Transport and Accessibility Impact Assessment

Volume 2

Appendices and Addendum 1

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 3A Concept Plan Application

Traffic and Transport

August 2011

Hyder

Addendum 1

Inner Area Paramics Modelling

SIMTA

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SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)

MOOREBANK INTERMODAL TERMINAL FACILITY (MITF)

TRAFFIC AND TRANSPORT

TRANSPORT AND ACCESSIBILITY IMPACT ASSESSMENT

ADDENDUM 1, INNER AREA PARAMICS MODELLING

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SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)

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TRAFFIC AND TRANSPORT

ADDENDUM 1, INNER AREA PARAMICS MODELLING

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A and B	30 Sept 2011	Internal Reviews	KN	
C		Final for Client/update to incorporate clients comments	KN	MR

CONTENTS

APPENDICES

1 INTRODUCTION

This traffic modelling report is an addendum to Transport and Accessibility Impact Assessment, August 2011 prepared by Hyder Consulting for the planned Moorebank Intermodal Terminal Facility (SIMTA proposal). The August 2011 Transport and Accessibility Impact Assessment Report was an input to the environmental assessment undertaken on the SIMTA proposal and was included in Appendix K submitted for the Concept Plan application approval in November 2011.

This addendum 1 is to be read in conjunction with the August 2011 Transport and Accessibility Impact Assessment Report as this work is an extension to that previously reported.

The modelling results here do not change the conclusions drawn in August 2011 Transport and Accessibility Impact Assessment Report.

2 PURPOSE

The purpose of this addendum is to document network operational impact outside the core area (i.e. inner area). In Section 1.6.2 of the August 2011 Transport and Accessibility Impact Assessment Report, reference was made to the extension of the “core area” Paramics micro-simulation traffic model to enable network operational impact outside the core area.

3 MODELLING APPROACH

Hyder’s modelling investigation reaffirms that the road network impact from the SIMTA proposal will decline with greater distance from the site. The analysis found that the impact of the SIMTA proposal would be largely confined within the boundary of the core area. Mitigation measures were identified and reported in August 2011 Transport and Accessibility Impact Assessment Report based on both strategic modelling and core area Paramics modelling results.

Figure 3.1 shows coverage of “core area” and “inner area” in the context of SIMTA site for modelling purpose.

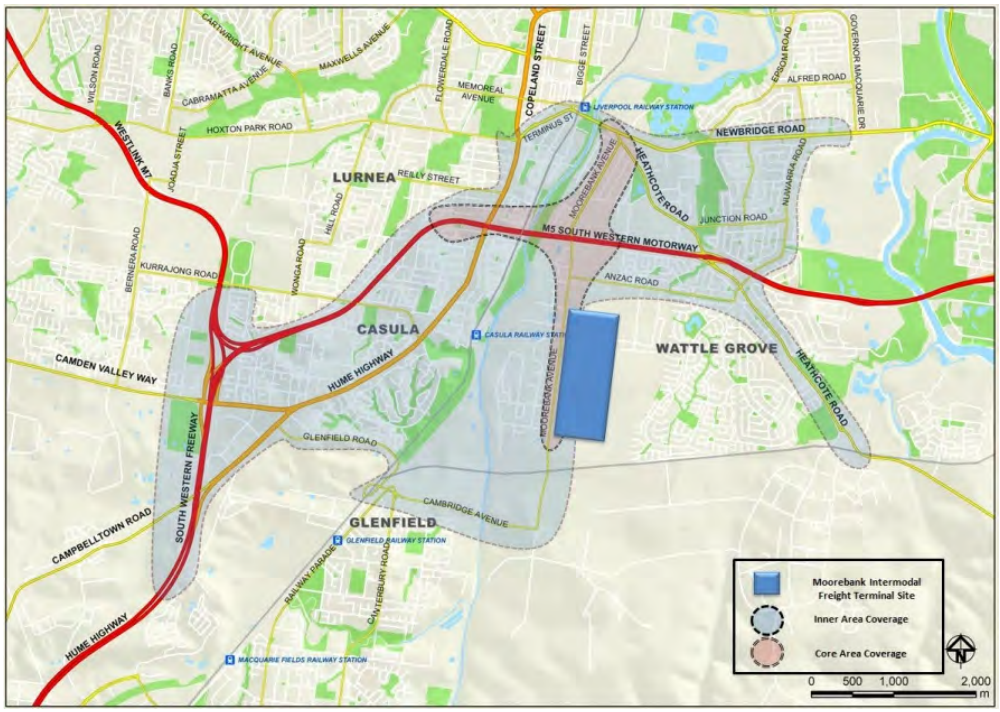


Figure 3.1 Core and Inner Area Road Network

The following Section 4 outlines modelling process undertaken for “inner area” Paramics modelling, the primary purpose of this addendum 1.

4 INNER AREA PARAMICS MODELLING

The “inner area” boundary was largely determined from Hyder’s own strategic modelling investigation and broader network capacity issues identified in the traffic and transport report prepared for the proposed M5 West Widening Project (M5 West widening, Environmental Assessment, September 2010, Roads and Traffic Authority).

Figure 4.1 shows Paramics modelling network for the inner area.

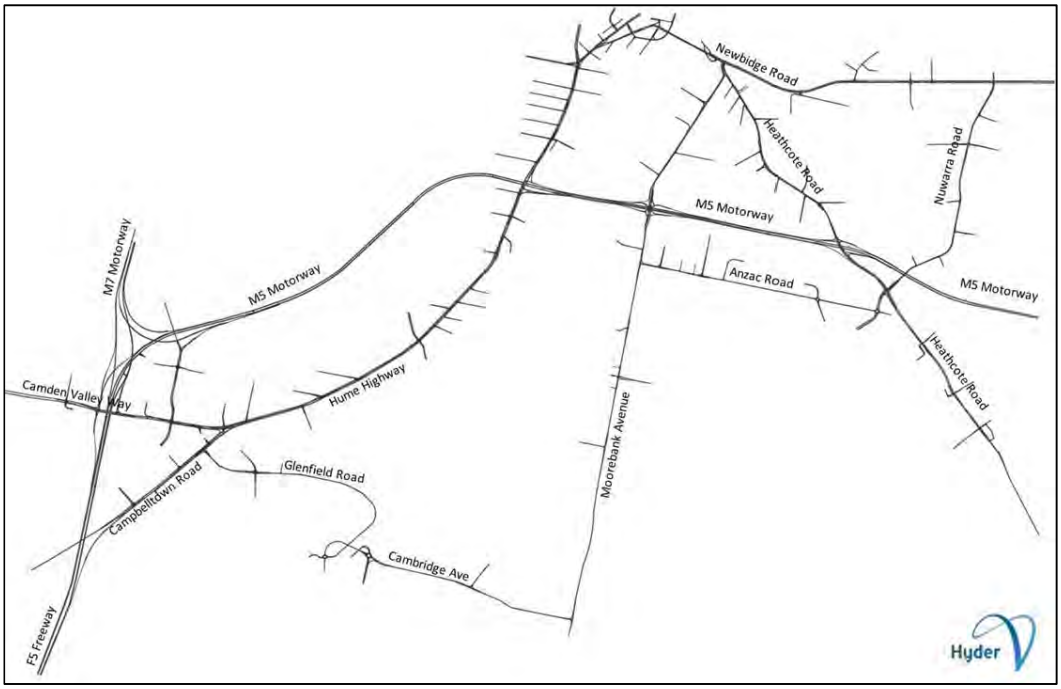


Figure 4.1 Inner Area Paramics Network

In general, the inner area Paramics model follows the similar modelling process undertaken for the core area. Both AM and PM peak period existing traffic conditions was modelled for inner area:

- AM peak period between 7:00 and 9:00, and
- PM peak period between 15:00 and 18:00.

In general, the inner area modelling network is bounded by the following key roads:

- **M5 Motorway** – Between F5 Freeway and Nuwarra Road overpass, including M5 interchanges with M7 Motorway, Hume Hwy, Moorebank Avenue and Heathcote Road.
- **Hume Highway and Campbelltown Road** – Between Hoxton Park Road and Hume Highway / Campbelltown Road overpass including interchange with the M5 Motorway.
- **Moorebank Avenue** – Between Cambridge Avenue and Newbridge Road.
- **Heathcote Road** – Between Newbridge Road and Macarthur Drive.
- **Anzac Road** – Anzac Road is an east-west local road that connects Moorebank Avenue and Heathcote Road.
- **Cambridge Avenue and Glenfield Road** – Between Moorebank Avenue and Campbelltown Road.

- **Macquarie Street / Terminus Street / Newbridge** – Between Hoxton Park Road and Nuwarra Road. These roads provide east-west access to Liverpool.
- **Camden Valley Way** – Between Ash Road and Campbelltown Road. This road provides access to M7 / M5 Motorway and Hume Highway.

Inner area Paramics models were calibrated and validated according to the RTA's Paramics modelling guideline. Detailed modelling results including network and demand development, calibration and validation, are documented in **Appendix A** of this Addendum 1 (Inner Area Paramics Model Development, Calibration and Validation).

The "inner area" Paramics modelling results confirmed that both AM and PM peak models were calibrated and validated adequately according to RTA guideline and models are fit for the study purpose.

4.1 Revalidate Existing Network Operation

In Section 3.3 of the August 2011 Transport and Accessibility Impact Assessment Report documented existing network operational issues and level of service (LoS) results. To revalidate the core area, the LoS analysis was repeated at following five key intersections (see Figure 4.2):

1. Moorebank Avenue / Anzac Road;
2. M5 Motorway / Moorebank Avenue;
3. M5 Motorway / Hume Highway;
4. Moorebank Avenue / Heathcote Road;
5. Newbridge Rd / Moorebank Avenue.

The LoS is forecast between B and E for above key intersections and in line with previous modelling outcome. Table B1 in **Appendix B** summarises LoS results for existing traffic condition based on inner area Paramics modelling.

The weaving issue on M5 Motorway between Moorebank Avenue and Hume Highway was revisited using inner area Paramics model. The weaving analysis predicts low level of service and is in line with previous modelling outcome. Detailed M5 weaving results are shown in Table B2 in **Appendix B**.

In addition to the above, level of service is estimated for additional eight key intersections outside the core area including (see Figure 4.2):

6. Hume Highway/Camden Valley Way
7. Hume Highway/Kurrajong Road
8. Hume Highway/ De Meyrick Avenue
9. Hume Highway/Hoxton Park Road
10. Newbridge Road/Speed Street
11. Newbridge Road/Nuwarra Road
12. Heathcote Road/ Nuwarra Road
13. Heathcote Road/M5 Motorway.

The LoS is forecast between B and F for key intersections analysed outside core area. The result shows that there are existing network capacity issues on the regional road network outside of core area. Table B3 in **Appendix B** shows LoS results for key intersections outside core area.

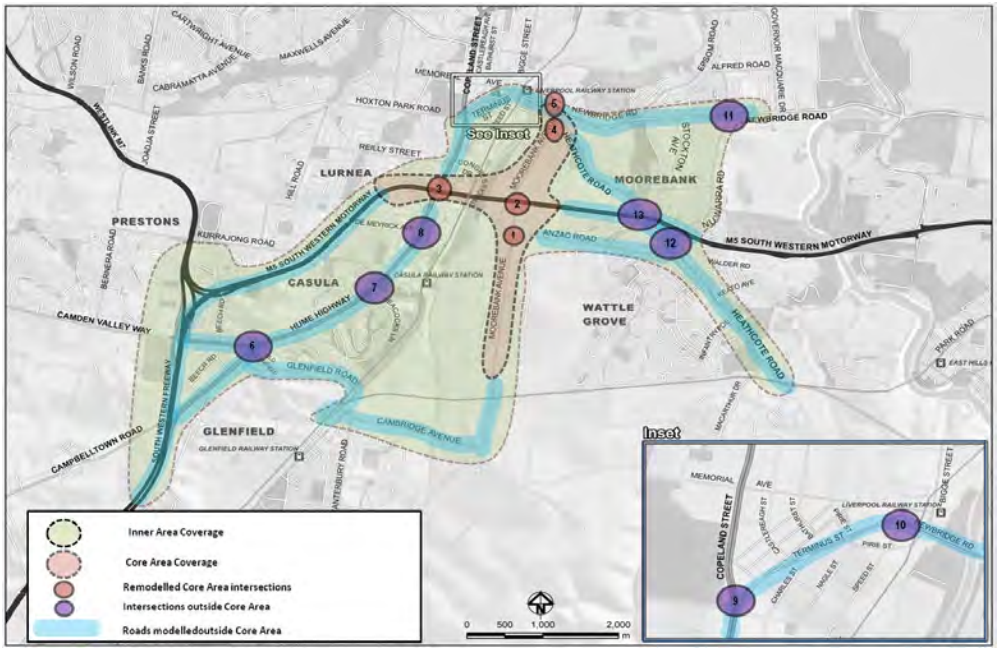


Figure 4-1 Inner area of impact (showing key intersections to be investigated / modelled)

4.2 Future Models

Inner area Paramics models were also developed for future year 2031 to compare the effect of SIMTA impact on road network. In Section 6.5 and Section 7.12 of the August 2011 Transport and Accessibility Impact Assessment Report documented future network performance without and with SIMTA case. The level of service analysis at key intersections is repeated.

The results show that outside the core area, there is no significant adverse impact on key roads following the introduction of the SIMTA proposal. Beyond the core area, where SIMTA heavy vehicle volume increases, it is generally by a small margin.

The level of service result at key intersections was found in line with previous modelling outcome. **Appendix C** summarises future level of service results without and with SIMTA case.

5 FINDINGS

There are forecast capacity issues for the local and regional road network; however, modelling result suggests that these are irrespective of whether or not the SIMTA proposal proceeds. In Section 9 of the August 2011 Transport and Accessibility Impact Assessment Report documented a range of infrastructure and non-infrastructure mitigation measures would be required when the SIMTA proposal is fully developed.

The inner area Paramics modelling results here do not change the conclusions drawn in August 2011 Transport and Accessibility Impact Assessment Report.

APPENDIX A

INNER AREA PARAMICS MODEL DEVELOPMENT, CALIBRATION AND VALIDATION

A1. MODEL DEVELOPMENT

Appendix A of Addendum 1 documents calibration and validation of the inner area micro-simulation models.

Quadstone Paramics Microsimulation Package (Version 6.6.1) was used for modelling.

The Paramics models were developed for both AM peak and PM peak periods:

- AM peak period between 7:00 and 9:00, and
- PM peak period between 15:00 and 18:00.

A1.1 Road Links

Previous Figure 4.1 in Addendum 1 shows Paramics modelling network for inner area.

The following road key roads were coded in the microsimulation models:

- **M5 Motorway** – Between F5 Freeway and Nuwarra Road overpass, including M5 interchanges with M7 Motorway, Hume Hwy, Moorebank Avenue and Heathcote Road.
- **Hume Highway and Campbelltown Road** – Between Hoxton Park Road and Hume Highway / Campbelltown Road overpass. This section includes a six lane divided highway and a major interchange with the M5 Motorway.
- **Moorebank Avenue** – Between Cambridge Avenue and Newbridge Road. This section mainly includes two lane undivided road (one lane each direction) up to south of its intersection with the M5 and provides a north-south link between Liverpool and Glenfield.
- **Heathcote Road** – Between Newbridge Road and Macarthur Drive. This road is generally a four-lane major road and extends north-south between Moorebank and Heathcote, where it links to the Southern Freeway (F6).
- **Anzac Road** – Anzac Road is an east-west local road that connects Moorebank Avenue and Heathcote Road. It provides access to Moorebank Business Park and the residential area of Wattle Grove. This is generally a two lane undivided road.
- **Cambridge Avenue and Glenfield Road** – Between Moorebank Avenue and Campbelltown Road.
- **Macquarie Street / Terminus Street / Newbridge** – Between Hoxton Park Road and Nuwarra Road. These roads provide east-west access to Liverpool.
- **Camden Valley Way** – Between Ash Road and Campbelltown Road. This road provides access to M7 / M5 Motorway and Hume Highway.

