space for clients, designers, construction contractor staff and independent verifiers. However, the project management head office site has not yet been identified. Therefore, the project management head office's traffic and transport impacts have not been assessed at this stage. These would need to be assessed by the appointed contractor.

The locations of the construction ancillary facilities are shown in Appendix B.

6.1.3.2 Construction staff car parking

The expected parking provision for each ancillary facility is included in Table 6-1. The on-site parking arrangements would be confirmed during detailed design by the appointed construction contractor.

Table 6-2 Overview of ancillary facilities by type

Ancillary facility type	Number of sites	Estimated parking provision per ancillary facility
Zone facilities	9	15-25 spaces
Site facilities	67	20-30 spaces
Project management office	1	25-35 spaces

6.1.3.3 Haulage, access, and traffic volumes

Haulage of construction materials to and from the project footprint would be via the Westlink M7, wherever possible. Where it is not possible to access the construction sites directly from the Westlink M7, haulage would occur via the ancillary facility access routes using roads in the adjoining residential/industrial areas. Some haulage would also take place within the construction footprint, generally within the central median.

Access to/from the ancillary facilities would be via the following roads:

- Westlink M7
- Ash Road (in Prestons)
- Jedda Road (in Prestons)
- Bernera Road (in Prestons)
- Yarato Road (in Hoxton Park)
- Wilson Road (in Hinchinbrook)
- Aviation Road (in Len Waters Estate)
- Blackbird Close (in Elizabeth Hills)
- Hoxton Park Road (in Hoxton Park and Hinchinbrook)
- Cowpasture Road (in Middleton Grange, Hinchinbrook and Hoxton Park)
- Dobroyd Drive (in Elizabeth Hills)
- Regentville Drive (in Elizabeth Hills)
- Redmayne Road (in Horsley Park)
- M12 haul road (approved as part of the M12 project) (in Cecil Park and Abbotsbury)
- Elizabeth Drive (in Cecil Park and Abbotsbury)
- Wallgrove Road (in Eastern Creek)

- Great Western Highway (in Eastern Creek)
- Mavis Street (in Rooty Hill)
- Rooty Hill Road South (in Rooty Hill)
- Woodstock Avenue (in Plumpton and Glendenning).

Further details are included in the following sections.

Access via the Westlink M7

It is anticipated that up to 50 ancillary facilities would be located within the Westlink M7 median, with direct access via the Westlink M7. The estimated traffic generation for each of these median facilities include:

- Up to 50 vehicle movements per hour during the extended work hours (occurring at shift start and end times) including:
  - Up to 40 light vehicle movements per hour
  - Up to 10 heavy vehicle movements per hour
- Up to 40 vehicle movements per hour during out of hours work:
  - Up to 30 light vehicle movements per hour
  - Up to 10 heavy vehicle movements per hour
- Up to 480 vehicle movements per day including:
  - Up to 320 light vehicle movements per day
  - Up to 160 heavy vehicle movements per day.

Table 6-3 shows that the ancillary facilities located within the Westlink M7 median would be spread along the length of the modification, with between four and eight facilities to be provided in each segment (refer to Table 5-2). However, it is anticipated that construction activity works would be staged such that less than 50 per cent of the ancillary facilities with access from the Westlink M7 would typically be active in each segment on any given day. Facilities located in adjacent segments wouldn't typically be active on the same day.

Therefore, it is estimated that each segment would carry up to an additional 2,000 vehicles per day or 200 vehicles per hour (approximately), as summarised in Table 6-3. Cumulative traffic volumes generated from ancillary facilities with access to/from various segments have not been considered, given that the activities would be spread along the length of the Westlink M7 corridor. Each vehicle would be expected to have varying origins and destinations which could be accessed by multiple routes, subject to the specific construction activities being undertaken on any given day.

The impacts associated with this additional traffic on the Westlink M7 is discussed in Section 6.3.1.1.

Table 6-3 Ancillary facilities with access via the Westlink M7

#	Westlink M7 segment	Number of facilities per segment	Daily construction vehicle estimates (vehicles)			Hourly construction vehicle estimates (vehicles)					
						Extended work hours			Out of hours		
			Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total
1	Camden Valley Way to Bernera Road	5	960	480	**1,440**	120	30	**150**	90	15	**105**
2	Bernera Road to Cowpasture Road	6	960	480	**1,440**	120	30	**150**	90	15	**105**
3	Cowpasture Road to Elizabeth Drive	8	1,280	640	**1,920**	160	40	**200**	120	20	**140**
4	Elizabeth Drive to The Horsley Drive	5	960	480	**1,440**	120	30	**150**	90	15	**105**
5	The Horsley Drive to Old Wallgrove Road	8	1,280	640	**1,920**	160	40	**200**	120	20	**140**
6	Old Wallgrove Road to Great Western Highway	4	640	320	**960**	80	20	**100**	60	10	**70**
7	Great Western Highway to Woodstock Avenue	6	960	480	**1,440**	120	30	**150**	90	15	**105**
8	Woodstock Avenue to Power Street	1	320	160	**480**	40	10	**50**	30	5	**35**
9	Power Street to Richmond Road	4	640	320	**960**	80	20	**100**	60	10	**70**

Ancillary facilities with access from the surrounding road network

Table 6-4 shows that up to 35 additional ancillary facilities with access via the surrounding road network would be required to facilitate the proposed works. These include a combination of ‘zone’ construction ancillary facilities and ‘site’ construction ancillary facilities near bridge widenings, as discussed in Section 6.1.3.

There is a lack of land available to support construction activity adjacent to the existing carriageway within the Westlink M7 lease area, such that larger construction ancillary facilities would be located on leased vacant, farmland, parkland, commercial office space or industrial land near the Westlink M7. It is proposed to use some construction ancillary sites approved under the M12 Motorway project which are located near the Westlink M7 at Cecil Hills. These construction ancillary facilities are referenced as AF8, AF17, AF18 and Zone B (approved under the M12 Motorway project as ‘AF9’). The proposed access routes for these facilities would be consistent with the M12 Motorway project approval.

The estimated vehicle movements and proposed access routes for each of the 35 facilities with access via the surrounding road network are also summarised in Table 6-4.

For the purpose of this assessment, the following is assumed with regards to the operation of these ancillary facilities with access to/from the surrounding road network:

- All ‘zone’ construction ancillary facilities would be operational on most days throughout the construction duration
- Less than 50 per cent of the ‘site’ construction ancillary facilities would be operational on any given day
- Less than 50 per cent of the ‘site’ construction ancillary facilities at each bridge widening area would be operational on any given day.

The impacts associated with this additional traffic using the surrounding road network is discussed in Section 6.3.1.2.

Table 6-4 Summary of ancillary facilities with access from the surrounding road network

Location	Ancillary facility name	Ancillary facility location	Proposed access route	Daily construction vehicle estimates			Hourly construction vehicle estimates					
							Work hours			Out of hours		
				Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total
Maxwell Creek	C2@B9817	330m north of Kurrajong Road	Westlink M7 shared path, Ash Road, Jedda Road	300	80	**380**	40	10	**50**	20	5	**25**
Bernera Road	C2@B9825 and C3@B9825	1km north of Kurrajong Road	Bernera Road	180	50	**230**	30	2	**32**	15	5	**20**
Cabramatta Creek	C2@B9826/27	580m south of Hoxton Park Drive	Westlink M7 shared path, Bernera Road	300	80	**380**	40	10	**50**	20	5	**25**
	C4@B9826/27	280m south of Hoxton Park Road	Yarato Road, Hoxton Park Road	320	160	**480**	40	10	**50**	30	5	**35**
Hoxton Park Road and Wilson Road	C2@B9829/30	South of Hoxton Park Road	Yarato Road, Hoxton Park Road	300	80	**380**	40	10	**50**	20	5	**25**
	C3@B9829/30	North side of Hoxton Park Road	Hoxton Park Road	300	80	**380**	40	10	**50**	20	5	**25**
	C4@B9829/30	150m north of Hoxton Park Road	Westlink M7 shared path, Wilson Road	300	80	**380**	40	10	**50**	20	5	**25**
	Zone A-1	North side of Hoxton Park Road	Construction zone, Wilson Road	490	120	**610**	70	20	**90**	40	0	**40**

Location	Ancillary facility name	Ancillary facility location	Proposed access route	Daily construction vehicle estimates			Hourly construction vehicle estimates					
							Work hours			Out of hours		
				Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total
	Zone A-2	1.1km north of Cowpasture Road	Aviation Road, Blackbird Close and Cowpasture Road	490	120	**610**	70	20	**90**	40	0	**40**
Hoxton Park Road	Zone D-2	345 Hoxton Park Road, Hinchinbrook	Hoxton Park Road	490	120	**610**	70	20	**90**	40	0	**40**
Cowpasture Road	C2@Cowpasture Road Bridge and C3@Cowpasture Road Bridge	At interchange with Cowpasture Road	Westlink M7 on/off ramp (at Cowpasture Road interchange)	180	50	**230**	30	2	**32**	15	5	**20**
Aviation Road	C2@B9839/40	1.5km north of Cowpasture Road	Aviation Road, Cowpasture Road	300	80	**380**	40	10	**50**	20	5	**25**
	Zone A-3	1.5km north of Cowpasture Road	Aviation Road, Cowpasture Road	490	120	**610**	70	20	**90**	40	0	**40**
Hinchinbrook Creek	C2@B9841/42	2.3km south of Elizabeth Drive	Westlink M7 shared path, Dobroyd Drive, Regentville Drive, Aviation Road, Cowpasture Road	300	80	**380**	40	10	**50**	20	5	**25**

Location	Ancillary facility name	Ancillary facility location	Proposed access route	Daily construction vehicle estimates			Hourly construction vehicle estimates					
							Work hours			Out of hours		
				Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total
No name bridge	C2@B9844/45	1.1km south of Elizabeth Drive	M12 haul road (approved for M12 project), Elizabeth Drive	180	50	**230**	30	2	**32**	15	5	**20**
	AF8 (site approved under M12 project)	800m south of Elizabeth Drive	M12 haul road (approved for M12 project), Elizabeth Drive	180	50	**230**	30	2	**32**	15	5	**20**
Elizabeth Drive/ M12	Zone B (site approved under M12 project as AF9)	460m north of Elizabeth Drive	M12 haul road (approved for M12 project), Elizabeth Drive	490	120	**610**	70	20	**90**	40	0	**40**
	AF18 (site approved under M12 project)	560m north of Elizabeth Drive	Wallgrove Road, Elizabeth Drive	490	120	**610**	70	20	**90**	40	0	**40**
	AF17 (site approved under M12 project)	720m north of Elizabeth Drive	Wallgrove Road, Elizabeth Drive	490	120	**610**	70	20	**90**	40	0	**40**
Redmayne Road	C2@B9858/59	470m north of The Horsley Drive	Redmayne Road, Wallgrove Road	320	160	**480**	40	10	**50**	30	5	**35**

Location	Ancillary facility name	Ancillary facility location	Proposed access route	Daily construction vehicle estimates			Hourly construction vehicle estimates					
							Work hours			Out of hours		
				Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total
Austral Bricks access	C2@B9861/62	738-780 Wallgrove Road, Horsley Park	Access road to Austral Bricks site, Wallgrove Road	180	50	**230**	30	2	**32**	15	5	**20**
Eastern Creek Waste Management access	C1@B9863/64 and C2@B9863/64	480m south of Old Wallgrove Road	Access road to existing SUEZ Eastern Creek waste management site, Wallgrove Road	320	160	**480**	40	10	**50**	30	5	**35**
Reedy Creek	C2@B9870/71	100m south of Mini Link Road	Westlink M7 off ramp (at interchange with Wallgrove Road)	320	160	**480**	40	10	**50**	30	5	**35**
Reedy Creek Tributary	C2@B9873/74	100m north of Old Wallgrove Road	Westlink M7 shared path, Wallgrove Road	180	50	**230**	30	2	**32**	15	5	**20**
Wallgrove Road	Zone C-3	600m south of M4 Motorway	Westlink M7 shared path, Wallgrove Road	490	120	**610**	70	20	**90**	40	0	**40**
Great Western Highway	C2@B9893/94	At interchange with Great Western Highway	Westlink M7 shared path, Great Western Highway	180	50	**230**	30	2	**32**	15	5	**20**

Location	Ancillary facility name	Ancillary facility location	Proposed access route	Daily construction vehicle estimates			Hourly construction vehicle estimates					
							Work hours			Out of hours		
				Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total	Light vehicles	Heavy vehicles	Total
Main Western Railway line	C1@B8245/9901 and C2@B8245/9901 (also referred to as bridge widening over rail bridge)	680m north of Eastern Road	Mavis Street, Rooty Hill Road South.	320	160	**480**	40	10	**50**	30	5	**35**
Woodstock Avenue	C2@B9902/03, C3@B9902/03 and C4@B9902/03	At Woodstock Avenue	Woodstock Avenue	180	50	**230**	30	2	**32**	15	5	**20**

Note: The project office location has not been identified and therefore associated traffic impacts have not been assessed.

6.2 Traffic management

The existing Westlink M7 traffic management system would be used extensively to manage traffic during construction, including temporary reductions in speed, lane closures and carriageway closures. This system may need to be augmented to suit the needs of construction traffic management. There would also be a need to integrate the construction traffic management with the existing operational traffic management, especially for incident management. This would require the construction contractor's traffic management personnel to work collaboratively with the Westlink M7 operators at the existing Motorway Control Centre.

Temporary road network changes are required to facilitate the construction of the proposed modification and the requirements of construction traffic and personnel. These would include, but not be limited to:

- Reduction in speed limits along the Westlink M7 from 100km/h to 80km/h, generally in the areas subject to and within the vicinity of the proposed modification (and lower speed limits outside of peak hours where feasible and reasonable)
- Temporary traffic diversions and lane closures on adjacent roads to allow for construction along the existing road alignment, particularly at bridge widening locations. These diversions and closures would occur outside of peak hours (where feasible and reasonable) and subject to the conditions of road occupancy licences
- Temporary closure of Westlink M7 carriageways with off motorway detours or contraflow arrangements. However, two lanes in each direction on the Westlink M7 would be maintained during peak traffic periods.

A Construction Traffic and Access Management Plan would be included in the Construction Environmental Management Plan (CEMP) to manage traffic impacts during construction. In preparing these plans, consideration would be given to:

- Minimising impacts on the existing traffic network (including the Westlink M7 and adjacent roads) capacity and performance during peak periods
- Maximising off-line/off-road work areas to allow for as much work as possible to occur during standard construction hours
- Minimising delays to motorists using this part of the arterial road network
- Undertaking the works efficiently to minimise the duration of traffic impacts along the existing Westlink M7
- Maintenance of the safety of motorists, cyclists, pedestrians, members of the public and construction personnel.

6.3 Impact assessment

6.3.1 Additional construction related traffic

6.3.1.1 Westlink M7

As discussed in Section 6.1.3.3, up to 50 ancillary facility sites are proposed to have access via the Westlink M7. An additional 2,000 vehicles per day or 200 vehicles per hour would be expected to use each of the Westlink M7 segments due to these proposed facilities. Existing traffic volumes and expected construction traffic volumes are summarised in Table 6-5. The construction traffic volumes represent an increase in traffic volumes on the Westlink M7 of up to two per cent per day or between one to three per cent during the peak hours. These traffic volume increases are minor and expected to be manageable given that they are within the realm of daily traffic variations typically experienced across Sydney's road network including the Westlink M7.

In addition, shuttle buses would be considered on an as needed basis to safely and efficiently convey workers from the zone construction ancillary facilities to the median sites. The use of shuttle buses would reduce the traffic volumes generated by the median sites and therefore further minimise impacts to the Westlink M7 operation.

Table 6-5 Existing Westlink M7 traffic volumes and proportional increases due to construction vehicles

#	Westlink M7 segment	Existing (2021) workday traffic volumes (vehicles)			Construction traffic volume estimates (vehicles)			
		Daily	AM peak hour	PM peak hour	Daily	%age change	Hourly	%age change
1	Camden Valley Way to Bernera Road	84,340	6,130	6,520	1,440	2%	150	2%
2	Bernera Road to Cowpasture Road	84,680	6,110	6,450	1,440	2%	150	2%
3	Cowpasture Road to Elizabeth Drive	85,820	5,940	6,460	1,920	2%	200	3%
4	Elizabeth Drive to The Horsley Drive	87,140	6,080	6,330	1,440	2%	150	2%
5	The Horsley Drive to Old Wallgrove Road	86,230	6,120	5,990	1,920	2%	200	3%
6	Old Wallgrove Road to Great Western Highway	84,170	5,900	6,080	960	1%	100	2%
7	Great Western Highway to Woodstock Avenue	80,020	6,160	6,210	1,440	2%	150	2%
8	Woodstock Avenue to Power Street	65,390	4,970	4,970	480	1%	50	1%
9	Power Street to Richmond Road	71,250	5,550	5,460	960	1%	100	2%

6.3.1.2 Surrounding road network

As discussed in Section 6.1.3, up to 35 ancillary facility sites are proposed to have access via the surrounding road network (not via Westlink M7). Table 6-6 summarises the construction traffic volume estimates that would use the surrounding road network to access each of the respective ancillary facilities and the percentage change from current traffic volumes (where available).

Table 6-6 Construction traffic volumes and proportional increases from existing traffic volumes

Potential access route	Daily construction vehicle estimates (vehicles)				Hourly construction vehicle estimates (vehicles)			
	Light	Heavy	Total	%age increase from 2021 [1]	Light	Heavy	Total	%age increase from 2021 [1]
Ash Road	300	80	**380**		40	10	**50**	
Jedda Road	300	80	**380**		40	10	**50**	
Bernera Road	300	80	**380**		40	10	**50**	
Yarato Road	320	160	**480**		40	10	**50**	
Wilson Road	490	120	**610**		70	20	**90**	
Aviation Road	790	200	**990**		110	30	**140**	
Blackbird Close	490	120	**610**		70	20	**90**	
Hoxton Park Road	705	220	**925**	3%	95	25	**120**	4%
Cowpasture Road	880	225	**1,105**	2%	125	31	**156**	3%
Dobroyd Drive	300	80	**380**		40	10	**50**	
Regentville Drive	300	80	**380**		40	10	**50**	
Redmayne Road	320	160	**480**		40	10	**50**	
M12 haul road [2]	490	120	**610**		70	20	**90**	
Elizabeth Drive	915	230	**1,145**	4%	135	32	**167**	7%
Wallgrove Road	698	235	**933**	6%	98	24	**242**	18%
Great Western Highway	180	50	**230**	1%	30	2	**32**	1%
Mavis Street	180	50	**230**		30	2	**32**	
Rooty Hill Road South	320	160	**480**		40	10	**50**	
Woodstock Avenue	180	50	**230**	1%	30	2	**32**	3%

[1] No data is available if cells are blank
[2] M12 haul road, as approved as part of the M12 project

Regional and local roads

The following Regional and local roads would be used by construction vehicles accessing adjacent ancillary facilities:

- Ash Road (industrial area)
- Jedda Road (industrial area)
- Bernera Road (industrial area)
- Yarato Road (unused road)
- Wilson Road (residential area access)
- Aviation Road (industrial area)
- Blackbird Close (industrial area)
- Dobroyd Drive (residential area)
- Regentville Drive (residential area)
- Redmayne Road (rural/farm area)
- Mavis Street (residential).

As shown in Table 6-6, most of the local and Regional roads are expected to carry approximately an additional 50 vehicles per hour. Most of these roads are in industrial areas, and therefore the additional construction related traffic volumes and minor increase to heavy vehicles would be expected to have minimal impact on the operation and safety of these roads. Construction activities at the ancillary facilities accessed via residential streets would be minimised as much as practical to limit adverse impacts on the adjacent residents. The minor increases to traffic volumes on these streets are expected to have minimal impact on the operation and safety of these roads.

Wilson Road, Aviation Road and Blackbird Close would experience the greatest impact due to additional traffic volumes accessing construction ancillary facilities. An additional 90 vehicles per hour are expected use Wilson Road and Blackbird Close and 140 additional vehicles per hour are expected to use Aviation Road due to the proposed construction ancillary facilities. Aviation Road and Blackbird Close are in an industrial area, and therefore the additional construction related traffic volumes and minor increase to heavy vehicles would be expected to have minimal impact on the operation and safety of these roads.

Wilson Road provides local access between Hoxton Park Road and the local residential area in Hinchinbrook. However, no residential properties have frontages to the southern section of Wilson Road which is planned to be used for access to/from the construction ancillary facility. Several community facilities have access and frontages to the southern section of Wilson Road. Therefore, use of Wilson Road as a construction facility access route should be coordinated to minimise concurrent timing with large gatherings that may occur at adjacent land-uses, to minimise the road network impacts of the Wilson Road access route.

State roads

The following State roads would be used by construction vehicles accessing adjacent ancillary facilities:

- Hoxton Park Road
- Cowpasture Road
- Elizabeth Drive
- Wallgrove Road
- Great Western Highway
- Woodstock Avenue.

Table 6-6 indicates that traffic volumes on these roads could increase by up to six per cent per day due to construction traffic accessing the ancillary facilities. For most locations, this would be expected to have minimal impact of the operation and safety of these roads given the existing traffic volumes and road network conditions.

However, peak hourly traffic volumes on Wallgrove Road and Elizabeth Drive could increase by up to 18 and seven per cent per hour, respectively. These are considered more significant traffic volume increases which are caused by the larger ‘zone’ ancillary facilities being accessed via these key roads. These traffic volume increases would likely result in increased peak period congestion and travel times along these roads.

Measures to minimise the traffic volumes on these roads during peak hours would be further investigated as part of the Construction Traffic and Access Management Plan to be developed by the appointed contractor. Measures for further consideration include:

- Modifying shift start and end times to minimise traffic generation coinciding with the road network peak hours
- Staggered shift times to minimise the hourly traffic generation
- Encouraging the use of alternative transport modes, carpooling, measures that minimise traffic generation associated with worker arrival, departures, and movements between sites.

6.3.2 Reduced speed limits on the Westlink M7

Reducing the posted speed limit on the Westlink M7 from 100 kilometres per hour to 80 kilometres per hour would result in a minor increase to travel times during off-peak periods of about four minutes. Travel times during peak periods are less likely to be affected due to the lower vehicle speeds and longer travel times that are currently experienced due to peak period congestion on the Westlink M7, as discussed in Section 5.8.3.

Some road users may choose to take alternative routes e.g., Wallgrove Road because of the lower posted speed limits on the Westlink M7 and increased travel times. However, this is expected mainly during the off-peak periods and/or at night when traffic flows across the surrounding network are usually free flowing and traffic volumes using the Westlink M7 are lower. Therefore, any off-peak traffic diversions could be catered for by the surrounding road network, without causing increased congestion.

The impacts of reduced speed limits on the Westlink M7 and associated traffic using alternative routes would be monitored throughout the construction period by the appointed contractor. This could include monitoring traffic volumes and change in patterns on the Westlink M7, at adjacent intersections and on the surrounding road network, as required.

6.3.3 Westlink M7 temporary road closures

Bridge widening works would require temporary lane closures and traffic detours on the Westlink M7. These traffic detours would only occur at night-time to allow critical construction activities that cannot otherwise be practically carried out without road or lane closures. Detour routes via the surrounding road network would be required due to road closures between the following Westlink M7 interchange locations:

- M5 Motorway and Bernera Road (in Prestons)
- Bernera Road and Cowpasture Road (in Prestons)
- Cowpasture Road and Elizabeth Drive (in Middleton Grange, Hinchinbrook, and Hoxton Park)
- Elizabeth Drive bridge (ramps would be maintained) (in Cecil Park and Abbotsbury)
- Elizabeth Drive and The Horsley Drive (in Cecil Park, Abbotsbury, and Horsley Park)
- The Horsley Drive and Old Wallgrove Road (in Horsley Park and Eastern Creek)
- Old Wallgrove Road and Great Western Highway (in Eastern Creek and Minchinbury)
- Great Western Highway and Power Street (in Eastern Creek, Minchinbury, Rooty Hill, Plumpton, and Bungarribee)
- Woodstock Avenue and Richmond Road (in Plumpton, Glendenning, and Oakhurst).

Table 6-7 includes a summary of the Westlink M7 temporary night-time road closures, anticipated detour routes and the existing Westlink M7 traffic volumes that would be affected.

For the purpose of this assessment, and based on the likely construction program, it is assumed that no more than one of these road closures would occur at the same time.

Up to 700 vehicles per hour including up to 180 heavy vehicles would use the identified detours in each direction, assuming the Westlink M7 closures would commence at 9:00 pm. Should the closures commence later at 10:00 pm, less than 550 vehicles per hour would use the identified detours. As shown in Figure 5-1 Westlink M7 traffic volumes are typically less than 500 vehicles per hour in each direction between 10:00 pm and 4:00 am.

Table 6-8 summarises the impacts of the required Westlink M7 closures on the respective detour routes, by comparing the estimated traffic volumes on the proposed detour routes during the night-time peak hours with the respective workday peak hour traffic volumes.

On most roads that would accommodate the detoured traffic, the estimated traffic volumes at 9:00 pm are less than or equal to the workday peak hour traffic volumes. Therefore, the surrounding road network and intersection performance during the Westlink M7 closures for most locations are expected to be similar to the existing workday peak hour performance, most of which perform with an overall LoS D or better as discussed in Section 5.8.5.

The estimated traffic volumes at 9:00 pm would be more than the workday peak hour traffic volumes at the following locations:

- Kurrajong Road
- The Horsley Drive
- Wallgrove Road
- Woodstock Avenue
- Power Street.

During Westlink M7 closures, the performance of the above-mentioned roads and their intersections would be similar to the performance experienced during a workday peak hour. If the Westlink M7 closures were to commence after 10:00 pm, the total traffic volumes would be lower and road network and intersection performance better than workday peak periods. Therefore, the construction contractor would investigate delaying commencement of some of these closures until 10:00 pm to minimise the impact to the surrounding road network. In addition, early communication of road closures is likely to result in travel behaviour changes. In particular, local drivers may consider alternative travel modes, travel times or travel routes at the time of the closures such that the overall traffic volumes using the detours would be less than the traffic volume estimates summarised in Table 6-7.

Table 6-7 Westlink M7 temporary road closures and detour routes

Westlink M7 segment closed (requiring detour)	Direction of travel	Detour description	Diverted Westlink M7 traffic volumes (vehicles)					
			9:00 pm to 10:00 pm			10:00 pm to 11:00 pm		
			Light	Heavy	Total	Light	Heavy	Total
Between M5 Motorway and Bernera Road	Northbound	Camden Valley Way, Old Kurrajong Road, Kurrajong Road, Bernera Road and Bernera Road entry ramp to Westlink M7	500	180	**680**	350	170	**520**
	Southbound	Westlink M7 exit ramp to Bernera Road, Bernera Road, Kurrajong Road and Camden Valley Way	440	180	**620**	290	170	**460**
Between Bernera Road and Cowpasture Road	Northbound	Westlink M7 exit ramp to Bernera Road, Bernera Road, Jedda Road, Joadja Road, Hoxton Park Road, Cowpasture Road and Cowpasture Road entry ramp to M7	520	170	**690**	350	160	**510**
	Southbound	Westlink M7 exit ramp to Cowpasture Road, Cowpasture Road, Hoxton Park Road, Joadja Road, Jedda Road, Bernera Road and Bernera Road entry ramp to Westlink M7	450	160	**610**	300	160	**460**
Between Cowpasture Road and Elizabeth Drive	Northbound	Westlink M7 exit ramp to Cowpasture Road, Cowpasture Road, Elizabeth Drive, Wallgrove Road, and Wallgrove Road entry ramp to Westlink M7	490	180	**670**	330	160	**490**
	Southbound	Westlink M7 exit ramp to Elizabeth Drive, Elizabeth Drive, Cowpasture Road and Cowpasture Road entry ramp to Westlink M7	480	160	**640**	320	160	**480**
Elizabeth Drive at the Westlink M7	Northbound	Westlink M7 exit ramp to Elizabeth Drive, Wallgrove Road, Wallgrove Road entry ramp to Westlink M7	510	180	**690**	350	160	**510**
	Southbound	Westlink M7 exit ramp to Elizabeth Drive, Elizabeth Drive (eastbound), Windsor Road (southbound), Windsor Road/Edinburgh Circuit/Sandringham Drive roundabout, Windsor Road (northbound) Elizabeth Drive (westbound) and Elizabeth Drive entry ramp to Westlink M7	520	170	**690**	330	170	**500**

Westlink M7 segment closed (requiring detour)	Direction of travel	Detour description	Diverted Westlink M7 traffic volumes (vehicles)					
			9:00 pm to 10:00 pm			10:00 pm to 11:00 pm		
			Light	Heavy	Total	Light	Heavy	Total
Between Elizabeth Drive and The Horsley Drive	Northbound	Westlink M7 exit ramp to Elizabeth Drive, Wallgrove Road, The Horsley Drive and The Horsley Drive entry ramp to Westlink M7	510	180	**690**	350	160	**510**
	Southbound	Westlink M7 exit ramp to The Horsley Drive, The Horsley Drive, Wallgrove Road, Elizabeth Drive and Elizabeth Drive entry ramp to Westlink M7	520	170	**690**	330	170	**500**
Between The Horsley Drive and Old Wallgrove Road	Northbound	Westlink M7 exit ramp to The Horsley Drive, The Horsley Drive, Wallgrove Road, and Wallgrove Road entry ramp to Westlink M7	540	170	**710**	370	150	**520**
	Southbound	Westlink M7 exit ramp to Wallgrove Road, Wallgrove Road, The Horsley Drive and The Horsley Drive entry ramp to Westlink M7	530	160	**690**	350	160	**510**
Between Old Wallgrove Road and Great Western Highway	Northbound	Westlink M7 exit ramp to Wallgrove Road, Wallgrove Road, Great Western Highway, Great Western Highway entry ramp to Westlink M7	510	160	**670**	340	130	**470**
Between Old Wallgrove Road and Power Street	Northbound	Westlink M7 exit ramp to Wallgrove Road, Wallgrove Road, Rooty Hill Road South, Francis Road, Railway Street, Duke Street, Woodstock Avenue, Rooty Hill Road North, Power Street and Power Street entry ramp to Westlink M7	510	160	**670**	340	130	**470**
	Southbound	Westlink M7 exit ramp to Power Street, Power Street, Rooty Hill Road North, Woodstock Avenue, Duke Street, Railway Street, Francis Road, Rooty Hill Road South, Wallgrove Road, and Wallgrove Road exit ramp to Westlink M7	490	120	**610**	310	130	**440**

Westlink M7 segment closed (requiring detour)	Direction of travel	Detour description	Diverted Westlink M7 traffic volumes (vehicles)					
			9:00 pm to 10:00 pm			10:00 pm to 11:00 pm		
			Light	Heavy	Total	Light	Heavy	Total
Between Woodstock Avenue and Power Street	Southbound	Westlink M7 exit ramp to Power Street, Power Street, Rooty Hill Road North, Woodstock Avenue, Woodstock Avenue entry ramp to Westlink M7	340	80	**420**	200	90	**290**
Between Woodstock Avenue and Richmond Road	Northbound	Westlink M7 exit ramp to Woodstock Avenue, Woodstock Avenue, Rooty Hill Road North, Richmond Road entry ramp to Westlink M7	450	110	**560**	260	70	**330**
	Southbound	Westlink M7 exit ramp to Richmond Road, Rooty Hill Road North, Woodstock Avenue, Woodstock Avenue entry ramp to Westlink M7	360	90	**450**	220	90	**310**

Table 6-8 Impacts of Westlink M7 closures on the surrounding road network

Location	Direction	Estimated traffic volumes during Westlink M7 closures (vehicles)							
		9:00 pm to 10:00 pm				10:00 pm to 11:00 pm			
		2021 traffic volumes	Detoured Westlink M7 traffic	Total	Percentage of peak hour traffic	2021 traffic volumes	Detoured Westlink M7 traffic	Total	Percentage of peak hour traffic
Kurrajong Road at Westlink M7	Eastbound	240	620	860	124%	180	460	640	93%
	Westbound	370	680	1,050	103%	280	520	800	78%
Hoxton Park Road	Eastbound	420	610	1,030	74%	270	460	730	53%
	Westbound	620	690	1,310	73%	460	510	970	55%
Cowpasture Road	Eastbound	890	690	1,580	57%	660	510	1,170	42%
	Westbound	1180	610	1,790	70%	950	460	1,410	55%
Elizabeth Drive	Eastbound	480	690	1,170	82%	420	500	920	65%
	Westbound	370	690	1,060	75%	300	500	800	57%
The Horsley Drive	Eastbound	220	690	910	103%	190	510	700	80%
	Westbound	170	710	880	154%	140	520	660	116%
Wallgrove Road	Eastbound	150	710	860	106%	130	520	650	80%
	Westbound	210	690	900	98%	210	510	720	78%
Great Western Highway	Eastbound	370	670	1,040	77%	320	470	790	58%
	Westbound	430	0 [1]	430	26%	380	0[1]	380	23%
Francis Road	Eastbound	380	610	990	102%	320	440	760	79%

Location	Direction	Estimated traffic volumes during Westlink M7 closures (vehicles)							
		9:00 pm to 10:00 pm				10:00 pm to 11:00 pm			
		2021 traffic volumes	Detoured Westlink M7 traffic	Total	Percentage of peak hour traffic	2021 traffic volumes	Detoured Westlink M7 traffic	Total	Percentage of peak hour traffic
	Westbound	380	670	1,050	96%	270	470	740	68%
Woodstock Avenue	Eastbound	150	670	820	116%	150	470	620	88%
	Westbound	140	610	750	101%	120	440	560	76%
Power Street	Eastbound	140	670	810	124%	110	470	580	89%
	Westbound	230	610	840	90%	180	440	620	66%
Rooty Hill Road	Eastbound	550	670	1,220	86%	400	470	880	62%
	Westbound	650	610	1,260	85%	510	440	950	64%

[1] Proposed detour routes do not travel westbound along Great Western Highway

6.3.4 Surrounding road network temporary road closures

In addition to the Westlink M7 closures, the construction of pier and abutment widening structures at bridge widening locations would require temporary lane closures and full road closures on the following roads:

- Hoxton Park Road and Wilson Road (in Hoxton Park and Hinchinbrook)
- Cowpasture Road (in Middleton Grange, Hinchinbrook and Hoxton Park)
- Elizabeth Drive (in Cecil Park and Abbotsbury)
- Great Western Highway (in Eastern Creek and Minchinbury)
- Woodstock Avenue (in Plumpton and Glendenning).

The above list does not account for temporary traffic management of other works including site establishment, utility adjustments, detention basin modifications and noise wall installation.

These road closures would typically be for short durations, at workday nights or on weekends. Temporary road closures would require vehicles to take detours along alternative routes for the duration of the closure.

Table 6-9 includes available alternative routes for these closures. Local detours are available for most of these road closures. However, no local detours are available for the Elizabeth Drive and Cowpasture Road closures. Therefore, strategic road diversions via the broader arterial road network would be needed to facilitate closure of these roads.

For the purpose of this assessment, it is assumed that road closures in close proximity to each other would occur at the same time. In particular, road closures at Hoxton Park Road and Cowpasture Road, (located approximately one kilometre from each other), would not occur at the same time.

Table 6-9 Surrounding road network closures - alternative routes

Road closure	Classification	Direction	Available alternative route
Hoxton Park Road	State road	Eastbound	Cowpasture Road, Kurrajong Road, Bernera Road, Jedda Road, Joadja Road
		Westbound	Joadja Road, Jedda Road, Bernera Road, Kurrajong Road, Cowpasture Road, Hoxton Park Road
Wilson Road	Local road	Northbound	Whitford Road, Topnot Avenue and Wilson Avenue
		Southbound	Topknot Avenue, Wilson Avenue and Hoxton Park Road
Cowpasture Road	State road	Eastbound	Limited local alternative routes available. Strategic detour would be required e.g. Hume Highway and Camden Valley Way
		Westbound	
Elizabeth Drive	State road	Eastbound	Limited local alternative routes available. Strategic detour would be required e.g. via Camden Valley Way, M4 Motorway or Great Western Highway
		Westbound	
Great Western Highway	State Road	Eastbound	Rooty Hill Road South, Eastern Road, Doonside Road, Great Western Highway
		Westbound	Doonside Road, Eastern Road, Rooty Hill Road South, Great Western Highway
Woodstock Avenue	State road/Regional road	Eastbound	Rooty Hill Road North, Power Street, Glendenning Road, Woodstock Avenue
		Westbound	Glendenning Road, Power Street, Rooty Hill Road North, Woodstock Avenue

It is understood that these road closures would occur at night and on occasional weekends. Table 6-10 includes the 2021 workday traffic volumes for the proposed road closure sites during the peak night-time construction hours. Similarly, Table 6-11 summarises the 2021 weekend peak hour traffic volumes at the same locations.

Table 6-10 and Table 6-11 also include a comparison of the existing traffic volumes during the workday night-time peak hours and weekend peak hour with the respective workday peak hour traffic volumes.

The detoured traffic volumes at night-time would vary significantly depending on the location. The Cowpasture Road closure would likely have the largest impact, with 1,100 to 1,800 vehicles to be detoured per direction at 9:00 pm. The contractor would seek to minimise the closure of Cowpasture Road closure as much as practical.

The operation and safety of all other roads with night-time road closures are expected to be manageable, with less than 500 vehicles to be detoured for each closure, representing 20 to 35 per cent of the workday peak hour traffic volumes.

Table 6-10 2021 workday traffic volumes at 9:00 pm and 10:00 pm

Road closure location	Direction	Estimated traffic volumes affected by road closures (vehicles)							
		9:00 pm to 10:00 pm				10:00 pm to 11:00 pm			
		Light	Heavy	Total	%age of workday peak hour	Light	Heavy	Total	%age of workday peak hour
Hoxton Park Road	Eastbound	400	20	420	30%	260	10	270	19%
	Westbound	600	20	620	35%	450	10	460	26%
Cowpasture Road	Eastbound	840	50	890	32%	630	30	660	24%
	Westbound	1,100	80	1,180	46%	890	60	950	37%
Elizabeth Drive	Eastbound	450	30	480	34%	400	20	420	29%
	Westbound	350	20	370	26%	290	10	300	21%
Great Western Highway	Eastbound	330	40	370	27%	290	30	320	24%
	Westbound	360	70	430	26%	320	60	380	23%
Woodstock Avenue	Eastbound	140	10	150	21%	140	10	150	21%
	Westbound	130	10	140	19%	110	10	120	16%

Table 6-11 shows that the weekend peak hour traffic volumes are higher than the workday night-time traffic volumes and represent about 50 to 80 per cent of the workday peak hour traffic volumes. Therefore, weekend road closures are expected to have a greater impact on the surrounding road network than the night-time closures. Therefore, weekend closures would be minimised as much as practical, by the contractor.

Table 6-11 2021 weekend peak hour traffic volumes

Road closure	Direction	Estimated traffic volumes affected by road closures (vehicles)			
		Light vehicles	Heavy vehicles	Total vehicles	Percentage of workday peak hour
Hoxton Park Road	Eastbound	860	40	900	65%
	Westbound	1,000	50	1,050	59%
Cowpasture Road	Eastbound	1,940	130	2,070	75%
	Westbound	1,840	110	1,950	76%
Elizabeth Drive	Eastbound	850	50	900	63%
	Westbound	860	50	910	64%
Great Western Highway	Eastbound	990	90	1,080	80%
	Westbound	970	100	1,070	65%
Woodstock Avenue	Eastbound	360	20	380	54%
	Westbound	390	10	400	54%

6.4 Public transport

6.4.1 Buses

The road closures discussed in Section 6.3.4 would affect bus services along the following roads:

- Hoxton Park Road (in Hoxton Park and Hinchinbrook)
- Cowpasture Road (in Middleton Grange, Hinchinbrook and Hoxton Park)
- Elizabeth Drive (in Cecil Park and Abbotsbury)
- Great Western Highway (in Easter Creek and Minchinbury).

Table 6-11 summarises the impacts of the proposed road closures on the existing bus services along these roads.

Assuming that road closures would typically occur between 9:00 pm and 4:00 am on a workday, several bus routes would not be affected by the workday road closures including services using The Horsley Drive and Elizabeth Drive (route 813), Elizabeth Drive (route 801), and Great Western Highway (route 723 on a weekend).

For all other locations, the contractor would be required to investigate the opportunities for road closures to occur outside the bus operating times. Alternatively, bus detour routes would be identified and agreed with Transport and bus operators during the planning for and prior to any road closures.

During weekend road closures, bus detours would be needed for closures. These bus detours would be developed during detailed design and would be agreed with Transport and bus operators.

In addition to the road closures, buses may also experience increased travel times and delays due to increased traffic congestion associated with the additional traffic volumes generated by the construction works, as discussed in Section 6.3.1.2.

Measures to minimise the traffic volumes on roads that are also used by buses, particularly during peak hours, would be further investigated as part of the Construction Traffic and Access Management Plan to be developed by the appointed contractor.

Table 6-12 Summary of bus services and potential impacts due to road closures

Road closure location	Route	Route description	Workday		Weekend	
			Hours of service	Impact	Hours of service	Impact
Hoxton Park Road	853	Liverpool to Carnes Hill via Hoxton Park Road	4:30am – 10:00pm	Services impacted. Detour routes required	6:00am – 10:00pm	Services impacted. Detour routes required
	854	Carnes Hill to Liverpool via Greenway Drive Hoxton Park Road	5:00am – 9:30pm	Services impacted. Detour routes required	6:30am – 9:00pm	Services impacted. Detour routes required
Cowpasture Road	827	Carnes Hill to Liverpool	4:30am – 11:30pm	Services impacted. Detour routes required	5:30am – 10:30pm	Services impacted. Detour routes required
Elizabeth Drive	801	Badgerys Creek to Liverpool	7:30am – 6:30pm	No impact	No services	No impact
The Horsley Drive and Elizabeth Drive	813	Bonnyrigg and Western Sydney Parklands to Fairfield	6:00am – 7:30pm	No impact	6:00am – 8:30pm	Services impacted. Detour routes required
Great Western Highway	723	Mount Druitt to Blacktown via Eastern Creek	5:00am – 9:30pm	Services impacted. Detour routes required	No services	No impact
	729	Mount Druitt to Blacktown via Minchinbury	5:00am – 11:00pm	Services impacted. Detour routes required	7:00am – 12:00am	Services impacted. Detour routes required

6.4.2 Rail

Rail possession would be required in one location during construction where the existing Westlink M7 bridge intersects the Main Western Railway Line near Rooty Hill Station (B8245/B9901). The works would occur during the available rail possession windows, in consultation with Transport and relevant stakeholders and therefore would have minimal impact on the rail network.

6.5 Active transport

To address potential safety risks to cyclists during construction, the proposed modification would introduce restrictions which would prohibit cycling on the Westlink M7 shoulder between the M5 Motorway and Richmond Road during both construction and operation. Cyclists would need to use the signed alternative route via the existing shared path or alternative routes across the surrounding road network.

In addition, construction of the proposed modification would require temporary closures of sections of the existing Westlink M7 shared path to support the following work:

- To allow for access to construction compounds and work zones to facilitate bridge widening work
- To allow for the construction or alterations to noise barriers at certain points along the Westlink M7.

The proposed Westlink M7 shared path closures and potential detour routes are summarised in Table 6-13. The identified detours would result in increased travel distances ranging between 200 meters and 1.3 kilometres for each closure. If multiple shared path closures occur simultaneously, travel distances would increase accordingly.

It is recognised that the Westlink M7 shared path has a variety of users including pedestrians and cyclists who use short sections of the shared path for local access, as well as cyclists that use long sections of the shared path to travel distances for commuting, training, and recreational purposes. The impact of the shared path closures and the respective detours would vary depending on the user, and the extent and duration of the closure. Users that do not rely on the shared path for access may use alternative routes (self-identified) if practical.

The timing, extent and duration of shared path closures and respective detours would be confirmed once the construction contractor has been appointed and would be influenced by the final construction methodology as well as feedback from stakeholders, councils and Transport . A pedestrian and cyclist management plan will be prepared by the construction contractor in consultation with stakeholders, councils and Transport and implemented to manage potential impacts during construction.

Table 6-13 also shows that if the identified shared path detours are adopted by the appointed contractor, improvements to the surrounding shared path/footpath network may be required to facilitate the detours:

- Bernera Road
- Jedda Road
- Hannibal Street
- Rooty Hill Road North.

Establishment of shared path detours would generally involve placement of signage and fencing to redirect pedestrians and cyclists.

Table 6-13 Westlink M7 shared path construction closures

ID	Westlink M7 shared path closed section	Detour description	Travel distance impact (meters)	Detour route assessment
1	Between Kurrajong Road and Bernera Road	Kurrajong Road and Bernera Road	300	Recommend upgrades to Bernera Road footpaths to facilitate detour
2	Between Ash Road and Bernera Road	Ash Road, Jedda Road, Bernera Road	700	Recommend improvements to Ash Road to facilitate detour and extension of Jedda Road shared path
3	Between Bernera Road and Hoxton Park Road	Jedda Road ramp, Joadja Road and Hoxton Park Road, Wilson Road	900	Uses existing shared path infrastructure
4	Between Hoxton Park Road and Cowpasture Road	Yarato Road, Hoxton Park Road, Cowpasture Road	1,100	Uses existing shared path infrastructure
5	Between Cowpasture Road and Elizabeth Drive	Cowpasture Road ramp and Elizabeth Drive ramp for M7 shared path	1,300	Uses existing shared path infrastructure
6	Between Old Wallgrove Road and Wonderland Drive	Old Wallgrove Road, Hannibal Street, Wonderland Drive	1,250	Recommend a new shared path to be constructed on Hannibal Street between Old Wallgrove Road and Wonderland Drive
7	Between Woodstock Avenue and Power Street	Woodstock Avenue, Rooty Hill Road North, and Power Street	400	Uses existing shared path infrastructure, except Rooty Hill Road North where footpath widening is recommended
8	Between Lamb Street and Florence Street	Lamb Street, Rooty Hill Road North, and Florence Street	200	Uses existing shared path infrastructure, except Rooty Hill Road North where footpath widening is recommended
9	Between Florence Street and Simms Road	Florence Street, Rooty Hill Road North, and Simms Road	800	Uses local roads with low traffic volumes, except Rooty Hill Road North where footpath widening is recommended
10	Between Florence Street/Woodley Crescent and Simms Road	Woodley Crescent, Armitage Drive and Simms Road	290	Uses local roads with low traffic volumes

6.6 Property access

The construction of pier and abutment widening structures at bridge widening locations would require temporary lane closures and full road closures on the following property access roads:

- Austral Bricks access road
- Suez Waste Management site access road.

Access closures would require temporary alternative driveways to be constructed prior to closures to provide continuity of access to affected properties.

6.7 On-street parking

No direct impacts to on-street parking have been identified due to the construction of the proposed modification. However, localised impacts to on-street parking may be identified during detailed design once the ancillary facilities and their designs are developed.

In addition, construction workers may use any available on-street parking. As part of the Construction Traffic and Access Management Plan, the contractor would develop a parking and access management plan and consider travel demand management measures to minimise the impacts of potential worker parking to the adjacent on-street parking and the residents and businesses that use these.

Table 6-14 summarises where on-street parking is permitted along the construction ancillary facility access routes discussed earlier in Section 6.3.1.2.

Table 6-14 On-street parking provisions along construction access routes

Potential access route	Adjacent land use	On-street parking permitted
Ash Road	Industrial	Yes
Jedda Road	Industrial	Yes
Bernera Road	Industrial	Yes - limited to the small section to the north of Jedda Road
Yarato Road	Unused	No
Wilson Road	Residential access road	Yes – to the north of the Westlink M7
Aviation Road	Industrial	Yes - west of Regentville Drive/Airfield Drive
Blackbird Close	Industrial	Yes
Hoxton Park Road	Various	No
Cowpasture Road	Various	No
Dobroyd Drive	Residential	Yes
Regentville Drive	Residential	Yes
Redmayne Road	Rural properties	No
M12 haul road	Vacant land	No
Elizabeth Drive	Various	No
Wallgrove Road	Various	No
Great Western Highway	Various	No
Mavis Street	Residential	Yes
Rooty Hill Road South	Residential	Yes
Woodstock Avenue	State	No

6.8 Road safety

There is an increased risk associated with construction traffic interacting with general traffic especially where the construction vehicles are entering and exiting ancillary facility sites. However, the severity of these risks would be reduced with reduced speed, particularly along the Westlink M7 which would have a reduced speed limit of 80 kilometres per hour.

Impacts on safety for all road users during construction would be further considered and managed through the requirement of the contractor to develop safe, effective traffic management plans and traffic control plans in consultation with Transport.

6.9 Cumulative impacts

Construction of the proposed modification would likely coincide with construction of the following projects:

- M12 Motorway including EDC
- Elizabeth Drive upgrade
- Richmond Road upgrade
- The Horsley Drive upgrade.

The interrelationships of these with the construction of the proposed modification are discussed further below.

6.9.1 M12 Motorway

The approved M12 Motorway project was granted planning approval in April 2021. The future M12 Motorway will intersect with the Westlink M7 near the Elizabeth Drive and Westlink M7 intersections, and includes the construction of a new M12/M7 interchange.

It is planned that the proposed widening of the Westlink M7 would be undertaken concurrently with the new interchange for the M12 Motorway by a single design and construct contractor. This would provide significant advantages compared to delivering these works separately, for example:

- A consistent approach can be applied to the detailed design of the interface works
- The M12 Motorway interchange construction ancillary facilities would be able to be shared for both works to minimise the need for extra construction ancillary facilities which would reduce potential environmental impacts
- Construction works can be planned to minimise the combined traffic impacts of M12 Motorway interchange and the proposed modification e.g. avoid conflicting requirements for access, traffic lane closures and nightworks
- The combined construction footprint of the M12 Motorway works and the proposed modification would provide more construction flexibility and space during construction. The M12 Motorway interchange works require extensive fill areas, potentially allowing material excavated from the proposed modification to be reused on the M12 site rather than exported off site for long term stockpiling or for disposal (subject to further investigation, construction planning and approval). This would allow for more efficient cut to fill operations as materials excavated on site can be taken to the M12 Motorway interchange site rather than relying on tip sites to be available at night
- Incident response can be more efficiently managed with a single design and construct contractor. Construction of the approved M12 Motorway, including its interchange with Westlink M7, would be subject to the relevant conditions of approval for that project.

Table 6-15 presents the estimated heavy vehicle volumes generated by the proposed modification and the M12 interchange works (Transport, 2020) at the shared construction ancillary sites. These sites either have access via Wallgrove Road or Elizabeth Drive. If both works occurred simultaneously without coordination to minimise impacts, up to 910 heavy vehicles per day or up to 112 heavy vehicles per hour could be expected on the surrounding network, distributed across Wallgrove Road and Elizabeth Drive. The cumulative impacts of these projects would likely include localised increased

congestion, poor intersection performance and reduced travel times resulting from the combined construction traffic generation of these projects.

However, as it is planned that the proposed widening of the Westlink M7 would be undertaken concurrently with the new interchange for the M12 Motorway by a single contractor, the cumulative construction works would be coordinated to minimise these impacts as much as practical.

It is noted that the M12 reporting did not include information relating to the light vehicle generation or the night time traffic generation at the shared ancillary facilities.

Table 6-15 Cumulative heavy vehicle traffic volumes

Site	Daily heavy vehicle estimates (two-way vehicles)			Work hour heavy vehicle estimates (two-way vehicles)		
	Proposed modification	M12 Motorway[1]	Combined	Proposed modification	M12 Motorway[1]	Combined
AF8	50	100	150	2	10	12
AF17	120	160	280	20	16	36
AF18	120	120	240	20	12	32
Zone B (AF9)	120	120	240	20	12	32
Total	410	500	910	62	50	112

1 Source: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSI-9364%2120200925T044334.213%20GMT, Transport, 2020

6.9.2 Adjacent road upgrades

The timing of construction of the Elizabeth Drive, Richmond Road and The Horsley Drive upgrade projects have not yet been announced. However, should construction of these projects coincide with construction of the proposed modification, the cumulative impacts would likely include localised increased congestion, poor intersection performance and reduced travel times resulting from the combined construction traffic generation of these projects.

Once the timing of these adjacent construction activities is known, Transport would coordinate these construction activities to minimise the extent of any localised cumulative impacts.

7.0 Operational impact assessment

This section provides an assessment of operational impacts from the proposed modification.

7.1 Road network

7.1.1 Traffic volumes and patterns

7.1.1.1 Wider transport network patterns

Figure 7-1 and Figure 7-2 show the TUSTM forecast difference in traffic volumes between the with modification and without modification scenarios for the 2026 AM and PM peak periods for the wider road network. The figures show only positive changes, i.e., where the expected traffic volumes with the proposed modification are higher than without the proposed modification by more than 100 vehicles.

The figures indicate that the change in traffic volumes associated with the proposed modification is largely restricted to the immediate intersecting roads between Camden Valley Way and Richmond Road.

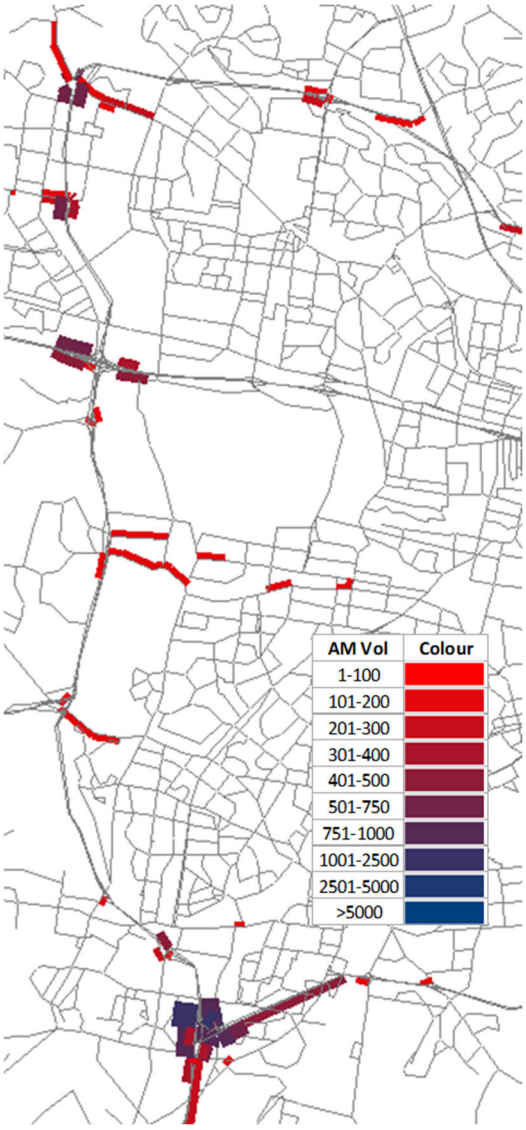


Figure 7-1 Change in traffic volumes in 2026 for the with and without the proposed modification – AM peak period

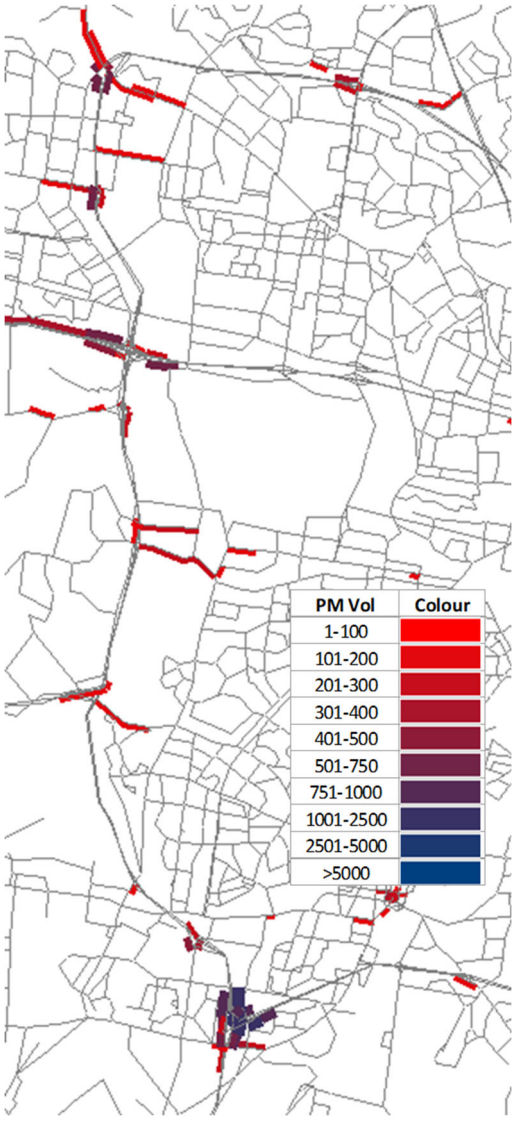


Figure 7-2 Change in traffic volumes in 2026 for the with and without the proposed modification - PM peak period

7.1.1.2 Westlink M7

The forecast traffic volumes along the Westlink M7 in 2026 and 2036 with the proposed modification are compared to those without the project modification. The comparisons are described and shown in Figure 7-3 and Figure 7-4.

Without the proposed modification traffic volumes along the Westlink M7 are forecast to increase from approximately 80,000 vehicles per workday in 2021 to approximately 90,000 vehicles per workday in 2026 (average across the nine segments) and 100,000 vehicles per workday in 2036.

In 2026, the Westlink M7 is anticipated to carry an additional 2,000 to 8,500 vehicles per workday in each direction with the proposed modification compared to without the modification. That is an additional five to 10 per cent vehicles per workday, depending on the Westlink M7 segment.

Similarly, in 2036, the Westlink M7 is anticipated to carry an additional 3,000 to 14,500 vehicles per workday with the proposed modification compared to without the modification. That is an additional five to 30 per cent vehicles per workday, depending on the Westlink M7 segment.

These increases in traffic with the modification are as a result of the Westlink M7 drawing traffic in from the surrounding network.

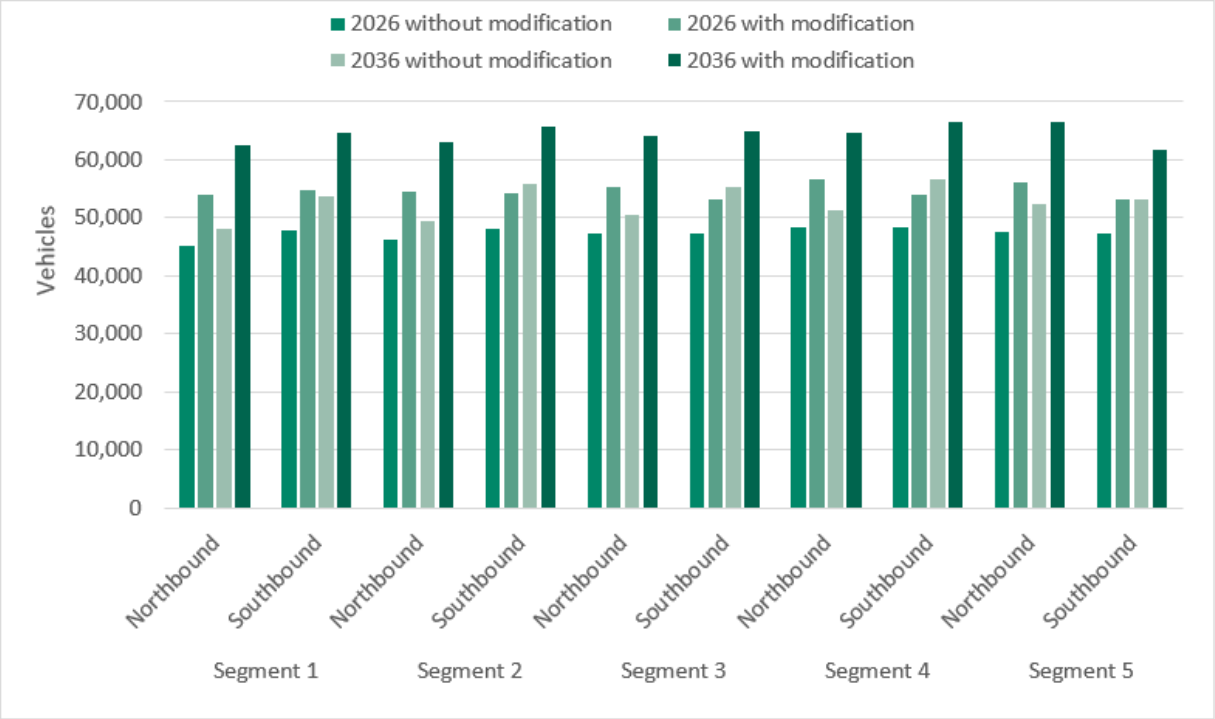


Figure 7-3 Workday traffic volume comparisons in 2026 and 2036 for Westlink segments 1 to 5

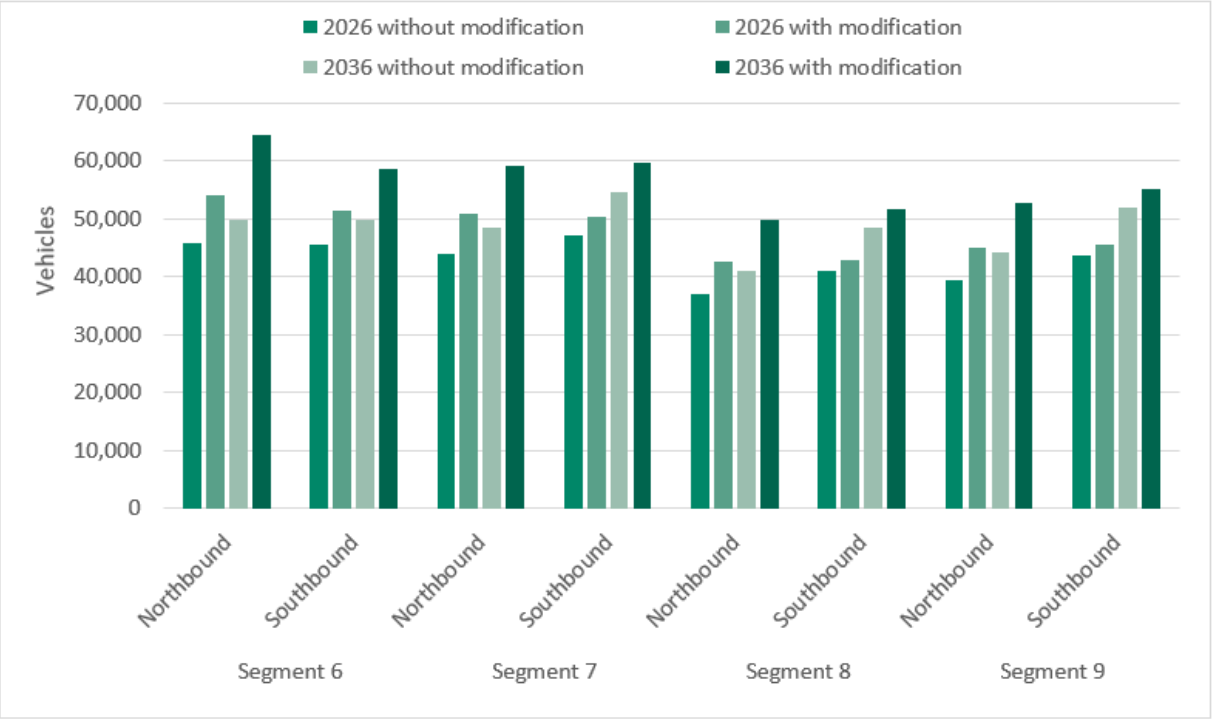


Figure 7-4 Workday traffic volume comparisons in 2026 and 2036 for Westlink segments 6 to 9

7.1.2 Network performance

Table 7-1 compares the forecast network performance statistics for the operational model area with and without the proposed modification in 2026 and 2036.

Without the proposed modification, the Westlink M7 would progressively get more congested in 2026 and 2036 due to background traffic growth. The harmonic speed would decrease from 70 kilometres per hour in 2021 to less than 60 kilometres per hour in 2036. Similarly the total number of stops would increase from nearly 170,000 in 2021 to around 380,000 stops in 2036.

The network performance would substantially improve with the proposed modification in both 2026 and 2036 based on the following findings:

- Vehicle kilometres travelled would increase by approximately 11 per cent and 13 per cent in 2026 and 2036, respectively
- The total serviced demand would increase by approximately 23,500 and 31,700 vehicles (10 and 12 per cent) in 2026 and 2036, respectively
- Vehicle hours travelled would decrease by approximately 2,000 and 9,000 hours (5 and 15 per cent) in 2026 and 2036, respectively. This suggests that vehicles would spend significantly less time on the network with the proposed modification
- The harmonic mean speed would increase by 8 and 16 kilometres per hour (11 and 28 per cent) in 2026 and 2036, respectively
- The network density would decrease by 3 and 5 vehicles per kilometre (22 and 30 per cent) in 2026 and 2036, respectively
- The total number of stops would decrease by approximately 98,000 and 207,000 (55 and 54 per cent) in 2026 and 2036, respectively. This suggests that traffic conditions would be less stop-start with the proposed modification.

Based on the above, the additional capacity that the proposed modification would offer would substantially improve the overall network performance of the Westlink M7 corridor.

