Moriah College

Transport and Accessibility Impact Assessment

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The Transport Planning Partnership

Moriah College

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APPENDICES

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B. GHD EXISTING CONDITIONS ROAD SAFETY AUDIT
C. SWEPT PATH ANALYSIS
D. STFM GROWTH PLOTS

1 Introduction

1.1 Background

The Transport Planning Partnership (TTPP) has prepared this Transport and Accessibility Impact Assessment report on behalf of Moriah College (the 'College'). The report accompanies an Environmental Impact Statement (EIS) in support of State Significant Development Application (SSD-10352) for new school buildings on the existing campus of Moriah College, Queens Park (the site).

An initial assessment was provided by Department of Planning, Industry and Environment (DPIE) dated 5 February 2020 incorporating the comments and matters identified during the formal exhibition period. The comments included submissions received from the State and local government agencies, authorities and members of the public. The traffic and parking matters of this assessment was addressed by TTPP in a letter dated 30 April 2020.

A secondary assessment has been provided by DPIE dated 30 July 2020, incorporating further comments, from DPIE as well as state and local government agencies.

DPIE has also engaged an independent traffic consultant to undertake a peer review of the SIDRA modelling and results presented in the Transport and Accessibility Impact Assessment (TAIA) report prepared by TTPP (dated 12 June 2020). DPIE requested additional information to be addressed as part of the Supplementary Response to Submissions.

This TAIA report has been updated to incorporate the responses to traffic related queries raised by DPIE on 30 July and 22 September 2020. A summary of DPIE's comments and requests for additional information is presented in Section 1.4.

1.2 Purpose of the Assessment

This report sets out an assessment of the anticipated transport implications of the proposed development including consideration of the following:

- existing traffic and parking conditions surrounding the site
- suitability of proposed parking in terms of quantum and layout
- the traffic generating characteristics of the proposed development
- suitability of proposed access arrangements for the site
- the transport impacts of the proposed development on the surrounding road network.

1.3 Secretary's Environmental Assessment Requirements

On 15 July 2019, the Department of Planning and Environment (DoPE) issued the Secretary's Environmental Assessment Requirements (SEARS) for SSD-10352. Specifically, a traffic and accessibility impact assessment is required as part of the Environmental Impact Statement (EIS), in accordance with the SEARs for the proposed development.

The issues raised in the SEARs have been considered during the preparation of this report and are summarised in Table 1.1.

Table 1.1: Review of Compliance with SEARs

SEARS Transport, Traffic, Parking and Access	Report Reference
Transport and Accessibility Include a transport and accessibility impact assessment, which details, but not limited to the following:	
• accurate details of the current daily and peak hour vehicle, existing and future public transport networks and pedestrian and cycle movement provided on the road network located adjacent to the proposed development	Refer to Section 3.3 and 7.4
• details of estimated total daily and peak hour trips generated by the proposal, including vehicle, public transport, pedestrian and bicycle trips	Refer to Section 3.3 and 7.4
• the adequacy of existing public transport or any future public transport infrastructure within the vicinity of the site, pedestrian and bicycle networks and associated infrastructure to meet the likely future demand of the proposed development	Refer to Section 7
• measures to integrate the development with the existing/future public transport network	Refer to Section 5
• the impact of trips generated by the development on nearby intersections, with consideration of the cumulative impacts from other approved developments in the vicinity, and the need/associated funding for, and details of, upgrades or road improvement works, if required (Traffic modelling is to be undertaken using SIDRA network modelling for current and future years)	Refer to Section 7
• the Transport and Accessibility Impact Assessment must respond to the findings of the road safety audit and provide recommended actions to address the findings of the audit.	Refer to Section 4
• the identification of infrastructure required to address any impacts on traffic efficiency and road safety impacts associated with the proposed development, including details on improvements required to affected intersections, additional school bus routes along bus capable roads (i.e. minimum 3.5m wide travel lanes), additional bus stops or bus bays	Refer to Section 7
• details of travel demand management measures to minimise the impact on general traffic and bus operations, including details of a location-specific sustainable travel plan (Green Travel Plan and specific Workplace travel plan) and the provision of facilities to increase the non-car mode share for travel to and from the site	Refer to Section 8 and TTPP's Green Travel Plan
• the proposed walking and cycling access arrangements and connections to public transport services	Refer to Section 5
• the proposed access arrangements, including car and bus pick-up/drop-off facilities, and measures to mitigate any associated traffic impacts and impacts on public transport, pedestrian and bicycle networks, including pedestrian crossings and refuges and speed control devices and zones	Refer to Section 5

SEARS Transport, Traffic, Parking and Access	Report Reference
• proposed bicycle parking provision, including end of trip facilities, in secure, convenient, accessible areas close to main entries incorporating lighting and passive surveillance	Refer to Section 6.3
• proposed number of on-site car parking spaces for staff and visitors and corresponding compliance with existing parking codes and justification for the level of car parking provided on-site	Refer to Section 6.1
• an assessment of the cumulative on-street parking impacts of cars and bus pick-up/drop-off, staff parking and any other parking demands associated with the development	Refer to Section 6 and 7
• an assessment of road and pedestrian safety adjacent to the proposed development and the details of required road safety measures and personal safety in line with CPTED	Refer to Section 4
• emergency vehicle access, service vehicle access, delivery and loading arrangements and estimated service vehicle movements (including vehicle type and the likely arrival and departure times)	Refer to Section 5.4
• the preparation of a preliminary Construction Traffic and Pedestrian Management Plan to demonstrate the proposed management of the impact in relation to construction traffic	Refer to TTPP's Preliminary Construction Traffic and Pedestrian Management Plan

1.4 DPIE Request for Information

The traffic related queries raised by DPIE have been considered during the preparation of this report and are summarised in Table 1.2.

Table 1.2: Response to DPIE Request for Information

DPIE RFI	Response to RFI	Report Reference
DPIE Assessment – 30 July 2020		
DPIE Preliminary Assessment		
1. Detail the proposed security measures and procedures to manage the vehicles entering the new drop-off and pick-up area at Gate 4 from York Road.	At drop-off and pick-up times, the security gate will be in open position. The proposed security measures that will be in place are detailed in this report.	Refer to Section 5.3
2. Further to the point above, provide details of any traffic management measures proposed as part of the development to ensure that queuing along York Road does not occur from the security measures and procedures carried out at Gate 4.	The security gate is to be in the 'open' position during drop-off and pick-up times so as to reduce the impact on York road from queuing cars	Refer to Section 5.3
3. Update Tables 7.10 and 7.11 of the Transport and Accessibility Impact Assessment (TAIA) (submitted at Appendix C1 of the RtS) to include the following traffic data and intersection analysis for the school AM and PM peak periods (i.e. additional columns): • Stage 1 with intersection upgrades (with no modal shift). • Stage 1 with intersection upgrades and modal shift. • Stage 1 and Stage 2 with intersection upgrades (with no modal shift).	The requested additional scenarios have been included in this report.	Refer to Section 7.3.4

DPIE RFI	Response to RFI	Report Reference
4. Update the TAIA to accurately reflect the total number of existing on-site car parking spaces currently provided for school staff and visitors. Table 2.2 at Section 2.4.2 of the TAIA currently includes the provision of four motorcycle spaces and two buckle-up bay spaces, which should be excluded from the total number of available parking spaces.	Table 2.2 has been updated to exclude the motorcycle and buckle up bay spaces from the total calculation.	Refer to Table 2.2
5. Update any reference to on-site car parking spaces in the TAIA considering the total number of existing on-site car parking spaces currently provided for school staff and visitors. In particular, the Parking Assessment at Section 6 should be amended to ensure the car parking provisions and assumptions are accurate.	No changes are required to the parking assessment in Section 6, which has not included the motorcycle parking in the car parking calculations	Not applicable
Council Submissions		
a. Increase of drop off and pick up (DOPU) activities is the principal point of objection.	The proposal includes the relocation of DOPU activities from the existing designated area on York Road to on-site and infrastructure upgrades to the intersections of York Road-Queens Park Road and York Road-Baronga Avenue. The proposal will result in better traffic management and flow around the site and will ensure that queues on the road are not significantly worse than present conditions.	Refer to Section 6.5
j. Increased shuttle bus services between Bondi Junction and the College.	The School is not able to commit to providing more shuttle bus services. However, site observations indicate that the existing bus services have spare capacity which may be able to accommodate this additional bus demand. It is still recommended undertake a regular monitoring of bus usage and to undertake a detailed review of the bus demand based on the expected student intake each year and their associated catchment radius from the school.	Refer to Section 7.4
DPIE Assessment – 22 September 2020		
1. Please provide evidence of model calibration and validation to real life conditions to ensure confidence in a robust Existing Base model.	The models were calibrated based on the observed traffic queue lengths on the survey date. A calibration report has been prepared documenting the methodology undertaken in developing the existing base model.	Refer to Appendix A
2. A Base scenario was prepared for existing year, 2023, 2030 and 2036. Future background growth rates were based on predictions extracted from the RMS Strategic Traffic Forecasting Model. Upon review of the provided SIDRA models, it is noted that some volumes remained unchanged at Queens Park Road / Baronga Avenue.	Traffic growth rates used in developing the future base models were based on the 2018-2026 Strategic Traffic Forecasting Model (STFM) plots received from Roads	Refer to Section 7.3 and Appendix D

DPIE RFI	Response to RFI	Report Reference
The west approach volumes on Queens Park Road show no growth between existing, 2023, 2030 and 2036 base scenarios. Additionally, the south approach volumes on Baronga Avenue remain consistent between 2023, 2030 and 2036 base scenarios. Please clarify the adopted background growth rates for the modelled network.	and Maritime Services on 15 August 2019. STFM plots indicate that some approaches have no growth rates. Latest STFM growth plots have been requested which have be adopted in the updated SIDRA modelling	
3. The scope of the modelled road network is limited to the three (3) main intersections located near the school – these intersections should not be modelled in isolation. The York Road / Darley Road intersection is noted to affect the performance of the York Road / Baronga Avenue intersection, with downstream blockages causing a significant pushback of the queue. This has not been considered in the modelling, which consequently shows uninterrupted eastbound flow on York Road and is not representative of the existing peak period traffic conditions. Also, the pedestrian crossing at the mid-point of Baronga Avenue has not been modelled in SIDRA. Given the proximity of the crossing to the school gate (Gate 3), it is frequently used during peak hour periods. Vehicles are currently required to stop to allow pedestrians to cross, with queues propagating towards Queens Park Road to the north and York Road to the south. This reduces the available capacity of the road and affects performance at the respective intersections. The scope of modelling should be widened to also include: • Darley Road / York Road traffic signals • Pedestrian Crossing (Zebra) on Baronga Avenue.	TTPP has commissioned the following additional traffic surveys to include the nominated intersection and crossing locations.	Refer to Section 2.8.2
4. York Road (West) has been modelled as two approach lanes: a through-lane and a short 45m left turn lane into Baronga Avenue. However, there is no existing line-marking at this intersection delineating two turning lanes. The lane is observed to be around 5.3m wide at the intersection, as measured from Nearmap satellite imagery which does not allow safe adequate width for two side-by-side lanes. Accordingly, the intersection model does not reflect the actual intersection operation. The modelling is expected to show greater delays compared to reality for the right turn from York Road into Baronga Avenue. The York Road / Baronga Avenue geometry should be adjusted to remove short turning lane on west approach – otherwise, provide evidence of road utilisation in this manner.	The intersection of York Road and Baronga Avenue for the existing and future base models has been updated to remove the short left turn lane on York Road west approach.	Refer to Appendix A
5. Model intersections together with SIDRA Network to replicate the effects of queue pushback and present the modelling results for each intersection on a by-Approach basis to ensure greater clarity of information.	The model has been assessed as a network to determine impacts of the signals and queue at York Road- Avoca Street-Darley Road and pedestrian movements at nominated crossing locations.	Refer to Section 2.9.2 and Appendix A
6. Clarify the adopted traffic distribution for development-generated traffic.	The travel questionnaire survey responses from car	Refer to Section 7.2

DPIE RFI	Response to RFI	Report Reference
	users have been assessed to determine the likely routes that they take to travel to/from the school.	
7. Prepare a 2036 Ultimate + Improvements scenario to demonstrate future intersection performance where aspirational mode shift targets (i.e. 10% shift) are not met.	The requested additional scenario has been included in this assessment.	Refer to Section 7.3.4
8. Consider preparing 2023 Stage 1 + Improvements and 2030 Stage 2 + Improvements scenarios to inform required staging of upgrades	The proposed roadworks will be undertaken as part of the Stage 1 works. The requested additional scenarios have been included in this report.	Refer to Section 7.3.4

1.5 Consultation

The traffic assessment findings and proposed infrastructure upgrades discussed in the previous versions of this report have been presented to Waverley Council (Council) on 11 November 2019. Council supports the following upgrade options as part of the proposed development:

- seagull intersection treatment at York Road-Queens Park Road
- introduction of a left-turn slip lane on York Road (west) at York Road-Baronga Avenue
- upgrade of the existing pedestrian refuge on York Road to a formal pedestrian crossing

TTPP has prepared concept drawings for the above proposed upgrade options which are attached in this report. It is noted however that these proposed upgrades are still subject to detailed design.

In addition, this TAIA has since been updated to incorporate the comments and matters identified in the Department of Planning, Industry and Development (DPIE) assessment dated 05 February 2020, 30 July 2020 and 22 September 2020. The comments include submissions received during the formal exhibition period from State and local government agencies, authorities and members of the public, as well as the comments from the independent peer review of the previous submission of TAIA report.

1.6 References

In preparing this report, reference has been made to the following:

- an inspection of the site and its surrounds
- traffic surveys undertake by Trans Traffic Survey
- Moriah College Transport Traffic and Parking Plan
- Waverley Development Control Plan 2012 (DCP)
- Waverley Local Environmental Plan 2012 (LEP)
- Roads and Maritime Guide to Traffic Generating Developments
- other documents as referenced in this report.

1.7 Report Structure

The remainder of this report is set out as follows:

- Chapter 2 examines the existing conditions surrounding the school
- Chapter 3 presents a summary of the existing travel and parking patterns of the school
- Chapter 4 discusses findings of the road safety audit undertake at the school
- Chapter 5 outlines the proposed school expansion
- Chapter 6 assesses the parking implications of the proposal
- Chapter 7 assesses the transport implications arising from the proposed development
- Chapter 8 outlines travel demand management measures to minimise the impact on general traffic and bus operations
- Chapter 9 presents a summary of the traffic assessment and implications of the proposal.

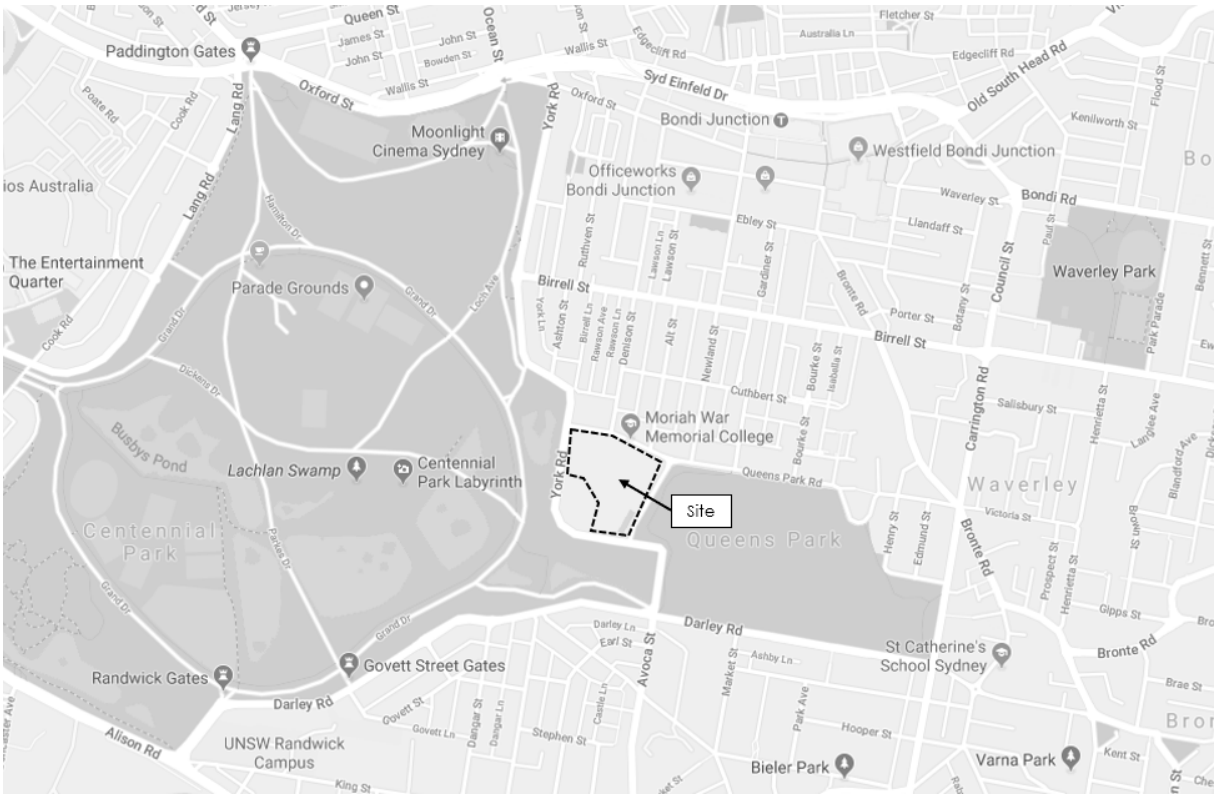
2 Existing Conditions

2.1 Site Description

The site is legally described as 101 York Road, Queens Park/ Lot 22 DP 879582, 1 Queens Park Road, Queens Park/ Lot 1 DP 701512 and 3 Queens Park Road, Queens Park/ Lot 3 DP 701512.

The location of the site and surrounding road network are shown in Figure 2.1.

Figure 2.1: Site Location

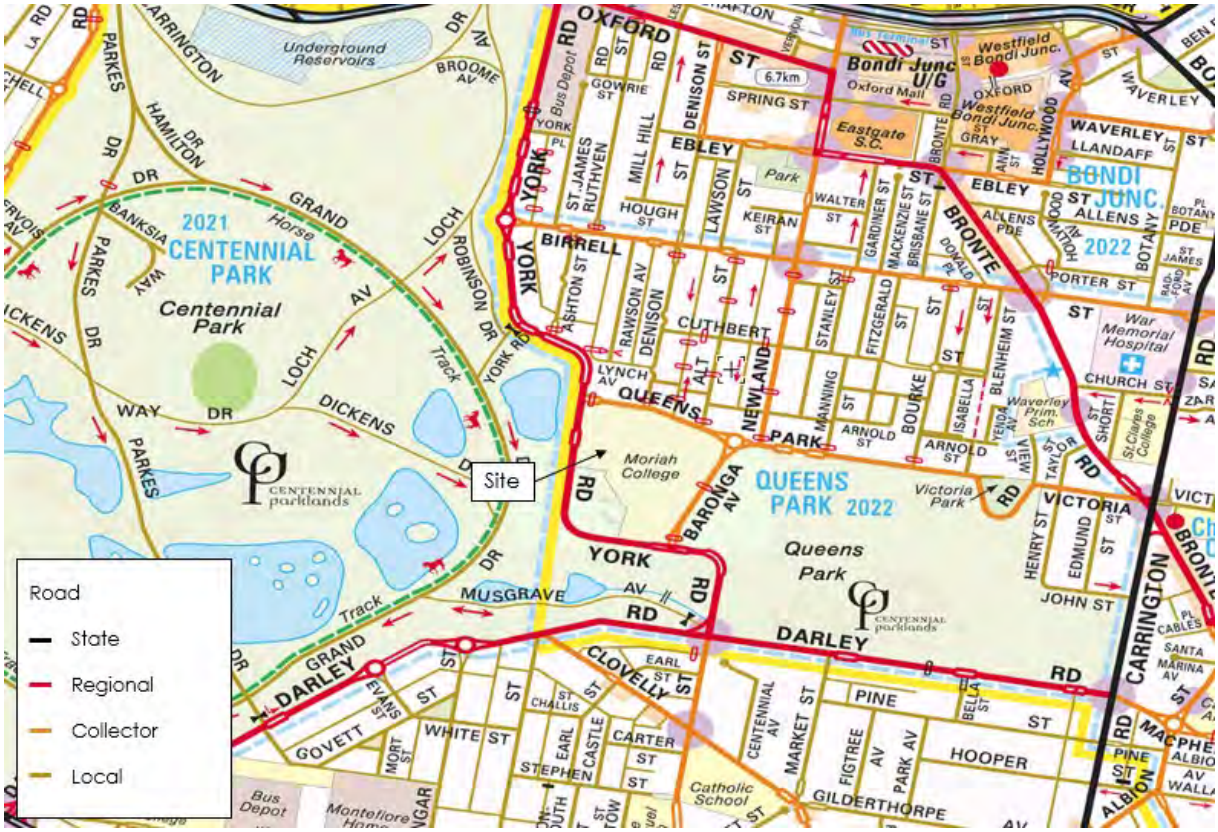


Source: Google Maps Australia

2.2 Surrounding Road Network

The site is surrounded by a network of regional and local roads, including York Road, Baronga Avenue and Queens Park Road along the south-west, west and north boundaries respectively, as shown in Figure 2.2. A brief description of these roads is provided below.

Figure 2.2: Surrounding Road Network Map



Source: Street Directory Australia

2.2.1 York Road

York Road is a regional road, generally aligned in a north-south direction between Oxford Street / Syd Einfield Drive and Darley Road. This road travels along the south and west boundary of the site. It is generally configured as a two-way, two-way road across a 11.5-wide road carriageway (kerb to kerb). Kerbside car parking provided on some section of the north end of the road.

Vehicle access to the primary school car park and high school and Early Learning Centre car park is provided off York Road via Gate 1 and Gate 4 respectively. The road has a posted speed limit of 50km/h, with 40km/h school zone restrictions that apply between 8:00am and 9:30am and between 2:30pm and 4:00pm Monday to Friday.

2.2.2 Baronga Avenue

Baronga Avenue functions as a local collector road, generally aligned in a north-south direction between York Road and Queens Park Road. This road is configured as a two-way, two-lane road, with kerbside car parking provided on either side of the road across a varied 7.0m to 11.5-wide road carriageway (kerb to kerb). This road predominately services school bus services, along the east boundary of the site, as well as local traffic in the area. No vehicle access to the school is currently provided off Baronga Avenue.

It has a posted speed limit of 50km/h, with 40km/h school zone restrictions that apply between 8:00am and 9:30am and between 2:30pm and 4:00pm Monday to Friday.

2.2.3 Queens Park Road

Queens Park Road functions as a local collector road, aligned in an east-west direction between York Road and Victoria Street. This road is configured as a two-way, two-lane road across an approx. 12.3-wide road carriageway (kerb to kerb). Kerbside car parking is generally provided on both sides of the road between York Road and Bourke Street. Vehicle access to the north car park is provided off Queens Park Road via Gate 2.

A dedicated cycle lane is also provided on the north side of the road between York Road and Bourke Street. The road has a posted speed limit of 50km/h, with 40km/h school zone restrictions that apply between 8:00am and 9:30am and between 2:30pm and 4:00pm Monday to Friday.

2.3 Current Site Provisions and Vehicle Access

The College currently provides education services from early learning through Kindergarten to Year 12. At present, the College currently has 1,535 enrolled students and 286 staff (as of 2019). The approved student population cap of the entire College (including the early learning centre) is 1,680 students.

The existing and approved student enrolment numbers are summarised in Table 2.1.

Table 2.1: Existing and Approved Student Enrolment Numbers

Facility	Existing Enrolments	Approved Cap
Primary	595	1,600
Secondary	860	
Early Learning Centre (ELC)	80	80
TOTAL	**1,535**	**1,680**

The site currently provides three (3) vehicle access gates along the York Road and Queens Park Road. No vehicle access gates are provided off Baronga Avenue.

The existing vehicle access gates are referred to as Gate 1, 2 and 4 and provide vehicle access to the existing three car parks along the York Road (west), Queens Park Road and York Road (south) site frontages respectively, as shown in Figure 2.3. It is noted that there is an existing Gate 3 on Baronga Avenue, but this is restricted as pedestrian access only.