A1.2 Intersection Control

In total 22 traffic junctions were coded and included in the micro simulation models. Table A1 shows the intersection description and control type.

Table A1 Major intersections in the microsimulation model

ID	Intersection/Interchange	Intersection Type	Control Type
	M5 Motorway and		
	M7 Motorway	Grade separated	Interchange
A-5	Hume Highway	Grade separated	Signal
A-2	Moorebank Avenue	Grade separated	Signal
I-36	Heathcote Road	Grade separated	Signal
	Moorebank Avenue and		
A-13	Chatham Avenue	At-grade	Signal
A-3, A-4	Car park access	At-grade	Priority
A-1	Anzac Road	At-grade	Signal
A-11	Helles Avenue	At-grade	Priority
A-10	Church Road	At-grade	Priority
A-13	M5 Industrial Park access road	At-grade	Priority
A-9	M5 Industrial Park access road	At-grade	Signal
A-8	Heathcote Road	At-grade	Signal
A-7	Newbridge Road	At-grade	Signal
	Hume Highway and		
B-10	Hoxton Park Road / Macquarie Street	At-grade	Signal
B-9	Congressional Place / Reilly Street	At-grade	Signal
B-8	De Meyrick Avenue	At-grade	Signal
B-2	Camden Valley Way / Campbelltown Road	At-grade	Signal
	Newbridge Road and		
B-15	Nuwarra Road	At-grade	Signal
B-14	Stockton Avenue	At-grade	Signal
B-13	Speed Street	At-grade	Signal
I-29	Heathcote Road and Nuwarra Road	At-grade	Signal
A-6	Cambridge Avenue and Canterbury Road	At-grade	Roundabout

A1.3 Traffic Survey Data

Section 3.1 of Transport and Accessibility Impact Assessment, August 2011 report documented traffic surveys undertaken for the inner area.

A1.4 Public Transport

Following fixed bus routes were coded in the models including:

- 851: Carnes Hill – Liverpool,
- 855: Austral – Bringelly – Narellan – Liverpool,
- 864: Carnes Hill – Glenfield via Hornigsea Park,
- 865: Casula – Liverpool via Lurnea,
- 867: Prestons – Glenfield via Prestons,
- 870: Campbelltown – Ingleburn – Liverpool,
- 900: Strathfield Station – Liverpool,
- 901: Liverpool – Holsworthy,
- 902: Liverpool – Holsworthy, and
- 903: Liverpool – Chipping Norton.

A2. RTA Standards for Paramics Modelling

A2.1 Paramics flies

The following RTA standard Paramics files were incorporated in the models

- Vehicles
- Categories,
- Configuration,
- Acceleration Profiles, and
- Behaviour.

A2.2 Traffic assignment

For inner area Paramics modelling dynamic feedback assignment method was used. Perturbation was set to the default values 5% (using the Percentage Algorithm) according to the RTA's default value. With this option enabled, link costs are perturbed for each individual vehicle on a random basis. This means vehicles travelling between the same origin and destination with multiple routing options with up to 5% difference in the drivers' perceived costs can be assigned on different routes. Feedback smoothing was applied to successive feedback periods.

A2.3 Additional techniques

Additional Paramics techniques were used to adjust model parameters to replicate the existing traffic conditions. They are defined as follow:

- Next Lanes – Forcing into the correct lanes and avoiding the attractive but incorrect lanes which the vehicles should not move into;
- Cost Factor – The effect of this is to improve the attractiveness of major links to vehicles;
- Sign Posting – Increasing the signposting distance as long as possible, which is often subject to the link length to improve earlier lane changes and reduce unrealistic congestion/weaving;
- Node Blocking – Avoiding vehicle staying at signalised intersection where congestion occurs;
- Force Merge / Across – Forcing turning vehicle to cross the oncoming traffic after they have been delayed for some time where oncoming traffic leaves a gap at non-signalised intersection. This function was mainly activate when minor traffic tries to merge or turn into heavily congested/queued major stream;
- Reaction Factor – The Mean Driver Reaction Time for all vehicles on the link can be modified using this factor. This factor is mainly applied on links to reduce shockwave effect where drivers are aware of the surrounding condition;
- Headway Factor – The Mean Target Headway for all vehicles on the link can be modified using the factor. This factor is applied on high volume/low speed links where appropriate; and
- Approach Visibility – This function specifies length from an intersection that vehicle will be able to visibly see conflicts and judge if they will have to yield.

The model parameters are documented as per RTA's standard pro-forma. Should RTA requires a copy of model parameters for auditing, Hyder can provide them on request.

A2.4 Road Network Coding

Aerial photography and design drawing were primarily utilised to code the road network for the base model. The geo-reference aerial photography provided adequate information for the network coding task including road length, lane width, and number of lanes, lane discipline and intersection configurations. The model network was coded in the RTA Lamberts 94 coordinate system as per the RTA's recommendations. A link types and categories were coded based on the RTA Paramics manual.

A2.5 Signal Coding

Signal timing and phasing was coded as fixed time based on IDM record (SCATS data). During site visit signal timing and phasing was verified. .

A3. TRAFFIC DEMAND

A3.1 Source of Traffic Demand

The Paramics demand matrix was estimated using Hyder's own Sydney Strategic Traffic Model (SSTM) via a sub-area modelling technique. The SSTM sub area model contained about 58 travel zones. Further travel zones and network refinement were undertaken in Paramics. A total 67 travel zones are modelled in Paramics. The sub area demand matrix was calibrated using traffic counts data collected for this study.

Figures A1 and A2 show the zoning system used in SSTM's sub-area and Paramics models respectively.

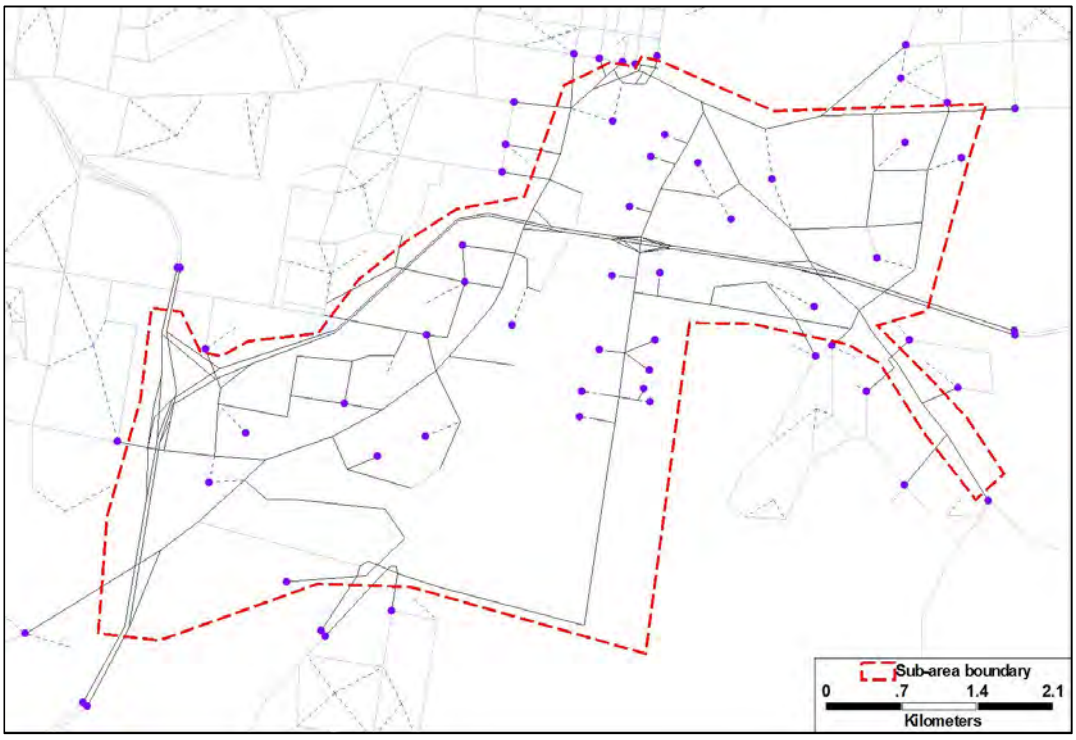


Figure A1 Zoning system in SSTM's sub-area

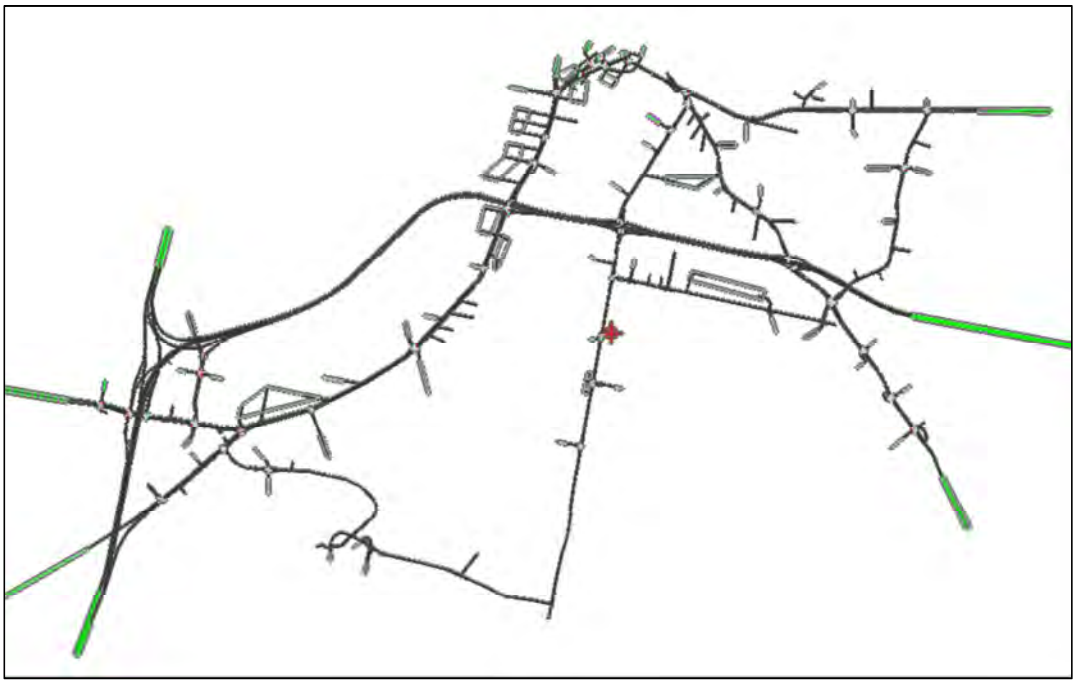


Figure A2 Zoning system in Paramics models

A3.2 Vehicle Classification

The demand matrices were produced for three main vehicle classes of:

- Light vehicle
- Truck/Bus
- Semi-Trailer and B-Double

Table A2 shows the proportion of vehicles in the matrices. The proportions have been modified according to the RTA Paramics guideline.

Table A2 Vehicle type proportion in the Paramics models

Matrix Number	Vehicle Type	Paramics Car Type	Proportion In Paramics Matrices
1	Private Car (Small)	type 1 car	31.223
	Private Car (Medium)	type 2 car	42.437
	Private Car (Large)	type 3 car	24.835
	Taxi	type 4 car	1.504
2	LGV	type 5 LGV	55.931
	STA Mini Bus – fixed	type 6 minibus	fixed route
	Non STA Mini Bus - fixed	type 7 minibus	fixed route
	STA Bus – fixed	type 8 bus	fixed route
	fixed route	fixed route	fixed route
	OD Bus	type 10 bus	0.786

Matrix Number	Vehicle Type	Paramics Car Type	Proportion In Paramics Matrices
3	Rigid (Light)	type 11 OGV1	5.263
	Rigid (Medium)	type 12 OGV1	32.757
	Rigid (Heavy)	type 13 OGV1	5.263
	Semi Trailer (Light)	type 14 OGV2	12.264
	Semi Trailer (Medium)	type 15 OGV2	69.811
	Semi Trailer (Heavy)	type 16 OGV2	12.264
	B-Double (Light)	type 17 OGV2	0.943
	B-Double (Medium)	type 18 OGV2	3.774
	B-Double (Heavy)	type 19 OGV2	0.943

A3.3 Temporal Distribution

Temporal traffic profiles for the inner area models were developed for 15-minute time slice for the entire simulation periods based on observed traffic flows data. About 28 directional traffic data was used to estimate sector-to-sector demand release profiles. About 13 sectors were identified for the modelling study area (see Figure A3).

In addition, 30 minutes warm-up and 30 minutes cool-down periods were applied based on the observed data.

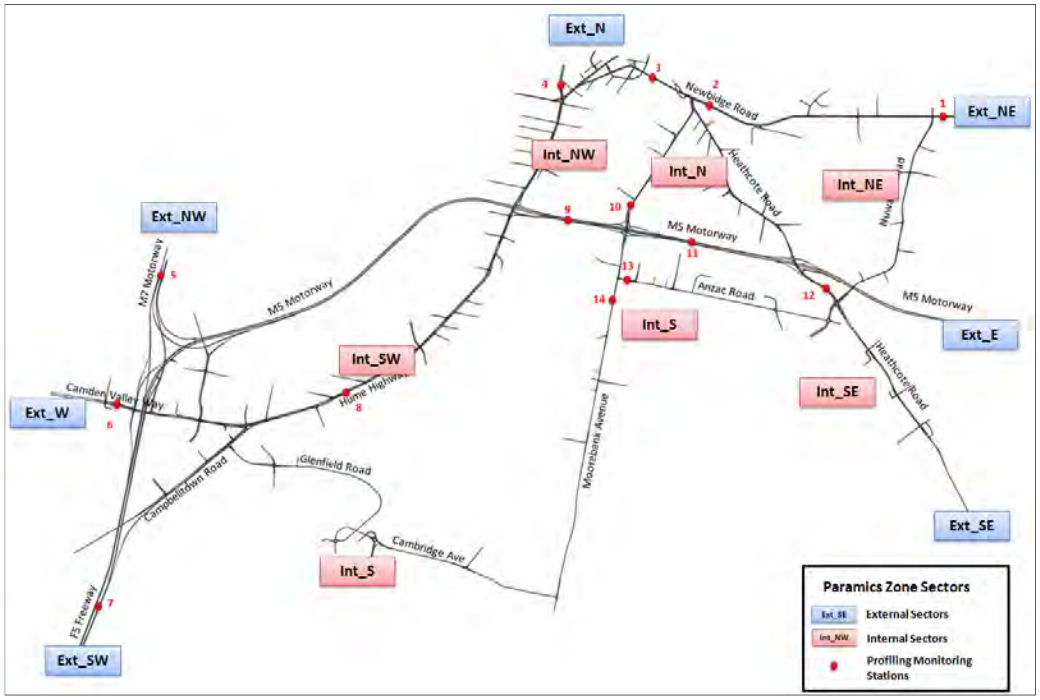


Figure A3 Paramics zone sections and profile monitoring stations

A4. CALIBRATION

The base year models were calibrated against set of survey data. Model calibration is the process that adjusts model parameters to adequately reflect the observed traffic behaviour and condition in the study area. The microsimulation calibration main guidelines were based on the following sources:

- RTA - Paramics Microsimulation Modelling Version 1.0 issued in May 2009,
- UK Design Manual for Road and Bridge (DMRB) issued by the Highway Agency, UK and last amended in November 2009.

A4.1 Link Flows and Intersection Turn Volumes

Individual link flows and intersection turning volumes have been assessed based on the calibration criteria. Tables A3 and A4 summarise the calibration results for AM and PM peak models. Tables A5 and A6 show link flow comparison for AM and PM peak models. Should RTA require a copy of turn flows comparison at individual intersections, Hyder can provide them on request.

The model calibration results summarised in this section demonstrate that both AM and PM peak models are calibrated adequately and models are fit for purpose.