Table 7-1 Average workday model network performance statistics

Network performance statistics	2026				2036			
	Without modification	With modification	Difference		Without modification	With modification	Difference	
Total serviced demand (vehicles)	235,369	258,917	23,548	10%	262,954	294,695	31,741	12%
VKT (million)	3.19	3.54	0.35	11%	3.60	4.09	0.49	13%
VHT (hours)	43,487	41,119	-2,367	-5%	60,645	51,762	-8,884	-15%
Harmonic mean speed (km/h)	71	79	8	11%	57	73	16	28%
Density (vehicles/km)	12	9	-3	-22%	16	12	-5	-30%
Total number of stops	177,925	80,182	-97,743	-55%	384,713	178,058	-206,655	-54%

7.1.3 Travel times and average speed

Table 7-2 displays the differences in AM peak hour and PM peak hour travel times for the Westlink M7 corridor between the M5 Motorway and Richmond Road. Without the proposed modification, the travel times would increase for all scenarios between 2021, 2026 and 2036, due to increased background traffic growth and associated congestion.

Figure 7-5 also shows that the travel times would significantly decrease in 2026 and 2036 with the proposed modification when compared to the scenario without the proposed modification (by 10 to 45 per cent). The travel times with the proposed modification would generally be similar in 2026 to 2036, except for southbound traffic in the PM peak hour - the forecast travel times in 2036 are expected to be nearly seven minutes slower than in 2026.

Table 7-2 AM and PM peak hour travel time between M5 Motorway and Richmond Road with and without the modification

Peak hour	Direction	Travel time (minutes)								
		2021	2026				2036			
			Without modification	With modification	Difference		Without modification	With modification	Difference	
AM	Northbound	26	27	19	-8	-30%	27	19	-8	-28%
	Southbound	22	18	16	-2	-9%	23	21	-2	-9%
PM	Northbound	25	28	18	-9	-34%	28	20	-8	-28%
	Southbound	27	30	16	-13	-45%	34	23	-12	-34%

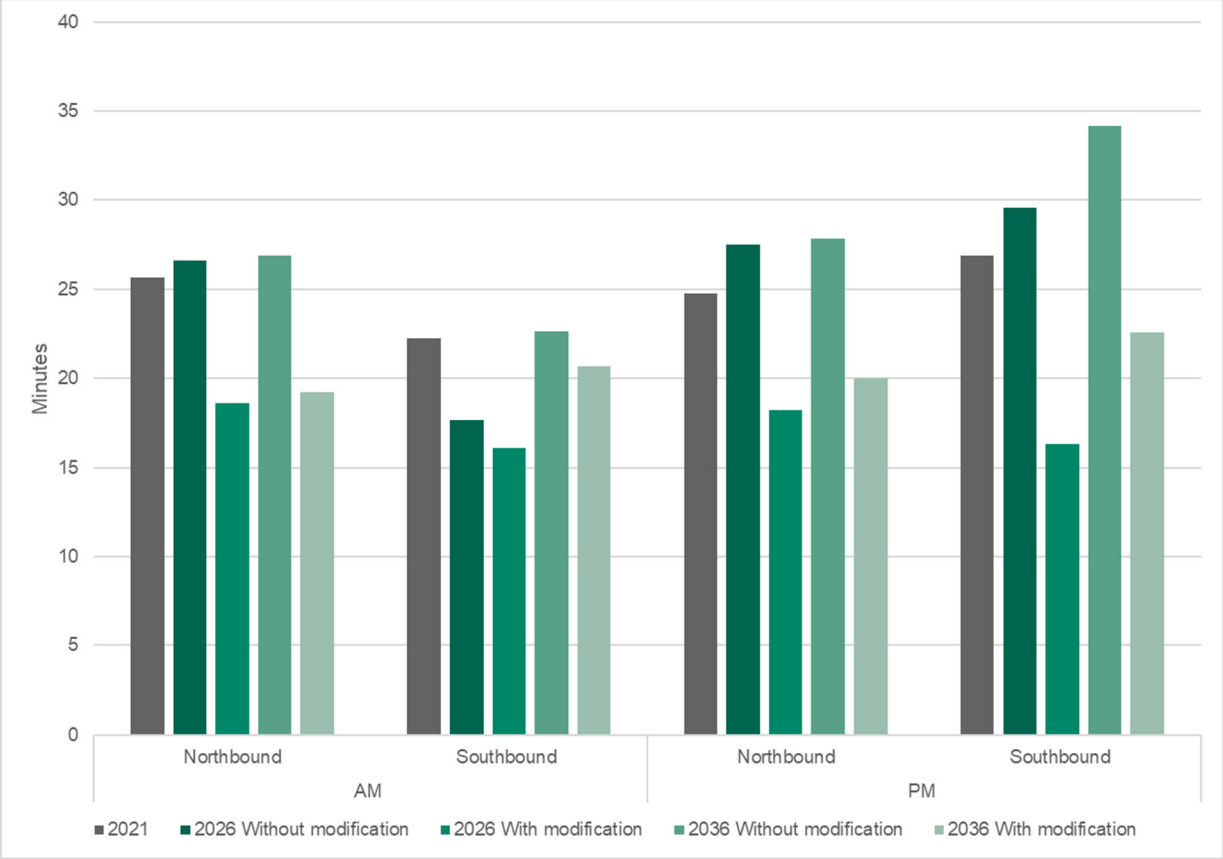


Figure 7-5 Travel time comparison – 2026 and 2036 with and without proposed modification

Hourly average speeds for the Westlink M7 segments were obtained from the operational model for 2026 and 2036 with and without the proposed modification.

In 2026 without the proposed modification, vehicle speeds for northbound traffic are expected to slow to between 25 and 50 kilometres per hour throughout the AM and PM peak periods at the southern extent of the study area between the M5 Motorway and Elizabeth Drive. Similar vehicle speeds are expected in 2036 without the proposed modification albeit extending across most of day. These vehicle speeds would increase in 2026 and 2036 with the proposed modification, including:

- Between 85 and 100 kilometres per hour throughout the day for segments between the M5 Motorway and Cowpasture Road
- Between 65 and 80 kilometres per hour throughout the day for segments between Cowpasture Road and Elizabeth Drive.

Beyond the study area at Abbot Road, vehicle speeds for northbound traffic are also expected to slow to between 45 and 60 kilometres per hour during the AM peak period in 2026 without the proposed modification. These vehicle speeds would further decrease in 2036 without the proposed modification to between 25 and 60 kilometres per hour. These low traffic speeds are a result of a bottleneck located north-east of Richmond Road at the Abbot Road ramps. With the proposed modification, northbound vehicle speeds at Abbott Road would further reduce, due to the increased traffic demands expected with the proposed modification, as the proposed modification would remove another bottleneck near Elizabeth Drive, which allows more traffic to approach Abbot Road . This downstream bottleneck would also result in vehicle speeds between Power Street and Richmond Road slowing to between 40 and 60 kilometres per hour during the AM peak hour in 2036 with the proposed modification.

For southbound traffic, vehicle speeds are expected to slow to between 50 and 70 kilometres per hour in 2026 without the proposed modification, particularly during the workday AM and PM peak periods and for the segments between the M5 Motorway and the Great Western Highway.

In 2036, southbound vehicle speeds in this segments would further reduce to between 15 and 60 kilometres per hour for most of the day.
These southbound vehicle speeds would substantially increase to between 80 and 95 kilometres per hour throughout the day with the proposed modification in 2026 and 2036 except at the southern extent of the corridor. Between the M5 Motorway and Bernera Road vehicles speeds would slow to between 25 and 50 kilometres per hour during the AM peak period.

Overall, the proposed modification would improve vehicle speeds for the sections that would be widened. However, vehicle speeds for the northern and southern extents outside the proposed widening would experience increased traffic demands, as more vehicles would be attracted to the Westlink M7 with the proposed modification. This would result in slower vehicle speeds in the areas outside the proposed modification.

In addition to the travel time savings and increased vehicle speeds discussed above, the proposed modification would also deliver improvements in travel time reliability on the Westlink M7. This benefit would be derived in two parts:

- The increased lane capacity provided by the proposed modification would result in a smoother traffic flow without the stop / start conditions currently experienced.
- The additional lanes would also provide spare capacity so that traffic should be delayed to a lesser extent by minor incidents such as break downs and minor crashes.

7.1.4 Roadway level of service

Figure 7-6 and Figure 7-7 present the level of service and density for the nine assessed segments along the Westlink M7, for the workday AM and PM peak hours in 2026 and 2036 comparing the with and without the proposed modification scenarios. The LoS would improve for some segments or be maintained with the proposed modification.

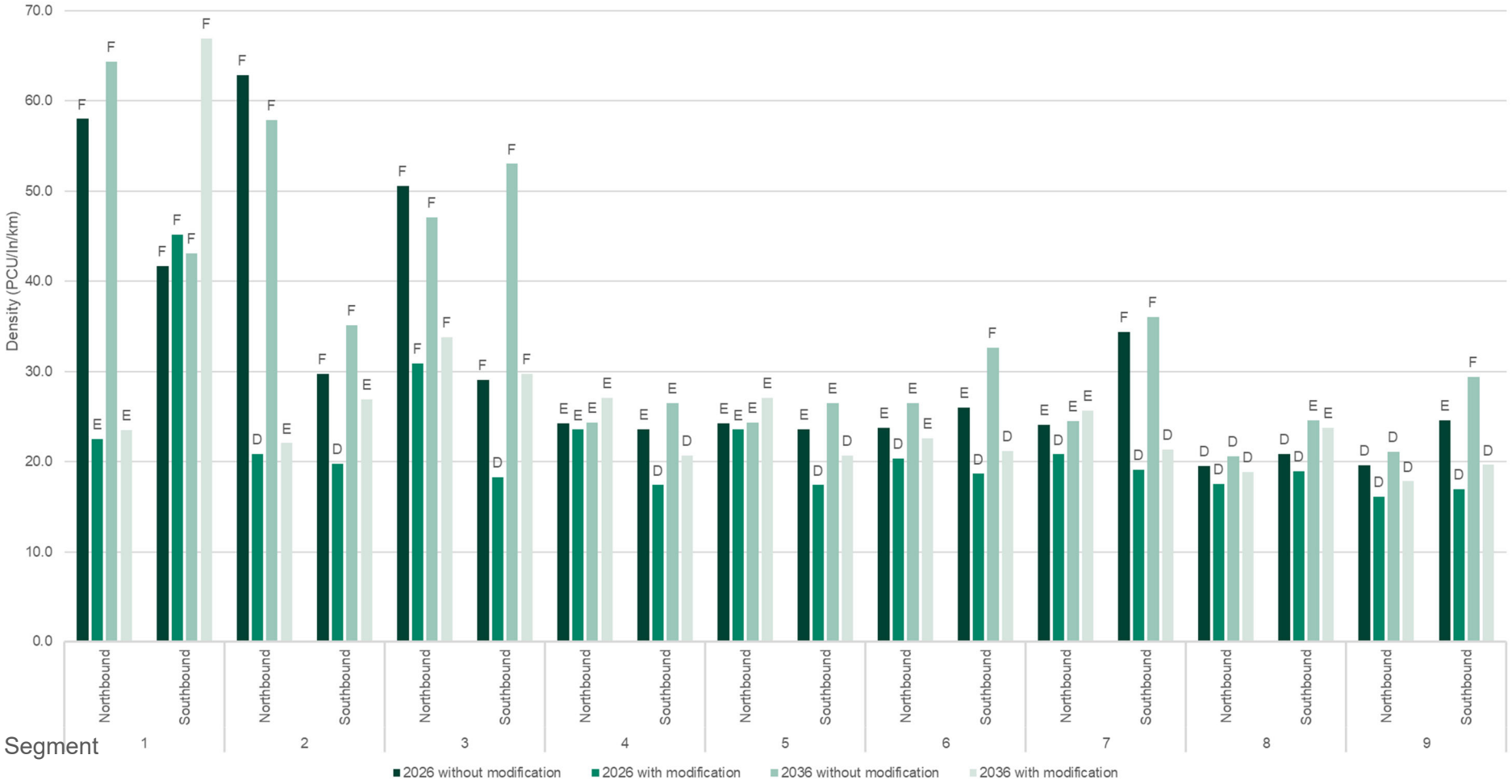


Figure 7-6 Modelled mid-block level of service and density for the AM peak hour for 2026 and 2036 with and without modification

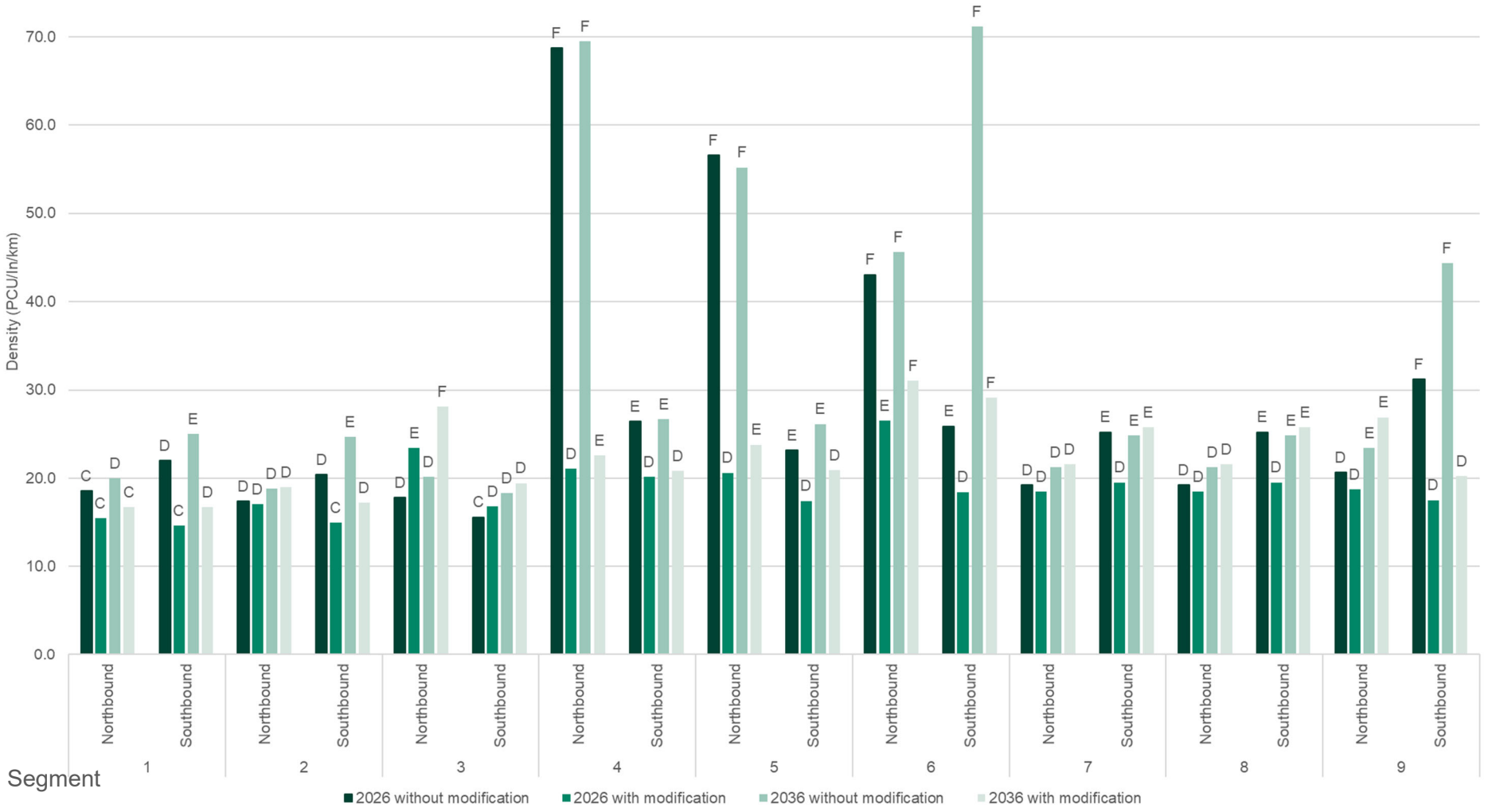


Figure 7-7 Modelled mid-block level of service and density for the PM peak hour for 2026 and 2036 with and without modification

7.1.5 Intersection performance

The modelled future intersection performance for key intersections within the study area with and without the proposed modification are compared in Table 7-3 and Table 7-4 and also Figure 7-8 and Figure 7-9 for the 2026 and 2036 workday AM and PM peak hours.
It is noted that in general, 2021 cycle times were adopted for the 2026 assessment and optimised signal settings were applied for the 2036 assessment.
Nine of the 23 study intersections would operate at an unsatisfactory LoS E or worse by 2026 and/or 2036 without the proposed modification, reflecting forecast traffic demands that exceed available capacity at most of these intersections for the AM or PM peak hours.
The following intersections would operate at LoS E or worse without the proposed modification due to forecast traffic growth:

- AM peak
    - Camden Valley Way/M7/M5 northbound entry ramp/M31 exit ramp would operate at an unsatisfactory LoS F by 2036
    - Bernera Road/Yarrawa Street/M7 exit ramp/M7 entry ramp would operate at an unsatisfactory LoS E by 2026
    - Cowpasture Road/M7 exit ramp/M7 entry ramp would operate at an unsatisfactory LoS E by 2026, and decline to LoS F by 2036
    - The Horsley Drive/Wallgrove Road would operate at an unsatisfactory LoS E by 2026, and decline to LoS F by 2036
    - Great Western Highway/Rooty Hill Road South/Wallgrove Road would operate at an unsatisfactory LoS E by 2026, and decline to LoS F by 2036
    - Rooty Hill Road North/Richmond Road/M7 entry ramp/M7 exit ramp would operate at an unsatisfactory LoS F by 2026, and continue to operate at a similar LoS by 2036.
- PM peak
    - Camden Valley Way/M5 southbound exit ramp would operate at an unsatisfactory LoS F by 2036
    - The Horsley Drive/Wallgrove Road would operate at an unsatisfactory LoS E by 2036
    - Great Western Highway/Rooty Hill Road South/Wallgrove Road would operate at an unsatisfactory LoS E by 2036
    - Rooty Hill Road North/M7 exit ramp would operate at an unsatisfactory LoS E by 2036
    - Rooty Hill Road North/Richmond Road/M7 entry ramp/M7 exit ramp would operate at an unsatisfactory LoS F by 2036
    - Richmond Road M7 entry ramp would operate at an unsatisfactory LoS F by 2036

Most intersections would continue to operate with the same LoS in both 2026 and 2036 with and without the proposed modification. The LoS at the following seven intersections would decline from a satisfactory level (LoS A to D) to an unsatisfactory level (LoS E or F) due to the proposed modification:

- AM peak
  - Bernera Road/Yarrawa Street/M7 exit ramp/M7entry ramp – traffic demand for the Westlink M7 exit ramp would increase with the proposed modification, resulting in increased delays for the opposing northbound traffic on Bernera Road, which would result in the intersection's performance declining from LoS C without the proposed modification to LoS F with the proposed modification in 2036
  - Old Wallgrove Road/Wallgrove Road/M7 entry ramp/M7 exit ramp – minor increase to traffic demand for the Westlink M7 with the proposed modification would result in the intersection's performance declining from LoS D without the proposed modification to LoS E with the proposed modification in 2036
  - Rooty Hill Road North/M7 exit ramp – increased delays to the southern leg (Rooty Hill Road North) due to the proposed modification would result in the intersection's performance declining from LoS D without the proposed modification to LoS E with the proposed modification in 2036.
- PM peak
  - Cowpasture Road/M7 exit ramp/M7 entry ramp - traffic demand for the Westlink M7 ramps would increase with the proposed modification resulting in the in the intersection's performance declining from LoS D without the proposed modification to LoS F with the proposed modification in 2036
  - The Horsley Drive/Wallgrove Road/M7 entry Ramp/M7 exit ramp – minor increase to traffic demand for the Westlink M7 with the proposed modification would result in a marginal increase to intersection delay and the intersection's LoS would decline from D without the proposed modification to LoS F with the proposed modification in 2026 and LoS D without the proposed modification to E with the proposed modification in 2036. Future road network improvements planned for The Horsley Drive would likely improve the performance of this intersection in the future
  - Great Western Highway/Rooty Hill Road South/Wallgrove Road – minor increase to traffic demand for the Westlink M7 with the proposed modification would result in a marginal increase to intersection delay and the intersection's LoS would decline from D without the proposed modification to LoS E with the proposed modification in 2026
  - Rooty Hill Road North/M7 exit ramp – increased demand for the Westlink M7 with the proposed modification would result in the intersection's performance declining from LoS B without the proposed modification to LoS E with the proposed modification in 2026. Future road network improvements planned for Richmond Road would likely improve the performance of this intersection in the future.
  - Rooty Hill Road North/Richmond Road/M7 entry ramp/M7 exit ramp – increased demand for the Westlink M7 with the proposed modification would result in a marginal increase to intersection delay and the LoS reducing from D without the proposed modification to E with the proposed modification in 2026. Future road network improvements planned for Richmond Road would likely improve the performance of this intersection in the future.

Five of these seven intersections would operate with an unsatisfactory LoS in either the AM or PM peak hours in 2026 and/or 2036 without the proposed modification. As indicated in Section 4.4.5.5.4 limited road capacity and high demand mean that LoS E and F are regularly experienced by Sydney motorists at pinch points on the existing strategic road network in during peak periods. Therefore, the widening would bring forward the need to consider solutions to cater for forecast increases in traffic volumes associated with population and employment growth and to a lesser degree the proposed modification in the following seven locations:

- Bernera Road/Yarrawa Street/M7 exit ramp/M7 entry ramp
- Cowpasture Road/M7 exit ramp/M7 entry ramp due to poor performance with and without the proposed modification in the AM peak hour
- The Horsley Drive/Wallgrove Road – already under consideration as discussed in Section 3.4.1
- Great Western Highway/Rooty Hill Road South/Wallgrove Road due to poor intersection performance with and without the proposed modification in the PM peak hour
- Old Wallgrove Road/Wallgrove Road/M7 entry ramp/M7 exit ramp due to the proposed modification's impact during the AM peak hour in 2036
- Rooty Hill Road North/M7 exit ramp and Rooty Hill Road North/Richmond Road/M7 entry ramp/M7 exit ramp – already under consideration as discussed in Section 3.4.

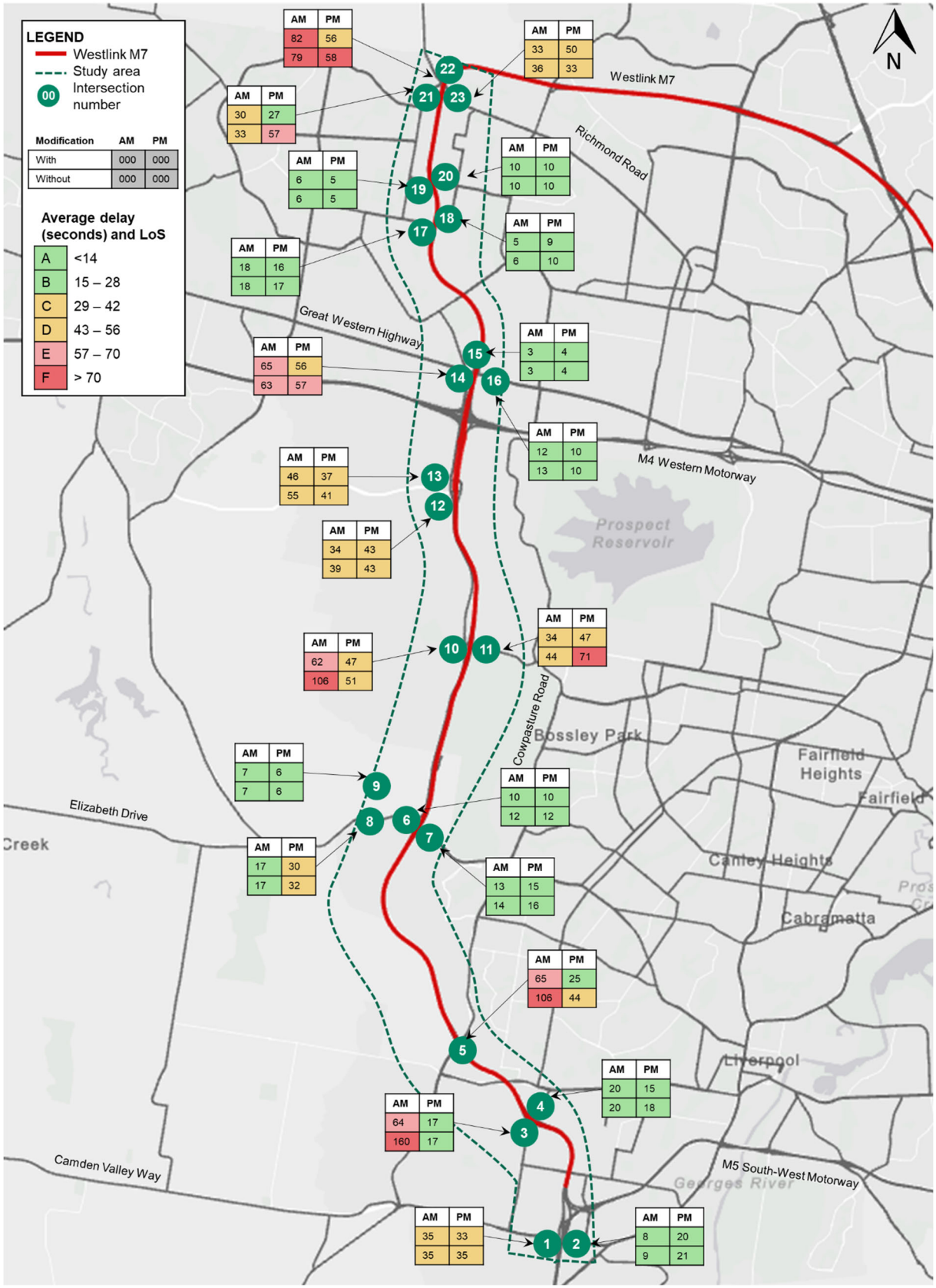


Figure 7-8 AM and PM peak hour intersection performance with and without proposed modification - 2026

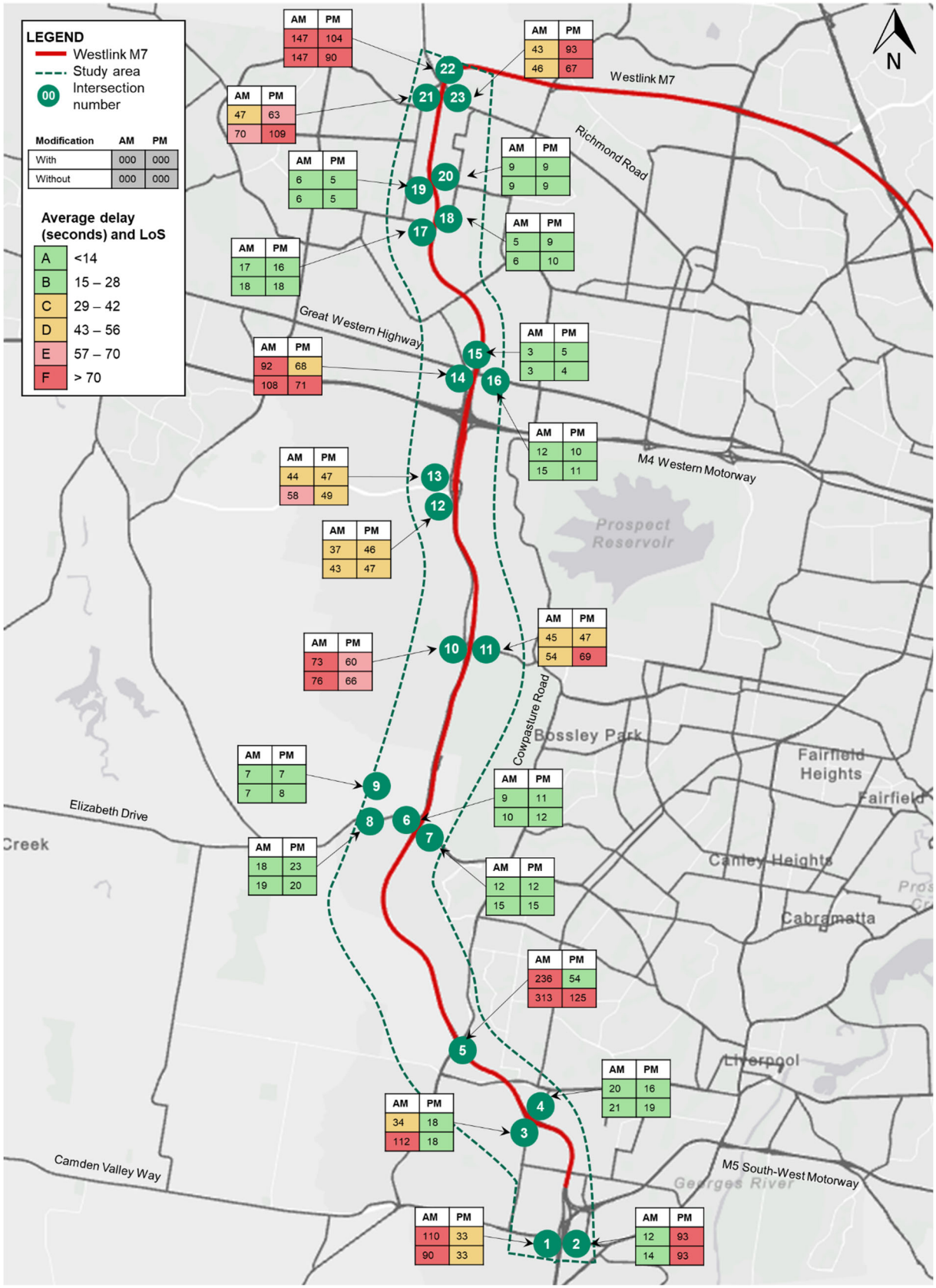


Figure 7-9 AM and PM peak hour intersection performance with and without proposed modification– 2036

Table 7-3 AM peak intersection performance – 2026 and 2036 with and without proposed modification

ID	Intersection	2026 without modification		2026 with modification		2036 without modification		2036 with modification	
		Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
1	Camden Valley Way/M7/M5 northbound entry ramp/M31 exit ramp	35	C	35	C	110	F	90	F
2	Camden Valley Way/M5 southbound exit ramp	8	A	9	A	12	A	14	A
3	Bernera Road/Yarrawa Street/M7 exit ramp/M7 entry ramp	64	E	160	F	34	C	112	F
4	Jedda Road/Bernera Road/M7 exit ramp/M7 entry ramp	20	B	20	B	20	B	21	B
5	Cowpasture Road/M7 exit ramp/M7 entry ramp	65	E	106	F	236	F	313	F
6	Elizabeth Drive/northbound M7entry ramp/M7 exit ramp	10	A	12	A	9	A	11	A
7	Elizabeth Drive/southbound M7 entry ramp/M7 exit ramp	13	A	14	A	12	A	15	B
8	Elizabeth Drive/M12 entry Ramp/Wallgrove Road	17	B	17	B	18	B	19	B
9	Wallgrove Road/Cecil Road	7	A	7	A	7	A	7	A
10	The Horsley Drive/Wallgrove Road	62	E	106	F	73	F	76	F
11	The Horsley Drive/Wallgrove Road/M7 entry Ramp/M7 exit ramp	34	C	44	D	45	D	54	D
12	Wallgrove Road/Mini Link Road/M7 entry ramp/M7 exit ramp	34	C	39	C	37	C	43	D
13	Old Wallgrove Road/Wallgrove Road/M7 entry ramp/M7 exit ramp	46	D	55	D	44	D	58	E
14	Great Western Highway/Rooty Hill Road South/Wallgrove Road	65	E	63	E	92	F	108	F

ID	Intersection	2026 without modification		2026 with modification		2036 without modification		2036 with modification	
		Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service	Average delay (seconds)	Level of service
15	Great Western Highway/M7 entry ramp	3	A	3	A	3	A	3	A
16	Great Western Highway/M7 exit ramp	12	A	13	A	12	A	15	B
17	Woodstock Avenue/M7 exit ramp	18	B	18	B	17	B	18	B
18	Woodstock Avenue/M7 entry ramp	5	A	6	A	5	A	6	A
19	Power Street/M7 entry ramp	6	A	6	A	6	A	6	A
20	Power Street/M7 exit ramp	10	A	10	A	9	A	9	A
21	Rooty Hill Road North/M7 exit ramp	30	C	33	C	47	D	70	E
22	Rooty Hill Road North/Richmond Road/M7 entry ramp/M7 exit ramp	82	F	79	F	147	F	147	F
23	Richmond Road/M7 entry ramp	33	C	36	C	43	D	46	D

Table 7-4 PM peak intersection performance – 2026 and 2036 with and without proposed modification

ID	Intersection	2026 Without Modification		2026 With Modification		2036 Without Modification		2036 With Modification	
		Average delay (seconds)	Level of Service	Average delay (seconds)	Level of Service	Average delay (seconds)	Level of Service	Average delay (seconds)	Level of Service
1	Camden Valley Way/M7/M5 northbound entry ramp/M31 exit ramp	33	C	35	C	33	C	33	C
2	Camden Valley Way/M5 southbound exit ramp	20	B	21	B	93	F	93	F
3	Bernera Road/Yarrawa Street/M7 exit ramp/M7entry ramp	17	B	17	B	18	B	18	B
4	Jedda Road/Bernera Road/M7 exit ramp/M7 entry ramp	15	B	18	B	16	B	19	B
5	Cowpasture Road/M7 exit ramp/M7 entry ramp	25	B	44	D	54	D	125	F
6	Elizabeth Drive/northbound M7entry ramp/M7 exit ramp	10	A	12	A	10	A	12	A
7	Elizabeth Drive/southbound M7 entry ramp/M7 exit ramp	15	B	16	B	12	A	15	B
8	Elizabeth Drive/M12 entry Ramp/Wallgrove Road	32	C	30	C	23	B	20	B
9	Wallgrove Road/Cecil Road	6	A	6	A	7	A	8	A
10	The Horsley Drive/Wallgrove Road	47	D	51	D	60	E	66	E
11	The Horsley Drive/Wallgrove Road/M7 entry Ramp/M7 exit ramp	47	D	71	F	47	D	69	E
12	Wallgrove Road/Mini Link Road/M7 entry ramp/M7 exit ramp	43	D	43	D	46	D	47	D
13	Old Wallgrove Road/Wallgrove Road/M7 entry ramp/M7 exit ramp	37	C	41	C	47	D	49	D
14	Great Western Highway/Rooty Hill Road South/Wallgrove Road	56	D	57	E	68	E	71	F

ID	Intersection	2026 Without Modification		2026 With Modification		2036 Without Modification		2036 With Modification	
		Average delay (seconds)	Level of Service	Average delay (seconds)	Level of Service	Average delay (seconds)	Level of Service	Average delay (seconds)	Level of Service
15	Great Western Highway/M7 entry ramp	4	A	4	A	5	A	4	A
16	Great Western Highway/M7 exit ramp	10	A	10	A	10	A	11	A
17	Woodstock Avenue/M7 exit ramp	16	B	17	B	16	B	18	B
18	Woodstock Avenue/M7 entry ramp	9	A	10	A	9	A	10	A
19	Power Street/M7 entry ramp	5	A	5	A	5	A	5	A
20	Power Street/M7 exit ramp	10	A	10	A	9	A	9	A
21	Rooty Hill Road North/M7 exit ramp	27	B	57	E	63	E	109	F
22	Rooty Hill Road North/Richmond Road/M7 entry ramp/M7 exit ramp	56	D	58	E	104	F	90	F
23	Richmond Road/M7 entry ramp	50	D	33	C	93	F	67	F

7.2 Heavy vehicles

The forecast heavy vehicle traffic volumes along the Westlink M7 in 2026 and 2036 with and without the proposed modification are shown in Table 7-1, Figure 7-10 and Figure 7-11.

Without the proposed modification, the number of heavy vehicles along the Westlink M7 in 2026 would be similar to 2021, with approximately 16,000 vehicles per workday forecast (average across the corridor). In 2036, the number of heavy vehicles is expected to increase to nearly 20,000 vehicles per workday (average across the corridor).

In 2026, the Westlink M7 is anticipated to carry an additional 300 to 1,300 heavy vehicles per workday in each direction with the proposed modification compared to without the modification. That is an additional six to 15 per cent vehicles per workday, depending on the Westlink M7 segment.

Similarly, in 2036, the Westlink M7 is anticipated to carry an additional 700 to 2,300 heavy vehicles per workday with the proposed modification compared to without the modification. That is an additional nine to 22 per cent vehicles per workday, depending on the Westlink M7 segment.

As discussed in Section 7.1.3, travel times are shown to decrease on the Westlink M7 as a result of the proposed modification. Heavy vehicles would benefit from these travel time savings, improving their connectivity and reliability particularly for longer distance freight movements.

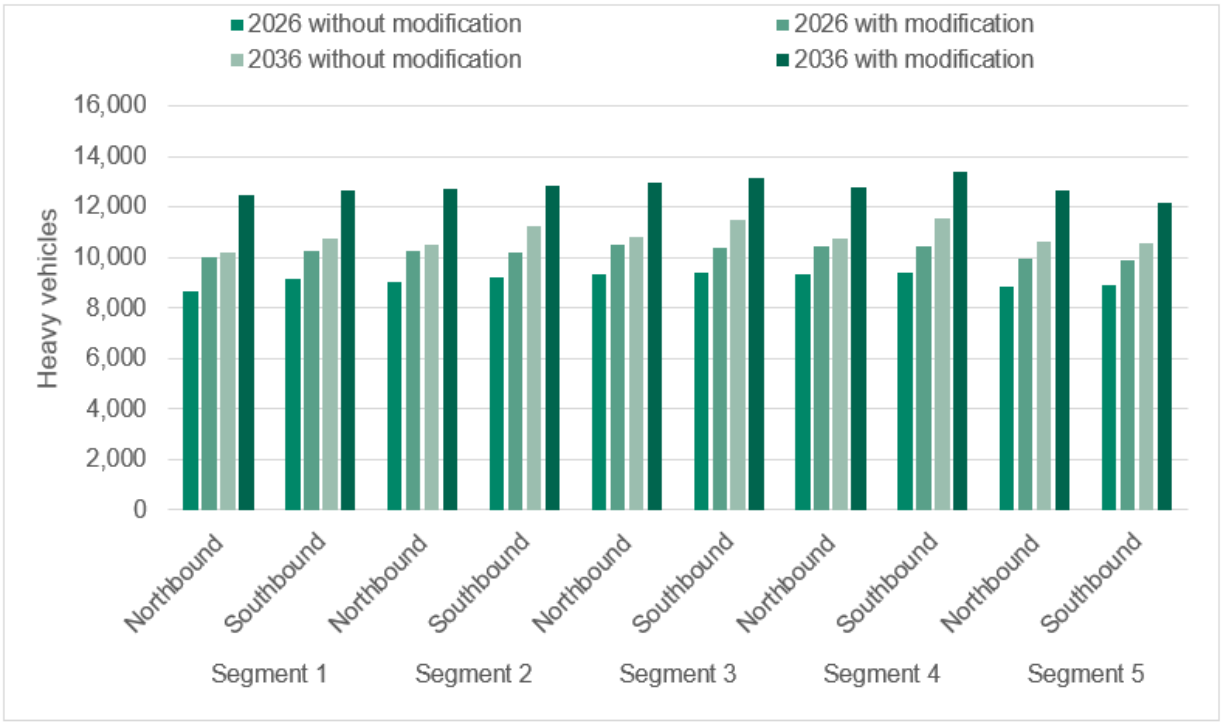


Figure 7-10 Workday heavy vehicle traffic volume comparisons in 2026 and 2036 for Westlink segments 1 to 5

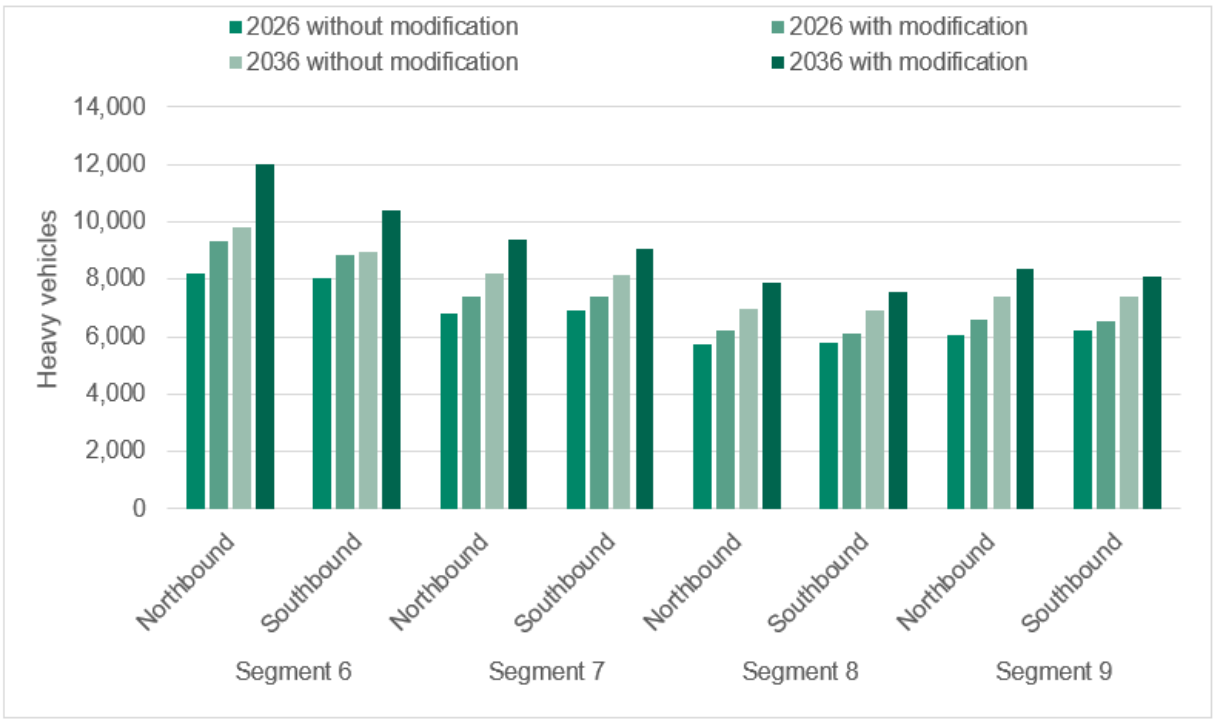


Figure 7-11 Workday heavy vehicle traffic volume comparisons in 2026 and 2036 for Westlink segments 6 to 9

Table 7-1 Comparison of workday heavy vehicle traffic volumes on the Westlink M7 in 2026 and 2036

#	Westlink M7 segment	Direction	Heavy vehicles (vehicles)							
			2026				2036			
			Without modification	With modification	Difference		Without modification	With modification	Difference	
1	Camden Valley Way to Bernera Road	Northbound	8,664	9,980	1,316	15%	10,194	12,445	2,251	22%
		Southbound	9,164	10,274	1,110	12%	10,741	12,648	1,907	18%
2	Bernera Road to Cowpasture Road	Northbound	9,034	10,252	1,218	13%	10,502	12,730	2,228	21%
		Southbound	9,230	10,211	981	11%	11,244	12,861	1,617	14%
3	Cowpasture Road to Elizabeth Drive	Northbound	9,320	10,508	1,189	13%	10,819	12,978	2,160	20%
		Southbound	9,373	10,386	1,013	11%	11,454	13,158	1,704	15%
4	Elizabeth Drive to The Horsley Drive	Northbound	9,340	10,457	1,117	12%	10,746	12,748	2,002	19%
		Southbound	9,420	10,466	1,046	11%	11,574	13,396	1,822	16%
5	The Horsley Drive to Old Wallgrove Road	Northbound	8,824	9,944	1,120	13%	10,644	12,657	2,013	19%
		Southbound	8,901	9,889	987	11%	10,580	12,133	1,553	15%
6	Old Wallgrove Road to Great Western Highway	Northbound	8,180	9,297	1,117	14%	9,827	11,977	2,150	22%
		Southbound	8,032	8,825	793	10%	8,963	10,401	1,438	16%
7	Great Western Highway to Woodstock Avenue	Northbound	6,806	7,420	614	9%	8,209	9,360	1,151	14%
		Southbound	6,917	7,402	485	7%	8,160	9,066	906	11%
8	Woodstock Avenue to Power Street	Northbound	5,719	6,233	514	9%	6,938	7,901	963	14%
		Southbound	5,800	6,128	328	6%	6,917	7,567	651	9%
9	Power Street to Richmond Road	Northbound	6,055	6,566	512	8%	7,397	8,335	938	13%
		Southbound	6,207	6,550	344	6%	7,420	8,091	671	9%

7.3 Active transport

No operational changes are proposed to the location and overall alignment of the Westlink M7 shared pedestrian and cycle path as part of the proposed modification. However, the proposed modification would create a dual lane exit to the M4 Motorway on the northbound carriageway, which is considered an unacceptable cyclist safety risk.

To address potential safety risks to cyclists, the proposed modification would introduce restrictions which would prohibit cycling on the Westlink M7 mainline between the M5 Motorway and Richmond Road during both construction and operation. Instead, cyclists would use the designated Westlink M7 shared path that runs parallel to the Westlink M7. This is consistent with road safety best practice, in that there are inherent safety risks in allowing cyclists to travel alongside high-speed traffic travelling at 100km/h. Risks associated with allowing cyclists to travel alongside high-speed traffic on the Westlink M7 include the following:

- Drivers are expected to provide a 1.5 metre distance when passing cyclists, which introduces the risk of side-swipes with traffic in adjacent lanes
- Any collision with cyclists at this speed, such as through an inattentive driver would inevitably result in fatal injuries to the cyclist
- Fifty-one (51) per cent of crashes on the Westlink M7 in the 2017-18 period involved a heavy vehicle, indicative of the high proportion of heavy vehicles of this portion of the road network. Heavy vehicles have reduced visibility in front and to the side of the vehicle, making it difficult for a driver to observe and safely pass a cyclist. In addition, heavy vehicles combinations will commonly sway within their lane, creating a risk of a cyclist being sideswiped by the combination's trailer.

The proposed modification does not directly improve active travel linkages and connections within the wider network surrounding the study area. However, the current active travel movements across and adjacent to the Westlink M7 corridor would be maintained. Furthermore, the proposed modification would not preclude the development of additional active travel infrastructure or further active travel integration as part of adjacent infrastructure projects mentioned in Section 3.4 and/or any future active transport projects that may be considered by the relevant asset owners.

7.4 Public Transport

Current transport strategies do not identify the need for the central median of the Westlink M7 as a public transport corridor. Alleviating capacity constraints on Greater Sydney's road network and the public transport system through the provision of public transport infrastructure has moved away from the Westlink M7. Instead, increasing the road capacity of this key north-south motorway, in conjunction with the development of the network of public transport infrastructure projects in Greater Sydney and Western Sydney in particular, would support the objectives of the strategic metropolitan and transport documents shaping Sydney's growth.

The proposed modification to the Westlink M7 could support more efficient connections to public transport corridors in the region. Improved efficiency in the road corridor compliments the objective of 30-minute cities by supporting connections to public transport corridors, including to the existing T1 Western train line service between Central Station and Emu Plains. The proposed modification would support future planned city-serving high-frequency services between Liverpool to Austral (north) and from Bonnyrigg to Western Sydney International Airport. Rapid bus connections between Western Sydney International Airport and Blacktown (which would intersect with the Westlink M7) are also currently being investigated.

7.5 Parking and access

The proposed modification is unlikely to have any operational impacts to property or business access or on-street parking, noting that the Westlink M7 is a separated motorway corridor.

7.6 Road safety

The frequency of crashes on the Westlink M7 would be expected to increase in line with increased traffic demand without modification of the existing capacity of the corridor, as the density and congestion would increase. In congested conditions drivers can become frustrated as their ability to travel at their desired speed is impaired; often more risks are taken and crashes occur more frequently as a result. Therefore, the potential for crashes – indicated by the crash rates per vehicle kilometre travelled in Section 5.9 – would remain. Rear-end collisions accounted for nearly 50 per cent of the crashes that have occurred along the Westlink M7 over the assessed period, some of these were likely attributed to congestion.

As discussed in Sections 7.1.2, 7.1.3 and 7.1.4, the proposed modification would generally lead to increased vehicle speeds and less congestion along the Westlink M7.Therefore, it is expected that the crash rates per vehicle kilometre travelled in Section 5.9 would decrease with the proposed modification.

7.7 Cumulative impact assessment

As discussed in Section 3.0, the operational assessment presented throughout Section 7.0 considers the cumulative impacts of the following key projects:

- Elizabeth Drive upgrade
- M12 Motorway and EDC project
- The Horsley Drive upgrade (qualitative only)
- Richmond Road upgrade (qualitative only)
- Other planned road network upgrades that are included within the TUSTM, which covers the Sydney metropolitan area.

8.0 Mitigation and management measures

This section describes performance outcomes related to construction and operational traffic and transport and mitigation and management measures to manage potential traffic and transport impacts from the proposed modification.

8.1 Performance outcomes

The performance outcomes for operational traffic and transport for the proposed modification are as follows:

- *Improved capacity on the Westlink M7*
- *Reduced travel times on the Westlink M7*
- *Increased vehicle speeds on the Westlink M7*
- *Maintained active transport connections surrounding the Westlink M7*
- *Maintained public transport connectivity surrounding the Westlink M7*

The proposed modification would be designed, constructed and operated with the aim of achieving these performance outcomes.

8.2 Mitigation and management measures

The current conditions of approval that apply to the approved project require mitigation and management measures to be implemented (either directly in the conditions or through reference to the environmental management plans required).

The mitigation and management measures described in Table 8-1 have been identified to address the impacts identified as a direct result of the assessment undertaken in this report. These measures would be incorporated into existing environmental management plans where they have not been accounted for already. Proposed amendments to the CoA for the proposed modification are described in Chapter 8 (Conditions of approval) of the Modification Report.

Table 8-1 Mitigation and management measures

ID	Mitigation and management measure	Responsibility	Phase
Traffic and transport C.1	A Construction Traffic and Access Management Plan (CTAMP) will be prepared as part of the Construction Environmental Management Plan (CEMP) in consultation with Transport, relevant local councils and in accordance with relevant guidelines including consideration for: • staggering shift times to minimise the hourly traffic generation • encouraging the use of alternative transport modes, carpooling, measures that minimise traffic generation associated with worker arrival, departures and movements between sites • using shuttle buses to move workers between sites • minimising road closures that would likely have large impacts to the network • pedestrian and cyclist access management plan parking and access management plan.	Contractor	Detailed design prior to construction and during construction

ID	Mitigation and management measure	Responsibility	Phase
Traffic and transport C.2	Changes to bus routes and bus stops will be implemented in consultation with Transport, local councils and bus operators. These will consider measures to minimise impacts to buses such as delaying road closures to avoid bus detours, if possible.	Contractor Transport	Detailed design prior to construction and during construction
Traffic and transport C.3	Movements of haulage vehicles will be planned to minimise movements on the road network during the AM and PM peak periods where practicable.	Contractor	Detailed design prior to construction and during construction
Traffic and transport C.4	An active transport strategy will be developed to document planned shared path detours and recommend upgrades to the surrounding shared path/footpath network to safely accommodate shared path users.	Contractor Transport	Detailed design prior to construction and during construction
Traffic and transport O.1	Potential impacts to vehicle speeds outside the proposed modification extents should be investigated.	Transport	Detailed design
	Solutions should be investigated to cater for forecast traffic volumes associated with population and employment growth and to some degree the proposed modification, at the following locations: • Bernera Road • Cowpasture Road • The Horsley Drive • Great Western Highway • Old Wallgrove • Rooty Hill Road • Richmond Road.	Transport	Detailed design

9.0 Conclusion

The traffic and transport assessment has been prepared to support the Modification Report and to address the relevant SEARs issued for the proposed modification. Specifically, this report has been prepared to assess the potential construction and operational impacts of the proposed modification on traffic and transport and to identify appropriate mitigation and management measures to address the impacts identified.

Construction

Construction of the proposed modification would result in the following impacts to the transport network:

- Additional construction related traffic using the Westlink M7 as well as the surrounding road network to access the proposed ancillary facilities
- Temporary lane or road closures on the Westlink M7 on workday nights
- Closure of adjacent arterial roads on workday nights and potentially on the weekend including some that are used by daytime or night-time bus services
- Temporary closures of sections of the existing Westlink M7 shared path, requiring detours via the surrounding shared path network
- Increased road safety risk associated with construction traffic interacting with general traffic especially where the construction vehicles are entering and exiting ancillary facility sites.

The following mitigation measures would be required to manage the construction traffic and transport impacts of the proposed modification:

- A Construction Traffic and Access Management Plan (CTAMP) will be prepared as part of the Construction Environmental Management Plan (CEMP) in consultation with Transport, relevant local councils and in accordance with relevant guidelines
- Changes to bus routes and bus stops will be implemented in consultation with Transport, local councils and bus operators.
- Movements of haulage vehicles will be planned to minimise movements on the road network during the AM and PM peak periods where practicable.
- An active transport strategy will be developed to document planned shared path detours and recommend upgrades to the surrounding shared path/footpath network to safely accommodate shared path users.

Operation

Based on the operational modelling, traffic volumes along the Westlink M7 are forecast to increase from approximately 80,000 vehicles per workday in 2021 to approximately 90,000 vehicles per workday in 2026 (average across the corridor) and 100,000 vehicles per workday in 2036. With the proposed modification, an additional 2,000 to 8,500 vehicles would be accommodated along the Westlink M7 per direction in 2026 and an additional 3,000 to 14,500 vehicles per workday in each direction 2026.

The forecast traffic volumes along the Westlink M7 would increase as a result of the proposed modification, overall network performance would improve, congestion would improve, vehicle speeds would generally increase, average travel times would decrease and the segment densities would also decrease.

However, the increased traffic volumes along the Westlink M7 due to the proposed modification could result in slower vehicle speeds at the northern and southern extents, outside the proposed widening areas. Potential impacts to vehicle speeds beyond the proposed modification extents should be investigated.

Most of the assessed intersections would continue to operate with the same level of service in both 2026 and 2036 with and without the proposed modification. However, there are some exceptions. Most of the intersections that would experience a change in level of service due to the proposed widening would operate unsatisfactorily in 2026 and/or 2036 without the proposed modification. Therefore, the proposed modification will bring forward the need to consider solutions for these areas.

No operational changes are proposed to the location and overall alignment of the Westlink M7 shared path as part of the proposed modification. However, at the M4 Motorway interchange, the proposed modification would create a dual lane exit to the M4 Motorway on the northbound carriageway. Therefore, cyclists would no longer be able to safely cross the northbound exit ramp to the M4 Motorway (due to the two lane arrangement). To address potential safety risks to cyclists, the proposed modification would introduce restrictions which would prohibit cycling on the Westlink M7 mainline between the M5 Motorway and Richmond Road. Cyclists would need to use the alternative route via the existing shared path.

As discussed above, the proposed modification would generally present significant benefits to the users of the Westlink M7, in relation to road safety, network performance and travel times. However, the following mitigation and management measures were identified to address the potential impacts of the proposed modification, as well as general traffic demand increases expected due to population and employment growth in the region:

- Potential impacts to vehicle speeds outside the proposed modification extents should be investigated
- Solutions should be investigated to cater for forecast traffic volumes associated with population and employment growth and to some degree the proposed modification.

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Appendix A

Operational Modelling Traffic Assessment Report

M7 Widening and M7-M12 Interface, Operational Modelling Traffic Assessment

Part A: Modelling Methodology
Part B: Base Model Development
Part C: Project Model Testing

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Document Control

Revision History

DOCUMENT OWNER / ISSUER	TRANSURBAN
DOCUMENT VERSION No.	V3.0

VERSION NO.	DATE OF ISSUE	PREPARED BY	REVIEWED BY	APPROVED FOR ISSUE BY
1.0		**Louis Franks** **Angela Jenks**	**Shane Bennett**	
2.0		**Louis Franks** **Angela Jenks**	**Shane Bennett**	
3.0		**Timothy Clark** **Angela Jenks**	**Shane Bennett`**	

Executive Summary

Westlink M7 has developed an unsolicited proposal to undertake an upgrade of the M7 Motorway between the Sir Roden Cutler Victoria Cross Memorial Interchange at the southern end of the corridor and the Richmond Road Interchange along the corridors northern extents.

In order to provide detailed operational traffic assessments of the M7 Upgrade's design, delivery and operation, Transurban will operate a fit for purpose, operational traffic model for the project area. This traffic model will be developed to comply with the advice in *Motorway Design Guide - Capacity Flow Analysis* published by TfNSW in 2017 as well as TfNSW's technical direction (TTD 2017/001) regarding the *Operational modelling reporting structure*. In accordance with the direction set out in TTD 2017/001, this document represents a composite of the following recommended reports –

1. **Modelling Methodology Report (Part A of this document)**
2. **Base Model Development Report (Part B of this document)**
3. **Option Testing Report (Part C of this document)**

The scope of the operational model and its intended deliverables are limited to the scope and items pre-agreed with TfNSW and outlined in Part A of this document. The methodology outlined in Part A is also intended to comply (where applicable) to recommendations for "Model Verification" and "Demand Calibration" set out in the *Traffic Modelling Guidelines (2013)* of the former New South Wales Roads and Maritime Service (now TfNSW).

The quality in Model Verification and Demand Calibration of the operational model developed by Transurban is detailed in Part B of this document. This section will also report the operational performance statistics resulting from the calibrated and validated Base Model to outline the "baseline" from which future no project and project scenarios will be assessed.

Part C of this document outlines the details and assumptions behind the future year scenarios. This includes an outline of the methodology applied to relate forecast demand levels into the operational model, the detailed network assumptions (detailed network geometry and any active management from related ITS overlays) and any sensitivity testing undertaken to frame the quality and stability of the future year scenario results. A comparison of the future year scenario performance results (both between each other and with the calibrated base year scenario) on the key performance metrics will also be provided in this section.

In summary, this document provides sufficient documentation to support the required review and endorsement of the operational model developed by Transurban to support the traffic impact assessment of the M7 Widening Proposal and its interface with the M12 Motorway project.

Part A: Modelling Methodology

1. Project Background

Westlink M7 is progressing an unsolicited proposal to Transport for New South Wales (TfNSW) to widen segments of the M7 Motorway. The upgrade of the M7 Motorway will not only relieve significant travel time delays and congestion presently experienced by Westlink M7 customers today, it will provide essential and complimentary capacity improvements to cater for the growth induced by major network and land use development directly adjacent to the corridor. In particular, the M7 has recently experienced an increase in traffic flows enabled by the delivery of TfNSW's M4 Smart Motorways Project and forecasts indicate that the new M12 Motorway connection and wider Western Sydney Airport Precinct will drive significant increases in demand for the M7 corridor in the near future.

Upgrades to key roads that support traffic movement in and out of south-west Sydney and around Western Sydney Airport is already a priority initiative at a Commonwealth and State level. As the key north-south link, the M7 Motorway forms an integral part of the future of Sydney's road network and is a key road freight transport link in the region. To support progressing the M7 Upgrade, detailed operational traffic assessments are required to help frame the case for upgrade and identify the various performance impacts that need to be considered within the project's design, delivery and operation.

2. Model Purpose

In order to provide detailed operational traffic assessments of the M7 Upgrade's design, delivery and operation, Transurban developed a fit for purpose, operational traffic model for the scope of the project area. This traffic model was developed to comply with the advice in *Motorway Design Guide - Capacity Flow Analysis* published by TfNSW in 2017 and is therefore suitable to inform the following operational traffic metrics with respect to the motorway network in the defined project area -

- Section Flows
- Section Level of Service (density based)
- Section and Route Average Speeds
- Section Proportion of Design Speed Achieved

Similarly, the traffic model is also deemed fit for purpose to inform the following network-wide performance metrics for the defined project area -

- Total Serviced Demands
- Total Travel Distance
- Total Travel Time
- Average Network Speed
- Unreleased Demands (when and where applicable)

2.1 Modelling Scope

Transurban already operates a "rapid" operational traffic model of the M7 "core network which focuses on the areas within the tolled boundaries of the asset. This model was developed to supplement the Transurban Strategic Model (TUSTM) and provide simulated capacity constrained assessments of the future demand forecasts estimated by the strategic model. Given the purpose of this "rapid" operational model, it has not been necessary to calibrate the OD matrices independent from the TUSTM's estimated demand matrices (both base year and future years) in order to retain an absolute 1:1 relationship with the TUSTM forecasts.

For the purposes of this phase of analysis, Transurban has both –

1. Expanded the existing Transurban operational model of the M7 core network; and
2. Undertaken an independent base year calibration and validation in line with the recommendations of *Traffic Modelling Guidelines (2013)* of the former New South Wales Roads and Maritime Service (now TfNSW).

The expanded network areas includes some network areas immediately adjacent to the M7 core area in order to ensure it can consider the following interfaces –

1. **The M7 and M2 Interface**: specifically, to include the Abbot Road eastbound merge with the mainline, which has been identified as a notable existing network constraint that needs to be assessed in the context of the M7 Upgrade Proposal.

2. **The M7 and M4 Smart Motorway Interface**: specifically, the M7 - M4 entry and exit ramps, where the M4 Smart Motorway currently meters traffic exiting the M7 during peak periods.

3. **The M7 and Elizabeth Drive / M12 Motorway Interface**: where it is expected that improved access to the emerging Western Sydney Airport Precinct provided by the M12 motorway will significantly increase traffic demand on the M7 motorway.

4. **The Sir Roden Cutler Victoria Cross Memorial Interchange**: Where the M7 interfaces with the M31, M5 and Camden Valley Way.

The proposed extents of the operational model network, illustrated in **Figure 1** has been organised into two separate subnetworks (see 3.1 Platform, Application for more details) of –

1. The extended **M7 Core Subnetwork**; and
2. The Sir Roden Cutler Victoria Cross Memorial Interchange **(Cutler Interchange) Subnetwork**.

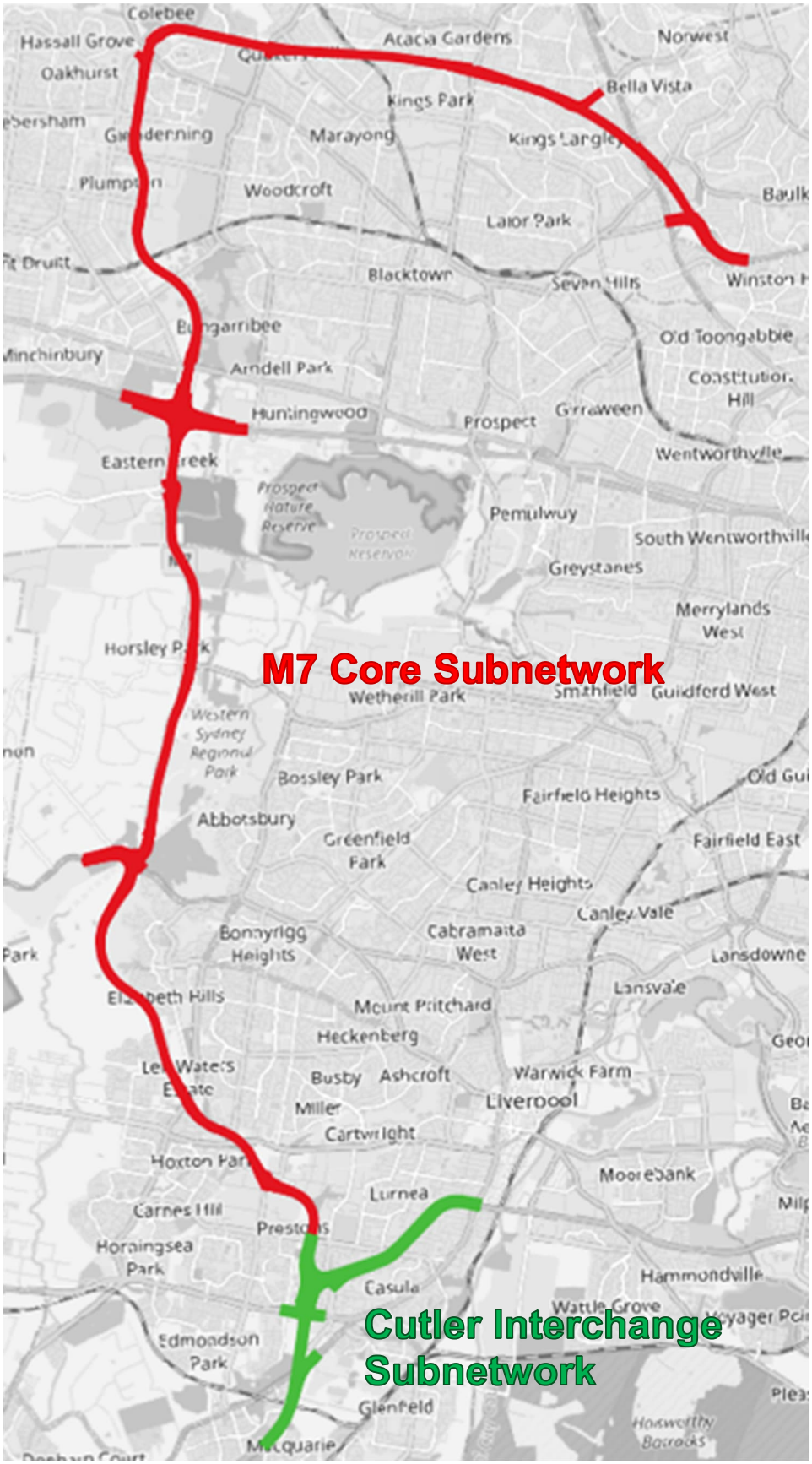


Figure 1 - M7 Upgrade and M12 Interface Operational Traffic Model Extents

2.2 Limitations of the Model

The scope of the operational model has been limited to the specific purposes outlined in this report. Additional detailed traffic analysis regarding the operational impacts between the proposed M7 Upgrade and the wider arterial network will be explored using other modelling and analysis tools. Specifically, it has been agreed with TfNSW (refer Traffic and Transport Impact Assessment scoping document, *Specialist scope – M7 Widening TTIA v2.0 20210427.docx)* that the traffic analysis for the M7 Upgrade and M12 Interface will consist of the following suite of traffic analysis tools outlined in **Table 1**

Analysis Scope	Analysis Tool	Analysis Objectives
Wider (whole of region) Network Impacts of the M7 Upgrade Proposal	The Transurban Strategic Transport Model (TUSTM)	To identify the wider daily and peak period volume affects wider Sydney Traffic Network from the proposed project. E.g. link volume difference plots.
Direct Motorway Network Operational Impacts of the M7 Upgrade Proposal	Two Subnetworks of the Transurban Operational Model	To identify the operational impacts on the M7 motorway mainline, ramps and interchanges with other motorways (i.e. M2, M4, M12, M31 and M5) E.g. mainline and ramp LOS, speeds and delays.
Immediate Motorway – Arterial Interface Impacts of the M7 Upgrade Proposal	A Series of SIDRA Intersection and Network Models for the following locations –	To identify the operational traffic affects at key intersections directly adjacent / interfacing with the M7 Motorway Upgrade. E.g. Intersection and approach LOS and max queue lengths on approaches.

