Chelsea Gardens, Moss Vale

Traffic Study

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Prepared for

Aoyuan

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Cardno

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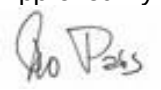

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1 Introduction

1.1 Background

Cardno was engaged by Aoyuan to undertake a traffic and transport analysis to assess the impacts of the Chelsea Gardens planned residential development in Moss Vale, New South Wales. Aoyuan and Cardno have been working in conjunction with Wingecarribee Shire Council (WSC) and Roads and Maritime Services (Roads and Maritime) to provide an outcome that addresses the concerns of the relevant stakeholders.

Moss Vale is located in the Southern Highlands region of New South Wales, approximately 125 kilometres south west of Sydney. The town has a population of 8579 and 3711 dwellings with an average of 2.4 people per household and 1.8 motor vehicles per dwelling (Australian Bureau of Statistics, 2011).

The Moss Vale development site is currently a large tract of rural land located within a naturally-formed amphitheatre which rises from Whites Creek to the hills surrounding the Moss Vale township. The site was identified as falling within an Urban Release Area under the Wingecarribee Local Environment Plan (WLEP) 2010 and was subsequently rezoned in 2017. The land rezoning was supported by a planning proposal which initially aimed to yield up to 1500 residential lots over a number of stages.

1.2 Project objective

The purpose of the Chelsea Gardens, Moss Vale Traffic Study is to evaluate the anticipated traffic network operation in Moss Vale following the Chelsea Gardens development. The outputs of the model will be used to assess the impacts of the development and inform recommendations for mitigating its effect on the traffic network.

The key objectives of the study are:

- Asses the cumulative impacts of the proposed development on the road network and surrounding intersections
- Evaluate existing and future year network performance with the aforementioned development, with and without the proposed Moss Vale bypass
- Identify and evaluate mitigation measures to accommodate traffic generated by the Chelsea Gardens development without detrimental effects to the surrounding transport network.

1.3 Scope of modelling works

The traffic modelling scope of works was as follows:

- Develop a traffic survey plan, coordinate and review traffic surveys
- Identify existing traffic conditions and estimate road traffic base demand for the Moss Vale area
- Develop morning and afternoon peak microsimulation models in Aimsun by building on the strategic modelling works of the WSC TRACKS models
- Calibrate and validate a microsimulation model in accordance with the *Traffic Modelling Guidelines* (Roads and Maritime, 2013)
- Establish 2021, 2026, 2031 and 2036 future traffic demands based on the WSC TRACKS models
- Undertake 2021, 2026, 2031 and 2036 future option testing and analysis for Chelsea Gardens with and without development scenarios and outline future road infrastructure bottlenecks
- Perform a sensitivity analysis to determine the effect of Chelsea Gardens on the base network
- Quantify the impact of Chelsea Gardens on current and future transport infrastructure and propose mitigation measures to address these impacts.

1.4 Study area

Moss Vale is situated on a scenic route which also includes the neighbouring towns of Mittagong and Bowral, just off the Hume Motorway between Sydney and Canberra. In addition, Illawarra Highway runs east from Moss Vale to Wollongong via Macquarie Pass and Nowra Road runs south east to Nowra via Kangaroo Valley.

The main street through the town is Argyle Street which is predominantly one lane in each direction and subject to significant congestion. The study area includes the corridor identified for the proposed Stage 1 Moss Vale Bypass. **Figure 1-1** indicates the extent of the study area and modelled roads. Traffic surveys indicated that the major current deficiencies experienced by the road network are within the CBD area and future modelling results suggest that these deficiencies will be exacerbated by the proposed developments. The core study area which includes these critical intersections is highlighted in **Figure 1-1**.

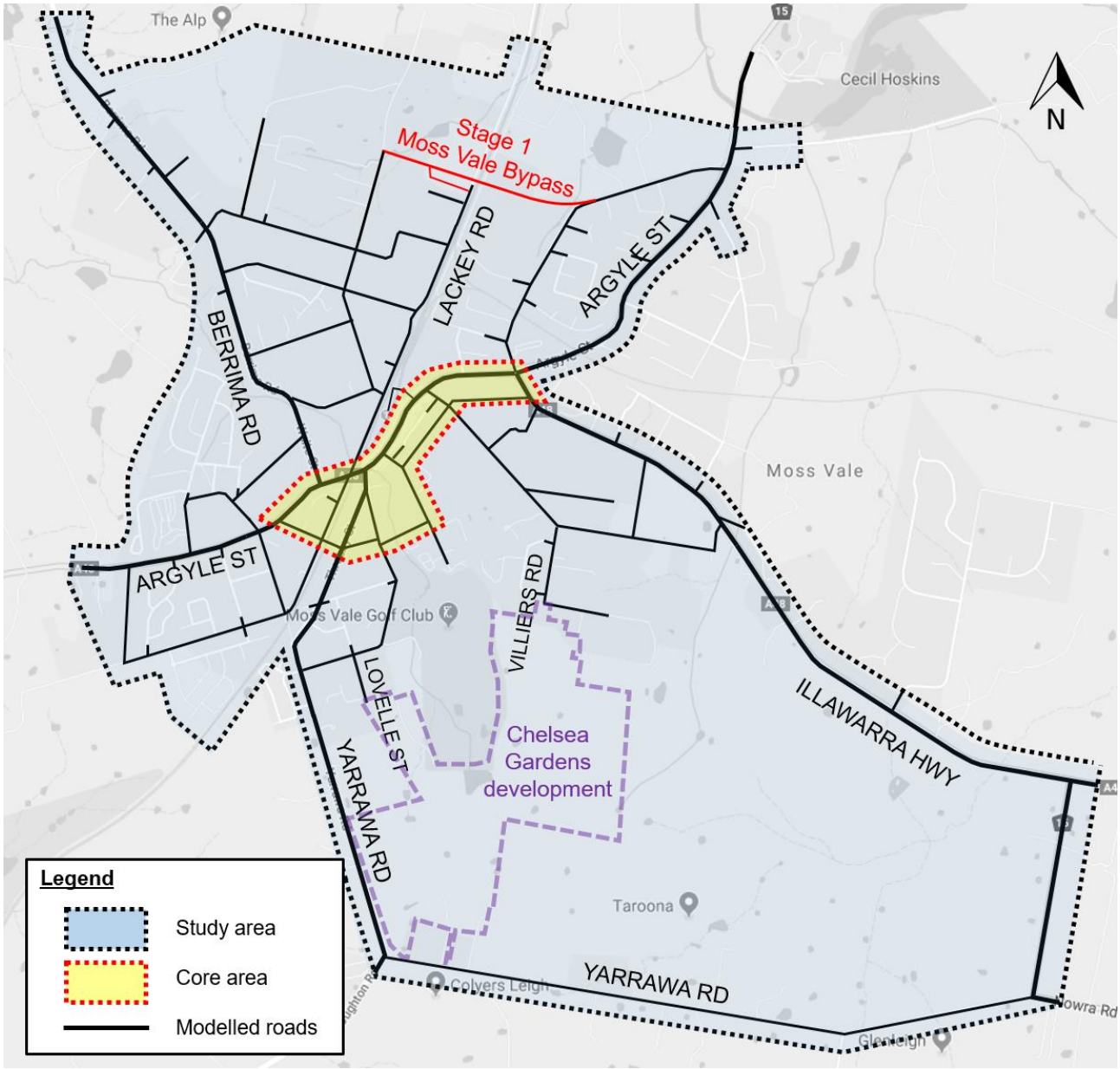


Figure 1-1 Study area boundary and modelled road network

1.5 Summary of previous reporting

This section provides a summary of the previous reporting by Cardno for this project.

Base Model Development Report

Cardno developed morning and afternoon peak microsimulation models in Aimsun building on the strategic modelling works of the WSC TRACKS models and based on survey data to identify the existing traffic conditions. The base model was calibrated and validated in accordance with the *Traffic Modelling Guidelines* (Roads and Maritime, 2013) to ensure that it accurately reflected to existing network. This procedure was previously documented in the **Base Model Development Report** (Cardno, 4 February 2019). A summary is provided in **Section 4** of this report. The Base Model was accepted as fit-for-purpose by an independent review by Roads and Maritime.

Future Modelling Report

Cardno built on the 2016 Base Model in conjunction with the 2036 future traffic demands based on the WSC TRACKS models to determine the impact of Chelsea Gardens and other growth in the area on the 2036 network state. Cardno identified future bottlenecks and deficiencies and proposed possible mitigation measures in the **Future Modelling Report** (Cardno, 4 February 2019).

Addendum to the Future Modelling Report

Following submission of the **Future Modelling Report**, Cardno was advised by Aoyuan that current development plans do not include a yield of 1500 lots but instead will be at most 1200. Cardno revised the 2036 future-year scenarios with 1200 lots and the inclusion of a North East Link Road from the development to Illawarra Highway. The findings of this were reported in the **Addendum to the Future Modelling Report** (Cardno, 5 April 2019). A summary of the findings of findings is provided in **Sections 7** to **9** of this report.

Staged Future Modelling Presentation

At the request of Council, Cardno undertook a staged modelling process to quantify the progressive traffic impacts for the short term, medium term and long term horizons based on the WSC TRACKS demands for 2021, 2026, 2031 and 2036. The results of this were presented to all parties at a meeting at Roads and Maritime's Wollongong office on 17 May 2019 and included in the **Staged Future Modelling Presentation** (Cardno, 17 May 2019). A summary of the findings of findings is provided in **Sections 7** to **9** of this report.

Future Modelling: 2016 + Chelsea Gardens Technical Memorandum

As per the outcomes of the meeting between Cardno, Aoyuan, RMS and Council on 17 May 2019, Cardno undertook additional modelling for a scenario which included the 2016 base demand plus the traffic demand for the fully-developed Chelsea Gardens (1200 lots) to satisfy Council and Roads and Maritime concerns. The purpose of this modelling was to quantify the impact of Chelsea Gardens traffic in isolation on the current traffic network (ie without background growth or other developments) to provide greater context for setting developer contributions between Council and Aoyuan under Section 7.11 (formerly Section 94) of the Environmental Planning & Assessment Act 1979. The findings of this modelling included proposed mitigation measures in the CBD such as right turn bans. These findings were presented in detail in the **Future Modelling: 2016 + Chelsea Gardens Technical Memorandum** (Cardno, 31 May 2019). A summary of the findings is provided in **Section 5** of this report.

Chelsea Gardens, Moss Vale Traffic Study Report

Following submission of this report to all parties, Roads and Maritime requested greater detail in the modelling to demonstrate that this scenario provides an accurate representation of the likely performance of the network with the development. Roads and Maritime requested further analysis of the performance of key intersections which is documented in **Section 5.4.2** of this report.

Cardno consolidated all works undertaken into a single comprehensive report, the **Chelsea Gardens, Moss Vale Traffic Study Report** (this report), which summarises the findings of all previous modelling.

1.6 Report structure

The purpose of this report is to consolidate the findings of each of the reports listed above in an informative and cohesive manner. This report documents all works undertaken as part of this study and provides a holistic summary of the conclusions and findings of the study.

The structure of this report is outlined below.

Section 1 Introduction

Outline of the background, project objective, scope of works, study area and summary of previous reporting.

Section 2 Existing conditions

Discussion of current traffic and transport conditions in the study area

Section 3 Base model development

Summary of the base model development procedure including underlying assumptions and explanation of the study methodology.

Section 4 Base model calibration and validation

Statistical analysis of the stability of the model in accordance with the relevant guidelines and summary of the base model calibration and validation procedure and results.

Section 5 Sensitivity analysis

Determination of the impact of Chelsea Gardens in isolation on the base traffic network.

Section 6 Future model development

Explanation of the procedure by which the future models were developed including infrastructure assumptions and demand estimation.

Section 7 Short term (2021) assessment

Analysis and discussion of the likely short term traffic state given the Chelsea Gardens development, other development in the region and background growth. Discussion of mitigation measures to address future network deficiencies.

Section 8 Medium term (2026) assessment

Analysis and discussion of the likely medium term traffic state given the Chelsea Gardens development, other development in the region and background growth. Discussion of mitigation measures to address future network deficiencies.

Section 9 Long term (2031-2036) assessment

Analysis and discussion of the likely long term traffic state given the Chelsea Gardens development, other development in the region and background growth. Discussion of mitigation measures to address future network deficiencies.

Section 10 Assumptions and limitations

Discussion of the assumptions and limitations associated with the study.

Section 11 Summary and recommendations

Summary of the findings of this report and consolidated list of recommendations.

2 Existing conditions

2.1 Land use

This section provides a high-level summary based on the land use assumptions (households and jobs) of the Wingecarribee Shire Council (WSC) strategic models for the Moss Vale study area and further large developments outside this area which are likely to have traffic impacts within Moss Vale. The strategic models land use assumptions were last interrogated in October 2018.

Table 2-1 lists of the estimated residential development in household numbers (HH) for the identified growth areas in WSC across 5 years increments. This list has been focused on locations for which over 100 household projections were identified, as many were small in the WSC area. The TRACKS Zone locations are shown in **Appendix C.**

Table 2-1 Wingecarribee strategic TRACKS model household land use assumptions

TRX Zone (Strategic Model)	Name	DPE 2016 HH Est	DPE 2021 HH Est	DPE 2026 HH Est	DPE 2031 HH Est	DPE Tot 2036 HH Est
844	Broughton Street	42	187	200	200	200
1150	Renwick	210	364	390	390	390
1155	Retford Park	0	141	151	151	151
1160	Chelsea Gardens	0	280	695	1,111	1,526
1175	Moss Vale Enterprise Corridor	0	0	114	229	343
1199	Nattai Ponds	39	119	213	213	213
1201	Braemar Garden World	0	23	52	81	110
1156	Narellan Road & Fitzroy Road	0	70	75	75	75

Data source: WSC TRACKS model (Stantec, interrogated October 2018).

For low density residential dwellings in regional areas, *Guide to Traffic Generating Developments – Updated Traffic Surveys* (Roads and Maritime) suggests a value of 0.71 to 0.85 trips per dwelling for the weekday average morning peak hour and 0.78 to 0.90 trips per dwelling for the weekday evening peak hour.

Table 2-2 summarises job growth in the area. This is assumed to be distributed pro rata around WSC except for the major developments in the Enterprise Zone (Moss Vale Enterprise Corridor) and the Northern Gateway.

Table 2-2 Wingecarribee strategic TRACKS model employment land use assumptions

TRX Zone (Strategic Model)	Desc.	2016 Total Jobs	2021 Total Jobs	2026 Total Jobs	2031 Total Jobs	2036 Total Jobs
1174	Northern Gate Way (Berrima Road)	0	87	196	306	416
1175	Moss Vale Enterprise Corridor	0	82	186	290	394

Data source: WSC TRACKS model (Stantec, interrogated October 2018).

2.2 Journey to work data

Journey to Work (JTW) data for the 2011 Census date (Tuesday 9th August) provides useful information about trips to work departing and arriving from Moss Vale (TZ 6017, 6018 and 6019). For that date, 3464 JTW trips were made from Moss Vale and 3606 JTW trips made to Moss Vale, including trips with Moss Vale as both origin and destination. The distribution of JTW trips from Moss Vale is shown in **Table 2-3** and **Figure 2-1** and to Moss Vale in **Table 2-4** and **Figure 2-2.** It can be observed the majority of the traffic heads north along Argyle Street (to Bowral, Mittagong, etc.) and that commuting to destinations outside the Southern Highlands (e.g. Wollongong/Sydney) is uncommon.

Table 2-3 Distribution of JTW trips from Moss Vale

Origin	Destination	Total trips	% trips
Moss Vale Station West, Moss Vale, Moss Vale Station East	Moss Vale Station West, Moss Vale, Moss Vale Station East	1505	43.4%
	Bowral	325	9.4%
	Mittagong Station West	226	6.5%
	No fixed work address (GMA)	181	5.2%
	Bowral High School	162	4.7%
	Burradoo Station	119	3.4%
	Burradoo	86	2.5%
	Exeter Station	72	2.1%
	Bowral Station West	71	2.0%
	Willow Vale	63	1.8%
	Bundanoon Station	46	1.3%
	Mittagong Station East	34	1.0%
	Other	574	16.6%
Total trips		**3464**	

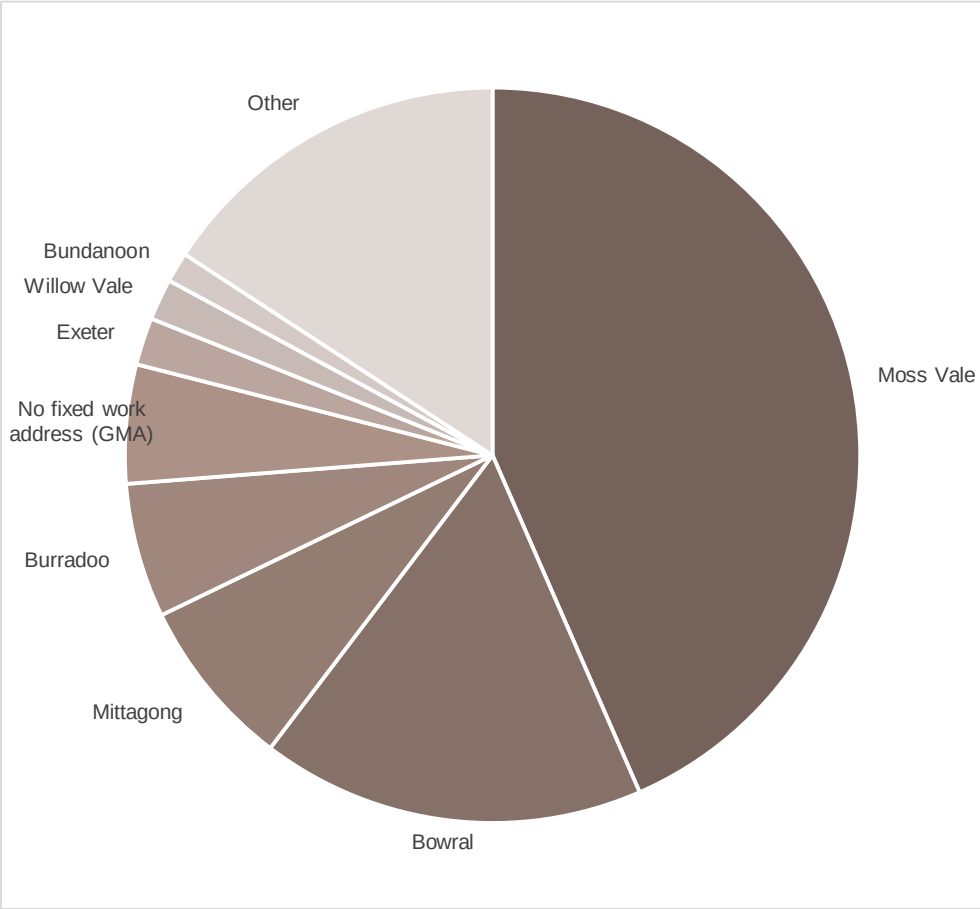


Figure 2-1 Distribution of JTW trips from Moss Vale

Data source: Census Data (Australian Bureau of Statistics, 2011)

Table 2-4 Distribution of JTW trips to Moss Vale

Origin	Destination	Total trips	% trips
Moss Vale Station West, Moss Vale, Moss Vale Station East	Moss Vale Station West, Moss Vale, Moss Vale Station East	1505	41.7%
East Bowral		136	3.8%
Bowral High School		120	3.3%
Mittagong Station West		115	3.2%
Bundanoon Station		111	3.1%
Yerrinbool Station West		110	3.1%
Burradoo Station		110	2.8%
Robertson Station		97	2.7%
Exeter Station		94	2.6%
Mittagong Station East		89	2.5%
Canyonleigh		85	2.4%
Bowral Station East		79	2.2%
Colo Vale Station		70	1.9%
Burradoo		68	1.9%
Willow Vale		61	1.7%
Marulan		56	1.6%
Burrawang Station		51	1.4%
Other		107	18.3%
Total trips		**3606**	

Data source: Census Data (Australian Bureau of Statistics, 2011).

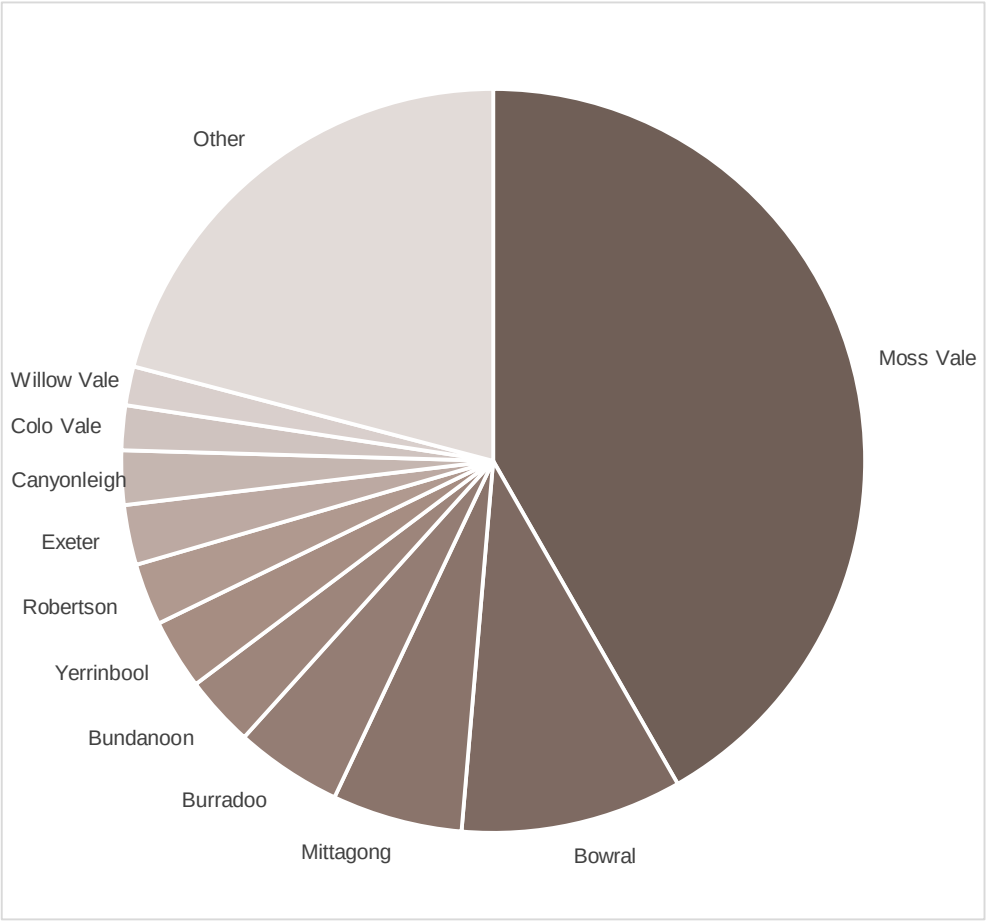


Figure 2-2 Distribution of JTW trips to Moss Vale

Forty-three per cent of residents within the Moss Vale area also work within the locality. The most popular work destinations outside Moss Vale include Bowral, Mittagong and Burradoo, all north of Moss Vale and accessible via Argyle Street. Forty-two per cent of workers within the Moss Vale area also reside within the locality. The most popular destinations from which to commute are Bowral, Mittagong, Yerrinbool and Burradoo, all north of Moss Vale and accessible via Argyle Street, Bundanoon to the south and Robertson to the east. The vast majority of trips to work do not leave the Southern Highlands region; less than one per cent of JTW trips are made to and from Wollongong and Sydney respectively.

JTW data also reveals the preferred mode choice of workers is private vehicle with 68 per cent of trips to work departing from Moss Vale and 77 per cent of trips arriving utilising this mode. Approximately 5-6 per cent of trips to work were as a vehicle passenger. Only 2 per cent of employees leaving Moss Vale used public transport to travel to work and less than 1 per cent of those arriving did the same. Walking was used by approximately 4 per cent of employees and predominantly only within the Moss Vale locality. The mode choice proportions for JTW data for Moss Vale is shown in **Figure 2-3**.

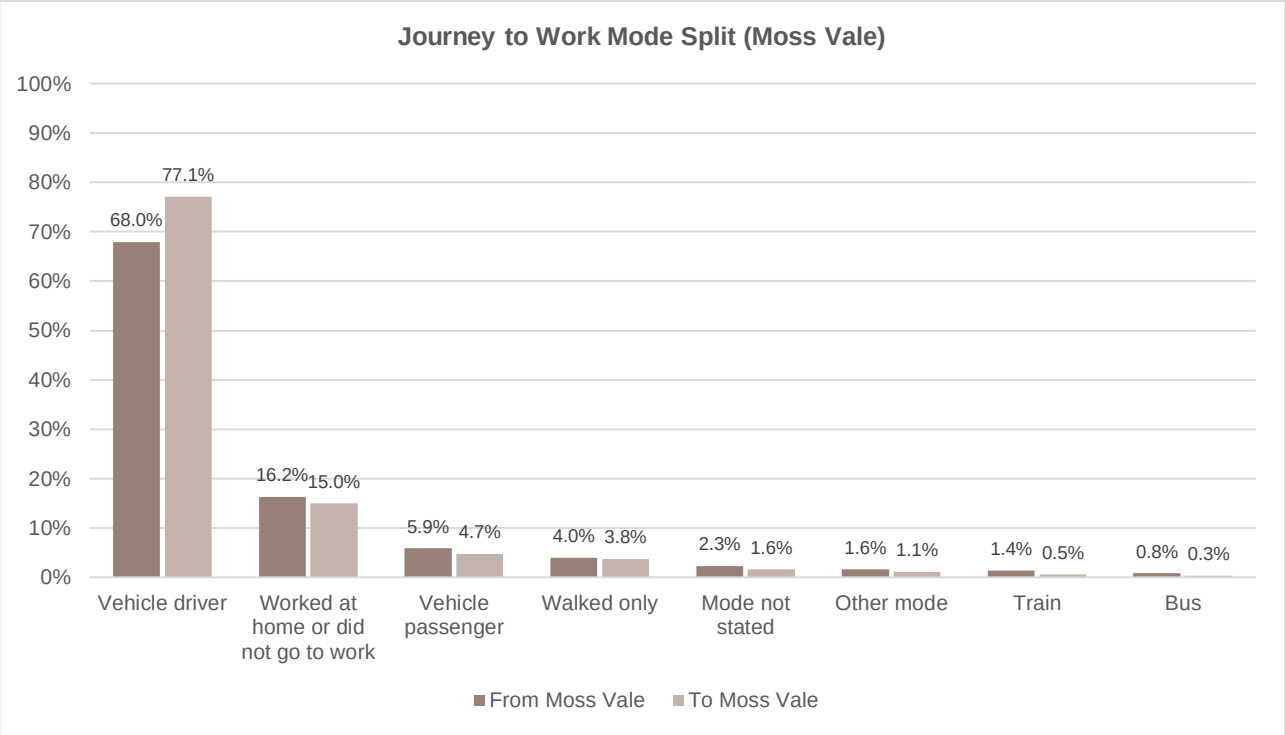


Figure 2-3 JTW mode choice proportions

Data source: Census Data (Australian Bureau of Statistics, 2011).

2.3 Existing route conditions and congestion locations

This section outlines the major roads within the study area and provides an overview of the likely traffic patterns. Traffic data and trends are based on information from traffic surveys for this study, previous traffic surveys and *Google Traffic* data.

2.3.1 Argyle Street

Argyle Street is a state road and the major thoroughfare for traffic through the town centre. It forms part of Tourist Route 15 which is a scenic route off the Hume Motorway through Mittagong, Bowral and Moss Vale. It is also trafficked by vehicles accessing the Hume Motorway from Illawarra Highway. The road is single lane in each direction through the town centre and the speed limit is 50 kilometres per hour in the CBD.

Argyle Street is the primary trunk through Moss Vale. The town is divided in half by the railway and only two vehicle crossings exist – the major crossing on Argyle Street and a single-lane underpass on Spring Street. The vast majority of vehicles travelling through the town use Argyle Street. Argyle Street also provides access to supermarkets, specialty shops, Moss Vale Railway Station, most local and regional bus routes and also distributes traffic into and between residential zones. *Google Traffic* data suggests the most congested zone is opposite the railway station between Valetta Street and White Street, a stretch which includes the majority of specialty shops, fast food, cafes and Leighton Gardens park.

2.3.2 Illawarra Highway

The Illawarra Highway is a state road that intersects with Argyle Street just north of the town centre and is the principle route for traffic travelling between Wollongong, the Illawarra and the Shoalhaven regions and Moss Vale, Bowral, the Southern Highlands and the Hume Motorway. Illawarra Highway also provides access to the town of Robertson, approximately 20 kilometres east of Moss Vale. From Robertson, the route proceeds down the steep and winding Macquarie Pass to Albion Park which has vehicle and speed restrictions.

The route is single lane in each direction and mostly undivided. Survey and traffic data suggest that congestion on Illawarra Highway is minimal in AM and PM peak periods except for the approach to the Argyle Street / Illawarra Highway / Suttor Road roundabout where queues were measured to exceed 13 vehicles in peak periods, and the school zone outside Tudor House School.

2.3.3 Throsby Street & Yarrawa Road

Throsby Street is primarily used as a residential access road for southern Moss Vale. Approximately two thirds of vehicles accessing southbound Argyle Street from Throsby Street use a single-lane underpass under the railway on Spring Street although this route has low visibility and low clearance (2.7 metres).

South of Spring Street, Throsby Street turns into Yarrawa Road which proceeds south and intersects with Mount Broughton Road. Mount Broughton Road provides an alternative access to the nearby town of Exeter and Bundanoon, both south of Moss Vale. Yarrawa Road proceeds west and intersects with Nowra Road which leads to the Shoalhaven region and Illawarra Highway to the Illawarra region, however the route is indirect and traffic is therefore more likely to use Illawarra Highway from Moss Vale town centre.

Throsby Street is single lane in each direction with street-side parking in residential areas. Survey and traffic data suggest that Throsby Street is only lightly-trafficked and does not have significant congestion issues during AM or PM peak periods. The Chelsea Gardens development has two proposed access roads onto Yarrawa Street which will increase traffic on Throsby Street accessing Moss Vale town centre.

2.3.4 Berrima Road

Berrima Road intersects with Argyle Street just west of the railway and connects to the neighbouring town of Berrima, approximately five kilometres north-west. Berrima Road is the principle means of accessing Moss Vale from Berrima and also connects to the Old Hume Highway, now bypassed by the Hume Motorway. Berrima Road is likely to be used be vehicles accessing Moss Vale and the Illawarra Highway, however alternative links to Bowral and the Hume Motorway mean that traffic on this route is low. Berrima Road is a single-lane road in both directions for the majority of its length.

The majority of traffic on Berrima Road is local traffic accessing residential areas and small industrial areas in north and north-west Moss Vale. About 300 metres north of Argyle Street, Berrima Road turns into Waite Street which intersects with Argyle Street at a three-way priority intersection. Queue lengths for vehicles turning left out of Waite Street were minimal in traffic survey data however vehicles turning right experienced queues of 12-13 vehicles during the AM and PM peak. Vehicles turning right from Argyle Street into Waite Street also experienced significant queues of up to 18 vehicles during AM peak and 7 vehicles in PM peak.

2.4 Existing intersection performance

This section provides a summary description of the intersections with the highest peak hour throughput (total number of vehicles during each peak hour exceeding 1600) of those surveyed.

2.4.1 Argyle Street / Illawarra Highway / Suttor Road

The intersection of Argyle Street / Illawarra Highway / Suttor Road has the highest throughput for surveyed intersections for both the AM and PM peak hour periods, of 1977 vehicles between 8:15 AM and 9:15 AM and 2107 vehicles between 3:30 PM and 4:30 PM. It provides access to Bowral and Mittagong to the north via Argyle Street, Moss Vale city centre to the west via Argyle Street and Wollongong and Nowra to the east via Illawarra Highway. The intersection consists of a four-way, one circulating lane roundabout with two-lanes on all approach roads except Suttor Road. High volume movements (greater than 10 per cent total throughput) are shown in **Table 2-5**. An aerial view of the intersection is shown in **Figure 2-4**.

Table 2-5 Intersection throughput for Argyle Street / Illawarra Highway / Suttor Road

Turn	AM peak (% of total)	PM peak (% of total)
(T): Argyle Street (E) into Argyle Street (W)	478 (24%)	521 (25%)
(T): Argyle Street (W) into Argyle Street (E)	448 (23%)	369 (18%)
(R): Illawarra Highway into Argyle Street (E)	354 (18%)	296(14%)
(L): Argyle Street (E) into Illawarra Highway	251 (13%)	310 (15%)
Total throughput	**1977**	**2107**

Data source: Traffic survey data (collected Thursday 30 August 2018).

Figure 2-4 Aerial photograph of Argyle Street / Illawarra Highway / Suttor Road intersection

Image source: Nearmap, (photographed 17 July 2018).

2.4.2 Argyle Street / White Street

The intersection of Argyle Street / White Street is a three-way signalised intersection with pedestrian crossings on all approaches. It is situated in the city centre in close proximity to Coles, specialty shops, Moss Vale Library, the War Memorial Aquatic Centre and the Community Oval. The intersection is situated on Argyle Street, the main street through the town. The intersection has two lanes on the approach from White Street and one lane on Argyle Street in both directions however there is sufficient lane width for vehicles on Argyle Street (W) proceeding through the intersection to pass vehicles waiting to turn right into White Street. High volume movements (greater than 10 per cent total throughput) are shown in **Table 2-6**. An aerial view of the intersection is shown in **Figure 2-5**.

Table 2-6 Intersection throughput for Argyle Street / White Street

Turn	AM peak (% of total)	PM peak (% of total)
(T): Argyle Street (E) into Argyle Street (W)	654 (37%)	612 (32%)
(T): Argyle Street (W) into Argyle Street (E)	577 (32%)	632 (33%)
(L): White Street into Argyle Street (W)	209 (12%)	334 (17%)
(R): Argyle Street (W) into White Street	208 (12%)	213 (11%)
Total throughput	**1780**	**1918**

Data source: Traffic survey data (collected Thursday 30 August 2018).

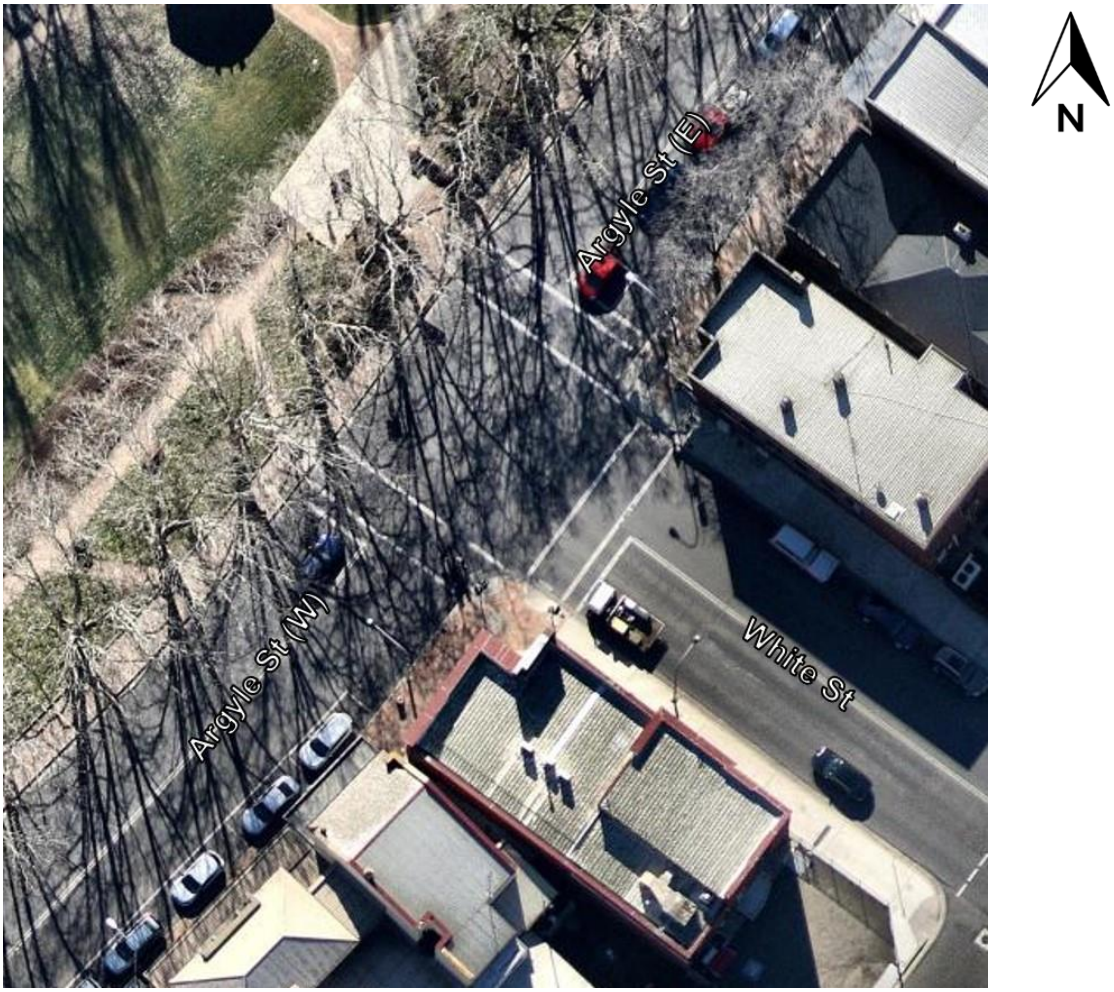


Figure 2-5 Aerial photograph of Argyle Street / White Street intersection

Image source: Nearmap, (photographed 17 July 2018).

2.4.3 Argyle Street / Arthur Street

The intersection of Argyle Street / Arthur Street is a three-way priority intersection which provides access from the main thoroughfare to residences in the south of Moss Vale. It also provides access to Moss Vale Golf Course. All approaches are single lane. Left and right turn out of Arthur Street are permitted, giving way to Argyle Street. High volume movements (greater than 10 per cent total throughput) are shown in **Table 2-7**. An aerial view of the intersection is shown in **Figure 2-6**.

Table 2-7 Intersection throughput for Argyle Street / Arthur Street

Turn	AM peak (% of total)	PM peak (% of total)
(T): Argyle Street (W) into Argyle Street (E)	804 (47%)	778 (42%)
(T): Argyle Street (E) into Argyle Street (W)	703 (41%)	874 (47%)
Total throughput	**1707**	**1845**

Data source: Traffic survey data (collected Thursday 30 August 2018).

Figure 2-6 Aerial photograph of Argyle Street / Arthur Street

Image source: Nearmap, (photographed 17 July 2018).

2.4.4 Argyle Street / Lackey Road

The intersection of Argyle Street / Lackey Road is situated on the main thoroughfare immediately to the west of the railway line. Lackey Road provides access to residences in the north western area of Moss Vale and to some commercial and industrial areas. The intersection is a three-way priority intersection with left and right turn movements from Lackey Road permitted after stopping. High volume movements (greater than 10 per cent total throughput) are shown in **Table 2-8**. An aerial view of the intersection is shown in **Figure 2-7**.

Table 2-8 Intersection throughput for Argyle Street / Arthur Street

Turn	AM peak (% of total)	PM peak (% of total)
(T): Argyle Street (E) into Argyle Street (W)	720 (43%)	702 (41%)
(T): Argyle Street (W) into Argyle Street (E)	699 (41%)	621 (36%)
(L): Argyle Street (W) into Lackey Road	167 (10%)	170 (10%)
Total throughput	**1691**	**1703**

Data source: Traffic survey data (collected Thursday 30 August 2018).

Figure 2-7 Aerial photograph of Argyle Street / Lackey Road

Image source: Nearmap, (photographed 17 July 2018).

2.4.5 Argyle Street / Headlam Road & Argyle Street / Suttor Road

The intersections of Argyle Street / Headlam Road and Argyle Street / Suttor Road are in the extreme north eastern corner of the study area and in close proximity to each other. Suttor Road provides access to some residences in the northern area of Moss Vale, north of the Unanderra-Moss Vale Railway Line and west of Argyle Street. Headlam Road has limited connectivity to residential or commercial areas. Argyle Street is the main road through Moss Vale from Bowral and Mittagong and is heavily trafficked by vehicles on this corridor taking the scenic route off the Hume Motorway. Argyle Street also links to Illawarra Highway which provides access from Moss Vale, Mittagong and Bowral to Wollongong and Nowra. Both intersections are priority-controlled. Argyle Street / Headlam Road is controlled by Give Way signs on Headlam Road. Argyle Street / Suttor Road is controlled by Stop signs on Suttor Road. High volume movements (greater than 10 per cent total throughput) are shown in **Table 2-9** for Argyle Street / Headlam Road and **Table 2-10** for Argyle Street / Suttor Road. An aerial view of the intersections is shown in **Figure 2-8**.

Table 2-9 Intersection throughput for Argyle Street / Headlam Road

Turn	AM peak (% of total)	PM peak (% of total)
(T): Argyle Street (S) into Argyle Street (N)	928 (56%)	733 (45%)
(T): Argyle Street (N) into Argyle Street (S)	719 (43%)	860 (53%)
Total throughput	**1665**	**1617**

Data source: Traffic survey data (collected Thursday 30 August 2018).

Table 2-10 Intersection throughput for Argyle Street / Suttor Road

Turn	AM peak (% of total)	PM peak (% of total)
(T): Argyle Street (S) into Argyle Street (N)	928 (56%)	733 (45%)
(T): Argyle Street (N) into Argyle Street (S)	719 (43%)	860 (53%)
Total throughput	**1657**	**1609**

Data source: Traffic survey data (collected Thursday 30 August 2018).

Figure 2-8 Aerial photograph of Argyle Street / Headlam Road and Argyle Street / Suttor Road

Image source: Nearmap, (photographed 17 July 2018).

3 Base model development

This section contains a summary of the base model development procedure previously documented in the **Base Model Development Report** (Cardno, 4 February 2019).

3.1 Software platform

The Chelsea Gardens, Moss Vale Traffic Study model was developed using Aimsun Next 8.2.3 (R54491). The model has been calibrated and validated according to the principles outlined in the *Traffic Modelling Guidelines*.

3.2 Assignment type

The two assignment methods used in the microsimulation model are summarised in **Section 3.2.1** and **Section 3.2.2**.

3.2.1 Dynamic User Equilibrium Assignment

The dynamic user equilibrium (DUE) traffic assignment uses an iterative process to determine the traffic flows across the network based on the travel route costs between origin and destination (OD) pairs calculated in the previous iteration until convergence to an equilibrium state.

The principle for this assignment is that users will try to minimise their individual travel times by travelling on the route which they perceive to be the shortest path given the traffic conditions. For a dynamic user equilibrium state to be achieved, the travel times of each OD pair for vehicles departing at the same time must be equal across all used routes and less than that of a single user on any of the unused routes (Ran and Boyce's dynamic version of Wardrop's user equilibrium).

3.2.2 Stochastic Route Choice Assignment

The stochastic route choice (SRC) assignment is based on discrete route choice models or on a user-defined assignment. Discrete route choice models are based on discrete choice theory and emulate the user's decision of selecting a path from those that are available. This model uses the probability of choosing alternative paths from those available as a function of their disutility, often associated with travel time or travel cost.

The flow diagram of the demand estimation and traffic assignment calibration procedure is shown in **Figure 3-1**.

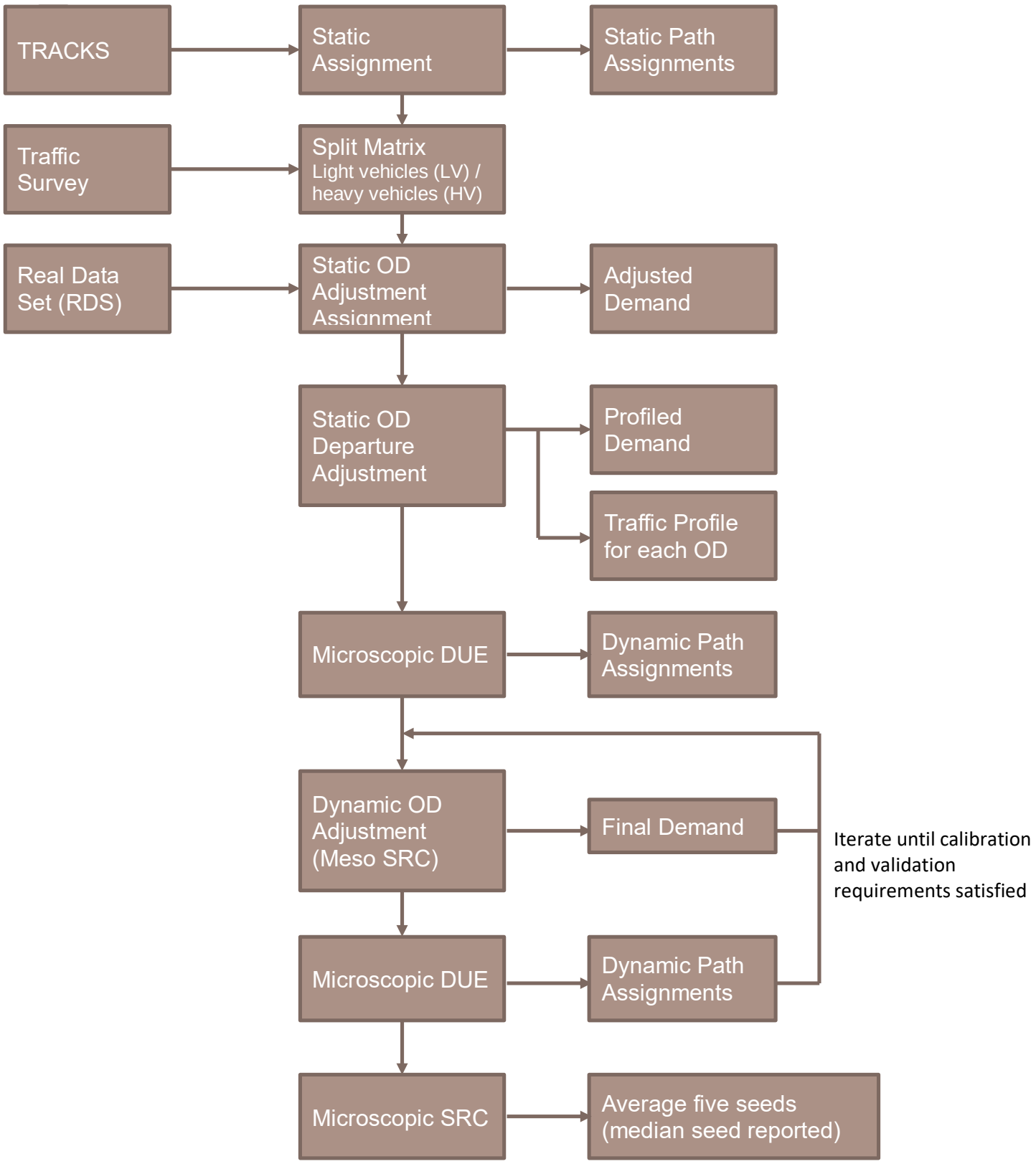


Figure 3-1 Multilevel modelling framework process

3.3 Model extent

3.3.1 Traffic zones

Traffic zones for trip generation and attraction were extracted from the TRACKS Moss Vale subarea model. This allowed for the generation of an origin-destination (OD) matrix for the 213 internal and external zones. The correlation between these zones and Statistical Area Level 1 (SA1) zones is outlined below. SA1 zones are geographical areas defined by the Australian Bureau of Statistics (ABS) and are the smallest unit for which census data is available. The SA1 zones which intersect with the study area are shown in **Table 3-1** alongside a description of their geographical extent, primary land use and other notable features. The TRACKS Moss Vale subarea zones which are located within each SA1 area also indicated.

Table 3-1 SA1 boundaries within the modelled area including a description of their primary land uses

SA1 No.	TRACKS Moss Vale Zones	Boundaries	Primary land uses
01	11, 19, 20, 42, 43, 44, 68, 69, 70, 71, 72 ,73, 74, 75, 76, 77,	South of Argyle Street, south of Illawarra Highway, north of Valetta Street and west of Young Road	Residential Limited commercial off Argyle Street Moss Vale High School
02	78, 79	North of Illawarra Highway, east of Church Road and south of Unanderra – Moss Vale Railway Line	Sparse residential
03	8, 47, 48, 49, 50, 51, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91	East of Berrima Road and Waite Street, north of Argyle Street, south of Parkes Road and west of the Main South Railway Line	Residential Limited industrial off Lackey Road Street Paul's International College Street Paul's Primary School
04	92, 93, 94, 95, 96, 97, 98, 99, 100, 105, 109	North of Argyle Street and west of Willow Dr	Residential Moss Vale Village Caravan Park
05	16, 25, 26, 29, 101, 102, 103, 104, 106, 107, 108	North of Argyle Street, west of Berrima Road and east of Willow Dr	Residential Limited commercial off Argyle Street Moss Vale Public School
06	06, 17, 110, 111, 112, 118,	South of Argyle Street, west of Yarrawa Street and east of Janice Cres	Residential Moss Vale RSL Club
07	113, 114, 115, 116, 117, 163	South of Argyle Street and west of Janice Cres	Residential
08	31, 35, 119, 120, 121, 122, 123, 124, 125, 126, 127, 179	East of Yarrawa Road, west of Arthur Street and east of the Main South Railway Line	Residential Moss Vale Golf Club Harbison Care
09	External zones only	East of Argyle Street and north of the Unanderra – Moss Vale Railway Line	Residential
10	53, 54, 55, 56, 128, 129, 130, 131	West of Argyle Street, east of Suttor Road, south of Semkin Street and Mawson Tce and north of the Unanderra – Moss Vale Railway Line	Residential
11	9, 10, 11, 21, 23, 45, 46, 49, 52, 132, 133, 134, 135, 136	North of Argyle Street and east of the Main South Railway Line	Residential Moss Vale Railway Station
12	15, 18, 24, 27, 28, 30, 33, 34, 137, 138, 139	South of Argyle Street, east of Yarrawa Street and west of the Main South Railway Line	Residential Limited commercial off Argyle Street
13	140, 141, 142	West of Yarrawa Road and east of the Main South Railway Line	Residential
14	143, 144, 149, 150, 151, 152, 153, 154, 159, 200, 201	East of Berrima Road, north of Parkes Road and west of the Main South Railway Line	Residential Industrial off Berrima Road and Lackey Road Moss Vale General Cemetary

15	57, 58, 59, 60, 155, 156, 157	West of Berrima Road and north of Whites Creek	Industrial and resource recovery
16	160, 162	Surrounding all other zones listed in this table	Sparse residential and agriculture
17	1, 2, 3, 4, 5, 6, 7, 12, 13, 14, 22, 32, 36, 37, 38, 39, 40, 41, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175	West of Argyle Street, south of Valetta Street and west of Arthur Street	Moss Vale CBD Commercial district including supermarkets, specialty shops, cafes, gymnasium, etc. Moss Vale Public Library Moss Vale War Memorial Aquatic Centre Moss Vale Community Oval
18	61, 62, 63, 64, 65, 66, 67, 158, 176, 177, 178, 180, 190	South of Narellan Road	Residential and sparse residential
19	181, 182, 183, 184, 185	North of Illawarra Highway, east of Suttor Road and south of Unanderra – Moss Vale Railway Line	Residential Limited commercial off Argyle Street Moss Vale Showground
23	186, 187, 188	East of Argyle Street, north of Semkin Street and Mawson Tce, south of Suttor Road	Residential
26	161, 189	West of Suttor Road, east of Main South Railway Line and north of Unanderra – Moss Vale Railway Line	Industrial

The locations of these SA1 zones are shown in **Figure 3-2**. All zones are within SA2 1287 (Moss Vale – Berrima).

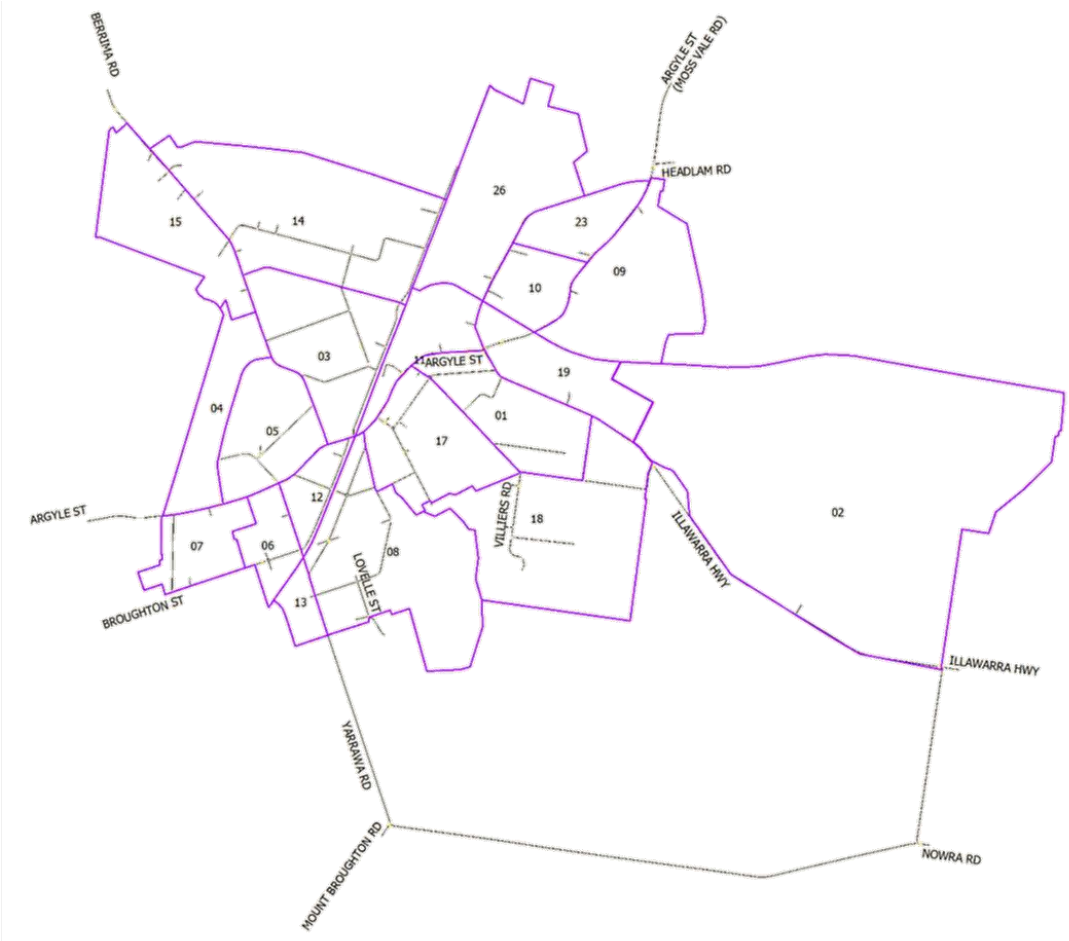


Figure 3-2 SA1 zones with ABS numbering scheme

3.3.2 Modelled road network

The modelled road network incorporates the major roads within the study area including Argyle Street which runs through the CBD, Illawarra Highway, Nowra Road and Berrima Road. Local roads were included to realistically distribute demand throughout the network and provide appropriate route choice for vehicles within the simulation.

The modelled road network is shown in **Figure 3-3**. Numbers indicate where the model boundaries intersect with a road included in the WSC TRACKS strategic model. These 'gates' represent demand from all origins and to all destinations external to the study area.

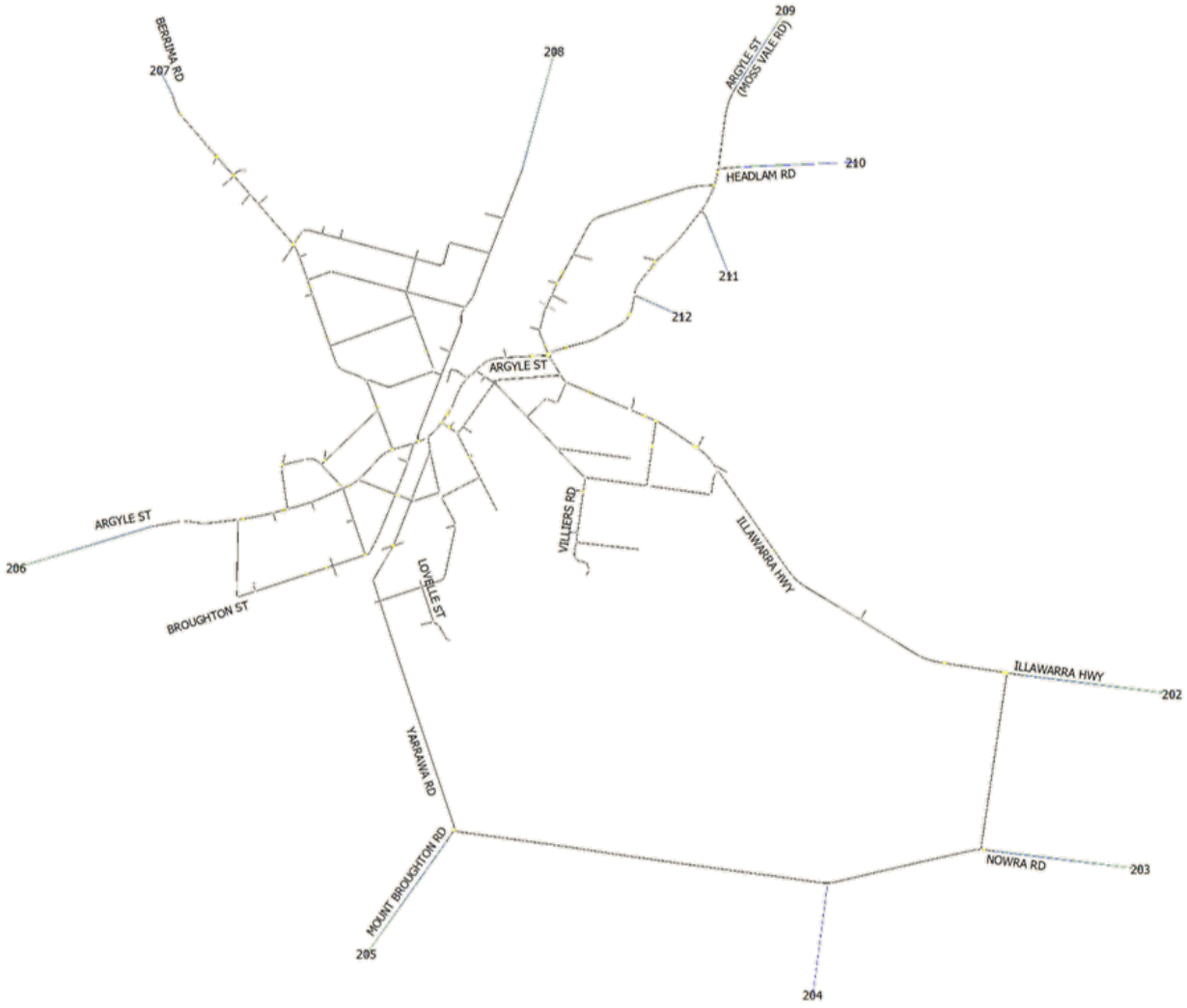


Figure 3-3 Modelled road network

3.3.3 Road type

Two state roads are present in the study area:

- Illawarra Highway
- Argyle Street.

All other roads are local roads. The speeds for each section are coded in the model according to the posted speeds.

3.3.4 Posted speeds

The speed of a vehicle is the determined by the lesser of the posted speed limit and the maximum desired speed of the vehicle. The posted speed limits within the study area are shown in **Figure 3-4**. Some road sections have variable speed limits due to school zones as discussed in **Section 3.3.5**.

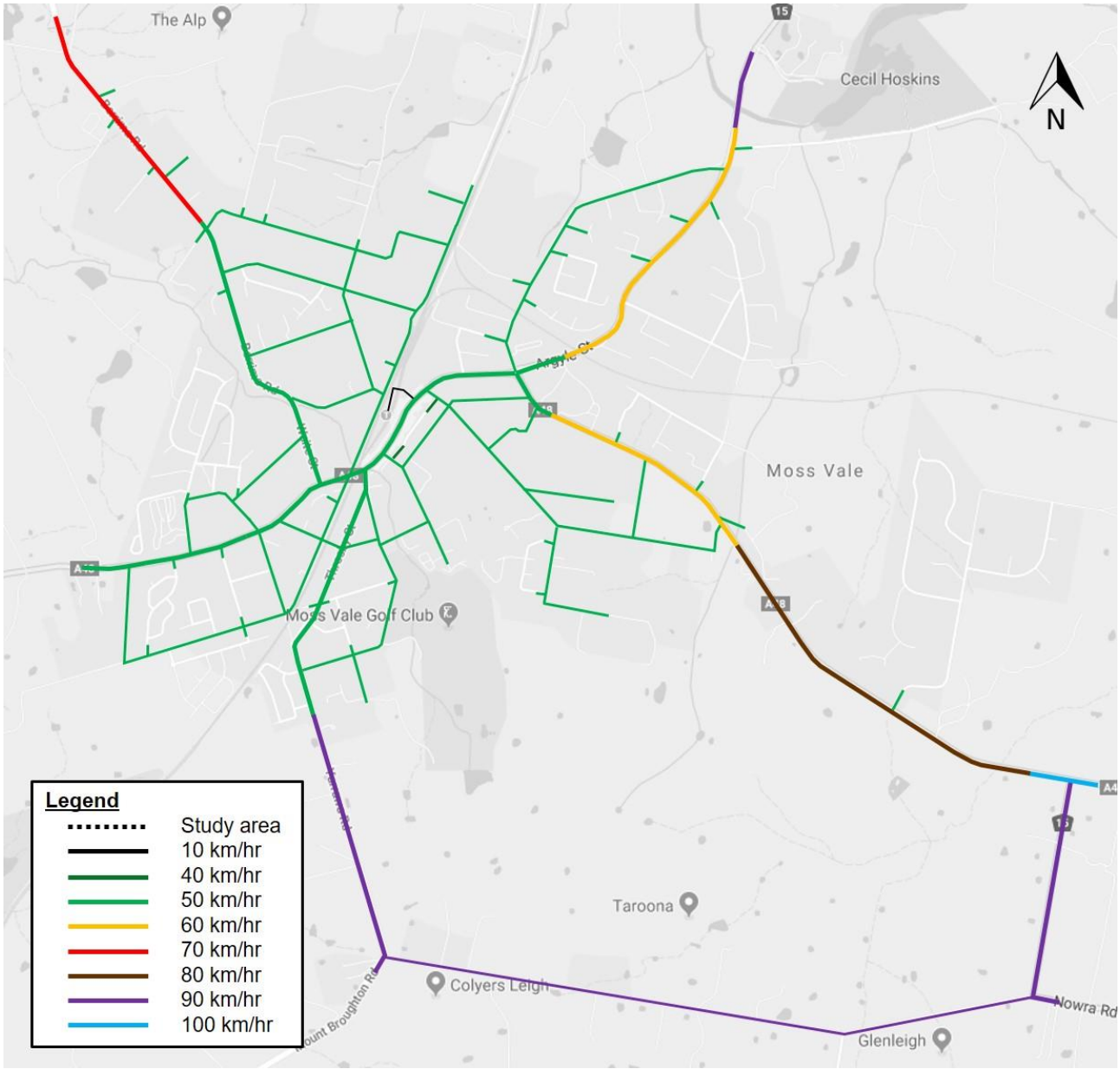


Figure 3-4 Posted speed limits within study area (only modelled roads highlighted)

Base image: Google Maps.

