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Wentworth Point Block H Transport Study (Traffic Report)

Prepared for Billbergia

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pwc

Version Control

Version	Date	Description	Prepared By	Reviewed By
1	14/10/2021	Working Draft report for client review	PwC	Billbergia
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3	26/10/2021	Final report for client review	PwC	Billbergia
4	29/10/2021	Updated report with client comments	PwC	Billbergia
5	28/01/2022	Updated report with TfNSW and Council comments	PwC	Billbergia
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Executive summary

Introduction

This study has been commissioned by Billbergia to investigate the cumulative traffic impacts of the proposed development in Block H and a new high school at Wentworth Point. The proposed Block H development would provide an additional 660 dwellings on the site and would be undertaken through an amendment of the existing Homebush Bay West Development Control Plan (DCP), which currently allows for approximately 330 dwellings on the site. This transport study builds on a previous work commissioned by Billbergia in October 2020, involving a high-level transport strategy for Wentworth Point and the proposed development undertaken by Viae Consulting. The earlier study found that "*While the Block H proposals will add marginally to overall transport needs, it may provide a significant opportunity for contribution and add impetus to the early implementation of long-term, frequent and direct services to the Metro rail station as well as help realise the full potential of the district's favourable environment and terrain for greater bicycle use".*

Project objectives

The key objectives for this transport study are as follows:

- Develop a robust modelling framework that is based on a common set of assumptions for land use and leverages Transport for NSW (TfNSW) modelling tools to estimate mode share, trip generation and distribution in the forecast scenarios.
- Assess the travel demand, mode shift and capacity on rail lines for the surrounding local and regional transport network under various public transport infrastructure scheme scenarios, with and without Parramatta Light Rail Stage 2 (PLR2) and/or Sydney Metro West (SMW).
- Assess the operational impacts to network performance on the road network in 2036 with the proposed Block H and new high school development.
- Identify and incorporate any facilitating works as necessary within the operational models that would be required to support the forecast vehicle growth in the Wentworth Point study area.

Modelling framework

The modelling framework leverages the most relevant tools to assess the traffic impact of the development at Wentworth Point. The Wentworth Point development is located close to major transport infrastructure investments such as the WestConnex, the planned SMW station at Olympic Park and PLR2 stops at Wentworth Point. The land use projections together with road and public transport infrastructure assumptions are fed into the four-step multimodal Sydney Strategic Travel Model (STM). The STM produces mechanised travel demand forecasts which are fed into the Public Transport Project Model (PTPM) to perform mode choice. The Parking Precinct Module (PPM) is applied to serve as a proxy for policy measures in travel demand management. The demand response to land use in STM and mode choice response in PTPM is applied to the Sydney Motorway Project Model (SMPM) matrix. The SMPM matrix represents the road user behaviour in response to WestConnex. The adjusted SMPM matrix is fed into the Wentworth Point Mesoscopic Model (WPMM) for operational road network assessment. The intersection turning volumes from the WPMM are extracted for input into SIDRA INTERSECTION (SIDRA) modelling for isolated intersection performance assessment.

Study area

The STM and PTPM cover the wider Sydney Greater Metropolitan Area (GMA), which includes Sydney, Wollongong, Newcastle and the Blue Mountains. The SMPM covers the Sydney Basin.

The operational model area in the WPMM covers the study area of Wentworth Point and Sydney Olympic Park, which is bounded by Parramatta River to the north, Concord Road to the east, Parramatta Road to the south and Hill Road to the west. It also includes the major corridors such as the M4 Motorway and Australia Avenue, and five key intersections for detailed intersection assessment.

Scenario assumptions

Land use Travel Zone Projections 2019 (TZP19) are used in the strategic modelling for the following scenarios:

- 2036 without PLR2 and without SMW.
- 2036 without PLR2 and with SMW.
- 2036 with PLR2 and with SMW (reference scenario).
- 2036 with PLR2 and with SMW + long-term impacts of COVID-19.

The operational modelling uses the strategic reference scenario for background traffic growth to test the following scenarios:

- 2036 reference scenario with approved road upgrades.
- 2036 reference scenario with Block H with approved road upgrades.
- 2036 reference scenario with Block H + high school with approved road upgrades.
- 2036 without PLR2 and without SMW with approved road upgrades (sensitivity scenario).
- 2036 reference scenario with approved road upgrades and additional upgrades at Australia Avenue (sensitivity scenario).
- 2036 reference scenario with approved road upgrades + long-term impacts of COVID-19 (sensitivity).

The operational modelling incorporates the following road upgrades:

- Bennelong Parkway / Hill Road intersection upgrade.
- Parramatta Road / Hill Road intersection upgrades.
- Various upgrade works along Hill Road between Parramatta Road and Old Hill Link.

The operational modelling has applied the following peak hourly car generation trip rates agreed with TfNSW and City of Parramatta Council (Council):

- High density residential: 0.19 AM peak/ 0.15 PM peak.
- Club: 0 AM peak/ 0.075 PM peak.
- Child Care: 0.16 AM peak/ 0.15 PM peak.
- High school (students): 0.37 AM peak/ 0 PM peak.
- High school (staff car parking spaces): 0.7 AM peak/ 0 PM peak.

Land use and transport context

The strategic modelling provides the following insights:

- Car trips from Wentworth Point are destined to areas with lower Public Transport accessibility. The demographic fabric of Wentworth Point could have a low car ownership and be working in areas with good public transport accessibility such as Sydney CBD and Parramatta. Therefore, the forecast car trips from Wentworth Point could be redirected to public transport.
- PTPM shows car growth which exceeds the road network capacity whereas the Public Transport capacity is not utilised to the full potential. As a consequence, the car growth may be overstated and Public Transport patronage underrepresented.
- The capacity of SMW and PLR2 is considered to be sufficient to accommodate demand in both the Sydney CBD and Parramatta bound directions which may justify locating future population growth in areas such as Wentworth Point to accommodate the associated travel demand growth.
- Around 500 car trips in the Wentworth Point area are within 5 km which could be undertaken by walking or cycling considering the Wentworth Point Peninsula has extensive cycling infrastructure. PTPM (version 5) does not model active transport and short trips are either allocated to car or public transport. Therefore, the short car trips are likely to be overestimated in the Wentworth Point area.

Operational scenario assessment

The operational modelling provides the following key findings:

- Outside the immediate vicinity of the Wentworth Point development, the additional Block H and high school development trips contribute to less than 5% increase to the total mid-block traffic volumes at Holker Street, Hill Road near Parramatta Road, Birnie Avenue and Australia Avenue in the morning and afternoon peak hours.
- Comparison of the modelled results shows no changes to the intersection LoS bands with and without the additional Block H and new high school trips in the Future Project scenarios.
- Less than 5% difference in travel times along Hill Road and Parramatta Road in both direction during the morning and afternoon peak hour. This indicates minimal differences in delay associated with the additional Block H and new high school trips along these corridors.
- The local road network within Wentworth Point (Holker Street, Hill Road, Bennelong Parkway, Australia Avenue north of Homebush Bay Drive) would generally experience similar levels of congestion for all sensitivity scenarios, except for the Future without PLR2 and SMW scenario.
- The alternative Australia Avenue roundabout design would reduce delays, providing up to ~15% improvement in travel times along the Australia Avenue corridor travelling northbound towards Hill Road.

Based on the traffic growth generated by the strategic models, the strategic road network surrounding the Wentworth Point is close to or at capacity. The additional traffic generated by Block H in Wentworth Point has no material impact on the performance of the road network and the identified four key intersections which are predicted to operate at the same level of service (LoS) with and without the development.

Conclusion

The strategic modelling indicates that the projected growth in traffic demand may be overstated and the future public transport infrastructure underutilised. The operational modelling shows that the additional development at Block H and new high school has no material impact on the performance of the road network relative to the Future Reference scenario.

Contents

1 Introduction

1.1 Background

Wentworth Point is one of the precincts in the Greater Parramatta Growth Area (GPOP) Place-Based Infrastructure Compact (PIC), a prime initiative set up by the NSW Government to promote better alignment of population and employment growth with infrastructure investment. With the road network surrounding Wentworth Point being close to capacity, particular emphasis has been placed on improving the public and active transport network surrounding Wentworth Point to facilitate sustainable travel choices for people living and working in Wentworth Point.

Billbergia's proposed development on Block H (see Figure 1-1 below) currently allows for approximately 330 dwellings. Approval is being sought for amendment to the existing Homebush Bay West Development Control Plan (DCP) to allow for the following additional developments on Block H:

- 660 high-density residential dwellings.
- 4,000m^2 floor space for a club which includes 2,400 m^2 licensed floor area.
- Childcare centre (up to 75 children capacity).

In addition to the above, a proposed development for a new high school located north of the Block H development has been put forward. To assess the cumulative road network impacts of the proposed developments it has been requested by the City of Parramatta Council (Council) that the new high school be included in the transport study.

Figure 1-1 Map of Block H, Wentworth Point (and other precincts in surrounding area)

Image source (top left): 'Precinct Planning - Wentworth Point', City of Parramatta. Last accessed August 2021. Retrieved from: https://www.cityofparramatta.nsw.gov.au/vision/precinct-planning/wentworth-point

1.2 Previous transport study

This transport study is the next step in the approval process that builds on previous work commissioned by Billbergia in October 2020 involving a high-level transport strategy for the proposed Block H development ("*Wentworth Point Block H Transport Strategy"*, Viae Consulting, Oct 2020). The purpose of the previous transport study was to a provide a strategic overview of the transport network across all transport modes for Wentworth Point. The previous study did not provide detailed area-wide operational modelling, but the study did recommend that this type of modelling be undertaken for subsequent stages of the proposal.

Table 1-1 highlights the following key findings and recommendations. The previous transport study was undertaken by Viae Consulting and has undergone several reviews with key stakeholders in TfNSW and Council.

Table 1-1 Previous transport study Wentworth Point Block H – key findings and recommendations.

Transport strategy	Key findings / recommendations*
Transport impacts of development	*The traffic generation accounts for the highly localised nature of trips associated with non-residential floorspace that are expected to take place predominantly by public and active transport. Lower traffic generation for retail, cafes and entertainment land uses will be supported by reduced parking provisions for these uses.*
	The primary impact of additional traffic will be at the intersection of Hill Road and Bennelong Parkway, which is the main point of access by road to Wentworth Point.
	Minor works at the intersection of Holker Street and Hill Road will be required to facilitate the opening of Holker Busway to public buses and improve access to Sydney Olympic Park by public transport.
	The existing Baylink Shuttle will continue to be a critical service in providing access to Rhodes Station from Wentworth Point, however this will need to be supplemented by increased frequency on public bus services including the 526 and 533 services.
	Parramatta Light Rail Stage 2 will be critical in providing a high-quality intermediate transport connection from Wentworth Point to Sydney Olympic Park and Sydney Metro West. This project is currently not committed by government, and in the event that this project does not go ahead, an alternative intermediate transport service will be required to supplement existing capacity such as a high-frequency shuttle service to Sydney Olympic Park.
	Pedestrian and cycle volumes on Bennelong Bridge are already at levels that warrant separating these modes to address the safety issues associated with mixing high pedestrian volumes with cyclists. Similar capacity issues exist on Bennelong Parkway at Haslams Creek Bridge where cyclists are required to cross to the southern side of the bridge to use the shared path.
Transport interventions to facilitate development	*Strengthen surrounding public transport network and connections to regional mass-transit:* • *Increase frequency and coverage of existing bus routes.* • *Implement Parramatta Light Rail Stage 2 or equivalent high-frequency and direct public transport services to Sydney Metro West at Sydney Olympic Park Station.*
	Resolve constraints in the local road network, specifically upgrade to the intersection of Hill Road and Bennelong Parkway.
	Improve the amenity of the active transport network.
	Encourage sustainable travel behaviours through travel demand management.
Strategic planning conclusions	*While the Block H proposals will add marginally to overall transport needs, it may provide a significant opportunity for contribution and add impetus to the early implementation of long-term, frequent and direct services to the Metro rail station as well as help realise the full potential of the district's favourable environment and terrain for greater bicycle use.*

*Source: "Wentworth Point Block H Transport Strategy", Viae Consulting, Oct 2020

1.3 Project objectives

To enable Council to progress with its post-exhibition assessment of the Block H proposal, Billbergia has commissioned an investigation of the cumulative traffic impacts of the proposed development in Block H and a new high school at Wentworth Point.

The key objectives for this transport study are as follows:

- Develop a robust modelling framework that is based on a common set of assumptions for land use and leverages TfNSW modelling tools (Sydney Strategic Travel Model (STM) and Public Transport Project Model (PTPM)) to estimate mode share, trip generation and distribution in the forecast scenarios.
- Assess the travel demand, mode shift and capacity on rail lines for the surrounding local and regional transport network under various public transport infrastructure scheme scenarios, with and without Parramatta Light Rail Stage 2 (PLR2) and/or Sydney Metro West (SMW).
- Assess the operational impacts to network performance on the road network in 2036 with the proposed Block H and new high school development.
- Identify and incorporate any facilitating works as necessary within the area-wide operational models that would be required to support the forecast traffic growth in the Wentworth Point study area.
- Undertake sensitivity testing of a separate modelling scenario to quantify the potential long-term impacts of the COVID-19 pandemic to forecast traffic growth.

1.4 Purpose of this report

The purpose of this report is to:

- Supplement the previous transport study with additional detailed operational modelling, as requested by Council.
- Outline the modelling framework, modelling assumptions and limitations of the modelling tools.
- Provide the broader transport analysis around Wentworth Point in the context of large public transport investment such as PLR2 and SMW.
- Assess the cumulative impacts of the proposed Block H and new high school developments on the operational performance of the road network within Wentworth Point and its surrounds, and specifically, impacts to the following intersections:
  - Silverwater Road / Holker Street.
  - Parramatta Road / Hill Road.
  - Parramatta Road / Birnie Avenue.
  - Australia Avenue / Homebush Bay Drive.
  - Bennelong Parkway / Hill Road.

1.5 Structure of this report

This report is structured as follows:

- Section 1 – Introduction (this section).
- Section 2 – Land Use and Transport Context.
- Section 3 – Modelling Methodology and Framework.
- Section 4 – Scenario Assumptions.
- Section 5 – Scenario Assessment.
- Section 6 – Conclusion.

2 Land Use and Transport Context

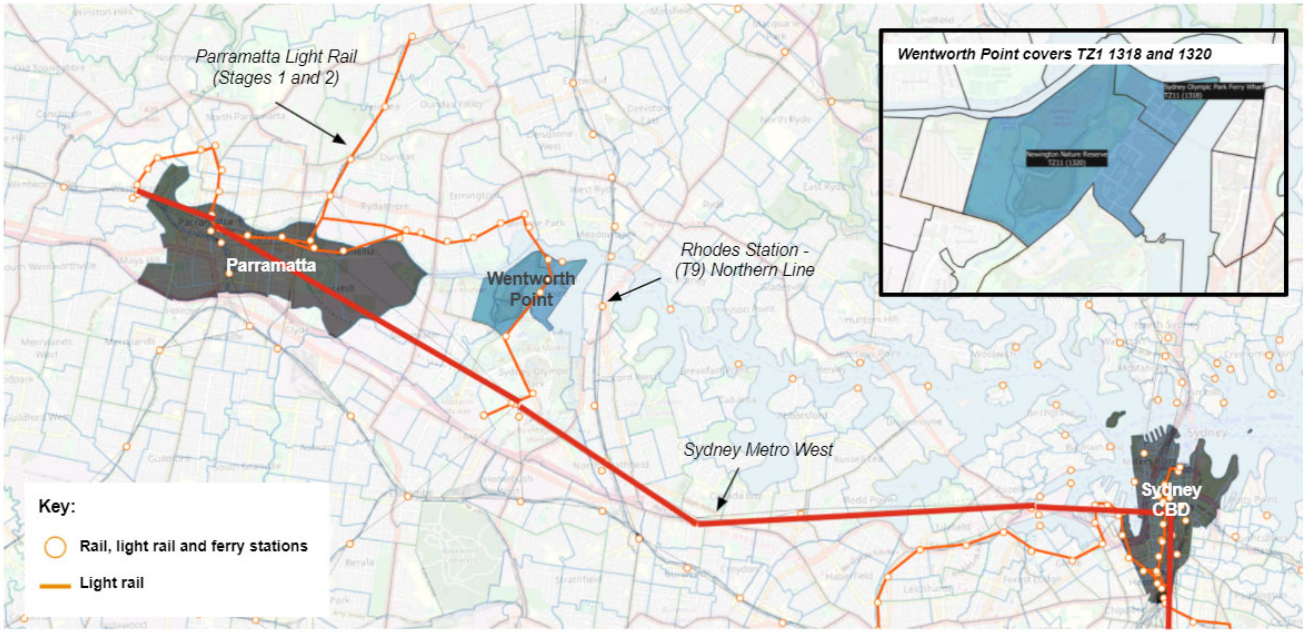
2.1 Overview

Wentworth Point is located in an area of unprecedented future public transport investment with SMW and PLR2 providing direct access to Sydney central business district (CBD) and Parramatta. Figure 4-1 shows the location of the Wentworth Point development, its proximity to major public transport infrastructure and accessibility to major employment areas, namely Parramatta and Sydney CBD. Wentworth Point is represented by Travel Zones 2011 (TZ11) 1318 and 1320 highlighted in blue.

Wentworth Point is one of 12 precincts in the GPOP and is part of the Central River City near the strategic centres of Rhodes and Sydney Olympic Park that has been identified in "*A Metropolis of Three Cities – The Greater Sydney Region Plan"* (Greater Sydney Commission, March 2018). This is a strategic land use, transport and infrastructure plan that sets out a 40-year vision of the region for the "three cities" in Sydney (Western Parkland City, Central River City and Eastern Harbour City) where "most residents live within 30 minutes of their jobs, education and health facilities, services and great places"[1].

This section provides a strategic analysis of the existing and forecast local transport network, land use and travel characteristics for Wentworth Point, as well as its implications for the proposed Block H and new high school developments. Note, the strategic analysis presented in this section are based on the PTPM, which is a demand forecasting tool that models for the morning peak period only. It is not a capacity constrained model, that is, it does not account for delays associated with accumulation of traffic in queues and traffic signals to the same level of detail as mesoscopic simulation modelling. The results for the mesoscopic simulation modelling are provided in Section 5.

Figure 2-1 Strategic location of Wentworth Point



1 *"Vision of A Metropolis of Three Cities"*, Greater Sydney Commission. Last accessed: October 2021, https://www.greater.sydney/metropolis-of-three-cities/vision-of-metropolis-of-three-cities

2.2 Transport network

Wentworth Point is situated 13km west of Sydney CBD, adjacent to the Sydney Olympic Park and Carter Street precincts and Parramatta. The transport network consists of the local road network, bus services and active transport infrastructure, with Bennelong Bridge providing a direct connection to the Rhodes rail station for the T9 Northern Line.

2.3 Land use

Sydney is the financial capital of Australia and the gateway to global markets. To ensure its position and attractiveness for investment the NSW and Federal Government is heavily investing in transport infrastructure to facilitate this growth. Wentworth Point is one of the growth areas with population set to double from 9,500 in 2017 to 20,500 in 2036. Figure 2-2 shows the population and employment growth for Wentworth Point based on TZP19 land use for TZ11 zones 1318 and 1320.

Figure 2-2 Summary of land use projections for Wentworth Point

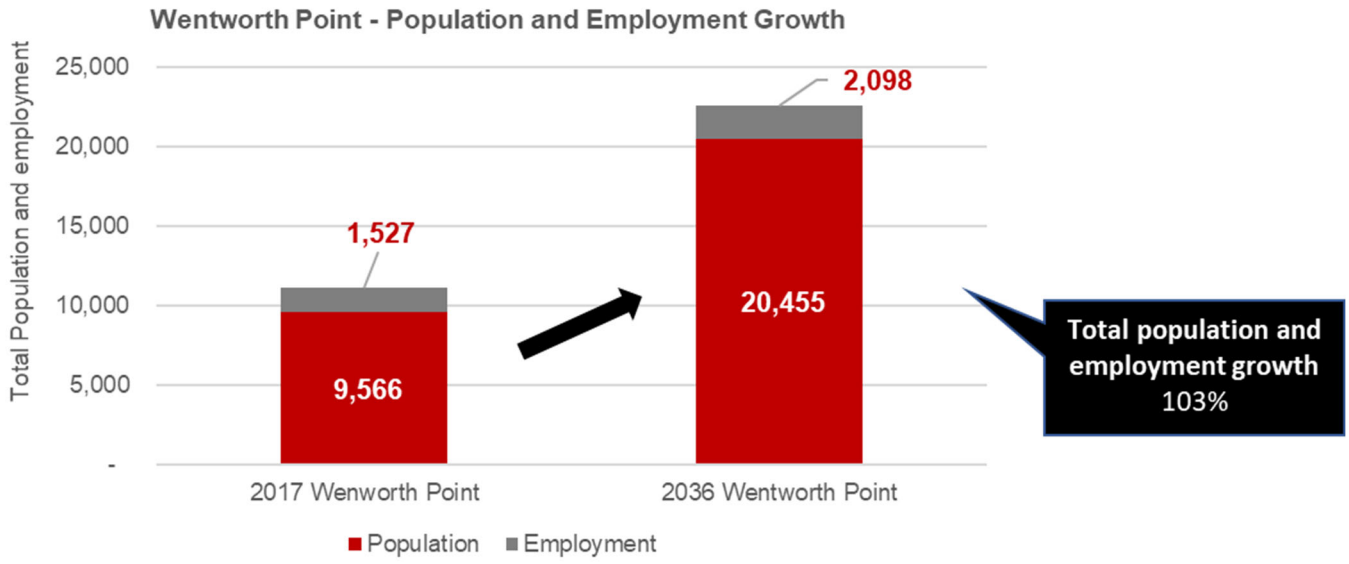


Table 2-1 and Figure 2-3 over-page shows the development status for the Wentworth Point precincts, which includes the additional Block H dwellings. The development status for the Wentworth Point precincts is based on information provided by Dowling Urban (July 2021), which includes a total of 12,790 dwellings, 17,900m^2 Gross Floor Area (GFA) and six precincts allocated to include community space, to be delivered by 2036.

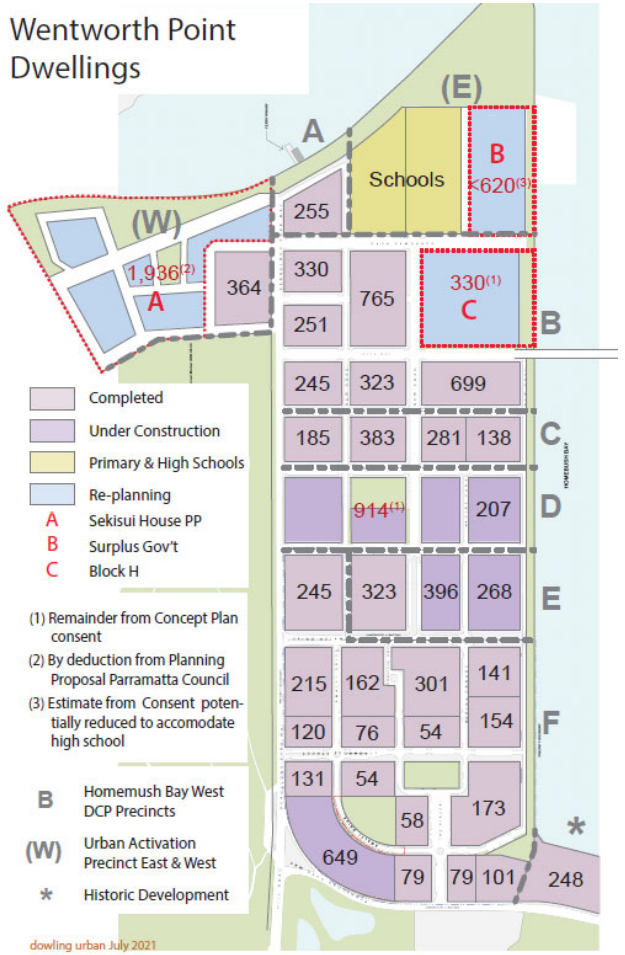
This influx of new population will benefit from world class public transport infrastructure, easy access to major employment areas such as the Sydney CBD and Parramatta; and will enjoy pedestrian and cycling infrastructure to Sydney Olympic Park sporting facilities, parklands, Parramatta River, nearby shopping centres and proposed high school.

Table 2-1 Wentworth Point Dwelling development status

* Proposed amendment to existing DCP for additional 660 dwelling with club and new childcare centre

Precinct	Status	Dwellings	Commercial	m²	Community
(W)	Approved	1,936			Open Space
	Construction	364			
(E)	Planned	640			Primary & High School
A	Occupied	255	Local Retail	TBA	Ferry Terminal
B (Block H)	Occupied	2,613	District Retail	15,000	Library
	Approved	330	Retail	2,900	
	Planned*	660	Club	4,000	Child care, Open Space
C	Occupied	844			
D	Construction	207			
	Approved	914			
E	Construction	664			
	Occupied	323			
F	Construction	649			
	Occupied	2,143	Local Retail	TBA	Parks, Pools, Courts
*	Occupied	248			
Total		**12,790**		**17,900**	

Figure 2-3 Extent of Wentworth Point Dwellings by precinct



Source: 'Wentworth Point Dwelling', Dowling Urban, July 2021

2.4 Travel characteristics

2.4.1 Trip distribution

The trip distribution in PTPM comes from the STM which uses the accessibility and land use data to distribute the trips. Figure 2-5 shows the distribution of car trips in the PTPM 2036 with SMW and PLR2 scenario to top ten destinations. The percentages shown represent the proportion of the car share in relation to all trips to a particular destination.

The Local Government Areas (LGAs) with high public transport accessibility such as Sydney CBD show a low car use of 15%. The Canterbury LGA has no direct public transport connection to Wentworth Point and as a result the car use is as high as 74%.