Table 1 - Proposed Traffic Analysis Suite for the M7 Upgrade and M12 Interface Traffic Analysis

Given the motorway to arterial interfaces will be primarily assessed in a series of SIDRA Intersection and SIDRA Network models, the operations at the intersection with the M7 ramps are only developed to align to the operational model validation criteria (see **3.3** for more detail on these criteria). That is the operational model network only replicates the degree of impedance required to reflect the base case surveyed speeds, travel times and delays at exit ramps. Further technical detail of this limitation is outlined further in this report.

A further limitation of the Operational Model that should be noted is that the independent calibration and validation of the Base Year Scenario has been to a specific date and time. For the M7 Core Subnetwork the date of calibration and validation has been selected as Thursday 25th of February 2021. For the Cutler Interchange Subnetwork the date of calibration and validation has been selected as Wednesday 10th of February 2021.

The selection of these dates has been based on both a speed and traffic count analysis for the busiest month of 2021 (at the time of developing this model) and represents what was determined to be the most “average” weekday of February 2021 in each of the proposed Subnetworks. Full detailed analysis of the method and reasons behind the selection of this specific date for calibration and validation, is included further in this report.

3. Key Methodological Components

3.1 Platform, Application and Accessibility

The Operational Model is built in the "Next" (version 20.0.2) software platform, developed by Aimsun Pty Ltd. In line with the capability of the Next platform, the Operational Model Network has been developed into two separate subnetworks (illustrated in **Figure 1**) each with its own independent centroid configuration.

All modelling for both subnetworks was conducted and contained within a single network (ang.) file and all associated scenarios and experiments and supporting inputs (e.g. Geometry Configurations, Traffic Demands, Master Control Plans, Traffic Management Strategies etc.) are contained within the single network (ang.) file.

Due to the size and nature of the outputs database(s) generated by the Operational Model, it is not intended that this will be provided or transferred as part of the standard model file package shared to an external party. The single network (ang.) file will be enabled that any external party user of the model will be able to re-generate an exact replication of any of the scenarios or experiments developed and run from the single network (ang.) file subject that user having both –

- Access to the exact version of Aimsun Next 20.0.02; and
- Access to at least an Aimsun Next Advanced License (or better).

3.2 Scale and Resolution

The Operational Model has been developed to undertake a continuous 16-hour microsimulation between the hours of 4am to 8pm in both subnetworks. The determination of the scale and resolution of the microsimulation time periods has been informed by initial analysis (see **Section 5** for more detail) of the available historic traffic count datasets consisting of both BAC (Transurban's Tolling Count System) and Loop data. As summarised in **Table 2** and **Table 3** below, the extent of the micro-simulated time-periods proposed ensures the Operational Model provides the following scale and resolution –

- At least 90% of all daily traffic is accounted for in the Base Year Scenario in both subnetwork areas.
- A full 5-hour AM and PM peak period was calibrated and validated for, including a 2-hour ramp up and cool down period on each of the identified peak hours (7am – 8am and 4pm – 5pm respectively).
- In order to account for any potential peak spreading effect from either of the 5-hour AM or PM peak periods resulting from the increase demand levels forecast in future years, 6 supplementary Off-peak hours directly adjacent to both peak periods were included.
- The inclusion of the Off-peak periods in the continuous microsimulation also allows for a better assessment of the operational performance impacts to daily freight traffic, which peak during the middle of the day around 11am – 12pm.
- Historical analysis of traffic count data has also indicated that over recent years, traffic demand growth along the M7 corridor has in many areas either maxed-out in the AM peak hour around 2017 – 2018 and has since declined. While this has occurred at the peak hour / peak flow rates on many of the congested parts of the corridor itself, the overall level of daily traffic demand growth along the corridor has continued driven largely by a spreading effect into the peak shoulder and to a larger extent significant growth in the mid-day off-peak period in heavy vehicle (and higher PCU) trips. The result of this increase temporal distribution of traffic demand across the corridor is the increasingly regular occurrence of multiple peak periods at multiple congestion bottlenecks throughout the day. It is for this reason that a continuous traffic simulation period that extends through the mid-day period would be better suited to assess the operational impacts on the M7 network in the future demands years both with and without the M7 Upgrade Project.

Cutler Interchange Subnetwork Area Count Summary			
HOUR END	LIGHT	HEAVY	*HEAVY % of total*
5:00am	1.3%	2.7%	*30.9%*
6:00am	4.4%	4.6%	*18.7%*
7:00am	6.9%	6.5%	*17.2%*
8:00am	7.5%	6.0%	*15.1%*
9:00am	7.2%	6.4%	*16.4%*
10:00am	5.8%	7.1%	*21.1%*
11:00am	4.8%	6.9%	*24.2%*
12:00pm	4.7%	7.1%	*24.9%*
1:00pm	4.8%	7.3%	*25.3%*
2:00pm	5.1%	7.1%	*23.4%*
3:00pm	6.1%	6.6%	*19.3%*
4:00pm	7.4%	5.4%	*14.0%*
5:00pm	7.9%	4.6%	*11.5%*
6:00pm	8.0%	4.1%	*10.2%*
7:00pm	6.1%	3.1%	*10.2%*
8:00pm	3.4%	2.5%	*14.2%*
Total % of Daily	91.4%	87.8%	*17.6%*

Table 2 - Summary of Hourly Traffic Counts in Cutler Subnetwork for Calibration Date (February 20th 2021)

M7 Subnetwork BAC (Toll) Count Summary			
HOUR END	LIGHT	HEAVY	*HEAVY % of total*
5:00am	1.3%	3.0%	*29.8%*
6:00am	4.7%	5.2%	*17.0%*
7:00am	6.8%	6.6%	*15.4%*
8:00am	8.0%	6.3%	*12.8%*
9:00am	7.0%	7.1%	*16.0%*
10:00am	5.6%	7.8%	*20.4%*
11:00am	5.2%	7.7%	*21.4%*
12:00pm	5.3%	8.0%	*21.7%*
1:00pm	5.4%	7.6%	*20.5%*
2:00pm	5.9%	7.1%	*18.3%*
3:00pm	7.3%	6.0%	*13.2%*
4:00pm	7.9%	4.9%	*10.3%*
5:00pm	8.2%	3.8%	*8.0%*
6:00pm	7.5%	3.5%	*8.0%*
7:00pm	4.7%	2.6%	*9.4%*
8:00pm	2.8%	2.0%	*12.0%*
Total % of Daily	93.6%	89.3%	*15.70%*

Table 3 - Summary of Hourly Traffic Counts in M7 Subnetwork for Calibration Date (February 25th 2021)

3.3 Demand Calibration and Operational Validation

Calibration and Validation of the Operational Model was undertaken via a methodology that is in line with the recommendations of “Model Verification” and “Demand Calibration” *Traffic Modelling Guidelines (2013)* of the former New

South Wales Roads and Maritime Service (now TfNSW). As summarised in **Figure 2** taken from the *Traffic Modelling Guidelines* below, the over-arching methodology suggested usually involves an iterative cycle of model refinements across the following 3 aspects –

1. Network Verification
2. Demand Calibration
3. Route Choice Calibration

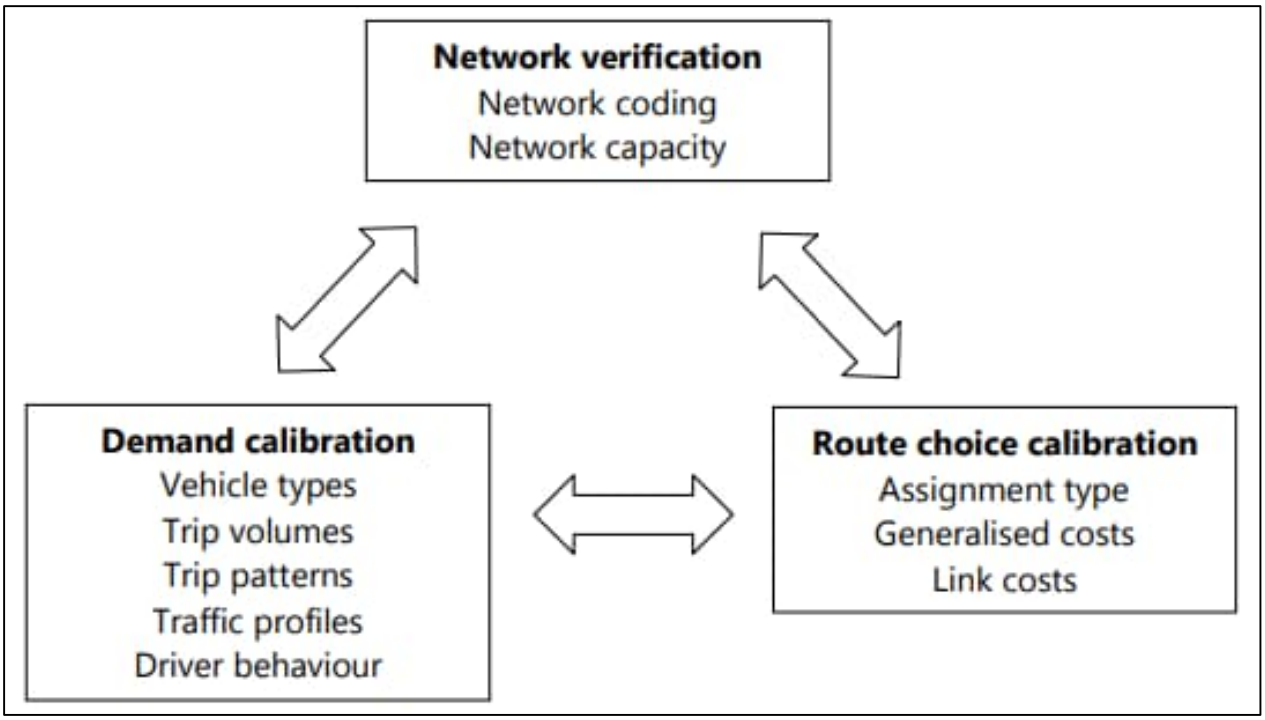


Figure 2 - TfNSW Traffic Modelling Guidelines (2013) overview of the Model verification and calibration process

Given the scope of the Operational Model network does not enable any route choice behaviour, this aspect of model verification and calibration will specifically relate to validating the results of the fix-route simulation in terms of ensuring the resulting traffic conditions reflect the observed traffic conditions at a high degree of space / time resolution (see **Section 3.3.2**).

3.3.1 Demand Matrix Calibration Methodology

In line with the recommendations of Section 11.3.3 of the *Traffic Modelling Guidelines*, calibration of the demand matrices has considered the following elements detailed in **Table 4**.

Recommended Demand Calibration Elements	Application in Operational Model Development
Defining Vehicle Types	The classification of vehicle classes modelled and specific simulation vehicle parameters applied was informed by both – 1. The availability of classified traffic counts for the modelled area. In the instance of this Operational Model, counts were sourced from Transurban's official tolling count system database (known as BAC) and Loop data. The BAC system only classifies

Recommended Demand Calibration Elements	Application in Operational Model Development
	counts between heavy and light vehicles, whereas the Loop data provides a classified count separated into the three classes of light vehicles - medium vehicles and long vehicles. 2. The suggested Aimsun (Next) specific simulation vehicle parameters set out in the Austroads guide for *Improving the Reliability of Heavy Vehicle Parameters to Support More Accurate Traffic Modelling in Australia and New Zealand (2019)*. This guide sets out the microsimulation vehicle parameters that have been applied for; rigid trucks, articulated truck, b-double trucks.
Demand Development	There are 2 separate demand methods for demand matrix development that were applied. For the Cutler Interchange Subnetwork, demand matrix development has followed the "Strategic model sub-area cordon" approach suggested in the *Traffic Modelling Guidelines*, with the TUSTM providing the cordon (seed) matrices for the Demand Adjustment Process. For the M7, demand matrix development (and demand profiling) are entirely covered by direct input of the actual recorded OD (BAC based) trip matrices on the M7 network. Transurban is able to produce these OD matrices at 15 min interval levels (based on the departure / origin side).
Demand Adjustment	Where applicable, Demand Adjustment was undertaken via the native Next (Aimsun) OD Adjustment procedure.
Demand Profiling	Demand Profiling was undertaken at 15 min intervals via the native Next (Aimsun) OD Departure Adjustment procedure.
Behavioural Parameters	Behavioural parameters have been calibrated to user-defined values as part of the model validation process. In general, the Next default parameters will be in place wherever no user-defined values have not been applied. **Section 4.1.1** of this document details the specific behavioural models where user defined values have been applied as part of the calibration and validation process.
Assignment Type	Given the scope of the network modelled allows for just a single route choice per OD, the scenarios are undertaken as a fixed route Stochastic Route Choice (SRC) microsimulation. In line with recommended practices, results from the model are assessed based on at least 5 separate microsimulation replications.
Generalised Cost	Not applicable in this model.
Link Hierarchy	The Model network was initiated via the native Next OpenStreetMap importer and subsequently the specific link hierarchy reflects that of the OpenStreetMap system as per the date of import (Tuesday 20th April 2021).
Localised Cost Adjustments	Not applicable in this model.
Route Assignment	Not applicable in this model.

Table 4 - Consideration of the Recommended Elements for Demand Calibration as Per the Traffic Modelling Guidelines (2013)

3.3.2 Traffic Simulation Validation Methodology

Validation of the resulting calibrated OD matrices was informed by the following analysis -

1. **Individual OD Route Travel Times:** This was the primary metric to assess the validity of the resulting model performance. Using TomTom route reports for the given date of calibration, the modelled average hourly OD route travel times were compared against the surveyed travel times to assess if the result were within acceptable thresholds. The determination of acceptable thresholds was informed by the recommendations outlined in the *Traffic Modelling Guidelines* (see **Figure 3**).

    a. For the M7 Core Subnetwork, the 10 OD Routes with the highest daily volumes are reported on ensuring around 50% of all traffic demand will have their travel times validated.

    b. For the Cutler Interchange Subnetwork, all 14 of the possible OD Routes are reported on ensuring all traffic demand will have their travel times validated. Origins include: Camden Valley Way, M5, M7 and M31. Destinations include: Beech Rd, Camden Valley Way (eastbound and westbound), M5, M7 and M31.

2. **Mainline Speeds (Spot Checks):** Using the recorded speed data from the Loops on the given date of calibration, comparisons of the mainline loop speed (per 15 min) detections against the modelled mainline loop speed (per 15 min) detections was also undertaken as part of the validation process. This was a secondary / supplementary check to the OD Route travel Times as the quality and consistency of raw loop data is often questionable and there are noted reporting errors (particular in speed) in the detection data taken for the date of model calibration.

3. **Ramp Delays:** using TomTom data for the given date of calibration, the observed ramp delays reflecting the level of impedance with the adjacent arterial and or motorway networks was compared against the modelled ramp delays at average hourly intervals. This was a secondary / supplementary check to ensure that any significant queue spill back events from exit ramps were accounted for in the model.

Topic	Criteria
Journey time average	Average modelled journey time to be within 15 per cent or one minute (whichever is greater) of average observed journey time for full length of route. Each route should be cumulatively graphed by section as shown above
Section time average	Average modelled journey time to be within 15 per cent of average observed journey time for individual sections
Journey time variability	Average and 95 per cent confidence intervals to be plotted for observed and modelled travel times for each journey time route. Comparison to be to modeller and RMS satisfaction.

Figure 3 - Suggested Model Validation Criteria for the Traffic Modelling Guidelines (2013)

3.4 Demand Forecasting

3.4.1 Demand Consistency with TUSTM

It is the preference of Transurban to also relate the Operational Model's future year demand forecasts with the TUSTM's future year demand forecasts. This approach is preferred by Transurban for the following reasons –

- The TUSTM demand forecasts specifically relate to the demand levels justifying the project case; and

- The level of demand in the operational model should closely reflect the official project demand forecasts assumptions to provide the project with the confidence that traffic operational issues are adequately addressed by the project's design.

3.4.2 Future Demand Profiling Assumptions

Given the Operational Model's Base Year calibrated OD matrices are profiled at 15min intervals, the future demand forecast levels adopted from the TUSTM will also reflect a dynamic departure profile estimated at 15min intervals. This approach is intended to ensure the future year demand levels consider the following -

- Demands between relevant ODs will not grow in intervals that would result in excessively overloading congested locations in the modelled network and producing unrealistic levels of congestion.

- A type of dynamic user equilibrium in terms of temporal distribution or departure time choice may be assumed to reflect the observed trends where peak spreading has already been observed to occur on the M7.

3.5 Intelligent Traffic System Facilities

3.5.1 Base Network Assumptions

Within the scope of the proposed operational model a range of intelligent traffic system features actively manage the network in a dynamically responsive manner. These actions do frame significant features of the recorded operational network performance and are key parameters that will be considered as part of the model validation exercise.

Network Element	Treatment in the Operational Models
SCATS & Intersection Operations	The exit ramp delay's created by the specific phase timings at intersections controlling the ramp to arterial interface will be via an end meter which will reflect the given movements relative phase times based on data collected to support the SIDRA intersection modelling components (outlined in **Table 1**).
Mainline Control (VSLS / LUMS)	VSLS is currently operated on the M7 mainline. For the base model the historic VSLS posted speed record has been collected and the model will seek reflect the time actual time-specific posted speeds applied on the day of model calibration through application of necessary traffic management strategies in the model.
Ramp Metering Systems	The M7 interface movements with the M4 motorway via the light horse interchange is now metered as part of the M4 Smart Motorways System. A "dummy" metering rate will be applied on the M7 to M4 ramps which will reflect the flow rate and delays that were recorded on the given day of calibration. Transurban will also request information on the M4 Smart Motorways Operations from TfNSW detailing when ramp metering is activated on the M7 ramps. This information will be used to determine when the metering will take effect (activate and deactivate) in the base model.

Table 5 - Base ITS Assumptions

3.5.2 Future ITS Network Assumptions

Beyond developing traffic management strategies and control plans that reflect the base year ITS operational assumptions, it is the intent that the following assumptions will be made in the future base case scenarios –

- There will be no default VSLS operation applied.
- The M4 Smart Motorway meters on the M7 ramps will operate for the same duration and metering rate as the base model; however

The future year operations will incorporate a back of queue management override that will deactivate metering in line with Transurban's understanding of the smart ramp metering logic for the M4 Smart Motorway system.

Part B: Base Model Development

4. Model Network

4.1 Network Geometry

The Operational Model network was initiated via the native Next OpenStreetMap importer and subsequently the specific link hierarchy and default road type attributes reflects that of the OpenStreetMap system as per the date of import (Tuesday 20th April 2021). In addition to the basic network import from OpenStreetMap, the following detailed network changes were made to calibrate the model network geometry –

1. **Simplification of sections;** where possible the number of separate sections along the motorway networks modelled were reduced (i.e. joined) to represent the standard motorway subsystems of isolated Highway Capacity Manual (HCM) analysis as a single section in the model as well as to supplement the requirement of the slope model in major downgrades. Specifically –

    a. A mainline section
    b. A diverge area
    c. A merge area
    d. A weave area

2. **Aerial alignment;** the detailed 2D geometry of the network was checked against high-resolution aerials of the network taken from Nearmaps for Monday 22nd February 2021.

3. **Significant Slopes;** an audit of the modelled network sections where a significant slope is present was undertaken to identify key areas where a section slope should be modelled. Some internal sensitivity tests found the (TWOPAS based see Section 4.2) slope model within Next was found to not produce a notable impact on model results unless it averaged over +/-3% a km. **Table 6** below summarises the modelled areas where a significant slope was identified and subsequently applied on sections in the model. Note that the slope values initially applied were generally rounded to the nearest 0.5% and in the instance of the Southern Approach to the hill at Elizabeth Dr eventually accentuated with an additional 1% to support modelled speeds and travel time validation in this section.

Network Area	Model Section (ID)	Slope (%) and Section Length
Elizabeth Dr Hill Southern Approach Area	1576750	1.5% 1861.92m
	1576759	4.5% 1346.34m
	1576765	4.5% 926.23m
	1576768	3.0% 124.7
	1576777	3.0% 1303.84m

Network Area	Model Section (ID)	Slope (%) and Section Length
Elizabeth Dr Hill Northern Approach Area	1577973	1.5% 2165.5m
	542920	2.5% 858m
	176786	2.5% 262.3m
	1577857	3.5% 900m
Elizabeth Dr Hill Southbound Decline	1576762	-3.5% 1045.9m
	1576756	-3.0% 3352.4m
Cutler Interchange	370318	3.0% 402m
	331928	2.4% 636m

Table 6 - Sections where a significant slope was identified and the modelled slope values

4.1.1 Section and Turn Behavioural Model Parameters

As part of the model validation process, a range of user-defined parameters were applied to override the software default settings in the section and turn parameters for the following vehicle behavioural models –

1. Lane Changing Model, including –
    a. Turn Based Look Ahead Zones
    b. Section Based Aggressiveness and Cooperation Levels
    c. Section Based Imprudent Lane Changing Model
    d. Section Based Overtaking Model
2. Side Lane (Merge) Model, including –
    a. Section Based Cooperation and Merge Distance
    b. Section Based “First Vehicle On / Off” Override (as a default has been removed at most arterial on ramps)
3. Queue Discharge Model, including
    a. Section Based Acceleration Factor
    b. Section Based Additional Reaction Time at Stops and Traffic Lights

The changes made at a detailed per turn and section level have been applied as the constant attributes i.e. applicable to the section or turn throughout the entire simulated period and no dynamic / time based behavioural model attributes have been assumed.

4.2 Slope Acceleration and Deceleration Behavioural Models

4.2.1 Acceleration on Upgrades

Given the relationship between significant grades on the M7 mainline and the high proportion of heavy vehicles are major component of the network's performance and operational capacity at critical sections, the operational model applies the Next (Aimsun) TWOPAS model for acceleration on upgrades. **Figure 4** details the equations based on the US Federal Highway Administration's report no. FHWA-RD-00-*078 Capability and Enhancement of the VDANL and TWOPAS for Analyzing Vehicle Performance on Upgrades and Downgrades With IHSDM (2000)* that are applied in the operational model. In **Figure 4**; V is the current speed in feet/s, G is the angle in radians, W/P is the Weight to Power Ratio in lb/hp, and W/A is the Weight to Front Surface Ratio in lb/ft^2. The crawl speed is obtained solving the equation for a=0.

$$a = \frac{-0.2445 - 0.0004V - 0.021\frac{V^2}{\frac{W}{A}} + \frac{15145.4}{\frac{W}{P} \times V} - 32.17G}{1 + \frac{14080}{\frac{W}{P} \times V^2}}$$

Figure 4 - TWOPAS acceleration model implementation in the operational model

4.2.2 Heavy Vehicle Deceleration on Downgrade

The operational model also considers the effect where heavy vehicles use a smaller gear to reduce their speed to avoid brake or overheating. This was considered appropriate given the scale of the downgrade southbound between Elizabeth Dr and Cowpasture Rd. The operational model calculates the maximum speed per heavy vehicle on downgrades based on the equation shown in **Figure 5**, taken from the US Federal Highway Administration's report no. FHWA-RD-79-116 *Feasibility of a grade severity rating system (1980)*. In **Figure 5**, V is the maximum speed in mph, W is the weight in lb, G is the angle in radian, L is the length of the downgrade in miles.

$$Vmax = \frac{-837.5}{55.4 - 0.0367WG + 275L/}$$

Figure 5 - Operational Model Downgrade Crawl Speed Calculation for Heavy Vehicles

4.3 Network Traffic Demand Structures

Given the Operational Model is divided into two separate subnetworks, there are two centroid configurations applied –

1. **The M7 Core Centroid Configuration**; consisting of a total of 27 dedicated demand origin zones and 27 dedicated demand destination zones (see **Table 7**) largely based on the M7 Toll Gantry System.

2. **The Cutler Interchange Centroid Configuration**; consisting of a total of 14 dedicated demand origin zones and 14 dedicated demand destination zones (see **Table 8**).

Origin Zones	Destination Zones
01A : Northbound from M31 & M5	01B : Southbound to M31 & M5
02B : Northbound from Bernera Rd	02A : Northbound to Bernera Rd
02D : Southbound from Bernera Rd	02C : Southbound to Bernera Rd

Origin Zones	Destination Zones
03B : Northbound from Cowpasture Rd	03A : Northbound to Cowpasture Rd
03D : Southbound from Cowpasture Rd	03C : Southbound to Cowpasture Rd
04B : Northbound from Elizabeth Dr	04A : Northbound to Elizabeth Dr
04D : Southbound from Elizabeth Dr	04C : Southbound to Elizabeth Dr
05B : Northbound from Horsley Dr	05A : Northbound to Horsley Dr
05D : Southbound from Horsley Dr	05C : Southbound to Horsley Dr
06B : Northbound from Old Wallgrove Rd	06A : Northbound to Old Wallgrove Rd
06D : Southbound from Old Wallgrove Rd	06C : Southbound to Old Wallgrove Rd
07BE : From M4 West to M7 Southbound	07AE : To M4 East from M7 Northbound
07BW : From M4 East to M7 Southbound	07AW : To M4 West from M7 Northbound
07DE : From M4 West to M7 Northbound	07CE : To M4 East from M7 Southbound
07DW: From M4 East to M7 Northbound	07CW : To M4 West from M7 Southbound
08A : From Great Western Hwy Northbound	08B : To Great Western Hwy Southbound
09B : From Power St Northbound	09A : To Woodstock Av Northbound
09D : From Woodstock Av Southbound	09C : To Power St Southbound
10B : From Richmond Rd Northbound	10A : To Richmond Rd Northbound
10D : From Richmond Rd Southbound	10C : To Richmond Rd Southbound
11A : From Quakers Pwy Eastbound	11B : To Quakers Pwy Westbound
12B : From Sunnyholt Rd Eastbound	12A : To Sunnyholt Rd Eastbound
12D : From Sunnyhold Rd Westbound	12C : To Sunnyholt Rd Westbound
13B : From Norwest Blvd Westbound	13A : To Norwest Blvd Eastbound
14A : From Old Windsor Rd Eastbound	14B : To Windsor Rd Westbound
15B : From M2 Westbound	15A : To M2 Eastbound
ABBOTT_EB : From Abbott Rd Eastbound	ABBOTT_WB : To Abbott Rd Westbound

Table 7 - M7 Traffic Demand Zone System

Origin Zones	Destination Zones
Camden Valley Way: Northbound	M5: Eastbound
Camden Valley Way: Northbound from arterial network	M7: Northbound
Campbelltown Rd: Southbound from arterial network	M31: Southbound
M5: Westbound	Beech Rd off-ramp: Westbound
M5: Westbound	M7: Northbound
M5: Westbound	M31: Southbound
M7: Southbound	Camden Valley Way off-ramp, left turn Eastbound onto arterial network
M7: Southbound	Camden Valley Way off-ramp, right turn Westbound onto arterial network
M7: Southbound	M5: Eastbound
M7: Southbound	M31: Southbound

Origin Zones	Destination Zones
M31: Northbound	Camden Valley Way off-ramp, right turn Eastbound onto arterial network
M31: Northbound	Camden Valley Way off-ramp, left turn Westbound onto arterial network
M31: Northbound	M5: Eastbound
M31: Northbound	M7: Northbound

Table 8 - Cutler Interchange Traffic Demand Zone System

4.4 ITS and Control Systems

The Operational Model has incorporated a range of ITS facilities actively operating on the date of calibration. Specifically, the following ITS elements have been set up in the Operational Models.

4.4.1 M7 Mainline VSLS

The detailed operation log of the VSLS was extracted for the date of 25th of February 2021. The operational log has been analysed with the detailed speed drops incorporated into the Operational Model as Traffic Management Strategies detailed in **Table 9** below.

Subnetwork	Traffic Management Strategy	Description
M7	M7_1am_510am	A posted speed drop to 80km/h around the northbound M7 starting on the approach to the Light Horse Interchange and concluding after the M4 northbound onramp onto the M7.
	M7_510am_600am	A posted speed drop to 70km/h around the northbound M7 starting on the approach to the Light Horse Interchange and concluding after the M4 northbound onramp onto the M7. *Note: based on travel time data & section speed data from TomTom on the given day, it is strongly suggested a low compliance to this VSLS action.*
	M7_600am_630am	A posted speed drop to 40km/h on approach to the ramp meter of the M7 to M4 eastbound ramp.
	M7_9am_1020am	A posted speed drop to 70km/h on approach to the M7-M2 interface as part of a frequent back of queue protection strategy.
	M7_545am_700pm	A posted speed drop to 80km/h on various section on the M7 southbound mainline between the Old Wallgrove Rd southbound on ramp to the Cutler Interchange. *Note: based on travel time data & section speed data from TomTom on the given day, it is strongly suggested a low compliance to this VSLS action, with vehicle speed drops more likely related to congestion levels.*

Table 9 - M7 Base VSLS Strategies

4.4.2 Signal Operations

Given the extent of the Operational Model is limited to the extent of the ramps, only dummy signals or meters have been considered at the ends of the ramps in the M7 Core Subarea. The timings for dummy signals and meters in the M7

Subnetwork do not currently reflect the related phase timings as this element of the data collection program related to the arterial interface impact assessments (see **Table 1**) and was not yet available at the time of calibration/validation. It is proposed that following receipt of SCATS intersection data, the models will be reviewed an updated if necessary to reflect the relevant signal operational data.

For the cutler interchange, Transurban has existing SCATS operational data available from November 11th 2020. These were used as the basis, along with some user defined edits to better align to the model performance to validation data.

Subnetwork	Control Plan	Description
M7	M7_BASE_VALI	A Set of fixed timed "dummy" meters to platoon on-ramp traffic flows at – 1. Cowpasture Rd Northbound 2. Cowpasture Rd Southbound 3. Elizabeth Dr Southbound 4. The Horsley Dr Northbound 5. The Horsley Dr Southbound 6. Old Wallgrove Rd Northbound 7. Richmond Rd Southbound 8. Abbot Rd Eastbound Control Plan duration throughout the full 16 hour simulation period.
Cutler Interchange	Camden Valley Way NT (midnight-4am) Camden Valley Way AM (6-9am) Camden Valley Way AMS (5-6am, 9-10am) Camden Valley Way EE (7pm-midnight) Camden Valley Way MD (10am-2pm) Camden Valley Way PM (3-6pm) Camden Valley Way PMS (2-3pm, 6-7pm)	A control plan was created for each time period to recreate any delays caused by traffic signals and the end of the Camden Valley Way northbound and southbound off-ramps. These control plans are based on known SCATS signal timing data from 11 November 2020 (same day of week selected as that was used for the model), where an average green time and cycle length was calculated per time period.

Table 10 - M7 & Cutler Interchange Control Plan Assumptions

4.4.3 M4 Smart Motorway

The Operational Model network scope is inclusive of the ramp metering facilities provisioned at the M7 – M4 ramps at the Light Horse Interchange. Similar to the assumptions made for arterial signal operations at exit ramps, a dummy meter has been applied in the model which reflects available data on ramp meter activation times and the average ramp delays observed in TomTom survey data.

Subnetwork	Control Plan	Description
M7	M4SM_AM	A Set of fixed timed “dummy” meters to platoon on-ramp traffic flows from the M7 to M4 eastbound on ramp. Based on insights shared between TfNSW and Transurban on the current operations of the M4SM, this control plan makes the following general assumptions – • The meters are active only during the AM period between 6am and 9am. • They are currently deactivated if excessive queue spill back onto the M7 is detected. • When operational they usually service a maximum hourly flow rate of ~1,100 vehicles from the M7 to the M4 east bound.

Table 11 - M4SM Base Control Plan Assumptions

5. Traffic Survey Data

5.1 Available Data Sources

The scope of operational model calibration and validation has been framed to maximise the use of a range of existing traffic survey database available to Transurban, namely those outlined in **Table 12** below.

Database / Source	Description	Use in Calibration & Validation
BAC (Toll Counts)	A complete record of all gantry based tags (counts) on the M7 network summarised at 15min intervals. Counts are classified based on tolling regime i.e. Lights and Heavy.	This database has been prioritised as the primary / most reliable source of OD based trip count data for Demand Calibration at the desired resolution of 15min intervals.
Westlink M7 Roadside Assets **&** **M5 West Roadside Assets**	A complete record of all functioning loop detections at 15min intervals for – • Count • Speed • Occupancy Data is classified into 3 vehicle types – • Short • Medium • Long Additionally this database provides access to the VSLS operational log.	This database has been primarily used to inform the split of the calibrated heavy vehicle class matrix into the three main subclasses for heavy vehicles (see Section 6). The detected loop speed data has also been used a secondary model validation data point to verify the intensity and extent of congestion modelled is reflective of the conditions on the date of calibration. Based on an initial quality analysis of the loop database, it was determined that issues in the reliability and consistency in the raw loop data was not sufficient to inform matrix calibration.

Database / Source	Description	Use in Calibration & Validation
TomTom historic device surveys	A complete survey of TomTom device population (includes apple maps users) that records – Section and route speeds and travel times, including – • Average (normal and harmonised) • Median • Percentiles (from 5th to 95%)	The database was used to estimate the average (and variability based on percentiles) travel time on major OD routes reported on (see Section 3.3.2). This database was used as the primary model validation data set. This data was assessed at hourly intervals over the full 16 hour model period.
Weigh in motion (WIM) sites	Transurban has access to relevant WIM sites on the M7 and M5 network which provides highly disaggregate (by vehicle, by time) record of detailed vehicle classifications. The data available to Transurban was for periods in 2020.	This database was used as a secondary validation dataset to check the estimated per 15min heavy vehicle class split into the three heavy vehicle subclasses (See Section 6).

Table 12 - Databases Utilised for Model Calibration and Validation

5.2 Survey Date Selection

It is the preference of the native Next (Aimsun) matrix estimation procedures to input detection data from a specific real date and avoid attempting to calibrate to an abstract "average" event. Given this preference, Transurban has selected specific dates for each of the two model subnetworks to generate the real data sets used to inform the matrix estimation procedures. At the time of model development, February 2021 was the month with the highest average daily trip count and subsequently a date was identified for both subareas which represented the "most average" day.

For the M7 Core Subnetwork Area: Thursday, February 25th, 2021

Based on an analysis of the total daily toll counts on the M7 network across each weekday in February the M7 was recorded to average 219,604 trips per day. On a given weekday this could fluctuate as high as 237,240 (or +8%) and as low as 206,847 (or -5.8%). Thursday, February 25th was selected given it was identified as being the date with network demand closets to the monthly average at 218,977 or just -0.3% lower than the average.

Month, Day, Year of Date	Daily Trip Sums	Absolute Difference from Average	% Difference from Average
1-Feb-21	206,847	-12,757	-5.80%
2-Feb-21	209,691	-9,913	-4.50%
3-Feb-21	217,719	-1,885	-0.90%
4-Feb-21	222,975	3,371	1.50%
5-Feb-21	233,574	13,970	6.40%
8-Feb-21	208,994	-10,610	-4.80%
9-Feb-21	218,547	-1,057	-0.50%
10-Feb-21	222,683	3,079	1.40%
11-Feb-21	226,502	6,898	3.10%
12-Feb-21	236,095	16,491	7.50%
15-Feb-21	210,493	-9,111	-4.10%

Month, Day, Year of Date	Daily Trip Sums	Absolute Difference from Average	% Difference from Average
16-Feb-21	210,887	-8,717	-4.00%
17-Feb-21	216,926	-2,678	-1.20%
18-Feb-21	221,027	1,423	0.60%
19-Feb-21	229,157	9,553	4.40%
22-Feb-21	210,825	-8,779	-4.00%
23-Feb-21	216,327	-3,277	-1.50%
24-Feb-21	216,600	-3,004	-1.40%
25-Feb-21	218,977	-627	-0.30%
26-Feb-21	237,240	17,636	8.00%
Monthly Average	219,604		

Table 13 - M7 BAC (Toll Count) Daily Trip Summaries - February 2021 Weekday

For the Cutler Interchange Subarea: Wednesday, February 10th

Due to the Cutler Interchange network area operating largely outside of the M7 tolling system and that the M5 West Tolling system is not applicable in this area, determination of the average demand day was based on the available loop data in the area. Based on an analysis of the sum of loop detection counts in the modelled network area of the Cutler Interchange Subnetwork, the average February weekday detection sum was recorded at 295,450. On a given weekday analysis found this detection sum could fluctuate as high as 343,219 (or +19.5%) and as low as 207,321 (or -27.8%). Given the high variability in the daily detection sum count (which can be attributed to common detection failures at various sites), the method of date selection was based on the day with a detection profile which best fit the average detection profile. **Figure 6** below illustrates the fit identified between Wednesday, February 10th and the average daily detection sum profile for February 2021. Overall, this date was within 0.3% of the average detection profile.

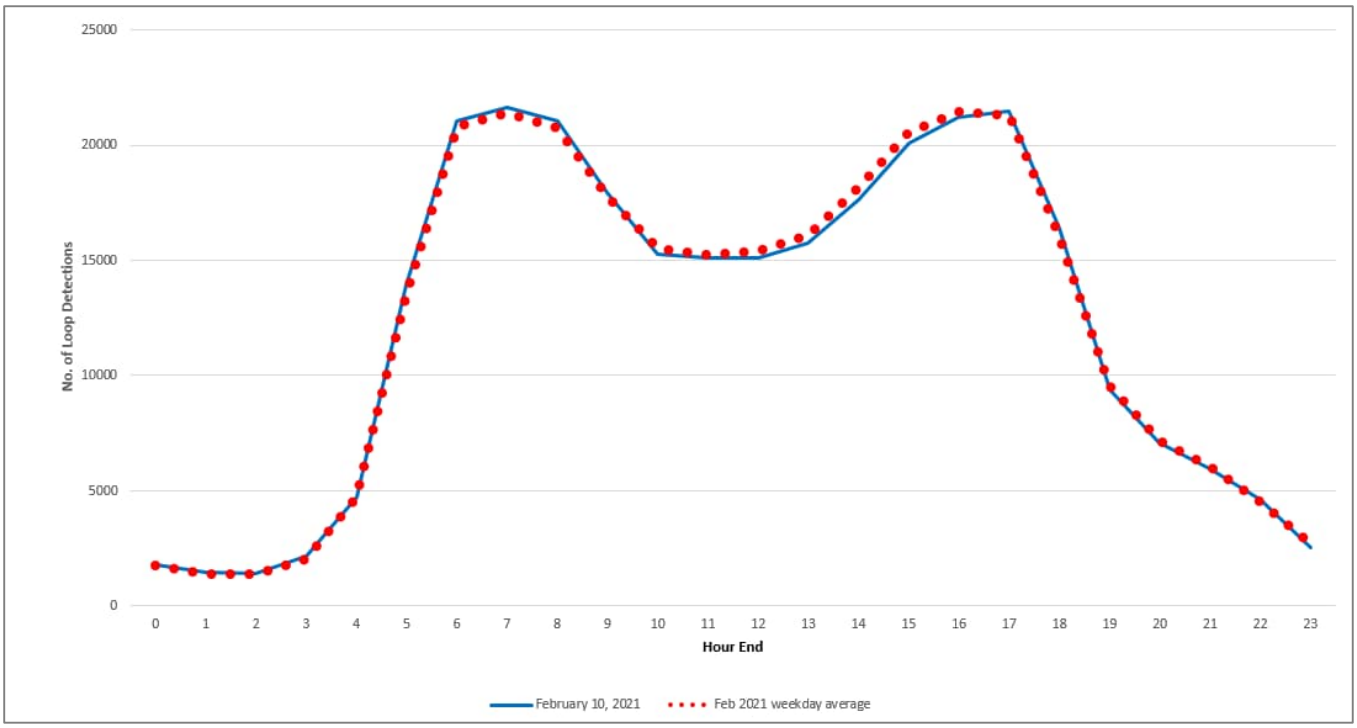


Figure 6 - Cutler Interchange Subnetwork Area - Comparison of Sum Loop Detection Daily Profiles

5.3 Real Data Sets

A set of Real Data Sets (RDS) were generated from the available databases for the date of calibration selected for each subnetwork. **Table 14** below lists the full set of RDS generated and how they were applied in the calibration and validation procedures.

Subnetwork	RDS	Description
M7	Real (Toll) Count	A 15 min classified vehicle based count detection. Total (turn) objects = 46
	Real Loop	A 15 min classified vehicle based count, speed and occupancy detections. Total (detector) objects = 199
	TomTom	A 1hr un-classified OD route travel time, speed, standard deviations and 5th and 95th percentile. Total (subpath) objects = 20
Cutler Interchange	Real (Toll) Count	A 15 min classified vehicle-based count detection. Total (detector) objects = 2
	Real Loop	A 15 min classified vehicle-based count, speed and occupancy detections. Total (detector) objects = 12
	SCATS	A 15 min unclassified vehicle-based count detection. Total (detector) objects = 3
	TomTom	TomTom system sample size results per time period (e.g. AM, AMS, PM, etc.) used to approximate volume on the Campbelltown SB on-ramp (volume unknown) via relationship to the adjacent mainline section (volume known via real loop data). Total (detector) objects = 1
	TomTom	A 1hr un-classified OD route travel time, speed, standard deviations and 5th and 95th percentile. Total (subpath) objects = 14

Table 14 - List of RDS Applied in Base Model Calibration and Validation

6. Simulated Traffic Classes

Detailed vehicle class breakdown in the operational model was based on a number of assumptions. For the initial dynamic matrix estimation (Matrix Adjustment and OD Departure Adjustment) exercises just 2 vehicle classes were assumed –

1. Light Vehicles; and
2. Heavy Vehicles

The calibrated Light Vehicle OD matrices have been attributed to the default “Car” vehicle type in the Next software. No further user defined changes to the dynamic attributes have been made to this vehicle type. The calibrated Heavy Vehicle OD matrices in both subnetworks have been further profiled down into a further 3 sub classes of –

1. Rigid Trucks
2. Articulated Trucks
3. B-Double Trucks

The attribute and behavioural parameter settings for the three heavy vehicle types assumed in the operational model are entirely based on those recommended in Austroads Publication No. AP-R609-19 *Improving the Reliability of Heavy Vehicle Parameters to Support More Accurate Traffic Modelling in Australia and New Zealand (2019).* The only additional user defined changes to the suggested Austroads settings have been to lift the “Median Desired Speed” for both Articulated and B-Double Truck types from the recommendation of 85km/h up to 95km/h in order to align the model performance to the validation data.

The detailed time profiling assumptions of the calibrated Heavy Vehicle OD matrices are discussed in **7.2.3**.

7. Demand Adjustments and Time Profiling

7.1 GEH Summary

An hour-by-hour summary of the Geoffrey E. Havers (GEH) statistic performance of the modelled results (for the median seed value, being 86524 and 560 for the M7 model and Cutler Interchange model respectively) in both model subnetworks is provided in **Table 15** and **Table 16** below. Based on the summary provided, it is believed that the demand matrices for both subnetworks are sufficiently calibrated given –

- Both subnetworks consistently achieve a 100% GEH <10 on modelled flow v. count across the full 16 hour simulation period.
- Both subnetwork achieve a high consistency of 100% GEH <5 on modelled flow v. count across a clear majority of hours in the 16 hour simulation period.
- Hours where the modelled GEH <5 is below a 100% rate, the specific sites impacting calibration performance have been identified as relating to between 1 - 2 count site subject to a high variability of congested traffic flows in the peak period shoulders i.e. the GEH performance reflects the natural variability of flow break downs around the peak demand periods.

Furthermore, given the simulation is a continuous 16 hour period which based on count analysis captures the warm up and cool down of the network from / to a low saturation traffic state, the consistently high GEH performance across the day provides confidence that any given hourly GEH performance is not the result of throughput calibration error. That is the result provides sufficient evidence that modelled traffic flows represent the real demand levels across the 16 hour modelled period.

M7 DEMAND CLIBRATION - NETWORK SUMMARY				
TIME	GEH <5	GEH < 10	MAX ABS DIFF	MEAN DIFF %
5:00:00 AM	100%	100%	28	0%
6:00:00 AM	100%	100%	109	-2%
7:00:00 AM	100%	100%	129	1%
8:00:00 AM	100%	100%	83	0%
9:00:00 AM	100%	100%	126	1%
10:00:00 AM	98%	100%	299	0%
11:00:00 AM	100%	100%	78	1%
12:00:00 PM	100%	100%	69	-1%
1:00:00 PM	100%	100%	76	1%
2:00:00 PM	100%	100%	99	0%
3:00:00 PM	100%	100%	83	2%
4:00:00 PM	98%	100%	482	3%
5:00:00 PM	100%	100%	245	1%
6:00:00 PM	98%	100%	279	-1%
7:00:00 PM	100%	100%	135	1%
8:00:00 PM	100%	100%	61	-1%

Table 15 - M7 Subnetwork Demand Calibration Summary

CUTLER INTERCHANGE DEMAND CLIBRATION - NETWORK SUMMARY				
TIME	GEH <5	GEH < 10	MAX ABS DIFF	MEAN DIFF %
5:00:00 AM	94%	100%	132	8%
6:00:00 AM	78%	100%	251	2%
7:00:00 AM	100%	100%	170	4%
8:00:00 AM	100%	100%	170	4%
9:00:00 AM	94%	100%	223	3%
10:00:00 AM	100%	100%	198	5%
11:00:00 AM	100%	100%	97	1%
12:00:00 PM	100%	100%	128	1%
1:00:00 PM	100%	100%	121	0%
2:00:00 PM	100%	100%	93	3%
3:00:00 PM	100%	100%	109	0%
4:00:00 PM	100%	100%	191	6%
5:00:00 PM	100%	100%	245	2%
6:00:00 PM	94%	100%	207	3%
7:00:00 PM	94%	100%	275	1%
8:00:00 PM	89%	100%	170	1%

Table 16 - Cutler Interchange Subarea Demand Calibration Summary

7.2 Demand Profiling Summary

7.2.1 Global Network Demand Profiles

The profiled 15 minute demand matrices for all vehicle classes was confirmed to align to the global summary of hourly vehicle and PCU demand % illustrated in **Table 2** and **Table 3** in **Part A** of this report. Specifically, the modelled demand profile summaries illustrated in **Figure 7**, **Figure 8**, **Figure 9**, **Figure 10** below confirm the following analysis of the real count data taken on the date of calibration –

- The AM Peak in both vehicle and PCU terms is between 7-8am in both subnetworks
- In PCU terms, the AM Peak in both subnetworks is notably higher that the levels seen in the PM Peak period.
- For the M7 Subnetwork, in PCU terms, the mid-day off peak period is approaching demand levels similar to that of the PM Peak Period. I.e. the mid-day period is becoming susceptible to increasing occurrences of congestion at levels similar to those seen in a PM peak period.

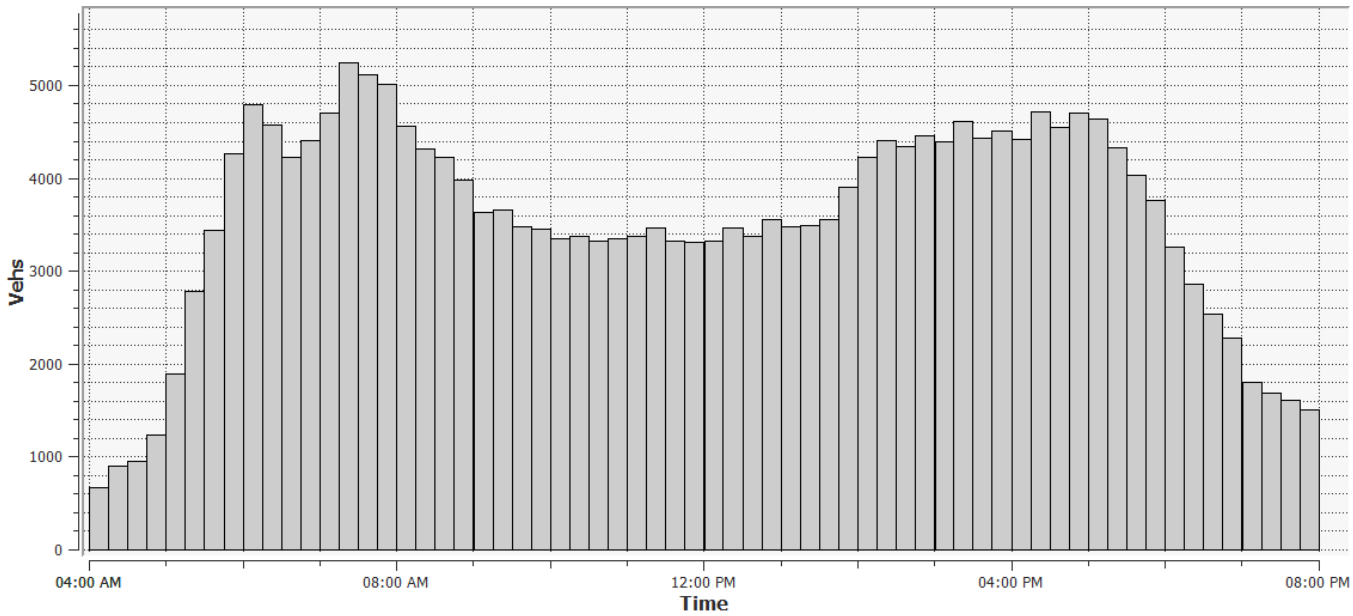


Figure 7 - Global Demand Profile for M7 Subnetwork (Vehicles)

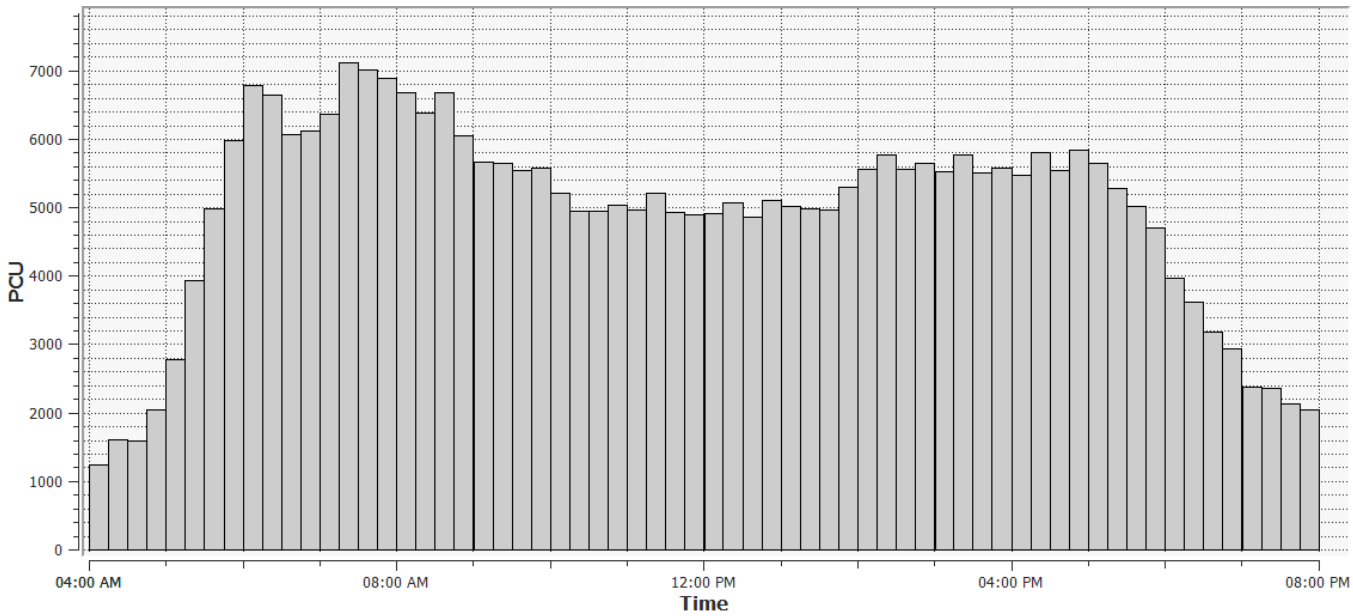


Figure 8 - Global Demand Profile for M7 Subarea (PCU)

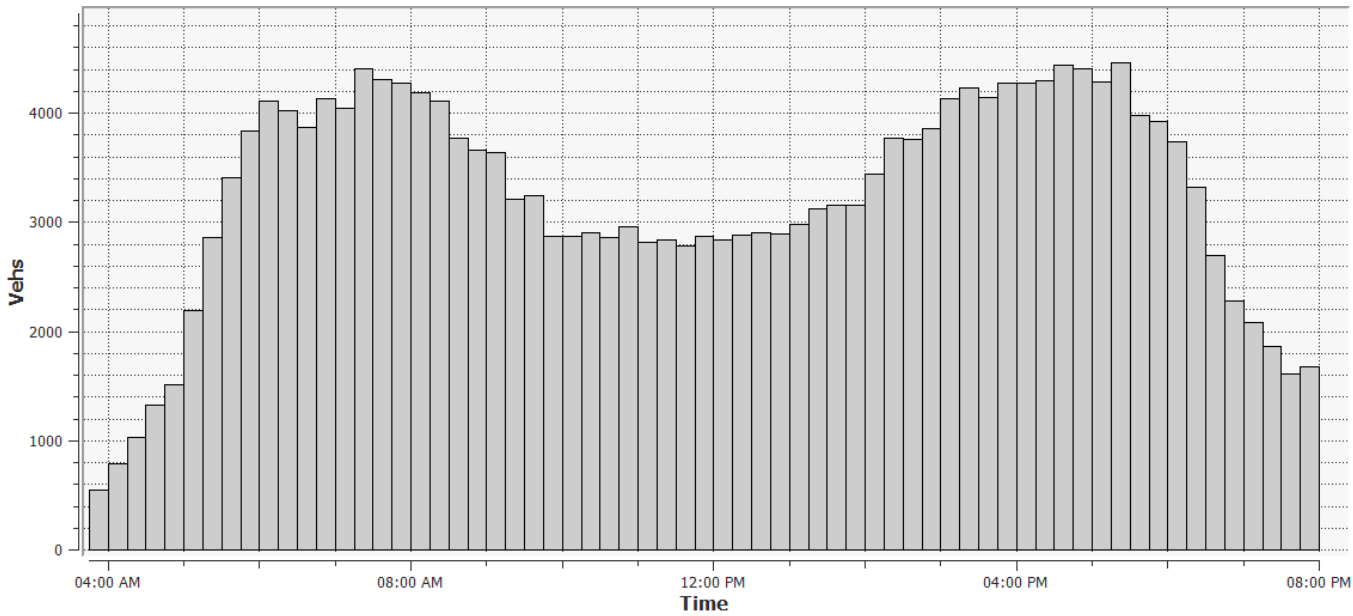


Figure 9 - Global Demand Profile for Cutler Interchange Subarea (Vehicles)

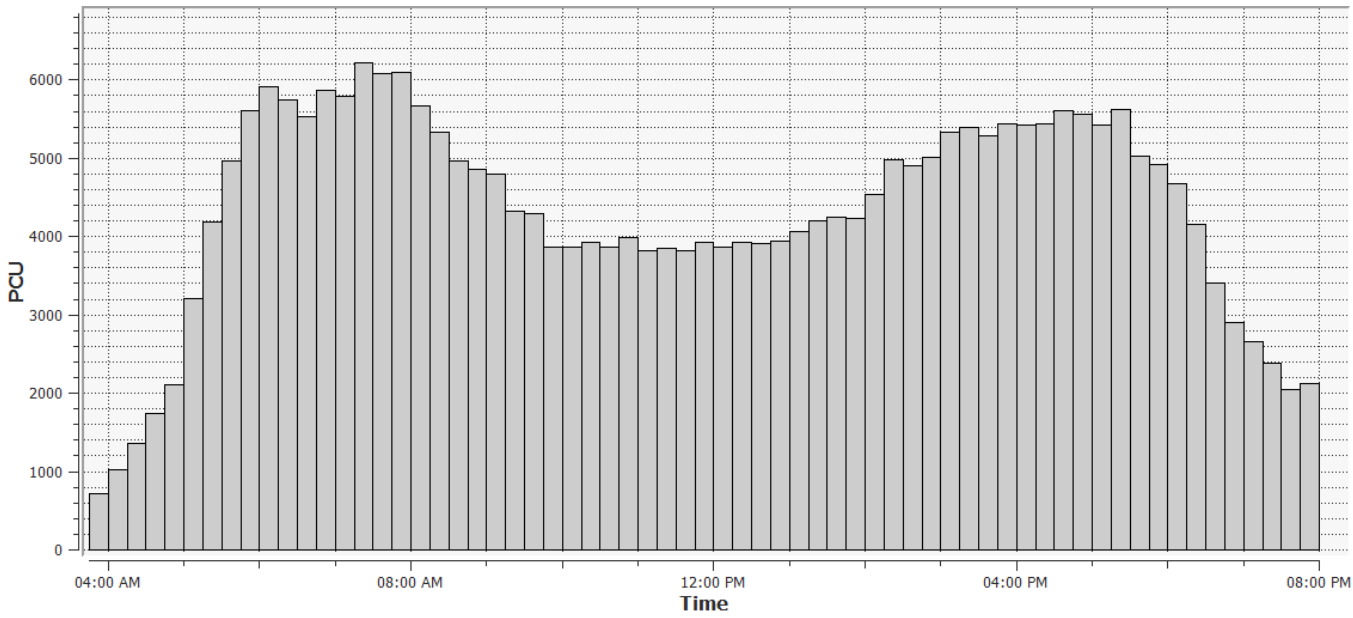


Figure 10 - Global Demand Profile for Cutler Interchange Subarea (PCU)

7.2.2 Key Count Site Time Series Comparisons

In addition to global hourly GEH and demand profile level analysis, detailed time-series spot checks where undertaken at key sites which represent the major demand loading and destination areas in the model. Specifically –

1. At M7 Gantry 1A & 1B – the M7: mainline entrance / exit with the Cutler Interchange
2. At M7 Gantry 7A, 7B, 7C & 7D: exit and entry ramps between the M7 and M4 motorways
3. At M7 Gantry 15A & 15B: mainline entrance / exit with the M2 Motorway

The following figures illustrates the modelled average 15min count result at these sites against the actual toll system (BAC) count. Overall these clearly indicate a strong fit and modelled replication of the real traffic flow and demand through these major sections of the M7 network. The main exception to note is in **Figure 12**, showing the Southbound Exit gantry from the M7 mainline into the Cutler Interchange. The modelled count profile highlights the hours which are not achieving a GEH <5 of 100% in **Table 15**. The analysis has found (and supported by the supplementary validation analysis in Section 8.2) that the modelled flows in the PM Peak arrive earlier than the count suggests but overall, the demand level is correct. This early flow arrival is due to the noted issues in replicating the significant and highly variable flow break down on the M7 network directly upstream of this count site (see Section 8.2).