3.3.5 School zones

There are three primary schools and two high schools located within the study area:

- Moss Vale Public School
- Street Paul's Primary School
- Tudor House
- Moss Vale High School
- Street Paul's International College.

There are four school zones located within the modelled area. The close proximity of two of the schools means they share a single school zone. The road speed limit in all school zones is 40 km/hr during the periods 8:00 AM – 9:30 AM and 2:30 PM – 4:00 PM. The affected roads are shown in **Figure 3-5**.

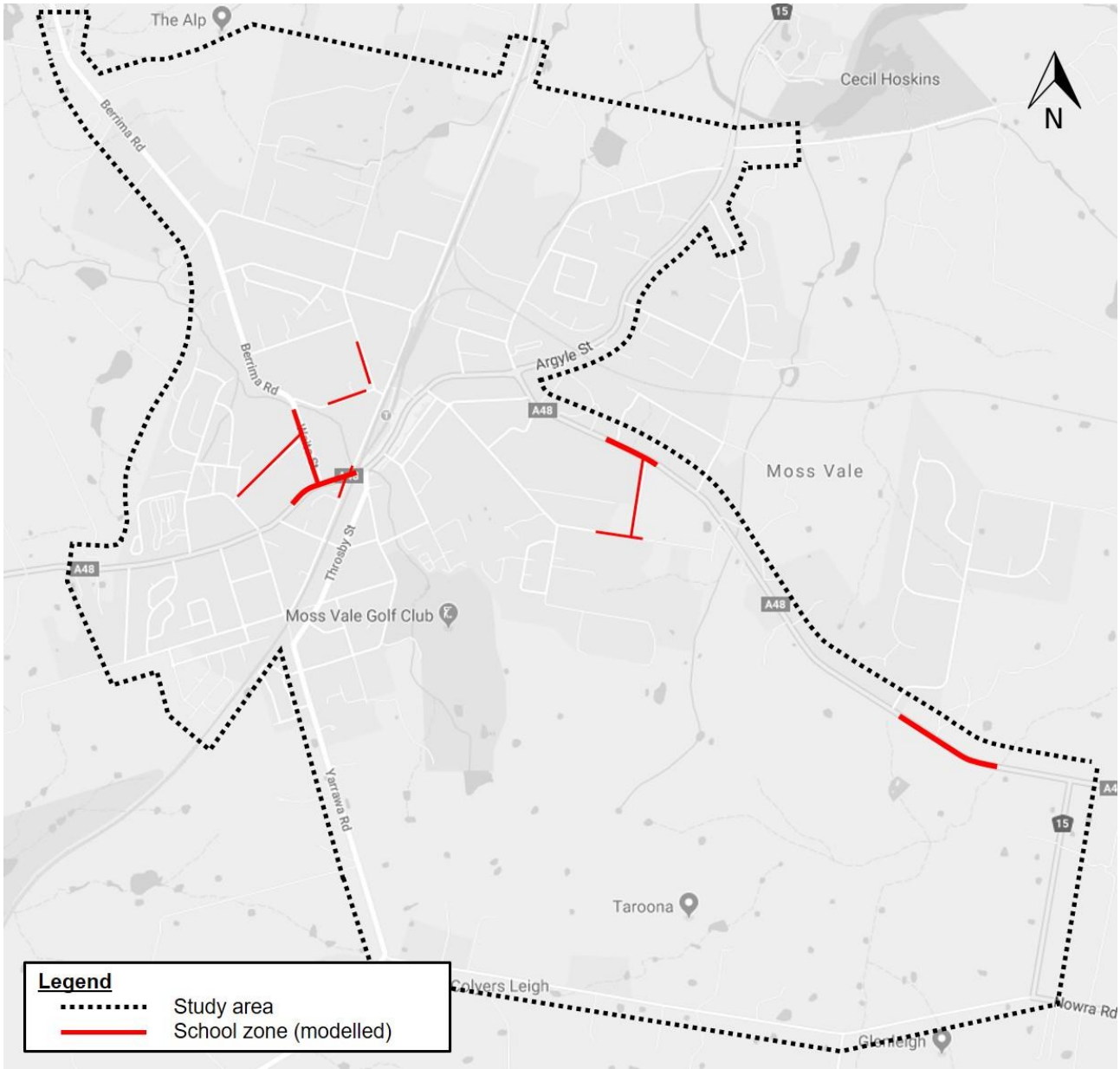


Figure 3-5 Location of schools and school zones in study area

Base image: Google Maps.

3.3.6 Traffic signals

There is one signalised intersection within the study area – the intersection of Argyle Street & White Street, shown in **Figure 3-6**.This intersection has been implemented in Aimsun using historical data obtained from the Sydney Coordinated Adaptive Traffic System (SCATS). The SCATS Traffic Control Signal (TCS) plans are used in conjunction with the historical data to determine the phase times associated with each signal phase including pedestrian walk phases.

There is one additional signalised pedestrian crossing on Argyle Street outside Moss Vale Public School, shown in **Figure 3-6**. The red phase is only triggered by pedestrians and was observed to be infrequent and irregular from the survey data. It is not considered likely to have a significant impact on travel times. Consequently, it has not been included in the model.

Figure 3-6 Location of signalised intersection and signalised pedestrian crossing

Base image: Google Maps.

3.4 Traffic surveys

Traffic surveys were undertaken for 27 sites on Thursday 30 August 2018 for two hours in the morning period (7:30 AM – 9:30 AM) and for three hours in the afternoon period (3:00 PM – 6:00 PM). Two one-hour peak hour periods were identified from a review of the survey data based on the one-hour period during which the greatest number of vehicles were recorded on the surveyed network:

- AM peak hour: 8:15 AM – 9:15 AM
- PM peak hour: 3:30 PM – 4:30 PM.

3.4.1 Classified intersection counts

The locations of the intersection counts are shown in **Figure 3-7** and listed in **Table 3-2**.

Figure 3-7 Classified Intersection Count (CIC) locations

Base image: Google Maps.

Table 3-2 Classified Intersection Count (CIC) locations

ID	Intersection
1	Argyle Street / Headlam Road
2	Argyle Street / Suttor Road
3	Argyle Street / Suttor Road / Illawarra Highway
4	Illawarra Highway / Elizabeth Street
5	Illawarra Highway / Throsby Park Road / Fitzroy Road
6	Illawarra Highway / Farnborough Dr
7	Illawarra Highway / Nowra Road
8	Argyle Street / Hawkins Street
9	Argyle Street / Valetta Street
10	Argyle Street / *Railway Station Access Road*
11	Elizabeth Street / Valetta Street
12	Valetta Street / Narellan Road / Villiers Road
13	Argyle Street / White Street
14	Elizabeth Street / White Street / Kirkham Street
15	Kirkham Street / Mack Street
16	Argyle Street / Arthur Street
17	Argyle Street / Lackey Road
18	Argyle Street / Railway Street
19	Throsby Street / Spring Street
20	Yarrawa Road / Spencer Street / Darran Road
21	Spencer Street / Lovelle Street
22	Yarrawa Road / Mount Broughton Road
23	Nowra Road / Yarrawa Road
24	Argyle Street / Waite Street
25	Argyle Street / Spring Street
26	Argyle Street / Yarrawa Street

Intersection 5 was surveyed as a single four-way intersection but was incorporated into the model as two three-way intersections in close proximity, being Intersection 5.1 – Illawarra Highway / Throsby Park Road and Intersection 5.2 – Illawarra Highway / Fitzroy Road.

3.4.2 Travel time data

Travel time data was collected for the route along Argyle Street between Yarrawa Street and Kings Road in both directions for the morning and afternoon survey periods. The surveyed route is 2410 metres long and is shown in **Figure 3-8**. The posted speed along the route is 50 kilometres per hour except for the eastern-most 470 metres after the intersection of Argyle Street / Illawarra Highway up to Kings Road where it is 60 kilometres per hour.

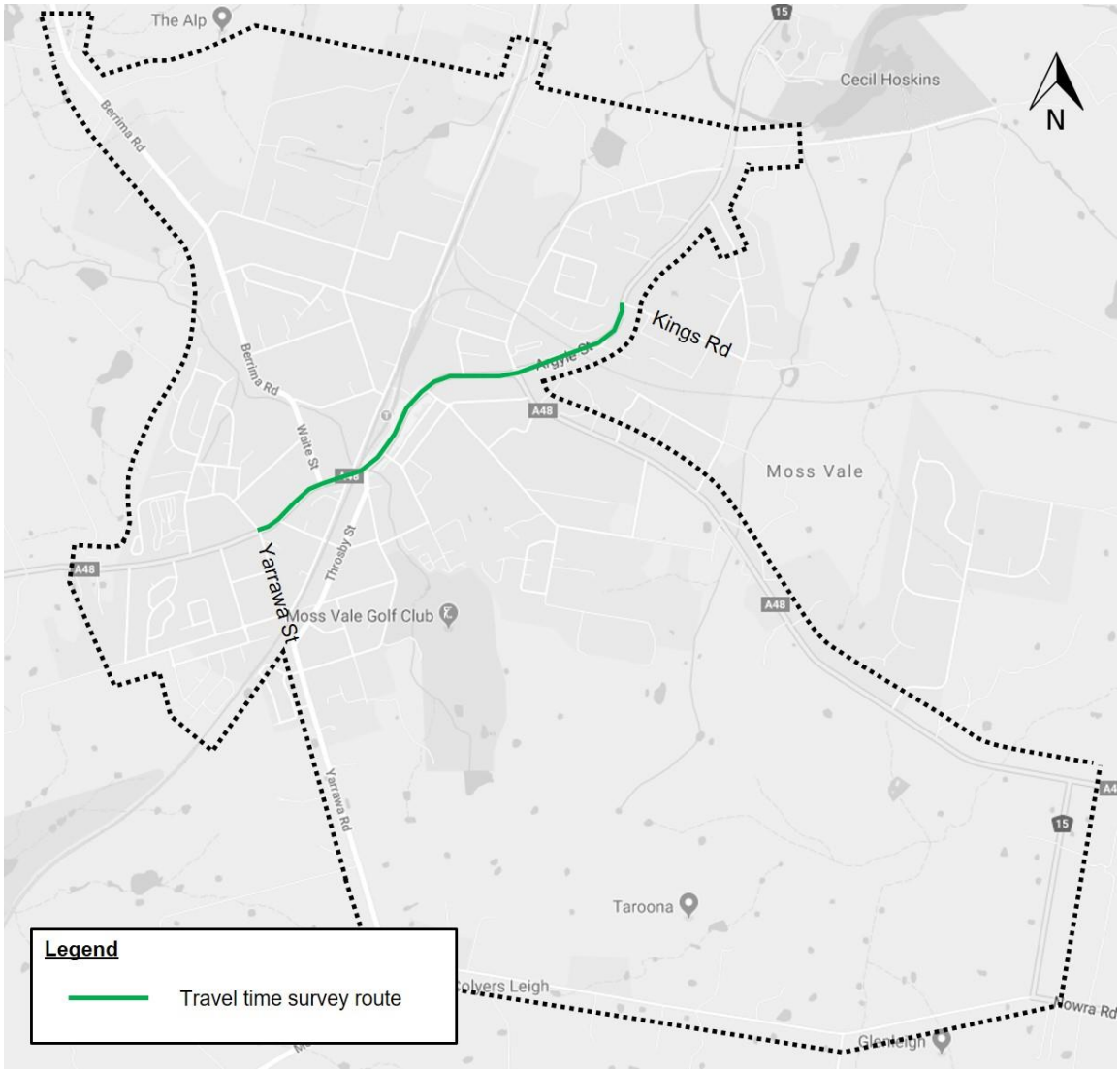


Figure 3-8 Travel time data survey route

Base image: Google Maps.

The average travel time, median travel time and average speed for the morning peak (8:15 AM – 9:15 AM) and afternoon peak (3:30 PM – 4:30 PM) are shown in **Table 3-3**.

Table 3-3 Travel time and speed data for surveyed route

Period	Direction	Average travel time (mm:ss)	Median travel time (mm:ss)	Average speed (km/hr)
AM Peak	Eastbound	03:51	03:54	37.6
	Westbound	04:30	04:27	32.2
PM Peak	Eastbound	03:36	03:30	40.2
	Westbound	04:34	04:32	31.7

3.5 Modelled periods

Two one-hour weekday peak periods were assessed in this study based on survey data from Thursday 30 August 2018. These were the 60-minute periods in the morning and afternoon for which the greatest number of vehicles were recorded over the surveyed area. The peak periods were determined to be 8:15 AM – 9:15 AM and 3:30 PM – 4:30 PM. For each peak period, a 'warm-up' period of 60 minutes was also included in the model to populate the road network with traffic and hence replicate the initial traffic state prior to the peak hour. The warm-up periods and simulation periods are indicated in **Table 3-4**.

Table 3-4 Warm-up and simulation time periods

	Warm-up period	Simulation period
Weekday AM	7:15 AM – 8:15 AM	8:15 AM – 9:15 AM
Weekday PM	2:30 PM – 3:30 PM	3:30 PM – 4:30 PM

It was noted that the study area does not appear to depict congestion patterns extending over a one-hour period during peaks, thus a one hour model is suitable for the intended traffic analysis.

3.6 Base year demand estimation and trip length distribution

Base year demand was extracted from the WSC TRACKS strategic model. The demands were run through Aimsun's Static OD Adjustment process which attempts to fit the strategic model data to the surveyed intersection counts.

The procedure results in a redistribution of trips to account for discrepancies between the strategic model and survey data. The AM and PM peak redistribution of trips remain consistent with a maximum of 4 per cent variation. The trip length distribution showed a reduction of longer trips in the 5-7 kilometre range and an increase in trips in the 0-2 kilometre range in the AM peak. The original PM distribution shows the highest proportion of trips belonging to the 3-4 kilometre range whilst also favouring shorter trips in the 0-2 kilometre range. The changes in trip length may also be due to discrete classifications, for example, trip lengths of 1100 metres reduce to 900 metres are reclassified from 1-2 kilometres to 0-1 kilometres. **Figure 3-9** and **Figure 3-10** show the trip length distribution between the original traffic demand and the adjusted demand based on observed real data sets in the AM and PM peaks respectively.

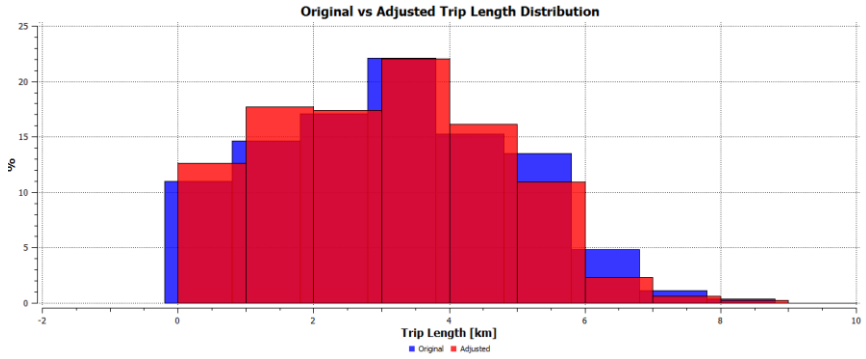


Figure 3-9 AM car trip length redistribution

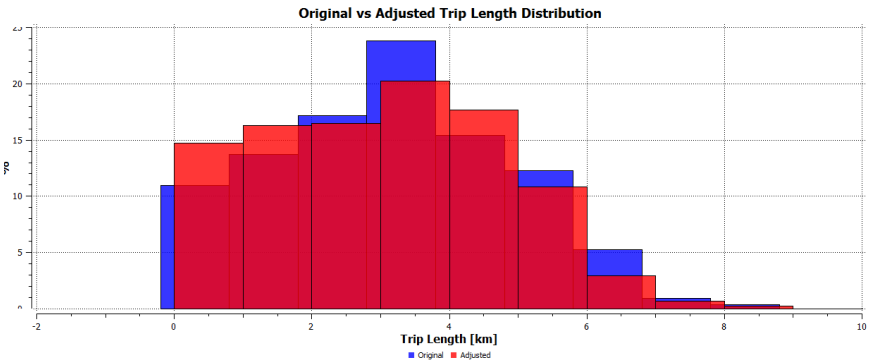


Figure 3-10 PM car trip length redistribution

4 Base model calibration and validation

This section provides a brief overview of the base model calibration and validation procedure. This which was used to verify that the model accurately reflects the existing conditions and therefore is a suitable base on which to build the future options analysis. The calibration and validation procedure was previously documented in greater detail in the **Base Model Development Report** (Cardno, 6 February 2019).

4.1 Stability

The stochasticity of a microsimulation model can cause instability in the model. This can undermine the reliability of the model to forecast future traffic conditions. It is important that the base model is stable and has an appropriate degree of accuracy for future options assessment. To determine the stability of a model, a total of five (5) seed values and the default time-step value in Aimsun are initially used to iteratively determine the required number of runs, as recommended by the *Traffic Modelling Guidelines*.

Vehicle hours travelled (VHT) was the statistic chosen to determine the model stability. The VHT results are a single-figure summary that provide an indication of whole-network performance by identifying whether the model has unrealistic gridlocks and/or excessive delays. VHT is calculated by summing the individual travel time for each vehicle across the whole network. In Aimsun, VHT is only calculated using vehicles which complete a trip from their origin to destination; any vehicles remaining in the system at the conclusion of the simulation period are excluded from the total system travel time.

The number of seed runs required to determine the stability of the model is calculated iteratively using **Equation 1**:

$$N = \left(\frac{t\sigma}{\Delta}\right)^2$$ Equation 1

where:

N = number of runs required
t = two-tailed inverse of Student's t-distribution
σ = standard deviation
Δ = Acceptable error (product of precision and sample mean).

The t-value required for a confidence interval of 95% given five (5) initial seeds is 2.776. The number of runs required for the AM and PM peak periods are shown in **Table 4-1**.

Table 4-1 Number of simulation runs required

	AM	PM
t	2.776	2.776
σ	10.827	10.784
Δ	27.113	29.490
N	1.229	1.031

The number of simulation runs required is below the initial five (5) seeds used in both peaks, therefore it is sufficient to retain the initial 5 seeds for a confidence interval of 95%.

The results of the VHT stability analysis are shown in **Figure 4-1** and **Figure 4-2** for the AM and PM peak periods respectively.

The VHT during the AM and PM peak models are consistent and sufficiently independent across different seed values. This confirms that one seed value for the model can be considered to be representative of a general model run. The peak hour models are considered stable and demonstrate that the model remains robust under varying conditions which will allow it to be used to reliably forecast future scenarios.

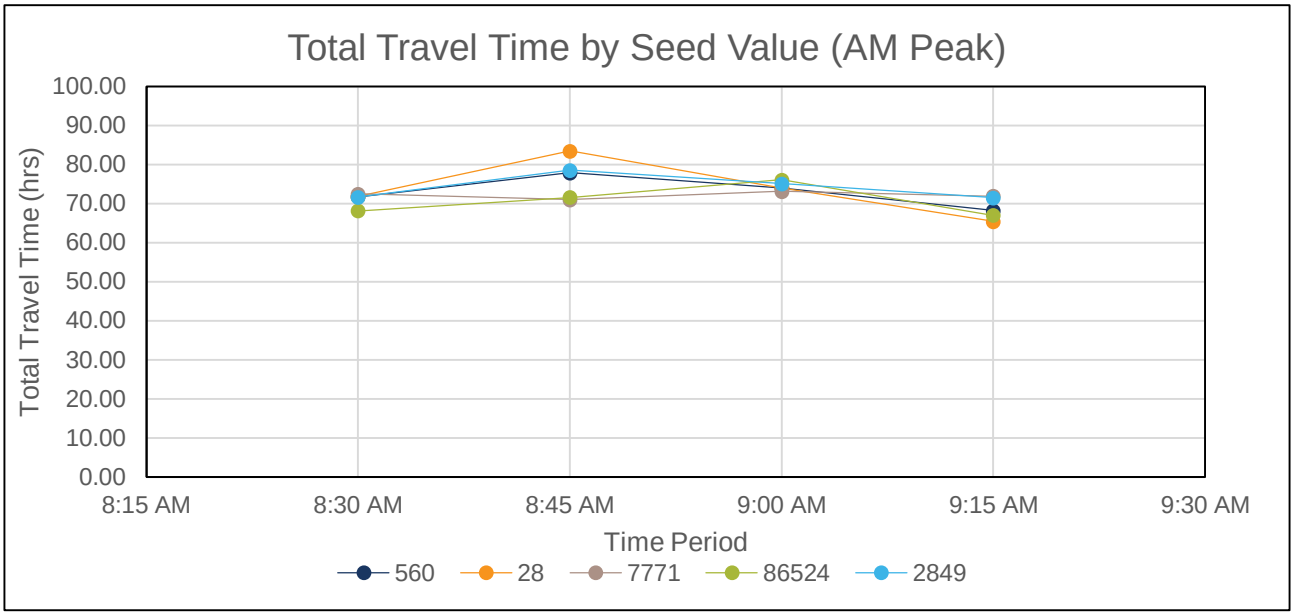


Figure 4-1 Total Travel Time by seed value (AM peak)

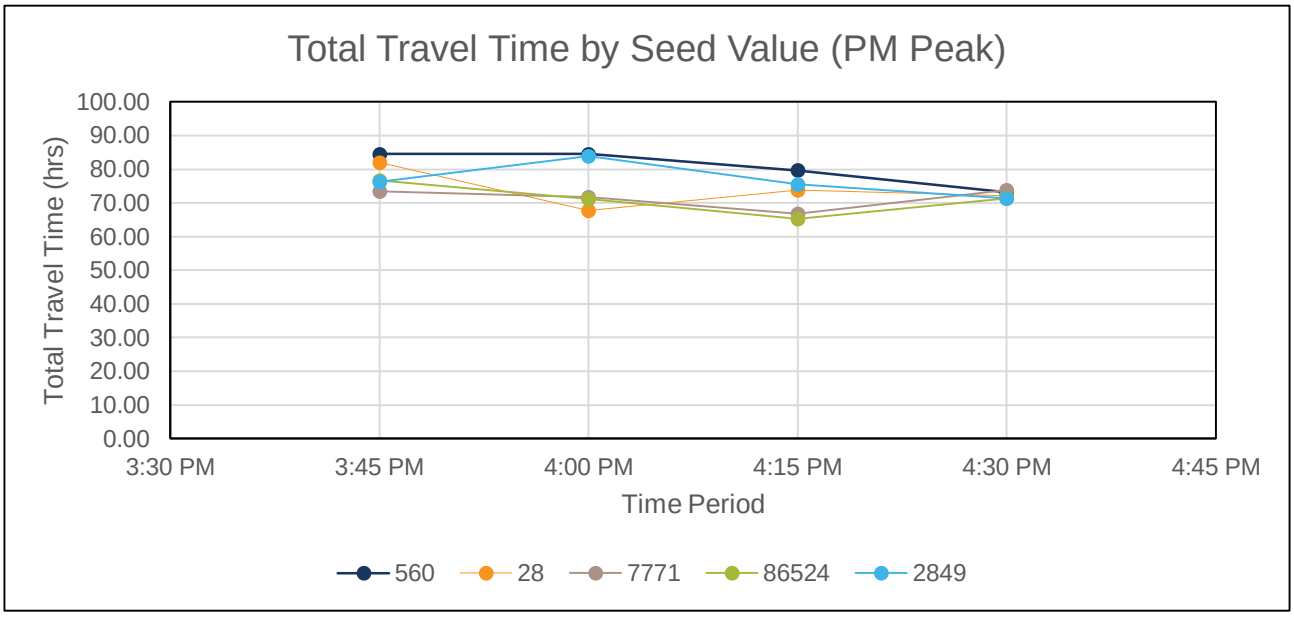


Figure 4-2 Total Travel Time by seed value (PM peak)

The resulting model performance is summarised by the total vehicle hours travelled comparisons above. The general network statistics for both periods show a substantially low level of variability in the peak hours of both the AM and PM peaks. Overall, the statistical analysis of the model runs demonstrates the modelled network and output results are stable.

The median seeds for reporting purposes identified for each peak are shown in **Table 4-2**.

Table 4-2 Median seed for each peak

Peak	Median Seed
Weekday AM (08:15 – 09:15)	560
Weekday PM (15:30 – 16:30)	2849

4.2 Calibration

A turning count calibration was used to compare observed on-site traffic volumes with equivalent outputs from the model. Turning count calibration was undertaken for each of the major intersections to ensure that simulated traffic volumes in the models are representative of traffic volumes observed for each movement at each surveyed intersection.

The model was calibrated using the criteria provided in the *Traffic Modelling Guidelines*. This uses an empirical formula known as the GEH-statistic. The GEH-statistic is used for individual flows and the R-Square (R^2) statistical measure is used for correlation of the entire data set. The GEH-statistic is given by **Equation 2**:

$$GEH = \sqrt{\frac{(V_o - V_m)^2}{0.5(V_o + V_m)}}$$ Equation 2

where:

V_o = the observed traffic flow
V_m = the modelled traffic flow.

A GEH-statistic of 5.0 or less is considered to provide a good match between the modelled and observed traffic flows. According to the *UK Highways Agency Design Manual for Roads and Bridges (DMRB)*, a model should be calibrated so that at least 85% of links or turns have a GEH not exceeding 5.0.

The following criteria were used during the turning count calibration process for the network:

- 100 per cent of turn and link flow comparisons to have a GEH not exceeding 10.0
- 85 per cent of turn and link flow comparisons to have a GEH not exceeding 5.0
- R^2 to be between 0.95 and 1.05 for a flow plot of observed versus modelled turn volumes (where $R^2 = 1.0$ is a perfect correlation).

The GEH-statistics for turns in the model are shown in **Table 4-3**.

Table 4-3 Summary of GEH-statistics

	AM peak (8:15 AM – 9:15 AM)		PM peak (3:30 PM – 4:30 PM)	
	Light vehicles	Heavy vehicles	Light vehicles	Heavy vehicles
GEH < 5.0	90%	100%	88%	99%
GEH < 10.0	100%	100%	99%	100%
Calibration achieved	✓	✓	*	✓

* An alternate route preferred by approximately 100 additional modelled vehicles was used in the PM peak which resulted in three right turns on the alternate route having a GEH of above 10.0 each. The GEH for this route is not substantially above the required value of 10.0. This presence of this route was not considered to significantly detract from the accuracy of the base model, however a limitation of the model is that the flows at this roundabout should not be used for detailed intersection analysis without correction to reflect observed conditions.

The alternate route is shown in **Figure 4-3**.

Figure 4-3 Alternate route over-utilised in PM Base Model

The turning count comparison between the observed and modelled flows for all turns are shown graphically in **Figure 4-4** and **Figure 4-5**.

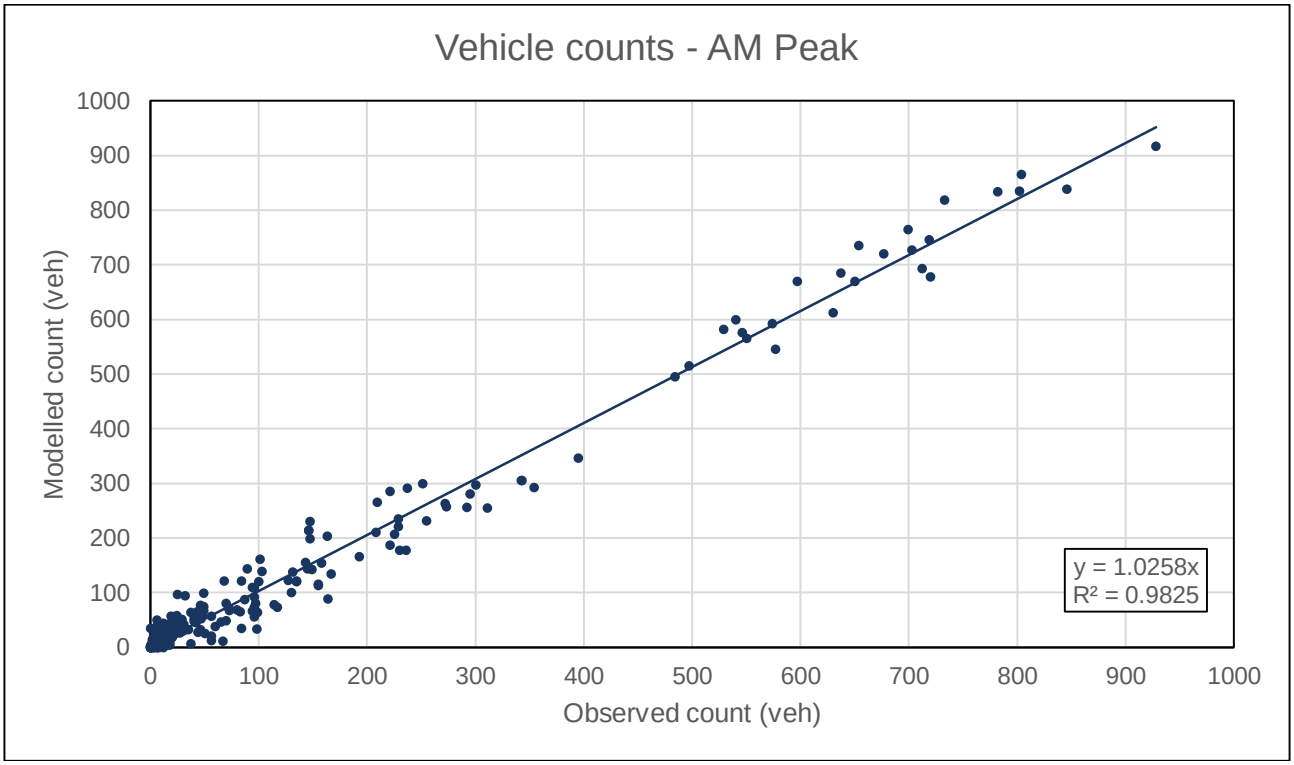


Figure 4-4 Regression analysis for all vehicles (8:15 AM – 9:15 AM)

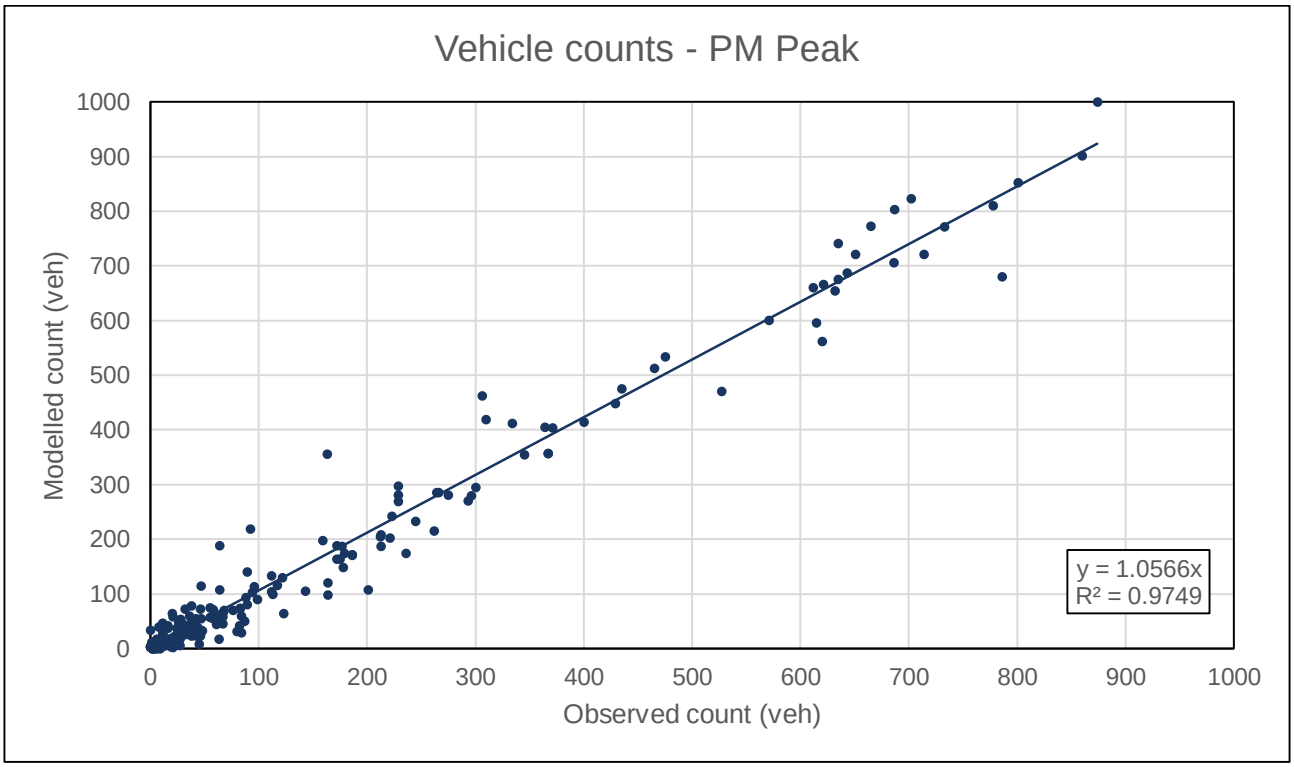


Figure 4-5 Regression analysis for all vehicles (3:30 PM – 4:30 PM)

4.3 Validation

4.3.1 Travel time

The *Traffic Modelling Guidelines* stipulate that the average modelled travel time should be within 15 per cent or one minute (whichever is greater) of the average observed travel time for the full length of each route. **Figure 4-6** to **Figure 4-9** show the travel time validation results between modelled and observed data for the eastbound and westbound route along Argyle Street from Yarrawa Road to Kings Road.

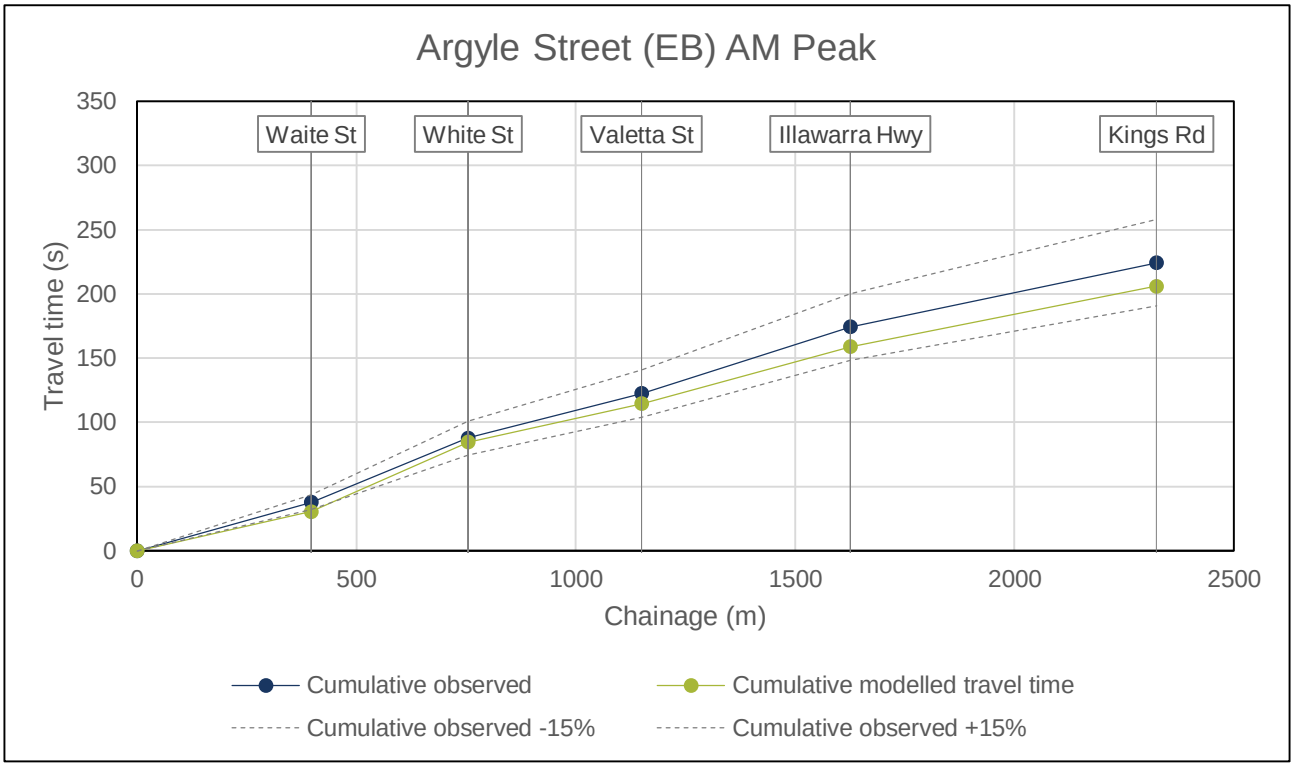


Figure 4-6 AM peak travel time for Argyle Street eastbound.

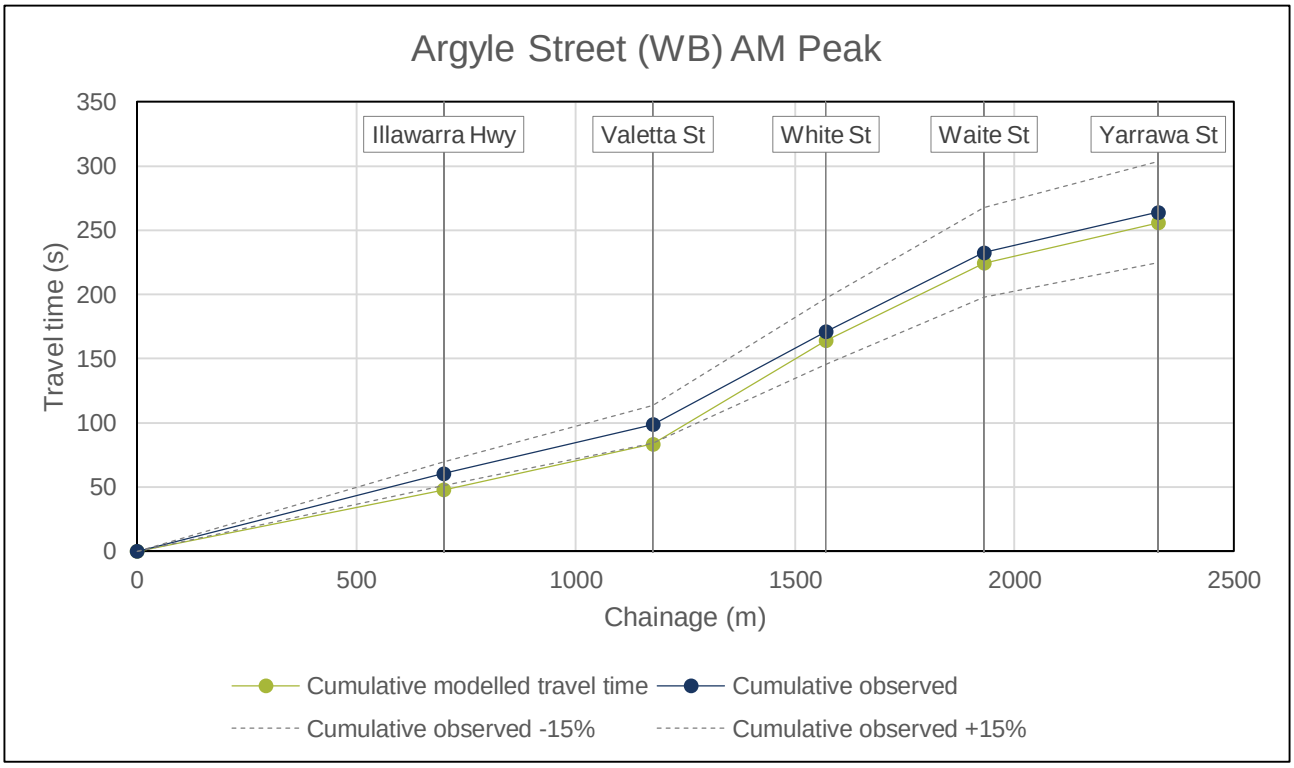


Figure 4-7 AM peak travel time for Argyle Street westbound

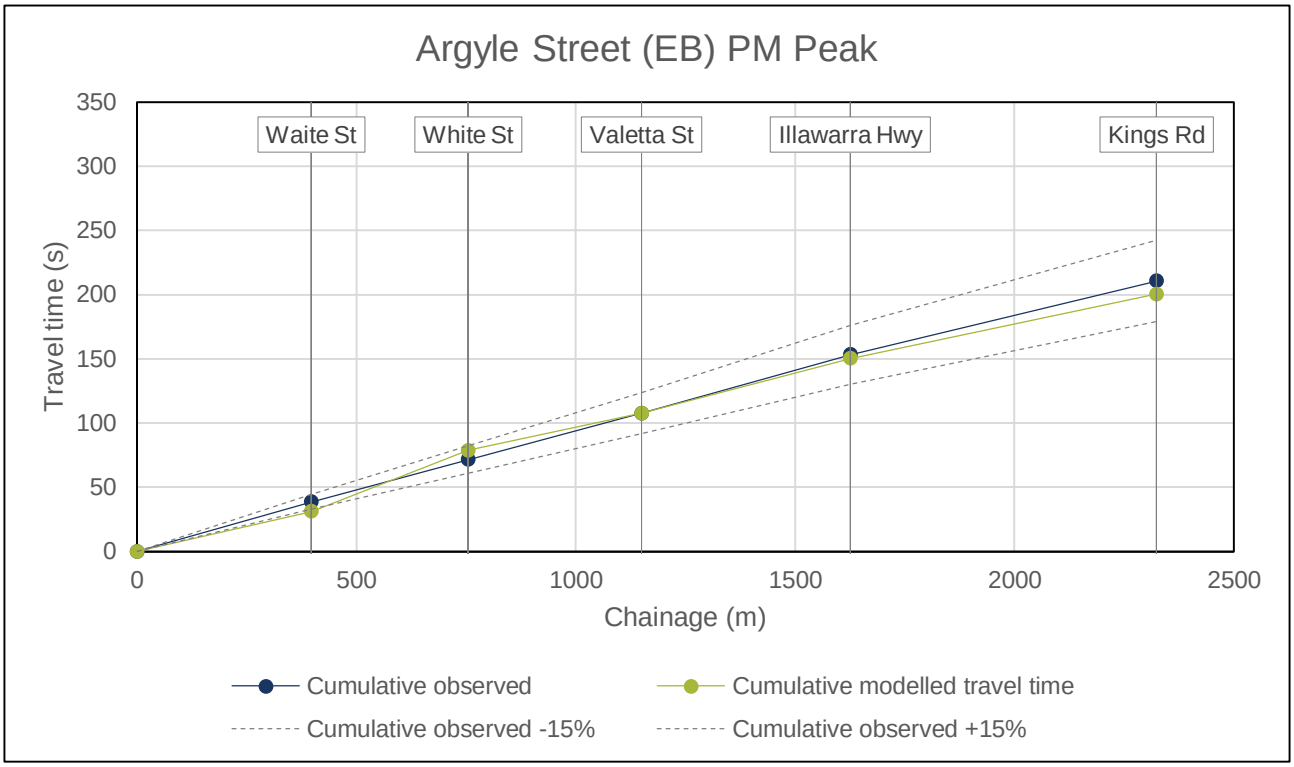


Figure 4-8 PM peak travel time for Argyle Street eastbound

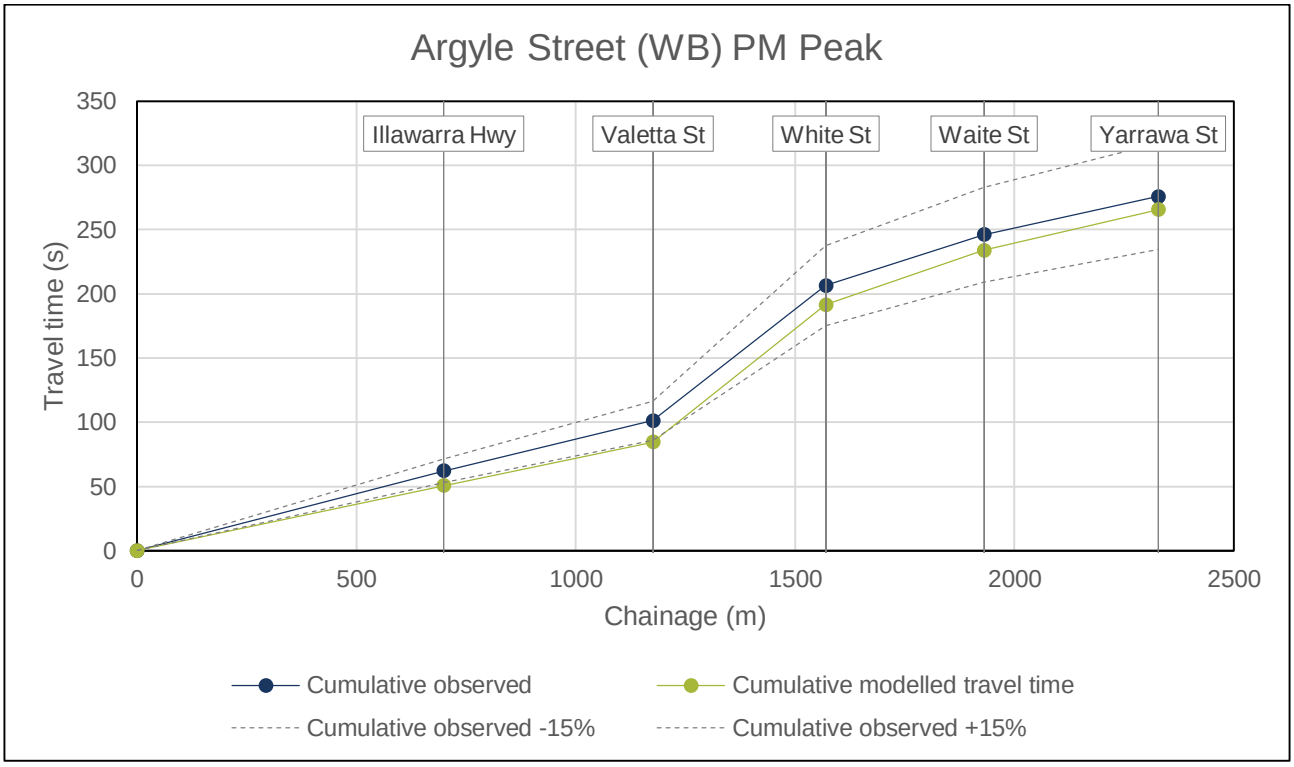


Figure 4-9 PM peak travel time for Argyle Street westbound

A summary of the travel time for the entire route along Argyle Street in both directions in both peak hours is shown in **Table 4-4**.

Table 4-4 Validation results for AM and PM peak.

Road	Period	Direction	Surveyed time (s)	Modelled time (s)	Difference (s)	Difference (%)	Validation
Argyle Street	AM	EB	224	206	-18	-8%	✓
		WB	264	256	-8	-3%	✓
	PM	EB	211	200	-10	-5%	✓
		WB	276	266	-10	-4%	✓

Data source: Traffic survey data (collected Thursday 30 August 2018).

4.4 Summary

The base model was calibrated and validated according to the procedure outlined in the *Traffic Modelling Guidelines*:

- Analysis of the AM and PM Total Travel Time shows that the models are consistent and sufficiently independent across the five different seed values
- The base model demonstrates an acceptable level of calibration with at least 88 per cent of turns having a GEH < 5.0 and 99 per cent of turns having a GEH < 10.0
- The previously-considered alternate route via Elizabeth Street results in three turns with a GEH > 10.0 and approximately 100 vehicles unrealistically routed in the base model. This was not considered to significantly impact the outputs of the model
- The base model was validated using travel time routes and all routes were within the greater of 15 per cent or one minute of the modelled travel time for both peaks

The base model was submitted to Roads and Maritime for review prior to Cardno proceeding with the future year modelling. The base model was deemed by Roads and Maritime to reflect the existing conditions sufficiently accurately to form a robust base for future options testing.

5 Sensitivity analysis

5.1 Overview

At the request of Roads and Maritime, Cardno undertook modelling of a 2016 + Chelsea Gardens scenario which utilised the 2016 base demand with the addition of the full Chelsea Gardens yield of 1200 lots. The purpose of this modelling was to quantify the impact of Chelsea Gardens traffic in isolation on the current traffic network (ie without background growth or other developments) to provide greater context for setting developer contributions between Council and Aoyuan under Section 7.11 (formerly Section 94) of the Environmental Planning & Assessment Act 1979.

This sensitivity analysis was undertaken following the Future Modelling and Staged Future Modelling (included in **Section 6** of this report). The purpose of the analysis is to increase the understanding of the relationship between the future traffic volume and the Chelsea Gardens development specifically. It is therefore appropriate to include it between the 2016 base demand (**Section 3**) and full future demand scenarios which include development and background growth (**Section 6**).

5.2 2016 + Chelsea Gardens demand development

5.2.1 Chelsea Gardens centroids

Base and future year demands were extracted from the Wingecarribee Shire Council TRACKS strategic model. Chelsea Gardens is represented by nine centroids labelled 191 to 199. Centroid 191 is connected to Lovelle Street, centroid 194 is connected to Villiers Road / Hill Road and the remaining centroids are within the main Chelsea Gardens development. The location of these centroids is shown in **Figure 5-1**.

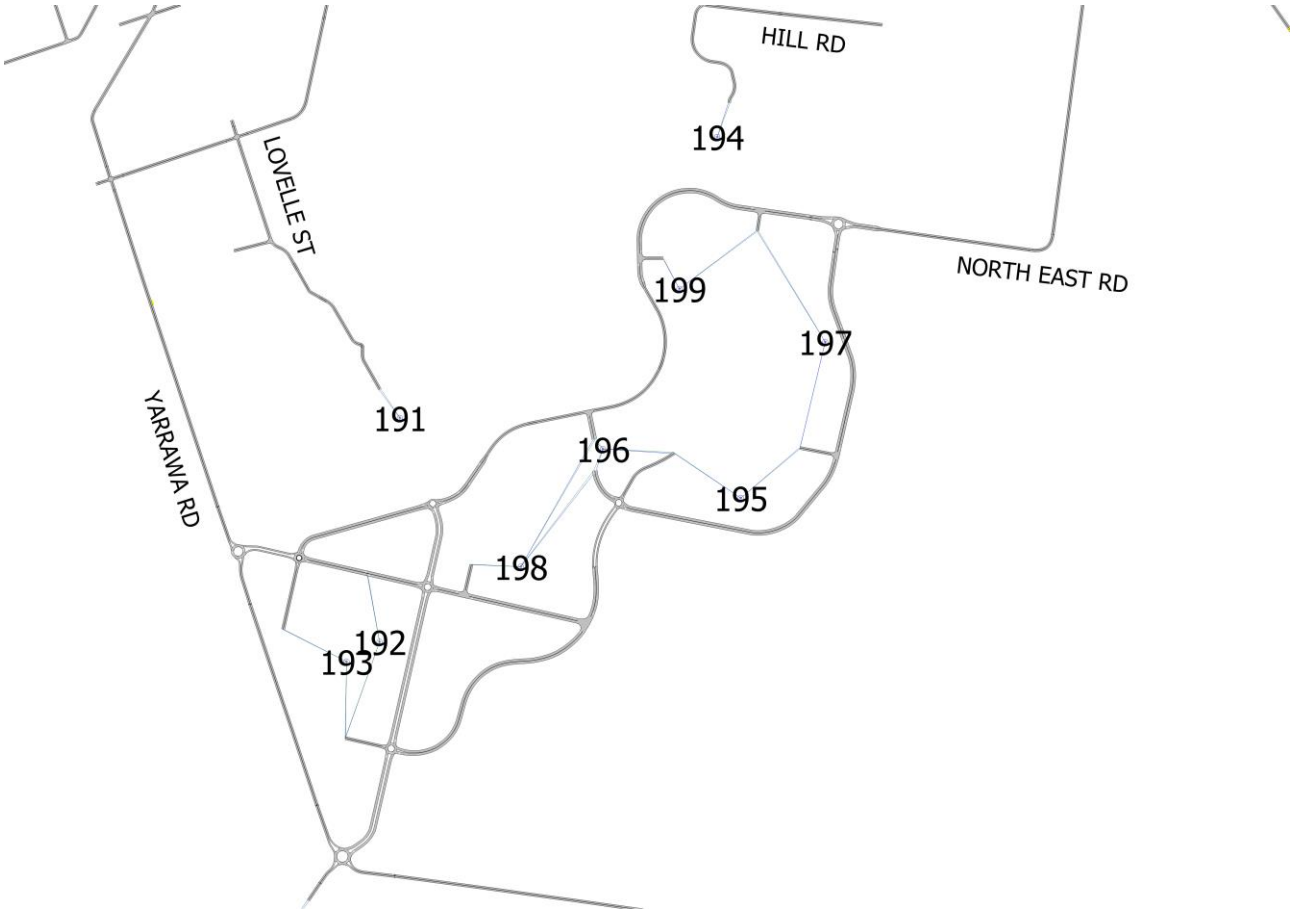


Figure 5-1 Chelsea Gardens centroids

The TRACKS strategic model was reinterrogated in April 2019 to provide 2036 demand matrices which included Chelsea Gardens, background growth and other developments in the area. The 2036 demand matrices also included Stage 1 of the Moss Vale Bypass. The Chelsea Gardens demand was extracted from the received matrices to determine the growth of the development in isolation. The presence of the bypass was assumed not to impact the trip generation/attraction of Chelsea Gardens based on observations of previous strategic model demand data from September 2018.

The TRACKS strategic model is based on 1526 lots for the full Chelsea Gardens development. However, the number of lots under current subdivision plans totals less than 1200 therefore the trip generation/attraction was reduced pro rata. This corresponds to a 21.4 per cent decrease for trips generated by, attracted to and internal to Chelsea Gardens across all centroids compared to old dated Council land use assumptions.

The latest Chelsea Gardens demand was added to the 2016 base demand to produce the 2016 + Chelsea Gardens demand matrix. This was then profiled into 15-minute time periods based on the same traffic profile used in the Base Model and then split based on 95%-5% light-to-heavy vehicle ratio. It was assumed that the traffic profile and LV-HV split will remain consistent following the introduction of Chelsea Gardens vehicles.

The final demand output consisted of 16 matrices in 15-minute slices for both peak hours for both vehicle types. The demand modelling procedure is summarised in **Figure 5-2**.

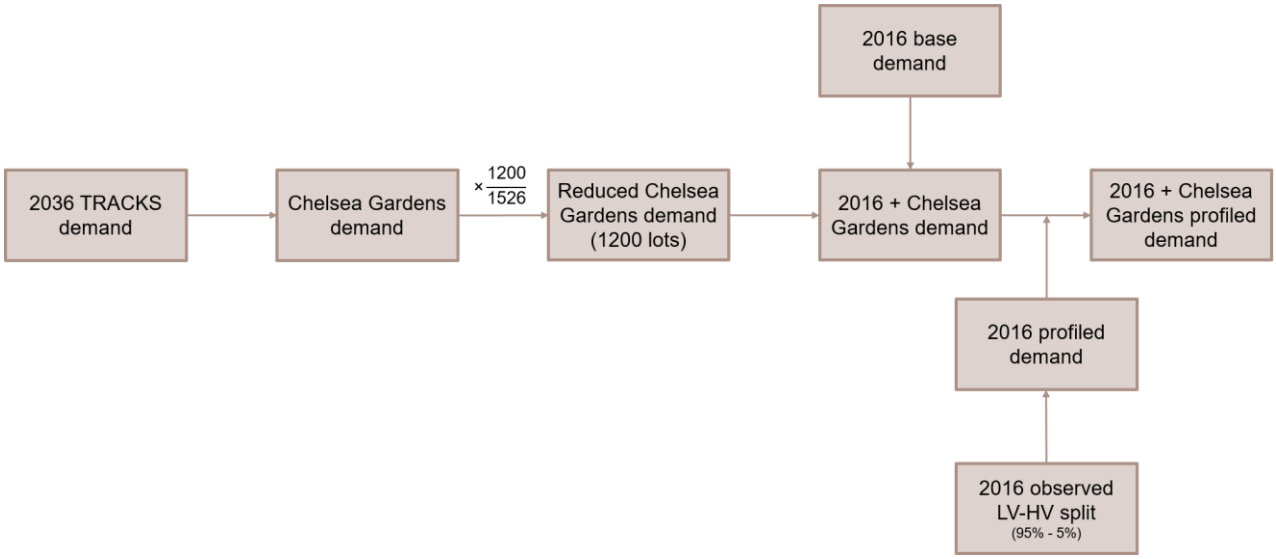


Figure 5-2 2016 + Chelsea Gardens demand matrix generation procedure

The total trips for each 15-minute time interval for both peaks is shown in **Figure 5-3** and **Figure 5-4** where the blue demand represents the base model trips and the brown demand is the additional trips due to Chelsea Gardens full yield (1200 lots). The total trips increase is also summarised in **Table 5-1**.

Table 5-1 Chelsea Gardens trips

	2016 trips	2016 + Chelsea Gardens trips	% increase	Chelsea Gardens trips per lot
AM	4459	1010	22.7%	0.84
PM	4580	815	17.8%	0.70

Given that the peak hour represents the afternoon school peak (3:30PM – 4:30PM), it is reasonable for the number of trips to and from Chelsea Gardens to be less than in the morning peak (8:15AM – 9:15AM) which coincides with the morning school peak and typical departure times for workers.

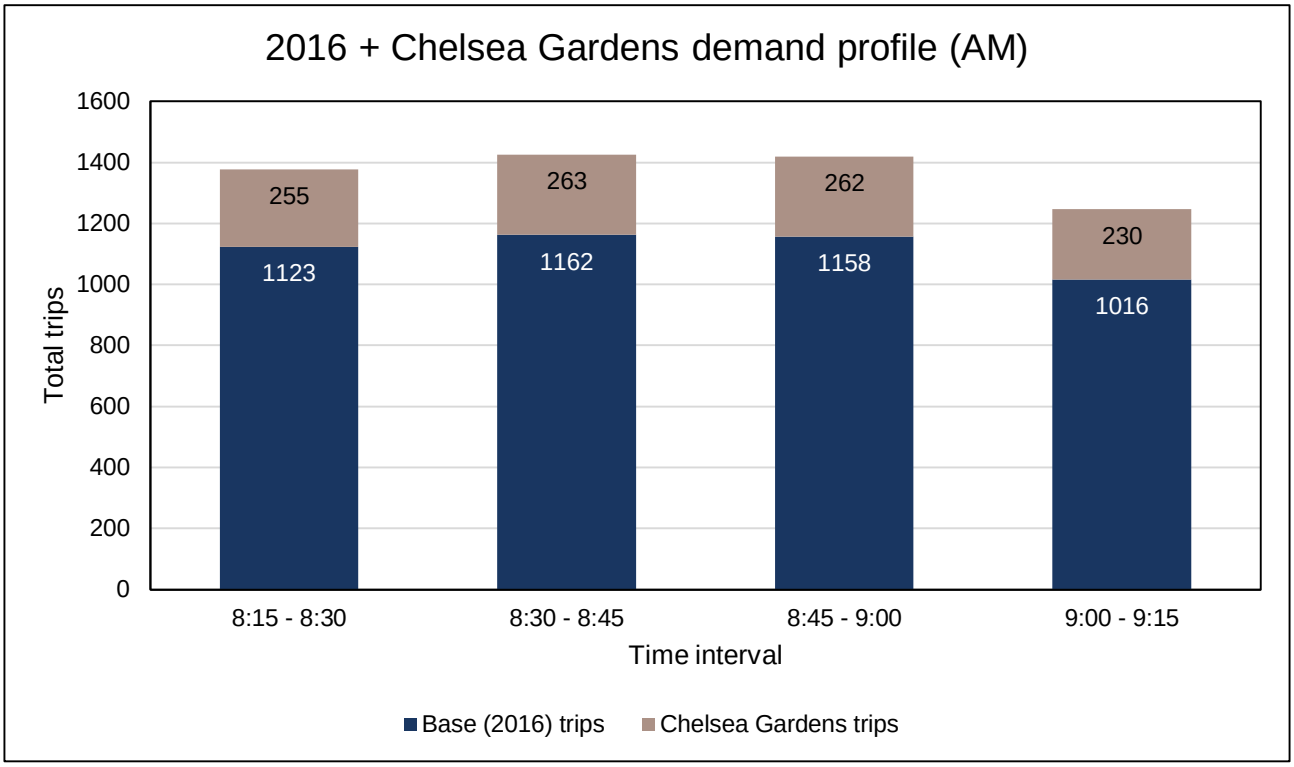


Figure 5-3 AM demand profile

Data source: WSC TRACKS model (Stantec, interrogated October 2018) and traffic survey data (collected Thursday 30 August 2018).