Figure 2.3: Existing Vehicle Access Arrangements

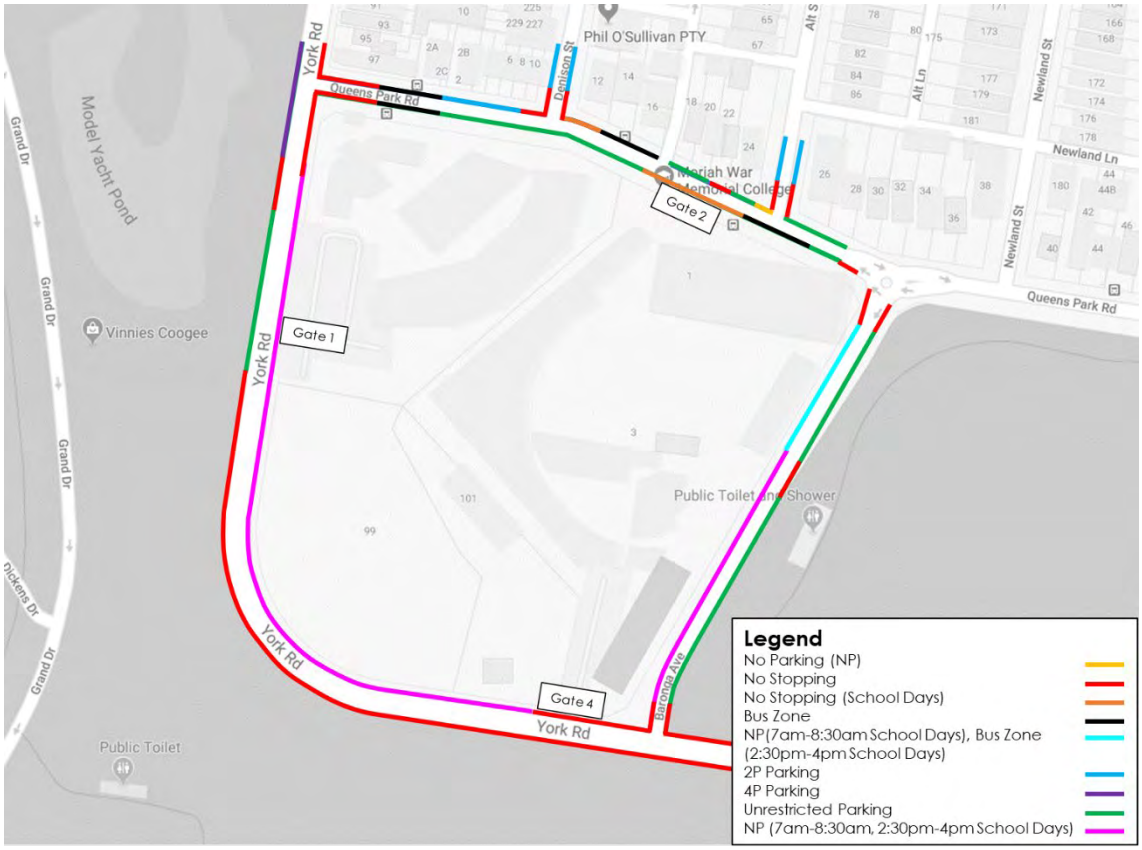
Source: nearmap Australia

2.4 Parking Provisions

2.4.1 On-Street Parking

The existing on-street parking restrictions within the immediate vicinity of the site are shown in Figure 2.4.

Figure 2.4: On-Street Parking Restrictions



Source: Google Maps Australia

Based on site observations, parking demand within the immediate vicinity of the site is high, generally with limited spare parking vacancies available during the day.

2.4.2 On-Site Parking

The site currently provides a total of 195 on-site car parking spaces, including a total of 158 staff car parking spaces.

The existing car parking breakdown is outlined in Table 2.2 (overleaf).

Table 2.2: Existing Car Parking Provision

Car Park Area	Number of Car Spaces							Other Parking	
	Staff	Visitors	Accessible (Staff)	Contractors/ Canteen (Staff)	College Vehicles	ELC Parent Drop off	Total	Motorbike	Buckle-up Bay
Queens Park Road (Gate 2)	17	2	1	0	0	0	20	0	0
York Road (west)l – Gate 1	69	5	2	1	4	0	81	0	2
York Road (south) – Gate 4	66	0	1	1	3	13	84	3	0
Total	**152**	**7**	**4**	**2**	**7**	**13**	**185**	**3**	**2**

Based on on-site observations, the existing car parks are generally well utilised throughout the day, with limited spare parking capacity available. All visitor car parking spaces are managed by the College through a booking system prior to their arrival to ensure appropriate allocation of the visitor spaces accordingly. All visitors are required to present a copy of the pre-registered barcode provided by the College when accessing the site.

Similarly, all parent drop-off/pick-up activities are managed by the College such that all parents are required to pre-register their vehicle to obtain a "number" to be displayed on their vehicle when accessing the designated drop off/pick up area. This system is used to enable site personnel to assist children in and out of the vehicle as efficiently as possible.

2.5 Existing Drop-Off/Pick-Up Activities

All parents dropping off and/or picking up their child at the College are required to display their designated "number" on their vehicle to access the drop-off/pick-up areas. Site personnel are deployed in the designed drop-off/pick-up areas to call out to students and assist them in and out of the vehicle to ensure safe and efficient operations during school peak periods.

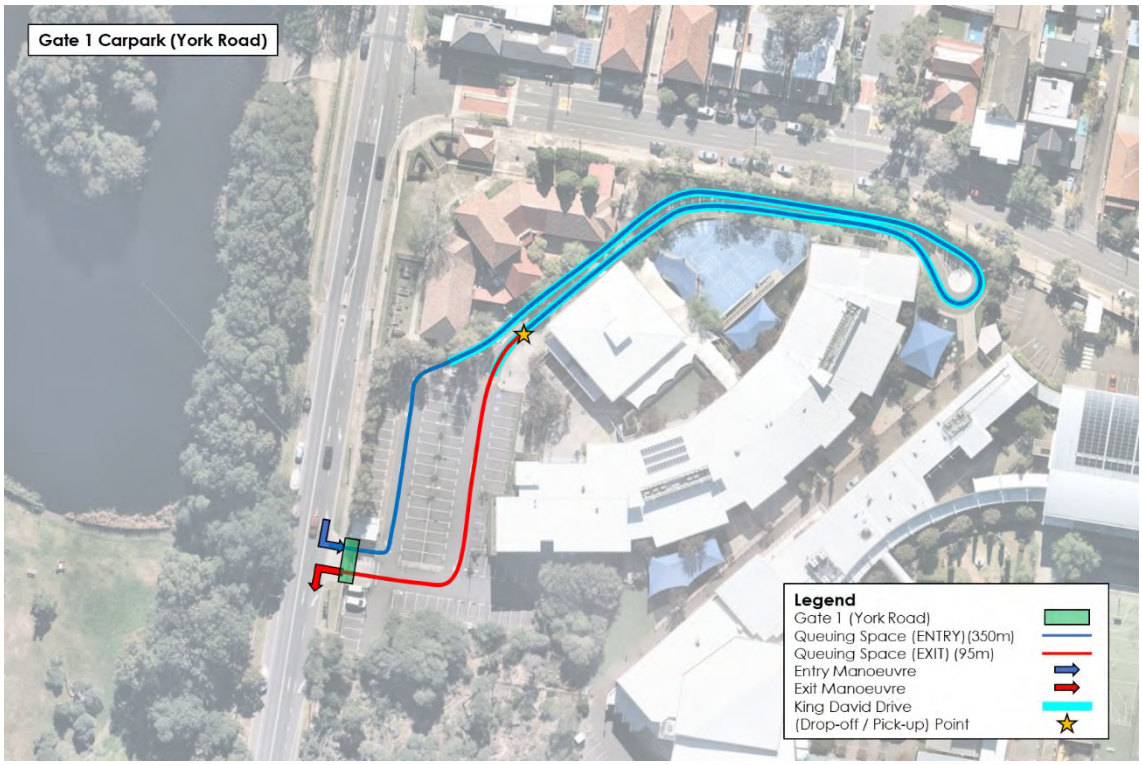
2.5.1 Primary School

The College currently provides a designated drop-off/pick-up area (referred to as 'Go With the Flow' arrangements) within the site to cater for drop-off/pick-up activities associated with the primary school. All vehicles are required to display their pre-registered "number" on their vehicle to access the site. Approximately six parking bays are currently provided and managed by site personnel to assist children in and out of the vehicle.

Access to the designated drop-off/pick-up area is provided directly off York Road via Gate 1.

Queues on approach to the designated parking bays are wholly stored within the site via a loop road through the car park, as shown in Figure 2.5. This loop road can cater approximately 48 vehicles.

Figure 2.5: GWTF vehicle paths at Gate 1 Carpark, York Road



Based on site observations, the existing drop-off/pick-up arrangements generally operates satisfactory (i.e. queues are wholly stored within the site). It is however noted that parents do experience delays when accessing the loop road, particularly during the PM peak, but this is not unusual for schools.

The existing AM and PM school peak internal queue lengths within the site are outlined in Figure 2.6 and Figure 2.7 respectively.

Figure 2.6: GWTF AM Peak Queue Lengths

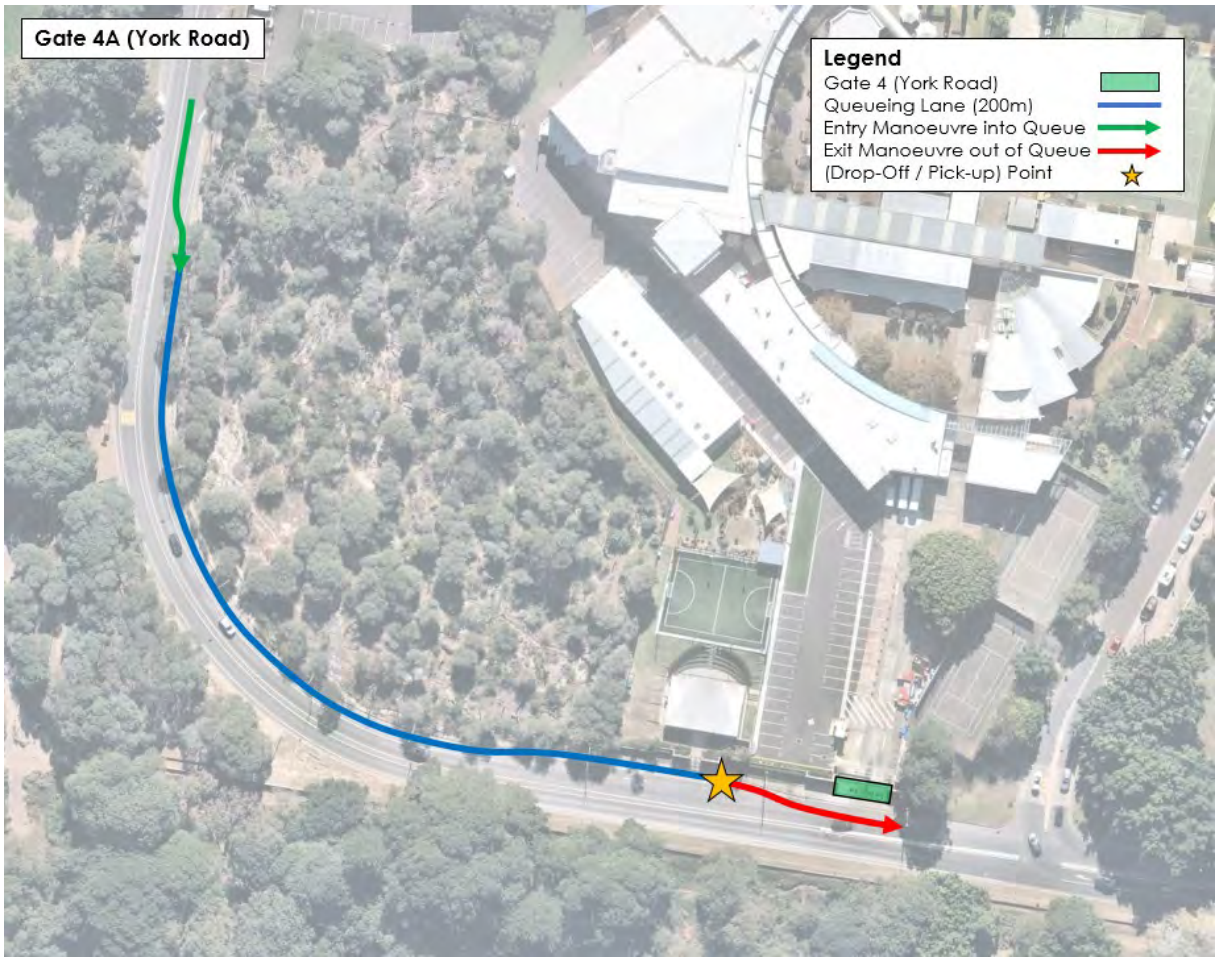
Figure 2.7: GWTF PM Peak Queue Lengths

On this basis, it is clear that there is some spare capacity to accommodate additional vehicles within the site, if required.

2.5.2 Secondary School

An indented parking area is provided on York Road, along the south boundary of the site. This area is used for drop-off/pick-up activities associated with the College. It is understood that drop-off/pick-up activities associated with the secondary school are undertaken within this zone, as shown in Figure 2.8.

Figure 2.8: Gate 4 York Road pick-up arrangements



The indented parking area accommodates about four to five vehicles at any one time. Queues on approach to this parking area are stored within the shoulder lane on York Road, which extends up to Gate 1.

Based on site observations, drop-off/pick-up activities are carried out at the front of queue, where vehicles must wait until they are at the front of the queue before dropping off / pick up their child. Queues were observed overspill into the shoulder lane during the school PM peak period (less so during the school AM peak).

The existing observed school PM queue length is shown in Figure 2.8.

Figure 2.9: York Road Drop-Off/Pick-Up Area (PM)

2.5.3 Early Learning Centre (ELC)

All drop-off/pick-up activities associated with the ELC are undertaken within the designed car parking bays within the south car park off York Road via Gate 4. At present, a total of 13 spaces are designated for ELC drop-off/pick-up activities between 7:00am and 6:00pm.

TTPP understands that the majority of ELC drop-off and pick-up activities occur between 7:30am and 8:30am in the morning and between 4:30pm and 6:00pm in the evening.

The existing ELC designated parking areas are shown in Figure 2.10.

Figure 2.10: Existing ELC designated parking area

2.5.4 Baronga Avenue

Baronga Avenue currently provides existing indented No Parking during school hours along the west side of the road, as shown in Figure 2.11. This area is generally used by school buses during the school PM peak period. Based on site observations, some drop-off/pick-up activities associated with the College were undertaken along Baronga Avenue during the school AM peak, with no more than four vehicles queued along this zone at any one time.

Figure 2.11: Gate 3 (Baronga Avenue) Drop-off arrangements

Figure 2.12 shows a photograph of the traffic conditions during the AM at 7:35am along Baronga Avenue.

Figure 2.12: Gate 3 (Baronga Avenue) Drop-off area

2.6 Public Transport Facilities

The site is generally serviced by bus services operated by Sydney Buses. The nearest railway station is located more than 1.2km north of the site at Bondi Junction.

Bus route 357 travels along Queens Park Road and York Road within the immediate vicinity of the site and provides connectivity between Mascot and Bondi Junction via Kingsford and Randwick. There are a number of bus stops servicing bus route 357 along the north boundary of the site along Queens Park Road, generally operating every 15 minutes during peak periods and every 30 minutes during off-peak periods.

In addition, several bus stops are present along Clovelly Road with the closest bus stop located about 650m or eight-minute walk from the College. This stop is served by bus routes 338, 339, X39 and X40 which provide connectivity between Clovelly and Sydney CBD.

The College currently has arrangements with the State Transit Authority for special school bus services to deliver and pick up students in the morning and afternoon. In addition to this, the College provides shuttle bus services between the Bondi Junction/Maroubra area and the site. This shuttle bus services (Moriah Shuttle Bus, MSB) supplements the regular bus services each school day. Students can be collected from any bus stop along the designated route.

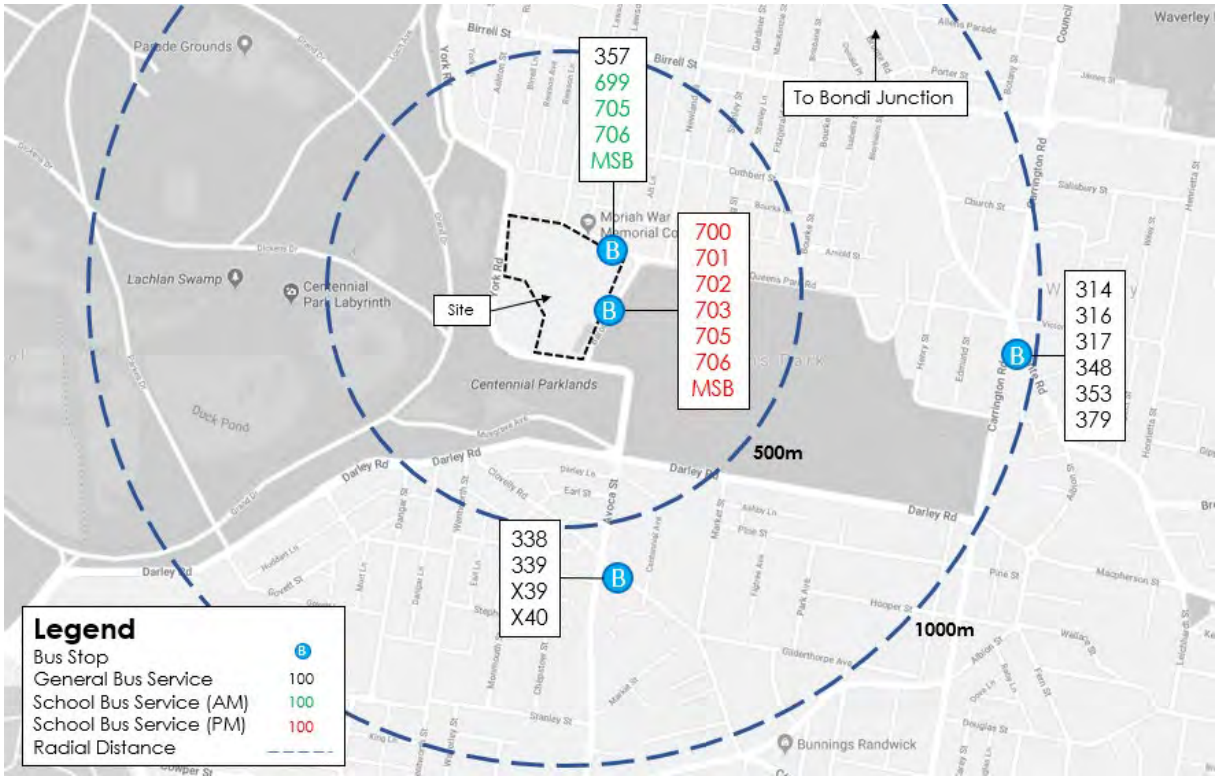
A summary of the existing bus services and their associated frequencies within the immediate vicinity of the site is provided in Table 2.3.

Table 2.3: Existing Bus Services and Associated Frequencies

Route Number	Description	Bus Stop Location	Frequency
357	Mascot to Bondi Junction via Kingsford	Queens Park Road (Gate 2), Queens Park	15 minutes (peak) 30 minutes (off-peak)
699E	Watsons Bay to Moriah College Queens Park	Queens Park Road (Gate 2), Queens Park	1 service (AM)
700E	Moriah College Queens Park to Watsons Bay	Baronga Avenue	1 service (PM)
701E	Moriah College Queens Park to Watsons Bay	Baronga Avenue	1 service (PM)
702E	Moriah College Queens Park to Dover & New South Head Roads	Baronga Avenue	3 services (PM)
703E	Moriah College Queens Park to Bondi Junction	Baronga Avenue	2 services (PM)
704E	Moriah College Queens Park to Maroubra Beach	Baronga Avenue	2 services (PM)
705E	Moriah College Queens Park to Dover Heights	Baronga Avenue	1 service (AM) 3 services (PM)
706E	Moriah College Queens Park to South Head Cemetery	Baronga Avenue	2 services (AM) 4 services (PM)
MSB (pick-up)	Moriah College to Bondi Junction	Baronga Avenue	1 service (PM)
MSB (drop-off)	Maroubra Beach to Moriah College	Queens Park Road (Gate 2), Queens Park	1 service (AM)
338	Clovelly to Central Railway Square	Clovelly Road	10 minutes (peak) 30 minutes (off-peak)
339	Clovelly to City Gresham Street	Clovelly Road	15 minutes (peak) 30 minutes (off-peak)
X39	Clovelly to City Martin Place (Express Service)	Clovelly Road	10 minutes (one direction per peak period only)
X40	Clovelly to City Museum (Express Service)	Clovelly Road	2-6 minutes (one direction per peak period only)

Figure 2.13 presents a map of the key existing bus stops and services within the immediate vicinity of the site. This map also indicates additional bus services located 500 to 1,000m from the site.

Figure 2.13: Bus Services within Close Proximity of Site



Source: Google Maps Australia
**MSB = Moriah Shuttle Bus*

Figure 2.14 shows existing school buses lining up along Baronga Avenue in the school PM peak.

Figure 2.14: Buses queueing along shoulder lane on Baronga Avenue (school PM)

Based on on-site observations, the existing bus services generally operate below capacity, with spare capacity available.

The existing bus bays on Baronga Avenue can accommodate some nine buses at any one time (four buses north of the pedestrian crossing and five buses south of the pedestrian crossing). No more than four buses were observed at any one time during the school AM and PM peak periods. The frequency and operation of school bus services were observed to be busier during the school PM peak compared to the school AM peak. Notwithstanding this, the existing bus bay was observed to operate satisfactory, with spare capacity to accommodate additional bus services if required.

2.7 Pedestrian and Cyclist Infrastructure

Well established pedestrian facilities are provided within the immediate vicinity of the site. Sealed pedestrian footpaths are provided along the site frontage, with dedicated pedestrian facilities provided along York Road, Queens Park Road and Baronga Avenue in the form of pedestrian refuges or pedestrian (zebra) crossings. At present, these pedestrian facilities are heavily used during school peak drop off and pick up times.

The existing pedestrian access gates and pedestrian facilities surrounding the site are shown in Figure 2.15.