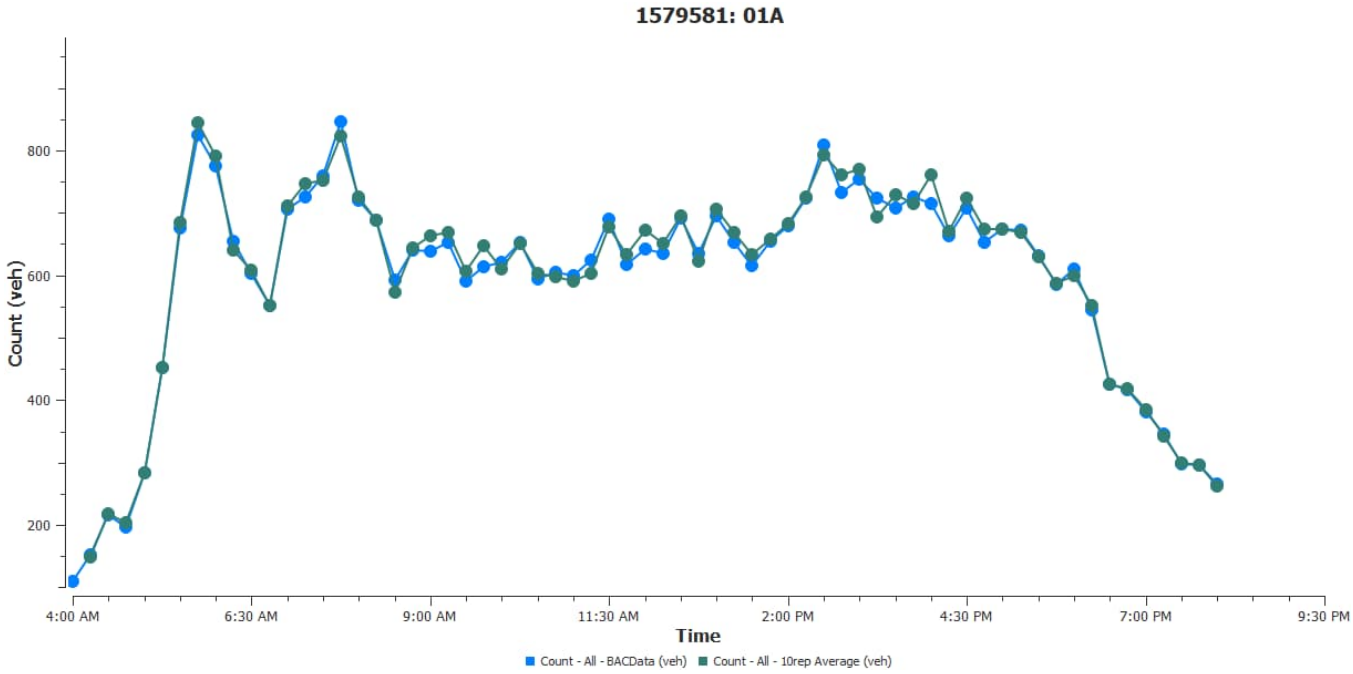


Figure 11 - Real Toll Count (25/02/2021) v. Modelled Count at Gantry 1A

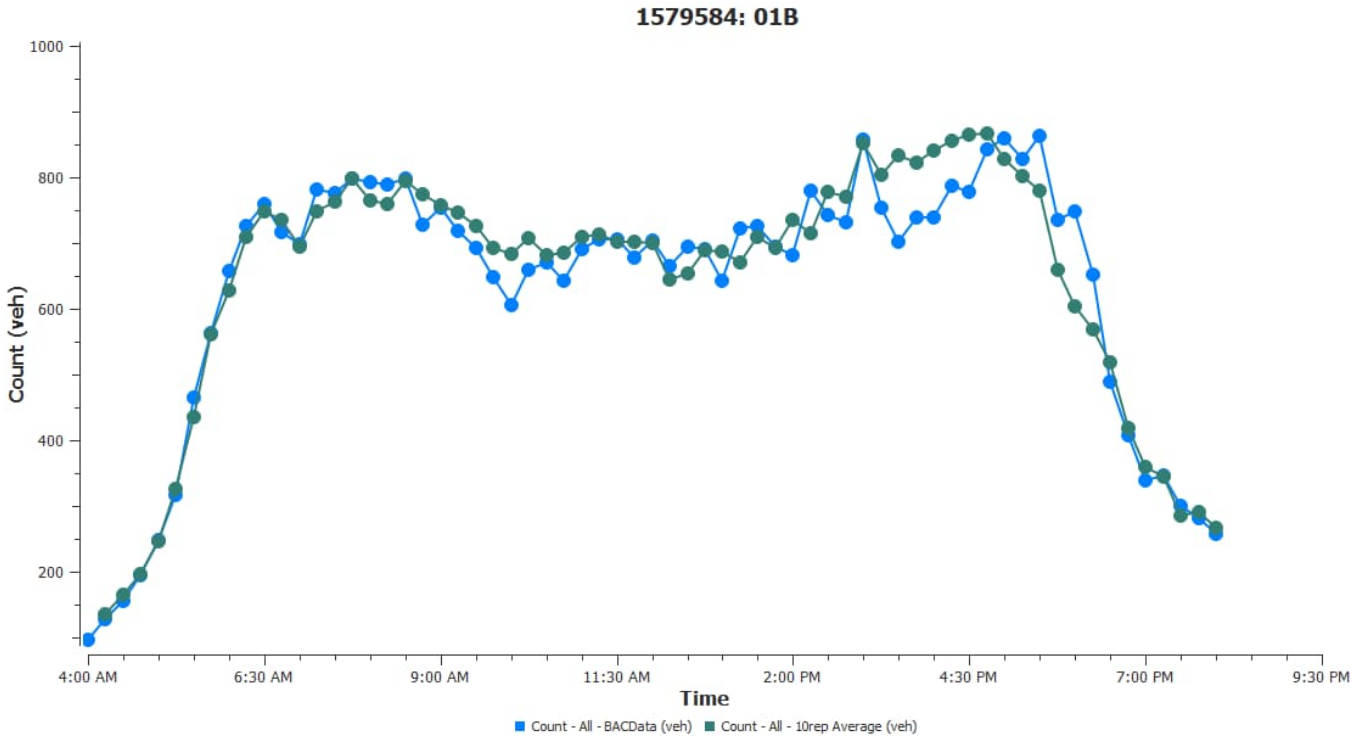


Figure 12 - Real Toll Count (25/02/2021) v. Modelled Count at Gantry 1B

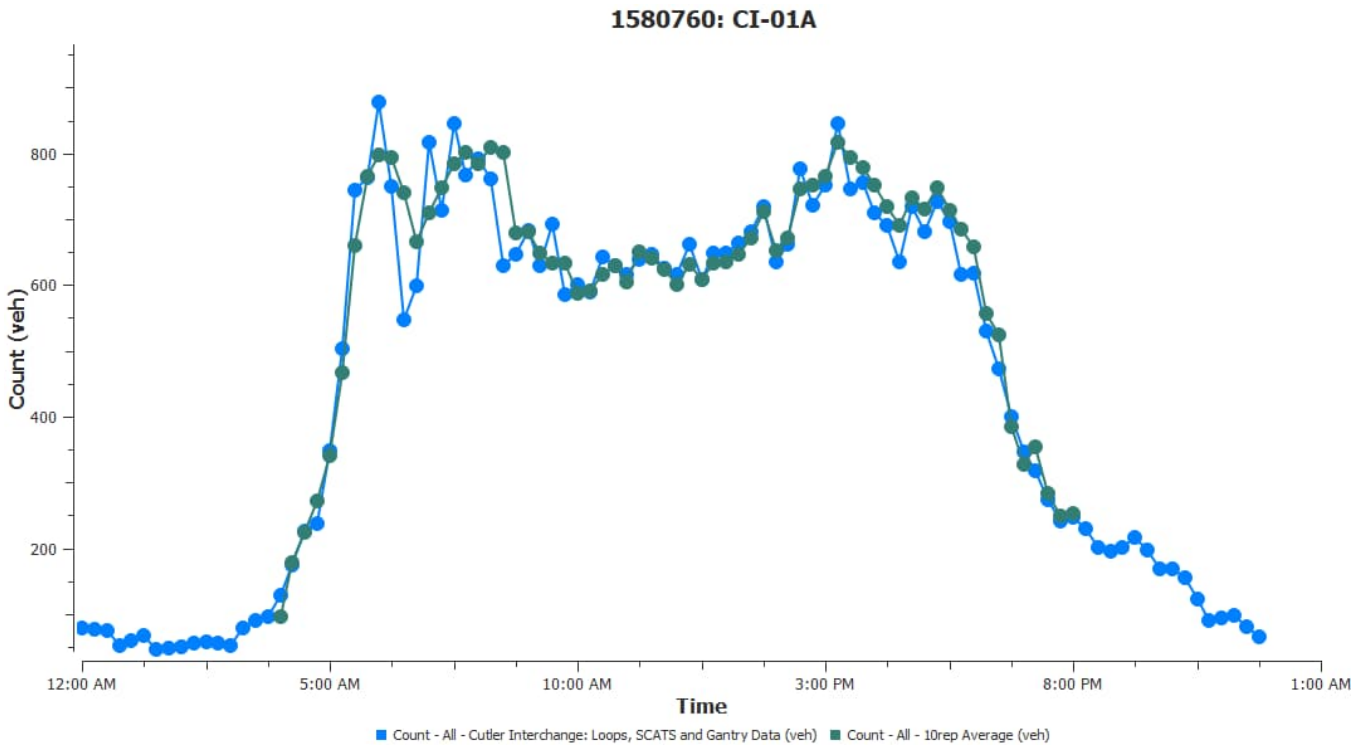


Figure 13 - Real Toll Count (10/02/2021) v. Modelled Count at Gantry 1A

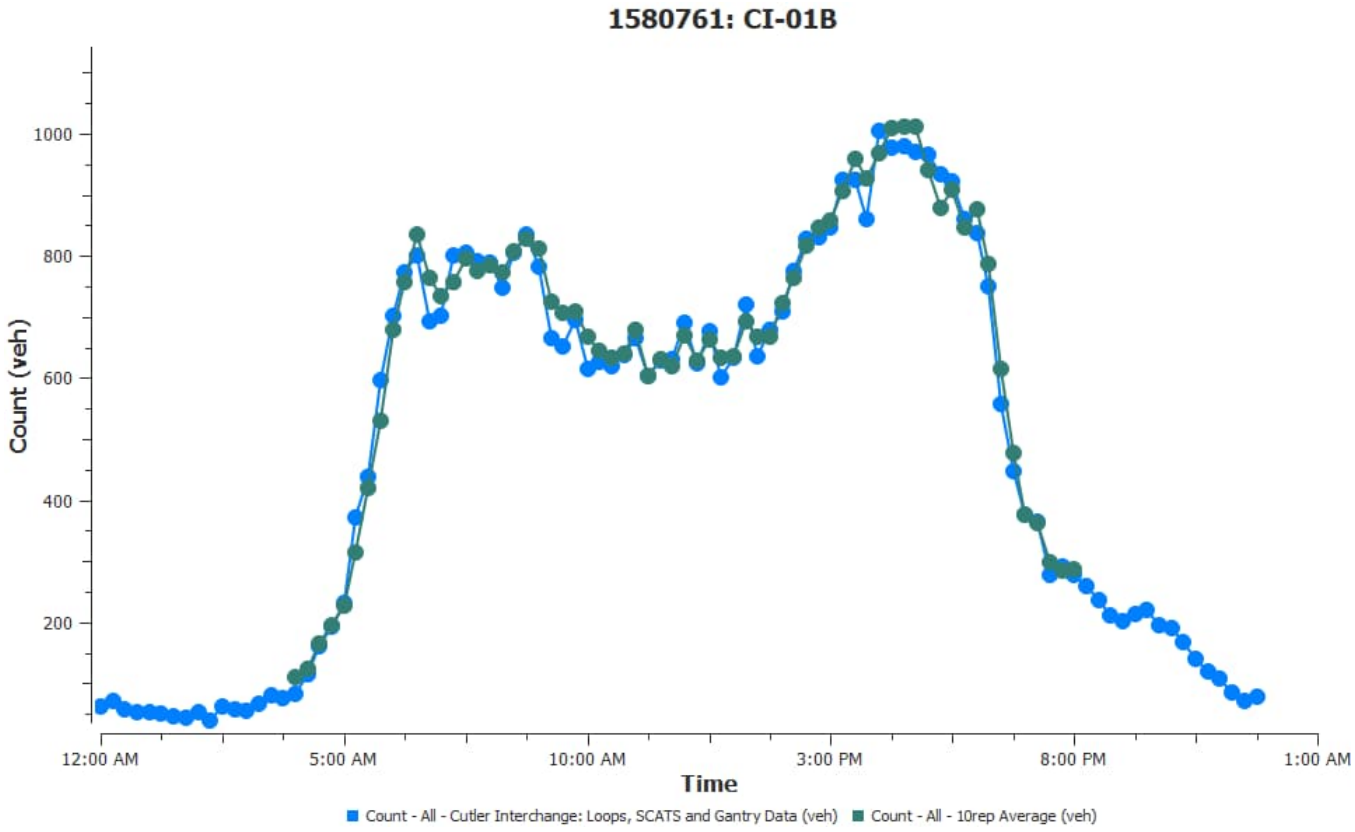


Figure 14 - Real Toll Count (10/02/2021) v. Modelled Count at Gantry 1B

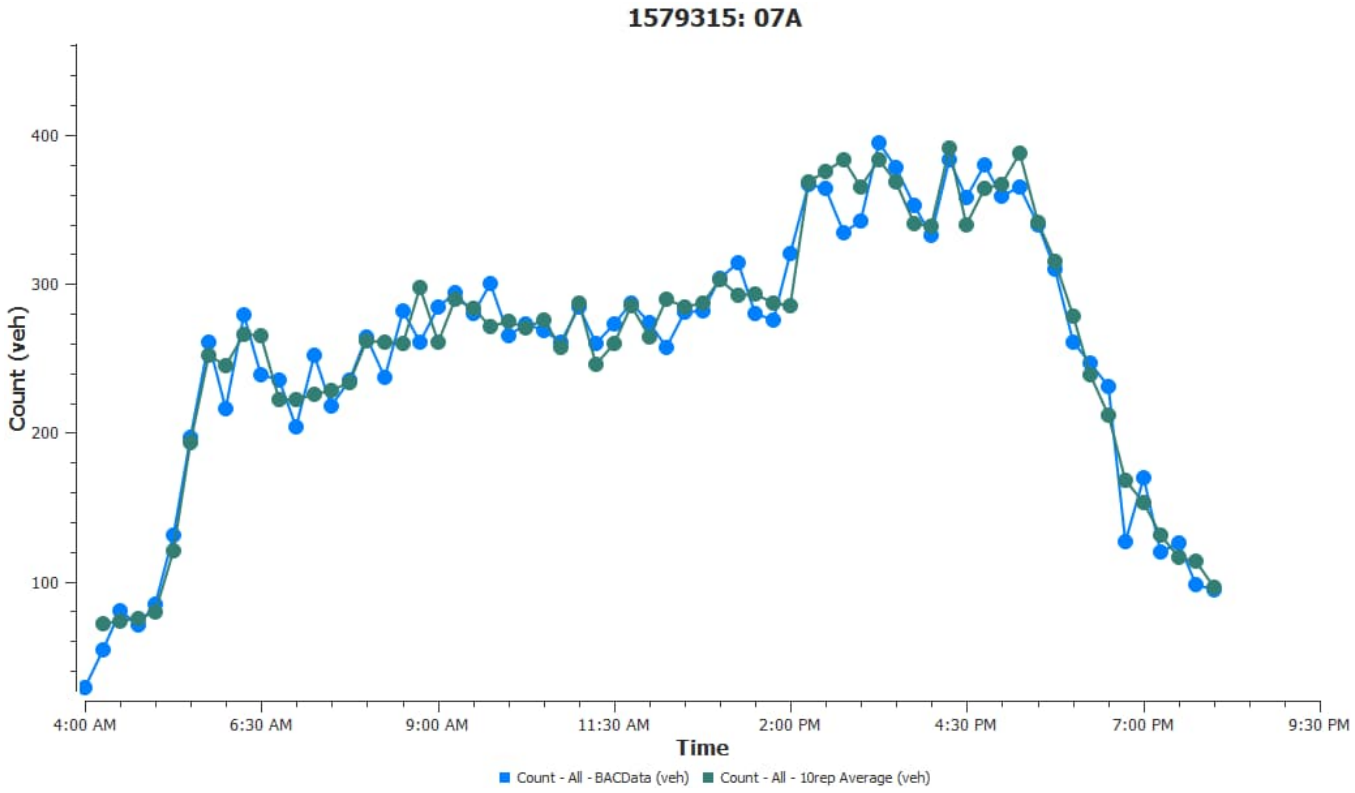


Figure 15 - Real Toll Count (25/02/2021) v. Modelled Count at Gantry 7A

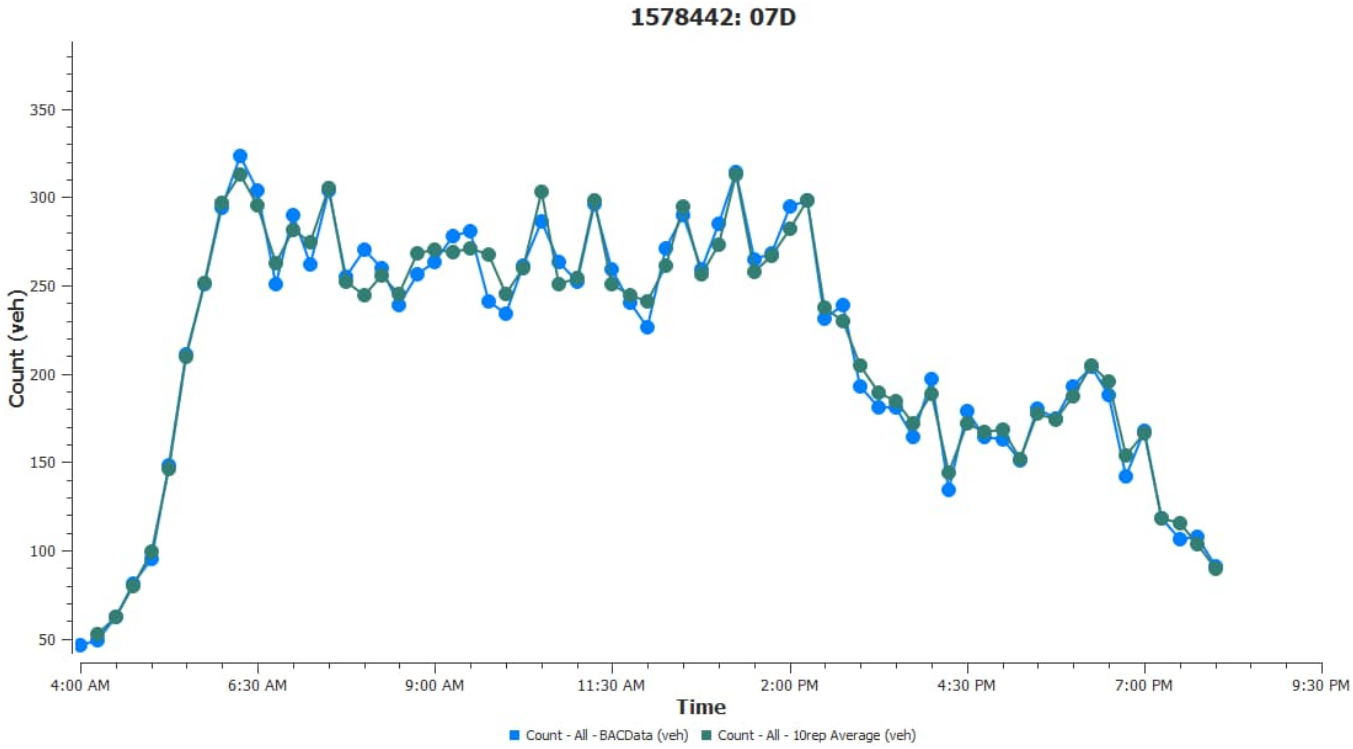


Figure 16 - Real Toll Count (25/02/2021) v. Modelled Count at Gantry 7D

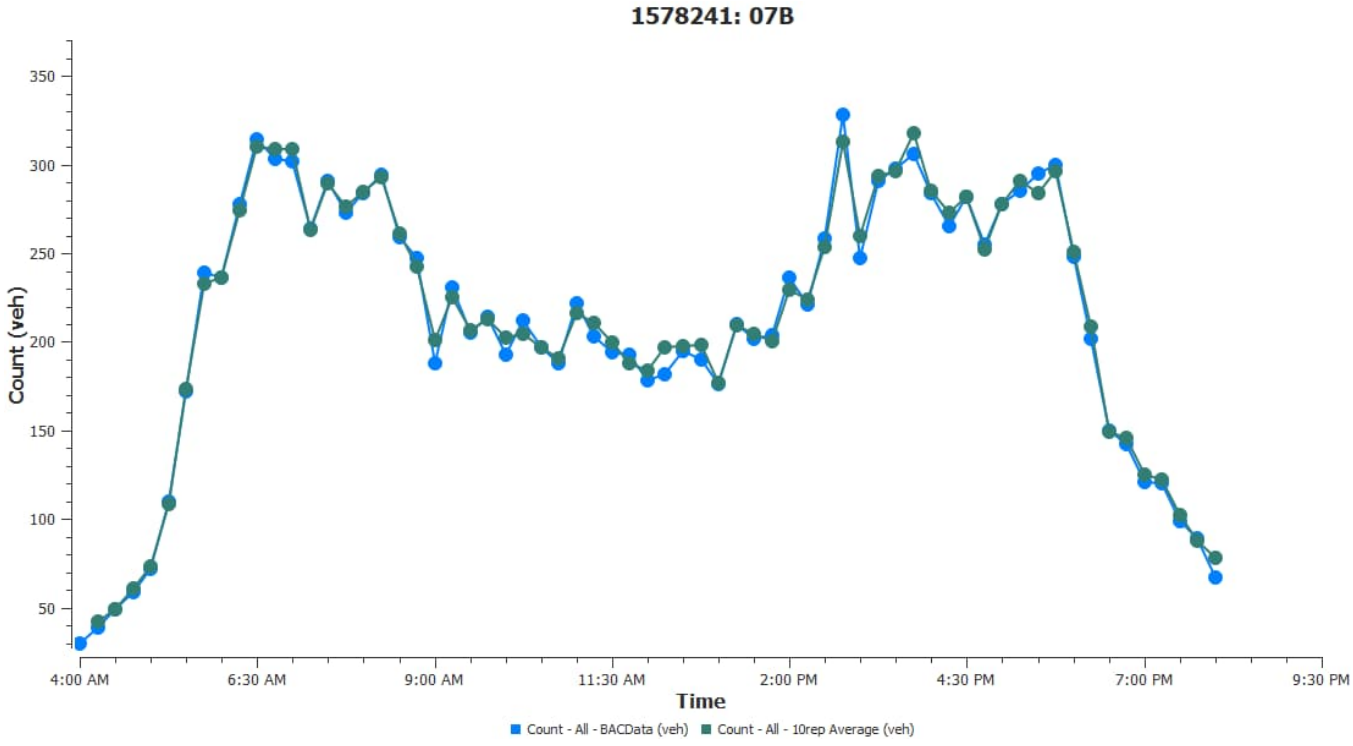


Figure 17 - Real Toll Count (25/02/2021) v. Modelled Count at Gantry 7B

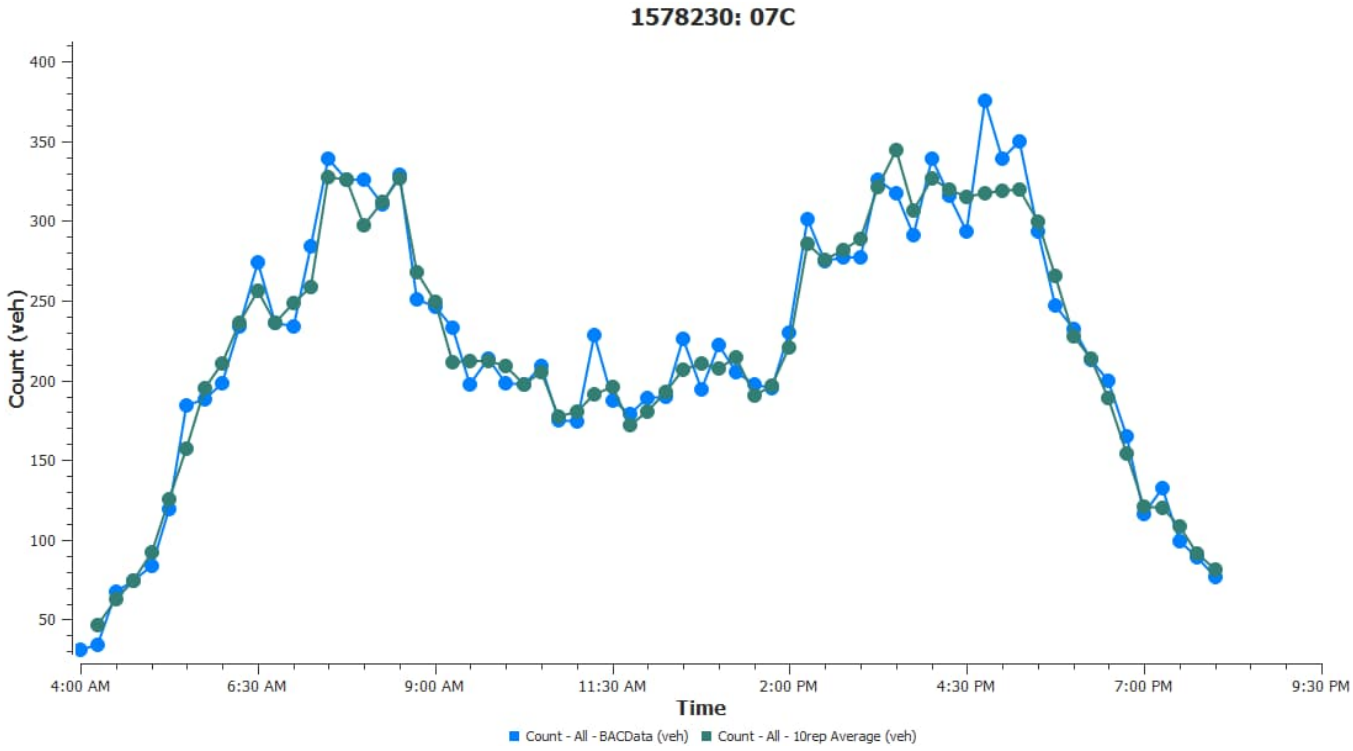


Figure 18 - Real Toll Count (25/02/2021) v. Modelled Count at Gantry 7C

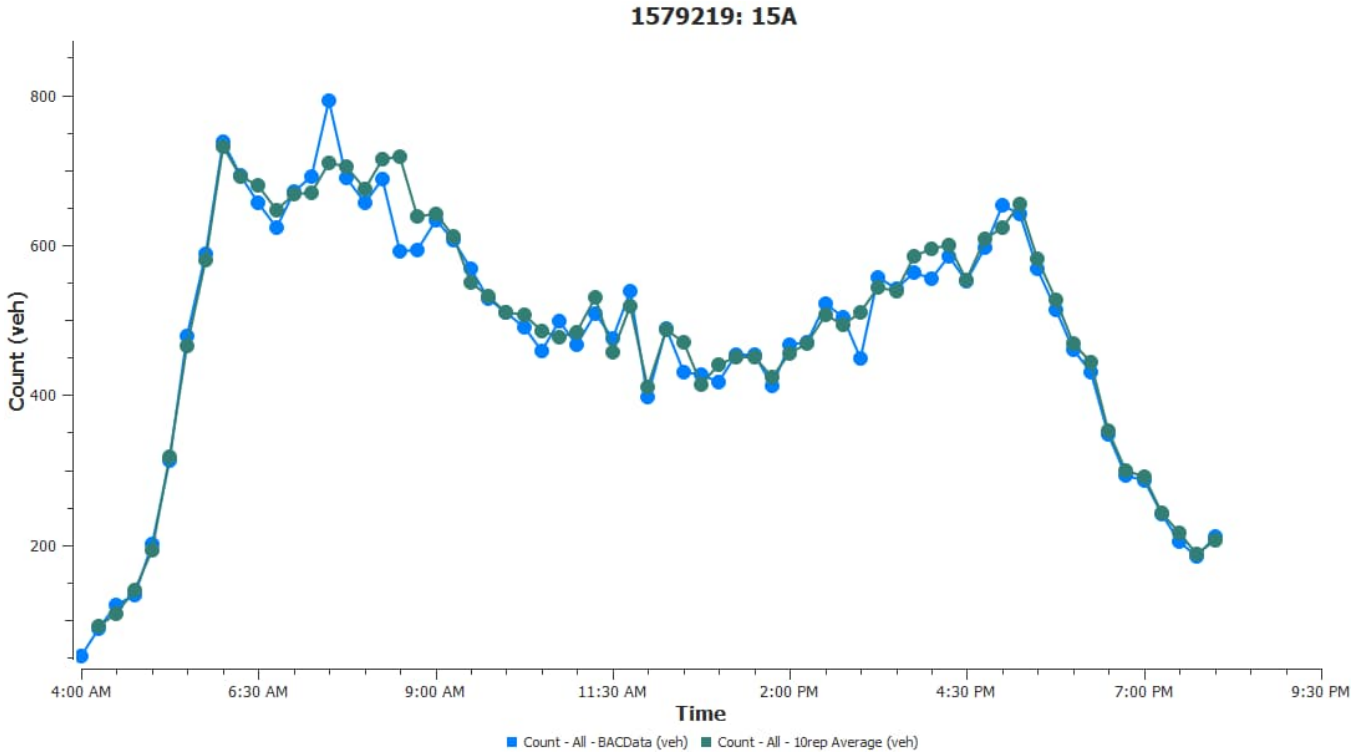


Figure 19 - Gantry 15A & 15B – M7 & M2 interface

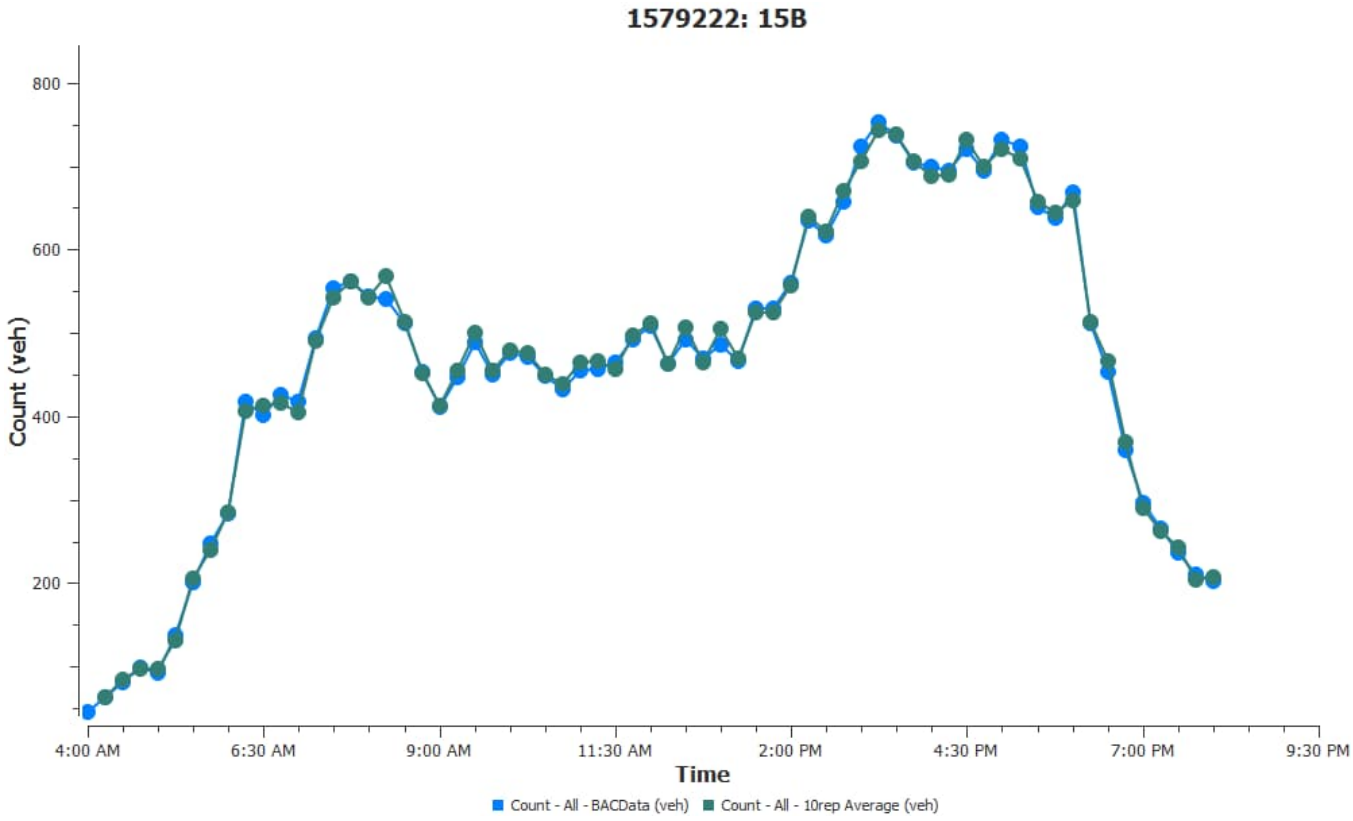


Figure 20 - Gantry 15A & 15B – M7 & M2 interface

7.2.3 Profiled Heavy Vehicle Classifications

In order to disaggregate the calibrated 15min heavy vehicle demand matrices further into three separate vehicle subclasses (see Section 6) an analysis of the global Loop vehicle classification break down between the Medium and Long class was undertaken across each 15 min interval across the date of calibration for the M7. Shown in **Figure 21** below, this analysis suggested a sharp decline in the proportion of Long vehicle types at 4:30am from an average of around 70% of the heavy vehicle class to as low as 30% by 11:00am. On average this proportion remains around ~40% throughout the middle of the day until from 6:00pm onwards a sharp recovery in the proportion of long trips back up to ~70% occurs. Loop data from the M5 network suggested a similar general profile as that illustrated in **Figure 21** and supplementary historical WIM data was made available for February 2020 which was used further to frame the heavy vehicle split assumptions finally applied (see **Figure 22**).

The final detailed (per 15min) splits of the calibrated heavy vehicle matrices in both subnetwork was ultimately determined following an extensive, iterative series of simulation tests using the analysis illustrated in both **Figure 21** and **Figure 22**. To summarise, the final application of these assumptions took on the following considerations –

- When compared against the WIM data, the Long and Medium definitions in the Loop classification system did not appear to directly relate to a consistent split assumption. That is –
    - The comparison would suggest that the Long vehicle classification in the Loop system can represent a significant proportion of Articulated type heavy vehicles in addition to B-Double type; and
    - Similarly a proportion of the Medium vehicle classification in the Loop system can represent a significant proportion of the Articulated type heavy vehicle classification in addition to the Rigid type; and
    - There is a potential that the Short and Medium definitions in the Loop classification system do not distinctively separate what may be classified by the tolling system (BAC) as a light vehicle or small truck that is tolled as a heavy vehicle.

- The application of a simple generalised time period split assumption was too aggregate based on modelled travel time validation analysis, particularly in the AM Peak period where –
    - Both in the M7 and Cutler Interchange Subnetwork, loop data suggests a brief surge (up from the average of ~30% to ~60-65%) in the representation of Long vehicle types around 7am – 9am.

- Ultimately the heavy vehicle sub-classification splits were estimated at a unique per 15min factors for each vehicle type, but applied to the global OD matrix, that's is –

    - The split assumption is shared across all ODs in the given OD matrix for that time periods; and
    - The split is not applied at a per OD, per 15 min interval basis.

It is believed that ultimately the operational model would benefit from a more detailed OD and time based profiling of the heavy vehicle sub-classifications as the iterative process identified this assumption plays one of the more significant role in modelled travel time validation performance at key congestion areas / time periods. However, without more consistent, high resolution and comprehensive detailed vehicle classification data at an OD basis, it was determined that this level of demand calibration and validation was unachievable.

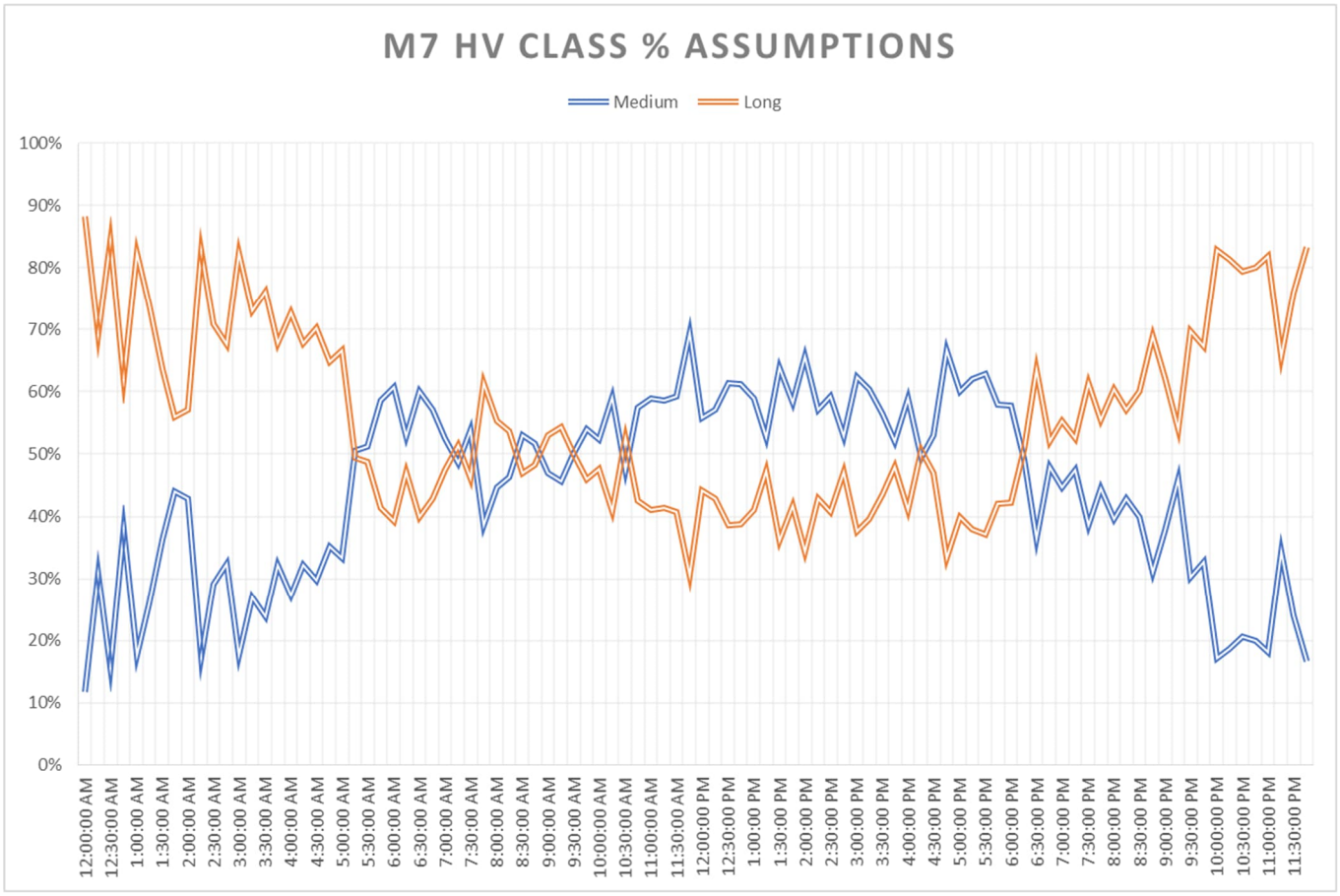


Figure 21 – M7 Loop Based Split between Medium and Long Heavy Vehicles

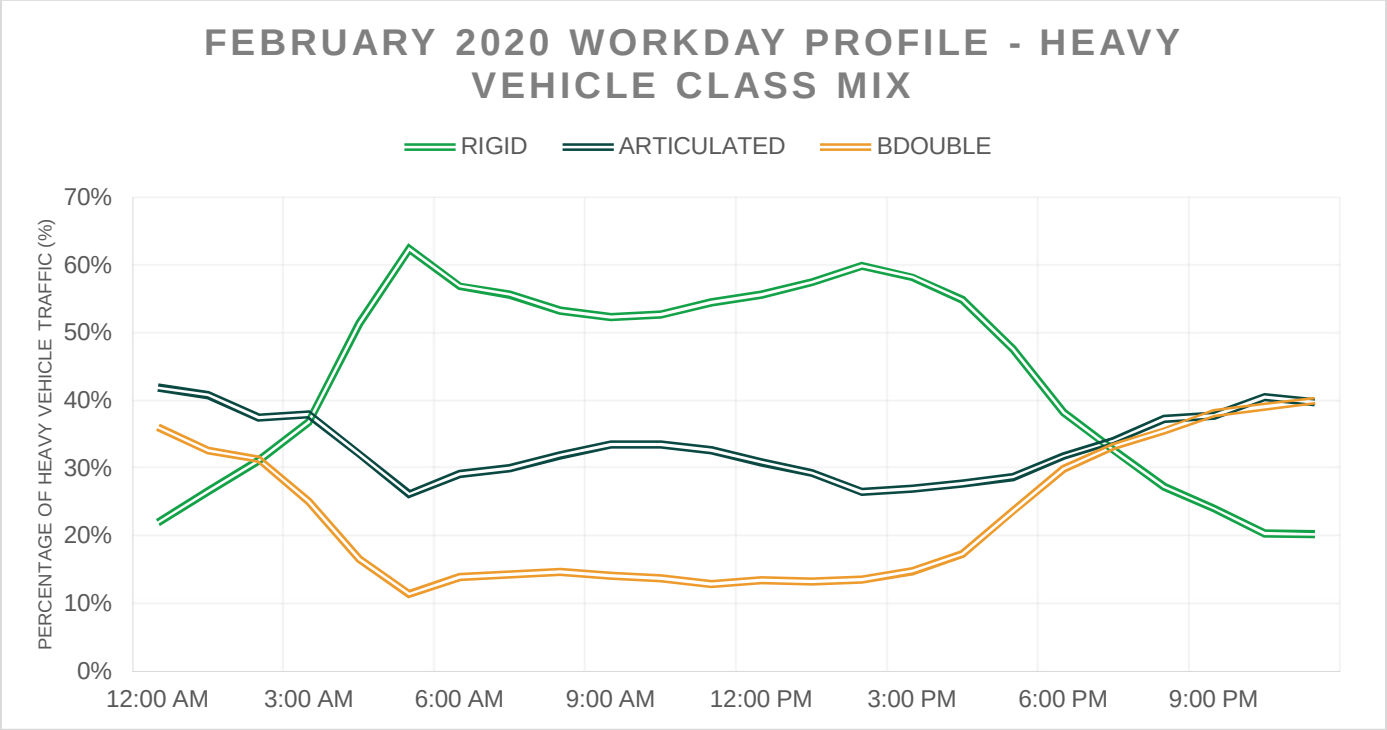


Figure 22 - Historic WIM Data at site 110 – February 2020 average workday

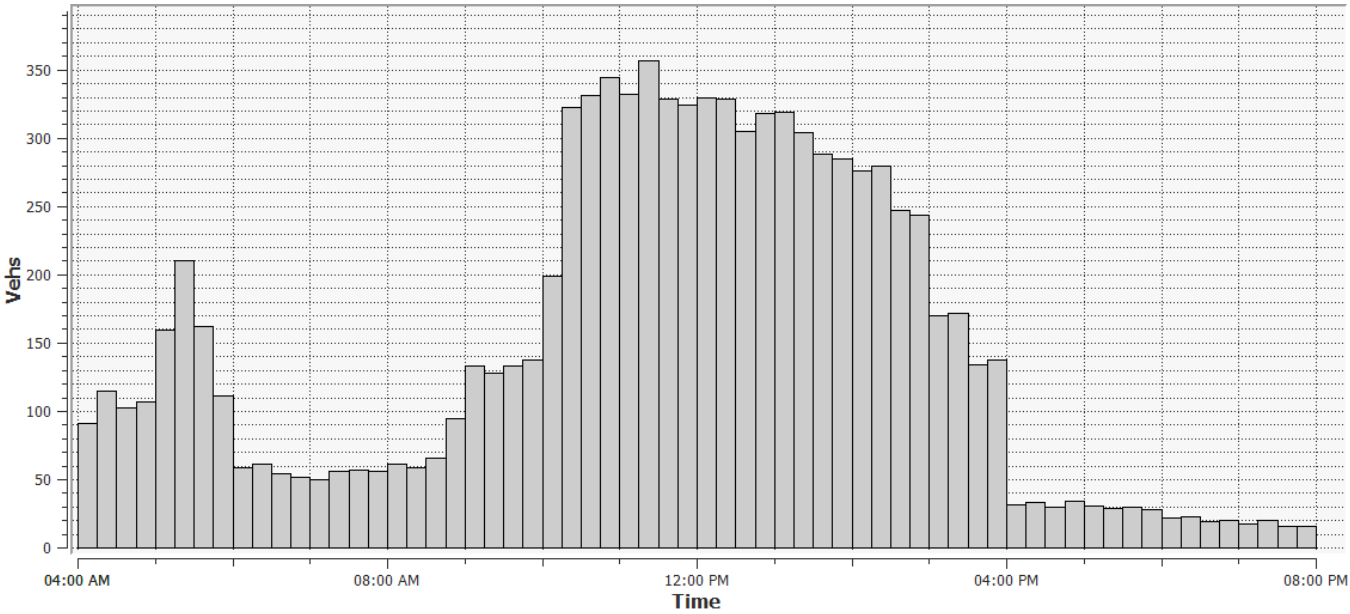


Figure 23 - M7 Subnetwork Demand Profile for Rigid Trucks

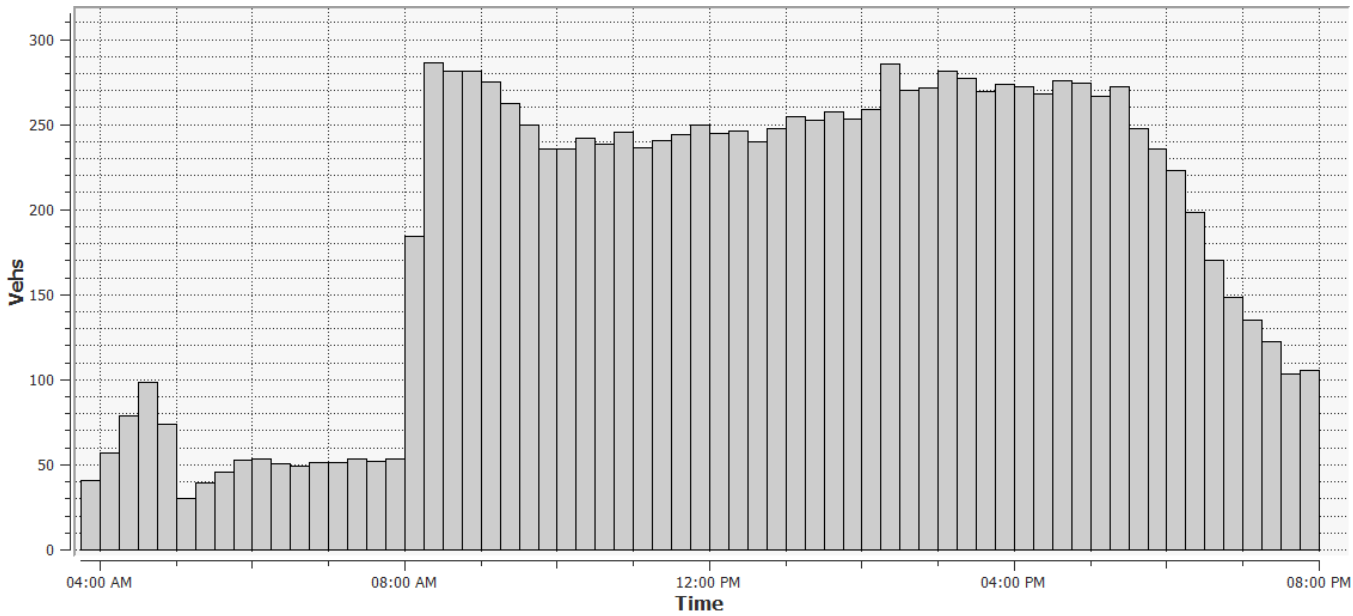


Figure 24 - Cutler Interchange Subnetwork Demand Profile for Rigid Trucks

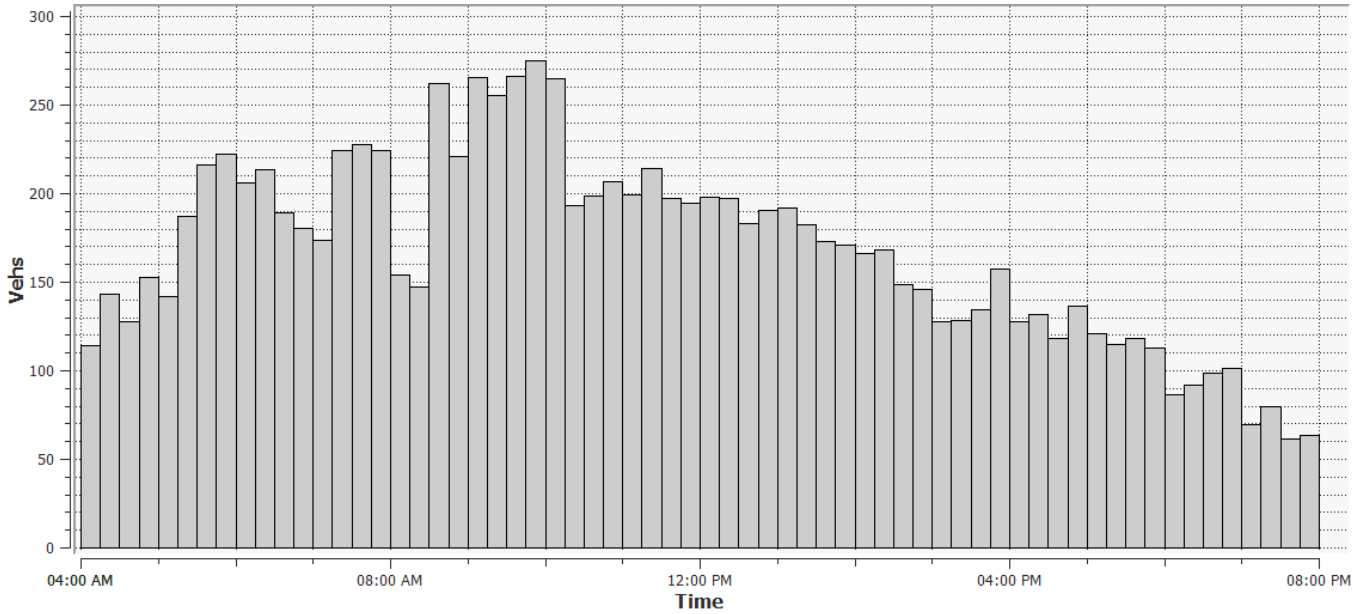


Figure 25 - M7 Subnetwork Demand Profile for Articulated Trucks

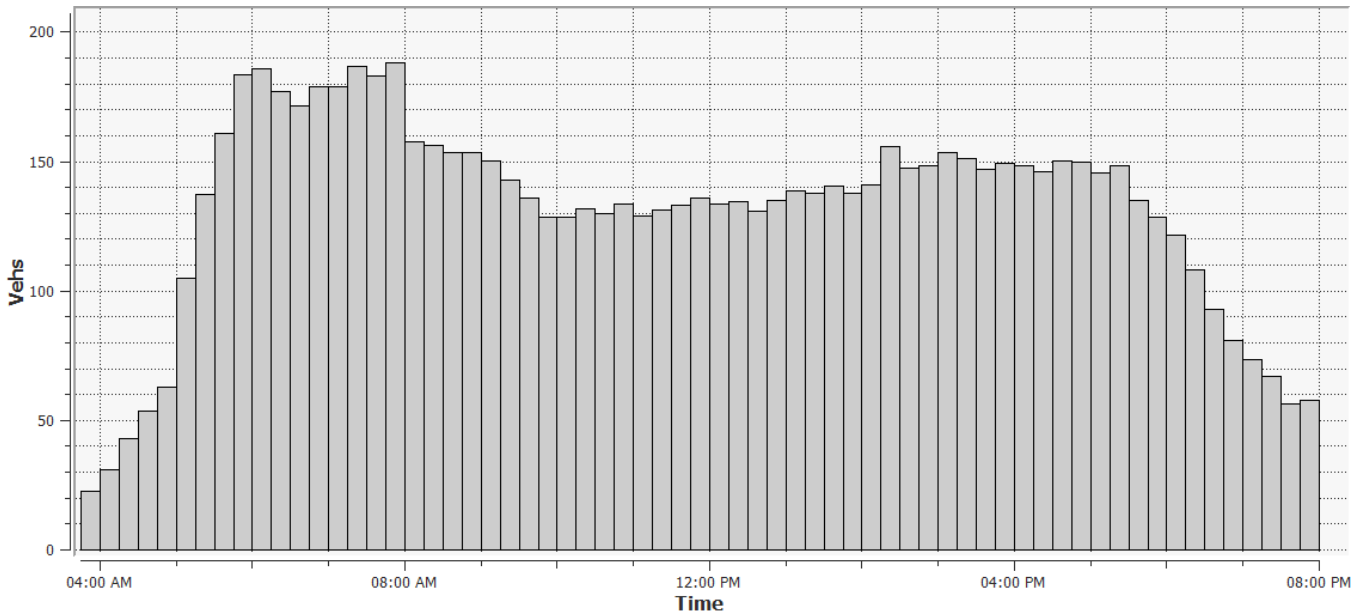


Figure 26 - Cutler Interchange Subnetwork Demand Profile for Articulated Trucks

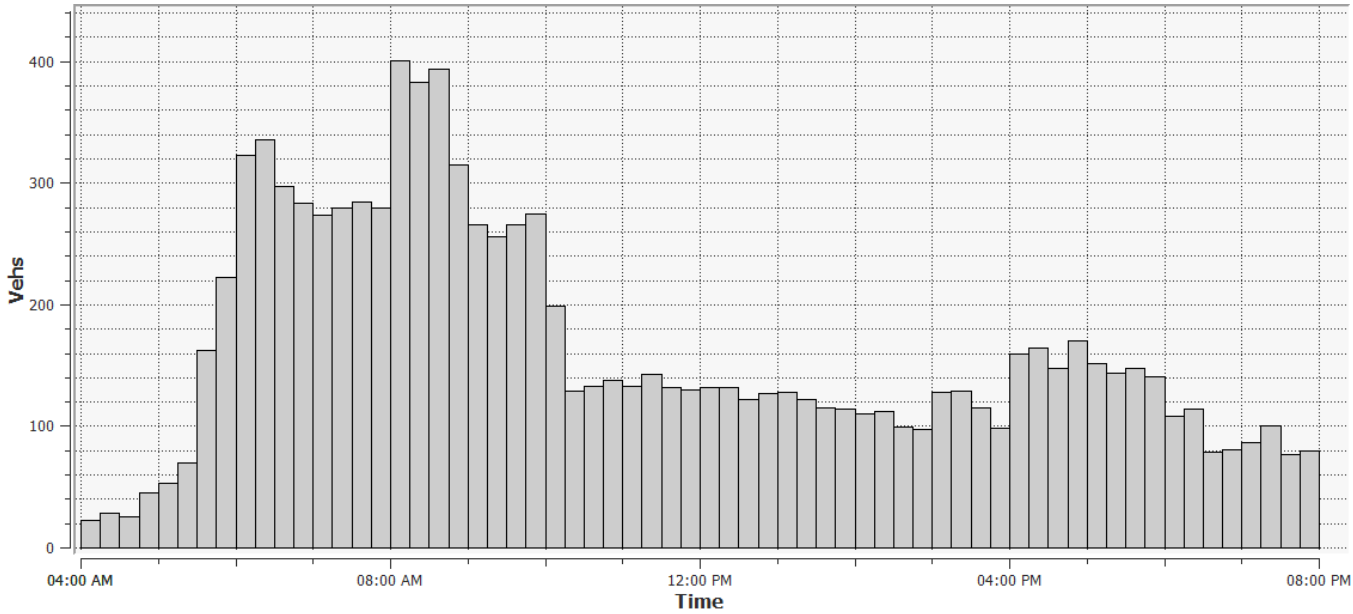


Figure 27 - M7 Subnetwork Demand Profile for B-Double Trucks

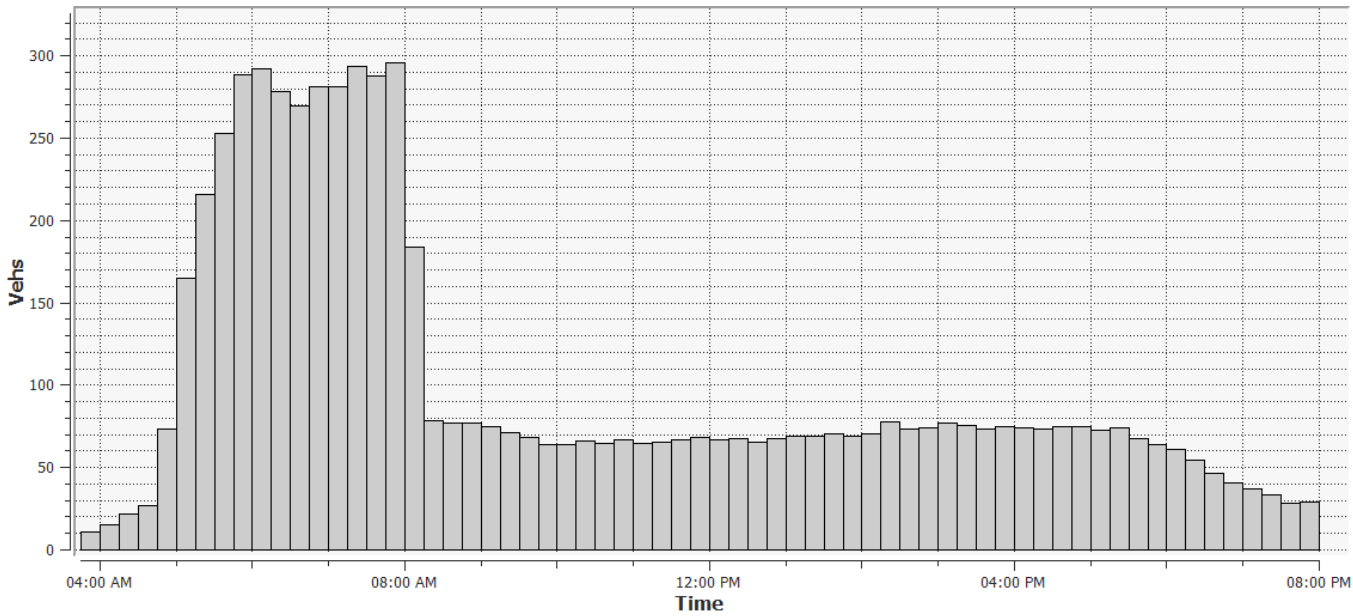


Figure 28 - Cutler Interchange Subnetwork Demand Profile for B-Double Trucks

8. Traffic Simulation Validations

The traffic simulation validation was conducted by assessing the average per hour modelled travel time against the equivalent route results in TomTom. The M7 Subarea utilised the 'cumulative' travel times for the full route of the mainline corridor in both directions. For the Cutler Interchange Subarea all 14 potential OD routes were assessed. A full Appendix showing the detailed route by route travel time validation charts can be found attached in **APPENDIX B** and **APPENDIX D** of this document.

This section provides an overview of the key observations from the model validation exercise. **Figure 29**, **Figure 30** and **Figure 31** illustrate the key congestion sites in each of the subnetworks, with the M7 analysis split by mainline direction. **Table 17**, **Table 18** and **Table 19** provide a summary of how the average and individual seed modelled performances fit against the historic TomTom validation data.

8.1 M7 Northbound

Figure 29 Site	Description	Time Occurred in TomTom	Average Occurrence in the Model?	Commentary
NB-1	Cowpasture Rd & Benera Rd Merge	6am – 10am 3pm – 5pm	6am – 10am 3pm – 5pm	Model occurrence generally performs within observed scale and time periods however highly variable degree of intensity between individual replications. It is noted that the variable performance of the merge break down contributes significantly to location NB-2. Specifically, the nature of the merge driven flow breakdown creates a type of mainline platooning event which creates dense platoons where light vehicles are more restricted to maneuver / overtake slow heavy vehicles through NB-2.
NB-2	Upgrade / Hill on Approach to Elizabeth Dr	6am – 10am 11am – 12pm 3pm – 5pm	6am – 12pm 3pm – 5pm	Model average speed breakdown performs slightly more intense in the model than on the given day of validation data, however remains within the highly variable range in observed travel time data. While there was a period of recovery between 10am - 11am recorded in the TomTom data for the given day of validation, there was a congestion event observed to occur in the mid-day period at 11am-12am. Over the spread of individual replications, the model more often than not will not recover between 10am – 11am as strongly as observed on the given day of validation. The model performs within the observed scale and time periods for the PM peak congestion event.
NB-3	Old Wallgrove Rd Ramps to M4 Exit	6am – 12pm 2pm – 4pm		Historic TomTom data suggests the occurrence of congestion in this area in the AM Peak period is highly variable and directly related to the intensity and or recovery of the Peak congestion period at NB-2. On the specific day of validation, speed and travel time data in this area suggested that the peak congestion period at this location occurred between 10am – 11am, directly corresponding to the short period where NB-2 appeared to recover briefly. Due to the model more frequently landing on the higher intensity / longer duration side of the congestion occurring at NB-2, this site therefore performs on the lighter side of observed probabilities in the model.

Figure 29 Site	Description	Time Occurred in TomTom	Average Occurrence in the Model?	Commentary
NB-4	Richmond Rd Exit	3pm – 5pm		Observed TomTom data suggest the event where Richmond Rd exit impacts in the PM Peak the mainline added ~1min – 2min of additional travel time on the date of validation. Presently the model does not accurately reflect signal timing at the stop line for the exit – it is intended this will be reviewed and updated once additional survey data for the Arterial Interface analysis is completed. Overall the model reflects the performance on the approach to the exit well even without an accurate reflection of the intersection phasing at the stopline.
NB-5	Abbott Rd Merge	6am – 8am		Model average performs well within observed scale, duration however there is a moderately variable degree of intensity between seeds.

Table 17 - Summary of Observed v. Modelled Congestion Area Performances (M7 Northbound)

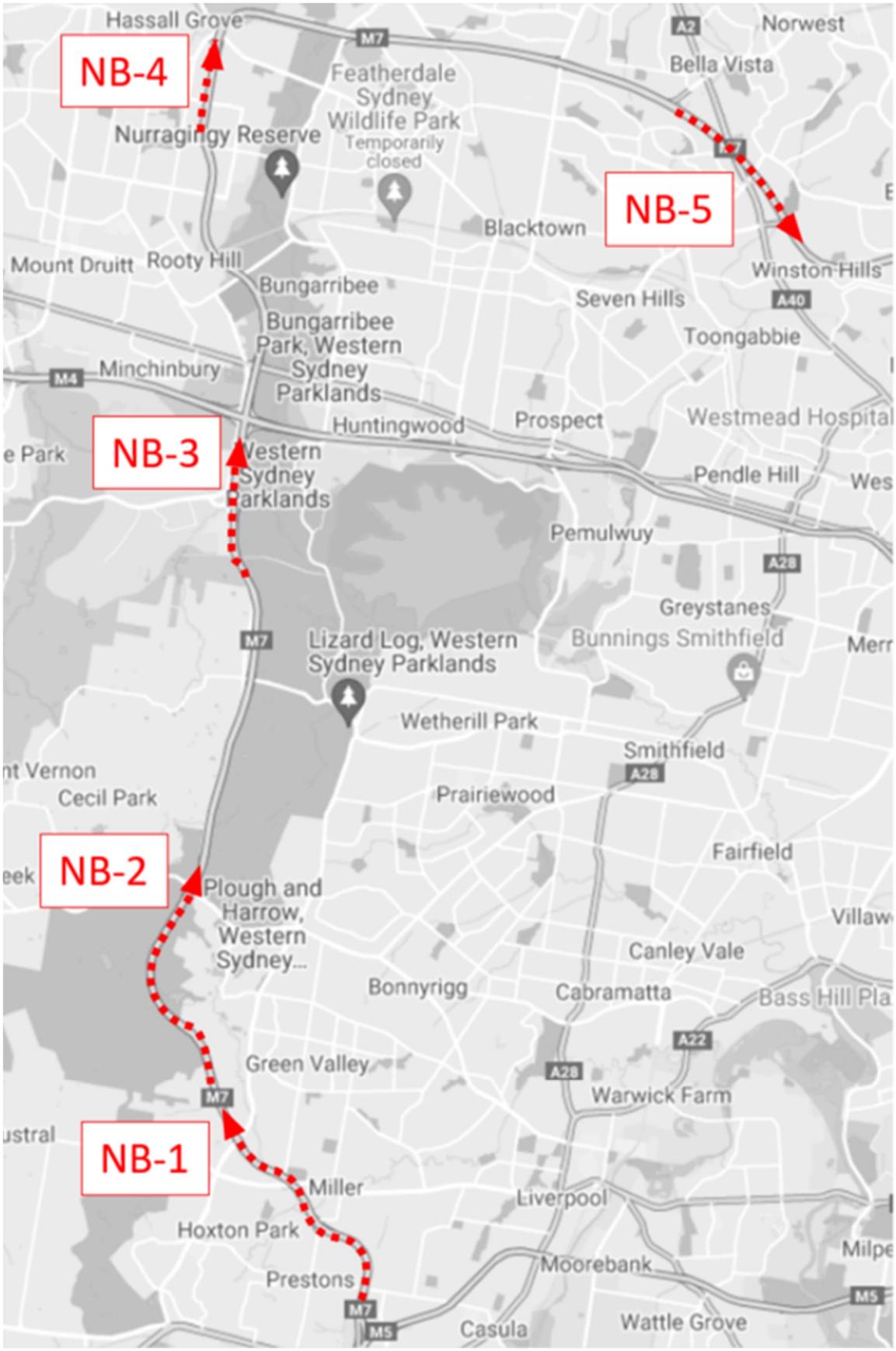


Figure 29 - Key Northbound Congestion Areas (M7)

8.2 M7 Southbound

Figure 30 Site	Description	Time Occurred in TomTom	Average Occurrence in the Model?	Commentary
SB-1	Richmond Rd Merge & Weave between Richmond & Woodstock ramps	8am – 11am	8am – 9am	The average modelled performance is well within observed scale and intensity, but on average recovers much earlier than observed. TomTom historic data does suggest a highly variable degree of intensity and time occurrence observed. The effect of detailed platooning from the arterial interface may be a significant element is the recovery profile. This will be reviewed and updated once the survey data collected for the arterial interface is conducted.
SB-2	M4 – M7 Merge	6am – 7am 11am – 12pm 2pm – 6pm	7am – 8am 2pm – 5pm	Historic TomTom data suggests the performance at this section is highly variable throughout the AM Peak and mid-day period. On the specific date of validation, this section performed worse than average This event occurs "variably" in the model, but at similar intensities. On average, the model slightly underperforms in the PM as the intensity is driven by spill-back from SB-3.
SB-3	The Horsley Dr Merge / Approach	6am – 8am 11am – 12pm 2pm – 6pm	6am – 9am 2pm – 5pm	Occurs in the model within comparable scale. In the AM period the modelled performance is on average towards being slightly more intense than the date of validation, while in the PM period it performs slightly less intensely and for a shorter duration than observed on the date of validation. The primary reason for the PM period performing at a lower intensity and shorter duration than the observed performance on the date of validation is driven by the lack of spill-back from SB-4.
SB-4	The Hill descent	2pm – 6pm	2pm – 5pm	Observed data suggests this is a highly variable but somewhat common event that has an approximately 5-20% probability of occurring on a given weekday. Additional investigations confirmed this event was not related to any (reported) crash or road incident on the date of validation. The cause of this effect is still largely unknown and therefore difficult to calibrate to. The model is unable to fully reflect the full intensity or duration of this event, impacting sites SB-2 & SB-3

Table 18 - Summary of Observed v. Modelled Congestion Area Performances (M7 Southbound)

Figure 30 - Key Southbound Congestion Areas (M7)

8.3 Cutler Interchange

Figure 31 Site	Description	Time Occurred in TomTom	Average Occurrence in the Model?	Commentary
1.	M7 Northbound (and upstream sections)	6AM - 10AM	6AM – 9AM	For most replications the AM congestion at this location reaches lower intensity than the observed day. In the event where congestion may spill back from further north on the M7, this effect would not be captured in the model.
2.	M5 Eastbound (and upstream sections)	6AM – 9AM	6AM – 9AM	Modelled congestion at this location is generally close to observed levels, though of slightly less intensity for some approaches. There may be an element of downstream AM congestion that cannot be fully captured in this model but is seen to have an effect in the observed data.