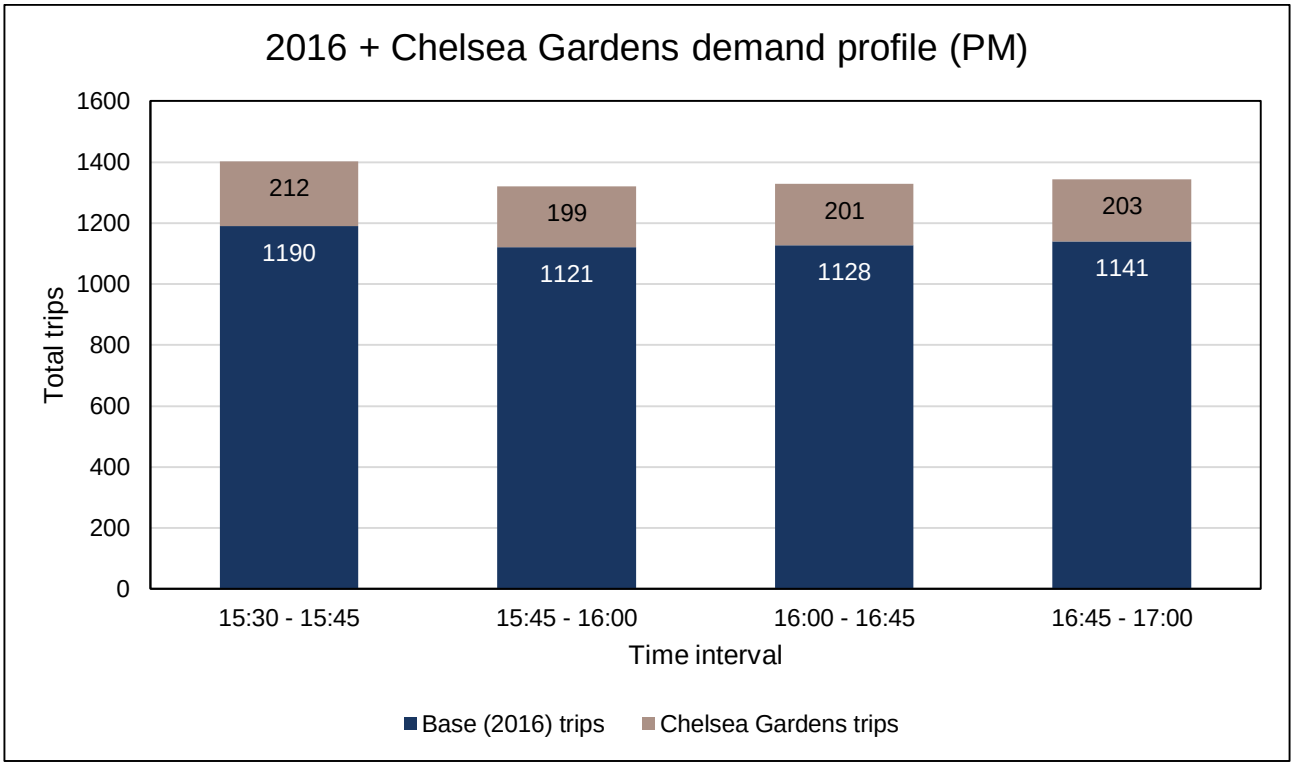


Figure 5-4 PM demand profile

Data source: WSC TRACKS model (Stantec, interrogated October 2018) and traffic survey data (collected Thursday 30 August 2018).

5.3 Infrastructure assumptions

5.3.1 Chelsea Gardens development

Chelsea Gardens is a residential development situated in south eastern Moss Vale. The development is expected to yield up to 1200 lots and is accessible from Yarrawa Road in the south and Fitzroy Road in the north. The location of the development is shown in **Figure 5-5**.

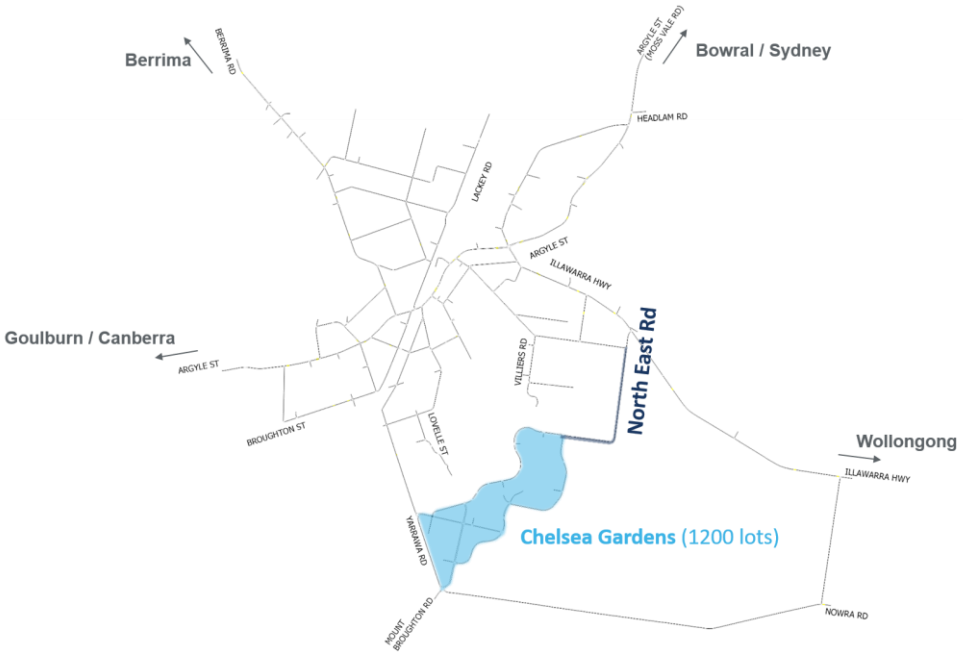


Figure 5-5 Chelsea Gardens and North East Road locations

The internal road network is based on the “Moss Vale Master Plan” (MP-02 Rev B, Arterra, 24 August 2018). The internal road layout has been subsequently revised, however connectivity to the surrounding road network remains the same.

5.3.2 North East Road

North East Road is a potential north-eastern connection between the Chelsea Gardens development and Fitzroy Road / Illawarra Highway. The connection was considered in the modelling process to provide additional connectivity to the development and minimise Chelsea Gardens traffic using the CBD. The link is approximately 1.3 kilometres long and is coded as 60 kilometres per hour for its length except within 250 metres of either end where it reduces to 50 kilometres per hour to remain consistent with the surrounding local roads. The alignment and posted speed limit on this link are shown in **Figure 5-6**.

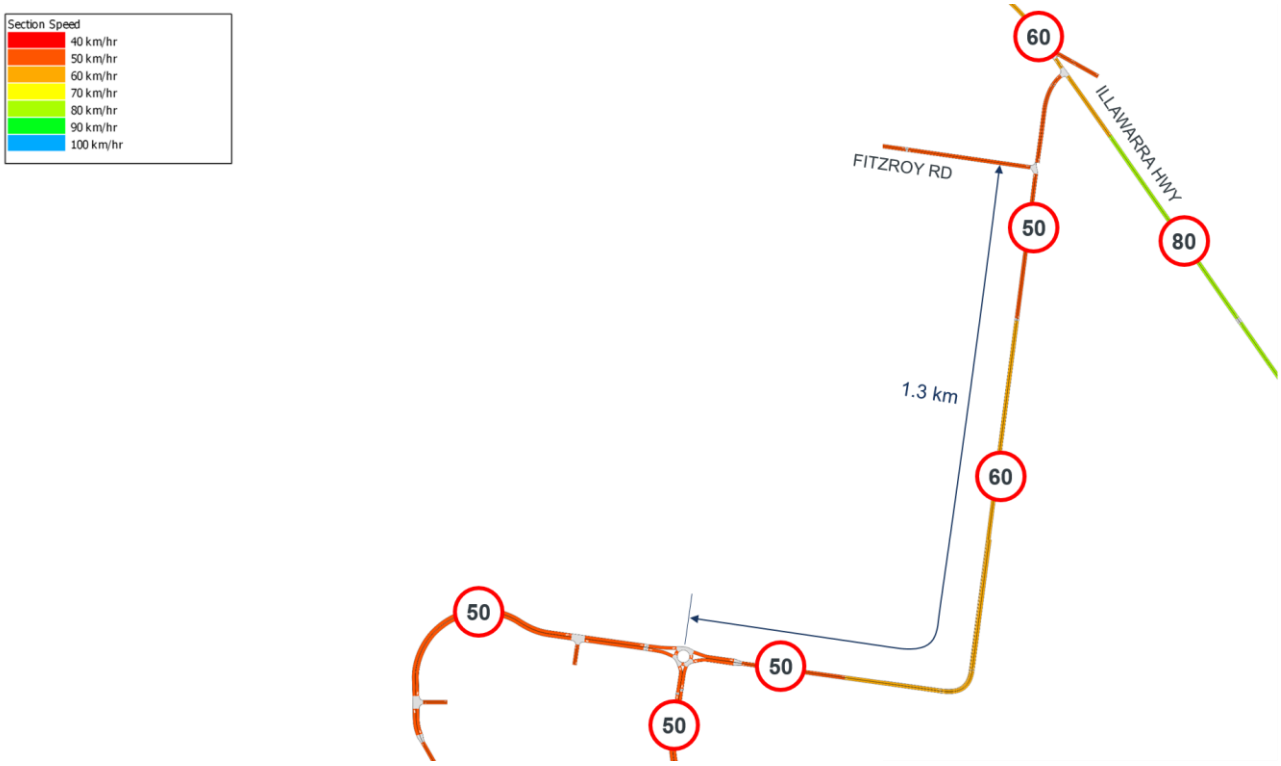


Figure 5-6 North East Road alignment and posted speed limit

5.4 Results

Cardno undertook modelling for both AM and PM peaks for the 2016 + Chelsea Gardens scenario. Results were outputted for a 'No Upgrades' Scenario which used an unmodified 2016 network with only adjustments to signal timings and also for a 'With Upgrades' Scenario in which potential mitigation measures were proposed to restore the performance of the network to 2016 conditions.

5.4.1 'No Upgrades' Scenario

The introduction of Chelsea Gardens vehicles using the North East Road to access the Argyle Street / Illawarra Highway roundabout causes an imbalance of flows. The heavy right turn from Illawarra Highway obstructs vehicles entering the roundabout from Argyle Street (W) and Suttor Road.

Additional vehicles using Arthur Street cause extensive delays on an intersection already performing at LOS F in 2016. In particular, heavy traffic on Argyle Street made it difficult for the additional vehicles to find sufficient gaps and hence the queues did not quickly clear.

Although the introduction of Chelsea Gardens did not significantly increase traffic on Lackey Road or Railway Street, the right turn movement from Argyle Street into Arthur Street often caused queues to back up on Argyle Street and prevented these vehicles from entering the Argyle Street flow. Consequently, there was observed to be a slight deterioration in the performance of these intersections.

Although the flows were observed to increase on the Spring Street underpass, performance was still at LOS C or higher and delays were not significantly higher than 2016 conditions. Other intersections performed similarly to the 2016 conditions.

AM and PM results for the 'No Upgrades' scenario are shown in **Figure 5-7** and **Figure 5-8** for the AM and PM peaks respectively. Areas which experience an increase in traffic density in the 'No Upgrades' scenario are highlighted.

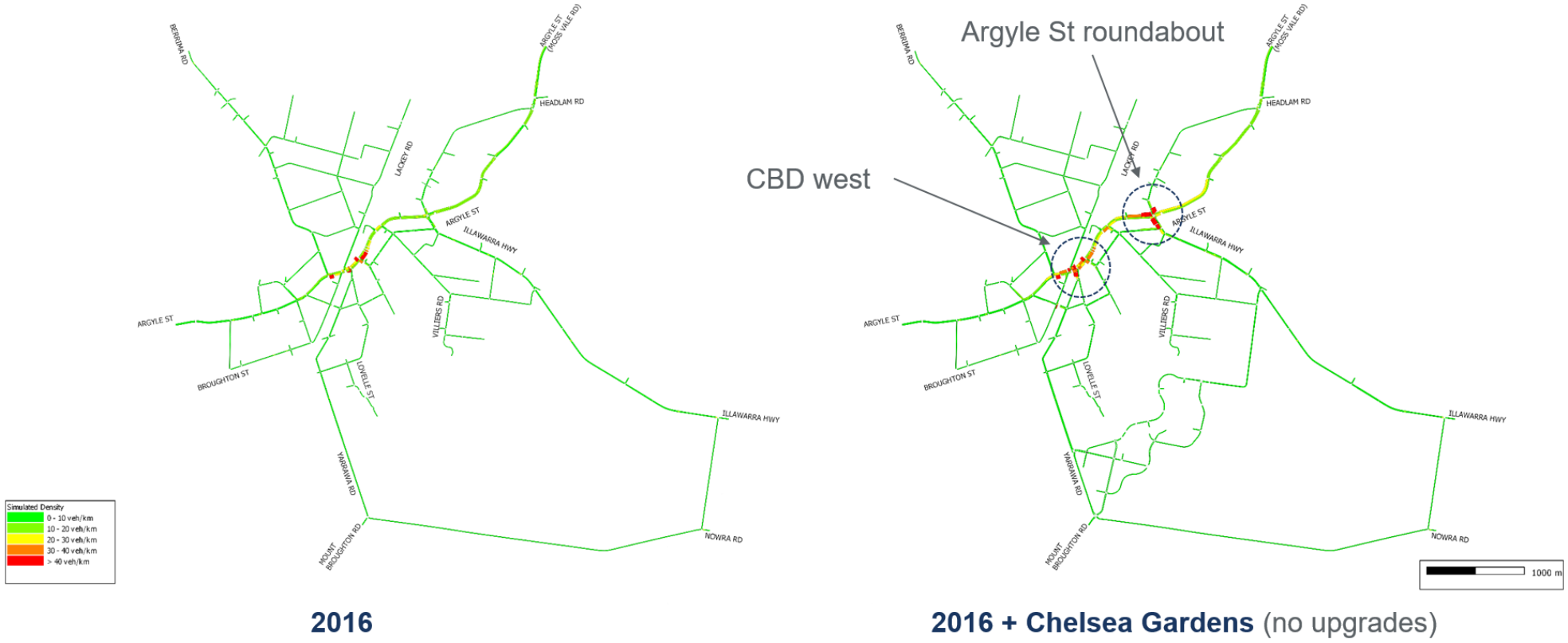


Figure 5-7 2016 + Chelsea Gardens 'No Upgrades' scenario (AM)

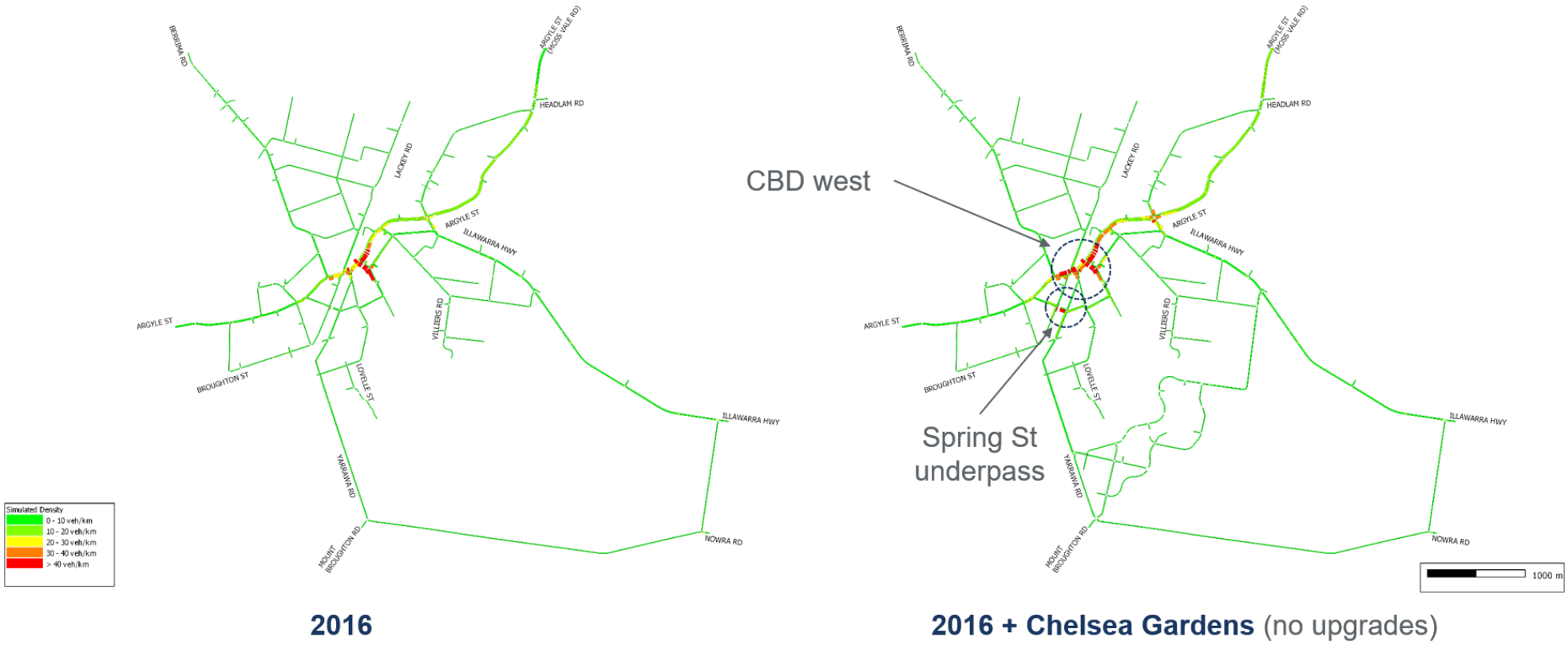


Figure 5-8 2016 + Chelsea Gardens 'No Upgrades' scenario (PM)

5.4.2 'With Upgrades' Scenario

The following mitigation measures address the network deficiencies caused by the introduction of the Chelsea Gardens traffic demand. The main locations considered were the section of Argyle Street through the CBD and the Argyle Street / Illawarra Highway roundabout.

As outlined above, vehicles making the right turn into Arthur Street from Argyle Street often caused long queues as the lack of a dedicated turning lane prevented vehicles making the through movement from going around the right-turning vehicles. A right turn ban at Arthur Street was introduced to encourage vehicles to make use of the right turning lane at Argyle Street / White Street or use Argyle Street / Railway Street instead. Similarly, the right turn movement out of Arthur Street often caused long queues as gaps were infrequent and irregular in the Argyle Street flow. A right turn ban at Arthur Street was introduced to encourage vehicles to make use of White Street or Railway Street to turn right.

Vehicles from Chelsea Gardens intending to turn right onto Argyle Street typically utilised the North East Road connection while local traffic from Arthur Street and the surrounding roads used White Street and Elizabeth Street. Consequently, the redistribution of these vehicles from Arthur Street was not observed to substantially increase the number of vehicles on White Street in the CBD. LOS results for the Argyle Street / White Street intersection do not indicate a significant deterioration in performance with the redistributed traffic.

Modelling indicates that the Argyle Street / Illawarra Highway roundabout performs near or at capacity with the full development of Chelsea Gardens. While the roundabout performs at LOS E, as the development is staged, impacts to the roundabout will be progressive, not immediate. Staged modelling (**Section 8**) indicated that with development and background growth, the roundabout performs at LOS E by 2026.

The implementation of roundabout metering may improve the performance of this intersection and address the delays. If the Stage 1 Moss Vale Bypass is implemented, performance of the roundabout is expected to improve to LOS B or C.

Queueing on the south approach to the roundabout occasionally extended beyond the preceding intersection which caused additional queueing on Elizabeth Street approaching Illawarra Highway, however these queues dispersed relatively quickly.

The locations of the proposed mitigation measures are shown in **Figure 5-9**.

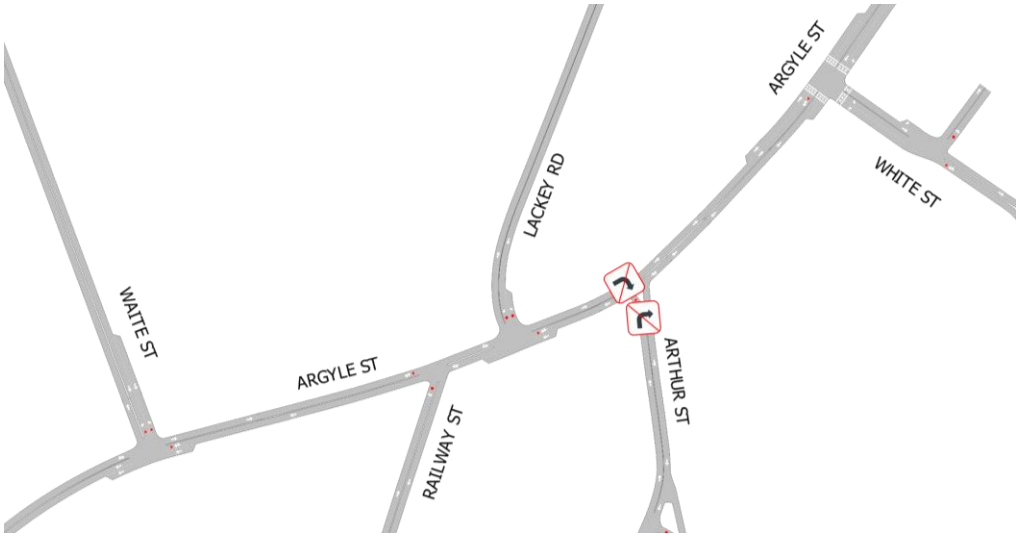


Figure 5-9 Location of proposed mitigation measures in the CBD

AM and PM results for the 'No Upgrades' scenario are shown in **Figure 5-10** and **Figure 5-11** or the AM and PM peaks respectively. Key areas to note which experience an increase in traffic density with respect to the 2016 Base Scenario are indicated.

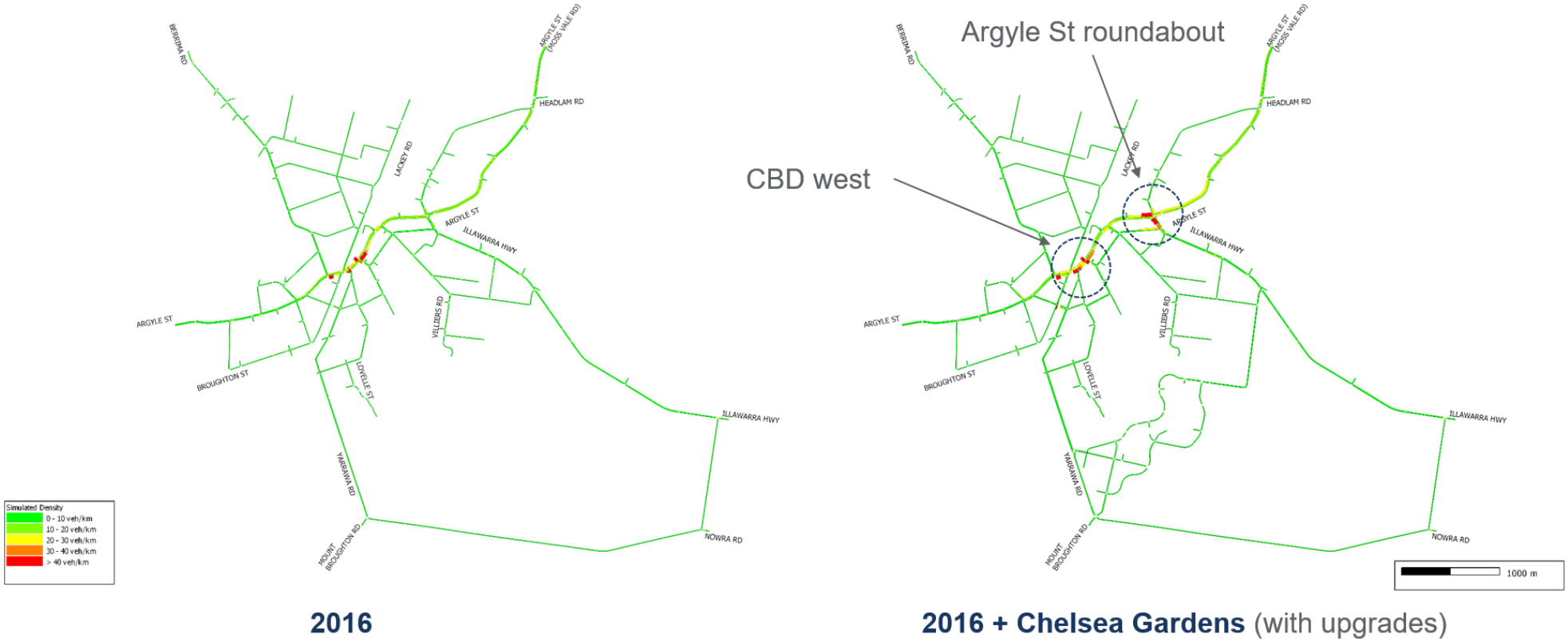


Figure 5-10 2016 + Chelsea Gardens 'With Upgrades' scenario (AM)

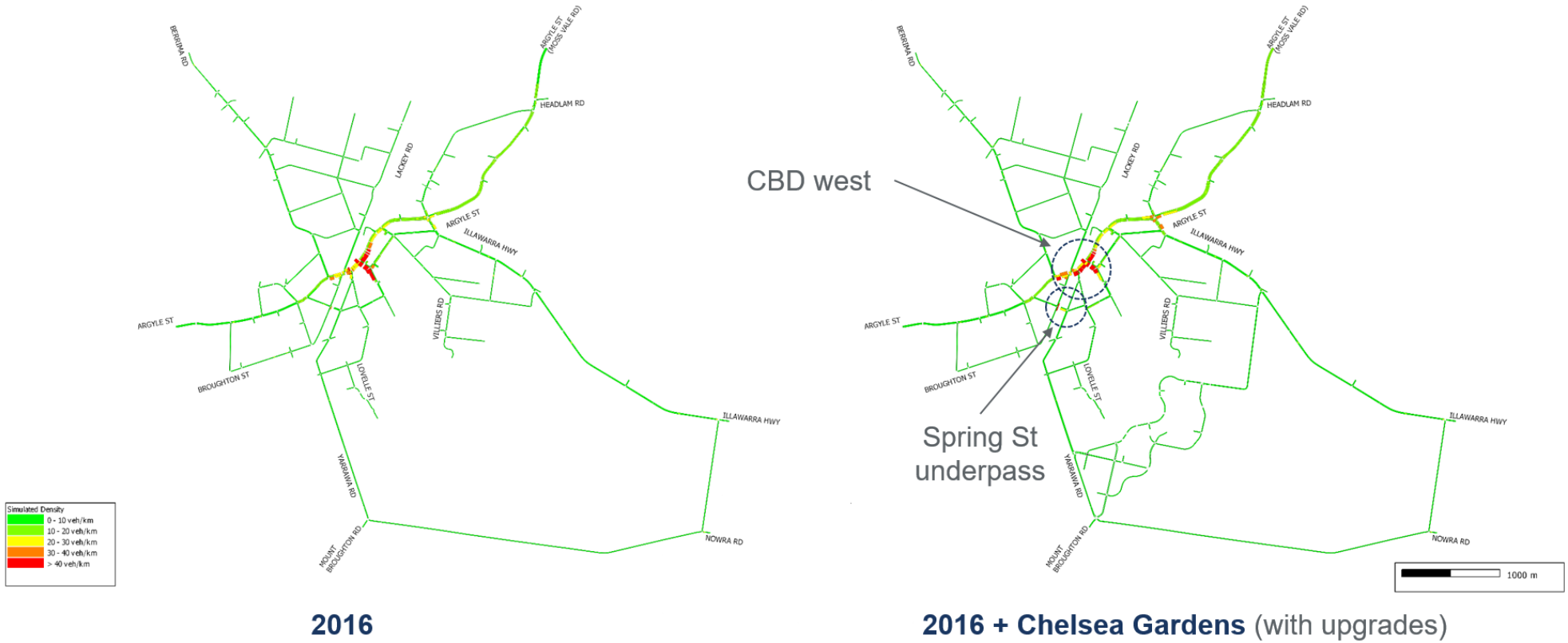


Figure 5-11 2016 + Chelsea Gardens 'With Upgrades' scenario (PM)

The performance of the network with these mitigation measures shows reduced congestion through the CBD area compared to the 'No Upgrades' scenario and minimal queueing on side roads approaching Argyle Street.

The redistribution of traffic due to the right turn ban from Arthur Street into Argyle Street is shown in **Figure 7-6**. In the 2016 Base Scenario, this right turn was made by an average of 57 vehicles in the AM peak and 47 vehicles in the PM peak. In the 2016 + Chelsea Gardens Scenario, the number of vehicles desiring this right turn increases by approximately 75 vehicles in the AM peak and 50 vehicles in the PM peak. This predominantly represents demand from Chelsea Gardens to access the southern CBD. Vehicles desiring to access destinations north of the Argyle Street / Illawarra Highway roundabout were more attracted to use the North East Road. This increase in demand can be absorbed by spare capacity at Railway Street, White Street and Elizabeth Street following the turn ban.

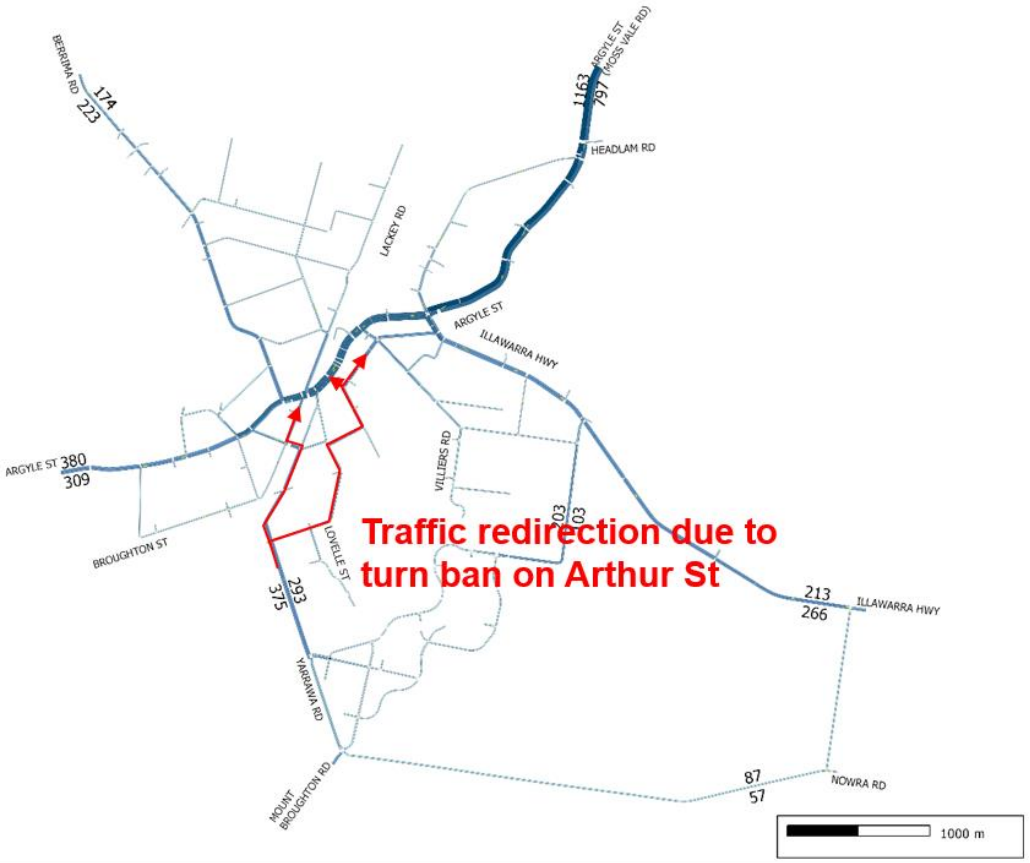


Figure 5-12 Traffic redistribution due to right turn ban on Argyle Street / Arthur Street

The redistribution of traffic desiring to turn right from Argyle Street into Arthur Road is predominantly concentrated to the same roads with vehicles tending to utilise either Railway Street or White Street. The route via Spring Street and the railway underpass is also attractive to these vehicles which reduces the number of vehicles using the CBD.

The right turn bans improve traffic flow through the most congested section of the CBD by removing the stop-start motions caused by vehicles waiting to turn right from a major single-lane road. The removal of the right turn out of Arthur Street also frees up capacity on this approach which makes it more attractive for left turning vehicles so they are less likely to use White Street or the Spring Street underpass to turn left onto Argyle Street.

5.4.3 Comparison of key intersection performance

The assessment of the 2016 + Chelsea Gardens scenarios was assisted by a comparison of intersection level of service based on experienced delays for vehicles in the Aimsun microsimulation model. In an urban network, the capacity of a road network can be largely determined by the capacity of the controlling intersections. The key indicator of intersection performance level of service (LOS) is delay as adopted by Roads and Maritime, where results are placed on a scale from A to F as shown in **Table 5-2**.

Table 5-2 Intersection level of service criteria (RMS)

Level of Service	Average delay per vehicle (sec)	Traffic signals & roundabout operation	Give way & stop sign operation
A	< 14	Good operation	Good operation
B	15 – 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 – 42	Satisfactory	Satisfactory but accident study required
D	43 – 56	Operating near capacity	Near capacity and accident study required
E	57 – 70	At capacity; at signals, incidents will cause excessive delays	At capacity, requires other control mode
F	> 70	Unsatisfactory and requires additional capacity	Unsatisfactory and requires additional capacity

Data source: Roads and Maritime Services.

The level of service extracted from Aimsun was used to assess options to determine the most appropriate mitigation measures for the network in each future year. Key intersections were also assessed for the 2016 base and 2016 + Chelsea Gardens 'With Upgrades' scenarios using SIDRA Intersection 8 based on turn volumes extracted from the Aimsun model. SIDRA Intersection 8 is a software package used to aid design and evaluation of individual intersections including signalised intersections, roundabouts and priority intersections. The SIDRA modelling provides an additional layer of verification and robustness to the modelling results. Level of service results from the SIDRA analysis are shown in **Table 5-3**.

Table 5-3 Intersection level of service

	2016		2016 + Chelsea Gardens with upgrades	
	AM	PM	AM	PM
Argyle Street / Railway Street	**B**	**D**	**C**	**D**
Argyle Street / Arthur Street	**E**	**F**	**A**	**A**
Argyle Street / White Street	**C**	**C**	**D**	**D**
Argyle Street / Illawarra Highway	**B**	**B**	**D**	**C**
Illawarra Highway / Fitzroy Road	**A**	**A**	**A**	**A**

Volumes were based on the average of the five seeds to maintain consistency with the future year modelling results and may therefore differ slightly from those reported in the **Base Model Development Report** (Cardno, 4 February 2019), which used values from the median seed only, due to the stochasticity of the microsimulation model. SIDRA movement summaries showing intersection layouts, level of service, approach delay and degree of saturation are shown in full in **Appendix B**.

Sections 5.4.3.1 to **5.4.3.5** show the turning volumes for each of the key intersections and an explanation of the changes in traffic behaviour following the introduction of Chelsea Gardens. The 2016 + Chelsea Gardens volumes refer to the 'With Upgrades' scenario.

Note that traffic microsimulations are inherently stochastic so network changes can introduce minute changes in driver behaviour and route choice. Consequently, changes in flows of less than approximately 25 vehicles (in either direction) were not considered significant for this analysis.

5.4.3.1 Argyle Street / Railway Street

Turning volumes for Argyle Street / Railway Street for the AM and PM peaks are shown in **Figure 5-13** and **Figure 5-14** respectively.

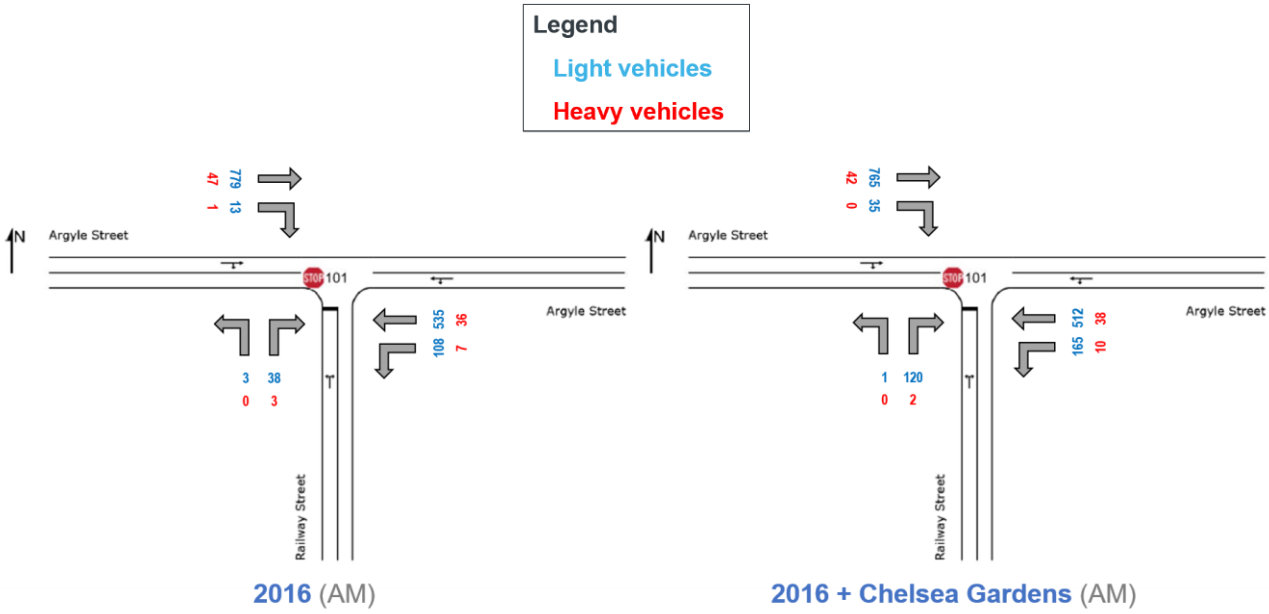


Figure 5-13 Argyle Street / Railway Street turning volumes (AM)

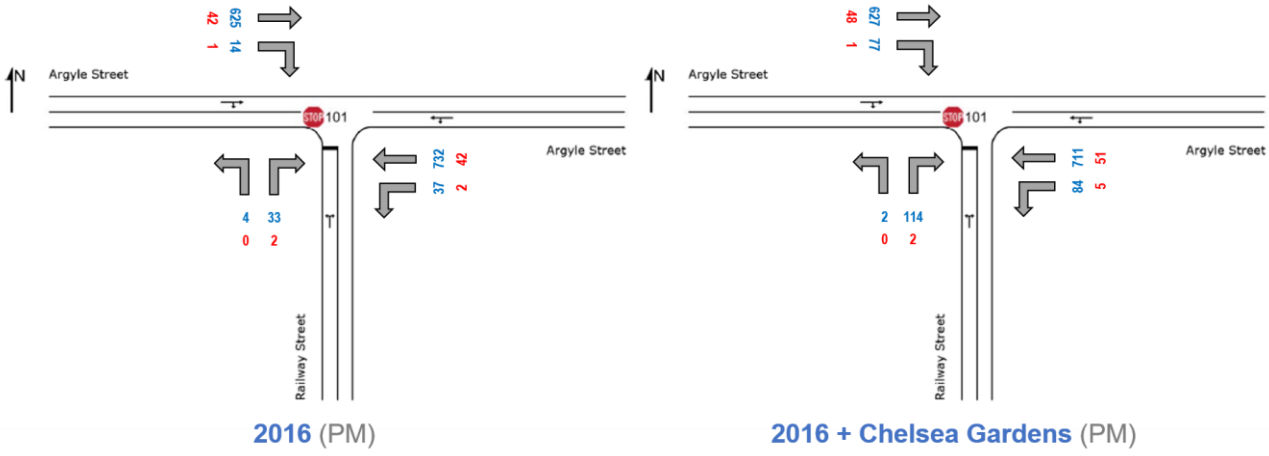


Figure 5-14 Argyle Street / Railway Street turning volumes (PM)

No significant changes in through traffic volumes were observed. An increase in the right turn volume from Railway Street was observed to be a consequence of the right turn ban at Argyle Street / Arthur Street, however the relatively-low base scenario volumes and high level of service suggest that there is sufficient capacity at this intersection to absorb the additional volumes with no adverse effects.

There is also an increase in right turning traffic from Argyle Street into Railway Street by approximately 30 vehicles which is the result of the redistribution of traffic due to the Argyle Street / Arthur Street right turn ban. Traffic on Argyle Street here is typically less congested than at Argyle Street / Arthur Street in the base scenario due to being further from the signalised Argyle Street / White Street intersection. Hence this limited number of right turning vehicles causes less congestion here than otherwise occurred at Arthur Street / Argyle Street.

5.4.3.2 *Argyle Street / Arthur Street*

Turning volumes for Argyle Street / Arthur Street for the AM and PM peaks are shown in **Figure 5-15** and **Figure 5-16** respectively.

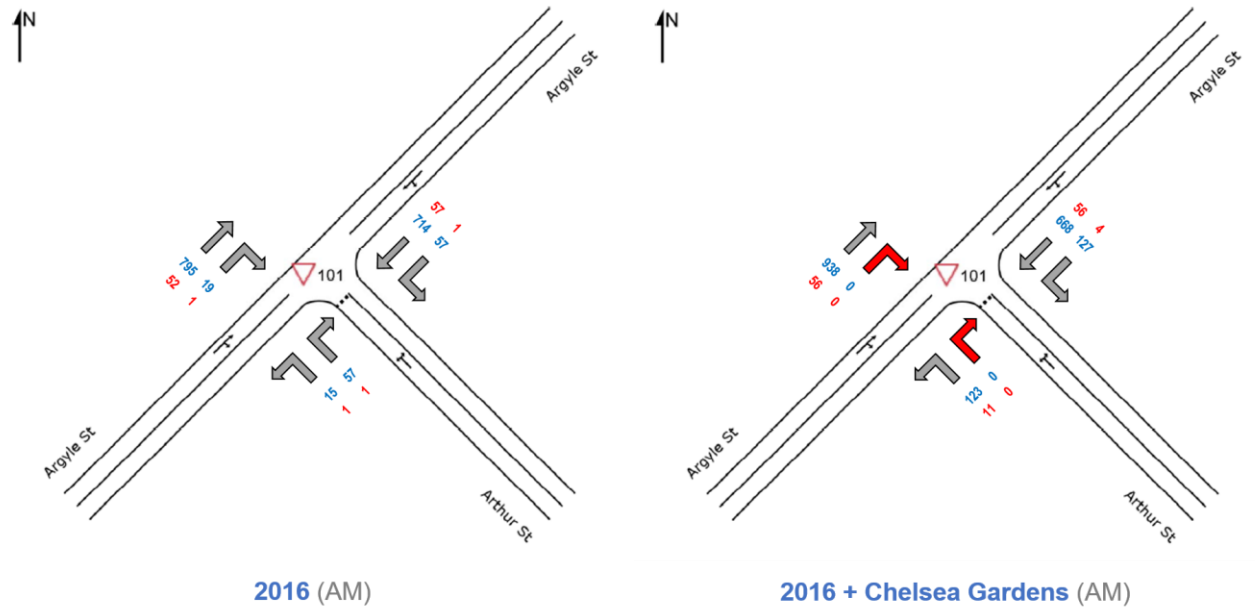


Figure 5-15 Argyle Street / Arthur Street turning volumes (AM)

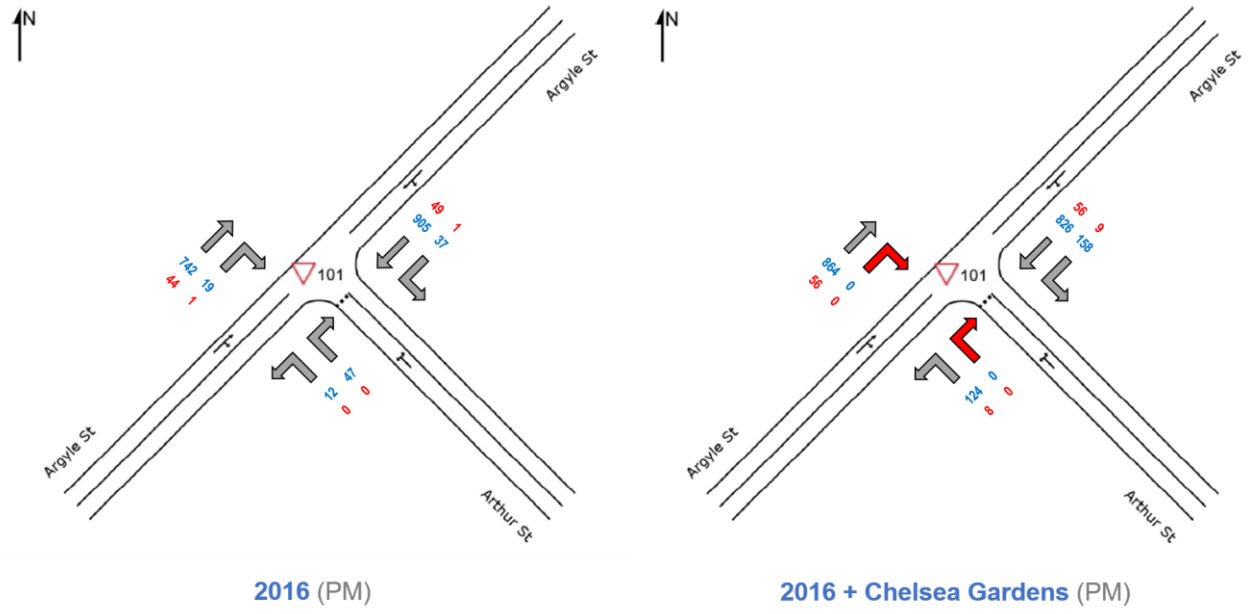


Figure 5-16 Argyle Street / Arthur Street turning volumes (PM)

The introduction of the right turn bans significantly reduces the delay on Arthur Street approaching Argyle Street. Consequently, the left turn movement becomes much more attractive compared to previously-utilised alternatives such as White Street and Spring Street and there is a corresponding increase in volume.

The right turn ban on Argyle Street shifts the small right turn volume to Spring Street or Railway Street. The increase in through traffic can be attributed in part to an increase in the attractiveness of the Argyle Street due to the reduction in congestion associated with these right turning vehicles and due to the shift of approximately 100 right turning vehicles from Arthur Street to Railway Street. These vehicles turn onto Argyle Street earlier than previously which increases the eastbound through movement volumes.

The decrease in westbound through traffic can be explained by Argyle Street reaching saturation with the increase left turning traffic, resulting in vehicles redistributing to parallel routes such as Elizabeth Street. Increases in volume on the other movements are associated with the additional Chelsea Gardens traffic.

5.4.3.3 Argyle Street / White Street

Turning volumes for Argyle Street / White Street for the AM and PM peaks are shown in **Figure 5-17** and **Figure 5-18** respectively. Signal timings were optimised in SIDRA for each scenario which resulted in the phase timings shown in **Appendix B**.

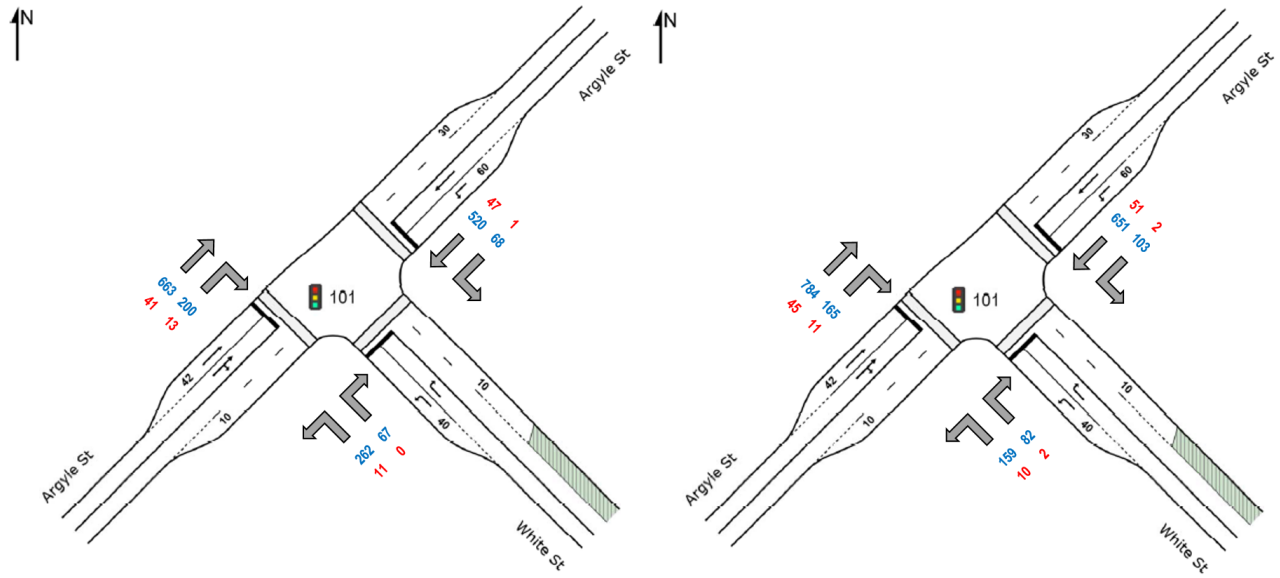


Figure 5-17 Argyle Street / White Street turning volumes (AM)

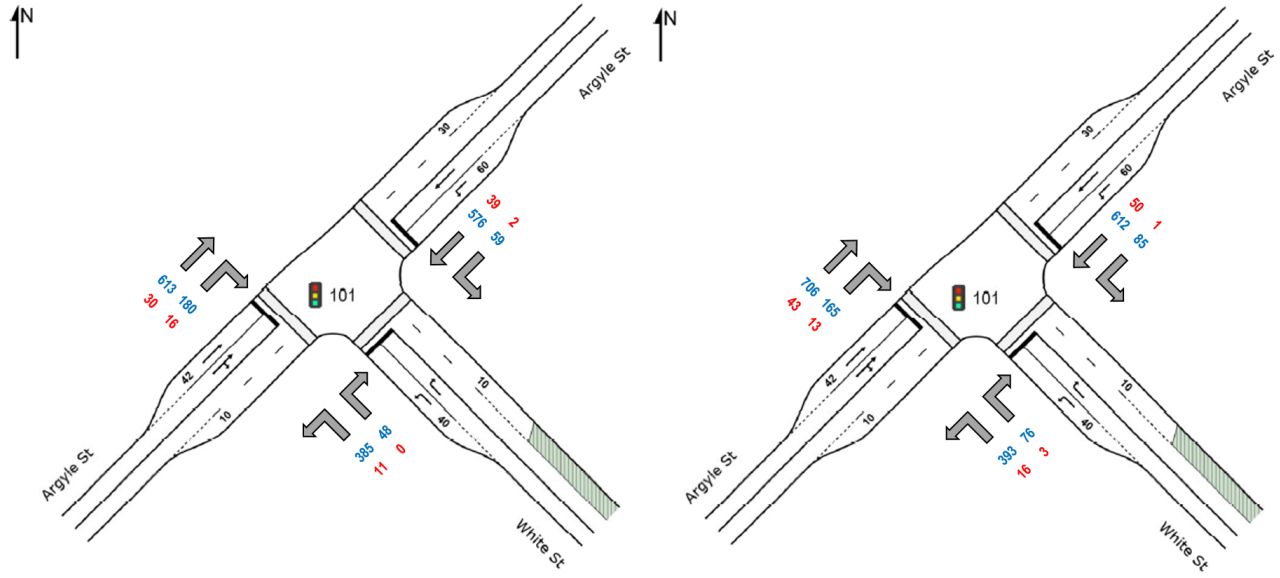


Figure 5-18 Argyle Street / White Street turning volumes (PM)

There is an increase in right turning vehicles out of White Street due to the right turn ban at Argyle Street / Arthur Street. Increases in volume on the other movements are associated with the additional Chelsea Gardens traffic.

5.4.3.4 Argyle Street / Illawarra Highway / Suttor Road

Turning volumes for Argyle Street / Illawarra Highway / Suttor Road for the AM and PM peaks are shown in **Figure 5-19** and **Figure 5-20** respectively.

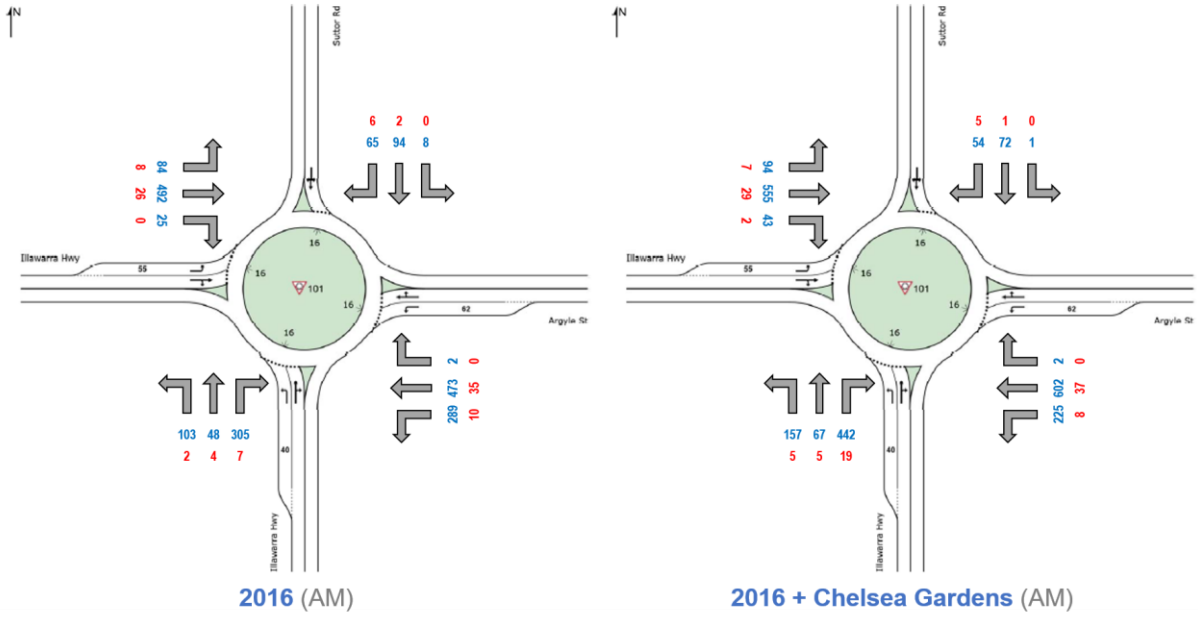


Figure 5-19 Argyle Street / Illawarra Highway / Suttor Road turning volumes (AM)

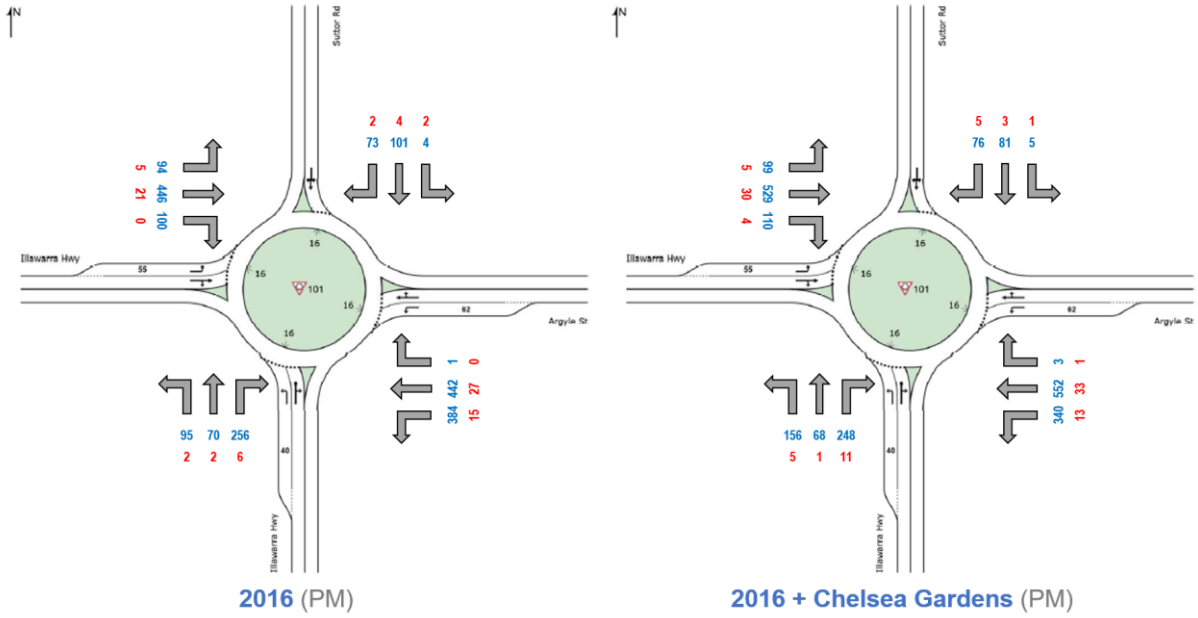


Figure 5-20 Argyle Street / Illawarra Highway / Suttor Road turning volumes (PM)

Cardno previously identified a deficiency of the base model was its inability to properly replicate the number of vehicles using the left turn from Argyle Street into Illawarra Highway (as documented in **Section 4.2**). The route choice described previously does not exist in the 2016 + Chelsea Gardens scenario, most likely because the right turn from Illawarra Highway to Elizabeth Street is made more difficult by a significant increase in opposing traffic due to Chelsea Gardens. Therefore, these additional vehicles should be taken into consideration when comparing volumes on these turns.

Although the model results indicate an apparent decrease in left turning vehicles from Argyle Street to Illawarra Highway by approximately 40-60, in reality this can be seen as approximately a 50 vehicle increase once the consequence of this unrealistic route choice is incorporated into the analysis. These vehicles shift to the through movement which partially accounts for the substantial increase of this movement.

The introduction of the Chelsea Gardens development, accessible via the Illawarra Highway, causes an imbalance in flows at this roundabout. While previously the dominant flow directions were east-west and west-east, the introduction of the additional right turning vehicles in the morning peak causes three dominant and conflicting movements. This results in a deterioration of performance in the morning peak to Level of Service D or E.

5.4.3.5 Argyle Street / Fitzroy Road

Turning volumes for Argyle Street / Fitzroy Road for the AM and PM peaks are shown in **Figure 5-21** and **Figure 5-22** respectively.

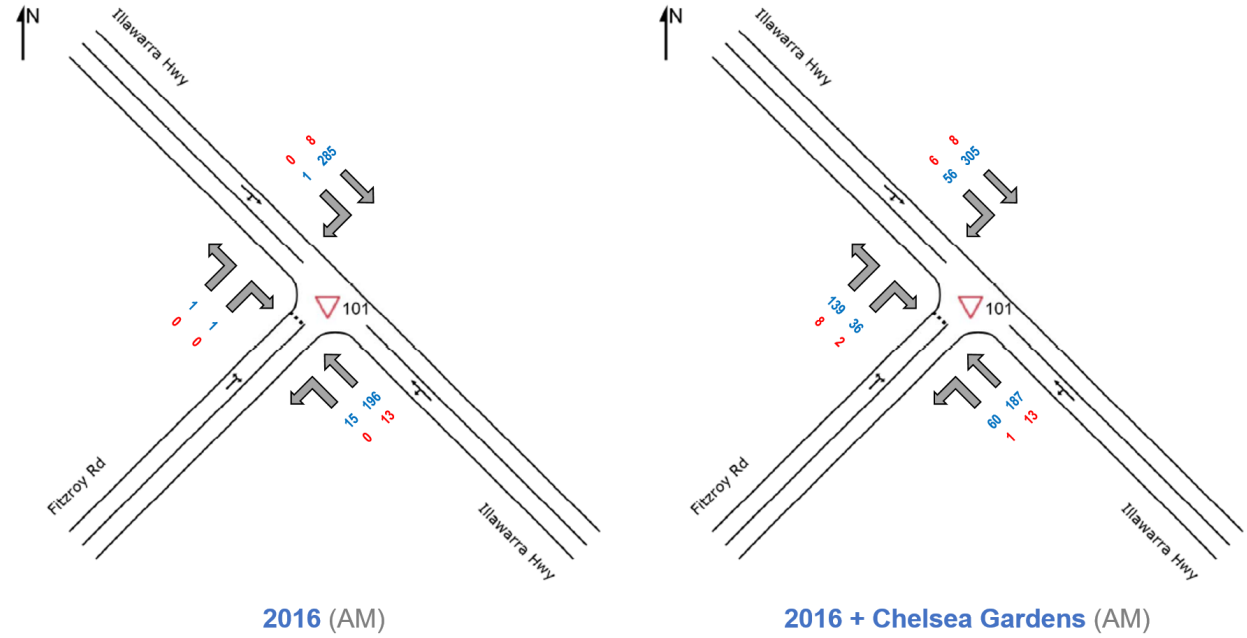


Figure 5-21 Argyle Street / Fitzroy Road turning volumes (AM)

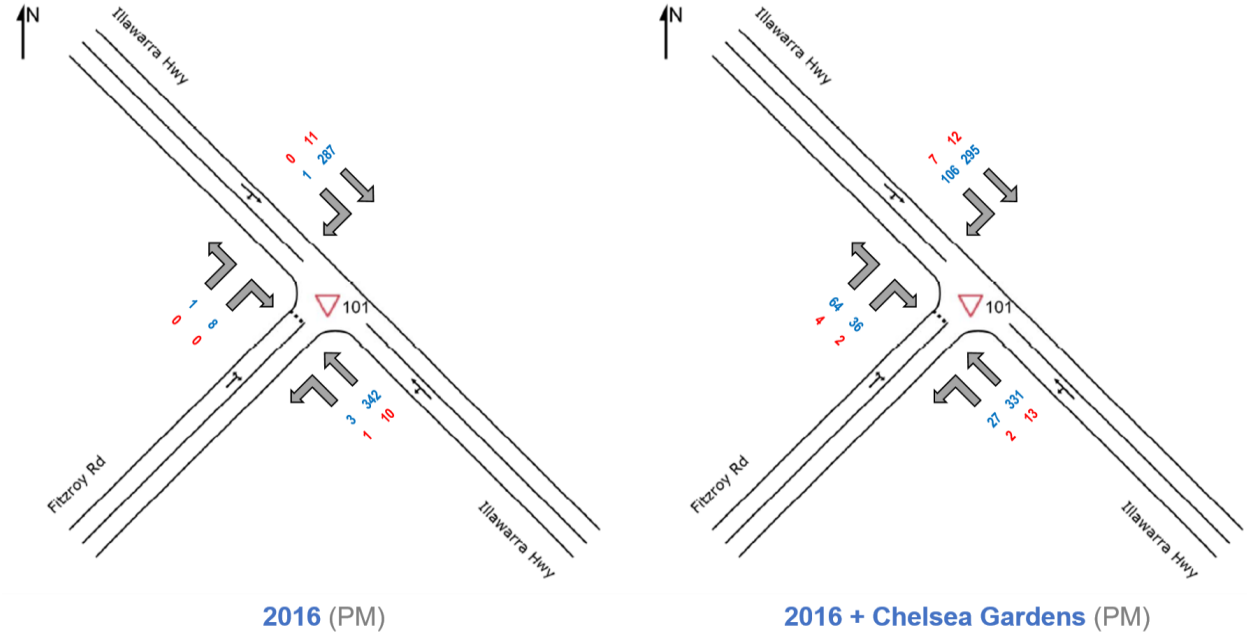


Figure 5-22 Argyle Street / Fitzroy Road turning volumes (PM)

Increase in volumes on Fitzroy Road and turning into Fitzroy Road from Illawarra Highway are directly related to the development traffic. Utilisation of the North East Road is approximately 200 vehicles per hour in each direction during the peaks with vehicles distributed between Illawarra Highway and Narellan Road.

