ARCADIS Design & Consultancy for natural and built assets

Moorebank Precinct East Stage 2 Proposal
Response to Submissions

Appendix C1: M5 Motorway/ Moorebank Avenue interchange Sensitivity Test

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

July 2017

MEMO

ARCADIS Design & Consultancy for natural and built assets

Date	21/07/2017
To	Nathan Cairney (Tactical Group)
From	Jerry Xiang (Arcadis) / Lorena Martins (Arcadis) / Luke Goldsworthy (Arcadis)
Copy to	Westley Owers (Arcadis), Claire Vahtra (Arcadis)
Subject	MPE Stage 2 - Sensitivity Test for M5 Motorway and Moorebank Avenue Interchange

1 INTRODUCTION

SIMTA are seeking approval for the construction and operation of the Moorebank Precinct East (MPE) Stage 2 Amended Proposal (the Proposal), which will be the second stage of development under the MPE Concept Approval (MP10_0193).

An Environmental Impact Statement (EIS) was prepared for the Proposal seeking approval under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The EIS for the Proposal was publicly exhibited between 13 December 2016 and 24 February 2017. During this exhibition period, submissions were invited from all stakeholders including members of the community and government stakeholders. A response to submissions (RtS) report has been prepared which provides a response to the submissions received in relation to the EIS.

Amendments are now proposed to the Proposal based on submissions provided by government agencies and the community, as part of design progression, and to provide additional clarity where relevant. Approval is sought for the Amended Proposal (as described in Appendix J, in accordance with Part 4, Division 4.1 of the EP&A Act.

These amendments to the Proposal result in a minor change from the Proposal as originally included within the EIS and remain consistent with the objectives of the Proposal provided within Section 1.3 of the EIS.

During the public exhibition period, submissions were received from government agencies and the community raising concern about the potential impacts of the Proposal relating to traffic congestion and intersection performance at the M5 Motorway/ Moorebank Avenue interchange.

To supplement the Operational Traffic and Transport Impact Assessment (OTTIA) prepared for the Proposal (and provided at Appendix K of the EIS) and to respond to the the submissions raised by government agencies and the community, a sensitivity test has been conducted to examine the potential impact of re-distributing development traffic at the M5 Motorway / Moorebank Avenue interchange. This sensitivity test describes the performance of each intersection approach as well as overall intersection performance under four traffic distribution scenarios.

This sensitivity analysis identifies the potential impacts to traffic congestion and intersection performance that may occur at the M5 Motorway/ Moorebank Avenue interchange, should heavy vehicle movements be undertaken which do not comply with the Operational Traffic Management Plan (OTMP) for the Proposal and/ or precinct-wide traffic management plan(s).

As detailed in Section 7.4.2 of the MPE Stage 2 EIS, heavy vehicles would access and egress the Proposal by travelling along Moorebank Avenue to the north of the Proposal site. As a result of visibility and the traffic controls to be implemented at the Proposal site, the first opportunity for a heavy vehicle to undertake a traffic movement that does not comply with the OTMP for the Proposal and/ or precinct-wide traffic management plan(s) is at the M5 Motorway/ Moorebank Avenue interchange (i.e. a vehicle may turn right and travel east towards Port Botany).

The aim of the sensitivity test is to demonstrate that the M5 Motorway/ Moorebank Avenue interchange would be able to accommodate changes in traffic distribution for vehicles using the M5 Motorway/ Moorebank Avenue interchange to access/ egress the Proposal site without significantly impacting on the operational performance of the interchange. Specifically, the sensitivity test has modelled a range of traffic distribution assumptions relating to the proportion of Proposal traffic travelling to and from the Proposal site along the M5 Motorway from the west and east of the interchange, to consider whether the road network would be able to accommodate some additional traffic from the Proposal turning right (eastbound) at the M5 Motorway / Moorebank Avenue interchange from the south approach. By considering these additional traffic distribution scenarios, the sensitivity test aims to demonstrate that the road network can cater for development traffic under a range of different traffic distribution scenarios, particularly additional traffic from the Proposal turning right at the interchange from Moorebank Avenue to travel eastwards along the M5 Motorway.

This technical memorandum has been prepared to describe the assumptions, approach to, and results of, this sensitivity test on the performance of the M5 Motorway / Moorebank Avenue interchange, and to provide conclusions based on the results.

2 BACKGROUND

An Operational Traffic and Transport Impact Assessment (OTTIA) was prepared as part of the EIS (and provided at Appendix K of the EIS), which provided an assessment of the potential impacts of the operation of the Proposal on the core traffic study area. The distribution of additional traffic generated by the Proposal is a key factor in determining the impact of the Proposal on the road network. As part of the OTTIA, the following assumptions about operational traffic distribution were assumed as part of the traffic modelling undertaken:

Heavy vehicles

The majority of trucks generated by the Proposal would reach the Proposal site via the M5 Motorway from the west (56%). Approximately 25% of trucks generated by the Proposal would reach the site from Moorebank Avenue to the north, and about 17% of trucks would arrive via the Hume Highway. In general, all trucks would travel via Moorebank Avenue north of the Precinct. No container trucks would travel via Anzac Road (east of Yulong Close) and Cambridge Avenue to reach the Proposal.

Light vehicles

The majority of employee cars travelling to the Proposal site in the morning peak period would travel via the M5 Motorway to Moorebank Avenue at the northern end of the Proposal. Approximately 18% of employees would enter the M5 Motorway from the Hume Highway to the west, while a minor percentage (8%) of employee traffic would use Anzac Road.

Traffic modelling identified that in 2029 under the Cumulative Development scenario, the M5 Motorway / Moorebank Avenue intersection would operate at either a better than or comparable level of service (LoS) with the operation of the Proposal, than without the Proposal. Under the Cumulative Development scenario, the M5 Motorway / Moorebank Avenue intersection is predicted to operate at a LoS C in the AM peak and a LoS D in the PM peak. The traffic modelling carried out as part of the OTTIA demonstrated that the operation of the Proposal would not result in the exceedance of capacity on the road network within the core traffic study area in 2029.

3 SCOPE OF WORK AND ASSUMPTIONS

The OTTIA for the Proposal included an analysis of the traffic impacts of future traffic demand on the surrounding road network from both background traffic growth and the additional traffic generated by the Proposal when the Proposal site is fully developed. This investigation reviewed the existing infrastructure and then identified the required road and intersection improvements needed to mitigate the additional traffic generated by the Proposal under the cumulative development scenario. It was identified as part of the OTTIA that the road network will need to be improved to cater for the forecast increase in traffic volumes which will result from both the general growth in background traffic and operational vehicles from the Proposal passing through the study area.

The M5 Motorway / Moorebank Avenue intersection was identified in the OTTIA as an intersection which would operate at a level of service which is unsatisfactory without the operation of the Proposal (i.e. due to background traffic growth). Potential road network solutions were identified in Table 6-2 of the OTTIA as recommendations for consideration by Roads and Maritime to consider to improve the existing and future operation of the local road network.

The sensitivity test involved assessing the performance of the proposed upgraded layout of the M5 Motorway / Moorebank Avenue interchange (refer to **Figure 4-1**), which is based on the recommended improvements due to background traffic included in Section 6 of the OTTIA (Appendix K of the EIS) for the MPE Stage 2 Cumulative Development in 2029 under four different traffic distribution scenarios. The sensitivity test has been undertaken for the interchange using SIDRA 7 intersection analysis software (version 7.0.5.6563).

The Cumulative Development scenario used for the purpose of the sensitivity test is consistent with the cumulative operational scenario used to undertake the OTTIA as part of the EIS, which consists of the following:

- MPE Stage 2 warehousing: 300,000 sq. m gross floor area (GFA)
- MPW Stage 2 intermodal terminal throughput: 500,000 Twenty foot equivalent unit (TEU)
- MPW Stage 2 warehousing: 215,000sq. m GFA
- MPE Stage 1 intermodal terminal throughput: 250,000 TEU

Four traffic distribution scenarios were investigated as part of the sensitivity test. The performance of the M5 Motorway / Moorebank Avenue interchange was tested using SIDRA for the following 2029[1] traffic distribution scenarios:

- Scenario 1 – without traffic redistribution (as per the EIS)
- Scenario 2 – with traffic redistribution (redistribute 10% of the development traffic from westbound to eastbound along the M5 Motorway)
- Scenario 3 – with traffic redistribution (redistribute 20% of the development traffic from westbound to eastbound along the M5 Motorway)
- Scenario 4 – with traffic redistribution (redistribute 30% of the development traffic from westbound to eastbound along the M5 Motorway)

Scenarios 2 to 4 assume that development traffic is redistributed from westbound to eastbound, namely from the left-turn to the right-turn on the south approach of the M5 Motorway / Moorebank Avenue interchange. The scenarios assume no additional development traffic was generated or reduced for the redistribution i.e. the sum of the left and right-turn volumes remained the same as modelled in the EIS OTTIA.

[1] A 2019 scenario was not assessed as this would not represent the design horizon with a worst-case scenario.

4 SIDRA MODEL DEVELOPMENT

The layout of the M5 Motorway / Moorebank Avenue interchange used in the SIDRA analysis for this sensitivity assessment is the proposed upgraded layout described in Table 6-1 of the OTTIA at Appendix K of the EIS and replicated in Figure 3-1 below. This layout has been based on the recommended improvements due to background traffic included in Section 6 (mitigation measures) of the OTTIA (Appendix K of the EIS).

It should be noted that in the EIS, intersection performance was modelled and assessed in AIMSUN as this is the platform used for the Liverpool Moorebank Arterial Road Investigations (LMARI) Model and mandated for use in traffic modelling of all future development applications by the MPE Concept Conditions of Approval (MP10_0193). The AIMSUN modelling was used to investigate the wider network impact as well as the performance of eight key intersections in the core modelling area.

SIDRA was used to provide an indication of the impact on, and performance of, the intersection and a calibration exercise was conducted between SIDRA and AIMSUN. The use of SIDRA as a method to test the sensitivity of the M5 Motorway / Moorebank Avenue interchange is considered acceptable as the SIDRA model was calibrated to the AIMSUN model and was used solely for a sensitivity analysis in order to understand to potential changes in intersection performance.

The peak hour traffic volumes (8am to 9am and 5pm to 6pm) from the AIMSUN model were extracted and adopted in the SIDRA model for this sensitivity test. The SIDRA input traffic volume diagrams, for both without and with redistribution, are provided in **Appendix A** of this document.

The AIMSUN models consider traffic influence and interaction between intersections. As a result, the SIDRA models were adjusted for the sensitivity test to account for the network influences (i.e. downstream delay and congestion effects) observed in the AIMSUN models.

The following heavy downstream congestion was observed at the M5 Motorway / Moorebank Avenue interchange within the AIMSUN model at the following location:

- the M5 Motorway westbound on-ramp from Moorebank Avenue, which impacted on the flow of traffic travelling north along Moorebank Avenue (to the south of the M5 Motorway / Moorebank Avenue interchange) and turning left onto the M5 Motorway from the interchange
- the M5 Motorway eastbound off-ramp at the interchange, which impacted on the flow of traffic exiting the Motorway from the west and travelling north along Moorebank Avenue.

The lane capacity at the M5 Motorway / Moorebank Avenue interchange has been adjusted in SIDRA for the abovementioned left-turn to reflect the downstream congestion and delay. The adjustment was made to calibrate the SIDRA model to align with the observed behaviour in AIMSUN so that the same, or similar, performance can be replicated. In addition, the same signal phases and times from the AIMSUN models were adopted in SIDRA for modelling consistency.

Table 4-1 compares the resulting intersection delay and level of service (LOS) between the AIMSUN models and the SIDRA models. With the lane capacity adjustment[2], the SIDRA models were able to provide similar results to AIMSUN and were considered appropriate to provide a comparative assessment of the intersection.

[2] The lane capacity adjustment is a parameter used within SIDRA Intersection modelling software to specify a capacity gain or loss for a lane, based on downstream effects. For this modelling exercise a capacity adjustment of -50% for the south approach left-turn for the AM and PM peak was adopted to produce similar delays as in the AIMSUN model.

Table 4-1 – M5 Motorway / Moorebank Avenue Interchange - Intersection Average Delay (seconds) and LOS for 2029 Cumulative Development

Model	AIMSUN		SIDRA	
Period	**AM (8:00-9:00am)**	**PM (5:00-6:00pm)**	**AM (8:00-9:00am)**	**PM (5:00-6:00pm)**
Average intersection delay (seconds) / LOS	34 (C)	51 (D)	33 (C)	55 (D)

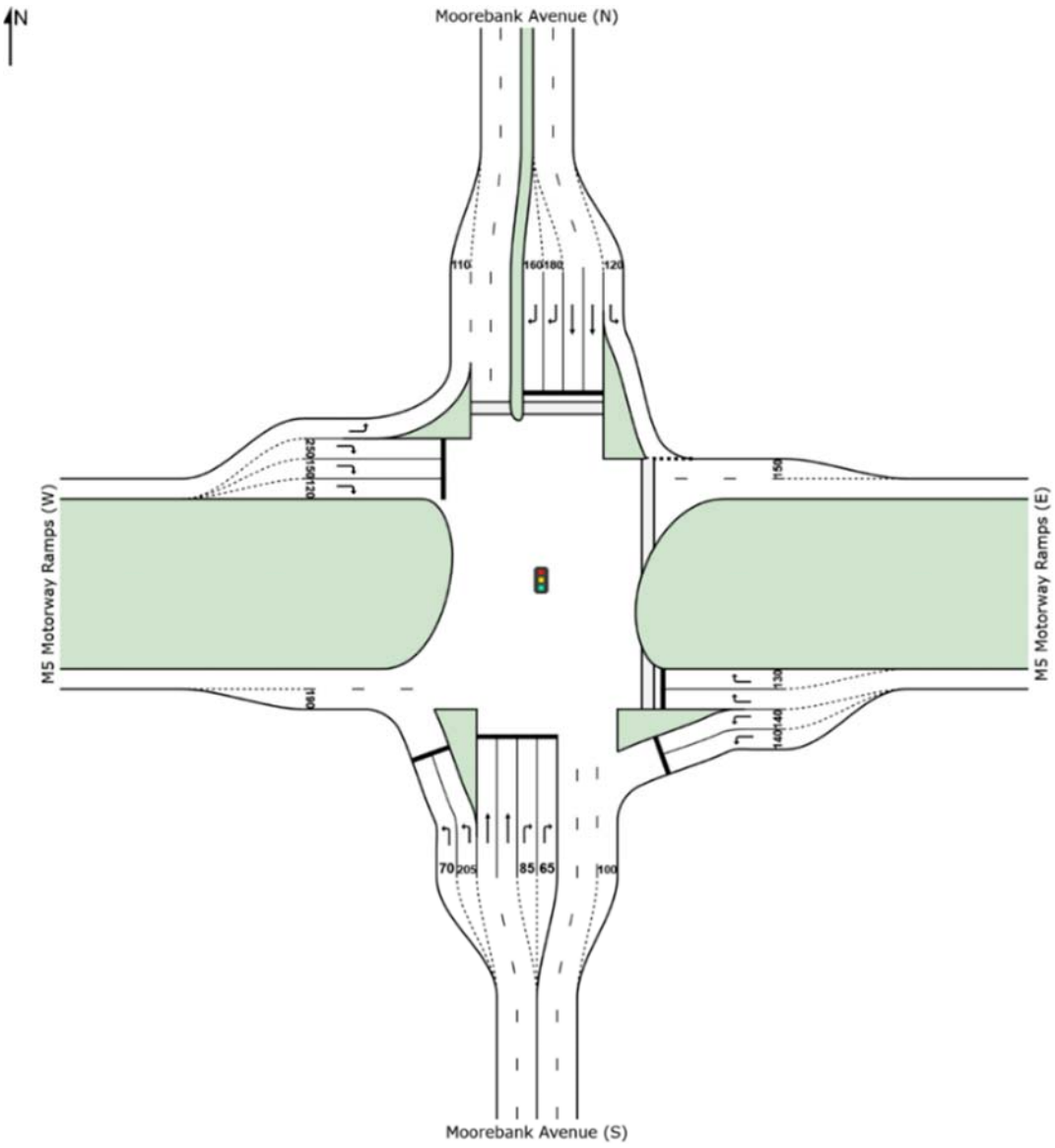


Figure 4-1 – Proposed M5 Motorway / Moorebank Avenue interchange Upgraded Layout (as per EIS)

5 SIDRA RESULTS

The SIDRA modelling results at the M5 Motorway / Moorebank Avenue interchange for each approach and turning movement and for the overall intersection over each of the four traffic distribution scenarios are summarised in **Table 5-1** (refer to Section 3 for more information).

The detailed SIDRA movement summaries are provided in **Appendix A** of this technical memorandum.

The SIDRA modelling results for the overall intersection performance in 2029 under the Cumulative Development scenario (as presented in **Table 5-1**) show that the performance of the M5 Motorway / Moorebank Avenue interchange as a result of redistributing the development traffic remained unchanged in the AM (LOS C) and PM peak (LOS D) for all scenarios assessed.