Table 19 - Summary of Observed v. Modelled Congestion Area Performances (Cutler Interchange Subnetwork)

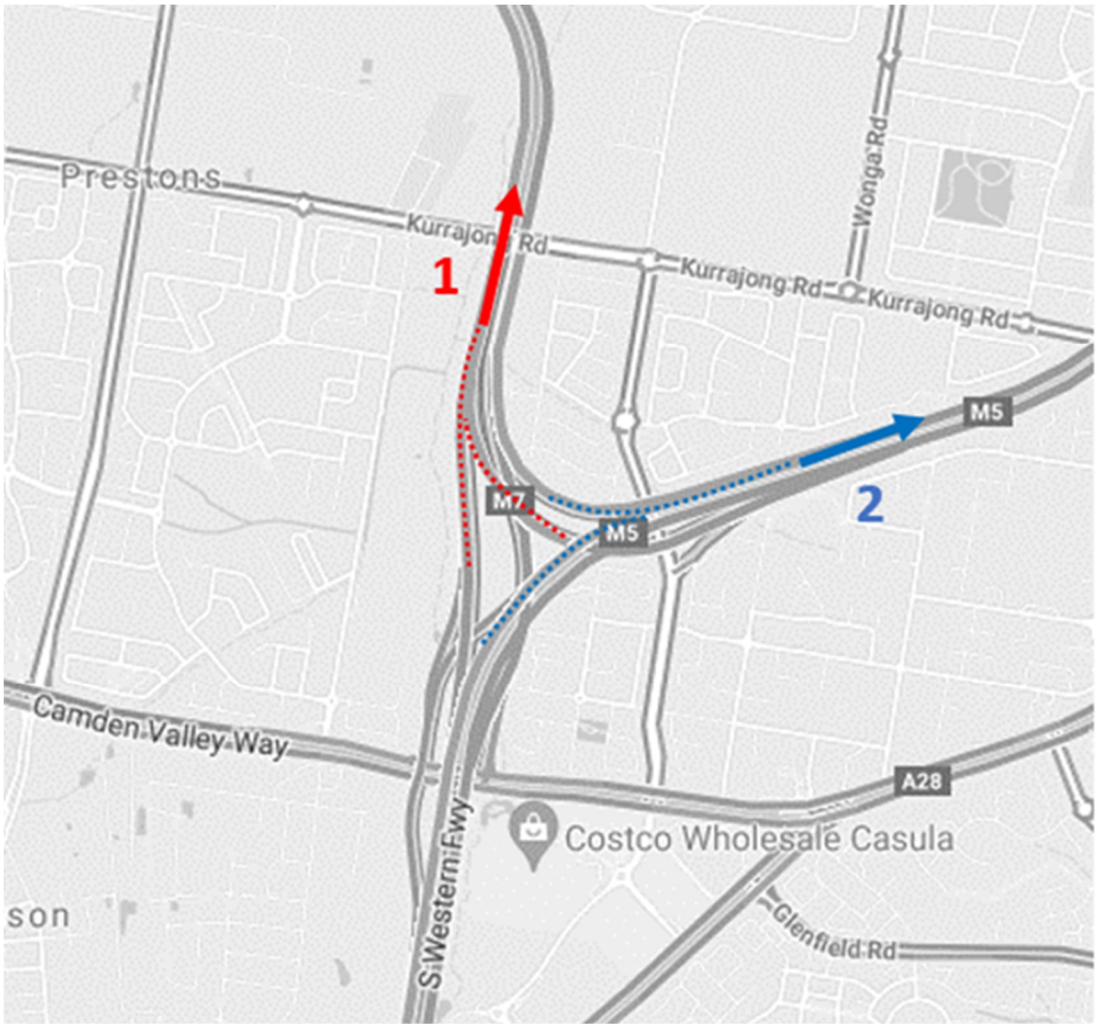


Figure 31- Key Cutler interchange Congestion Areas

9. Network Statistics and Variability

Standard analysis of the operational model's level of demand calibration (GEH analysis) and traffic simulation validation (travel time analysis) has indicated that the base model is suitable for the purpose of supporting detailed operational analysis of the M7 Widening Project and M12 Interface given it has demonstrated the capability to represent existing traffic conditions. However, while the "average" performance of the model across multiple replications has indicated an ability to reflect existing conditions, the travel time validation analysis has also revealed that the current real level of performance at major congestion bottlenecks is increasingly variable in the peak demand periods. To highlight the impact that these real variable conditions have on the model statistics variability, an analysis of the variability between individual model replications total vehicle kilometres travelled (VKT) and vehicle hours travelled (VHT) under unique seed values has been undertaken for this section.

9.1 M7 Subarea

The validation data indicates that the M7 network in particular is seeing significant deterioration in traffic conditions outside of the traditional peak demand periods. In particular, the AM peak's recovery is becoming slower and more drawn out with the mid-day period becoming almost as prone to congestion as the PM peak, especially in the southern half of the M7 between the Cutler Interchange and the M4. **Table 20** summarises how the model's VKT and VHT results can vary across 10 unique seed replications. Overall VHT can vary +-4.9% from the average, which is considered significant over a 16 hour model scale. However, looking at the average network speed and standard deviation shown in **Figure 32**, the period where the model's greatest variability is between 9:30 am and 12:00pm - the period which the TomTom validation data indicates is becoming more variable as the post AM peak recovery becomes more drawn out.

Replication Seed	Total Vehicle Kilometres Travelled	Variance From Average (%)	Total Vehicle Hours Travelled	Variance From Average (%)	Average Network Speed
Average	3,069,012.7	N/A	40,658.8	N/A	79.2
5035	3,068,662.9	0.0%	42,653.4	4.9%	77.2
3110	3,072,453.0	0.1%	39,547.0	-2.7%	80.3
32255	3,068,787.5	0.0%	41,423.6	1.9%	78.5
22057	3,077,853.2	0.3%	39,979.5	-1.7%	79.7
3318	3,062,549.9	-0.2%	39,382.4	-3.1%	80.3
5530	3,061,921.1	-0.2%	39,552.1	-2.7%	80.1
28850	3,073,313.2	0.1%	41,335.6	1.7%	78.6
5007	3,061,041.4	-0.3%	39,329.0	-3.3%	80.4
17749	3,068,245.6	0.0%	40,903.0	0.6%	78.8
3132	3,075,299.3	0.2%	42,482.3	4.5%	77.9

Table 20 - Summary of Model Result Variability (M7 Subnetwork)

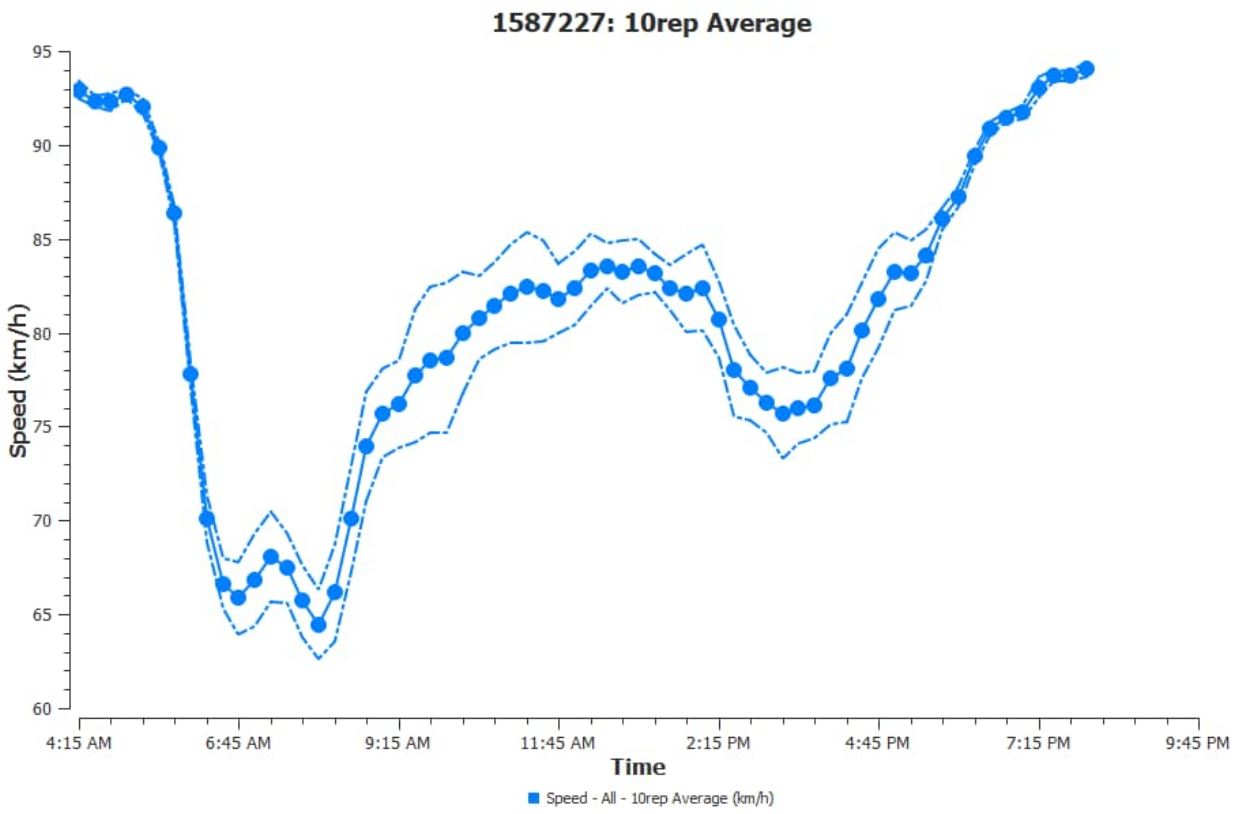


Figure 32 - M7 Subarea Average Network Speed and Standard Deviation

9.2 Cutler Interchange Subarea

Across 10 unique seed replications The Cutler Interchange Model demonstrates a relatively low variability in global VKT and VHT network statistics, indicating a model network that is relatively stable. The primary source of any variability in potential model results is clearly related to the main period of congestion – the AM Peak as is illustrated in **Figure 33**.

Replication Seed	Total Vehicle Kilometres Travelled	Variance From Average (%)	Total Vehicle Hours Travelled	Variance From Average (%)	Average Network Speed
Average	1,033,476.9	N/A	12,262.6	N/A	86.6
23404	1,031,945.0	-0.1%	12,369.5	0.9%	86.3
2137	1,036,079.5	0.3%	11,992.0	-2.2%	87.5
18865	1,034,538.7	0.1%	12,513.2	2.0%	85.9
10418	1,033,834.3	0.0%	12,300.9	0.3%	86.5
4357	1,031,555.1	-0.2%	11,901.5	-2.9%	87.8
1618	1,030,571.9	-0.3%	12,437.3	1.4%	86.0
30591	1,035,484.2	0.2%	12,431.9	1.4%	86.0
10769	1,032,230.9	-0.1%	12,357.9	0.8%	86.1
9915	1,031,166.9	-0.2%	12,113.5	-1.2%	87.0
16263	1,037,362.3	0.4%	12,208.4	-0.4%	86.8

Table 21 - Summary of Model Result Variability (Cutler Interchange)

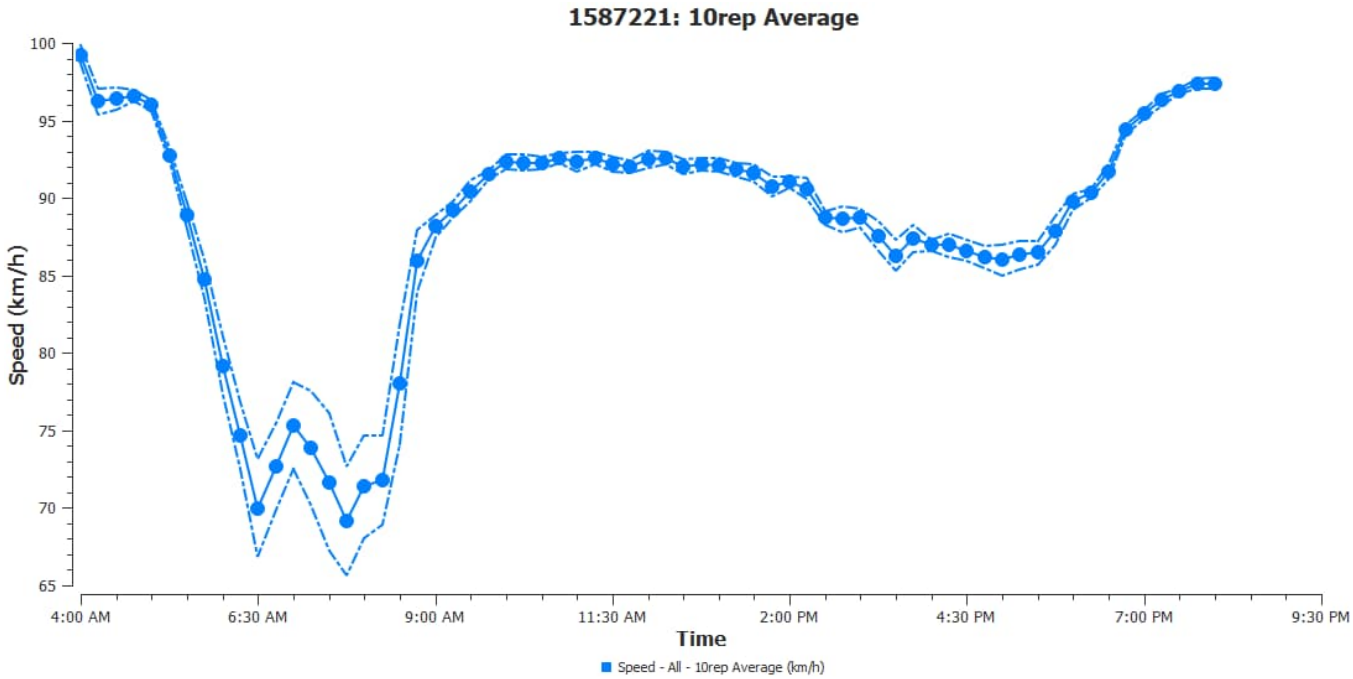


Figure 33 – Cutler Interchange Subarea Average Network Speed and Standard Deviation

Part C: Project Model Testing

10. Option Testing

The development of the M7 Subarea microsimulation model was undertaken to provide a detailed operational traffic assessment of the M7 widening design and anticipated future operation. An additional subarea, the Cutler interchange, was also developed to provide insight on the impact of the project to the surrounding motorway network.

11. Assumption list

11.1 Network Geometry

11.1.1 M7 Subarea

M7 Widening

Widening of the M7 was implemented into the model (following the Base model Calibration and Validation) as per the proposed project design with widening into the median from the southern boundary through to Richmond Rd in the north. Most interchanges remain unchanged with the exception of the Light horse Interchange, Richmond Rd, and Elizabeth drive which now contains the M12 connection and is described in more detail below.

The Light Horse Interchange, the M7 connection with the M4, retained two lanes through the interchange owing to large on and off ramp movements in this location. The configuration of the interchange was such that all movements, except the northbound off ramp, were configured as a trap/add lane with the kerb side lane continuing or starting from the on/off ramp. The northbound off ramp being the heaviest movement is configured as a dual lane off ramp.

Richmond Rd south-facing ramps, at the northern most extent of the widening, was configured as a trap/add lane to bring the mainline back down to two lanes beyond this point, see **Figure 34**.

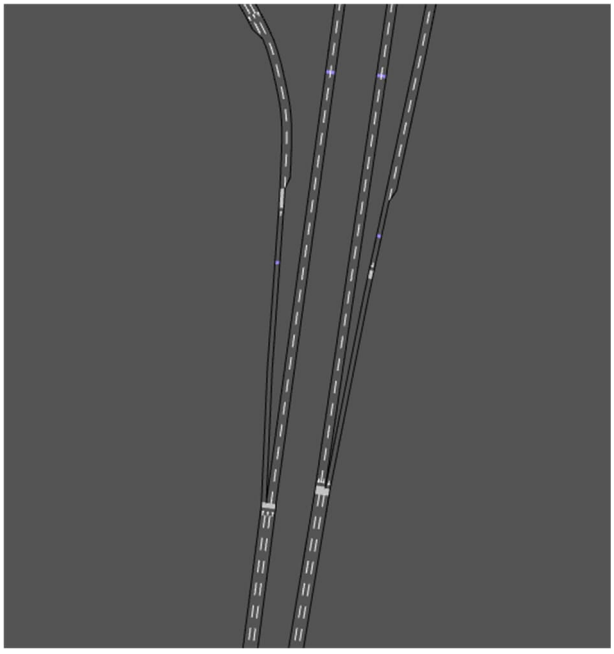


Figure 34 - Richmond Rd south facing ramps

M12 Connection

The new M12 interchange alignment and elevation were informed by the document "M12 Motorway Package 3 – East Elizabeth Drive Connection" issued to Transport for NSW by WSP in May of 2021. The design involved modifying the Elizabeth Drive interchange such that ramps incorporated a shared access arrangement to the new M12 motorway.

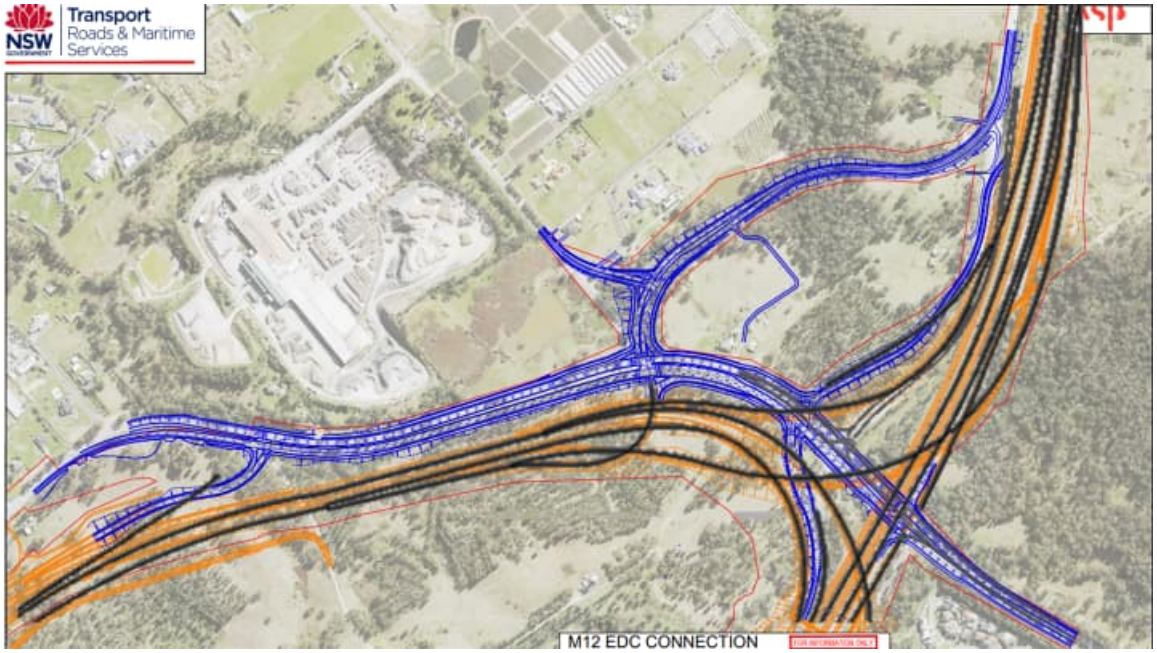


Figure 35 - M12 interchange with model schematic overlay in black with Elizabeth Drive shown in blue

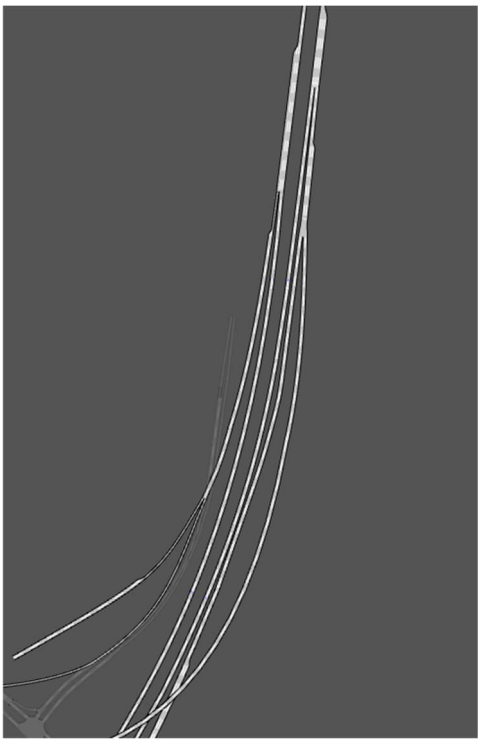


Figure 36 - M12/Elizabeth Dr north facing ramps showing joint ramp configuration

11.1.2 Cutler Interchange Subarea

No physical network changes were incorporated into the Cutler Interchange subnetwork other than changes to the M7 carriageway to reflect the widening, see **Figure 37**.

As per the current designs the M7 widening is incorporated into the Cutler Interchange in the northbound direction with two lanes originating from the M31 (from south) and one lane from the M5SW (from east). Adapting the current design that is configured with two lanes from the M31 reducing to a single lane prior to joining the single lane from the M5SW.

In the southbound direction the middle lane, lane 2, has the choice to either head southbound on the M31 or eastbound on the M5SW. Reflecting the existing design as the M7 currently widens to 3 lanes just prior to the Cutler Interchange.

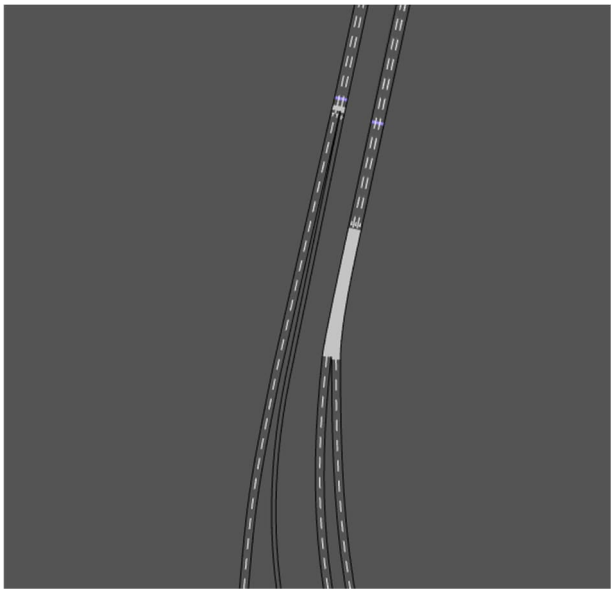


Figure 37 - M7 Connection with Cutler Interchange

11.2 External network constraints

To consider external impacts (from the ramp junctions/interchanges onto the mainline operation) a process was undertaken whereby the one-hour volumes from the model for the AM and PM peak periods were exported and then modelled in the SIDRA analyses. Any corresponding queue from the SIDRA models that was of sufficient magnitude to impact the M7 mainline i.e. due to exit ramp queue lengths, was then represented in the Aimsun model. However, the SIDRA modelling assessments indicated that none of the arterial interchanges (except for Richmond Rd) would impact the operation of the M7 mainline through anticipated queue lengths (95th percentile maximum) extending beyond the existing storage provisions. Therefore, no end constraints (through dummy-signal operation or similar) at the interchanges/exit ramp terminals were therefore necessary within the Aimsun modelling assessment. With regards to Richmond Rd/Rooty Hill Rd, it is understood these arterial connections are planned to be upgraded (which was not captured in the SIDRA assessments), and hence would improve the operation of this movement.

For the Cutler Interchange subnetwork, to seamlessly link the two models a common section of the M7 was incorporated in both models. On these sections a network speed override was incorporated to match measured speeds in both models and to make sure the equivalent queuing behaviour was carried from one model into the next. This was an iterative process, as the results of each model network needed to feed into the other. Specifically, the northbound movements/conditions at the southern extent of the M7 network model were applied to the Cutler Interchange model, and the southbound M7 movements/conditions at the northern extent of the Cutler Interchange model were applied into the M7 network model.

11.3 Future ITS Network Assumptions

The following assumptions were made in the future base case (i.e. no-project) and future project (i.e. with-project) scenarios –

- There will be no default VSLS operation applied; and
- Minor improvements to M4 Smart Motorway meters on the M7 ramps will be incorporated in line with the maturing of the M4 Smart Motorways project

11.4 Future Year Traffic Volume Inputs

The future year simulation assessments were undertaken using forecast traffic volumes for the various scenarios, being both with and without widening for horizon years of 2026 and 2036. These volumes were provided for AM and PM peak periods (3-hours each), as well as the off-peak/daily figures, and were classified into light and heavy vehicles separately. The current 15-minute profiling (based on existing/observed data underpinning the Base model) of each time periods was retained and applied to the supplied forecast traffic volumes, and then input as the origin-destination demands for future year simulation assessments.

12. Future operational results

12.1 Network Wide Statistics

Whole Model	Total Serviced Demand	Vehicle Kilometres Travelled	Vehicle Hours Travelled	Harmonic Mean Speed (km/h)	Total Number of Stops
2026 no project	235369	3189699	43487	71	177925
2026 with project	258917	3538869	41119	79	80182
2036 no project	262954	3604257	60645	57	384713
2036 with project	294695	4090565	51762	73	178058

Table 22 - M7 corridor model network statistics

6 key network wide statistics were analysed for all five models; Total Serviced Demand (Demand), Vehicle Kilometres Travelled (VKT), Vehicle Hours Travelled (VHT), Harmonic Mean Speed (Speed), Peak Density, and Total Number of Stops.

- Demand increases from the no project (NP) to the project case as the widening of the M7 allows for additional capacity and increased growth. There is also a logical progression through the years.
- VKT increases as demand increases from the no-project case to the with-project (WP) case, and as there is no route choice within the model.
- VHT provides a more telling comparison as time spent on the network is not only influenced by number of trips but by levels of congestion. VHT indicates that vehicles in the with-project case spend significantly less time on the network than in the no-project case.
- Speed provides the another like for like comparison of the network with the with-project case performing better than the no-project case regardless of the increase in traffic volumes, especially in 2036.
- Peak Density (average traffic density for the AM and PM peak) indicating the level of service reinforces the analysis from speed with the with-project case improving conditions over the no project case in both 2026 and 2036.
- Total Number of Stops highlights the smoothness of the journey where it is evident that the with-project case results in a significant reduction of stop-start movements with almost half the total number total stops.

Network wide statistics for peak periods are presented in **Appendix E**.

12.2 Speed Heatmaps

Speed 'heatmaps' were developed to analyses key congestion areas, by reporting on motorway midblock average modelled speed individually by each hour throughout the model simulation duration.

Areas of particular congestion issues (which are discussed further below) include the following: In the Northbound direction these include the northern extent of the simulation model approaching M2 (i.e. beyond the widening scope) as well as around Elizabeth Drive where the gradients and a high number of heavy vehicles cause a localised bottleneck. In the southbound direction the main area of traffic performance concern is just south of the light horse interchange.

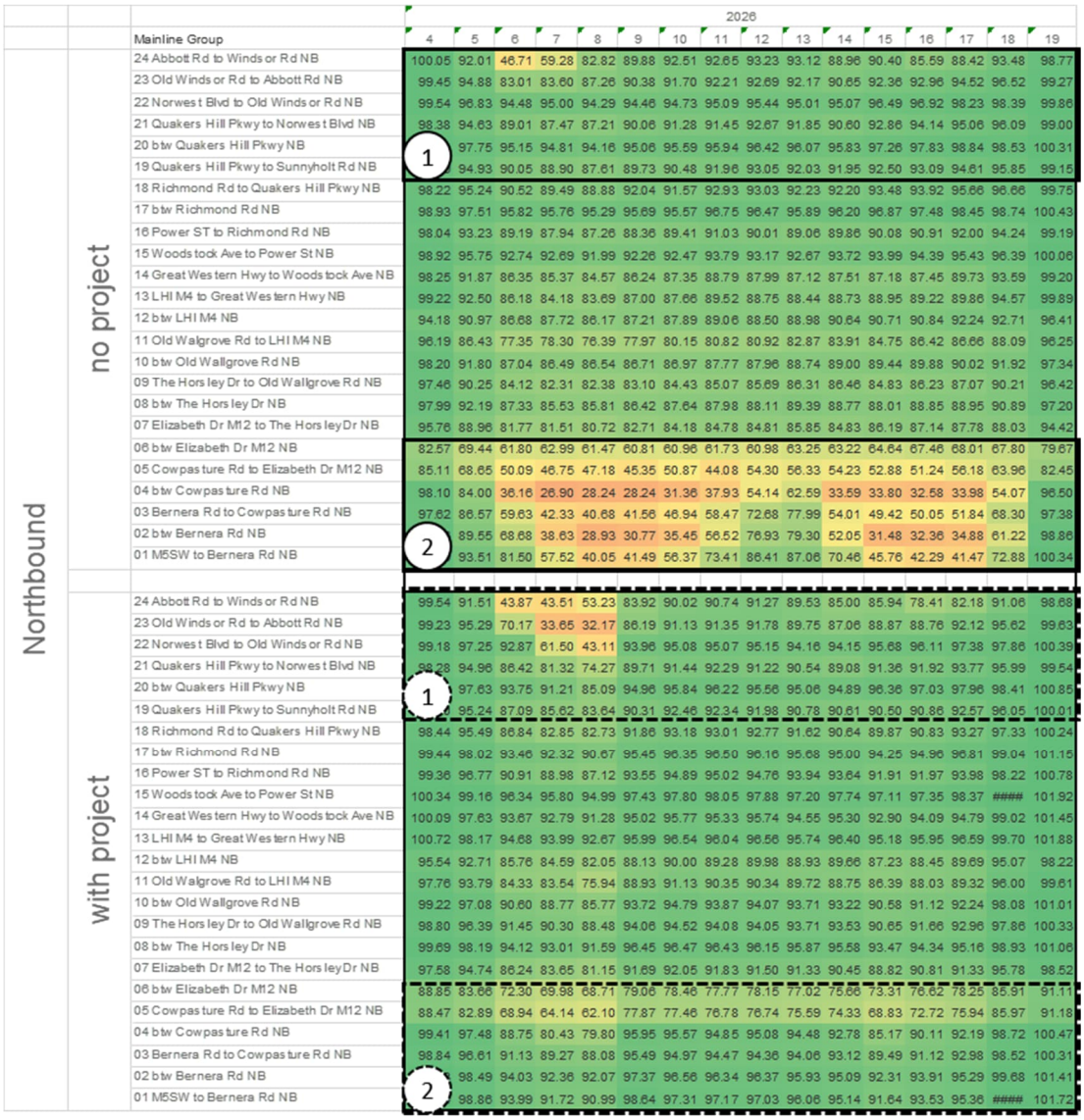


Figure 38 – Northbound Speed Heatmap 2026

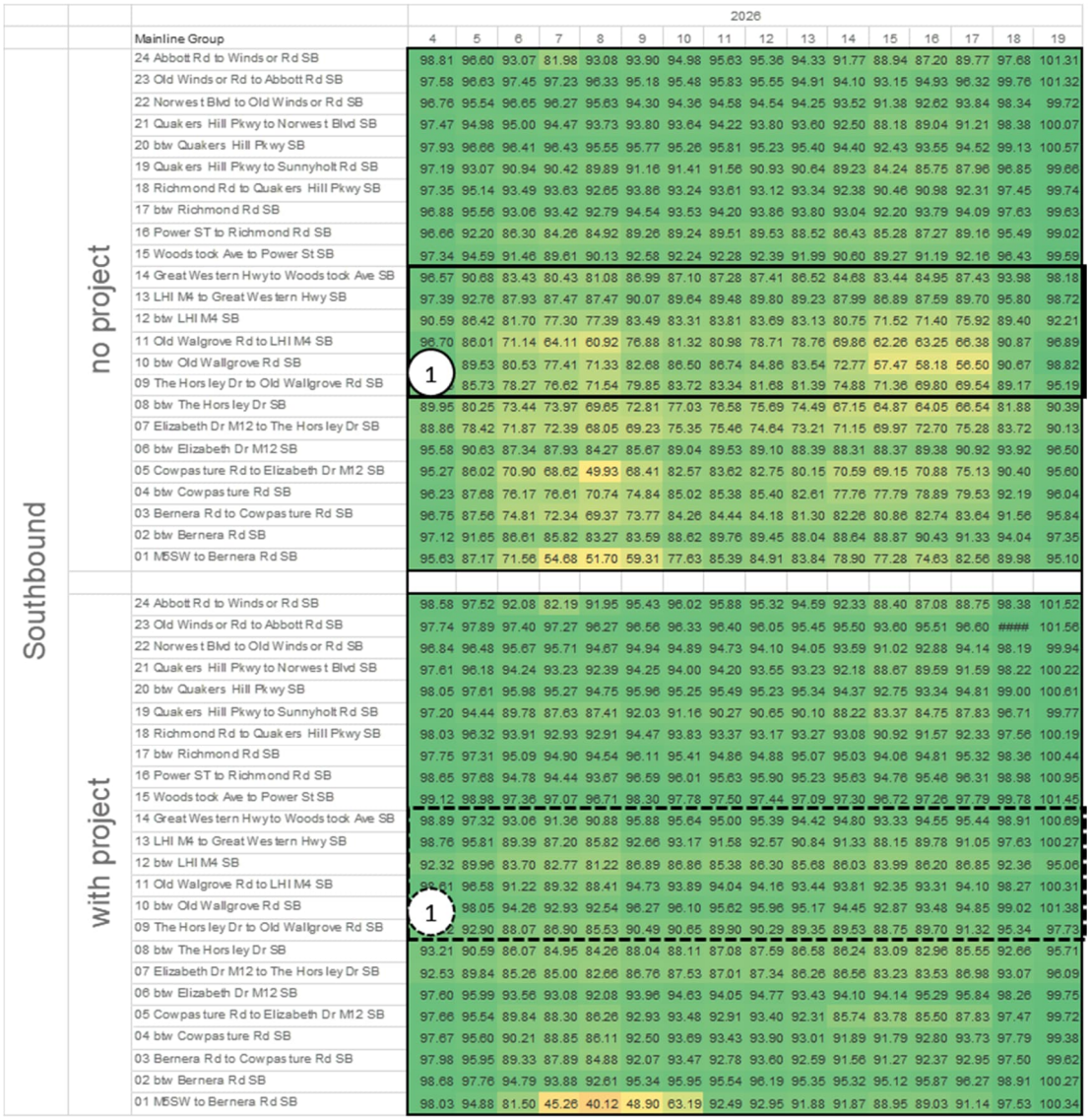
Figure 38 and **Figure 39** presents the modelled speed heatmap for the northbound direction in 2026 and 2036 respectively under the 'with' and 'without' project scenarios.

In the northbound direction at location 2 (approaching Elizabeth Drive/M12) in **Figure 38** and **Figure 39** the Elizabeth Hill bottleneck intensifies with increasing traffic demands as a result of the introduction of the M12. However this modelled congestion was is anticipated to significantly improve under an widening M7 scenario.

Location 1 in **Figure 38** and **Figure 39**, is the northern, un-widened portion of the M7. This section of carriageway experiences a capacity constraint at the merge with the M2 and Abbot Rd (which is outside of the scope of the Project). This capacity constraint (i.e. the two-lane section of the M2 Motorway) causes congestion and reduced performance onto the northern eastbound section of M7. Into the future, the previously discussed southern M7 bottleneck (approaching Elizabeth Dr/M12 northbound) will in part restrict traffic demands reaching this northern section of M7. The alleviation of the southern bottleneck (i.e. 'with project') enables traffic demands to traverse this northern section.

			2036																
		Mainline Group	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Northbound	no project	24 Abbott Rd to Windsor Rd NB	99.62	86.66	39.19	39.98	47.63	82.44	90.44	90.80	90.12	90.57	85.37	87.59	81.52	83.01	89.70	96.64
		23 Old Windsor Rd to Abbott Rd NB	98.65	91.60	43.16	26.79	30.38	81.77	89.06	89.23	88.85	88.46	86.09	89.57	90.84	92.15	94.22	97.10
		22 Norwest Blvd to Old Windsor Rd NB	98.96	95.63	87.83	57.27	33.33	89.56	93.66	93.73	93.96	93.38	93.59	95.40	96.71	97.18	97.09	98.33
		21 Quakers Hill Pkwy to Norwest Blvd NB	98.03	92.09	84.92	82.35	70.73	86.41	88.33	89.32	89.85	88.09	87.64	90.89	92.95	93.47	94.17	96.23
		20 btw Quakers Hill Pkwy NB	1	96.41	93.79	92.29	79.15	93.07	94.35	94.68	95.19	93.96	94.46	96.30	97.59	98.05	97.50	98.58
		19 Quakers Hill Pkwy to Sunnyholt Rd NB		92.56	87.93	86.53	82.08	88.26	89.49	89.67	90.44	88.53	89.45	91.55	92.31	93.38	93.62	96.15
		18 Richmond Rd to Quakers Hill Pkwy NB	97.81	92.72	88.40	86.92	87.87	89.93	91.05	90.27	91.03	89.36	90.06	92.28	93.56	94.74	94.50	97.37
		17 btw Richmond Rd NB	98.59	96.08	95.05	95.06	94.76	94.44	95.50	94.77	95.53	94.80	95.64	96.88	97.40	98.19	97.61	98.74
		16 Power ST to Richmond Rd NB	97.62	90.84	88.12	86.73	86.28	86.60	88.08	88.00	87.99	87.47	87.84	89.25	89.33	89.99	90.96	94.67
		15 Woodstock Ave to Power St NB	98.61	93.96	92.26	91.55	91.29	91.33	92.07	91.85	92.10	91.82	92.21	93.43	94.18	94.43	94.49	96.32
		14 Great Western Hwy to Woodstock Ave NB	97.56	88.23	85.57	83.90	83.22	81.80	85.05	85.26	84.62	84.09	85.34	85.34	84.38	84.92	87.71	93.91
		13 LHI M4 to Great Western Hwy NB	98.47	89.84	86.42	83.66	83.04	82.90	86.39	86.26	85.77	84.52	86.72	86.67	83.92	84.51	84.97	94.68
		12 btw LHI M4 NB	93.40	89.06	87.45	87.52	87.12	85.84	87.47	87.74	87.87	86.98	88.59	91.50	91.41	91.47	91.40	92.66
		11 Old Walgrove Rd to LHI M4 NB	95.24	82.03	78.62	78.70	78.84	72.09	78.01	78.26	78.34	75.33	76.13	85.35	88.51	87.72	88.94	87.84
		10 btw Old Wallgrove Rd NB	97.76	89.65	86.97	87.30	87.62	84.11	86.36	86.51	87.04	85.27	84.02	89.57	92.02	91.81	91.18	91.92
		09 The Horsley Dr to Old Wallgrove Rd NB	96.81	87.96	81.56	78.88	78.97	80.32	83.73	83.51	83.26	81.30	82.36	82.10	85.42	85.77	89.34	90.49
		08 btw The Horsley Dr NB	97.42	91.16	85.54	82.14	83.24	84.40	86.77	86.25	86.95	85.86	85.52	86.96	88.37	88.30	90.14	90.96
		07 Elizabeth Dr M12 to The Horsley Dr NB	95.00	87.95	82.58	81.54	81.06	81.97	83.22	83.45	83.77	83.24	83.15	84.81	86.44	86.74	87.09	86.43
		06 btw Elizabeth Dr M12 NB	81.38	68.09	61.66	62.75	61.59	61.59	61.70	61.66	61.35	61.26	62.15	64.21	66.51	67.67	66.63	64.51
		05 Cowpasture Rd to Elizabeth Dr M12 NB	83.53	67.59	50.46	50.67	46.53	47.73	47.44	45.80	41.20	45.88	45.63	50.68	51.58	52.94	54.51	57.03
		04 btw Cowpasture Rd NB	97.37	74.72	30.32	30.63	28.96	29.97	29.88	30.69	30.69	30.71	30.71	31.93	32.62	36.85	37.59	45.03
		03 Bernera Rd to Cowpasture Rd NB	96.90	84.18	53.48	46.14	42.27	44.53	47.08	45.84	45.08	47.14	46.59	47.44	50.85	54.81	54.04	61.23
		02 btw Bernera Rd NB	2	88.17	53.50	34.94	28.52	31.05	33.10	35.50	32.65	34.20	32.12	31.97	30.86	34.20	40.47	58.71
		01 M5SW to Bernera Rd NB		92.00	78.19	48.89	37.91	43.46	48.64	54.77	51.70	51.76	47.04	42.80	34.72	33.97	41.82	73.31
	with project	24 Abbott Rd to Windsor Rd NB	99.18	88.77	43.29	42.43	54.35	83.31	87.02	86.80	86.38	84.21	71.19	74.44	66.39	70.56	88.06	96.87
		23 Old Windsor Rd to Abbott Rd NB	98.75	93.97	41.92	22.74	34.68	51.09	86.54	86.68	85.68	83.03	69.61	74.56	79.38	81.62	93.38	97.96
		22 Norwest Blvd to Old Windsor Rd NB	99.16	96.63	79.76	21.77	35.39	70.13	93.60	92.78	92.51	92.10	86.96	92.27	95.13	95.54	96.71	99.09
		21 Quakers Hill Pkwy to Norwest Blvd NB	97.91	93.78	83.39	55.76	45.61	70.26	88.80	87.23	86.61	86.05	82.12	87.24	89.80	90.71	93.58	97.91
		20 btw Quakers Hill Pkwy NB	1	97.19	92.77	58.54	23.98	73.46	94.26	93.54	93.27	93.08	91.56	94.55	96.10	96.77	97.33	99.64
		19 Quakers Hill Pkwy to Sunnyholt Rd NB		94.06	86.49	69.90	40.72	67.55	89.44	88.19	88.19	86.77	84.87	87.36	89.41	90.78	94.47	98.32
		18 Richmond Rd to Quakers Hill Pkwy NB	97.68	94.63	85.38	77.69	31.03	62.14	89.28	87.76	88.14	86.47	82.06	85.93	88.60	90.52	95.57	99.21
		17 btw Richmond Rd NB	98.79	97.08	92.57	90.00	41.01	71.96	94.46	93.01	93.41	92.35	91.42	92.00	93.84	94.76	97.91	100.42
		16 Power ST to Richmond Rd NB	98.15	95.69	88.97	86.76	61.75	76.83	92.24	91.18	90.71	89.43	88.94	87.25	89.80	91.21	96.81	100.07
		15 Woodstock Ave to Power St NB	99.37	98.46	95.74	94.83	87.37	90.52	96.64	96.02	95.78	95.36	95.62	95.57	96.91	97.36	99.61	101.36
		14 Great Western Hwy to Woodstock Ave NB	98.81	96.68	92.53	90.73	90.84	93.96	93.42	92.69	92.33	91.91	92.05	89.82	91.97	93.27	97.89	100.78
		13 LHI M4 to Great Western Hwy NB	99.38	97.54	93.88	92.90	92.30	95.24	94.75	94.26	94.17	94.05	94.56	93.22	94.77	95.54	98.82	101.18
		12 btw LHI M4 NB	93.78	91.03	83.19	81.44	79.57	85.96	86.53	85.64	85.79	85.15	85.33	81.77	86.23	87.49	93.05	96.87
		11 Old Walgrove Rd to LHI M4 NB	96.75	91.83	80.38	77.38	73.93	85.63	85.00	84.88	83.53	82.40	77.42	70.66	82.61	85.16	93.77	97.80
		10 btw Old Wallgrove Rd NB	98.87	95.79	88.84	86.15	84.61	92.03	90.53	90.47	89.68	87.81	76.92	65.36	86.98	89.36	96.32	99.98
		09 The Horsley Dr to Old Wallgrove Rd NB	98.26	95.71	89.67	88.03	87.45	92.63	91.58	91.18	90.90	90.33	89.04	81.38	89.71	91.28	96.03	99.33
		08 btw The Horsley Dr NB	99.27	97.61	92.83	91.38	90.36	95.15	94.57	94.22	93.95	93.49	91.86	91.80	92.91	94.36	97.53	100.27
		07 Elizabeth Dr M12 to The Horsley Dr NB	96.81	93.88	83.09	79.34	74.34	89.33	89.34	89.02	88.10	87.59	84.56	86.06	88.15	90.12	93.51	97.14
		06 btw Elizabeth Dr M12 NB	87.79	82.19	71.31	69.64	67.61	77.33	74.26	73.24	72.91	71.66	68.86	70.97	73.58	76.57	81.20	89.01
		05 Cowpasture Rd to Elizabeth Dr M12 NB	87.40	81.65	66.88	61.56	55.80	76.30	72.09	70.65	70.22	68.35	63.67	63.83	68.03	73.23	81.61	89.25
		04 btw Cowpasture Rd NB	98.89	96.62	87.13	75.61	76.20	95.05	92.27	91.73	90.55	88.89	78.04	72.57	80.81	88.58	96.98	99.63
		03 Bernera Rd to Cowpasture Rd NB	98.46	96.28	90.18	88.45	87.35	95.39	91.87	92.13	91.21	90.23	88.24	85.69	88.62	91.56	96.92	99.44
		02 btw Bernera Rd NB	2	98.02	93.35	92.17	91.46	97.17	94.24	94.28	93.55	92.80	91.33	90.10	92.17	94.19	98.18	100.42
		01 M5SW to Bernera Rd NB		98.31	92.24	90.71	90.61	98.05	94.46	94.41	93.76	92.21	89.70	90.19	92.51	95.14	98.74	100.91

Figure 39 - Northbound Speed Heatmap 2036



		Mainline Group	2026 4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Southbound	no project	24 Abbott Rd to Windsor Rd SB	98.81	96.60	93.07	81.98	93.08	93.90	94.98	95.63	95.36	94.33	91.77	88.94	87.20	89.77	97.68	101.31
		23 Old Windsor Rd to Abbott Rd SB	97.58	96.63	97.45	97.23	96.33	95.18	95.48	95.83	95.55	94.91	94.10	93.15	94.93	96.32	99.76	101.32
		22 Norwest Blvd to Old Windsor Rd SB	96.76	95.54	96.65	96.27	95.63	94.30	94.36	94.58	94.54	94.25	93.52	91.38	92.62	93.84	98.34	99.72
		21 Quakers Hill Pkwy to Norwest Blvd SB	97.47	94.98	95.00	94.47	93.73	93.80	93.64	94.22	93.80	93.60	92.50	88.18	89.04	91.21	98.38	100.07
		20 btw Quakers Hill Pkwy SB	97.93	96.66	96.41	96.43	95.55	95.77	95.26	95.81	95.23	95.40	94.40	92.43	93.55	94.52	99.13	100.57
		19 Quakers Hill Pkwy to Sunnyholt Rd SB	97.19	93.07	90.94	90.42	89.89	91.16	91.41	91.56	90.93	90.64	89.23	84.24	85.75	87.96	96.85	99.66
		18 Richmond Rd to Quakers Hill Pkwy SB	97.35	95.14	93.49	93.63	92.65	93.86	93.24	93.61	93.12	93.34	92.38	90.46	90.98	92.31	97.45	99.74
		17 btw Richmond Rd SB	96.88	95.56	93.06	93.42	92.79	94.54	93.53	94.20	93.86	93.80	93.04	92.20	93.79	94.09	97.63	99.63
		16 Power ST to Richmond Rd SB	96.66	92.20	86.30	84.26	84.92	89.26	89.24	89.51	89.53	88.52	86.43	85.28	87.27	89.16	95.49	99.02
		15 Woodstock Ave to Power St SB	97.34	94.59	91.46	89.61	90.13	92.58	92.24	92.28	92.39	91.99	90.60	89.27	91.19	92.16	96.43	99.59
		14 Great Western Hwy to Woodstock Ave SB	96.57	90.68	83.43	80.43	81.08	86.99	87.10	87.28	87.41	86.52	84.68	83.44	84.95	87.43	93.98	98.18
		13 LHI M4 to Great Western Hwy SB	97.39	92.76	87.93	87.47	87.47	90.07	89.64	89.48	89.80	89.23	87.99	86.89	87.59	89.70	95.80	98.72
		12 btw LHI M4 SB	90.59	86.42	81.70	77.30	77.39	83.49	83.31	83.81	83.69	83.13	80.75	71.52	71.40	75.92	89.40	92.21
		11 Old Wallgrove Rd to LHI M4 SB	96.70	86.01	71.14	64.11	60.92	76.88	81.32	80.98	78.71	78.76	69.86	62.26	63.25	66.38	90.87	96.89
		10 btw Old Wallgrove Rd SB	1	89.53	80.53	77.41	71.33	82.68	86.50	86.74	84.86	83.54	72.77	57.47	58.18	56.50	90.67	98.82
		09 The Horsley Dr to Old Wallgrove Rd SB		85.73	78.27	76.62	71.54	79.85	83.72	83.34	81.68	81.39	74.88	71.36	69.80	69.54	89.17	95.19
		08 btw The Horsley Dr SB	89.95	80.25	73.44	73.97	69.65	72.81	77.03	76.58	75.69	74.49	67.15	64.87	64.05	66.54	81.88	90.39
		07 Elizabeth Dr M12 to The Horsley Dr SB	88.86	78.42	71.87	72.39	68.05	69.23	75.35	75.46	74.64	73.21	71.15	69.97	72.70	75.28	83.72	90.13
		06 btw Elizabeth Dr M12 SB	95.58	90.63	87.34	87.93	84.27	85.67	89.04	89.53	89.10	88.39	88.31	88.37	89.38	90.92	93.92	96.50
		05 Cowpasture Rd to Elizabeth Dr M12 SB	95.27	86.02	70.90	68.62	49.93	68.41	82.57	83.62	82.75	80.15	70.59	69.15	70.88	75.13	90.40	95.60
		04 btw Cowpasture Rd SB	96.23	87.68	76.17	76.61	70.74	74.84	85.02	85.38	85.40	82.61	77.76	77.79	78.89	79.53	92.19	96.04
		03 Bernera Rd to Cowpasture Rd SB	96.75	87.56	74.81	72.34	69.37	73.77	84.26	84.44	84.18	81.30	82.26	80.86	82.74	83.64	91.56	95.84
		02 btw Bernera Rd SB	97.12	91.65	86.61	85.82	83.27	83.59	88.62	89.76	89.45	88.04	88.64	88.87	90.43	91.33	94.04	97.35
		01 M5SW to Bernera Rd SB	95.63	87.17	71.56	54.68	51.70	59.31	77.63	85.39	84.91	83.84	78.90	77.28	74.63	82.56	89.98	95.10
	with project	24 Abbott Rd to Windsor Rd SB	98.58	97.52	92.08	82.19	91.95	95.43	96.02	95.88	95.32	94.59	92.33	88.40	87.08	88.75	98.38	101.52
		23 Old Windsor Rd to Abbott Rd SB	97.74	97.89	97.40	97.27	96.27	96.56	96.33	96.40	96.05	95.45	95.50	93.60	95.51	96.60	####	101.56
		22 Norwest Blvd to Old Windsor Rd SB	96.84	96.48	95.67	95.71	94.67	94.94	94.89	94.73	94.10	94.05	93.59	91.02	92.88	94.14	98.19	99.94
		21 Quakers Hill Pkwy to Norwest Blvd SB	97.61	96.18	94.24	93.23	92.39	94.25	94.00	94.20	93.55	93.23	92.18	88.67	89.59	91.59	98.22	100.22
		20 btw Quakers Hill Pkwy SB	98.05	97.61	95.98	95.27	94.75	95.96	95.25	95.49	95.23	95.34	94.37	92.75	93.34	94.81	99.00	100.61
		19 Quakers Hill Pkwy to Sunnyholt Rd SB	97.20	94.44	89.78	87.63	87.41	92.03	91.16	90.27	90.65	90.10	88.22	83.37	84.75	87.83	96.71	99.77
		18 Richmond Rd to Quakers Hill Pkwy SB	98.03	96.32	93.91	92.93	92.91	94.47	93.83	93.37	93.17	93.27	93.08	90.92	91.57	92.33	97.56	100.19
		17 btw Richmond Rd SB	97.75	97.31	95.09	94.90	94.54	96.11	95.41	94.86	94.88	95.07	95.03	94.06	94.81	95.32	98.36	100.44
		16 Power ST to Richmond Rd SB	98.65	97.68	94.78	94.44	93.67	96.59	96.01	95.63	95.90	95.23	95.63	94.76	95.46	96.31	98.98	100.95
		15 Woodstock Ave to Power St SB	99.12	98.98	97.36	97.07	96.71	98.30	97.78	97.50	97.44	97.09	97.30	96.72	97.26	97.79	99.78	101.46
		14 Great Western Hwy to Woodstock Ave SB	98.89	97.32	93.06	91.36	90.88	95.88	95.64	95.00	95.39	94.42	94.80	93.33	94.55	95.44	98.91	100.69
		13 LHI M4 to Great Western Hwy SB	98.76	95.81	89.39	87.20	85.82	92.66	93.17	91.58	92.57	90.84	91.33	88.15	89.78	91.05	97.63	100.27
		12 btw LHI M4 SB	92.32	89.96	83.70	82.77	81.22	86.89	86.86	85.38	86.30	85.68	86.03	83.99	86.20	86.85	92.36	95.06
		11 Old Wallgrove Rd to LHI M4 SB	96.61	96.58	91.22	89.32	88.41	94.73	93.89	94.04	94.16	93.44	93.81	92.35	93.31	94.10	98.27	100.31
		10 btw Old Wallgrove Rd SB	1	98.05	94.26	92.93	92.54	96.27	96.10	95.62	95.96	95.17	94.45	92.87	93.48	94.85	99.02	101.38
		09 The Horsley Dr to Old Wallgrove Rd SB		92.90	88.07	86.90	85.53	90.49	90.65	89.90	90.29	89.35	89.53	88.75	89.70	91.32	95.34	97.73
		08 btw The Horsley Dr SB	93.21	90.59	86.07	84.95	84.26	88.04	88.11	87.08	87.59	86.58	86.24	83.09	82.96	85.55	92.66	95.71
		07 Elizabeth Dr M12 to The Horsley Dr SB	92.53	89.84	85.26	85.00	82.66	86.76	87.53	87.01	87.34	86.26	86.56	83.23	83.53	86.98	93.07	96.09
		06 btw Elizabeth Dr M12 SB	97.60	95.99	93.56	93.08	92.08	93.96	94.63	94.05	94.77	93.43	94.10	94.14	95.29	95.84	98.26	99.75
		05 Cowpasture Rd to Elizabeth Dr M12 SB	97.66	95.54	89.84	88.30	86.26	92.93	93.48	92.91	93.40	92.31	85.74	83.78	85.50	87.83	97.47	99.72
		04 btw Cowpasture Rd SB	97.67	95.60	90.21	88.85	86.11	92.50	93.69	93.43	93.90	93.01	91.89	91.79	92.80	93.73	97.79	99.38
		03 Bernera Rd to Cowpasture Rd SB	97.98	95.95	89.33	87.89	84.88	92.07	93.47	92.78	93.60	92.59	91.56	91.27	92.37	92.95	97.50	99.62
		02 btw Bernera Rd SB	98.68	97.76	94.79	93.88	92.61	95.34	95.95	95.54	96.19	95.35	95.32	95.12	95.87	96.27	98.91	100.27
		01 M5SW to Bernera Rd SB	98.03	94.88	81.50	45.26	40.12	48.90	63.19	92.49	92.95	91.88	91.87	88.95	89.03	91.14	97.53	100.34

Figure 40 - Southbound Speed Heatmap 2026

Figure 40 and **Figure 41** indicate the modelled southbound performance with location 1 highlighting the main capacity constraint, just south of the Light Horse Interchange. This capacity constraint is expected to remain in 2026 intensifying towards 2036 where additional capacity constraints become evident, see location 2. The widening of the mainline to 3 lanes adds sufficient additional capacity southbound to alleviate otherwise poor anticipated performance. However as in the northbound direction the M7 sits within a wider network and by 2036 there is likely to be some minor queueing developing at the Cutler Interchange owing to eastbound capacity constraints on the M5SW (outside the project scope), see location 3, with the M7 impacted to approximately Bernara Road (in 2036) in both the with and without project cases.

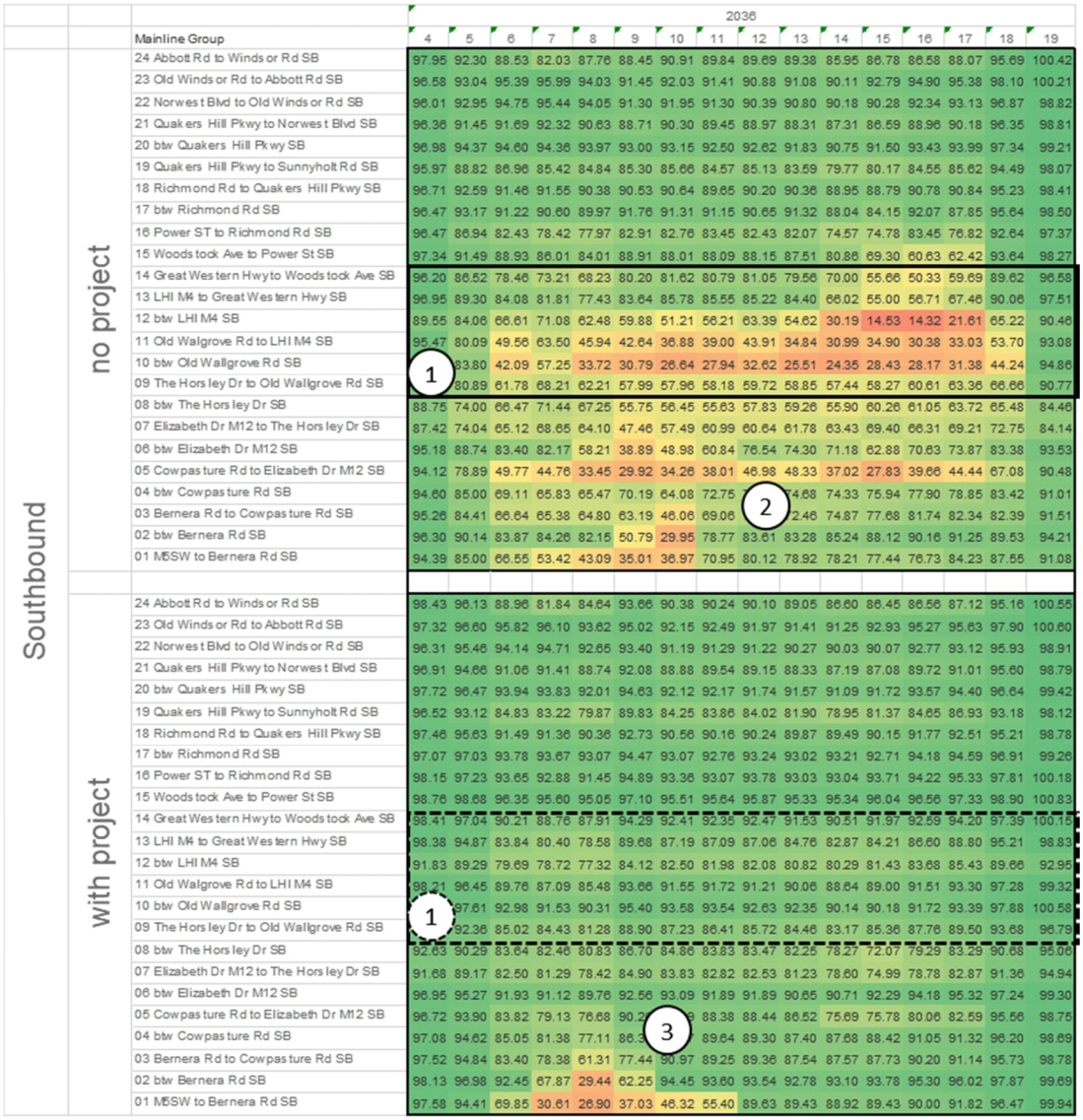


Figure 41 - Southbound Speed Heatmap 2036

12.3 Select Route Travel Time Analysis

Several key trip pair travel times have been extracted, and are presented below, to analyse the effect of the widening project on journey times along the corridor throughout the 16-hour simulation period. The key journeys assessed within the project scope were the motorway to motorway connection of M5SW/M31 to/from the M4, and to/from Richmond Rd which represents the northern extent of widening.

Each of these charts demonstrate journey times are anticipated to deteriorate in 2026 and 2036 with congestion extending into the middle periods of the day, based on the current two-lane configuration i.e. no-project (NP). The with-project (WP) modelled travel times are considerable improved along this corridor with the removal of the previously discussed congestion/bottleneck locations.

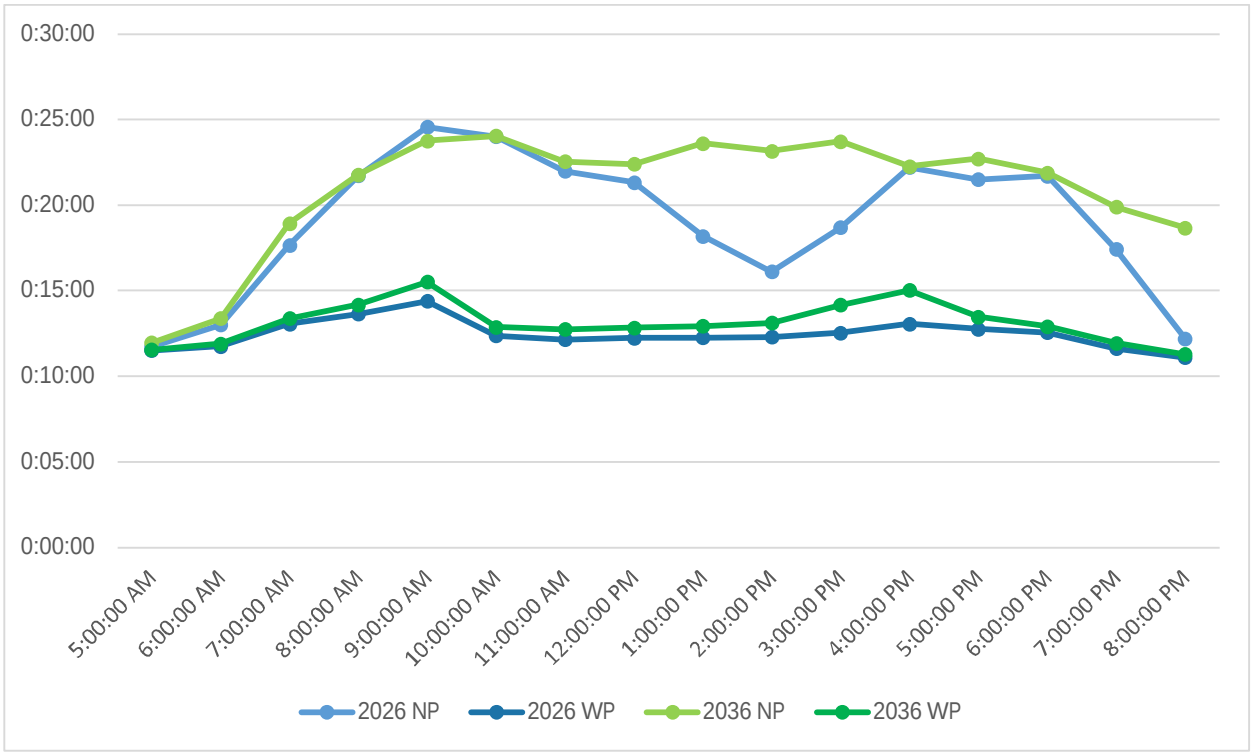


Figure 42 - M5SW to M7 Northbound

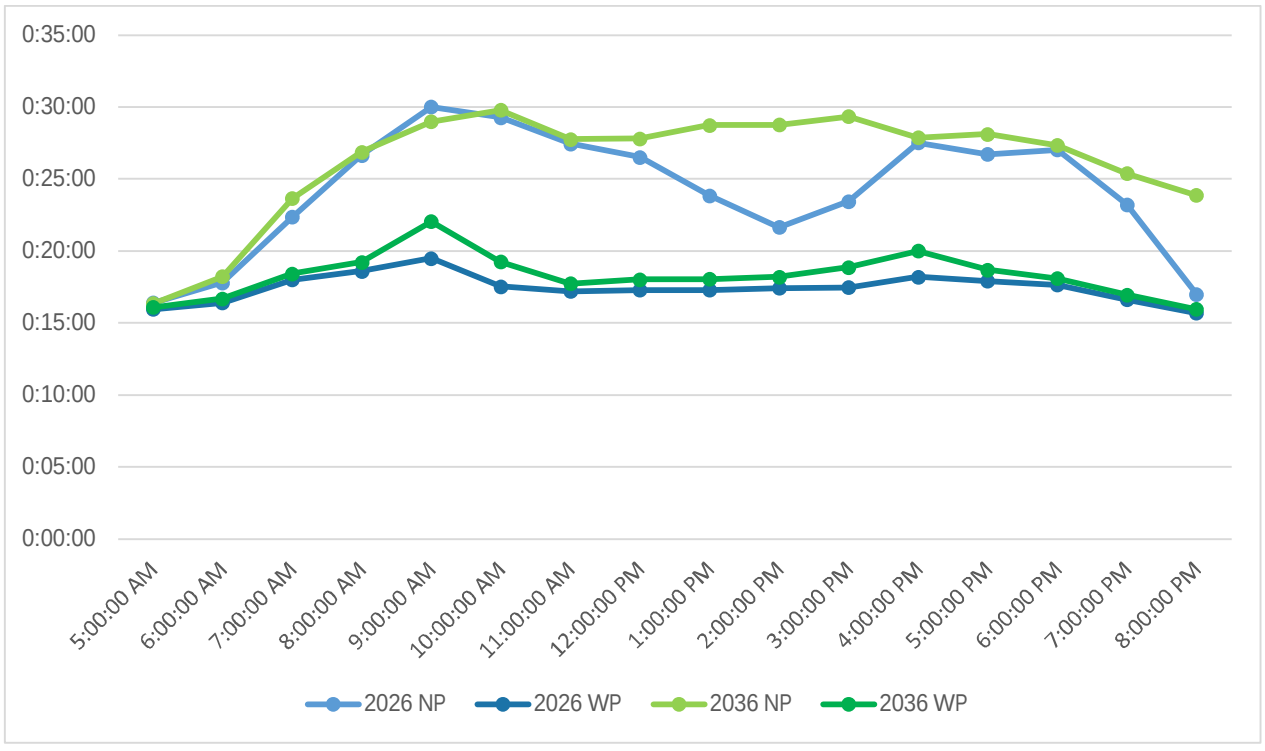


Figure 43 - M5SW to Richmond Rd Northbound

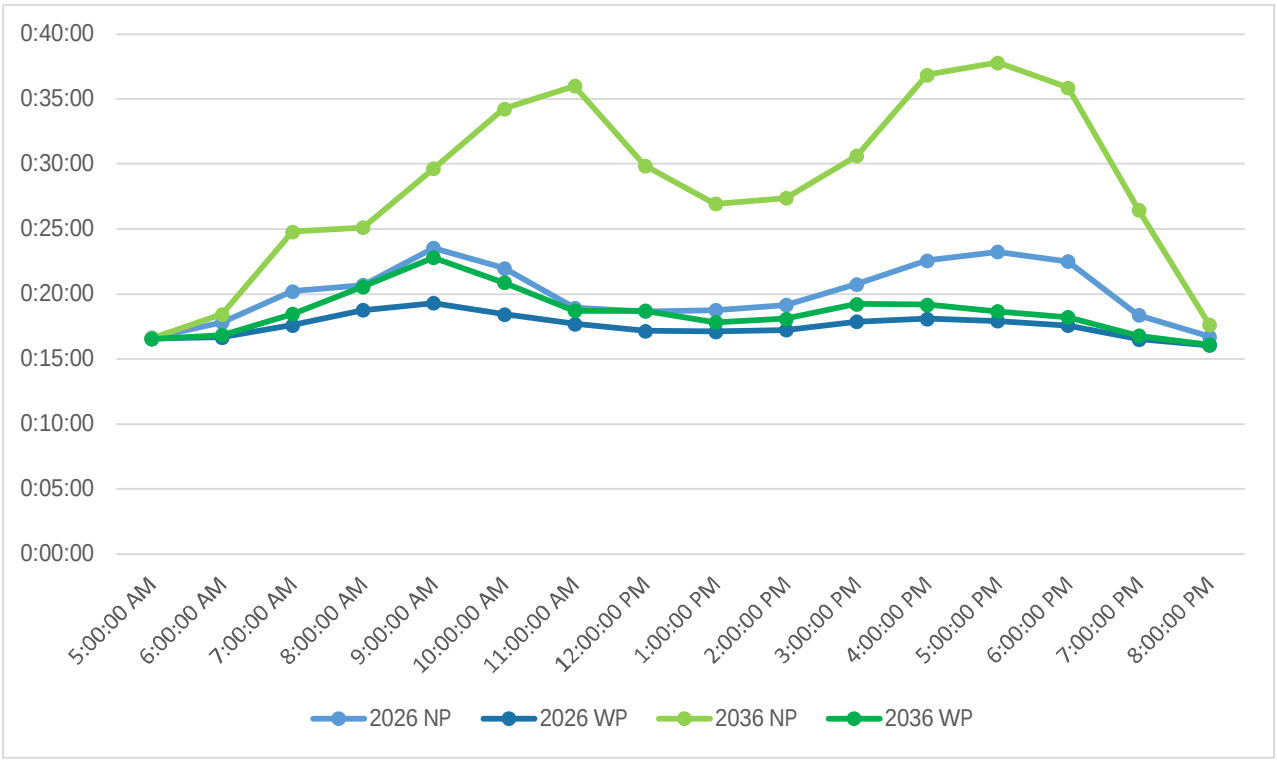


Figure 44 - Richmond Rd to M5SW Southbound

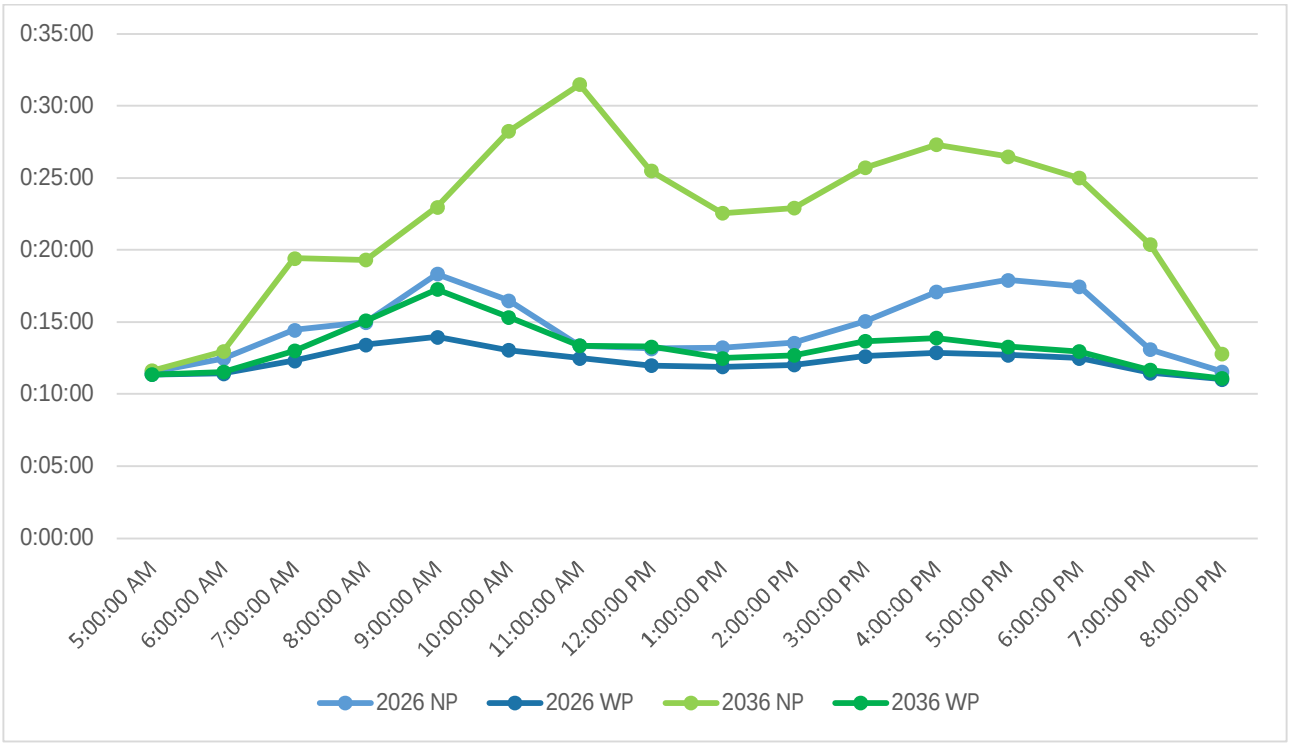


Figure 45 - M7 to M5SW Southbound

12.4 Cutler Interchange: M7/M21/M5SW

The Cutler Interchange model was developed to assess the impact of the M7 widening on the performance of the direct motorway-to-motorway connections at its southern extent. **Figure 46** details the average network speed of all vehicles through the interchange across the duration of the simulation period. The results indicate a deterioration in performance between 2026 and 2036, for both scenarios, as well as the 'no-project' performance being slightly worse than the 'with-project'.