Figure 2.15: Existing Pedestrian Facilities

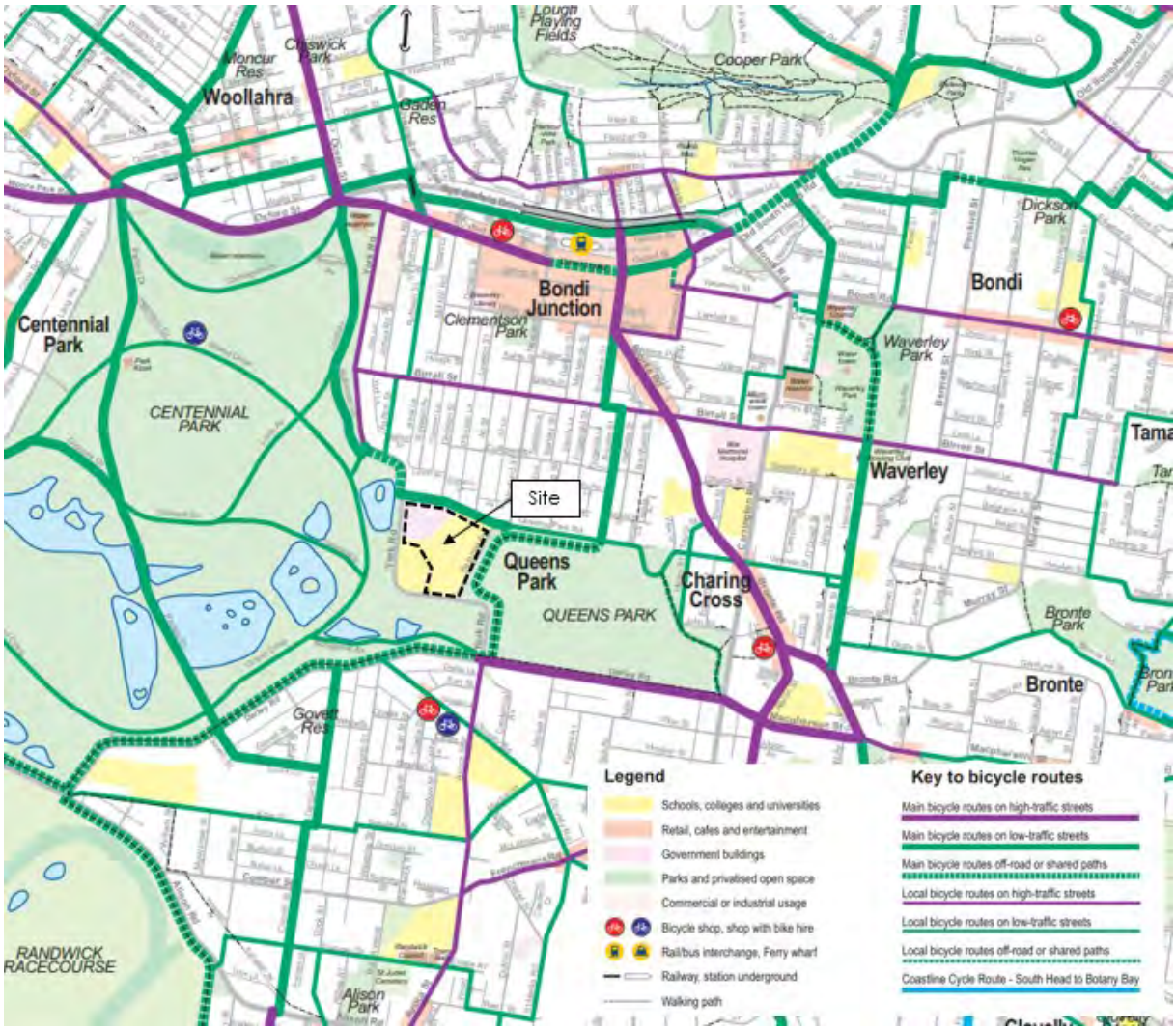
Source: nearmap Australia

Further to this, a good cycle network is currently provided within the immediate vicinity of the site. A dedicated on-road cycle path is currently provided on the north side of Queens Park Road, which provides good connectivity to the wider cycle network in the area.

Off-road shared paths are also present along Darley Road (east of York Road) and through Queens Park (between Darley Road and Queens Park Road).

The existing cycle network is shown in Figure 2.16.

Figure 2.16: Cycle Paths within the Vicinity of the Site



Source: Extract of the Waverley Bike Plan, Waverly Council

It is noted that a new pedestrian and cycleway along Darley Road, between York Road and Carrington Road, is set to commence construction in 2020. The new cycleway will connect to the existing shared path on Queens Park.

The proposed route of the cycleway is shown in Figure 2.17.

Figure 2.17: Proposed Darley Road Cycleway Route

Source: Waverley Council

2.8 Existing Traffic Volumes

2.8.1 Site Access Counts

Traffic surveys were conducted at the existing site access gates and on Tuesday, 28 June 2019 between 7:00am and 9:00am and between 2:00pm and 4:00pm to determine the existing traffic generated by the school during school peak periods. Traffic volumes were also collected to record vehicles accessing to/from the designated drop-off/pick-up areas along York Road and Baronga Avenue.

A summary of the existing traffic volumes generated at the site access gates and York Road and Baronga Avenue drop-off/pick-up areas is provided in Table 2.4.

Table 2.4: Vehicle Counts at School Access Gates

Gate	AM (7:00am-9:00am)			PM (2:00pm-4:00pm)		
	In	Out	Two-Way	In	Out	Two-Way
York Road west access (Gate 1)	321	297	618	148	165	313
Queens Park Road access (Gate 2)	14	19	33	0	15	15
York Road south access (Gate 4a)	110	55	165	39	58	97
York Road (on-street)	89	88	177	86	80	166

Baronga Avenue (on-street)	79	79	158	27	30	57
Total	**613**	**538**	**1,151**	**300**	**348**	**648**

Table 2.4 indicates at the existing site currently generates 1,151 trips and 648 trips during the AM and PM surveyed periods respectively. These trips are associated with staff and parent drop-off/pick-up activities. Further to this, it is expected that minimal traffic would generally be generated outside of typical school peak periods based on the existing use of the site. The exception to this would however be pick-up drips associated with the ELC which generally occur between 4:30pm and 6:00pm.

Notwithstanding this, it is noted that Baronga Avenue was used more frequently during the AM period compared to the PM period by cars. During the PM period after 3:00pm, the majority of trips made to/from Baronga Avenue was by bus. One bus was recorded during the AM survey period and 21 buses (or 42 two-way bus movements) during the PM survey period.

2.8.2 Intersection Counts

Traffic counts were conducted on Tuesday, 28 June 2019 between 7:00am and 9:00am and between 2:00pm and 4:00pm at the following key locations:

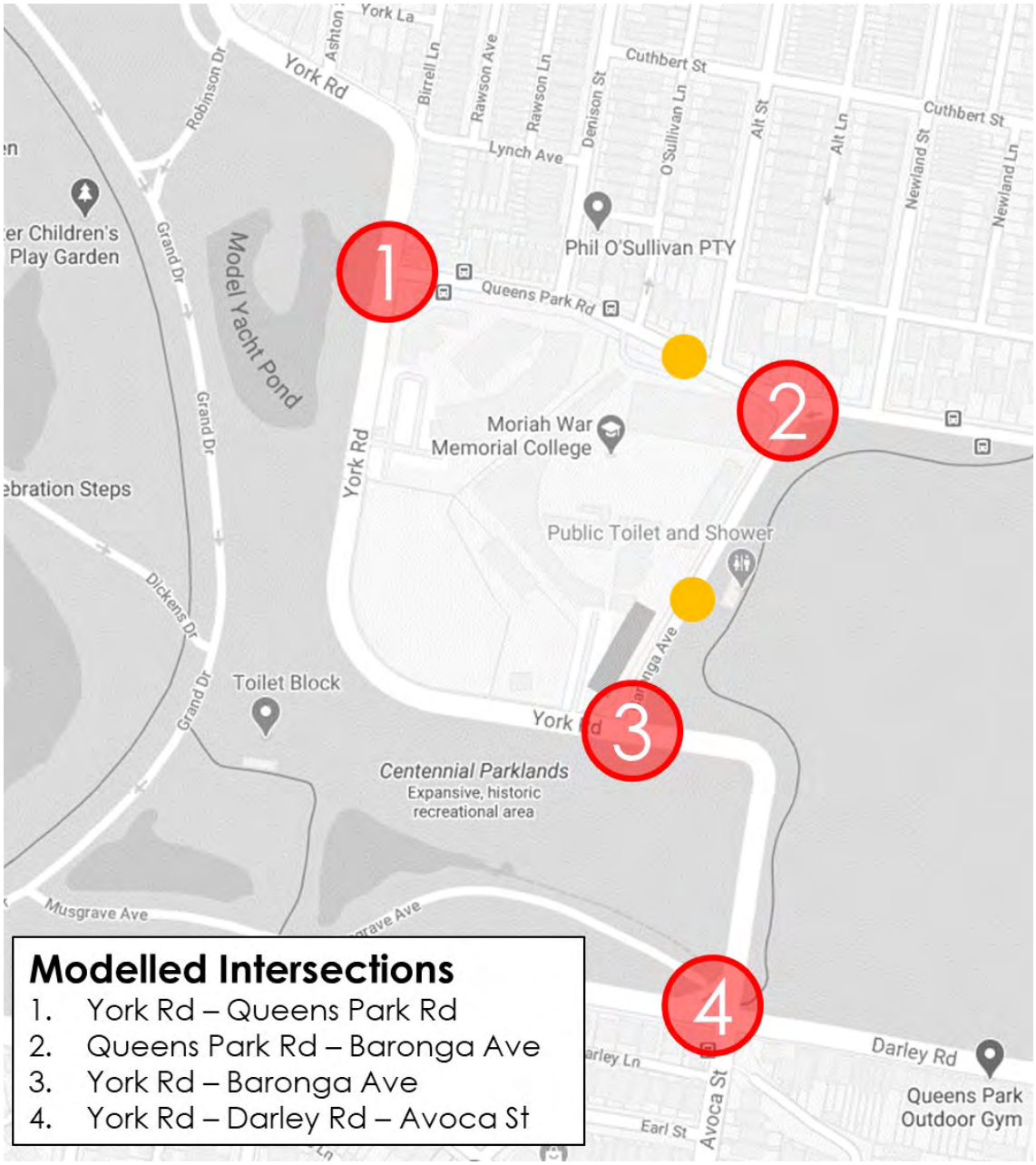
- York Road-Queens Park Road
- Queens Park Road-Baronga Avenue
- York Road-Baronga Avenue

In addition, the following additional traffic surveys were undertaken on 22 October 2020 from 7:00am to 9:00am, and from 2:00pm to 4:00pm:

- Classified vehicle and pedestrian counts at the following intersections:
  - York Road-Darley Road-Avoca Street
  - York Road-Baronga Avenue (for comparison with previous Pre-Covid 19 counts)
- Pedestrian crossing movements at the following locations:
  - Baronga Avenue zebra crossing
  - Queens Park Road zebra crossing

The surveyed locations are outlined in Figure 2.18. Red circles indicate the surveyed intersections whilst yellow circles correspond to the surveyed pedestrian crossings.

Figure 2.18: Traffic Survey Locations



Source: Google Maps Australia

The existing peak hours at the surveyed intersections were identified as follows:

- AM Peak: 7:45am-8:45am
- PM Peak: 3:00pm-4:00pm.

York Road-Baronga Avenue intersection has been included in the October 2020 survey scope to compare traffic volumes and ascertain any differences due to impacts of COVID-19 and HSC exams. A comparison of May 2019 and October 2020 traffic volumes at York Road-Baronga Avenue intersection is presented in Table 2.5.

Table 2.5: York Road-Baronga Avenue Traffic Volume Comparison

Approach	AM Peak			PM Peak		
	May 2019	Oct 2020	Difference	May 2019	Oct 2020	Difference
Baronga Avenue	413	477	+64	401	506	+105
York Road East	1,441	1,499	+58	1,049	1,118	+69
York Road West	813	947	+134	846	937	+91
Total	**2,667**	**2,923**	**+256**	**2,296**	**2,561**	**+265**

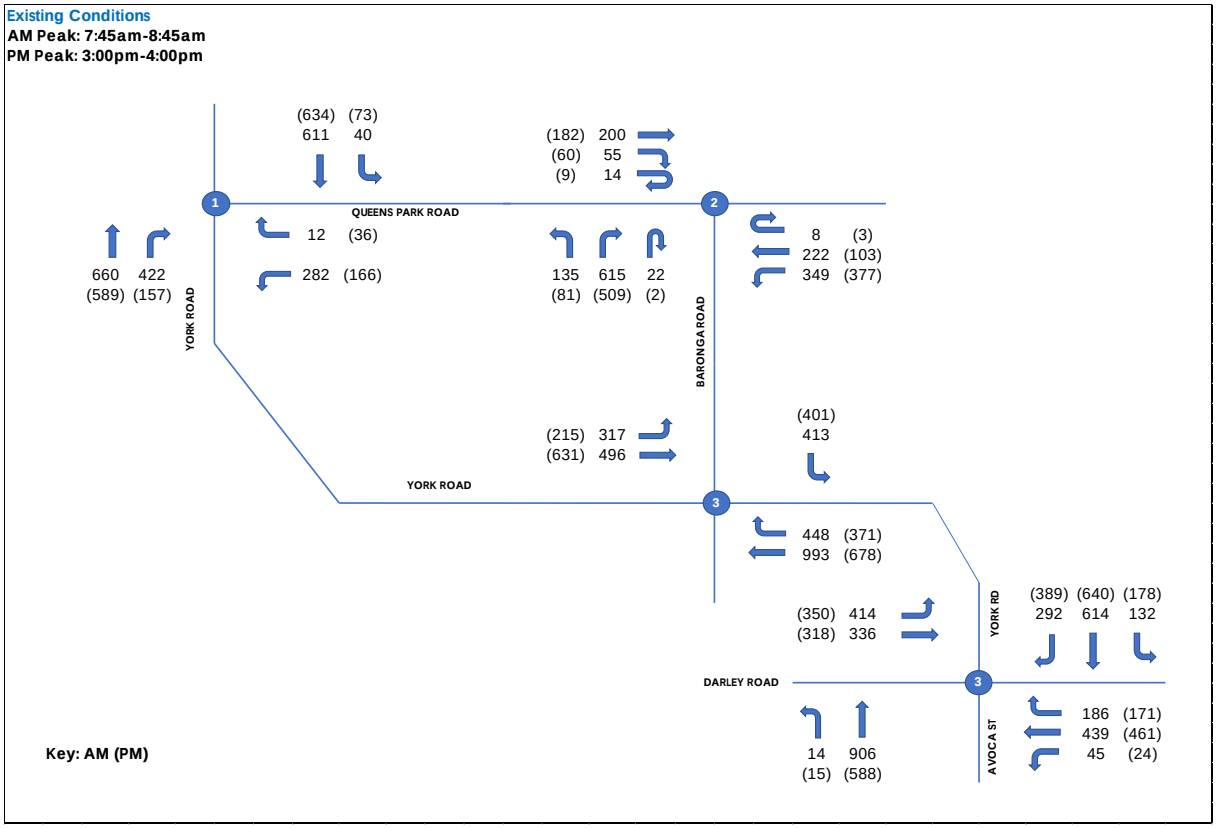
Based on the above, the traffic volumes obtained from the October 2020 survey are generally higher as compared with the May 2019 model. It indicates that there is no significant decrease in traffic volumes due to COVID-19 and HSC exams.

This 2020 increase in traffic volumes is likely to be linked with more people who preferred to be dropped off than to use public transport due to potential health issues associated with COVID-19. Based on the comparison of data collected by Transport for NSW, there was a decrease of about 50% patronage on Sydney buses between September 2019 and September 2020 (https://www.transport.nsw.gov.au/data-and-research/passenger-travel/bus-patronage/bus-patronage-monthly-comparison).

Therefore, the unaffected May 2019 traffic volumes on the three key intersections have been maintained in this assessment.

The existing intersection peak hour traffic volumes are shown in Figure 2.19.

Figure 2.19: Existing Peak Hour Traffic Volumes



2.9 Existing Intersection Performance

Intersection capacity analysis has been undertaken using SIDRA Intersection 8 modelling software to ascertain the intersection performance of the key intersections surrounding the site as outlined in Section 2.8.2.

2.9.1 Level of Service Criteria

Roads and Maritime uses level of service as a measure of performance for all intersection types operating under prevailing traffic conditions. The level of service ranges from LoS A to LoS F which is directly related to the average intersection delays experienced by traffic travelling through the intersection. LoS A to LoS D are considered to provide acceptable performance with LoS A providing better performance than LoS D. LoS D is the long-term desirable level of service. LoS E and LoS F are considered to provide unsatisfactory intersection performance.

At signalised intersections, the average delay is the volume weighted average of all movements. For roundabouts and priority (give way and stop sign) controlled intersections, the average delay relates to the worst movement.

Table 2.6 shows the criteria that SIDRA Intersection adopts in assessing the LoS.

Table 2.6: Roads and Maritime LoS Criteria

Level of Service (LoS)	Average Delay per vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Sign
A	Less than 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	Near capacity	Near capacity, accident study required
E	57 to 70	At capacity; at signals incidents would cause excessive delays. Roundabouts require other control mode	At capacity, requires other control mode.
F	Greater than 70	Unsatisfactory, requires additional capacity	Unsatisfactory, requires other control mode or major treatment

2.9.2 Existing Model Calibration

An existing traffic model has been developed using the peak hour traffic volumes presented in Figure 2.19. The model is configured as a network of surveyed key intersections to incorporate impacts of queue pushback from adjacent intersections and pedestrian movements at nominated crossing locations.

The models have been calibrated based on the observed traffic queue lengths on the survey date. A calibration report has been prepared documenting the methodology undertaken in developing the existing base model. The calibration report is presented in Appendix A.

2.9.3 Modelling Results

A summary of the school AM and PM school peak hour traffic modelling results is provided in Table 2.7.

Table 2.7: Existing Peak Hour Intersection Analysis Results

Intersection	Control	AM Peak (7:45am-8:45am)			PM Peak (3pm-4pm)		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	65	E	27	39	C	7
Queens Park Rd-Baronga Ave	Roundabout	13	A	72	10	A	30
York Rd-Baronga Ave	Priority	46	D	109	61	E	117
York Rd-Darley Rd-Avoca St	Signals	55	D	266	48	D	218

**The above reported results for priority-controlled intersections and roundabout relate to the worst movement of the intersection*

Based on the results presented above, the York Road-Queens Park Road intersection operates at LoS E during the AM Peak, while the York Road-Baronga Avenue Road intersection operates at LoS E in the PM peak with delays experienced by right-turn movements from Queens Park Road onto York Road in the AM peak and the right-turn movement from York Road to Baronga Avenue in the PM peak.

The signalised intersection of York Road-Darley Road-Avoca Street is already operating at capacity, with LoS almost tipping to LoS E in the AM peak. Long queues are observed at York Road, Avoca Street and Darley Road east approaches.

It is however noted that the overall intersection operation (i.e. LoS based on the weighted average delay of all movements and not based on the delay of the worst movement) at the key surrounding priority-controlled intersections operate satisfactory at LoS A during both AM and PM peak periods.

3 Existing Travel Patterns

3.1 Travel Questionnaires

Online questionnaires were distributed to school staff and parents via email in June 2019 to determine their travel mode choice and behaviour.

The ratio of completed surveys in relation to the student and staff population is shown in Table 3.1. The sample size obtained is considered adequate for this study.

Table 3.1: Survey Response Rates

Group	Total Number of Students/ Staff	Total Number of Surveys Completed	Ratio of Completion
Primary Students	595	512	86%
Secondary Students	860	496	58%
Staff	286	75	26%

A summary of existing staff and student travel modes is provided in Table 3.2.

Table 3.2: Summary of Existing Staff and Student Travel Modes

Mode	Staff	Primary Students		Secondary Students	
		Arrival	Departure	Arrival	Departure
Car Driver (no passengers)	71%	-	-	6%	6%
Car Driver (with passenger)	22%	-	-	0%	0%
Dropped Off (only passenger)	1%	22%	16%	19%	10%
Dropped Off (with other passengers)	1%	64%	41%	42%	19%
Walk	1%	2%	1%	1%	2%
Public Bus	3%	1%	3%	1%	2%
School Bus	0%	11%	39%	31%	61%
Train	1%	0%	0%	0%	0%
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Based on the travel survey questionnaires, the following average car occupancy numbers were recorded:

- staff: 2.6 persons per vehicle (including driver)

- primary school: 2.65 passengers per vehicle
- secondary school: 2.62 passengers per vehicle

A summary of the staff and student arrival and departure travel patterns is shown in Figure 3.1 and Figure 3.2 respectively.

Figure 3.1: Student and Staff Arrival Times

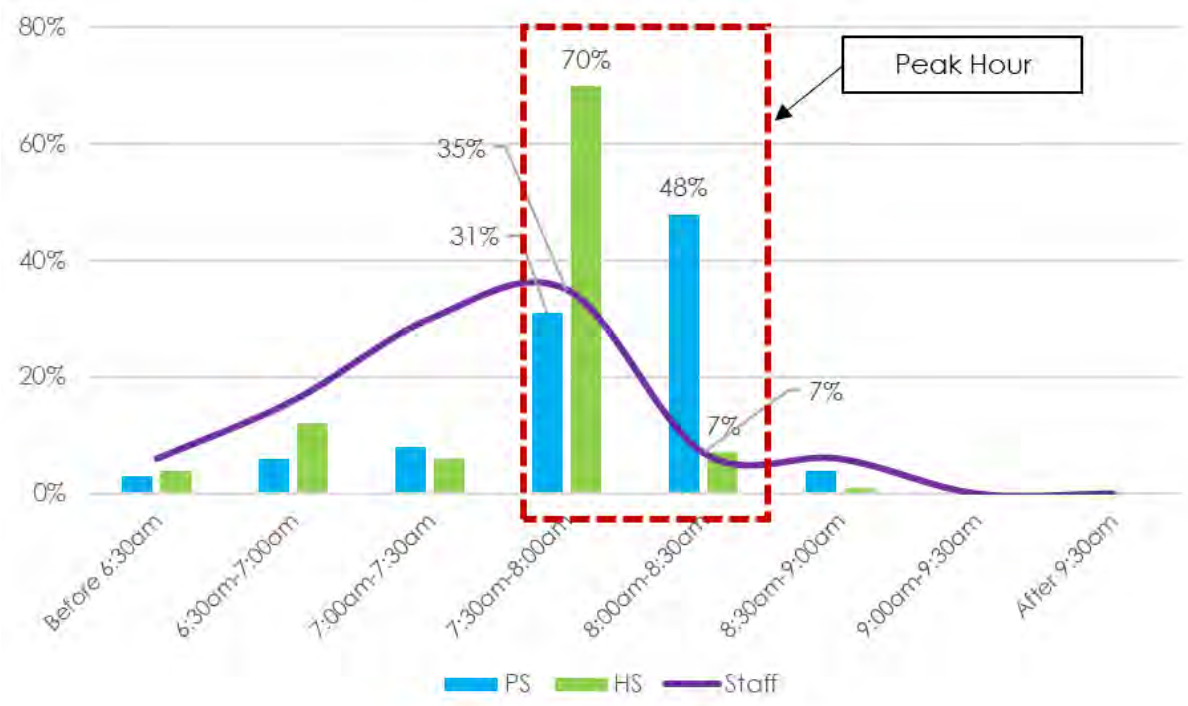
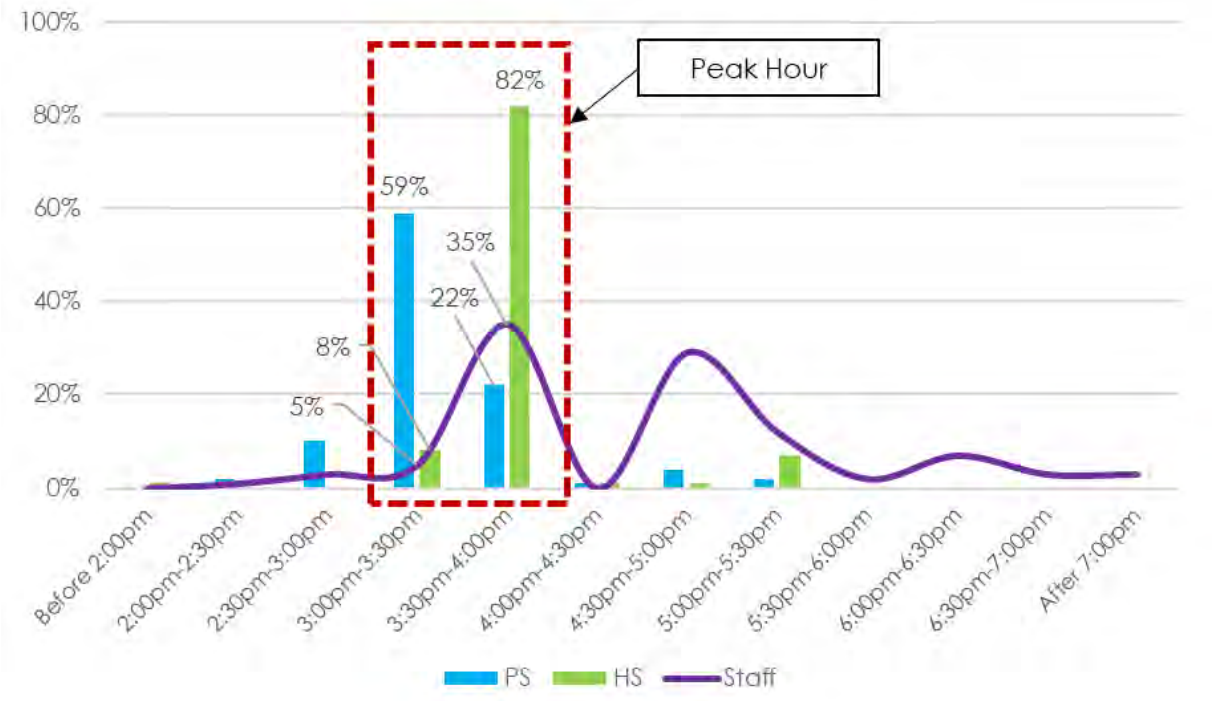


Figure 3.2: Student and Staff Departure Times



Based on the above, it is clear that the overall school arrival patterns peak between 7:30am and 8:30am, where staff and student arrival times generally coinciding between 7:30am and 8:00am. Similarly, the overall school departure patterns generally peak between 3:00pm and 4:00pm, with the majority of staff generally leaving after student departure times (i.e. after 4:00pm).