With each increase in the percentage of traffic being redistributed from turning westbound to eastbound along the M5 Motorway, the average delay for traffic turning left (westbound) onto the M5 Motorway reduced. However, the performance of the movement would remain equal to or worse than LoS D and there would continue to be heavy delays due to congestion because of lane merging at the on-ramp and traffic merging on the M5 Motorway. By lowering the proportion of traffic turning westbound onto the M5 Motorway during the AM peak, the average delay was significantly reduced by 45% from 88 seconds to 48 seconds with 30% of the Proposal traffic redistributed, and the LoS improves from a LoS F to a LoS D. In the PM Peak, the average delay was significantly reduced (by 39%) from 114 seconds with no redistribution, to 69 seconds with 30% of the development traffic redistributed.

The average delay for traffic turning east onto the M5 Motorway at the interchange would slightly increase in the AM and PM peak between scenario 1 and scenario 4 by three seconds, and one second respectively. These minor changes to average delay would have no impact on the LoS during the AM peak, however the marginal increase for the PM peak resulted in the LoS to change from a LoS B to a LoS C. The dominant right-turn (westbound) movement from the Moorebank Avenue north approach determines the performance of the right-turn (eastbound) movement on Moorebank Avenue from the south approach. The Moorebank Avenue north approach has much higher traffic volumes than the south approach, ranging from 500 to 600 vehicles per hour in the AM peak and from 1200 to 1,300 vehicles per hour in the PM peak (see **Appendix A** for breakdown of traffic volumes and signal phasing for all scenarios).

The right-turn (eastbound) movement onto the M5 Motorway from the Moorebank Avenue south approach has 18 seconds of ‘green time’ in the AM peak (signal phase D) and 56 seconds of green time in the PM peak (signal phase C) (refer to **Appendix A** of this memo for more information regarding signal phasing). As this interchange works in a diamond configuration, the time allocated to this signal phase is determined by the length of ‘green time’ required for the predominant right-turn (westbound) movement onto the M5 Motorway from the north approach.

As there are more vehicles undertaking the predominant right-turn (westbound) movement onto the M5 Motorway from the north approach than the right-turn (eastbound) movement from the south approach, there is spare ‘green time’ for the eastbound right-turn movement onto the M5 Motorway from south. Due to the spare ‘green time’, the average delay for the right-turn on the south approach did not increase significantly when adding development traffic onto this movement.

The right-turn (eastbound) movement onto the M5 Motorway from traffic travelling north along Moorebank Avenue would be able to accommodate additional traffic movements under scenarios 2, 3 and 4 without significantly increasing the average delay or LoS.

The redistribution of traffic under all scenarios would not impact the average delay or LoS for through-traffic along Moorebank Avenue in both directions.

The performance of the remaining intersection movements/approaches (i.e. north, east and west approaches) in Scenarios 2 to 4 remained unchanged compared to Scenario 1 and remained unaffected by the traffic redistribution.

Table 5-1 – SIDRA modelling results for the four traffic distribution scenarios at the M5 Motorway / Moorebank Avenue interchange under the 2029 Cumulative Development scenario

Scenario	Redistribution	Movement	M5 Motorway / Moorebank Avenue interchange traffic approach								Overall Intersection	
			South *		East **		North *		West **			
			AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Scenario 1	No redistribution	Left-turn	88 (F)	114 (F)	41 (C)	27 (B)	8 (A)	6 (A)	6 (A)	6 (A)	33 (C)	55 (D)
		Through	36 (C)	42 (C)	-	-	18 (B)	43 (D)	-	-		
		Right-turn	47 (D)	28 (B)	46 (D)	62 (E)	31 (C)	70 (E)	44 (D)	91 (F)		
Scenario 2	10% redistribution	Left-turn	71 (F)	95 (F)	41 (C)	27 (B)	8 (A)	6 (A)	6 (A)	6 (A)	31 (C)	54 (D)
		Through	36 (C)	42 (C)	-	-	18 (B)	43 (D)	-	-		
		Right-turn	48 (D)	28 (B)	46 (D)	62 (E)	31 (C)	70 (E)	44 (D)	91 (F)		
Scenario 3	20% redistribution	Left-turn	57 (E)	81 (F)	41 (C)	27 (B)	9 (A)	7 (A)	6 (A)	6 (A)	30 (C)	52 (D)
		Through	36 (C)	42 (C)	-	-	18 (B)	43 (D)	-	-		
		Right-turn	49 (D)	28 (B)	46 (D)	62 (E)	31 (C)	70 (E)	44 (D)	91 (F)		
Scenario 4	30% redistribution	Left-turn	48 (D)	69 (E)	41 (C)	27 (B)	9 (A)	7 (A)	6 (A)	6 (A)	29 (C)	51 (D)
		Through	36 (C)	42 (C)	-	-	18 (B)	43 (D)	-	-		
		Right-turn	50 (D)	29 (C)	46 (D)	62 (E)	31 (C)	70 (E)	44 (D)	91 (F)		

Note: Approach denotes the direction from which traffic is approaching the M5 Motorway / Moorebank Avenue intersection i.e. 'south approach' is traffic travelling north along Moorebank Avenue and approaching the M5 Motorway / Moorebank Avenue interchange from the south.

*traffic approaching from Moorebank Avenue **traffic approaching from M5 Motorway

6 CONCLUSIONS

This technical memorandum has been prepared to describe the assumptions and approach to, and results of, this sensitivity test on the performance of the M5 Motorway / Moorebank Avenue interchange with a redistribution of development traffic.

Three redistribution scenarios were assessed using the SIDRA modelling software; with each scenario investigating a proportional redistribution of the development traffic from turning westbound to eastbound from the south approach onto the M5 Motorway under the 2029 Cumulative Development scenario.

The results of the SIDRA modelling demonstrated that the overall intersection performance as a result of redistributing 10%, 20% and 30% of the development traffic remained unchanged for intersection performance in the AM (LOS C) and PM peak (LOS D) when compared to the results in the EIS.

With each increase in the percentage of traffic being redistributed, the average delay for traffic turning left (westbound) onto the M5 Motorway reduced. However, the performance of the movement would remain at a LoS D or worse and there would continue to be heavy delays due to congestion because of lane merging at the on-ramp and traffic merging on the M5 Motorway.

The average delay for traffic turning right (eastbound) onto the M5 Motorway from the south approach would slightly increase in the AM and PM peak; however, these minor changes to average delay would have no impact on the LoS during the AM or PM peak. The analysis showed that the performance of the right-turn (eastbound) movement onto the M5 Motorway from the Moorebank Avenue south approach is determined by the (dominant) right-turn movement on Moorebank Avenue north approach and the right-turn movement would have spare capacity for accommodating additional traffic without significantly increasing the average delay for the right-turn movement

The redistribution of traffic under all scenarios would not impact the average delay or LoS for through-traffic along Moorebank Avenue in both directions. The performance of the remaining intersection movements/approaches (i.e. north, east and west approaches) in Scenarios 2 to 4 remained unchanged compared to Scenario 1 and remained unaffected by the traffic redistribution.

The sensitivity analysis demonstrated that the undertaking of heavy vehicle traffic movements which do not comply with those prescribed in the OTMP for the Proposal and/ or precinct-wide traffic management plan(s) (such as a right-turn movement at the M5 Motorway/ Moorebank Avenue interchange to travel east towards Port Botany), would result in minimal impacts to the performance of the M5 Motorway/ Moorebank interchange within the redistribution scenarios tested.

One of the key influencing factors to the performance of the M5 Motorway/ Moorebank Avenue intersection is the merging/ weaving of traffic along the M5 to access the off-ramps at the M5 Motorway/ Moorebank Avenue intersection and the large volume of traffic exiting the M5 Motorway and turning north along Moorebank Avenue at the interchange during the AM Peak, and traffic along Moorebank Avenue to the north of the interchange turning west onto the M5 motorway at the interchange during the PM peak.

The findings of the sensitivity test demonstrated that the M5 Motorway / Moorebank Avenue interchange would be able to accommodate changes in traffic distribution assumptions without significantly impacting the operation of the interchange.

7 REFERENCES

‘Moorebank Precinct West – Stage 2 Proposal – Environmental Impact Statement, Part 4, Division 4.1, State Significant Development, Dated October 2016, Appendix M, Operational Traffic and Transport Impact Assessment’

‘Moorebank Precinct East – Stage 2 Proposal – Environmental Impact Statement, Part 4, Division 4.1, State Significant Development, Dated December 2016, Appendix K, Operational Traffic and Transport Impact Assessment’

APPENDIX A – SIDRA RESULTS

Scenario 1 – AM Peak

MOVEMENT SUMMARY

Site: MPE_AM_1 [1 - M5 Motorway / Moorebank Avenue 2029 AM Peak]

MPE - AM Peak / Scenario 1
Signals - Fixed Time Isolated Cycle Time = 90 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Moorebank Avenue (S)											
1	L2	407	19.1	0.985	88.3	LOS F	12.5	123.5	1.00	1.27	22.9
2	T1	454	9.7	0.637	36.1	LOS C	9.4	79.6	0.96	0.81	35.6
3	R2	451	7.2	0.681	47.1	LOS D	9.7	78.1	0.98	0.86	31.4
Approach		1312	11.8	0.985	56.1	LOS D	12.5	123.5	0.98	0.97	29.1
East: M5 Motorway Ramps (E)											
4	L2	287	9.5	0.565	41.1	LOS C	7.4	62.4	0.93	0.80	31.9
6	R2	323	16.6	0.558	45.7	LOS D	6.6	63.1	0.95	0.81	31.9
Approach		611	13.3	0.565	43.6	LOS D	7.4	63.1	0.94	0.80	31.9
North: Moorebank Avenue (N)											
7	L2	72	52.9	0.095	8.4	LOS A	0.7	10.3	0.28	0.60	48.5
8	T1	136	28.7	0.131	17.8	LOS B	2.0	22.3	0.65	0.52	44.9
9	R2	608	31.8	0.798	31.3	LOS C	8.3	98.1	0.97	0.93	38.9
Approach		816	33.2	0.798	27.1	LOS B	8.3	98.1	0.85	0.84	40.3
West: M5 Motorway Ramps (W)											
10	L2	1364	10.6	0.867	6.3	LOS A	0.0	0.0	0.00	0.52	53.3
12	R2	294	26.5	0.409	44.0	LOS D	4.2	45.9	0.91	0.78	34.4
Approach		1658	13.5	0.867	12.9	LOS A	4.2	45.9	0.16	0.56	48.4
All Vehicles		4396	16.6	0.985	32.7	LOS C	12.5	123.5	0.64	0.77	37.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P21	East Stage 1	53	6.4	LOS A	0.1	0.1	0.38	0.38
P22	East Stage 2	53	6.4	LOS A	0.1	0.1	0.38	0.38
P31	North Stage 1	50	36.5	LOS D	0.1	0.1	0.90	0.90
P32	North Stage 2	50	14.8	LOS B	0.1	0.1	0.81	0.81
All Pedestrians		205	15.8	LOS B			0.61	0.61

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: MPE_AM_1 [1 - M5 Motorway / Moorebank Avenue 2029 AM Peak]

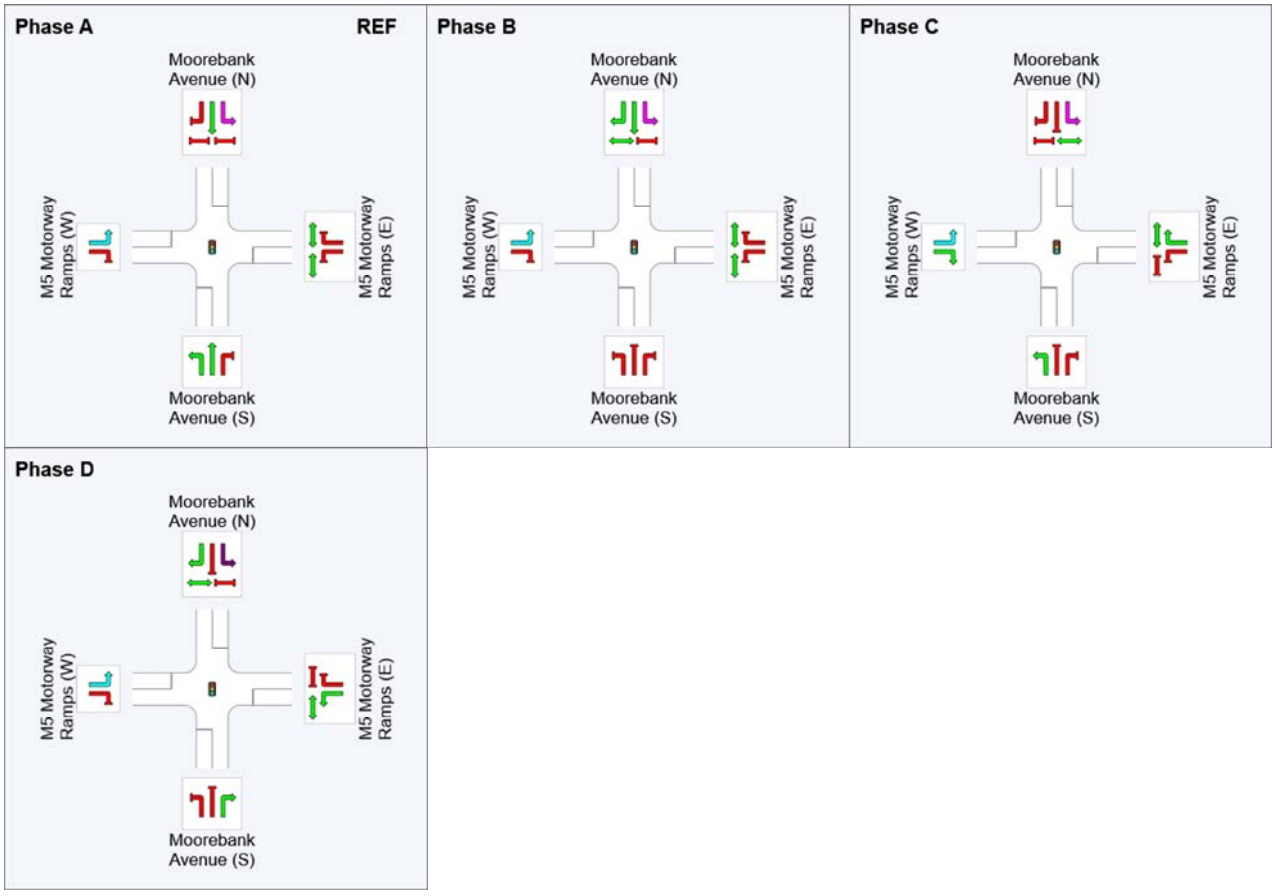
MPE - AM Peak / Scenario 1
Signals - Fixed Time Isolated Cycle Time = 90 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: LMARI_SIGNALS_0800_GTA
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	25	43	66
Green Time (sec)	19	12	18	18
Phase Time (sec)	25	17	24	24
Phase Split	28%	19%	27%	27%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

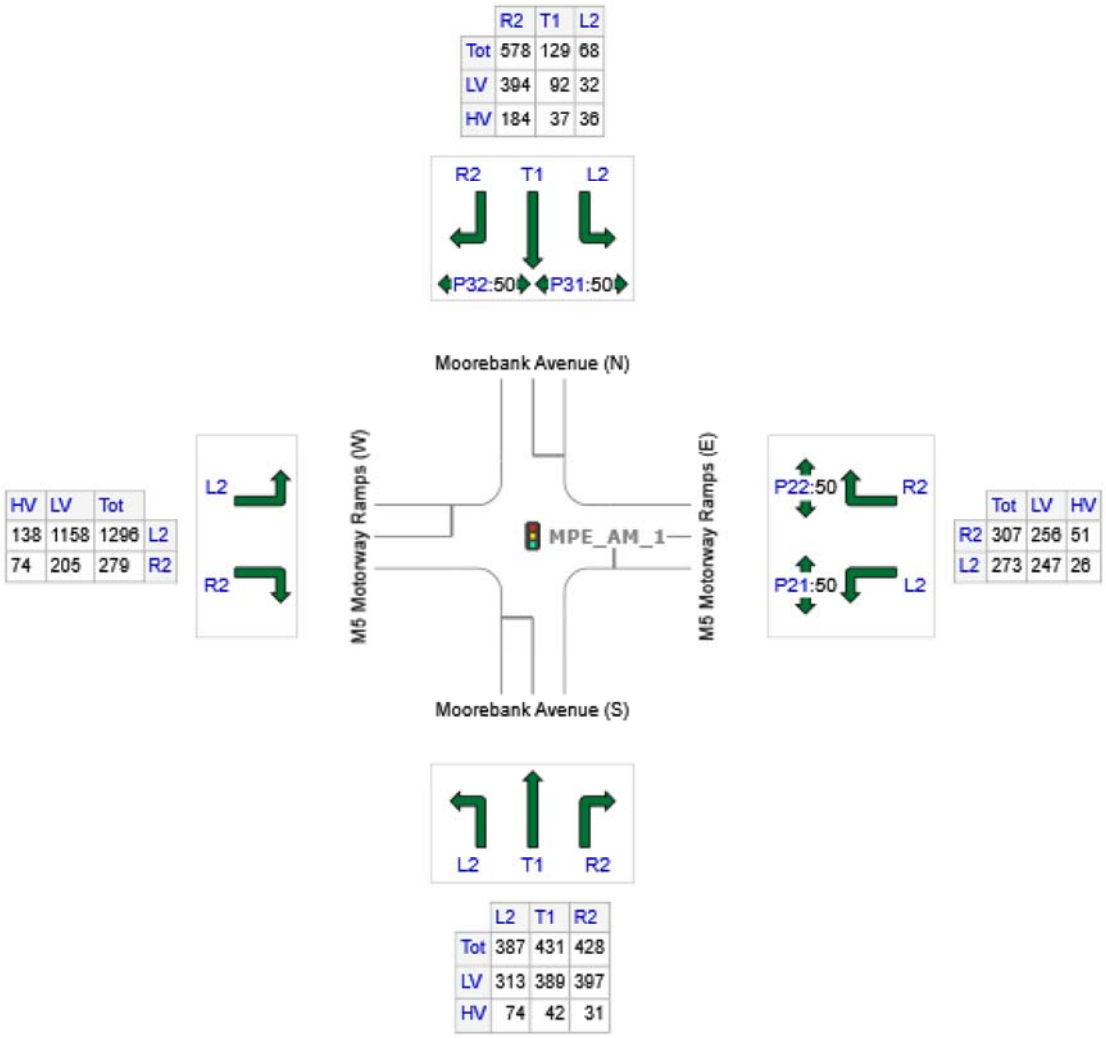
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: MPE_AM_1 [1 - M5 Motorway / Moorebank Avenue 2029 AM Peak]