5.5 Summary of findings

- The addition of Chelsea Gardens full yield (1200 lots) traffic to the 2016 base scenario provides an indication of the locations impacted solely by the additional development traffic.
- Modelling results indicate that the North East Road is required to provide alternative access to Chelsea Gardens that does not add traffic to the CBD sections of Argyle Street that are already approaching capacity.
- Minor intersection upgrades (right turn bans) at Argyle Street / Arthur Street on the Arthur Street and western Argyle Street approaches are required to improve traffic flow on Argyle Street and mitigate the impact of additional traffic from Chelsea Gardens.
- Because of the right turn ban, vehicles are redistributed primarily to Argyle Street / White Street where additional phase timing to these movements can mitigate any impacts of the increased demand. This intersection performs at a level similar to the 2016 base case with the additional flow.
- The Argyle Street / Illawarra Highway roundabout performs near or at capacity with the full development.
- As the development is staged, impacts to the roundabout will be progressive, not immediate.
- A solution such as roundabout metering could improve the performance of this intersection in the medium to long term by addressing delays.
- If the Stage 1 Moss Vale Bypass is implemented, it is likely that the roundabout metering could be removed and the roundabout returned to its existing layout.
- It is not necessary to remove any parking in the CBD for the mitigation measures proposed for this scenario.

6 Future model development

6.1 Overview of staged modelling

Based on comments received from Council, Cardno undertook future staged modelling to determine the likely traffic state in the short term, medium term and long term. Future year horizons were selected to maintain consistency with the WSC TRACKS model as shown in **Table 6-1**.

Table 6-1 Future assessment periods

Future assessment period	Assessment year
Base	2016
Short term	2021
Medium term	2026
Long term	2031
	2036

For each future year, Cardno:

- Estimated the future year demand by combining the growth rates from the WSC TRACKS model with the 2016 base demand matrices
- Began by assuming no additional infrastructure upgrades from the previous scenario
- Identified deficiencies within the network based on intersection performance, link performance and observed traffic behaviour
- Proposed mitigation measure/s to restore the traffic state to an acceptable performance level.

While undertaking the future modelling, Cardno has remained mindful of the relevant stakeholders including local residents, workers and local businesses. Council indicated their preference to minimise the removal or restriction of parking in the CBD as much as possible and minimise the increase of flows on local roads where possible.

The following sections outline the assumptions and results of the staged modelling:

- **Section 6** Overview of the staged modelling procedure, explanation of future land uses and major infrastructure assumptions
- **Section 7** Results and proposed mitigation measures for the short term (2021) scenario
- **Section 8** Results and proposed mitigation measures for the medium term (2026) scenario
- **Section 9** Results and proposed mitigation measures for the long term (2031/36) scenarios
- **Section 10** Summary of the findings of this report, including a summary of the staged future modelling process.

6.2 Land use and demand scenario testing

This section provides a high-level summary based on the land use assumptions (households and jobs) of the Wingecarribee Shire Council (WSC) strategic models for the Moss Vale study area and large developments outside this area which are likely to have traffic impacts within Moss Vale. The strategic model land use assumptions were last interrogated in October 2018.

Table 6-2 lists the estimated residential development in household numbers (HH) for the identified growth areas in WSC across 5 year increments. This list focuses on locations in which a minimum of around 100 household projections were identified. The TRACKS Zone locations are shown in **Appendix C**.

Table 6-2 Wingecarribee Strategic TRACKS Model household land use assumptions.

TRX Zone (Strategic Model)	Name	DPE 2016 HH Est	DPE 2021 HH Est	DPE 2026 HH Est	DPE 2031 HH Est	DPE Tot 2036 HH Est
844	Broughton Street	42	187	200	200	200
1150	Renwick	210	364	390	390	390
1155	Retford Park	0	141	151	151	151
1160	Chelsea Gardens	0	280	695	1,111	1,526
1175	Moss Vale Enterprise Corridor	0	0	114	229	343
1199	Nattai Ponds	39	119	213	213	213
1201	Braemar Garden World	0	23	52	81	110
1156	Narellan Road & Fitzroy Road	0	70	75	75	75

Data source: WSC TRACKS model (Stantec, interrogated October 2018).

Chelsea Gardens is the largest development in the area by a significant margin when compared to the other two developments (Broughton Street and Narellan Road), both expected to be fully developed by 2026.

Table 6-3 summarises job growth in the area. This is assumed to be distributed using pro-rata around the WSC area except for the major developments in the Enterprise Zone (Moss Vale Enterprise Corridor) and the Northern Gateway. There is not expected to be a significant amount of employment within the Chelsea Gardens development.

Table 6-3 Wingecarribee Strategic TRACKS Model employment land use assumptions.

TRX Zone (Strategic Model)	Name	2016 Total Jobs	2021 Total Jobs	2026 Total Jobs	2031 Total Jobs	2036 Total Jobs
1174	Northern Gateway (Berrima Road)	0	87	196	306	416
1175	Moss Vale Enterprise Corridor	0	82	186	290	394

Data source: WSC TRACKS model (Stantec, interrogated October 2018).

6.3 Infrastructure assumptions

This section outlines the major infrastructure assumptions which are referred to in the following sections:

- Stage 1 Moss Vale Bypass
- North East Road
- Chelsea Gardens development.

The locations of these within the Moss Vale study area are shown in **Figure 6-1**.

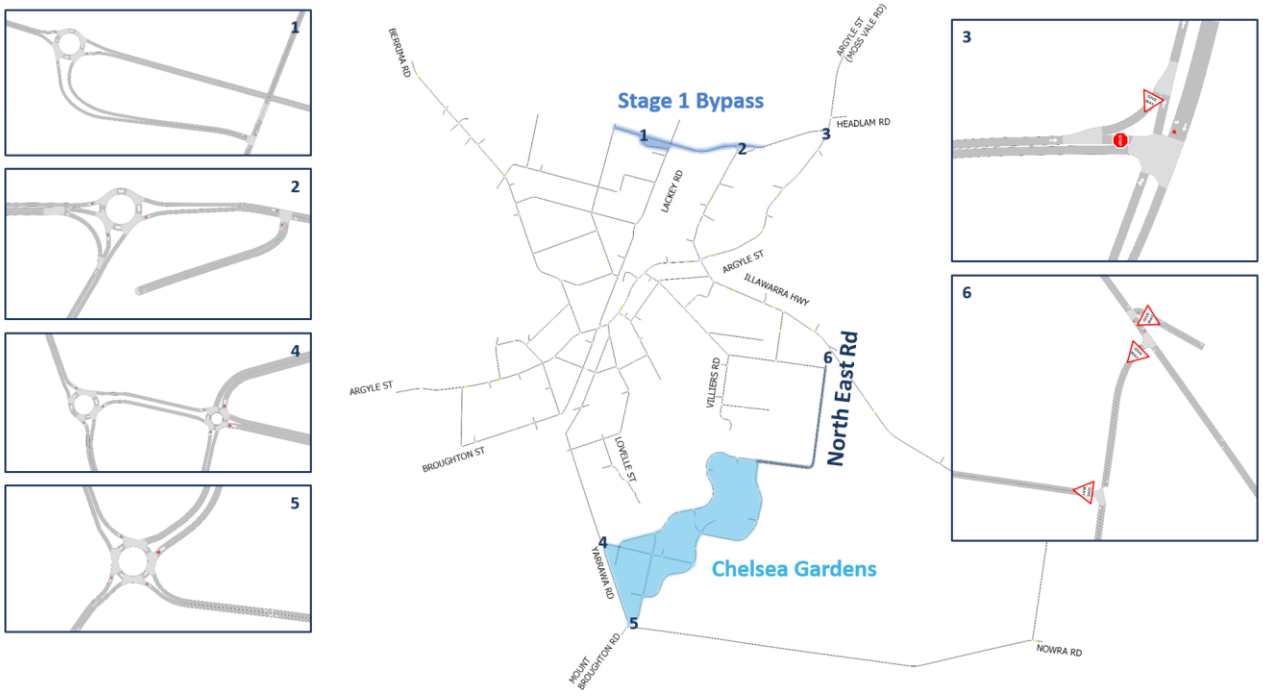


Figure 6-1 Major infrastructure assumptions

For each scenario, beginning with 2021, it was initially assumed that only the infrastructure upgrades from the previous modelled year were carried forward and no other infrastructure upgrades were implemented. Based on the modelling results for each year, additional mitigation measures were proposed at key locations and the below major upgrades were included when required.

6.3.1 Chelsea Gardens development

The Chelsea Gardens development, road layout and network connectivity remains as described in **Section 5.3.1**.

6.3.2 North East Road

The North East Road layout and connectivity remains as described in **Section 5.3.2**.

6.3.3 Stage 1 Moss Vale Bypass

The Stage 1 Moss Vale Bypass is a possible future road connection between Suttor Road and Beaconsfield Road in north Moss Vale which provides an additional railway crossing bridge and improves connectivity between Argyle Street and development on the western side of the railway line.

Cardno has coded in the model a single-lane road with a speed limit of 70 kilometres per hour between Suttor Road and Beaconsfield Road. This is consistent with the data received from Stantec for the 2036 TRACKS model. Intersections at Suttor Road and Beaconsfield Road are single-lane roundabouts as per the TRACKS model. The bypass involves a new railway overbridge which also passes over Lackey Road and McCourt Road. Connection to Lackey Road has been provisioned by an offset single-lane roundabout.

The alignment and posted speed limit on the bypass are shown in **Figure 6-2**.

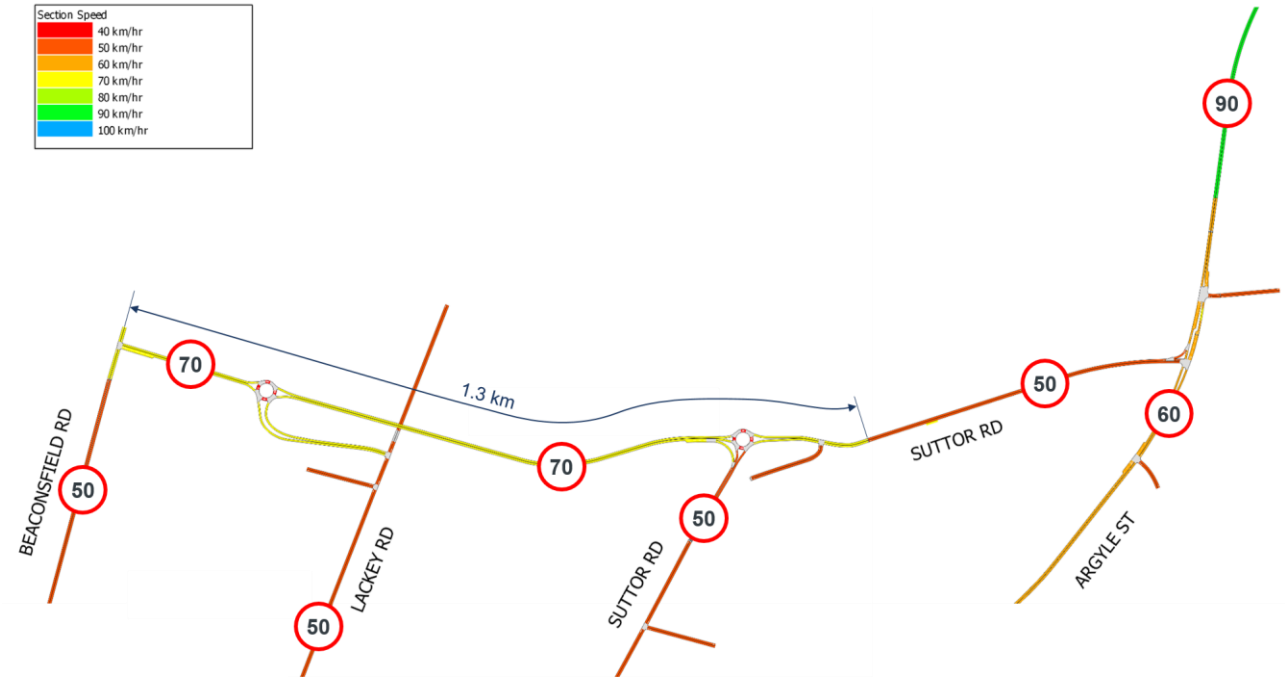


Figure 6-2 Moss Vale Bypass alignment and posted speed limit

6.4 Future demand development

The future year demands adopted in the future year modelling are based on the land use assumptions outlined in **Section 6.2**. A subarea cordon was defined in the TRACKS model consistent with the Aimsun study area and was used to provide origin-destination (OD) matrices for all vehicles. The light-heavy vehicle split was assumed to remain constant across all future years.

For each future year, the OD matrix was extracted from the TRACKS model and the 2016 to future year growth rate was determined. The TRACKS model is based on a fully-developed yield of 1526 lots for Chelsea Gardens. However, the number of lots under the current subdivision plans totals less than 1200. The future-year traffic generation for Chelsea Gardens centroids was therefore scaled down proportionally, according to the values shown in **Table 6-4**.

Table 6-4 Comparison of Chelsea Gardens ultimate-year yields for TRACKS and Aimsun models and trip scale factors

	TRACKS	Reduced yield (Aimsun)	Chelsea Gardens trip reduction factor
2016	0	0	100%
2021	280	280	100%
2026	695	695	100%
2031	1111	900	81.0%
2036	1526	1200	78.6%

In each case, the 2016 to future year TRACKS growth was added to the 2016 base demand to produce a future year adjusted demand. This was then profiled according to the observed 2016 traffic profile and split into light and heavy vehicles based on the surveyed light-heavy vehicle split. The demand estimation procedure is shown in **Figure 6-3**.

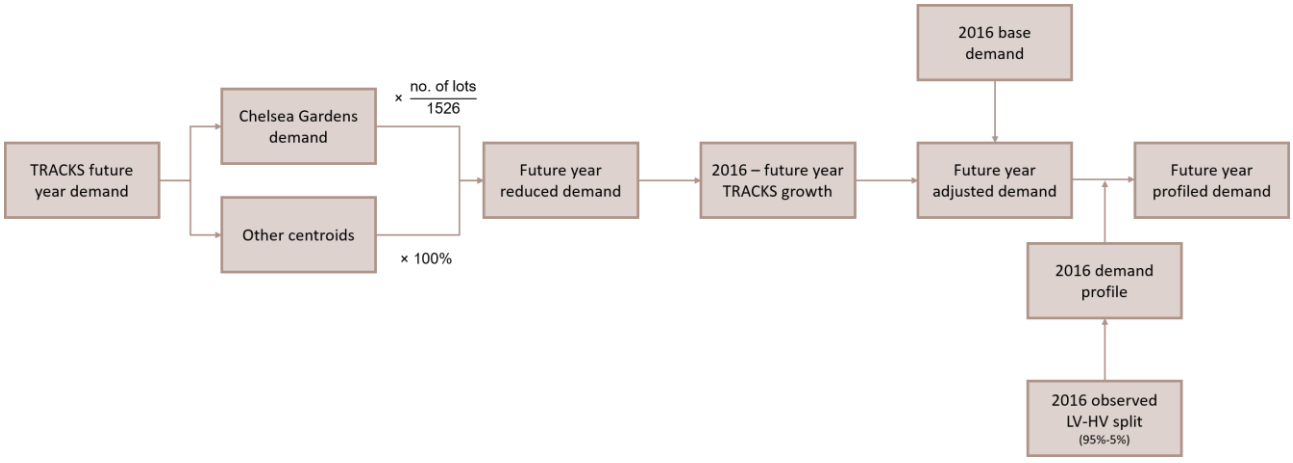


Figure 6-3 Future year demand estimation procedure

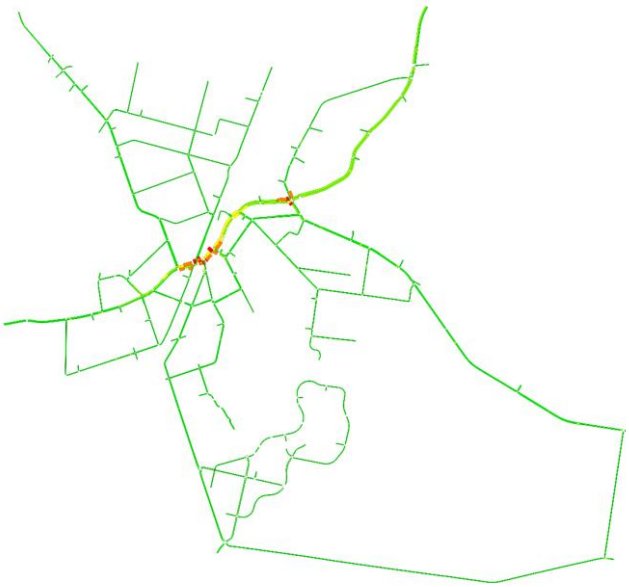
7 Short term (2021) assessment

Short term modelling was undertaken based off the strategic demands for 2021 which included background growth, other development growth and 280 lots for Chelsea Gardens. Based on an analysis of the traffic flow and density patterns, the North East Road and Stage 1 Moss Vale Bypass were deemed to not be required in the short term and were therefore excluded from the analysis.

7.1 Results

Initially, the short term assessment was undertaken assuming no infrastructure upgrades to assess the impact of 2016-2021 growth on the base network.

Figure 7-1 and **Figure 7-2** show the performance of the network in 2021 absent any upgrades for the AM and PM peaks respectively.



2021 without upgrades (AM)

Figure 7-1 Network density for 2021 (AM) without upgrades

2021 without upgrades (PM)

Figure 7-2 Network density for 2021 (PM) without upgrades

The network density plots highlight the following deficiencies in the network:

- Queues and delays on Arthur Street and Railway Street as vehicles do not have sufficient gaps on Argyle Street into which to turn
- Right turning vehicles exceeded the available storage on Argyle Street and block through traffic
- Left turn movement out of White Street exceeds available storage and blocks right turning vehicles.

Based on these results, the following mitigation measures are suggested:

- Restrictions on 6 spaces on Argyle Street westbound approaching Argyle Street / Waite Street to provide a dedicated right turning bay
- Restrictions on 7 spaces on Argyle Street eastbound approaching Argyle Street / Arthur Street to provide a dedicated right turning bay
- Dual left turn from White Street into Argyle Street, requiring restrictions on 6 spaces on Argyle Street westbound after Argyle Street / White Street to accommodate the merge
- Right turn bans at Argyle Street / Railway Street from Argyle Street eastbound and Railway Street
- Right turn ban at Argyle Street / Arthur Street from Arthur Street

The locations of these mitigation measures are shown in **Figure 7-3**. The upgrades aim to increase throughput and reduce delays on Argyle Street by providing right turn bays at intersections where right turning vehicles block the main through traffic if space permits, and removing these right turns if space does not permit.

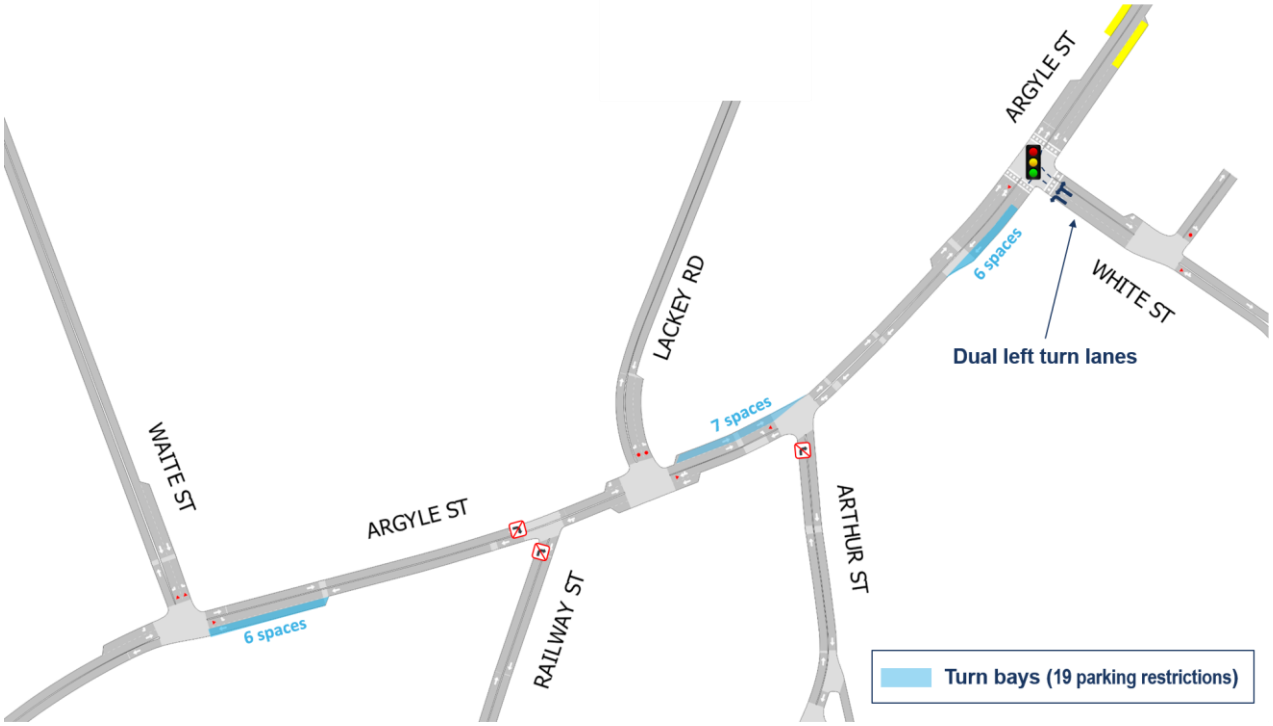


Figure 7-3 Short term (2021) proposed mitigation measures

Figure 7-4 and **Figure 7-5** show the network performance for the AM and PM peaks respectively and **Table 7-1** gives level of service results for key intersections compared to 2016 conditions.

Table 7-1 Level of service results (Aimsun) for key intersections for 2021

	2016		2021 with upgrades	
	AM	PM	AM	PM
Argyle Street / Waite Street	B	B	B	A
Argyle Street / Railway Street	B	D	A	B
Argyle Street / Lackey Road	B	C	C	B
Argyle Street / Arthur Street	D	F	B	B
Argyle Street / White Street	C	D	C	D
Argyle Street / Illawarra Highway	B	B	D	B
Spring Street / Railway Street (incl. underpass)	B	B	A	A

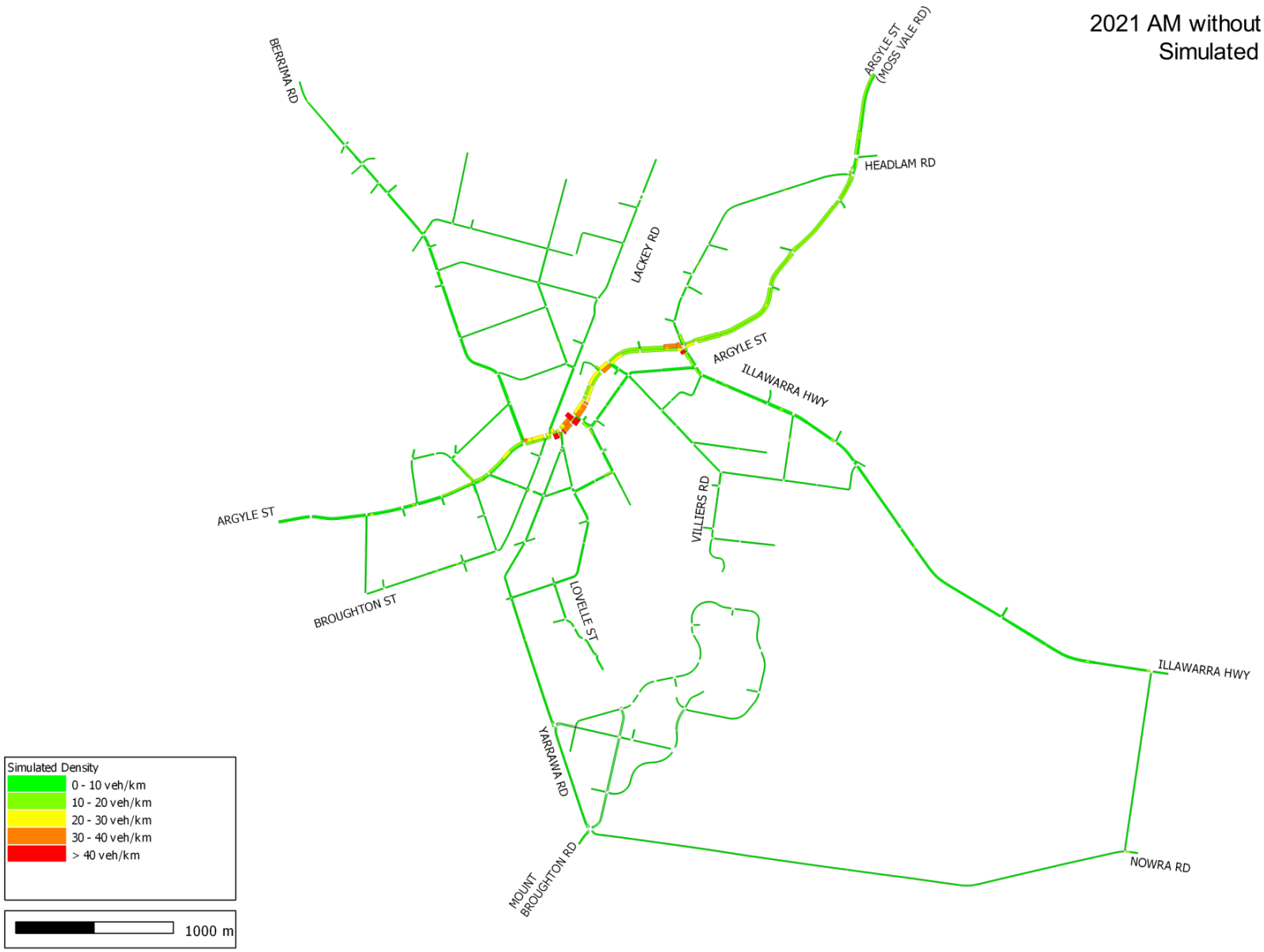


Figure 7-4 2021 with upgrades network density (AM)

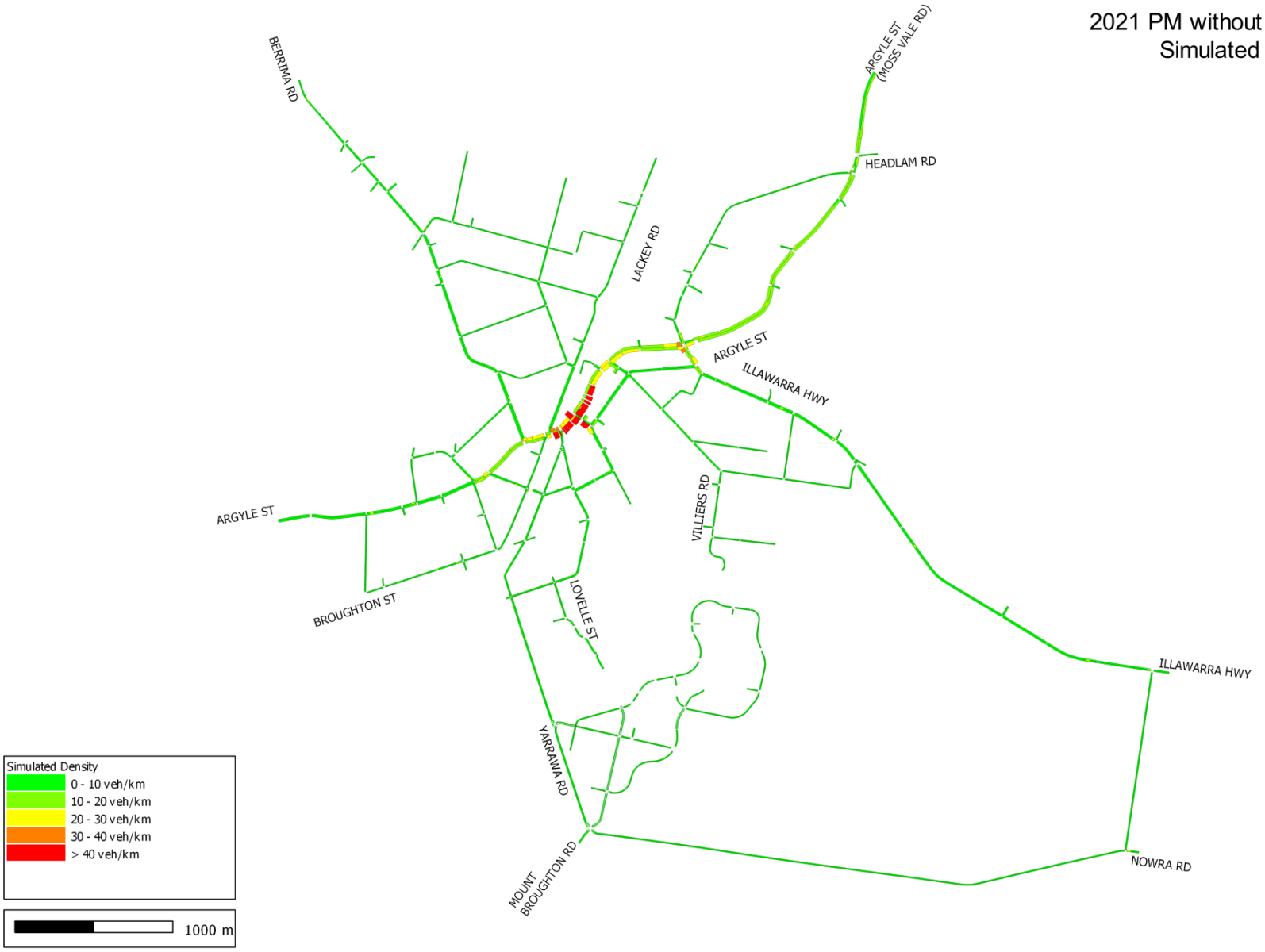


Figure 7-5 2021 with upgrades network density (PM)

The performance of the network with these mitigation measures shows reduced congestion through the CBD area and no major queueing on side roads approaching Argyle Street.

The redistribution of traffic due to the right turn ban from Arthur Street into Argyle Street is shown in **Figure 7-6**. In the 2016 Base Scenario, this right turn was made by an average of 57 vehicles in the AM peak and 47 vehicles in the PM peak. By 2021, following the introduction of 280 Chelsea Gardens lots, the number of vehicles desiring this right turn increases by approximately 80 vehicles in each peak, however the resulting total demand can be absorbed by spare capacity at Railway Street, White Street and Elizabeth Street following the turn ban.

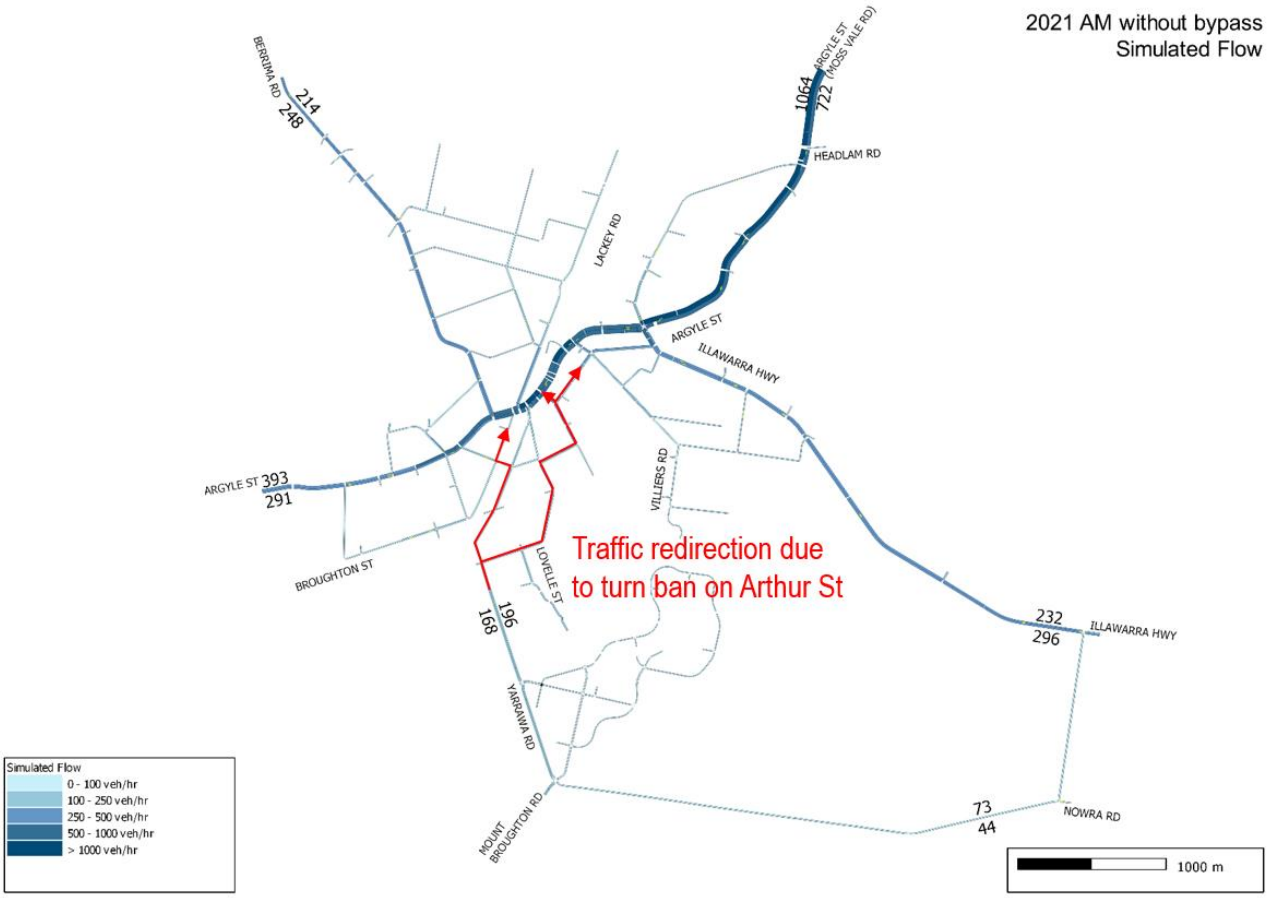


Figure 7-6 Traffic redistribution due to right turn ban at Arthur Street / Argyle Street

7.2 Summary of findings

The key findings for this scenario are:

- The North East Road is not required in the short term based on the conservative scenario in which all traffic travelling to/from Chelsea Gardens uses Argyle Street
- Improvements to the CBD section of Argyle Street and the intersections of Argyle Street / Arthur Street and Argyle Street / Railway Street can be achieved by banning right turns out of Arthur Street and Railway Street onto Argyle Street. Traffic volumes making these turns are low and a shift to other intersections such as Argyle Street / White Street can be accommodated.
- The left turn movement out of White Street is heavier than the right turn movement, however, the left turn pocket is short in length. This results in left turning vehicles blocking vehicles waiting to turn right. Dual left turn lanes (right lane shared with right turn) effectively doubles the storage available for left turning vehicles and significantly improves the LOS of this intersection.

8 Medium term (2026) assessment

Medium term modelling was undertaken based off the strategic demands for 2026 which included background growth, other development growth and 695 lots for Chelsea Gardens. There is significant growth on Argyle Street through the CBD by the medium term which necessitates the introduction of the North East Road to Chelsea Gardens to provide alternate access and remove some vehicles accessing the development from the congested CBD. Although Argyle Street through the CBD is approaching saturation with over 1000 vehicles on some single-lane sections, the Stage 1 Moss Vale Bypass may be deferred but with deterioration of performance of some intersections within the CBD. It was therefore not included in the analysis.

8.1 Results

Congestion in the 2026 network is distributed predominantly along Argyle Street between Illawarra Highway and Waite Street which means that there are no obvious one or two sites to implement mitigation measures. Cardno undertook a detailed analysis of successive upgrades to determine the most optimal for this future horizon.

Two options were developed maintaining upgrades from 2021 and keeping any proposed upgrades compatible with potential post-bypass scenarios to avoid overprovision of infrastructure. Analysis of the performance of the network highlighted the following deficiencies:

- Development and increased traffic demand in the north-western area (Moss Vale Enterprise Corridor) results in heavier right turns in the CBD, particularly on Waite Street and Lackey Road
- Right turning traffic at priority intersections typically causes long queues on Argyle Street as there are limited gaps in the opposing main stream

The infrastructure for the two scenarios outlined in **Table 8-1** are compared in this analysis.

Table 8-1 Comparison of 2026 Option A and Option B

	Option A	Option B
Infrastructure	> Concentrate vehicles accessing north-west Moss Vale (including Enterprise Corridor) to new signalised intersection at Argyle Street / White Street > Right turn ban implemented from Argyle Street into Lackey Road and Lackey Road into Argyle Street > Formalised left turn on Elizabeth Street at Elizabeth Street / Illawarra Highway	> Distribution of vehicles accessing north-west Moss Vale (including Moss Vale Enterprise Corridor) to two new signalised intersections at Argyle Street / Waite Street and Argyle Street / Lackey Road > Right turn ban implemented from Argyle Street into Arthur Street > Formalised left turn on Elizabeth Street at Elizabeth Street / Illawarra Highway
Notes	> Requires restriction of approximately 8 additional parking spaces but new parking spaces may be instated under the railway bridge > Argyle Street / Waite Street signals would require coordination with or removal of signalised midblock pedestrian crossing outside Moss Vale Public School	> Requires no additional removal of parking (compared to 2021 scenario); parking spaces relocated from northern side to southern side of Argyle Street under railway bridge > Possible safety implications of signals under the railway bridge; Warning ("Prepare to Stop") signs would need to be provided on the eastern approach

The infrastructure for the two options are shown in **Figure 8-1** and **Figure 8-2**. The upgrades aim to increase throughput and reduce delays on Argyle Street by providing dedicated and signalised right turns for vehicles accessing north-west Moss Vale including the Moss Vale Enterprise Corridor. This ensures that right turning vehicles do not block the main through traffic stream and have signalised turns to prevent queues from backing up.

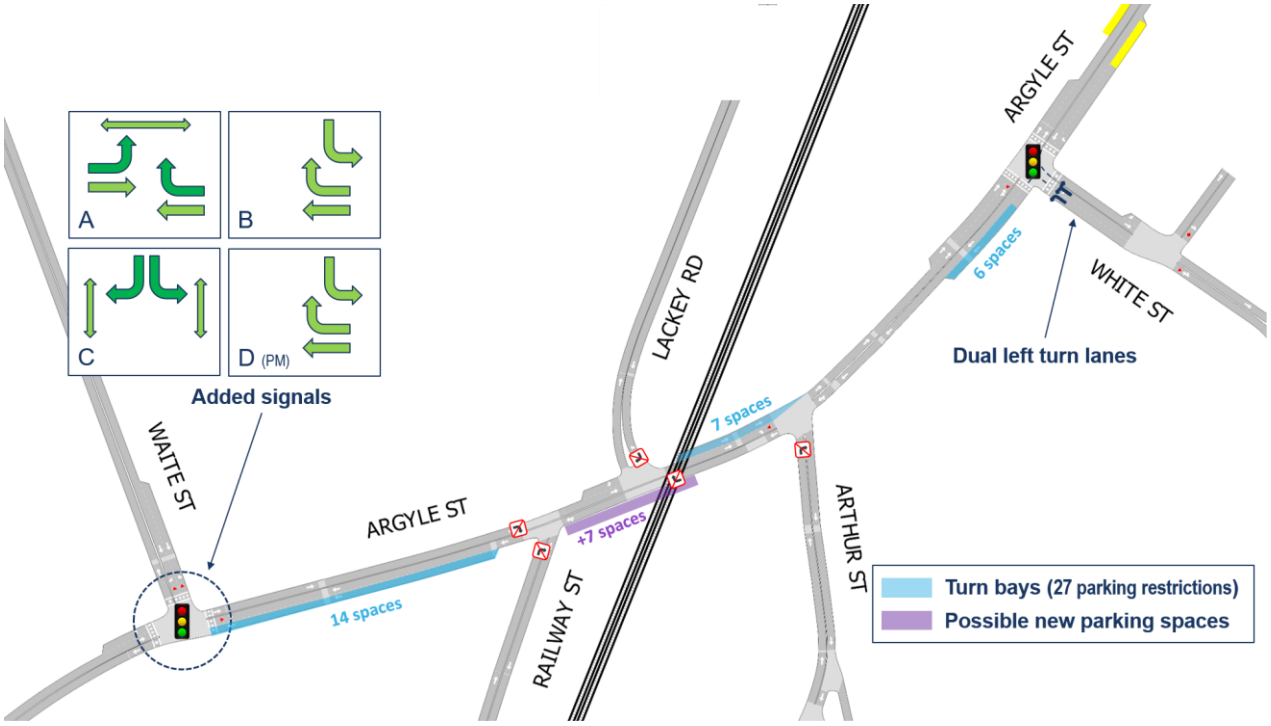


Figure 8-1 2026 Option A infrastructure

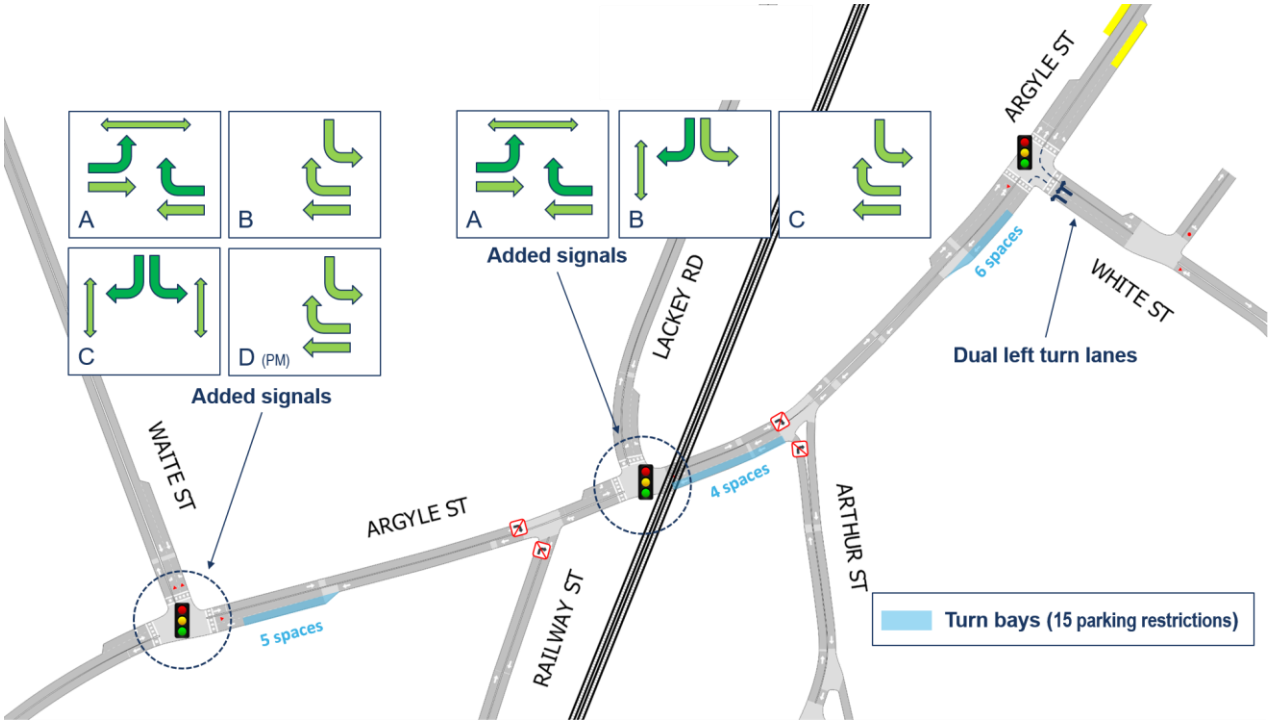


Figure 8-2 2026 Option B infrastructure

Figure 8-3 2026 with upgrades Option A network density (AM)

Figure 8-4 2026 with upgrades Option A network density (PM)

Figure 8-5 2026 with upgrades Option B network density (AM)

Figure 8-6 2026 with upgrades Option B network density (PM)

Table 8-2 gives level of service results for key intersections compared to 2016 conditions.

Table 8-2 Level of service results (Aimsun) for key intersections

	2026 Option A		2026 Option B	
	AM	PM	AM	PM
Argyle Street / Waite Street	C	C	C	B
Argyle Street / Railway Street	B	B	B	B
Argyle Street / Lackey Road	C	A	B	B
Argyle Street / Arthur Street	B	A	B	A
Argyle Street / White Street	C	D	C	D
Argyle Street / Illawarra Highway	E	B	E	C
Spring Street / Railway Street (incl. underpass)	B	A	B	A

The performance of the network with these mitigation measures shows congestion in the CBD mostly contained between Waite Street and Valetta Street. Although the traffic density is heavy, intersection performance is still acceptable in most cases. Turn bans in the CBD greatly reduce stop-start traffic motion and improve the overall flow. Queueing is generally contained within dedicated turn bays.

Note that the implementation of signals changes the Level of Service calculation so that the worst approach is no longer reported in favour of the weighted average delay which makes the performance of Argyle Street / Waite Street and Argyle Street / Lackey Road appear comparable to the previous years although queues on side streets remain similar in length and delay time to the 2021 scenario.

High turn volumes on Illawarra Highway approaching the Argyle Street / Illawarra Highway roundabout conflict with the already-heavy movements on Argyle Street causing an imbalance in flows. The performance of this roundabout was LOS E by 2026 without substantial mitigation measures. Although not included in the modelling, it is likely that the performance of this roundabout would improve with mitigation measures such as roundabout metering which would act to even out the approach delays. Signalisation of this intersection was not considered as the long term post-bypass scenarios show that the roundabout has sufficient capacity once the Stage 1 Moss Vale Bypass is opened. Roundabout metering could provide a sufficient interim solution until this point.

Note that signals in the microsimulation were coded as fixed so do not adapt to the traffic state. It is likely that there would be an improvement in performance with actuated signals that can react to the traffic flow conditions.

8.2 Summary of findings

The key findings of this scenario are:

- North East Road is required by this horizon to alleviate congestion on local roads connecting to Argyle Street
- Option A impacts approximately 27 parking spaces (compared to existing conditions) compared to 15 for Option B, but Option A is a better option to retrofit once the Stage 1 Bypass is operational (due to fewer redundant upgrades)
- There are safety concerns associated with the potential installation of traffic signals next to the railway bridge and resulting sight distances
- Parking can be reinstated and turn bans removed once the bypass is opened.
- Option A and Option B result in similar operational performance for intersections within the CBD.

9 Long term (2031-2036) assessment

Long term modelling was undertaken based off the strategic demands for 2031 and 2036 which included background growth, other development growth and 900 and 1200 lots, respectively, for Chelsea Gardens.

By 2031, significant growth through Argyle S results in queues filling the dedicated turn bays and failure of the Argyle Street / Illawarra Highway roundabout (LOS F). Argyle Street is past the saturation point which results in long queues and delays. Preliminary modelling indicated that without an alternate railway crossing, the concentration of traffic associated with the bottleneck under the railway bridge at Argyle Street could not be prevented from reaching critical levels. Long term modelling indicates that the Stage 1 Moss Vale Bypass is required by 2031 and was included in both the 2031 and 2036 scenarios.

Given the two options for 2026 and the long term scenarios involve a major infrastructure change, the network was restored to 2016 infrastructure for the long term analysis. This is not a recommendation to remove signals implemented in the short or medium term, but pending endorsement of the preferred option, Cardno deemed it appropriate to remove all proposed upgrades for the long term analysis. This means that the results of this scenario likely represent a worse traffic state in the CBD than would be realistic given that these upgrades would be retained.

A major benefit of the bypass is that it allows for the reconfiguration of the CBD to remove turning bans and reinstate parking.

9.1 Results

The long term assessment was undertaken initially with the 2026 upgrades in situ to determine whether the network could function without the Stage 1 Moss Vale Bypass by 2031. The network density is shown in **Figure 9-1** and **Figure 9-2** respectively for the AM and PM peaks.

2031 without Stage 1 Moss Vale Bypass (AM)

Figure 9-1 Network density for 2031 (AM) with 2026 proposed upgrades

2031 without Stage 1 Moss Vale Bypass (PM)

Figure 9-2 Network density for 2031 (PM) with 2026 proposed upgrades

An analysis of the flows through the CBD section showed that the number of vehicles desiring to use the single lane section of Argyle Street through the CBD was as high as 1200 for some sections. This exceeds the theoretical capacity of a single lane road, particularly with street-side parking. Cardno understands that removal of parking through the CBD to provide a two-lane section for Argyle Street is not an acceptable mitigation measure. Consequently, it was not possible to restore the network to an acceptable level of performance by intersection upgrades alone in the long term, necessitating the implementation of the Stage 1 Moss Vale Bypass.

The implementation of the Stage 1 Moss Vale Bypass has a significant impact on the Moss Vale CBD. Flows on the bypass are shown in **Table 9-1**.

Table 9-1 Flows on Stage 1 Moss Vale Bypass

	2031 with bypass		2036 with bypass	
	Eastbound	Westbound	Eastbound	Westbound
AM	325	362	400	433
PM	473	342	562	433

Given that Moss Vale only has one major railway crossing, the above volumes previously all would have used Argyle Street without the introduction of the bypass. Hence, the bypass provides a reduction of approximately 800 – 1000 vehicles on Argyle Street in both directions for each peak. This significant reduction frees up additional capacity on Argyle Street and modelling indicates a return to 2016 conditions or better for 2031.

Figure 9-3 and **Figure 9-4** show the network performance for 2031 'With Bypass' scenario for the AM and PM peaks respectively. **Figure 9-5** and **Figure 9-6** show the network performance for 2036 'With Bypass' scenario for the AM and PM peaks respectively. Level of service results for both years are shown in **Table 9-2**.

Table 9-2 Level of service results (Aimsun) for key intersections for 2031 'With Bypass' and 2036 'With Bypass'

	2031 with bypass		2036 with bypass	
	AM	PM	AM	PM
Argyle Street / Waite Street	**C**	**B**	**D**	**B**
Argyle Street / Railway Street	**C**	**E**	**C**	**E**
Argyle Street / Lackey Road	**C**	**C**	**C**	**D**
Argyle Street / Arthur Street	**D**	**E**	**E**	**E**
Argyle Street / White Street	**B**	**C**	**B**	**C**
Argyle Street / Illawarra Highway	**B**	**B**	**C**	**B**
Spring Street / Railway Street (incl. underpass)	**B**	**B**	**B**	**B**

Minor mitigation measures in the form of 35 metre left turn bays on Railway Street and Arthur Street were implemented for these scenarios to ensure that volumes on these approaches flush through by the end of the simulation.

Note that although Argyle Street / Railway Street and Argyle Street / Arthur Street perform at LOS E, these results are without the infrastructure upgrades outlined for previous future modelling years. It is likely that these intersections could be improved substantially if modelling were undertaken with these previously-identified mitigation measures.

Figure 9-3 2031 with bypass network density (AM)

Figure 9-4 2031 with bypass network density (PM)

Figure 9-5 2036 with bypass network density (AM)

Figure 9-6 2036 with bypass network density (PM)

9.2 Summary of findings and implementation strategy

Cardno undertook staged modelling to determine the likely traffic state of the network in the short term, medium term and long term. Future year horizons were based on the WSC TRACKS data. The analyses included all growth from the Chelsea Gardens development, other developments in the area and background growth on top of the base demand.

In the short term, minor improvements to the CBD are required which are suggested to include:

> Restriction of some parking spaces to provide dedicated right turn lanes so that right turning traffic does not obstruct through traffic on Argyle Street

> Right turn bans at Argyle Street / Arthur Street and Argyle Street / Railway Street

> Dual left turn lanes for White Street at Argyle Street / White Street to more quickly clear traffic and prevent the left turning vehicles from exceeding the storage available and blocking the right turn movement.

In the medium term, 1-2 signalised intersections in the CBD are required to accommodate relatively high volumes of right turning traffic accessing north-west Moss Vale and the Enterprise Corridor. This necessitates the restriction of some parking spaces to provide right turn lanes at the signalised intersections. Roundabout metering or other control system may be required at the Argyle Street/ Illawarra Highway roundabout in the medium term to manage demands.

Previous modelling indicated that without infrastructure upgrades or Chelsea Gardens, but including other development and background growth, the Moss Vale CBD experiences significant traffic congestion and delays by 2036 (**Future Modelling Report**, Cardno, 4 February 2019). The Stage 1 Moss Vale Bypass is required to mitigate CBD traffic congestion by 2036 even without Chelsea Gardens. The forecast vehicle demand for Argyle Street through the CBD exceeds the theoretical capacity of a single-lane road with parking

The Stage 1 Moss Vale Bypass provides an alternate route for vehicles to cross the railway line and would also provide broad traffic benefits for Moss Vale resulting in a reduction of approximately 1000 vehicles on Argyle Street in the AM and PM peaks by 2036. This would improve traffic conditions, amenity and intersection performance while retaining existing parking provisions

Figure 9-7 presents the staged implementation strategy based on modelling results for the baseline (no Chelsea Gardens) and 2021 to 2036 scenarios (with Chelsea Gardens).

Figure 9-7 Staged implementation strategy

10 Assumptions and limitations

Demand assumptions/adjustment

Although the TRACKS model which was used to generate the demand matrices is capable of providing data for light and heavy vehicles, the process of separating the two vehicle types is time consuming. The creation of subarea matrices was estimated by Stantec to increase the time required for demand estimation by threefold as the matrices need to be broken up to assign each to the model and then tracked separately to produce sub-area matrices.

Cardno commissioned intersection counts and OD surveys. This data was used to estimate the vehicle splits across the network which was then split into heavy vehicles from the TRACKS demand matrices. It was observed that heavy vehicles comprised approximately five per cent of vehicles during the peak periods. As the heavy vehicle proportion was estimated using survey data, it is likely to be acceptably realistic and therefore unlikely to negatively affect the model results.

Exclusion of surveyed intersection

Due to a surveying error, Intersection 6 (Illawarra Highway / Farnborough Dr) was not surveyed on the same day as the remaining intersections. Consequently, the data received was inconsistent with the counts of neighbouring intersections. As turning movement flows were observed to be comparatively minor, it was excluded from the real data set for the model. This is not likely to effect the calibration as the very small flows would likely result in a GEH less than 5.0.

Exclusion of midblock signalised intersection

The signalised pedestrian crossing on Argyle Street outside Moss Vale Public School was excluded from the model as the red phase is only triggered by pedestrians and was observed to be infrequent and irregular. Due this this infrequency, it is not considered likely to significantly impact on travel times.

Fixed signal timings

Signals in the microsimulation were coded as fixed so do not adapt to the traffic state. It is likely that there would be an improvement in performance with actuated signals that can react to the traffic flow conditions.

Turn count calibration

As outlined in **Section 4.2**, three turns on a single alternate route in the model during the PM period have a GEH exceeding 10.0. This is due to approximately 100 additional vehicles using the alternate route in the model during the PM period than were observed. The GEH for this route is not substantially above the required value of 10.0 and the alternate route has a relatively-low traffic flow of 100 additional vehicles which is not likely to significantly impact the model. This should be considered when examining future year flows for this intersection.

Chelsea Gardens trip reduction

Future modelling was undertaken based on an ultimate yield of 1200 lots for Chelsea Gardens. The Wingecarribee Shire Council (WSC) TRACKS strategic model used to extract the demands is based on 1526 lots. Cardno scaled down the trips from Chelsea Gardens pro rata for the 2016 + Chelsea Gardens and long term staged modelling scenarios. As Chelsea Gardens is mainly a residential development, a pro rata trip reduction is considered appropriate.

SIDRA modelling

SIDRA models were based on volumes extracted from Aimsun for the 2016 and 2016 + Chelsea Gardens scenarios. Base models used default parameters and were then calibrated to match observed conditions. Opposing pedestrian gap time of six seconds was applied to the signalised intersection of Argyle Street / White Street to represent the late start during pedestrian phases. School zones (40 km/hr) were adopted at all times for the SIDRA models where appropriate as both peak hours overlap at least partially with school zone times.

Future options

Future options were based on Cardno's assessment of deficiencies in the current and future transport network and were not endorsed by Roads and Maritime or Council prior to implementation in the model.

11 Summary and recommendations

This section provides a summary of the findings and recommendations of this report.

11.1 Base model development, calibration and validation

The base model was calibrated and validated according to the procedure outlined in the *Traffic Modelling Guidelines* (Roads and Maritime, 2013):

- Analysis of the AM and PM vehicle hours travelled (VHT) shows that the models are consistent and sufficiently independent across the five different seed values
- The base model demonstrates an acceptable level of calibration with at least 88 per cent of turns having a GEH < 5.0 and 99 per cent of turns having a GEH < 10.0
- An alternate route was identified for vehicles between the Argyle Street / Illawarra Highway roundabout and Argyle Street / Valetta Street. Approximately 100 modelled vehicles divert via Elizabeth Street which was not observed in the survey counts. This alternate route was not considered to adversely affect the performance of the base model, however consideration should be given to this when comparing the base and future performance of these intersections and sections
- The base model was validated using travel time routes and all routes were within the greater of 15 per cent or one minute of the modelled travel time for both peaks

The base model was submitted to Roads and Maritime for review prior to Cardno proceeding with the future year modelling. The base model was deemed by Roads and Maritime to reflect the sufficient conditions sufficiently accurately to form a robust base for scenario testing.

11.2 Scenario testing

Scenario testing for 2016 with Chelsea Gardens full development yield identified the road network impacts just from the development (2016 + Chelsea Gardens scenario). Future modelling included design years 2021, 2026, 2031 and 2036 scenarios with Chelsea Gardens.

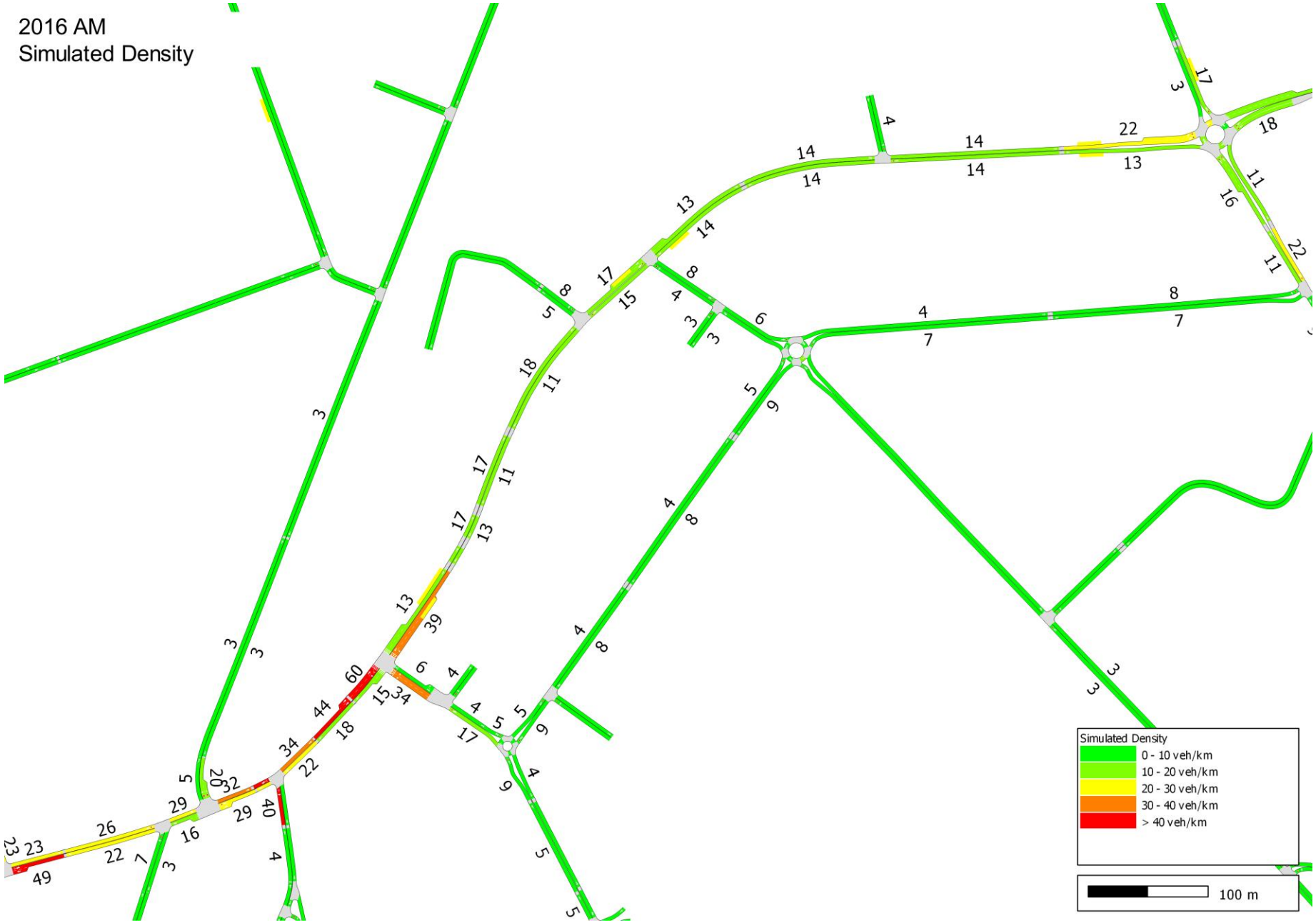
The purpose of these analyses was to increase understanding of the relationship between the future traffic volume and the Chelsea Gardens development. The key findings of this study are:

- With the North East Road, the impact of Chelsea Gardens on the traffic network is predominantly concentrated at the following intersections:
  - Argyle Street / Arthur Street
  - Argyle Street / White Street
  - Argyle Street / Illawarra Highway / Suttor Road
  - Illawarra Highway / Fitzroy Road.
- Minor intersection upgrades (right turn bans) at Argyle Street / Arthur Street on the Arthur Street and western Argyle Street approaches are recommended to improve network level of service and mitigate the impact of additional traffic from Chelsea Gardens
- The Argyle Street / Illawarra Highway roundabout performs near or at capacity with the full development
- Roundabout metering (not modelled) could be employed to improve the performance of this roundabout
- The staged development means that impacts to the roundabout will be progressive not immediate
- It is not necessary to remove any parking in the CBD for the suggested infrastructure upgrades based on the impact of Chelsea Gardens only
- The Stage 1 Moss Vale Bypass is not directly triggered by the Chelsea Gardens development as the impact of the development in isolation can be mitigated by infrastructure upgrades
- Previous modelling indicated that without infrastructure upgrades or Chelsea Gardens but including other development and background growth, the Moss Vale CBD experiences significant traffic congestion and delays by 2036
- If the Stage 1 Moss Vale Bypass is implemented in the future, this would improve traffic conditions, amenity and intersection performance on Argyle Street while retaining existing car parking provisions.