3.2 Early Learning Centre

Information provided by the Client indicates that approximately 97 per cent of children are currently driven to/from the ELC. The remaining 3 per cent walk with their parent or caretaker as they live close by.

In addition to this, the following information has provided:

- Existing ELC children population: 80
- ELC children with at least one sibling in the Centre: 14
- ELC children with at least one sibling in Primary School: 40
- ELC children with at least one sibling in High School: 1
- ELC children who have parent(s) working in the School: 1

Based on the above, this equates to an average of 1.37 passengers per vehicle.

3.3 Existing Mode Trip Generation

Based on the travel questionnaires undertaken and information provided by the Client, an estimate of the existing site traffic generation for each mode is shown in Table 3.3.

Table 3.3: Estimated Existing Staff and Student Trips for Each Mode (Existing Enrolments)

Mode	Staff (286)	ELC (80)	Primary Students (595)		Secondary Students (860)	
			Arrival	Departure	Arrival	Departure
Car Driver (no passengers)	203	0	0	0	51	52
Car Driver (with passenger)	62	0	0	0	0	0
Dropped Off (only passenger)	3	24	131	95	163	86
Dropped Off (with other passengers)	3	54	381	244	361	164
Walk	3	2	12	6	9	17
Public Bus	9	0	6	18	9	17
School Bus	0	0	65	232	267	525
Train	3	0	0	0	0	0
Total	**286**	**80**	**595**	**595**	**860**	**861**

Table 3.3 indicates that the existing site could generate circa 990-1,436 car trips, 26-28 walking trips, 24-44 public bus trips, 332-757 school bus trips and three train trips.

Further to this, Table 3.4 estimates the anticipated site traffic generation for each mode under the existing approved school population cap of the College of 1,600 students and 80 ELC children based upon the existing travel survey questionnaire responses outlined above. It is noted that the current primary and secondary student enrolment proportions of the College have been adopted for the purpose of this assessment.

Table 3.4: Estimated Staff and Student Trips for Each Mode (Existing Approved School Cap)

Mode	Staff (286)	ELC (80)	Primary Students (654)		Secondary Students (946)	
			Arrival	Departure	Arrival	Departure
Car Driver (no passengers)	203	0	0	0	57	57
Car Driver (with passenger)	62	0	0	0	0	0
Dropped Off (only passenger)	3	24	144	105	180	94
Dropped Off (with other passengers)	3	54	419	268	397	180
Walk	3	2	13	6	9	19
Public Bus	9	0	6	20	9	19
School Bus	0	0	72	255	294	577
Train	3	0	0	0	0	0
Total	**286**	**80**	**654**	**654**	**946**	**946**

Table 3.4 indicates that the existing approved capacity of the College could theoretically generate about 1,054-1,545 car trips, 27-31 walking trips, 25-48 public bus trips, 365-832 school bus trips and three train trips.

3.3.1 Peak Hour Trip Generation Rate

It is noted that arrival and departure trips are generally distributed during the AM and PM periods as not all trips associated with the school occur within one hour as some students are dropped off or picked up earlier or later than school bell times.

Based on the travel questionnaire surveys, the following peak hour proportions for each school group was identified:

- Staff: AM Peak – 42% and PM Peak – 40%
- Primary school: AM Peak – 79% and PM Peak – 81%
- Secondary school: AM Peak – 42% and PM Peak – 19%

In addition to this, it is understood based on information provided by the Client that the majority of ELC drop-off generally occurs between 7:30am and 8:30am whilst pick-up occurs between 4:30pm and 6:00pm. Therefore, it is assumed that all drop-off activities associated with the ELC school would occur within the same one hour in the AM Peak (i.e. 100 per cent of trips occurring in the AM Peak), while all pick-up activities would occur outside of the PM Peak (i.e. 0 per cent of trips occurring in the PM Peak).

On this basis, a summary of estimated existing peak hour traffic generation estimates is presented in Table 3.5.

Table 3.5: Existing Peak Hour Traffic Generation Estimates

Group	Population	AM Peak Trips			PM Peak Trips			AM Trip Rate	PM Trip Rate
		In	Out	Two Way	In	Out	Two Way		
ELC Children	80	27	27	54	0*	0*	0*	0.67	-
Primary School Students	595	217	217	434	152	152	304	0.73	0.51
High School Students	860	246	232	478	134	151	285	0.56	0.33
Staff	286	113	0	113	0	108	110	0.40	0.38

** Trips generated by ELC would occur outside the PM peak hour and has been excluded in the above assessment*

3.4 Roads and Maritime Traffic Generation Studies at Schools (2014)

Roads and Maritime has collected recent traffic generation data from schools across NSW. A total of 22 schools were surveyed over a typical school day, including metropolitan primary and secondary schools.

A comparison of the trip generation rates calculated above, and the Roads and Maritime survey results is provided in Table 3.6.

Table 3.6: Comparison of Person and Vehicle Trip Generation Rates

	AM Vehicle Trip per Student	PM Vehicle Trip per Student
Primary School		
Roads and Maritime Survey Data (Average)	0.67	0.53
Moriah Primary School	0.73	0.51
Secondary School		
Roads and Maritime Survey Data (Average)	0.51	0.28
Moriah Secondary School	0.56	0.33

Table 3.6 indicates that the vehicle trip generation rates for the College are slightly higher compared with the average Roads and Maritime trip rates, but slightly less during the AM peak for the primary school.

4 Road Safety Aspects

4.1 Audit Findings and Recommended Actions

In accordance with SEARs requirement (no. 7), GHD undertook a road safety audit of the existing conditions surrounding the site. This is documented in their Existing Conditions Road Safety Audit report dated August 2019. A summary of the recommended actions to address the road safety audit findings is provided in Table 4.1.

Table 4.1: Summary of Recommended Actions

Item	Finding	Risk	Category	Recommended Action
3.1	Visibility of signage	High	Traffic Signs	Whilst it is generally Council's responsibility to maintain existing line-marking and signage within the LGA, it is recommended that the School consider contributing to the identified existing faded line-marking and signage as part of the proposed development.
3.2	Linemarking / Delineation deterioration	Medium	Delineation	
3.3	Deterioration of pavement	Medium	Road Pavement	
3.4	York Road – Pedestrian Refuge	-	-	It is recommended that traffic surveys be undertaken to determine whether the existing pedestrian refuge meets the RMS warrants for a children's crossing or pedestrian crossing. If so, Council/RMS approval would be required to upgrade the existing pedestrian refuge. Refer to Section 4.1.1 for further details.
3.4.1	Pedestrian Refuge Layout	High	Pedestrian Infrastructure	
3.4.2	Pedestrian refuge crossing operation	Intolerable	Pedestrian Infrastructure	
3.5	Baronga Avenue – Raised pedestrian crossing	-	-	It is recommended that the existing pedestrian crossing on Baronga Avenue be extended across the kerbside travel lane. A kerb build-out is also recommended to remove the dual through lanes and improve visibility on approach to the pedestrian crossing.
3.5.1	Change in priority at Baronga Avenue pedestrian crossing	High	Pedestrian Infrastructure	
3.5.2	Dual through travel lanes – visibility obstruction	High	Pedestrian Infrastructure	
3.5.3	Lighting	High	Lighting	It is recommended that the School liaise with relevant authorities to address the identified lighting issues.
3.6	Gate 4A pick up operation	-	-	It is recommended that the Applicant educate all staff and parents to address the identified road safety concerns (i.e. do not queue earlier than the designated pick-up times and do not walk on the roadway).
3.6.1	Gate 4A vehicle queue	Medium	Network Effects / Roadside Hazard	
3.6.2	Traffic controller safety	High	Traffic Management and Operation	
3.6.3	Safety to waiting people with the vehicle queue	High	Traffic Management and Operation	
3.7	Gate 4 access operation	Medium	Traffic Management and Operation	

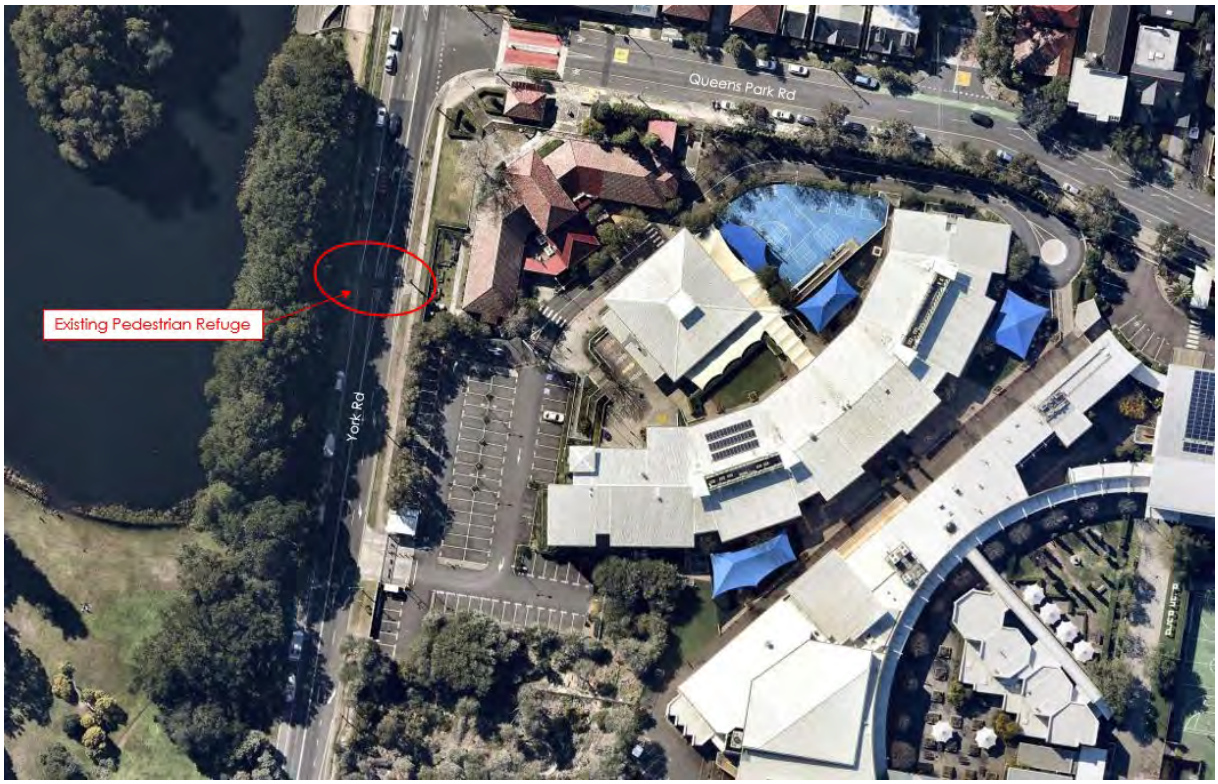
Item	Finding	Risk	Category	Recommended Action
3.8	Baronga Avenue – Existing barrier end treatment	Medium	Roadside Hazard	Whilst it is generally Council's responsibility to maintain existing line-marking and signage within the LGA, it is recommended that the Applicant consider contributing to the upgrade/maintenance of the identified existing barrier end treatment as part of the proposed development.
3.9	Temporary traffic management devices	Low	Traffic Management and Operation	It is recommended that any temporary traffic management devices used on-site are upgraded as per current standards (i.e. cones with reflective bands).

The GHD Road Safety Audit is provided in Appendix B.

4.1.1 York Road Pedestrian Surveys

TTPP commissioned pedestrian volume counts at the existing York Road pedestrian refuge between 6am and 6pm on Tuesday 17 September (heavy rain) and Friday 20 September 2019 (light showers). The location of the pedestrian counts is circled in red in Figure 4.1.

Figure 4.1: Location of Pedestrian Counts



A summary of the pedestrian volume counts is provided in Figure 4.2. It is also noted that the majority of pedestrians crossing at the existing pedestrian refuge were generally found to be students.

Figure 4.2: Summary of York Road Pedestrian Counts

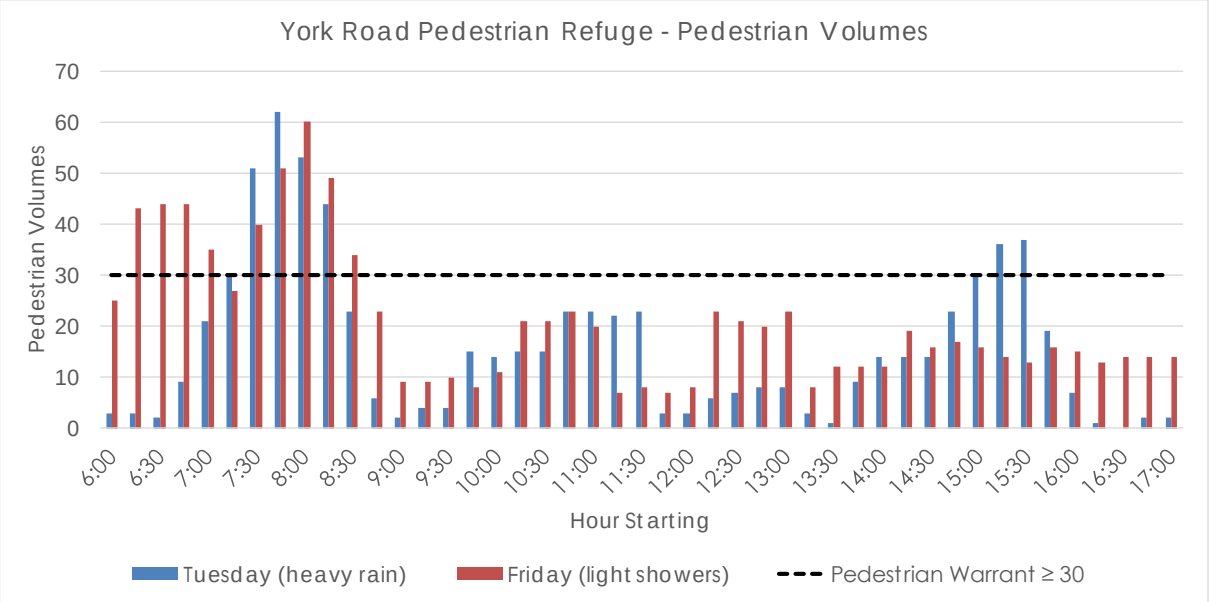
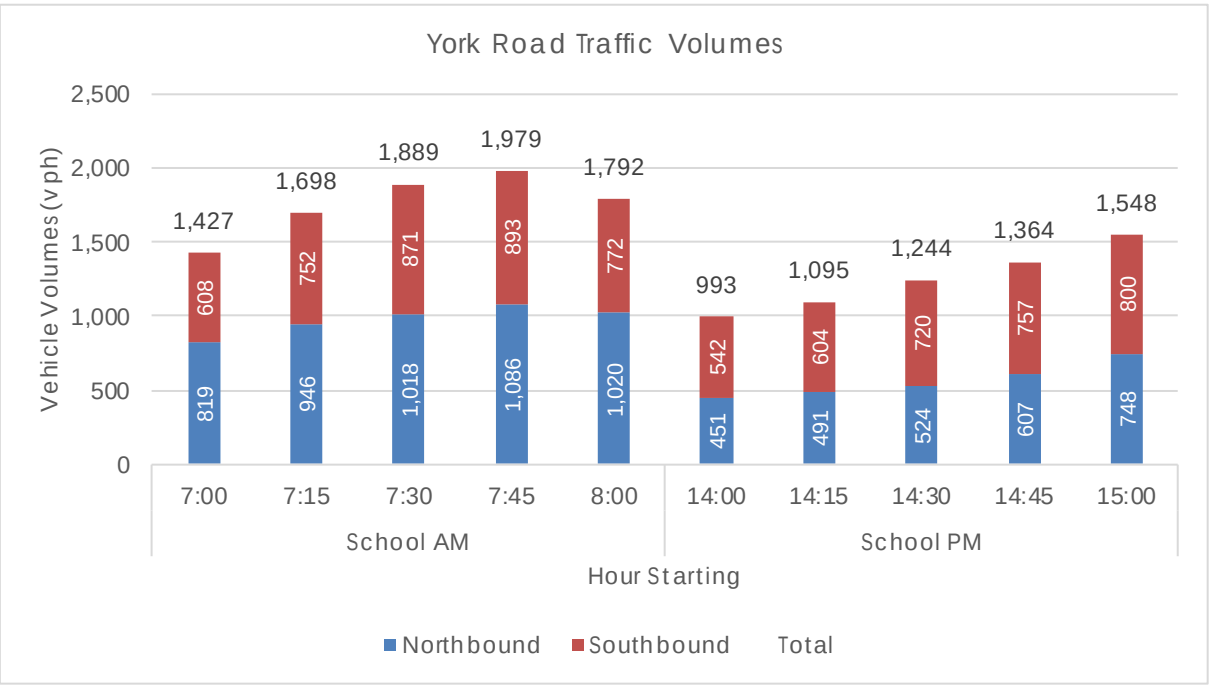


Figure 4.2 indicates that there are generally more than 30 pedestrians crossing at the York Road pedestrian refuge before and after school hours (i.e. between 6:15am and 9:30am and between 3:00pm and 4:30pm). Based on the pedestrian counts, the peak number of pedestrians crossing at the York Road pedestrian refuge is some 62 pedestrians between 7:45am and 8:45am.

Similarly, based on the traffic volume surveys as outlined in Section 2.8, a summary of the traffic volumes along York Road, near the pedestrian refuge, is shown in Figure 4.2.

Figure 4.3: Summary of York Road Traffic Volumes



4.1.1.1 Pedestrian Crossing Warrants

Children's Crossing

The RMS practice for locating Children's Crossings on local lightly trafficked roads are determined by:

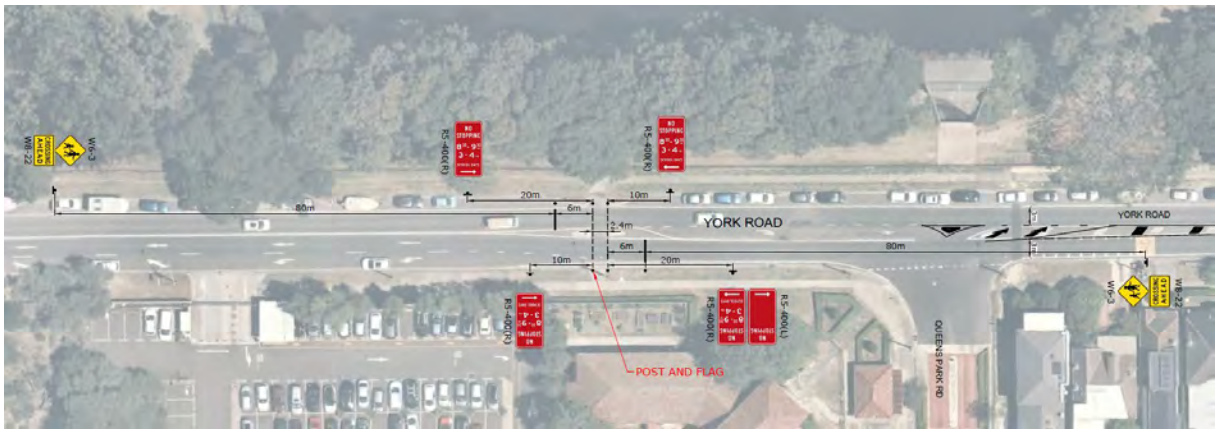
- Traffic one hour duration immediately before and after school hours the traffic flow exceeds 50 vehicles per hour in each direction
- One hour duration immediately before and after school hours 20 or more children cross the road within 20m of the proposed crossing location
- The 85% percentile speed of traffic must not exceed 60km/h one hour before or after school hours.

Based on the above, a Children's Crossing is considered suitable at the existing pedestrian refuge on York Road.

Based on the road safety audit findings outlined above, it is recommended that the existing pedestrian refuge on York Road be upgraded to a Children's Crossing.

A concept plan of a proposed Children's Crossing is shown in Figure 4.4.

Figure 4.4: Proposed Concept Plan of Children's Crossing



Pedestrian (Zebra) Crossing

Roads and Maritime Services also sets out numerical warrants for the implementation of pedestrian (zebra) crossings, which is also referred to in Austroads Guide to Traffic Management Part 8 Section 7.5.6.

Roads and Maritime's Supplement to Australian Standard 1742 Roads and Maritime stipulates the following warrants for a pedestrian crossing:

- Reduced Warrant (for sites used predominately by children and by aged and impaired pedestrians).

If the crossing is used predominately by school children, is not suitable site for a Children's Crossing and in two counts of one hour duration immediately before and after school hours:

a) P ≥ 30

AND

b) V ≥200

A pedestrian (zebra) crossing may be installed.

A summary of the existing pedestrian and vehicular flow per hour on York Road before and after school hours is provided in Table 4.2: .

Table 4.2: Thursday Pedestrian Crossing Assessment – Special Warrant

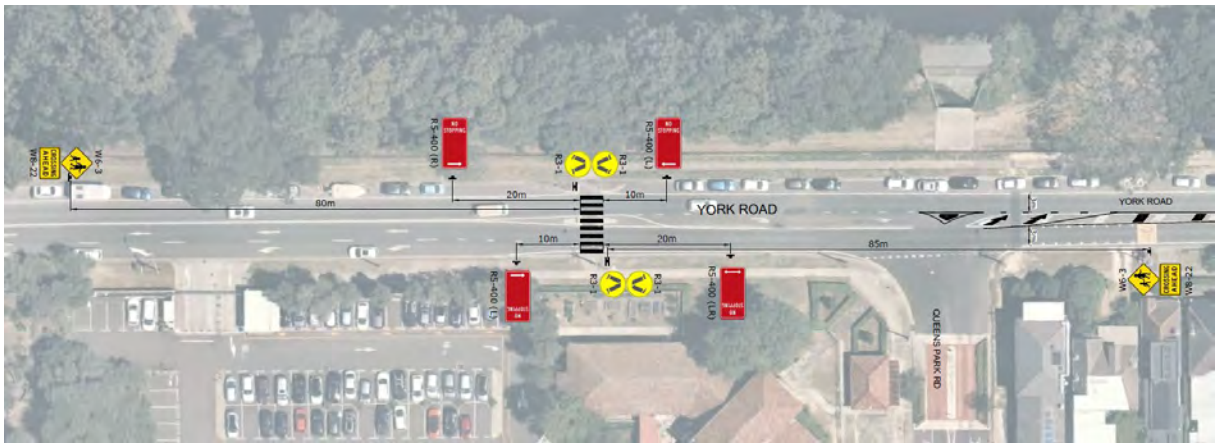
Time	Pedestrian flow per hour (P)		Vehicular flow per hour (V)	
	P	≥ 30	V	≥ 200
7:45am-8:45am	62	Yes	1,979	Yes
3:30pm-4:30pm	37	Yes	1,319	Yes

On the above basis, a formal pedestrian (zebra) crossing is also considered suitable at the existing pedestrian refuge on York Road.

Furthermore, based on the pedestrian counts outlined in Figure 4.2, there is generally a constant stream of pedestrians crossing at the existing pedestrian refuge on York Road. On this basis, the provision of a formal pedestrian (zebra) crossing at this location will provided pedestrians with right of way at all times when crossing York Road, which is considered beneficial from a pedestrian safety perspective.

The concept plan of a formal pedestrian (zebra) crossing is shown in Figure 4.5.

Figure 4.5: Proposed Concept Plan of Pedestrian (Zebra) Crossing



In recognition of the above, it is recommended that the existing pedestrian refuge on York Road be upgraded to either a Children's Crossing or formal pedestrian (zebra) crossing.

Indeed, there are also locations where zebra crossings are provided but also operate as School Crossings at AM and PM peak periods. This upgrade will address the road safety audit finding for items 3.4, 3.4.1 and 3.4.2 outlined in Table 4.1.