MPE - AM Peak / Scenario 1
Signals - Fixed Time Isolated

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Moorebank Avenue (S)	1246	1099	147
E: M5 Motorway Ramps (E)	580	503	77
N: Moorebank Avenue (N)	775	518	257
W: M5 Motorway Ramps (W)	1575	1363	212
Total	4176	3483	693

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Scenario 1 – PM Peak

MOVEMENT SUMMARY

Site: MPE_PM_1 [1 - M5 Motorway / Moorebank Avenue 2029 PM Peak]

MPE - PM Peak / Scenario 1
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Moorebank Avenue (S)											
1	L2	426	19.5	0.982	113.8	LOS F	21.1	209.3	1.00	1.25	19.5
2	T1	238	14.6	0.322	41.5	LOS C	5.8	53.6	0.87	0.71	33.6
3	R2	168	4.4	0.104	28.0	LOS B	2.7	20.8	0.59	0.74	39.1
Approach		833	15.0	0.982	75.8	LOS F	21.1	209.3	0.88	0.99	24.8
East: M5 Motorway Ramps (E)											
4	L2	447	4.5	0.349	26.7	LOS B	10.4	79.6	0.66	0.75	38.1
6	R2	229	17.9	0.537	62.1	LOS E	6.4	62.4	0.97	0.80	27.2
Approach		677	9.0	0.537	38.7	LOS C	10.4	79.6	0.77	0.77	33.4
North: Moorebank Avenue (N)											
7	L2	97	25.0	0.088	6.4	LOS A	0.5	5.0	0.14	0.58	51.1
8	T1	328	11.9	0.455	42.7	LOS D	8.8	77.6	0.90	0.74	33.2
9	R2	1294	10.3	0.942	70.2	LOS E	49.4	421.9	1.00	1.05	27.2
Approach		1719	11.4	0.942	61.4	LOS E	49.4	421.9	0.93	0.97	28.8
West: M5 Motorway Ramps (W)											
10	L2	760	20.6	0.553	5.9	LOS A	0.0	0.0	0.00	0.52	53.5
12	R2	605	15.3	0.975	91.4	LOS F	17.3	161.0	1.00	1.09	23.5
Approach		1365	18.3	0.975	43.8	LOS D	17.3	161.0	0.44	0.77	33.9
All Vehicles		4594	13.7	0.982	55.4	LOS D	49.4	421.9	0.75	0.88	29.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P21	East Stage 1	53	4.8	LOS A	0.1	0.1	0.28	0.28
P22	East Stage 2	53	21.6	LOS C	0.1	0.1	0.60	0.60
P31	North Stage 1	50	51.4	LOS E	0.2	0.2	0.93	0.93
P32	North Stage 2	50	21.0	LOS C	0.1	0.1	0.59	0.59
All Pedestrians		205	24.4	LOS C			0.60	0.60

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: MPE_PM_1 [1 - M5 Motorway / Moorebank Avenue 2029 PM Peak]

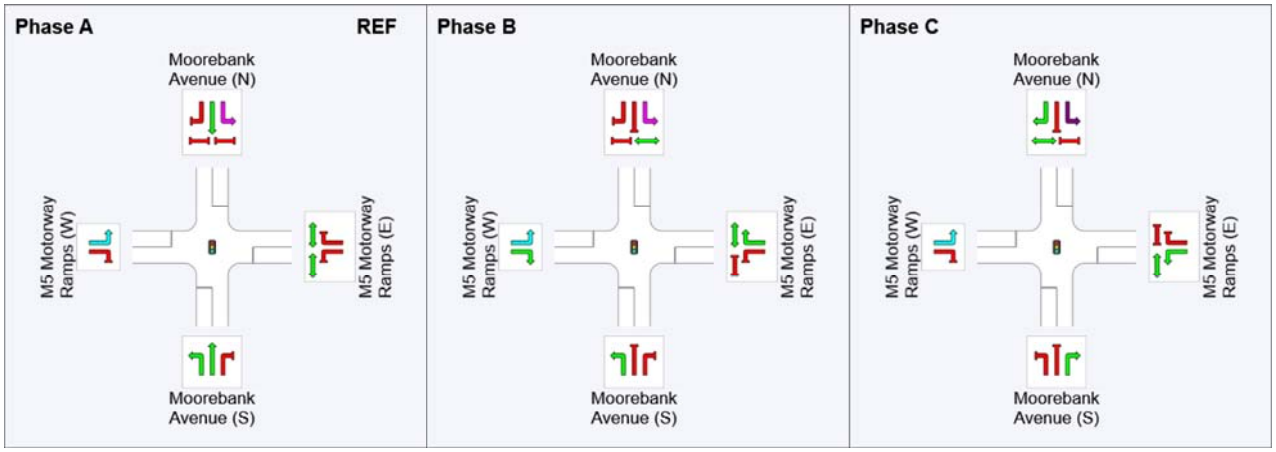
MPE - PM Peak / Scenario 1
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: LMARI_SIGNALS_1700
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Phase Change Time (sec)	0	34	58
Green Time (sec)	28	18	56
Phase Time (sec)	34	24	62
Phase Split	28%	20%	52%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

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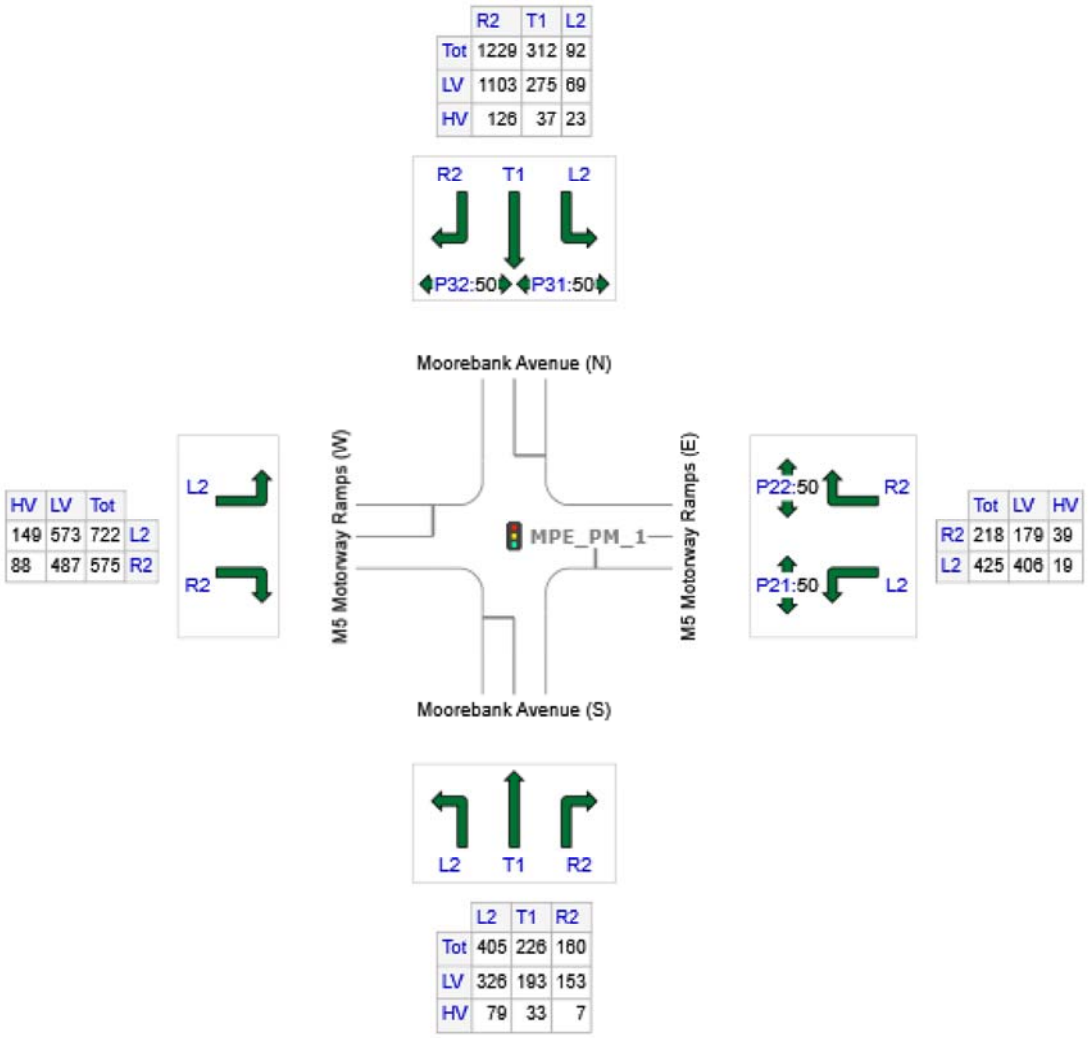
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: MPE_PM_1 [1 - M5 Motorway / Moorebank Avenue 2029 PM Peak]

MPE - PM Peak / Scenario 1
Signals - Fixed Time Isolated

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Moorebank Avenue (S)	791	672	119
E: M5 Motorway Ramps (E)	643	585	58
N: Moorebank Avenue (N)	1633	1447	186
W: M5 Motorway Ramps (W)	1297	1060	237
Total	4364	3764	600

Scenario 2 – AM Peak

MOVEMENT SUMMARY

Site: MPE_AM_2 [2 - M5 Motorway / Moorebank Avenue 2029 AM Peak - 10%]

MPE - AM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 90 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Moorebank Avenue (S)											
1	L2	398	18.3	0.951	70.8	LOS F	10.8	105.6	1.00	1.20	26.0
2	T1	454	9.7	0.637	36.1	LOS C	9.4	79.6	0.96	0.81	35.6
3	R2	460	8.2	0.706	47.9	LOS D	10.0	82.6	0.99	0.87	31.1
Approach		1312	11.8	0.951	50.8	LOS D	10.8	105.6	0.98	0.95	30.5
East: M5 Motorway Ramps (E)											
4	L2	287	9.5	0.565	41.1	LOS C	7.4	62.4	0.93	0.80	31.9
6	R2	323	16.6	0.558	45.7	LOS D	6.6	63.1	0.95	0.81	31.9
Approach		611	13.3	0.565	43.6	LOS D	7.4	63.1	0.94	0.80	31.9
North: Moorebank Avenue (N)											
7	L2	72	52.9	0.095	8.4	LOS A	0.7	10.4	0.28	0.60	48.5
8	T1	136	28.7	0.131	17.8	LOS B	2.0	22.3	0.65	0.52	44.9
9	R2	608	31.8	0.798	31.3	LOS C	8.3	98.1	0.97	0.93	38.9
Approach		816	33.2	0.798	27.1	LOS B	8.3	98.1	0.85	0.84	40.3
West: M5 Motorway Ramps (W)											
10	L2	1364	10.6	0.867	6.3	LOS A	0.0	0.0	0.00	0.52	53.3
12	R2	294	26.5	0.409	44.0	LOS D	4.2	45.9	0.91	0.78	34.4
Approach		1658	13.5	0.867	12.9	LOS A	4.2	45.9	0.16	0.56	48.4
All Vehicles		4396	16.6	0.951	31.1	LOS C	10.8	105.6	0.64	0.76	38.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P21	East Stage 1	53	6.4	LOS A	0.1	0.1	0.38	0.38
P22	East Stage 2	53	6.4	LOS A	0.1	0.1	0.38	0.38
P31	North Stage 1	50	36.5	LOS D	0.1	0.1	0.90	0.90
P32	North Stage 2	50	14.8	LOS B	0.1	0.1	0.81	0.81
All Pedestrians		205	15.8	LOS B			0.61	0.61

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: MPE_AM_2 [2 - M5 Motorway / Moorebank Avenue 2029 AM Peak - 10%]

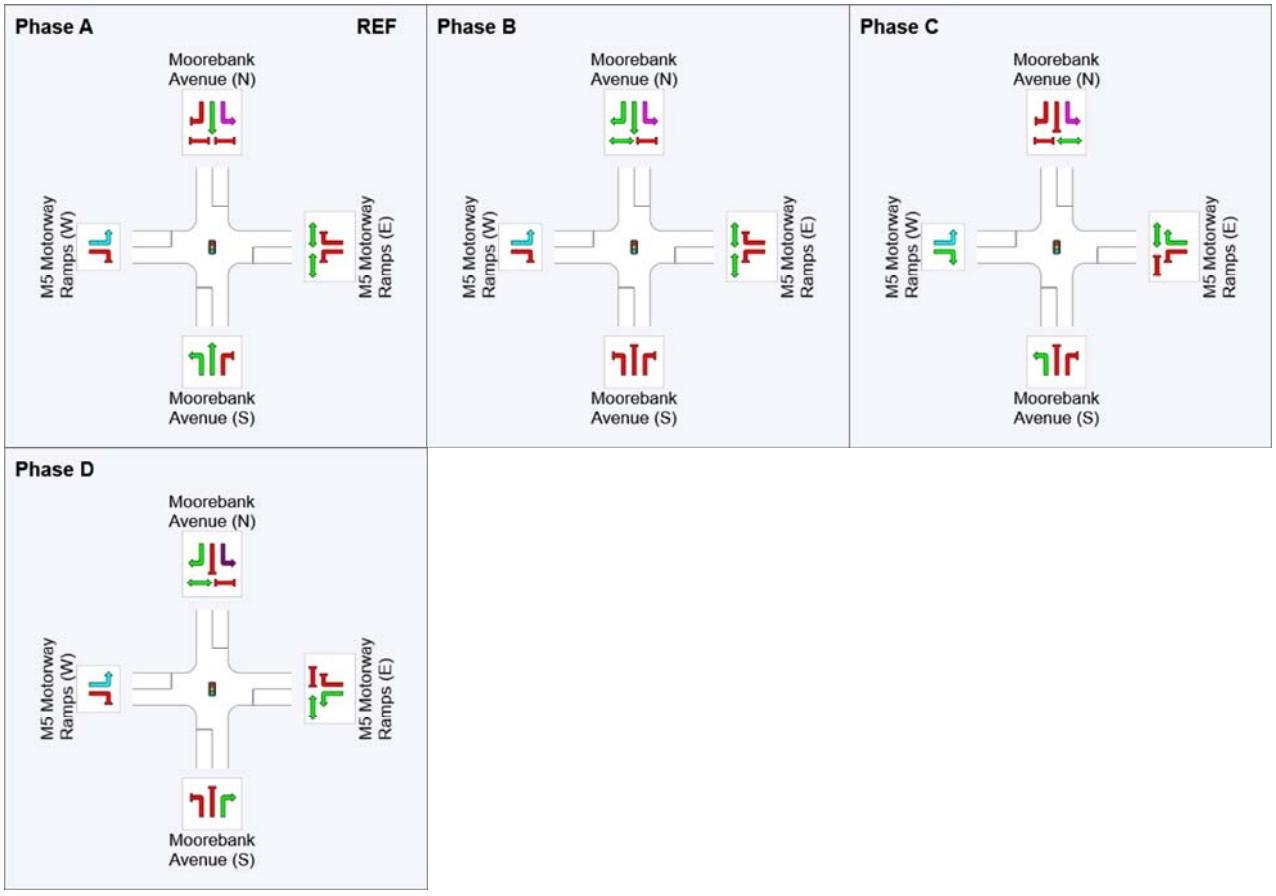
MPE - AM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 90 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: LMARI_SIGNALS_0800_GTA
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	25	43	66
Green Time (sec)	19	12	18	18
Phase Time (sec)	25	17	24	24
Phase Split	28%	19%	27%	27%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