Figure 2-5 Trip distribution from Wentworth Point for car trips in 2036 with SMW and PLR2

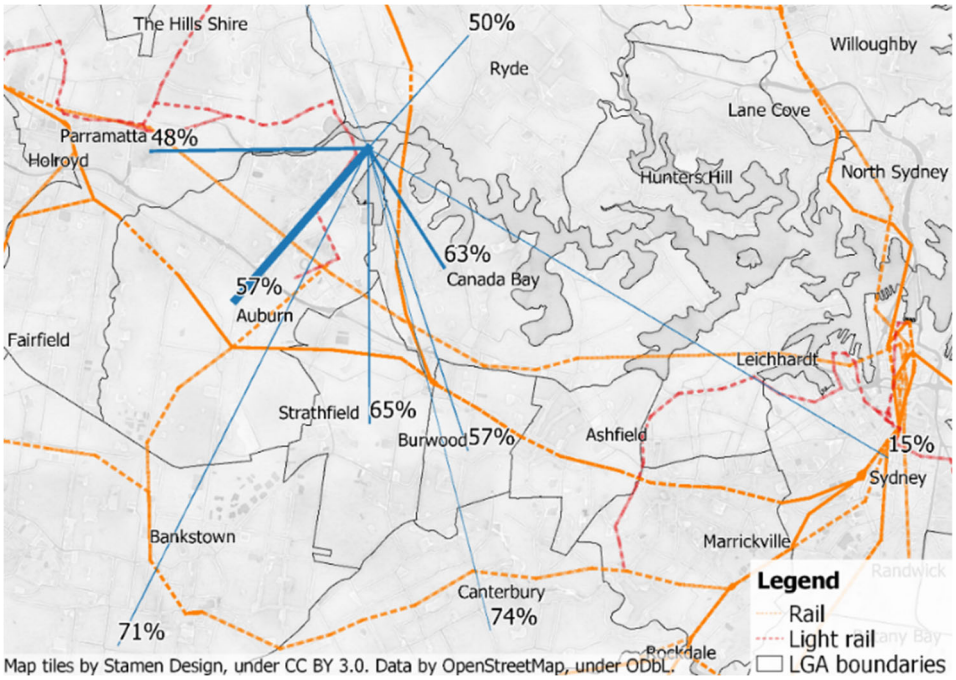


Table 2-2 shows the trip distribution from Wentworth Point to top ten LGAs by number of trips for car in 1 hour AM peak 2036 with SMW and with PLR2 by trip purpose. The majority of trips are commuting trips, which are considered to be non-discretionary trips. However, over 40% of Auburn car trips and over 35% of Canada Bay car trips have a different purpose than work, business and education (i.e. “Other” trip purpose) and may be treated as discretionary trips.

The discretionary trips could travel at a different time of day as those trips are unlikely to be bound by time constraints and therefore free up the road network in the peak hour.

Table 2-2 Trip distribution by purpose from Wentworth Point to top ten LGAs by car in 2036 with SMW and with PLR2

To LGA	Total 1hr car trips	Work	Business	Education	Other	Non-discretionary	Discretionary
Auburn	755	352	84	5	314	58%	42%
Parramatta	338	200	44	8	86	75%	25%
Canada Bay	319	155	45	5	114	64%	36%
Strathfield	180	85	24	3	68	62%	38%
Ryde	139	80	25	5	29	79%	21%

To LGA	Total 1hr car trips	Work	Business	Education	Other	Non-discretionary	Discretionary
Burwood	130	63	20	7	40	69%	31%
Bankstown	129	68	24	6	31	76%	24%
Sydney	111	82	18	4	7	94%	6%
Canterbury	79	41	15	1	22	72%	28%
The Hills Shire	62	34	12	4	12	81%	19%

Note: "Work", "Business" or "Education" trip purposes are considered to be non-discretionary trips. "Other" trip purpose is considered to be discretionary trips. -

The spatial trip distribution and mode choice is dictated by land use characteristics, such as employment and points of interest, and accessibility by public transport. Figure 2-6 shows the trip length distribution for trips originating at Wentworth Point. Around 500 trips in 2036 AM peak hour undertaken by car are within 5 km. Those trips could be undertaken by active transport modes considering Wentworth Point has an extensive cycling infrastructure. Figure 2-7 shows the cycling infrastructure in Wentworth Point indicating high connectivity to Rhodes and Sydney Olympic Park which are within 5 km.

However, the PTPM (version 5) does not model active transport and short trips are either allocated to car or public transport. Therefore, the car short trips are likely to be overestimated in the Wentworth Point area considering the active transport facilities in the area.

While PTPM does not model active transport trips it does model walk access to rail stations. In 2036 the pedestrian activity across Bennelong Bridge associated with accessing Rhodes station is predicted to be at a similar level as in the base year with the additional demand accommodated by SWM and PLR2. The 2036 PTPM scenario without SMW and PLR2 predicts the walk access demand accessing Rhodes station would more than double the base year demand. The PTPM modelling indicates the following pedestrian demand crossing the Bennelong Bridge to access Rhodes Station in the 1 hour AM peak:

- **2017 base year:** 200 people access Rhodes station from Wentworth Point.
- **2036 with SMW and with PLR2 scenario:** 180 people access Rhodes station from Wentworth Point (similar to 2017 levels).
- **2036 without SMW and without PRL2:** over 440 people access Rhodes station from Wentworth.

This highlights the importance of SMW with some active transport trips being diverted from Bennelong Bridge to light rail/bus trips to access the planned metro station at Sydney Olympic Park, as opposed to Rhodes Station from Wentworth Point. It should be further noted that the new high school in Wentworth Point will attract walking and cycling trips across the Bennelong Bridge. It is estimated that based on the catchment set out in the SCT report ("*Sydney Olympic Park new high school – Transport Access Impact Assessment)", SCT Consulting, 16 September 2021)*, 20% or around 140 students will be walking or cycling across the bridge in 1 hour AM peak.

Figure 2-6 Trip length distribution from Wentworth Point for car trips in 2036 with PLR2 and SMW

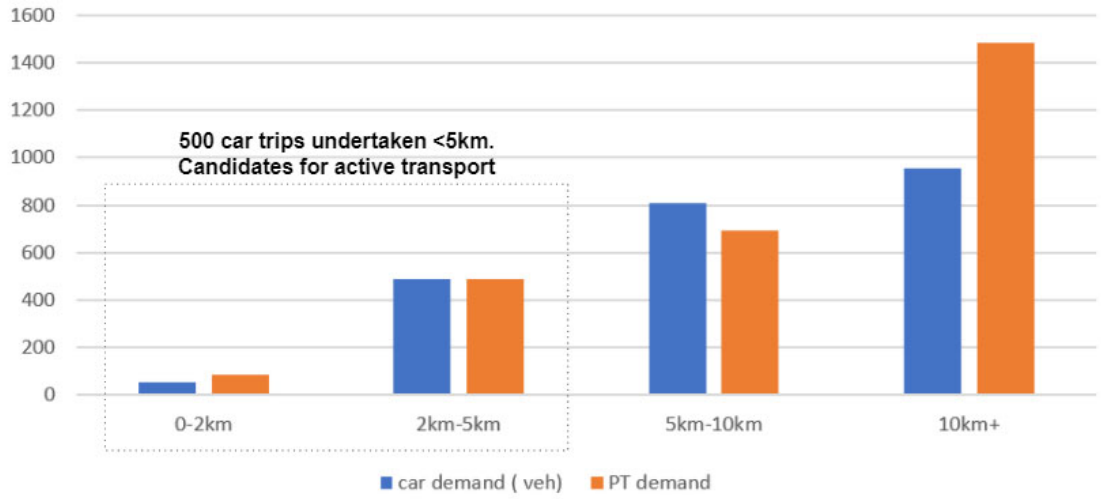


Figure 2-7 Cycling infrastructure in Wentworth Point

Implications for Wentworth Point, Block H and new high school development

- Car trips from Wentworth Point are destined to areas with lower public transport accessibility. These include the LGAs of Canterbury and Bankstown. The demographic fabric of Wentworth Point could have a low car ownership and be working in areas with good public transport accessibility such as Sydney CBD and Parramatta. Therefore, the forecast car trips from Wentworth Point could be redirected to public transport reducing travel demands on the surrounding Wentworth Point road network.
- There is a significant proportion of car trips from Wentworth Point that is not related to work, business or education purposes (over 40% of Auburn car trips and over 35% of Canada Bay car trips), which could be considered as discretionary trips. These trips could travel at a different time of day as those trips are unlikely to be bound by time constraints and therefore free up the road network that surround the Block H and new high school developments.
- Around 500 car trips in the Wentworth Point area are within 5 km which could be undertaken by walking or cycling considering the Wentworth Point Peninsula has extensive cycling infrastructure. PTPM (version 5) does not model active transport and short trips are either allocated to car or public transport. Therefore, the short car trips are likely to be overestimated in the Wentworth Point area.

3 Modelling Methodology and Framework

3.1 Overview

This section provides an overview of the modelling framework, including the roles, approach and assumptions used to develop the demand and operational models. It also outlines the model study area and limitations to the modelling process.

3.2 Stakeholder engagement

Since 2018, there have been ongoing discussions with TfNSW and Council regarding the proposed amendment. A project working group consisting of representatives from key stakeholders in TfNSW and Council was established in 2020 when the previous transport study was undertaken. This working group has been expanded to include PwC for this transport study, with the primary purpose of providing a forum for Bilbergia and PwC to present to key stakeholders the modelling results, methodology and assumptions, address key concerns and provide clarifications. This group consists of representatives from the following:

- Billbergia Project Team:
  - Client – Billbergia.
  - Transport Modelling – PwC.
  - Transport Advisor – Pentelic Advisory.
  - Land Use Planner – Dowling Urban.
- TfNSW, including the Advanced Analytics and Insights (AAI) modelling team
- Council.

The following workshops were held with the project working group:

- **Workshop #1: Inception (18-Aug-2021) -** Initial meeting to discuss stakeholder expectations, proposed scope and methodology, and data requirements to kick-start the project.
- **Workshop #2: Initial Modelling Results (15-Sep-2021) -** Workshop to discuss initial modelling results and assumptions that have been adopted for the demand and operational models, including trip generation and the projected land use. Key questions raised from the workshop included:
  - What are impacts of trip generation and distribution 'with' and 'without' the new high school, specifically, would there be a net increase in external trips from Wentworth Point without the new high school (as students would need to travel outside their local area)?
  - What are the key intersections for operational assessment, including Silverwater Road / Holker Street that is located outside the Wentworth Point study area?
  - Where are the trips to Wentworth Point coming from?
  - What road upgrades have been committed / planned to occur by 2036?
- **Workshop #3: Final Modelling Outcomes (10-Nov-2021).** – Workshop to present the final modelling results and quantify the impact of the Block H development on the road network.
- **Workshop #4: Presentation of Homebush Bay Drive / Australia Avenue Roundabout Operations – Partial Signalisation Design (29-Nov-2021) –** Workshop with TfNSW modelling team to discuss details of (1) level of delay / congestion the roundabout is forecast to experience under the current design versus alternative partial signalisation design option (further discussed in Section 4.5.3), and (2) the modelled signal settings of the roundabout under the alternative partial signalisation design option.

This report has been reviewed by Council (comments received 12-Jan-2022) and TfNSW (comments received 20-Jan-2022 and 1-Feb-2022).

3.3 Modelling framework

A multi-modal modelling framework has been applied to assess the impact of the future development in Wentworth Point as agreed with key stakeholders (TfNSW and Council). The study area is complex; the surrounding road network is currently

experiencing a high level of road congestion, the precinct has a limited number of available parking spaces, population that is projected to more than double by 2036, and is in the vicinity of the M4 Motorway and planned major public transport projects such as SMW and PLR (Stages 1 and 2).

Figure 3-1 shows the modelling flowchart and the interaction between the strategic and operational models. The land use projections together with road and public transport infrastructure assumptions are fed into the four-step multimodal STM. The STM produces mechanised travel demand forecasts which are fed into PTPM to perform mode choice. The Parking Precinct Module (PPM) is applied in PTPM to serve as a proxy for policy measures in travel demand management.

The demand response to land use in STM and mode choice response in PTPM are subsequently applied to the Sydney Motorway Project Model (SMPM) demand matrices, The SMPM demand matrix represents the road user behaviour in response to tolls and are split into toll and non-toll users for light and heavy vehicles.

This adjusted SMPM demand matrix is then fed into the Wentworth Point Mesoscopic Model (WPMM) for operational assessment (both network-wide and intersection-level analysis). For the intersection at Silverwater Road / Holker Street, which is located outside the WPMM study area (refer to map shown in Section 3.4), SIDRA modelling has been used.

Figure 3-1 Wentworth Point transport study modelling process

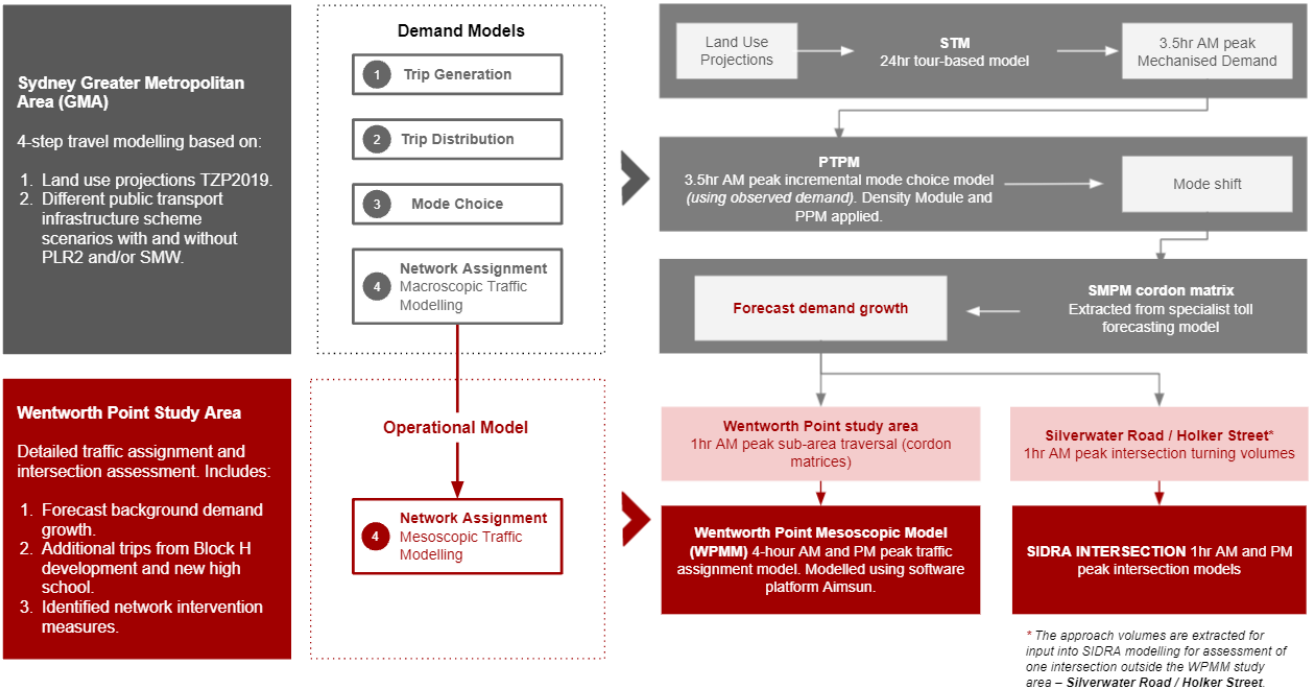


Table 3-1 provides an overview of the models used for Wentworth Point, including base year, summary of input assumptions, model version, spatial and temporal coverage of the models. It should be noted that the base years vary between the demand and operational models. The STM base year is 2016, PTPM base year is 2017 and the WPMM base year is 2019. To account for this difference, the traffic growth applied to the operational models is interpolated to calculate the forecast demand for the ultimate year 2036.

Table 3-1 Overview of Wentworth Point modelling suite

Model	Model Version	Software Platform	Model Zoning System	Spatial, Temporal Coverage	Horizon Years	Notes
STM	STM 3.8	Emme	TZ16 with outputs converted to TZ11	Sydney GMA, 24-hr model	• Base (2016) • Future (2036)	• Land Use Projections TZP2019 • Future network includes PLR and SMW

Model	Model Version	Software Platform	Model Zoning System	Spatial, Temporal Coverage	Horizon Years	Notes
PTPM	PTPM5	Emme	TZ11	Sydney GMA, 3.5hr AM peak model	• Base (2017) • Future (2036)	• Includes density module • 30 min Parking Precinct Module (PPM) applied to the area • Future network includes various combinations of with and without PLR2 and / or SMW
SMPM	SMPM 1	Emme	TZ11	Cordon for Wentworth Point	• Base (2021) • Future (2036)	• Land Use Projections TZP2016 • Without SMW
WPMM	N/A	AIMSUN	TZ11	Wentworth Point Study Area, 4-hr models (6-9am and 3-7pm)	• Base (2019) • Future (2036)	• TZ11 zones are further subdivided based on the calibrated base year model. • Model developed in AIMSUN version 2020.
SIDRA models	N/A	SIDRA INTERSE-CTION	N/A	Isolated intersection (Silverwater Road / Holker Street), peak 1-hr models (8-9am and 5-6pm)	• Base (2019) • Future (2036)	• Model developed in SIDRA INTERSECTION version 9

3.3.1 Traffic growth process

At a high-level, the traffic growth process is undertaken in the following steps:

- The land use projections (Travel Zone Projects 2019 (TZP19)) are run through STM to generate travel demand and distribute the trips between origins and destinations.
- The 3.5-hour morning peak mechanised demand is extracted from the STM and fed into PTPM to perform mode choice.
- The SMPM demand matrix, which is based on a sub-area of the model derived from earlier land use projections (Travel Zone Projects 2016 (TZP16)) than those used in STM (TZP19) is adjusted using the outputs from PTPM. An equivalent PTPM to SMPM was ran to enable the adjustment. The following formula is applied:

  Adjusted SMPM = SMPM TZP16 + (PTPM TZP19 – PTPM TZP16)

- Peak hourly traffic growth from 2019 to 2036 is calculated on an origin-destination (OD) basis from the adjusted SMPM sub-area demand matrix. This traffic growth is added to the WPMM calibrated base year 2019 demand to produce the 2036 forecasts. Note:
  - The base years for the demand models vary from 2016 to 2021. The traffic growth from 2019 is calculated via interpolation for the intervening year from 2016 to 2021.
  - Traffic growth is calculated in absolute terms for each OD pair (i.e. 2036 minus 2019) for light and heavy vehicles.
  - The PTPM produces forecasts for the morning peak only. It is assumed that the peak hourly growth for the afternoon period is an inverse of the morning peak (i.e. the number of outbound trip in the morning peak are the same as the inbound trips in the afternoon).
  - Peak hourly traffic growth is expanded to cover the full 4-hour morning and afternoon periods based on the existing expansion profiles from the WPMM calibrated base year (2019) demand.
  - Zonal splits for the sub-divided travel zones are apportioned based on the existing splits from the WPMM calibrated base year (2019) demand.
  - Traffic growth resulting in negative trips (i.e. where the decrease in trips is greater than the calibrated base year demand) are zeroed out.

- Additional traffic from the proposed Block H development and new high school are calculated via spreadsheet analysis and applied directly to the 2036 forecasts in the WPMM for further network testing. The trip distribution is based on the existing distribution in the WPMM calibrated base year (2019) demand.

The following sections provide further details on the individual models used in the Wentworth Point modelling framework.

3.3.2 Sydney Strategic Travel Model (STM)

STM is a 24-hour tour-based model, developed using the data from Household Travel Survey (HTS) and Journey to Work (JTW). Key inputs in STM are based on assumptions for land use and demographics. For Wentworth Point, the land use projections are based TZP19.

A tour in STM is defined as a return trip to the primary destination e.g. a home-based work tour means a trip from home to work and then a trip from work back to home. HTS is a survey that collects information about the day-to-day travel for people living in the Sydney GMA (e.g. where they go, when they travel, purpose of trip, the mode of transport and cost of the trip). JTW is a survey that collects information about where people work or reside as well as the mode used for the journey to work.

The STM is a four-step model which performs trip generation, trip distribution, mode choice and trip assignment. The demand resulting from the trip generation and distribution steps are used as inputs to the PTPM.

3.3.3 Public Transport Project Model (PTPM)

PTPM is an incremental mode choice model used for assessing public transport projects. PTPM uses observed travel demand for the base year and applies growth from the STM for future years. The PTPM has an inbuilt land use density module which serves as a proxy of car parking availability. PTPM also uses a subjective PPM which serves as a proxy for policy measures. A 30-minute PPM was used to reflect future assumptions for policy measures to limit car use in Wentworth Point.

3.3.4 Sydney Motorway Project Model (SMPM)

SMPM is a specialist road assignment and toll choice model of Sydney. The model takes three categories of inputs: demand, road network, and other tolling-related inputs (i.e. toll pricing, macroeconomics and behavioural data). Using the input data and a toll choice procedure within the Emme modelling software package, SMPM estimates motorway traffic volumes and traffic within the wider Sydney road network; including for greenfield and brownfield toll roads. It uses multiple toll user classes, and the network coding is frequently audited. However, as the SMPM (version 1) does not allow testing different land uses, only land use TZP16 can be used with this version. For Wentworth Point, the SMPM outputs were adjusted using PTPM to account for changes in land use and infrastructure.

3.3.5 Wentworth Point Mesoscopic Model (WPMM)

The WPMM is a detailed road assignment model that has been developed for the purposes of assessing the operational impacts of the proposed developments in the surrounding Wentworth Point road network. The model is based on the calibrated base model supplied by TfNSW. No changes have been made to the base model by PwC.

WPMM is based on Dynamic User Equilibrium (DUE) assignment under mesoscopic traffic simulation that accounts for delays associated with accumulation of traffic in queues and traffic signals. This step assigns each OD travel pair to the road network iteratively, updating the generalised costs (‘travel cost’) to available paths it is assigned to until equilibrium is reached whereby travellers are no longer switching their routes because they would not be able to further reduce their travel costs. The travel costs are a function of perceived travel time and distance. This traffic assignment methodology provides more detail than static assignment and can better capture the delays experienced by drivers on a capacity-constrained network.

The forecast scenarios are based on the following key inputs: the cordon matrices from the demand models, additional trips from the proposed Block H developments and new high school, planned network upgrades and signal optimisation works. No other changes to the modelling parameters have been made to the forecast scenarios.

3.3.6 SIDRA INTERSECTION (SIDRA)

SIDRA is a micro-analytics lane-based model that has been used to provide intersection performance analysis for Silverwater Road / Holker Street, which is located outside the Wentworth Point study area. The approach to developing the base and forecast SIDRA models are described as follows:

- The base year intersection turning volumes at Silverwater Road / Holker Street have been provided by TfNSW, which are derived from survey counts collected on Thursday 11 March 2021. Further work has been undertaken using Apple Mobility data to verify the impacts of COVID-19 related restrictions on traffic volumes. Based on Apple Mobility data on routing requests for "driving" mode (used as proxy for traffic demand), the data shows traffic returning to pre-COVID-19 levels by March 2021. This timing aligns with the easing of restrictions following the Northern Beaches outbreak detected in Sydney's north in December 2020.
- The base year SIDRA model has been calibrated based on a qualitative analysis of:
  - Simulated density plots extracted from the WPMM base model to approximate level of congestion at each approach leg for the morning and afternoon peak hours of 8-9am and 5-6pm respectively.
  - Google Traffic for a typical Thursday during the morning and afternoon peak hours of 8-9am and 5-6pm respectively. This has been used as a secondary source of information to verify intersection congestion levels observed in the WPMM base model.
- The forecast intersection turning volumes at Silverwater Road / Holker Street are based on the peak hourly traffic growth derived from the demand models.

3.3.7 COVID-19 sensitivity

COVID-19 has to-date had a significant impact on the economy, migration trends and travel behaviour. While the long-term impacts are unknown, TfNSW have produced a guideline '*Technical Note on assessing the impacts of COVID-19 for business cases'* (Version 1.0, TfNSW June 2021)[4] which advises to undertake sensitivity testing into the potential long-term downside risks associated with COVID-19 impacts due to lower land use growth and higher levels of working from home. The TfNSW guidelines were implemented into the PTPM based on the advice from the TfNSW's AAI. The adjustments are made to the total mechanised demand extracted from the STM and applied to home-based work, work-based business and business detour purposes. The adjusted mechanised demand is fed into PTPM for mode choice which in turn informs the operational modelling.

It has been assumed that the migration and population forecasts will not change from the core scenarios and only the travel behaviour will. The TfNSW guidelines suggest that 40% of all employees could work from home but only 30% of those will regularly work from home 2 days a week.

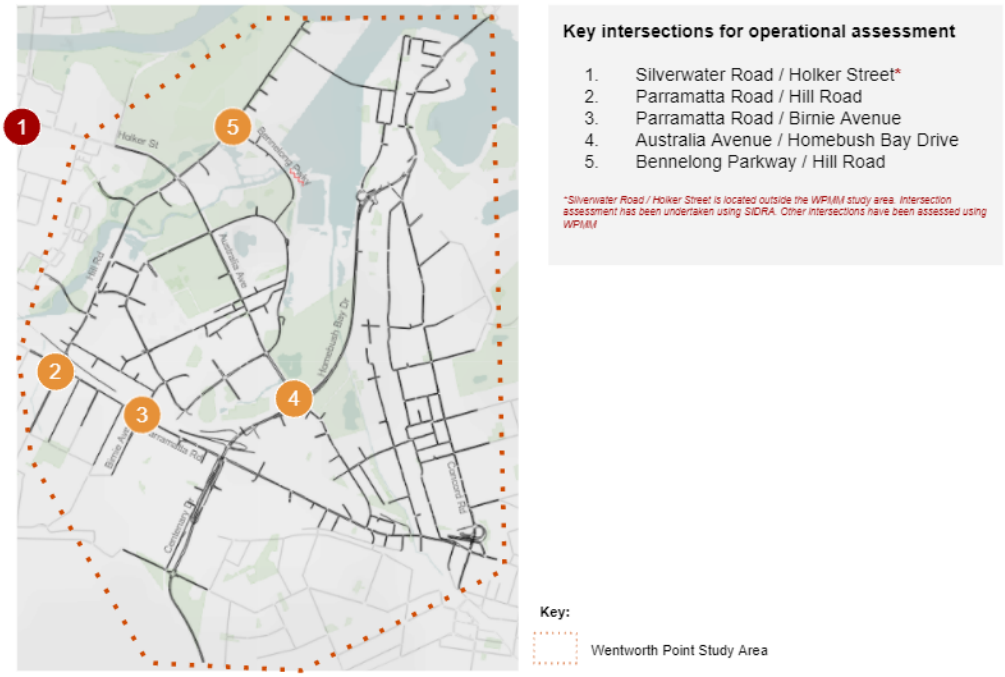
3.4 Model extents

The STM and PTPM cover the whole of the wider Sydney GMA, which includes Sydney, Wollongong, Newcastle and the Blue Mountains. The SMPM covers the Sydney Basin.