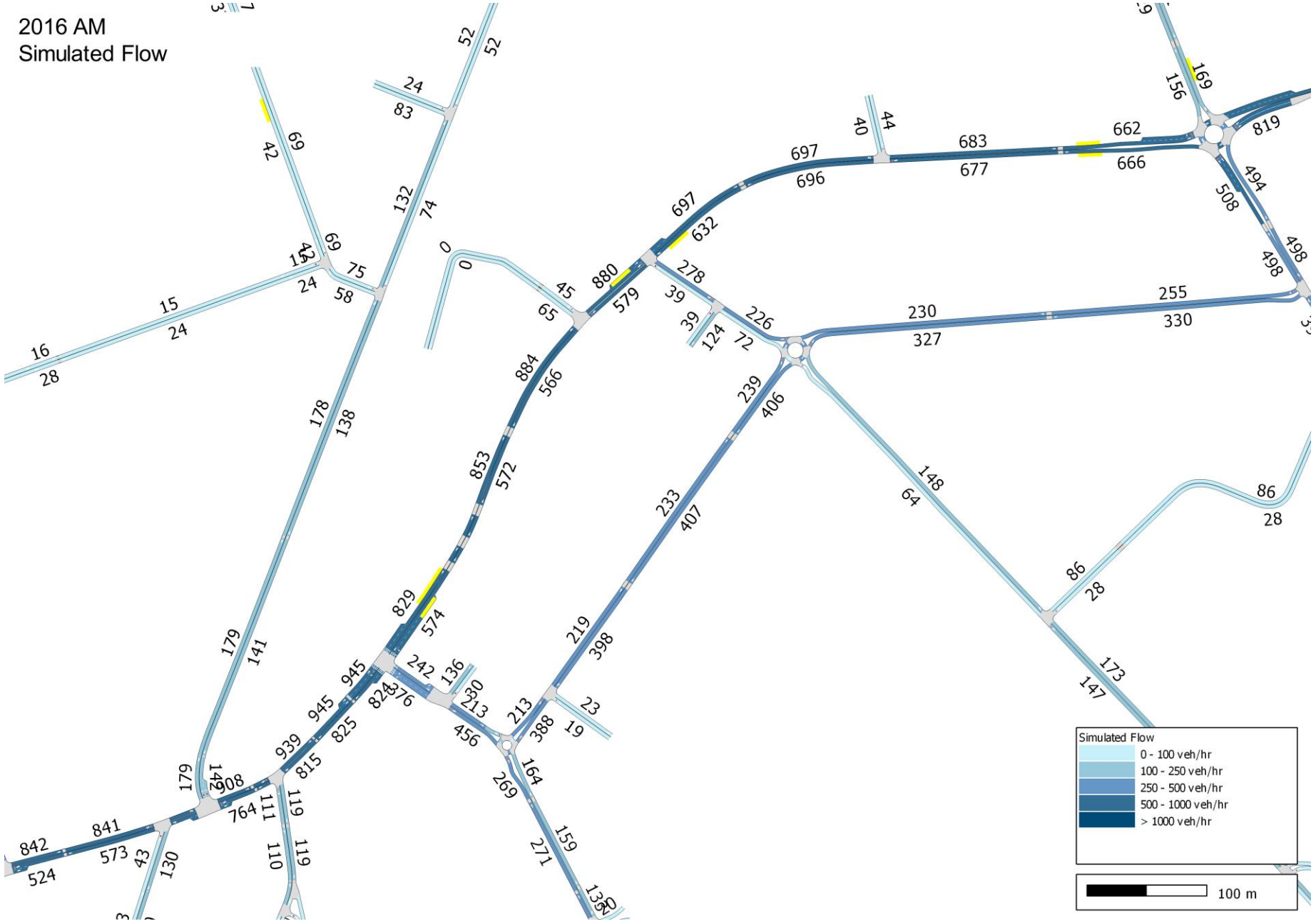
APPENDIX A

AIMSUN PLOTS


2016 AM
Simulated Density
BERRIMA RD
ARGYLE ST
(MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
VILLIERS RD
ARGYLE ST
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

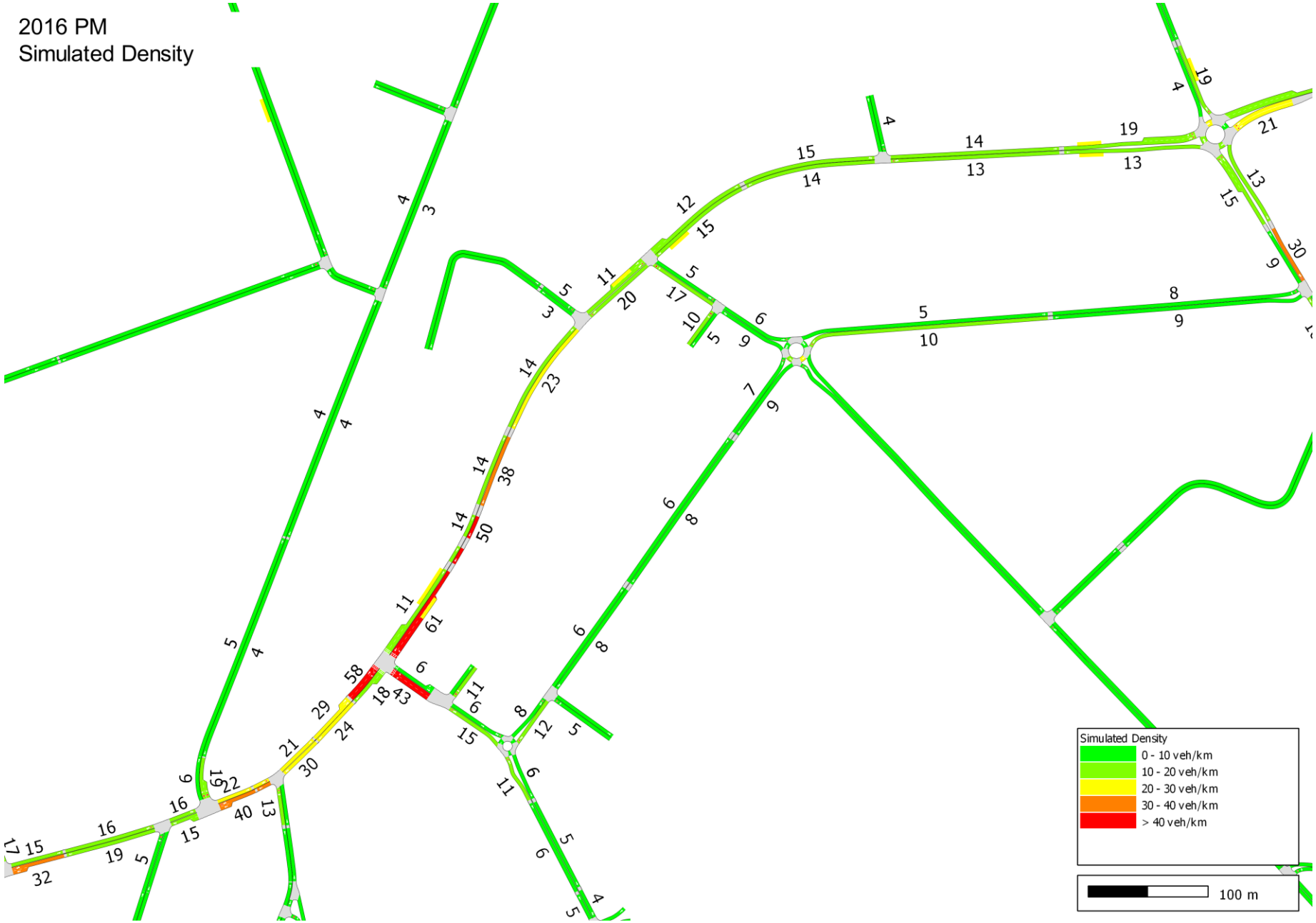

2016 AM
Simulated Density
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
100 m


2016 AM
Simulated Flow
BERRIMA RD
153
171
ARGYLE ST
(MOSS VALE RD)
941
762
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
369
283
VILLIERS RD
BROUGHTON ST
LOVELLE ST
172
143
177
240
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
63
50
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m

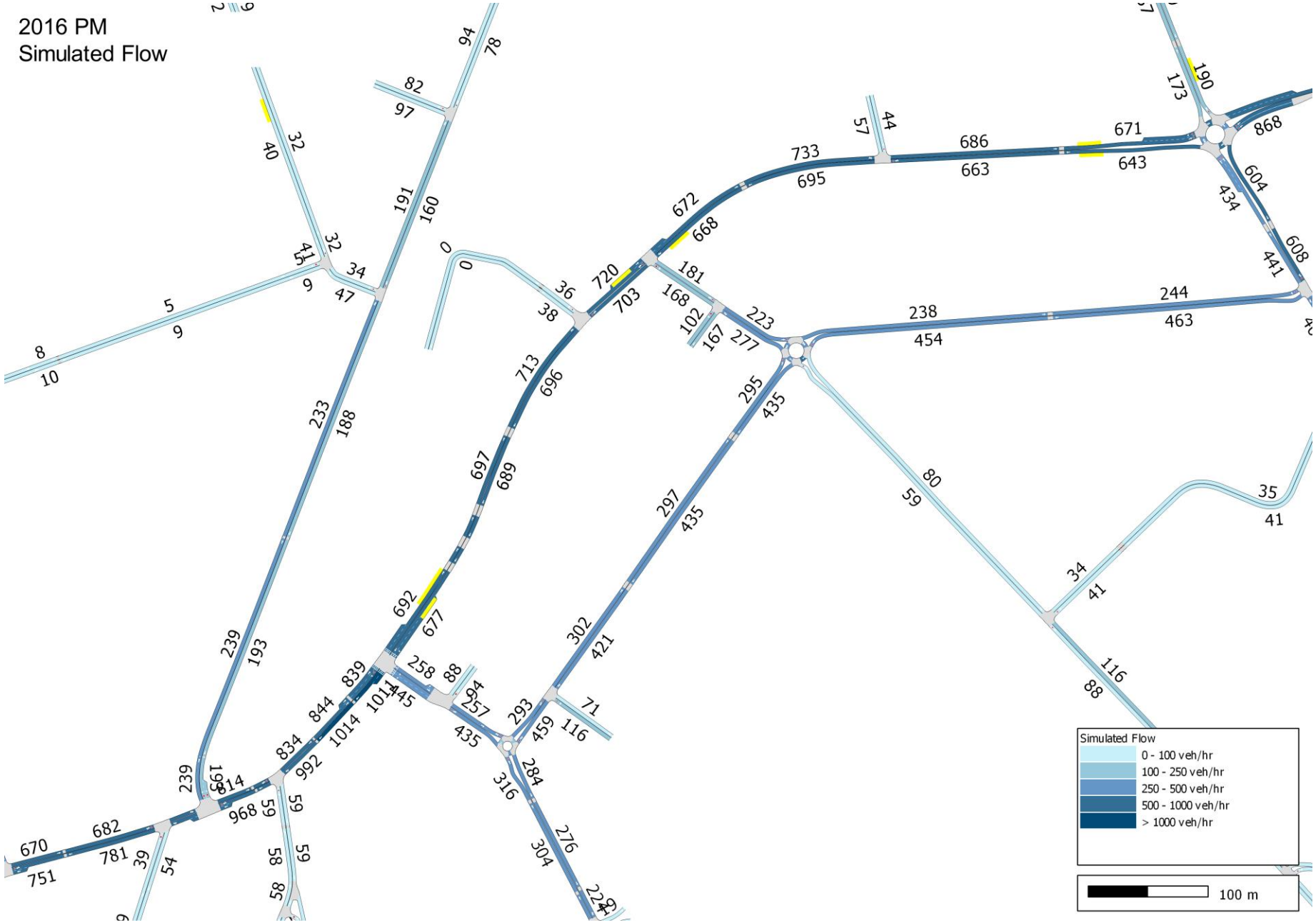

2016 AM
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m

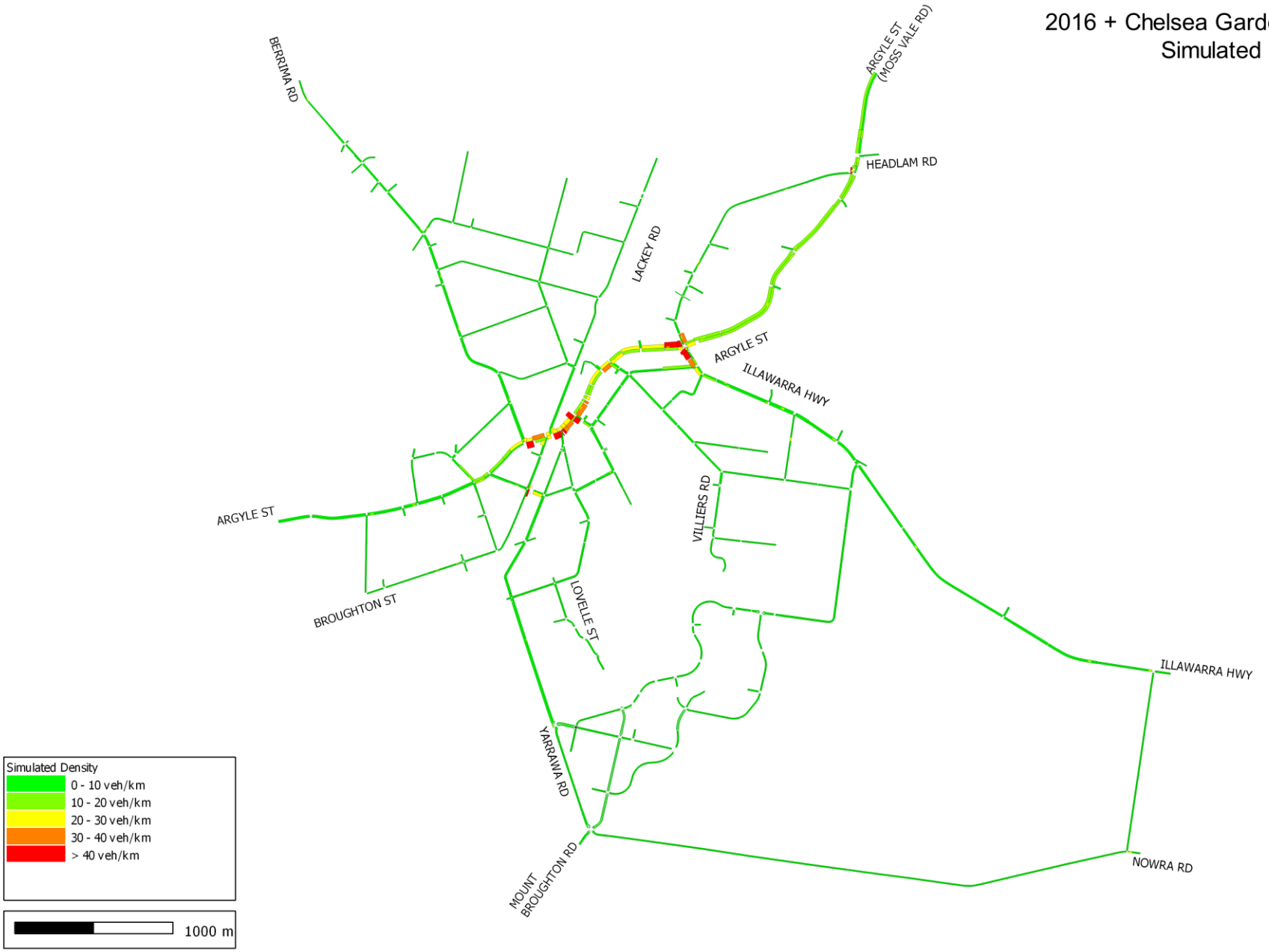

2016 PM
Simulated Density
BERRIMA RD
ARGYLE ST
(MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
VILLIERS RD
ARGYLE ST
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

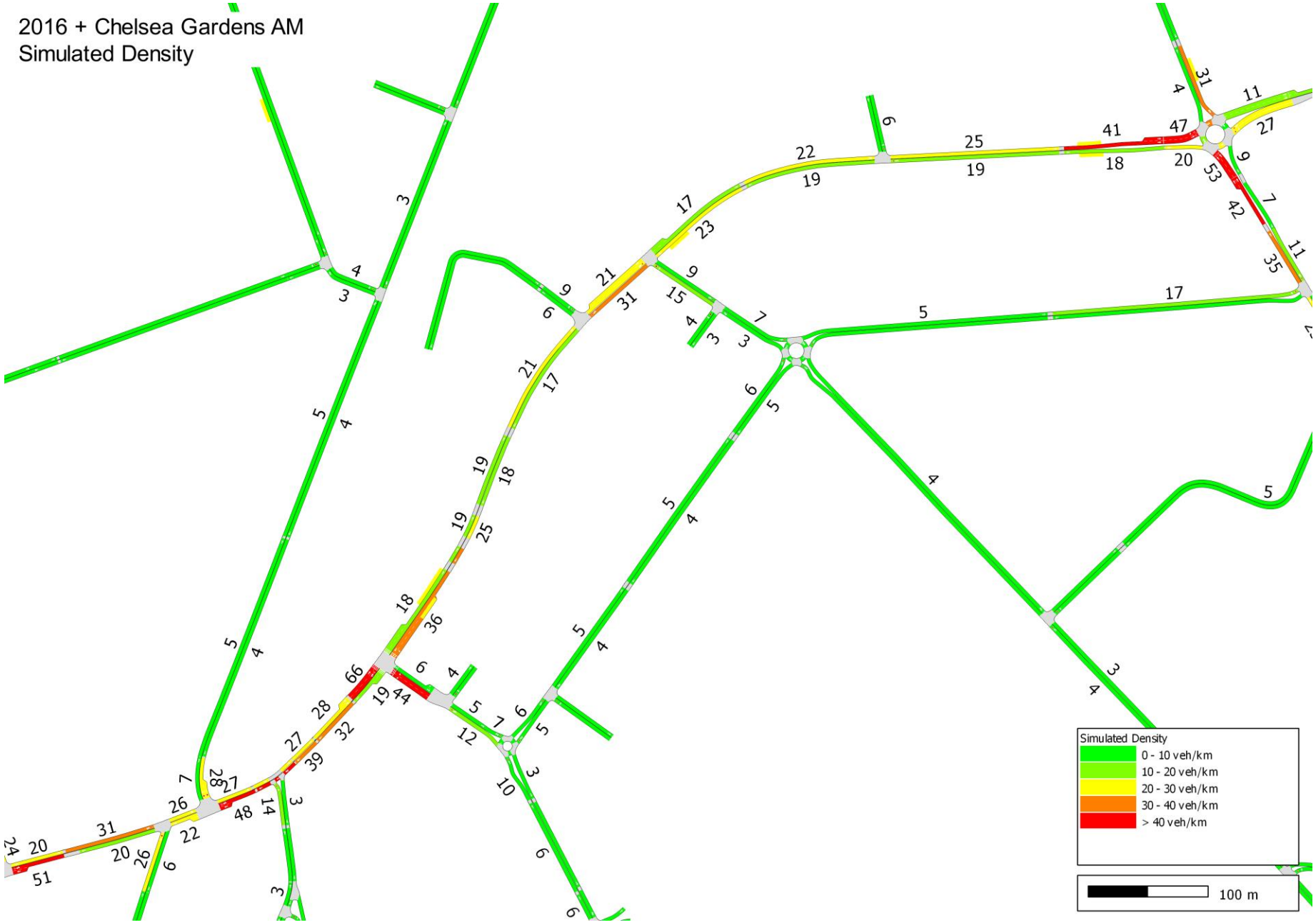
2016 PM
Simulated Density

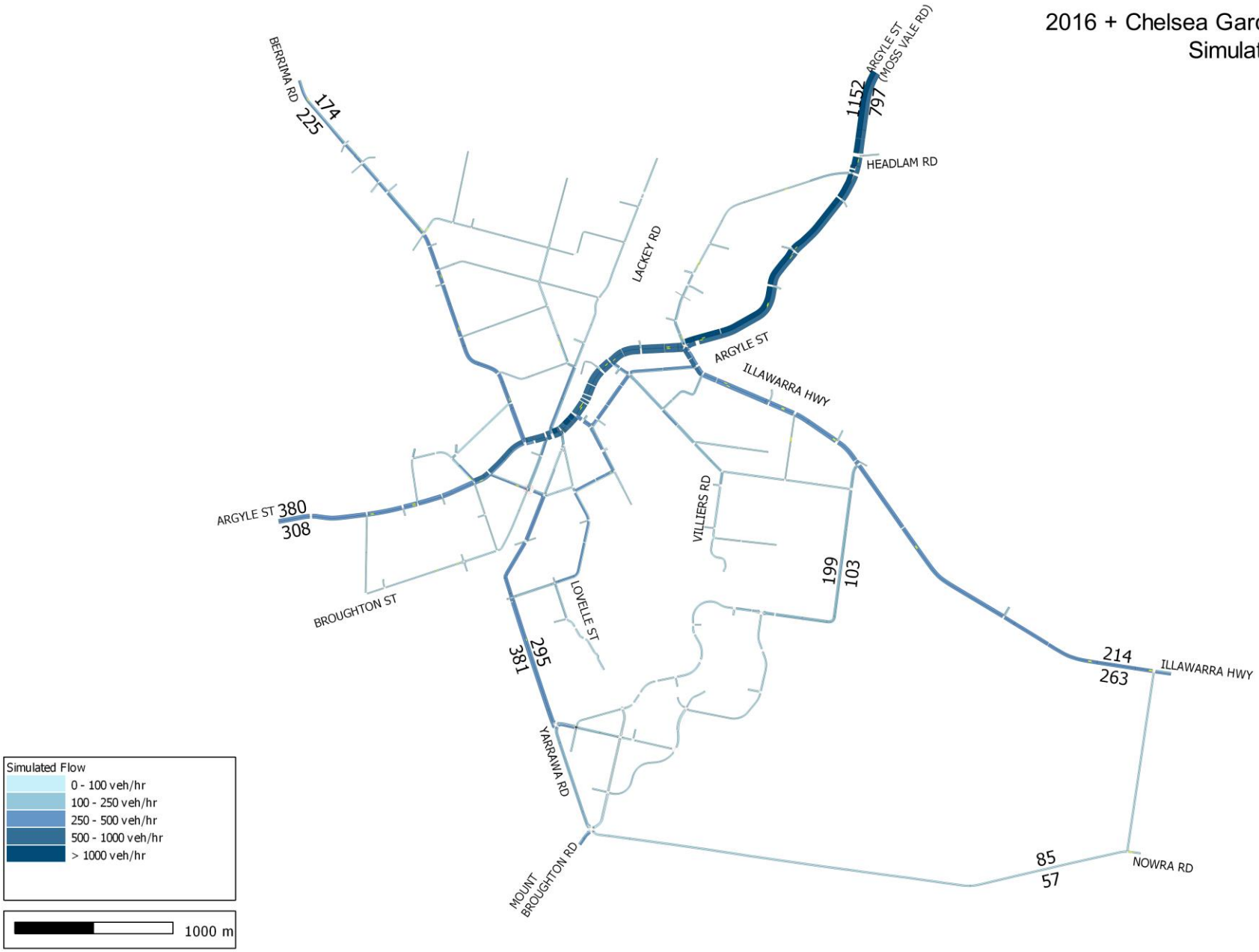


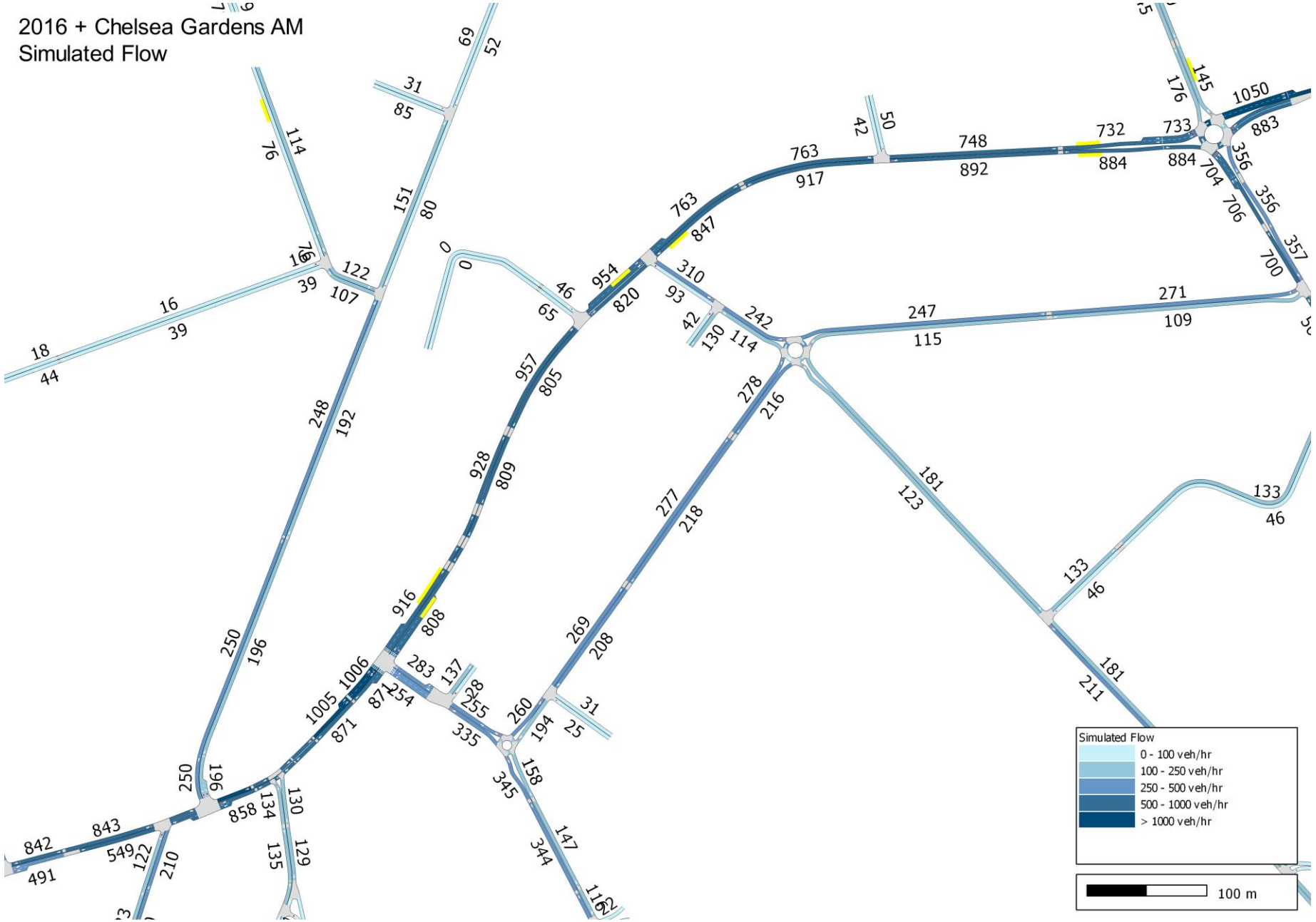

2016 PM
Simulated Flow
BERRIMA RD
134
180
ARGYLE ST (MOSS VALE RD)
737
892
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
365
357
VILLIERS RD
BROUGHTON ST
LOVELLE ST
150
121
279
256
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
71
50
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m

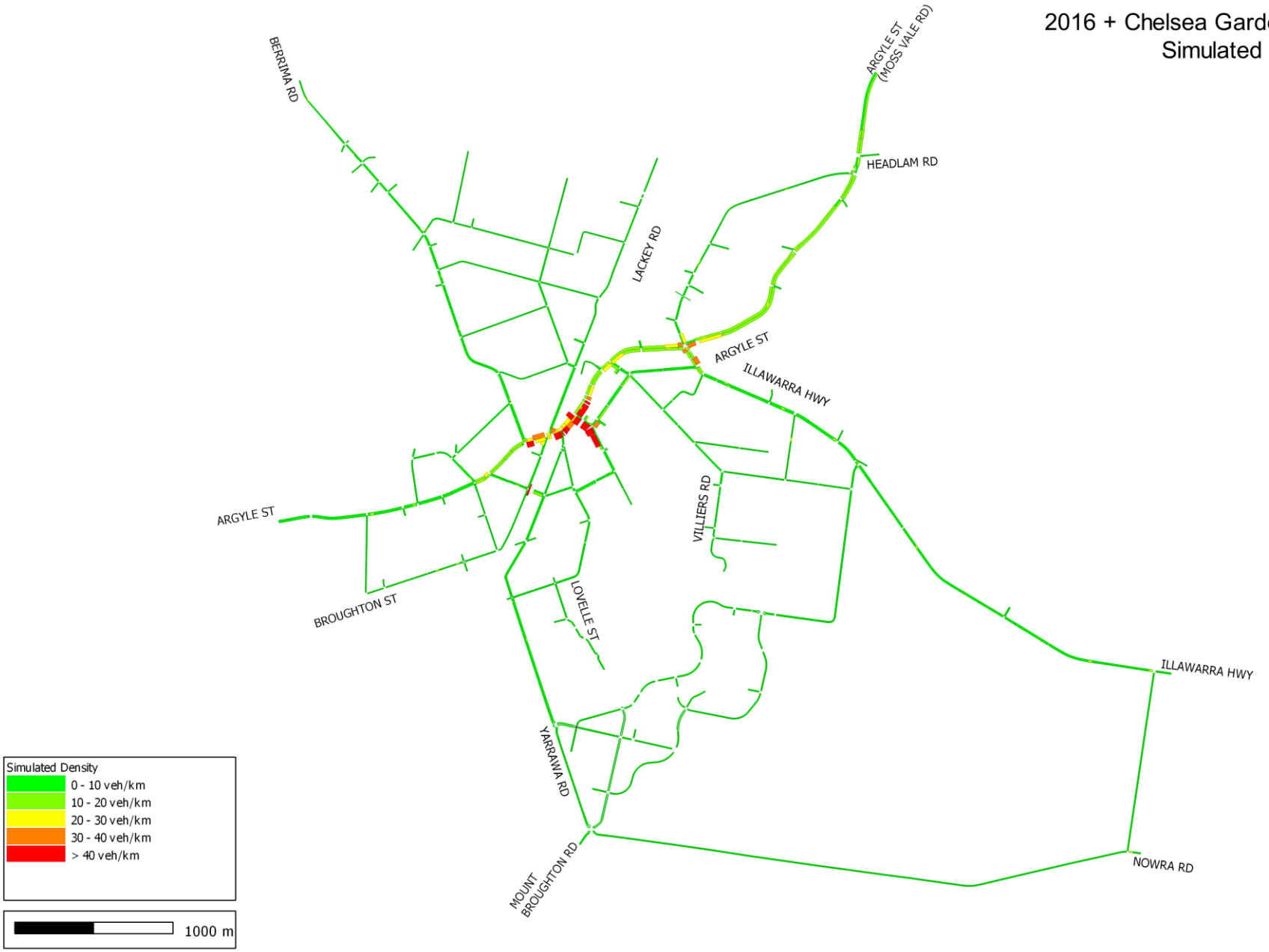

2016 PM
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m

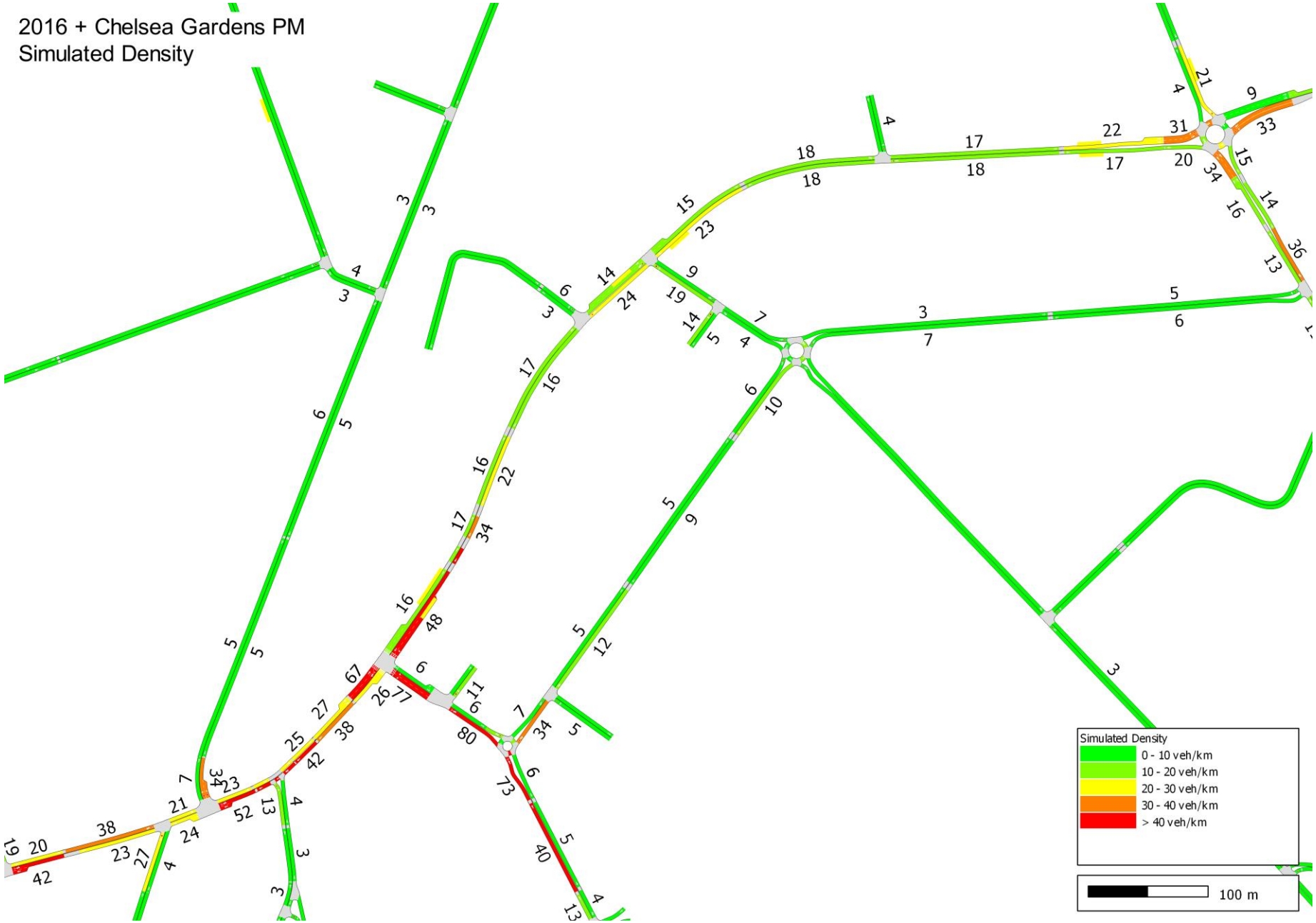

2016 + Chelsea Gardens AM
Simulated Density
BERRIMA RD
ARGYLE ST
(MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
VILLIERS RD
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

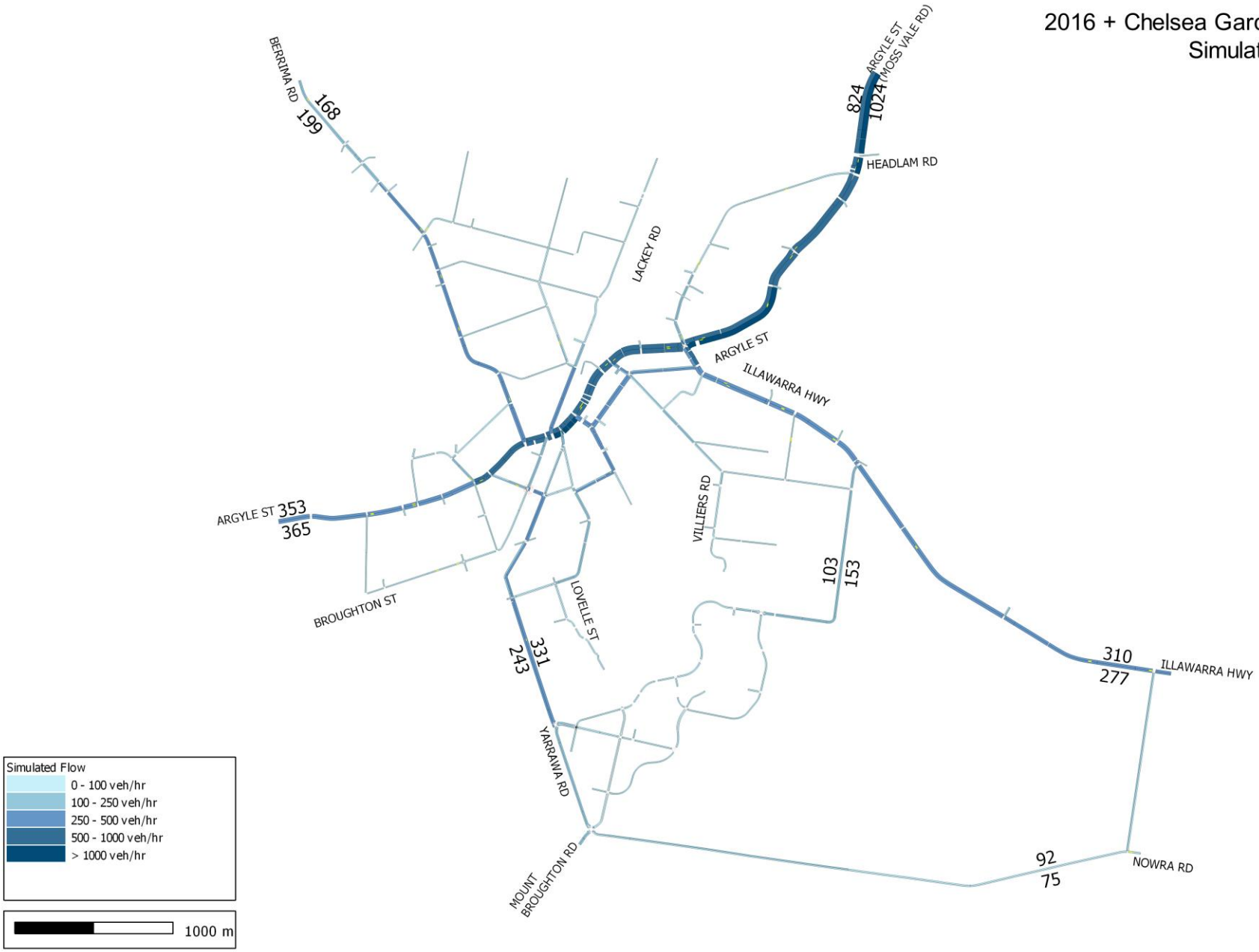

2016 + Chelsea Gardens AM
Simulated Density
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
100 m

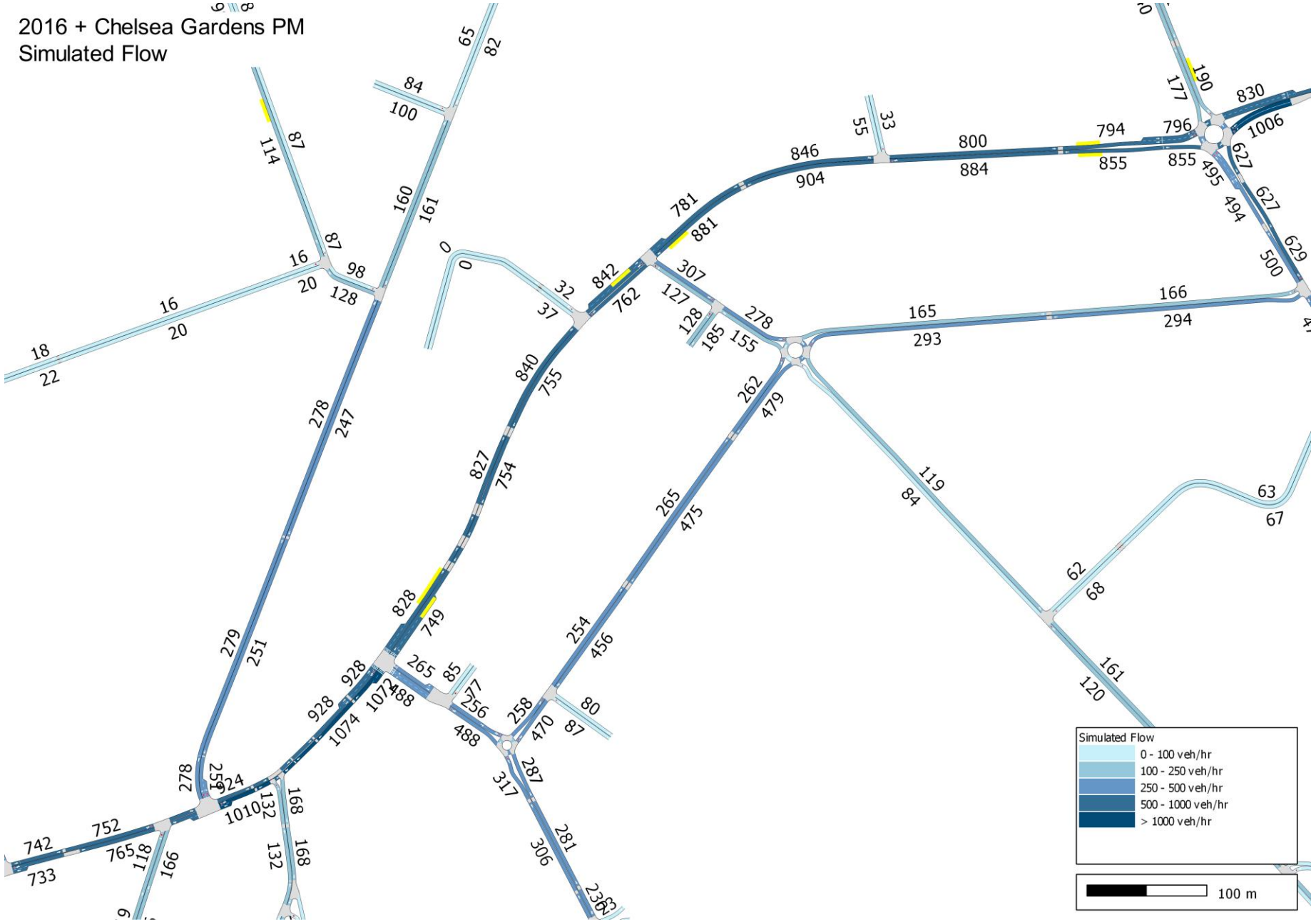

2016 + Chelsea Gardens AM
Simulated Flow
BERRIMA RD
174
225
ARGYLE ST
(MOSS VALE RD)
1152
797
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
380
308
BROUGHTON ST
VILLIERS RD
199
103
LOVELLE ST
295
381
214
263
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
85
57
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m


2016 + Chelsea Gardens AM
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m


2016 + Chelsea Gardens PM
Simulated Density
BERRIMA RD
ARGYLE ST
(MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
VILLIERS RD
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

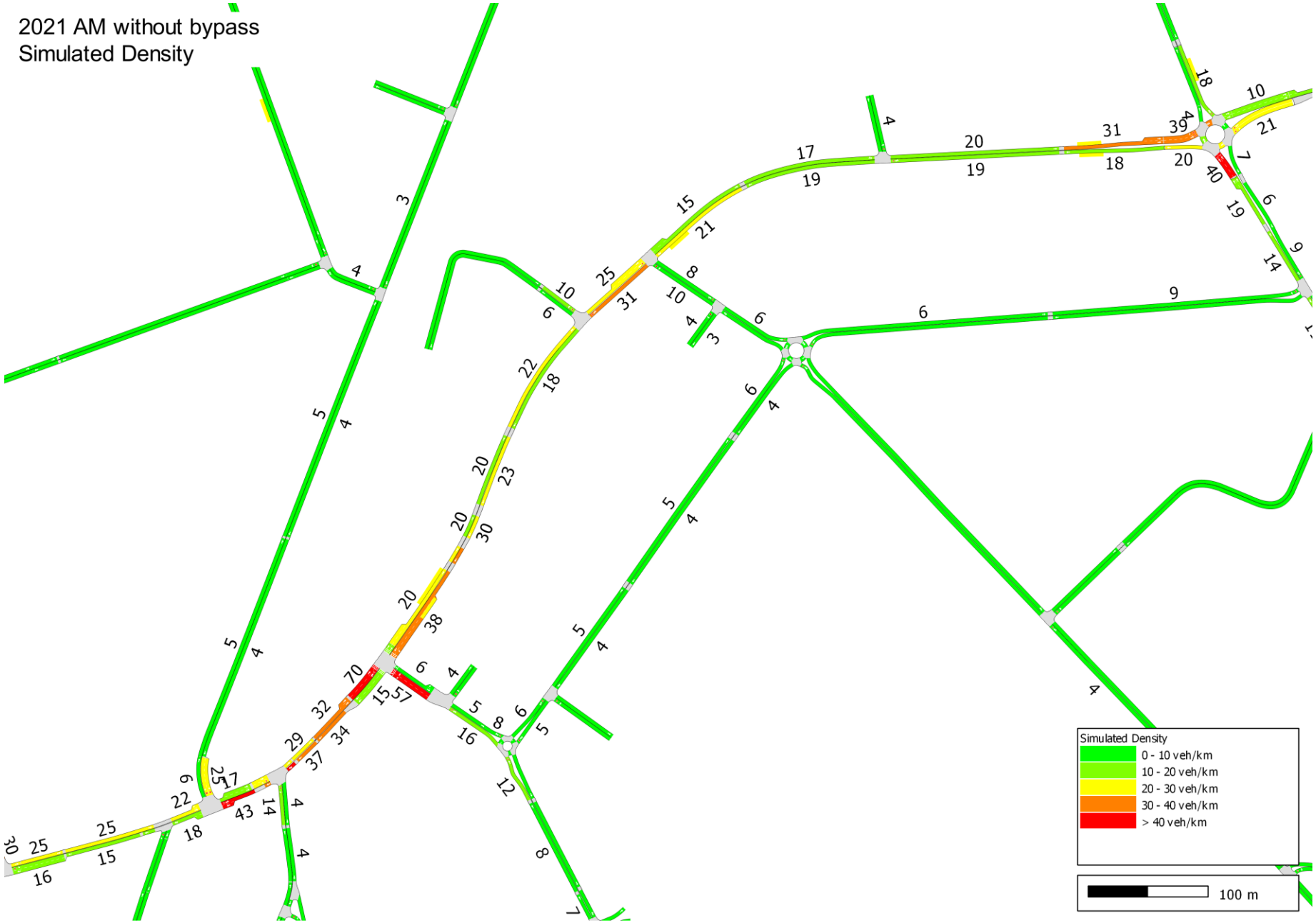

2016 + Chelsea Gardens PM
Simulated Density
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
100 m


2016 + Chelsea Gardens PM
Simulated Flow
BERRIMA RD
168
199
ARGYLE ST
(MOSS VALE RD)
824
1024
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
353
365
VILLIERS RD
103
153
BROUGHTON ST
LOVELLE ST
331
243
310
277
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
92
75
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m

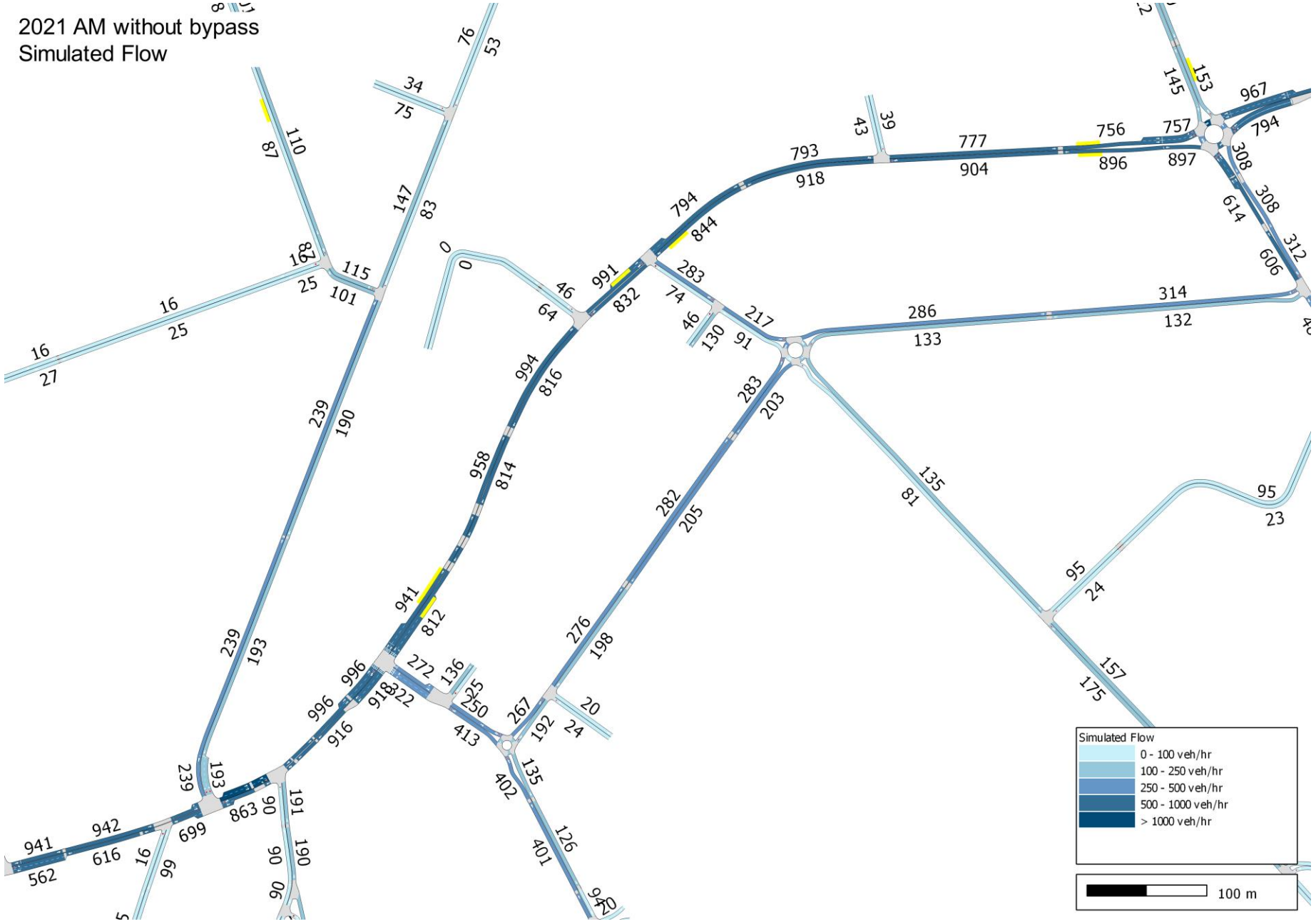

2016 + Chelsea Gardens PM
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m

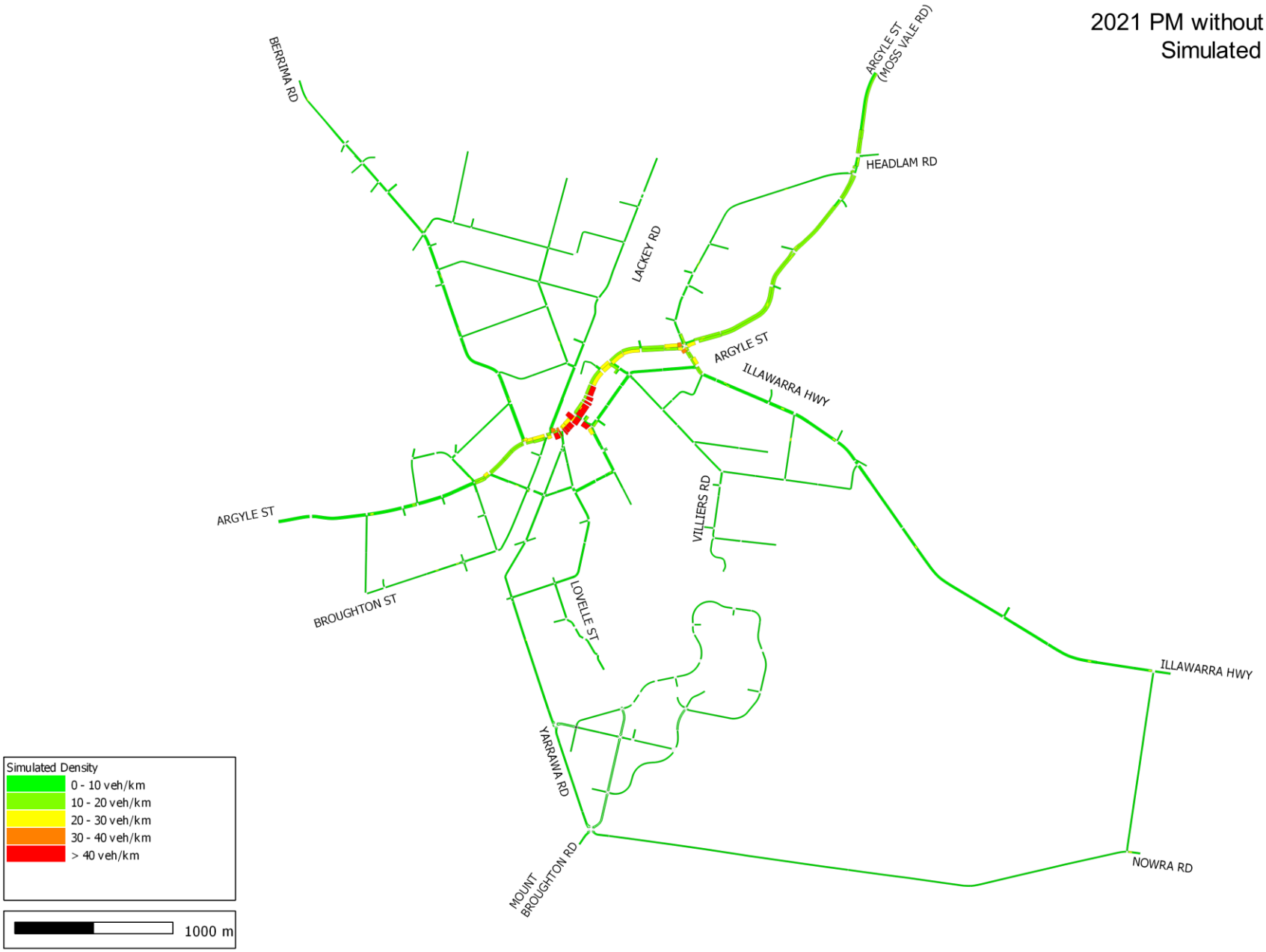

2021 AM without bypass
Simulated Density
BERRIMA RD
ARGYLE ST
(MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
VILLIERS RD
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

2021 AM without bypass
Simulated Density

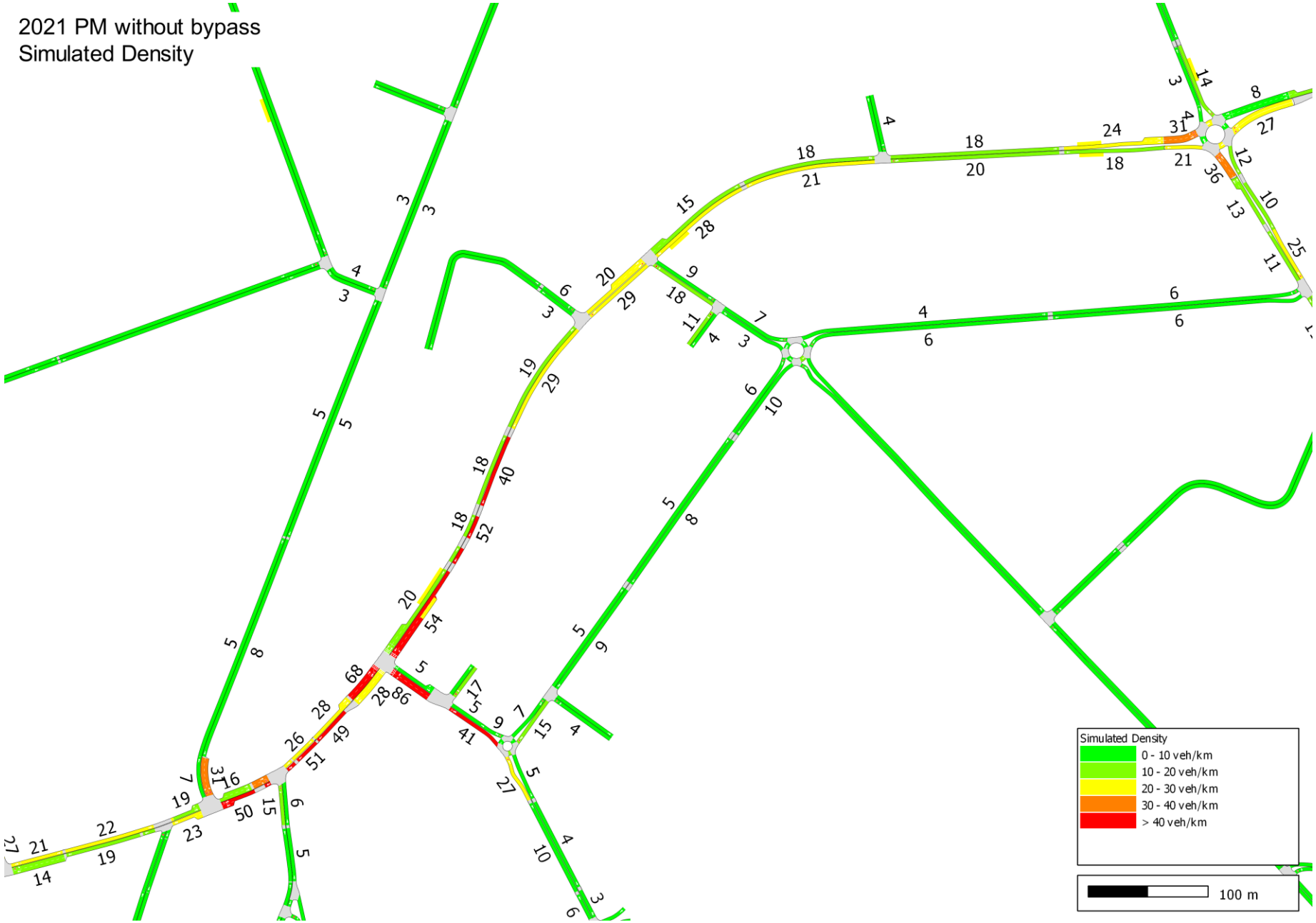


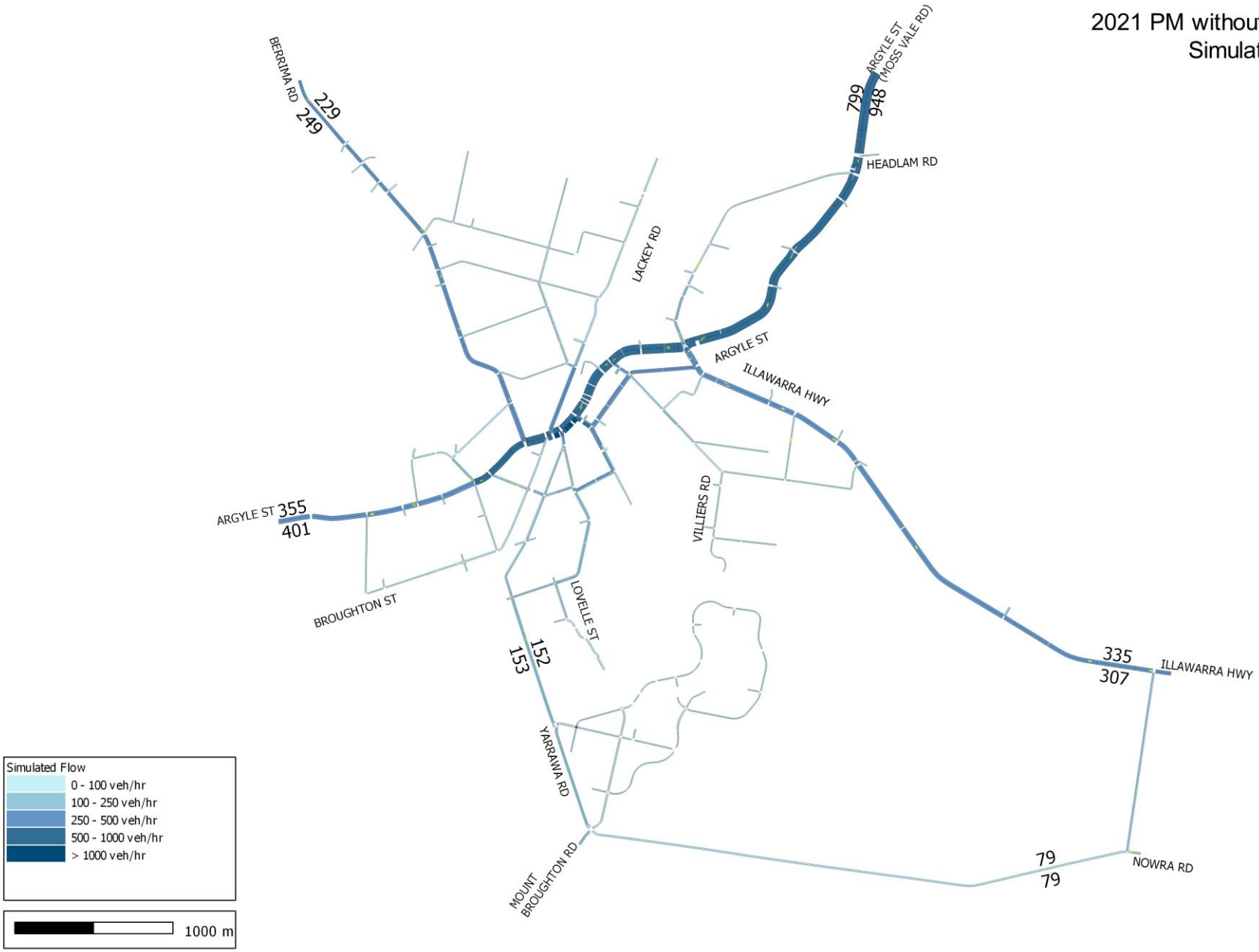

2021 AM without bypass
Simulated Flow
BERRIMA RD
214
249
ARGYLE ST
(MOSS VALE RD)
1064
722
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
393
290
VILLIERS RD
BROUGHTON ST
LOVELLE ST
169
196
231
295
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
73
44
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m