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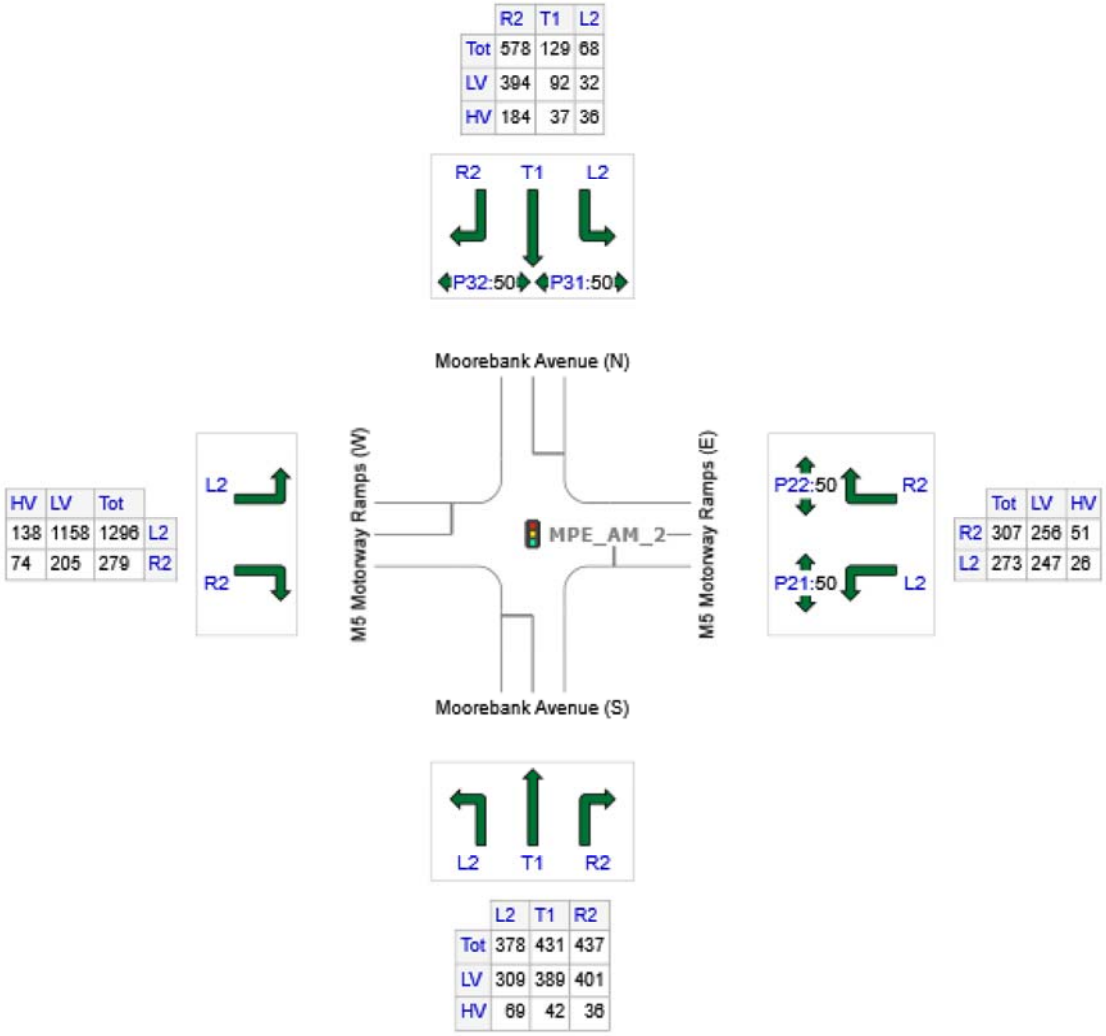
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: MPE_AM_2 [2 - M5 Motorway / Moorebank Avenue 2029 AM Peak - 10%]

MPE - AM Peak / Scenario 2
Signals - Fixed Time Isolated

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Moorebank Avenue (S)	1246	1099	147
E: M5 Motorway Ramps (E)	580	503	77
N: Moorebank Avenue (N)	775	518	257
W: M5 Motorway Ramps (W)	1575	1363	212
Total	4176	3483	693

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Scenario 2 – PM Peak

MOVEMENT SUMMARY

Site: MPE_PM_2 [2 - M5 Motorway / Moorebank Avenue 2029 PM Peak - 10%]

MPE - PM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Moorebank Avenue (S)											
1	L2	417	18.4	0.947	95.2	LOS F	18.7	182.6	1.00	1.18	21.8
2	T1	238	14.6	0.322	41.5	LOS C	5.8	53.6	0.87	0.71	33.6
3	R2	178	7.1	0.115	28.2	LOS B	2.9	23.3	0.59	0.75	39.0
Approach		833	14.9	0.947	65.5	LOS E	18.7	182.6	0.88	0.95	26.9
East: M5 Motorway Ramps (E)											
4	L2	447	4.5	0.349	26.7	LOS B	10.4	79.6	0.66	0.75	38.1
6	R2	229	17.9	0.537	62.1	LOS E	6.4	62.4	0.97	0.80	27.2
Approach		677	9.0	0.537	38.7	LOS C	10.4	79.6	0.77	0.77	33.4
North: Moorebank Avenue (N)											
7	L2	97	25.0	0.088	6.4	LOS A	0.5	5.0	0.14	0.58	51.1
8	T1	328	11.9	0.455	42.7	LOS D	8.8	77.6	0.90	0.74	33.2
9	R2	1294	10.3	0.942	70.2	LOS E	49.4	421.9	1.00	1.05	27.2
Approach		1719	11.4	0.942	61.4	LOS E	49.4	421.9	0.93	0.97	28.8
West: M5 Motorway Ramps (W)											
10	L2	760	20.6	0.553	5.9	LOS A	0.0	0.0	0.00	0.52	53.5
12	R2	605	15.3	0.975	91.4	LOS F	17.3	161.0	1.00	1.09	23.5
Approach		1365	18.3	0.975	43.8	LOS D	17.3	161.0	0.44	0.77	33.9
All Vehicles		4594	13.7	0.975	53.6	LOS D	49.4	421.9	0.75	0.88	30.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P21	East Stage 1	53	4.8	LOS A	0.1	0.1	0.28	0.28
P22	East Stage 2	53	21.6	LOS C	0.1	0.1	0.60	0.60
P31	North Stage 1	50	51.4	LOS E	0.2	0.2	0.93	0.93
P32	North Stage 2	50	21.0	LOS C	0.1	0.1	0.59	0.59
All Pedestrians		205	24.4	LOS C			0.60	0.60

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: MPE_PM_2 [2 - M5 Motorway / Moorebank Avenue 2029 PM Peak - 10%]

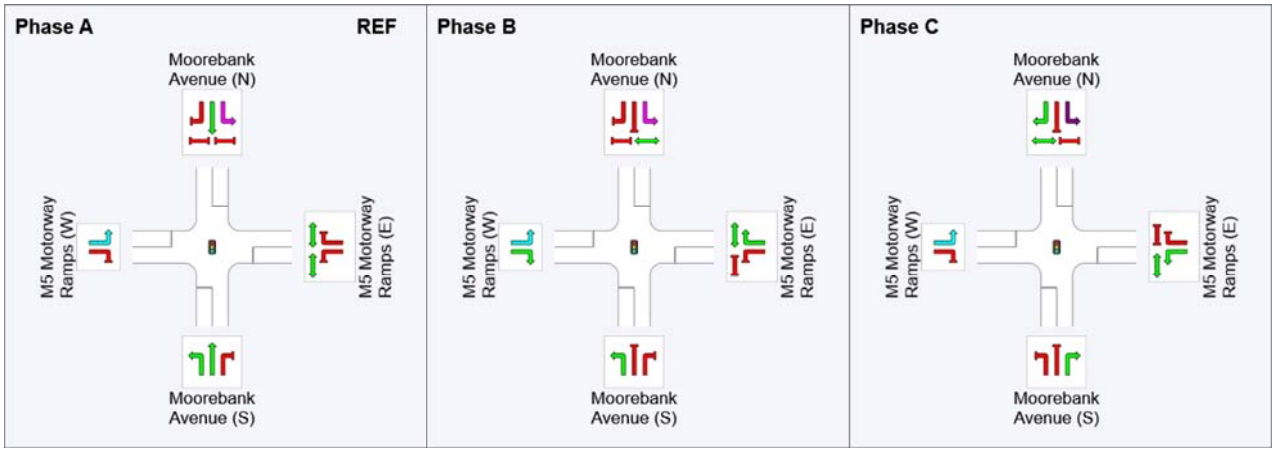
MPE - PM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: LMARI_SIGNALS_1700
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Phase Change Time (sec)	0	34	58
Green Time (sec)	28	18	56
Phase Time (sec)	34	24	62
Phase Split	28%	20%	52%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

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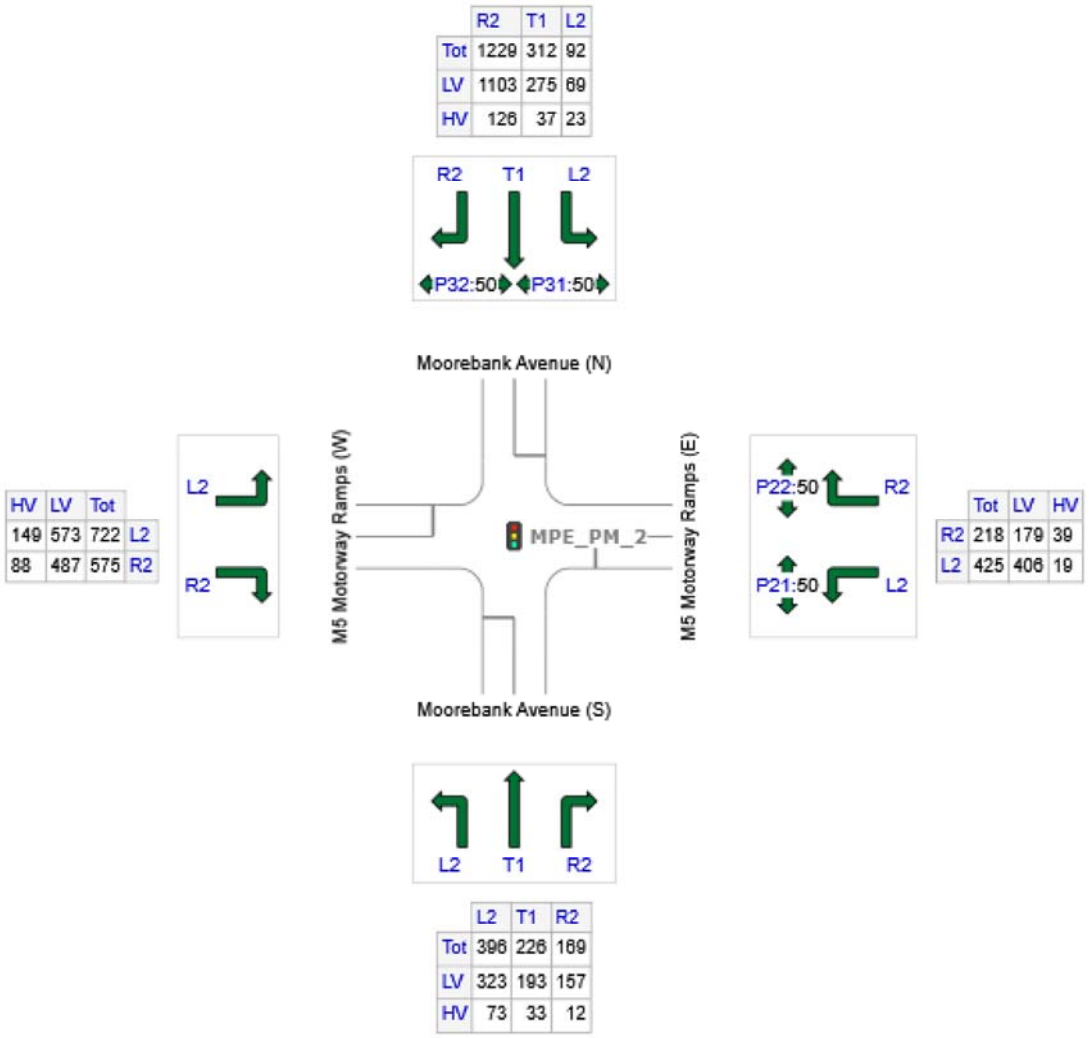
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: MPE_PM_2 [2 - M5 Motorway / Moorebank Avenue 2029 PM Peak - 10%]

MPE - PM Peak / Scenario 2
Signals - Fixed Time Isolated

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Moorebank Avenue (S)	791	673	118
E: M5 Motorway Ramps (E)	643	585	58
N: Moorebank Avenue (N)	1633	1447	186
W: M5 Motorway Ramps (W)	1297	1060	237
Total	4364	3765	599

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Scenario 3 – AM Peak

MOVEMENT SUMMARY

Site: MPE_AM_2 [3 - M5 Motorway / Moorebank Avenue 2029 AM Peak - 20%]

MPE - AM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 90 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Moorebank Avenue (S)											
1	L2	388	17.3	0.917	57.4	LOS E	9.3	89.7	1.00	1.14	29.1
2	T1	454	9.7	0.637	36.1	LOS C	9.4	79.6	0.96	0.81	35.6
3	R2	468	9.2	0.729	48.7	LOS D	10.4	87.0	0.99	0.88	30.8
Approach		1311	11.8	0.917	46.9	LOS D	10.4	89.7	0.98	0.93	31.7
East: M5 Motorway Ramps (E)											
4	L2	287	9.5	0.565	41.1	LOS C	7.4	62.4	0.93	0.80	31.9
6	R2	323	16.6	0.558	45.7	LOS D	6.6	63.1	0.95	0.81	31.9
Approach		611	13.3	0.565	43.6	LOS D	7.4	63.1	0.94	0.80	31.9
North: Moorebank Avenue (N)											
7	L2	72	52.9	0.096	8.7	LOS A	0.7	11.0	0.30	0.60	48.3
8	T1	136	28.7	0.131	17.8	LOS B	2.0	22.3	0.65	0.52	44.9
9	R2	608	31.8	0.798	31.3	LOS C	8.3	98.1	0.97	0.93	38.9
Approach		816	33.2	0.798	27.1	LOS B	8.3	98.1	0.85	0.84	40.3
West: M5 Motorway Ramps (W)											
10	L2	1364	10.6	0.867	6.3	LOS A	0.0	0.0	0.00	0.52	53.3
12	R2	294	26.5	0.409	44.0	LOS D	4.2	45.9	0.91	0.78	34.4
Approach		1658	13.5	0.867	12.9	LOS A	4.2	45.9	0.16	0.56	48.4
All Vehicles		4395	16.6	0.917	30.0	LOS C	10.4	98.1	0.64	0.76	38.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P21	East Stage 1	53	6.4	LOS A	0.1	0.1	0.38	0.38
P22	East Stage 2	53	6.4	LOS A	0.1	0.1	0.38	0.38
P31	North Stage 1	50	36.5	LOS D	0.1	0.1	0.90	0.90
P32	North Stage 2	50	14.8	LOS B	0.1	0.1	0.81	0.81
All Pedestrians		205	15.8	LOS B			0.61	0.61

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: MPE_AM_2 [3 - M5 Motorway / Moorebank Avenue 2029 AM Peak - 20%]

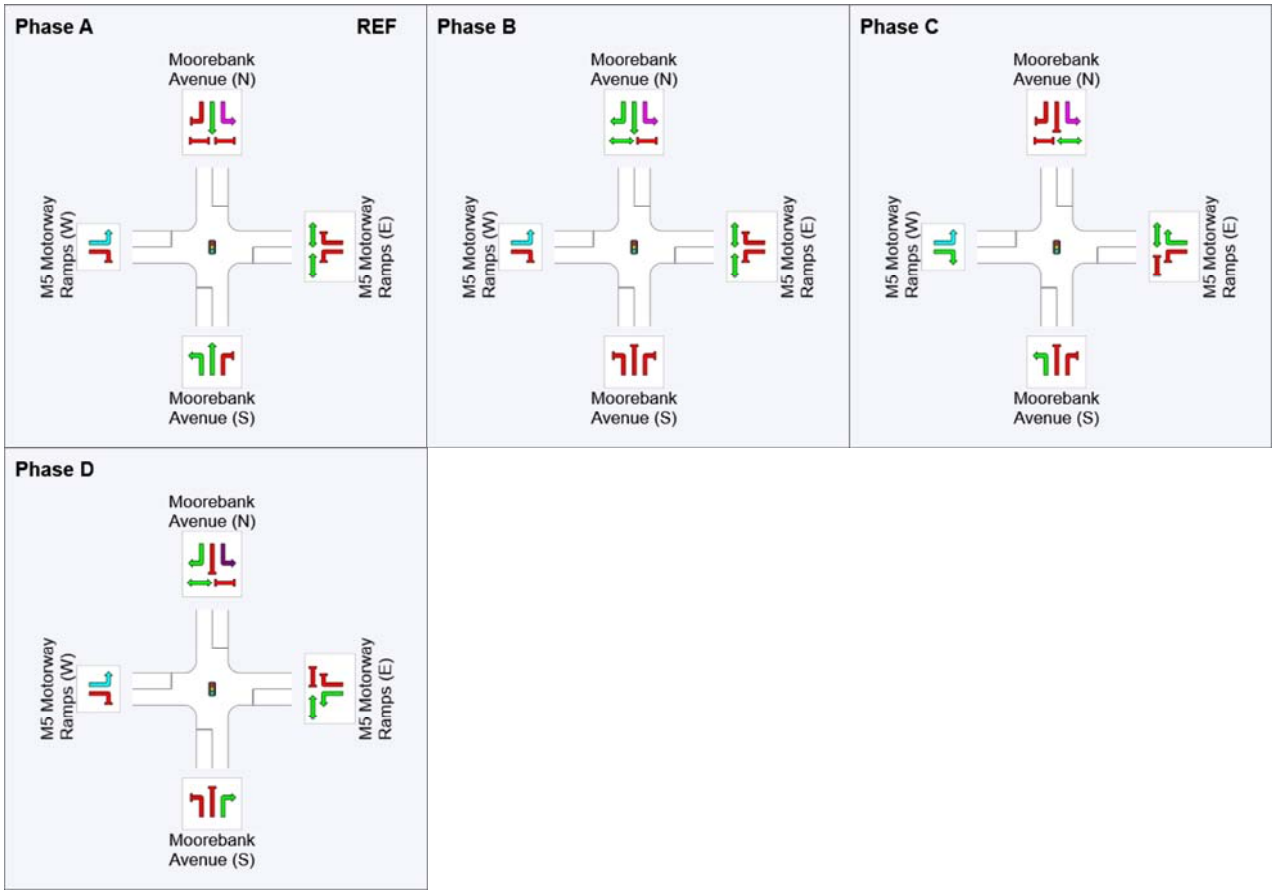
MPE - AM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 90 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: LMARI_SIGNALS_0800_GTA
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	25	43	66
Green Time (sec)	19	12	18	18
Phase Time (sec)	25	17	24	24
Phase Split	28%	19%	27%	27%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