As discussed in Section 1.4, the proposed upgrade options of the existing pedestrian refuge on York Road into formal pedestrian crossing have been presented to Waverley Council on 11 November 2019, which Council has supported. The proposed upgrade options are still subject to detailed design prior to implementation.

4.2 Road and Personal Safety (CPTED Principles)

A number of potential design measures should be considered to maintain road and personal safety in line with the Crime Prevention through Environmental Design (CPTED) principles of surveillance, access control and space and activity management.

It is however noted that the College currently provides the following design measures:

- provision of appropriate lighting at pedestrian access points, parking areas and footpaths
- provision of Closed Circuit Television (CCTV) to maximise surveillance opportunities out of school hours
- provision of boom gates, secured access control devices to regulate and restrict vehicle movements to/from the schools for authorised personnel only
- provision of security on pedestrian access points to the school to reduce opportunities for perpetrators to enter the school undetected
- provision of crime awareness training with staff to identify any potential suspicious behaviour and reporting procedures within or near the schools
- provision of a mixture of long-term and short-term car parking to enhance natural/passive surveillance of the area, where practical.

In addition to this, the following design measures should be considered as part of the proposed development in consultation with relevant authorities such as Council:

- provision of safety signage in different languages around designated drop-off and pick-up areas to enhance awareness for a larger audience and thus mitigate the risk of any safety issues around the schools
- trim or remove foliage blocking sight lines and ensure there is minimal obstruction to lines of sight near key pedestrian facilities and pedestrian access points
- ensure regular maintenance is in place including rubbish removal, repair of light fixtures, trimming of vegetation and/or regular patrols, where feasible.

4.3 Other Potential Safety Upgrade Measures

The following potential upgrade works to pedestrian facilities are included in the preliminary assessment of DPIE:

- extension of existing pedestrian crossing in Baronga Avenue across the layby, and
- consideration of future local area traffic management (LATM) measures

Baronga Avenue Pedestrian Crossing Extension

A raised zebra crossing is currently provided along Baronga Avenue in front of the existing Gate 3. It is noted that an indented No Parking zone is present along the west side of the road which is generally used by school buses during the school afternoon peak period. This layby results to a gap between the footpath and the pedestrian crossing facility.

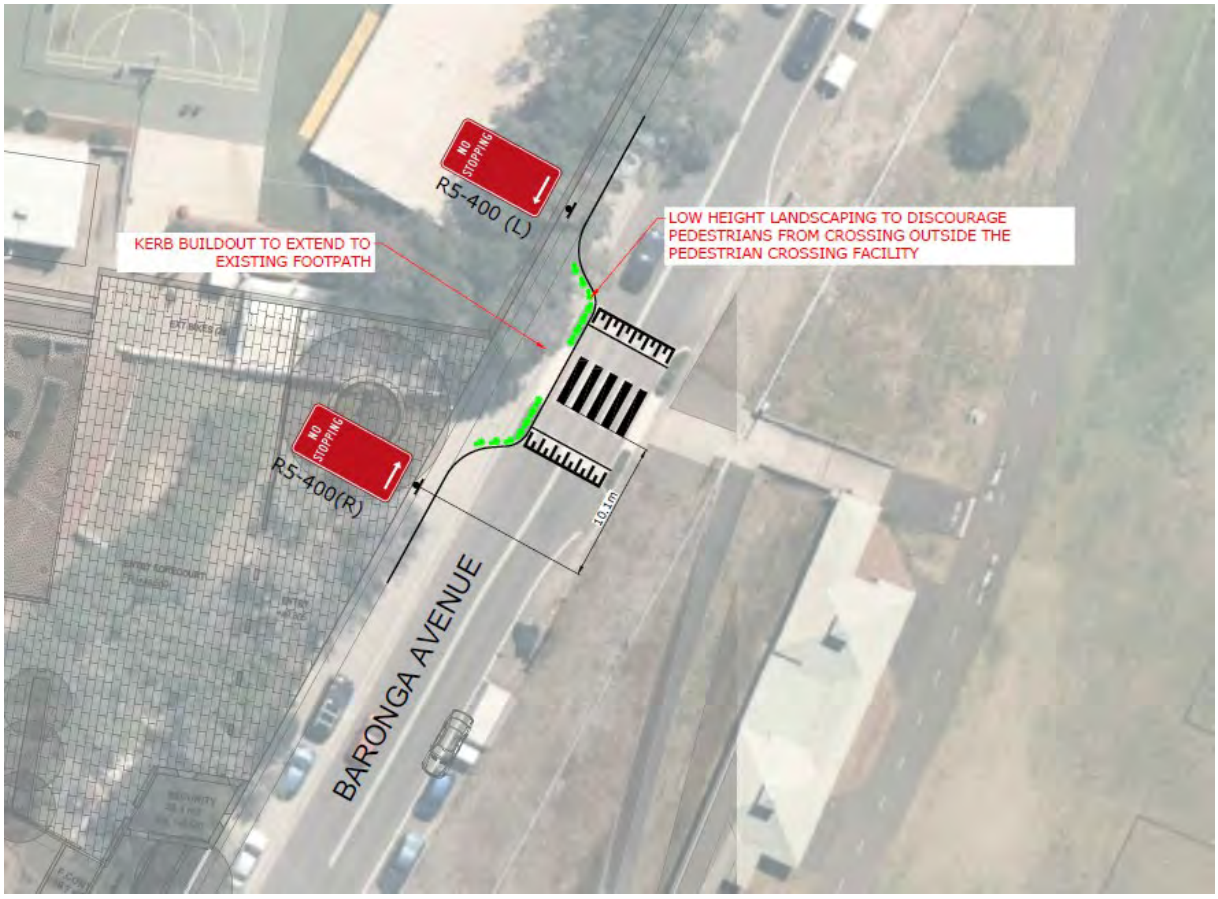
This gap presented a safety concern with pedestrians as it could allow a vehicle to pass through. As such, Council has suggested to extend the existing pedestrian crossing across the layby.

Figure 4.7 shows the proposed concept design of Baronga Avenue pedestrian crossing extension. The design involves reconstruction of the kerb buildouts to connect with the existing footpath and the extension of zebra crossing markings. This design would provide continuous path for pedestrians across Baronga Avenue and would stop vehicles from travelling in between the pedestrian crossing and footpath.

Figure 4.6: Existing Baronga Avenue Pedestrian Crossing

In addition, it is recommended to investigate potential upgrade works on the connection of the Baronga Avenue pedestrian crossing to the existing cycleway on Queens Park. This would improve connectivity of the College with the surrounding existing and future cycling routes.

Figure 4.7: Proposed Concept Design of Baronga Avenue Pedestrian Crossing Extension



Local Area Traffic Management

Local area traffic management (LATM) generally involves provision of traffic calming devices on local streets to create safer and more pleasant streets in local areas. The main objective of LATM is to reduce traffic volumes and travel speeds in local streets.

Since the traffic through the road network surrounding the College cannot be directly attributed to the school traffic only, it is suggested that Council should investigate this separately to determine the appropriate traffic calming measures required in the area and whether they are required.

It is noted that provision of LATM could have positive or negative consequences. Negative impacts could include increased travel time for drivers and frustration for residents (e.g. noise, signs), possible discomfort for bus passengers and re-routing of buses if lane narrowing is proposed, increased response times for emergency and service vehicles, and diversion of traffic from one street to another.

Consultation with residents and other agencies such as State Transit Authority should be undertaken to adequately discuss the positive and negative implications of proposed LATM plans.

5 Proposed Development

5.1 Proposal Description

The development proposal seeks approval to deliver a new STEAM and ELC building to facilitate new teaching spaces across two key stages. The proposed site layout plan is shown in Figure 5.1 and Figure 5.2.

Figure 5.1: Proposed Site Layout Plan – Upper Ground

Source: FJMT Architects

Figure 5.2: Proposed Site Layout Plan – Lower Ground

Source: FJMT Architects

The proposal seeks to increase the number of primary and secondary students from the existing approved population cap of 1,600 to 1,840 students (i.e. increase of 240 students). It is however noted that the existing school population (as of 2019) is 1,455 students. In addition to this, it is proposed to increase the number of ELC students from 80 to 130 children.

It is noted that the proposed student numbers would generally be incrementally staged each year up to Year 2036. It is expected that the potential student number incremental increase would be as shown in Figure 5.3.

Figure 5.3: Proposed Student Numbers

Year	ELC	K-12	Total	Difference
Current Student Cap	80	1,600	1,680	-
Proposed 2023 (completion of stage 1)	80	1,760 (+160)	1,840 (+160)	Additional 160 students in K-12
Proposed 2030 (completion of Stage 2)	130 (+50)	1,800 (+40)	1,930 (+90)	Additional 40 students in K-12 Additional 50 ELC students
Proposed 2036+	130	1,840 (+40)	1,970 (+40)	Additional 40 students in K-12

Additionally, the proposed estimated changes to the student and staff numbers across each stage are summarised in Table 5.1. For the purpose of this assessment, it has been assumed that the future primary and secondary school student population would increase as per existing proportions for each stage. Furthermore, the staff numbers for each stage has been interpolated based on the existing approved and proposed ultimate staff numbers for the purpose of this assessment.

Table 5.1: Proposed Future Population Cap

Group	Existing Population (Year 2019)	Approved Population	Stage 1 (Year 2023)	Stage 2 (Year 2030)	Ultimate Stage (Year 2036)
Early Learning Centre Children	80	80	80	130	130
K-12 Students	1,455	1,600	1,760	1,800	1,840
Primary School Students	595	654	720	736	752
High School Students	860	946	1,040	1,064	1,088
Total Students	1,535	1,680	1,840	1,930	1,970
Primary School and High School Staff	276	276	293	298	302
Early Learning Centre Staff	10	10	10	13	13
Total Staff	**286**	**286**	**303**	**311**	**315**

5.2 Proposed Access and Car Park Arrangements

Vehicle access to the site would generally remain the same as per existing conditions. Access to the site would continue to be provided off the three existing vehicle access gates along York Road and Queens Park Road. However, it is noted that the existing Gate 4 off York Road will be relocated towards the western boundary of the site.

Pedestrian access would continue to be provided as per existing pedestrian site access gates with an enhanced pedestrian access via Baronga Road (Gate 3).

As part of the proposed development, it is proposed to provide an additional 15 on site car parking spaces to cater for the increased staff numbers and ELC provisions. No on-site car parking would be provided for College students as per existing conditions.

5.3 Proposed Drop-off and Pick-up Arrangements

It is proposed to provide a new dedicated drop-off/pick-up area to relocate the existing York Street designated drop-off/pick-up area within the site. Access to this designated drop-off/pick-up area will be provided off York Road via relocated Gate 4, as shown in Figure 5.1. The proposed on-site queuing area would be able to accommodate approximately 240m of vehicle queuing on-site, on approach to the new drop-off/pick-up area.

The proposed Gate 4 parking layout and drop-off/pick-up area will ensure that queues on the road are not significantly worse than the present conditions.

At drop-off/pick-up times, the security gate will be in the open position as to reduce the impact on York road from queuing cars. Cars will enter the driveway and have their driver visor down and name label visible identifying the family name of the child(ren) they are collecting. The security guard positioned at the driveway gate will usher through all permitted vehicles to enter the drop-off/pick-up 'go with the flow' queue. The proposed drop-off/pick-up system at Gate 4 is consistent as that employed at the Gate 1 York Road entry and primary school system.

If a car that is not permitted to enter the school is in the queue, they will be turned around with a U-turn before entering the school premises and exit onto York Road.

Outside of drop-off/pick-up times, the gate will be closed and will open when the driver is cleared for entry by the security guard positioned at the driveway gate. The proposed location of the Gate 4 security gate would be further within the site unlike the existing gate which currently sits up to the site boundary line. This would allow a car to turn around wholly within the site when the gate is closed instead of doing a reverse movement onto York Road.

As per Council's suggestion, the existing median on York Road in front of Gate 4 access will be extended towards the west to restrict access to left in / left out arrangement. This proposal has been approved by the School.

5.4 Service Vehicle and Emergency Vehicle Access

Service and emergency vehicle access will continue to be provided as per existing conditions. A new loading area is proposed within the south car park on York Road to service the new STEAM building. Swept path analysis has been undertaken and demonstrates that all anticipated service vehicles can enter and exit the site in a forward direction. This is provided in Appendix C. This loading area will be managed by the College to ensure servicing requirements are undertaken outside of school peak times to minimise interactions between vehicles and pedestrians.

6 Parking Assessment

6.1 Car Parking Requirements

6.1.1 State Environmental Planning Policy (Educational Establishments)

There is no specific car parking rate under the Education State Environmental Planning Policy (SEPP). However, generally, any car parking must not reduce the number of car parking spaces provided and/or must not contravene any existing condition of the most recent development consent relating to car parking.

6.1.2 Waverly Council Development Control Plan

The latest DCP (Amendment 6), effective 1 November 2018, outlines that development applications for centre-based child care facilities are to comply with the provisions of the Child Care Planning Guideline 2017 (CCPG).

The CCPG recommends car parking to be provided at a rate of 1 space per 4 children in the absence car parking rates in the DCP. It is however noted that the former DCP (Amendment 5) contained car parking rates for child care centres at a rate of 1 parking space per 4 employees, plus 1 per 8 children.

On this basis, the proposed ELC (130 children, 13 staff) would require 33 spaces under the CCPG, or 20 spaces (i.e. 16 drop off spaces and four staff car spaces) under the former DCP (Amendment 5). TTPP is of the view that the lesser car parking requirement as outlined in the former DCP is appropriate for the site to manage car parking use to/from the site, as well to promote non-car travel (e.g. walking and public transport) or carpooling to/from the site. Further to this, the existing ELC operations have been based on the former DCP car parking rates and operate satisfactory.

On this basis, it is proposed to provide 20 car parking spaces (four staff spaces and 16 visitor/ drop off spaces) to serve the proposed expansion of the ELC site. This is considered satisfactory and complies the child care car parking requirements outlined in the former DCP (Amendment 5).

6.1.3 Existing Car Parking Provision

There are no specific car parking rates for educational establishments for primary and secondary schools under the Waverley Council Development Control Plan (DCP) 2012.

Based on the existing on-site car parking provision of 155 spaces for 276 staff (minus three staff spaces for the 10 existing ELC staff; but including accessible staff spaces and contractors/canteen staff spaces), this equates to a car parking provision of 0.56 spaces per

staff. It is proposed to provide an additional 26 staff as part of the proposed development (primary and secondary school expansion). On this basis, an additional 15 staff car parking spaces would be required based on existing on-site car parking provisions.

It is proposed to provide an additional 15 car parking spaces to cater for the proposed increase in staff numbers. This is considered satisfactory based on the existing car parking provisions for staff.

6.2 Accessible Parking Requirements

The Building Code of Australia (BCA) requires accessible car parking spaces to be provided for school developments at a rate of one space for every 100 car parking spaces or part thereof. Based on the proposed additional provision of 15 car parking spaces, the proposal would require at least one space designed as an accessible space. It is proposed to provide eight accessible spaces, which complies with BCA requirements.

In addition, Council DCP requires 10% of all car spaces to be provided as accessible car parking spaces. Based on this rate, the additional parking supply would require include two accessible parking spaces. Therefore, the proposed provision of eight accessible spaces also comply with Council requirements.

6.3 Bicycle Parking Requirements

The bicycle parking requirements for the proposed development has been assessed in accordance with Council's DCP and is outlined in Table 6.1.

Table 6.1: Bicycle Parking Assessment

Land Use	Size	DCP Rate		Requirement		
		Staff	Student / Visitor	Staff	Student / Visitor	Total
Education (primary and secondary)	+26 staff and +240 students	0.3 spaces per staff	0.4 spaces per student	8 spaces	96 spaces	104 spaces
Childcare (ELC)	+3 staff and +50 students	0.1 spaces per staff	0.05 spaces per visitor	1 space	3 spaces	4 spaces
Total				**9 spaces**	**99 spaces**	**108 spaces**

Table 6.1 indicates that the proposed additions to the site would require 108 additional bicycle spaces (i.e. nine staff and 99 student/visitor spaces). It is proposed to provide a total of 160 bicycle parking spaces as part of the proposal which satisfies the minimum DCP requirements. The bicycle parking spaces are proposed to be designed in accordance with AS2890.3:2015.

6.4 Motorcycle Parking Requirements

Council's DCP requires motorcycle parking to be provided at a rate of 1 motorcycle parking bay per 3 car parking bays (including visitors). Based upon an additional provision of 15 spaces, five motorcycle parking spaces would be required. It is proposed to comply with these motorcycle parking requirements and provide five spaces, designed as 1.2m wide by 2.5m long motorcycle spaces in accordance with AS2890.1:2004.

6.5 Proposed Drop-Off/Pick-Up Facilities

It is proposed to maintain existing drop-off/pick-up arrangements for the primary school and ELC within the site. It is however proposed to relocate the existing on-street drop-off/pick-up facilities on York Street within the site in the south car park off York Road via Gate 4. This new drop-off/pick-up area is proposed to be allocated for secondary students via a loop rood system, similar to the existing drop-off/pick-up area provided for the primary school (GWTF). This loop road will enable queues to be maximised within the site to minimise on-street queueing. Details of the proposed drop-off/pick-up arrangements are presented in Section 5.3.

The proposed location of Gate 4 is located about 50m from the kerb tangent point of York Road-Baronga Street intersection which is outside the prohibited access driveway location specified in AS2890.1:2004 (i.e. 6m from the kerb tangent point).

Site observations of the existing scenario indicates that there are around 23 vehicles queued to use York Road drop-off/pick-up facility during the busiest period (i.e. afternoon peak). Based on this observation and the estimated increase of 23 veh/hr inbound trips generated by secondary students (i.e. combined development stages) in the PM (further discussed in Section 7.1, the future queue length could be in the up to 46 vehicles.

As shown in Appendix C, the proposed future drop-off/pick-up facility would be able to accommodate the estimated future queue on site.

All drop-off/pick-up activities will be managed by the College as per existing conditions to minimise traffic and parking impacts on the surrounding road network in consultation with Council. All parents will be required to pre-register their vehicle to access the designated drop-off/pick up areas as per existing conditions.

Appendix C also shows the proposed additional line markings to minimise conflict between entering and exiting cars during drop-off/pick-up period.

In addition, staff will be advised to access the parking spaces outside the drop-off/pick-up times, especially those that will use the stacked parking spaces located on the southern area of the site.

7 Traffic Assessment

This section outlines the traffic assessment associated with the proposed development in future stages. For a conservative assessment, the additional traffic associated with the proposed development has been estimated assuming that there would be no modal shift away from car (or other mode).

It is however noted that travel demand strategies are proposed to be implemented at the school, as detailed in Section 8 and the Green Travel Plan, which aim to influence the way people move to/from the school to encourage sustainable travel and reduce traffic and parking impacts within communities. Such measures could facilitate a modal shift away from car and an increased uptake in more sustainable transport options.

7.1 Future Trip Generation Estimates

By applying the vehicle trip generation rates in Table 3.5, the net additional peak hour traffic associated with each stage is estimated in Table 7.1 to Table 7.3.

Table 7.1: Stage 1 Proposed Additional Peak Hour School Traffic Generation

Group	Net Increase in Population	AM Trip Rate	PM Trip Rate	AM Peak Trips (veh/hr)			PM Peak Trips (veh/hr)		
				In	Out	Two Way	In	Out	Two Way
ELC Children	0	0.67	-	0	0	0	0	0	0
Primary School Students	+66	0.73	0.51	24	24	48	17	17	34
High School Students	+94	0.56	0.33	27	25	52	15	17	31
Staff	+17	0.40	0.38	7	0	7	0	6	6
Total				**58**	**49**	**107**	**32**	**40**	**71**

Table 7.1 indicates that the Stage 1 proposal is expected to generate an additional 107vph and 71vph during the school AM and PM peak periods respectively. It is noted that the net increase in traffic associated with Stage 1 development have been calculated based on the estimated trip generation of the approved cap of the College.

Similarly, after the completion of the Stage 1 works, the net additional traffic associated with Stage 2 works is estimated in Table 7.2.

Table 7.2: Stage 2 Proposed Additional Peak Hour School Traffic Generation

Group	Net Increase in Population	AM Trip Rate	PM Trip Rate	AM Peak Trips (veh/hr)			PM Peak Trips (veh/hr)		
				In	Out	Two Way	In	Out	Two Way
ELC Children	+50	0.67	-	17	17	34	7	7	13
Primary School Students	+16	0.73	0.51	6	6	12	4	4	8
High School Students	+24	0.56	0.33	7	6	13	4	4	8
Staff	+8	0.40	0.38	3	0	3	0	3	3
Total				**33**	**29**	**62**	**15**	**18**	**32**

Following the completion of Stage 1 works, Table 7.2 that the Stage 2 proposal is expected to generate an additional 62vph and 32vph during the school AM and PM peak periods respectively. It should also be noted that additional ELC trips are expected in the PM Peak, but this would occur outside of the PM Peak, as outlined in Section 3.3.

Table 7.3: Ultimate Stage Proposed Additional Peak Hour School Traffic Generation

Group	Net Increase in Population	AM Trip Rate	PM Trip Rate	AM Peak Trips (veh/hr)			PM Peak Trips (veh/hr)		
				In	Out	Two Way	In	Out	Two Way
ELC Children	0	0.67	-	0	0	0	0	0	0
Primary School Students	+16	0.73	0.51	6	6	12	4	4	8
High School Students	+24	0.56	0.33	7	6	13	4	4	8
Staff	+4	0.40	0.38	2	0	2	0	2	2
Total				**15**	**12**	**27**	**8**	**10**	**18**

Table 7.3 indicates that with the completion of the ultimate stage in 2036, the site would generate an additional 27vph and 18vph during the school AM and PM peak periods respectively.

Ultimately, the proposed scheme combined (i.e. Stages 1, 2 and ultimate stage) is expected to generate an additional 196vph and 121vph during the school AM and PM peak periods respectively.

The proportions of inbound and outbound trips for students have been assumed to be generally 50% inbound and 50% outbound to account for arrival and departure trips occurring in the same hour during both school peak periods. For staff, it has been assumed that 100% are inbound trips in the school AM peak and 100% are outbound trips in the school PM peak.

7.1.1 ELC Trip Generation Estimates

The existing ELC use has been estimated to generate 0.67 trips per student (two-way). This trip rate assumes that both inbound and outbound trips occur in the same hour. In addition to this, for the purpose of this assessment, it has been assumed that 100 per cent of ELC trips in the same hour in the AM Peak, as outlined in Section 3.3.

However, for the PM Peak, it is understood that ELC pick-up activities occur between 4:30pm and 6:00pm. Assuming that trips are generally evenly distributed across the two-and-a-half-hour period, this could equate to a trip rate of 0.27 trips per student per hour in the PM Peak.

Using this metric and the proposed ELC additions (+50 children), this could equate to an additional 14 trips in the PM Peak. This level of development traffic is considered low and could not be expected to register any material change in the performance of nearby intersections. On this basis, the traffic implications associated with ELC trips during the PM Peak are not expected to result in any adverse impact on the surrounding road network.

7.2 Trip Distribution

As part of the travel questionnaire survey, staff and students were asked where they currently reside. The responses from car users have been assessed to determine the likely routes that they take to travel to/from the school.

Figure 7.1 and Figure 7.2 present the assumed directional distribution of development trips by using the above methodology. Since the ELC was not included in the travel questionnaire survey, the trip distribution of ELC children has been assumed based on the average of primary and high school student results.