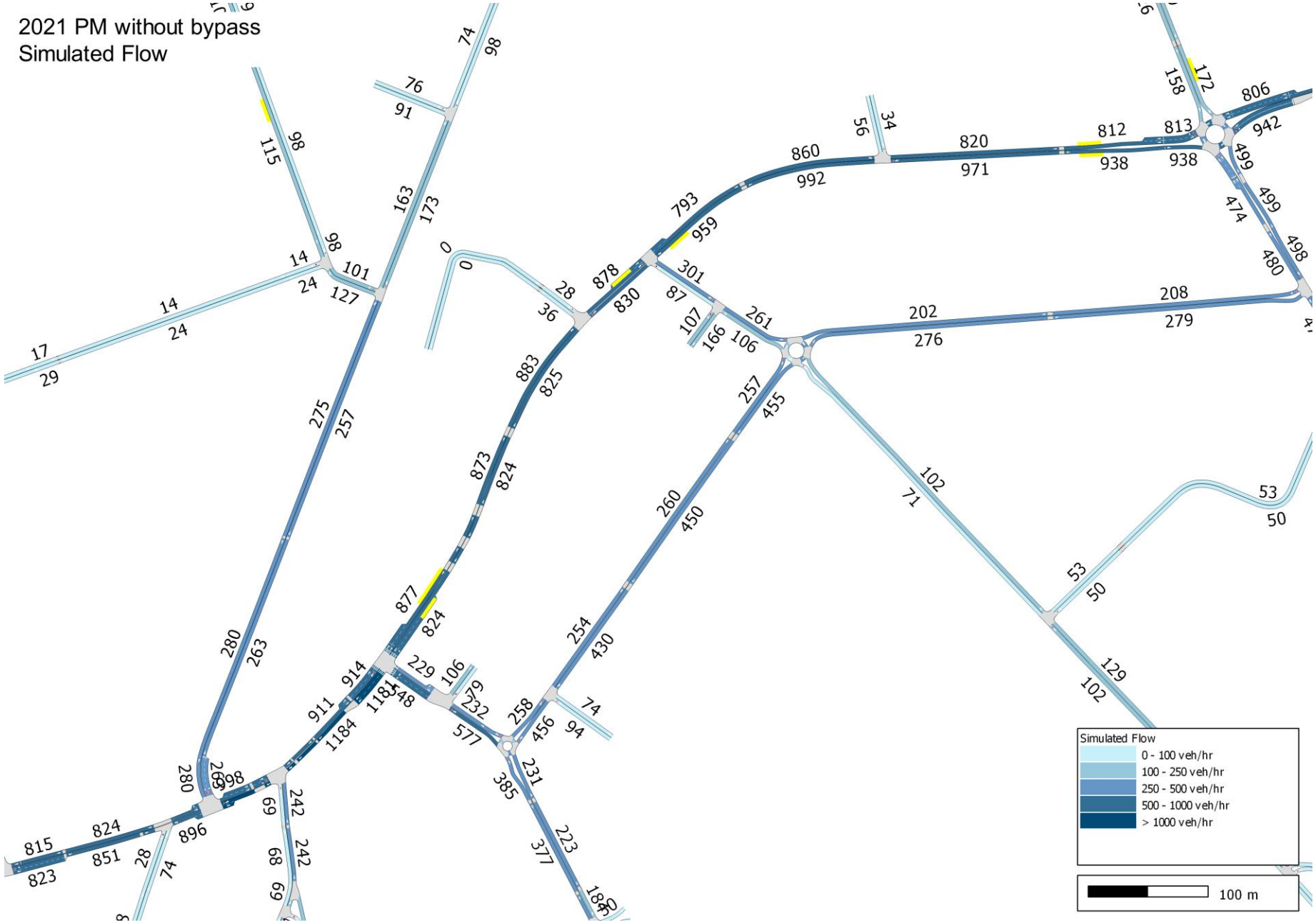

2021 AM without bypass
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m

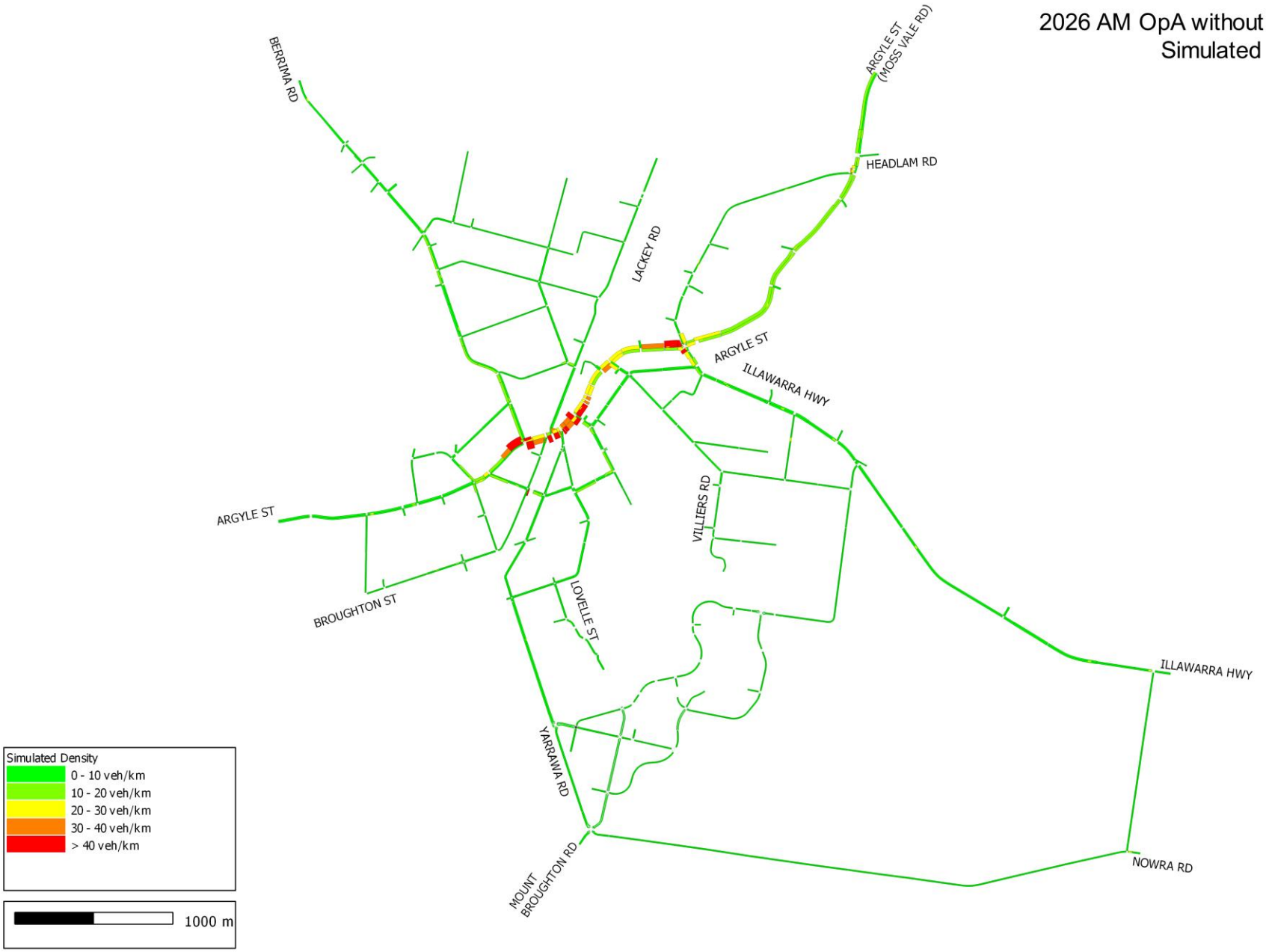

2021 PM without bypass
Simulated Density
BERRIMA RD
ARGYLE ST
(MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
VILLIERS RD
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

2021 PM without bypass
Simulated Density

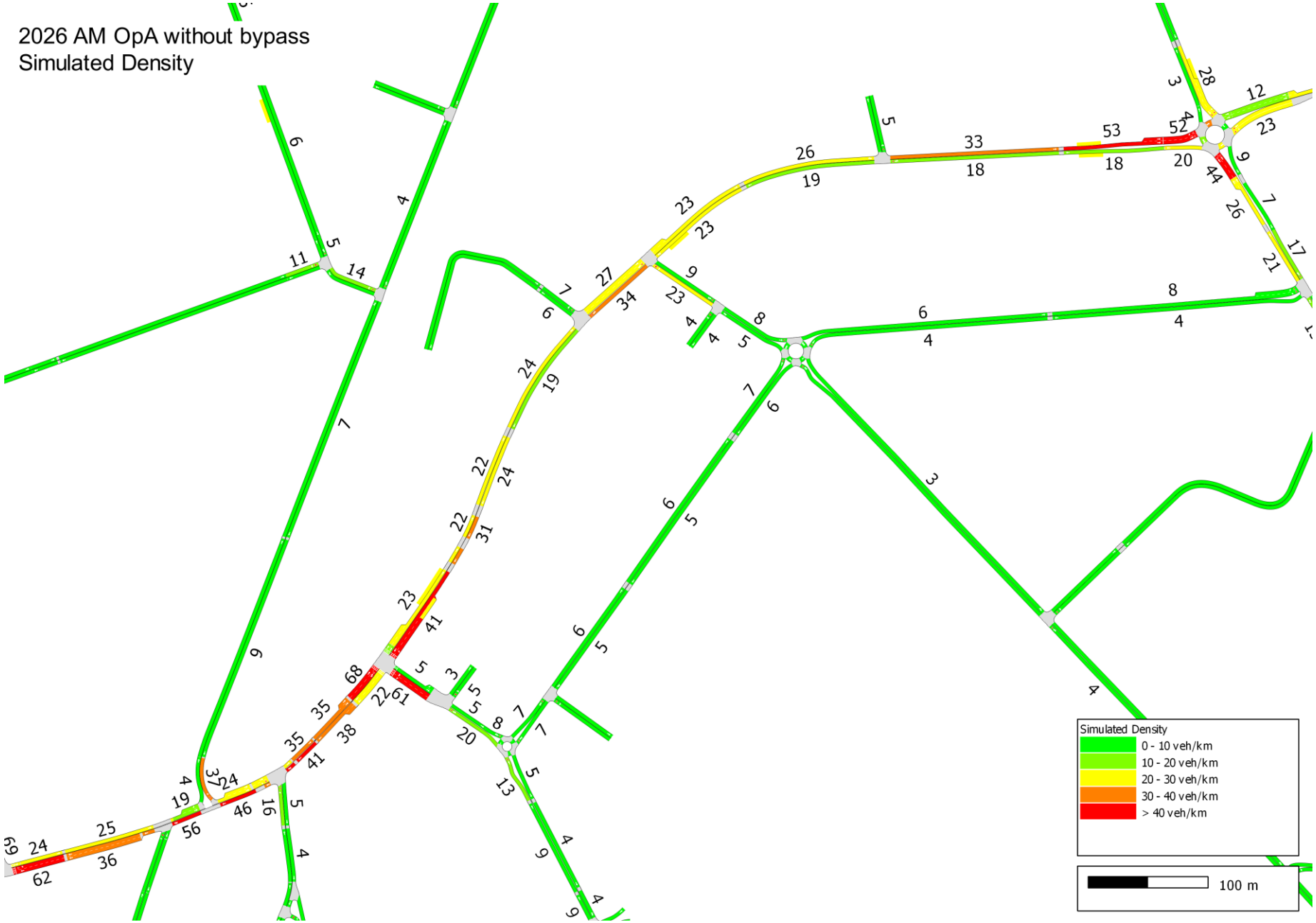


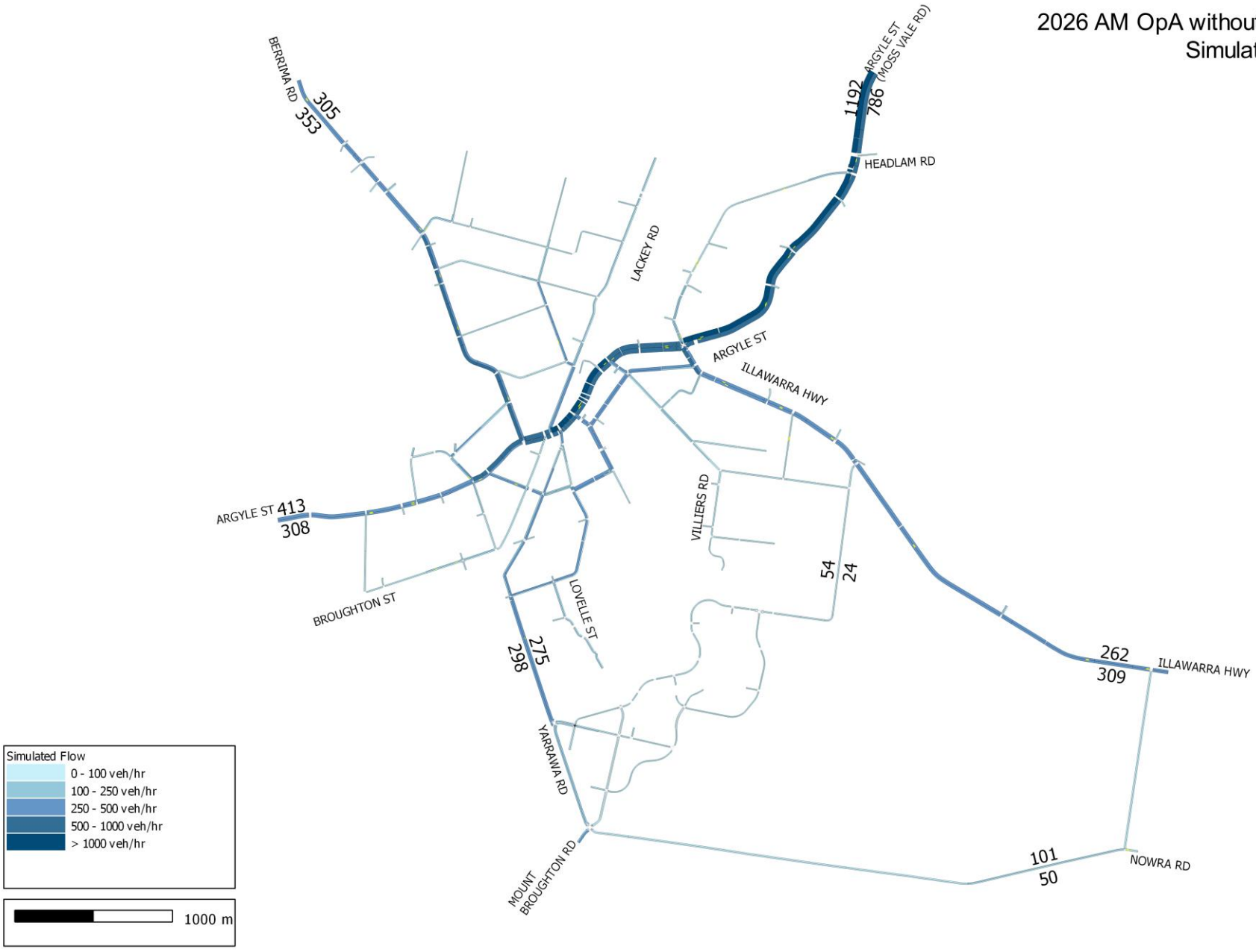

2021 PM without bypass
Simulated Flow
BERRIMA RD
229
249
ARGYLE ST
(MOSS VALE RD)
799
948
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
355
401
VILLIERS RD
BROUGHTON ST
LOVELLE ST
152
153
335
307
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
79
79
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m

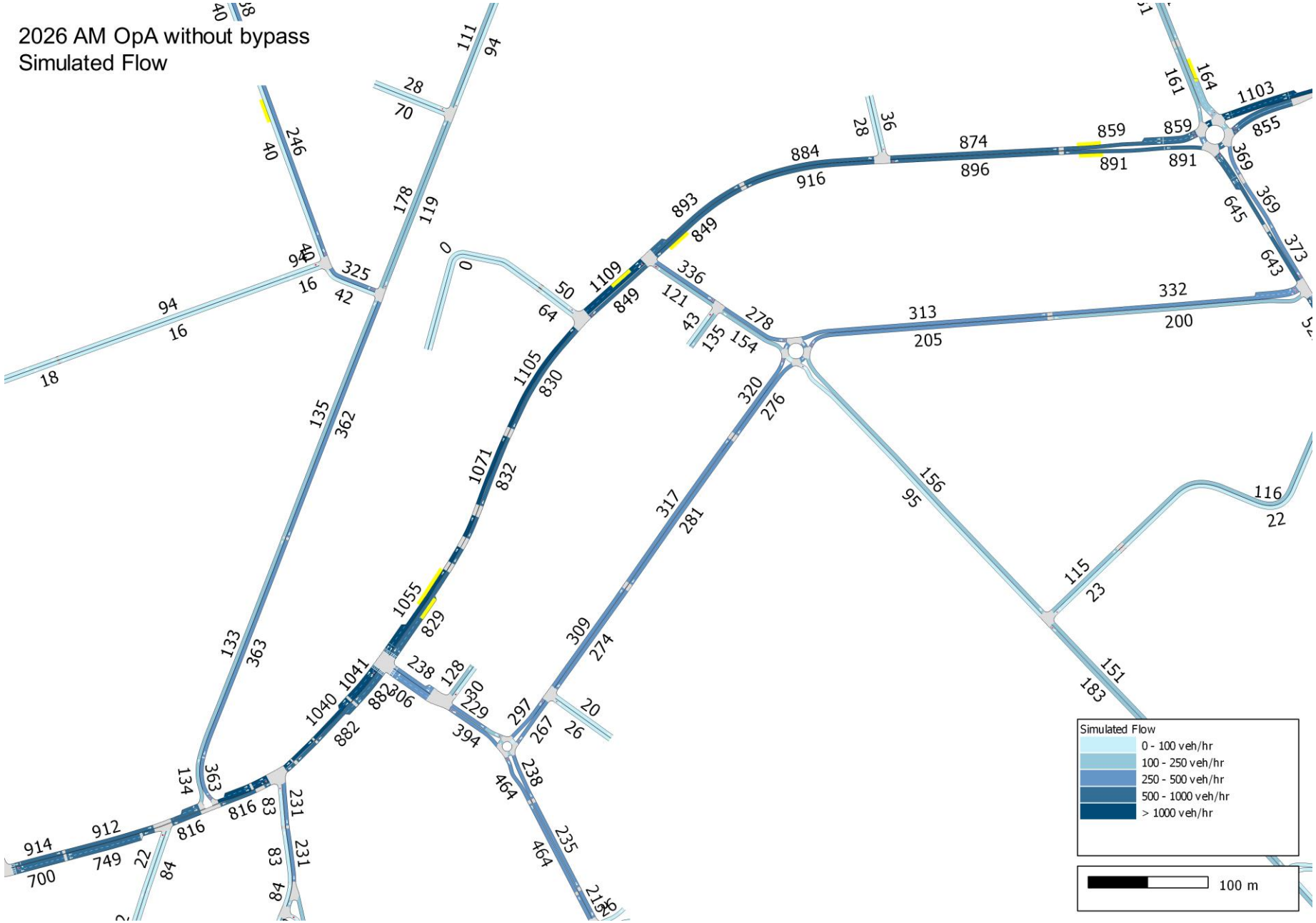

2021 PM without bypass
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m


2026 AM OpA without bypass
Simulated Density
BERRIMA RD
ARGYLE ST (MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
VILLIERS RD
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

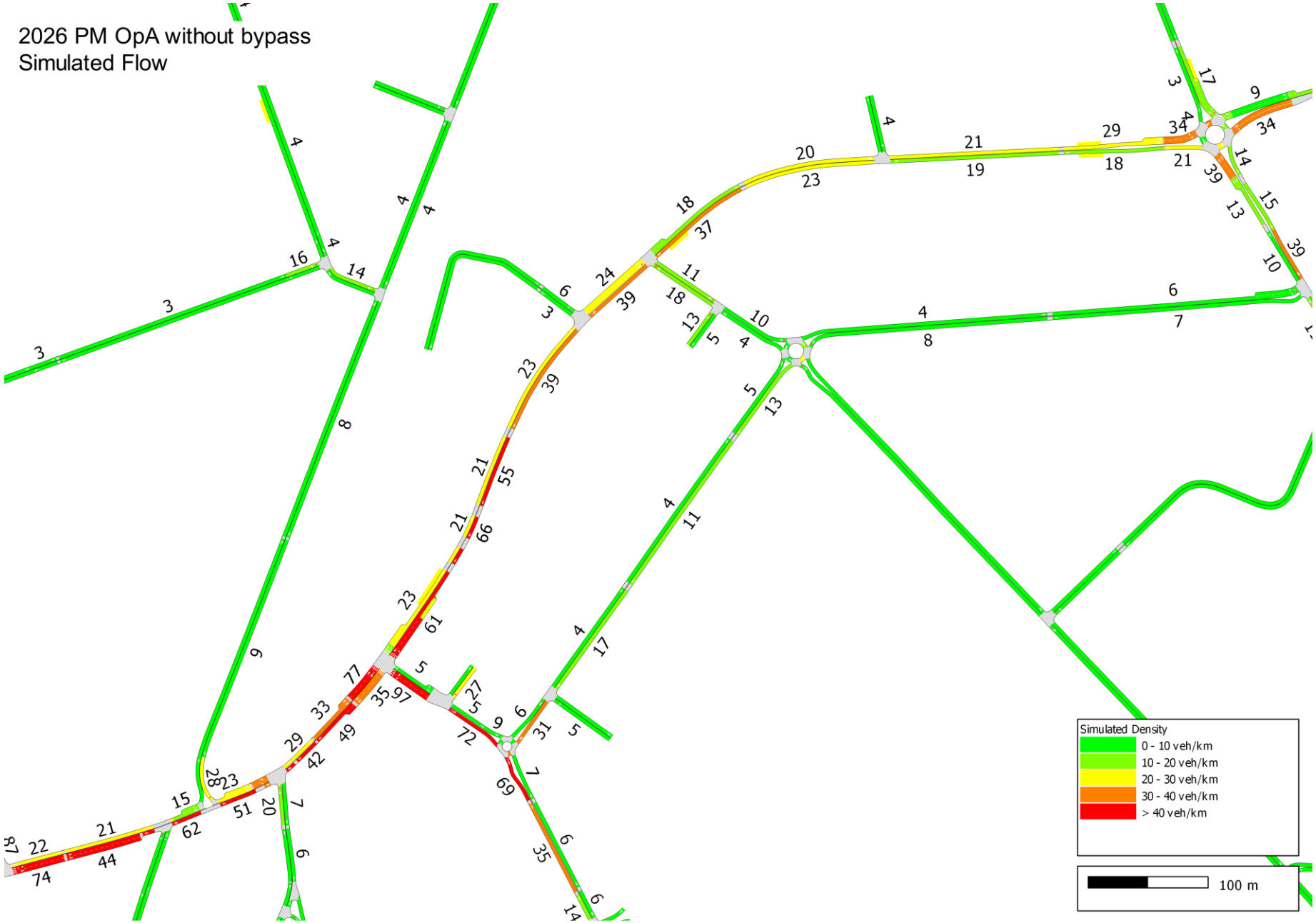
2026 AM OpA without bypass
Simulated Density

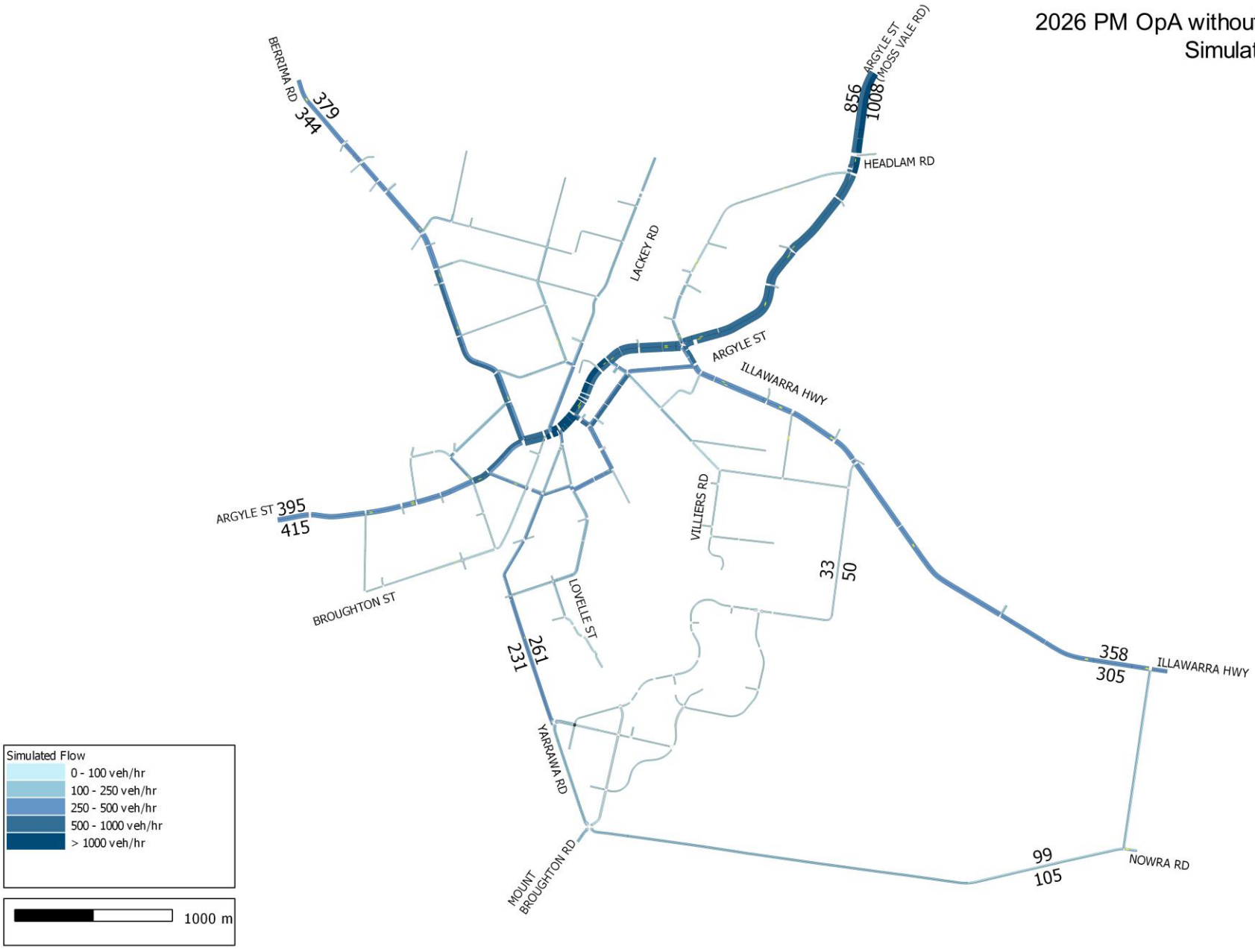


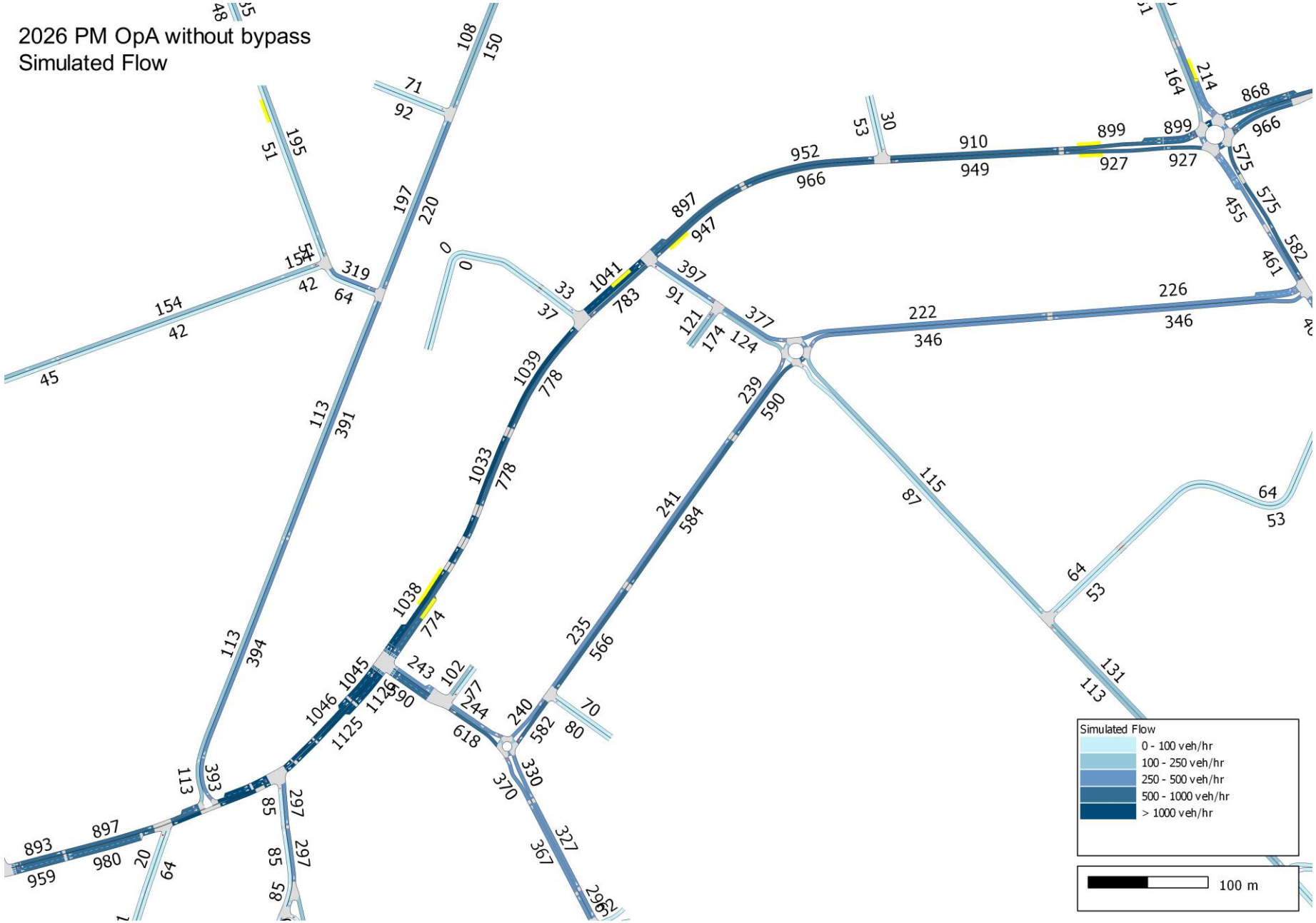

2026 AM OpA without bypass
Simulated Flow
BERRIMA RD
305
353
ARGYLE ST (MOSS VALE RD)
1192
786
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
413
308
BROUGHTON ST
VILLIERS RD
54
24
LOVELLE ST
275
298
262
309
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
101
50
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m


2026 AM OpA without bypass
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m

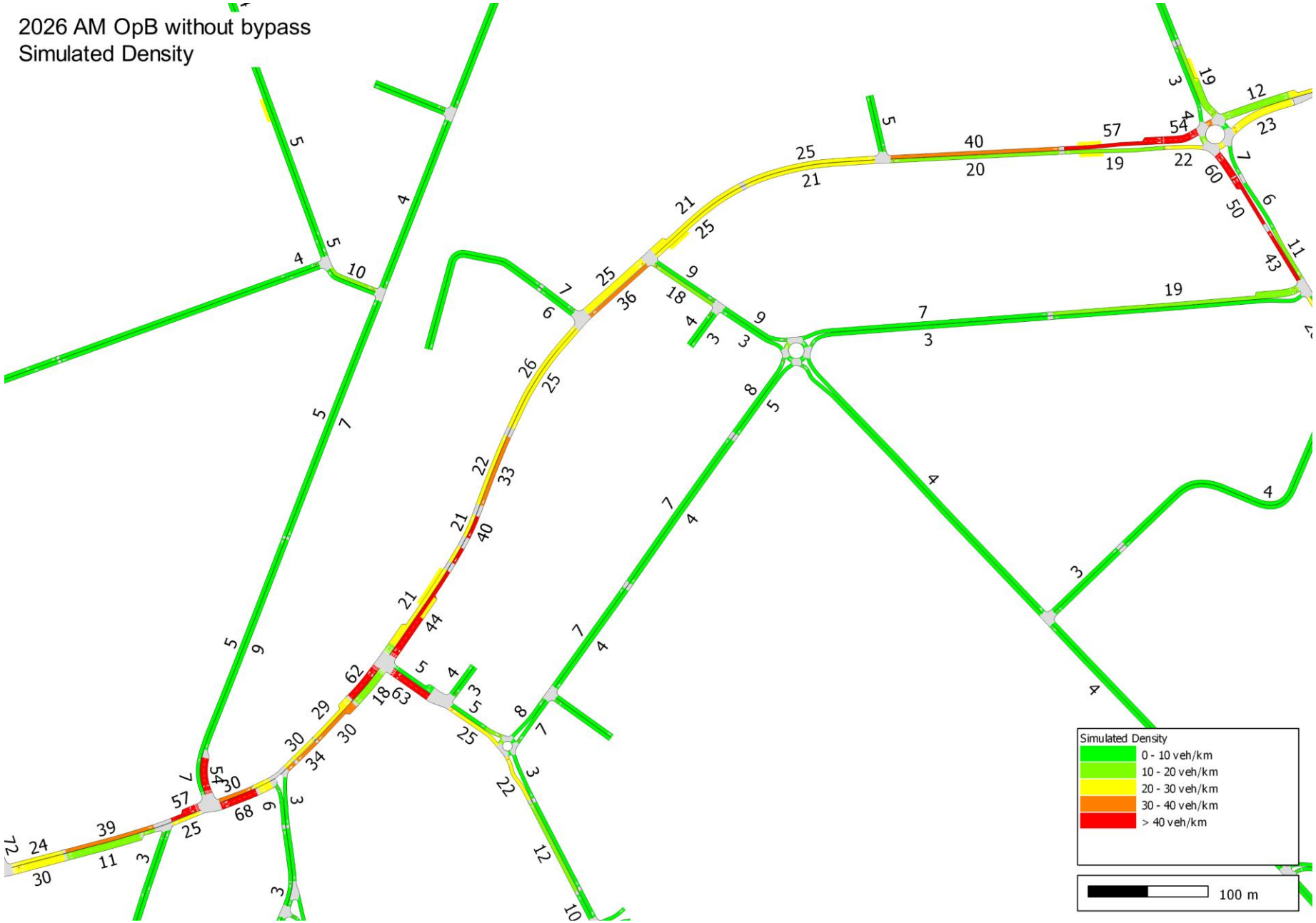

2026 PM OpA without bypass
Simulated Density
BERRIMA RD
ARGYLE ST (MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
VILLIERS RD
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

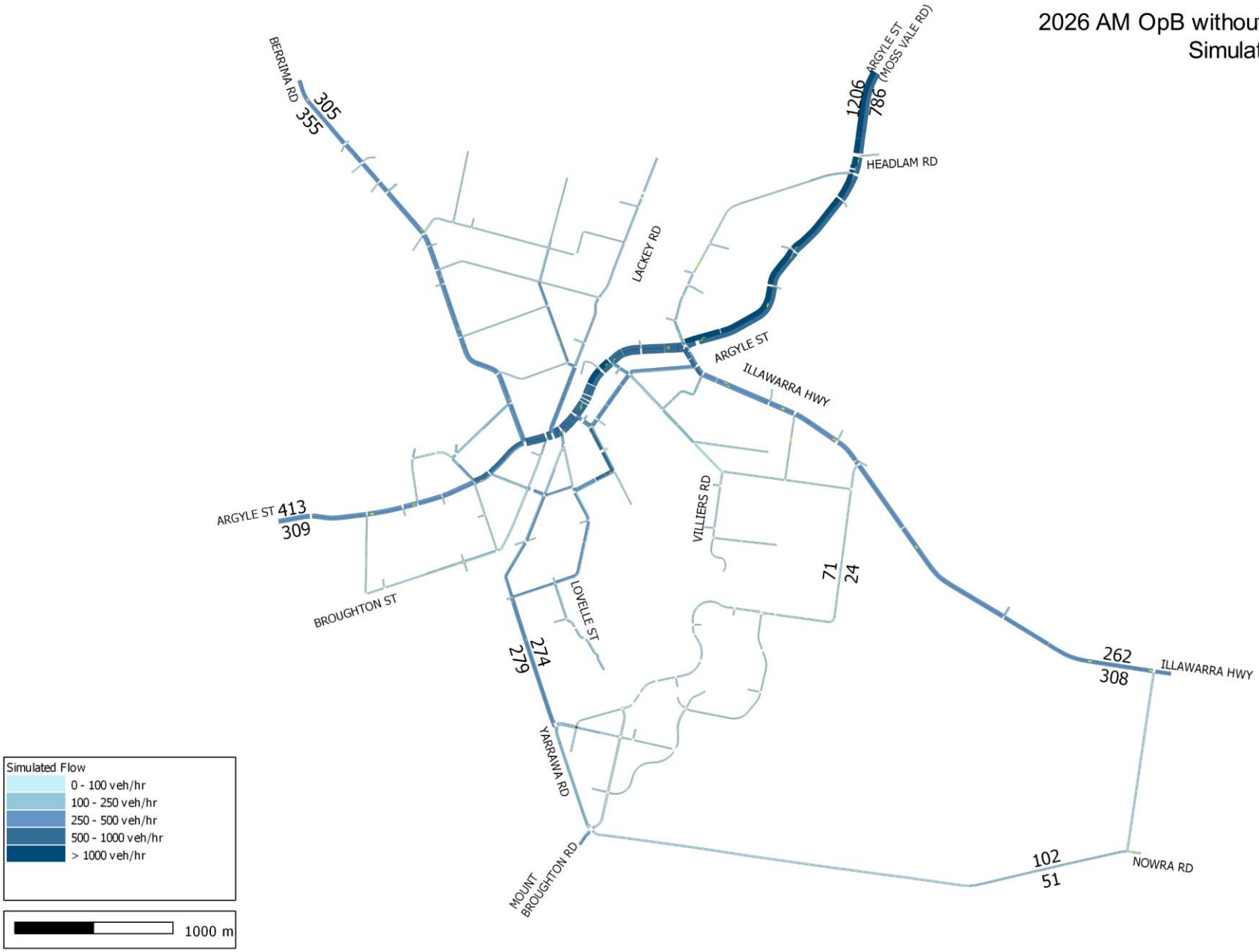

2026 PM OpA without bypass
Simulated Flow
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
100 m

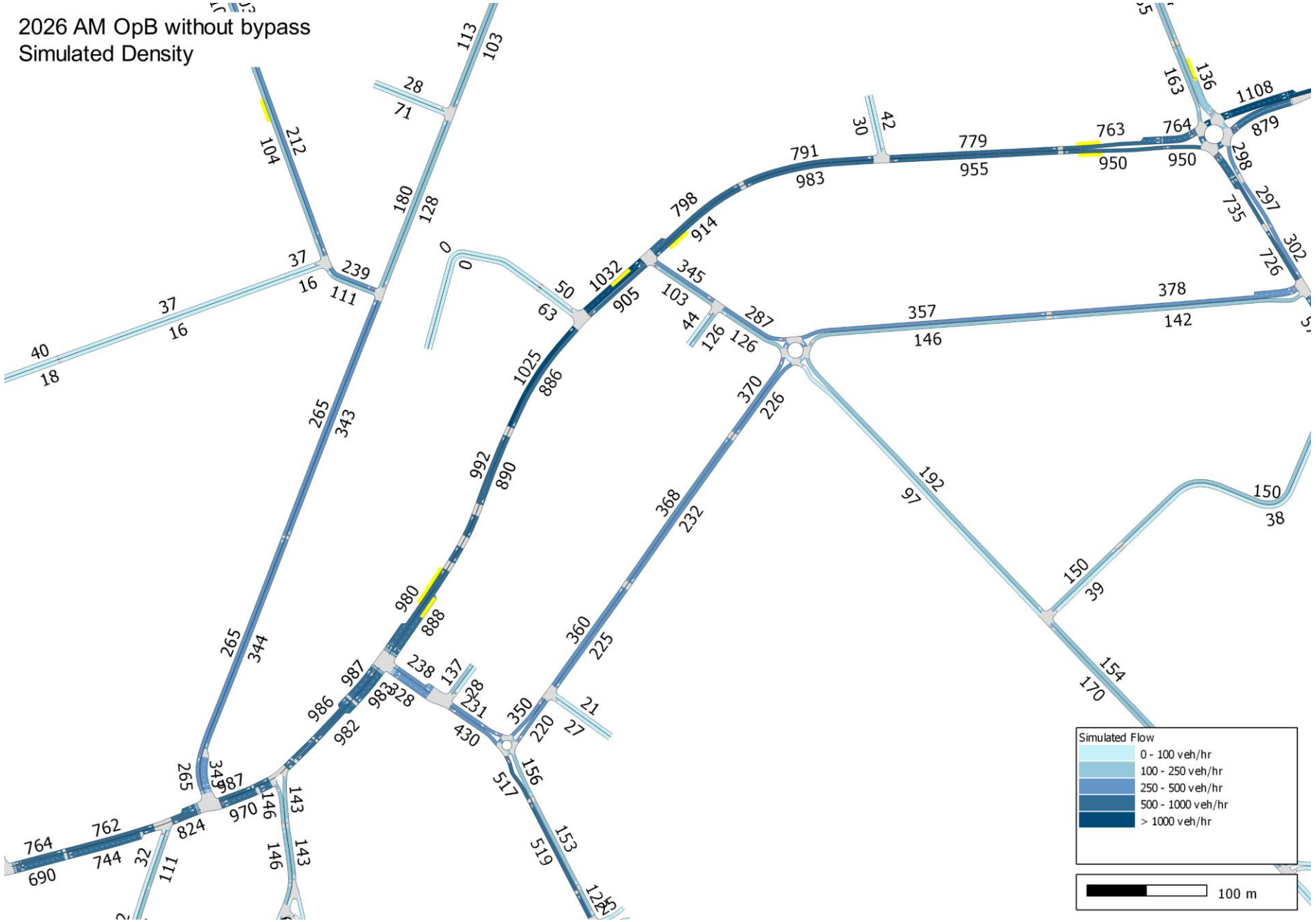

2026 PM OpA without bypass
Simulated Flow
BERRIMA RD
379
344
ARGYLE ST (MOSS VALE RD)
856
1008
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
395
415
BROUGHTON ST
VILLIERS RD
33
50
LOVELLE ST
261
231
358
305
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
99
105
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m

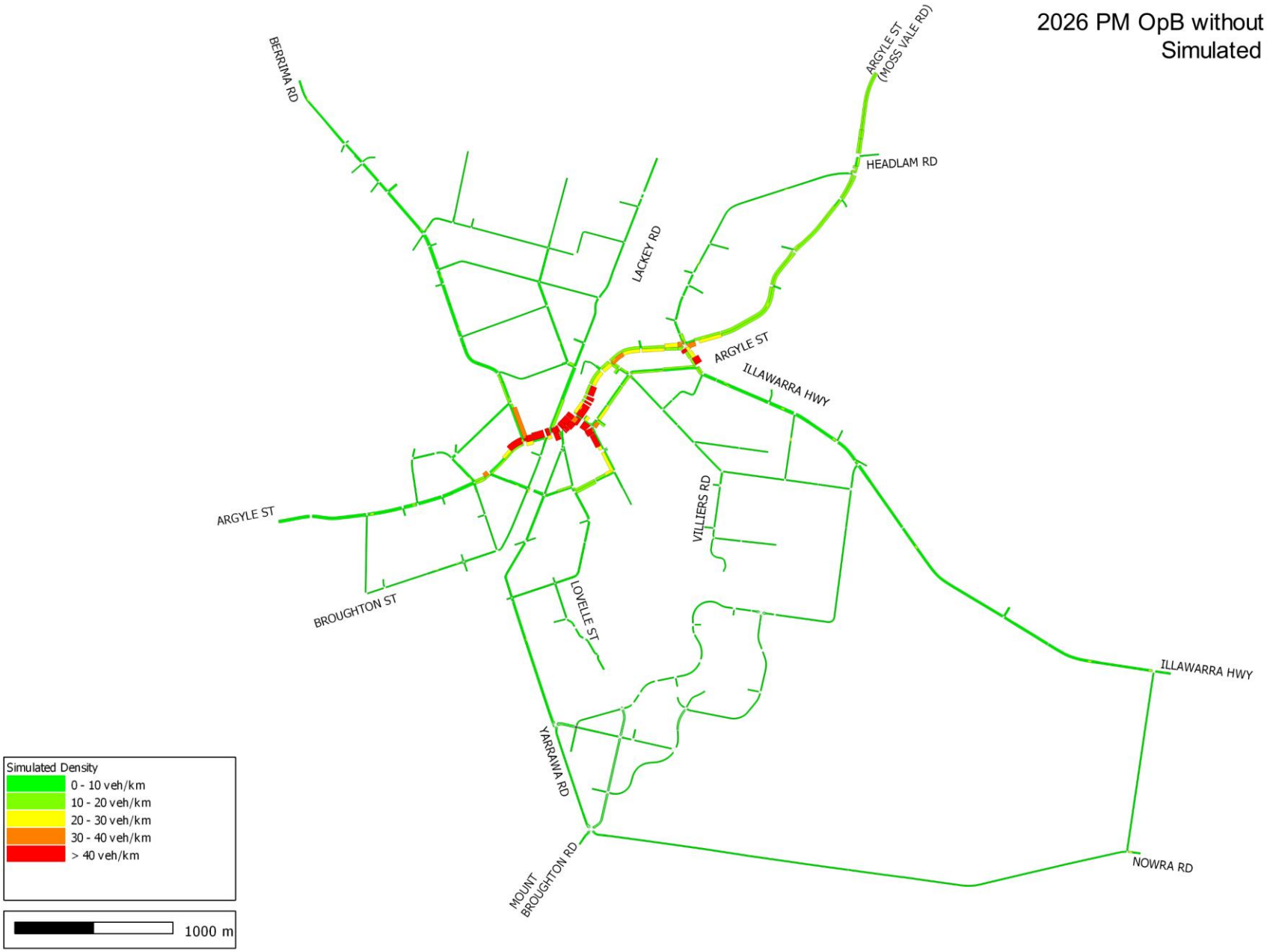

2026 PM OpA without bypass
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m

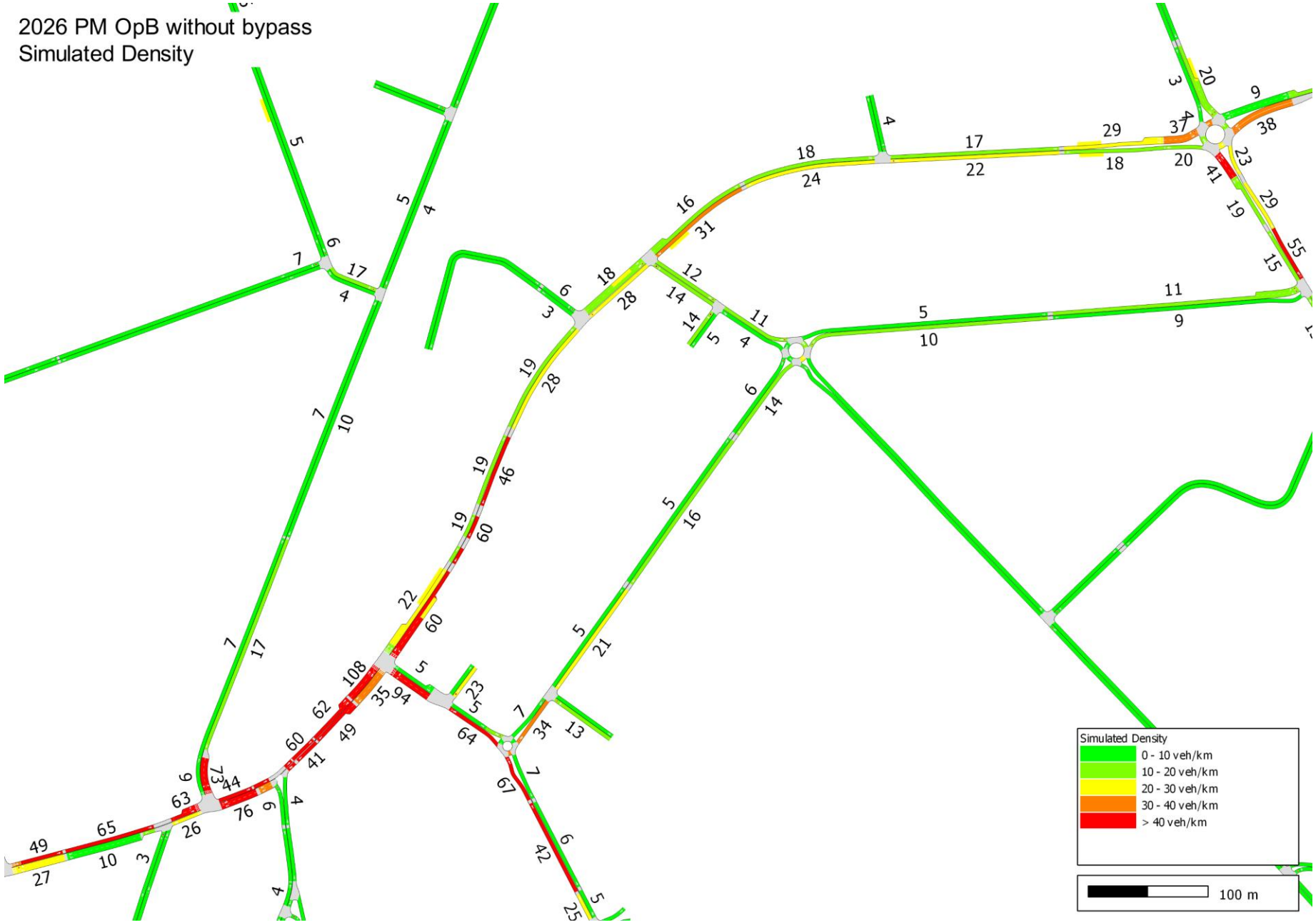

2026 AM OpB without bypass
Simulated Density
BERRIMA RD
ARGYLE ST (MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
VILLIERS RD
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

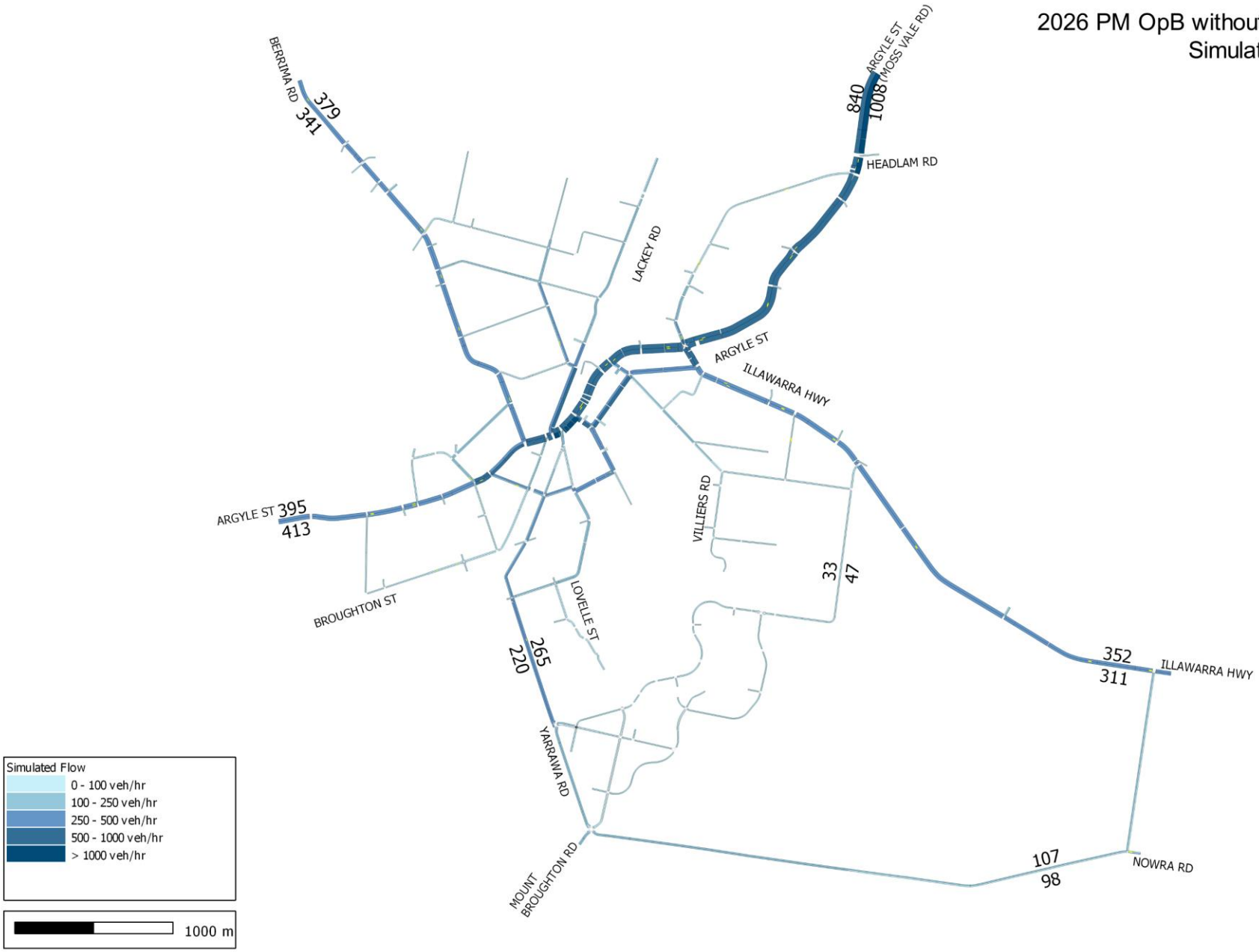

2026 AM OpB without bypass
Simulated Density
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
100 m

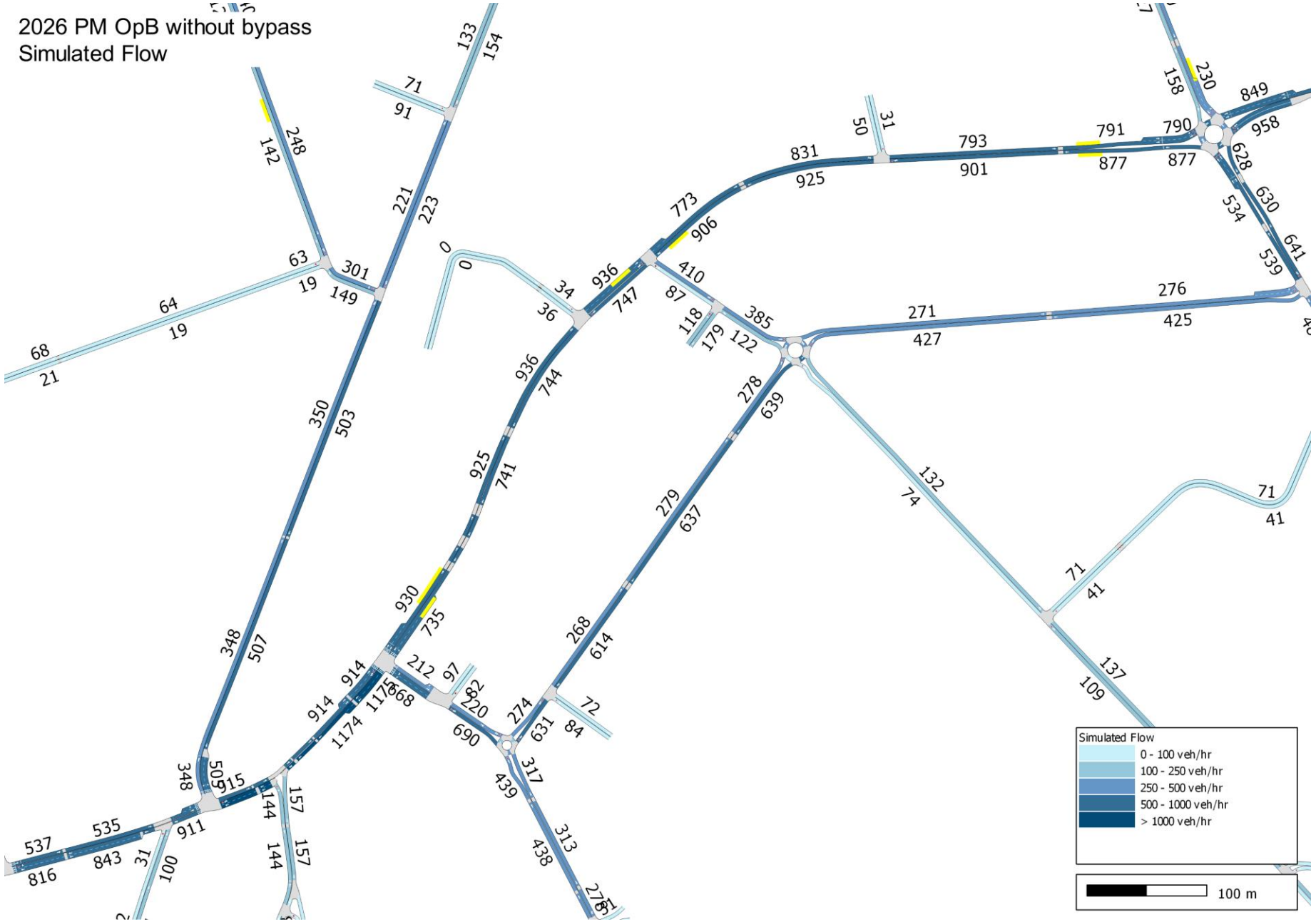

2026 AM OpB without bypass
Simulated Flow
BERRIMA RD
305
355
ARGYLE ST (MOSS VALE RD)
1206
786
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
413
309
BROUGHTON ST
VILLIERS RD
71
24
LOVELLE ST
274
279
262
308
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
102
51
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m


2026 AM OpB without bypass
Simulated Density
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m

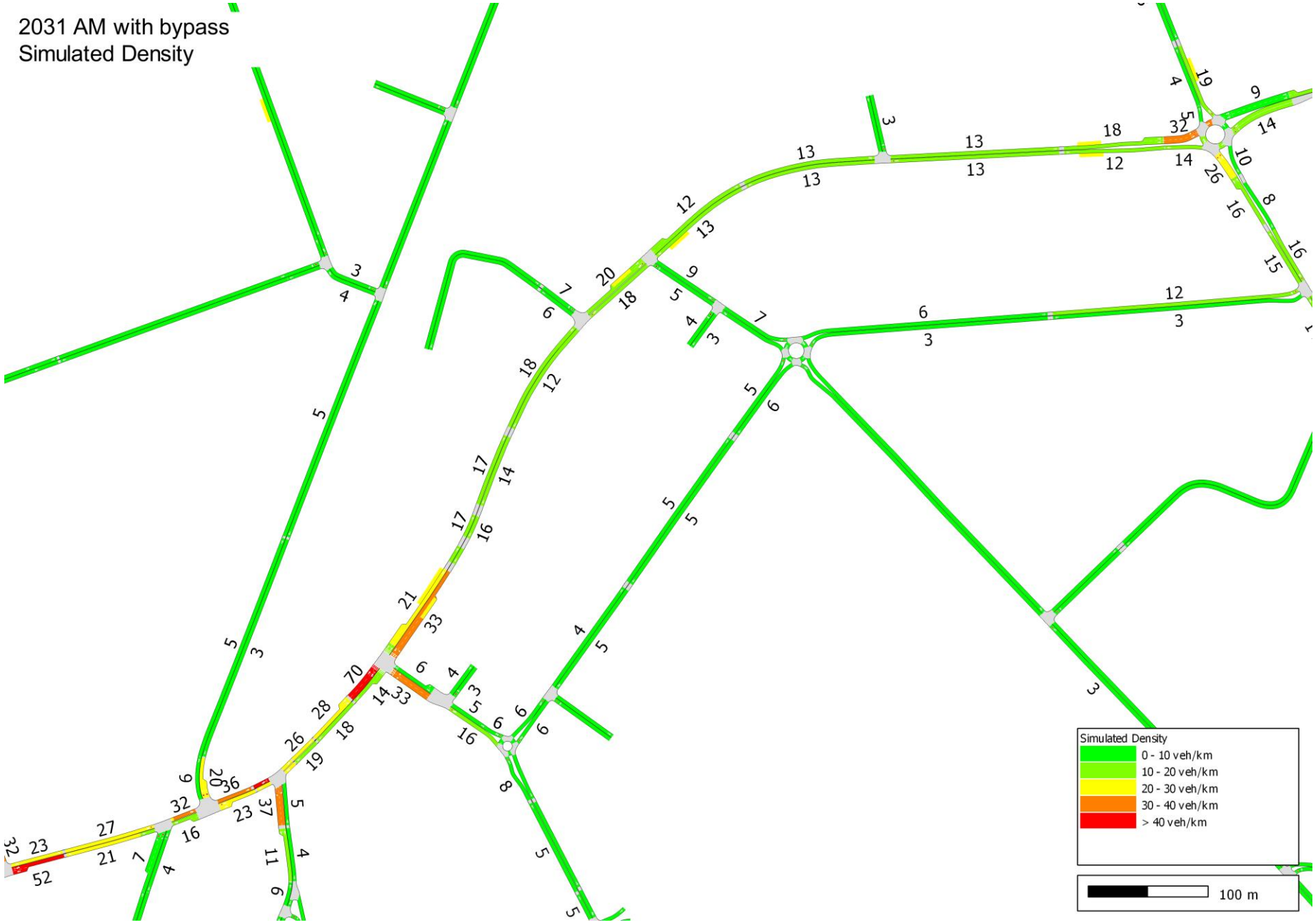

2026 PM OpB without bypass
Simulated Density
BERRIMA RD
ARGYLE ST (MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
VILLIERS RD
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