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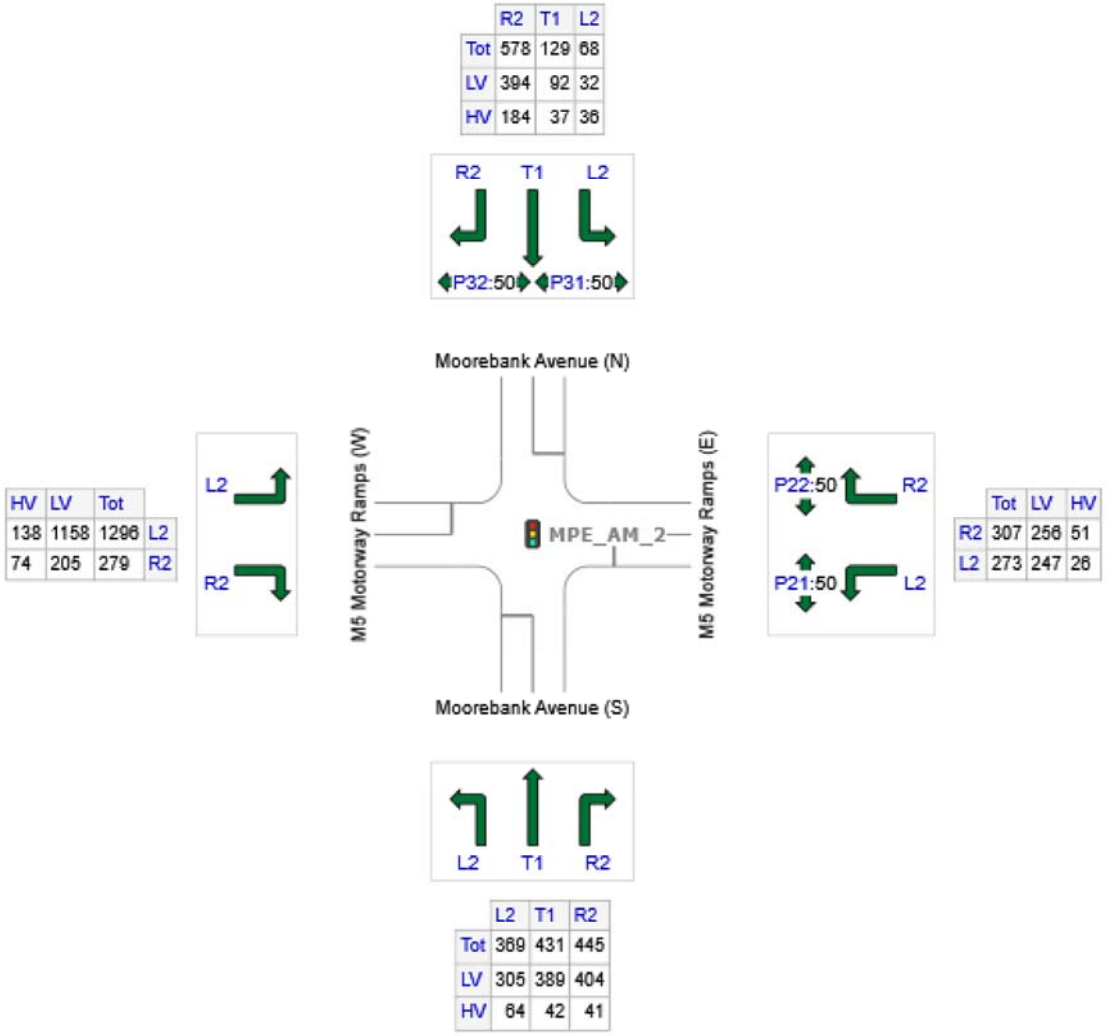
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: MPE_AM_2 [3 - M5 Motorway / Moorebank Avenue 2029 AM Peak - 20%]

MPE - AM Peak / Scenario 2
Signals - Fixed Time Isolated

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Moorebank Avenue (S)	1245	1098	147
E: M5 Motorway Ramps (E)	580	503	77
N: Moorebank Avenue (N)	775	518	257
W: M5 Motorway Ramps (W)	1575	1363	212
Total	4175	3482	693

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Scenario 3 – PM Peak

MOVEMENT SUMMARY

Site: MPE_PM_2 [3 - M5 Motorway / Moorebank Avenue 2029 PM Peak - 20%]

MPE - PM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Moorebank Avenue (S)											
1	L2	407	17.6	0.916	81.4	LOS F	16.8	161.4	1.00	1.13	24.0
2	T1	238	14.6	0.322	41.5	LOS C	5.8	53.6	0.87	0.71	33.6
3	R2	187	10.1	0.127	28.4	LOS B	3.1	26.1	0.60	0.75	38.9
Approach		833	15.0	0.916	58.1	LOS E	16.8	161.4	0.87	0.92	28.6
East: M5 Motorway Ramps (E)											
4	L2	447	4.5	0.349	26.7	LOS B	10.4	79.6	0.66	0.75	38.1
6	R2	229	17.9	0.537	62.1	LOS E	6.4	62.4	0.97	0.80	27.2
Approach		677	9.0	0.537	38.7	LOS C	10.4	79.6	0.77	0.77	33.4
North: Moorebank Avenue (N)											
7	L2	97	25.0	0.089	6.5	LOS A	0.5	5.5	0.15	0.58	51.1
8	T1	328	11.9	0.455	42.7	LOS D	8.8	77.6	0.90	0.74	33.2
9	R2	1294	10.3	0.942	70.2	LOS E	49.4	421.9	1.00	1.05	27.2
Approach		1719	11.4	0.942	61.4	LOS E	49.4	421.9	0.93	0.97	28.8
West: M5 Motorway Ramps (W)											
10	L2	760	20.6	0.553	5.9	LOS A	0.0	0.0	0.00	0.52	53.5
12	R2	605	15.3	0.975	91.4	LOS F	17.3	161.0	1.00	1.09	23.5
Approach		1365	18.3	0.975	43.8	LOS D	17.3	161.0	0.44	0.77	33.9
All Vehicles		4594	13.7	0.975	52.2	LOS D	49.4	421.9	0.75	0.87	30.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P21	East Stage 1	53	4.8	LOS A	0.1	0.1	0.28	0.28
P22	East Stage 2	53	21.6	LOS C	0.1	0.1	0.60	0.60
P31	North Stage 1	50	51.4	LOS E	0.2	0.2	0.93	0.93
P32	North Stage 2	50	21.0	LOS C	0.1	0.1	0.59	0.59
All Pedestrians		205	24.4	LOS C			0.60	0.60

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: MPE_PM_2 [3 - M5 Motorway / Moorebank Avenue 2029 PM Peak - 20%]

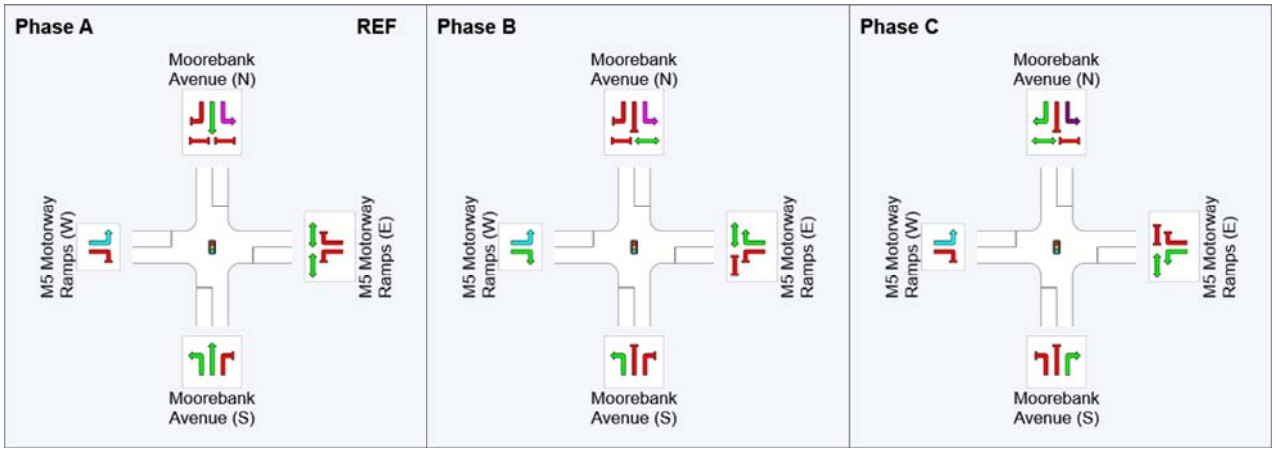
MPE - PM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: LMARI_SIGNALS_1700
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Phase Change Time (sec)	0	34	58
Green Time (sec)	28	18	56
Phase Time (sec)	34	24	62
Phase Split	28%	20%	52%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

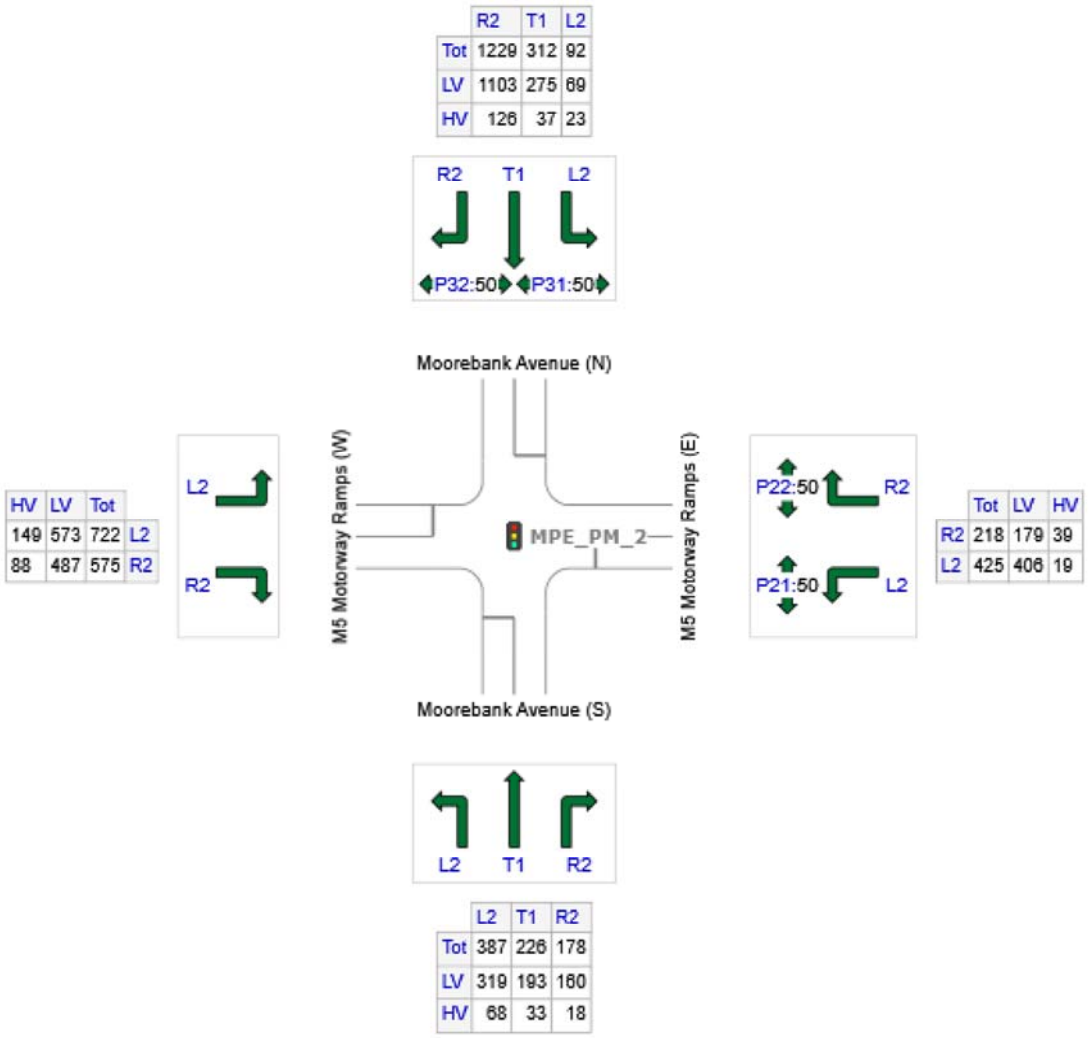
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: MPE_PM_2 [3 - M5 Motorway / Moorebank Avenue 2029 PM Peak - 20%]

MPE - PM Peak / Scenario 2
Signals - Fixed Time Isolated

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Moorebank Avenue (S)	791	672	119
E: M5 Motorway Ramps (E)	643	585	58
N: Moorebank Avenue (N)	1633	1447	186
W: M5 Motorway Ramps (W)	1297	1060	237
Total	4364	3764	600

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Scenario 4 – AM Peak

MOVEMENT SUMMARY

Site: MPE_AM_2 [4 - M5 Motorway / Moorebank Avenue 2029 AM Peak - 30%]

MPE - AM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 90 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Moorebank Avenue (S)											
1	L2	380	16.3	0.886	47.8	LOS D	8.2	77.0	0.98	1.08	31.7
2	T1	454	9.7	0.637	36.1	LOS C	9.4	79.6	0.96	0.81	35.6
3	R2	478	10.1	0.754	49.7	LOS D	10.8	91.9	1.00	0.90	30.5
Approach		1312	11.8	0.886	44.4	LOS D	10.8	91.9	0.98	0.92	32.5
East: M5 Motorway Ramps (E)											
4	L2	287	9.5	0.565	41.1	LOS C	7.4	62.4	0.93	0.80	31.9
6	R2	323	16.6	0.558	45.7	LOS D	6.6	63.1	0.95	0.81	31.9
Approach		611	13.3	0.565	43.6	LOS D	7.4	63.1	0.94	0.80	31.9
North: Moorebank Avenue (N)											
7	L2	72	52.9	0.097	8.7	LOS A	0.7	11.1	0.30	0.60	48.3
8	T1	136	28.7	0.131	17.8	LOS B	2.0	22.3	0.65	0.52	44.9
9	R2	608	31.8	0.798	31.3	LOS C	8.3	98.1	0.97	0.93	38.9
Approach		816	33.2	0.798	27.1	LOS B	8.3	98.1	0.85	0.84	40.3
West: M5 Motorway Ramps (W)											
10	L2	1364	10.6	0.867	6.3	LOS A	0.0	0.0	0.00	0.52	53.3
12	R2	294	26.5	0.409	44.0	LOS D	4.2	45.9	0.91	0.78	34.4
Approach		1658	13.5	0.867	12.9	LOS A	4.2	45.9	0.16	0.56	48.4
All Vehicles		4396	16.6	0.886	29.2	LOS C	10.8	98.1	0.64	0.75	38.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P21	East Stage 1	53	6.4	LOS A	0.1	0.1	0.38	0.38
P22	East Stage 2	53	6.4	LOS A	0.1	0.1	0.38	0.38
P31	North Stage 1	50	36.5	LOS D	0.1	0.1	0.90	0.90
P32	North Stage 2	50	14.8	LOS B	0.1	0.1	0.81	0.81
All Pedestrians		205	15.8	LOS B			0.61	0.61

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: MPE_AM_2 [4 - M5 Motorway / Moorebank Avenue 2029 AM Peak - 30%]