Figure 3-2 shows the Wentworth Point study area in the WPMM, which is bounded by Parramatta River to the north, Concord Road to the east, Parramatta Road to the south and Hill Road to the west. It also includes the major corridors at the M4 Motorway and Australia Avenue, and the five key intersections for intersection assessment.

4 Retrieved from https://www.transport.nsw.gov.au/system/files/media/documents/2021/TfNSW%20COVID-19%20Guidelines%20-%20v1.0.pdf)

Figure 3-2 Wentworth Point study area in WPMM and location of intersections for detailed assessment



3.5 Limitations in the modelling process

Traffic models rely upon complex sets of data, assumptions and numerous factors which can influence actual network performance, many being beyond the control or reasonable foresight of the forecaster. Any traffic forecast or other information contained in this report are based on the information provided, and obtained from the sources identified, and the assumptions agreed, and therefore is inherently subject to uncertainties. Inevitably, some assumptions will not be realised, and unanticipated events and circumstances may occur. It is important to appreciate that traffic models and forecasts are not a precise science and are only an indication of what might happen in the future and may not be achieved.

PwC does not provide any form of assurance that the forecasts documented in this Report will be achieved and no warranty should be implied as to the accuracy of the forecasts. The traffic forecasts developed for this project are subject to the following limitations:

- PTPM and STM uses volume delay functions for the car assignment. Those functions reduce the modelled travel speed as the flow of traffic increases. However, the PTPM and STM are demand models and forecast the number of people willing to use the car rather than how many people can use the car. Therefore, the assigned car demand on links can exceed the capacity of the link.
- PTPM and STM uses fixed travel times for public transport. As a result, the public transport travel times do not deteriorate as the traffic congestion increases in the forecast years. Car travel times cannot be used in the public transport assignment as they are not calibrated.
- The STM is not doubly constrained for trip production and attraction affecting the trip distribution between scenarios. This means that under the same land use conditions and different accessibility costs the number of trips attracted to an area could be different. For example, if a number of jobs in the Sydney CBD does not change between scenarios and the accessibility improves, there will be more work trips attracted to Sydney CBD.
- The operational assessment of the road network performance has been limited to mesoscopic modelling for the Wentworth Point model study area.
- The observed traffic counts for Silverwater and Holker Street are based on March 2021 provided by TfNSW. Our analysis show that the overall intersection traffic volumes are similar to those pre-COVID-19. However, the trip pattern may have been affected.
- Calibration of the SIDRA base model for Silverwater Road and Holker Street have been limited to a qualitative analysis of simulated density plots extracted from the WPMM calibrated base model and Google Traffic.

4

Scenario Assumptions

4.1 Overview

The modelling framework relies on a number of inputs which are determined by observations and assumptions about the future as agreed with key stakeholders (TfNSW and Council). This section documents the modelling scenarios, the assumptions for the forecast network and demand, including the Block H and new high school development.

4.2 Modelling scenarios

The modelling scenarios have been split into the two main categories; (1) demand and (2) operational modelling, with the operational models further split between 'core' and 'sensitivity'. Table 4-1 to Table 4-3 provides an overview of the scenario definitions, which are described as follows:

- **Demand scenarios:** Run in STM, PTPM and SMPM and includes different assumptions within the transport network for scenarios with and without PLR2 and / or SMW, as well as a "COVID-19" scenario for sensitivity testing to assess the long-term impacts of the pandemic on the traffic forecasts. These scenarios do not include the additional trips from the proposed developments and have been run primarily to generate the forecast background growth and to provide an understanding of the current travel patterns in Wentworth Point and future impacts under different public transport infrastructure scenarios. The following demand scenarios have been used for input to the operational models:
  - Scenario D1 (2036 without PLR2 and SMW), for input to Scenario S1 (Future without PLR2 and SMW).
  - Scenario D4 (2036 with PLR2 and with SMW), for input to Scenario O1 to O3 (all 'core' scenarios) and S2 (Future Project (with school) and mitigation measure).
  - Scenario D5 (2036 with PLR2 and with SMW (COVID)), for input to Scenario S3 (Future Reference (COVID)).
- **Operational scenarios:** Run in WPMM and includes forecast scenarios with and without the proposed developments.
  - The core models represent scenarios that have been tested primarily to evaluate the impacts of the Block H developments with / without the new high school. Background growth is based on demand scenario that includes both PLR2 and SMW (Scenario D4).
  - The sensitivity scenarios are used to assess the operational performance of the forecast road network under (1) an alternative Australia Avenue / Homebush Bay Drive roundabout upgrade design, (2) high demand scenario without PLR2 and SMW, and (3) reduced demand scenario where more people are likely to work from home post-COVID-19.

Table 4-1 Demand models (STM / PTPM / SMPM) – scenario definitions[5]

Demand Scenario ID	Scenario Name	Year	Public Transport Infrastructure Scheme	
			PLR2	SMW
D0	Base	2017**	✗	✗
D1*	2036 without PLR2 and without SMW	2036	✗	✗
D2	2036 without PLR2 and with SMW	2036	✗	✓
D3	2036 with PLR2 and without SMW	2036	✓	✗
D4*	2036 with PLR2 and with SMW	2036	✓	✓
D5*	2036 with PLR2 and with SMW (COVID)	2036	✓	✓

[5] A bus alternative scenario representing a demand scenario where an equivalent bus network would operate in lieu of PLR2 was discussed with key stakeholders. It has been agreed that there would be no material differences in the demand forecasts for scenarios with a bus alternative or with PLR2.

* Traffic growth from D0 to D1 / D4 / D5 scenarios (i.e. D1 / D4 / D5 minus D0) are applied to the operational models. Other demand models were used to provide understanding of the impacts to travel demand with / without PLR2 and / or SMW.

** The base years for the demand models vary from 2016 to 2021. The traffic growth from 2019 for operational models is calculated via interpolation for the intervening year from 2016 to 2021.

Table 4-2 Operational models (WPMM / SIDRA), core – scenario definitions

Core Models **Operational Scenario ID**	**Scenario Name**	**Year**	**Future Assumptions**	
			Demand forecasts	**Road Network**
O0	Base	2019	-	2019 network
O1	Future Reference	2036	D4	Approved upgrades + signal optimisation
O2	Future Project (without school)	2036	D4 + Block H	Approved upgrades + signal optimisation
O3	Future Project (with school)	2036	D4 + Block H + school	Approved upgrades + signal optimisation

Note: The Core Models represent scenarios that have been tested primarily to evaluate the impacts of the Block H developments and the new high school.

Table 4-3 Operational models (WPMM / SIDRA), sensitivity – scenario definitions

Sensitivity Models **Operational Scenario ID**	**Scenario Name**	**Year**	**Future Assumptions**	
			Demand forecasts	**Road Network**
S1	Future Reference and mitigation measure	2036	D4	Approved upgrades + signal optimisation + Australia Ave roundabout upgrade
S2	Future without PLR2 and SMW	2036	D1	Approved upgrades + signal optimisation
S3	Future Reference (COVID)	2036	D5	Approved upgrades + signal optimisation

Note: The Sensitivity Models represent scenarios that have been tested to assess: (1) what additional network mitigations measures would be required to cater for forecast demand i.e. S1 scenario with alternative Australia Avenue / Homebush Bay Drive roundabout upgrade design, (2) how the network would perform under a forecast demand scenario without any of the major public transport infrastructure schemes i.e. S2 scenario without PLR2 and SMW and (3) reduced demand scenario where more people are likely to work from home post-COVID-19.

4.3 Future Demand Assumptions

Table 4-4 shows the traffic forecasts and annual growth rates extracted from the demand models (cordon matrices), and similarly in Table 4-5 for the operational model (WPMM) for the Wentworth Point study area. Note, the traffic forecasts extracted from the demand models are limited to the morning peak as PTPM (version 5) only models the morning period. The demand matrices for the hourly traffic growth for the afternoon peak are assumed to be the inverse of the morning peak, which is an accepted practice that has been adopted on other modelling projects with TfNSW.

Based on the traffic forecasts and growth rates:

- **Scenario D4 versus D1:** The 2036 demand scenario with PLR2 and with SMW would result in a lower traffic growth rate of 1.1 % p.a (20% from base year) when compared to 2.4% p.a. (40% from base year) when those projects are not included. This difference further highlights the positive impacts of PLR2 and SMW and benefits associated in reducing car demand in Wentworth Point.
- **Scenario D4 versus D5:** The 2036 demand scenario with the adjustments made to account for the long-term impacts of COVID-19 would result in the lowest traffic growth of 0.9% p.a. due to the higher number of people that are assumed to be working from home (as indicated in Section 3.3.7).
- **Scenario D4 versus O1-3 and S1:** There is a 0.2% p.a. difference in traffic growth during the morning peak and up to 0.5% p.a. difference in the afternoon peak when comparing the demand models with the operational models. Some difference is expected given the base year demand in the demand models are not calibrated to the same level of detail as the operational models, particularly in the afternoon peak, which is an inherent limitation in the demand models.
- **Scenario D1 versus S2:** There is up to 0.1% p.a. difference in traffic growth between the operational and demand models. This difference is generally in-line with the variability observed above for "Scenario D4 versus O1-3 and S1".

In general, the traffic growth rates from the operational models are higher than the demand models. Within the demand models, the traffic demand is forecast to exceed network capacity. From an operational perspective, as the demand models are not capacity-constrained, this suggests that the traffic growth rates are likely to be higher than what the network is able to realistically handle, particularly in the afternoon peak.

It should be further noted that no demand capping (or other similar treatments to suppress traffic demand growth) has been applied in the WPMM; the car trips that have been forecast for Wentworth Point represent a potential "worst-case" scenario in which the maximum traffic growth is realised.

Table 4-4 Demand models (cordon matrices) forecasts and annual traffic growth

Demand Scenario ID	Scenario Name	Morning peak 7-9am		Peak hourly traffic growth (trips)
		Demand (trips)	Per annum growth (from 2019)	
D0	Base	60,550	-	
D1	2036 without PLR2 and without SMW	85,757	2.4%	12,604
D4	2036 with PLR2 and with SMW	72,162	1.1%	5,806
D5	2036 with PLR2 and with SMW (COVID)	70,309	0.9%	4,880

Notes: (1) The traffic forecasts extracted from the demand models are limited to the morning peak only as PTPM only models for the morning period, (2) demand represents the sub-area traversal (i.e. cordon matrices) for number of trips within the Wentworth Point study area and (3) the peak hourly traffic growth is calculated by halving the traffic growth for the morning peak demand.

Table 4-5 Operational models (WPMM) forecasts and annual traffic growth

Operational Scenario ID	Scenario Name	Input Demand Scenario ID (for traffic growth)	Morning peak 6-10am		Afternoon peak 3-7pm	
			Demand (trips)	Per annum growth (from 2019)	Demand (trips)	Per annum growth (from 2019)
O0	Base	-	107,537	-	120,500	-
O1	Future Reference	D4	130,406	1.3%	151,773	1.5%

Operational Scenario ID	Scenario Name	Input Demand Scenario ID (for traffic growth)	Morning peak 6-10am		Afternoon peak 3-7pm	
			Demand (trips)	Per annum growth (from 2019)	Demand (trips)	Per annum growth (from 2019)
O2	Future Project (without school)	D4	130,922	1.3%	152,266	1.6%
O3	Future Project (with school)	D4	130,888	1.3%	152,232	1.5%
S1	Future Reference and mitigation measure	D4	130,406	1.3%	151,773	1.5%
S2	Future without PLR2 and SMW	D1	149,446	2.3%	168,815	2.4%
S3	Future Reference (COVID)	D5	121,465	0.8%	142,353	1.1%

Note: The traffic forecasts represent total demand within the Wentworth Point study area in the WPMM where an expansion profile is applied to the peak hourly traffic growth to cover the full 4-hour period.

4.4 Block H Development and New High School Assumptions

4.4.1 Trip generation rates

The assumptions for the trips rates have been derived from various sources based on similar traffic studies and have been agreed and discussed with key stakeholders (TfNSW and Council). Table 4-6 describes the assumption sources for the trip rates, including the directional splits.

Table 4-6 Block H and new high school trip rates and assumption source

Land Use	Peak hour trip rate		Assumption source
	AM peak (8-9am)	PM peak (5-6pm)	
High density residential	0.19	0.15	• Trips rates derived from similar traffic studies including Rhodes East Precinct and Planning Proposal for 14-16 Hill Road, Wentworth Point. • These are reflective of an area with localised trip-making, good accessibility to public transport, demand management strategies (e.g. parking controls) and supporting infrastructure in place to promote greater uptake of active transport in Wentworth Point. • Confirmation of trip rates received from TfNSW, with no further issues raised during stakeholder consultation.
Club	0	0.075	• Trip rates derived from *"Wentworth Point Block H Transport Strategy"*, Viae Consulting, Oct 2020, which assumes: – 0.1 trip rate per sqm licensed floor area, 50% of trips in and 50% trips out. – 75% discount to account for the likely shift towards walking customers due to the localised nature of these trips. Based on the report, this is "*evidenced by observed reduced trip generation for the existing Marina square shopping centre which currently exhibits low rates of car trip generation and parking utilisation*". The report further notes that for both retail and club/entertainment uses "*this lower trip*

Land Use	Peak hour trip rate AM peak (8-9am)	PM peak (5-6pm)	Assumption source
			generation would also be supported by reduced parking provision for these land uses".
Child Care	0.16	0.15	• Initial trip rates from *"Wentworth Point Block H Transport Strategy",* Viae Consulting, Oct 2020. • Trip rates have been further reduced based on assumption that majority of trips generated would be parents walking their child to the childcare centre. For the *Proposed Mixed-Use Development, VRS Site: 657-661 Victoria Road & 4-6 Wharf Road, Melrose Park*, Parramatta Council approved the ASON Traffic Impact Assessment, which assumes: – 20% of the trips would be external and generate traffic. – 80% of the trips generated by the childcare centre would be internal trips from parents living in the units within the site (i.e. walking their child to the centre or pick-up/drop-off on the way from/to work).
Secondary school	0.37	0	• Trips rates from *"Meadowbank Education and Employment Precinct Schools Project Transport and Accessibility Impact Assessment",* GTA Consultants on behalf of School Infrastructure NSW, Oct 2019, which assumes: – Vehicle occupancy of 1.7 for secondary students (i.e. 0.59 trip rate), which has been based on the *"Trip Generation Surveys, School - Analysis Report"* GTA Consultants on behalf of RMS, August 2014. – 62% of secondary students will arrive within 8am to 9am, with car drop-offs departing within the same hour. For Wentworth Point, this corresponds with the AM peak hour in the operational model. – 37% of secondary students will depart within 2:30pm to 3:30pm, with car pick-ups arriving within the same hour. It is assumed that the remainder of the students (i.e. 63%) will depart within 3.30pm-4.30pm, which corresponds with the finish time for last lessons and Out of School Hours care for secondary students, noting that this is outside the PM peak hour in operational model.
Secondary school (staff)	0.7	0	• Trip rate per parking space is based on *"Meadowbank Education and Employment Precinct Schools Project Transport and Accessibility Impact Assessment",* GTA Consultants on behalf of School Infrastructure NSW, Oct 2019, which assumes: – 70% of staff arriving and 0% departing in the morning peak hour. – No staff arriving / departing in the afternoon peak hour.

For the new high school development, the following assumptions have been applied:

- The number of students for the new high school are based on the *"Sydney Olympic Park new high school - Request for Secretary Environmental Assessment Requirements (SEARs)*", Mecone on behalf of NSW Department of Education, June 2021, which states that 1,530 new students by end of Stage 2. For the purposes of this transport study this is assumed to occur by 2036.
- The mode shares for students to arrive at school are based on "*Sydney Olympic Park new high school – Transport Access Impact Assessment)",* SCT Consulting, 16 September 2021, which states:
  - 13% of students (i.e.199 students) will arrive by car. By applying the 0.37 rate this equates to additional 73 vehicles.
  - 73% of students (i.e. 1,117 students) will arrive by active transport. Using the STM education mode share, 22% of those students (i.e. 246 students) would previously travel to school by car. By applying the 0.37 rate this equates to a reduction of 90 vehicles.

– 30 off-street car parking spaces will be available for staff use. This will generate 21 car trips based on the assumption that 70% of staff arrive in the morning peak.

4.4.2 Trip generation (Block H and new high school)

Table 4-7 and Table 4-8 below presents a breakdown of the Block H and new high school trips for the morning and afternoon peak hours based on the trip generation rates approved by key stakeholders:

- The Block H trips accounts for 4.5% and 8.3% of forecast demand for the morning and afternoon peak hour, respectively, as a proportion of all trips within the Wentworth Point study area.
- The new high school trips are disaggregated into (1) new trips that would be attracted to the new high school and (2) trips that would no longer travel by car. The trips that would no longer travel by car represents students living within the walking catchment that would otherwise have to travel outside the local area for access to a high school, resulting in an overall decrease in trips.[6]

Table 4-7 Summary of Block H trips 2036

	Trip Rate				AM peak (8-9am)		PM peak (5-6pm)	
Land Use	**AM peak**	**PM peak**	**Quantity**	**Unit**	**Trips In**	**Trips Out**	**Trips In**	**Trips Out**
High density residential	0.19	0.15	660	per dwellings	25	100	79	20
Club	0	0.075	2,400	per sqm licensed floor area	0	0	90	90
Child Care	0.16	0.15	75	per child	12	12	11	11
				Total Block H trips	**37**	**112**	**180**	**121**
				Total vehicle trips in Wentworth Point	**3,279**		**3,645**	
Proportion of Block H vehicle trips as a proportion of Wentworth Point					**4.5%**		**8.3%**	

Table 4-8 Summary of new high school trips in 2036

	Trip Rate				AM peak (8-9am)		PM peak (5-6pm)	
Land Use	**AM peak**	**PM peak**	**Quantity**	**Unit**	**Trips In**	**Trips Out**	**Trips In**	**Trips Out**
Secondary school (new trips attracted)	0.37	0	199	per student	73	73	0	0
Secondary school (no longer travel by car)	0.37	0	246	per student	- 90	-90	0	0
Secondary school staff	0.7	0	30	per space	21	0	0	0
				Net increase in trips	+4	-17	0	0

6 The mode splits used to calculate the decrease in car trips are based on a transport study for the new high school: "*Sydney Olympic Park new high school – Transport Access Impact Assessment)",* SCT Consulting, 16 September 2021. Retrieved from: https://majorprojects.planningportal.nsw.gov.au/prweb/PRRestService/mp/01/getContent?AttachRef=SSD-11802230%2120210921T083249.739%20GMT

4.4.3 Trip distribution

The trip distribution is based on the existing distribution in the WPMM calibrated base year (2019) demand. Table 4-9 provides a summary of the 2036 trip distribution travelling from / to Block H and the new high school to / from various travel zones during the morning (8-9am) and afternoon peak (5-6pm) hours. The external travel zones located along the western boundary of the study area and the internal zones located within the Wentworth Point, Sydney Olympic Park and Carter Street precincts represent the major origin / destination points for the Block H and new high school traffic.

Table 4-9 2036 trip distribution for Block H and new high school

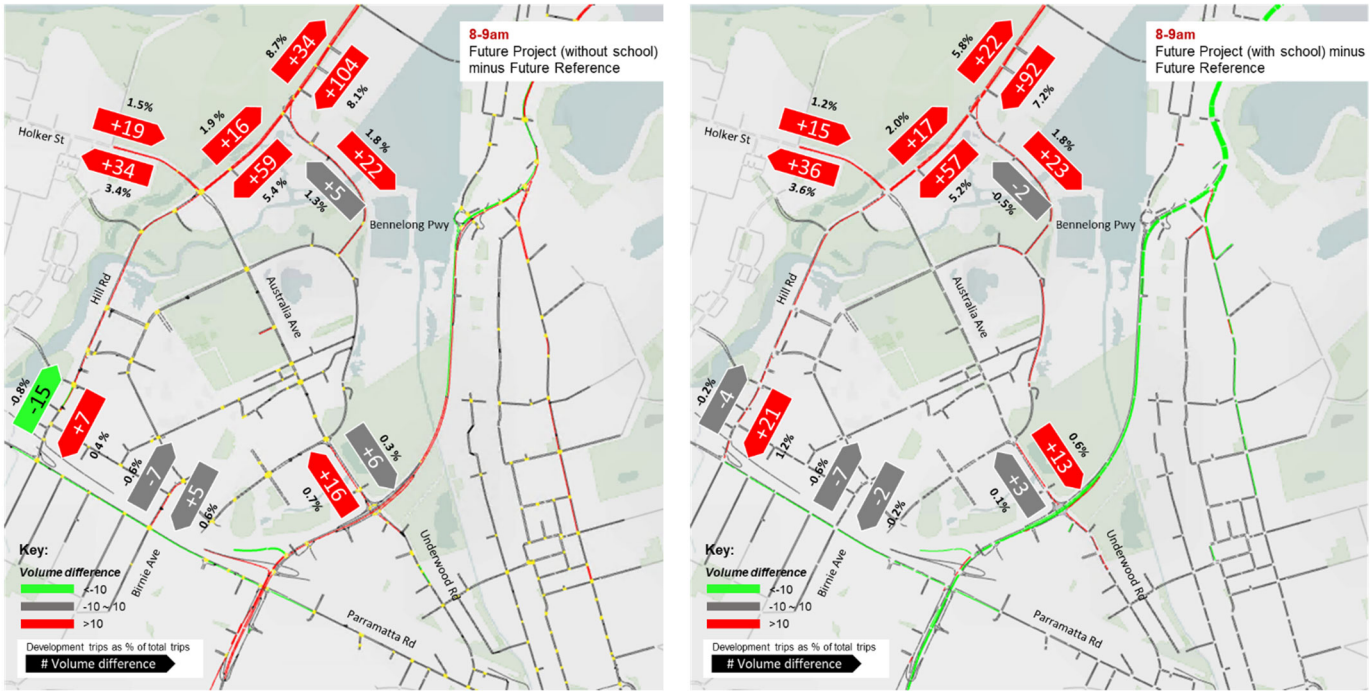
Travel Zones	Morning Peak (8-9am)		Afternoon Peak (5-6pm)	
From / To Block H and new high school	To	From	To	From
Internal zones – Wentworth Point + Sydney Olympic Park + Carter Street	25%	38%	16%	22%
Internal zones – Concord + Rhodes + Homebush	3%	5%	9%	8%
External zones – East direction	2%	2%	8%	3%
External zones – South direction	5%	8%	5%	28%
External zones – West direction	61%	44%	57%	28%
External zones – North direction	3%	4%	4%	10%
Total	**100%**	**100%**	**100%**	**100%**

Traffic flow difference plots have been extracted from the WPMM to illustrate the resulting trip distribution with the new Block H and new high school trips in the model. It should be noted that these plots show the net difference only in terms of the overall changes to traffic flow with and without the addition of the Block H and new high school trips; it does not provide a detailed breakdown of the internal reassignment of trips that make up the net difference.

Based on the traffic flow difference plots shown in Figure 4-1 and Figure 4-2:

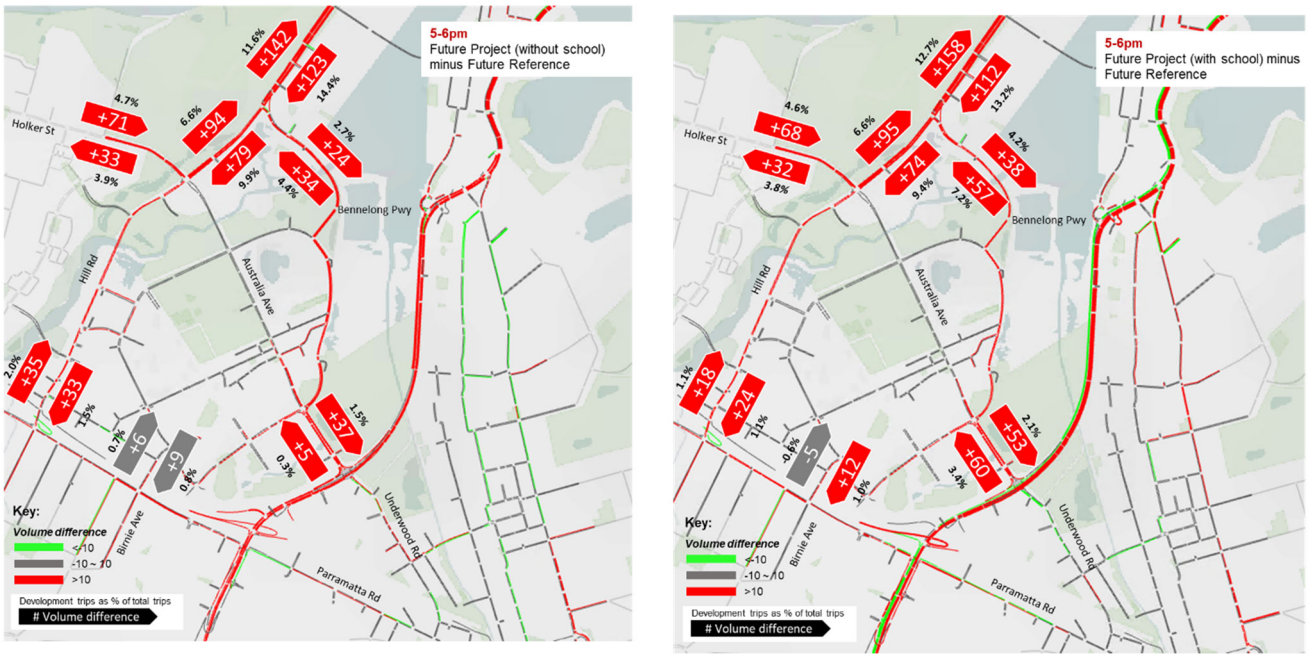
- Outside the immediate vicinity of the Wentworth Point development, the additional Block H and high school development trips contribute to less than 5% increase to the total mid-block traffic volumes at Holker Street, Hill Road near Parramatta Road, Birnie Avenue and Australia Avenue in the morning and afternoon peak hours.
- **In the morning peak hour, there are more trips travelling from Wentworth Point on Hill Road, where:**
  - Majority are new Block H residents travelling to work.
  - Flow difference shows more traffic on Hill Road (north of Australia Avenue), Holker Street and Bennelong Parkway, representing the main access routes for the development trips where the majority are distributed to the external zone at Holker St for trips travelling towards to Parramatta CBD, and internal zones within the Wentworth Point, Sydney Olympic Park and Carter Street precincts.
  - There would be a net reduction in trips with the new high school as students would no longer need to travel outside the local area to study.