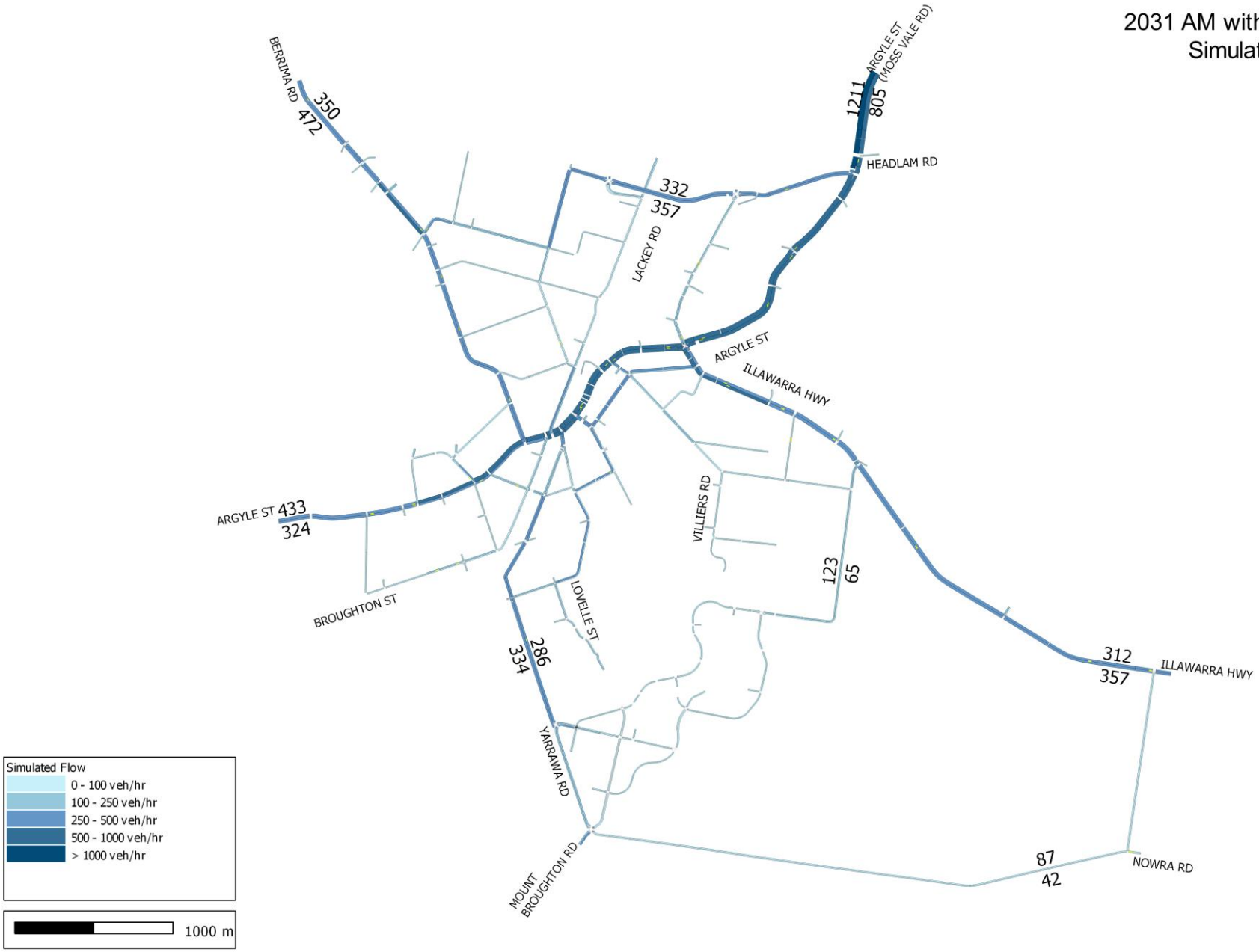

2026 PM OpB without bypass
Simulated Density
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
100 m

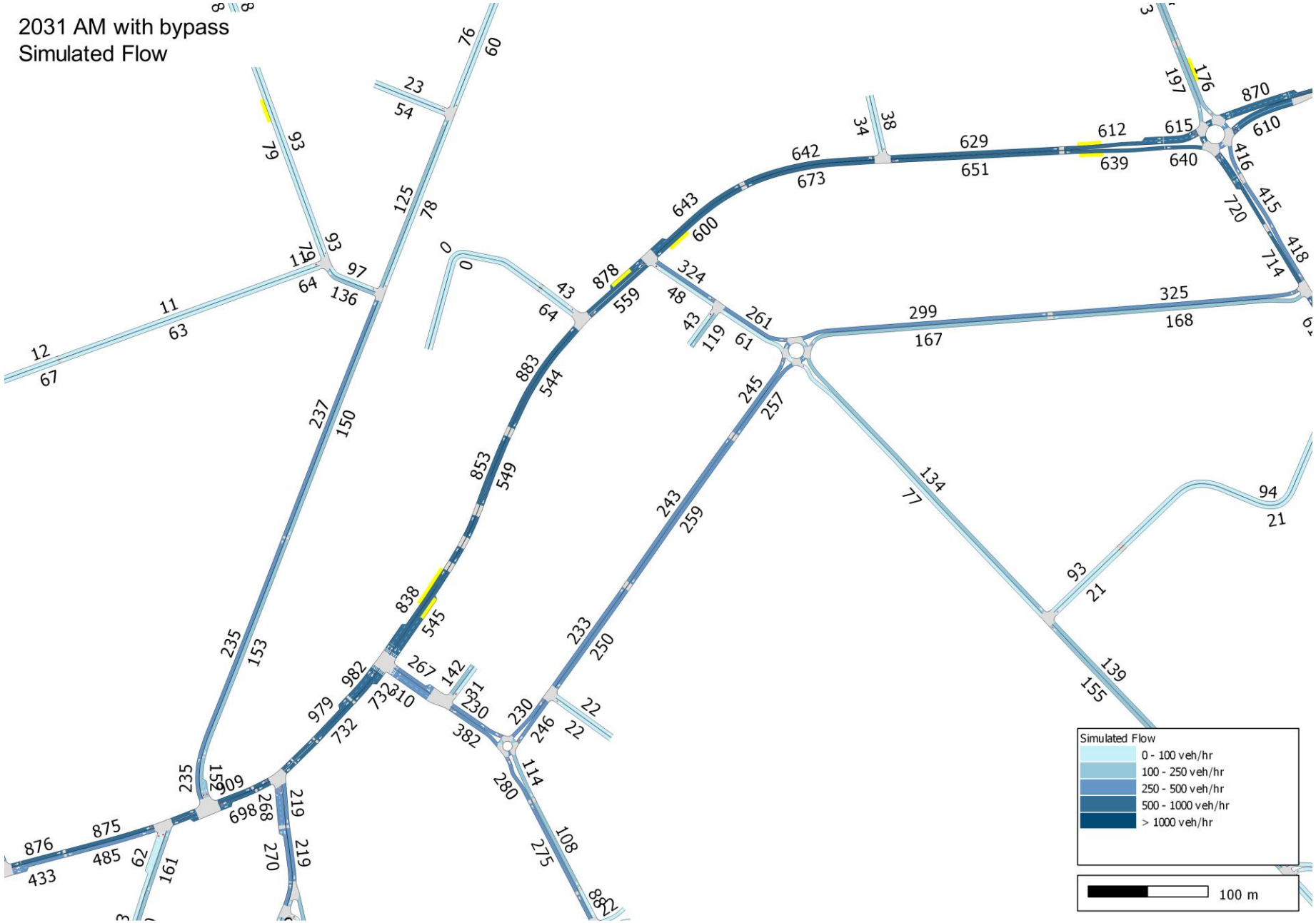

2026 PM OpB without bypass
Simulated Flow
BERRIMA RD
379
341
ARGYLE ST
(MOSS VALE RD)
840
1008
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
395
413
VILLIERS RD
33
47
BROUGHTON ST
LOVELLE ST
265
220
352
311
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
107
98
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m


2026 PM OpB without bypass
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m


2031 AM with bypass
Simulated Density
BERRIMA RD
ARGYLE ST
(MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
BROUGHTON ST
VILLIERS RD
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

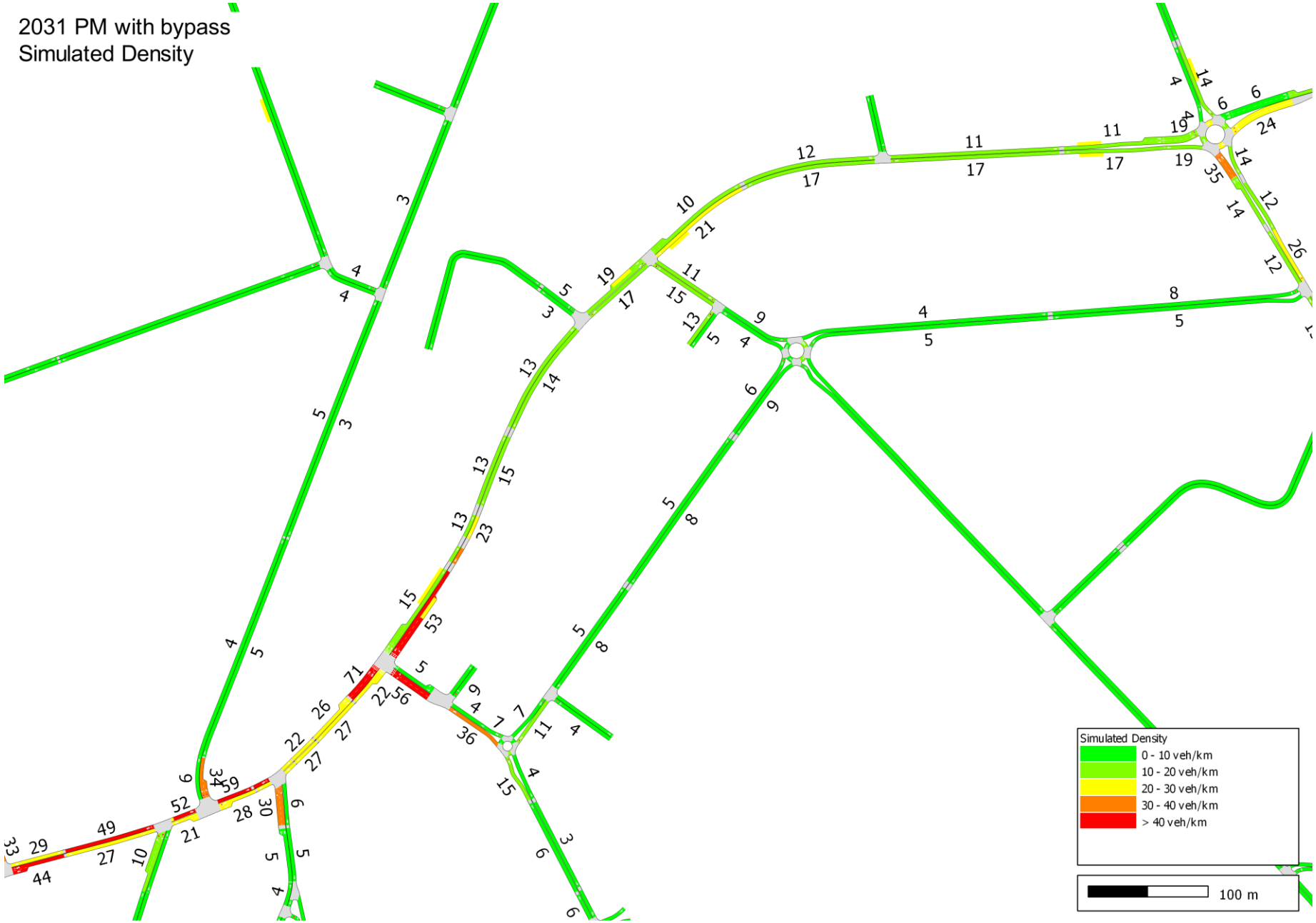

2031 AM with bypass
Simulated Density
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
100 m

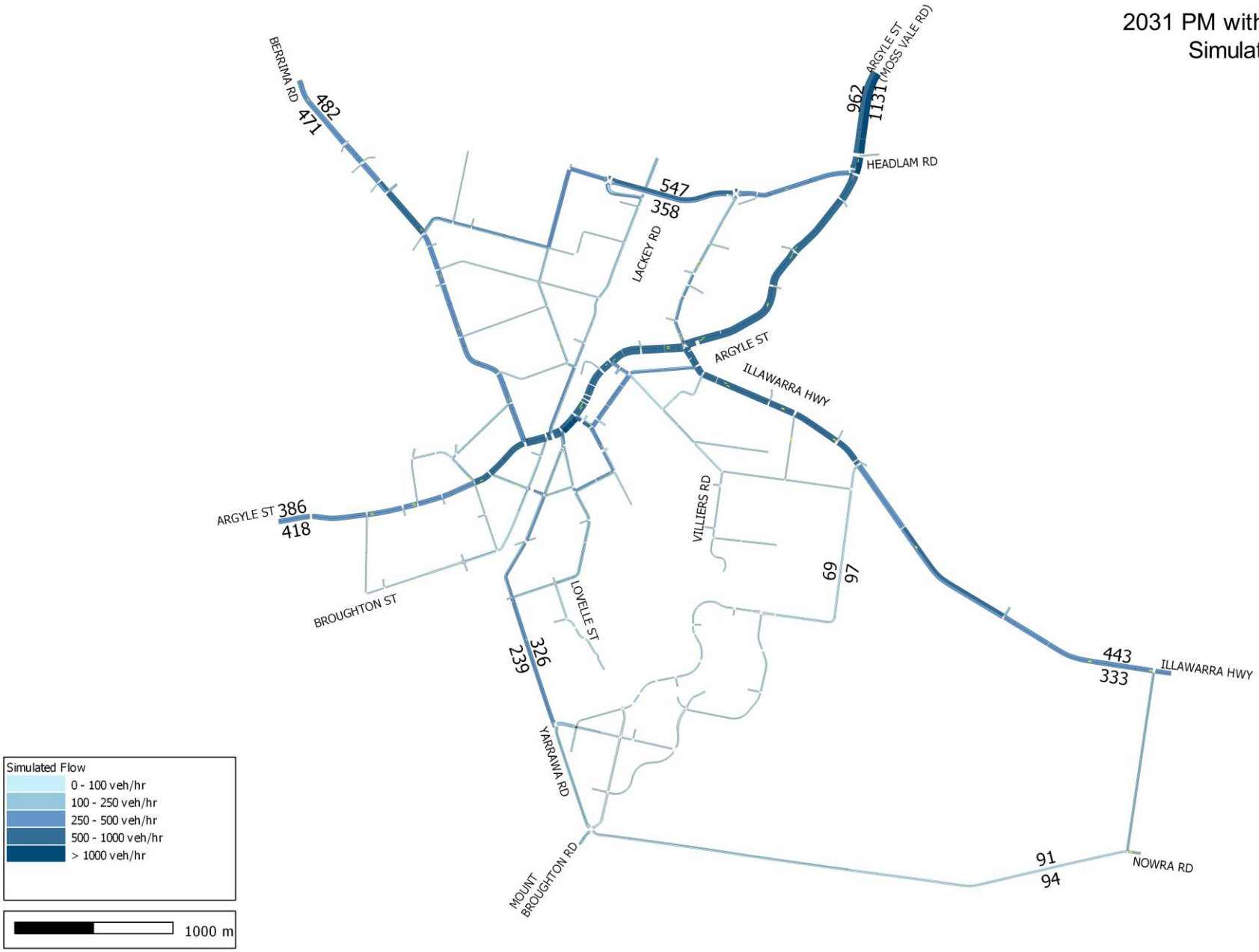

2031 AM with bypass
Simulated Flow
BERRIMA RD
350
472
ARGYLE ST
(MOSS VALE RD)
1211
805
HEADLAM RD
332
357
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
433
324
VILLIERS RD
123
65
BROUGHTON ST
LOVELLE ST
286
334
312
357
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
87
42
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m

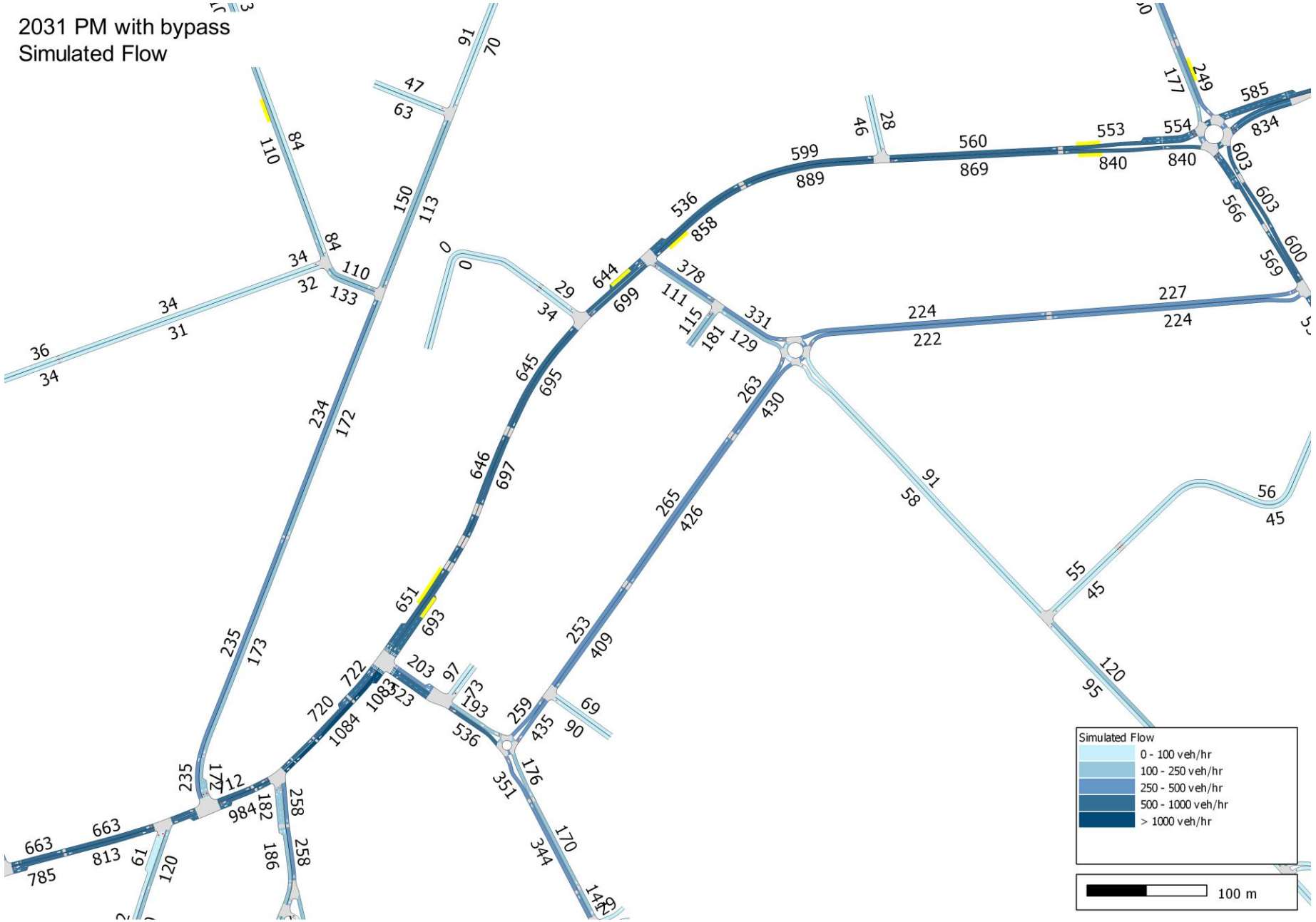

2031 AM with bypass
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m


2031 PM with bypass
Simulated Density
BERRIMA RD
ARGYLE ST
(MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
VILLIERS RD
BROUGHTON ST
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m

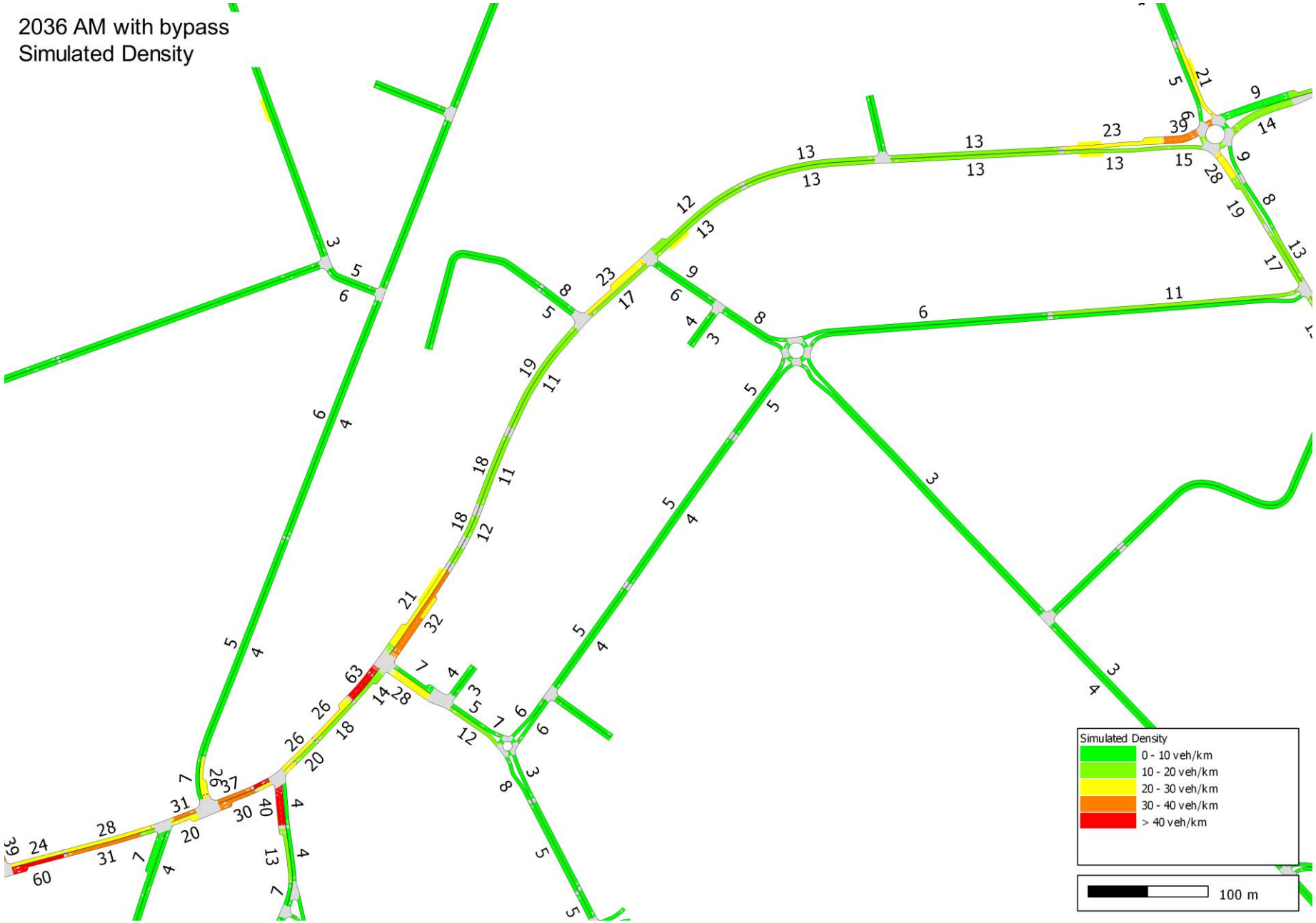
2031 PM with bypass
Simulated Density



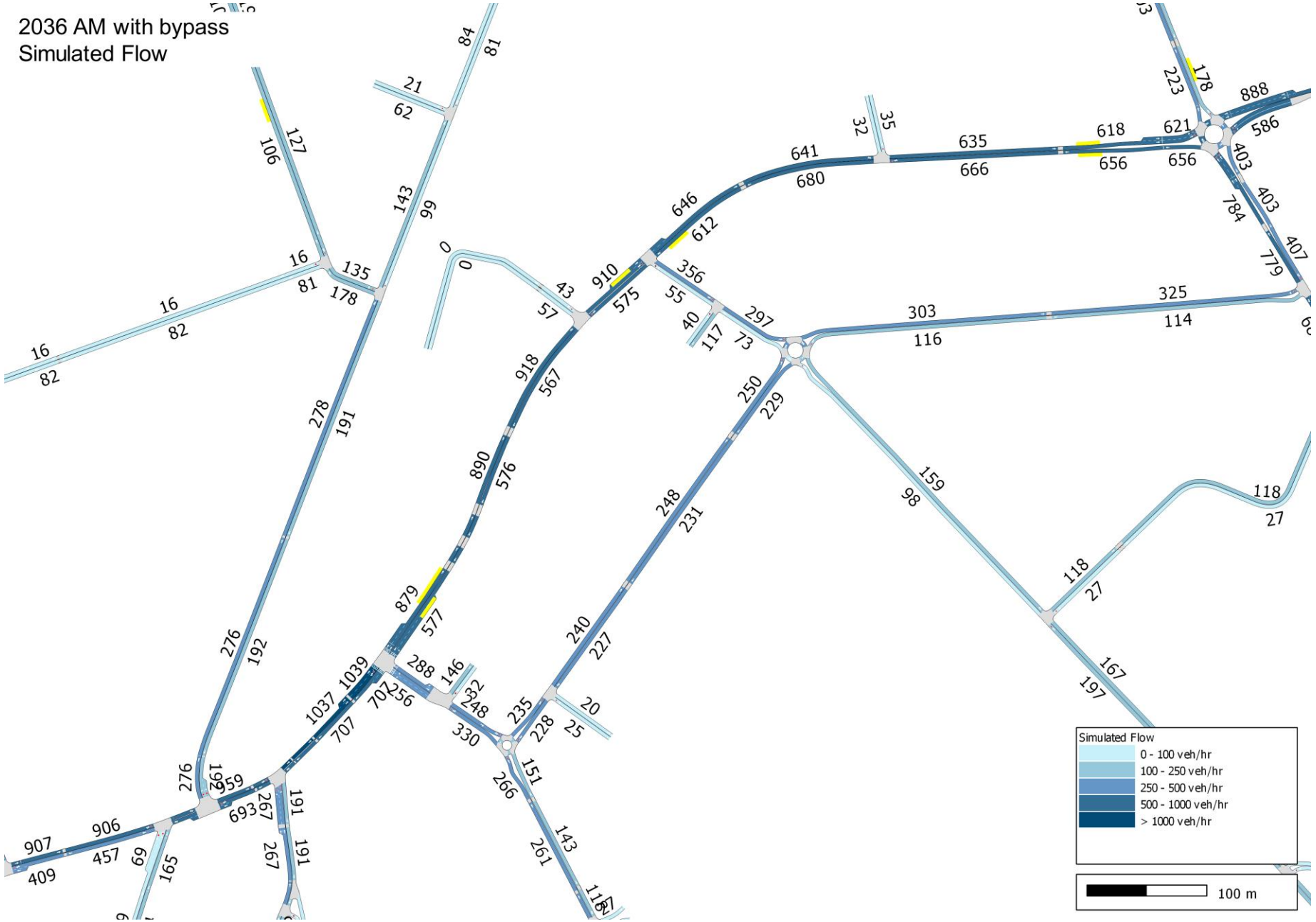

2031 PM with bypass
Simulated Flow
BERRIMA RD
482
471
ARGYLE ST (MOSS VALE RD)
962
1131
HEADLAM RD
547
358
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
386
418
BROUGHTON ST
VILLIERS RD
69
97
LOVELLE ST
326
239
443
333
ILLAWARRA HWY
YARRAWA RD
MOUNT BROUGHTON RD
91
94
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m

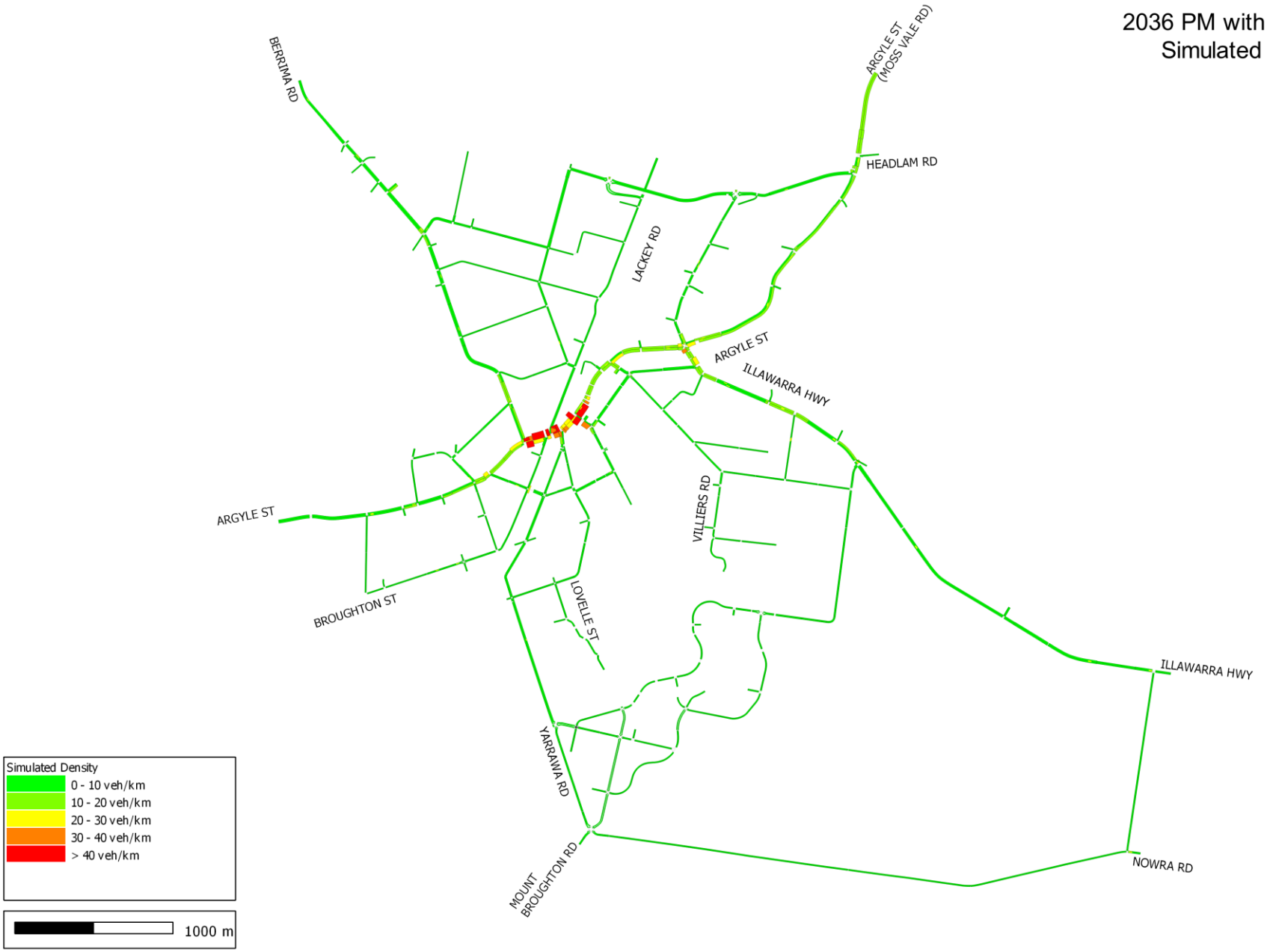

2031 PM with bypass
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m

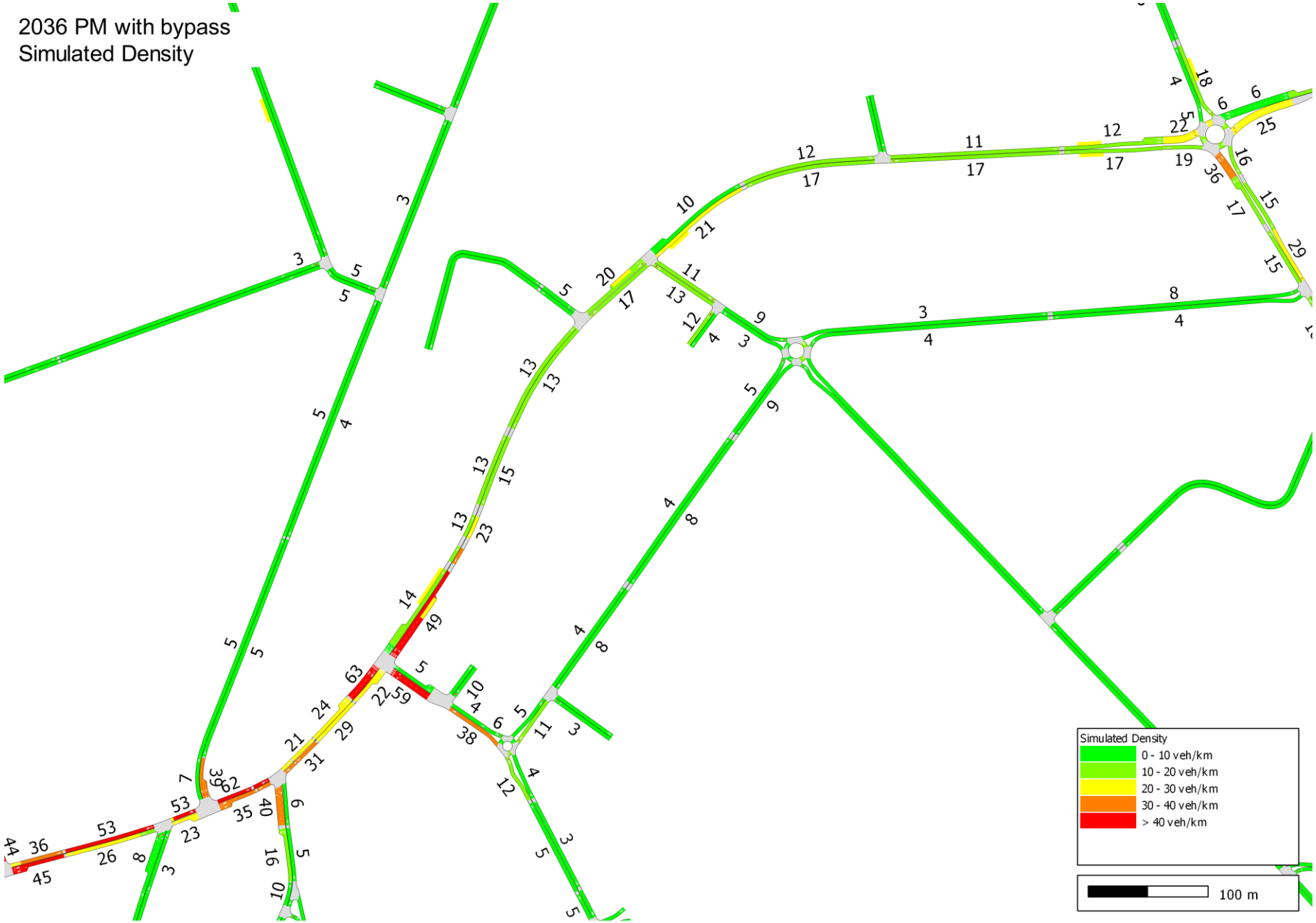

2036 AM with bypass
Simulated Density
BERRIMA RD
ARGYLE ST
(MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
BROUGHTON ST
VILLIERS RD
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m


2036 AM with bypass
Simulated Density
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
100 m

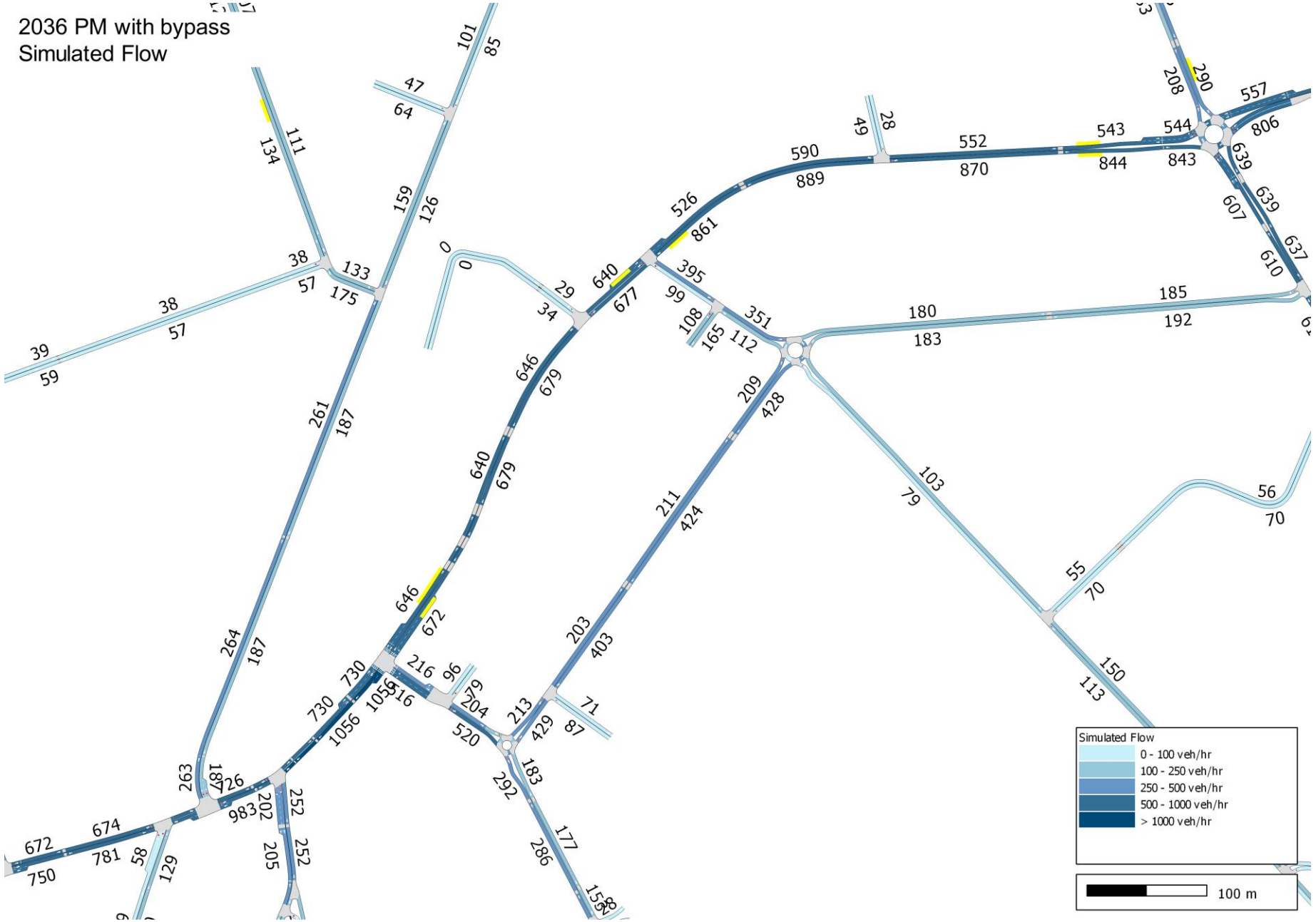

2036 AM with bypass
Simulated Flow
BERRIMA RD
420
563
ARGYLE ST
(MOSS VALE RD)
1267
836
HEADLAM RD
395
438
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
449
348
BROUGHTON ST
VILLIERS RD
207
105
LOVELLE ST
284
358
363
365
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
83
48
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m


2036 AM with bypass
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m


2036 PM with bypass
Simulated Density
BERRIMA RD
ARGYLE ST
(MOSS VALE RD)
HEADLAM RD
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
BROUGHTON ST
VILLIERS RD
LOVELLE ST
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
NOWRA RD
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
1000 m


2036 PM with bypass
Simulated Density
Simulated Density
0 - 10 veh/km
10 - 20 veh/km
20 - 30 veh/km
30 - 40 veh/km
> 40 veh/km
100 m


2036 PM with bypass
Simulated Flow
BERRIMA RD
578
536
ARGYLE ST
(MOSS VALE RD)
917
1100
HEADLAM RD
568
422
LACKEY RD
ARGYLE ST
ILLAWARRA HWY
ARGYLE ST
443
461
BROUGHTON ST
VILLIERS RD
103
148
LOVELLE ST
292
234
443
399
ILLAWARRA HWY
YARRAWA RD
MOUNT
BROUGHTON RD
92
80
NOWRA RD
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
1000 m


2036 PM with bypass
Simulated Flow
Simulated Flow
0 - 100 veh/hr
100 - 250 veh/hr
250 - 500 veh/hr
500 - 1000 veh/hr
> 1000 veh/hr
100 m

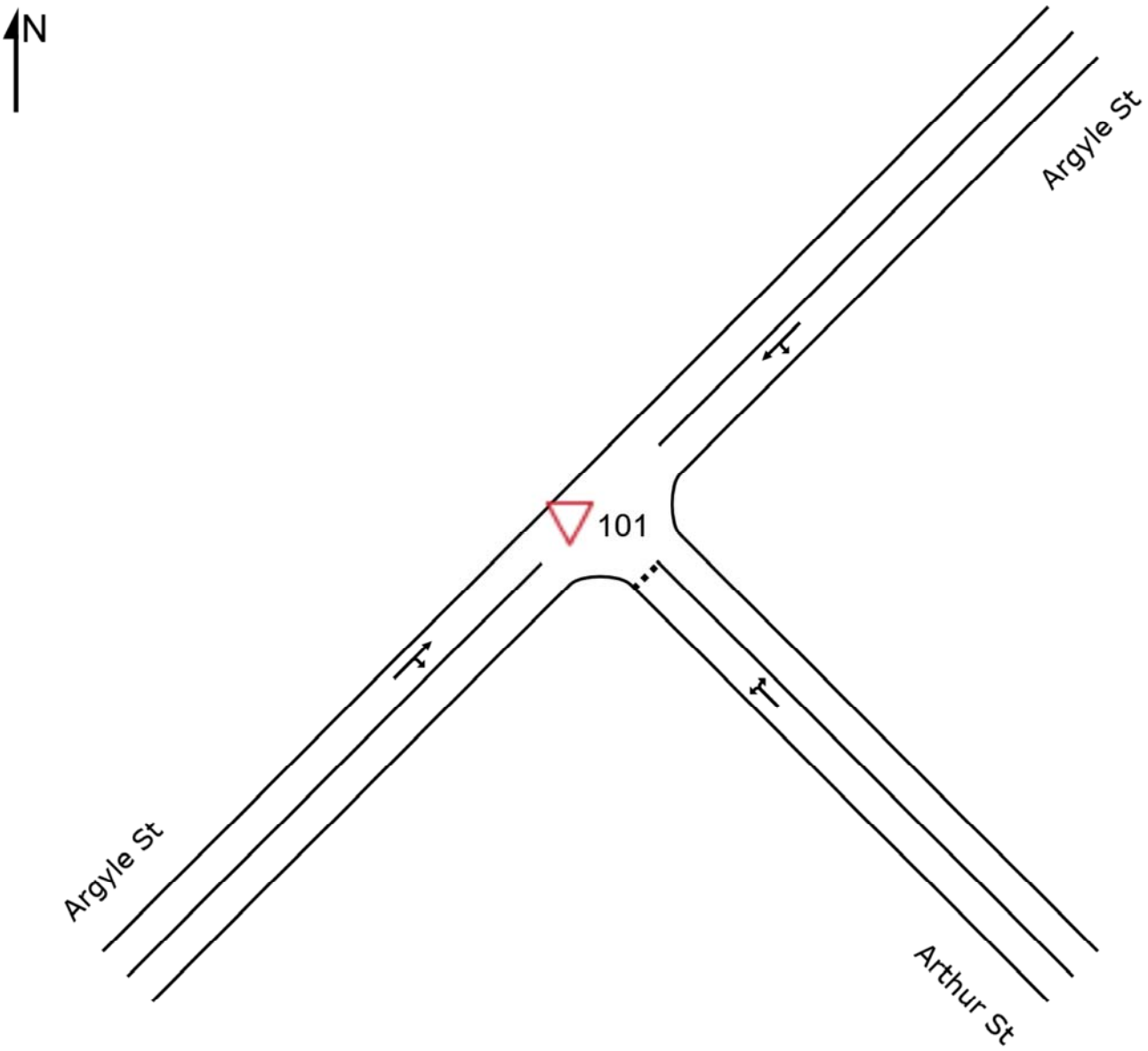
APPENDIX B

SIDRA RESULTS

SITE LAYOUT

Site: 101 [Argyle St / Arthur St (Base) - AM Peak]

Argyle St / Arthur St
Site Category: (None)
Giveway / Yield (Two-Way)



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Organisation: CARDNO (QLD) PTY LTD | Created: Monday, 8 July 2019 10:08:51 AM
Project: N:\Projects\820\FY18\221_Aoyuan Moss Vale Project PS\Des-An\Traffic Modelling\20181204 SIDRA Base and Future Models\Des-An\Model files\2016 SIDRA Models\2016 Base AM.sip8

MOVEMENT SUMMARY

Site: 101 [Argyle St / Arthur St (Base) - AM Peak]

Argyle St / Arthur St
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Arthur St												
4	L2	17	6.3	0.682	32.0	LOS C	2.4	17.2	0.96	1.13	1.50	27.7
6	R2	61	1.7	0.682	64.7	LOS E	2.4	17.2	0.96	1.13	1.50	27.6
Approach		78	2.7	0.682	57.6	LOS E	2.4	17.2	0.96	1.13	1.50	27.6
NorthEast: Argyle St												
7	L2	61	1.7	0.469	3.5	LOS A	0.0	0.0	0.00	0.03	0.00	40.0
8	T1	812	7.4	0.469	0.1	LOS A	0.0	0.0	0.00	0.03	0.00	39.8
Approach		873	7.0	0.469	0.3	NA	0.0	0.0	0.00	0.03	0.00	39.8
SouthWest: Argyle St												
2	T1	892	6.1	0.514	0.8	LOS A	1.1	7.9	0.11	0.01	0.16	39.5
3	R2	21	5.0	0.514	16.1	LOS B	1.1	7.9	0.11	0.01	0.16	42.9
Approach		913	6.1	0.514	1.2	NA	1.1	7.9	0.11	0.01	0.16	39.6
All Vehicles		1863	6.4	0.682	3.1	NA	2.4	17.2	0.09	0.07	0.14	39.0

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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 SUMMARY

Site: 101 [Argyle St / Arthur St (Base) - PM Peak]

Argyle St / Arthur St
Site Category: (None)
Giveway / Yield (Two-Way)

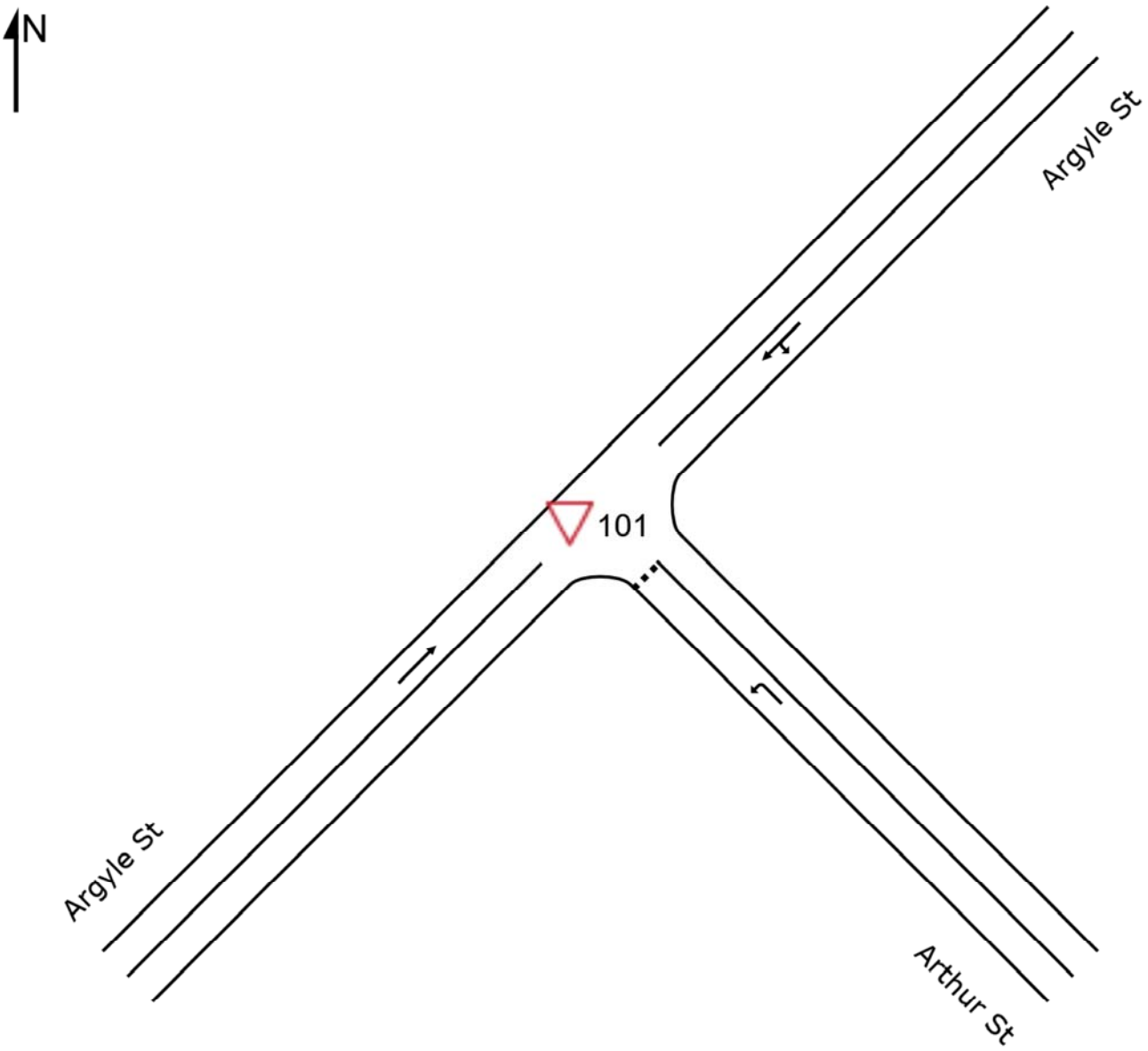
Movement Performance - Vehicles													
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Arthur St												
4	L2	13	0.0	0.753	52.8	LOS D	2.6	18.1	0.98	1.15	1.58	22.7
6	R2	49	0.0	0.753	95.6	LOS F	2.6	18.1	0.98	1.15	1.58	22.6
Approach		62	0.0	0.753	86.9	LOS F	2.6	18.1	0.98	1.15	1.58	22.6
NorthEast: Argyle St												
7	L2	40	2.6	0.554	3.5	LOS A	0.0	0.0	0.00	0.02	0.00	40.0
8	T1	1004	5.1	0.554	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	39.8
Approach		1044	5.0	0.554	0.2	NA	0.0	0.0	0.00	0.02	0.00	39.9
SouthWest: Argyle St												
2	T1	827	5.6	0.496	1.6	LOS A	1.6	11.8	0.15	0.02	0.22	39.1
3	R2	21	5.0	0.496	22.0	LOS B	1.6	11.8	0.15	0.02	0.22	42.5
Approach		848	5.6	0.496	2.2	NA	1.6	11.8	0.15	0.02	0.22	39.2
All Vehicles		1955	5.1	0.753	3.8	NA	2.6	18.1	0.10	0.05	0.15	38.6

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

SITE LAYOUT

Site: 101 [Argyle St / Arthur St (Base+CG) - AM Peak]

Argyle St / Arthur St
Site Category: (None)
Giveway / Yield (Two-Way)



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Organisation: CARDNO (QLD) PTY LTD | Created: Monday, 8 July 2019 10:08:23 AM
Project: N:\Projects\820\FY18\221_Aoyuan Moss Vale Project PS\Des-An\Traffic Modelling\20181204 SIDRA Base and Future Models\Des-An\Model files\2016 SIDRA Models\2016 Base AM.sip8

MOVEMENT SUMMARY

Site: 101 [Argyle St / Arthur St (Base+CG) - AM Peak]

Argyle St / Arthur St
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Arthur St												
4	L2	141	8.2	0.232	10.0	LOS A	0.9	6.7	0.67	0.86	0.72	43.6
Approach		141	8.2	0.232	10.0	LOS A	0.9	6.7	0.67	0.86	0.72	43.6
NorthEast: Argyle St												
7	L2	138	3.1	0.486	3.5	LOS A	0.0	0.0	0.00	0.07	0.00	39.8
8	T1	762	7.7	0.486	0.1	LOS A	0.0	0.0	0.00	0.07	0.00	39.7
Approach		900	7.0	0.486	0.6	NA	0.0	0.0	0.00	0.07	0.00	39.7
SouthWest: Argyle St												
2	T1	1046	5.6	0.556	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.9
Approach		1046	5.6	0.556	0.1	NA	0.0	0.0	0.00	0.00	0.00	39.9
All Vehicles		2087	6.4	0.556	1.0	NA	0.9	6.7	0.05	0.09	0.05	40.1

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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MOVEMENT SUMMARY

Site: 101 [Argyle St / Arthur St (Base+CG) - PM Peak]

Argyle St / Arthur St
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Arthur St												
4	L2	139	6.1	0.307	13.2	LOS A	1.2	8.8	0.78	0.95	0.94	42.0
Approach		139	6.1	0.307	13.2	LOS A	1.2	8.8	0.78	0.95	0.94	42.0
NorthEast: Argyle St												
7	L2	176	5.4	0.594	3.6	LOS A	0.0	0.0	0.00	0.07	0.00	39.8
8	T1	928	6.3	0.594	0.1	LOS A	0.0	0.0	0.00	0.07	0.00	39.7
Approach		1104	6.2	0.594	0.7	NA	0.0	0.0	0.00	0.07	0.00	39.7
SouthWest: Argyle St												
2	T1	968	6.1	0.516	0.1	LOS A	0.0	0.0	0.00	0.00	0.00	39.9
Approach		968	6.1	0.516	0.1	NA	0.0	0.0	0.00	0.00	0.00	39.9
All Vehicles		2212	6.1	0.594	1.2	NA	1.2	8.8	0.05	0.10	0.06	39.9

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

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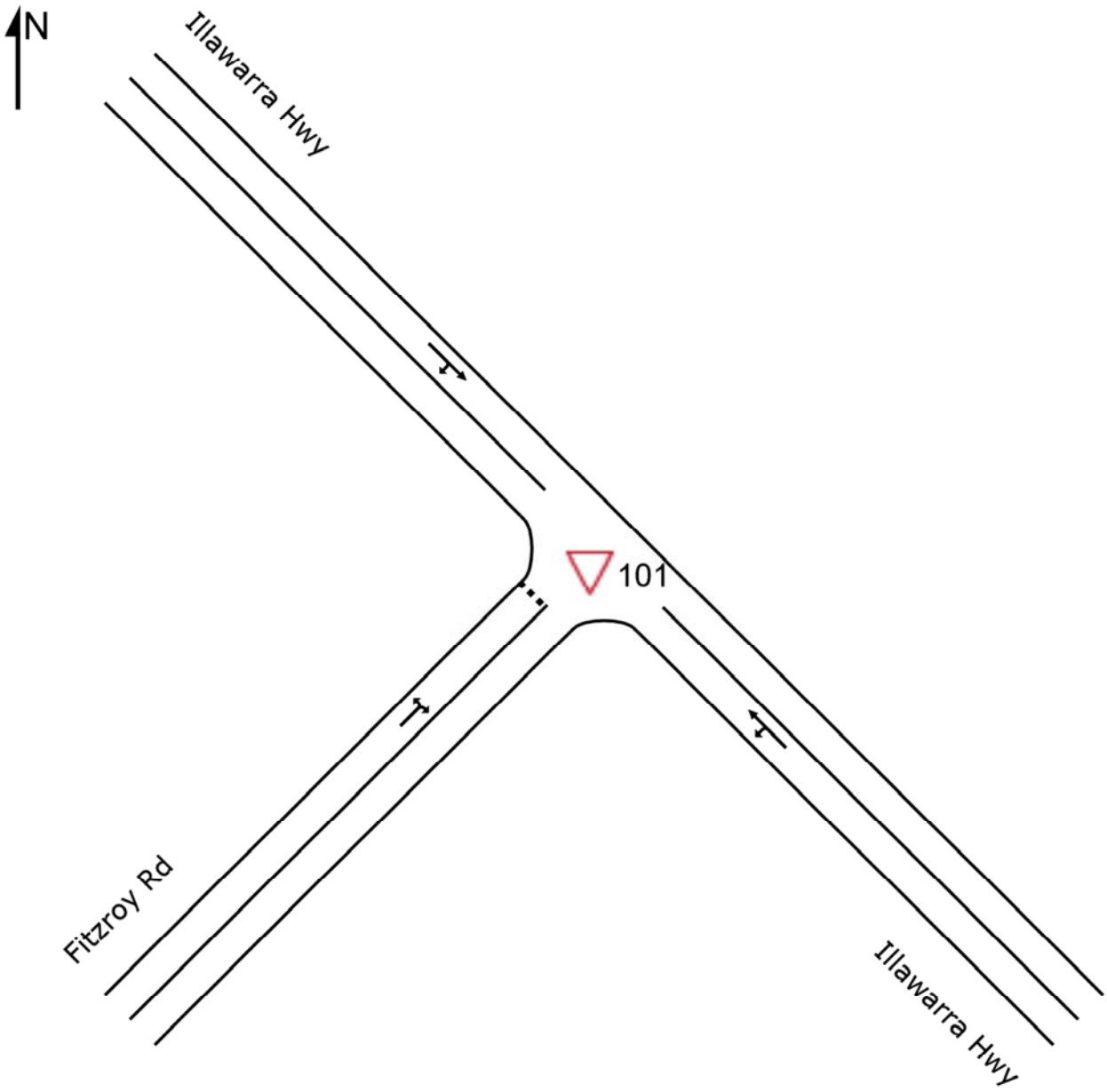
SITE LAYOUT

Site: 101 [Illawarra Hwy / Fitzroy Rd (Base) - AM Peak]

Illawarra Hwy / Fitzroy Rd
Site Category: (None)
Giveway / Yield (Two-Way)



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Organisation: CARDNO (QLD) PTY LTD | Created: Monday, 8 July 2019 10:07:32 AM
Project: N:\Projects\820\FY18\221_Aoyuan Moss Vale Project PS\Des-An\Traffic Modelling\20181204 SIDRA Base and Future Models\Des-An\Model files\2016 SIDRA Models\2016 Base AM.sip8

MOVEMENT SUMMARY

Site: 101 [Illawarra Hwy / Fitzroy Rd (Base) - AM Peak]

Illawarra Hwy / Fitzroy Rd
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Illawarra Hwy												
1	L2	16	0.0	0.126	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	58.0
2	T1	220	6.2	0.126	0.0	LOS A	0.0	0.0	0.00	0.04	0.00	59.6
Approach		236	5.8	0.126	0.4	NA	0.0	0.0	0.00	0.04	0.00	59.5
NorthWest: Illawarra Hwy												
8	T1	308	2.7	0.162	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	60.0
9	R2	1	0.0	0.162	6.4	LOS A	0.0	0.1	0.00	0.00	0.00	53.4
Approach		309	2.7	0.162	0.0	NA	0.0	0.1	0.00	0.00	0.00	59.9
SouthWest: Fitzroy Rd												
10	L2	1	0.0	0.002	5.2	LOS A	0.0	0.1	0.34	0.53	0.34	48.9
12	R2	1	0.0	0.002	6.8	LOS A	0.0	0.1	0.34	0.53	0.34	48.4
Approach		2	0.0	0.002	6.0	LOS A	0.0	0.1	0.34	0.53	0.34	48.7
All Vehicles		547	4.0	0.162	0.2	NA	0.0	0.1	0.00	0.02	0.00	59.7

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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 SUMMARY

Site: 101 [Illawarra Hwy / Fitzroy Rd (Base) - PM Peak]

Illawarra Hwy / Fitzroy Rd
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

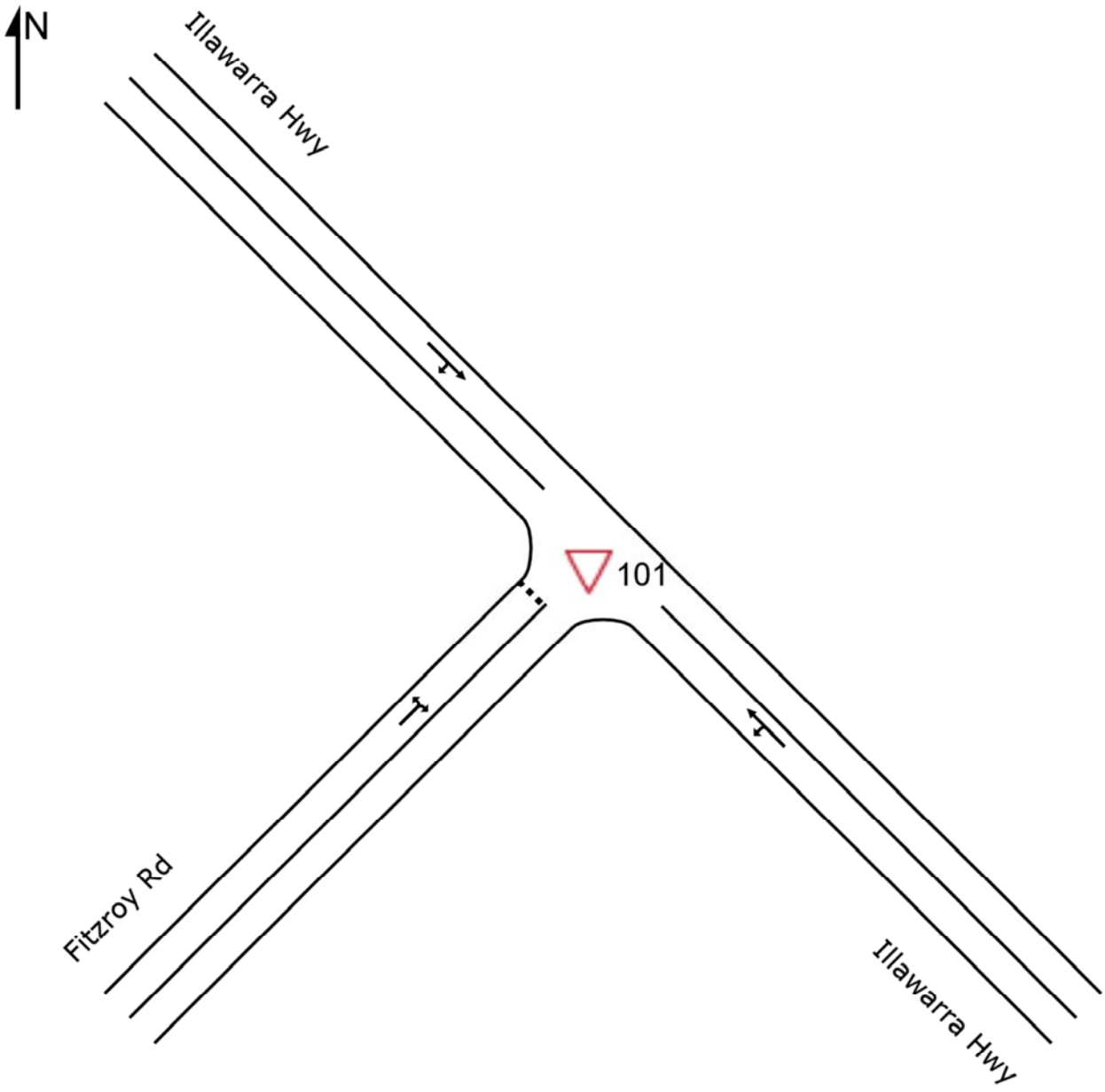
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Illawarra Hwy												
1	L2	4	25.0	0.196	5.8	LOS A	0.0	0.0	0.00	0.01	0.00	57.0
2	T1	371	2.8	0.196	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	59.9
Approach		375	3.1	0.196	0.1	NA	0.0	0.0	0.00	0.01	0.00	59.9
NorthWest: Illawarra Hwy												
8	T1	314	3.7	0.166	0.0	LOS A	0.0	0.1	0.00	0.00	0.00	60.0
9	R2	1	0.0	0.166	7.1	LOS A	0.0	0.1	0.00	0.00	0.00	53.4
Approach		315	3.7	0.166	0.0	NA	0.0	0.1	0.00	0.00	0.00	59.9
SouthWest: Fitzroy Rd												
10	L2	1	0.0	0.014	5.8	LOS A	0.0	0.3	0.49	0.67	0.49	47.8
12	R2	8	0.0	0.014	7.8	LOS A	0.0	0.3	0.49	0.67	0.49	47.4
Approach		9	0.0	0.014	7.6	LOS A	0.0	0.3	0.49	0.67	0.49	47.5
All Vehicles		699	3.3	0.196	0.2	NA	0.0	0.3	0.01	0.01	0.01	59.7