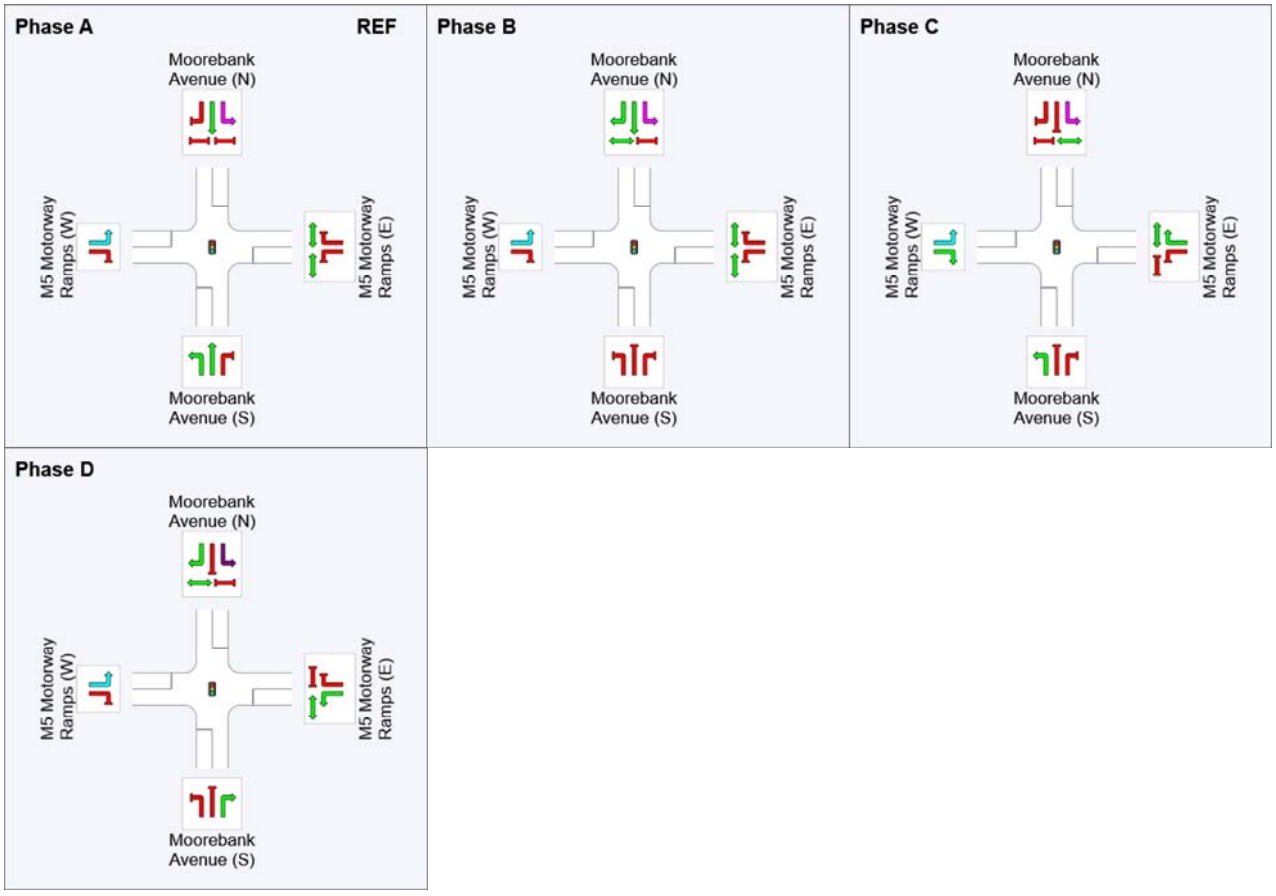
MPE - AM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 90 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: LMARI_SIGNALS_0800_GTA
Reference Phase: Phase A
Input Phase Sequence: A, B, C, D
Output Phase Sequence: A, B, C, D

Phase Timing Results

Phase	A	B	C	D
Phase Change Time (sec)	0	25	43	66
Green Time (sec)	19	12	18	18
Phase Time (sec)	25	17	24	24
Phase Split	28%	19%	27%	27%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

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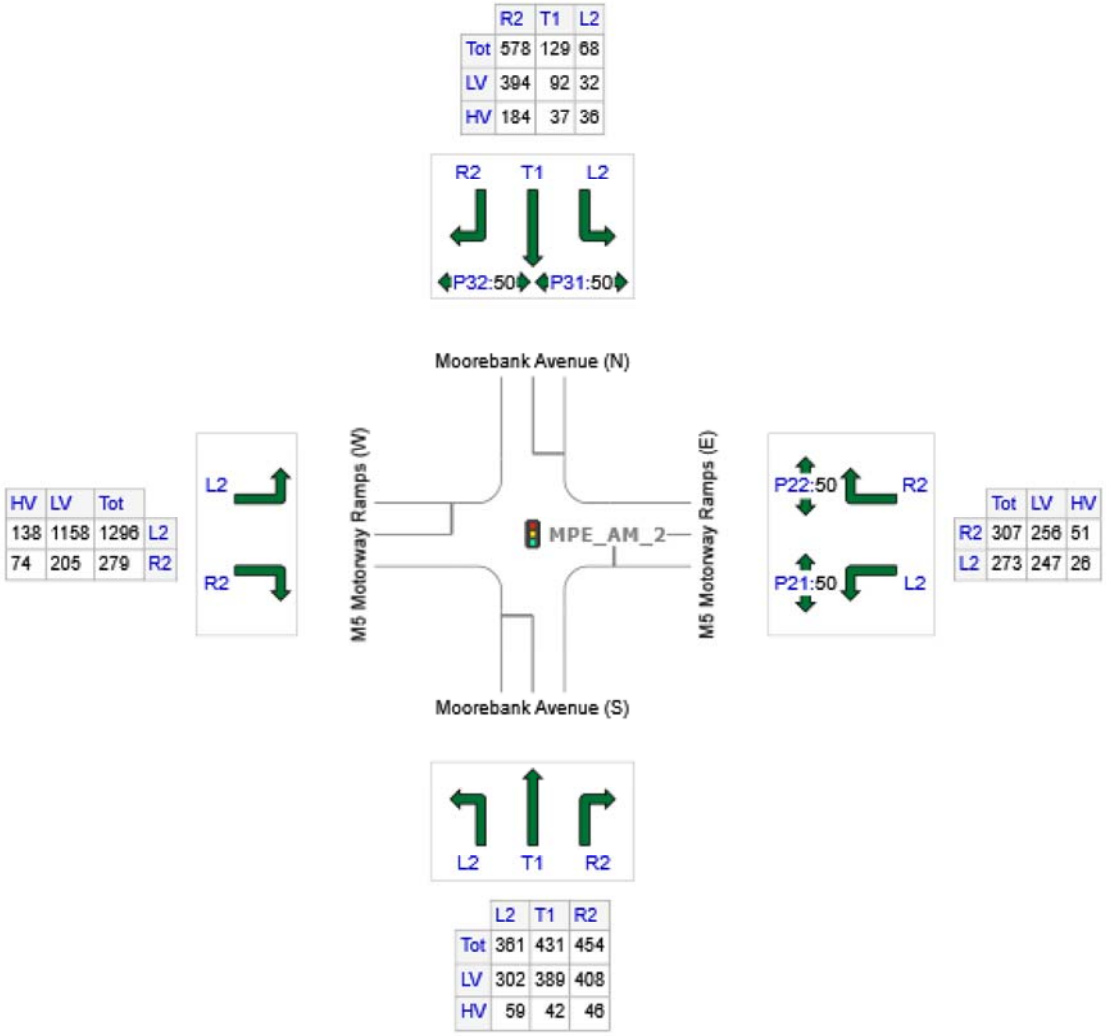
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: MPE_AM_2 [4 - M5 Motorway / Moorebank Avenue 2029 AM Peak - 30%]

MPE - AM Peak / Scenario 2
Signals - Fixed Time Isolated

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Moorebank Avenue (S)	1246	1099	147
E: M5 Motorway Ramps (E)	580	503	77
N: Moorebank Avenue (N)	775	518	257
W: M5 Motorway Ramps (W)	1575	1363	212
Total	4176	3483	693

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Scenario 4 – PM Peak

MOVEMENT SUMMARY

Site: MPE_PM_2 [4 - M5 Motorway / Moorebank Avenue 2029 PM Peak - 30%]

MPE - PM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Moorebank Avenue (S)											
1	L2	398	16.4	0.881	69.4	LOS E	14.9	141.4	0.98	1.07	26.3
2	T1	238	14.6	0.322	41.5	LOS C	5.8	53.6	0.87	0.71	33.6
3	R2	198	12.8	0.139	28.5	LOS C	3.3	29.1	0.60	0.75	38.7
Approach		834	15.0	0.881	51.7	LOS D	14.9	141.4	0.86	0.89	30.3
East: M5 Motorway Ramps (E)											
4	L2	447	4.5	0.349	26.7	LOS B	10.4	79.6	0.66	0.75	38.1
6	R2	229	17.9	0.537	62.1	LOS E	6.4	62.4	0.97	0.80	27.2
Approach		677	9.0	0.537	38.7	LOS C	10.4	79.6	0.77	0.77	33.4
North: Moorebank Avenue (N)											
7	L2	97	25.0	0.090	6.5	LOS A	0.5	5.5	0.15	0.58	51.1
8	T1	328	11.9	0.455	42.7	LOS D	8.8	77.6	0.90	0.74	33.2
9	R2	1294	10.3	0.942	70.2	LOS E	49.4	421.9	1.00	1.05	27.2
Approach		1719	11.4	0.942	61.4	LOS E	49.4	421.9	0.93	0.97	28.8
West: M5 Motorway Ramps (W)											
10	L2	760	20.6	0.553	5.9	LOS A	0.0	0.0	0.00	0.52	53.5
12	R2	605	15.3	0.975	91.4	LOS F	17.3	161.0	1.00	1.09	23.5
Approach		1365	18.3	0.975	43.8	LOS D	17.3	161.0	0.44	0.77	33.9
All Vehicles		4595	13.7	0.975	51.1	LOS D	49.4	421.9	0.75	0.87	31.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P21	East Stage 1	53	4.8	LOS A	0.1	0.1	0.28	0.28
P22	East Stage 2	53	21.6	LOS C	0.1	0.1	0.60	0.60
P31	North Stage 1	50	51.4	LOS E	0.2	0.2	0.93	0.93
P32	North Stage 2	50	21.0	LOS C	0.1	0.1	0.59	0.59
All Pedestrians		205	24.4	LOS C			0.60	0.60

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

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PHASING SUMMARY

Site: MPE_PM_2 [4 - M5 Motorway / Moorebank Avenue 2029 PM Peak - 30%]

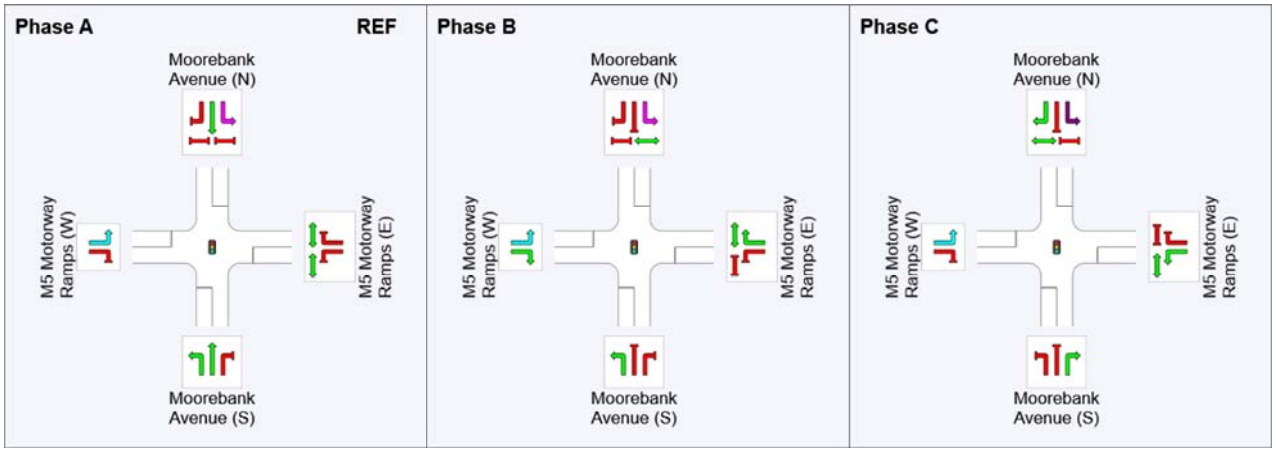
MPE - PM Peak / Scenario 2
Signals - Fixed Time Isolated Cycle Time = 120 seconds (User-Given Phase Times)

Phase Times specified by the user
Phase Sequence: LMARI_SIGNALS_1700
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Results

Phase	A	B	C
Phase Change Time (sec)	0	34	58
Green Time (sec)	28	18	56
Phase Time (sec)	34	24	62
Phase Split	28%	20%	52%

See the Phase Information section in the Detailed Output report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.



REF: Reference Phase
VAR: Variable Phase

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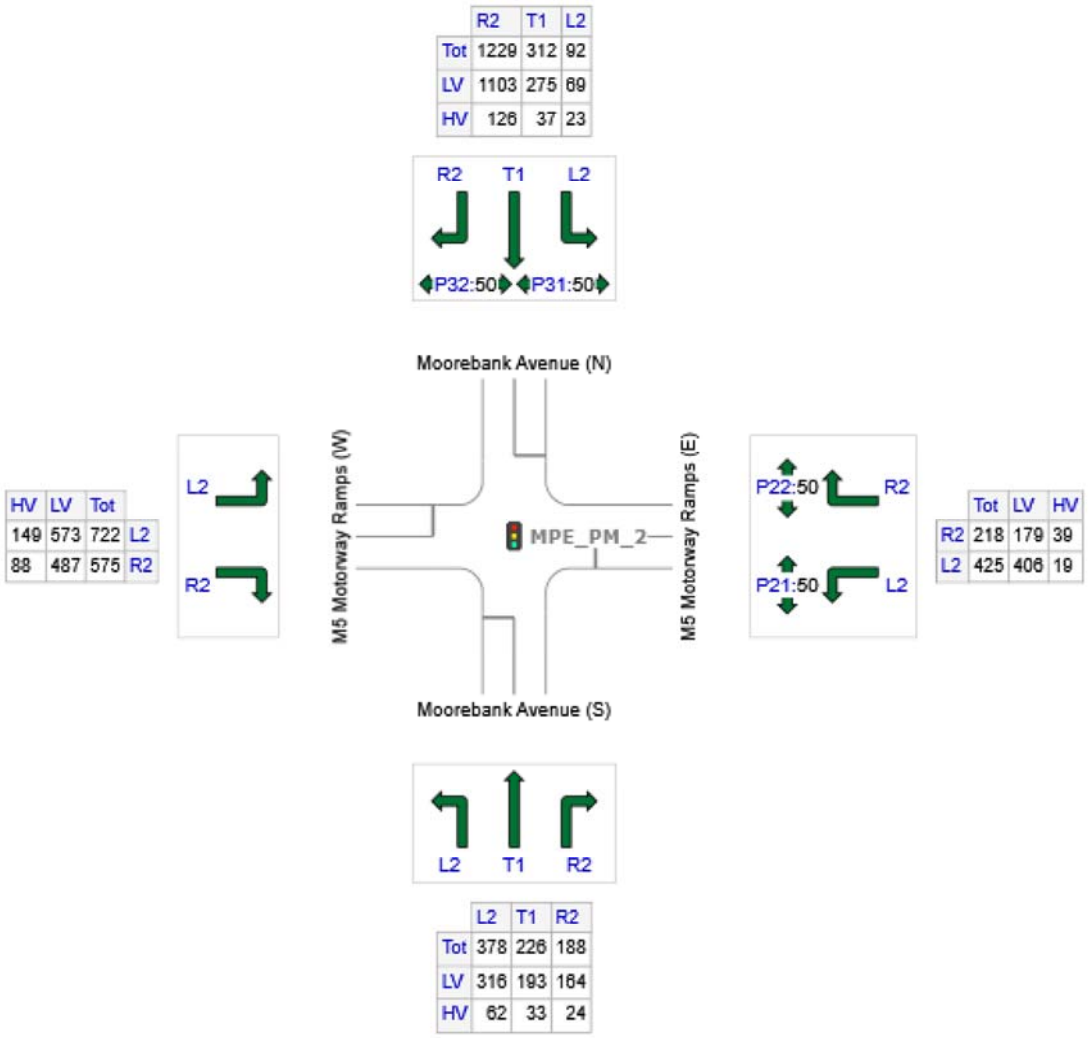
INPUT VOLUMES

Vehicles and pedestrians per 60 minutes

Site: MPE_PM_2 [4 - M5 Motorway / Moorebank Avenue 2029 PM Peak - 30%]

MPE - PM Peak / Scenario 2
Signals - Fixed Time Isolated

Volume Display Method: Separate



	All MCs	Light Vehicles (LV)	Heavy Vehicles (HV)
S: Moorebank Avenue (S)	792	673	119
E: M5 Motorway Ramps (E)	643	585	58
N: Moorebank Avenue (N)	1633	1447	186
W: M5 Motorway Ramps (W)	1297	1060	237
Total	4365	3765	600