Figure 4-1 2036 morning peak (8-9am), traffic flow difference plots and development trips as proportion of total trips (%) – "Future Project (without school) minus Future Reference" (left), "Future Project (with school) minus Future Reference" (right)



- **In the afternoon peak hour, there are more trips travelling to and from Wentworth Point on Hill Road, where:**
  - Flow difference shows more traffic on Hill Road and Holker Street, the main access points during the afternoon peak for residents returning home and people travelling to / from club
  - There would also be increased traffic flow on Bennelong Parkway and Australia Avenue for trips travelling to Wentworth Point.

Figure 4-2 2036 afternoon peak (5-6pm), traffic flow difference plots and development trips as proportion of total trips (%) – “Future Project (without school) minus Future Reference” (left), “Future Project (with school) minus Future Reference” (right)



4.5 Future network assumptions

4.5.1 Approved upgrades

The following network upgrades have been included within the 2036 forecast network for all scenarios. Plots extracted from the WPMM illustrating the upgrade works are provided in Appendix A. These projects are based on information received from TfNSW and Council representing planned / committed works:

- Bennelong Parkway / Hill Road intersection upgrade.
- Parramatta Road / Hill Road intersection upgrades.
- Various upgrade works along Hill Road between Parramatta Road and Old Hill Link, including:
  - Widening Hill Road between M4 and Old Link Road.
  - Prohibiting the right turn onto Carter Street from Hill Road (left-in, left-out only).
  - Widening and signalising the M4 eastbound exit ramp.

Figure 4-3 provides a map of the locations for the 2036 approved upgrades.

Figure 4-3 2036 approved upgrades

A Bennelong Pkwy / Hill Rd upgrades to signalised intersection

B Widening Hill Road between the M4 and Old Hill Link

C Prohibiting the right turn onto Carter Street

D Widening and signalising the M4 eastbound off ramp

E Upgrading the intersection of Parramatta Road and Hill Road

Note: Upgrade C (i.e. proposed left-in left-out only at Carter Street) will alleviate traffic congestion on Hill Road but is likely to increase the traffic on Birnie Road

4.5.2 Signal optimisation

Any supporting works required to facilitate the forecast demand that could reasonably be incorporated into the road network has also been examined. These have included signal optimisation work that has been implemented consistently across all forecast scenarios across various location within the WPMM. Table 4-10 lists the locations where this signal optimisation has been applied.

Table 4-10 WPMM signal optimisation locations (applied to all forecast scenarios)

Signal optimisation location	Time Period
Australia Av / Sarah Durack Av	AM
Parramatta Rd / George St	AM and PM
Parramatta Rd / Birnie Av	AM and PM
Centenary Dr / Arthur St	AM and PM
Parramatta Rd / Bridge Rd	AM and PM
Parramatta Rd / Leicester Av	AM and PM
Underwood Rd / Pomeroy St	AM and PM
Homebush Bay Dr / M4 WB On Ramp	AM and PM
Homebush Bay Dr / M4 EB Off Ramp	AM and PM
Parramatta Rd / Hill Rd	AM and PM
Concord Rd / Alfred St	AM and PM

Signal optimisation location	Time Period
Edwin Flack Av / Shane Gould Ave	PM
Hill Rd / John Ian Wing Pde	AM and PM
Homebush Bay Dr / M4 EB On Ramp	AM and PM
Parramatta Rd / Linfox Rd	AM and PM
Parramatta Rd / Marlborough Rd	AM and PM
Parramatta Rd / Potts St	AM and PM

4.5.3 Australia Ave roundabout upgrade

It has been identified that more substantial mitigation works would be required to facilitate the background growth for the Future Reference scenario, even without the additional trips from Block H and new high school within Wentworth Point. Testing showed substantial delays arising from the Australia Avenue and Homebush Bay Drive roundabout, resulting in traffic gridlock and a significant number of vehicles unable to enter the network, particularly in the afternoon peak period. This is primarily due to southbound congestion on Concord Road at the roundabout (north-eastern approach) conflicting with the increased demand from Sydney Olympic Park and Carter Street precincts travelling southbound on Australia Avenue (north-western approach).

Ramp metering (similar to the existing arrangement which operates during the peak periods on the weekend) was implemented to increase traffic flow at this intersection, however, this results in minimal improvements to the overall network performance. An alternative roundabout design was explored, which proposes to provide partial signalisation and an additional lane through the roundabout (colloquially referred to as a "hamburger lane"[7]). This design is based on the Elmbridge Court roundabout in the United Kingdom.

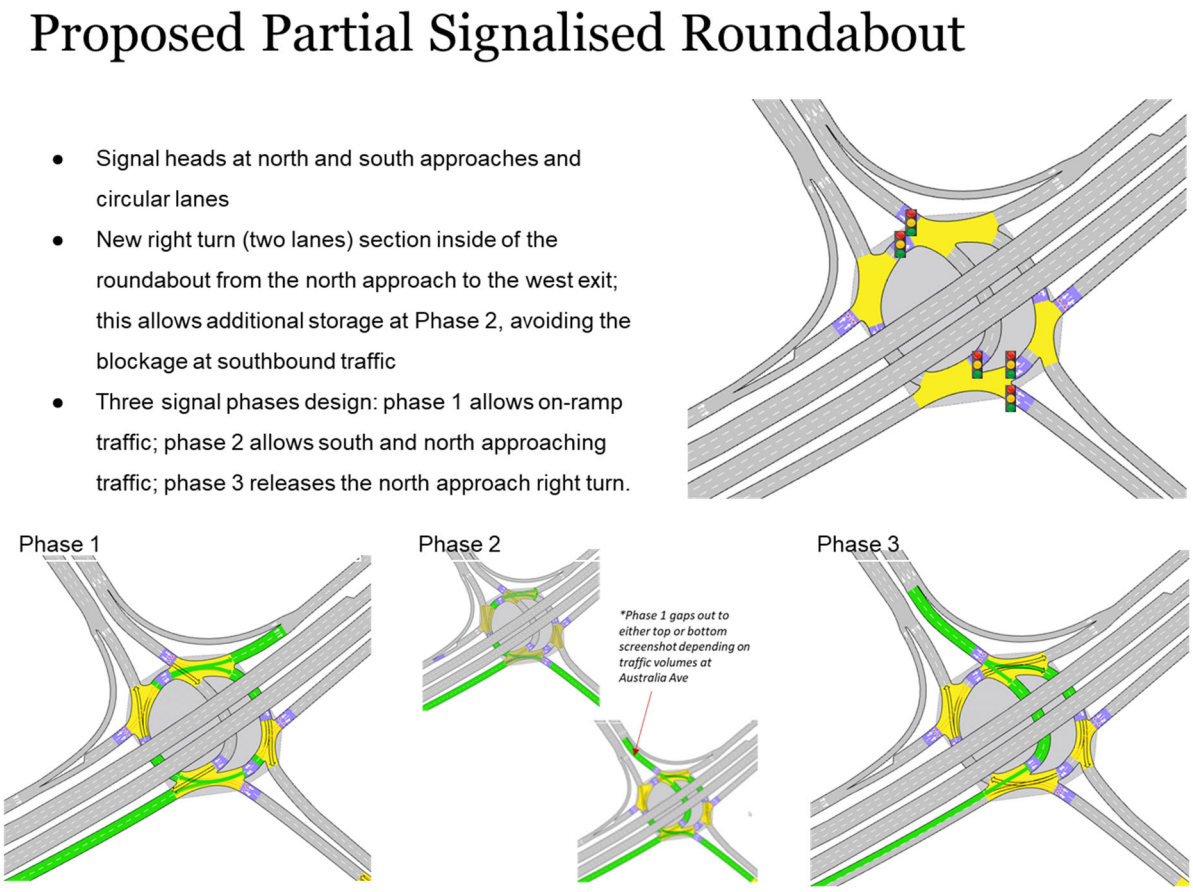
Figure 3-3 provides a plot of the roundabout design that has been coded in the WPMM, which is proposed as a three-phase signal design. This design has been applied as a sensitivity test for Scenario ID S1.

PwC understands that TfNSW are currently investigating upgrade options for this roundabout, with the NSW Government committing to $100 million upgrade at Homebush Bay Drive and Australia Avenue to *"complement other NSW Government transport initiatives in the area, including the WestConnex Motorway project, the development of the Sydney Metro"*[8]. This upgrade option has been developed for modelling purposes only. More detailed studies would be required to assess the feasibility of this design. The purpose of this sensitivity test is to provide a benchmark for comparison under a scenario in which the Australia Avenue roundabout operates at an acceptable level and there is increased traffic flow travelling to / from Wentworth Point and Sydney Olympic Park via the Australia Avenue, Underwood Road and Homebush Bay Drive.

7 *"Elmbridge Court roundabout hamburger lane – how to guide",* Gloucester City Council, September 2017. Retrieved from: https://www.gloucestershire.gov.uk/gloucestershire-county-council-news/news-september-2017/elmbridge-court-roundabout-hamburger-lane-how-to-guide/

8 "Proposed upgrade of Hill Road at Sydney Olympic Park and Lidcombe - Community Consultation Report", TfNSW, September 2021, Retrieved from: https://roads-waterways.transport.nsw.gov.au/projects/01documents/hill-road-upgrade/hill-road-consultation-report-september-2021.pdf

Figure 3-3 Australia Avenue / Homebush Bay Drive - proposed partial signalisation



5 Scenario Assessment

5.1 Overview

The scenario assessment is based on the outcomes from the operational modelling (i.e. WPMM and SIDRA) for each of the core and sensitivity scenarios outlined in Section 4.2 . This section documents the modelled outputs and provides an assessment of: (1) what impacts the proposed Block H development with / without the new high school would have on forecast (2036) traffic within the Wentworth Point study area, and (2) outcomes from the sensitivity testing.

5.2 Approach to analysis

The approach to assessment has been undertaken based on the relative performance of the road network under the Base, Future Reference and Future Project scenarios to evaluate the level of additional delay that would arise from the proposed Block H development and new high school.

Figure 5-1 Map of Wentworth Point travel time corridors

The key operational measures used are:

- Changes to network congestion based on a qualitative assessment of the simulated density plots of the whole model area for the forecast scenarios. This has been undertaken to highlight any congestion hotspots within the future network.
- Increase / decrease in car travel times in both directions along the following corridors, as shown adjacent in Figure 5-1:
  - Australia Avenue and Underwood Road (between Kevin Coombs Ave / Marjorie Jackson Pkwy and Parramatta Road).
  - Hill Road (between Bennelong Bridge and Parramatta Road).
  - Parramatta Road (between Hill Road and Concord Road / Leicester Avenue).
  - Homebush Bay Drive southbound (towards Parramatta Road) to Australia Avenue northbound (towards Hill Road).
- Increase / decrease in intersection delays and significance of impact to intersection LoS for the five key intersections:
  - Silverwater Road / Holker Street.
  - Parramatta Road / Hill Road.
  - Parramatta Road / Birnie Avenue.
  - Australia Avenue / Homebush Bay Drive.
  - Bennelong Parkway / Hill Road.
- The intersection LoS are based on the *RTA Guide to Traffic Generating Developments (RTA, 2002)* criteria. Table 5-1 shows the intersection LoS bands, which are based on average delay per vehicle. Intersections that are LoS A to D are generally considered to be operating satisfactorily to near capacity. LoS E and F corresponds to intersections that are operating at or over capacity.

Table 5-1 Intersection LoS criteria

LoS	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabouts	Give Way and Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays	At capacity, requires other control mode
F	>70	Roundabouts require other control modes	Over capacity unstable operation.

Source: RTA Guide to Traffic Generating Developments (RTA, 2002)

Note: (1) The average daily assessed for signalised intersection is overall movements, (2) For roundabouts and priority control intersections (with Stop and Give Way signs or operating under the T-junction rule), the critical criterion for assessment is the movement with the highest delay per vehicle. Average daily is expressed in seconds per vehicle.

- Increase / decrease to the network-wide statistics collected at the end of the simulation period. These statistics are useful in providing an overview of the impact to the overall network performance (when analysed in conjunction with the corridor travel times and intersection delays) and include:
  - Unreleased traffic (as a percentage of total demand), which represents the number of vehicles that are unable to enter the network at the end of the simulation period.
  - Vehicle-kilometres-travelled (VKT), which represents the total distance travelled by all vehicles within the network.
  - Average network speed.

The above metrics, excluding the network statistics, have been extracted for the morning and evening peak hours at 8-9am and 5-6pm. The network statistics are based on the full 4-hour morning and evening peak periods at 6-10am and 3-7pm.

5.3 Road network performance (Core scenarios)

This section documents the modelled road network performance of the operational models for the core scenarios, which are comprised of the following:

- Scenario O0 – Base.
- Scenario O1 – Future Reference.
- Scenario O2 – Future Project (without school).
- Scenario O3 – Future Project (with school).

5.3.1 Network congestion

Figure 5-2 and Figure 5-3 shows the simulated density plots for the morning and afternoon peak hours respectively. These plots have been used to provide an understanding of the network congestion across the Wentworth Point study area.The simulated density plots show that:

- Modelled traffic conditions under the Future Project scenarios would be largely consistent with the Future Reference scenario.
- The congestion hotspots identified at the following locations are generally present across all forecast scenarios:

- **Rhodes (morning and afternoon):** High levels of delays along Concord Road between Ryde Bridge Homebush Bay Drive in both directions, causing significant congestion and vehicles unable to enter the network at the north-east boundary of the model area.
- **Homebush West (afternoon):** Substantial delays along Centenary Drive on approach to Homebush Bay Drive northbound with traffic queueing as far back to Arthur Street, resulting in vehicles unable to enter the network at the south-east boundary of the model area.
- **Sydney Olympic Park (morning and afternoon):** High levels of delay from M4 exit ramp onto Homebush Bay Drive which causes significant queuing, blocking vehicles from exiting the ramp and entering the network. There is also significant northbound congestion from Underwood Road on approach Australia Avenue in the afternoon peak.
- **Lidcombe (morning and afternoon):** Eastbound and westbound delays along Parramatta Road where the majority of the increased demand are external trips travelling through the study area.

Figure 5-2 2036 morning peak (8-9am), simulated density plots – Future Reference (left), Future Project (without school) (middle), Future Project (with school) (right)

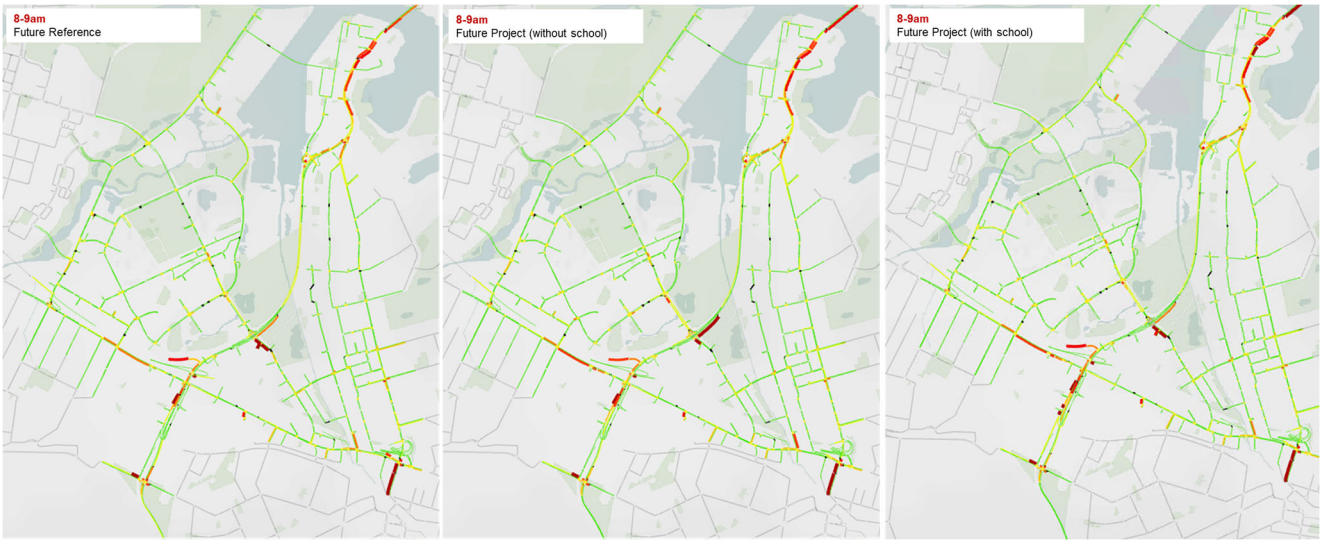
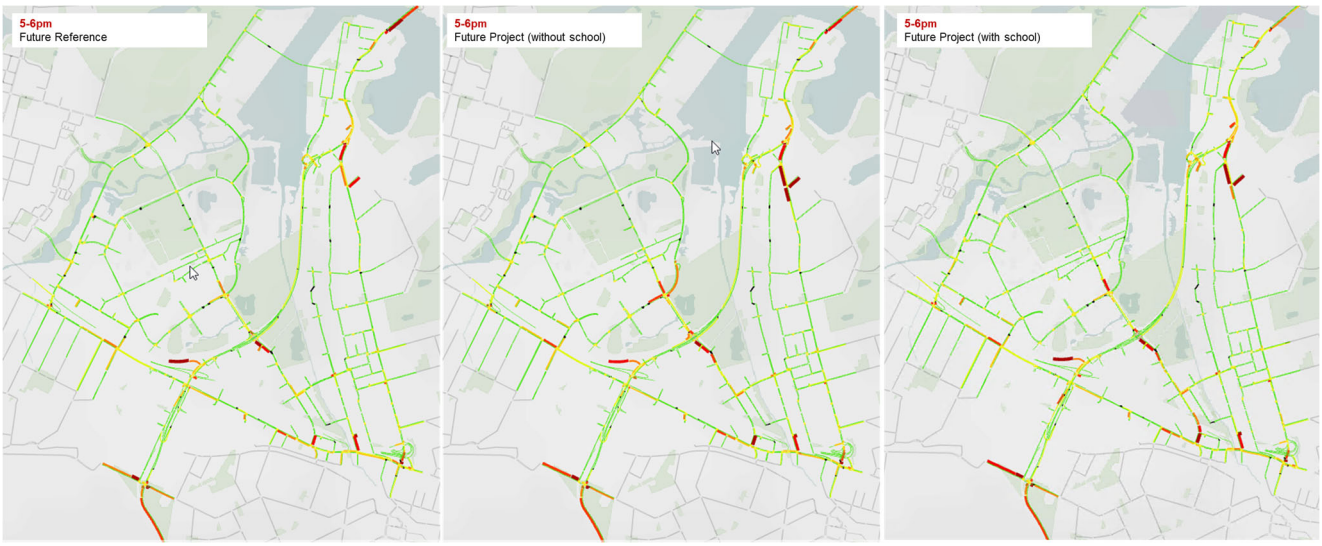


Figure 5-3 2036 afternoon peak (5-6pm), Future Reference (left), Future Project (without school) (middle), Future Project (with school) (right)



5.3.2 Travel times

Table 5-2 and Table 5-3 provides peak hour travel times for the morning and afternoon periods respectively. The comparisons with the Future Project scenarios have been provided as a percentage difference to the Future Reference scenario. The modelled travel times shows:

- Less than 5% difference in travel times along Hill Road and Parramatta Road in both direction during the morning and afternoon peak hour. This indicates minimal differences in delay associated with the additional Block H and new high school trips along these corridors.
- Substantial increase in travel times travelling along (1) Underwood Road northbound on approach to Homebush Bay Drive, and (2) Homebush Bay Drive southbound on approach to Australia Avenue. Most of the delay occurs at the roundabout, which is already operating over capacity and sensitive to small increases in demand. This causes more vehicles to remain stationary for longer periods of time at the back of the queue and lowering the average speeds.

Figure 5-4 provides a plot of the afternoon peak hour link analysis that has been undertaken at the Australia Avenue, which shows the majority of development trips travelling through the roundabout are (1) northbound traffic travelling to Wentworth Point / Sydney Olympic Park (which includes additional seven vehicles in the peak hour generated by the developments), which conflicts with (2) right-turning southbound traffic from Wentworth Point / Sydney Olympic Park travelling to the M4 or Parramatta Road (which includes additional 18 vehicles in the peak hour generated by the developments).

Table 5-2 Morning peak (8-9am), general traffic cumulative traffic time comparison

			General traffic cumulative travel time (mm:ss)		% Difference (from Future Reference)	
Corridor	**Direction**	**Travel distance (km)**	**Base**	**Future Reference**	**Future Project (without school)**	**Future Project (with school)**
Australia Avenue and Underwood Road	Northbound*	2.97	05:15	05:42	8.8%	14.9%
	Southbound**	2.97	05:08	05:36	-0.3%	-1.5%
Hill Road	Northbound	3.62	04:46	05:39	-1.2%	-2.4%
	Southbound	3.59	04:44	05:18	1.6%	1.3%
Parramatta Road	Eastbound	4.17	06:22	06:54	-0.7%	1.0%
	Westbound	4.18	06:49	07:06	-0.5%	-1.2%
Homebush Bay Drive southbound** to Australia Avenue northbound*		1.5	01:46	04:24	19.6%	-1.0%

* Towards Hill Road, ** Towards Parramatta Road

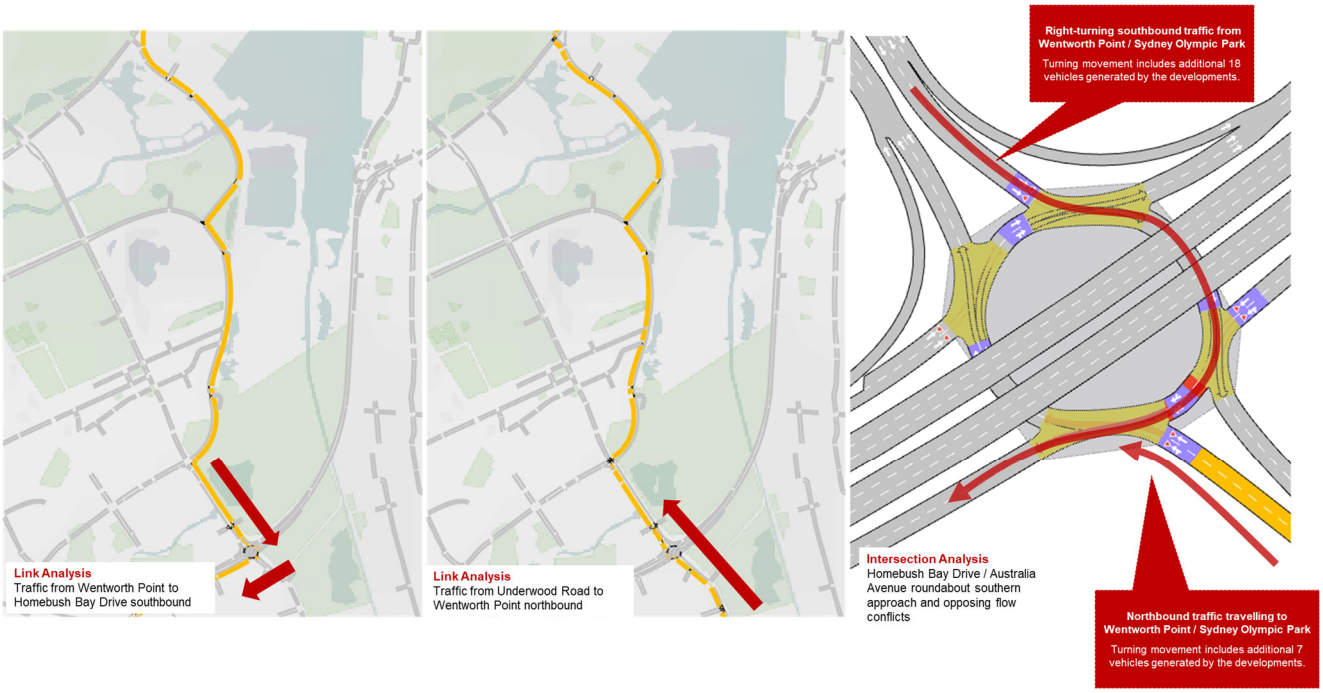
Table 5-3 Afternoon peak (5-6pm), general traffic cumulative traffic time comparison

			General traffic cumulative travel time (mm:ss)		% difference (from Future Reference)	
Corridor	**Direction**	**Travel distance (km)**	**Base**	**Future Reference**	**Future Project (without school)**	**Future Project (with school)**
Australia Avenue and Underwood Road	Northbound*	2.97	04:52	07:23	35.6%	31.3%
	Southbound**	2.97	05:08	06:00	1.7%	0.8%
Hill Road	Northbound	3.62	04:34	05:19	-0.6%	-2.2%
	Southbound	3.59	05:27	06:09	4.6%	0.8%

Corridor	Direction	Travel distance (km)	General traffic cumulative travel time (mm:ss)		% difference (from Future Reference)	
			Base	Future Reference	Future Project (without school)	Future Project (with school)
Parramatta Road	Eastbound	4.17	05:54	07:17	0.0%	0.0%
	Westbound	4.18	07:34	08:17	4.8%	1.2%
Homebush Bay Drive southbound** to Australia Avenue northbound*		1.5	02:13	02:43	0.7%	-3.6%

* Towards Hill Road, ** Towards Parramatta Road

Figure 5-4 Link analysis for proposed development trips – Australia Avenue roundabout (5-6pm)



5.3.3 Impact to intersection performance

Figure 5-5 presents the intersection LoS for all forecast scenarios at the five key intersections in the morning and afternoon peak hours. Table 5-4 and Table 5-5 summarises the level of impact the development trips would have on the intersection, which has been determined based on increase / decrease in intersection delay relative to the Future Reference scenario (refer to Appendix B for further details of the intersection delay times, volume and degree of saturation (DoS) across each modelled scenario).