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

SITE LAYOUT

Site: 101 [Illawarra Hwy / Fitzroy Rd (Base+CG) - AM Peak]

Illawarra Hwy / Fitzroy Rd
Site Category: (None)
Giveway / Yield (Two-Way)



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MOVEMENT SUMMARY

Site: 101 [Illawarra Hwy / Fitzroy Rd (Base+CG) - AM Peak]

Illawarra Hwy / Fitzroy Rd
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Illawarra Hwy												
1	L2	64	1.6	0.148	5.6	LOS A	0.0	0.0	0.00	0.14	0.00	57.0
2	T1	211	6.5	0.148	0.0	LOS A	0.0	0.0	0.00	0.14	0.00	58.7
Approach		275	5.4	0.148	1.3	NA	0.0	0.0	0.00	0.14	0.00	58.3
NorthWest: Illawarra Hwy												
8	T1	329	2.6	0.225	0.3	LOS A	0.6	4.4	0.17	0.10	0.17	58.5
9	R2	65	9.7	0.225	6.9	LOS A	0.6	4.4	0.17	0.10	0.17	52.0
Approach		395	3.7	0.225	1.4	NA	0.6	4.4	0.17	0.10	0.17	57.3
SouthWest: Fitzroy Rd												
10	L2	155	5.4	0.180	5.4	LOS A	0.7	5.3	0.35	0.59	0.35	48.7
12	R2	40	5.3	0.180	8.5	LOS A	0.7	5.3	0.35	0.59	0.35	48.2
Approach		195	5.4	0.180	6.1	LOS A	0.7	5.3	0.35	0.59	0.35	48.6
All Vehicles		864	4.6	0.225	2.4	NA	0.7	5.3	0.16	0.22	0.16	55.3

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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 SUMMARY

Site: 101 [Illawarra Hwy / Fitzroy Rd (Base+CG) - PM Peak]

Illawarra Hwy / Fitzroy Rd
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

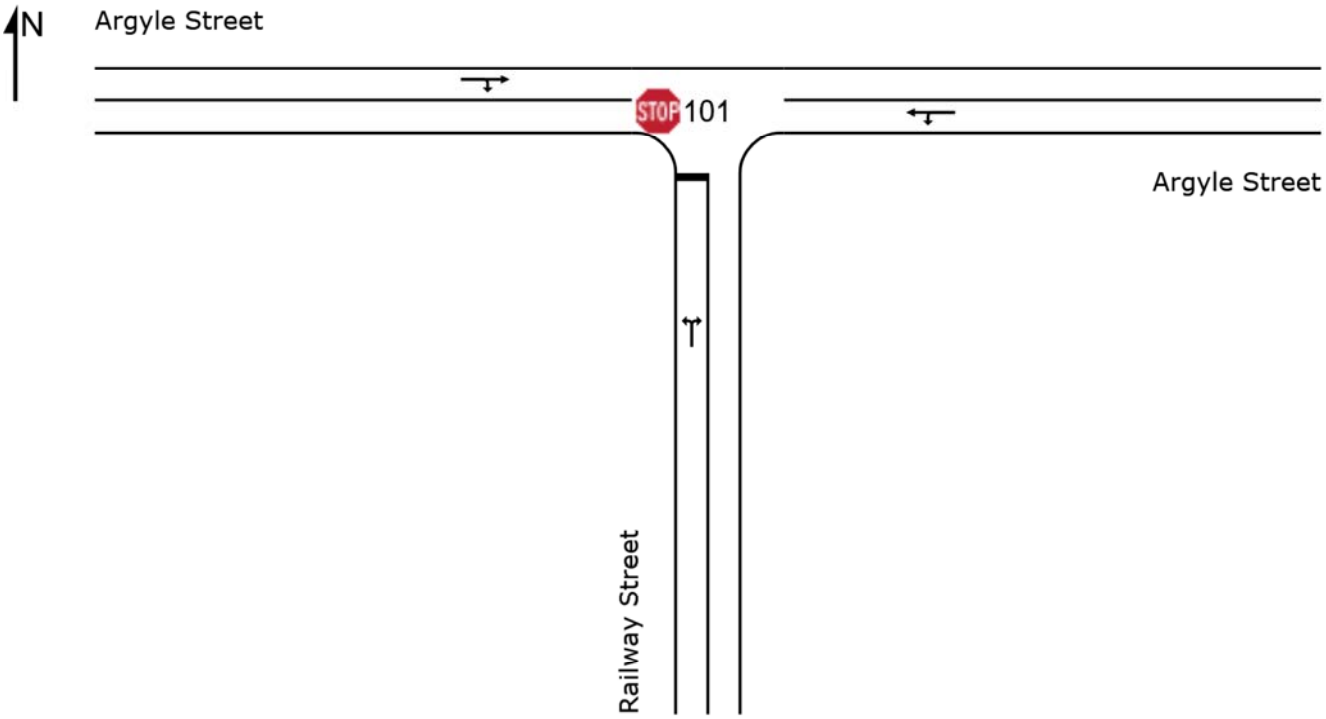
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: Illawarra Hwy												
1	L2	31	6.9	0.208	5.6	LOS A	0.0	0.0	0.00	0.05	0.00	57.6
2	T1	362	3.8	0.208	0.0	LOS A	0.0	0.0	0.00	0.05	0.00	59.5
Approach		393	4.0	0.208	0.5	NA	0.0	0.0	0.00	0.05	0.00	59.4
NorthWest: Illawarra Hwy												
8	T1	323	3.9	0.275	0.9	LOS A	1.2	8.6	0.33	0.18	0.33	57.3
9	R2	119	6.2	0.275	7.6	LOS A	1.2	8.6	0.33	0.18	0.33	51.2
Approach		442	4.5	0.275	2.7	NA	1.2	8.6	0.33	0.18	0.33	55.5
SouthWest: Fitzroy Rd												
10	L2	72	5.9	0.142	6.1	LOS A	0.5	3.7	0.48	0.69	0.48	47.7
12	R2	40	5.3	0.142	10.0	LOS A	0.5	3.7	0.48	0.69	0.48	47.3
Approach		112	5.7	0.142	7.5	LOS A	0.5	3.7	0.48	0.69	0.48	47.6
All Vehicles		946	4.4	0.275	2.3	NA	1.2	8.6	0.21	0.19	0.21	55.9

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

SITE LAYOUT

Site: 101 [Argyle St / Railway St (Base) - AM Peak]

Argyle St / Railway St
Site Category: (None)
Stop (Two-Way)



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MOVEMENT SUMMARY

Site: 101 [Argyle St / Railway St (Base) - AM Peak]

Argyle St / Railway St
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Railway Street												
1	L2	3	0.0	0.250	11.6	LOS A	0.7	4.9	0.86	1.03	0.96	32.2
3	R2	43	7.3	0.250	24.9	LOS B	0.7	4.9	0.86	1.03	0.96	32.0
Approach		46	6.8	0.250	24.0	LOS B	0.7	4.9	0.86	1.03	0.96	32.0
East: Argyle Street												
4	L2	121	6.1	0.389	3.5	LOS A	0.0	0.0	0.00	0.08	0.00	39.8
5	T1	601	6.3	0.389	0.1	LOS A	0.0	0.0	0.00	0.08	0.00	39.7
Approach		722	6.3	0.389	0.6	NA	0.0	0.0	0.00	0.08	0.00	39.7
West: Argyle Street												
11	T1	869	5.7	0.484	0.3	LOS A	0.5	3.9	0.06	0.01	0.09	39.8
12	R2	15	7.1	0.484	11.8	LOS A	0.5	3.9	0.06	0.01	0.09	39.5
Approach		884	5.7	0.484	0.5	NA	0.5	3.9	0.06	0.01	0.09	39.8
All Vehicles		1653	6.0	0.484	1.2	NA	0.7	4.9	0.06	0.07	0.07	39.5

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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 SUMMARY

Site: 101 [Argyle St / Railway St (Base) - PM Peak]

Argyle St / Railway St
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles

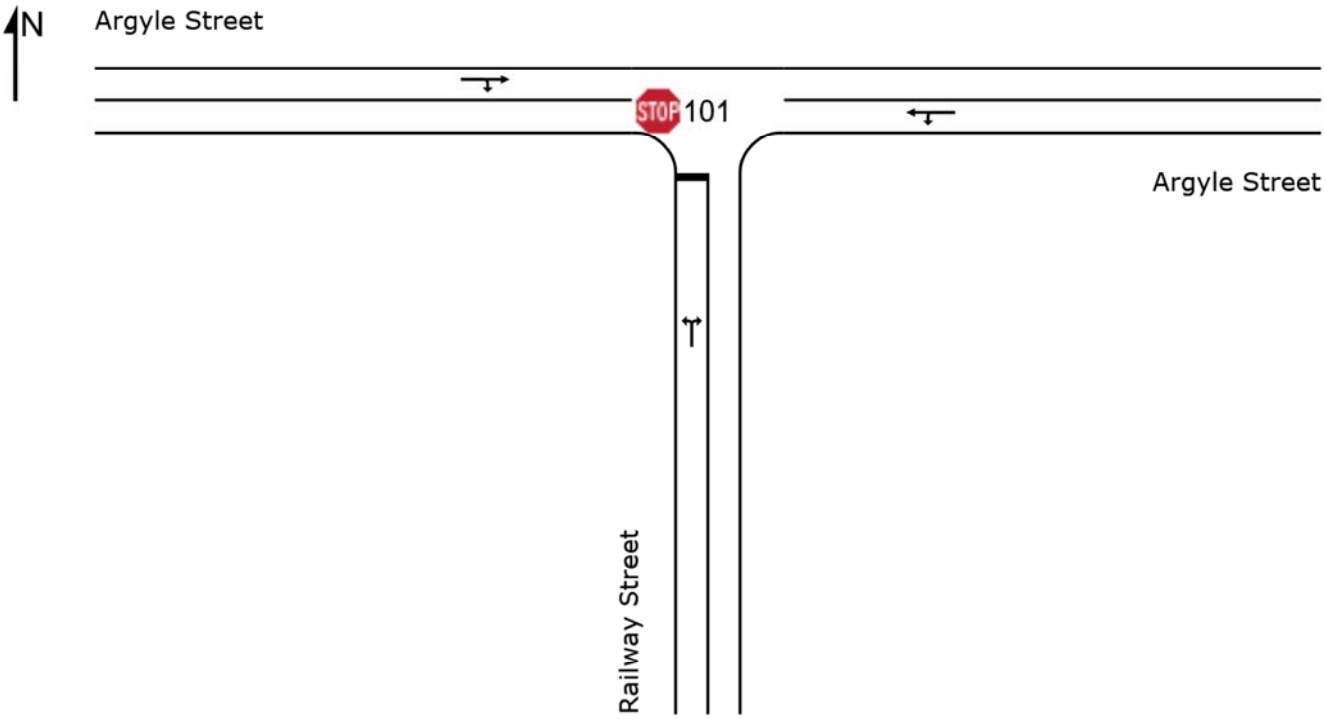
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Railway Street												
1	L2	4	0.0	0.404	21.4	LOS B	1.2	8.9	0.94	1.06	1.13	26.5
3	R2	37	5.7	0.404	51.8	LOS D	1.2	8.9	0.94	1.06	1.13	26.3
Approach		41	5.1	0.404	48.6	LOS D	1.2	8.9	0.94	1.06	1.13	26.3
East: Argyle Street												
4	L2	41	5.1	0.455	3.5	LOS A	0.0	0.0	0.00	0.02	0.00	40.0
5	T1	815	5.4	0.455	0.1	LOS A	0.0	0.0	0.00	0.02	0.00	39.9
Approach		856	5.4	0.455	0.2	NA	0.0	0.0	0.00	0.02	0.00	39.9
West: Argyle Street												
11	T1	702	6.3	0.403	0.6	LOS A	0.6	4.7	0.08	0.01	0.12	39.6
12	R2	16	6.7	0.403	13.5	LOS A	0.6	4.7	0.08	0.01	0.12	39.4
Approach		718	6.3	0.403	0.9	NA	0.6	4.7	0.08	0.01	0.12	39.6
All Vehicles		1615	5.8	0.455	1.8	NA	1.2	8.9	0.06	0.04	0.08	39.2

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

SITE LAYOUT

Site: 101 [Argyle St / Railway St (Base+CG) - AM Peak]

Argyle St / Railway St
Site Category: (None)
Stop (Two-Way)



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Organisation: CARDNO (QLD) PTY LTD | Created: Monday, 8 July 2019 10:09:45 AM
Project: N:\Projects\820\FY18\221_Aoyuan Moss Vale Project PS\Des-An\Traffic Modelling\20181204 SIDRA Base and Future Models\Des-An\Model files\2016 SIDRA Models\2016 Base AM.sip8

MOVEMENT SUMMARY

Site: 101 [Argyle St / Railway St (Base+CG) - AM Peak]

Argyle St / Railway St
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Railway Street												
1	L2	1	0.0	0.680	18.9	LOS B	2.3	16.5	0.94	1.19	1.55	30.0
3	R2	128	1.6	0.680	32.4	LOS C	2.3	16.5	0.94	1.19	1.55	29.8
Approach		129	1.6	0.680	32.3	LOS C	2.3	16.5	0.94	1.19	1.55	29.8
East: Argyle Street												
4	L2	184	5.7	0.413	3.5	LOS A	0.0	0.0	0.00	0.11	0.00	39.7
5	T1	579	6.9	0.413	0.1	LOS A	0.0	0.0	0.00	0.11	0.00	39.6
Approach		763	6.6	0.413	0.9	NA	0.0	0.0	0.00	0.11	0.00	39.6
West: Argyle Street												
11	T1	849	5.2	0.502	0.9	LOS A	1.3	9.5	0.15	0.03	0.22	39.4
12	R2	37	0.0	0.502	12.0	LOS A	1.3	9.5	0.15	0.03	0.22	39.2
Approach		886	5.0	0.502	1.4	NA	1.3	9.5	0.15	0.03	0.22	39.4
All Vehicles		1779	5.4	0.680	3.4	NA	2.3	16.5	0.14	0.15	0.22	38.6

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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 SUMMARY

Site: 101 [Argyle St / Railway St (Base+CG) - PM Peak]

Argyle St / Railway St
Site Category: (None)
Stop (Two-Way)

Movement Performance - Vehicles

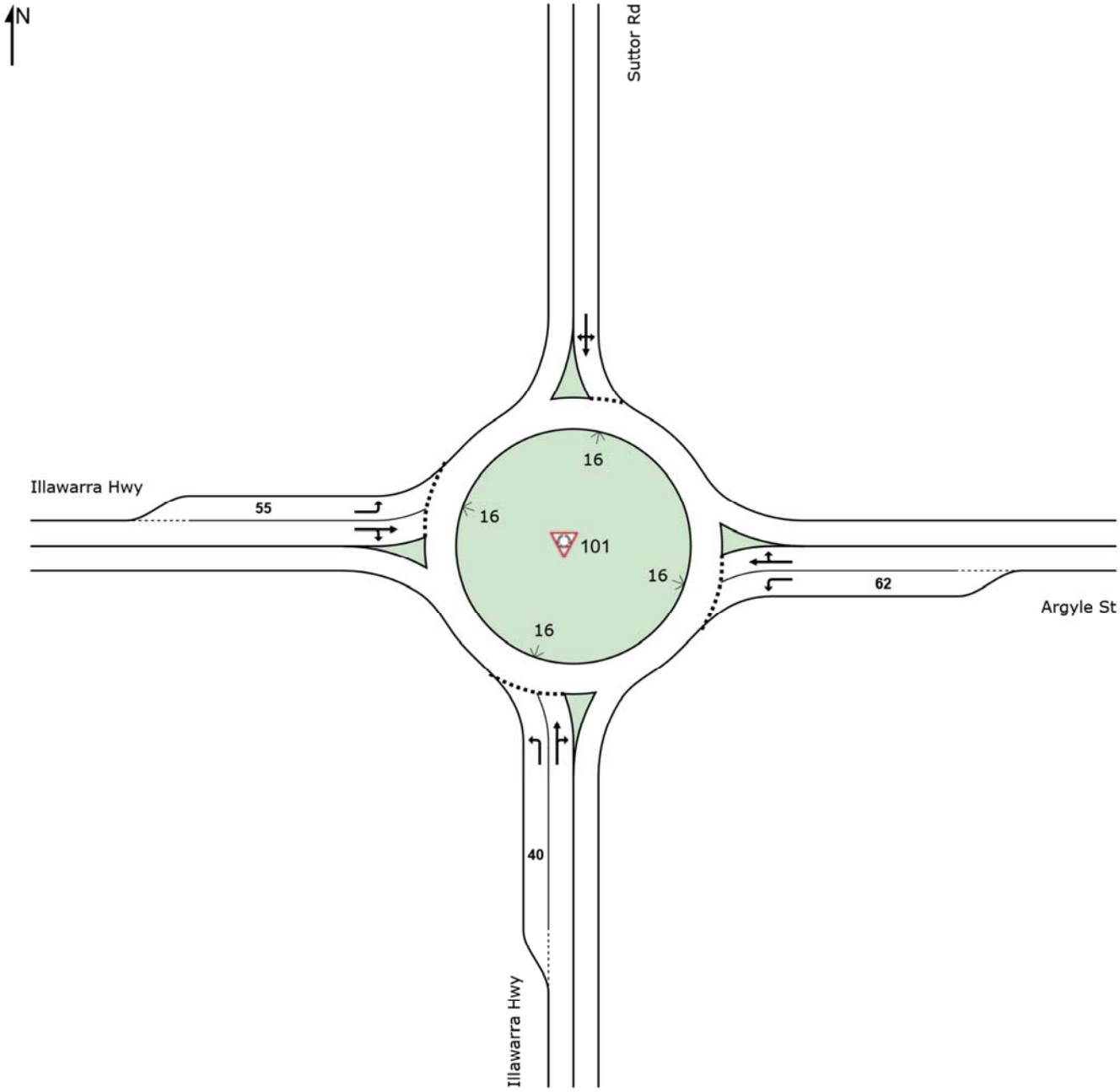
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Railway Street												
1	L2	2	0.0	0.843	39.5	LOS C	3.4	24.0	0.98	1.36	2.14	25.5
3	R2	122	1.7	0.843	54.1	LOS D	3.4	24.0	0.98	1.36	2.14	25.4
Approach		124	1.7	0.843	53.8	LOS D	3.4	24.0	0.98	1.36	2.14	25.4
East: Argyle Street												
4	L2	94	5.6	0.514	3.5	LOS A	0.0	0.0	0.00	0.05	0.00	39.9
5	T1	865	6.2	0.514	0.1	LOS A	0.0	0.0	0.00	0.05	0.00	39.8
Approach		959	6.1	0.514	0.4	NA	0.0	0.0	0.00	0.05	0.00	39.8
West: Argyle Street												
11	T1	711	7.1	0.553	4.3	LOS A	4.2	31.4	0.45	0.09	0.72	37.7
12	R2	82	1.3	0.553	17.4	LOS B	4.2	31.4	0.45	0.09	0.72	37.5
Approach		793	6.5	0.553	5.6	NA	4.2	31.4	0.45	0.09	0.72	37.6
All Vehicles		1876	6.0	0.843	6.2	NA	4.2	31.4	0.25	0.15	0.45	37.5

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.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road 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.

SITE LAYOUT

Site: 101 [Argyle St / Illawarra Hwy / Suttor Rd (Base) - AM Peak]

Argyle St / Illawarra Hwy / Suttor Rd (Base)
Site Category: (None)
Roundabout



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Organisation: CARDNO (QLD) PTY LTD | Created: Monday, 8 July 2019 10:08:37 AM
Project: N:\Projects\820\FY18\221_Aoyuan Moss Vale Project PS\Des-An\Traffic Modelling\20181204 SIDRA Base and Future Models\Des-An\Model files\2016 SIDRA Models\2016 Base AM.sip8

MOVEMENT SUMMARY

Site: 101 [Argyle St / Illawarra Hwy / Suttor Rd (Base) - AM Peak]

Argyle St / Illawarra Hwy / Suttor Rd (Base)
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Illawarra Hwy												
1	L2	111	1.9	0.138	8.3	LOS A	1.1	7.8	0.83	0.72	0.83	44.7
2	T1	55	7.7	0.484	10.2	LOS A	4.7	34.0	0.96	0.90	1.03	43.1
3	R2	328	2.2	0.484	14.0	LOS A	4.7	34.0	0.96	0.90	1.03	43.1
Approach		494	2.8	0.484	12.3	LOS A	4.7	34.0	0.93	0.86	0.99	43.5
East: Argyle St												
4	L2	315	3.3	0.234	4.7	LOS A	2.0	14.7	0.56	0.53	0.56	46.1
5	T1	535	6.9	0.407	4.8	LOS A	4.1	30.2	0.64	0.53	0.64	46.6
6	R2	2	0.0	0.407	8.7	LOS A	4.1	30.2	0.64	0.53	0.64	46.7
Approach		852	5.6	0.407	4.8	LOS A	4.1	30.2	0.61	0.53	0.61	46.4
North: Suttor Rd												
7	L2	8	0.0	0.371	13.3	LOS A	3.2	23.1	1.00	0.93	1.00	41.4
8	T1	101	2.1	0.371	13.5	LOS A	3.2	23.1	1.00	0.93	1.00	42.2
9	R2	75	8.5	0.371	18.1	LOS B	3.2	23.1	1.00	0.93	1.00	42.1
Approach		184	4.6	0.371	15.4	LOS B	3.2	23.1	1.00	0.93	1.00	42.1
West: Illawarra Hwy												
10	L2	97	8.7	0.096	6.0	LOS A	0.8	5.7	0.70	0.60	0.70	45.7
11	T1	545	5.0	0.550	6.9	LOS A	5.9	43.3	0.91	0.75	0.93	45.7
12	R2	26	0.0	0.550	10.8	LOS A	5.9	43.3	0.91	0.75	0.93	45.8
Approach		668	5.4	0.550	6.9	LOS A	5.9	43.3	0.88	0.73	0.89	45.7
All Vehicles		2198	4.8	0.550	8.0	LOS A	5.9	43.3	0.80	0.70	0.81	45.1

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.
Roundabout Capacity Model: SIDRA Standard.
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.

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MOVEMENT SUMMARY

Site: 101 [Argyle St / Illawarra Hwy / Suttor Rd (Base) - PM Peak]

Argyle St / Illawarra Hwy / Suttor Rd (Base)
Site Category: (None)
Roundabout

Movement Performance - Vehicles

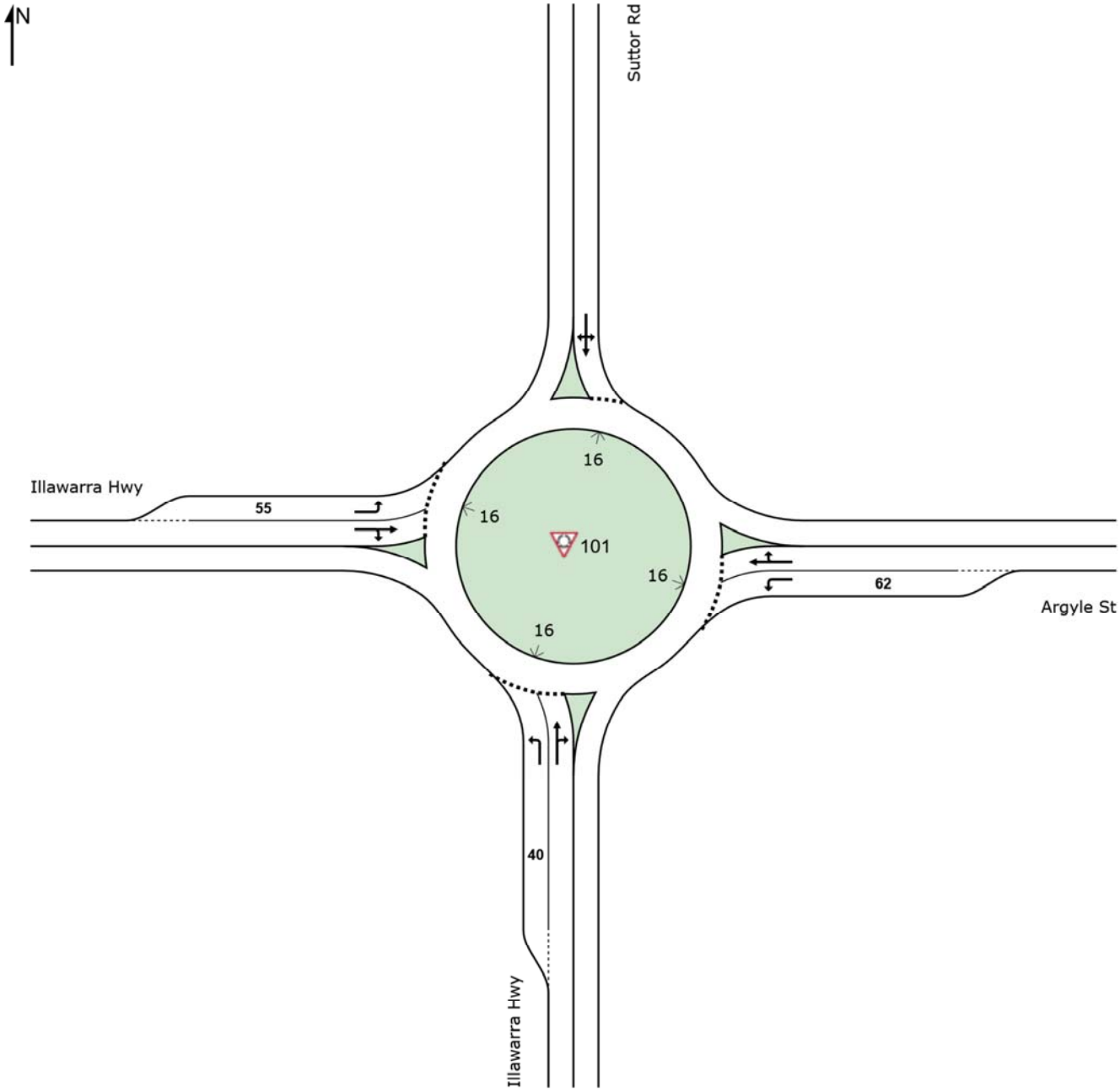
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Illawarra Hwy												
1	L2	102	2.1	0.122	7.7	LOS A	1.0	6.8	0.81	0.69	0.81	45.0
2	T1	76	2.8	0.420	8.4	LOS A	3.8	27.1	0.92	0.83	0.92	44.1
3	R2	276	2.3	0.420	12.4	LOS B	3.8	27.1	0.92	0.83	0.92	44.1
Approach		454	2.3	0.420	10.7	LOS B	3.8	27.1	0.89	0.80	0.89	44.3
East: Argyle St												
4	L2	420	3.8	0.346	5.6	LOS A	3.1	22.4	0.69	0.61	0.69	45.8
5	T1	494	5.8	0.412	5.5	LOS A	3.9	28.5	0.72	0.60	0.72	46.4
6	R2	1	0.0	0.412	9.4	LOS A	3.9	28.5	0.72	0.60	0.72	46.4
Approach		915	4.8	0.412	5.6	LOS A	3.9	28.5	0.71	0.61	0.71	46.1
North: Suttor Rd												
7	L2	6	33.3	0.377	15.5	LOS B	3.2	23.6	1.00	0.93	1.00	41.4
8	T1	111	3.8	0.377	13.0	LOS B	3.2	23.6	1.00	0.93	1.00	42.5
9	R2	79	2.7	0.377	17.0	LOS B	3.2	23.6	1.00	0.93	1.00	42.5
Approach		196	4.3	0.377	14.7	LOS B	3.2	23.6	1.00	0.93	1.00	42.5
West: Illawarra Hwy												
10	L2	104	5.1	0.095	5.6	LOS A	0.8	5.5	0.66	0.58	0.66	45.8
11	T1	492	4.5	0.542	6.4	LOS A	5.8	41.6	0.88	0.72	0.88	45.6
12	R2	105	0.0	0.542	10.3	LOS B	5.8	41.6	0.88	0.72	0.88	45.7
Approach		701	3.9	0.542	6.8	LOS A	5.8	41.6	0.84	0.70	0.84	45.7
All Vehicles		2265	4.0	0.542	7.8	LOS A	5.8	41.6	0.81	0.70	0.81	45.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
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.
Roundabout Capacity Model: SIDRA Standard.
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.

SITE LAYOUT

Site: 101 [Argyle St / Illawarra Hwy / Suttor Rd (Base+CG) - AM Peak - Copy]

Argyle St / Illawarra Hwy / Suttor Rd (Base+CG)
Site Category: (None)
Roundabout



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Organisation: CARDNO (QLD) PTY LTD | Created: Tuesday, 9 July 2019 4:35:59 PM
Project: N:\Projects\820\FY18\221_Aoyuan Moss Vale Project PS\Des-An\Traffic Modelling\20181204 SIDRA Base and Future Models\Des-An\Model files\2016 SIDRA Models - Updated\2016 Base AM.sip8

MOVEMENT SUMMARY

Site: 101 [Argyle St / Illawarra Hwy / Suttor Rd (Base+CG) - AM Peak - Copy]

Argyle St / Illawarra Hwy / Suttor Rd (Base+CG)
Site Category: (None)
Roundabout

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Illawarra Hwy												
1	L2	171	3.1	0.264	10.5	LOS A	2.2	15.9	0.94	0.84	0.94	43.5
2	T1	76	6.9	0.880	42.4	LOS C	21.3	154.9	1.00	1.71	2.51	31.4
3	R2	485	4.1	0.880	46.3	LOS D	21.3	154.9	1.00	1.71	2.51	31.5
Approach		732	4.2	0.880	37.6	LOS C	21.3	154.9	0.99	1.51	2.14	33.6
East: Argyle St												
4	L2	245	3.4	0.178	4.6	LOS A	1.5	10.5	0.51	0.50	0.51	46.2
5	T1	673	5.8	0.495	4.8	LOS A	5.4	39.3	0.66	0.53	0.66	46.6
6	R2	2	0.0	0.495	8.7	LOS A	5.4	39.3	0.66	0.53	0.66	46.6
Approach		920	5.1	0.495	4.7	LOS A	5.4	39.3	0.62	0.52	0.62	46.5
North: Suttor Rd												
7	L2	1	0.0	0.457	28.2	LOS B	4.3	31.0	1.00	1.10	1.23	35.4
8	T1	77	1.4	0.457	28.4	LOS B	4.3	31.0	1.00	1.10	1.23	36.0
9	R2	62	8.5	0.457	33.4	LOS C	4.3	31.0	1.00	1.10	1.23	36.0
Approach		140	4.5	0.457	30.6	LOS C	4.3	31.0	1.00	1.10	1.23	36.0
West: Illawarra Hwy												
10	L2	106	6.9	0.138	7.8	LOS A	1.1	8.5	0.85	0.72	0.85	44.9
11	T1	615	5.0	0.850	26.0	LOS B	19.2	139.8	1.00	1.39	1.92	37.5
12	R2	47	4.4	0.850	30.1	LOS C	19.2	139.8	1.00	1.39	1.92	37.5
Approach		768	5.2	0.850	23.7	LOS B	19.2	139.8	0.98	1.30	1.77	38.3
All Vehicles		2560	4.9	0.880	21.2	LOS B	21.3	154.9	0.85	1.07	1.43	39.1

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.
Roundabout Capacity Model: SIDRA Standard.
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.

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MOVEMENT SUMMARY

Site: 101 [Argyle St / Illawarra Hwy / Suttor Rd (Base+CG) - PM Peak - Copy]

Argyle St / Illawarra Hwy / Suttor Rd (Base)
Site Category: (None)
Roundabout

Movement Performance - Vehicles

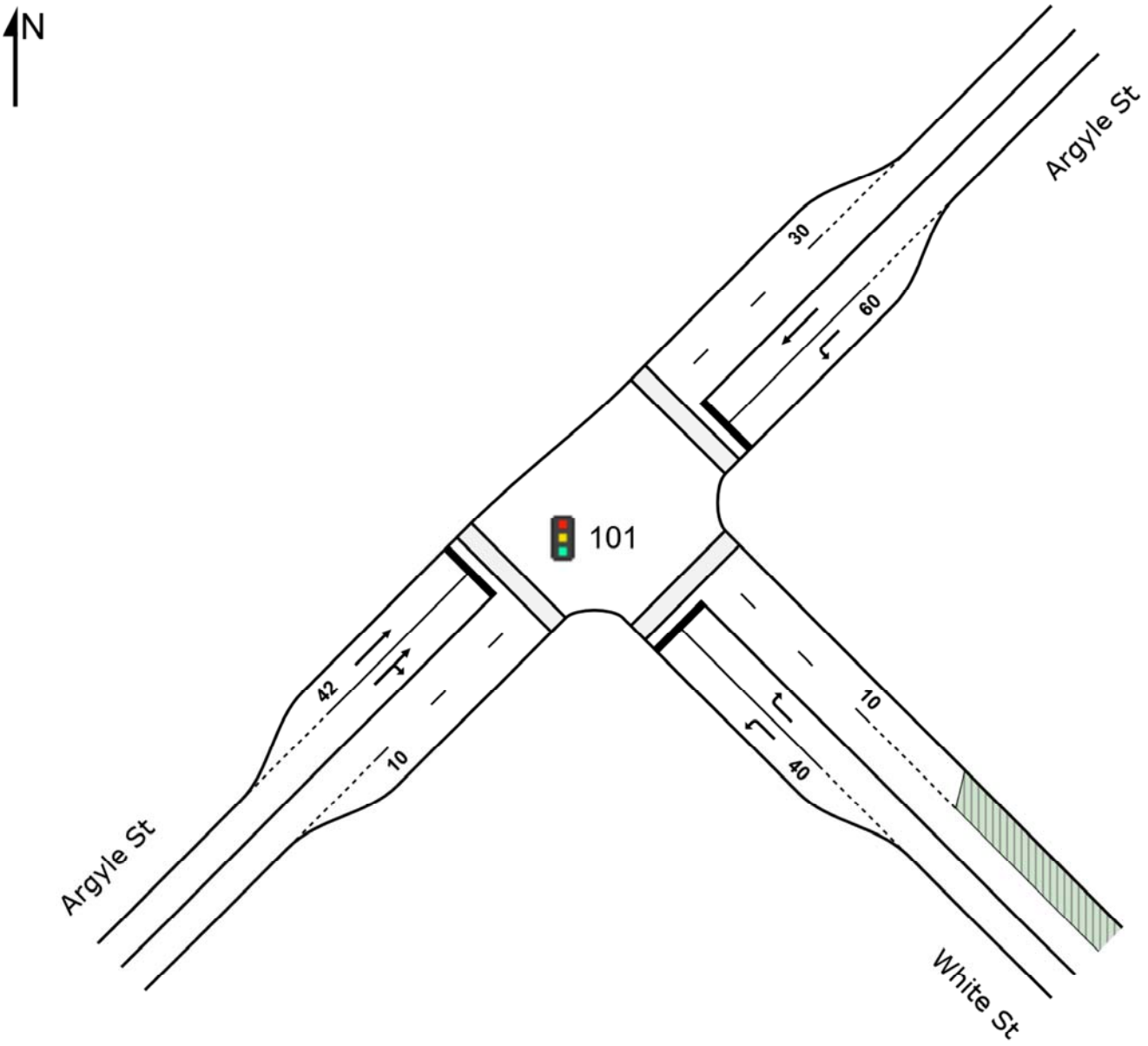
Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Illawarra Hwy												
1	L2	169	3.1	0.255	9.9	LOS A	2.1	15.4	0.93	0.83	0.93	43.8
2	T1	73	1.4	0.522	12.9	LOS B	5.5	39.9	1.00	1.00	1.17	41.8
3	R2	273	4.2	0.522	17.2	LOS B	5.5	39.9	1.00	1.00	1.17	41.8
Approach		515	3.5	0.522	14.2	LOS B	5.5	39.9	0.98	0.94	1.09	42.4
East: Argyle St												
4	L2	372	3.7	0.305	5.6	LOS A	2.6	19.0	0.66	0.60	0.66	45.8
5	T1	616	5.6	0.516	5.8	LOS A	5.3	38.6	0.78	0.64	0.78	46.2
6	R2	4	25.0	0.516	10.6	LOS B	5.3	38.6	0.78	0.64	0.78	45.9
Approach		992	5.0	0.516	5.7	LOS A	5.3	38.6	0.74	0.63	0.74	46.0
North: Suttor Rd												
7	L2	6	16.7	0.453	20.7	LOS C	4.3	31.3	1.00	1.04	1.16	38.7
8	T1	88	3.6	0.453	19.3	LOS B	4.3	31.3	1.00	1.04	1.16	39.5
9	R2	85	6.2	0.453	23.7	LOS C	4.3	31.3	1.00	1.04	1.16	39.4
Approach		180	5.3	0.453	21.5	LOS C	4.3	31.3	1.00	1.04	1.16	39.4
West: Illawarra Hwy												
10	L2	109	4.8	0.101	5.6	LOS A	0.8	5.9	0.67	0.58	0.67	45.8
11	T1	588	5.4	0.654	8.2	LOS A	8.9	64.8	0.96	0.82	1.07	45.3
12	R2	120	3.5	0.654	12.2	LOS B	8.9	64.8	0.96	0.82	1.07	45.3
Approach		818	5.0	0.654	8.4	LOS A	8.9	64.8	0.92	0.79	1.01	45.3
All Vehicles		2504	4.7	0.654	9.5	LOS A	8.9	64.8	0.87	0.78	0.93	44.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
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.
Roundabout Capacity Model: SIDRA Standard.
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.

SITE LAYOUT

Site: 101 [Argyle St / White St (Base) - AM Peak]

Argyle St / White St
Site Category: (None)
Signals - Fixed Time Isolated



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Organisation: CARDNO (QLD) PTY LTD | Created: Monday, 8 July 2019 10:07:53 AM
Project: N:\Projects\820\FY18\221_Aoyuan Moss Vale Project PS\Des-An\Traffic Modelling\20181204 SIDRA Base and Future Models\Des-An\Model files\2016 SIDRA Models\2016 Base AM.sip8

MOVEMENT SUMMARY

Site: 101 [Argyle St / White St (Base) - AM Peak]

Argyle St / White St
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 92 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: White St												
4	L2	287	4.0	0.312	18.6	LOS B	7.4	54.0	0.62	0.73	0.62	39.5
6	R2	71	0.0	0.873	62.1	LOS E	3.7	26.0	1.00	0.97	1.61	26.9
Approach		358	3.2	0.873	27.2	LOS B	7.4	54.0	0.70	0.78	0.81	36.2
NorthEast: Argyle St												
7	L2	73	1.4	0.110	25.7	LOS B	2.2	15.3	0.70	0.71	0.70	36.7
8	T1	597	8.3	0.950	57.5	LOS E	36.0	270.0	1.00	1.25	1.45	28.0
Approach		669	7.5	0.950	54.1	LOS D	36.0	270.0	0.97	1.19	1.37	28.7
SouthWest: Argyle St												
2	T1	741	5.8	0.808	17.7	LOS B	21.8	160.3	0.68	0.75	0.94	39.8
3	R2	224	6.1	0.808	31.5	LOS C	21.8	160.3	0.92	1.05	1.34	35.7
Approach		965	5.9	0.808	20.9	LOS B	21.8	160.3	0.74	0.82	1.03	38.8
All Vehicles		1993	6.0	0.950	33.2	LOS C	36.0	270.0	0.81	0.94	1.11	34.3

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	Distance m	Prop. Queued	Effective Stop Rate
P2	SouthEast Full Crossing	15	37.5	LOS D	0.0	0.0	0.90	0.90
P3	NorthEast Full Crossing	20	37.5	LOS D	0.0	0.0	0.90	0.90
P1	SouthWest Full Crossing	25	37.5	LOS D	0.1	0.1	0.90	0.90
All Pedestrians		60	37.5	LOS D			0.90	0.90

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: 101 [Argyle St / White St (Base) - AM Peak]

Argyle St / White St
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 92 seconds (Site User-Given Cycle Time)

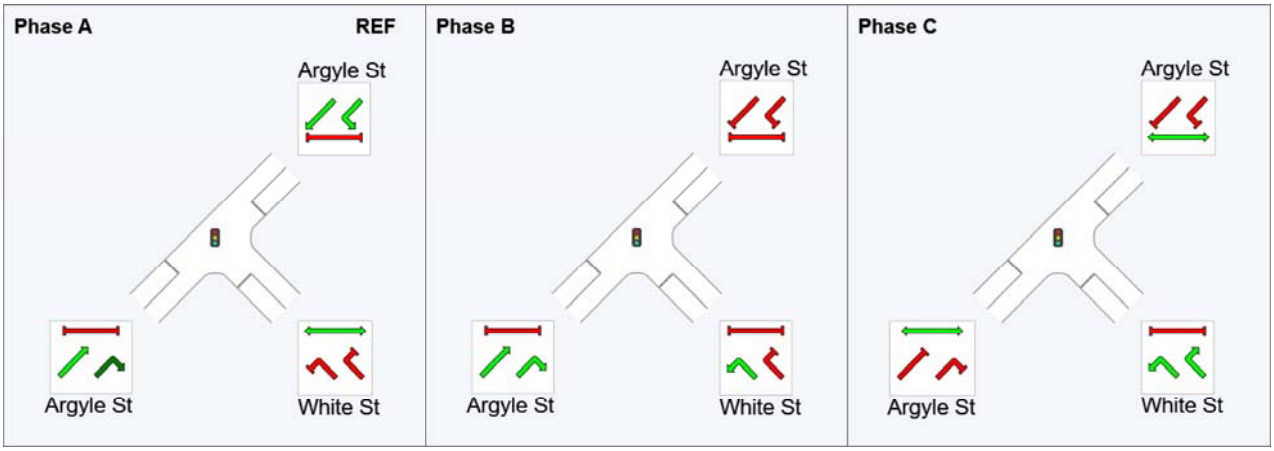
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: 3 Phases
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	39	76
Green Time (sec)	33	31	10
Phase Time (sec)	39	37	16
Phase Split	42%	40%	17%

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%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

MOVEMENT SUMMARY

Site: 101 [Argyle St / White St (Base) - PM Peak]

Argyle St / White St
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 92 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: White St												
4	L2	417	2.8	0.520	22.0	LOS B	12.6	90.5	0.72	0.78	0.72	38.1
6	R2	51	0.0	0.834	61.6	LOS E	2.7	18.6	1.00	0.91	1.55	27.0
Approach		467	2.5	0.834	26.3	LOS B	12.6	90.5	0.75	0.79	0.81	36.5
NorthEast: Argyle St												
7	L2	64	3.3	0.090	23.4	LOS B	1.8	13.0	0.66	0.69	0.66	37.6
8	T1	647	6.3	0.927	48.4	LOS D	36.2	267.2	1.00	1.17	1.34	30.1
Approach		712	6.1	0.927	46.2	LOS D	36.2	267.2	0.97	1.12	1.28	30.6
SouthWest: Argyle St												
2	T1	677	4.7	0.748	15.1	LOS B	18.7	137.4	0.65	0.69	0.84	41.0
3	R2	206	8.2	0.748	27.9	LOS B	18.7	137.4	0.89	0.98	1.21	37.0
Approach		883	5.5	0.748	18.1	LOS B	18.7	137.4	0.70	0.75	0.93	40.0
All Vehicles		2062	5.0	0.927	29.6	LOS C	36.2	267.2	0.81	0.89	1.02	35.5

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	Distance m	Prop. Queued	Effective Stop Rate
P2	SouthEast Full Crossing	15	37.5	LOS D	0.0	0.0	0.90	0.90
P3	NorthEast Full Crossing	20	37.5	LOS D	0.0	0.0	0.90	0.90
P1	SouthWest Full Crossing	25	37.5	LOS D	0.1	0.1	0.90	0.90
All Pedestrians		60	37.5	LOS D			0.90	0.90

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: 101 [Argyle St / White St (Base) - PM Peak]

Argyle St / White St
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 92 seconds (Site User-Given Cycle Time)

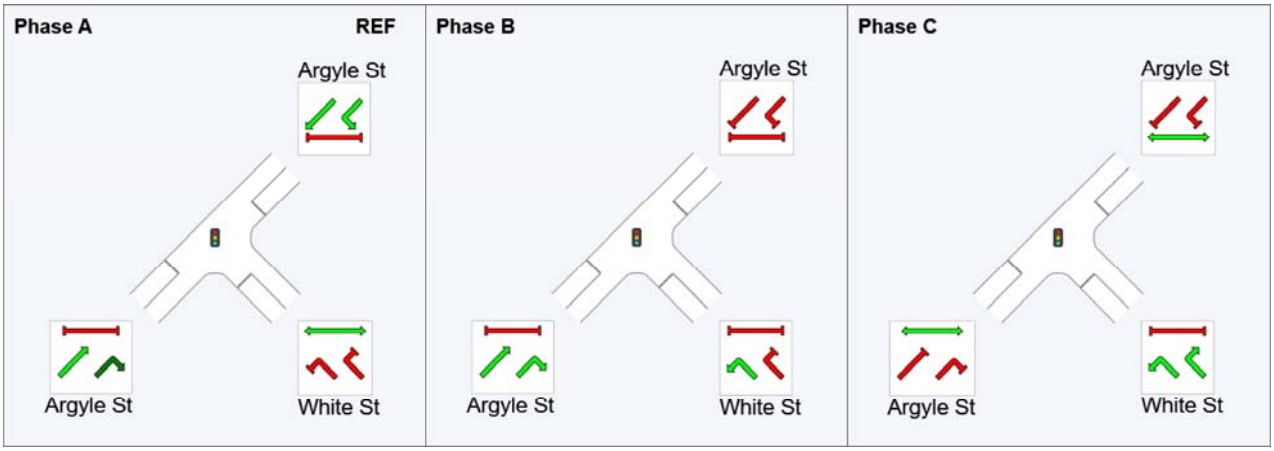
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: 3 Phases
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	42	77
Green Time (sec)	36	29	9
Phase Time (sec)	42	35	15
Phase Split	46%	38%	16%

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%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

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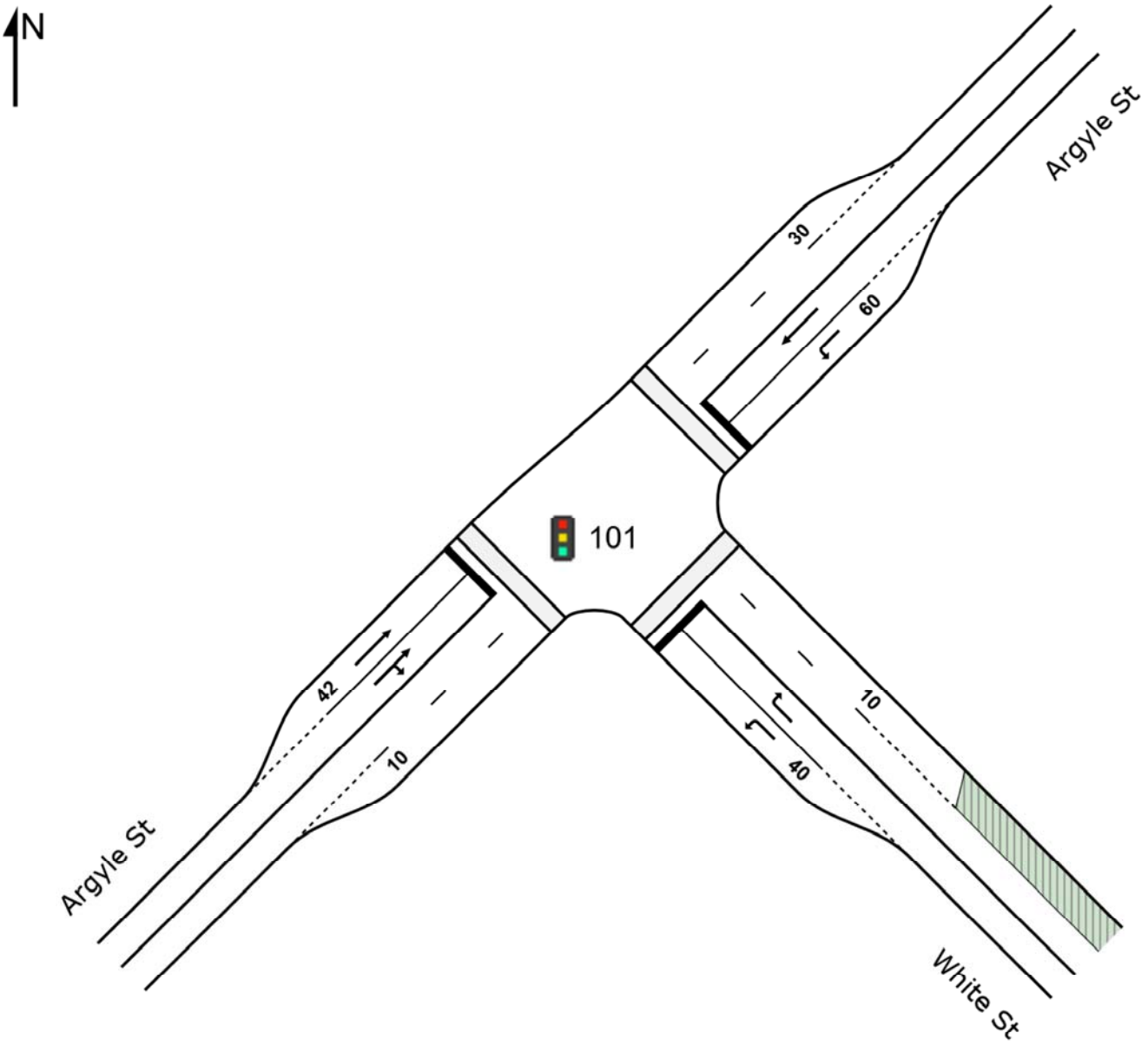
SITE LAYOUT

Site: 101 [Argyle St / White St (Base+CG) - AM Peak]

Argyle St / White St
Site Category: (None)
Signals - Fixed Time Isolated



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Organisation: CARDNO (QLD) PTY LTD | Created: Monday, 8 July 2019 10:09:59 AM
Project: N:\Projects\820\FY18\221_Aoyuan Moss Vale Project PS\Des-An\Traffic Modelling\20181204 SIDRA Base and Future Models\Des-An\Model files\2016 SIDRA Models\2016 Base AM.sip8

MOVEMENT SUMMARY

Site: 101 [Argyle St / White St (Base+CG) - AM Peak]

Argyle St / White St
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 105 seconds (Site Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: White St												
4	L2	178	5.9	0.233	24.9	LOS B	5.7	42.2	0.67	0.73	0.67	37.0
6	R2	88	2.4	0.847	66.6	LOS E	5.1	36.7	1.00	0.96	1.44	26.0
Approach		266	4.7	0.847	38.8	LOS C	5.7	42.2	0.78	0.81	0.93	32.4
NorthEast: Argyle St												
7	L2	111	1.9	0.132	22.1	LOS B	3.2	22.9	0.61	0.70	0.61	38.1
8	T1	739	7.3	0.949	55.5	LOS D	47.7	354.9	0.97	1.15	1.32	28.4
Approach		849	6.6	0.949	51.2	LOS D	47.7	354.9	0.93	1.10	1.22	29.4
SouthWest: Argyle St												
2	T1	873	5.4	0.946	37.1	LOS C	39.7	291.6	0.73	0.92	1.15	33.0
3	R2	185	6.2	0.946	63.4	LOS E	39.7	291.6	1.00	1.34	1.70	27.3
Approach		1058	5.6	0.946	41.7	LOS C	39.7	291.6	0.77	0.99	1.25	31.8
All Vehicles		2174	5.9	0.949	45.1	LOS D	47.7	354.9	0.83	1.01	1.20	30.9

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	Distance m	Prop. Queued	Effective Stop Rate
P2	SouthEast Full Crossing	15	43.9	LOS E	0.0	0.0	0.91	0.91
P3	NorthEast Full Crossing	20	43.9	LOS E	0.1	0.1	0.92	0.92
P1	SouthWest Full Crossing	25	43.9	LOS E	0.1	0.1	0.92	0.92
All Pedestrians		60	43.9	LOS E			0.92	0.92

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: 101 [Argyle St / White St (Base+CG) - AM Peak]

Argyle St / White St
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 105 seconds (Site Optimum Cycle Time - Minimum Delay)

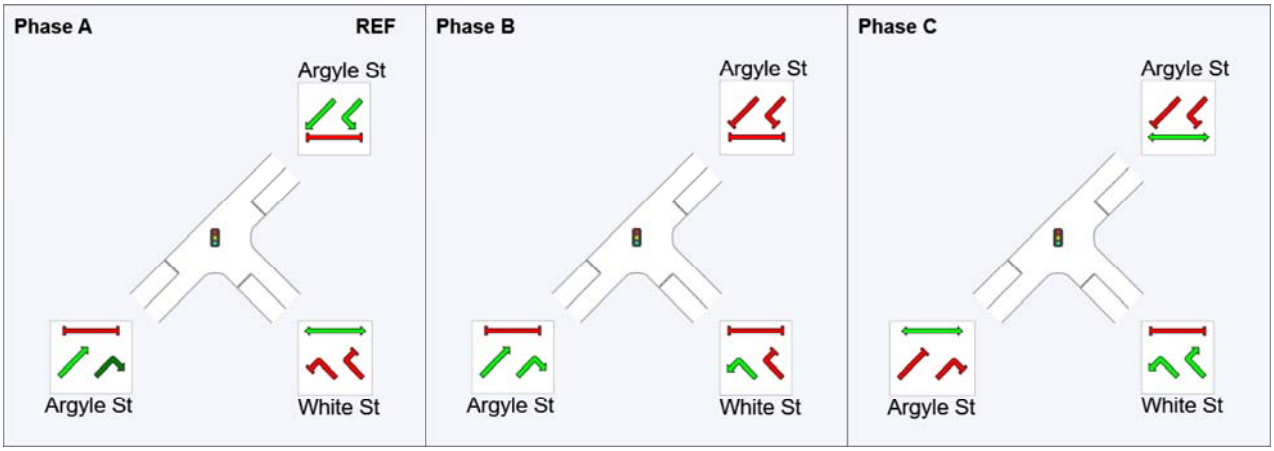
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: 3 Phases
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	54	87
Green Time (sec)	48	27	12
Phase Time (sec)	54	33	18
Phase Split	51%	31%	17%

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%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

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MOVEMENT SUMMARY

Site: 101 [Argyle St / White St (Base+CG) - PM Peak]

Argyle St / White St
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 93 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
SouthEast: White St												
4	L2	431	3.9	0.573	22.8	LOS B	13.5	97.5	0.74	0.79	0.74	37.8
6	R2	83	3.8	1.069	131.3	LOS F	7.0	50.4	1.00	1.29	2.48	17.5
Approach		514	3.9	1.069	40.4	LOS C	13.5	97.5	0.78	0.87	1.02	31.8
NorthEast: Argyle St												
7	L2	91	1.2	0.124	23.5	LOS B	2.6	18.2	0.67	0.71	0.67	37.5
8	T1	697	7.6	1.010	86.6	LOS F	53.4	398.0	1.00	1.47	1.72	22.9
Approach		787	6.8	1.010	79.3	LOS F	53.4	398.0	0.96	1.38	1.60	23.9
SouthWest: Argyle St												
2	T1	788	5.7	0.866	23.3	LOS B	25.5	188.0	0.71	0.82	1.05	37.6
3	R2	187	7.3	0.866	40.8	LOS C	25.5	188.0	0.98	1.17	1.54	32.8
Approach		976	6.0	0.866	26.6	LOS B	25.5	188.0	0.76	0.89	1.15	36.6
All Vehicles		2277	5.8	1.069	48.0	LOS D	53.4	398.0	0.84	1.05	1.27	30.1

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.
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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	Distance m	Prop. Queued	Effective Stop Rate
P2	SouthEast Full Crossing	15	38.0	LOS D	0.0	0.0	0.90	0.90
P3	NorthEast Full Crossing	20	38.0	LOS D	0.0	0.0	0.90	0.90
P1	SouthWest Full Crossing	25	38.0	LOS D	0.1	0.1	0.90	0.90
All Pedestrians		60	38.0	LOS D			0.90	0.90

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: 101 [Argyle St / White St (Base+CG) - PM Peak]

Argyle St / White St
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 93 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
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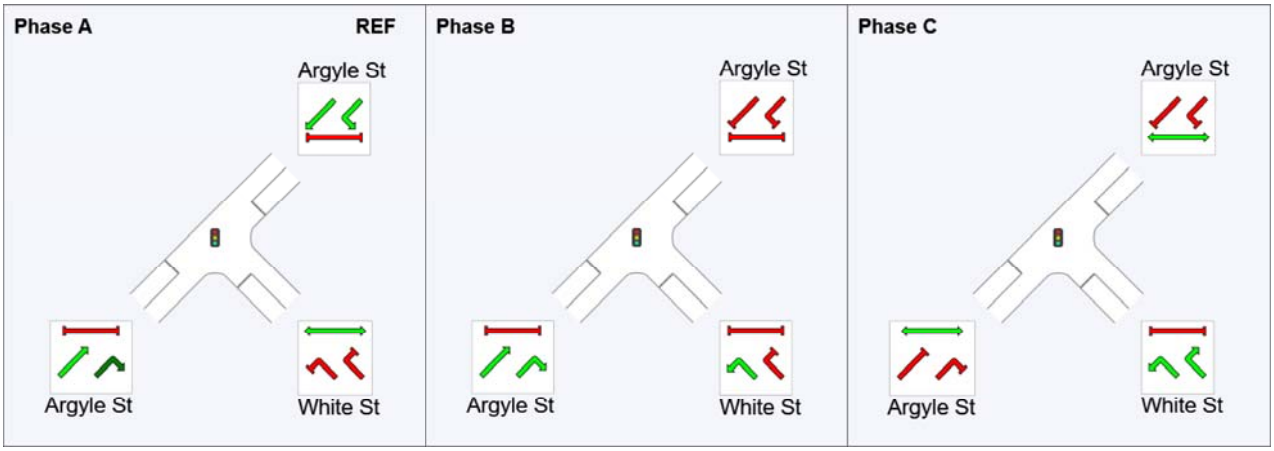
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	42	76
Green Time (sec)	36	28	11
Phase Time (sec)	42	34	17
Phase Split	45%	37%	18%

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%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase

Normal Movement	Permitted/Opposed
Slip/Bypass-Lane Movement	Opposed Slip/Bypass-Lane
Stopped Movement	Turn On Red
Other Movement Class (MC) Running	Undetected Movement
Mixed Running & Stopped MCs	Continuous Movement
Other Movement Class (MC) Stopped	Phase Transition Applied

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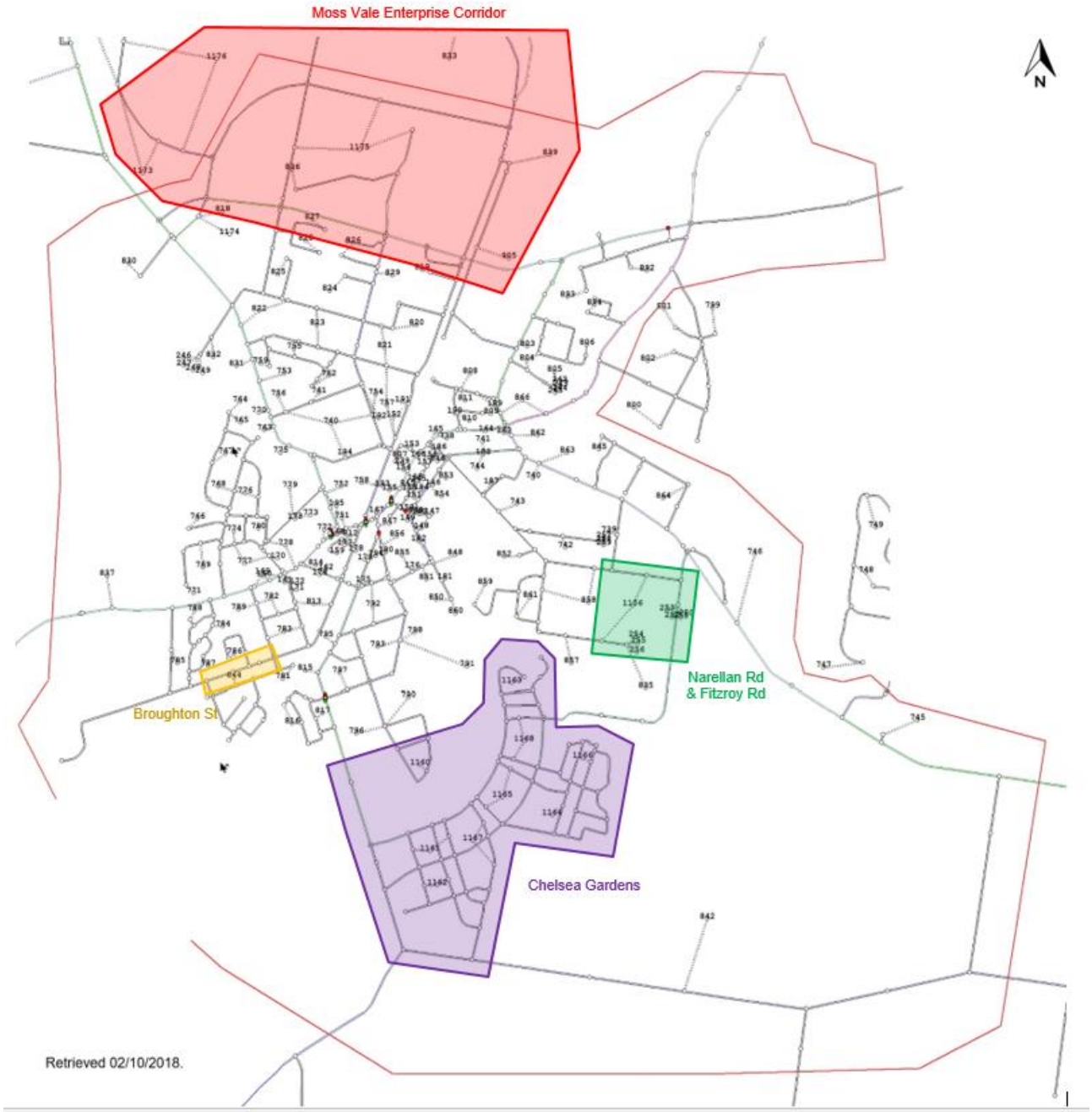
APPENDIX C

TRAVEL DEMAND ZONES



Wingecarribee Shire Council (WSC) TRACKS Model Zones in the study area with growth areas identified

Retrieved 02/10/2018.

Cardno Moss Vale subarea zone numbering