Figure 7.1: Assumed Directional Distribution – Inbound

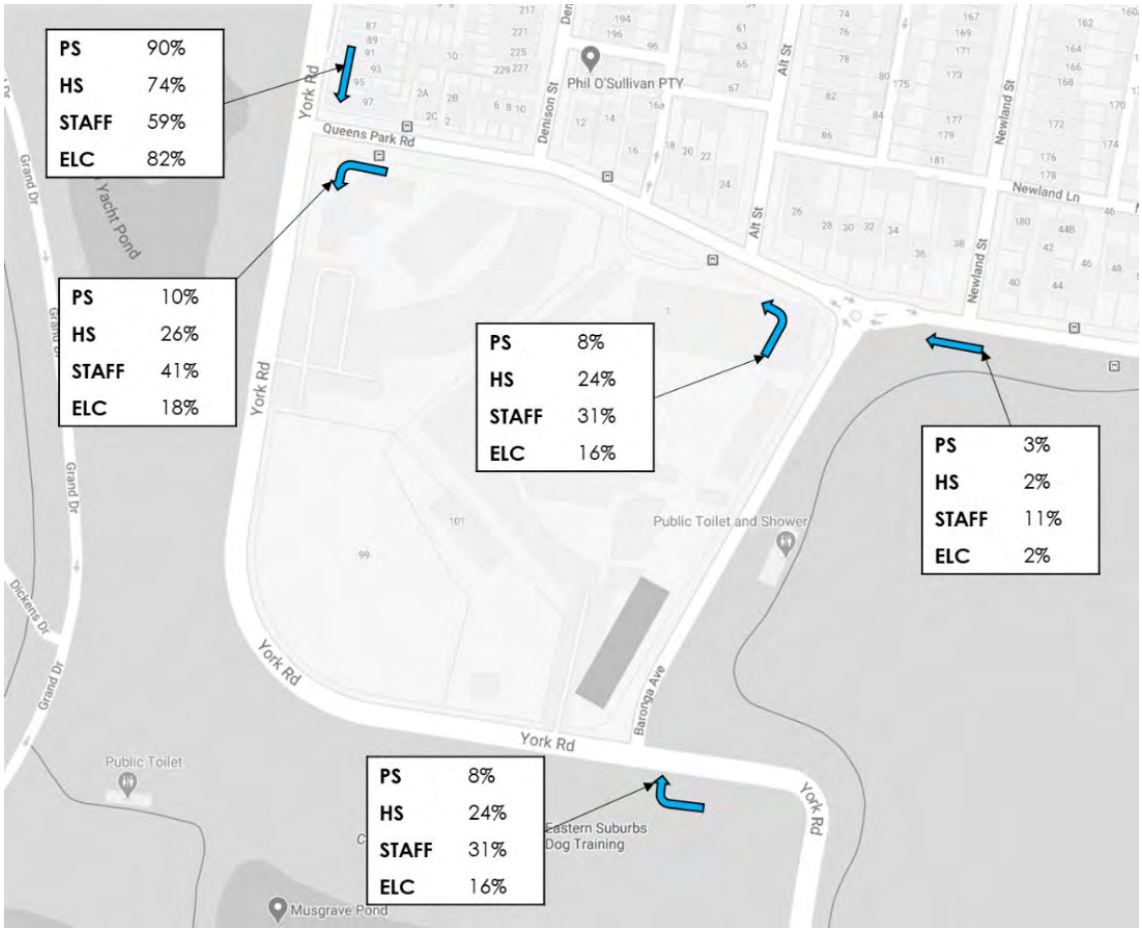
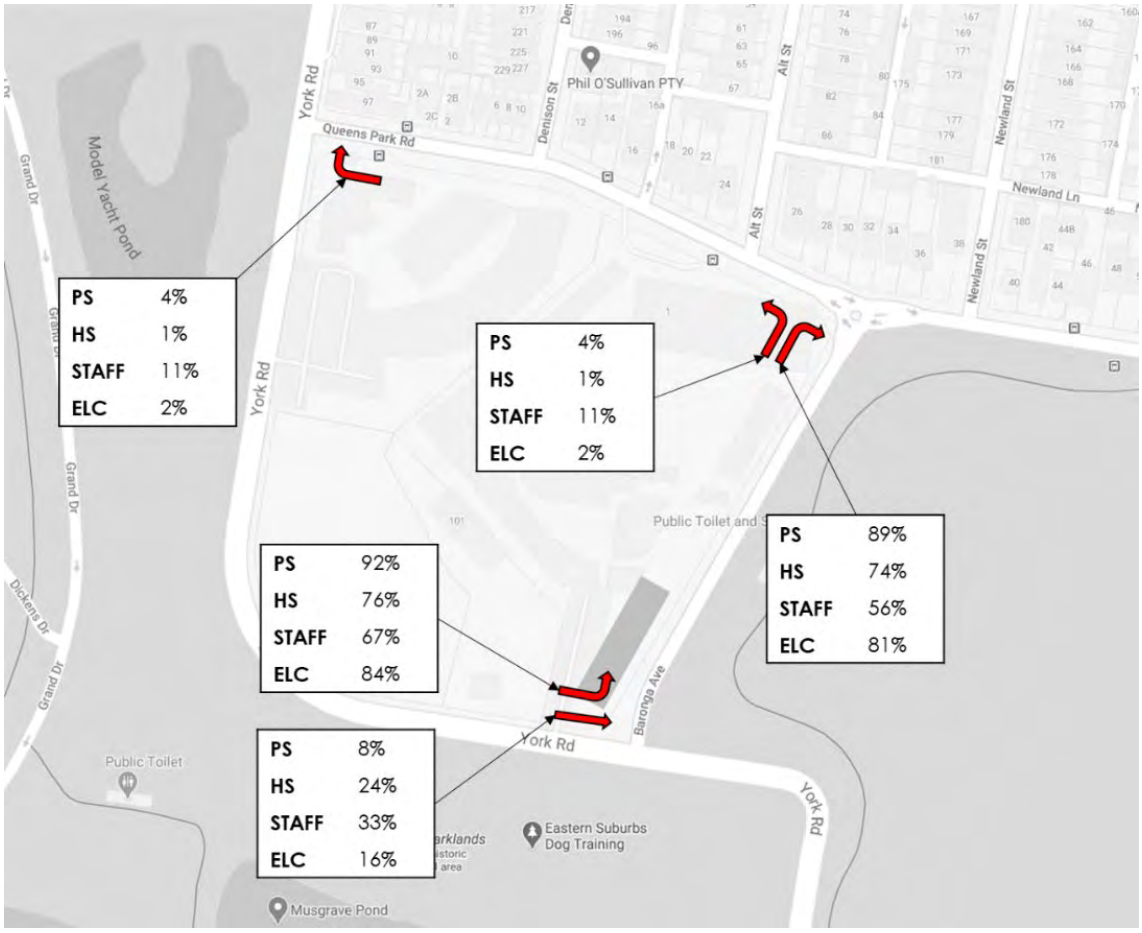


Figure 7.2: Assumed Directional Distribution – Outbound



7.3 Network Capacity Analysis

7.3.1 Stage 1 Proposed Development

The proposed development will be delivered in three stages, with Stage 1 of the development proposed to provide 303 staff (including 10 ELC staff) and 1,760 students by Year 2023. This equates to an additional 17 staff and 160 students compared to the existing approved school capacity.

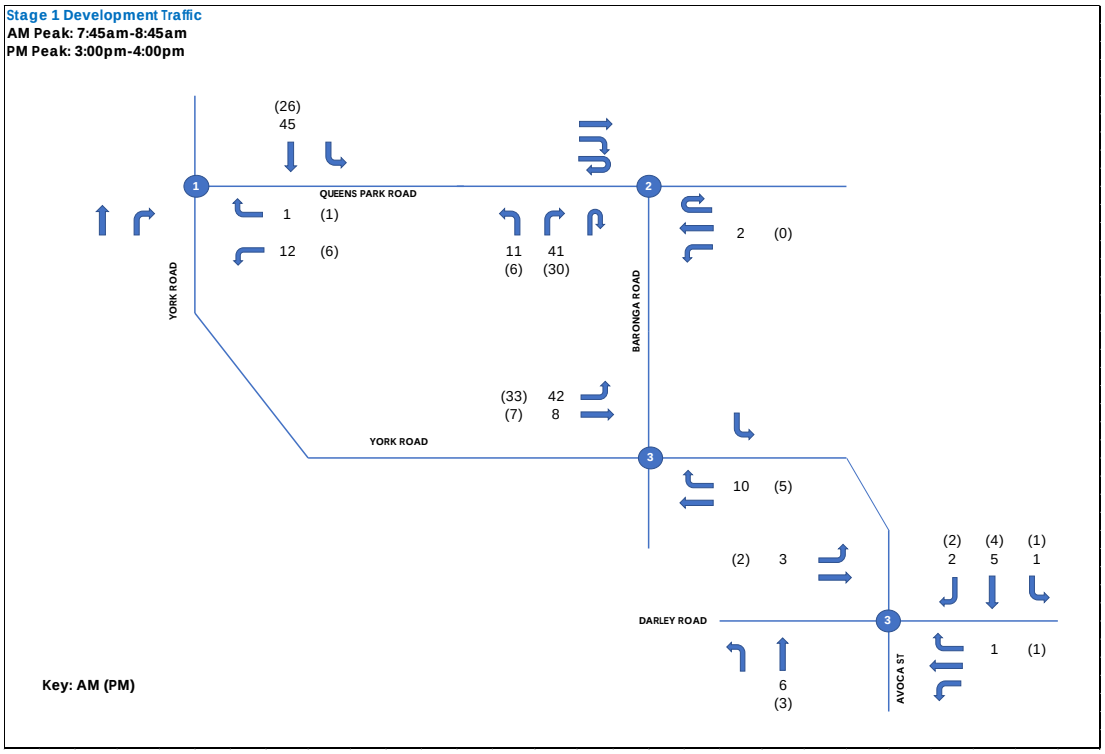
Future background growth figures up to Year 2023 have been applied to the background traffic models (i.e. excluding estimated existing school traffic generation) based on future traffic growth predictions extracted from Roads and Maritime's Sydney Strategic Traffic Forecasting Model. It is noted that where the net difference resulted to negative figure (i.e. York Road left turn to Baronga Avenue), the background traffic in this movement is estimated to be zero which indicates that this movement is generally generated by the existing school traffic.

The STFM growth plots adopted in this assessment are presented in Appendix D.

It is noted that the existing traffic volumes obtained from the intersection count surveys only captured the development trips generated by the existing school population (i.e. 1,455 students). Thus, the net traffic associated with the approved school enrolment numbers (i.e. 1,600 students) have been added to the base model to account for any variation in the school population within the model year.

The Stage 1 development traffic volumes are shown in Figure 7.3.

Figure 7.3: Stage 1 Development Peak Traffic Volumes



A comparison between the future base Year 2023 and the Stage 1 development scenario during the school AM and PM peaks is provided in Table 7.4 and Table 7.5 respectively.

Table 7.4: Stage 1 Development AM Peak Hour Intersection Analysis Results

Intersection	Control	Future 2023 – No Dev			Future 2023 – Stage 1 Dev		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	69	E	28	81	F	31
Queens Park Rd-Baronga Ave	Roundabout	13	A	91	13	A	91
York Rd-Baronga Ave	Priority	29	B	196	73	F	243

York Rd-Darley Rd-Avoca St	Signals	60	E	308	63	E	315

Table 7.5: Stage 1 Development PM Peak Hour Intersection Analysis Results

Intersection	Control	Future 2023 – No Dev			Future 2023 – Stage 1 Dev		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	39	C	7	53	D	9
Queens Park Rd-Baronga Ave	Roundabout	10	A	30	10	A	27
York Rd-Baronga Ave	Priority	61	E	117	366	F	545
York Rd-Darley Rd-Avoca St	Signals	48	D	218	65	E	298

The above results indicate that the intersections of York Road-Baronga Avenue and York Road-Darley Road-Avoca Street would deteriorate to LoS E in the afternoon and morning peak periods, respectively, even without the additional development traffic.

With the addition of Stage 1 development traffic, York Road-Darley Road-Avoca Street and York Road is anticipated to operate from LoS D to E in the evening peak. York Road-Baronga Avenue intersection would also deteriorate from LoS B to LoS F in the morning peak.

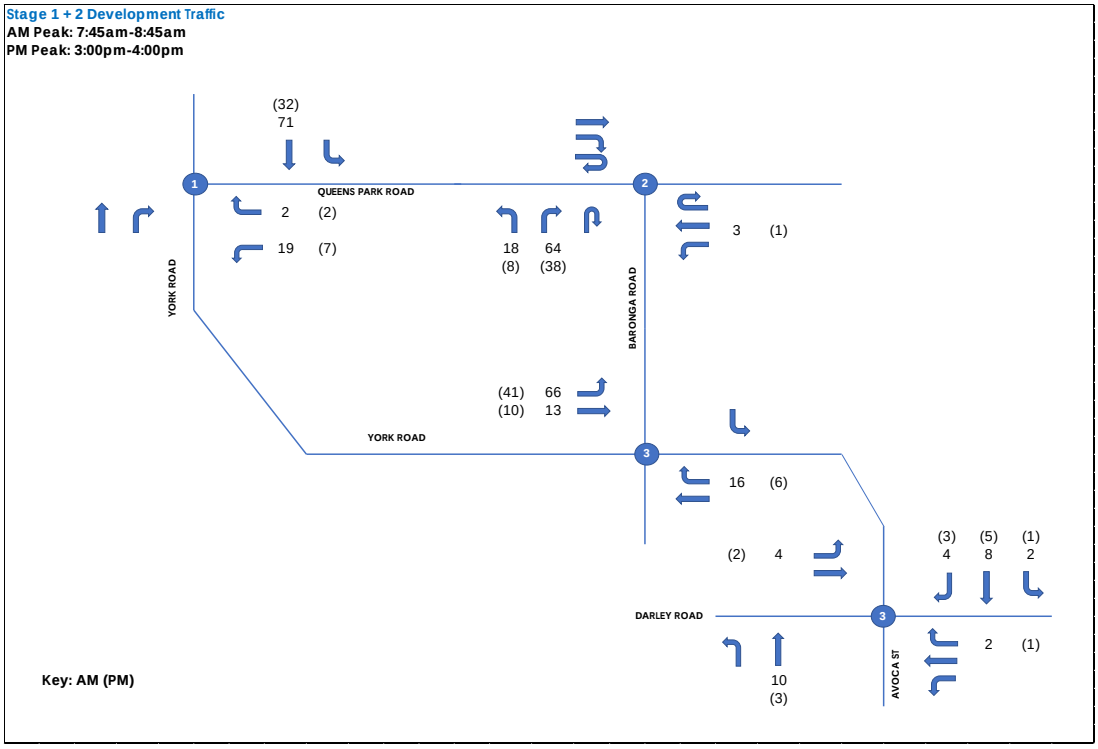
In addition to this, the York Road-Queens Park Road intersection would continue to operate above capacity in the AM peak with minimal additional delays and queue due to the increase in school traffic.

7.3.2 Stage 2 Proposed Development

Stage 2 of the development proposes to increase the ELC provisions to accommodate 13 staff and 130 students (i.e. net increase of three staff and 50 students) by say Year 2030. It is also proposed to increase the primary and high school population to 1,800 students and say 298 staff. Future background growth figures up to Year 2030 have been applied to the traffic models accordingly.

The combined Stage 1 and 2 development traffic volumes are shown in Figure 7.4.

Figure 7.4: Stage 1 + Stage 2 Development Peak Traffic Volumes



A comparison between the future base Year 2030 (under existing approved student numbers), future Year 2030 plus Stage 1 development and combined Stage 1 and Stage 2 scenario during the school AM and PM peaks is provided in Table 7.4 and Table 7.5 respectively.

Table 7.6: Stage 1 + Stage 2 Development AM Peak Hour Intersection Analysis Results

Intersection	Control	Future 2030 – No Dev			Future 2030 – Stage 1 Dev			Future 2030 – Stage 1 + 2 Dev		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	90	F	34	108	F	39	121	F	42
Queens Park Rd-Baronga Ave	Roundabout	14	A	93	14	A	93	14	A	93
York Rd-Baronga Ave	Priority	79	F	192	174	F	380	244	F	497
York Rd-Darley Rd-Avoca St	Signals	75	F	379	96	F	408	119	F	408

Table 7.7: Stage 1 + Stage 2 Development PM Peak Hour Intersection Analysis Results

Intersection	Control	Future 2030 – No Dev			Future 2030 – Stage 1 Dev			Future 2030 – Stage 1 + 2 Dev		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	72	F	12	81	F	13	85	F	13
Queens Park Rd-Baronga Ave	Roundabout	10	A	23	10	A	23	10	A	24
York Rd-Baronga Ave	Priority	468	F	621	657	F	621	715	F	621
York Rd-Darley Rd-Avoca St	Signals	82	F	355	83	F	356	83	F	356

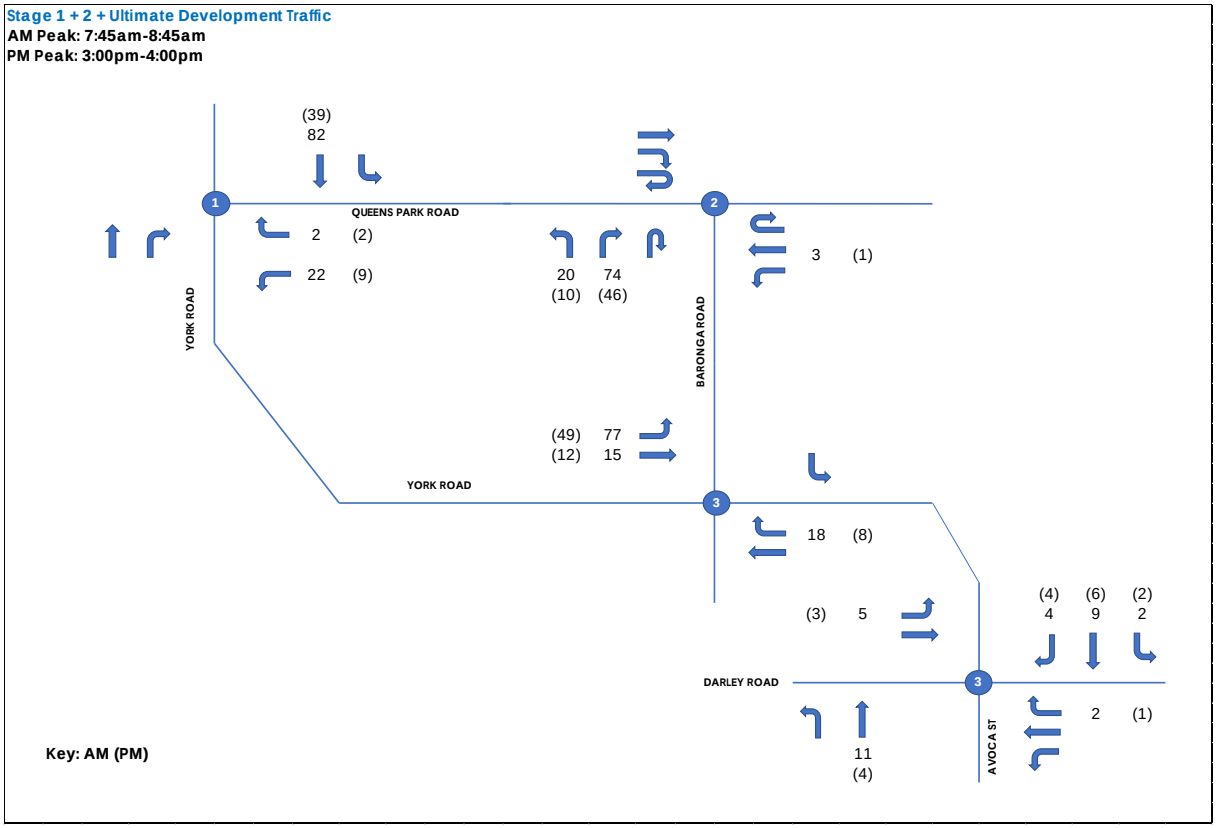
Based on the above, York Road-Queens Park Road, York Road-Baronga Avenue and York Road-Darley Road-Avoca Street would continue operate with F during the AM and PM peak periods with the completion of Phase 2 development.

7.3.3 Ultimate Stage Proposed Development

The ultimate stage of the development is expected to increase the school enrolment numbers to 1,840 primary and high school students and 302 staff by Year 2036. The ELC population and staff numbers will be maintained as per the Stage 2 development outlined above.

The ultimate development traffic volumes are shown in Figure 7.4.

Figure 7.5: Stage 1 + Stage 2 + Ultimate Development Peak Traffic Volumes



A comparison of the intersection performance between the future base Year 2036 (under existing approved student numbers), and all future development stages during the school AM and PM peaks is provided in Table 7.8 and Table 7.9 respectively.

Table 7.8: Stage 1 + Stage 2 + Ultimate Development AM Peak Hour Intersection Analysis Results

Intersection	Control	Future 2036 – No Dev			Future 2036 – Stage 1 Dev			Future 2036 – Stage 1 + 2 Dev			Future 2036 – Stage 1 + 2 + Ultimate Dev		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	102	F	37	122	F	43	139	F	48	146	F	50
Queens Park Rd-Baronga Ave	Roundabout	14	A	94	12	A	76	14	A	94	14	A	93
York Rd-Baronga Ave	Priority	169	F	364	440	F	621	363	F	621	411	F	621
York Rd-Darley Rd-Avoca St	Signals	109	F	408	185	F	586	191	F	606	191	F	609

Table 7.9: Stage 1 + Stage 2 + Ultimate Development PM Peak Hour Intersection Analysis Results

Intersection	Control	Future 2036 – No Dev			Future 2036 – Stage 1 Dev			Future 2036 – Stage 1 + 2 Dev			Future 2036 – Stage 1 + 2 + Ultimate Dev		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	104	F	15	122	F	16	130	F	17	136	F	18
Queens Park Rd-Baronga Ave	Roundabout	9	A	22	10	A	22	10	A	22	10	A	22
York Rd-Baronga Ave	Priority	691	F	621	928	F	621	1002	F	621	1076	F	621
York Rd-Darley Rd-Avoca St	Signals	94	F	368	95	F	371	96	F	371	97	F	372

Intersection modelling results of Year 2036 scenarios are comparable with the Year 2030 scenarios. Background traffic growth by Year 2036 would tip the performance of key signalised and priority-controlled intersections during both peak periods even without the school expansion.

The delays at these intersections would increase with the completion of school redevelopment.

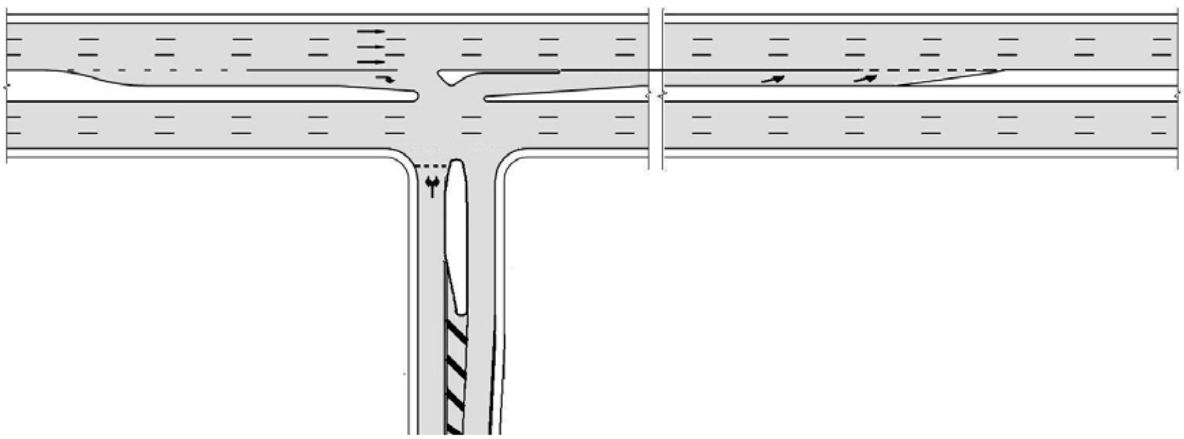
7.3.4 Potential Mitigation Measures

Traffic modelling results indicate that the York Road-Queens Park Road, York Road-Baronga Avenue and York Road-Darley Road-Avoca Street intersections are expected to operate at LoS F during the peak periods in the future irrespective of the proposed development. With the proposed development traffic, these intersections would experience higher delays as a result of mainly due to the increased right-turn delays at the priority-controlled intersections.

York Road-Queens Park Road Intersection

These results suggest that the current intersection control should be investigated to improve intersection capacity. A possible improvement measure at the York Road-Queens Park road intersection would be to upgrade this intersection to a seagull intersection, such that right-turn traffic from Queens Park Road would be able to turn onto York Road in two stages, as shown in Figure 7.6.