Comparison of the modelled results shows no changes to the intersection LoS bands with and without the additional Block H and new high school trips in the Future Project scenarios, with the worst performing intersection at Australia Avenue / Homebush Bay Drive roundabout in the morning and afternoon peak, and Parramatta Road / Birnie Avenue in the morning peak.

Note, in all future scenarios the Australia Avenue / Homebush Bay Drive roundabout operates at LoS F (over 200 seconds delay). Under this unstable flow circumstance, the delays may vary significantly even with slight changes on the traffic demand. It should also be noted that the intersection LoS reported for roundabouts are based on the delay times for the

worst performing leg. For all scenarios, the worst performing leg at the roundabouts is at the southern approach (Underwood Road) and the second worst performing leg at the eastern approach (M4 westbound entry ramp).

Figure 5-5 Map of intersection LoS, all Future Reference and Project scenarios - morning peak hour (8-9am) (left), afternoon peak hour (5-6pm)

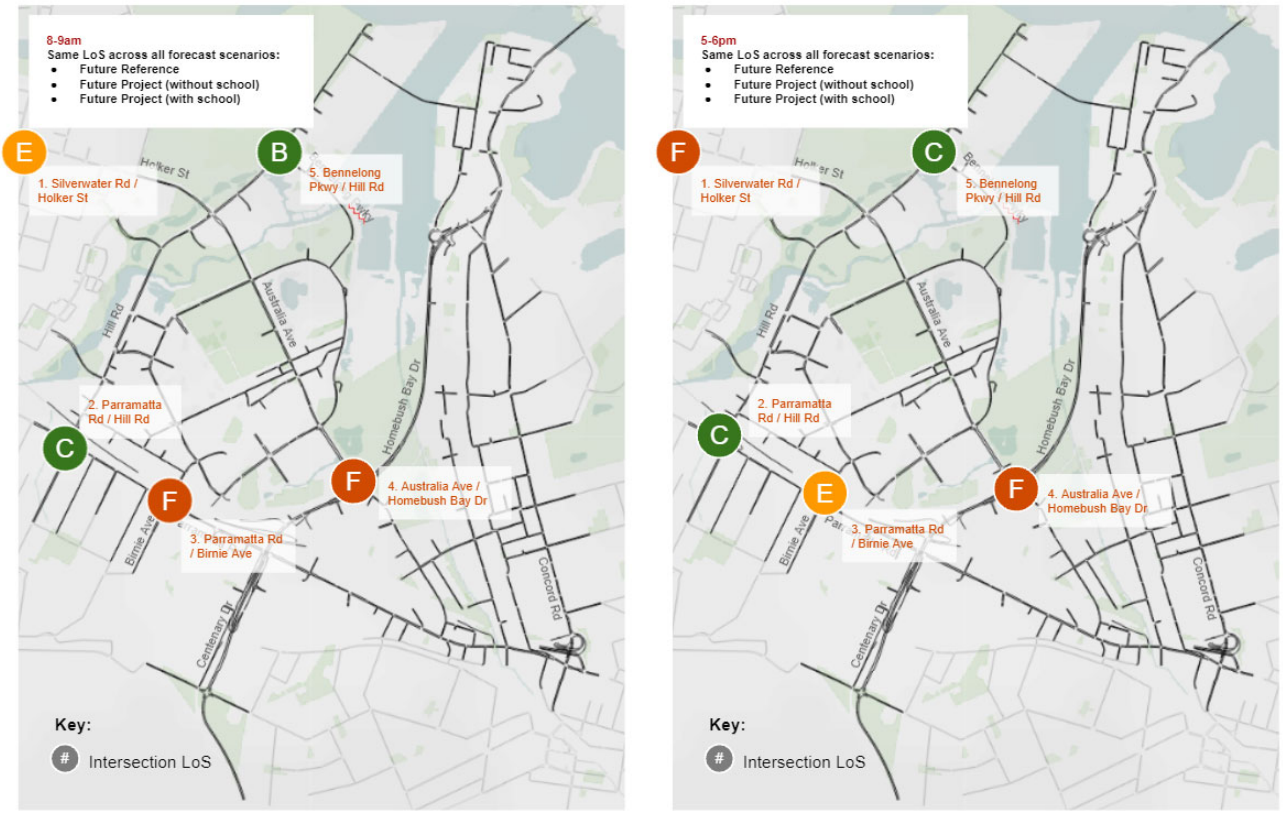


Table 5-4 2036 morning and afternoon peaks (8-9am, 5-6pm), intersection performance impact for Future Project (without school) scenario

Future Project (without school) scenario	**8-9am**		**5-6pm**	
Intersection	**Impact**	**Delay Impact (sec)**	**Impact**	**Delay Impact (sec)**
Silverwater Road / Holker Street	No Significant Changes	+ 3	No Significant Changes	+ 7
Parramatta Road / Hill Road	No Significant Changes	< 1	No Significant Changes	+ 1
Parramatta Road / Birnie Avenue	No Significant Changes	+5	No Significant Changes	+ 2
Australia Avenue / Homebush Bay Drive	Potential Impact	-173	Potential Impact	-12
Bennelong Parkway / Hill Road	No Significant Changes	+ 2	No Significant Changes	+ 3

Note: (1) Delay impact has been assessed for the Future Project (without school) scenario relative to the Future Reference scenario, and (2) level of impact has been assessed based on change in average intersection delay.

Table 5-5 2036 morning and afternoon peaks (8-9am, 5-6pm), intersection performance impact for Future Project (with school)

Future Project (with school) scenario	8-9am		5-6pm	
Intersection	Impact	Delay Impact (sec)	Impact	Delay Impact (sec)
Silverwater Road / Holker Street	No Significant Changes	+2	No Significant Changes	+7
Parramatta Road / Hill Road	No Significant Changes	<1	No Significant Changes	+ 1
Parramatta Road / Birnie Avenue	No Significant Changes	+ 5	No Significant Changes	<1
Australia Avenue / Homebush Bay Drive	Potential Impact	-28	Potential Impact	+98
Bennelong Parkway / Hill Road	No Significant Changes	<1	No Significant Changes	+ 2

Note: (1) Delay impact has been assessed for the Future Project (with school) scenario relative to the Future Reference scenario, and (2) level of impact has been assessed based on change in average intersection delay.

5.3.4 Network statistics

Table 5-6 and Table 5-7 provides a summary of the modelled network statistics for the morning and afternoon peak periods respectively. Analysis of the modelled network statistics shows the following:

- All forecast scenarios show a substantial reduction in average network speed of up to 20% from the base year, generally resulting from increased delays across the network.
- The afternoon peak periods show a higher number of unreleased vehicles due to increased demand in population and employment growth within the modelled area when compared to the morning peak period. This indicates that the forecast demand growth would exceed network capacity, even without the addition of the trips generated by Block H and the new high school.
- While there is some difference in the modelled network statistics, the Future Project would generally perform comparably to the Future Reference.

Table 5-6 Morning peak periods (6-10am), network statistics comparison for core scenarios

AM Network Statistics	Base	Future Reference	Future Project (without school)	Future Project (with school)
Total distance travelled VKT (km)	345,924	406,549	408,066	407,570
Average network speed (km/hr)	40.2	32.3	32.4	32.4
Unreleased vehicles (% total)	0.0%	0.4%	0.4%	0.4%

Table 5-7 Afternoon peak periods (3-7pm), network statistics comparison for core scenarios

PM Network Statistics	Base	Future Reference	Future Project (without school)	Future Project (with school)
Total distance travelled VKT (km)	372,167	449,837	453,962	453,843
Average network speed (km/hr)	36.4	29.9	29.2	29.3
Unreleased vehicles (% total)	0.0%	0.8%	0.8%	0.8%

5.4 Road network performance (Sensitivity scenarios)

This section documents the modelled road network performance of the operational models for the sensitivity scenarios, which are comprised of the following:

- Scenario S1 – Future Reference and mitigation measure.
- Scenario S2 – Future without PLR2 and SMW.
- Scenario S3 – Future Reference (COVID).

5.4.1 Network congestion

Figure 5-6 and Figure 5-7 shows the simulated density across the Wentworth Point study area during the morning and afternoon peak hours respectively for the sensitivity scenarios. The results indicates that, when compared to the Future Reference scenario

- Without PLR2 and SMW, there is significant congestion across the entire network, particularly in the afternoon peak. This is due to the higher reliance on car usage that is associated with this scenario, further highlighting the public transport needs of this area to support population and employment growth in Wentworth Point.
- With the partial signalisation of the Homebush Bay Drive / Australia Avenue roundabout, the traffic flow across all approach is more balanced. This provides major benefits on the southern approach (Underwood Road), resulting in less congestion and more northbound traffic along Underwood Road and Australia Avenue in both morning and evening periods
- The local road network within Wentworth Point (Holker Street, Hill Road, Bennelong Parkway, Australia Avenue north of Homebush Bay Drive) would generally experience similar levels of congestion for all sensitivity scenarios, except for the Future without PLR2 and SMW scenario,
- Under a reduced traffic demand scenario that assumes more people would work from home post-COVID-19, there would be an overall reduction in congestion across the entire road network within the modelled area, including Parramatta Road and Concord Road.

Figure 5-6 2036 morning peak (8-9am), simulated density plots – Future Reference (upper-left), Future without PLR2 SMW (upper-right), Future Reference with mitigation measure (lower-left), Future Reference (COVID) (lower-right)

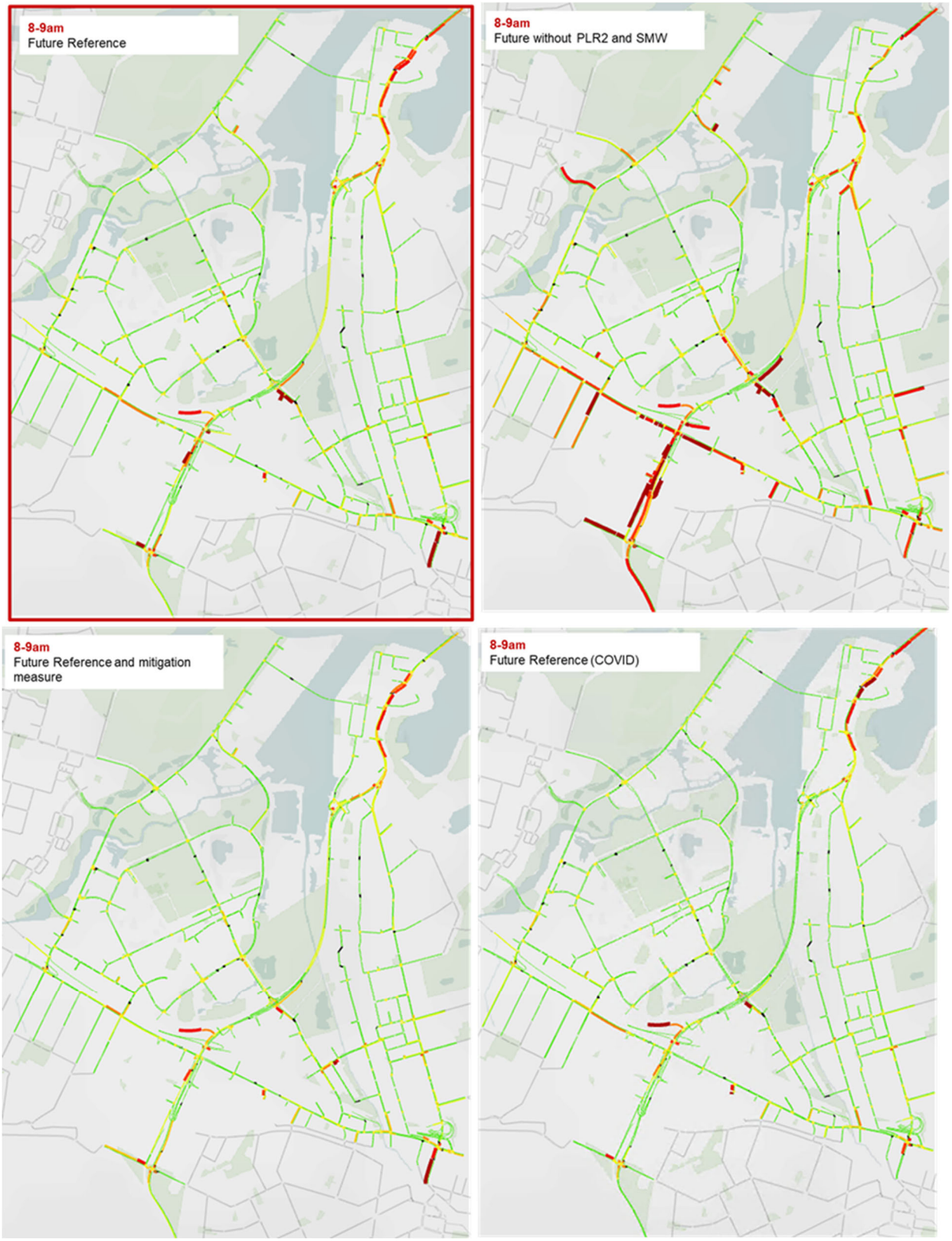
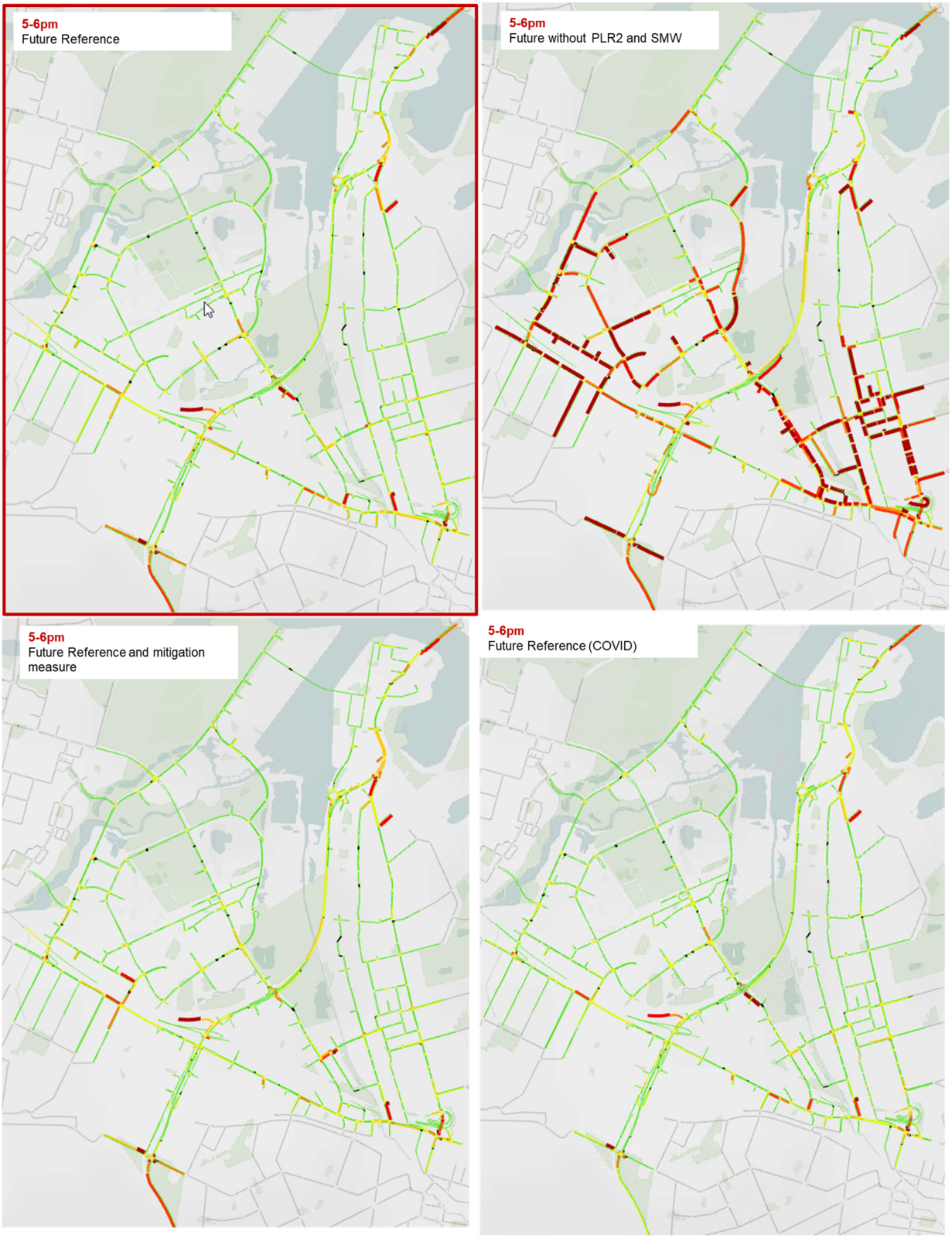


Figure 5-7 2036 afternoon peak (5-6am), simulated density plots – Future Reference (upper-left), Future without PLR2 SMW (upper-right), Future Reference with mitigation measure (lower-left), Future Reference (COVID) (lower-right)



5.4.2 Travel times

Table 5-8 and Table 5-9 provides peak hour travel times for the morning and afternoon periods respectively. The comparisons with the sensitivity scenarios have been provided as a percentage difference to the Future Reference scenario. The modelled travel times shows:

- There would be substantial increase in travel time for the Future without PLR2 and SMW scenario, particularly along the Australia Avenue / Underwood Road, Homebush Bay Drive and Parramatta Road corridors. This is due to the high level of demand associated with this scenario resulting in network delays across the study area.
- The alternative Australia Avenue roundabout design would reduce delays, providing up to ~15% improvement in travel times along the Australia Avenue corridor travelling northbound towards Hill Road.
- There would be an increase in northbound travel time along Underwood Road on approach to the Australia Avenue roundabout under the Future Reference (COVID) scenario. This is due the reduced traffic demand causing less "blockages" in the network, leading to less unreleased demand (i.e. more traffic can enter the network). The majority of the previously unreleased demand are trips travelling southbound from Rhodes to Sydney Olympic Park / Wentworth Point via Homebush Bay Drive.

Table 5-8 2036 morning peak (8-9am), general traffic cumulative traffic time comparison

			General traffic cumulative travel time (mm:ss)		% Difference (from Future Reference)		
Corridor	**Direction**	**Travel distance (km)**	**Base**	**Future Reference**	**Future without PLR2 and SMW**	**Future Reference and mitigation measure**	**Future Reference (COVID)**
Australia Avenue and Underwood Road	Northbound*	2.97	05:15	05:42	48.6%	-9.4%	0.6%
	Southbound**	2.97	05:08	05:36	2.9%	0.4%	-9.8%
Hill Road	Northbound	3.62	04:46	05:39	0.2%	-3.3%	4.1%
	Southbound	3.59	04:44	05:18	-2.8%	-0.3%	-3.5%
Parramatta Road	Eastbound	4.17	06:22	06:54	13.7%	6.3%	-0.5%
	Westbound	4.18	06:49	07:06	7.9%	1.0%	-1.6%
Homebush Bay Drive southbound** to Australia Avenue northbound*		1.5	01:46	04:24	144.0%	-16.3%	-29.0%

* Towards Hill Road, ** Towards Parramatta Road

Table 5-9 2036 afternoon peak (5-6pm), general traffic cumulative traffic time comparison

Corridor	Direction	Travel distance (km)	General traffic cumulative travel time (mm:ss)		% Difference (from Future Reference)		
			Base	Future Reference	Future without PLR2 and SMW	Future Reference and mitigation measure	Future Reference (COVID)
Australia Avenue and Underwood Road	Northbound*	2.97	04:52	07:23	55.3%	-14.7%	29.8%
	Southbound**	2.97	05:08	06:00	22.6%	-0.9%	1.1%
Hill Road	Northbound	3.62	04:34	05:19	-0.1%	-0.6%	0.6%
	Southbound	3.59	05:27	06:09	1.9%	3.1%	0.8%
Parramatta Road	Eastbound	4.17	05:54	07:17	18.9%	-0.5%	0.7%
	Westbound	4.18	07:34	08:17	37.7%	1.6%	-0.6%
Homebush Bay Drive southbound** to Australia Avenue northbound*		1.5	02:13	02:43	28.5%	-11.4%	9.5%

* Towards Hill Road, ** Towards Parramatta Road

5.4.3 Impact to intersection performance

Figure 5-8 and Figure 5-9 presents the intersection LoS for the Future Reference and sensitivity scenarios at the five key intersections in the morning and afternoon peak hours. Table 5-10 to Table 5-12 summarises the level of impact these scenarios would have on the intersections, which has been determined based on increase / decrease in intersection delay relative to the Future Reference scenario (refer to Appendix B for further details of the intersection delay times, volume and DoS across each modelled scenario).

Comparison of the modelled results shows:

- Increased intersection delays for forecast scenario without PLR2 and SMW, with all intersection operating over capacity in the afternoon peak.
- Substantial improvements to intersection LoS and delays with partial signalisation of the Australia Avenue roundabout, which would now operate at LoS E in the morning peak and LoS D in the afternoon peak.
- There are some improvements to intersection delays under the Future Reference (COVID) scenario, however, the Australia Avenue roundabout would still operate over capacity in the morning and afternoon peak. This is due to more vehicles being able to enter the network travelling southbound from Rhodes to Sydney Olympic Park / Wentworth Point via Homebush Bay Drive, increasing delays at the roundabout (also discussed in Section 5.4.2).
- Parramatta Road / Birnie Avenue would operate at LoS E or LoS F during the morning and afternoon peak hours in all scenarios, except the Future Reference (COVID). This is due to the high levels of delays that are associated with (1) the increased demand on Parramatta Road for external east-west traffic traveling through the model area and (2) more traffic that is forecast to travel to / from the Wentworth Point, Sydney Olympic Park and Carter Street Precincts via Parramatta Road and Birnie Avenue.
- Silverwater Road / Holker Street would operate at LoS E or LoS F during the morning and afternoon peak hours in all scenarios, except the Future Reference (COVID) scenario. It should be noted that this intersection is outside the WPMM study area and has been modelled using SIDRA. The intersection turning movement volumes are based on the traffic growth rates extracted from the demand models, which is not capacity-constrained and may be overestimating the volume of traffic growth that this intersection can realistically provide capacity for.