Table A3 2010 AM peak Paramics model calibration summary

Link Flows		
Individual links		
Number of individual link flows (by direction)	22	
< 700 vhp	*3*	
700 - 2,700 vhp	*10*	
> 2,700 vhp	*9*	
Average link flow	2359	vph
Meet the assessment criteria (UK-DMRB)	**Target**	**Achieved**
Difference in link flow within 100 for flows <700 vph	85%	100%
Difference in link flow within 15% for flows 700-2,700 vph	85%	100%
Difference in link flow within 400 for flows >2700 vph	85%	89%
Difference of total screen line flows	10%	3%
GEH Statistic less than 5 of all individual modelled flow	85%	95%
Intersection Turning Volunms		
Number of turn flows	199	(24 intersections)
< 700 vhp	*154*	
700 - 2,700 vhp	*43*	
> 2,700 vhp	*2*	
Average turn flow	422	vph
Meet the assessment criteria (UK-DMRB)	**Target**	**Achieved**
Difference in link flow within 100 for flows <700 vph	85%	93%
Difference in link flow within 15% for flows 700-2,700 vph	85%	88%
Difference in link flow within 400 for flows >2,700 vph	85%	100%
GEH Statistic less than 5 of all individual modelled flow	85%	83%
Demand Release		
Meet the assessment criteria (RTA Guideline)	**Target**	**Achieved**
Release for the base model	100%	100%

Model code: 2010 AM_TZ067_BC_RevH

Table A4 2010 PM peak Paramics model calibration summary

Link Flows		
Individual links		
Number of individual link flows (by direction)	22	
< 700 vhp	*3*	
700 - 2,700 vhp	*10*	
> 2,700 vhp	*9*	
Average link flow	2409	vph
Meet the assessment criteria (UK-DMRB)	**Target**	**Achieved**
Difference in link flow within 100 for flows <700 vph	85%	100%
Difference in link flow within 15% for flows 700-2,700 vph	85%	90%
Difference in link flow within 400 for flows >2700 vph	85%	89%
Difference of total screen line flows	10%	2%
GEH Statistic less than 5 of all individual modelled flow	85%	91%
Intersection Turning Volunms		
Number of turn flows	199	(24 intersections)
< 700 vhp	*155*	
700 - 2,700 vhp	*41*	
> 2,700 vhp	*3*	
Average turn flow	Mean Flow	vph
Meet the assessment criteria (UK-DMRB)	**Target**	**Achieved**
Difference in link flow within 100 for flows <700 vph	85%	94%
Difference in link flow within 15% for flows 700-2,700 vph	85%	85%
Difference in link flow within 400 for flows >2,700 vph	85%	100%
GEH Statistic less than 5 of all individual modelled flow	85%	83%
Demand Release		
Total vehicle demand input to network (From Demand Modelling)		
Modelled - Total vehicles released from the zones in Paramics	94,491	
Modelled - Total vehicles Blocked in the zones	757	
Meet the assessment criteria (RTA Guideline)	**Target**	**Achieved**
Release for the base model	100%	99.2%

Model code: 2010 PM_TZ067_BC_RevC

Table A5 Comparisons of link flows - AM Peak

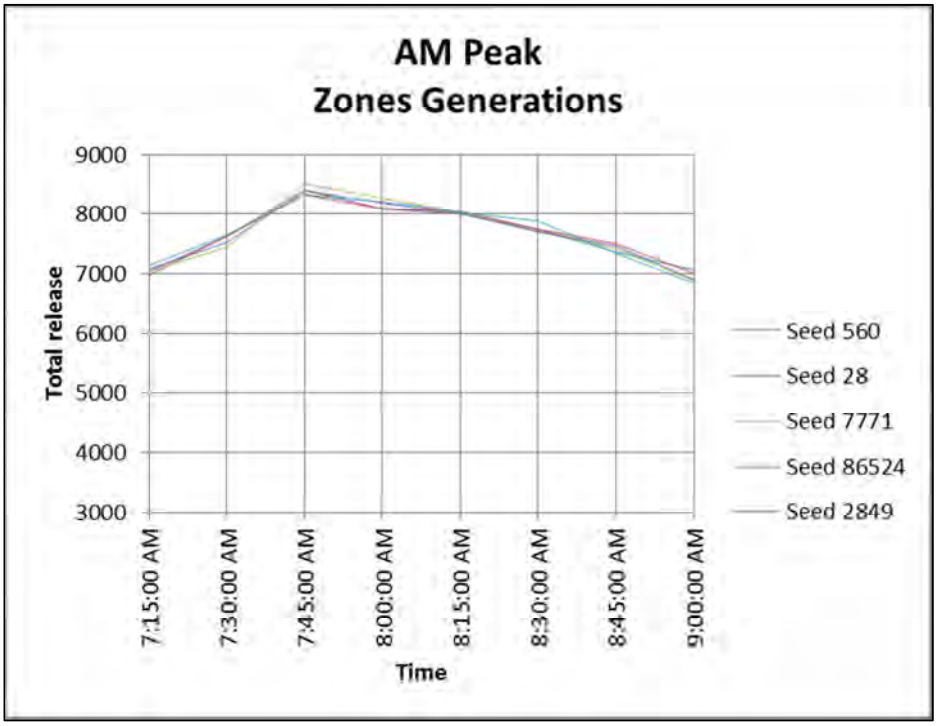
Road/Location	Observed			Modelled			Difference			GEH		
	NB/EB	SB/WB	Two-Way	NB/EB	SB/WB	Two-Way	NB/EB	SB/WB	Two-Way	NB/EB	SB/WB	Two-Way
M5 Motorway-East of Moorebank Avenue	4,071	4,214	8,285	4,210	3,800	8,000	3%	-10%	-3%	2	7	3
M5 Motorway-West of Moorebank Avenue	5,249	4,390	9,638	5,080	4,350	9,430	-3%	-1%	-2%	2	1	2
M5 Motorway-South of Kurrajong Road	3,997	3,280	7,277	3,920	3,030	6,950	-2%	-8%	-4%	1	4	4
Moorebank Avenue-North of M5 Motorway	1,945	554	2,499	2,050	530	2,580	5%	-4%	3%	2	1	2
Moorebank Avenue-South of Anzac Road	1,114	622	1,735	1,050	550	1,600	-6%	-12%	-8%	2	3	3
Moorebank Avenue-South of Jacquinot Road	1,098	372	1,471	1,070	310	1,390	-3%	-17%	-5%	1	3	2
Newbridge Road-East of Moorebank Avenue	2,229	965	3,194	2,200	1,040	3,240	-1%	8%	1%	1	2	1
Newbridge Road-West of Moorebank Avenue	1,549	1,590	3,140	1,600	1,680	3,280	3%	6%	4%	1	2	2
Newbridge Road-East of Nuwarra Road	2,740	1,185	3,925	2,890	1,270	4,160	5%	7%	6%	3	2	4
F5 Freeway-South of Campbelltown Road	4,442	3,079	7,521	4,350	3,100	7,450	-2%	1%	-1%	1	0	1
Heathcote Road-South of Nuwarra Road	1,845	1,360	3,205	1,840	1,320	3,160	0%	-3%	-1%	0	1	1

Table A6 Comparisons of link flows - PM Peak

Road/Location	Observed			Modelled			Difference			GEH		
	NB/EB	SB/WB	Two-Way	NB/EB	SB/WB	Two-Way	NB/EB	SB/WB	Two-Way	NB/EB	SB/WB	Two-Way
M5 Motorway-East of Moorebank Avenue	4,107	4,367	8,474	4,680	4,130	8,810	14%	-5%	4%	9	4	4
M5 Motorway-West of Moorebank Avenue	4,483	5,477	9,960	4,410	5,480	9,890	-2%	0%	-1%	1	0	1
M5 Motorway-South of Kurrajong Road	3,404	3,865	7,269	3,290	3,720	7,000	-3%	-4%	-4%	2	2	3
Moorebank Avenue-North of M5 Motorway	669	1,818	2,487	720	1,880	2,600	7%	3%	4%	2	1	2
Moorebank Avenue-South of Anzac Road	587	1,117	1,704	530	1,220	1,750	-10%	9%	2%	3	3	1
Moorebank Avenue-South of Jacquinot Road	376	1,190	1,566	320	1,210	1,530	-14%	2%	-2%	3	1	1
Newbridge Road-East of Moorebank Avenue	1,199	2,147	3,345	1,100	2,280	3,390	-8%	6%	1%	3	3	1
Newbridge Road-West of Moorebank Avenue	1,545	1,612	3,157	1,810	1,430	3,250	17%	-11%	3%	7	5	2
Newbridge Road-East of Nuwarra Road	1,556	2,784	4,340	1,480	2,760	4,240	-5%	-1%	-2%	2	0	2
F5 Freeway-South of Campbelltown Road	3,873	3,660	7,532	3,870	3,480	7,350	0%	-5%	-2%	0	3	2
Heathcote Road-South of Nuwarra Road	1,477	1,686	3,163	1,490	1,780	3,260	1%	5%	3%	0	2	2

A4.2 Model Stability

The stability of the Paramics modes was checked by running the model for five different seeds recommended by the RTA (seed 560, 28, 7771, 86524 and 2849) and producing the zone release graphs over time. Figure A4 and Figure A5 show the model stability graphs. The results confirm that both models are stable.



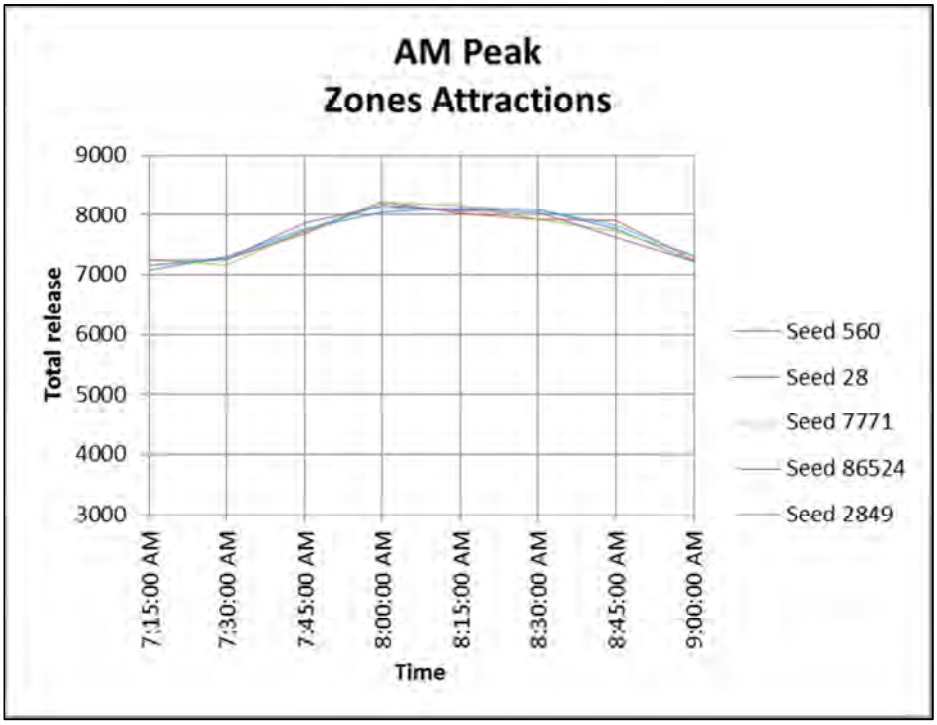
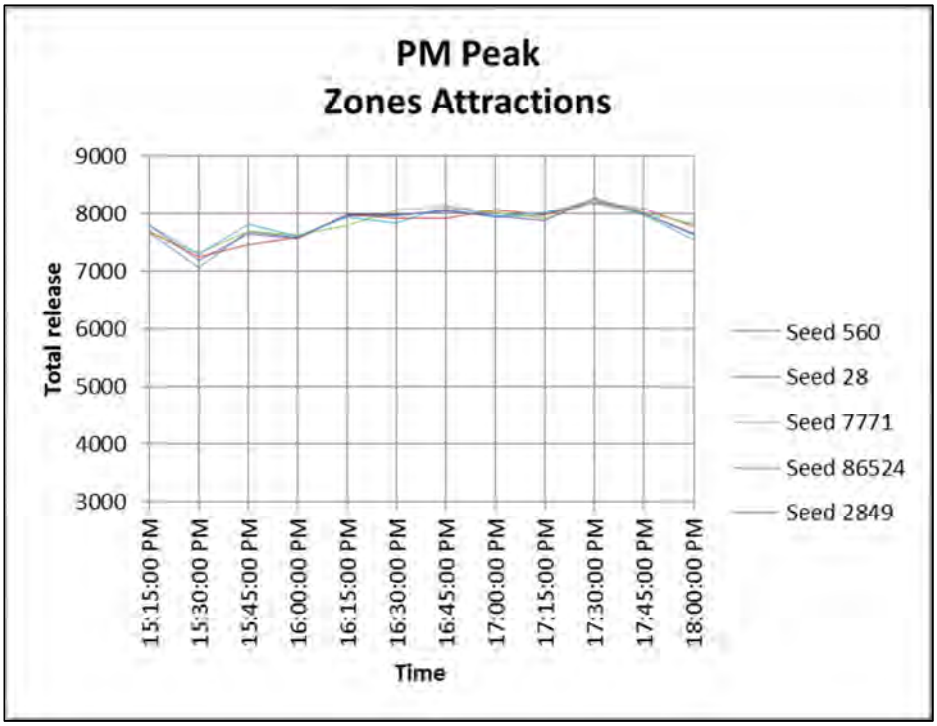


Figure A5 Model stability check – AM peak model



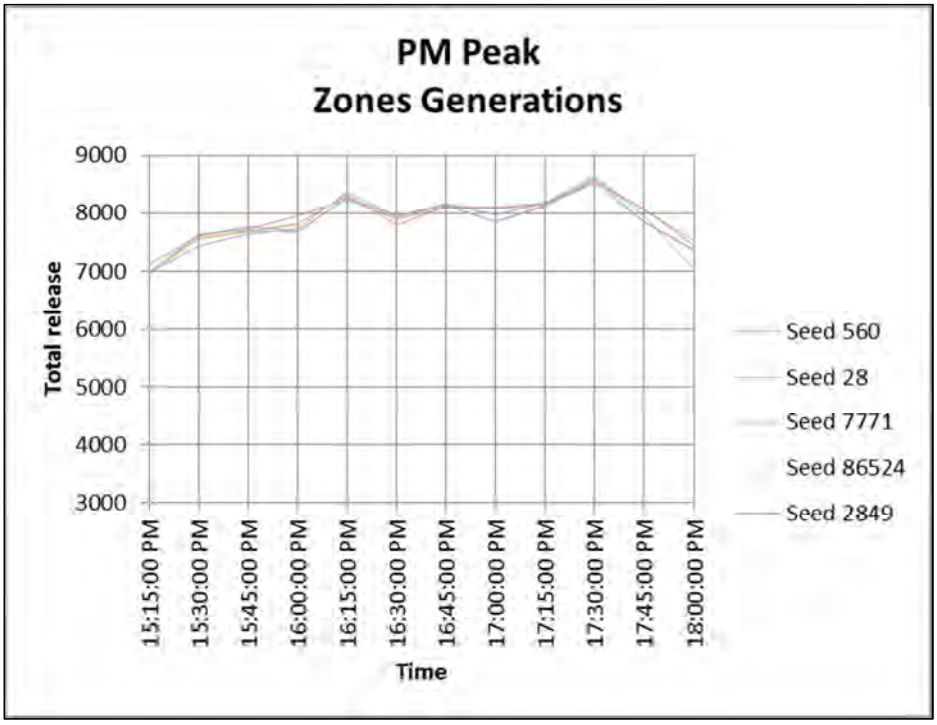


Figure A6 Model stability check – PM peak model

A5. VALIDATION

The Paramics models were validated against observed screenline flows, travel time, traffic profiles and queue length. An analytical model based on HCM 2000 was developed to assess the performance of the weaving section in AM and PM peak periods. This was based on the Origin-Destination survey on M5 eastbound between Hume Highway Interchange and Moorebank Avenue Interchange. The results of HCM 2000 modelling were further compared with Paramics results to provide an independent verification of the modelled weaving section.