Figure 7.6: Typical Seagull Treatment Layout



Under such seagull arrangements, right-turn movements would have to first give way to one direction of traffic (i.e. southbound traffic on Queens Park Road) to travel into the “merge lane”, before merging onto Queens Park Road in the northbound direction.

A concept layout plan of the proposed seagull intersection improvements is shown in Figure 7.7.

Notwithstanding, the proposed concept layout is still subject to detailed design prior to implementation. The proposed design will require consultation with the State Transit Authority and Council to ensure that buses, waste collection and emergency vehicles can still be facilitated through the intersection.

Figure 7.7: Concept Seagull Intersection Treatment

One of Council's recommendation is the provision of a pedestrian refuge at the intersection of York Road-Queens Park Road which is proposed to be converted into a seagull intersection.

Although a pedestrian refuge would assist pedestrians to safely cross the wide intersection, the following matters should be considered in deciding the appropriate location for the refuge island:

- Provision of a refuge island immediately north of Queens Park Road could accommodate a wider island (about 1.8m wide). However, a vehicle stopped on the right turn bay on the south leg could block the northbound motorist's sight of a pedestrian standing on the island which could have safety implications.
- Provision of a refuge island further north of Queens Park Road (in between the driveways of 95 York Road and 93 York Road but this could only accommodate about a 1.6m wide and 3.2m long refuge which may not be sufficient to provide a safe refuge for pedestrians (especially those with prams)

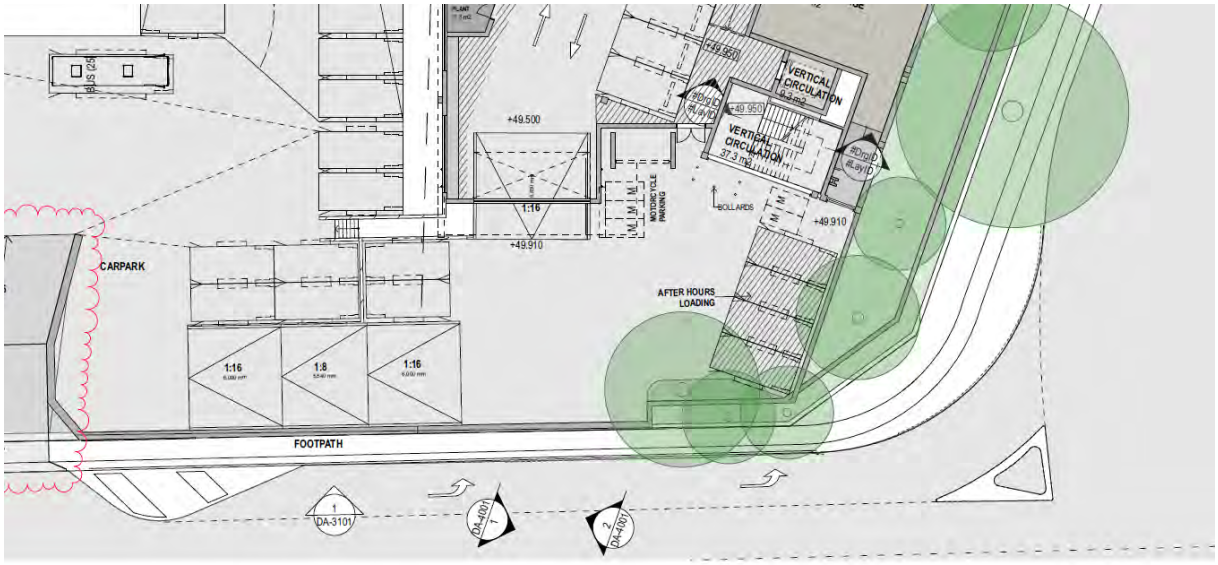
On the above basis, it is recommended that Council further investigate the need for a pedestrian refuge at this intersection and identification of an appropriate location.

York Road-Baronga Avenue Intersection

It is noted that the York Road-Baronga Avenue would continue to operate at LoS F in the future case as a result of traffic turning right from York Road into Baronga Avenue during school peak periods. Limited road infrastructure improvement works can be accommodated based upon existing site constraints. A possible solution may however be the provision of a left-turn slip lane on York Road to improve right-turn movements, as shown in Figure 7.8 and Figure 7.9.

Figure 7.8: York Road (looking to the east)

Figure 7.9: Concept Slip-lane Treatment



Waverley Council has provided in-principle support to the proposed upgrades as part of the proposed Moriah College redevelopment.

In addition, travel demand management measures will be implemented to reduce the overall school traffic to manage the traffic impacts during school peak periods and reduce its impacts on the surrounding road network. Travel demand management measures that could be implemented by the school are presented in Section 8.

It is anticipated that the proposed management measures could result to 10% modal shift away from car use therefore reducing the overall car trips generated by the school. Overall, the additional vehicle trip generation of the proposed scheme combined (i.e. Stages 1, 2 and ultimate stage) could decrease from 196vph to 59vph during the school AM peak and from 108vph to 22vph during school PM peak period.

The successful implementation of proposed modal shift initiatives would also result in an associated reduction of drop-off/pick-up activities. As such, the estimated future drop-off/pick-up queue length of 46 vehicles as discussed in 6.5 could be reduced.

The ultimate development traffic volumes with the 10% reduction in car use are shown in Figure 7.10 to Figure 7.12.

Figure 7.10: Stage 1 Development Peak Traffic Volumes with 10% Modal Shift

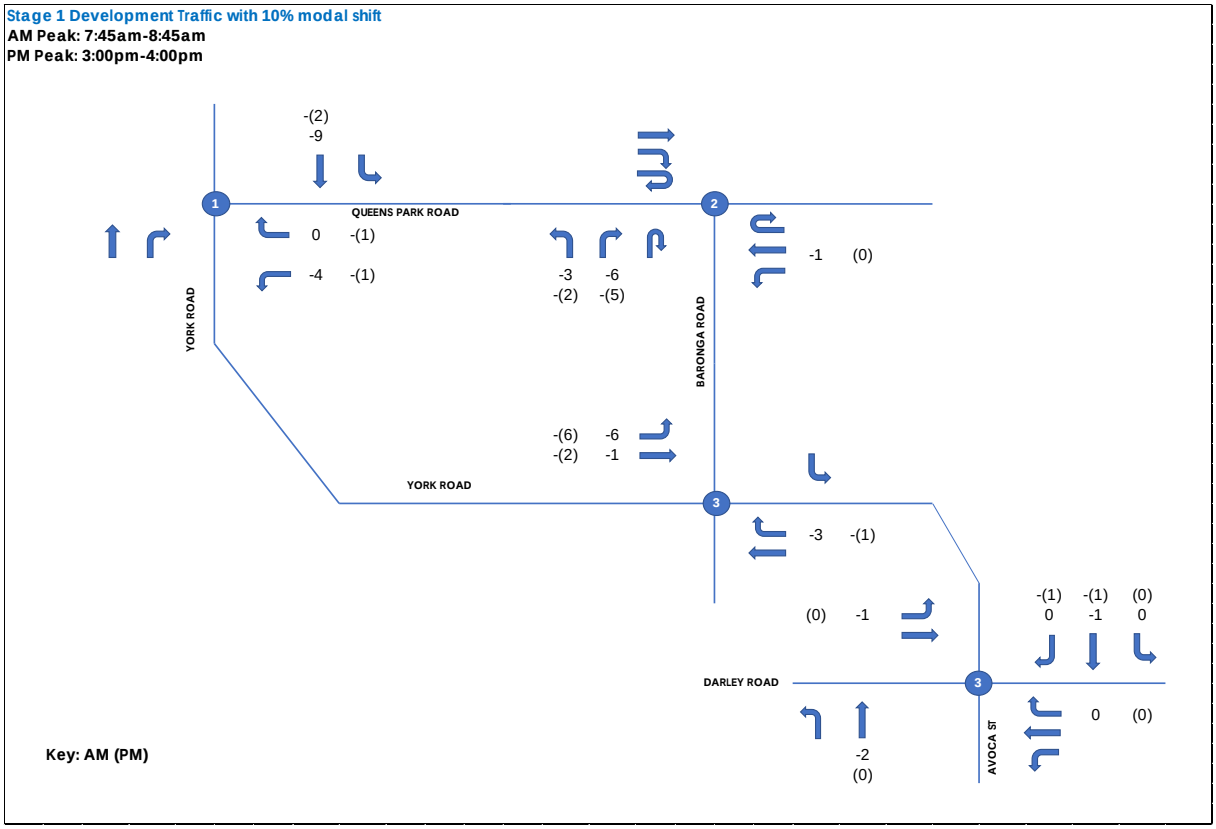


Figure 7.11: Stage 1 + Stage 2 Development Peak Traffic Volumes with 10% Modal Shift

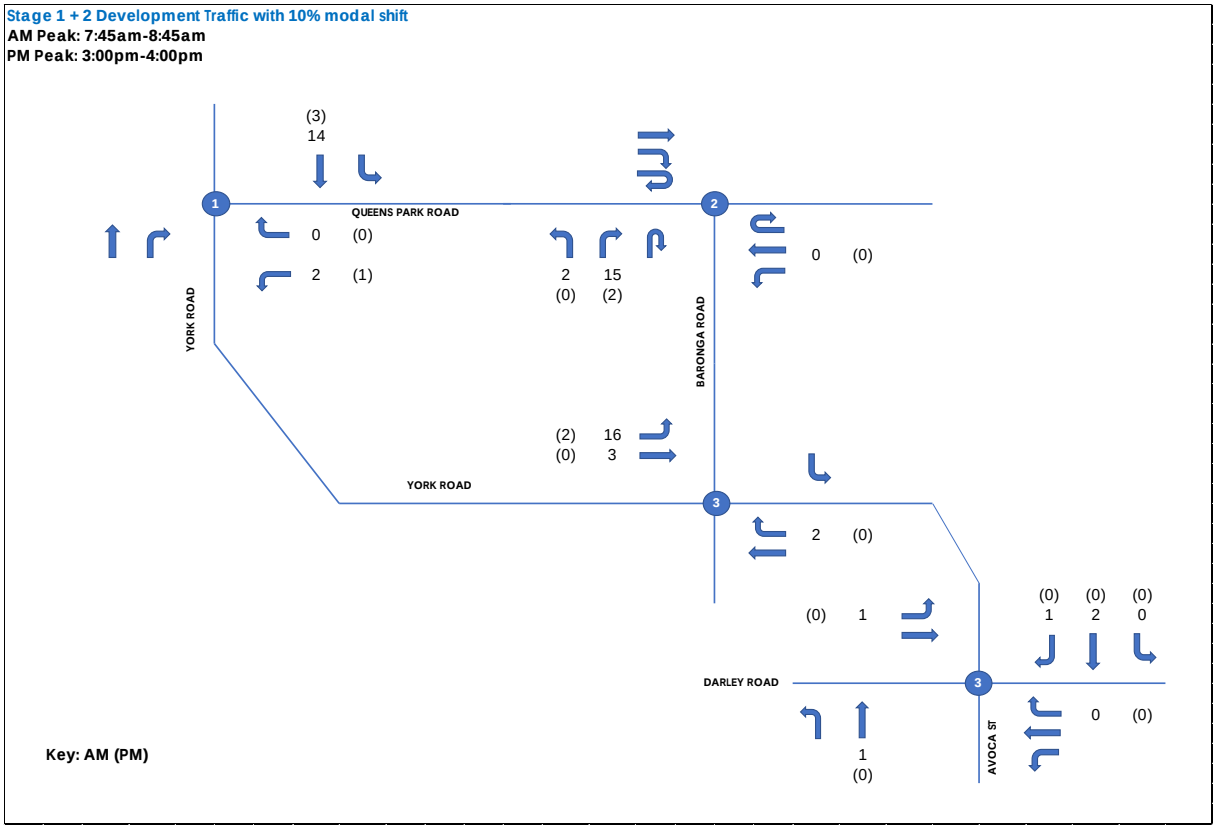
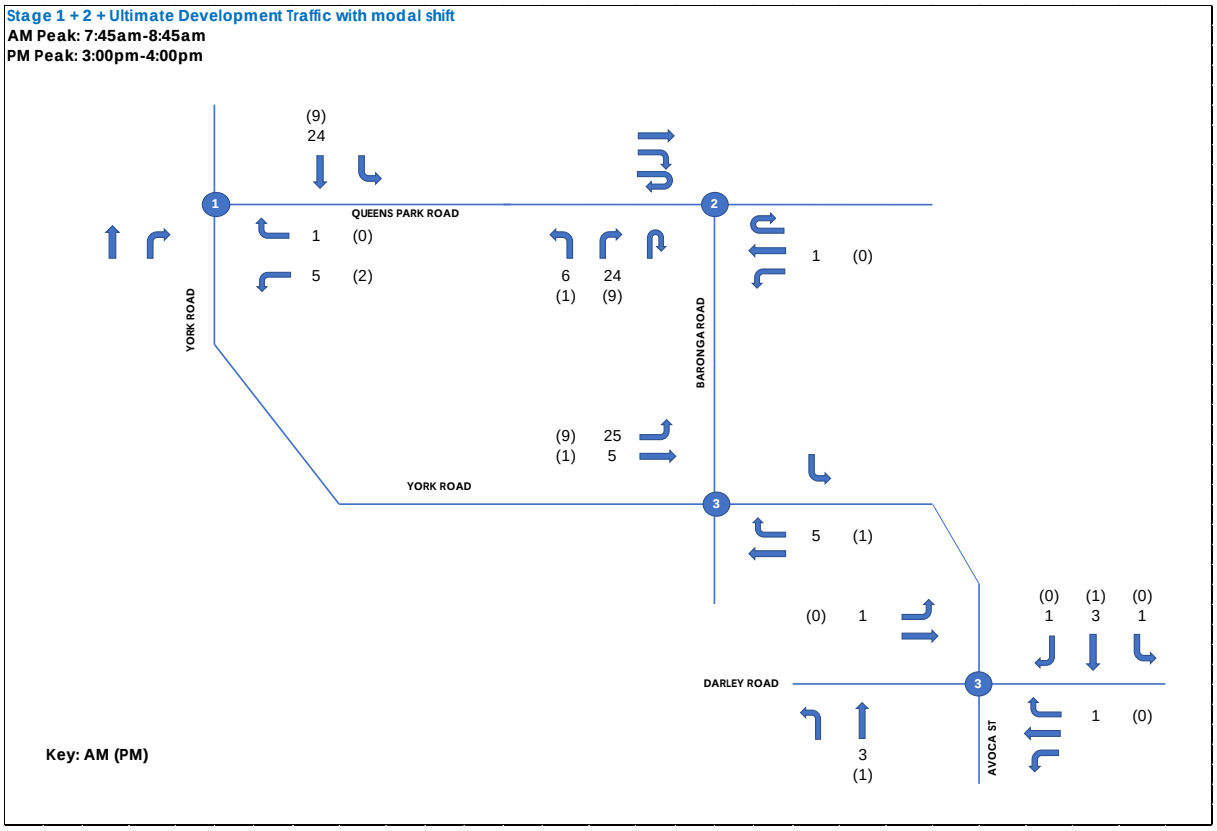


Figure 7.12: Stage 1 + Stage 2 + Ultimate Development Peak Traffic Volumes with 10% Modal Shift



A summary of the traffic modelling results with the proposed intersection treatments and modal shift, is shown in Table 7.10 to Table 7.15.

Table 7.10: Stage 1 Development AM Peak Hour Intersection Analysis Results – With Improvements

Intersection	Control	Future 2023 – No Dev			Future 2023 – Stage 1 Dev			Future 2023 – Stage 1 (with intersection upgrade only)			Future 2023 – Stage 1 (with modal shift only)			Future 2023 – Stage 1 (with modal shift + intersection upgrade)		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	69	E	28	81	F	31	13	A	31	67	E	28	12	A	28
Queens Park Rd-Baronga Ave	Roundabout	13	A	91	13	A	91	13	A	91	13	A	91	13	A	91
York Rd-Baronga Ave	Priority	29	B	196	73	F	243	14	A	277	26	B	177	10	A	177
York Rd-Darley Rd-Avoca St	Signals	60	E	308	63	E	315	65	E	307	60	E	308	60	E	308

Table 7.11: Stage 1 Development PM Peak Hour Intersection Analysis Results – With Improvements

Intersection	Control	Future 2023 – No Dev			Future 2023 – Stage 1 Dev			Future 2023 – Stage 1 (with intersection upgrade only)			Future 2023 – Stage 1 (with modal shift only)			Future 2023 – Stage 1 (with modal shift + intersection upgrade)		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	39	C	7	53	D	9	11	A	9	48	D	8	10	A	8
Queens Park Rd-Baronga Ave	Roundabout	10	A	30	10	A	27	11	A	35	10	A	27	11	A	32
York Rd-Baronga Ave	Priority	61	E	117	366	F	545	14	A	34	203	F	343	16	B	41
York Rd-Darley Rd-Avoca St	Signals	48	D	218	65	E	298	65	E	299	66	E	328	66	E	329

Stage 1 development scenario results presented in Table 7.10 and Table 7.11 indicate that the proposed upgrades would be sufficient to cater the future background growth and additional Stage 1 development trips, even without the modal shift.

With the proposed intersection upgrades, the key intersections would operate satisfactorily with LoS A or B, with the exception of York Road-Darley Road-Avoca Street intersection.

However, with modal shift alone (i.e. no intersection upgrades), York Road-Queens Park Road and York Road-Baronga Avenue intersections would still operate above their theoretical capacities in the morning and afternoon peak periods, respectively.

Table 7.12: Stage 1 + Stage 2 Development AM Peak Hour Intersection Analysis Results – With Improvements

Intersection	Control	Future 2030 – No Dev			Future 2030 – Stage 1 + 2 Dev			Future 2030 – Stage 1 + 2 (with intersection upgrade only)			Future 2030 – Stage 1 + 2 (with modal shift only)			Future 2030 – Stage 1 + 2 (with modal shift + intersection upgrade)		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	90	F	34	121	F	42	15	B	40	95	F	35	13	A	35
Queens Park Rd-Baronga Ave	Roundabout	14	A	93	14	A	93	14	A	93	14	A	93	14	A	93
York Rd-Baronga Ave	Priority	79	F	192	244	F	497	77	F	180	112	F	182	21	B	273
York Rd-Darley Rd-Avoca St	Signals	75	F	379	119	F	408	94	F	406	76	F	382	80	F	372

Table 7.13: Stage 1 + Stage 2 Development PM Peak Hour Intersection Analysis Results – With Improvements

Intersection	Control	Future 2030 – No Dev			Future 2030 – Stage 1 + 2 Dev			Future 2030 – Stage 1 + 2 (with intersection upgrade only)			Future 2030 – Stage 1 + 2 (with modal shift only)			Future 2030 – Stage 1 + 2 (with modal shift + intersection upgrade)		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	72	F	12	85	F	13	12	A	10	73	F	12	11	A	10
Queens Park Rd-Baronga Ave	Roundabout	10	A	23	10	A	24	11	A	36	10	A	23	11	A	32
York Rd-Baronga Ave	Priority	468	F	621	715	F	621	99	F	212	476	F	621	85	F	186
York Rd-Darley Rd-Avoca St	Signals	82	F	355	83	F	356	83	F	355	82	F	355	82	F	355

Based on Table 7.12 and Table 7.13, the intersection of York Road-Queens Park Road would operate at LoS A in both peak periods with the proposed intersection upgrades even with the additional combined trips of Stage 1 and Stage 2.

However, providing the intersection upgrades alone (i.e. no modal shift) would still result to York Road-Baronga Avenue intersection operating above its capacity for both peak periods. With the additional improvement associated with the modal shift, York Road-Baronga Avenue intersection would operate at LoS B in the morning peak.

It is noted that York Road-Baronga Avenue intersection would still be performing at LoS F in the afternoon peak even with the proposed upgrades and modal shift. High delays at this intersection are from the left-turn movements from Baronga Avenue which is caused by the upstream congestion generating from York Road-Darley Road-Avoca Street.

Table 7.14: Stage 1 + Stage 2 + Ultimate Development AM Peak Hour Intersection Analysis Results – With Improvements

Intersection	Control	Future 2036 – No Dev			Future 2036 – Stage 1 + 2 + Ultimate Dev			Future 2036 – Stage 1 + 2 + Ultimate (with intersection upgrade only)			Future 2036 – Stage 1 + 2 + Ultimate (with modal shift only)			Future 2036 – Stage 1 + 2 + Ultimate (with modal shift + intersection upgrade)		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	102	F	37	146	F	50	18	B	45	112	F	40	14	A	38
Queens Park Rd-Baronga Ave	Roundabout	14	A	94	14	A	93	14	A	94	15	B	104	15	B	104
York Rd-Baronga Ave	Priority	169	F	364	411	F	621	162	F	323	231	F	482	154	F	405
York Rd-Darley Rd-Avoca St	Signals	109	F	408	191	F	609	126	F	408	134	F	408	113	F	408

Table 7.15: Stage 1 + Stage 2 + Ultimate Development PM Peak Hour Intersection Analysis Results – With Improvements

Intersection	Control	Future 2036 – No Dev			Future 2036 – Stage 1 + 2 + Ultimate Dev			Future 2036 – Stage 1 + 2 + Ultimate (with intersection upgrade only)			Future 2036 – Stage 1 + 2 + Ultimate (with modal shift only)			Future 2036 – Stage 1 + 2 + Ultimate (with modal shift + intersection upgrade)		
		Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)	Ave Delay (s)	LoS	95th %ile Queue Length (m)
York Rd-Queens Park Rd	Priority	104	F	15	136	F	18	13	A	12	109	F	15	12	A	11
Queens Park Rd-Baronga Ave	Roundabout	9	A	22	10	A	22	11	A	36	9	A	22	11	A	32
York Rd-Baronga Ave	Priority	691	F	621	1076	F	621	279	F	323	745	F	621	240	F	323
York Rd-Darley Rd-Avoca St	Signals	94	F	368	97	F	372	97	F	371	94	F	369	94	F	368

Similar to the results obtained from Stage 2 scenarios, intersection upgrades would be required at York Road-Queens Park road intersection for it to operate satisfactorily even with the combined additional trips from the three development stages.

Although there would be significant improvement in the delays at York Road-Baronga Avenue intersection due to the combined improvement from the proposed upgrades and modal shift, the intersection would still operate at LoS F in both peak periods. However, the high delays at this intersection are generally caused by the left-turn movements from Baronga Avenue which are in turn caused by the upstream congestion generating from York Road-Darley Road-Avoca Street.

It is noted that analysing York Road-Baronga Avenue intersection with proposed upgrades and modal shift in an isolated model would result to a satisfactory level of service (level of Service B). Therefore, poor LoS at this intersection is caused by the congestion at York Road-Darley Road-Avoca Street intersection.

Even on the existing scenario, York Road-Darley Road-Avoca Street intersection is already operating at its theoretical capacity with LoS D. Future traffic growth is anticipated to tip the intersection performance to LoS F even without the development traffic, as shown in the future base year scenarios.

As such, it is noted that an existing traffic capacity issue already exists at the York Road-Darley Road-Avoca Street intersection and this intersection will go overcapacity with background traffic growth even without the subject development. This existing traffic capacity issue does have knock on effects at intersections closer to the college notably York Road- Baronga Avenue.

Whilst the College can directly address the impacts in the close vicinity of the College with the roadworks proposed, the York Road-Darley Road-Avoca Street intersection is an existing problem which needs to be addressed by Council.

Notwithstanding this, it is of note that the average delay at the York Road-Darley Road-Avoca Street intersection in the “With Development Scenarios” compared to the “Background traffic growth only” is only 3 seconds longer with 4m more additional queue in the AM peak whereas in the PM peak, there is 3 additional seconds delay but the queue is the same length. Consequently, the proposed development will have little impact at this intersection.

The resulting queue on the future left turn slip lane at York Road-Baronga Avenue intersection has been assessed to determine if the proposed left turn slip lane storage length would be able to accommodate the future queues.

Table 7.16: York Road-Baronga Avenue Left Turn Slip Lane Queue Length – Ultimate Stage

Scenario	York Road West Approach Left Turn Slip Lane 95th Percentile Queue Length (m)	
	AM Peak	PM Peak
Future 2036 – Stage 1 + 2 + Ultimate (with intersection upgrade only)	74	11
Future 2036 – Stage 1 + 2 + Ultimate (with modal shift + intersection upgrade)	37	10

As shown in Table 7.16, the resulting eastbound left turn queue is anticipated to reach 74m in the AM peak period if there would be no modal shift. This resulting queue would exceed the estimated left turn storage capacity of 46m.