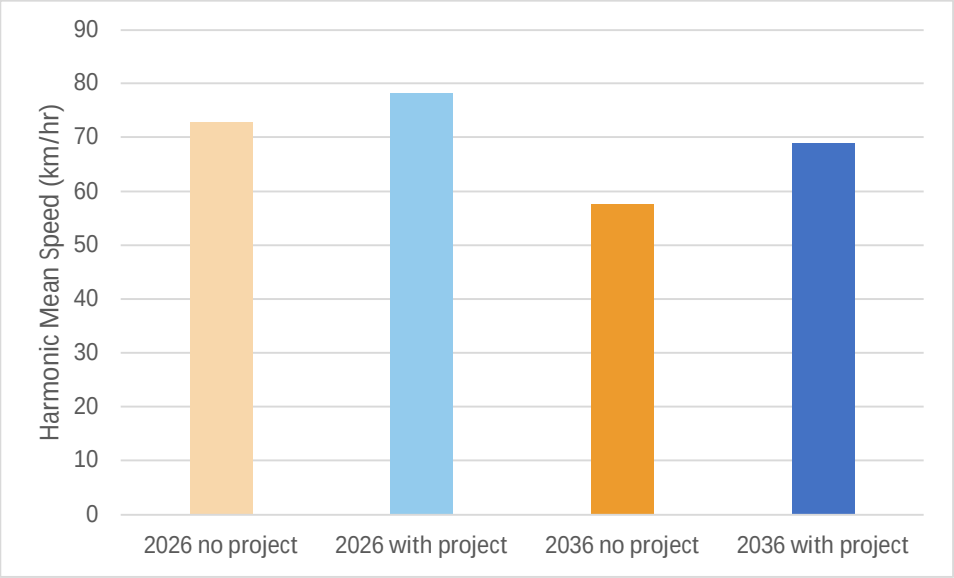


Figure 46 - Cutler Interchange Subarea average speed

The above changes in performance are in part is due to how congestion on the M7 impacts the arrangement of the Cutler Interchange. In the un-widened without-project scenario heavy northbound congestion on the M7 (approaching Elizabeth Drive/M12) propagates back into the Cutler Interchange and affects 2 of 4 lanes on the M31 northbound, See **Figure 47**. If the M7 motorway is widened this congestion is alleviated, as hence so too is the impact to the M31.

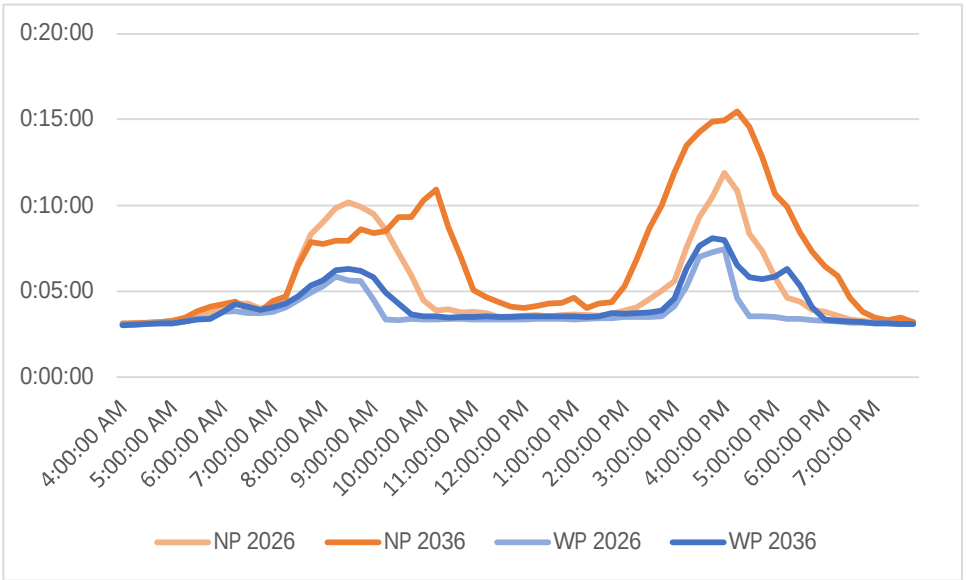


Figure 47 - M31 to M7 travel times

Figure 48 and **Figure 49** displayed the modelled travel times for the routes towards M5SW from M7 and M31 respectively.

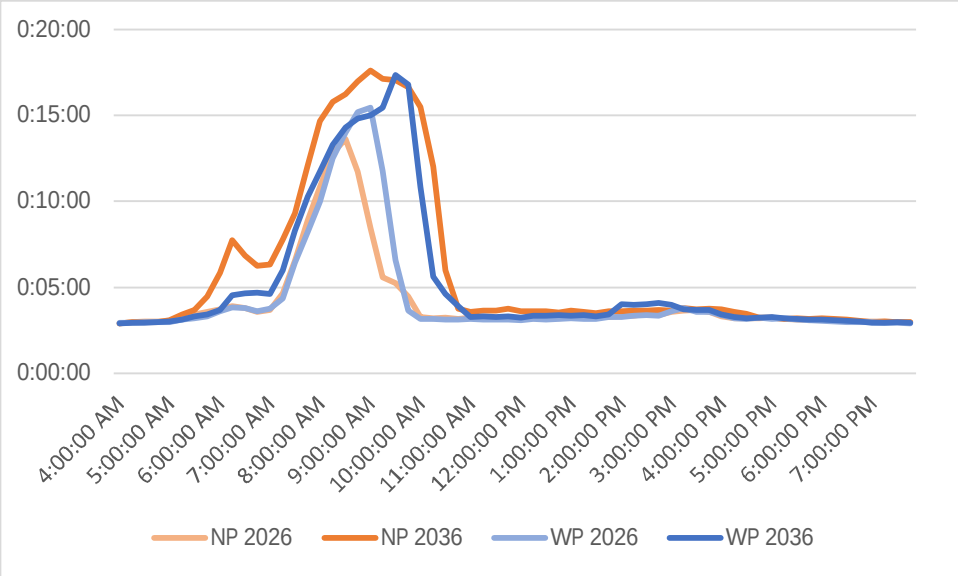


Figure 48 - M7 SB to M5SW EB

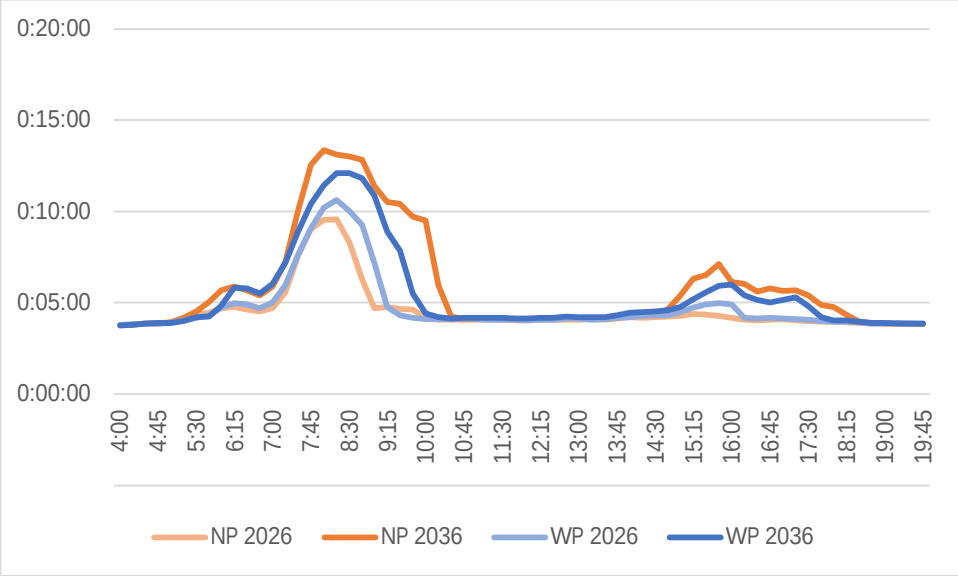


Figure 49 - M31 NB to M5SW EB

Figure 50 highlights that the project is not anticipated to impact southbound movements through the Cutler interchange from M5SW. **Figure 51** does however indicate that by 2036 there are some mild impacts caused by the lane drop from 4 lanes down to 3 on M31 under the project scenario, in the PM peak.

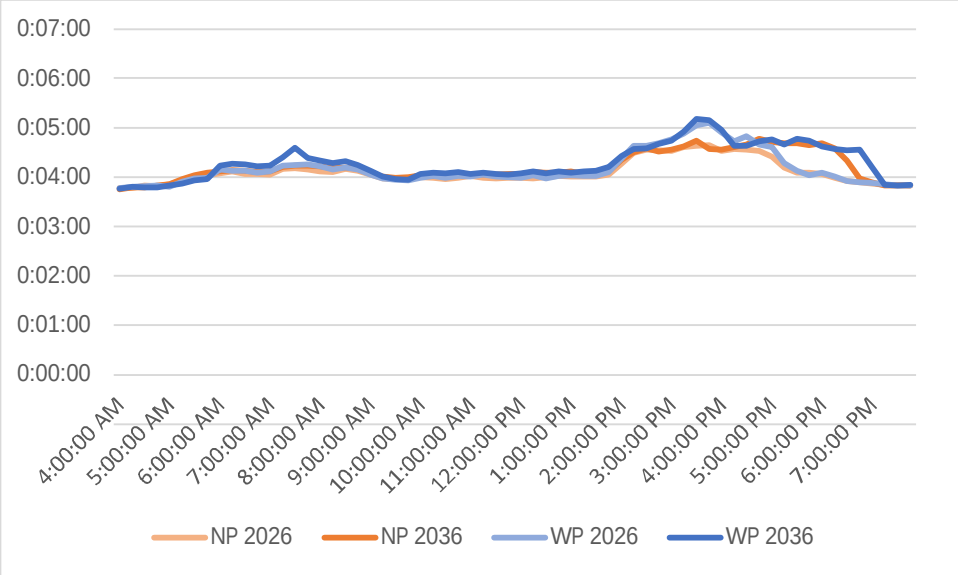


Figure 50 - M5SW SB to M31 SB

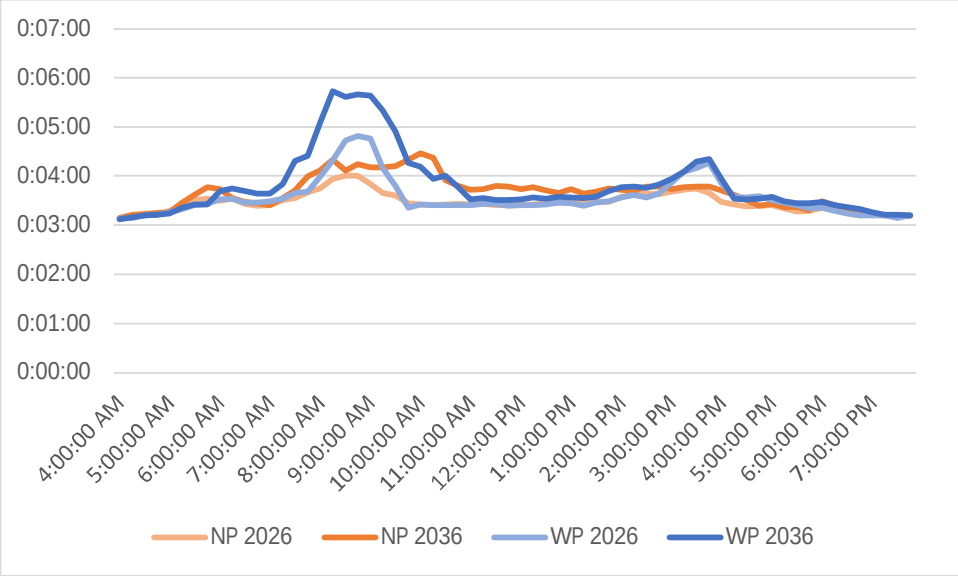


Figure 51 - M7 SB to M31 SB

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APPENDICES

APPENDIX A – Detailed Turn Count Calibration Summary (M7 Subarea)

DETAILED TURN SUMMARY

HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
5:00:00 AM	1579581: 01A	848	846	-2	0	0.1	2
5:00:00 AM	1578113: 06C	97	109	12	12	1.2	12
5:00:00 AM	1578647: 11B	12	18	6	50	1.5	6
5:00:00 AM	1578086: 06B	47	49	2	4	0.3	2
5:00:00 AM	1578541: 09A	114	111	-3	-3	0.3	3
5:00:00 AM	1577698: 02B	79	87	8	10	0.9	8
5:00:00 AM	1577990: 05D	32	31	-1	-3	0.2	1
5:00:00 AM	1578531: 09D	217	197	-20	-9	1.4	20
5:00:00 AM	1578518: 08B	56	55	-1	-2	0.1	1
5:00:00 AM	1577748: 03A	52	52	0	0	0.0	0
5:00:00 AM	1577775: 04D	65	64	-1	-2	0.1	1
5:00:00 AM	1579272: 10C	61	57	-4	-7	0.5	4
5:00:00 AM	1577694: 02C	84	86	2	2	0.2	2
5:00:00 AM	1160391: 09B	47	48	1	2	0.1	1
5:00:00 AM	1578820: 12D	98	95	-3	-3	0.3	3
5:00:00 AM	1578230: 07C	259	245	-14	-5	0.9	14
5:00:00 AM	1579584: 01B	727	707	-20	-3	0.7	20
5:00:00 AM	1578442: 07D	287	268	-19	-7	1.1	19
5:00:00 AM	1579315: 07A	290	318	28	10	1.6	28
5:00:00 AM	1578081: 06A	168	174	6	4	0.5	6
5:00:00 AM	860254: 03B	156	145	-11	-7	0.9	11
5:00:00 AM	1577965: 05B	55	49	-6	-11	0.8	6
5:00:00 AM	1579222: 15B	335	340	5	1	0.3	5
5:00:00 AM	1577845: 04C	33	27	-6	-18	1.1	6
5:00:00 AM	1578103: 06D	85	79	-6	-7	0.7	6
5:00:00 AM	1579257: 10B	144	149	5	3	0.4	5
5:00:00 AM	860308: 03D	104	108	4	4	0.4	4
5:00:00 AM	1579578: 12C	27	20	-7	-26	1.4	7
5:00:00 AM	1579249: 10A	117	120	3	3	0.3	3
5:00:00 AM	1578836: 12B	54	61	7	13	0.9	7
5:00:00 AM	1577815: 04B	91	91	0	0	0.0	0

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
5:00:00 AM	1577946: 05A	117	127	10	9	0.9	10
5:00:00 AM	1578849: 13A	69	74	5	7	0.6	5
5:00:00 AM	1578712: 12A	48	44	-4	-8	0.6	4
5:00:00 AM	1579032: 14C	21	22	1	5	0.2	1
5:00:00 AM	1578603: 09C	26	18	-8	-31	1.7	8
5:00:00 AM	1577766: 04A	71	71	0	0	0.0	0
5:00:00 AM	1578241: 07B	219	236	17	8	1.1	17
5:00:00 AM	1579083: 14B	107	104	-3	-3	0.3	3
5:00:00 AM	1578861: 13B	59	53	-6	-10	0.8	6
5:00:00 AM	1577758: 03C	49	58	9	18	1.2	9
5:00:00 AM	1577969: 05C	75	74	-1	-1	0.1	1
5:00:00 AM	1579305: 10D	381	392	11	3	0.6	11
5:00:00 AM	1579219: 15A	544	543	-1	0	0.0	1
5:00:00 AM	1578635: 11A	36	40	4	11	0.6	4
5:00:00 AM	1578513: 08A	33	31	-2	-6	0.4	2
6:00:00 AM	1579581: 01A	2726	2774	48	2	0.1	48
6:00:00 AM	1578113: 06C	227	207	-20	-9	1.2	20
6:00:00 AM	1578647: 11B	33	25	-8	-24	1.5	8
6:00:00 AM	1578086: 06B	88	78	-10	-11	0.3	10
6:00:00 AM	1578541: 09A	288	288	0	0	0.3	0
6:00:00 AM	1577698: 02B	218	202	-16	-7	0.9	16
6:00:00 AM	1577990: 05D	100	116	16	16	0.2	16
6:00:00 AM	1578531: 09D	507	488	-19	-4	1.4	19
6:00:00 AM	1578518: 08B	124	140	16	13	0.1	16
6:00:00 AM	1577748: 03A	123	116	-7	-6	0.0	7
6:00:00 AM	1577775: 04D	151	153	2	1	0.1	2
6:00:00 AM	1579272: 10C	149	166	17	11	0.5	17
6:00:00 AM	1577694: 02C	221	196	-25	-11	0.2	25
6:00:00 AM	1160391: 09B	165	164	-1	-1	0.1	1
6:00:00 AM	1578820: 12D	326	314	-12	-4	0.3	12
6:00:00 AM	1578230: 07C	689	664	-25	-4	0.9	25
6:00:00 AM	1579584: 01B	2003	1894	-109	-5	0.7	109
6:00:00 AM	1578442: 07D	904	890	-14	-2	1.1	14
6:00:00 AM	1579315: 07A	805	740	-65	-8	1.6	65
6:00:00 AM	1578081: 06A	313	303	-10	-3	0.5	10
6:00:00 AM	860254: 03B	513	520	7	1	0.9	7
6:00:00 AM	1577965: 05B	180	180	0	0	0.8	0
6:00:00 AM	1579222: 15B	867	832	-35	-4	0.3	35

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
6:00:00 AM	1577845: 04C	120	129	9	8	1.1	9
6:00:00 AM	1578103: 06D	186	159	-27	-15	0.7	27
6:00:00 AM	1579257: 10B	681	688	7	1	0.4	7
6:00:00 AM	860308: 03D	304	333	29	10	0.4	29
6:00:00 AM	1579578: 12C	71	61	-10	-14	1.4	10
6:00:00 AM	1579249: 10A	485	479	-6	-1	0.3	6
6:00:00 AM	1578836: 12B	208	194	-14	-7	0.9	14
6:00:00 AM	1577815: 04B	286	260	-26	-9	0.0	26
6:00:00 AM	1577946: 05A	310	274	-36	-12	0.9	36
6:00:00 AM	1578849: 13A	327	305	-22	-7	0.6	22
6:00:00 AM	1578712: 12A	261	255	-6	-2	0.6	6
6:00:00 AM	1579032: 14C	112	125	13	12	0.2	13
6:00:00 AM	1578603: 09C	56	57	1	2	1.7	1
6:00:00 AM	1577766: 04A	196	200	4	2	0.0	4
6:00:00 AM	1578241: 07B	757	732	-25	-3	1.1	25
6:00:00 AM	1579083: 14B	481	463	-18	-4	0.3	18
6:00:00 AM	1578861: 13B	225	224	-1	0	0.8	1
6:00:00 AM	1577758: 03C	151	178	27	18	1.2	27
6:00:00 AM	1577969: 05C	238	225	-13	-5	0.1	13
6:00:00 AM	1579305: 10D	1048	1033	-15	-1	0.6	15
6:00:00 AM	1579219: 15A	2116	2045	-71	-3	0.0	71
6:00:00 AM	1578635: 11A	157	173	16	10	0.6	16
6:00:00 AM	1578513: 08A	109	103	-6	-6	0.4	6
7:00:00 AM	1579581: 01A	2514	2435	-79	-3	1.6	79
7:00:00 AM	1578113: 06C	316	317	1	0	0.1	1
7:00:00 AM	1578647: 11B	114	101	-13	-11	1.3	13
7:00:00 AM	1578086: 06B	130	115	-15	-12	1.4	15
7:00:00 AM	1578541: 09A	393	430	37	9	1.8	37
7:00:00 AM	1577698: 02B	279	267	-12	-4	0.7	12
7:00:00 AM	1577990: 05D	199	202	3	2	0.2	3
7:00:00 AM	1578531: 09D	642	628	-14	-2	0.6	14
7:00:00 AM	1578518: 08B	285	303	18	6	1.0	18
7:00:00 AM	1577748: 03A	229	239	10	4	0.7	10
7:00:00 AM	1577775: 04D	253	263	10	4	0.6	10
7:00:00 AM	1579272: 10C	399	418	19	5	0.9	19
7:00:00 AM	1577694: 02C	382	384	2	1	0.1	2
7:00:00 AM	1160391: 09B	209	232	23	11	1.5	23
7:00:00 AM	1578820: 12D	541	568	27	5	1.1	27

DETAILED TURN SUMMARY

HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
7:00:00 AM	1578230: 07C	978	953	-25	-3	0.8	25
7:00:00 AM	1579584: 01B	2900	2963	63	2	1.2	63
7:00:00 AM	1578442: 07D	1168	1202	34	3	1.0	34
7:00:00 AM	1579315: 07A	957	1086	129	13	4.0	129
7:00:00 AM	1578081: 06A	380	373	-7	-2	0.4	7
7:00:00 AM	860254: 03B	572	588	16	3	0.7	16
7:00:00 AM	1577965: 05B	275	277	2	1	0.1	2
7:00:00 AM	1579222: 15B	1661	1656	-5	0	0.1	5
7:00:00 AM	1577845: 04C	234	237	3	1	0.2	3
7:00:00 AM	1578103: 06D	289	272	-17	-6	1.0	17
7:00:00 AM	1579257: 10B	763	792	29	4	1.0	29
7:00:00 AM	860308: 03D	412	406	-6	-1	0.3	6
7:00:00 AM	1579578: 12C	181	176	-5	-3	0.4	5
7:00:00 AM	1579249: 10A	1101	1108	7	1	0.2	7
7:00:00 AM	1578836: 12B	349	357	8	2	0.4	8
7:00:00 AM	1577815: 04B	428	432	4	1	0.2	4
7:00:00 AM	1577946: 05A	304	318	14	5	0.8	14
7:00:00 AM	1578849: 13A	657	729	72	11	2.7	72
7:00:00 AM	1578712: 12A	515	574	59	11	2.5	59
7:00:00 AM	1579032: 14C	263	245	-18	-7	1.1	18
7:00:00 AM	1578603: 09C	120	118	-2	-2	0.2	2
7:00:00 AM	1577766: 04A	192	179	-13	-7	1.0	13
7:00:00 AM	1578241: 07B	1197	1210	13	1	0.4	13
7:00:00 AM	1579083: 14B	531	511	-20	-4	0.9	20
7:00:00 AM	1578861: 13B	474	482	8	2	0.4	8
7:00:00 AM	1577758: 03C	400	366	-34	-9	1.7	34
7:00:00 AM	1577969: 05C	375	354	-21	-6	1.1	21
7:00:00 AM	1579305: 10D	1281	1261	-20	-2	0.6	20
7:00:00 AM	1579219: 15A	2643	2693	50	2	1.0	50
7:00:00 AM	1578635: 11A	227	212	-15	-7	1.0	15
7:00:00 AM	1578513: 08A	146	154	8	5	0.7	8
8:00:00 AM	1579581: 01A	3051	3118	67	2	1.2	67
8:00:00 AM	1578113: 06C	344	373	29	8	1.5	29
8:00:00 AM	1578647: 11B	111	131	20	18	1.8	20
8:00:00 AM	1578086: 06B	187	175	-12	-6	0.9	12
8:00:00 AM	1578541: 09A	535	531	-4	-1	0.2	4
8:00:00 AM	1577698: 02B	348	376	28	8	1.5	28
8:00:00 AM	1577990: 05D	266	275	9	3	0.5	9

DETAILED TURN SUMMARY

HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
8:00:00 AM	1578531: 09D	661	647	-14	-2	0.5	14
8:00:00 AM	1578518: 08B	379	392	13	3	0.7	13
8:00:00 AM	1577748: 03A	361	387	26	7	1.3	26
8:00:00 AM	1577775: 04D	277	274	-3	-1	0.2	3
8:00:00 AM	1579272: 10C	498	489	-9	-2	0.4	9
8:00:00 AM	1577694: 02C	427	407	-20	-5	1.0	20
8:00:00 AM	1160391: 09B	241	229	-12	-5	0.8	12
8:00:00 AM	1578820: 12D	706	742	36	5	1.3	36
8:00:00 AM	1578230: 07C	1275	1192	-83	-7	2.4	83
8:00:00 AM	1579584: 01B	3146	3095	-51	-2	0.9	51
8:00:00 AM	1578442: 07D	1091	1101	10	1	0.3	10
8:00:00 AM	1579315: 07A	969	924	-45	-5	1.5	45
8:00:00 AM	1578081: 06A	314	316	2	1	0.1	2
8:00:00 AM	860254: 03B	475	522	47	10	2.1	47
8:00:00 AM	1577965: 05B	298	276	-22	-7	1.3	22
8:00:00 AM	1579222: 15B	2152	2138	-14	-1	0.3	14
8:00:00 AM	1577845: 04C	313	274	-39	-12	2.3	39
8:00:00 AM	1578103: 06D	330	308	-22	-7	1.2	22
8:00:00 AM	1579257: 10B	828	825	-3	0	0.1	3
8:00:00 AM	860308: 03D	516	482	-34	-7	1.5	34
8:00:00 AM	1579578: 12C	292	276	-16	-5	0.9	16
8:00:00 AM	1579249: 10A	876	887	11	1	0.4	11
8:00:00 AM	1578836: 12B	493	465	-28	-6	1.3	28
8:00:00 AM	1577815: 04B	419	438	19	5	0.9	19
8:00:00 AM	1577946: 05A	410	411	1	0	0.0	1
8:00:00 AM	1578849: 13A	1032	1052	20	2	0.6	20
8:00:00 AM	1578712: 12A	584	602	18	3	0.7	18
8:00:00 AM	1579032: 14C	398	380	-18	-5	0.9	18
8:00:00 AM	1578603: 09C	277	274	-3	-1	0.2	3
8:00:00 AM	1577766: 04A	203	235	32	16	2.2	32
8:00:00 AM	1578241: 07B	1112	1101	-11	-1	0.3	11
8:00:00 AM	1579083: 14B	626	651	25	4	1.0	25
8:00:00 AM	1578861: 13B	764	756	-8	-1	0.3	8
8:00:00 AM	1577758: 03C	315	320	5	2	0.3	5
8:00:00 AM	1577969: 05C	483	443	-40	-8	1.9	40
8:00:00 AM	1579305: 10D	1240	1259	19	2	0.5	19
8:00:00 AM	1579219: 15A	2831	2800	-31	-1	0.6	31
8:00:00 AM	1578635: 11A	261	278	17	7	1.0	17

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
8:00:00 AM	1578513: 08A	202	221	19	9	1.3	19
9:00:00 AM	1579581: 01A	2560	2539	-21	-1	0.4	21
9:00:00 AM	1578113: 06C	314	334	20	6	1.1	20
9:00:00 AM	1578647: 11B	112	120	8	7	0.7	8
9:00:00 AM	1578086: 06B	251	288	37	15	2.3	37
9:00:00 AM	1578541: 09A	442	409	-33	-7	1.6	33
9:00:00 AM	1577698: 02B	289	288	-1	0	0.1	1
9:00:00 AM	1577990: 05D	260	281	21	8	1.3	21
9:00:00 AM	1578531: 09D	514	549	35	7	1.5	35
9:00:00 AM	1578518: 08B	356	368	12	3	0.6	12
9:00:00 AM	1577748: 03A	195	181	-14	-7	1.0	14
9:00:00 AM	1577775: 04D	231	236	5	2	0.3	5
9:00:00 AM	1579272: 10C	410	394	-16	-4	0.8	16
9:00:00 AM	1577694: 02C	371	354	-17	-5	0.9	17
9:00:00 AM	1160391: 09B	187	193	6	3	0.4	6
9:00:00 AM	1578820: 12D	598	604	6	1	0.2	6
9:00:00 AM	1578230: 07C	1136	1192	56	5	1.6	56
9:00:00 AM	1579584: 01B	3070	3013	-57	-2	1.0	57
9:00:00 AM	1578442: 07D	1018	1012	-6	-1	0.2	6
9:00:00 AM	1579315: 07A	1064	1116	52	5	1.6	52
9:00:00 AM	1578081: 06A	351	370	19	5	1.0	19
9:00:00 AM	860254: 03B	496	469	-27	-5	1.2	27
9:00:00 AM	1577965: 05B	315	305	-10	-3	0.6	10
9:00:00 AM	1579222: 15B	1916	1914	-2	0	0.0	2
9:00:00 AM	1577845: 04C	289	293	4	1	0.2	4
9:00:00 AM	1578103: 06D	342	349	7	2	0.4	7
9:00:00 AM	1579257: 10B	711	691	-20	-3	0.8	20
9:00:00 AM	860308: 03D	472	462	-10	-2	0.5	10
9:00:00 AM	1579578: 12C	280	306	26	9	1.5	26
9:00:00 AM	1579249: 10A	797	742	-55	-7	2.0	55
9:00:00 AM	1578836: 12B	437	472	35	8	1.6	35
9:00:00 AM	1577815: 04B	394	419	25	6	1.2	25
9:00:00 AM	1577946: 05A	435	422	-13	-3	0.6	13
9:00:00 AM	1578849: 13A	882	831	-51	-6	1.7	51
9:00:00 AM	1578712: 12A	487	487	0	0	0.0	0
9:00:00 AM	1579032: 14C	388	383	-5	-1	0.3	5
9:00:00 AM	1578603: 09C	257	256	-1	0	0.1	1
9:00:00 AM	1577766: 04A	226	228	2	1	0.1	2

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
9:00:00 AM	1578241: 07B	988	924	-64	-6	2.1	64
9:00:00 AM	1579083: 14B	527	527	0	0	0.0	0
9:00:00 AM	1578861: 13B	653	698	45	7	1.7	45
9:00:00 AM	1577758: 03C	265	273	8	3	0.5	8
9:00:00 AM	1577969: 05C	394	437	43	11	2.1	43
9:00:00 AM	1579305: 10D	1105	1184	79	7	2.3	79
9:00:00 AM	1579219: 15A	2505	2631	126	5	2.5	126
9:00:00 AM	1578635: 11A	231	200	-31	-13	2.1	31
9:00:00 AM	1578513: 08A	224	217	-7	-3	0.5	7
10:00:00 AM	1579581: 01A	2477	2453	-24	-1	0.5	24
10:00:00 AM	1578113: 06C	219	244	25	11	1.6	25
10:00:00 AM	1578647: 11B	80	75	-5	-6	0.6	5
10:00:00 AM	1578086: 06B	256	275	19	7	1.2	19
10:00:00 AM	1578541: 09A	367	358	-9	-2	0.5	9
10:00:00 AM	1577698: 02B	251	274	23	9	1.4	23
10:00:00 AM	1577990: 05D	263	290	27	10	1.6	27
10:00:00 AM	1578531: 09D	366	358	-8	-2	0.4	8
10:00:00 AM	1578518: 08B	226	251	25	11	1.6	25
10:00:00 AM	1577748: 03A	227	212	-15	-7	1.0	15
10:00:00 AM	1577775: 04D	141	151	10	7	0.8	10
10:00:00 AM	1579272: 10C	413	378	-35	-8	1.8	35
10:00:00 AM	1577694: 02C	317	311	-6	-2	0.3	6
10:00:00 AM	1160391: 09B	156	141	-15	-10	1.2	15
10:00:00 AM	1578820: 12D	479	498	19	4	0.9	19
10:00:00 AM	1578230: 07C	842	800	-42	-5	1.5	42
10:00:00 AM	1579584: 01B	2665	2964	299	11	5.6	299
10:00:00 AM	1578442: 07D	1034	1118	84	8	2.6	84
10:00:00 AM	1579315: 07A	1139	1078	-61	-5	1.8	61
10:00:00 AM	1578081: 06A	323	306	-17	-5	1.0	17
10:00:00 AM	860254: 03B	337	354	17	5	0.9	17
10:00:00 AM	1577965: 05B	286	276	-10	-3	0.6	10
10:00:00 AM	1579222: 15B	1862	1836	-26	-1	0.6	26
10:00:00 AM	1577845: 04C	221	277	56	25	3.5	56
10:00:00 AM	1578103: 06D	319	300	-19	-6	1.1	19
10:00:00 AM	1579257: 10B	518	517	-1	0	0.0	1
10:00:00 AM	860308: 03D	271	286	15	6	0.9	15
10:00:00 AM	1579578: 12C	242	230	-12	-5	0.8	12
10:00:00 AM	1579249: 10A	768	736	-32	-4	1.2	32

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
10:00:00 AM	1578836: 12B	273	256	-17	-6	1.0	17
10:00:00 AM	1577815: 04B	290	269	-21	-7	1.3	21
10:00:00 AM	1577946: 05A	334	314	-20	-6	1.1	20
10:00:00 AM	1578849: 13A	602	607	5	1	0.2	5
10:00:00 AM	1578712: 12A	395	429	34	9	1.7	34
10:00:00 AM	1579032: 14C	331	313	-18	-5	1.0	18
10:00:00 AM	1578603: 09C	198	193	-5	-3	0.4	5
10:00:00 AM	1577766: 04A	191	159	-32	-17	2.4	32
10:00:00 AM	1578241: 07B	843	830	-13	-2	0.4	13
10:00:00 AM	1579083: 14B	462	448	-14	-3	0.7	14
10:00:00 AM	1578861: 13B	529	527	-2	0	0.1	2
10:00:00 AM	1577758: 03C	239	251	12	5	0.8	12
10:00:00 AM	1577969: 05C	342	350	8	2	0.4	8
10:00:00 AM	1579305: 10D	849	819	-30	-4	1.0	30
10:00:00 AM	1579219: 15A	2213	2159	-54	-2	1.2	54
10:00:00 AM	1578635: 11A	132	139	7	5	0.6	7
10:00:00 AM	1578513: 08A	185	184	-1	-1	0.1	1
11:00:00 AM	1579581: 01A	2451	2443	-8	0	0.2	8
11:00:00 AM	1578113: 06C	171	163	-8	-5	0.6	8
11:00:00 AM	1578647: 11B	91	112	21	23	2.1	21
11:00:00 AM	1578086: 06B	211	217	6	3	0.4	6
11:00:00 AM	1578541: 09A	353	330	-23	-7	1.2	23
11:00:00 AM	1577698: 02B	281	280	-1	0	0.1	1
11:00:00 AM	1577990: 05D	300	271	-29	-10	1.7	29
11:00:00 AM	1578531: 09D	375	384	9	2	0.5	9
11:00:00 AM	1578518: 08B	188	203	15	8	1.1	15
11:00:00 AM	1577748: 03A	193	175	-18	-9	1.3	18
11:00:00 AM	1577775: 04D	170	172	2	1	0.2	2
11:00:00 AM	1579272: 10C	426	425	-1	0	0.0	1
11:00:00 AM	1577694: 02C	247	241	-6	-2	0.4	6
11:00:00 AM	1160391: 09B	136	136	0	0	0.0	0
11:00:00 AM	1578820: 12D	395	416	21	5	1.0	21
11:00:00 AM	1578230: 07C	755	792	37	5	1.3	37
11:00:00 AM	1579584: 01B	2665	2743	78	3	1.5	78
11:00:00 AM	1578442: 07D	1062	1043	-19	-2	0.6	19
11:00:00 AM	1579315: 07A	1087	1049	-38	-3	1.2	38
11:00:00 AM	1578081: 06A	337	350	13	4	0.7	13
11:00:00 AM	860254: 03B	340	322	-18	-5	1.0	18

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
11:00:00 AM	1577965: 05B	292	264	-28	-10	1.7	28
11:00:00 AM	1579222: 15B	1806	1803	-3	0	0.1	3
11:00:00 AM	1577845: 04C	248	241	-7	-3	0.4	7
11:00:00 AM	1578103: 06D	303	305	2	1	0.1	2
11:00:00 AM	1579257: 10B	401	360	-41	-10	2.1	41
11:00:00 AM	860308: 03D	259	232	-27	-10	1.7	27
11:00:00 AM	1579578: 12C	225	250	25	11	1.6	25
11:00:00 AM	1579249: 10A	680	693	13	2	0.5	13
11:00:00 AM	1578836: 12B	229	250	21	9	1.4	21
11:00:00 AM	1577815: 04B	218	225	7	3	0.5	7
11:00:00 AM	1577946: 05A	322	330	8	2	0.4	8
11:00:00 AM	1578849: 13A	486	488	2	0	0.1	2
11:00:00 AM	1578712: 12A	368	344	-24	-7	1.3	24
11:00:00 AM	1579032: 14C	309	306	-3	-1	0.2	3
11:00:00 AM	1578603: 09C	160	153	-7	-4	0.6	7
11:00:00 AM	1577766: 04A	178	192	14	8	1.0	14
11:00:00 AM	1578241: 07B	819	831	12	1	0.4	12
11:00:00 AM	1579083: 14B	396	396	0	0	0.0	0
11:00:00 AM	1578861: 13B	492	489	-3	-1	0.1	3
11:00:00 AM	1577758: 03C	280	299	19	7	1.1	19
11:00:00 AM	1577969: 05C	311	331	20	6	1.1	20
11:00:00 AM	1579305: 10D	756	811	55	7	2.0	55
11:00:00 AM	1579219: 15A	1915	1963	48	3	1.1	48
11:00:00 AM	1578635: 11A	102	107	5	5	0.5	5
11:00:00 AM	1578513: 08A	224	211	-13	-6	0.9	13
12:00:00 PM	1579581: 01A	2573	2610	37	1	0.7	37
12:00:00 PM	1578113: 06C	180	179	-1	-1	0.1	1
12:00:00 PM	1578647: 11B	109	84	-25	-23	2.5	25
12:00:00 PM	1578086: 06B	237	214	-23	-10	1.5	23
12:00:00 PM	1578541: 09A	372	330	-42	-11	2.2	42
12:00:00 PM	1577698: 02B	277	291	14	5	0.8	14
12:00:00 PM	1577990: 05D	321	322	1	0	0.1	1
12:00:00 PM	1578531: 09D	366	363	-3	-1	0.2	3
12:00:00 PM	1578518: 08B	196	189	-7	-4	0.5	7
12:00:00 PM	1577748: 03A	211	218	7	3	0.5	7
12:00:00 PM	1577775: 04D	167	175	8	5	0.6	8
12:00:00 PM	1579272: 10C	426	490	64	15	3.0	64
12:00:00 PM	1577694: 02C	294	284	-10	-3	0.6	10

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
12:00:00 PM	1160391: 09B	150	128	-22	-15	1.9	22
12:00:00 PM	1578820: 12D	371	354	-17	-5	0.9	17
12:00:00 PM	1578230: 07C	783	758	-25	-3	0.9	25
12:00:00 PM	1579584: 01B	2792	2830	38	1	0.7	38
12:00:00 PM	1578442: 07D	1021	963	-58	-6	1.8	58
12:00:00 PM	1579315: 07A	1094	1025	-69	-6	2.1	69
12:00:00 PM	1578081: 06A	309	273	-36	-12	2.1	36
12:00:00 PM	860254: 03B	312	308	-4	-1	0.2	4
12:00:00 PM	1577965: 05B	256	239	-17	-7	1.1	17
12:00:00 PM	1579222: 15B	1921	1929	8	0	0.2	8
12:00:00 PM	1577845: 04C	213	213	0	0	0.0	0
12:00:00 PM	1578103: 06D	314	337	23	7	1.3	23
12:00:00 PM	1579257: 10B	398	391	-7	-2	0.4	7
12:00:00 PM	860308: 03D	277	295	18	6	1.1	18
12:00:00 PM	1579578: 12C	296	276	-20	-7	1.2	20
12:00:00 PM	1579249: 10A	774	735	-39	-5	1.4	39
12:00:00 PM	1578836: 12B	277	305	28	10	1.6	28
12:00:00 PM	1577815: 04B	201	210	9	4	0.6	9
12:00:00 PM	1577946: 05A	347	346	-1	0	0.1	1
12:00:00 PM	1578849: 13A	446	439	-7	-2	0.3	7
12:00:00 PM	1578712: 12A	391	384	-7	-2	0.4	7
12:00:00 PM	1579032: 14C	302	299	-3	-1	0.2	3
12:00:00 PM	1578603: 09C	140	150	10	7	0.8	10
12:00:00 PM	1577766: 04A	202	210	8	4	0.6	8
12:00:00 PM	1578241: 07B	768	798	30	4	1.1	30
12:00:00 PM	1579083: 14B	381	343	-38	-10	2.0	38
12:00:00 PM	1578861: 13B	500	538	38	8	1.7	38
12:00:00 PM	1577758: 03C	293	284	-9	-3	0.5	9
12:00:00 PM	1577969: 05C	332	316	-16	-5	0.9	16
12:00:00 PM	1579305: 10D	712	758	46	6	1.7	46
12:00:00 PM	1579219: 15A	1921	1856	-65	-3	1.5	65
12:00:00 PM	1578635: 11A	113	110	-3	-3	0.3	3
12:00:00 PM	1578513: 08A	185	173	-12	-6	0.9	12
1:00:00 PM	1579581: 01A	2656	2705	49	2	0.9	49
1:00:00 PM	1578113: 06C	193	217	24	12	1.7	24
1:00:00 PM	1578647: 11B	100	104	4	4	0.4	4
1:00:00 PM	1578086: 06B	264	271	7	3	0.4	7
1:00:00 PM	1578541: 09A	361	404	43	12	2.2	43

DETAILED TURN SUMMARY

HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
1:00:00 PM	1577698: 02B	292	318	26	9	1.5	26
1:00:00 PM	1577990: 05D	314	309	-5	-2	0.3	5
1:00:00 PM	1578531: 09D	378	372	-6	-2	0.3	6
1:00:00 PM	1578518: 08B	206	201	-5	-2	0.4	5
1:00:00 PM	1577748: 03A	250	237	-13	-5	0.8	13
1:00:00 PM	1577775: 04D	167	172	5	3	0.4	5
1:00:00 PM	1579272: 10C	486	477	-9	-2	0.4	9
1:00:00 PM	1577694: 02C	300	280	-20	-7	1.2	20
1:00:00 PM	1160391: 09B	146	139	-7	-5	0.6	7
1:00:00 PM	1578820: 12D	402	400	-2	0	0.1	2
1:00:00 PM	1578230: 07C	832	816	-16	-2	0.6	16
1:00:00 PM	1579584: 01B	2691	2616	-75	-3	1.5	75
1:00:00 PM	1578442: 07D	1105	1110	5	0	0.2	5
1:00:00 PM	1579315: 07A	1124	1140	16	1	0.5	16
1:00:00 PM	1578081: 06A	238	252	14	6	0.9	14
1:00:00 PM	860254: 03B	316	344	28	9	1.5	28
1:00:00 PM	1577965: 05B	266	265	-1	0	0.1	1
1:00:00 PM	1579222: 15B	1911	1979	68	4	1.5	68
1:00:00 PM	1577845: 04C	260	245	-15	-6	0.9	15
1:00:00 PM	1578103: 06D	351	327	-24	-7	1.3	24
1:00:00 PM	1579257: 10B	414	403	-11	-3	0.5	11
1:00:00 PM	860308: 03D	215	223	8	4	0.5	8
1:00:00 PM	1579578: 12C	299	255	-44	-15	2.6	44
1:00:00 PM	1579249: 10A	756	720	-36	-5	1.3	36
1:00:00 PM	1578836: 12B	209	222	13	6	0.9	13
1:00:00 PM	1577815: 04B	209	216	7	3	0.5	7
1:00:00 PM	1577946: 05A	346	360	14	4	0.7	14
1:00:00 PM	1578849: 13A	447	407	-40	-9	1.9	40
1:00:00 PM	1578712: 12A	385	407	22	6	1.1	22
1:00:00 PM	1579032: 14C	272	288	16	6	1.0	16
1:00:00 PM	1578603: 09C	168	167	-1	-1	0.1	1
1:00:00 PM	1577766: 04A	176	171	-5	-3	0.4	5
1:00:00 PM	1578241: 07B	743	728	-15	-2	0.6	15
1:00:00 PM	1579083: 14B	378	422	44	12	2.2	44
1:00:00 PM	1578861: 13B	518	552	34	7	1.5	34
1:00:00 PM	1577758: 03C	314	310	-4	-1	0.2	4
1:00:00 PM	1577969: 05C	324	323	-1	0	0.1	1
1:00:00 PM	1579305: 10D	840	806	-34	-4	1.2	34

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
1:00:00 PM	1579219: 15A	1764	1840	76	4	1.8	76
1:00:00 PM	1578635: 11A	100	104	4	4	0.4	4
1:00:00 PM	1578513: 08A	183	212	29	16	2.1	29
2:00:00 PM	1579581: 01A	2603	2653	50	2	1.0	50
2:00:00 PM	1578113: 06C	189	215	26	14	1.8	26
2:00:00 PM	1578647: 11B	112	121	9	8	0.8	9
2:00:00 PM	1578086: 06B	331	328	-3	-1	0.2	3
2:00:00 PM	1578541: 09A	446	450	4	1	0.2	4
2:00:00 PM	1577698: 02B	292	320	28	10	1.6	28
2:00:00 PM	1577990: 05D	346	324	-22	-6	1.2	22
2:00:00 PM	1578531: 09D	437	423	-14	-3	0.7	14
2:00:00 PM	1578518: 08B	212	209	-3	-1	0.2	3
2:00:00 PM	1577748: 03A	253	264	11	4	0.7	11
2:00:00 PM	1577775: 04D	186	160	-26	-14	2.0	26
2:00:00 PM	1579272: 10C	483	461	-22	-5	1.0	22
2:00:00 PM	1577694: 02C	311	323	12	4	0.7	12
2:00:00 PM	1160391: 09B	166	166	0	0	0.0	0
2:00:00 PM	1578820: 12D	450	491	41	9	1.9	41
2:00:00 PM	1578230: 07C	827	776	-51	-6	1.8	51
2:00:00 PM	1579584: 01B	2823	2733	-90	-3	1.7	90
2:00:00 PM	1578442: 07D	1142	1160	18	2	0.5	18
2:00:00 PM	1579315: 07A	1190	1195	5	0	0.1	5
2:00:00 PM	1578081: 06A	255	290	35	14	2.1	35
2:00:00 PM	860254: 03B	362	363	1	0	0.1	1
2:00:00 PM	1577965: 05B	332	317	-15	-5	0.8	15
2:00:00 PM	1579222: 15B	2086	1987	-99	-5	2.2	99
2:00:00 PM	1577845: 04C	272	274	2	1	0.1	2
2:00:00 PM	1578103: 06D	357	330	-27	-8	1.5	27
2:00:00 PM	1579257: 10B	428	418	-10	-2	0.5	10
2:00:00 PM	860308: 03D	296	305	9	3	0.5	9
2:00:00 PM	1579578: 12C	320	318	-2	-1	0.1	2
2:00:00 PM	1579249: 10A	798	854	56	7	1.9	56
2:00:00 PM	1578836: 12B	208	225	17	8	1.2	17
2:00:00 PM	1577815: 04B	198	190	-8	-4	0.6	8
2:00:00 PM	1577946: 05A	340	361	21	6	1.1	21
2:00:00 PM	1578849: 13A	450	445	-5	-1	0.2	5
2:00:00 PM	1578712: 12A	468	479	11	2	0.5	11
2:00:00 PM	1579032: 14C	306	285	-21	-7	1.2	21

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
2:00:00 PM	1578603: 09C	179	179	0	0	0.0	0
2:00:00 PM	1577766: 04A	203	198	-5	-2	0.4	5
2:00:00 PM	1578241: 07B	852	844	-8	-1	0.3	8
2:00:00 PM	1579083: 14B	376	378	2	1	0.1	2
2:00:00 PM	1578861: 13B	595	586	-9	-2	0.4	9
2:00:00 PM	1577758: 03C	352	308	-44	-13	2.4	44
2:00:00 PM	1577969: 05C	305	306	1	0	0.1	1
2:00:00 PM	1579305: 10D	790	799	9	1	0.3	9
2:00:00 PM	1579219: 15A	1787	1800	13	1	0.3	13
2:00:00 PM	1578635: 11A	97	96	-1	-1	0.1	1
2:00:00 PM	1578513: 08A	196	165	-31	-16	2.3	31
3:00:00 PM	1579581: 01A	3019	2999	-20	-1	0.4	20
3:00:00 PM	1578113: 06C	167	196	29	17	2.2	29
3:00:00 PM	1578647: 11B	187	188	1	1	0.1	1
3:00:00 PM	1578086: 06B	576	603	27	5	1.1	27
3:00:00 PM	1578541: 09A	601	597	-4	-1	0.2	4
3:00:00 PM	1577698: 02B	299	321	22	7	1.2	22
3:00:00 PM	1577990: 05D	630	605	-25	-4	1.0	25
3:00:00 PM	1578531: 09D	452	469	17	4	0.8	17
3:00:00 PM	1578518: 08B	218	225	7	3	0.5	7
3:00:00 PM	1577748: 03A	349	363	14	4	0.7	14
3:00:00 PM	1577775: 04D	280	265	-15	-5	0.9	15
3:00:00 PM	1579272: 10C	641	642	1	0	0.0	1
3:00:00 PM	1577694: 02C	280	253	-27	-10	1.7	27
3:00:00 PM	1160391: 09B	217	219	2	1	0.1	2
3:00:00 PM	1578820: 12D	584	572	-12	-2	0.5	12
3:00:00 PM	1578230: 07C	1130	1119	-11	-1	0.3	11
3:00:00 PM	1579584: 01B	3110	3145	35	1	0.6	35
3:00:00 PM	1578442: 07D	961	934	-27	-3	0.9	27
3:00:00 PM	1579315: 07A	1407	1465	58	4	1.5	58
3:00:00 PM	1578081: 06A	195	226	31	16	2.1	31
3:00:00 PM	860254: 03B	421	425	4	1	0.2	4
3:00:00 PM	1577965: 05B	431	436	5	1	0.2	5
3:00:00 PM	1579222: 15B	2631	2714	83	3	1.6	83
3:00:00 PM	1577845: 04C	265	292	27	10	1.6	27
3:00:00 PM	1578103: 06D	454	495	41	9	1.9	41
3:00:00 PM	1579257: 10B	451	416	-35	-8	1.7	35
3:00:00 PM	860308: 03D	348	365	17	5	0.9	17

DETAILED TURN SUMMARY

HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
3:00:00 PM	1579578: 12C	408	428	20	5	1.0	20
3:00:00 PM	1579249: 10A	1030	1044	14	1	0.4	14
3:00:00 PM	1578836: 12B	268	293	25	9	1.5	25
3:00:00 PM	1577815: 04B	280	281	1	0	0.1	1
3:00:00 PM	1577946: 05A	267	272	5	2	0.3	5
3:00:00 PM	1578849: 13A	497	528	31	6	1.4	31
3:00:00 PM	1578712: 12A	613	631	18	3	0.7	18
3:00:00 PM	1579032: 14C	375	396	21	6	1.1	21
3:00:00 PM	1578603: 09C	211	187	-24	-11	1.7	24
3:00:00 PM	1577766: 04A	185	190	5	3	0.4	5
3:00:00 PM	1578241: 07B	1054	1056	2	0	0.1	2
3:00:00 PM	1579083: 14B	405	375	-30	-7	1.5	30
3:00:00 PM	1578861: 13B	843	856	13	2	0.4	13
3:00:00 PM	1577758: 03C	401	351	-50	-12	2.6	50
3:00:00 PM	1577969: 05C	274	294	20	7	1.2	20
3:00:00 PM	1579305: 10D	820	820	0	0	0.0	0
3:00:00 PM	1579219: 15A	1946	1940	-6	0	0.1	6
3:00:00 PM	1578635: 11A	113	115	2	2	0.2	2
3:00:00 PM	1578513: 08A	261	263	2	1	0.1	2
4:00:00 PM	1579581: 01A	2870	2932	62	2	1.2	62
4:00:00 PM	1578113: 06C	160	200	40	25	3.0	40
4:00:00 PM	1578647: 11B	257	272	15	6	0.9	15
4:00:00 PM	1578086: 06B	481	541	60	12	2.7	60
4:00:00 PM	1578541: 09A	637	615	-22	-3	0.9	22
4:00:00 PM	1577698: 02B	235	258	23	10	1.5	23
4:00:00 PM	1577990: 05D	790	796	6	1	0.2	6
4:00:00 PM	1578531: 09D	508	495	-13	-3	0.6	13
4:00:00 PM	1578518: 08B	301	312	11	4	0.6	11
4:00:00 PM	1577748: 03A	399	410	11	3	0.5	11
4:00:00 PM	1577775: 04D	427	406	-21	-5	1.0	21
4:00:00 PM	1579272: 10C	892	830	-62	-7	2.1	62
4:00:00 PM	1577694: 02C	250	272	22	9	1.4	22
4:00:00 PM	1160391: 09B	238	228	-10	-4	0.7	10
4:00:00 PM	1578820: 12D	549	526	-23	-4	1.0	23
4:00:00 PM	1578230: 07C	1273	1313	40	3	1.1	40
4:00:00 PM	1579584: 01B	2930	3412	482	16	8.6	482
4:00:00 PM	1578442: 07D	723	840	117	16	4.2	117
4:00:00 PM	1579315: 07A	1459	1485	26	2	0.7	26

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
4:00:00 PM	1578081: 06A	188	173	-15	-8	1.1	15
4:00:00 PM	860254: 03B	396	396	0	0	0.0	0
4:00:00 PM	1577965: 05B	497	492	-5	-1	0.2	5
4:00:00 PM	1579222: 15B	2891	2856	-35	-1	0.7	35
4:00:00 PM	1577845: 04C	234	263	29	12	1.8	29
4:00:00 PM	1578103: 06D	487	503	16	3	0.7	16
4:00:00 PM	1579257: 10B	542	549	7	1	0.3	7
4:00:00 PM	860308: 03D	380	379	-1	0	0.1	1
4:00:00 PM	1579578: 12C	561	567	6	1	0.3	6
4:00:00 PM	1579249: 10A	1146	1114	-32	-3	1.0	32
4:00:00 PM	1578836: 12B	249	254	5	2	0.3	5
4:00:00 PM	1577815: 04B	289	276	-13	-4	0.8	13
4:00:00 PM	1577946: 05A	191	184	-7	-4	0.5	7
4:00:00 PM	1578849: 13A	566	572	6	1	0.3	6
4:00:00 PM	1578712: 12A	733	711	-22	-3	0.8	22
4:00:00 PM	1579032: 14C	332	323	-9	-3	0.5	9
4:00:00 PM	1578603: 09C	232	229	-3	-1	0.2	3
4:00:00 PM	1577766: 04A	195	191	-4	-2	0.3	4
4:00:00 PM	1578241: 07B	1179	1184	5	0	0.1	5
4:00:00 PM	1579083: 14B	489	525	36	7	1.6	36
4:00:00 PM	1578861: 13B	833	845	12	1	0.4	12
4:00:00 PM	1577758: 03C	381	438	57	15	2.8	57
4:00:00 PM	1577969: 05C	169	209	40	24	2.9	40
4:00:00 PM	1579305: 10D	784	804	20	3	0.7	20
4:00:00 PM	1579219: 15A	2215	2411	196	9	4.1	196
4:00:00 PM	1578635: 11A	140	155	15	11	1.2	15
4:00:00 PM	1578513: 08A	302	342	40	13	2.2	40
5:00:00 PM	1579581: 01A	2697	2787	90	3	1.7	90
5:00:00 PM	1578113: 06C	177	201	24	14	1.7	24
5:00:00 PM	1578647: 11B	326	337	11	3	0.6	11
5:00:00 PM	1578086: 06B	547	563	16	3	0.7	16
5:00:00 PM	1578541: 09A	578	547	-31	-5	1.3	31
5:00:00 PM	1577698: 02B	263	247	-16	-6	1.0	16
5:00:00 PM	1577990: 05D	751	787	36	5	1.3	36
5:00:00 PM	1578531: 09D	447	447	0	0	0.0	0
5:00:00 PM	1578518: 08B	309	286	-23	-7	1.3	23
5:00:00 PM	1577748: 03A	368	392	24	7	1.2	24
5:00:00 PM	1577775: 04D	538	532	-6	-1	0.3	6

DETAILED TURN SUMMARY

HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
5:00:00 PM	1579272: 10C	809	808	-1	0	0.0	1
5:00:00 PM	1577694: 02C	250	258	8	3	0.5	8
5:00:00 PM	1160391: 09B	253	265	12	5	0.7	12
5:00:00 PM	1578820: 12D	479	473	-6	-1	0.3	6
5:00:00 PM	1578230: 07C	1323	1286	-37	-3	1.0	37
5:00:00 PM	1579584: 01B	3266	3511	245	8	4.2	245
5:00:00 PM	1578442: 07D	640	613	-27	-4	1.1	27
5:00:00 PM	1579315: 07A	1480	1437	-43	-3	1.1	43
5:00:00 PM	1578081: 06A	196	197	1	1	0.1	1
5:00:00 PM	860254: 03B	367	388	21	6	1.1	21
5:00:00 PM	1577965: 05B	553	561	8	1	0.3	8
5:00:00 PM	1579222: 15B	2840	2810	-30	-1	0.6	30
5:00:00 PM	1577845: 04C	207	220	13	6	0.9	13
5:00:00 PM	1578103: 06D	332	328	-4	-1	0.2	4
5:00:00 PM	1579257: 10B	493	487	-6	-1	0.3	6
5:00:00 PM	860308: 03D	439	477	38	9	1.8	38
5:00:00 PM	1579578: 12C	658	649	-9	-1	0.4	9
5:00:00 PM	1579249: 10A	1132	1121	-11	-1	0.3	11
5:00:00 PM	1578836: 12B	270	282	12	4	0.7	12
5:00:00 PM	1577815: 04B	273	292	19	7	1.1	19
5:00:00 PM	1577946: 05A	163	144	-19	-12	1.5	19
5:00:00 PM	1578849: 13A	598	595	-3	-1	0.1	3
5:00:00 PM	1578712: 12A	794	834	40	5	1.4	40
5:00:00 PM	1579032: 14C	325	327	2	1	0.1	2
5:00:00 PM	1578603: 09C	280	303	23	8	1.3	23
5:00:00 PM	1577766: 04A	193	190	-3	-2	0.2	3
5:00:00 PM	1578241: 07B	1080	1131	51	5	1.5	51
5:00:00 PM	1579083: 14B	591	632	41	7	1.7	41
5:00:00 PM	1578861: 13B	985	991	6	1	0.2	6
5:00:00 PM	1577758: 03C	400	410	10	3	0.5	10
5:00:00 PM	1577969: 05C	166	165	-1	-1	0.1	1
5:00:00 PM	1579305: 10D	721	692	-29	-4	1.1	29
5:00:00 PM	1579219: 15A	2387	2496	109	5	2.2	109
5:00:00 PM	1578635: 11A	146	145	-1	-1	0.1	1
5:00:00 PM	1578513: 08A	306	319	13	4	0.7	13
6:00:00 PM	1579581: 01A	2500	2509	9	0	0.2	9
6:00:00 PM	1578113: 06C	157	149	-8	-5	0.6	8
6:00:00 PM	1578647: 11B	267	278	11	4	0.7	11