A5.1 Screenline

Screenline flows comparison provides a good indication that the calibrated models accurately replicate observed traffic patterns on the major routes. Figure A6 shows six screenlines developed for the study area.

The comparison results in Tables A7 and A8 indicates close match within 10 per cent different between observed and modelled screenline flows. This indicates that the models replicate the observed traffic pattern for the study area.

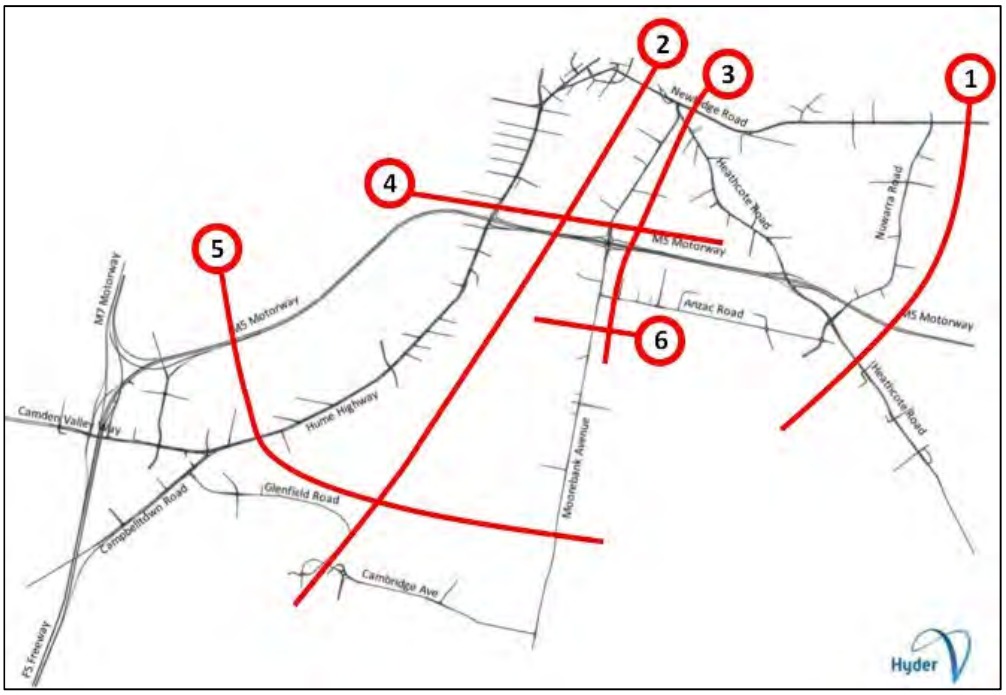


Figure A6 Screenline locations – inner area model

Table A7 Screenline flow comparisons – AM peak

Screenline Comparisons	Observed		Model		Achieved Values		
	All - AM 1Hr		All - AM 1Hr		All - AM 1Hr		
	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	Two-way
1	7,473	5,821	8,200	6,200	10%	7%	9%
2	7,349	6,557	7,200	6,900	-2%	5%	1%
3	7,134	6,279	7,500	5,800	5%	-8%	-1%
4	5,291	2,396	5,300	2,200	0%	-9%	-3%
5	7,671	4,898	7,200	5,000	-6%	2%	-3%
6(1)	1,114	622	1,000	600	-6%	-11%	-8%

Note: (1) Screenline 6 consist of one road, Moorebank Avenue

Table A8 Screenline flow comparisons – PM peak

Screenline Comparisons	Observed		Model		Achieved Values		
	All - AM 1Hr		All - AM 1Hr		All - AM 1Hr		
	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB	Two-way
1	6,423	8,604	6,600	8,700	3%	1%	2%
2	6,724	7,521	6,800	7,500	1%	0%	1%
3	6,436	7,477	6,800	7,500	5%	1%	3%
4	2,976	5,324	2,900	5,400	-2%	2%	1%
5	5,221	7,658	5,300	7,800	2%	2%	2%
6(1)	587	1,117	500	1,200	-10%	9%	2%

Note: (1) Screenline 6 consist of one road, Moorebank Avenue

A5.2 Queue Length

In order to validate the observed queue length, extensive queue surveys were carried out during AM peak and PM peak for the following key intersections in the study area:

- Moorebank Avenue and Anzac Road
- M5 and Moorebank Avenue
- M5 and Hume Highway
- Newbridge Road and Moorebank Avenue
- Moorebank Avenue and Heathcote Road
- Newbridge Road and Nuwarra Road
- Heathcote Road and Nuwarra Road
- M5 and Heathcote Road
- Newbridge Road and Speed Street

- Hume Highway and Hoxton Park Road
- Camden Valley Way and Campbelltown Road

The queue length data were compared for minimum, maximum, average and 95th percentile queue length. During validation period, queue length data from video survey was observed.

Should RTA require a copy of queue length comparison between observed and modelled condition, Hyder can provide them on request.

A5.3 Travel Time

Travel time comparison provides a good indication that the calibrated models accurately reflect delay conditions on major routes in the study area. Modelled travel time was validated against observed data for three key strategic routes for the study area as shown in Figure A7.

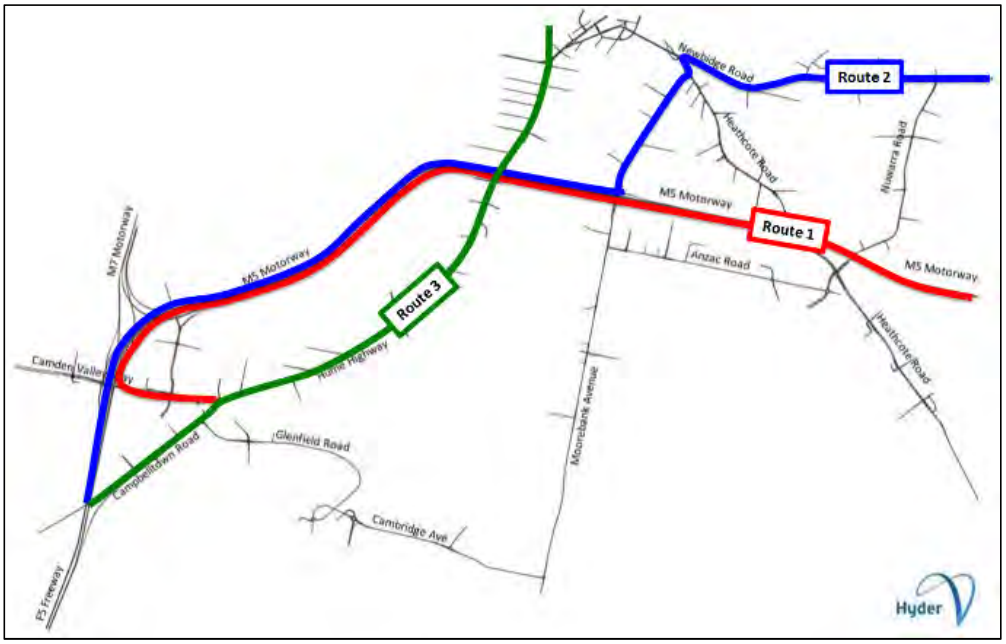


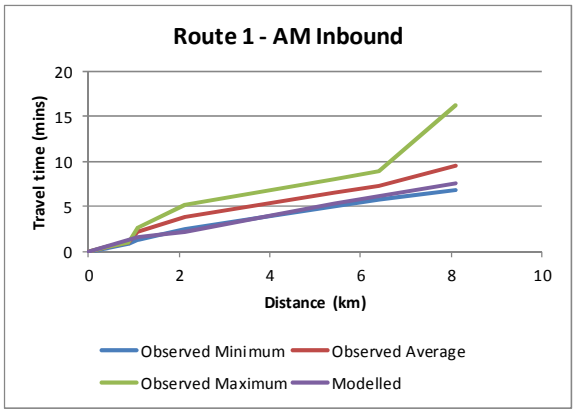
Figure A7 Travel time validation routes

The travel time comparisons in Figures A8 and A9 below show the modelled travel times well within the upper and lower bounds of observed travel times.

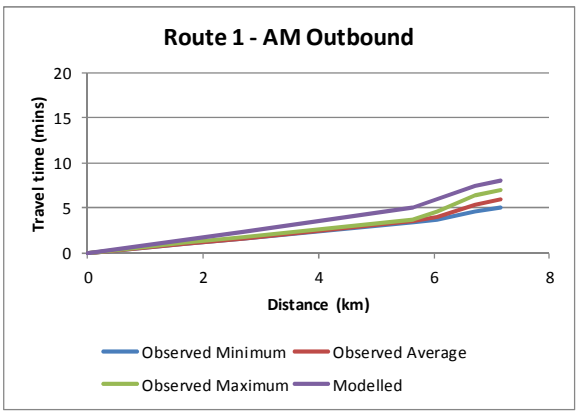
In a summary, inner area Paramics models are validated against observed queue length and travel time data for both AM and PM peak period.

AM Peak

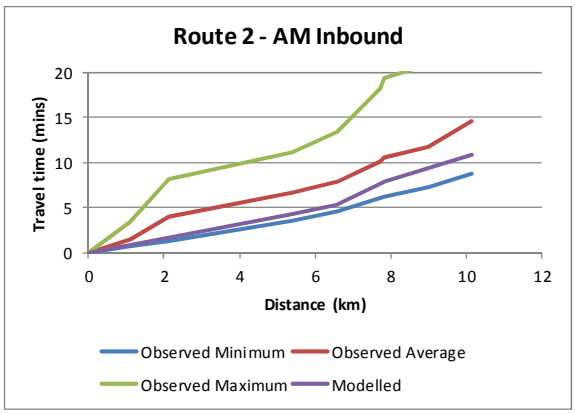
Route 1 - Inbound



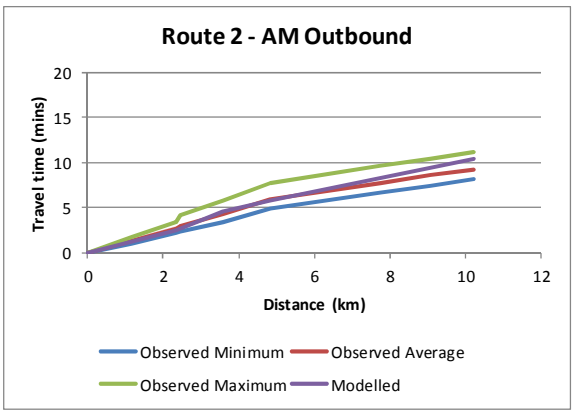
Route 1 - Outbound



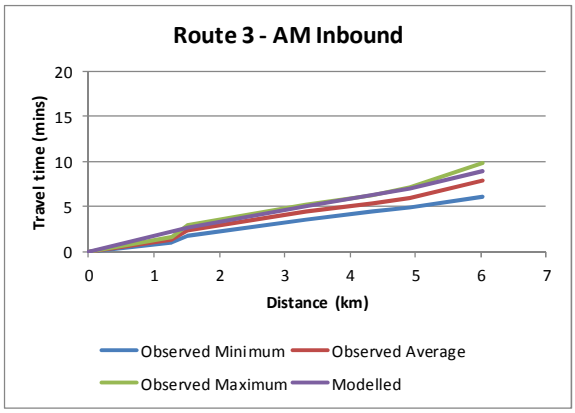
Route 2 - Inbound



Route 2 - Outbound



Route 3 - Inbound



Route 3 - Outbound

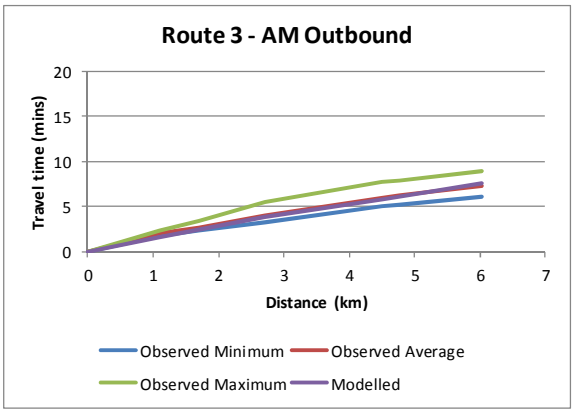
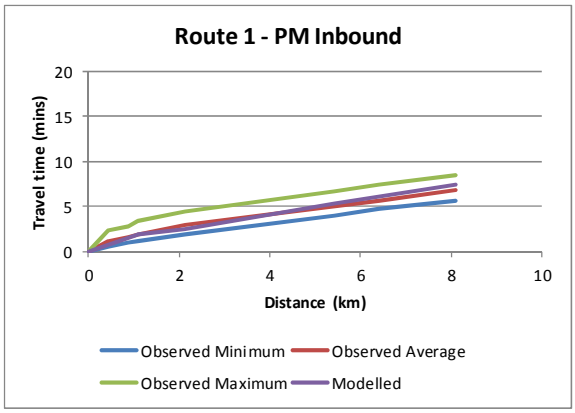


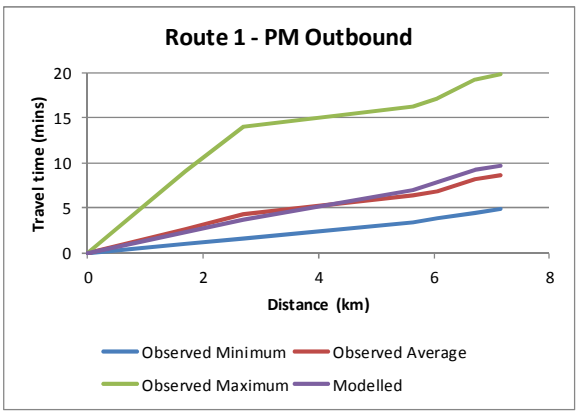
Figure A8 Travel time comparisons – AM Peak

PM Peak

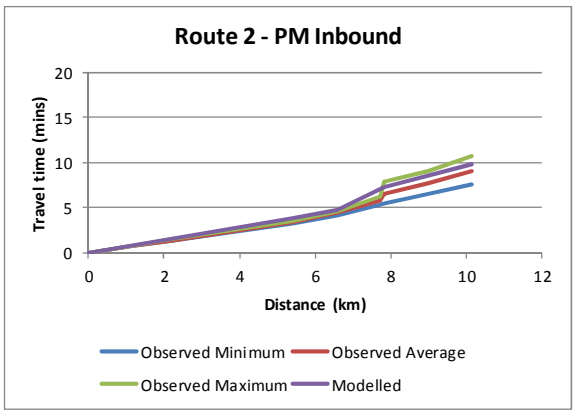
Route 1 - Inbound



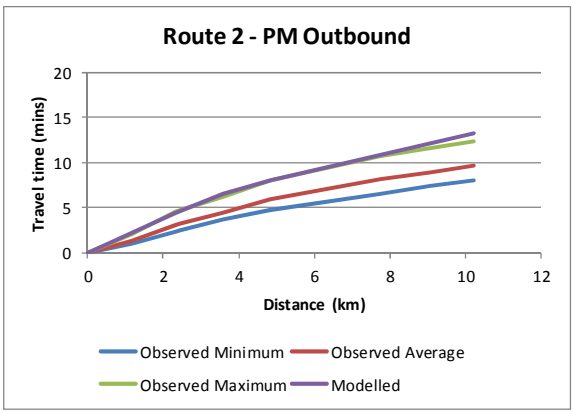
Route 1 - Outbound



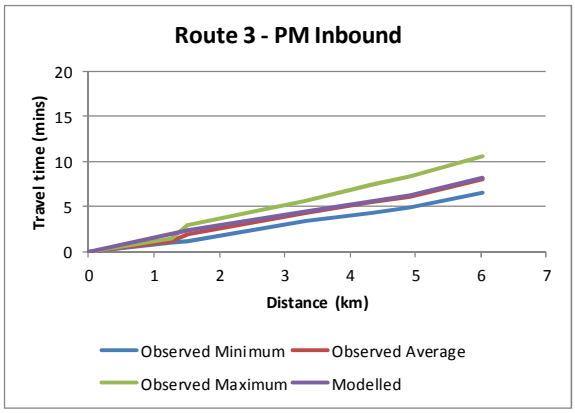
Route 2 - Inbound



Route 2 - Outbound



Route 3 - Inbound



Route 3 - Outbound

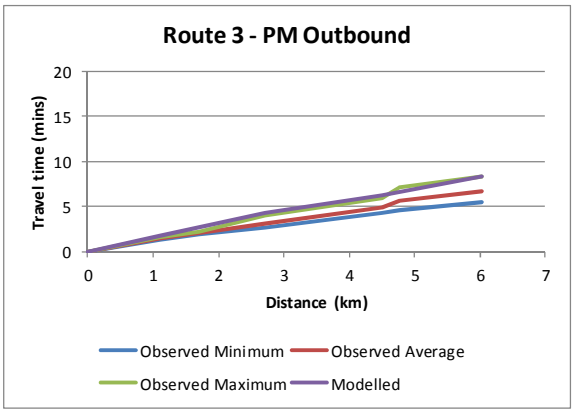


Figure A9 Travel time comparisons – PM Peak

A5.4 Demand Profile

Demand profile validation was undertaken at 15-minute intervals against observed data at 28 monitoring stations across the study area. Figures A10 to A13 show comparison between observed and modelled profiling. The results suggest that models are validated to reflect travel behaviour across the study area.