Figure 5-8 2036 morning peak (8-9am), map of intersection LoS – Future Reference (upper-left), Future without PLR2 SMW (upper-right), Future Reference with mitigation measure (lower-left), Future Reference (COVID) (lower-right)

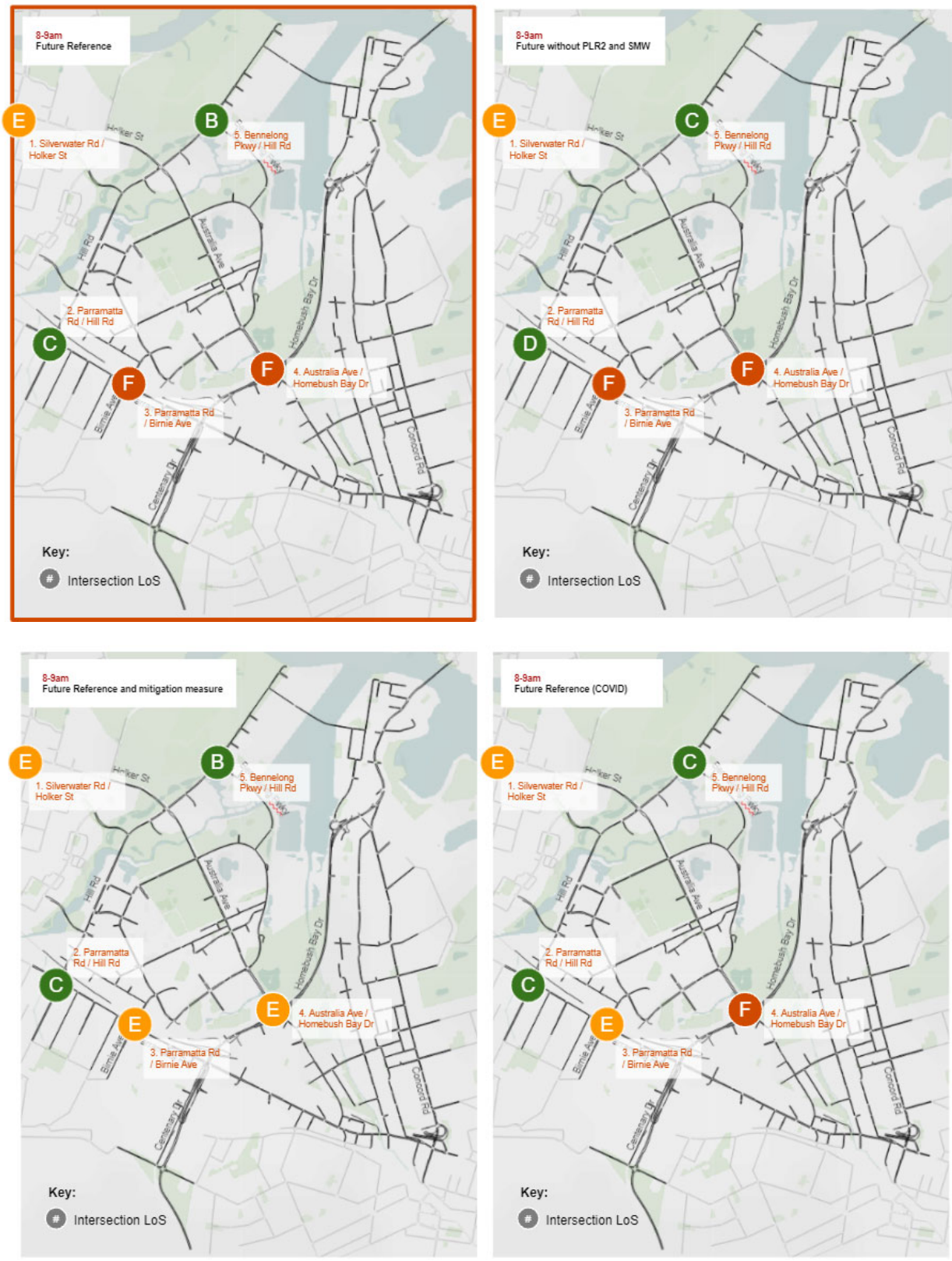


Figure 5-9 2036 afternoon peak (5-6pm), map of intersection LoS – Future Reference (upper-left), Future without PLR2 SMW (upper-right), Future Reference with mitigation measure (lower-left), Future Reference (COVID) (lower-right))

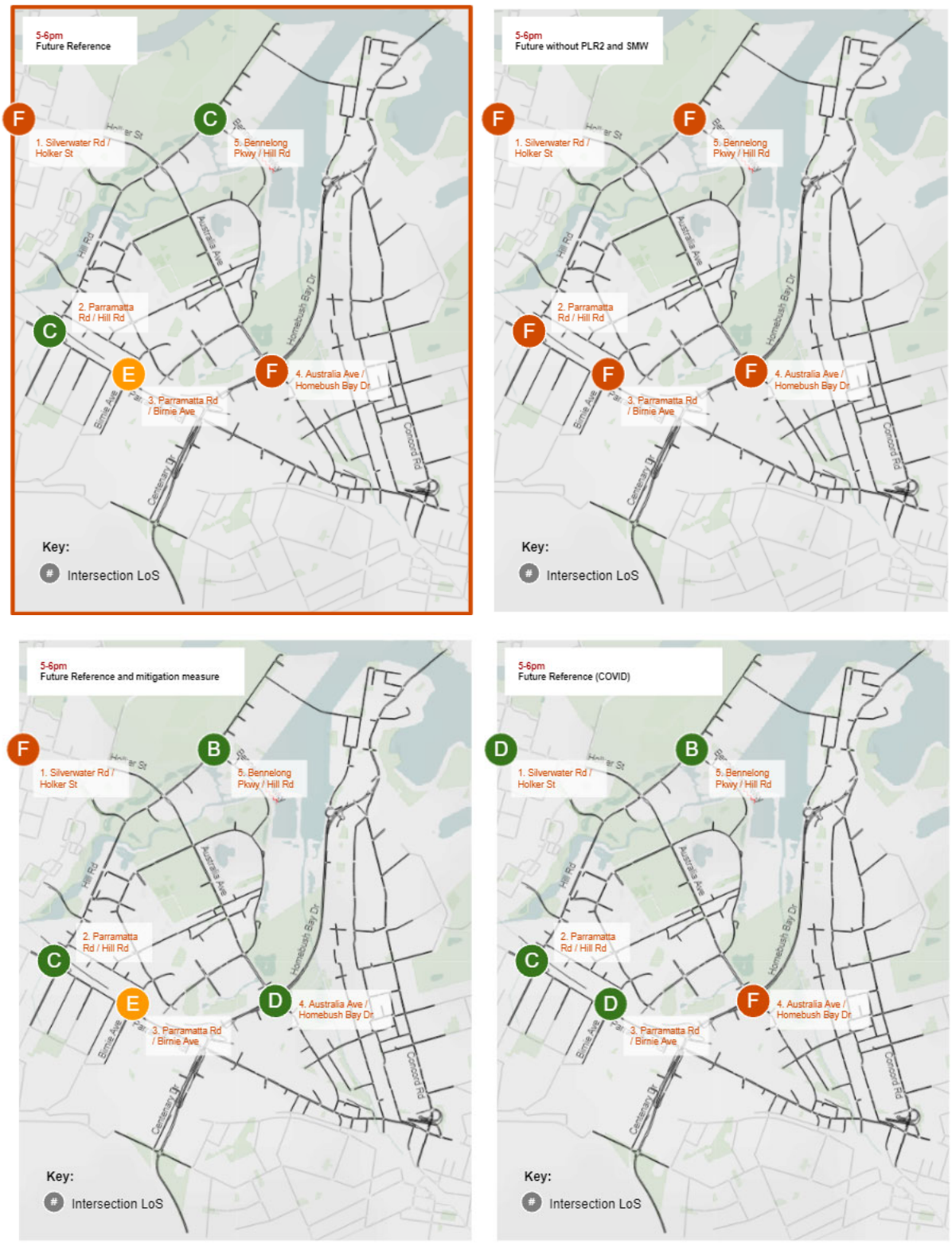


Table 5-10 Intersection performance impact for Future without PLR2 and SMW

Future without PLR2 and SMW Intersection	8-9am Impact	8-9am Delay Impact (sec)	5-6pm Impact	5-6pm Delay Impact (sec)
Silverwater Road / Holker Street	No Significant Changes	+ 8	Potential Impact	+ 30
Parramatta Road / Hill Road	Potential Impact	+22	Potential Impact	+53
Parramatta Road / Birnie Avenue	Potential Impact	+45	Potential Impact	+24
Australia Avenue / Homebush Bay Drive	Potential Impact	+235	Potential Impact	+219
Bennelong Parkway / Hill Road	Potential Impact	3	Potential Impact	+42

Note: (1) Delay impact has been assessed relative to the Future Reference scenario, and (2) level of impact has been assessed based on change in average intersection delay.

Table 5-11 Intersection performance impact for Future Reference with mitigation measure

Future Reference and mitigation measure Intersection	8-9am Impact	8-9am Delay Impact (sec)	5-6pm Impact	5-6pm Delay Impact (sec)
Silverwater Road / Holker Street	No Significant Changes	<1	No Significant Changes	<1
Parramatta Road / Hill Road	No Significant Changes	-1	No Significant Changes	-2
Parramatta Road / Birnie Avenue	Potential Impact (Improvement)	-20	No Significant Changes	+7
Australia Avenue / Homebush Bay Drive	Potential Impact (Improvement)	-345	Potential Impact (Improvement)	-313
Bennelong Parkway / Hill Road	No Significant Changes	-3	No Significant Changes	-12

Note: (1) Delay impact has been assessed relative to the Future Reference scenario, and (2) level of impact has been assessed based on change in average intersection delay.

Table 5-12 Intersection performance impact for Future Reference (COVID)

Future Reference (COVID) Intersection	8-9am Impact	8-9am Delay Impact (sec)	5-6pm Impact	5-6pm Delay Impact (sec)
Silverwater Road / Holker Street	No Significant Changes	-12	Potential Impact (Improvement)	-20
Parramatta Road / Hill Road	No Significant Changes	+7	No Significant Changes	-2
Parramatta Road / Birnie Avenue	Potential Impact (Improvement)	-16	No Significant Changes	-9

Future Reference (COVID) Intersection	8-9am		5-6pm	
	Impact	Delay Impact (sec)	Impact	Delay Impact (sec)
Australia Avenue / Homebush Bay Drive	Potential Impact (Improvement)	-51	Potential Impact	+55
Bennelong Parkway / Hill Road	No Significant Changes	+9	No Significant Changes	-13

Note: (1) Delay impact has been assessed relative to the Future Reference scenario, and (2) level of impact has been assessed based on change in average intersection delay.

5.4.4 Network statistics

Table 5-13 and Table 5-14 provides a summary of the modelled network statistics for the morning and afternoon peak periods respectively. The Future Scenario has also been provided as a benchmark for the sensitivity scenarios.

Analysis of the modelled network statistics shows the following:

- The Future without PLR2 and SMW scenario shows substantial reduction in average speed of up to 27% from Future Reference. It also shows over 55,000 unreleased vehicles, which represents over 18% of the total demand in the afternoon peak period. These modelled statistics are reflective of a scenario where traffic growth within a public transport intervention measures would result in a network where demand far exceeds network capacity.
- The Future Reference and mitigation measure scenario would provide some improvements to the average network speed; however, it should be noted that the majority of the unreleased vehicles are at Concord Road in Rhodes and Centenary Drive in Homebush Bay West and not directly related to the roundabout performance.
- Future Reference (COVID) would operate with the highest average network speed and lowest number of unreleased vehicles.

Table 5-13 Morning peak (6-10am), network statistics comparison

AM Network Statistics	Future Reference	Future without PLR2 and SMW	Future Reference and mitigation measure	Future Reference (COVID)
Total distance travelled VKT (km)	406,549	432,438	407,356	377,828
Average network speed (km/hr)	32.3	23.7	33.1	35.2
Unreleased vehicles (% total)	0.4%	1.1%	0.4%	0.3%

Table 5-14 Afternoon peak (3-7pm), network statistics comparison

PM Network Statistics	Future Reference	Future without PLR2 and SMW	Future Reference and mitigation measure	Future Reference (COVID)
Total distance travelled VKT (km)	449,837	294,350	454,138	438,677
Average network speed (km/hr)	29.9	22.8	30.5	32.4
Unreleased vehicles (% total)	0.8%	18.70%	0.7%	0.2%

6 Conclusion

6.1 Overview

Wentworth Point is located in an area of unprecedented future public transport investment with Sydney Metro West and Parramatta Light Rail Stage 2 providing direct access to Sydney CBD and Parramatta. The area is well served by bus services and active transport infrastructure connecting Rhodes and Sydney Olympic Park. Wentworth Point is also located close to the strategic road network, the WestConnex M4 Motorway and Homebush Bay Drive.

6.2 Key insights

The transport modelling provides the following key insights:

- Some car trips from Wentworth Point in the morning peak will travel for other purposes than work or education. Those trips could be considered as discretionary trips. High levels of road congestion would likely discourage car travel for those trips in the peak period if they had the choice to travel at a different time. The modelling is predicting that over 40% of car trips, or over 300 vehicles per hour, from Wentworth Point to Auburn LGA could be considered discretionary trips. Therefore, some car trips which are currently modelled in the morning peak are at a discretion of travelling outside the peak as they are not bound by a time commitment imposed by work or educational institutions.
- Some Wentworth Point residents will travel by car to areas with low public transport accessibility. The demographic fabric of Wentworth Point could evolve to lower car ownership and choice of employment in areas with high public transport accessibility such as Sydney CBD and Parramatta. Therefore, the forecast car trips from Wentworth Point will tend to be redirected to public transport.
- Around 500 car trips from Wentworth Point are for trips with a length less than 5 km. Considering Wentworth Point has an extensive active transport network, these short trips could be undertaken on foot or bicycle. The adopted modelling framework does not model directly active transport and short trips are either allocated to car or public transport. Therefore, the short car trips are likely to be overestimated in the Wentworth Point area.

6.3 Summary of traffic implications

Based on the traffic growth generated by the strategic models, the strategic road network surrounding the Wentworth Point is at capacity. The additional traffic generated by Block H and new high school in Wentworth Point has no material impact on the performance of the road network and the identified five key intersections are forecast to operate at the same LoS with and without the development.

6.4 Managing transport growth

Prosperous cities attract skilled interstate and international migrants, which contributes to population and employment growth. As a result, the cities' critical infrastructure such as transport is under more pressure to cater for the increased demand. Traditional measures of dealing with the increased demand by the means of "predict and provide" lead to short term outcomes. To accommodate the future growth, cities need to embrace higher density-built form, provide frequent and efficient public transport for long trips and active transport facilities for short distance trips. The public and active transport infrastructure investment coupled with car parking and car use policy measures will ensure the economic growth and liveability standards are not hindered by the deteriorating accessibility to jobs, schools, retail, and parks.

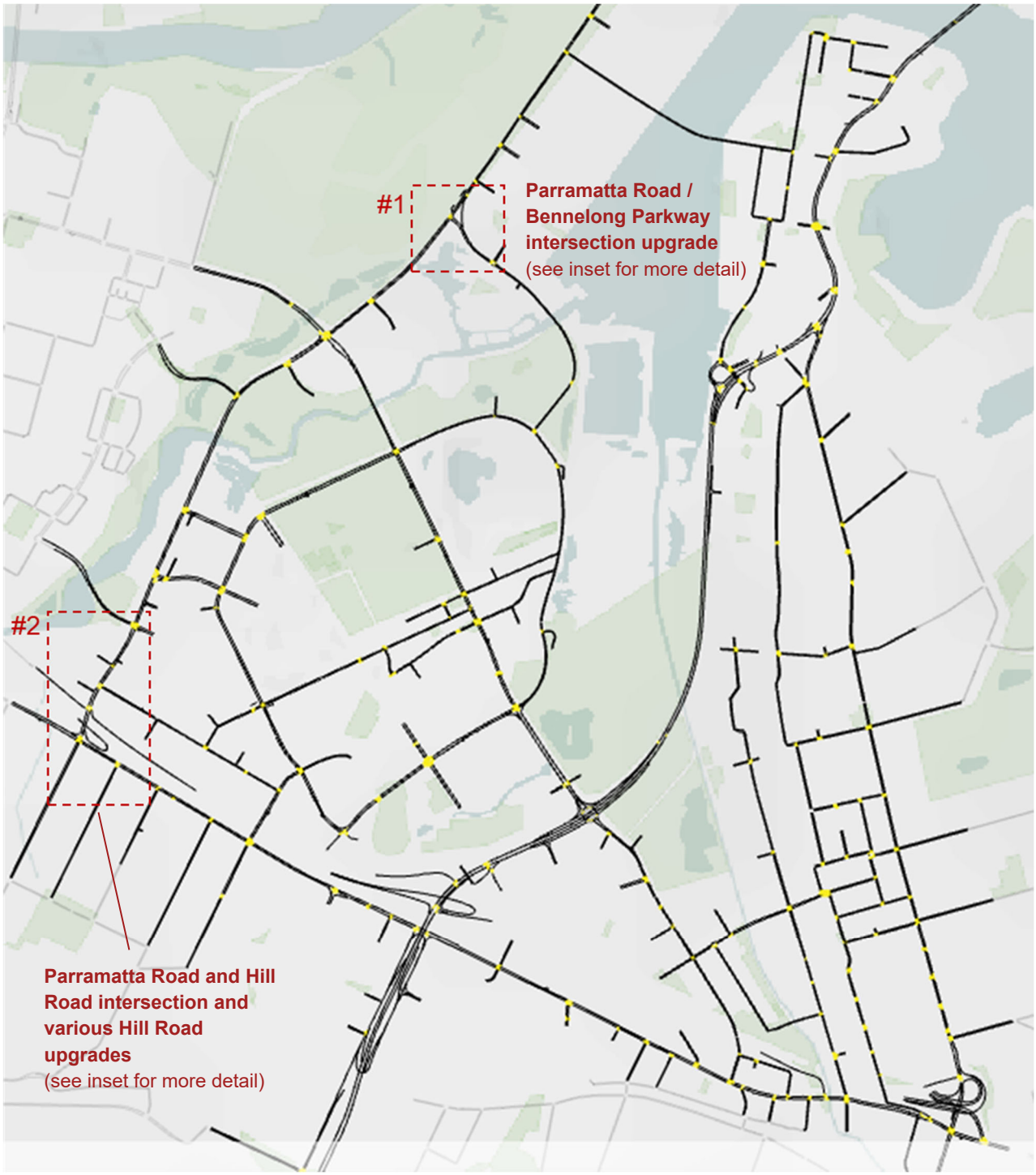
Wentworth Point is an example of a precinct which adopted higher density living, has high level of accessibility to world class public transport infrastructure, cycling facilities, sporting facilities, parks and foreshore walkways. Wentworth Point is a candidate precinct for high level of self-containment while local initiatives such as Green Travel Plans could ensure that public and active transport use is further optimised.

Appendices

A

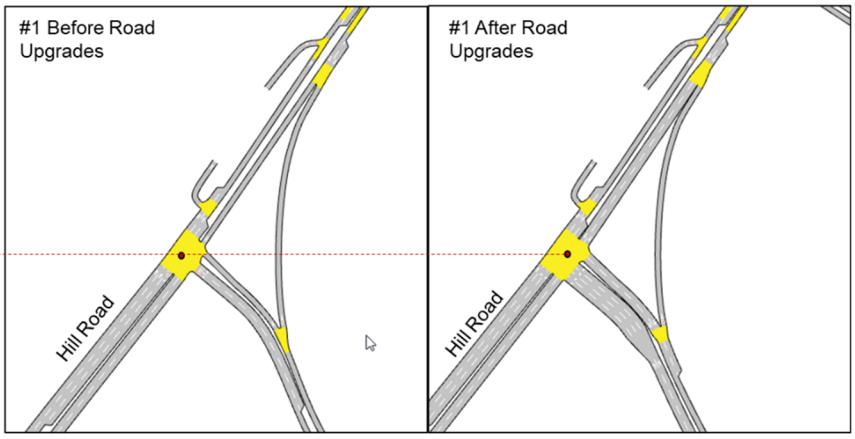
WPMM plots - planned upgrades (2036)

Overview of planned upgrades in the WPMM



Inset #1 - Parramatta Road / Bennelong Parkway intersection upgrade

Upgrading and signalising intersection of Hill Road and Bennelong Parkway



Inset #2 - Parramatta Road and Hill Road intersection and various Hill Road upgrades

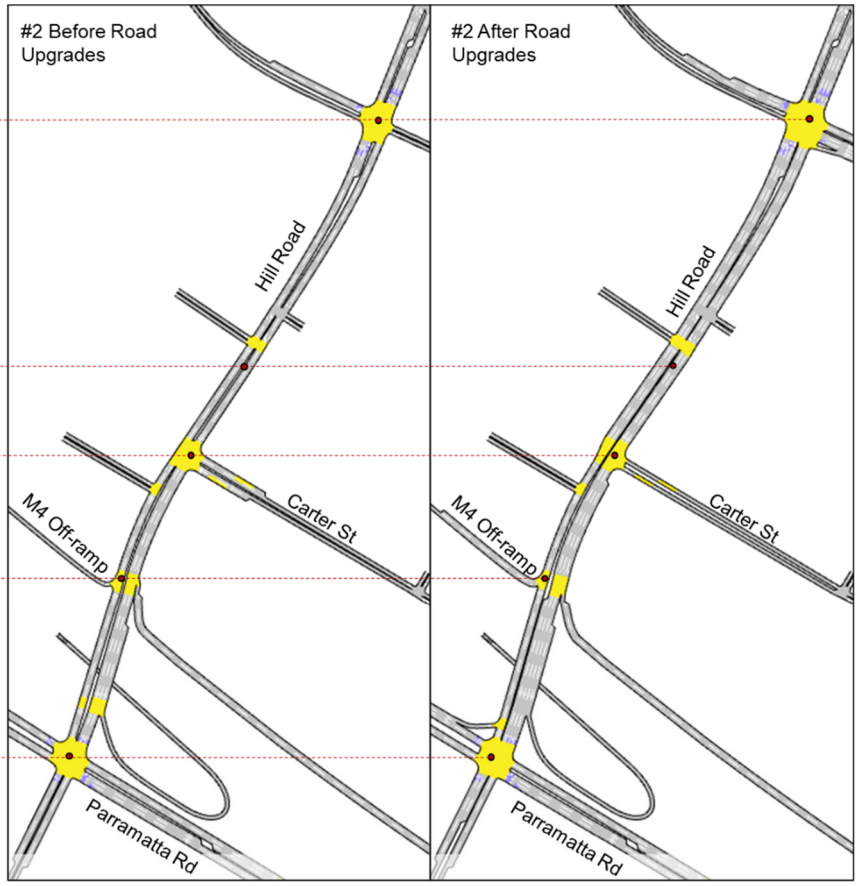
Upgrading the intersection of John Ian Wing Parade Road and Hill Road

Widening Hill Road between the M4 and Old Hill Link(4-lane to 6-lane)

Prohibiting the right turn onto Carter Street

Widening and signalising the M4 eastbound off-ramp

Upgrading the intersection of Parramatta Road and Hill Road



B

Intersection performance outputs

This section provides the following information:

- Intersection delay times (sec), all scenarios.
- Intersection volume (veh), all scenarios.
- DoS, core scenarios only. Provided for comparative purposes for overall assessment of the Future Project scenarios with and without the proposed developments*
- Australia Avenue / Homebush Bay Drive alternate design ("hamburger lane') - intersection capacity ('Base' versus 'Future Reference and mitigation measure' scenario)**

Please note, DoS is not a typical output provided by the AIMSUN modelling platform, and as such cannot be directly outputted from the WPMM. For comparative purpose, the DoS for the intersections within the study area[9] have been separately modelled using SIDRA. Due to the underlying differences in the modelling software packages used and limitations to the base year calibration of the SIDRA models, there are some discrepancies in the intersection performances between the WPMM (delay) and SIDRA (DoS) outputs. Notwithstanding these differences, comparison of the forecast scenarios shows little to no impacts to the DoS with and without the additional Block H and new high school trips.

**Aimsun does not explicitly provide intersection capacity information. Furthermore, the alternate design option is unable to be modelled in SIDRA. For the purposes of this analysis, calculation of the intersection capacities has been calculated using a manual process based on the proportion of green time allocated to the signalised arm of the approach leg.

[9] Outside the Wentworth Point study area, the Silverwater Rd/Holker St intersection is already been modelled using SIDRA.

Intersection Delay times (sec)

Delay time (sec) *Morning peak hour (8-9am)* Intersection	Core Scenarios				Sensitivity Scenarios		
	Base	Future Reference	Future Project (without school)	Future Project (with school)	Future without PLR2 and SMW	Future Reference and mitigation measure	Future Reference (COVID)
Silverwater Road / Holker Street	68	59	63	61	67	59	48
Parramatta Road / Hill Road	34	32	32	32	54	31	39
Parramatta Road / Birnie Avenue	52	77	82	82	122	58	61
Australia Avenue / Homebush Bay Drive	47	411	238	383	646	66	360
Bennelong Parkway / Hill Road	3	26	28	27	30	24	35

Delay time (sec) *Morning peak hour (8-9am)* Intersection	Core Scenarios				Sensitivity Scenarios		
	Base	Future Reference	Future Project (without school)	Future Project (with school)	Future without PLR2 and SMW	Future Reference and mitigation measure	Future Reference (COVID)
Silverwater Road / Holker Street	88	74	81	81	104	74	54
Parramatta Road / Hill Road	35	39	40	40	92	37	37
Parramatta Road / Birnie Avenue	44	61	63	62	85	68	52
Australia Avenue / Homebush Bay Drive	206	360	348	458	579	47	415
Bennelong Parkway / Hill Road	4	35	38	37	77	23	22

Intersection Volume (no. vehicles)*

Volume (veh) *Morning peak hour (8-9am)*	Core Scenarios				Sensitivity Scenarios		
Intersection	**Base**	**Future Reference**	**Future Project (without school)**	**Future Project (with school)**	**Future without PLR2 and SMW**	**Future Reference and mitigation measure**	**Future Reference (COVID)**
Silverwater Road / Holker Street	5,847	6,825	6,878	6,876	7,221	6,825	6,431
Parramatta Road / Hill Road	4,123	4,832	4,834	4,833	5,238	4,811	4,500
Parramatta Road / Birnie Avenue	4,138	4,697	4,680	4,676	5,087	4,772	4,606
Australia Avenue / Homebush Bay Drive	2,841	3,213	3,232	3,249	3,160	3,376	3,081
Bennelong Parkway / Hill Road	1,777	2,450	2,563	2,549	2,905	2,389	2,321

Volume (veh) *Morning peak hour (8-9am)*	Core Scenarios				Sensitivity Scenarios		
Intersection	**Base**	**Future Reference**	**Future Project (without school)**	**Future Project (with school)**	**Future without PLR2 and SMW**	**Future Reference and mitigation measure**	**Future Reference (COVID)**
Silverwater Road / Holker Street	6,214	7,733	7,833	7,833	8,240	7,733	7,244
Parramatta Road / Hill Road	4,343	5,379	5,452	5,450	1,502	5,479	5,118
Parramatta Road / Birnie Avenue	4,437	5,502	5,558	5,575	1,652	5,601	5,433
Australia Avenue / Homebush Bay Drive	3,075	3,331	3,349	3,399	2,350	3,477	3,339
Bennelong Parkway / Hill Road	1,937	2,605	2,859	2,796	2,241	2,644	2,487

**Based on WPMM outputs, except Silverwater Road / Holker Street, which is located outside the model area*

Intersection DoS*

Delay time (sec) *Morning peak hour (8-9am)*	**Core Scenarios**			
Intersection	**Base**	**Future Reference**	**Future Project (without school)**	**Future Project (with school)**
Silverwater Road / Holker Street	1.09	0.99	0.99	0.99
Parramatta Road / Hill Road	0.91	1.09	1.09	1.09
Parramatta Road / Birnie Avenue	0.87	1.18	1.16	1.16
Australia Avenue / Homebush Bay Drive	1.01	1.49	1.50	1.50
Bennelong Parkway / Hill Road	0.48	0.77	0.82	0.82

Delay time (sec) *Morning peak hour (8-9am)*	**Core Scenarios**			
Intersection	**Base**	**Future Reference**	**Future Project (without school)**	**Future Project (with school)**
Silverwater Road / Holker Street	1.11	1.04	1.06	1.07
Parramatta Road / Hill Road	1.03	1.10	1.11	1.10
Parramatta Road / Birnie Avenue	1.02	1.22	1.22	1.24
Australia Avenue / Homebush Bay Drive	1.07	1.21	1.21	1.21
Bennelong Parkway / Hill Road	0.74	0.89	0.90	0.90

**Based on SIDRA outputs*

Comparison of Australia Avenue / Homebush Bay Drive intersection performance - existing roundabout arrangement versus alternate design option (partial signalisation)

Intersection: Australia Avenue / Homebush Bay Drive Operational Modelling Scenario	Control Type	8-9am			5-6pm		
		Total Capacity	Total DoS	Worst Arm DoS	Capacity (veh/h)	Total DoS	Worst Arm DoS
Future Reference*	Priority	4,225	0.78	1.49(E)	4,225	0.77	1.21(N)
Future Reference and mitigation measure	Signal	4,693	0.70	0.89(N)	4,693	0.71	0.97(N)

**In the AIMSUN model, the Future Reference and mitigation measure scenario has a slightly higher volume (3%-6%) compared to the Future Reference due to 'induced traffic'. For the comparison purpose, the table above provides the results based on demand input from Future Reference*

Comparison of the intersection performances show an overall increase in the Australia Avenue / Homebush Bay Drive roundabout capacity with the alternate design option.