DETAILED TURN SUMMARY

HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
6:00:00 PM	1578086: 06B	407	430	23	6	1.1	23
6:00:00 PM	1578541: 09A	511	483	-28	-5	1.3	28
6:00:00 PM	1577698: 02B	276	239	-37	-13	2.3	37
6:00:00 PM	1577990: 05D	560	582	22	4	0.9	22
6:00:00 PM	1578531: 09D	326	315	-11	-3	0.6	11
6:00:00 PM	1578518: 08B	211	195	-16	-8	1.1	16
6:00:00 PM	1577748: 03A	397	404	7	2	0.3	7
6:00:00 PM	1577775: 04D	378	353	-25	-7	1.3	25
6:00:00 PM	1579272: 10C	787	793	6	1	0.2	6
6:00:00 PM	1577694: 02C	240	223	-17	-7	1.1	17
6:00:00 PM	1160391: 09B	179	168	-11	-6	0.8	11
6:00:00 PM	1578820: 12D	421	400	-21	-5	1.0	21
6:00:00 PM	1578230: 07C	1122	1088	-34	-3	1.0	34
6:00:00 PM	1579584: 01B	3174	2895	-279	-9	5.1	279
6:00:00 PM	1578442: 07D	699	708	9	1	0.3	9
6:00:00 PM	1579315: 07A	1276	1304	28	2	0.8	28
6:00:00 PM	1578081: 06A	174	172	-2	-1	0.2	2
6:00:00 PM	860254: 03B	330	371	41	12	2.2	41
6:00:00 PM	1577965: 05B	457	498	41	9	1.9	41
6:00:00 PM	1579222: 15B	2680	2690	10	0	0.2	10
6:00:00 PM	1577845: 04C	266	261	-5	-2	0.3	5
6:00:00 PM	1578103: 06D	289	301	12	4	0.7	12
6:00:00 PM	1579257: 10B	458	458	0	0	0.0	0
6:00:00 PM	860308: 03D	331	347	16	5	0.9	16
6:00:00 PM	1579578: 12C	631	668	37	6	1.5	37
6:00:00 PM	1579249: 10A	1069	1097	28	3	0.9	28
6:00:00 PM	1578836: 12B	240	269	29	12	1.8	29
6:00:00 PM	1577815: 04B	239	252	13	5	0.8	13
6:00:00 PM	1577946: 05A	150	156	6	4	0.5	6
6:00:00 PM	1578849: 13A	568	618	50	9	2.1	50
6:00:00 PM	1578712: 12A	789	765	-24	-3	0.9	24
6:00:00 PM	1579032: 14C	329	331	2	1	0.1	2
6:00:00 PM	1578603: 09C	196	172	-24	-12	1.8	24
6:00:00 PM	1577766: 04A	168	195	27	16	2.0	27
6:00:00 PM	1578241: 07B	1128	1096	-32	-3	1.0	32
6:00:00 PM	1579083: 14B	547	593	46	8	1.9	46
6:00:00 PM	1578861: 13B	861	867	6	1	0.2	6
6:00:00 PM	1577758: 03C	458	382	-76	-17	3.7	76

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
6:00:00 PM	1577969: 05C	174	149	-25	-14	2.0	25
6:00:00 PM	1579305: 10D	695	692	-3	0	0.1	3
6:00:00 PM	1579219: 15A	2185	2343	158	7	3.3	158
6:00:00 PM	1578635: 11A	119	92	-27	-23	2.6	27
6:00:00 PM	1578513: 08A	281	281	0	0	0.0	0
7:00:00 PM	1579581: 01A	1768	1773	5	0	0.1	5
7:00:00 PM	1578113: 06C	49	55	6	12	0.8	6
7:00:00 PM	1578647: 11B	191	187	-4	-2	0.3	4
7:00:00 PM	1578086: 06B	122	112	-10	-8	0.9	10
7:00:00 PM	1578541: 09A	315	310	-5	-2	0.3	5
7:00:00 PM	1577698: 02B	171	151	-20	-12	1.6	20
7:00:00 PM	1577990: 05D	186	180	-6	-3	0.4	6
7:00:00 PM	1578531: 09D	247	267	20	8	1.2	20
7:00:00 PM	1578518: 08B	129	132	3	2	0.3	3
7:00:00 PM	1577748: 03A	317	299	-18	-6	1.0	18
7:00:00 PM	1577775: 04D	128	126	-2	-2	0.2	2
7:00:00 PM	1579272: 10C	502	458	-44	-9	2.0	44
7:00:00 PM	1577694: 02C	273	294	21	8	1.2	21
7:00:00 PM	1160391: 09B	99	106	7	7	0.7	7
7:00:00 PM	1578820: 12D	258	264	6	2	0.4	6
7:00:00 PM	1578230: 07C	694	714	20	3	0.8	20
7:00:00 PM	1579584: 01B	1887	1752	-135	-7	3.2	135
7:00:00 PM	1578442: 07D	702	734	32	5	1.2	32
7:00:00 PM	1579315: 07A	775	759	-16	-2	0.6	16
7:00:00 PM	1578081: 06A	148	157	9	6	0.7	9
7:00:00 PM	860254: 03B	175	192	17	10	1.3	17
7:00:00 PM	1577965: 05B	199	181	-18	-9	1.3	18
7:00:00 PM	1579222: 15B	1619	1629	10	1	0.2	10
7:00:00 PM	1577845: 04C	252	259	7	3	0.4	7
7:00:00 PM	1578103: 06D	206	197	-9	-4	0.6	9
7:00:00 PM	1579257: 10B	294	281	-13	-4	0.8	13
7:00:00 PM	860308: 03D	244	238	-6	-2	0.4	6
7:00:00 PM	1579578: 12C	362	362	0	0	0.0	0
7:00:00 PM	1579249: 10A	627	609	-18	-3	0.7	18
7:00:00 PM	1578836: 12B	171	170	-1	-1	0.1	1
7:00:00 PM	1577815: 04B	151	148	-3	-2	0.2	3
7:00:00 PM	1577946: 05A	142	136	-6	-4	0.5	6
7:00:00 PM	1578849: 13A	348	355	7	2	0.4	7

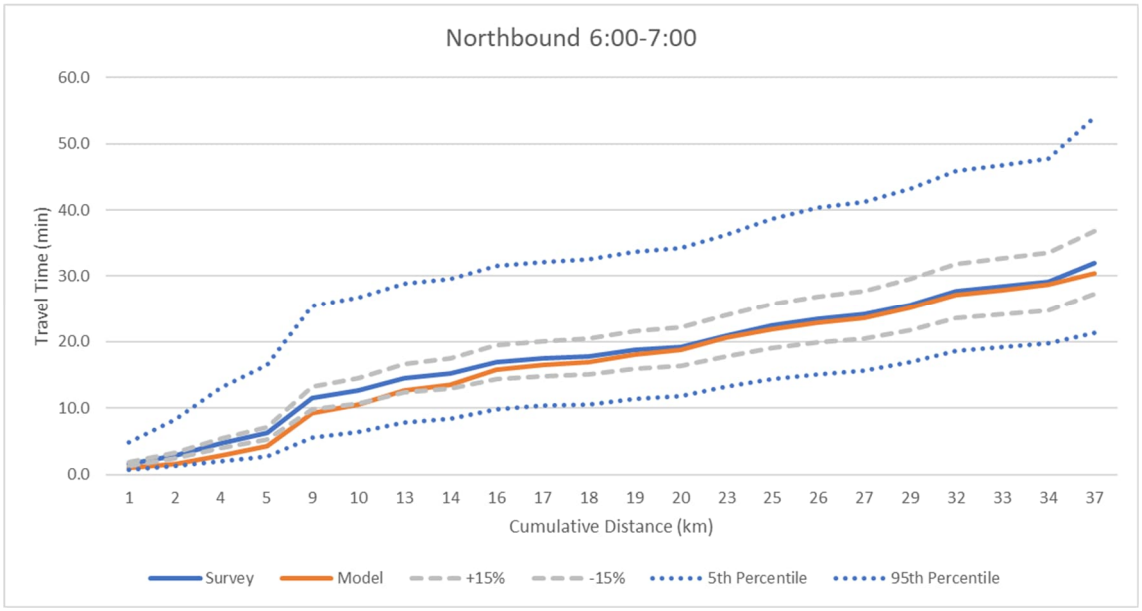
DETAILED TURN SUMMARY

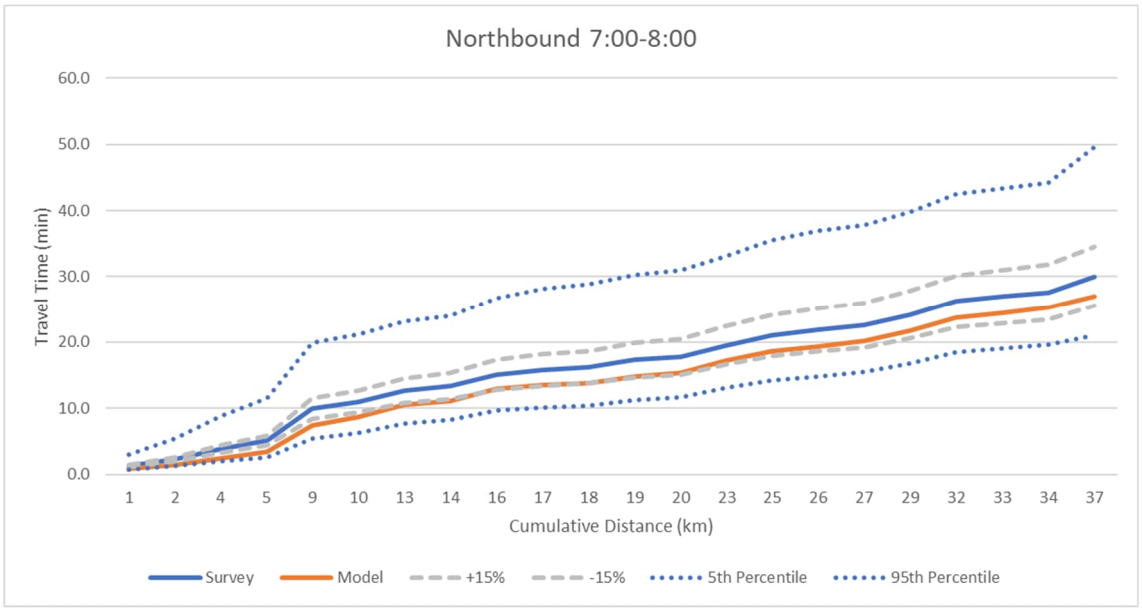
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
7:00:00 PM	1578712: 12A	427	416	-11	-3	0.5	11
7:00:00 PM	1579032: 14C	264	271	7	3	0.4	7
7:00:00 PM	1578603: 09C	106	115	9	8	0.9	9
7:00:00 PM	1577766: 04A	108	119	11	10	1.0	11
7:00:00 PM	1578241: 07B	615	599	-16	-3	0.6	16
7:00:00 PM	1579083: 14B	331	342	11	3	0.6	11
7:00:00 PM	1578861: 13B	469	483	14	3	0.6	14
7:00:00 PM	1577758: 03C	335	358	23	7	1.2	23
7:00:00 PM	1577969: 05C	151	179	28	19	2.2	28
7:00:00 PM	1579305: 10D	427	443	16	4	0.8	16
7:00:00 PM	1579219: 15A	1358	1321	-37	-3	1.0	37
7:00:00 PM	1578635: 11A	91	84	-7	-8	0.7	7
7:00:00 PM	1578513: 08A	142	137	-5	-4	0.4	5
8:00:00 PM	1579581: 01A	1204	1214	10	1	0.3	10
8:00:00 PM	1578113: 06C	27	29	2	7	0.4	2
8:00:00 PM	1578647: 11B	78	93	15	19	1.6	15
8:00:00 PM	1578086: 06B	59	71	12	20	1.5	12
8:00:00 PM	1578541: 09A	180	155	-25	-14	1.9	25
8:00:00 PM	1577698: 02B	111	102	-9	-8	0.9	9
8:00:00 PM	1577990: 05D	119	116	-3	-3	0.3	3
8:00:00 PM	1578531: 09D	194	186	-8	-4	0.6	8
8:00:00 PM	1578518: 08B	88	78	-10	-11	1.1	10
8:00:00 PM	1577748: 03A	191	184	-7	-4	0.5	7
8:00:00 PM	1577775: 04D	64	55	-9	-14	1.2	9
8:00:00 PM	1579272: 10C	265	284	19	7	1.1	19
8:00:00 PM	1577694: 02C	125	119	-6	-5	0.5	6
8:00:00 PM	1160391: 09B	68	65	-3	-4	0.4	3
8:00:00 PM	1578820: 12D	178	203	25	14	1.8	25
8:00:00 PM	1578230: 07C	397	404	7	2	0.3	7
8:00:00 PM	1579584: 01B	1185	1182	-3	0	0.1	3
8:00:00 PM	1578442: 07D	423	382	-41	-10	2.0	41
8:00:00 PM	1579315: 07A	438	446	8	2	0.4	8
8:00:00 PM	1578081: 06A	108	121	13	12	1.2	13
8:00:00 PM	860254: 03B	128	105	-23	-18	2.1	23
8:00:00 PM	1577965: 05B	110	99	-11	-10	1.1	11
8:00:00 PM	1579222: 15B	917	950	33	4	1.1	33
8:00:00 PM	1577845: 04C	116	113	-3	-3	0.3	3
8:00:00 PM	1578103: 06D	154	167	13	8	1.0	13

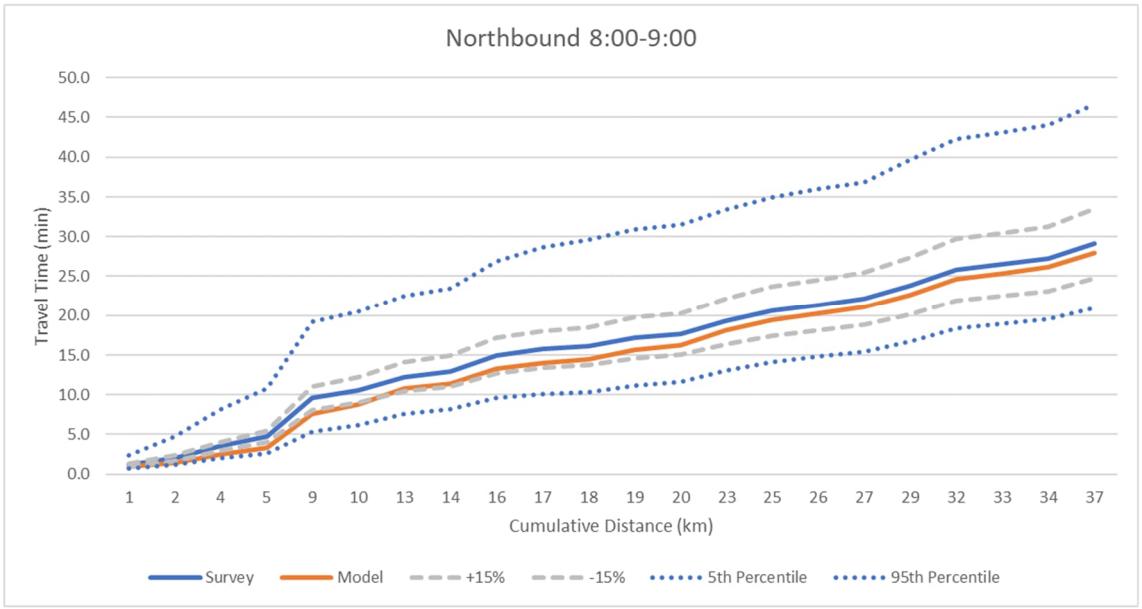
DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - BACData	Count – Median Seed (86524)	Absolute Difference	Relative Difference (%)	GEH	ABS
8:00:00 PM	1579257: 10B	188	173	-15	-8	1.1	15
8:00:00 PM	860308: 03D	147	145	-2	-1	0.2	2
8:00:00 PM	1579578: 12C	157	161	4	3	0.3	4
8:00:00 PM	1579249: 10A	376	344	-32	-9	1.7	32
8:00:00 PM	1578836: 12B	93	83	-10	-11	1.1	10
8:00:00 PM	1577815: 04B	84	73	-11	-13	1.2	11
8:00:00 PM	1577946: 05A	76	78	2	3	0.2	2
8:00:00 PM	1578849: 13A	223	194	-29	-13	2.0	29
8:00:00 PM	1578712: 12A	220	238	18	8	1.2	18
8:00:00 PM	1579032: 14C	209	206	-3	-1	0.2	3
8:00:00 PM	1578603: 09C	67	76	9	13	1.1	9
8:00:00 PM	1577766: 04A	85	92	7	8	0.7	7
8:00:00 PM	1578241: 07B	375	385	10	3	0.5	10
8:00:00 PM	1579083: 14B	181	198	17	9	1.2	17
8:00:00 PM	1578861: 13B	245	238	-7	-3	0.5	7
8:00:00 PM	1577758: 03C	213	200	-13	-6	0.9	13
8:00:00 PM	1577969: 05C	100	94	-6	-6	0.6	6
8:00:00 PM	1579305: 10D	325	327	2	1	0.1	2
8:00:00 PM	1579219: 15A	843	904	61	7	2.1	61
8:00:00 PM	1578635: 11A	59	53	-6	-10	0.8	6
8:00:00 PM	1578513: 08A	79	88	9	11	1.0	9

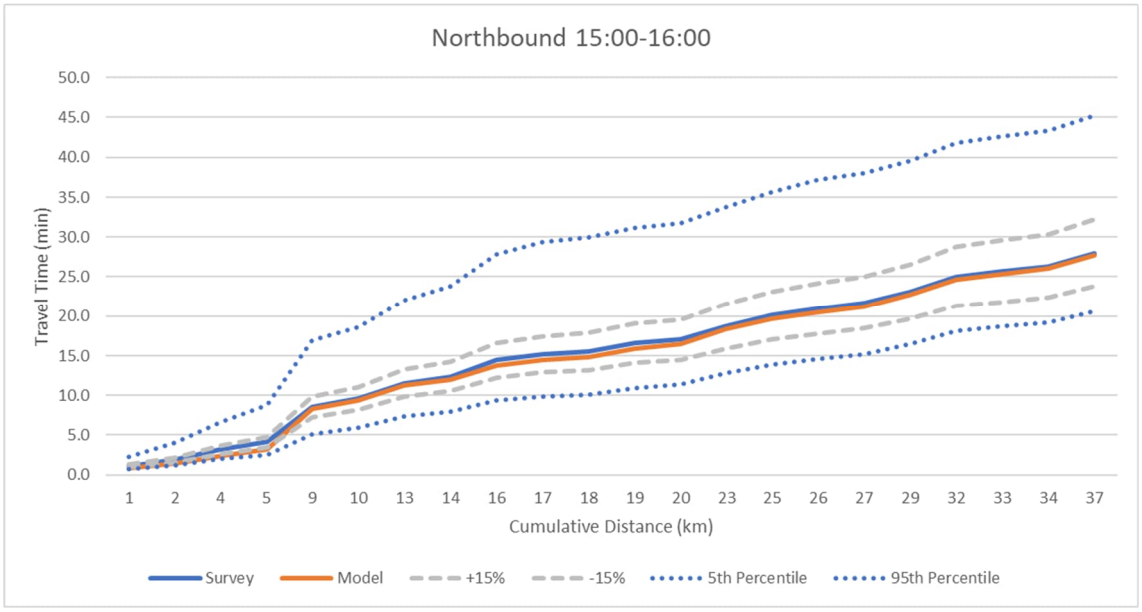
Appendix B – Detailed Model Route Travel Time Summaries (M7 Subarea)

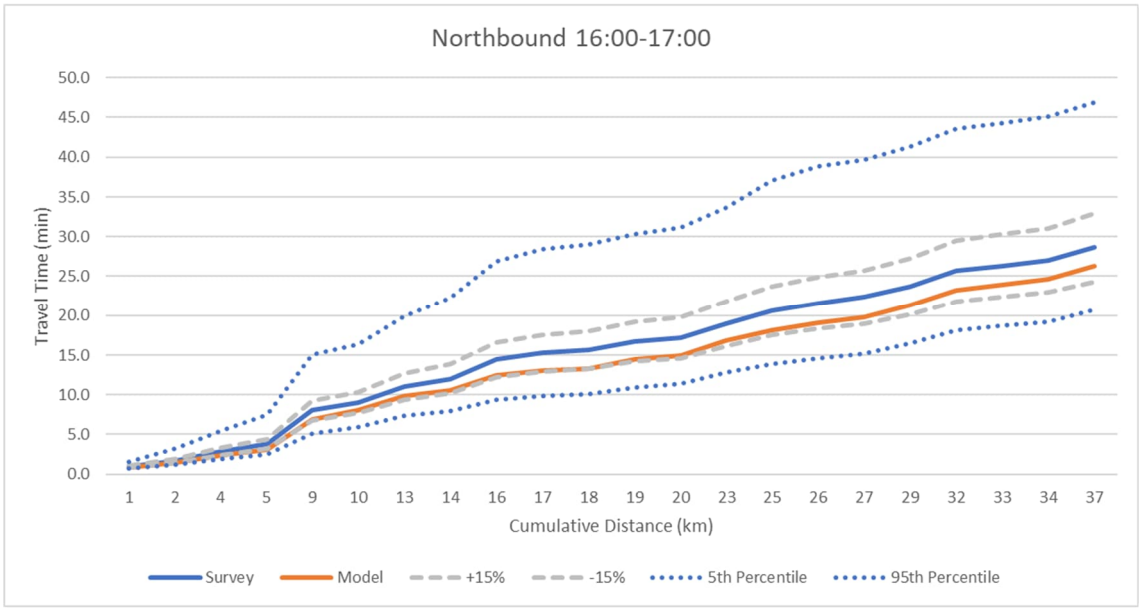
RESULTS OF MEDIAN SEED REPLICATION (86524), WHOLE TOMTOM MONTH (FEBRUARY 2021 WORKDAYS)

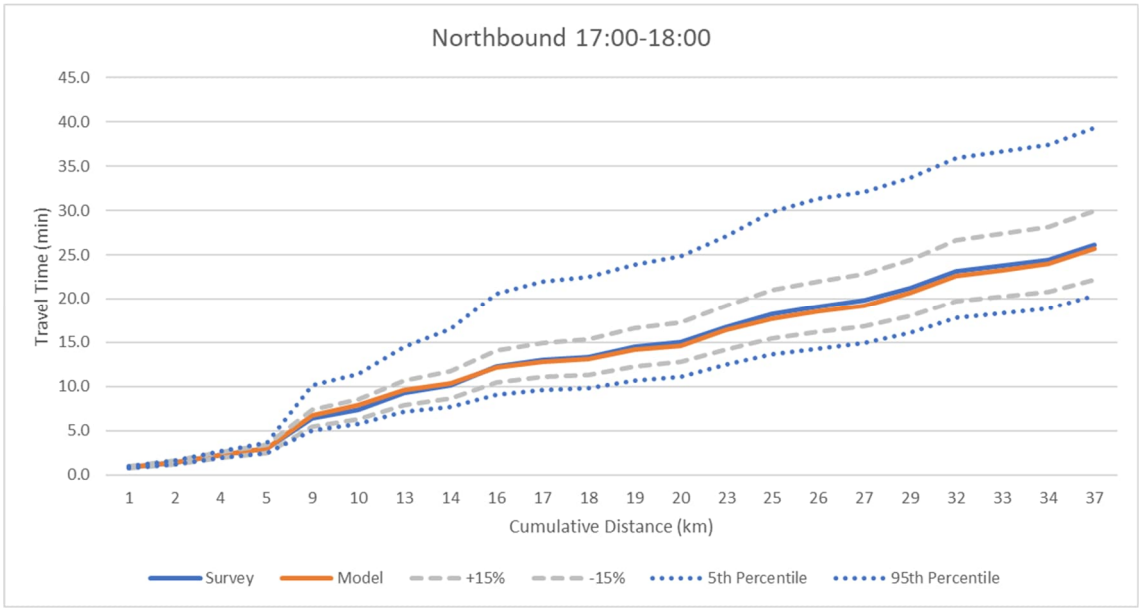


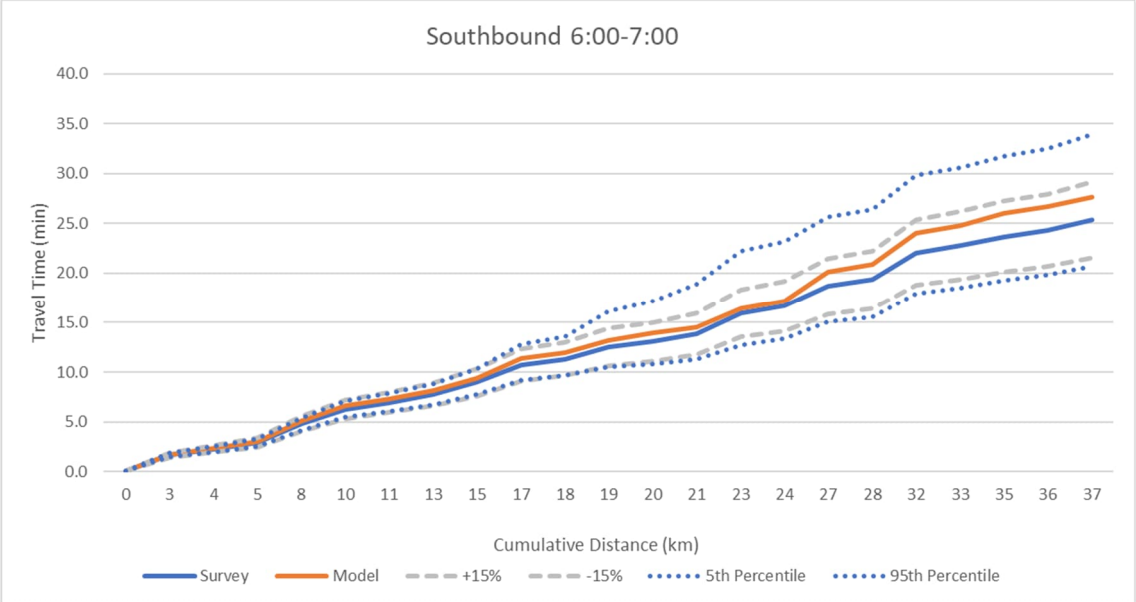


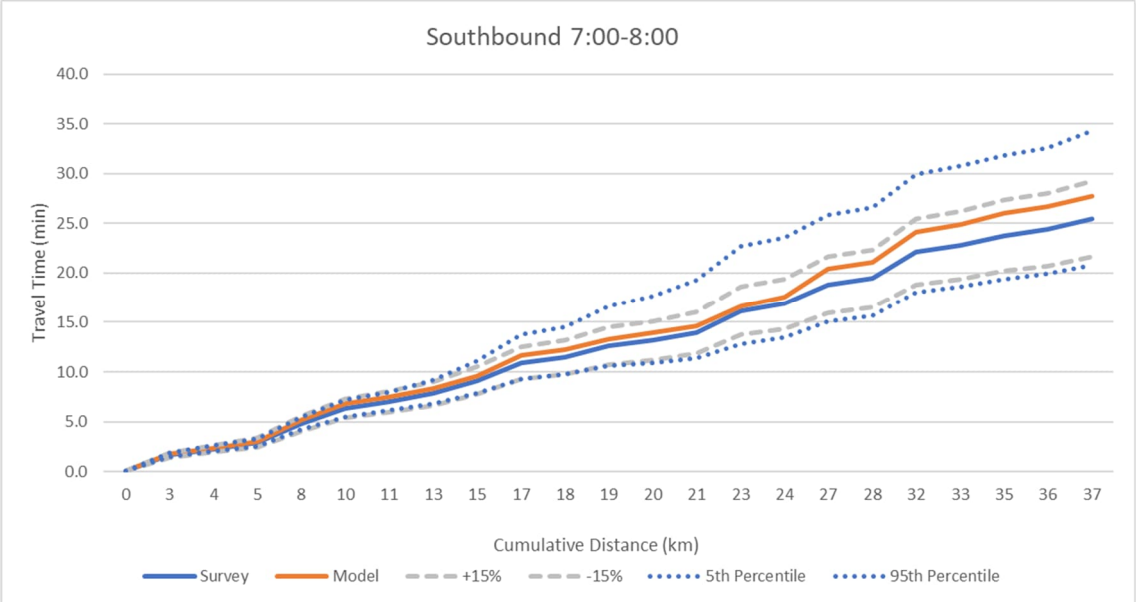

Northbound 8:00-9:00
Travel Time (min)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1 2 4 5 9 10 13 14 16 17 18 19 20 23 25 26 27 29 32 33 34 37
Cumulative Distance (km)
Survey
Model
+15%
-15%
5th Percentile
95th Percentile

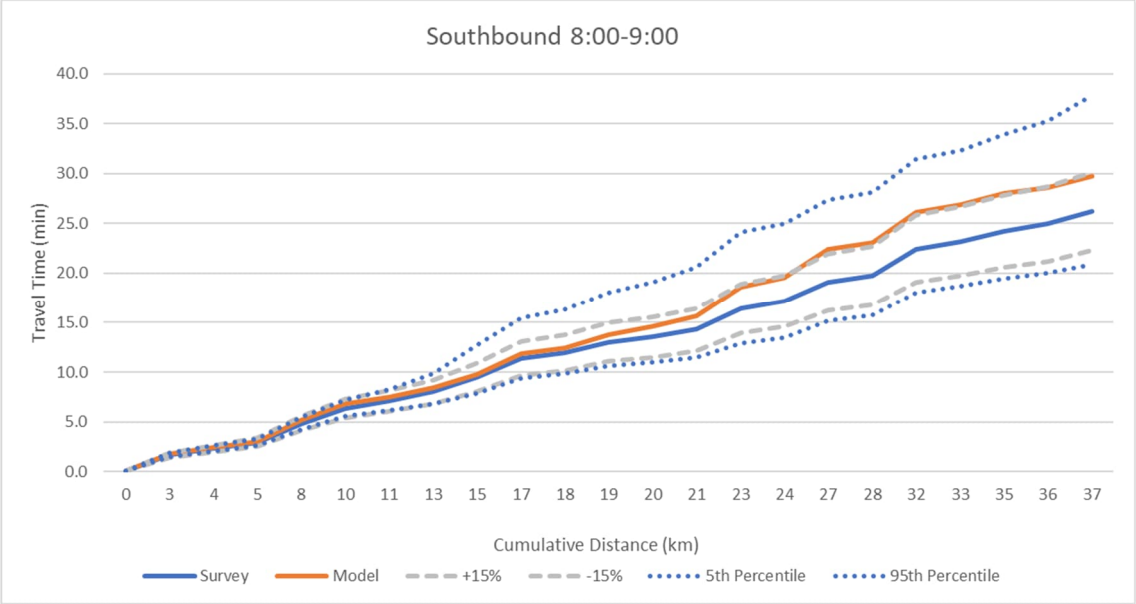

Northbound 15:00-16:00
Travel Time (min)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1 2 4 5 9 10 13 14 16 17 18 19 20 23 25 26 27 29 32 33 34 37
Cumulative Distance (km)
Survey
Model
+15%
-15%
5th Percentile
95th Percentile

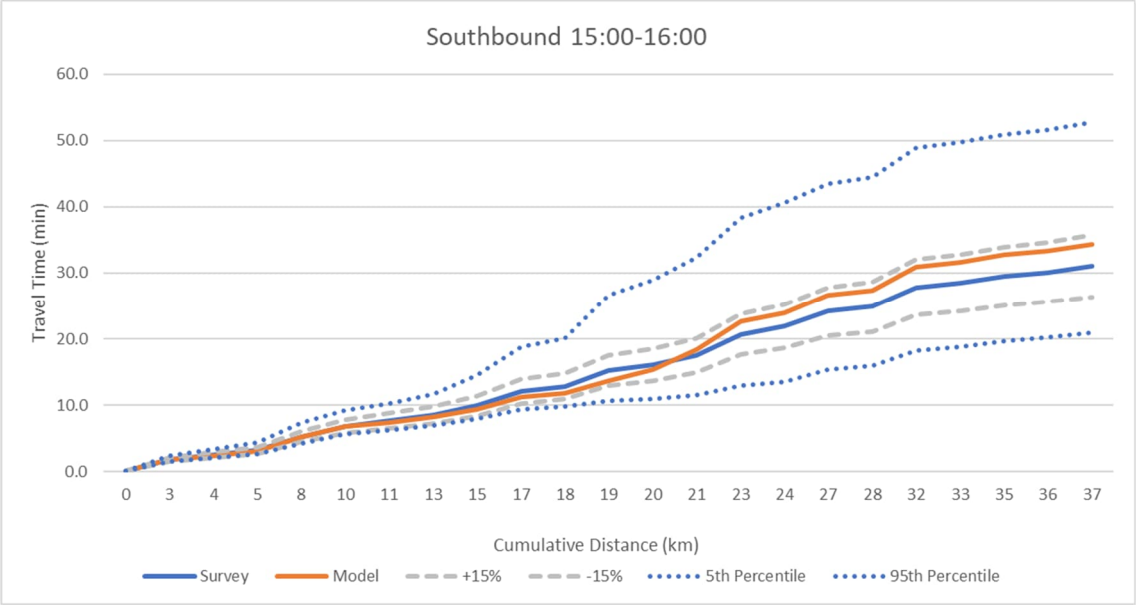

Northbound 16:00-17:00
Travel Time (min)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1 2 4 5 9 10 13 14 16 17 18 19 20 23 25 26 27 29 32 33 34 37
Cumulative Distance (km)
Survey
Model
+15%
-15%
5th Percentile
95th Percentile

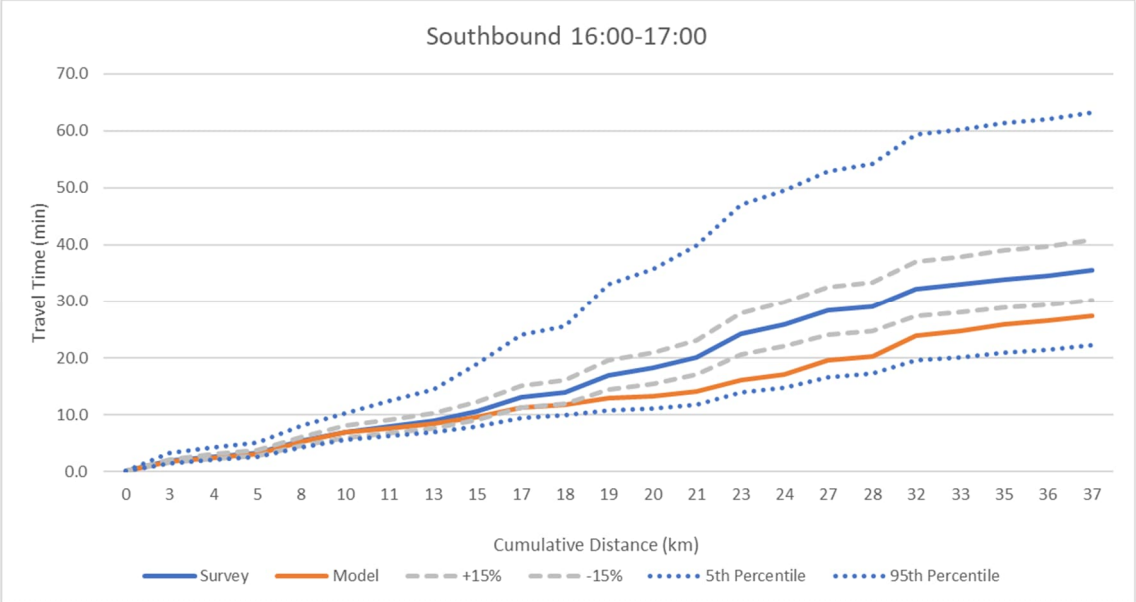

Northbound 17:00-18:00
Travel Time (min)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1 2 4 5 9 10 13 14 16 17 18 19 20 23 25 26 27 29 32 33 34 37
Cumulative Distance (km)
Survey
Model
+15%
-15%
5th Percentile
95th Percentile

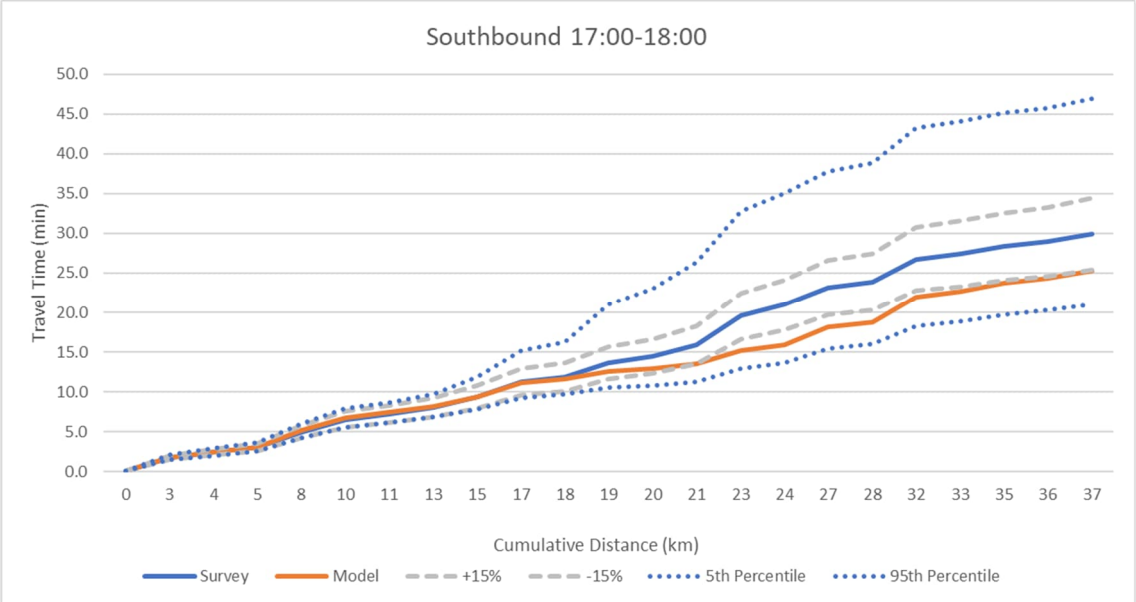

Southbound 6:00-7:00
Travel Time (min)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0 3 4 5 8 10 11 13 15 17 18 19 20 21 23 24 27 28 32 33 35 36 37
Cumulative Distance (km)
Survey
Model
+15%
-15%
5th Percentile
95th Percentile


Southbound 7:00-8:00
Travel Time (min)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0 3 4 5 8 10 11 13 15 17 18 19 20 21 23 24 27 28 32 33 35 36 37
Cumulative Distance (km)
Survey
Model
+15%
-15%
5th Percentile
95th Percentile


Southbound 8:00-9:00
Travel Time (min)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0 3 4 5 8 10 11 13 15 17 18 19 20 21 23 24 27 28 32 33 35 36 37
Cumulative Distance (km)
Survey
Model
+15%
-15%
5th Percentile
95th Percentile


Southbound 15:00-16:00
Travel Time (min)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0 3 4 5 8 10 11 13 15 17 18 19 20 21 23 24 27 28 32 33 35 36 37
Cumulative Distance (km)
Survey
Model
+15%
-15%
5th Percentile
95th Percentile


Southbound 16:00-17:00
Travel Time (min)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0 3 4 5 8 10 11 13 15 17 18 19 20 21 23 24 27 28 32 33 35 36 37
Cumulative Distance (km)
Survey
Model
+15%
-15%
5th Percentile
95th Percentile


Southbound 17:00-18:00
Travel Time (min)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0 3 4 5 8 10 11 13 15 17 18 19 20 21 23 24 27 28 32 33 35 36 37
Cumulative Distance (km)
Survey
Model
+15%
-15%
5th Percentile
95th Percentile

Appendix C – Detailed Turn Count Calibration Summaries (Cutler Interchange)

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - Cutler Interchange: Loops, SCATS and Gantry Data	Count - Median Seed (560)	Absolute Difference	Relative Difference (%)	GEH	ABS
5:00:00 AM	1580744: Mainline EB pre M7 on-ramp	1534	1606	72	5	1.8	72
5:00:00 AM	1580750: M7 WB on-ramp	318	450	132	42	6.7	132
5:00:00 AM	1580812: Camden Valley SB off-ramp	26	35	9	35	1.6	9
5:00:00 AM	1580749: Mainline WB pre M7 on-Ramp	355	395	40	11	2.1	40
5:00:00 AM	1580745: M7 EB on-ramp	222	250	28	13	1.8	28
5:00:00 AM	1580748: Mainline EB post M7 off-Ramp	1155	1155	0	0	0.0	0
5:00:00 AM	1580811: Camden Valley NB on-ramp	610	553	-57	-9	2.4	57
5:00:00 AM	1580747: M7 EB off-Ramp	568	608	40	7	1.6	40
5:00:00 AM	1580751: CI-LOOP02S	458	485	27	6	1.2	27
5:00:00 AM	1580754: CI-LOOP03S	400	487	87	22	4.1	87
5:00:00 AM	1580762: CI-LOOP03M	261	289	28	11	1.7	28
5:00:00 AM	1580809: Campbelltown SB on-ramp	195	160	-35	-18	2.6	35
5:00:00 AM	1580810: Camden Valley NB off-ramp	551	542	-9	-2	0.4	9
5:00:00 AM	1580743: M7 Beach Rd WE off-ramp	324	359	35	11	1.9	35
5:00:00 AM	1580746: Camden Valley Way EB on-ramp	391	465	74	19	3.6	74
5:00:00 AM	1580760: CI-01A	988	972	-16	-2	0.5	16
5:00:00 AM	1580752: CI-LOOP01N	703	605	-98	-14	3.8	98
5:00:00 AM	1580761: CI-01B	698	746	48	7	1.8	48
6:00:00 AM	1580744: Mainline EB pre M7 on-ramp	4105	4198	93	2	1.4	93
6:00:00 AM	1580750: M7 WB on-ramp	867	879	12	1	0.4	12
6:00:00 AM	1580812: Camden Valley SB off-ramp	89	103	14	16	1.5	14
6:00:00 AM	1580749: Mainline WB pre M7 on-Ramp	1045	1081	36	3	1.1	36
6:00:00 AM	1580745: M7 EB on-ramp	722	860	138	19	4.9	138
6:00:00 AM	1580748: Mainline EB post M7 off-Ramp	3095	3088	-7	0	0.1	7
6:00:00 AM	1580811: Camden Valley NB on-ramp	1245	1296	51	4	1.4	51
6:00:00 AM	1580747: M7 EB off-Ramp	1656	1794	138	8	3.3	138
6:00:00 AM	1580751: CI-LOOP02S	1217	981	-236	-19	7.1	236
6:00:00 AM	1580754: CI-LOOP03S	1168	984	-184	-16	5.6	184
6:00:00 AM	1580762: CI-LOOP03M	870	892	22	3	0.7	22
6:00:00 AM	1580809: Campbelltown SB on-ramp	478	526	48	10	2.2	48
6:00:00 AM	1580810: Camden Valley NB off-ramp	1013	1075	62	6	1.9	62
6:00:00 AM	1580743: M7 Beach Rd WE off-ramp	1027	1196	169	17	5.1	169
6:00:00 AM	1580746: Camden Valley Way EB on-ramp	1016	1133	117	12	3.6	117
6:00:00 AM	1580760: CI-01A	2890	2737	-153	-5	2.9	153

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - Cutler Interchange: Loops, SCATS and Gantry Data	Count - Median Seed (560)	Absolute Difference	Relative Difference (%)	GEH	ABS
6:00:00 AM	1580752: CI-LOOP01N	1919	1789	-130	-7	3.0	130
6:00:00 AM	1580761: CI-01B	2106	1855	-251	-12	5.6	251
7:00:00 AM	1580744: Mainline EB pre M7 on-ramp	4719	4882	163	3	2.4	163
7:00:00 AM	1580750: M7 WB on-ramp	1551	1575	24	2	0.6	24
7:00:00 AM	1580812: Camden Valley SB off-ramp	200	219	19	9	1.3	19
7:00:00 AM	1580749: Mainline WB pre M7 on-Ramp	2147	2192	45	2	1.0	45
7:00:00 AM	1580745: M7 EB on-ramp	1290	1288	-2	0	0.1	2
7:00:00 AM	1580748: Mainline EB post M7 off-Ramp	3459	3553	94	3	1.6	94
7:00:00 AM	1580811: Camden Valley NB on-ramp	1347	1439	92	7	2.5	92
7:00:00 AM	1580747: M7 EB off-Ramp	1705	1740	35	2	0.8	35
7:00:00 AM	1580751: CI-LOOP02S	1641	1803	162	10	3.9	162
7:00:00 AM	1580754: CI-LOOP03S	1705	1812	107	6	2.6	107
7:00:00 AM	1580762: CI-LOOP03M	1052	976	-76	-7	2.4	76
7:00:00 AM	1580809: Campbelltown SB on-ramp	830	912	82	10	2.8	82
7:00:00 AM	1580810: Camden Valley NB off-ramp	1422	1509	87	6	2.3	87
7:00:00 AM	1580743: M7 Beach Rd WE off-ramp	1891	1812	-79	-4	1.8	79
7:00:00 AM	1580746: Camden Valley Way EB on-ramp	1330	1357	27	2	0.7	27
7:00:00 AM	1580760: CI-01A	2710	2880	170	6	3.2	170
7:00:00 AM	1580752: CI-LOOP01N	1578	1746	168	11	4.1	168
7:00:00 AM	1580761: CI-01B	2966	3114	148	5	2.7	148
8:00:00 AM	1580744: Mainline EB pre M7 on-ramp	4719	4882	163	3	2.4	163
8:00:00 AM	1580750: M7 WB on-ramp	1551	1575	24	2	0.6	24
8:00:00 AM	1580812: Camden Valley SB off-ramp	200	219	19	9	1.3	19
8:00:00 AM	1580749: Mainline WB pre M7 on-Ramp	2147	2192	45	2	1.0	45
8:00:00 AM	1580745: M7 EB on-ramp	1290	1288	-2	0	0.1	2
8:00:00 AM	1580748: Mainline EB post M7 off-Ramp	3459	3553	94	3	1.6	94
8:00:00 AM	1580811: Camden Valley NB on-ramp	1347	1439	92	7	2.5	92
8:00:00 AM	1580747: M7 EB off-Ramp	1705	1740	35	2	0.8	35
8:00:00 AM	1580751: CI-LOOP02S	1641	1803	162	10	3.9	162
8:00:00 AM	1580754: CI-LOOP03S	1705	1812	107	6	2.6	107
8:00:00 AM	1580762: CI-LOOP03M	1052	976	-76	-7	2.4	76
8:00:00 AM	1580809: Campbelltown SB on-ramp	830	912	82	10	2.8	82
8:00:00 AM	1580810: Camden Valley NB off-ramp	1422	1509	87	6	2.3	87
8:00:00 AM	1580743: M7 Beach Rd WE off-ramp	1891	1812	-79	-4	1.8	79
8:00:00 AM	1580746: Camden Valley Way EB on-ramp	1330	1357	27	2	0.7	27
8:00:00 AM	1580760: CI-01A	2710	2880	170	6	3.2	170
8:00:00 AM	1580752: CI-LOOP01N	1578	1746	168	11	4.1	168

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - Cutler Interchange: Loops, SCATS and Gantry Data	Count - Median Seed (560)	Absolute Difference	Relative Difference (%)	GEH	ABS
8:00:00 AM	1580761: CI-01B	2966	3114	148	5	2.7	148
9:00:00 AM	1580744: Mainline EB pre M7 on-ramp	4292	4332	40	1	0.6	40
9:00:00 AM	1580750: M7 WB on-ramp	1681	1683	2	0	0.0	2
9:00:00 AM	1580812: Camden Valley SB off-ramp	181	186	5	3	0.3	5
9:00:00 AM	1580749: Mainline WB pre M7 on-Ramp	2516	2462	-54	-2	1.1	54
9:00:00 AM	1580745: M7 EB on-ramp	1326	1392	66	5	1.8	66
9:00:00 AM	1580748: Mainline EB post M7 off-Ramp	2921	3073	152	5	2.8	152
9:00:00 AM	1580811: Camden Valley NB on-ramp	1290	1328	38	3	1.0	38
9:00:00 AM	1580747: M7 EB off-Ramp	1522	1590	68	4	1.7	68
9:00:00 AM	1580751: CI-LOOP02S	1754	1863	109	6	2.6	109
9:00:00 AM	1580754: CI-LOOP03S	1906	1859	-47	-2	1.1	47
9:00:00 AM	1580762: CI-LOOP03M	1218	1201	-17	-1	0.5	17
9:00:00 AM	1580809: Campbelltown SB on-ramp	982	1089	107	11	3.3	107
9:00:00 AM	1580810: Camden Valley NB off-ramp	1100	1069	-31	-3	0.9	31
9:00:00 AM	1580743: M7 Beach Rd WE off-ramp	1884	1970	86	5	2.0	86
9:00:00 AM	1580746: Camden Valley Way EB on-ramp	1297	1239	-58	-4	1.6	58
9:00:00 AM	1580760: CI-01A	2721	2944	223	8	4.2	223
9:00:00 AM	1580752: CI-LOOP01N	1389	1596	207	15	5.4	207
9:00:00 AM	1580761: CI-01B	3167	3211	44	1	0.8	44
10:00:00 AM	1580744: Mainline EB pre M7 on-ramp	3387	3423	36	1	0.6	36
10:00:00 AM	1580750: M7 WB on-ramp	1488	1404	-84	-6	2.2	84
10:00:00 AM	1580812: Camden Valley SB off-ramp	145	203	58	40	4.4	58
10:00:00 AM	1580749: Mainline WB pre M7 on-Ramp	1917	1880	-37	-2	0.8	37
10:00:00 AM	1580745: M7 EB on-ramp	1225	1248	23	2	0.7	23
10:00:00 AM	1580748: Mainline EB post M7 off-Ramp	2480	2470	-10	0	0.2	10
10:00:00 AM	1580811: Camden Valley NB on-ramp	896	1023	127	14	4.1	127
10:00:00 AM	1580747: M7 EB off-Ramp	1314	1358	44	3	1.2	44
10:00:00 AM	1580751: CI-LOOP02S	1642	1609	-33	-2	0.8	33
10:00:00 AM	1580754: CI-LOOP03S	1555	1606	51	3	1.3	51
10:00:00 AM	1580762: CI-LOOP03M	972	1072	100	10	3.1	100
10:00:00 AM	1580809: Campbelltown SB on-ramp	893	903	10	1	0.3	10
10:00:00 AM	1580810: Camden Valley NB off-ramp	868	860	-8	-1	0.3	8
10:00:00 AM	1580743: M7 Beach Rd WE off-ramp	1644	1754	110	7	2.7	110
10:00:00 AM	1580746: Camden Valley Way EB on-ramp	907	952	45	5	1.5	45
10:00:00 AM	1580760: CI-01A	2508	2517	9	0	0.2	9
10:00:00 AM	1580752: CI-LOOP01N	1299	1357	58	4	1.6	58
10:00:00 AM	1580761: CI-01B	2627	2825	198	8	3.8	198

DETAILED TURN SUMMARY

HOUR END	Object	Count - All - Cutler Interchange: Loops, SCATS and Gantry Data	Count - Median Seed (560)	Absolute Difference	Relative Difference (%)	GEH	ABS
11:00:00 AM	1580744: Mainline EB pre M7 on-ramp	2650	2657	7	0	0.1	7
11:00:00 AM	1580750: M7 WB on-ramp	1373	1355	-18	-1	0.5	18
11:00:00 AM	1580812: Camden Valley SB off-ramp	149	161	12	8	0.9	12
11:00:00 AM	1580749: Mainline WB pre M7 on-Ramp	1717	1632	-85	-5	2.1	85
11:00:00 AM	1580745: M7 EB on-ramp	1014	1082	68	7	2.1	68
11:00:00 AM	1580748: Mainline EB post M7 off-Ramp	1966	1964	-2	0	0.0	2
11:00:00 AM	1580811: Camden Valley NB on-ramp	749	771	22	3	0.8	22
11:00:00 AM	1580747: M7 EB off-Ramp	1392	1385	-7	-1	0.2	7
11:00:00 AM	1580751: CI-LOOP02S	1458	1520	62	4	1.6	62
11:00:00 AM	1580754: CI-LOOP03S	1542	1529	-13	-1	0.3	13
11:00:00 AM	1580762: CI-LOOP03M	925	938	13	1	0.4	13
11:00:00 AM	1580809: Campbelltown SB on-ramp	792	764	-28	-4	1.0	28
11:00:00 AM	1580810: Camden Valley NB off-ramp	765	816	51	7	1.8	51
11:00:00 AM	1580743: M7 Beach Rd WE off-ramp	1501	1534	33	2	0.9	33
11:00:00 AM	1580746: Camden Valley Way EB on-ramp	682	690	8	1	0.3	8
11:00:00 AM	1580760: CI-01A	2477	2380	-97	-4	2.0	97
11:00:00 AM	1580752: CI-LOOP01N	1413	1384	-29	-2	0.8	29
11:00:00 AM	1580761: CI-01B	2549	2632	83	3	1.6	83
12:00:00 PM	1580744: Mainline EB pre M7 on-ramp	2518	2552	34	1	0.7	34
12:00:00 PM	1580750: M7 WB on-ramp	1427	1415	-12	-1	0.3	12
12:00:00 PM	1580812: Camden Valley SB off-ramp	136	145	9	6	0.7	9
12:00:00 PM	1580749: Mainline WB pre M7 on-Ramp	1680	1564	-116	-7	2.9	116
12:00:00 PM	1580745: M7 EB on-ramp	979	892	-87	-9	2.8	87
12:00:00 PM	1580748: Mainline EB post M7 off-Ramp	1874	1896	22	1	0.5	22
12:00:00 PM	1580811: Camden Valley NB on-ramp	655	709	54	8	2.1	54
12:00:00 PM	1580747: M7 EB off-Ramp	1425	1442	17	1	0.4	17
12:00:00 PM	1580751: CI-LOOP02S	1493	1564	71	5	1.8	71
12:00:00 PM	1580754: CI-LOOP03S	1577	1551	-26	-2	0.7	26
12:00:00 PM	1580762: CI-LOOP03M	999	947	-52	-5	1.7	52
12:00:00 PM	1580809: Campbelltown SB on-ramp	796	813	17	2	0.6	17
12:00:00 PM	1580810: Camden Valley NB off-ramp	724	816	92	13	3.3	92
12:00:00 PM	1580743: M7 Beach Rd WE off-ramp	1585	1572	-13	-1	0.3	13
12:00:00 PM	1580746: Camden Valley Way EB on-ramp	640	655	15	2	0.6	15
12:00:00 PM	1580760: CI-01A	2526	2455	-71	-3	1.4	71
12:00:00 PM	1580752: CI-LOOP01N	1402	1444	42	3	1.1	42
12:00:00 PM	1580761: CI-01B	2551	2423	-128	-5	2.6	128
1:00:00 PM	1580744: Mainline EB pre M7 on-ramp	2412	2446	34	1	0.7	34

DETAILED TURN SUMMARY

HOUR END	Object	Count - All - Cutler Interchange: Loops, SCATS and Gantry Data	Count - Median Seed (560)	Absolute Difference	Relative Difference (%)	GEH	ABS
1:00:00 PM	1580750: M7 WB on-ramp	1421	1408	-13	-1	0.3	13
1:00:00 PM	1580812: Camden Valley SB off-ramp	155	161	6	4	0.4	6
1:00:00 PM	1580749: Mainline WB pre M7 on-Ramp	1771	1650	-121	-7	2.9	121
1:00:00 PM	1580745: M7 EB on-ramp	1038	942	-96	-9	3.1	96
1:00:00 PM	1580748: Mainline EB post M7 off-Ramp	1848	1768	-80	-4	1.9	80
1:00:00 PM	1580811: Camden Valley NB on-ramp	745	738	-7	-1	0.3	7
1:00:00 PM	1580747: M7 EB off-Ramp	1425	1432	7	0	0.2	7
1:00:00 PM	1580751: CI-LOOP02S	1683	1564	-119	-7	2.9	119
1:00:00 PM	1580754: CI-LOOP03S	1548	1570	22	1	0.6	22
1:00:00 PM	1580762: CI-LOOP03M	987	1007	20	2	0.6	20
1:00:00 PM	1580809: Campbelltown SB on-ramp	818	857	39	5	1.4	39
1:00:00 PM	1580810: Camden Valley NB off-ramp	737	717	-20	-3	0.8	20
1:00:00 PM	1580743: M7 Beach Rd WE off-ramp	1651	1646	-5	0	0.1	5
1:00:00 PM	1580746: Camden Valley Way EB on-ramp	584	672	88	15	3.5	88
1:00:00 PM	1580760: CI-01A	2567	2508	-59	-2	1.2	59
1:00:00 PM	1580752: CI-LOOP01N	1447	1430	-17	-1	0.4	17
1:00:00 PM	1580761: CI-01B	2532	2501	-31	-1	0.6	31
2:00:00 PM	1580744: Mainline EB pre M7 on-ramp	2534	2627	93	4	1.8	93
2:00:00 PM	1580750: M7 WB on-ramp	1498	1576	78	5	2.0	78
2:00:00 PM	1580812: Camden Valley SB off-ramp	170	186	16	9	1.2	16
2:00:00 PM	1580749: Mainline WB pre M7 on-Ramp	1978	1904	-74	-4	1.7	74
2:00:00 PM	1580745: M7 EB on-ramp	1015	961	-54	-5	1.7	54
2:00:00 PM	1580748: Mainline EB post M7 off-Ramp	1906	1924	18	1	0.4	18
2:00:00 PM	1580811: Camden Valley NB on-ramp	756	782	26	3	0.9	26
2:00:00 PM	1580747: M7 EB off-Ramp	1555	1560	5	0	0.1	5
2:00:00 PM	1580751: CI-LOOP02S	1823	1762	-61	-3	1.4	61
2:00:00 PM	1580754: CI-LOOP03S	1700	1767	67	4	1.6	67
2:00:00 PM	1580762: CI-LOOP03M	1048	1109	61	6	1.9	61
2:00:00 PM	1580809: Campbelltown SB on-ramp	884	940	56	6	1.8	56
2:00:00 PM	1580810: Camden Valley NB off-ramp	882	930	48	5	1.6	48
2:00:00 PM	1580743: M7 Beach Rd WE off-ramp	1728	1778	50	3	1.2	50
2:00:00 PM	1580746: Camden Valley Way EB on-ramp	624	708	84	13	3.3	84
2:00:00 PM	1580760: CI-01A	2698	2738	40	1	0.8	40
2:00:00 PM	1580752: CI-LOOP01N	1510	1556	46	3	1.2	46
2:00:00 PM	1580761: CI-01B	2742	2738	-4	0	0.1	4
3:00:00 PM	1580744: Mainline EB pre M7 on-ramp	2833	2770	-63	-2	1.2	63
3:00:00 PM	1580750: M7 WB on-ramp	1779	1888	109	6	2.5	109

DETAILED TURN SUMMARY

HOUR END	Object	Count - All - Cutler Interchange: Loops, SCATS and Gantry Data	Count - Median Seed (560)	Absolute Difference	Relative Difference (%)	GEH	ABS
3:00:00 PM	1580812: Camden Valley SB off-ramp	189	190	1	0	0.1	1
3:00:00 PM	1580749: Mainline WB pre M7 on-Ramp	2787	2698	-89	-3	1.7	89
3:00:00 PM	1580745: M7 EB on-ramp	1199	1171	-28	-2	0.8	28
3:00:00 PM	1580748: Mainline EB post M7 off-Ramp	2154	2150	-4	0	0.1	4
3:00:00 PM	1580811: Camden Valley NB on-ramp	801	708	-93	-12	3.4	93
3:00:00 PM	1580747: M7 EB off-Ramp	1496	1604	108	7	2.7	108
3:00:00 PM	1580751: CI-LOOP02S	2103	2077	-26	-1	0.6	26
3:00:00 PM	1580754: CI-LOOP03S	2053	2084	31	2	0.7	31
3:00:00 PM	1580762: CI-LOOP03M	1207	1311	104	9	2.9	104
3:00:00 PM	1580809: Campbelltown SB on-ramp	1125	1104	-21	-2	0.6	21
3:00:00 PM	1580810: Camden Valley NB off-ramp	993	989	-4	0	0.1	4
3:00:00 PM	1580743: M7 Beach Rd WE off-ramp	2199	2144	-55	-3	1.2	55
3:00:00 PM	1580746: Camden Valley Way EB on-ramp	690	622	-68	-10	2.7	68
3:00:00 PM	1580760: CI-01A	2911	2942	31	1	0.6	31
3:00:00 PM	1580752: CI-LOOP01N	1564	1608	44	3	1.1	44
3:00:00 PM	1580761: CI-01B	3280	3257	-23	-1	0.4	23
4:00:00 PM	1580744: Mainline EB pre M7 on-ramp	3325	3515	190	6	3.2	190
4:00:00 PM	1580750: M7 WB on-ramp	1993	2086	93	5	2.1	93
4:00:00 PM	1580812: Camden Valley SB off-ramp	189	254	65	34	4.3	65
4:00:00 PM	1580749: Mainline WB pre M7 on-Ramp	3042	3043	1	0	0.0	1
4:00:00 PM	1580745: M7 EB on-ramp	1374	1376	2	0	0.1	2
4:00:00 PM	1580748: Mainline EB post M7 off-Ramp	2559	2656	97	4	1.9	97
4:00:00 PM	1580811: Camden Valley NB on-ramp	822	952	130	16	4.4	130
4:00:00 PM	1580747: M7 EB off-Ramp	1618	1667	49	3	1.2	49
4:00:00 PM	1580751: CI-LOOP02S	2354	2338	-16	-1	0.3	16
4:00:00 PM	1580754: CI-LOOP03S	2266	2333	67	3	1.4	67
4:00:00 PM	1580762: CI-LOOP03M	1301	1446	145	11	3.9	145
4:00:00 PM	1580809: Campbelltown SB on-ramp	1201	1274	73	6	2.1	73
4:00:00 PM	1580810: Camden Valley NB off-ramp	1083	1003	-80	-7	2.5	80
4:00:00 PM	1580743: M7 Beach Rd WE off-ramp	2357	2425	68	3	1.4	68
4:00:00 PM	1580746: Camden Valley Way EB on-ramp	779	866	87	11	3.0	87
4:00:00 PM	1580760: CI-01A	3056	3247	191	6	3.4	191
4:00:00 PM	1580752: CI-LOOP01N	1572	1670	98	6	2.4	98
4:00:00 PM	1580761: CI-01B	3713	3699	-14	0	0.2	14
5:00:00 PM	1580744: Mainline EB pre M7 on-ramp	3583	3828	245	7	4.0	245
5:00:00 PM	1580750: M7 WB on-ramp	2280	2182	-98	-4	2.1	98
5:00:00 PM	1580812: Camden Valley SB off-ramp	241	200	-41	-17	2.8	41

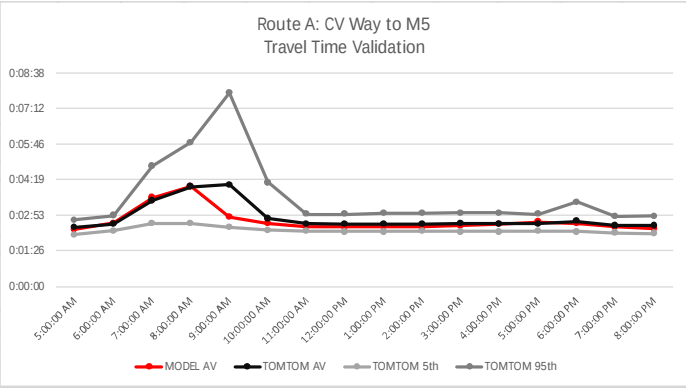
DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - Cutler Interchange: Loops, SCATS and Gantry Data	Count - Median Seed (560)	Absolute Difference	Relative Difference (%)	GEH	ABS
5:00:00 PM	1580749: Mainline WB pre M7 on-Ramp	3362	3268	-94	-3	1.6	94
5:00:00 PM	1580745: M7 EB on-ramp	1456	1516	60	4	1.6	60
5:00:00 PM	1580748: Mainline EB post M7 off-Ramp	2742	2884	142	5	2.7	142
5:00:00 PM	1580811: Camden Valley NB on-ramp	913	1035	122	13	3.9	122
5:00:00 PM	1580747: M7 EB off-Ramp	1522	1551	29	2	0.7	29
5:00:00 PM	1580751: CI-LOOP02S	2338	2383	45	2	0.9	45
5:00:00 PM	1580754: CI-LOOP03S	2494	2387	-107	-4	2.2	107
5:00:00 PM	1580762: CI-LOOP03M	1091	1235	144	13	4.2	144
5:00:00 PM	1580809: Campbelltown SB on-ramp	1346	1388	42	3	1.1	42
5:00:00 PM	1580810: Camden Valley NB off-ramp	1074	1062	-12	-1	0.4	12
5:00:00 PM	1580743: M7 Beach Rd WE off-ramp	2215	2173	-42	-2	0.9	42
5:00:00 PM	1580746: Camden Valley Way EB on-ramp	858	950	92	11	3.1	92
5:00:00 PM	1580760: CI-01A	2725	2863	138	5	2.6	138
5:00:00 PM	1580752: CI-LOOP01N	1497	1551	54	4	1.4	54
5:00:00 PM	1580761: CI-01B	3891	3903	12	0	0.2	12
6:00:00 PM	1580744: Mainline EB pre M7 on-ramp	3669	3876	207	6	3.4	207
6:00:00 PM	1580750: M7 WB on-ramp	2093	1949	-144	-7	3.2	144
6:00:00 PM	1580812: Camden Valley SB off-ramp	206	212	6	3	0.4	6
6:00:00 PM	1580749: Mainline WB pre M7 on-Ramp	3134	3200	66	2	1.2	66
6:00:00 PM	1580745: M7 EB on-ramp	1378	1313	-65	-5	1.8	65
6:00:00 PM	1580748: Mainline EB post M7 off-Ramp	2831	2943	112	4	2.1	112
6:00:00 PM	1580811: Camden Valley NB on-ramp	817	973	156	19	5.2	156
6:00:00 PM	1580747: M7 EB off-Ramp	1479	1473	-6	0	0.2	6
6:00:00 PM	1580751: CI-LOOP02S	2024	2166	142	7	3.1	142
6:00:00 PM	1580754: CI-LOOP03S	2174	2171	-3	0	0.1	3
6:00:00 PM	1580762: CI-LOOP03M	1089	1194	105	10	3.1	105
6:00:00 PM	1580809: Campbelltown SB on-ramp	1260	1305	45	4	1.3	45
6:00:00 PM	1580810: Camden Valley NB off-ramp	1014	1075	61	6	1.9	61
6:00:00 PM	1580743: M7 Beach Rd WE off-ramp	2324	2289	-35	-2	0.7	35
6:00:00 PM	1580746: Camden Valley Way EB on-ramp	857	930	73	9	2.4	73
6:00:00 PM	1580760: CI-01A	2657	2704	47	2	0.9	47
6:00:00 PM	1580752: CI-LOOP01N	1433	1469	36	3	0.9	36
6:00:00 PM	1580761: CI-01B	3551	3494	-57	-2	1.0	57
7:00:00 PM	1580744: Mainline EB pre M7 on-ramp	2572	2744	172	7	3.3	172
7:00:00 PM	1580750: M7 WB on-ramp	1401	1126	-275	-20	7.7	275
7:00:00 PM	1580812: Camden Valley SB off-ramp	140	132	-8	-6	0.7	8
7:00:00 PM	1580749: Mainline WB pre M7 on-Ramp	2501	2435	-66	-3	1.3	66