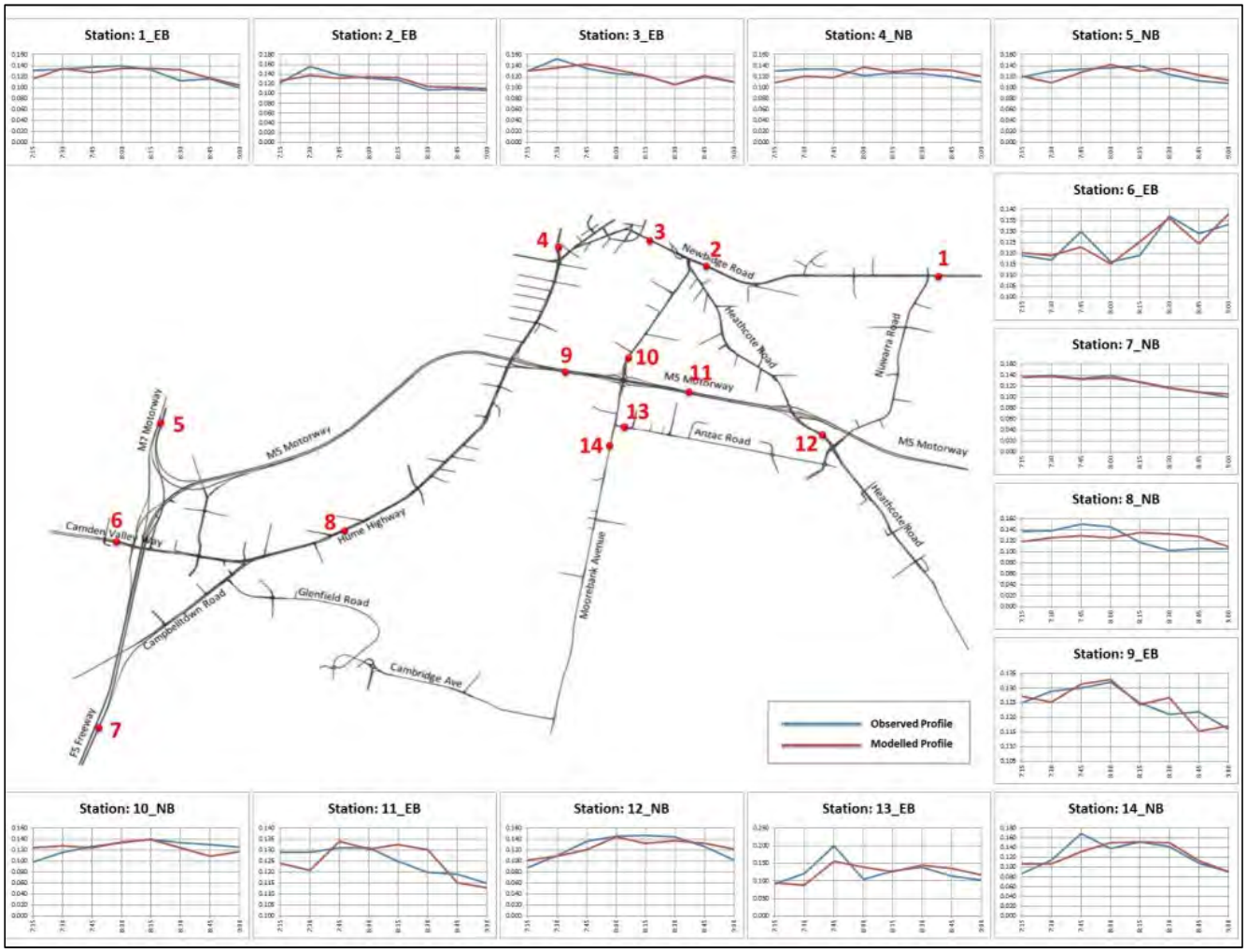


Figure A10 Demand profile validation – AM Peak Northbound/Eastbound

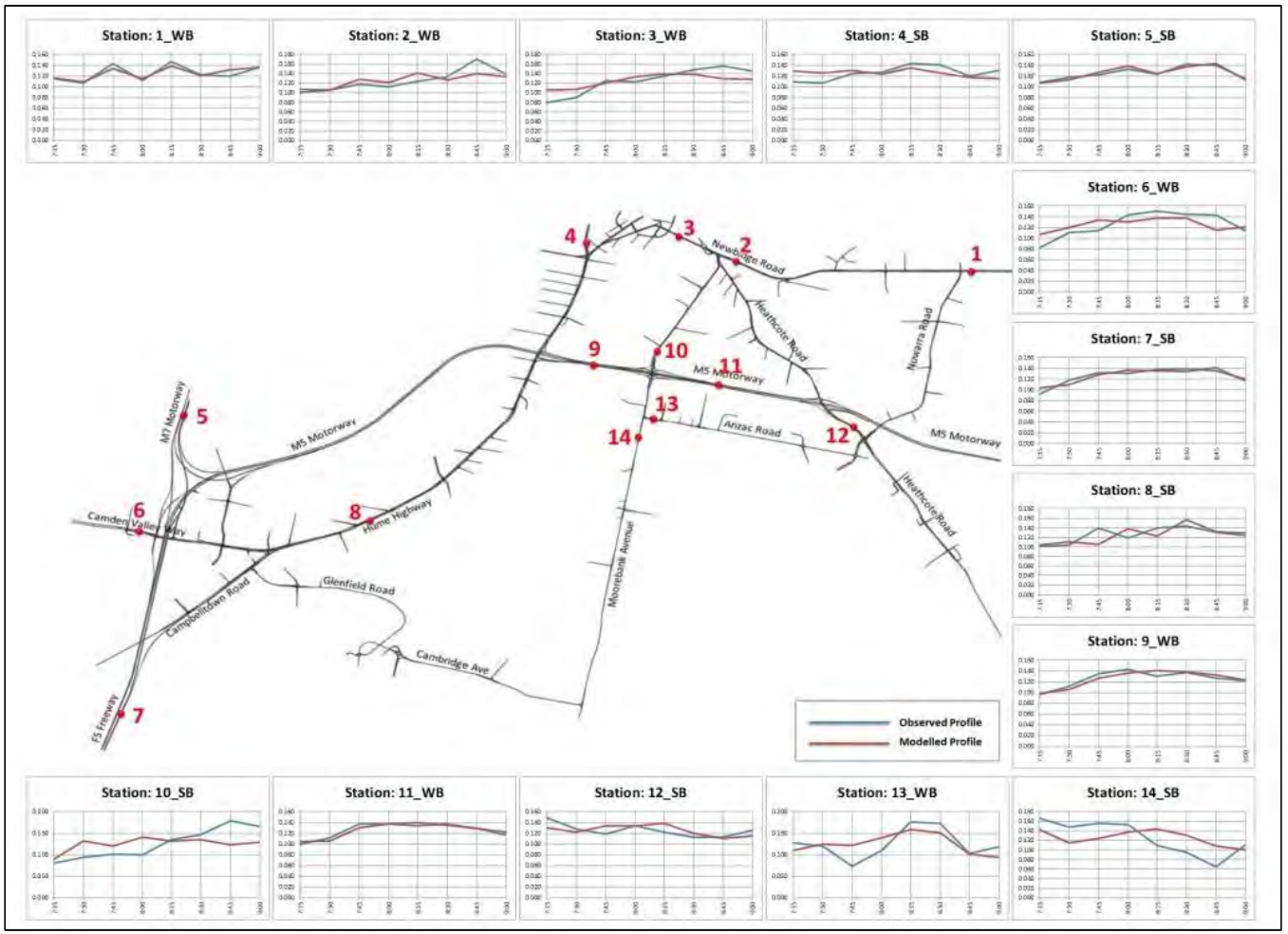


Figure A11 Demand profile validation – AM Peak Southbound/Westbound

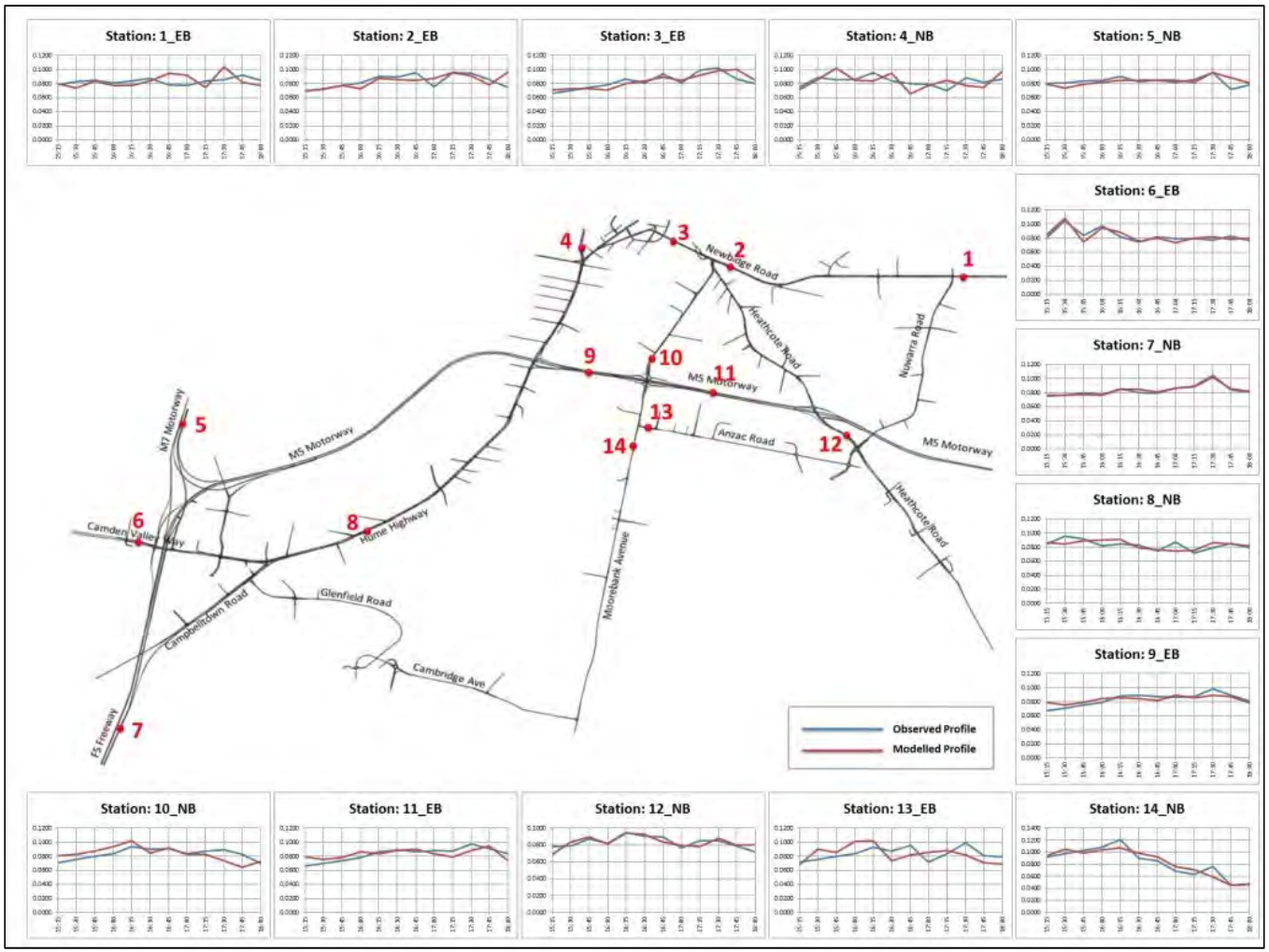


Figure A12 Demand profile validation – PM Peak Northbound/Eastbound

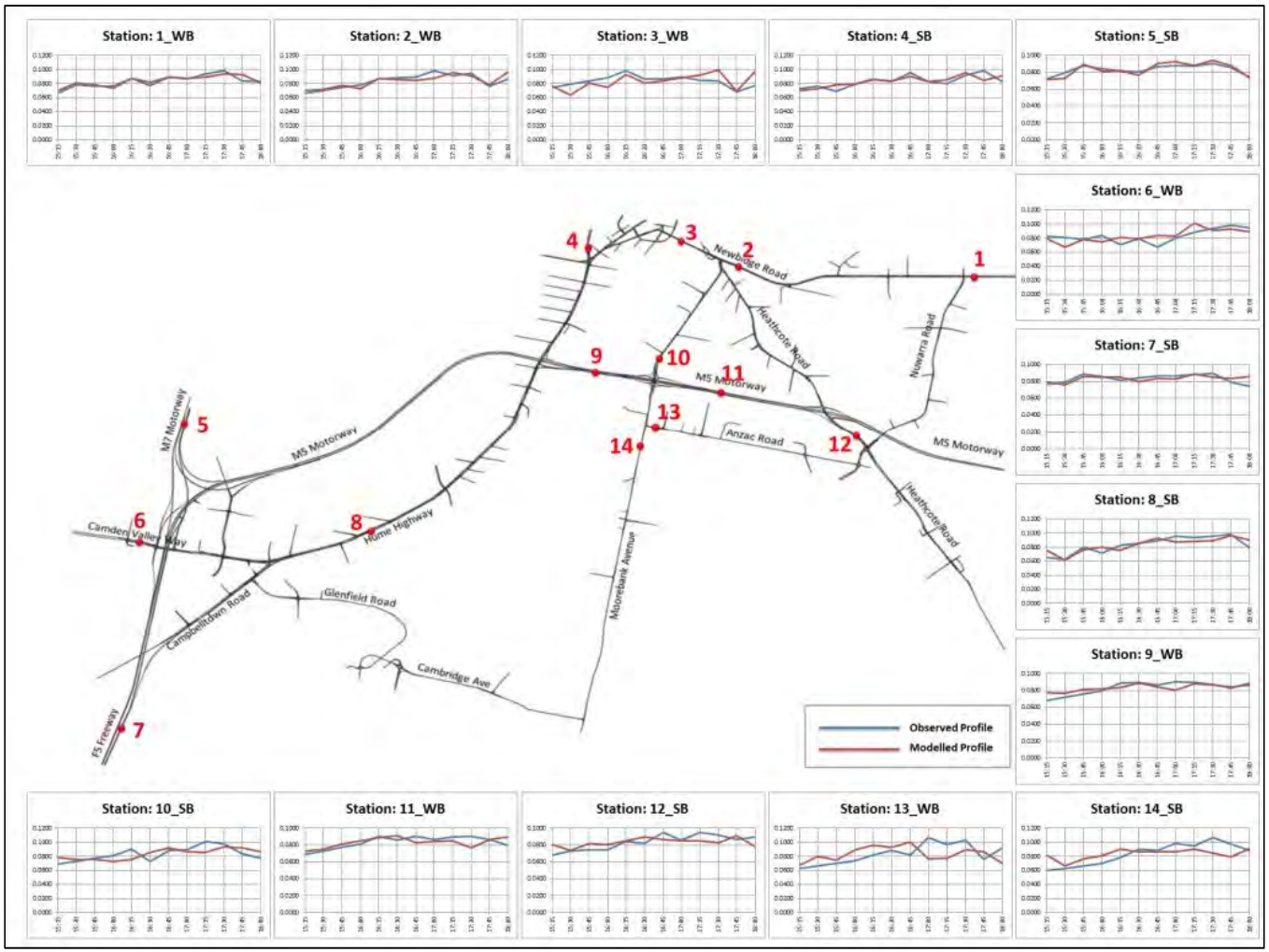


Figure A13 Demand profile validation – PM Peak Southbound/Westbound

A5.5 M5 Weaving Validation

The weaving analysis for M5 eastbound between Hume Highway and Moorebank Avenue was repeated using inner area Paramics models (see Table A9 below). The inner area Paramics shows similar weaving results to previous analysis. The inner area Paramics modelling results here do not change the previous conclusions drawn in August 2011 Transport and Accessibility Impact Assessment Report (Section 3.3.4).