SIDRA Outputs

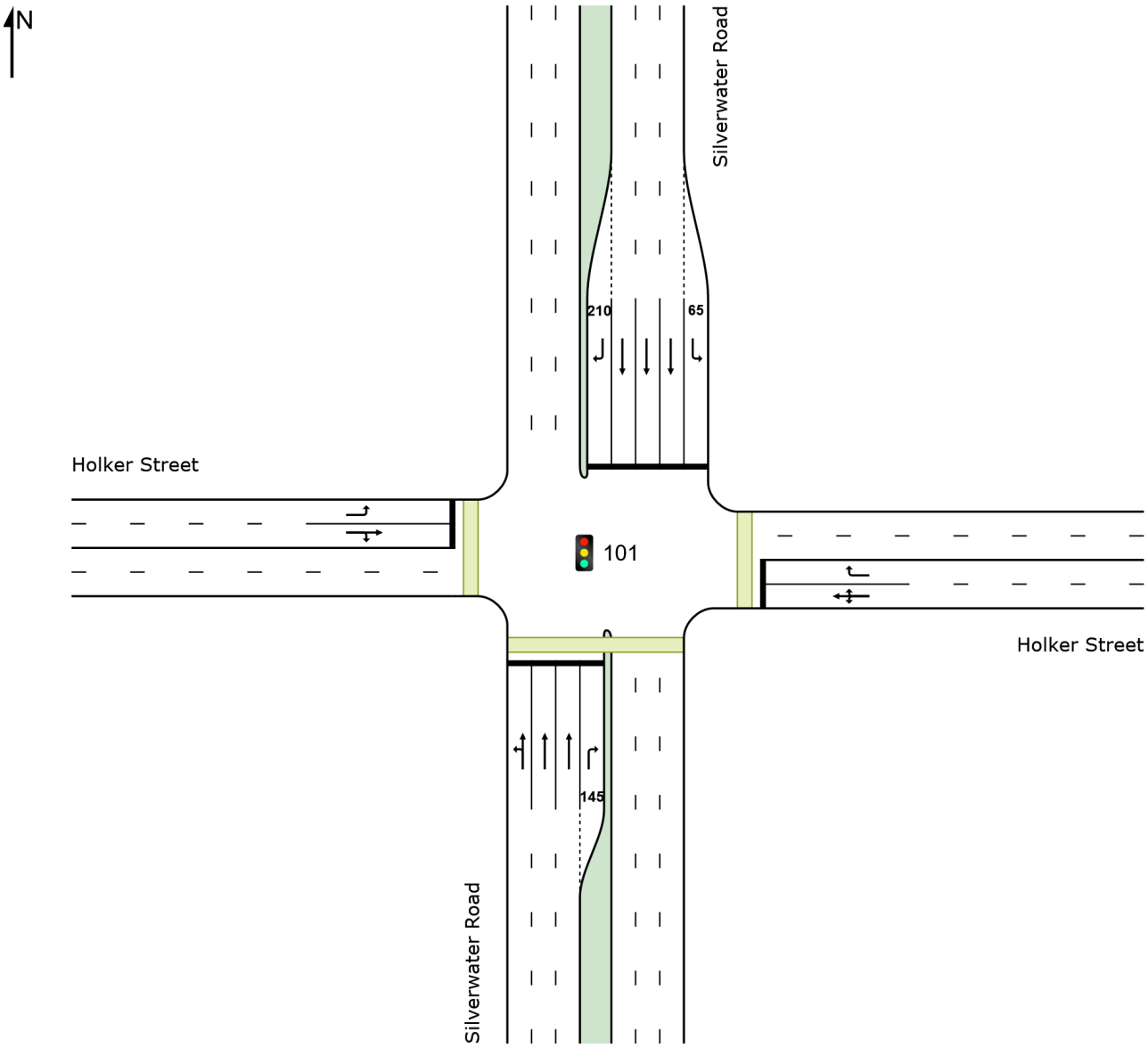
C

SITE LAYOUT

Site: 101 [1_AM_SilverwaterRd_HolkerSt-Base (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



LANE SUMMARY

Site: 101 [1_AM_SilverwaterRd_HolkerSt-Base (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 150 seconds (Site Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance

	DEMAND FLOWS [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Silverwater Road													
Lane 1	658	9.2	918	0.717	100	31.2	LOS C	36.9	278.9	Full	500	0.0	0.0
Lane 2	660	9.2	920	0.717	100	30.9	LOS C	37.0	279.4	Full	500	0.0	0.0
Lane 3	619	9.2	863[1]	0.717	100	29.9	LOS C	33.5	253.2	Full	500	0.0	0.0
Lane 4	116	21.8	161	0.720	100	81.8	LOS F	8.7	72.4	Short	145	0.0	NA
Approach	2053	9.9		0.720		33.6	LOS C	37.0	279.4				
East: Holker Street													
Lane 1	304	10.3	353	0.861	100	74.9	LOS F	23.5	178.9	Full	500	0.0	0.0
Lane 2	315	2.4	365	0.861	100	75.8	LOS F	24.5	174.8	Full	500	0.0	0.0
Approach	619	6.3		0.861		75.4	LOS F	24.5	178.9				
North: Silverwater Road													
Lane 1	1192	2.1	1088[1]	1.095	100	153.3	LOS F	159.2	1134.8	Short	65	0.0	NA
Lane 2	366	3.7	419[1]	0.874	100	44.3	LOS D	21.7	156.3	Full	500	0.0	81.6[8]
Lane 3	833	3.7	952	0.874	100	39.6	LOS C	56.4	407.1	Full	500	0.0	0.0
Lane 4	813	3.7	930	0.874	100	39.4	LOS C	54.4	392.8	Full	500	0.0	0.0
Lane 5	189	5.6	179	1.061	100	159.2	LOS F	21.5	158.0	Short	210	0.0	NA
Approach	3393	3.2		1.095		86.7	LOS F	159.2	1134.8				
West: Holker Street													
Lane 1	33	19.4	294	0.111	100	60.2	LOS E	2.0	16.3	Full	300	0.0	0.0
Lane 2	58	27.3	64	0.906	100	96.3	LOS F	4.9	42.5	Full	300	0.0	0.0
Approach	91	24.4		0.906		83.3	LOS F	4.9	42.5				
Intersection	6155	6.1		1.095		67.8	LOS E	159.2	1134.8				

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

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.
8 Probability of Blockage has been set on the basis of a queue that overflows from a short lane.

Approach Lane Flows (veh/h)

South: Silverwater Road

Mov. From S To Exit:	L2 W	T1 N	R2 E	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	24	634	-	658	9.2	918	0.717	100	NA	NA
Lane 2	-	660	-	660	9.2	920	0.717	100	NA	NA
Lane 3	-	619	-	619	9.2	863[1]	0.717	100	NA	NA

Lane 4	-	-	116	116	21.8	161	0.720	100	0.0	3
Approach	24	1913	116	2053	9.9		0.720			
East: Holker Street										
Mov. From E To Exit:	L2 S	T1 W	R2 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	51	36	218	304	10.3	353	0.861	100	NA	NA
Lane 2	-	-	315	315	2.4	365	0.861	100	NA	NA
Approach	51	36	533	619	6.3		0.861			
North: Silverwater Road										
Mov. From N To Exit:	L2 E	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	1192	-	-	1192	2.1	1088[1]	1.095	100	100.0	2
Lane 2	-	366	-	366	3.7	419[1]	0.874	100	NA	NA
Lane 3	-	833	-	833	3.7	952	0.874	100	NA	NA
Lane 4	-	813	-	813	3.7	930	0.874	100	NA	NA
Lane 5	-	-	189	189	5.6	179	1.061	100	0.0	4
Approach	1192	2012	189	3393	3.2		1.095			
West: Holker Street										
Mov. From W To Exit:	L2 N	T1 E	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	33	-	-	33	19.4	294	0.111	100	NA	NA
Lane 2	-	26	32	58	27.3	64	0.906	100	NA	NA
Approach	33	26	32	91	24.4		0.906			

	Total	%HV	Deg.Satn (v/c)
Intersection	6155	6.1	1.095

Lane flow rates given in this report are based on the arrival flow rates subject to upstream capacity constraint where applicable.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
South Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										
East Exit: Holker Street Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
North Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										
West Exit: Holker Street Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										

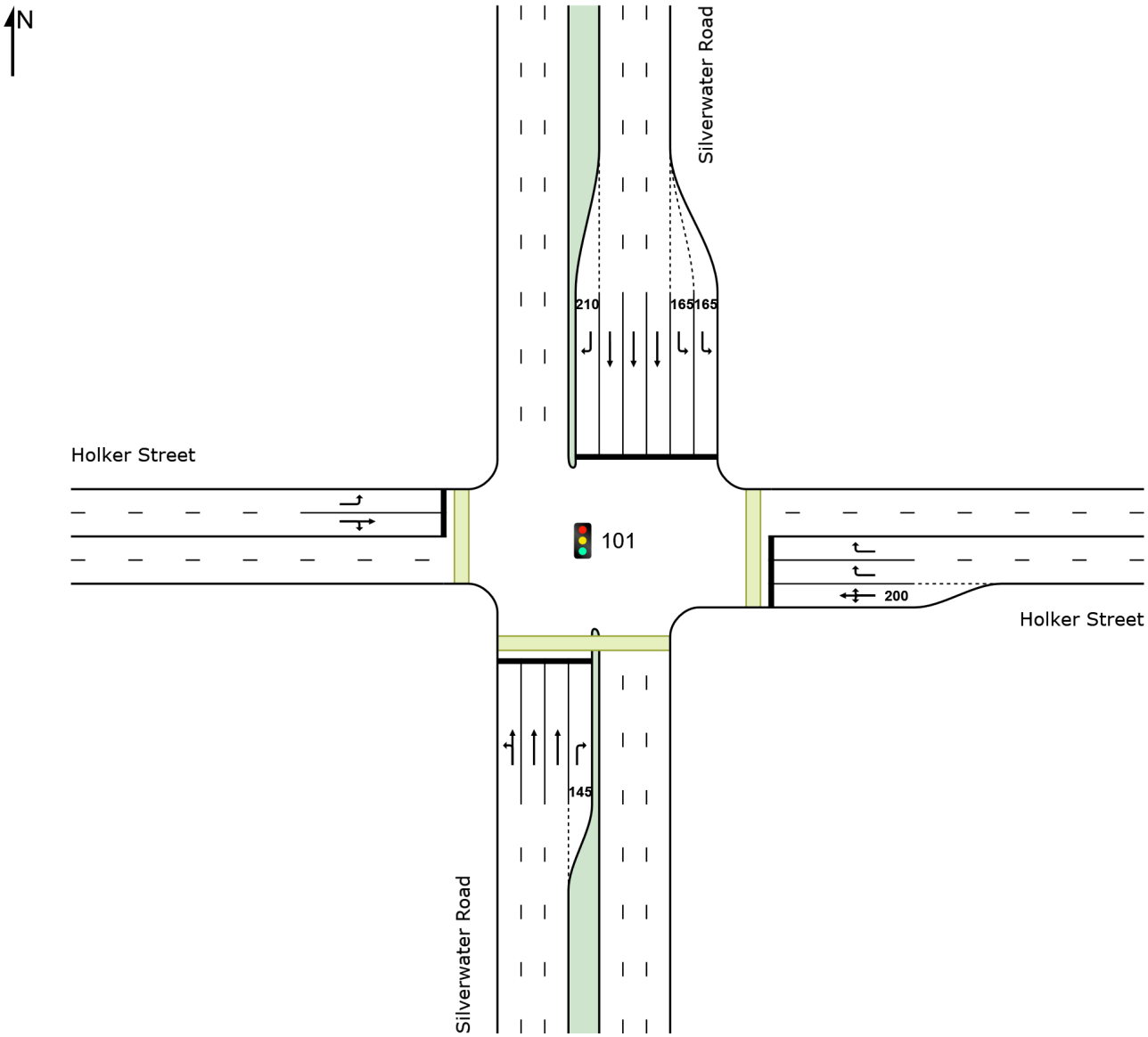
Full Length Lane	2	Merge Analysis not applied.

SITE LAYOUT

Site: 101 [1_AM_SilverwaterRd_HolkerSt-FutureRef (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



LANE SUMMARY

Site: 101 [1_AM_SilverwaterRd_HolkerSt-FutureRef (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 150 seconds (Site Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance

	DEMAND FLOWS [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Silverwater Road													
Lane 1	764	9.1	857	0.891	100	47.6	LOS D	55.7	420.6	Full	500	0.0	0.0
Lane 2	765	9.2	859	0.891	100	47.3	LOS D	55.8	421.3	Full	500	0.0	0.0
Lane 3	702	9.2	788[1]	0.891	100	46.8	LOS D	49.5	373.9	Full	500	0.0	0.0
Lane 4	133	21.4	269	0.494	100	68.8	LOS E	9.0	74.2	Short	145	0.0	NA
Approach	2363	9.8		0.891		48.5	LOS D	55.8	421.3				
East: Holker Street													
Lane 1	350	14.3	372	0.941	100	89.5	LOS F	30.5	239.9	Short	200	0.0	NA
Lane 2	367	2.4	390	0.941	100	91.0	LOS F	32.3	230.7	Full	500	0.0	0.0
Lane 3	367	2.4	390	0.941	100	91.0	LOS F	32.3	230.7	Full	500	0.0	0.0
Approach	1083	6.2		0.941		90.5	LOS F	32.3	239.9				
North: Silverwater Road													
Lane 1	639	2.1	1232	0.518	100	19.3	LOS B	22.9	163.1	Short	165	0.0	NA
Lane 2	639	2.1	1232	0.518	100	19.3	LOS B	22.9	163.1	Short	165	0.0	NA
Lane 3	645	3.7	672[1]	0.960	100	74.2	LOS F	55.1	398.0	Full	500	0.0	0.0
Lane 4	768	3.7	800	0.960	100	74.1	LOS F	69.0	498.0	Full	500	0.0	4.6
Lane 5	746	3.7	777[1]	0.960	100	74.0	LOS F	66.3	478.9	Full	500	0.0	1.1
Lane 6	202	5.2	215	0.941	100	99.9	LOS F	17.7	129.5	Short	210	0.0	NA
Approach	3639	3.2		0.960		56.3	LOS D	69.0	498.0				
West: Holker Street													
Lane 1	36	17.6	330	0.108	100	57.4	LOS E	2.1	17.2	Full	300	0.0	0.0
Lane 2	63	26.7	64	0.986	100	115.3	LOS F	5.9	51.1	Full	300	0.0	0.0
Approach	99	23.4		0.986		94.3	LOS F	5.9	51.1				
Intersection	7184	6.1		0.986		59.4	LOS E	69.0	498.0				

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

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Approach Lane Flows (veh/h)

South: Silverwater Road

Mov. From S To Exit:	L2 W	T1 N	R2 E	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	27	736	-	764	9.1	857	0.891	100	NA	NA
Lane 2	-	765	-	765	9.2	859	0.891	100	NA	NA

Lane 3	-	702	-	702	9.2	788[1]	0.891	100	NA	NA
Lane 4	-	-	133	133	21.4	269	0.494	100	0.0	3
Approach	27	2203	133	2363	9.8		0.891			

East: Holker Street

Mov. From E To Exit:	L2 S	T1 W	R2 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	87	62	200	350	14.3	372	0.941	100	21.5	2
Lane 2	-	-	367	367	2.4	390	0.941	100	NA	NA
Lane 3	-	-	367	367	2.4	390	0.941	100	NA	NA
Approach	87	62	934	1083	6.2		0.941			

North: Silverwater Road

Mov. From N To Exit:	L2 E	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	639	-	-	639	2.1	1232	0.518	100	4.0	2
Lane 2	639	-	-	639	2.1	1232	0.518	100	4.0	3
Lane 3	-	645	-	645	3.7	672[1]	0.960	100	NA	NA
Lane 4	-	768	-	768	3.7	800	0.960	100	NA	NA
Lane 5	-	746	-	746	3.7	777[1]	0.960	100	NA	NA
Lane 6	-	-	202	202	5.2	215	0.941	100	0.0	5
Approach	1278	2159	202	3639	3.2		0.960			

West: Holker Street

Mov. From W To Exit:	L2 N	T1 E	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	36	-	-	36	17.6	330	0.108	100	NA	NA
Lane 2	-	28	35	63	26.7	64	0.986	100	NA	NA
Approach	36	28	35	99	23.4		0.986			

	Total	%HV	Deg.Satn (v/c)
Intersection	7184	6.1	0.986

Lane flow rates given in this report are based on the arrival flow rates subject to upstream capacity constraint where applicable.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
South Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										
East Exit: Holker Street Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
North Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										

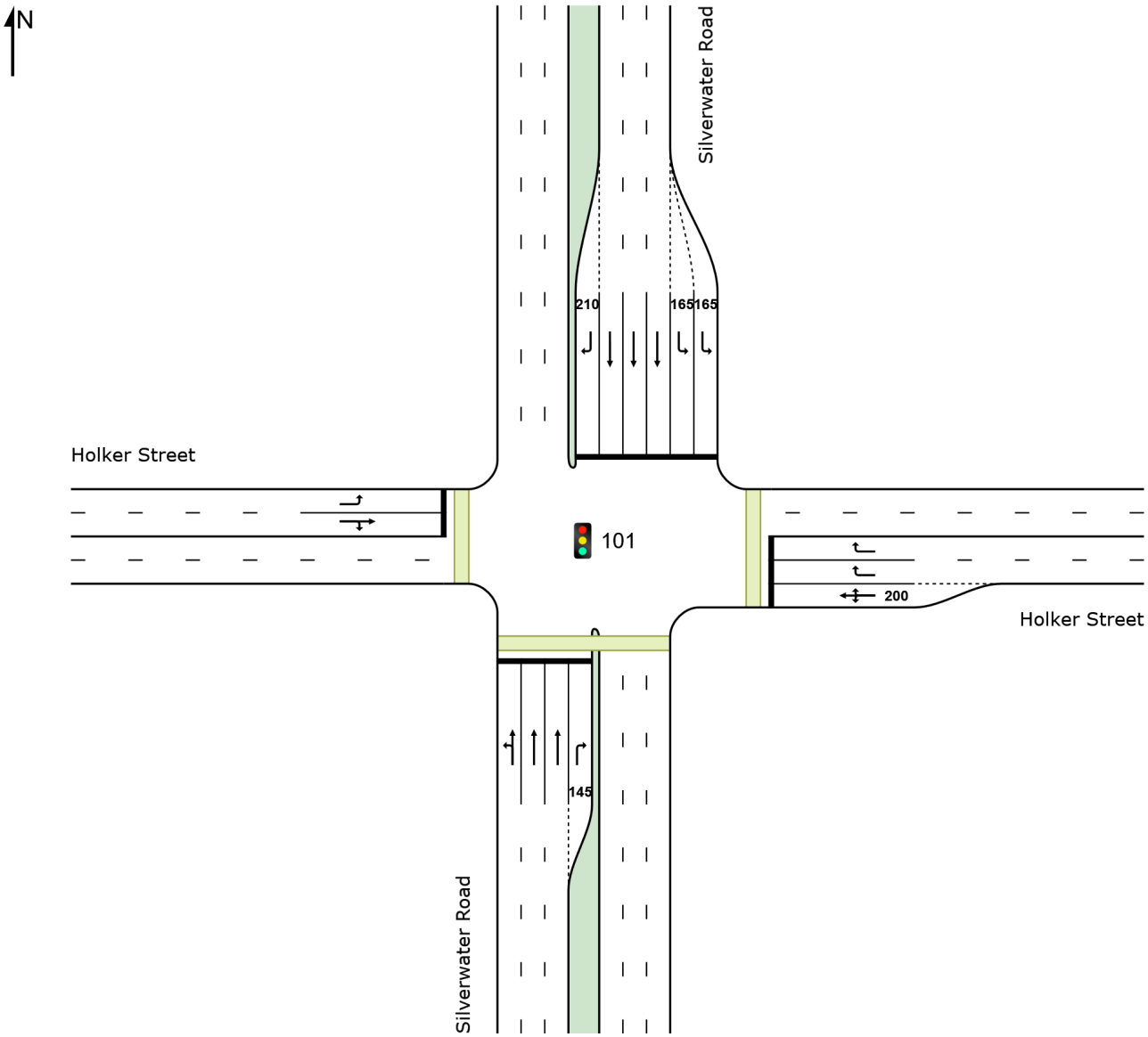
West Exit: Holker Street Merge Type: **Not Applied**		
Full Length Lane	1	Merge Analysis not applied.
Full Length Lane	2	Merge Analysis not applied.

SITE LAYOUT

Site: 101 [1_AM_SilverwaterRd_HolkerSt-FutureWoSM (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Organisation: PRICEWATERHOUSECOOPERS | Licence: PLUS / 1PC | Created: Thursday, 21 October 2021 10:35:13 AM
Project: G:\Shared drives\AU STM NSW\02 Clients\Billbergia\Wentworth Point\03 Working\AIMSUN\Sidra\WentworthPt_Base_v5_toSend.sip9

LANE SUMMARY

Site: 101 [1_AM_SilverwaterRd_HolkerSt-FutureWoSM (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 150 seconds (Site Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance

	DEMAND FLOWS [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Silverwater Road													
Lane 1	794	8.8	822	0.965	100	75.1	LOS F	72.6	546.1	Full	500	0.0	13.0
Lane 2	795	8.8	824	0.965	100	74.8	LOS F	72.7	547.1	Full	500	0.0	13.1
Lane 3	734	8.8	760[1]	0.965	100	74.6	LOS F	65.1	490.1	Full	500	0.0	3.2
Lane 4	137	20.8	183	0.746	100	80.9	LOS F	10.3	84.9	Short	145	0.0	NA
Approach	2459	9.5		0.965		75.2	LOS F	72.7	547.1				
East: Holker Street													
Lane 1	377	13.3	397	0.952	100	92.6	LOS F	33.8	263.2	Short	200	0.0	NA
Lane 2	394	2.2	414	0.952	100	93.6	LOS F	35.5	253.4	Full	500	0.0	0.0
Lane 3	394	2.2	414	0.952	100	93.6	LOS F	35.5	253.4	Full	500	0.0	0.0
Approach	1166	5.8		0.952		93.2	LOS F	35.5	263.2				
North: Silverwater Road													
Lane 1	680	1.9	1319	0.516	100	16.2	LOS B	21.6	153.7	Short	165	0.0	NA
Lane 2	680	1.9	1319	0.516	100	16.2	LOS B	21.6	153.7	Short	165	0.0	NA
Lane 3	674	3.4	703[1]	0.958	100	70.3	LOS E	56.0	403.8	Full	500	0.0	0.0
Lane 4	829	3.4	865	0.958	100	70.0	LOS E	73.6	530.4	Full	500	0.0	10.3
Lane 5	793	3.4	828[1]	0.958	100	69.9	LOS E	69.2	498.9	Full	500	0.0	4.8
Lane 6	215	4.9	215	0.997	100	122.4	LOS F	21.1	154.0	Short	210	0.0	NA
Approach	3871	3.0		0.997		54.0	LOS D	73.6	530.4				
West: Holker Street													
Lane 1	38	16.7	343	0.110	100	56.5	LOS E	2.2	17.9	Full	300	0.0	0.0
Lane 2	67	25.0	76	0.892	100	94.0	LOS F	5.6	48.0	Full	300	0.0	0.0
Approach	105	22.0		0.892		80.5	LOS F	5.6	48.0				
Intersection	7601	5.8		0.997		67.3	LOS E	73.6	547.1				

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

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Approach Lane Flows (veh/h)

South: Silverwater Road

Mov. From S To Exit:	L2 W	T1 N	R2 E	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	28	765	-	794	8.8	822	0.965	100	NA	NA
Lane 2	-	795	-	795	8.8	824	0.965	100	NA	NA

Lane 3	-	734	-	734	8.8	760[1]	0.965	100	NA	NA
Lane 4	-	-	137	137	20.8	183	0.746	100	0.0	3
Approach	28	2294	137	2459	9.5		0.965			

East: Holker Street

Mov. From E To Exit:	L2 S	T1 W	R2 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	92	66	219	377	13.3	397	0.952	100	30.0	2
Lane 2	-	-	394	394	2.2	414	0.952	100	NA	NA
Lane 3	-	-	394	394	2.2	414	0.952	100	NA	NA
Approach	92	66	1008	1166	5.8		0.952			

North: Silverwater Road

Mov. From N To Exit:	L2 E	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	680	-	-	680	1.9	1319	0.516	100	0.0	2
Lane 2	680	-	-	680	1.9	1319	0.516	100	0.0	3
Lane 3	-	674	-	674	3.4	703[1]	0.958	100	NA	NA
Lane 4	-	829	-	829	3.4	865	0.958	100	NA	NA
Lane 5	-	793	-	793	3.4	828[1]	0.958	100	NA	NA
Lane 6	-	-	215	215	4.9	215	0.997	100	0.0	5
Approach	1360	2296	215	3871	3.0		0.997			

West: Holker Street

Mov. From W To Exit:	L2 N	T1 E	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	38	-	-	38	16.7	343	0.110	100	NA	NA
Lane 2	-	31	37	67	25.0	76	0.892	100	NA	NA
Approach	38	31	37	105	22.0		0.892			

	Total	%HV	Deg.Satn (v/c)
Intersection	7601	5.8	0.997

Lane flow rates given in this report are based on the arrival flow rates subject to upstream capacity constraint where applicable.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
South Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										
East Exit: Holker Street Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
North Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										

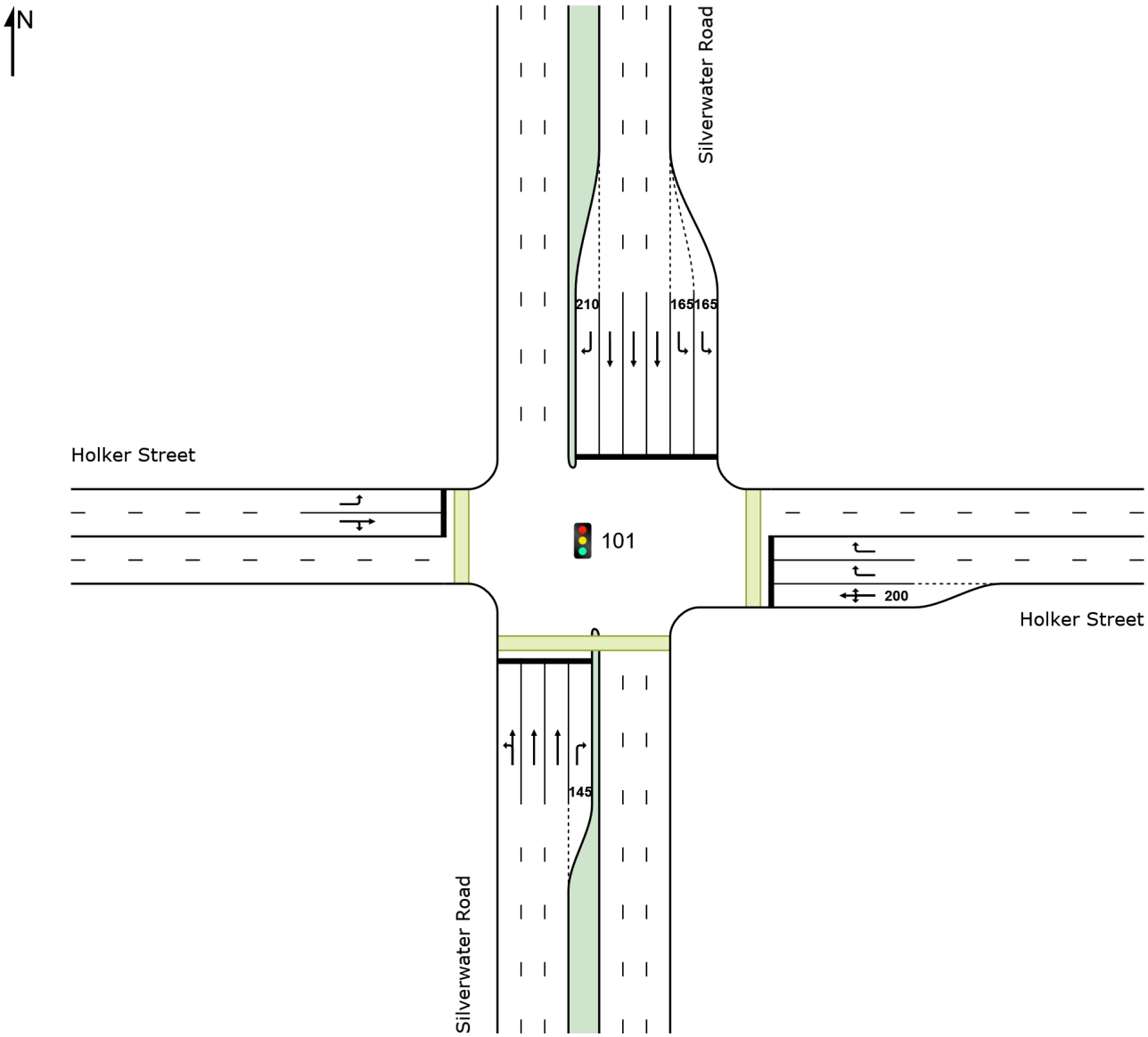
West Exit: Holker Street Merge Type: **Not Applied**		
Full Length Lane	1	Merge Analysis not applied.
Full Length Lane	2	Merge Analysis not applied.