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ARCADIS Design & Consultancy for natural and built assets

Moorebank Precinct East Stage 2 Proposal
Response to Submissions

Appendix C2: SIDRA Traffic Movement Diagrams

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

July 2017

MPE STAGE 2 RTS APPENDIX C – SIDRA TRAFFIC MOVEMENT DIAGRAMS

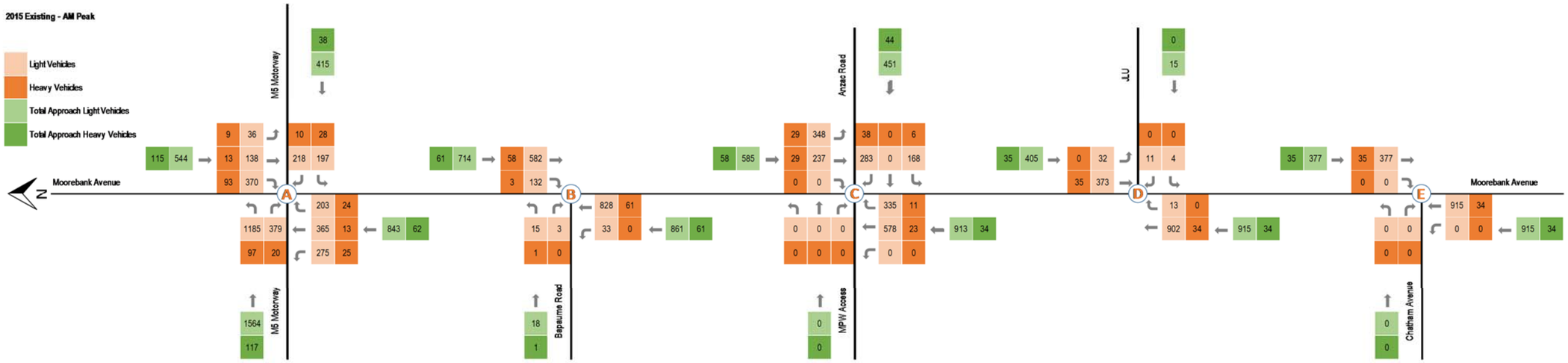

Figure 1 Existing AM peak 1 hour flows (vehicles) in 2015

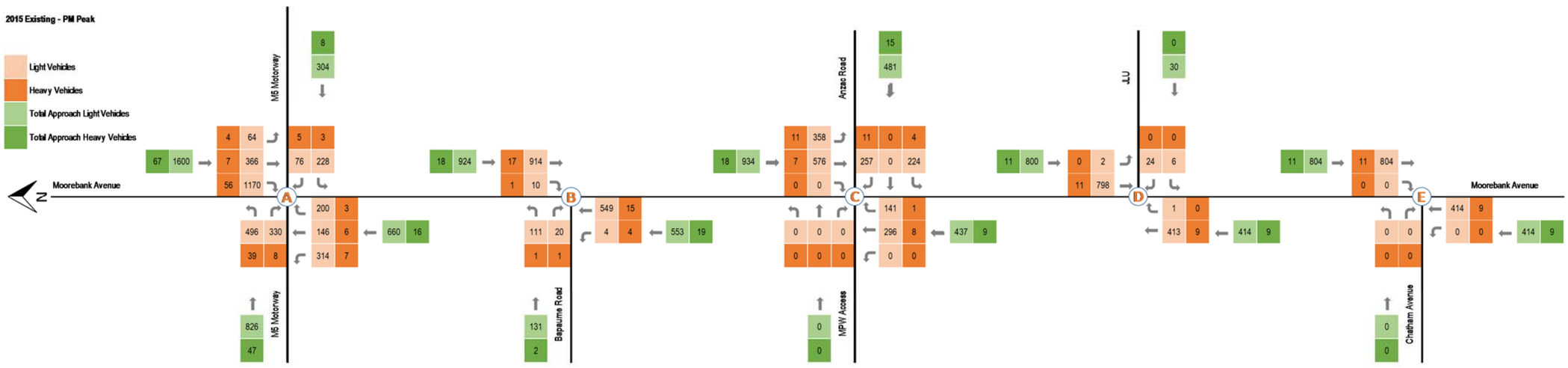

Figure 2 Existing PM peak 1 hour flows (vehicles) in 2015

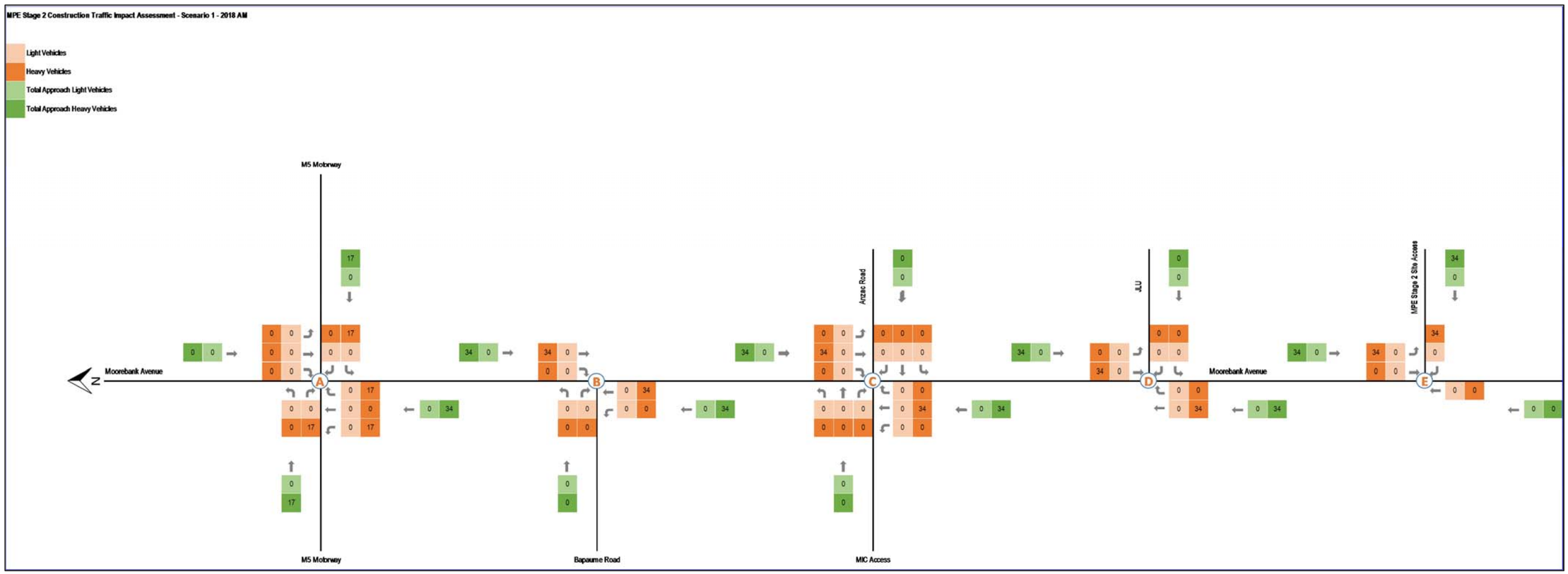

Figure 3 MPE Stage 2 construction – Scenario 1 AM peak one hour construction traffic volumes

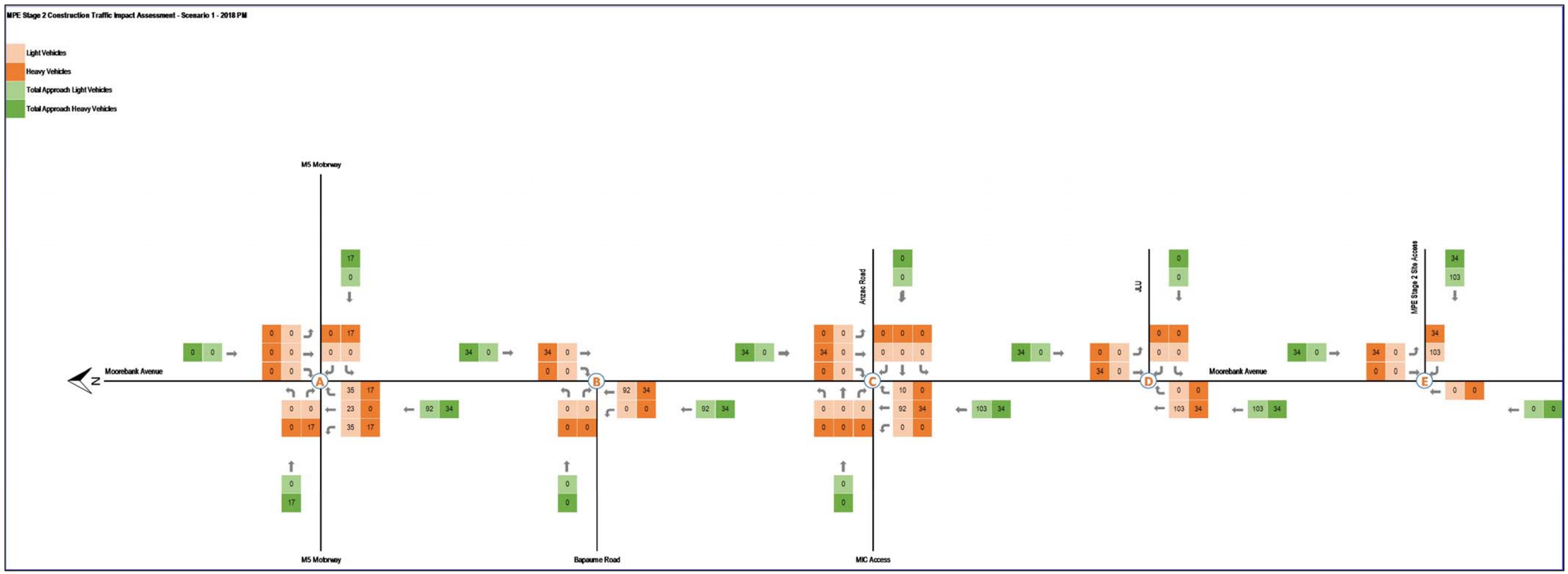

Figure 4 MPE Stage 2 construction – Scenario 1 PM peak one hour construction traffic volumes

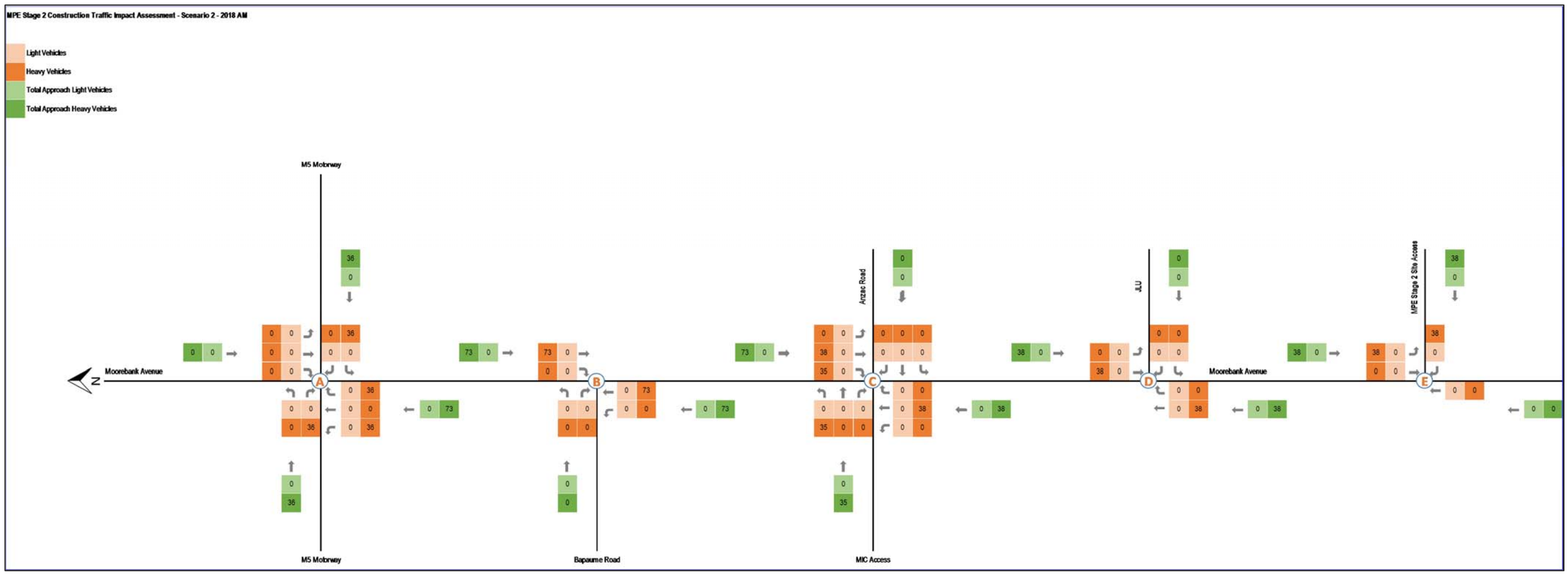

Figure 5 MPE Stage 2 construction – Scenario 2 AM peak one hour construction traffic volumes

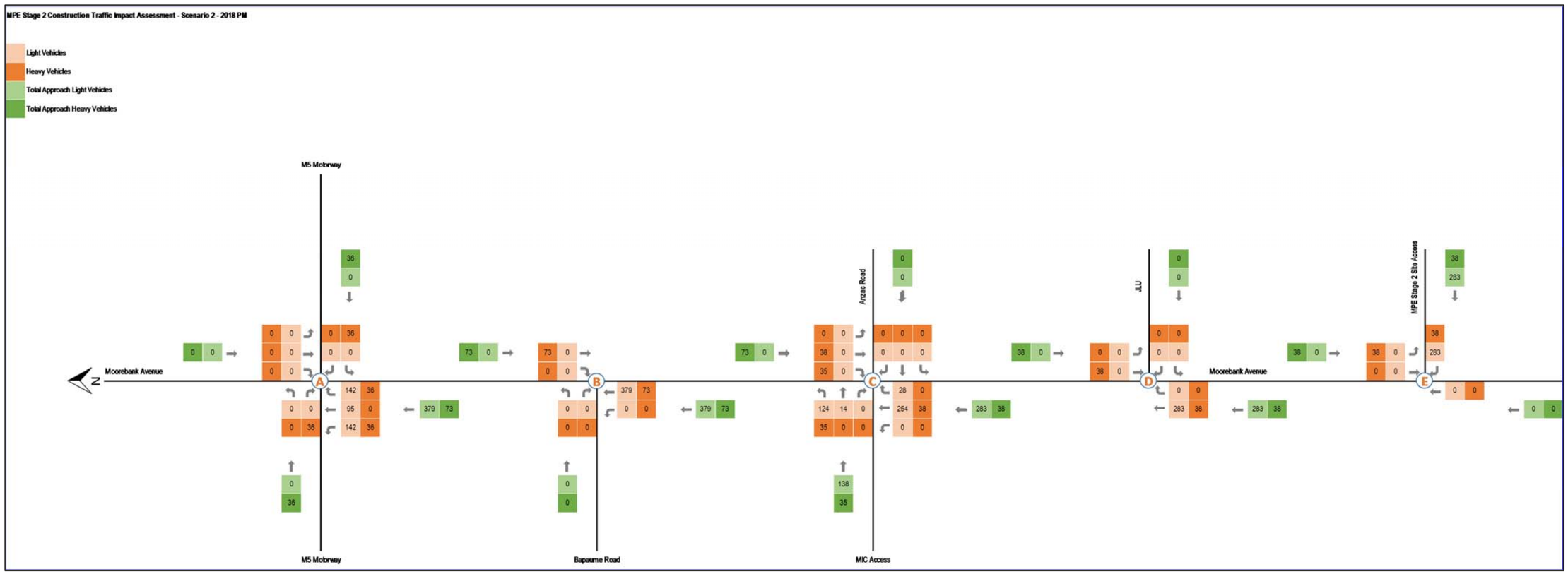

Figure 6 MPE Stage 2 construction – Scenario 2 PM peak one hour construction traffic volumes