Table A9 Weaving validation results

Performance Index	AM Peak (7-8 am)		PM Peak (5-6 pm)	
	HCM 2000[1]	Paramics	HCM 2000[1]	Paramics
Weaving segment speed (km/h)	62.96	51.90	72.82	77.62
Weaving segment density (pc/km/ln)	23.60	26.59	16.50	14.76
Weaving segment LoS	E	E	C	C
Weaving flow Ratio (VR)	0.39		0.32	

Note: 1. Analysis based on Highway Capacity Manual (2000) weaving segment Type A

A6. SUMMARY

The modelling results presented above confirmed that both AM and PM peak Paramics models for “inner area” were calibrated and validated adequately and models are fit for the study purpose.

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APPENDIX B

EXISTING ROAD NETWORK PERFORMANCE

B1. Existing Road Network Performance

The existing road network issues are revised using inner area Paramics model. The results from Paramics model are reported in a similar fashion to Section 3.3 of August 2011 Transport and Accessibility Impact Assessment Report.

To maintain the consistency with main traffic report (August 2011 Transport and Accessibility Impact Assessment Report), the network capacity issues are identified and reported for following two cases:

- Within the core area.
- Outside the core area.

The LoS analysis was repeated for existing traffic condition at following five key intersections:

- Moorebank Avenue / Anzac Road;
- M5 Motorway / Moorebank Avenue;
- M5 Motorway / Hume Highway;
- Moorebank Avenue / Heathcote Road;
- Newbridge Rd / Moorebank Avenue.

The LoS is forecast between B and E for above key intersections and in line with previous modelling outcome. Table B1 summarises LoS results for existing traffic condition based on inner area Paramics modelling.

The weaving issue on M5 Motorway between Moorebank Avenue and Hume Highway was revisited using inner area Paramics model. The weaving analysis predicts low level of service and is in line with previous modelling outcome. Detailed M5 weaving results are shown in Table B2.

In addition to the above, LoS is estimated for additional eight key intersections outside the core area including.

- Hume Highway/Camden Valley Way
- Hume Highway/Kurrajong Road
- Hume Highway/ De Meyrick Avenue
- Hume Highway/Hoxton Park Road
- Newbridge Road/Speed Street
- Newbridge Road/Nuwarra Road
- Heathcote Road/ Nuwarra Road
- Heathcote Road/M5 Motorway.

The LoS is forecast between B and F for key intersections analysed outside core area (see Table B3). The results in Table B3 suggest that currently there are network capacity issues on the regional road network outside the core area.

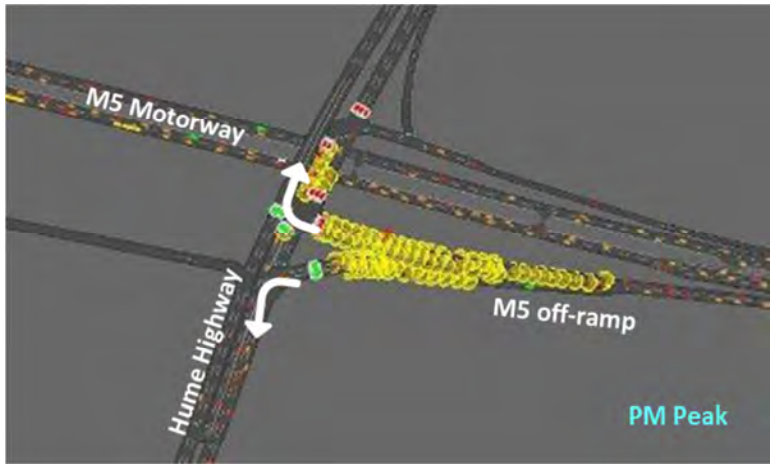
The results summarise in Appendix B here therefore do not change the conclusion drawn in Section 3.3.2 of the August 2011 Transport and Accessibility Impact Assessment Report.

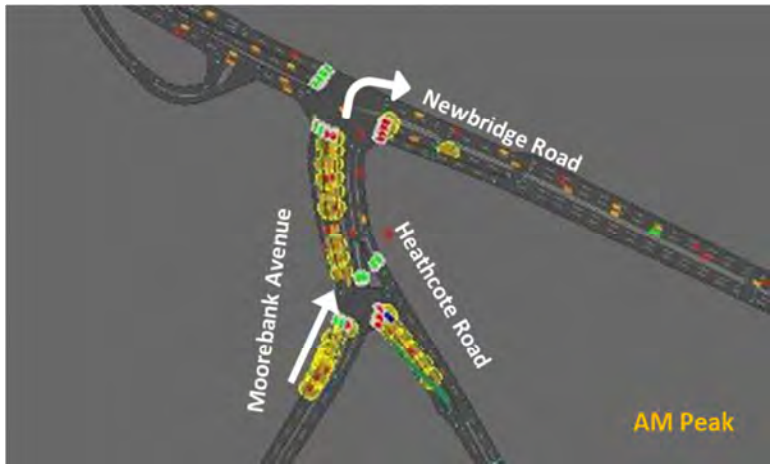
Table B1 Current road network capacity – Core Area

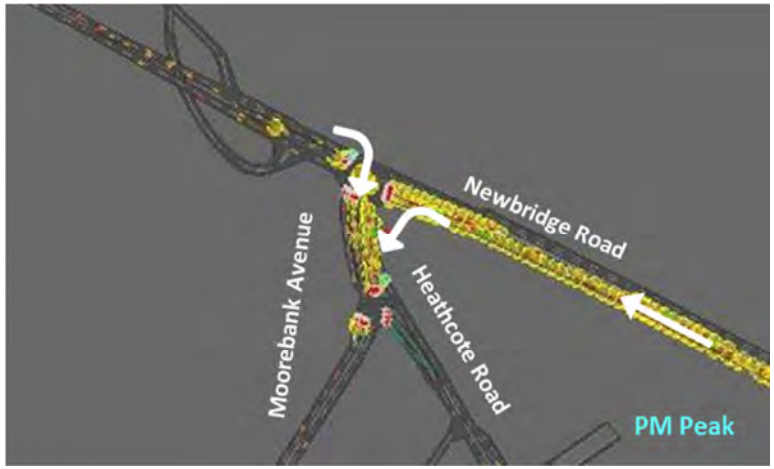
Intersection Level of Service (LoS) – Core Area									
Intersection	Approach	AM Peak				PM Peak			
		Average Delay	LoS (Delay)	Overall Average Delay	LoS	Average Delay	LoS (Delay)	Overall Average Delay	LoS
1. Moorebank Avenue / Anzac Road	North	33	C	24	B	30	C	25	B
	East	27	B			33	C		
	South	24	B			17	B		
	North Slip Lane	3	A			3	A		
2. M5 Motorway / Moorebank Avenue	North -Right Turn	27	B	24	B	26	B	25	B
	North- Trough	26	B			25	B		
	East	22	B			33	C		
	South - Right Turn	29	C			37	C		
	South - Trough	28	B			35	C		
	West	24	B			31	C		
	North - Slip Lane	13	A			13	A		
	East -Slip Lane	14	A			23	B		
	South - Slip Lane	11	A			15	B		
3. M5 Motorway / Hume Highway	North	37	C	38	C	42	C	60	E
	East - Right Turn	59	E			101	F		
	South - Right Turn	67	E			152	F		
	South - Trough	25	B			15	B		
	East - Left Turn	32	C			67	E		

Intersection Level of Service (LoS) – Core Area									
Intersection	Approach	AM Peak				PM Peak			
		Average Delay	LoS (Delay)	Overall Average Delay	LoS	Average Delay	LoS (Delay)	Overall Average Delay	LoS
	North - Slip Lane	34	C			54	D		
4. Moorebank Avenue / Heathcote Road	North	22	B	64	E	13	A	41	C
	East	47	D			54	D		
	South - Right Turn	97	F			76	F		
	South - Trough	84	F			104	F		
5. Moorebank Avenue / Newbridge Road	East - Trough	81	F	35	C	32	C	52	D
	East - Left Turn	27	B			65	E		
	South - Right Turn	28	B			71	F		
	South - Left Turn	12	A			24	B		
	West - Right Turn	59	E			98	F		
	West – Through	30	C			18	B		

Paramics Model Code: 2010 PM_TZ67_PDBC_RevC, Link: F:\AA003210\D-Calculations\Traffic and Modelling_POST DGR\Modelling\Paramics\3- Spreadsheets\1 LoS\Report\2010

Network Operational Issues – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
M5 Motorway/ Hume Highway Interchange	In general, north-south through movement demand on Hume Highway (4,800 veh/hr, two way, AM and PM Peak) is the highest. A major portion of green time is allocated for the major north south movement. Traffic models show higher delays to the following movements: 1) Right turn from M5 westbound off-ramp experience higher delays during both AM and PM Peaks (Avg Delays= 60/100 s, LoS=E/F), however no queue spills back from the off-ramp onto the M5 Motorway is observed	
	2) Left turn from westbound M5 off-ramp experience slightly higher delays during PM Peak (Avg Delays= 60 s, LoS=E), however no queue spills back from the off-ramp onto the M-5 Motorway is observed	

Network Operational Issues – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
	3) Right turn from Hume Highway south to M-5 eastbound on-ramp experiencing higher delays during AM and PM Peaks (Avg Delays= 30/60 s, LoS=C/E), however queue lengths exceeding the right turn bay was not observed.	
Moorebank Avenue intersections with Heathcote Road and Newbridge Road	4) High turning traffic is observed at Newbridge Road/ Moorebank Avenue (1,200 veh/hr turning right and 1,100 veh/hr turning left during AM peak) intersection. Model indicates extensive delays to right turn movements from Moorebank Avenue to Newbridge Road. Traffic models shows queue spill back at this approach leads to adversely affecting the operation of adjacent Moorebank Avenue/Heathcote Road intersection (high delays to upstream northbound through movement with LoS F).	

Network Operational Issues – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
	5) Westbound through movement on Newbridge Road shows higher delays during AM and PM peak periods (Avg Delays=30/80 s, LoS=C/F).	
	6) Southbound queues on Moorebank Avenue/Heathcote Road intersection affect the upstream operation of Moorebank Avenue/Newbridge Road intersection. Traffic models indicate increased delays and long queue for right turn movement from Newbridge Road to Moorebank Avenue during PM peak (Avg Delays= 90 s, LoS=F).	

Network Operational Issues – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
	7) Right turn movement from Newbridge Road west to Moorebank Avenue experiences higher delays particularly during PM peak period (Avg Delays= 100 s, LoS=F). The queue occasionally spills back from the right turn bay onto the main stream affecting the eastbound through movement.	
M5 Motorway/ Moorebank Avenue Interchange	8) High right turn volumes from Moorebank Avenue north onto M5 westbound on-ramp (1,200 veh/hr in PM peak) affect surface intersection performance. Model shows long queues during PM peak period. The queue occasionally spills back from right turn bay onto the main stream affecting the southbound through traffic movement on Moorebank Avenue.	

Network Operational Issues – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
	9) Left turn movement (Give-way slip lane) from Moorebank Avenue south onto M5 westbound on-ramp shows occasional queues. The queue is caused by high right turn demand from Moorebank Avenue north onto M5 westbound on-ramp. While this issue alone is not critical for existing conditions , any increase on the movements traffic volumes is expected to have an impact from the SIMTA traffic.	
Moorebank Avenue/ Anzac Road	10) Through movements along Moorebank Avenue show occasional queues in northbound and southbound directions during AM peak and PM peak periods respectively. However, these queues are clearing during each cycle time and traffic models do not indicate any residual queues.	

Network Operational Issues – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
		

B2. M5 Motorway Weaving

The weaving issue on the M5 Motorway was reassessed using the inner area Paramics model.

Figure B1 shows traffic model's screenshot of the M5 Motorway weaving section during AM Peak period. Vehicles highlighted in purple are attempting to make a lane change, but are being obstructed by other vehicles in an adjacent lane.

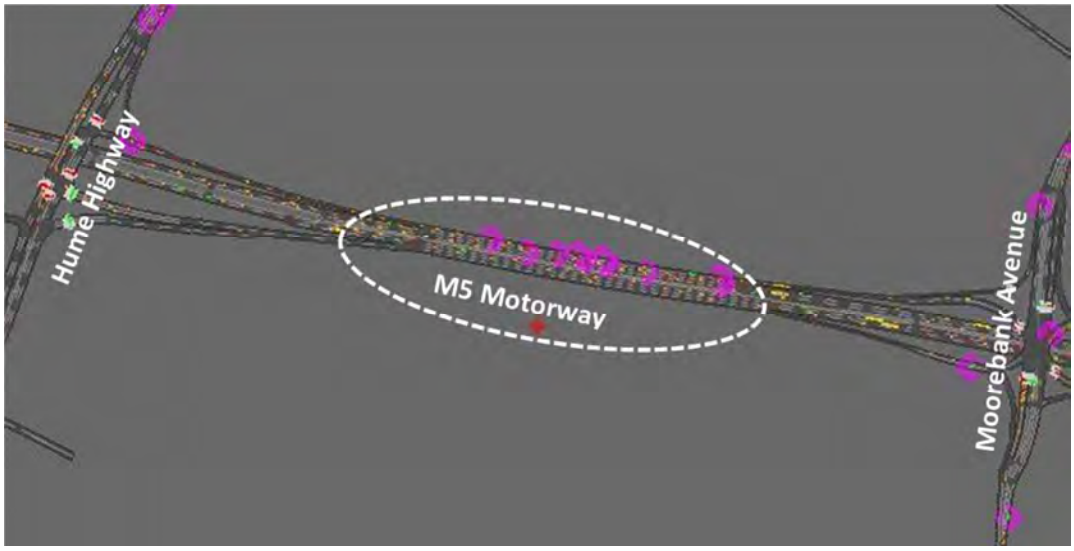


Figure B1 M5 Weaving section

Paramics model outputs summarised in Table B2 indicate low LoS E and a travel speed of approximately between 50 and 60 km/h during morning peak and LoS C and a travel speed of approximately between 70 and 80 km/h during evening peak. As a result, there appears to be an existing weaving problem on M5 for eastbound traffic.

The findings from inner area models are in line with modelling outcome drawn in Section 3.3.4 of August 2011 Transport and Accessibility Impact Assessment Report.