SITE LAYOUT

Site: 101 [1_AM_SilverwaterRd_HolkerSt-FutureBH (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



LANE SUMMARY

Site: 101 [1_AM_SilverwaterRd_HolkerSt-FutureBH (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 150 seconds (Site Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance

	DEMAND FLOWS [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Silverwater Road													
Lane 1	763	9.1	845	0.903	100	51.2	LOS D	57.8	436.2	Full	500	0.0	0.0
Lane 2	765	9.2	847	0.903	100	51.0	LOS D	57.9	437.0	Full	500	0.0	0.0
Lane 3	703	9.2	778[1]	0.903	100	50.6	LOS D	51.5	388.9	Full	500	0.0	0.0
Lane 4	133	21.4	269	0.494	100	68.8	LOS E	9.0	74.2	Short	145	0.0	NA
Approach	2363	9.8		0.903		51.9	LOS D	57.9	437.0				
East: Holker Street													
Lane 1	361	13.9	384	0.942	100	89.6	LOS F	31.6	247.9	Short	200	0.0	NA
Lane 2	379	2.3	402	0.942	100	90.8	LOS F	33.4	238.6	Full	500	0.0	0.0
Lane 3	379	2.3	402	0.942	100	90.8	LOS F	33.4	238.6	Full	500	0.0	0.0
Approach	1119	6.0		0.942		90.4	LOS F	33.4	247.9				
North: Silverwater Road													
Lane 1	649	2.0	1233	0.526	100	19.4	LOS B	23.5	167.0	Short	165	0.0	NA
Lane 2	649	2.0	1233	0.526	100	19.4	LOS B	23.5	167.0	Short	165	0.0	NA
Lane 3	647	3.7	665[1]	0.972	100	81.0	LOS F	57.7	416.3	Full	500	0.0	0.0
Lane 4	766	3.7	787	0.972	100	81.0	LOS F	71.6	517.0	Full	500	0.0	8.0
Lane 5	746	3.7	767[1]	0.972	100	80.9	LOS F	69.2	499.4	Full	500	0.0	4.9
Lane 6	202	5.2	215	0.941	100	99.9	LOS F	17.7	129.5	Short	210	0.0	NA
Approach	3659	3.2		0.972		60.2	LOS E	71.6	517.0				
West: Holker Street													
Lane 1	36	17.6	330	0.108	100	57.4	LOS E	2.1	17.2	Full	300	0.0	0.0
Lane 2	63	26.7	64	0.986	100	115.3	LOS F	5.9	51.1	Full	300	0.0	0.0
Approach	99	23.4		0.986		94.3	LOS F	5.9	51.1				
Intersection	7240	6.1		0.986		62.6	LOS E	71.6	517.0				

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

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Approach Lane Flows (veh/h)

South: Silverwater Road

Mov. From S To Exit:	L2 W	T1 N	R2 E	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	27	736	-	763	9.1	845	0.903	100	NA	NA
Lane 2	-	765	-	765	9.2	847	0.903	100	NA	NA

Lane 3	-	703	-	703	9.2	778[1]	0.903	100	NA	NA
Lane 4	-	-	133	133	21.4	269	0.494	100	0.0	3
Approach	27	2203	133	2363	9.8		0.903			

East: Holker Street

Mov. From E To Exit:	L2 S	T1 W	R2 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	87	62	212	361	13.9	384	0.942	100	24.5	2
Lane 2	-	-	379	379	2.3	402	0.942	100	NA	NA
Lane 3	-	-	379	379	2.3	402	0.942	100	NA	NA
Approach	87	62	969	1119	6.0		0.942			

North: Silverwater Road

Mov. From N To Exit:	L2 E	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	649	-	-	649	2.0	1233	0.526	100	6.1	2
Lane 2	649	-	-	649	2.0	1233	0.526	100	6.1	3
Lane 3	-	647	-	647	3.7	665[1]	0.972	100	NA	NA
Lane 4	-	766	-	766	3.7	787	0.972	100	NA	NA
Lane 5	-	746	-	746	3.7	767[1]	0.972	100	NA	NA
Lane 6	-	-	202	202	5.2	215	0.941	100	0.0	5
Approach	1298	2159	202	3659	3.2		0.972			

West: Holker Street

Mov. From W To Exit:	L2 N	T1 E	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	36	-	-	36	17.6	330	0.108	100	NA	NA
Lane 2	-	28	35	63	26.7	64	0.986	100	NA	NA
Approach	36	28	35	99	23.4		0.986			

	Total	%HV	Deg.Satn (v/c)
Intersection	7240	6.1	0.986

Lane flow rates given in this report are based on the arrival flow rates subject to upstream capacity constraint where applicable.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
South Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										
East Exit: Holker Street Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
North Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										

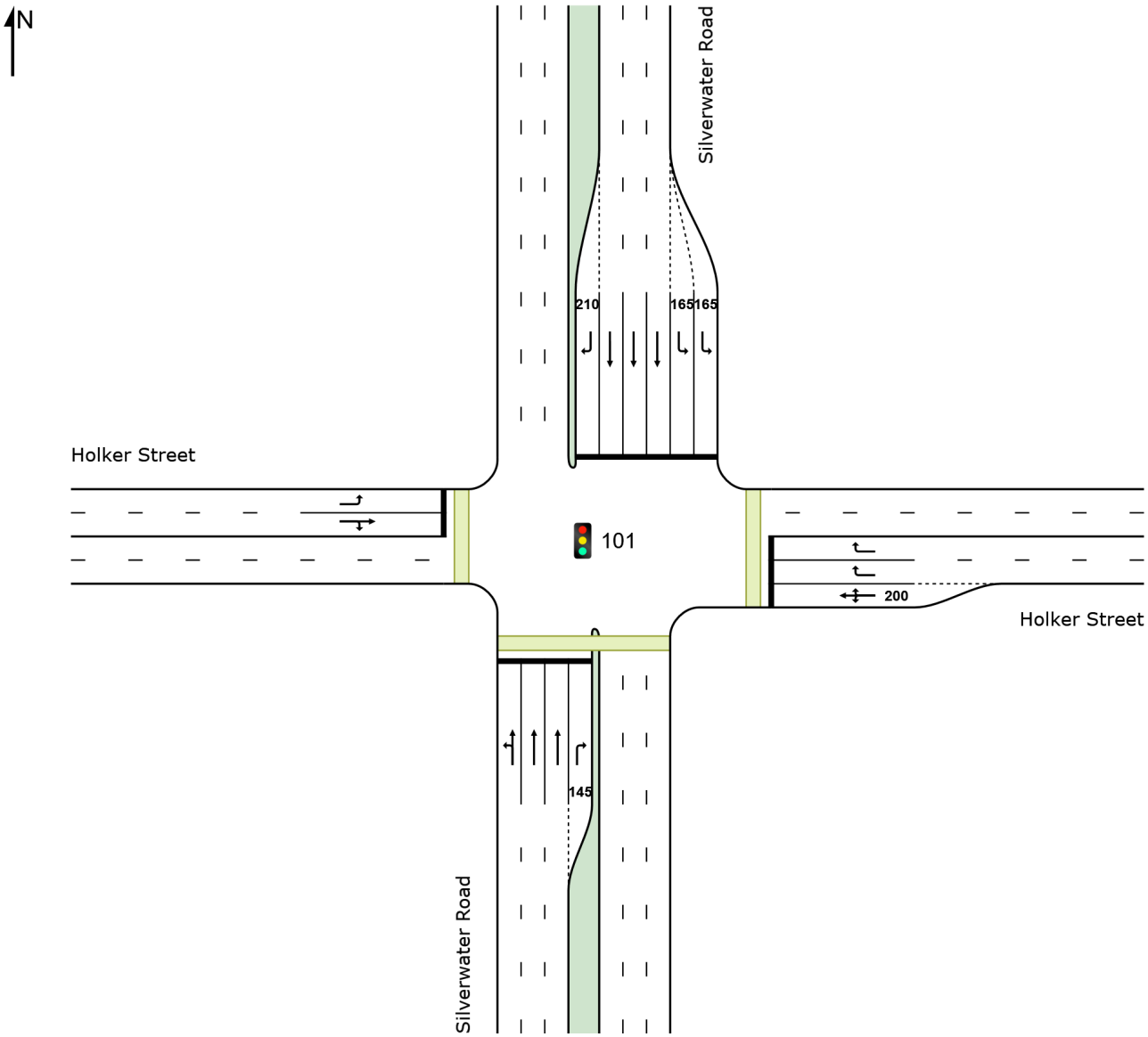
West Exit: Holker Street Merge Type: **Not Applied**		
Full Length Lane	1	Merge Analysis not applied.
Full Length Lane	2	Merge Analysis not applied.

SITE LAYOUT

Site: 101 [1_AM_SilverwaterRd_HolkerSt-FutureBHSch (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



LANE SUMMARY

Site: 101 [1_AM_SilverwaterRd_HolkerSt-FutureBHSch (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 150 seconds (Site Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance

	DEMAND FLOWS [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Silverwater Road													
Lane 1	762	9.1	796	0.957	100	72.6	LOS F	68.1	513.9	Full	500	0.0	7.5
Lane 2	763	9.2	797	0.957	100	72.3	LOS F	68.2	514.8	Full	500	0.0	7.6
Lane 3	706	9.2	738[1]	0.957	100	72.1	LOS F	61.4	463.6	Full	500	0.0	0.0
Lane 4	133	21.4	236	0.561	100	72.2	LOS F	9.2	76.4	Short	145	0.0	NA
Approach	2363	9.8		0.957		72.4	LOS F	68.2	514.8				
East: Holker Street													
Lane 1	362	13.8	384	0.944	100	90.2	LOS F	31.8	249.2	Short	200	0.0	NA
Lane 2	379	2.3	402	0.944	100	91.3	LOS F	33.6	239.9	Full	500	0.0	0.0
Lane 3	379	2.3	402	0.944	100	91.3	LOS F	33.6	239.9	Full	500	0.0	0.0
Approach	1121	6.0		0.944		91.0	LOS F	33.6	249.2				
North: Silverwater Road													
Lane 1	647	2.0	1269	0.510	100	17.8	LOS B	21.9	155.9	Short	165	0.0	NA
Lane 2	647	2.0	1269	0.510	100	17.8	LOS B	21.9	155.9	Short	165	0.0	NA
Lane 3	647	3.7	705[1]	0.918	100	56.9	LOS E	48.8	352.3	Full	500	0.0	0.0
Lane 4	758	3.7	825	0.918	100	57.1	LOS E	60.0	433.5	Full	500	0.0	0.0
Lane 5	754	3.7	822	0.918	100	57.1	LOS E	59.7	430.9	Full	500	0.0	0.0
Lane 6	202	5.2	263	0.770	100	76.8	LOS F	15.0	109.4	Short	210	0.0	NA
Approach	3655	3.2		0.918		44.3	LOS D	60.0	433.5				
West: Holker Street													
Lane 1	36	17.6	374	0.096	100	53.7	LOS D	2.1	16.6	Full	300	0.0	0.0
Lane 2	63	26.7	64	0.986	100	115.3	LOS F	5.9	51.1	Full	300	0.0	0.0
Approach	99	23.4		0.986		93.0	LOS F	5.9	51.1				
Intersection	7238	6.1		0.986		61.3	LOS E	68.2	514.8				

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

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Approach Lane Flows (veh/h)

South: Silverwater Road

Mov. From S To Exit:	L2 W	T1 N	R2 E	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	27	734	-	762	9.1	796	0.957	100	NA	NA
Lane 2	-	763	-	763	9.2	797	0.957	100	NA	NA

Lane 3	-	706	-	706	9.2	738[1]	0.957	100	NA	NA
Lane 4	-	-	133	133	21.4	236	0.561	100	0.0	3
Approach	27	2203	133	2363	9.8		0.957			

East: Holker Street

Mov. From E To Exit:	L2 S	T1 W	R2 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	87	62	213	362	13.8	384	0.944	100	25.0	2
Lane 2	-	-	379	379	2.3	402	0.944	100	NA	NA
Lane 3	-	-	379	379	2.3	402	0.944	100	NA	NA
Approach	87	62	972	1121	6.0		0.944			

North: Silverwater Road

Mov. From N To Exit:	L2 E	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	647	-	-	647	2.0	1269	0.510	100	0.0	2
Lane 2	647	-	-	647	2.0	1269	0.510	100	0.0	3
Lane 3	-	647	-	647	3.7	705[1]	0.918	100	NA	NA
Lane 4	-	758	-	758	3.7	825	0.918	100	NA	NA
Lane 5	-	754	-	754	3.7	822	0.918	100	NA	NA
Lane 6	-	-	202	202	5.2	263	0.770	100	0.0	5
Approach	1294	2159	202	3655	3.2		0.918			

West: Holker Street

Mov. From W To Exit:	L2 N	T1 E	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	36	-	-	36	17.6	374	0.096	100	NA	NA
Lane 2	-	28	35	63	26.7	64	0.986	100	NA	NA
Approach	36	28	35	99	23.4		0.986			

	Total	%HV	Deg.Satn (v/c)
Intersection	7238	6.1	0.986

Lane flow rates given in this report are based on the arrival flow rates subject to upstream capacity constraint where applicable.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
South Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										
East Exit: Holker Street Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
North Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										

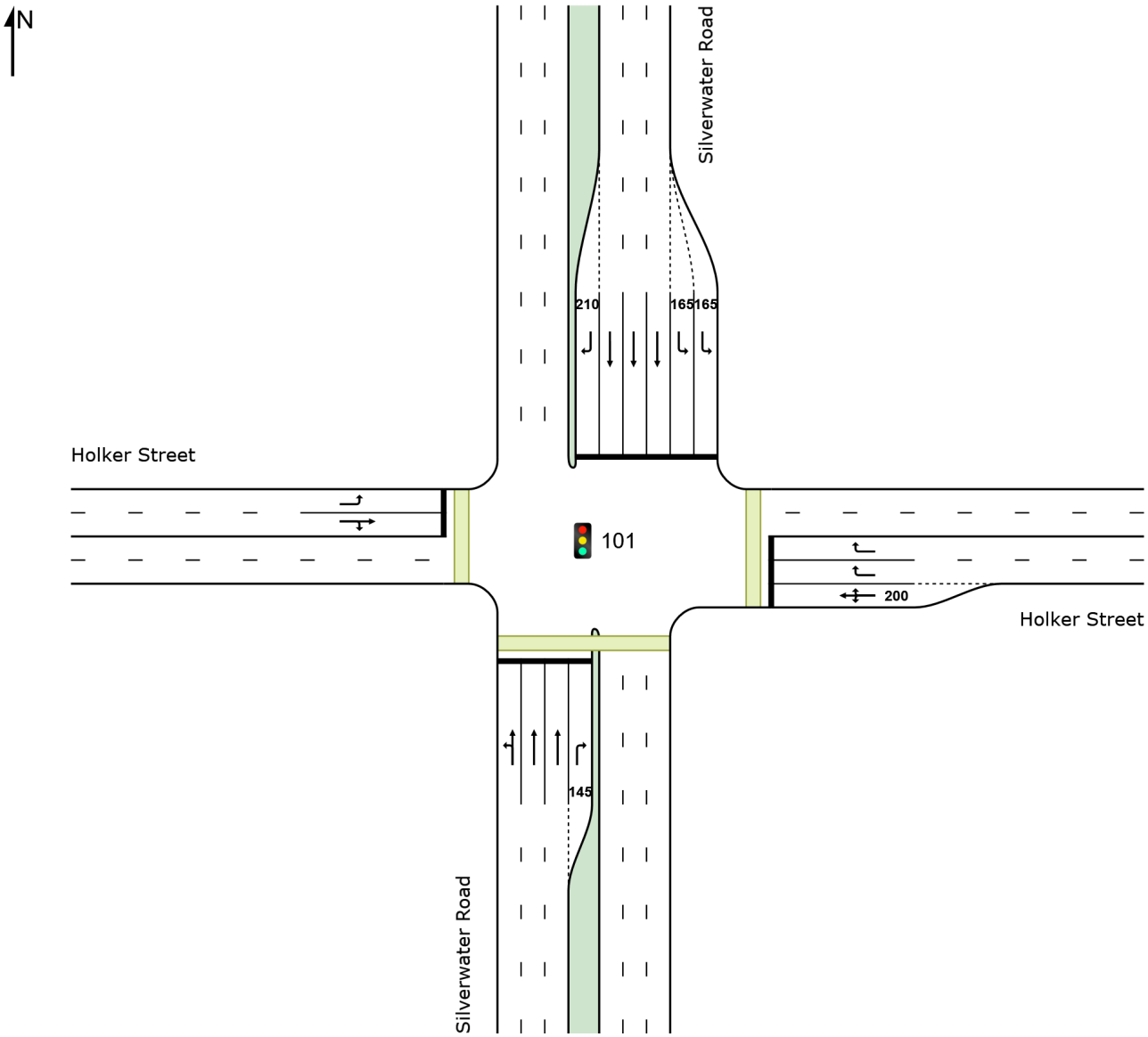
West Exit: Holker Street Merge Type: **Not Applied**		
Full Length Lane	1	Merge Analysis not applied.
Full Length Lane	2	Merge Analysis not applied.

SITE LAYOUT

Site: 101 [1_AM_SilverwaterRd_HolkerSt-FutureCovid (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



LANE SUMMARY

Site: 101 [1_AM_SilverwaterRd_HolkerSt-FutureCovid (Site Folder: 1_AM_SilverwaterRd_HolkerSt)]

Silverwater Rd / Holker Rd
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 150 seconds (Site Practical Cycle Time)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Lane Use and Performance

	DEMAND FLOWS [Total veh/h	HV] %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh	Dist] m	Lane Config	Lane Length m	Cap. Adj. %	Prob. Block. %
South: Silverwater Road													
Lane 1	723	9.6	806	0.897	100	52.1	LOS D	54.5	412.9	Full	500	0.0	0.0
Lane 2	724	9.7	807	0.897	100	51.8	LOS D	54.6	413.6	Full	500	0.0	0.0
Lane 3	669	9.7	745[1]	0.897	100	51.4	LOS D	49.0	371.1	Full	500	0.0	0.0
Lane 4	126	22.5	235	0.538	100	72.0	LOS F	8.7	73.0	Short	145	0.0	NA
Approach	2242	10.4		0.897		52.9	LOS D	54.6	413.6				
East: Holker Street													
Lane 1	324	15.4	358	0.905	100	80.2	LOS F	26.4	209.1	Short	200	0.0	NA
Lane 2	341	2.6	377	0.905	100	82.2	LOS F	28.1	201.3	Full	500	0.0	0.0
Lane 3	341	2.6	377	0.905	100	82.2	LOS F	28.1	201.3	Full	500	0.0	0.0
Approach	1006	6.7		0.905		81.5	LOS F	28.1	209.1				
North: Silverwater Road													
Lane 1	601	2.2	1256	0.478	100	17.9	LOS B	20.0	142.6	Short	165	0.0	NA
Lane 2	601	2.2	1256	0.478	100	17.9	LOS B	20.0	142.6	Short	165	0.0	NA
Lane 3	668	3.9	820	0.814	100	38.7	LOS C	41.7	301.8	Full	500	0.0	0.0
Lane 4	681	3.9	837	0.814	100	38.9	LOS C	42.9	310.5	Full	500	0.0	0.0
Lane 5	681	3.9	837	0.814	100	38.9	LOS C	42.9	310.5	Full	500	0.0	0.0
Lane 6	191	5.5	262	0.727	100	75.0	LOS F	13.8	101.3	Short	210	0.0	NA
Approach	3422	3.4		0.814		33.5	LOS C	42.9	310.5				
West: Holker Street													
Lane 1	36	17.6	385	0.093	100	52.8	LOS D	2.0	16.4	Full	300	0.0	0.0
Lane 2	63	26.7	75	0.845	100	90.4	LOS F	5.2	44.5	Full	300	0.0	0.0
Approach	99	23.4		0.845		76.8	LOS F	5.2	44.5				
Intersection	6769	6.5		0.905		47.7	LOS D	54.6	413.6				

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

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Approach Lane Flows (veh/h)

South: Silverwater Road

Mov. From S To Exit:	L2 W	T1 N	R2 E	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	25	698	-	723	9.6	806	0.897	100	NA	NA
Lane 2	-	724	-	724	9.7	807	0.897	100	NA	NA

Lane 3	-	669	-	669	9.7	745[1]	0.897	100	NA	NA
Lane 4	-	-	126	126	22.5	235	0.538	100	0.0	3
Approach	25	2091	126	2242	10.4		0.897			

East: Holker Street

Mov. From E To Exit:	L2 S	T1 W	R2 N	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	83	59	182	324	15.4	358	0.905	100	9.0	2
Lane 2	-	-	341	341	2.6	377	0.905	100	NA	NA
Lane 3	-	-	341	341	2.6	377	0.905	100	NA	NA
Approach	83	59	864	1006	6.7		0.905			

North: Silverwater Road

Mov. From N To Exit:	L2 E	T1 S	R2 W	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	601	-	-	601	2.2	1256	0.478	100	0.0	2
Lane 2	601	-	-	601	2.2	1256	0.478	100	0.0	3
Lane 3	-	668	-	668	3.9	820	0.814	100	NA	NA
Lane 4	-	681	-	681	3.9	837	0.814	100	NA	NA
Lane 5	-	681	-	681	3.9	837	0.814	100	NA	NA
Lane 6	-	-	191	191	5.5	262	0.727	100	0.0	5
Approach	1201	2031	191	3422	3.4		0.814			

West: Holker Street

Mov. From W To Exit:	L2 N	T1 E	R2 S	Total	%HV	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Prob. SL Ov. %	Ov. Lane No.
Lane 1	36	-	-	36	17.6	385	0.093	100	NA	NA
Lane 2	-	28	35	63	26.7	75	0.845	100	NA	NA
Approach	36	28	35	99	23.4		0.845			

	Total	%HV	Deg.Satn (v/c)
Intersection	6769	6.5	0.905

Lane flow rates given in this report are based on the arrival flow rates subject to upstream capacity constraint where applicable.

1 Reduced capacity due to a short lane effect. Short lane queues may extend into the full-length lanes. Some upstream delays at entry to short lanes are not included.

Merge Analysis

	Exit Lane Number	Short Lane Length m	Percent Opng in Lane %	Opposing Flow Rate veh/h	Opposing Flow Rate pcu/h	Critical Gap sec	Follow-up Headway sec	Lane Flow Rate veh/h	Capacity veh/h	Deg. Satn v/c	Min. Delay sec	Merge Delay sec
South Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										
East Exit: Holker Street Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
North Exit: Silverwater Road Merge Type: **Not Applied**												
Full Length Lane	1	Merge Analysis not applied.										
Full Length Lane	2	Merge Analysis not applied.										
Full Length Lane	3	Merge Analysis not applied.										

West Exit: Holker Street Merge Type: **Not Applied**		
Full Length Lane	1	Merge Analysis not applied.
Full Length Lane	2	Merge Analysis not applied.

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