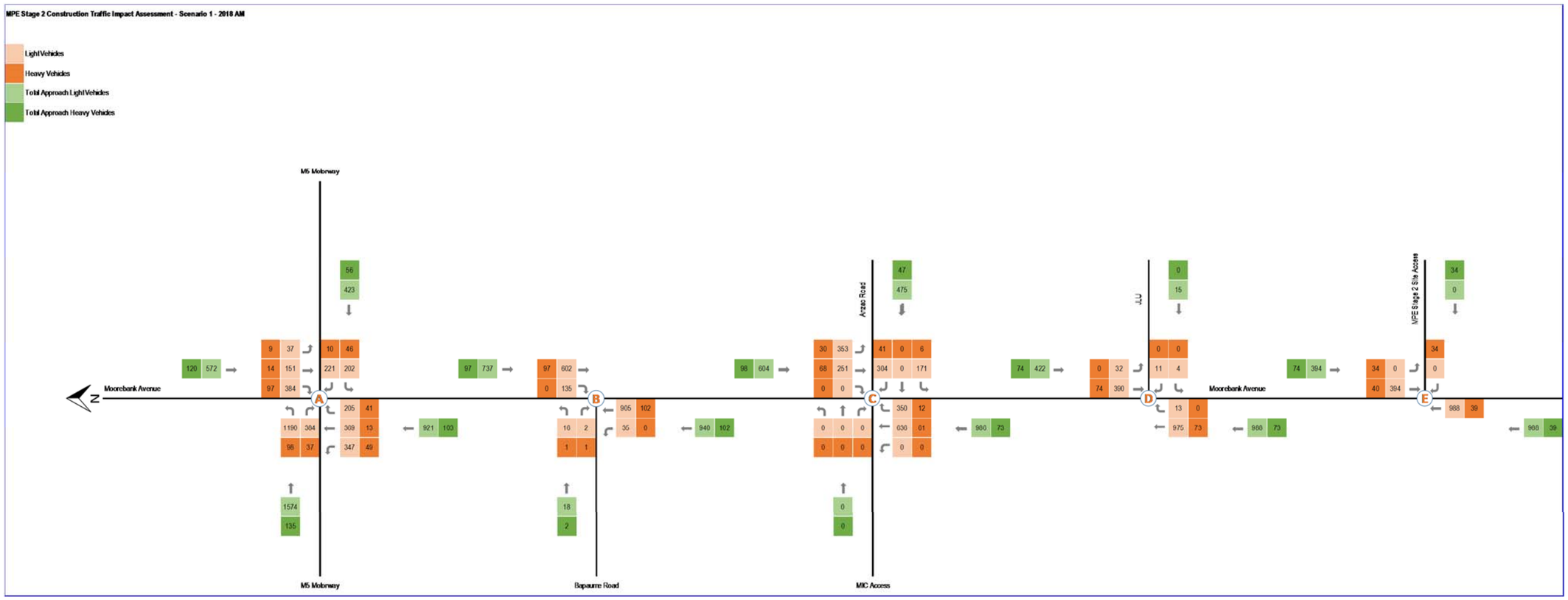

Figure 7 MPE Stage 2 construction – Background + Scenario 1 AM peak one hour traffic volumes

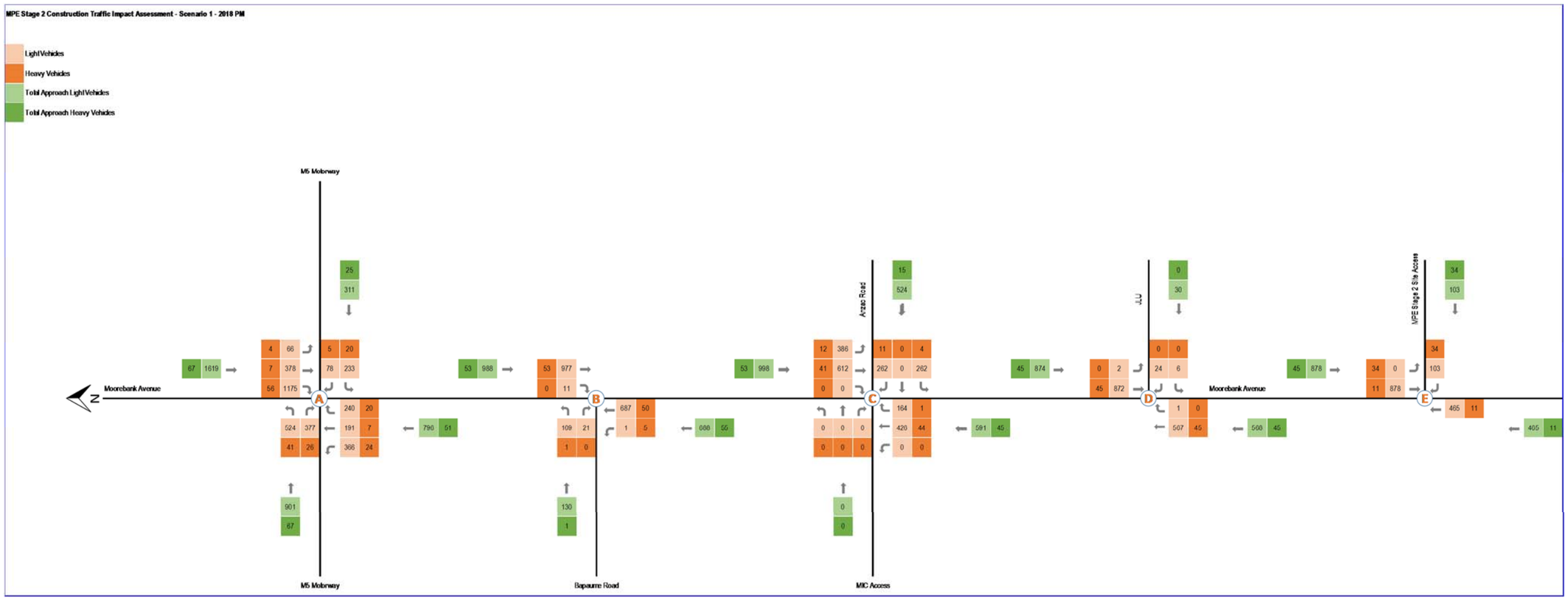

Figure 8 MPE Stage 2 construction – Background + Scenario 1 PM peak one hour traffic volumes

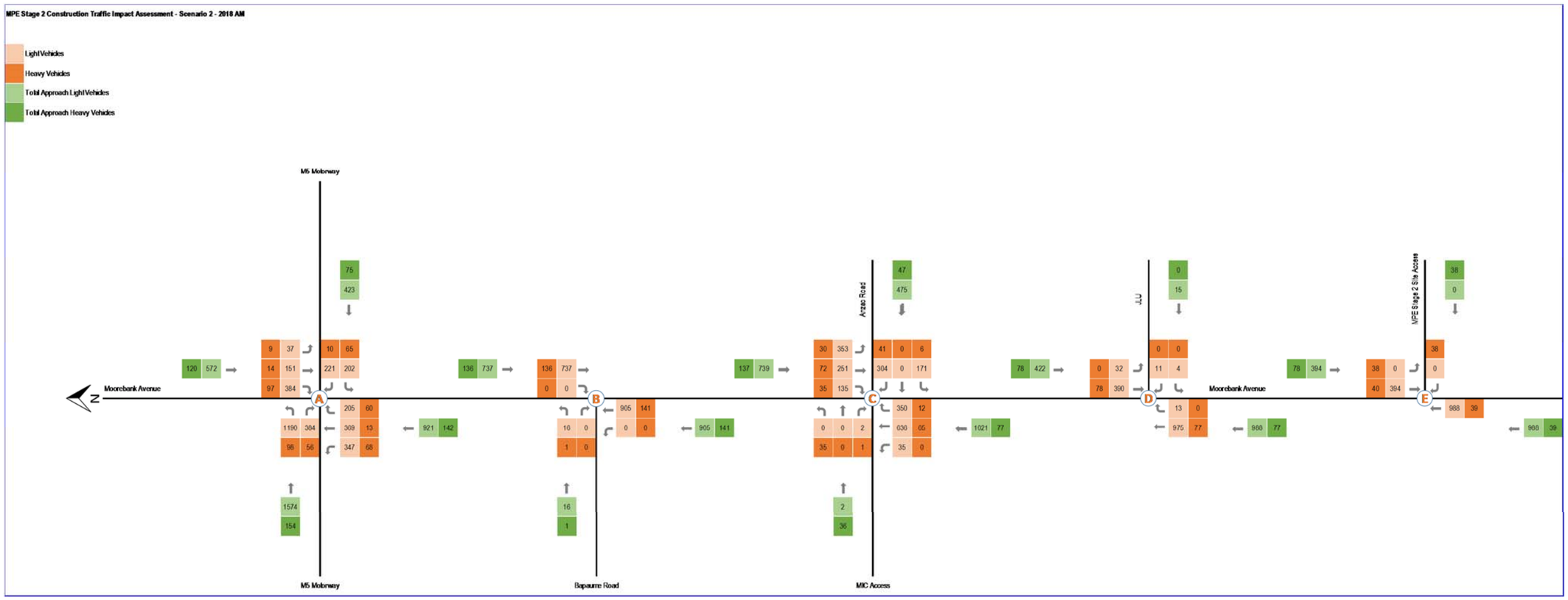

Figure 9 MPE Stage 2 construction – Background + Scenario 2 AM peak one hour traffic volumes

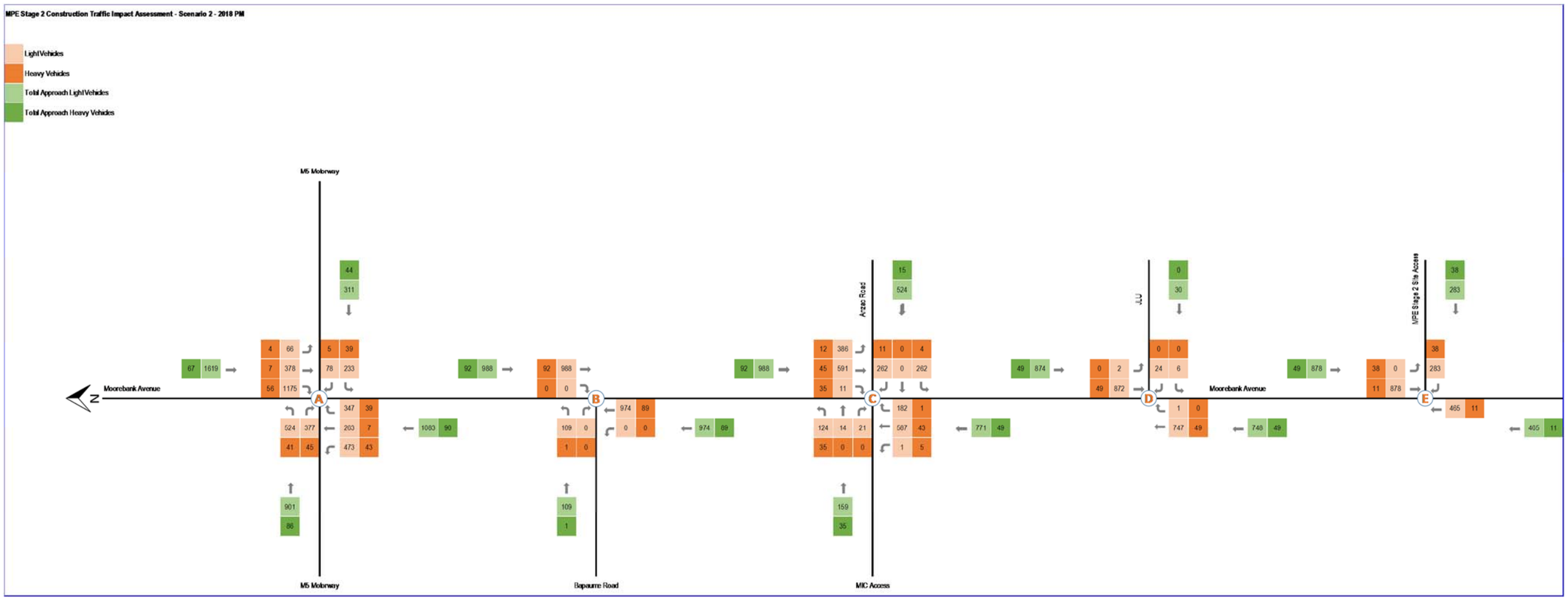

Figure 10 MPE Stage 2 construction – Background + Scenario 2 PM peak one hour traffic volumes

ARCADIS Design & Consultancy for natural and built assets

ARCADIS Design & Consultancy for natural and built assets

Moorebank Precinct East Stage 2 Proposal
Response to Submissions

Appendix C3: Consolidated Traffic Table

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

July 2017

Application	Description	Concept Approval	Approval to build	Terminal Approval to operate	Cumulative Approval to build	Cumulative Terminal Approval to Operate	Anticipated commencement of construction	Anticipated commencement of operations	Traffic Movements				Cumulative Trip Generation	Operational trip generation assumptions
									Construction		Operation			
									Daily	Peak	Daily	Peak		
MP10_0193 (determined 29 September 2014)	MPE Concept approval	300,000 m2 warehousing IMEX terminal up to 500,000 TEU	Nil	Nil	Nil	Nil	Nil	Q3 2019					LV = 9,337 HV = 10,798	Refer below
SSD 5066 (determined 3 June 2016)	MPW Concept Approval	300,000m2 warehousing Interstate terminal 500,000 IMEX terminal 1M TEU	Demolition & Early Works	Nil	Nil	Nil	Commenced	Nil						
SSD 6766 (determined 12 December 2016)	MPE Stage 1	n/a	IMEX terminal	IMEX 250,000 TEU	IMEX Terminal	IMEX 250k	Commenced	Q3 2018	LV = 750 HV = 112	LV (AM) - 210 trips per hour LV (PM) - 180 trips per hour HV (AM) - 6 trips per hour HV (PM) - 6 trips per hour	LV = 80 HV = 670	LV (AM) - 15 trips per hour LV (PM) - 14 trips per hour HV (AM) - 52 trips per hour HV (PM) - 62 trips per hour	LV = 80 HV = 670	<u>Intermodal terminal</u> • The IMT facility (within the MPE Stage 1 site) would operate 52 weeks per year, 7 days a week and 24 hours a day. • Containers would arrive every day of the year. In a typical week, 85% of containers would be processed on weekdays (Monday – Friday), with the remaining 15% being processed on Saturday and Sunday. • The containers arriving at the IMT facility by rail would be transferred onto trucks for transport on-site and off-site. In some instance containers will be unloaded from trains into the container storage area (i.e. stacked) and then transferred onto trucks. • Containers would be loaded onto either B-doubles or semi-trailers. On average a semi-trailer is equivalent to 1.6 TEUs and a B-double equivalent to 2.4 TEUs • About 80% of container deliveries would be made by semi-trailers and 20% by B-doubles.
SSD 16_7709	MPW Stage 2	n/a	215,000m^2 warehousing Interstate terminal	Interstate 500,000 TEU	IMEX Terminal Interstate terminal 215,000m^2 warehousing	IMEX 250k Interstate 500k Warehouse 215,000m^2	Q1 2018	Q3 2019	LV = 570 HV = 810	LV (AM) - 0 trips per hour LV (PM) - 274 trips per hour HV (AM) - 112 trips per hour HV (PM) - 112 trips per hour	LV = 2,670 HV = 1,458	LV (AM) - 252 LV (PM) - 80 HV (AM) - 99 HV (PM) - 105	LV = 2,815 HV = 2,778	<u>warehousing</u> • Warehousing facilities would operate 52 weeks of year, 7 days a week and 24 hours a day. • Containers will arrive every day of the year. In a typical week 95% of containers will be processed on weekdays (Monday – Friday), with the remaining 5% being processed on Saturday and Sunday. • Container are loaded onto either on to a B-double, semi-trailer or rigid trucks. On average a rigid truck is equivalent to 0.8 TEUs • About 65% of delivers will be made by semi-trailers, 30% will be made by rigid trucks and 5% will be made by B-doubles. <u>Intermodal terminal</u> • The intermodal terminal facility would operate 52 weeks of year, 7 days a week and 24 hours a day. • Containers will arrive every day of the year. In a typical week, 85% of containers will be processed on weekdays (Monday – Friday), with the remaining 15% being processed on Saturday and Sunday. • The containers arriving by rail will be transferred on to trucks for transport on-site and off-site. In some instances containers will be unloaded from trains into the container storage area (i.e. stacked) and then transferred onto trucks. • Containers are loaded onto either B-doubles or semi-trailers. On average a semi-trailer is equivalent to 1.6 TEUs and a B-double equivalent to 2.4 TEUs • About 80% of container deliveries will be made by semi-trailers and 20% by B-doubles. <u>Staff shift works</u> Two shifts per day transitioning to three shifts per day
SSD 16_7628	MPE Stage 2	n/a	300,000m^2 warehousing Precinct amenity (retail)	n/a	IMEX Terminal Interstate terminal 515,000m^2 warehousing	IMEX 250k Interstate 500k Warehouse 515,000m^2	Q1 2018	Q3 2019	LV = 428 HV = 1,022	LV (AM) - 0 trips per hour LV (PM) - 102 trips per hour HV (AM) - 67 trips per hour HV (PM) - 67 trips per hour	LV = 3,993 HV = 564	LV (AM) - 377 trips per hour LV (PM) - 120 trips per hour HV (AM) - 51 trips per hour HV (PM) - 33 trips per hour	LV = 6,808 HV= 2,540	<u>Warehousing</u> • Warehousing would operate 52 weeks of year, 7 days a week and 24 hours a day. • Containers would arrive every day of the year. In a typical week, 95% of containers would be processed on weekdays (Monday – Friday), with the remaining five per cent being processed on Saturday and Sunday. • Containers would loaded onto either B-doubles, semi-trailers or rigid trucks for dispatch from the Proposal site. On average, a semi-trailer is equivalent to 1.6 TEUs, a B-double is equivalent to 2.4 TEUs, and a rigid truck is equivalent to 0.8 TEUs • About 65% of deliveries to warehouses within the Proposal site would be made by semi-trailers, 30% would be made by rigid trucks and five per cent would be made by B-doubles. <u>Staff shift work</u> • Staff would work across three shifts per day