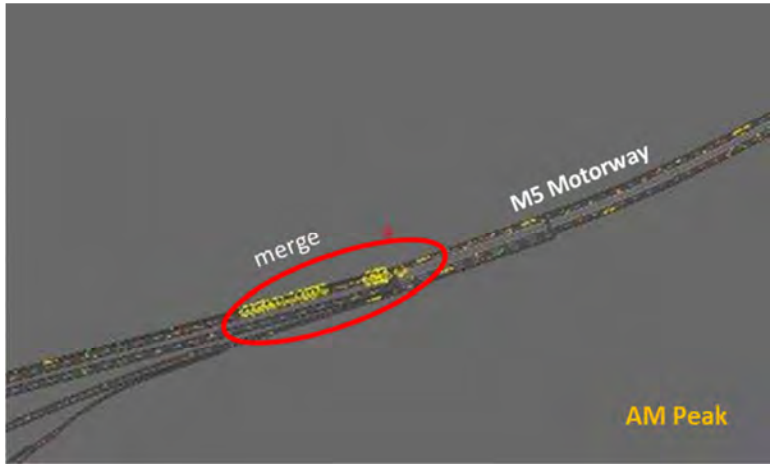
Table B2 Paramics weaving analysis

Performance Index	AM Peak	PM Peak
Weaving segment speed (km/h)	51.90	77.62
Weaving segment LoS	E	C

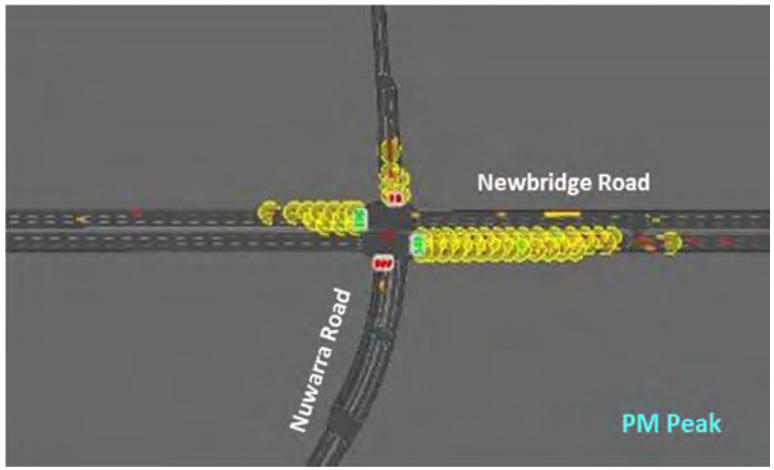
Table B3 Current road network capacity – Outside Core Area

Intersection Level of Service (LoS) – Outside Core Area				
Intersection	AM Peak		PM Peak	
	Overall Average Delay	LoS	Overall Average Delay	LoS
6. Hume Highway / Camden Valley Way	47	D	31	C
7. Hume Highway / Kurrajong Road	45	D	50	D
8. Hume Highway / De Meyrick Avenue	21	B	20	B
9. Hume Highway / Hoxton Park Road / Macquarie Street	95	F	69	E
10. Terminus Street / Speed Street	17	B	29	C
11. Newbridge Road / Nuwarra Road	41	C	70	E
12. Heathcote Road / Nuwarra Road	39	C	39	C
13. M5 Motorway / Heathcote Road	37	C	59	E

Paramics Model Code: 2010 PM_TZ67_PDBC_RevC, Link: F:\AA003210\D-Calculations\Traffic and Modelling_POST DGR\Modelling\Paramics\3- Spreadsheets\1 LoS\Report\2010

Network Operational Issues – Outside Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
M5 Motorway, between Camden Valley Way and Hume Highway	11) Slow traffic movement is observed on eastbound direction during AM peak due the merge of eastbound traffic from M7 Motorway and Camden Valley Way onto M5 Motorway. There are only two lanes provided in each direction.	 
Terminus Street between Hume Highway and	12) The congestion is observed at this section during PM peak due to the four closely-spaced signalised intersections and several direct access points along this road. Extensive queues and delays are	

Network Operational Issues – Outside Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
Newbridge Road	observed on westbound direction. Modelling results suggest queue extension from Hume Highway/Hoxton Park Road intersection and its spill backs to adjacent intersections.	
Hume Highway/ Hoxton Park Road/ Macquarie Street intersection	13) This intersection is operating over capacity at LoS F during PM peak due to heavy outbound traffic from Macquarie Street. Extensive queues are observed on Macquarie Street back to upstream intersections on Terminus Street. Queues and delay are also observed on Hume Highway and Hoxton Park Road approaches in both peak periods	

Network Operational Issues – Outside Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
		
Newbridge Road/ Nuwarra Road intersection	14) This intersection is operating overcapacity at LoS E during PM period. Queues and delays were observed on Newbridge Road due to high left and right turn traffic from Newbridge Road onto Nuwarra Road. Queues occasionally spill back from turn bay onto the main stream affecting through movement.	

Network Operational Issues – Outside Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
M5 Motorway / Heathcote Road interchange	15) This interchange consists of two signalised intersections. In general, these intersections are operating at overcapacity condition. LoS is predicted E during PM peak due to high southbound traffic on the Heathcote Road. Long queue is observed on Heathcote Road southbound. Traffic models indicate queue on right turn traffic from M5 eastbound off-ramp onto Heathcote road in both peak periods. However, the queues clear at every cycle time. The traffic models do not indicate queue spill back on motorway main stream.	
Heathcote Road/ Nuwarra Road intersection	16) Model predicts LoS C during both AM and PM peaks for the entire intersection. Some queues and delays are occasionally observed on Nuwarra Road during PM peak. The observed queues clear at each cycle time.	

Network Operational Issues – Outside Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
		
Hume Highway between M5 Motorway and Camden Valley Way	17) Occasional queues are observed along Hume Highway. The queue clears at each cycle time. No residual queue is observed. Key intersections LoS: ▪ Hume Highway and Camden Valley Way intersection LoS is forecast D during PM peak period, average delay of 50 s. ▪ Hume Highway and Kurrajong Road intersection LoS is forecast D during both peak periods, average delay between 45-50 s. ▪ Hume Highway and De Meyrick Avenue is forecast LoS B during both peak periods, average delay about 20 s.	

Network Operational Issues – Outside Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
		

APPENDIX C

FUTURE ROAD NETWORK CAPACITY

C1. FUTURE ROAD NETWORK CAPACITY

Inner area Paramics models were also developed for future year 2031 to compare the effect of SIMTA impact on road network.

To maintain the consistency with the main traffic report (August 2011 Transport and Accessibility Impact Assessment Report), future network capacity issues are identified and reported for following two cases:

- Impact assessment for future year 2031 without SIMTA.
- Impact assessment for future year 2031 with SIMTA.

In Section 6.5 and Section 7.12 of the August 2011 Transport and Accessibility Impact Assessment Report documented future network performance without and with SIMTA case. The levels of service analyses at key intersections are repeated.

The results from inner area Paramics model are reported in a similar fashion to main traffic report. The following results are reproduced:

- Table C1 summarises forecast intersection level of service and future network capacity issues without SIMTA. The assessment was undertaken for key intersections within the core area.
- Table C2 summarises forecast intersection level of service without SIMTA. The LoS assessment was undertaken for key intersections outside the core area.
- Table C3 summarises forecast intersection level of service and future network capacity issues with SIMTA. The assessment was undertaken for key intersections within the core area.
- Table C4 summarises forecast intersection level of service with SIMTA. The LoS assessment was undertaken for key intersections outside the core area.

There are forecast capacity issues for the local and regional road network; however, modelling result suggests that these are irrespective of whether or not the SIMTA proposal proceeds. The results show that outside the core area, there is no significant adverse impact on key roads following the introduction of the SIMTA proposal. Beyond the core area, where SIMTA heavy vehicle volume increases, it is generally by a small margin.

In Section 9 of the August 2011 Transport and Accessibility Impact Assessment Report documented a range of infrastructure and non-infrastructure mitigation measures would be required when the SIMTA proposal is fully developed.

The inner area Paramics modelling results in Appendix C here do not change the conclusions drawn in August 2011 Transport and Accessibility Impact Assessment Report.

Table C1 Impact on road network without SIMTA – Core Area

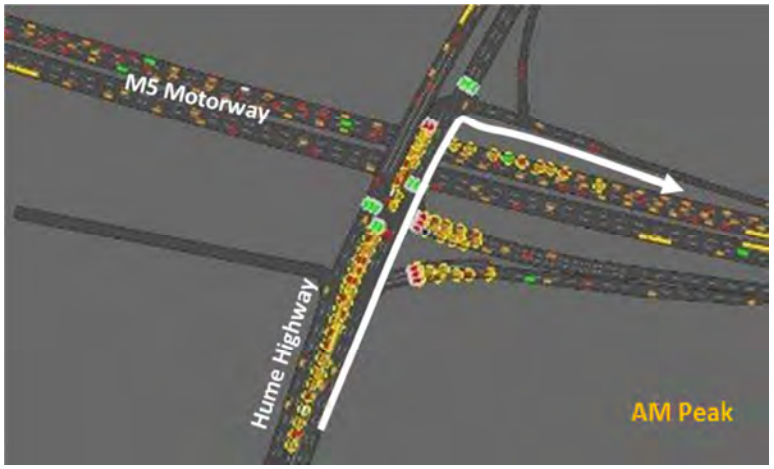
Forecast Intersection Level of Service (LoS) for 2031 Future Base Case without SIMTA – Core Area									
Intersection	Approach	AM Peak				PM Peak			
		Average Delay	LoS (Delay)	Overall Average Delay	LoS	Average Delay	LoS (Delay)	Overall Average Delay	LoS
1. Moorebank Avenue / Anzac Road	North	35	C	46	D	25	B	38	C
	East	77	F			79	F		
	South	33	C			23	B		
	North Slip Lane	4	A			3	A		
2. M5 Motorway / Moorebank Avenue	North -Right Turn	27	B	29	C	46	D	46	D
	North- Trough	26	B			24	B		
	East	20	B			29	C		
	South - Right Turn	33	C			39	C		
	South – Trough	28	B			36	C		
	West	25	B			32	C		
	North - Slip Lane	13	A			15	B		
	East -Slip Lane	14	A			15	B		
	South - Slip Lane	37	C			165	F		
3. M5 Motorway / Hume Highway	North	38	C	113	F[1]	69	E	80	F
	East - Right Turn	226	F			148	F		

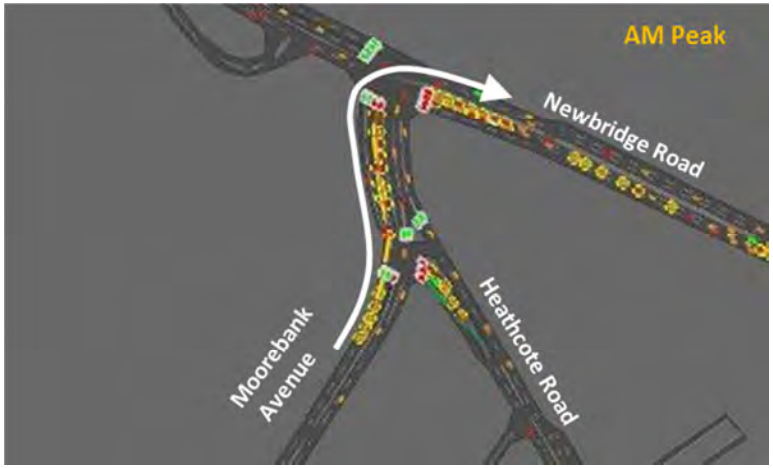
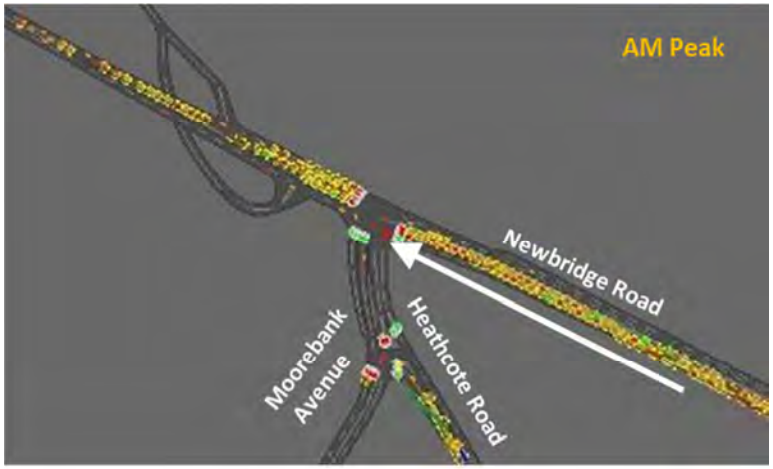
[1] Core Area Paramics model has boundary issue, upstream and downstream congestion was not modelling adequately. This intersection was reassessed in the Inner Area Paramics model to included upstream and downstream effects.

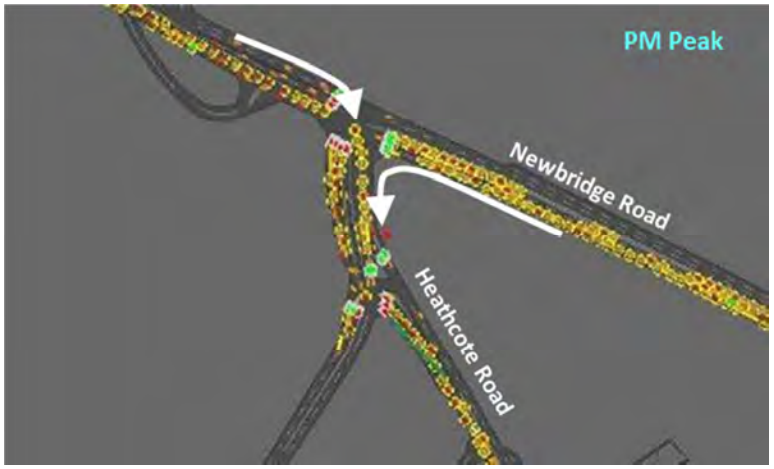
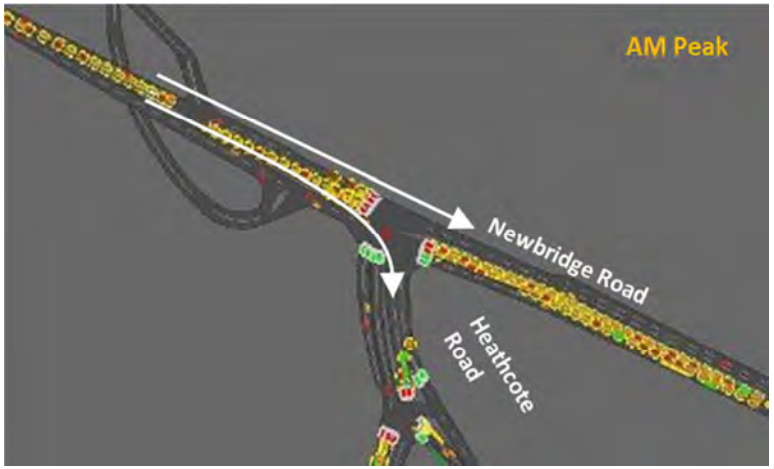
Forecast Intersection Level of Service (LoS) for 2031 Future Base Case without SIMTA – Core Area									
Intersection	Approach	AM Peak				PM Peak			
		Average Delay	LoS (Delay)	Overall Average Delay	LoS	Average Delay	LoS (Delay)	Overall Average Delay	LoS
	South - Right Turn	137	F			96	F		
	South - Trough	120	F			32	C		
	East - Left Turn	46	D			64	E		
	North - Slip Lane	40	C			106	F		
4. Moorebank Avenue / Heathcote Road	North	15	B	105	F	15	B	205	F
	East	208	F			692	F		
	South - Right Turn	95	F			124	F		
	South - Trough	62	E			247	F		
5. Moorebank Avenue / Newbridge Road	East - Trough	573	F	144	F	149	F	124	F
	East - Left Turn	389	F			115	F		
	South - Right Turn	30	C			73	F		
	South - Left Turn	16	B			99	F		
	West - Right Turn	116	F			190	F		
	West - Through	52	D			65	E		

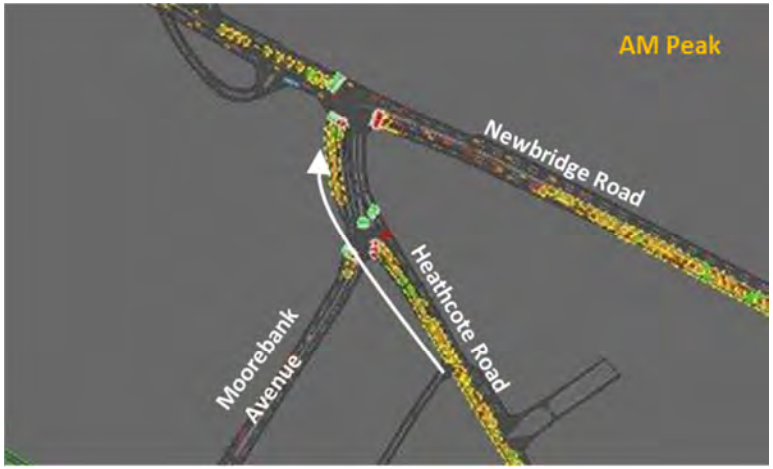
Paramics Model Code: 2031 PM_TZ67_PDBC, Link: F:\AA003210\D-Calculations\Traffic and Modelling_POST DGR\Modelling\Paramics\3- Spreadsheets\1 LoS\Report\2031\Base Case

Forecast Network Operational Issue for 2031 Future Base Case without SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
M5 Motorway/ Hume Highway Interchange	1) By 2031, background growth is forecast to increase delays for right turn movement from the M5 westbound off-ramp to Hume Highway (north) during both AM and PM peak. Low LoS F is forecast. The model however does not suggest queue spills back from the off-ramp onto the M5 Motorway.	
	2) Compared to the existing situation, minor increase in delay is forecast to the left turn traffic from the M5 westbound off-ramp to the Hume Highway (south). The LoS for PM peak is forecast E. No queue spills back from the off-ramp onto the M5 Motorway is observed in the model.	