DETAILED TURN SUMMARY							
HOUR END	Object	Count - All - Cutler Interchange: Loops, SCATS and Gantry Data	Count - Median Seed (560)	Absolute Difference	Relative Difference (%)	GEH	ABS
7:00:00 PM	1580745: M7 EB on-ramp	1032	996	-36	-3	1.1	36
7:00:00 PM	1580748: Mainline EB post M7 off-Ramp	1937	1985	48	2	1.1	48
7:00:00 PM	1580811: Camden Valley NB on-ramp	702	787	85	12	3.1	85
7:00:00 PM	1580747: M7 EB off-Ramp	1024	955	-69	-7	2.2	69
7:00:00 PM	1580751: CI-LOOP02S	1151	1252	101	9	2.9	101
7:00:00 PM	1580754: CI-LOOP03S	1323	1234	-89	-7	2.5	89
7:00:00 PM	1580762: CI-LOOP03M	732	777	45	6	1.6	45
7:00:00 PM	1580809: Campbelltown SB on-ramp	1010	1028	18	2	0.6	18
7:00:00 PM	1580810: Camden Valley NB off-ramp	684	742	58	8	2.2	58
7:00:00 PM	1580743: M7 Beach Rd WE off-ramp	2118	1909	-209	-10	4.7	209
7:00:00 PM	1580746: Camden Valley Way EB on-ramp	640	740	100	16	3.8	100
7:00:00 PM	1580760: CI-01A	1748	1822	74	4	1.8	74
7:00:00 PM	1580752: CI-LOOP01N	928	960	32	3	1.0	32
7:00:00 PM	1580761: CI-01B	2130	2196	66	3	1.4	66
8:00:00 PM	1580744: Mainline EB pre M7 on-ramp	1567	1737	170	11	4.2	170
8:00:00 PM	1580750: M7 WB on-ramp	684	699	15	2	0.6	15
8:00:00 PM	1580812: Camden Valley SB off-ramp	75	40	-35	-46	4.6	35
8:00:00 PM	1580749: Mainline WB pre M7 on-Ramp	1478	1432	-46	-3	1.2	46
8:00:00 PM	1580745: M7 EB on-ramp	526	514	-12	-2	0.5	12
8:00:00 PM	1580748: Mainline EB post M7 off-Ramp	1132	1182	50	4	1.5	50
8:00:00 PM	1580811: Camden Valley NB on-ramp	472	598	126	27	5.4	126
8:00:00 PM	1580747: M7 EB off-Ramp	667	595	-72	-11	2.9	72
8:00:00 PM	1580751: CI-LOOP02S	743	737	-6	-1	0.2	6
8:00:00 PM	1580754: CI-LOOP03S	737	734	-3	0	0.1	3
8:00:00 PM	1580762: CI-LOOP03M	408	457	49	12	2.4	49
8:00:00 PM	1580809: Campbelltown SB on-ramp	649	623	-26	-4	1.0	26
8:00:00 PM	1580810: Camden Valley NB off-ramp	547	544	-3	-1	0.1	3
8:00:00 PM	1580743: M7 Beach Rd WE off-ramp	1187	1104	-83	-7	2.4	83
8:00:00 PM	1580746: Camden Valley Way EB on-ramp	435	557	122	28	5.5	122
8:00:00 PM	1580760: CI-01A	1079	1098	19	2	0.6	19
8:00:00 PM	1580752: CI-LOOP01N	615	597	-18	-3	0.7	18
8:00:00 PM	1580761: CI-01B	1210	1247	37	3	1.1	37

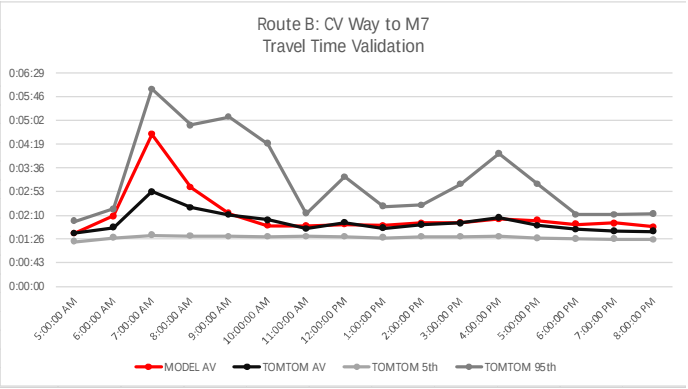
Appendix – D Detailed Model Route Travel Time Summaries (Cutler Interchange)

RESULTS OF MEDIAN SEED REPLICATION (560), WHOLE TOMTOM MONTH (FEBRUARY 2021 WORKDAYS)

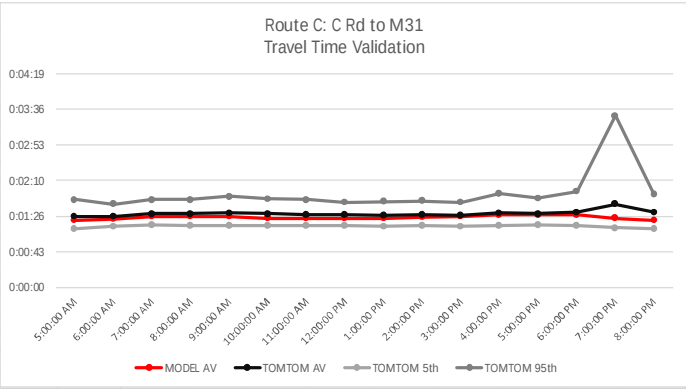
ROUTE A: CV WAY TO M5							
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th	Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:02:18	0:02:23	0:02:05	0:02:41	4%	0:00:05	TRUE
6:00:00 AM	0:02:34	0:02:31	0:02:15	0:02:52	2%	0:00:03	TRUE
7:00:00 AM	0:03:35	0:03:29	0:02:33	0:04:52	3%	0:00:06	TRUE
8:00:00 AM	0:04:03	0:04:02	0:02:33	0:05:49	0%	0:00:01	TRUE
9:00:00 AM	0:02:48	0:04:07	0:02:23	0:07:50	47%	0:01:19	TRUE
10:00:00 AM	0:02:33	0:02:45	0:02:16	0:04:12	8%	0:00:12	TRUE
11:00:00 AM	0:02:25	0:02:32	0:02:14	0:02:55	5%	0:00:07	TRUE
12:00:00 PM	0:02:24	0:02:31	0:02:13	0:02:55	5%	0:00:07	TRUE
1:00:00 PM	0:02:25	0:02:31	0:02:13	0:02:57	4%	0:00:06	TRUE
2:00:00 PM	0:02:24	0:02:31	0:02:14	0:02:57	5%	0:00:07	TRUE
3:00:00 PM	0:02:28	0:02:33	0:02:13	0:02:58	3%	0:00:05	TRUE
4:00:00 PM	0:02:31	0:02:32	0:02:13	0:02:58	1%	0:00:01	TRUE
5:00:00 PM	0:02:36	0:02:32	0:02:14	0:02:55	3%	0:00:04	TRUE
6:00:00 PM	0:02:33	0:02:38	0:02:13	0:03:25	3%	0:00:05	TRUE
7:00:00 PM	0:02:24	0:02:28	0:02:10	0:02:50	3%	0:00:04	TRUE
8:00:00 PM	0:02:20	0:02:28	0:02:08	0:02:51	6%	0:00:08	TRUE



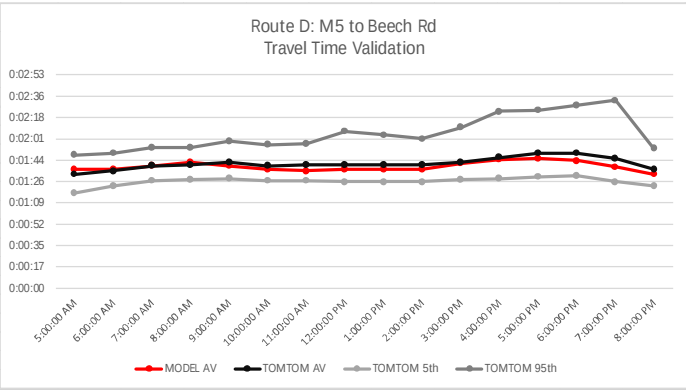
ROUTE B: CV WAY TO M7							
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th	Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:01:37	0:01:37	0:01:22	0:01:59	0%	0:00:00	TRUE
6:00:00 AM	0:02:08	0:01:47	0:01:29	0:02:21	20%	0:00:21	TRUE
7:00:00 AM	0:04:37	0:02:52	0:01:33	0:05:59	61%	0:01:45	TRUE
8:00:00 AM	0:03:00	0:02:24	0:01:32	0:04:53	25%	0:00:36	TRUE
9:00:00 AM	0:02:13	0:02:10	0:01:31	0:05:08	2%	0:00:03	TRUE
10:00:00 AM	0:01:50	0:02:01	0:01:30	0:04:20	10%	0:00:11	TRUE
11:00:00 AM	0:01:50	0:01:45	0:01:31	0:02:13	5%	0:00:05	TRUE
12:00:00 PM	0:01:53	0:01:56	0:01:30	0:03:19	3%	0:00:03	TRUE
1:00:00 PM	0:01:51	0:01:46	0:01:29	0:02:26	5%	0:00:05	TRUE
2:00:00 PM	0:01:55	0:01:52	0:01:30	0:02:28	3%	0:00:03	TRUE
3:00:00 PM	0:01:56	0:01:55	0:01:30	0:03:06	1%	0:00:01	TRUE
4:00:00 PM	0:02:02	0:02:05	0:01:31	0:04:02	2%	0:00:03	TRUE
5:00:00 PM	0:02:00	0:01:51	0:01:28	0:03:06	8%	0:00:09	TRUE
6:00:00 PM	0:01:53	0:01:44	0:01:27	0:02:11	9%	0:00:09	TRUE
7:00:00 PM	0:01:55	0:01:41	0:01:26	0:02:11	14%	0:00:14	TRUE
8:00:00 PM	0:01:48	0:01:40	0:01:25	0:02:12	8%	0:00:08	TRUE



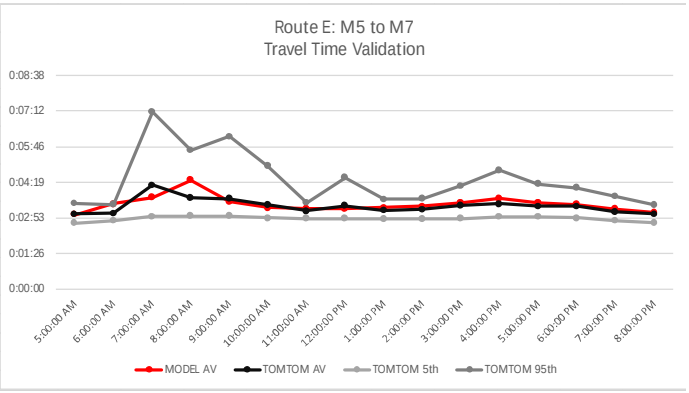
ROUTE C: C RD TO M31							
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th	Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:01:21	0:01:26	0:01:11	0:01:46	6%	0:00:05	TRUE
6:00:00 AM	0:01:23	0:01:26	0:01:14	0:01:41	4%	0:00:03	TRUE
7:00:00 AM	0:01:26	0:01:29	0:01:16	0:01:46	3%	0:00:03	TRUE
8:00:00 AM	0:01:26	0:01:29	0:01:15	0:01:46	3%	0:00:03	TRUE
9:00:00 AM	0:01:26	0:01:30	0:01:15	0:01:50	5%	0:00:04	TRUE
10:00:00 AM	0:01:24	0:01:29	0:01:15	0:01:47	6%	0:00:05	TRUE
11:00:00 AM	0:01:24	0:01:28	0:01:15	0:01:46	5%	0:00:04	TRUE
12:00:00 PM	0:01:24	0:01:28	0:01:15	0:01:43	5%	0:00:04	TRUE
1:00:00 PM	0:01:24	0:01:27	0:01:14	0:01:44	4%	0:00:03	TRUE
2:00:00 PM	0:01:25	0:01:28	0:01:15	0:01:45	4%	0:00:03	TRUE
3:00:00 PM	0:01:26	0:01:27	0:01:14	0:01:43	1%	0:00:01	TRUE
4:00:00 PM	0:01:28	0:01:30	0:01:15	0:01:54	2%	0:00:02	TRUE
5:00:00 PM	0:01:28	0:01:29	0:01:16	0:01:48	1%	0:00:01	TRUE
6:00:00 PM	0:01:28	0:01:31	0:01:15	0:01:56	3%	0:00:03	TRUE
7:00:00 PM	0:01:24	0:01:41	0:01:12	0:03:28	20%	0:00:17	TRUE
8:00:00 PM	0:01:21	0:01:31	0:01:11	0:01:53	12%	0:00:10	TRUE



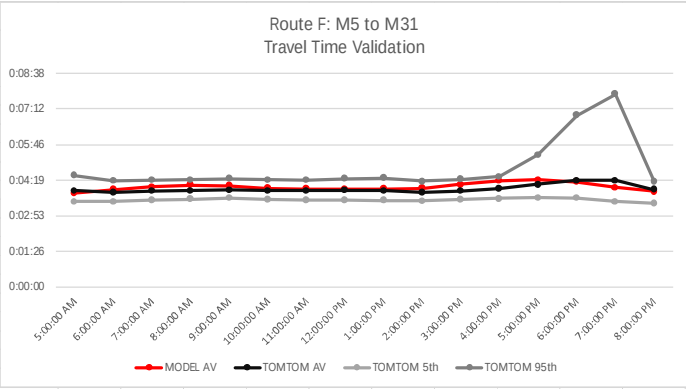
ROUTE D: M5 TO BEECH RD							
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th	Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:01:36	0:01:32	0:01:17	0:01:48	4%	0:00:04	TRUE
6:00:00 AM	0:01:36	0:01:35	0:01:23	0:01:49	1%	0:00:01	TRUE
7:00:00 AM	0:01:39	0:01:39	0:01:27	0:01:54	0%	0:00:00	TRUE
8:00:00 AM	0:01:42	0:01:40	0:01:28	0:01:54	2%	0:00:02	TRUE
9:00:00 AM	0:01:39	0:01:42	0:01:29	0:01:59	3%	0:00:03	TRUE
10:00:00 AM	0:01:36	0:01:39	0:01:27	0:01:56	3%	0:00:03	TRUE
11:00:00 AM	0:01:35	0:01:40	0:01:27	0:01:57	5%	0:00:05	TRUE
12:00:00 PM	0:01:36	0:01:40	0:01:26	0:02:07	4%	0:00:04	TRUE
1:00:00 PM	0:01:36	0:01:40	0:01:26	0:02:04	4%	0:00:04	TRUE
2:00:00 PM	0:01:36	0:01:40	0:01:26	0:02:01	4%	0:00:04	TRUE
3:00:00 PM	0:01:41	0:01:42	0:01:28	0:02:10	1%	0:00:01	TRUE
4:00:00 PM	0:01:44	0:01:46	0:01:29	0:02:23	2%	0:00:02	TRUE
5:00:00 PM	0:01:45	0:01:49	0:01:30	0:02:24	4%	0:00:04	TRUE
6:00:00 PM	0:01:43	0:01:49	0:01:31	0:02:28	6%	0:00:06	TRUE
7:00:00 PM	0:01:38	0:01:45	0:01:26	0:02:32	7%	0:00:07	TRUE
8:00:00 PM	0:01:32	0:01:36	0:01:23	0:01:53	4%	0:00:04	TRUE



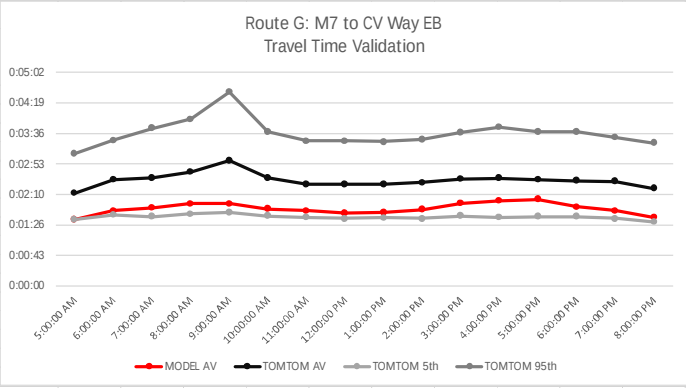
ROUTE E: M5 TO M7							
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th	Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:03:01	0:03:02	0:02:40	0:03:28	1%	0:00:01	TRUE
6:00:00 AM	0:03:27	0:03:04	0:02:46	0:03:26	13%	0:00:23	FALSE
7:00:00 AM	0:03:43	0:04:12	0:02:56	0:07:10	13%	0:00:29	TRUE
8:00:00 AM	0:04:25	0:03:42	0:02:57	0:05:37	19%	0:00:43	TRUE
9:00:00 AM	0:03:32	0:03:39	0:02:57	0:06:10	3%	0:00:07	TRUE
10:00:00 AM	0:03:17	0:03:25	0:02:53	0:04:59	4%	0:00:08	TRUE
11:00:00 AM	0:03:15	0:03:10	0:02:52	0:03:30	3%	0:00:05	TRUE
12:00:00 PM	0:03:15	0:03:22	0:02:52	0:04:30	4%	0:00:07	TRUE
1:00:00 PM	0:03:17	0:03:11	0:02:51	0:03:38	3%	0:00:06	TRUE
2:00:00 PM	0:03:21	0:03:13	0:02:51	0:03:39	4%	0:00:08	TRUE
3:00:00 PM	0:03:30	0:03:23	0:02:52	0:04:10	3%	0:00:07	TRUE
4:00:00 PM	0:03:40	0:03:27	0:02:55	0:04:48	6%	0:00:13	TRUE
5:00:00 PM	0:03:30	0:03:21	0:02:55	0:04:15	4%	0:00:09	TRUE
6:00:00 PM	0:03:26	0:03:21	0:02:53	0:04:06	2%	0:00:05	TRUE
7:00:00 PM	0:03:14	0:03:08	0:02:46	0:03:45	3%	0:00:06	TRUE
8:00:00 PM	0:03:06	0:03:02	0:02:41	0:03:25	2%	0:00:04	TRUE



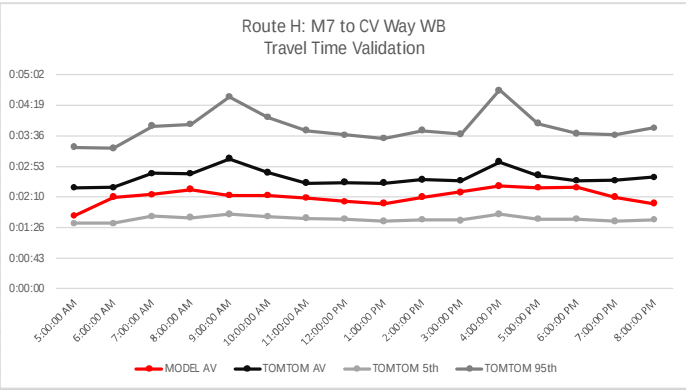
ROUTE F: M5 TO M31							
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th	Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:03:48	0:03:53	0:03:27	0:04:30	2%	0:00:05	TRUE
6:00:00 AM	0:03:56	0:03:50	0:03:27	0:04:17	3%	0:00:06	TRUE
7:00:00 AM	0:04:03	0:03:52	0:03:31	0:04:19	5%	0:00:11	TRUE
8:00:00 AM	0:04:08	0:03:53	0:03:33	0:04:20	6%	0:00:15	TRUE
9:00:00 AM	0:04:06	0:03:55	0:03:35	0:04:23	5%	0:00:11	TRUE
10:00:00 AM	0:04:00	0:03:53	0:03:32	0:04:20	3%	0:00:07	TRUE
11:00:00 AM	0:03:58	0:03:53	0:03:31	0:04:19	2%	0:00:05	TRUE
12:00:00 PM	0:03:57	0:03:54	0:03:31	0:04:23	1%	0:00:03	TRUE
1:00:00 PM	0:03:58	0:03:53	0:03:30	0:04:25	2%	0:00:05	TRUE
2:00:00 PM	0:04:00	0:03:50	0:03:29	0:04:16	4%	0:00:10	TRUE
3:00:00 PM	0:04:09	0:03:52	0:03:32	0:04:21	7%	0:00:17	TRUE
4:00:00 PM	0:04:17	0:03:59	0:03:34	0:04:28	8%	0:00:18	TRUE
5:00:00 PM	0:04:20	0:04:09	0:03:36	0:05:21	4%	0:00:11	TRUE
6:00:00 PM	0:04:15	0:04:18	0:03:35	0:06:57	1%	0:00:03	TRUE
7:00:00 PM	0:04:01	0:04:18	0:03:27	0:07:48	7%	0:00:17	TRUE
8:00:00 PM	0:03:51	0:03:56	0:03:23	0:04:16	2%	0:00:05	TRUE



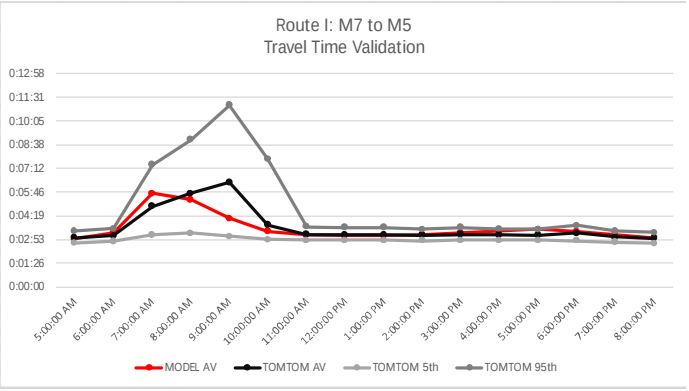
ROUTE G: M7 TO CV WAY EB							
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th	Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:01:34	0:02:11	0:01:34	0:03:07	39%	0:00:37	TRUE
6:00:00 AM	0:01:46	0:02:30	0:01:40	0:03:26	42%	0:00:44	TRUE
7:00:00 AM	0:01:50	0:02:33	0:01:38	0:03:43	39%	0:00:43	TRUE
8:00:00 AM	0:01:56	0:02:41	0:01:42	0:03:56	39%	0:00:45	TRUE
9:00:00 AM	0:01:56	0:02:57	0:01:44	0:04:34	53%	0:01:01	TRUE
10:00:00 AM	0:01:49	0:02:33	0:01:39	0:03:38	40%	0:00:44	TRUE
11:00:00 AM	0:01:46	0:02:24	0:01:37	0:03:25	36%	0:00:38	TRUE
12:00:00 PM	0:01:43	0:02:24	0:01:35	0:03:25	40%	0:00:41	TRUE
1:00:00 PM	0:01:44	0:02:24	0:01:36	0:03:24	38%	0:00:40	TRUE
2:00:00 PM	0:01:48	0:02:26	0:01:35	0:03:27	35%	0:00:38	TRUE
3:00:00 PM	0:01:57	0:02:31	0:01:39	0:03:37	29%	0:00:34	TRUE
4:00:00 PM	0:02:00	0:02:32	0:01:37	0:03:44	27%	0:00:32	TRUE
5:00:00 PM	0:02:02	0:02:30	0:01:38	0:03:38	23%	0:00:28	TRUE
6:00:00 PM	0:01:52	0:02:29	0:01:38	0:03:38	33%	0:00:37	TRUE
7:00:00 PM	0:01:46	0:02:28	0:01:35	0:03:30	40%	0:00:42	TRUE
8:00:00 PM	0:01:37	0:02:18	0:01:30	0:03:22	42%	0:00:41	TRUE



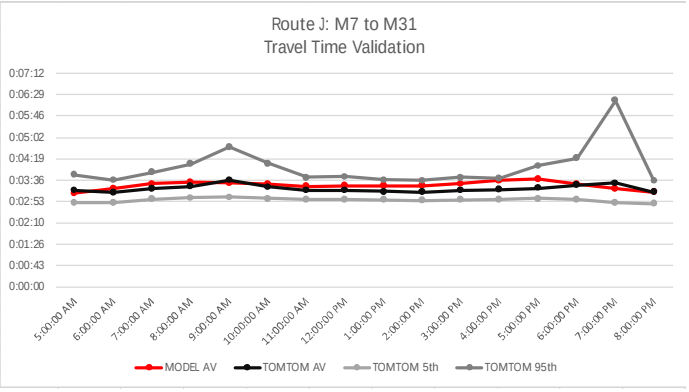
ROUTE H: M7 TO CV WAY WB								
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th		Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:01:43	0:02:22	0:01:32	0:03:20		38%	0:00:39	TRUE
6:00:00 AM	0:02:09	0:02:23	0:01:32	0:03:18		11%	0:00:14	TRUE
7:00:00 AM	0:02:13	0:02:43	0:01:42	0:03:50		23%	0:00:30	TRUE
8:00:00 AM	0:02:20	0:02:42	0:01:40	0:03:52		16%	0:00:22	TRUE
9:00:00 AM	0:02:11	0:03:03	0:01:45	0:04:31		40%	0:00:52	TRUE
10:00:00 AM	0:02:11	0:02:44	0:01:41	0:04:02		25%	0:00:33	TRUE
11:00:00 AM	0:02:08	0:02:29	0:01:39	0:03:43		16%	0:00:21	TRUE
12:00:00 PM	0:02:03	0:02:30	0:01:38	0:03:37		22%	0:00:27	TRUE
1:00:00 PM	0:02:00	0:02:29	0:01:35	0:03:32		24%	0:00:29	TRUE
2:00:00 PM	0:02:09	0:02:34	0:01:37	0:03:43		19%	0:00:25	TRUE
3:00:00 PM	0:02:16	0:02:32	0:01:36	0:03:38		12%	0:00:16	TRUE
4:00:00 PM	0:02:25	0:02:59	0:01:45	0:04:40		23%	0:00:34	TRUE
5:00:00 PM	0:02:22	0:02:40	0:01:38	0:03:53		13%	0:00:18	TRUE
6:00:00 PM	0:02:23	0:02:32	0:01:38	0:03:39		6%	0:00:09	TRUE
7:00:00 PM	0:02:09	0:02:33	0:01:35	0:03:37		19%	0:00:24	TRUE
8:00:00 PM	0:02:00	0:02:37	0:01:37	0:03:47		31%	0:00:37	TRUE



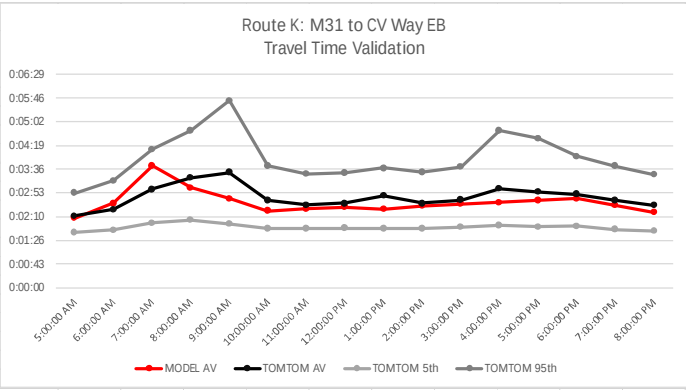
ROUTE I: M7 TO M5								
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th		Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:02:56	0:03:00	0:02:40	0:03:25		2%	0:00:04	TRUE
6:00:00 AM	0:03:18	0:03:07	0:02:47	0:03:33		6%	0:00:11	TRUE
7:00:00 AM	0:05:42	0:04:55	0:03:11	0:07:25		16%	0:00:47	TRUE
8:00:00 AM	0:05:19	0:05:42	0:03:16	0:08:57		7%	0:00:23	TRUE
9:00:00 AM	0:04:11	0:06:21	0:03:05	0:11:02		52%	0:02:10	TRUE
10:00:00 AM	0:03:23	0:03:46	0:02:54	0:07:45		11%	0:00:23	TRUE
11:00:00 AM	0:03:10	0:03:12	0:02:51	0:03:40		1%	0:00:02	TRUE
12:00:00 PM	0:03:07	0:03:11	0:02:50	0:03:38		2%	0:00:04	TRUE
1:00:00 PM	0:03:08	0:03:10	0:02:50	0:03:37		1%	0:00:02	TRUE
2:00:00 PM	0:03:10	0:03:09	0:02:49	0:03:31		1%	0:00:01	TRUE
3:00:00 PM	0:03:17	0:03:12	0:02:50	0:03:37		3%	0:00:05	TRUE
4:00:00 PM	0:03:24	0:03:10	0:02:50	0:03:32		7%	0:00:14	TRUE
5:00:00 PM	0:03:30	0:03:09	0:02:50	0:03:30		11%	0:00:21	TRUE
6:00:00 PM	0:03:22	0:03:16	0:02:49	0:03:44		3%	0:00:06	TRUE
7:00:00 PM	0:03:10	0:03:02	0:02:43	0:03:24		4%	0:00:08	TRUE
8:00:00 PM	0:03:00	0:02:58	0:02:39	0:03:19		1%	0:00:02	TRUE



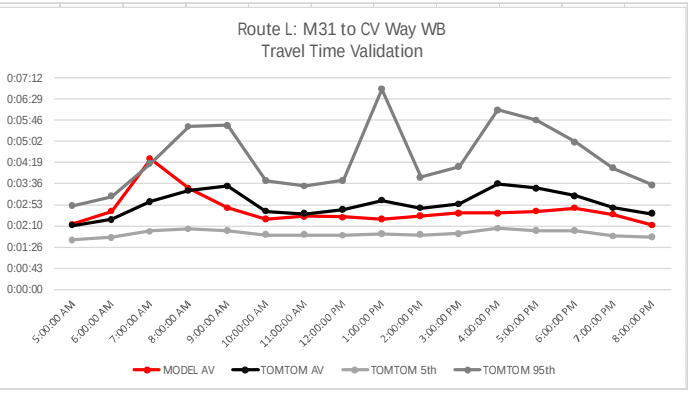
ROUTE J: M7 TO M31								
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th		Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:03:10	0:03:15	0:02:51	0:03:47		3%	0:00:05	TRUE
6:00:00 AM	0:03:19	0:03:11	0:02:51	0:03:36		4%	0:00:08	TRUE
7:00:00 AM	0:03:29	0:03:19	0:02:58	0:03:52		5%	0:00:10	TRUE
8:00:00 AM	0:03:32	0:03:23	0:03:00	0:04:09		4%	0:00:09	TRUE
9:00:00 AM	0:03:30	0:03:36	0:03:02	0:04:43		3%	0:00:06	TRUE
10:00:00 AM	0:03:28	0:03:22	0:02:59	0:04:10		3%	0:00:06	TRUE
11:00:00 AM	0:03:23	0:03:15	0:02:57	0:03:41		4%	0:00:08	TRUE
12:00:00 PM	0:03:25	0:03:15	0:02:57	0:03:43		5%	0:00:10	TRUE
1:00:00 PM	0:03:25	0:03:13	0:02:56	0:03:37		6%	0:00:12	TRUE
2:00:00 PM	0:03:25	0:03:12	0:02:55	0:03:35		7%	0:00:13	TRUE
3:00:00 PM	0:03:29	0:03:15	0:02:56	0:03:41		7%	0:00:14	TRUE
4:00:00 PM	0:03:35	0:03:17	0:02:57	0:03:40		9%	0:00:18	TRUE
5:00:00 PM	0:03:38	0:03:20	0:02:59	0:04:05		9%	0:00:18	TRUE
6:00:00 PM	0:03:28	0:03:26	0:02:57	0:04:20		1%	0:00:02	TRUE
7:00:00 PM	0:03:19	0:03:30	0:02:51	0:06:17		6%	0:00:11	TRUE
8:00:00 PM	0:03:12	0:03:12	0:02:48	0:03:34		0%	0:00:00	TRUE



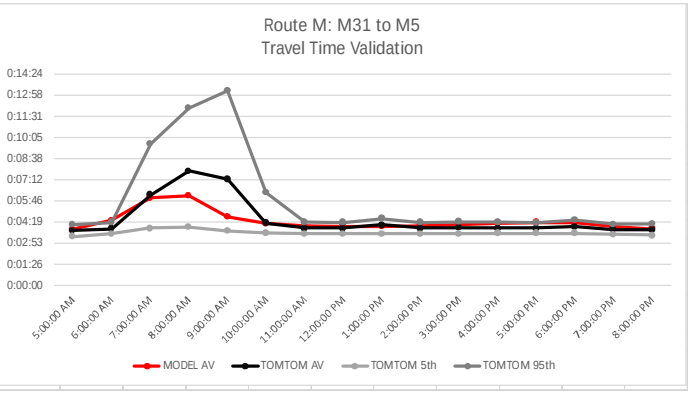
ROUTE K: M31 TO CV WAY EB								
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th		Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:02:07	0:02:11	0:01:41	0:02:53		3%	0:00:04	TRUE
6:00:00 AM	0:02:34	0:02:22	0:01:45	0:03:15		8%	0:00:12	TRUE
7:00:00 AM	0:03:42	0:02:59	0:01:58	0:04:12		24%	0:00:43	TRUE
8:00:00 AM	0:03:02	0:03:20	0:02:03	0:04:46		10%	0:00:18	TRUE
9:00:00 AM	0:02:42	0:03:30	0:01:56	0:05:40		30%	0:00:48	TRUE
10:00:00 AM	0:02:20	0:02:39	0:01:48	0:03:42		14%	0:00:19	TRUE
11:00:00 AM	0:02:24	0:02:31	0:01:48	0:03:27		5%	0:00:07	TRUE
12:00:00 PM	0:02:27	0:02:34	0:01:49	0:03:29		5%	0:00:07	TRUE
1:00:00 PM	0:02:23	0:02:47	0:01:48	0:03:38		17%	0:00:24	TRUE
2:00:00 PM	0:02:29	0:02:34	0:01:48	0:03:31		3%	0:00:05	TRUE
3:00:00 PM	0:02:33	0:02:40	0:01:50	0:03:40		5%	0:00:07	TRUE
4:00:00 PM	0:02:35	0:03:00	0:01:54	0:04:46		16%	0:00:25	TRUE
5:00:00 PM	0:02:39	0:02:54	0:01:51	0:04:32		9%	0:00:15	TRUE
6:00:00 PM	0:02:42	0:02:50	0:01:52	0:03:59		5%	0:00:08	TRUE
7:00:00 PM	0:02:30	0:02:39	0:01:46	0:03:41		6%	0:00:09	TRUE
8:00:00 PM	0:02:17	0:02:30	0:01:43	0:03:26		9%	0:00:13	TRUE



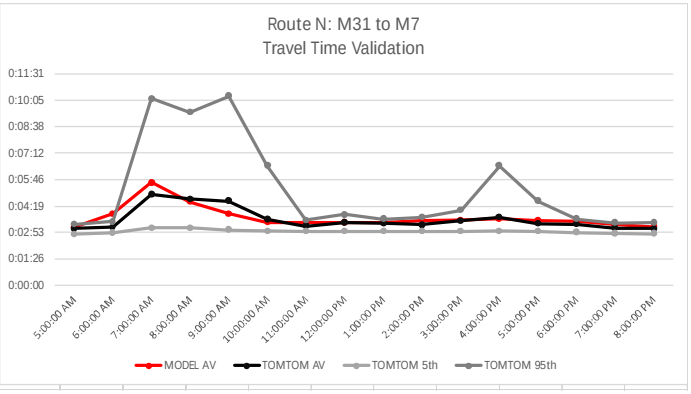
ROUTE L: M31 TO CV WAY WB								
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th		Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:02:13	0:02:11	0:01:41	0:02:51		2%	0:00:02	TRUE
6:00:00 AM	0:02:40	0:02:23	0:01:46	0:03:10		12%	0:00:17	TRUE
7:00:00 AM	0:04:27	0:03:00	0:01:59	0:04:17		48%	0:01:27	FALSE
8:00:00 AM	0:03:26	0:03:22	0:02:04	0:05:33		2%	0:00:04	TRUE
9:00:00 AM	0:02:47	0:03:32	0:02:00	0:05:35		27%	0:00:45	TRUE
10:00:00 AM	0:02:24	0:02:40	0:01:52	0:03:42		11%	0:00:16	TRUE
11:00:00 AM	0:02:29	0:02:35	0:01:52	0:03:32		4%	0:00:06	TRUE
12:00:00 PM	0:02:28	0:02:43	0:01:51	0:03:43		10%	0:00:15	TRUE
1:00:00 PM	0:02:24	0:03:02	0:01:53	0:06:49		26%	0:00:38	TRUE
2:00:00 PM	0:02:30	0:02:46	0:01:52	0:03:49		11%	0:00:16	TRUE
3:00:00 PM	0:02:36	0:02:55	0:01:54	0:04:11		12%	0:00:19	TRUE
4:00:00 PM	0:02:36	0:03:36	0:02:05	0:06:07		38%	0:01:00	TRUE
5:00:00 PM	0:02:40	0:03:27	0:02:00	0:05:46		29%	0:00:47	TRUE
6:00:00 PM	0:02:46	0:03:11	0:02:00	0:05:01		15%	0:00:25	TRUE
7:00:00 PM	0:02:33	0:02:47	0:01:49	0:04:08		9%	0:00:14	TRUE
8:00:00 PM	0:02:12	0:02:35	0:01:47	0:03:33		17%	0:00:23	TRUE



ROUTE M: M31 TO M5								
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th		Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:03:51	0:03:44	0:03:20	0:04:08		3%	0:00:07	TRUE
6:00:00 AM	0:04:25	0:03:52	0:03:32	0:04:18		14%	0:00:33	FALSE
7:00:00 AM	0:05:59	0:06:10	0:03:54	0:09:37		3%	0:00:11	TRUE
8:00:00 AM	0:06:07	0:07:47	0:03:58	0:12:05		27%	0:01:40	TRUE
9:00:00 AM	0:04:40	0:07:13	0:03:42	0:13:15		55%	0:02:33	TRUE
10:00:00 AM	0:04:13	0:04:14	0:03:34	0:06:19		0%	0:00:01	TRUE
11:00:00 AM	0:04:03	0:03:53	0:03:31	0:04:19		4%	0:00:10	TRUE
12:00:00 PM	0:04:02	0:03:54	0:03:32	0:04:17		3%	0:00:08	TRUE
1:00:00 PM	0:04:02	0:04:06	0:03:31	0:04:33		2%	0:00:04	TRUE
2:00:00 PM	0:04:05	0:03:53	0:03:31	0:04:18		5%	0:00:12	TRUE
3:00:00 PM	0:04:07	0:03:55	0:03:32	0:04:21		5%	0:00:12	TRUE
4:00:00 PM	0:04:14	0:03:54	0:03:33	0:04:19		9%	0:00:20	TRUE
5:00:00 PM	0:04:18	0:03:53	0:03:33	0:04:16		11%	0:00:25	FALSE
6:00:00 PM	0:04:16	0:04:00	0:03:33	0:04:28		7%	0:00:16	TRUE
7:00:00 PM	0:04:01	0:03:49	0:03:28	0:04:10		5%	0:00:12	TRUE
8:00:00 PM	0:03:52	0:03:48	0:03:25	0:04:11		2%	0:00:04	TRUE



ROUTE N: M31 TO M7								
HOUR END	MODEL AV	TOMTOM AV	TOMTOM 5th	TOMTOM 95th		Average Within <15%	Average Within <1min	Within 90% Confidence Interval
5:00:00 AM	0:03:10	0:03:04	0:02:46	0:03:19		3%	0:00:06	TRUE
6:00:00 AM	0:03:53	0:03:09	0:02:52	0:03:27		23%	0:00:44	FALSE
7:00:00 AM	0:05:36	0:04:57	0:03:07	0:10:10		13%	0:00:39	TRUE
8:00:00 AM	0:04:33	0:04:42	0:03:07	0:09:25		3%	0:00:09	TRUE
9:00:00 AM	0:03:53	0:04:35	0:03:01	0:10:18		18%	0:00:42	TRUE
10:00:00 AM	0:03:26	0:03:35	0:02:57	0:06:31		4%	0:00:09	TRUE
11:00:00 AM	0:03:25	0:03:13	0:02:56	0:03:33		6%	0:00:12	TRUE
12:00:00 PM	0:03:25	0:03:25	0:02:55	0:03:51		0%	0:00:00	TRUE
1:00:00 PM	0:03:26	0:03:22	0:02:56	0:03:36		2%	0:00:04	TRUE
2:00:00 PM	0:03:31	0:03:17	0:02:56	0:03:42		7%	0:00:14	TRUE
3:00:00 PM	0:03:33	0:03:30	0:02:56	0:04:04		1%	0:00:03	TRUE
4:00:00 PM	0:03:38	0:03:41	0:02:57	0:06:30		1%	0:00:03	TRUE
5:00:00 PM	0:03:31	0:03:21	0:02:56	0:04:35		5%	0:00:10	TRUE
6:00:00 PM	0:03:29	0:03:19	0:02:53	0:03:36		5%	0:00:10	TRUE
7:00:00 PM	0:03:17	0:03:06	0:02:49	0:03:23		6%	0:00:11	TRUE
8:00:00 PM	0:03:11	0:03:05	0:02:48	0:03:25		3%	0:00:06	TRUE



Appendix E – Network Wide Statistics – Future Scenarios: Peak Periods

M7: AM Peak (6am-9am)

Whole Model	Total Serviced Demand	Vehicle Kilometres Travelled	Vehicle Hours Travelled	Ave Speed (km/h)	Density (veh/km)	Total Number of Stops
2026 no project	54,090	684,628	9,795	73	14	49,216
2026 with project	62,383	812,873	10,520	76	13	44,725
2036 no project	56,924	729,107	12,190	63	18	79,570
2036 with project	66,905	870,103	13,083	70	16	82,662

M7: AM Peak (7am-8am)

Whole Model	Total Serviced Demand	Vehicle Kilometres Travelled	Vehicle Hours Travelled	Ave Speed (km/h)	Density (veh/km)	Total Number of Stops
2026 no project	19,231	235,314	3,334	73	15	16,017
2026 with project	22,187	279,644	3,681	75	14	17,056
2036 no project	19,947	247,170	4,105	63	19	26,680
2036 with project	23,290	293,409	4,330	69	17	26,630

M7: PM Peak (3pm-6pm)

Whole Model	Total Serviced Demand	Vehicle Kilometres Travelled	Vehicle Hours Travelled	Ave Speed (km/h)	Density (veh/km)	Total Number of Stops
2026 no project	55,058	751,195	10,857	75	16	55,110
2026 with project	65,180	897,977	10,324	86	12	14,447
2036 no project	57,524	794,130	14,820	66	21	105,945
2036 with project	70,115	991,211	12,054	82	14	35,072

M7: PM Peak (4pm-5pm)

Whole Model	Total Serviced Demand	Vehicle Kilometres Travelled	Vehicle Hours Travelled	Ave Speed (km/h)	Density (veh/km)	Total Number of Stops
2026 no project	18,155	247,953	3,586	76	15	18,527
2026 with project	21,175	290,278	3,287	87	11	4,097
2036 no project	19,195	265,588	4,910	66	20	34,475
2036 with project	22,609	317,300	3,718	84	13	7,572

Cutler Interchange: AM Peak (6am-9am)

Whole Model	Total Serviced Demand	Vehicle Kilometres Travelled	Vehicle Hours Travelled	Ave Speed (km/h)	Density (veh/km)	Total Number of Stops
2026 no project	49,696	242,956	3,940	73	21	32,114
2026 with project	53,848	261,251	4,083	73	21	28,682
2036 no project	51,086	247,754	4,651	66	25	39,462
2036 with project	56,839	274,508	4,783	68	25	40,090

Cutler Interchange: AM Peak (7am-8am)

Whole Model	Total Serviced Demand	Vehicle Kilometres Travelled	Vehicle Hours Travelled	Ave Speed (km/h)	Density (veh/km)	Total Number of Stops
2026 no project	17,350	84,375	1,308	72	22	11,408
2026 with project	18,926	91,490	1,354	73	22	10,026
2036 no project	17,747	85,728	1,551	65	27	14,304
2036 with project	19,922	95,972	1,605	67	26	14,462

Cutler Interchange: PM Peak (3pm-6pm)

Whole Model	Total Serviced Demand	Vehicle Kilometres Travelled	Vehicle Hours Travelled	Ave Speed (km/h)	Density (veh/km)	Total Number of Stops
2026 no project	50,468	246,667	3,414	80	18	22,655
2026 with project	56,507	273,238	3,499	81	18	20,808
2036 no project	53,896	261,801	5,035	69	26	64,646
2036 with project	59,668	286,995	4,357	73	22	38,035

Cutler Interchange: PM Peak (4pm-5pm)

Whole Model	Total Serviced Demand	Vehicle Kilometres Travelled	Vehicle Hours Travelled	Ave Speed (km/h)	Density (veh/km)	Total Number of Stops
2026 no project	15,353	75,264	906	86	14	3,861
2026 with project	17,004	82,412	928	89	14	3,079
2036 no project	17,278	84,486	1,529	71	24	23,083
2036 with project	19,145	92,635	1,345	76	20	12,346

Appendix B

Construction ancillary facilities

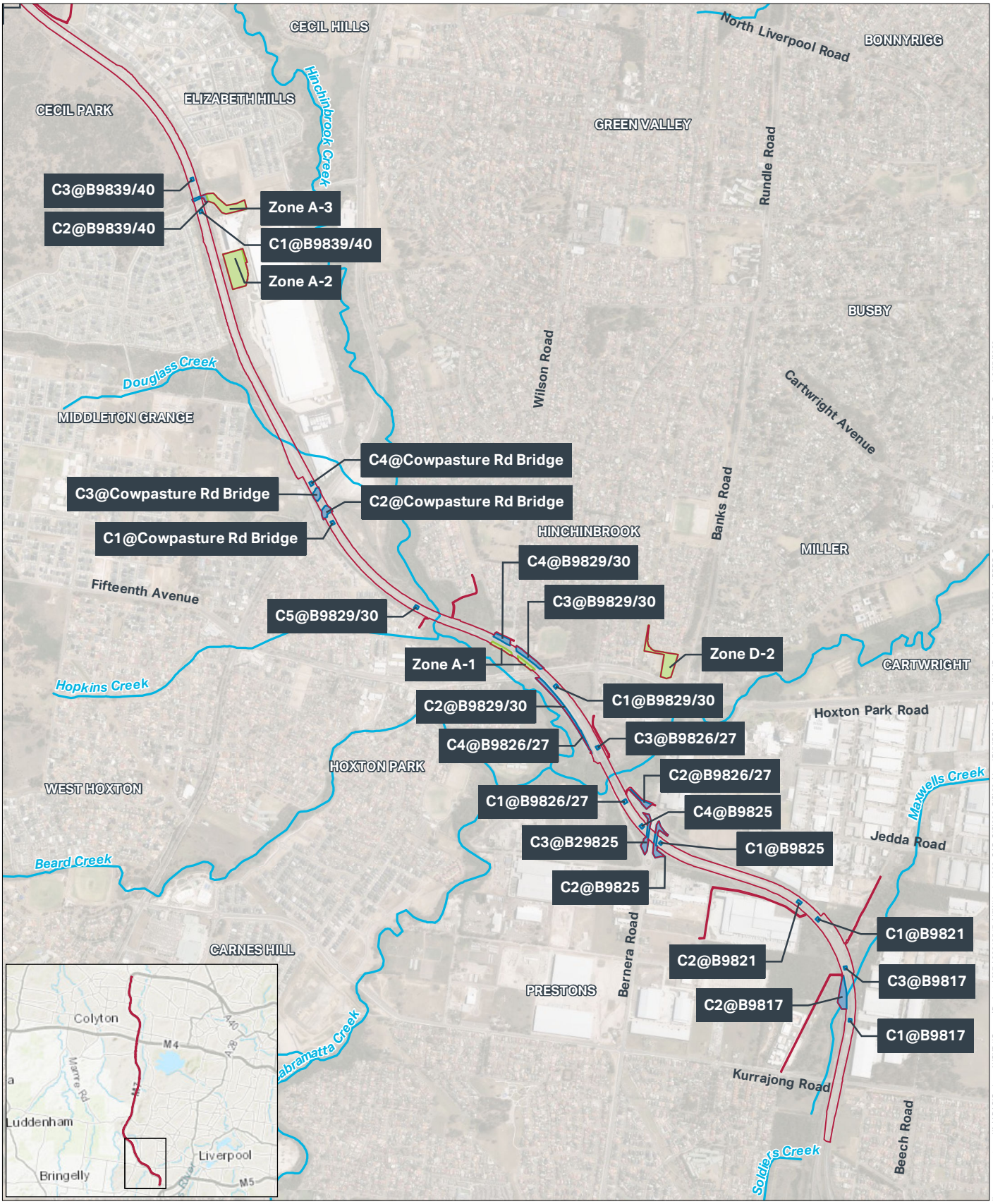


FIGURE 4-8: CONSTRUCTION FOOTPRINT FOR THE PROPOSED MODIFICATION

N

0 400 800 m

AECOM

Legend

Construction footprint

Construction Ancillary Facilities

Site construction ancillary facility

Zone construction ancillary facility

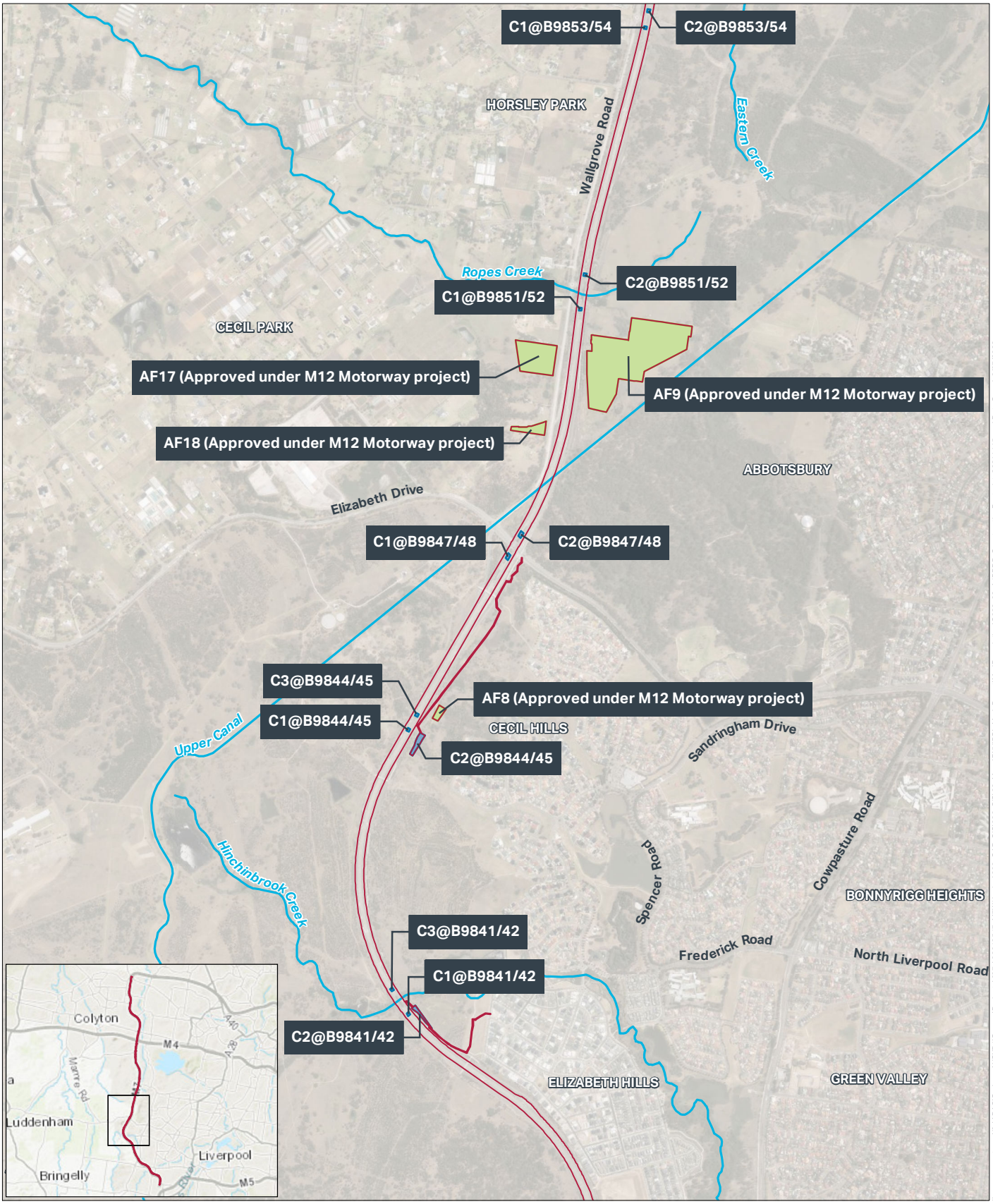


FIGURE 4-9: CONSTRUCTION FOOTPRINT FOR THE PROPOSED MODIFICATION

N

0 400 800 m

AECOM

Legend

Construction footprint

Construction Ancillary Facilities

Site construction ancillary facility

Zone construction ancillary facility

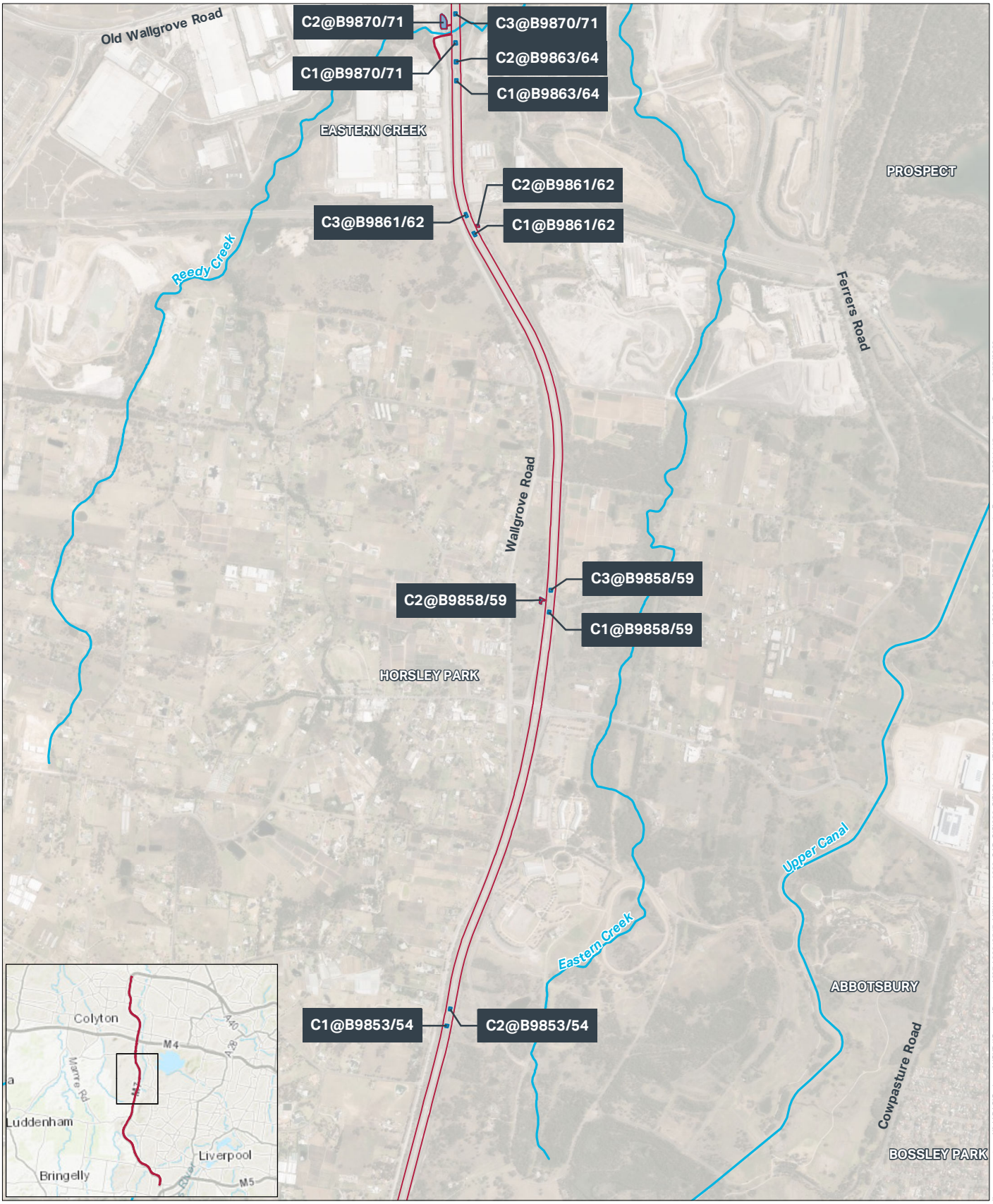


FIGURE 4-10: CONSTRUCTION FOOTPRINT FOR THE PROPOSED MODIFICATION

N 0 400 800 m

AECOM

Legend

Construction footprint

Construction Ancillary Facilities

Site construction ancillary facility

Source: magery © Department of Customer Service 2020
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance

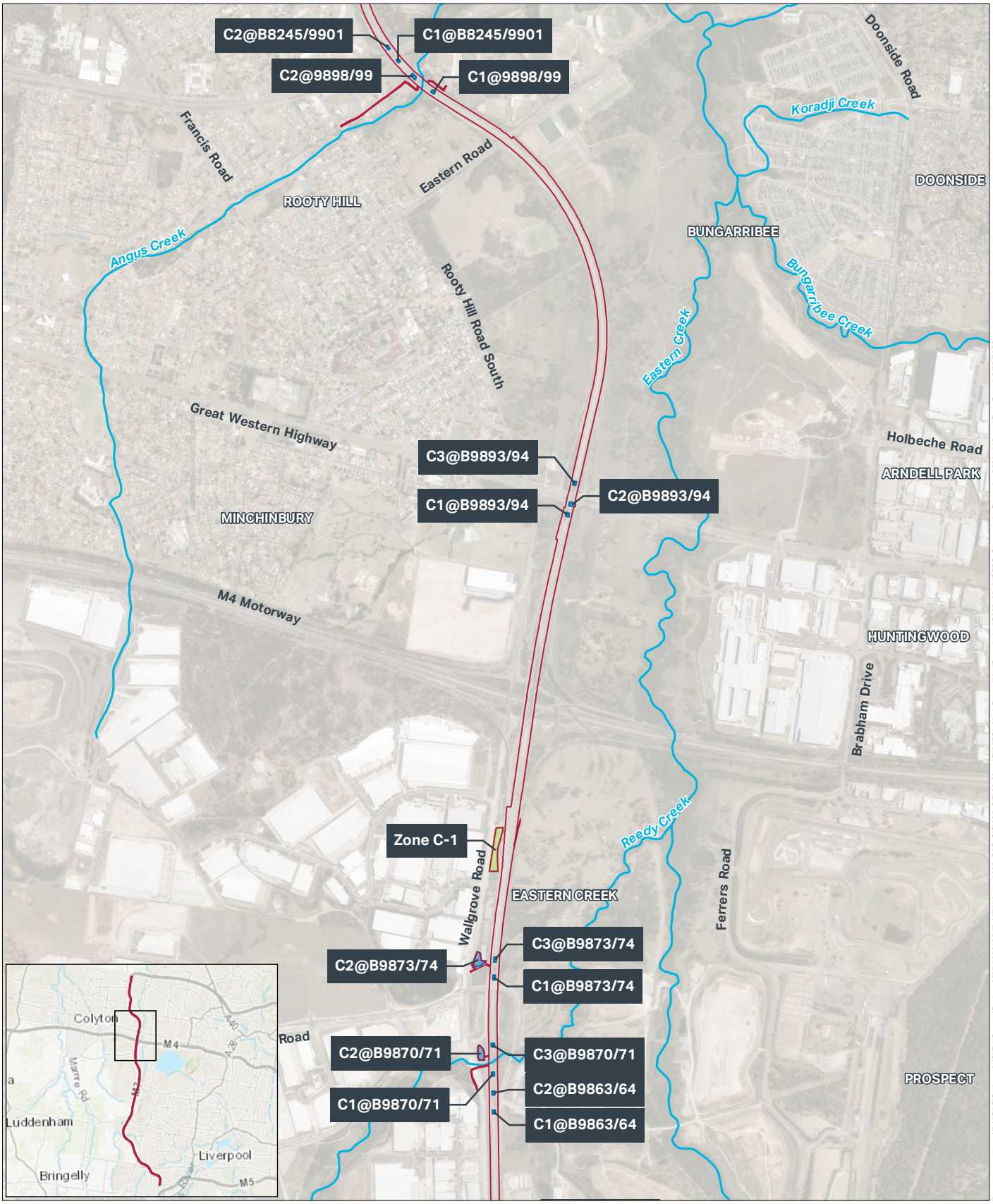


FIGURE 4-11: CONSTRUCTION FOOTPRINT FOR THE PROPOSED MODIFICATION

N

0 400 800 m

AECOM

Legend

Construction footprint

Construction Ancillary Facilities

Site construction ancillary facility

Zone construction ancillary facility

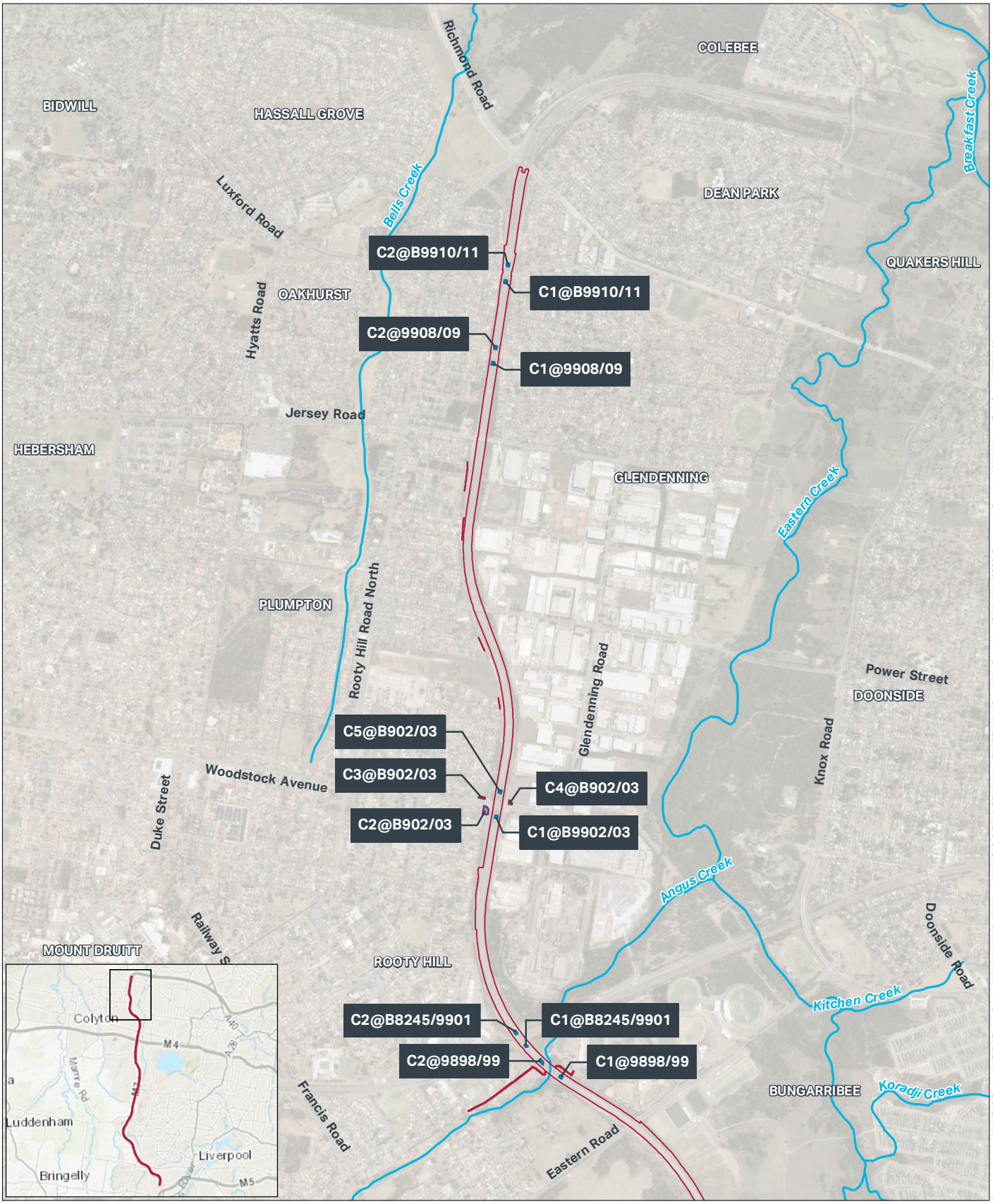


FIGURE 4-12: CONSTRUCTION FOOTPRINT FOR THE PROPOSED MODIFICATION

Legend

Construction footprint

Construction Ancillary Facilities

Site construction ancillary facility