Forecast Network Operational Issue for 2031 Future Base Case without SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
	3) The right turn movement from Hume Highway (south) to the M5 eastbound on-ramp is forecast to increase in delays during both AM and PM peaks. In 2031. The model forecasts low LoS F. The model also suggest extended queues and potential queue spill backs onto the main stream particularly in during PM peak.	
	3-A) The model forecasts increased delays for left turn movement from Hume Highway (north) to M5 eastbound on-ramp particularly during PM peak period (LoS F). The model suggests occasional queue spill back onto the main stream from the left turn slip lane.	

Forecast Network Operational Issue for 2031 Future Base Case without SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
Moorebank Avenue intersections with Heathcote Road and Newbridge Road	4) In the future, back ground growth is forecast to increase delays and queues through Newbridge Road/ Heathcote Road and Moorebank Avenue (north of M5) areas. The model forecasts low LoS F regardless of any development at the SIMTA site. Future model shows queue spills back, affecting the operation of the adjacent Moorebank Avenue / Heathcote Road signal. This will cause an increase in delays to the northbound through movement at the Moorebank Avenue/ Heathcote Road intersection.	
	5) The future case traffic model forecasts a low LoS F for westbound through movements on Newbridge Road. The model suggest significant queues during both AM and PM peak periods, regardless of any SIMTA proposal.	

Forecast Network Operational Issue for 2031 Future Base Case without SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
	6) Similar to issues 4 and 5 above, background growth is forecast to increase delays and queues through the Moorebank Avenue/ Heathcote Road area. The model forecasts low LoS F for the right turn movement from Newbridge Road to Moorebank Avenue regardless of any SIMTA development.	
	7) Similar to issue 6 above, background growth is forecast to increase delays and queues through Moorebank Avenue/ Newbridge Road area. The model forecasts low LoS F for right turn movements from Newbridge Road into Moorebank Avenue. The model shows queue spill backs from right turn bay onto the main stream affecting eastbound through traffic.	

Forecast Network Operational Issue for 2031 Future Base Case without SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
	7-A) The model suggests right turn from Heathcote Road into Moorebank Avenue would experience high delays in both AM and PM peak periods. The model forecasts long and frequent queues for right turning vehicles with LoS F.	
M5 Motorway/ Moorebank Avenue Interchange	8) The model shows increased delays and longer queues for the right turn movement from Moorebank Avenue (north) into the M5 westbound on-ramp during PM peak period, regardless of any development at the SIMTA site. Frequent queues are observed and likely to spill back from the right turn bay onto the main stream affecting the southbound through traffic movement on Moorebank Avenue.	

Forecast Network Operational Issue for 2031 Future Base Case without SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
	9) In the future, background traffic growth has minor impact on the operation of left turn movements (Give-way slip lane) from Moorebank Avenue south onto M5 westbound on-ramp. The model shows some occasional queues on Moorebank Avenue northbound. The occasional queues are caused by high volume right turn demand from Moorebank Avenue (north) onto M5 westbound on-ramp.	
Moorebank Avenue/ Anzac Road	10) The model suggests background traffic growth has minor impact on the operation of through movements along Moorebank Avenue. At Anzac Road signalised intersection, the model shows occasional queues in the northbound and southbound direction. Longer queues are more noticeable during PM peaks for the southbound direction.	

Forecast Network Operational Issue for 2031 Future Base Case without SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
		

Table C2 Impact on road network without SIMTA – Outside Core Area

Forecast Intersection Level of Service (LoS) for 2031 Future Base Case without SIMTA – Outside Core Area				
Intersection	AM Peak		PM Peak	
	Overall Average Delay	LoS	Overall Average Delay	LoS
6. Hume Highway / Camden Valley Way	69	E	66	E
7. Hume Highway / Kurrajong Road	239	F	75	F
8. Hume Highway / De Meyrick Avenue	177	F	19	B
9. Hume Highway / Hoxton Park Road / Macquarie Street	97	F	136	F
10. Terminus Street / Speed Street	39	C	152	F
11. Newbridge Road / Nuwarra Road	50	D	357	F
12. Heathcote Road / Nuwarra Road	94	F	78	F
13. M5 Motorway / Heathcote Road	59	E	108	F

Paramics Model Code: 2031 PM_TZ67_PDBC, Link: F:\AA003210\D-Calculations\Traffic and Modelling_POST DGR\Modelling\Paramics\3- Spreadsheets\1 LoS\Report\2031\Base Case

Table C3 Impact of SIMTA Proposal at key intersections – Core Area

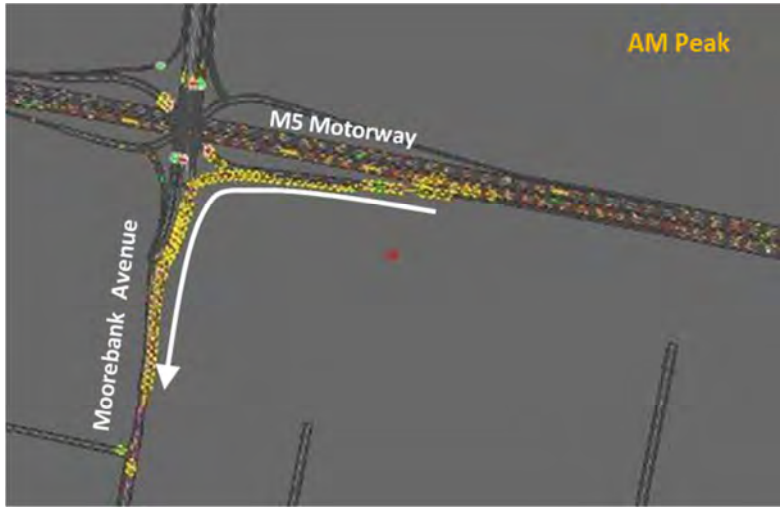
Forecast Intersection Level of Service (LoS) for 2031 Future Base Case with SIMTA – Core Area									
Intersection	Approach	AM Peak				PM Peak			
		Average Delay	LoS (Delay)	Overall Average Delay	LoS	Average Delay	LoS (Delay)	Overall Average Delay	LoS
1. Moorebank Avenue / Anzac Road	North	102	F	71	F	32	C	71	F
	East	83	F			105	F		
	South	44	D			120	F		
	North Slip Lane	4	A			3	A		
2. M5 Motorway / Moorebank Avenue	North -Right Turn	33	C	49	D	64	E	68	E[2]
	North- Trough	32	C			28	B		
	East	55	D			32	C		
	South - Right Turn	31	C			56	D		
	South - Trough	30	C			53	D		
	West	40	C			36	C		
	North - Slip Lane	13	A			17	B		
	East -Slip Lane	155	F			30	C		
	South - Slip Lane	65	E			283	F		
3. M5 Motorway / Hume Highway	North	43	D	124	F	74	F	111	F
	East - Right Turn	251	F			243	F		
	South - Right Turn	163	F			172	F		

[2] Underestimated level of service due to upstream congestion on M5 Motorway westbound

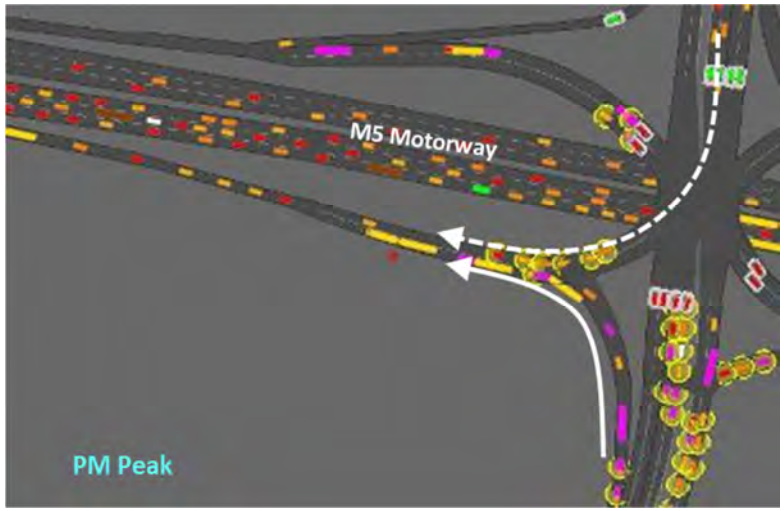
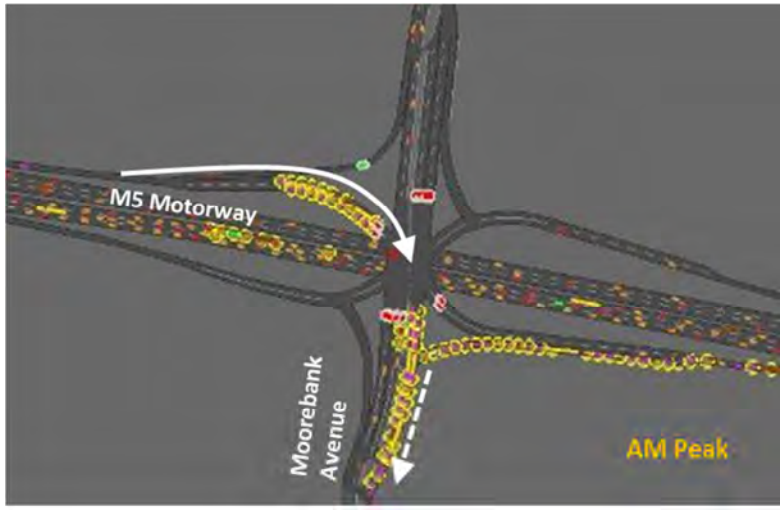
Forecast Intersection Level of Service (LoS) for 2031 Future Base Case with SIMTA – Core Area									
Intersection	Approach	AM Peak				PM Peak			
		Average Delay	LoS (Delay)	Overall Average Delay	LoS	Average Delay	LoS (Delay)	Overall Average Delay	LoS
	South - Trough	125	F			72	F		
	East - Left Turn	50	D			86	F		
	North - Slip Lane	66	E			108	F		
4. Moorebank Avenue / Heathcote Road	North	15	B	152	F	29	C	255	F
	East	358	F			867	F		
	South - Right Turn	88	F			218	F		
	South - Trough	72	F			231	F		
5. Moorebank Avenue / Newbridge Road	East - Trough	559	F	147	F	152	F	134	F
	East - Left Turn	382	F			143	F		
	South - Right Turn	29	C			71	F		
	South - Left Turn	19	B			78	F		
	West - Right Turn	127	F			217	F		
	West - Through	60	E			71	F		

Paramics Model Code: 2031 AM_TZ070_PDStg2, Link: F:\AA003210\D-Calculations\Traffic and Modelling_POST DGR\Modelling\Paramics\3- Spreadsheets\1 LoS\Report\2031\SIMTA

Forecast Network Operational Issue for 2031 Future Base Case with SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
Moorebank Avenue/ Anzac Road	1) With full SIMTA development traffic, the model indicates long and extended queues on Moorebank Avenue (south of M5) in the southbound direction. The model forecasts a low LoS F. Long queues are predicted on Moorebank Av south of M5.	

Forecast Network Operational Issue for 2031 Future Base Case with SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
Moorebank Avenue/M5 Interchange	2) The traffic model indicates extended queues on the left turn slip lane from M5 westbound off-ramp onto Moorebank Avenue south. This operational issue was observed in both the AM and PM. The capacity constraint (one lane per direction) on Moorebank Av also contributes the queues.	

Forecast Network Operational Issue for 2031 Future Base Case with SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
	3) The increased SIMTA traffic has predicted occasional queues along the left turn slip lane from Moorebank Avenue (south) onto the M5 westbound on-ramp. During the PM peak, queues from the left turn slip lane are likely to spill back to one lane section of Moorebank Avenue. This is likely to cause disruption and low speeds on Moorebank Avenue for traffic in the northbound direction. The predicted heavy vehicles from the SIMTA site are likely to contribute to longer queues as they need longer gaps and more time to accelerate.	

Forecast Network Operational Issue for 2031 Future Base Case with SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
	4) The traffic model indicates a capacity issue due to a two-lane to one-lane merge on the short section of the M5 westbound on-ramp, particularly during the PM peak.	
	5) The model indicates queues to the right turning vehicles from the M5 west into Moorebank Avenue (south). Queues are likely to spill back onto one lane section of M5 eastbound off-ramp.	

Forecast Network Operational Issue for 2031 Future Base Case with SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
Moorebank Avenue	6) The model indicates long queues between Anzac Road and SIMTA's northern Access. This was observed on Moorebank Avenue in the northbound direction (PM peak). The two through lane capacity on Moorebank Avenue is likely to contribute to the extended delays when the SIMTA site is fully developed.	

Forecast Network Operational Issue for 2031 Future Base Case with SIMTA – Core Area		
Intersection	**Network operational issue**	**Paramics snapshot**
		

Table C4 Impact on road network with SIMTA – Outside Core Area

Forecast Intersection Level of Service (LoS) for 2031 Future Base Case with SIMTA – Outside Core Area				
Intersection	AM Peak		PM Peak	
	Overall Average Delay	LoS	Overall Average Delay	LoS
6. Hume Highway / Camden Valley Way	80	F	69	E
7. Hume Highway / Kurrajong Road	294	F	77	F
8. Hume Highway / De Meyrick Avenue	220	F	19	B
9. Hume Highway / Hoxton Park Road / Macquarie Street	96	F	150	F
10. Terminus Street / Speed Street	41	C	136	F
11. Newbridge Road / Nuwarra Road	75	F	404	F
12. Heathcote Road / Nuwarra Road	120	F	126	F
13. M5 Motorway / Heathcote Road	90	F	131	F

Paramics Model Code: 2031 AM_TZ070_PDStg2, Link: F:\AA003210\D-Calculations\Traffic and Modelling_POST DGR\Modelling\Paramics\3- Spreadsheets\1 LoS\Report\2031\SIMTA