However, with modal shift, the resulting queue length would be 37m in the AM peak period which could be accommodated within the proposed left turn bay.

It is also noted that the existing left turn movements at York Road-Baronga Avenue intersection is observed to be mainly generated by the school traffic, as discussed in Section 7.3.1. As such, the overflow left turn queue would likely to be contained and extend within the school property and would not impact the adjacent through traffic.

7.4 Future Estimated Modal Splits

Based on the existing modal splits at the school outlined in Section 3, the existing staff and student private car mode share (including drop offs) is generally as follows:

- Staff: 95 per cent
- primary school students: 86 per cent
- secondary school students: 67 per cent

Travel demand measures are recommended to be implemented to achieve a modal shift away from car use. Details of these measures are discussed in Section 8 and the Green Travel Plan.

It is noted that a modal shift between 3-5 per cent is typically considered to be a significant achievement (based on knowledge of local and international GTPs, and as stated by experts in Land Environment Court proceedings).

On this basis, a summary of the existing and projected modal splits for each user type is provided in Table 7.17.

Table 7.17: Existing and Projected Modal Splits

Main method of Travel	Staff		Primary Students*		Secondary Students*	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
Car Driver (no passengers)	71%	60%	-		6%	2%
Car Driver (with passenger)	22%	23%	-		0%	3%
Dropped Off (only passenger)	1%	1%	22%	10%	19%	8%
Dropped Off (with other passengers)	1%	1%	64%	66%	42%	44%
Walk	1%	3%	2%	5%	1%	3%
Cycling	0%	2%	0%	2%	0%	2%
Train / Bus	4%	10%	12%	17%	32%	38%
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

**These mode splits represent the arrival trips (AM) which have higher private car use than departure trips (PM)*

The above represents a modal shift of some 10 per cent from car travel based on existing travel modes to/from the College. In addition to this, an increased uptake in carpooling should also be targeted in order to reduce single occupancy trips to/from the College.

A 2% increase in bicycle use is anticipated which is considered achievable as an effect of increased bicycle parking and end-of-trip facilities in College, as well as the future extension of cycleway along Darley Road as discussed in Section 2.7.

Table 7.18 summarises the anticipated net additional site traffic generation for each mode associated with the proposed College redevelopment under the existing mode splits (assuming no mode shifts) and proposed mode share targets (as outlined in Table 7.17). These future modal split figures have been based upon the net additional provisions compared to the existing approved cap of the school (i.e. net additional 240 students and 29 staff).

Table 7.18: Estimated Student Trips for Each Mode (Ultimate Development Scenario)

Main method of Travel	Staff (+29)		Primary Students (+98)*		Secondary Students (+142)*	
	Existing Mode Splits	Mode Share Targets	Existing Mode Splits	Mode Share Targets	Existing Mode Splits	Mode Share Targets
Car Driver (no passengers)	21	17	-	0	9	3
Car Driver (with passenger)	6	7	-	0	0	4
Dropped Off (only passenger)	0	0	21	10	27	12
Dropped Off (with other passengers)	0	0	63	65	60	62
Walk	1	1	2	5	1	4
Cycling	0	1	0	2	0	3
Train / Bus	1	3	12	16	45	54
Total	**29**	**29**	**98**	**98**	**142**	**142**

**These mode splits represent the arrival trips (AM) which have higher private car use than departure trips (PM)*

As indicated previously, the above modal split targets, in our view, are considered realistic and a significant achievement.

It is noted that the travel mode split of students during the morning (arrival) is different than during the afternoon (departure) particularly with the bus trips. The mode splits presented in Table 7.17 and Table 7.18 represent the morning trips (arrival) which have higher private car use. On the other hand, bus mode share in the afternoon (departure) is significantly higher than in the morning. Table 7.19 presents the estimated bus trips in the future scenario with the associated proposed mode shift.

Table 7.19: Estimated Future Bus Trips

Mode	Staff (+29)	Primary Students (+98)		Secondary Students (+142)	
		Arrival	Departure	Arrival	Departure
Public Bus	+1 (3%)	+1 (1%)	+3 (3%)	+2 (1%)	+3 (2%)
School Bus	0%	+15 (16%)	+43 (44%)	+52 (37%)	+95 (67%)

As shown in Table 7.19, the proposed development is expected to result in a net increase of 67-138 students catching the school bus.

Based on the above estimate and typical bus capacity (i.e. 50 to 60 passengers per bus), it is expected that two to three buses would be required to cater an additional 138 students.

However, the School administration advised that additional shuttle bus services may not be able to be provided.

Notwithstanding, Section 2.6 indicates that the existing bus services generally operate below capacity. As such, the spare capacity may be able to accommodate this additional bus demand.

It is however recommended to undertake a regular monitoring of bus usage to assess if the bus services could still accommodate the increased population of the School. In addition, further detailed review is required to determine how many and what bus routes would be required based on the expected student intake each year and their associated catchment radius from the school.

8 Travel Demand Measures

Travel demand management is a term for strategies to encourage a modal shift from single occupant private vehicle trips and influence the way people move to/from a site to deliver better environmental outcomes to encourage sustainable travel and reduce traffic and parking impacts within communities.

A key element of travel demand management is the preparation of a Green Travel Plan (GTP). The primary purpose of GTPs at schools is to encapsulate a strategy for managing travel demand that embraces the principles of sustainable transport whilst recognising the unique context of travel planning at education facilities. In its simplest form, GTPs encourage travel using transport modes that have low environmental impacts, for example active transport modes including walking, cycling, public transport, and encourages better management of car use.

In the case of GTPs for schools, this is of vital importance as schools are often located in local residential areas which can negatively impact local traffic and parking amenity during the concentrated peak periods of school pick up and drop off times. Furthermore, on-site car parking is often a luxury as schools cannot afford to apportion limited land resources due to teaching space and play space requirements.

Therefore, the implementation of a GTP would assist manage travel demand at the school, particularly with consideration to the future expansion of the school. It is expected that the GTP document would target staff and parents at the school.

It is however noted that the College already carries out a number of green travel measures for members of staff, parents/caregivers and students. These include:

- Provision of a Transport Access Guide (TAG) (or Transport Management Plan) which is given to all staff, students and parents/ caregivers
- Provision of information at the School and on the School's website to make staff and students more aware of the alternative transport options available to them
- Provision of bicycle facilities including bicycle parking and shower and change room facilities
- Regular updates on active travel in the School's newsletter to staff and visitors to help promote local travel initiatives.

8.1 School Feedback

As part of the survey questionnaire distributed to both staff and students at the school, staff and students were asked why they chose drive to the school. The majority of responses related to convenience, as shown in Figure 8.1 and Figure 8.2.

Figure 8.1: Reasons for Travel Choices – Staff

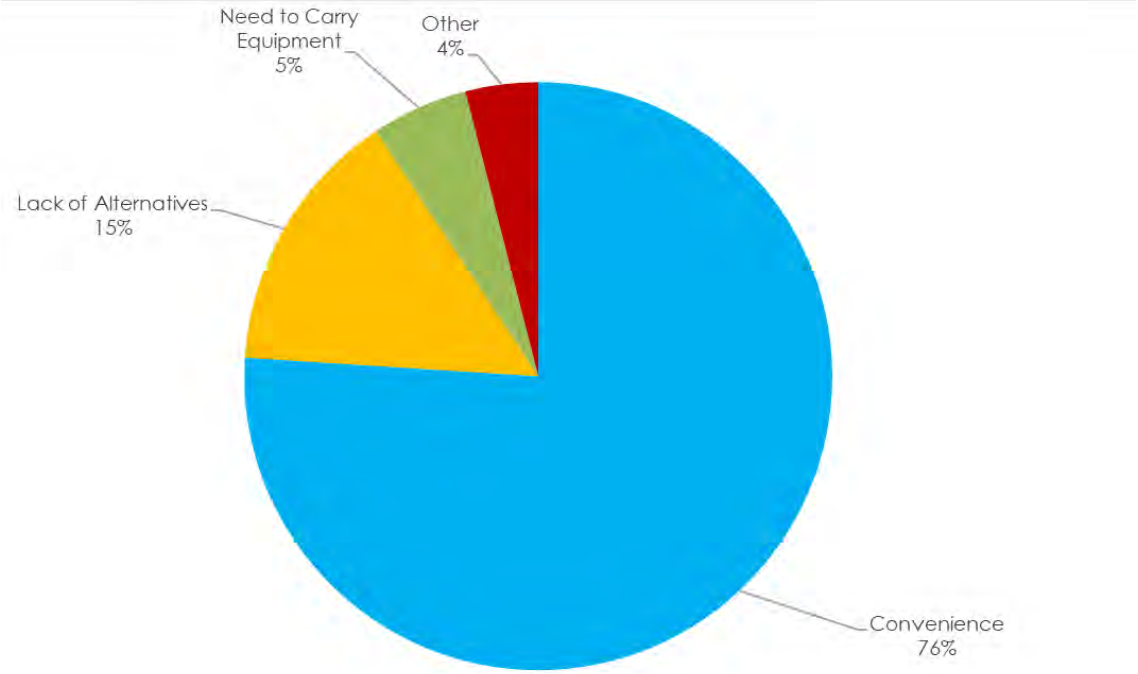
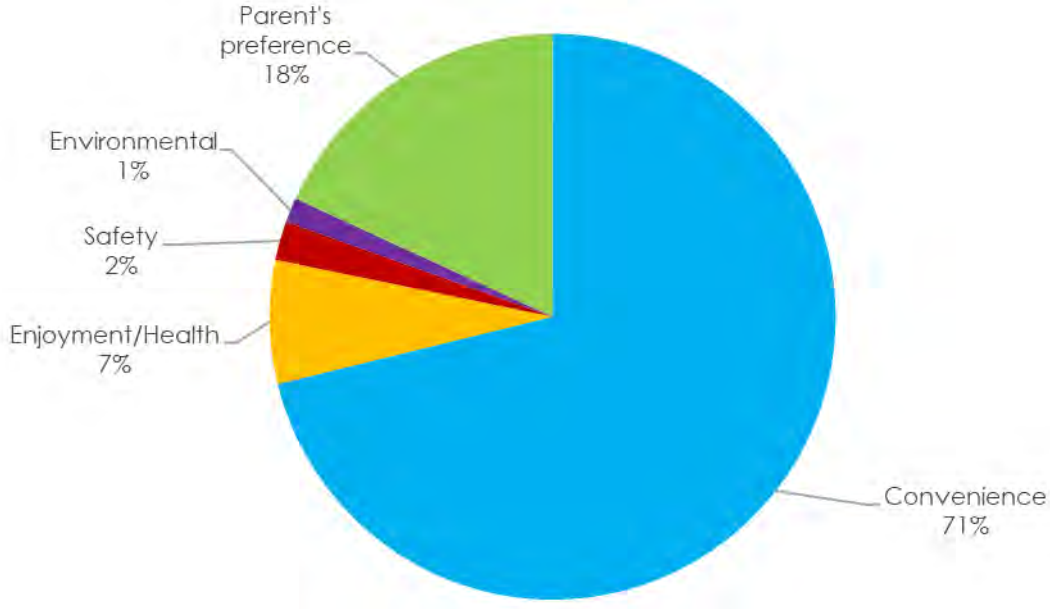


Figure 8.2: Main reason for travelling this way – Students



On this basis, one of the underlying measures to reduce car travel would be to reduce the convenience (i.e. reducing / restricting car parking provision on-site).

8.2 Green Travel Plan Initiatives

Based on the above, the following general travel strategies have been considered for implementation in the GTP to encourage more sustainable travel:

- organise a carpool system/registry which could reduce single private vehicle car trips to and from the school
- provision of public transport timetable, car share vehicle locations and cycle maps on noticeboards to make staff more aware of alternative transport options
- organise a walking/cycling group, or similar, to promote walking/use of bicycles of staff and students living in the same area
- organise lessons to teach students and staff to ride a bike
- provision of appropriate uniform for students to ride to school
- enhance existing bicycle repair tools and end-of-trip facilities including shower and changing rooms as well as bicycle infrastructure
- arrange activities and promotions to encourage staff and students to use public transport
    - hosting and participating on active travel events such as Ride2Work Day and National Bike Week
    - provision of Opal card or GoGet car share discounts or incentives
    - affiliation to local bicycle retailer and service centre to provide discounts for staff and students
- provision of a dedicated car share bay within the school grounds to promote staff use of such car share facilities.

In addition, the College will consult with Waverley Council and/or TfNSW with a view to implementing several off-site measures to improve the transport connections to and from site including:

- investigations with Council to improve the existing bike routes surrounding the College as shown in Council's Bike Map. This is to include improvement of infrastructure to provide better bicycle access from existing Queens Park cycleway to Baronga Avenue zebra crossing.
- improved signage and way finding from the surrounding local road network, to improve walking and cycling experience. Signage would include way finding for cyclists on the best and safest route to the College.
- discussions with TfNSW to provide additional school bus services and more frequent services to/from the Campus, particularly during the school morning period.

Further details of the above proposed measures are discussed in the GTP report.

8.2.1 Monitoring of the GTP

For the GTP to be effective, it is recommended that the GTP be monitored on a regular basis, e.g. per term or yearly, through travel surveys, staff meetings, parent consultations or similar. Travel surveys would show how staff, students and parents travel to/from the site and assist identify whether the proposed initiatives and measures outlined in the GTP are effective or are required to be replaced or modified to ensure that the best outcomes are achieved. Regular consultation with staff, students and parents would also be beneficial to help understand people's reasons for travelling the way they do and help identify any potential barriers to change their travel behaviours.

In order to ensure successful implementation of the GTP, a Travel Plan Coordinator (TPC) should be appointed to oversee the measures and resultant impacts of the GTP.

8.3 Staggering Arrival and Departure Times

At present, primary and secondary start and finish times are staggered. However, it may be desirable to further stagger start and finish times for each year group. Staggering drop off and pick up times for school children can help alleviate congestion during peak periods. It is therefore recommended that the start and finish times be amended for each year group to assist distribute school related trips during school drop off and pick up times.

In addition to this, schemes can also be easily implemented by the schools through the School News Bulletin (or similar) to provide parents with a general guideline as to what time they should drop off and pick up their child for each year group. This however may raise some concerns for parents who have more than one child in different year group at the school.

Further detailed consultation with staff and students/parents would need to be conducted to understand if amending the existing start and finish times are viable. It may become necessary that an "after class" room be established with a supervising teacher to accommodate any students who are waiting for their sibling in a different year group at the school.

A more detailed Green Travel Plan has been prepared as part of the SSD package of works. It is however envisaged that that any consent of the approval would require a commitment to prepare an Operational Transport Management Plan prior to Construction Certificate to outline the proposed traffic management measures to be implemented at the school, including mode share targets and proposed travel strategies to reduce private vehicle trips.

9 Conclusion

This study details our assessment of the traffic and transport implications associated with the proposed expansion of the school. The key findings of this report are presented below.

- It is proposed to deliver a new STEAM building to facilitate new teaching spaces across two stages.
- The proposal seeks to increase the number of primary and secondary students from the existing approved population cap of 1,600 to 1,840 students (i.e. increase of 240 students). It is however noted that the existing school population (as of 2019) is 1,455 students. In addition to this, it is proposed to increase the number of ELC students from 80 to 130 children.
- It is anticipated that the Stage 1 (Year 2023) proposal would generate additional 107vph and 71vph during the school AM and PM peak periods respectively.
- The Stage 2 (Year 2030) proposal is expected to generate an additional 62vph and 32vph during the school AM and PM peak periods respectively.
- The ultimate development stage (Year 2036) is anticipated to generate additional 27vph and 18vph during the school AM and PM peak periods respectively.
- Overall, the proposed scheme combined (i.e. Stages 1, 2 and ultimate stage) is expected to generate an additional 196vph and 121vph during the school AM and PM peak periods respectively.
- The intersections of York Road-Queens Park Road and York Road-Baronga Avenue currently operates at E in the AM peak and PM peak respectively.
- The signalised intersection of York Road-Darley Road-Avoca Street is currently operating at capacity, with LoS almost tipping to LoS E in the AM peak.
- Traffic modelling results indicate that the key signalised and priority-controlled intersections would operate with LoS F by year 2036, regardless of the additional school traffic.
- Queens Park Road-Baronga Avenue intersection would still continue to operate satisfactorily at LoS A or better during the AM and PM peak periods even with the completion of ultimate development stage.
- It is recommended that the existing York Road-Queens Park Road intersection be upgraded as a seagull intersection to improve the existing and future operations of the intersection. A slip lane at York Road-Baronga Avenue intersection could also significantly improve the intersection performance.
- To manage the impacts associated with the proposal, the school will implement travel demand management measures to minimise its impact on the surrounding road network, including the:
    - provision of a green travel plan for the school

  - introduction of staggered arrival and departure times for each year group and ELC.
- The proposed travel demand measures are expected to reduce the school car use by 10%.
- The achievement of 10% modal shift will ensure that traffic levels post development are comparable to those currently achieved.
- Although there would be significant improvement in the delays at York Road-Baronga Avenue intersection due to the combined improvement from the proposed upgrades and modal shift, the intersection would still operate at LoS F in both peak periods. However, the high delays at this intersection are caused by the left-turn movements from Baronga Avenue which are in turn caused by the upstream congestion generating from York Road-Darley Road-Avoca Street.
- Whilst the College can directly address the impacts in the close vicinity of the College with the roadworks proposed, the York Road-Darley Road-Avoca Street intersection is an existing problem which needs to be addressed by Council.

Overall, it is concluded that the traffic and parking aspects of the proposed scheme could be managed and would generally be acceptable. With the implementation of green travel strategies, the vehicle trip generation of the proposed scheme would significantly be reduced such that it would be comparable with that generated by the approved school capacity.

Thus, the surrounding key intersections would not be unreasonably affected by the proposed school expansion.

Regular management and extensive education/consultation with key stakeholders of the schools, including staff and parents, would need to be conducted to ensure the success of the proposed mitigation measure and green travel strategies/initiatives.

Appendix A

SIDRA Calibration Report

Memorandum

To: Moriah College

From: The Transport Planning Partnership (TTPP)

Date: 5 November 2020

TTPP REF: 19143

RE: MORIAH COLLEGE
SIDRA MODELLING CALIBRATION REPORT

As requested, please find herein The Transport Planning Partnership's (TTPP) traffic modelling calibration report as part of the response to Department of Planning, Industry and Environment (DPIE) request for information (RFI).

Traffic Modelling Purpose and Scope

A traffic network model has been prepared to assess the impacts of the additional traffic generated by the SSD-10352 proposal located at Queens Park Rd, Queens Park. The modelling analysis was undertaken as part of a Traffic and Accessibility Impact Assessment (TIA) to support an Environmental Impact Statement for the proposal.

The traffic model has been updated to incorporate the comments raised by DPIE based on the independent peer review of the TIA report prepared by TTPP (dated 12 June 2020).

The traffic modelling scope undertaken for the proposal is shown in Figure 1.

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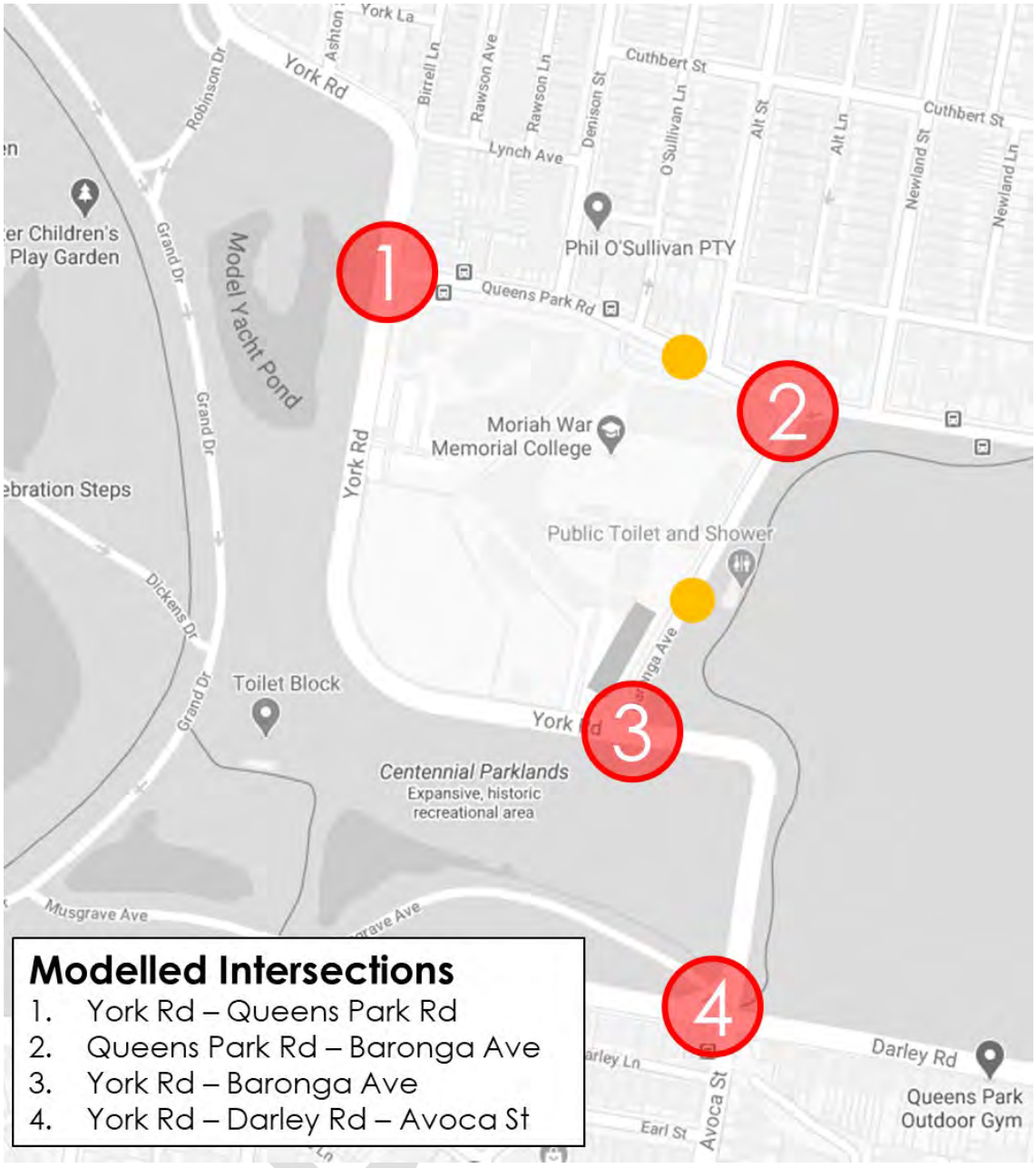
The Transport Planning Partnership
Suite 402, 22 Atchison Street
ST LEONARDS NSW 2065

Figure 1: Traffic Modelling Scope



Traffic Survey Data

Classified intersection counts were commissioned by TTPP on Tuesday, 28 May 2019 in the morning peak period between 7:00am - 9:00am and the afternoon peak period between 2:00pm – 6:00pm at the following intersections:

- York Road – Queens Park Road
- Queens Park Road – Baronga Avenue

- York Road – Baronga Avenue

Traffic survey cameras were installed at the intersections listed in Figure 1 and the video survey footage was reviewed, and data processed by Trans Traffic Survey Pty Ltd.

To address the comments and request for information (RFI) raised by DPIE, additional traffic surveys were commissioned on Thursday, 22 October 2020 for the same time period.

The additional surveys were undertaken at the following locations:

- York Road – Darley Road – Avoca Street
- York Road – Baronga Avenue (for comparison purposes)
- Baronga Avenue zebra crossing
- Queens Park Road zebra crossing

The location of surveyed pedestrian zebra crossings are depicted as yellow circles in Figure 1.

These additional surveys were collected and processed by Matrix Traffic and Transport Data.

SIDRA Version and Peak Periods

Traffic modelling was undertaken using SIDRA Intersection (Version 8.0). The peak periods were identified across the network as follows:

- Weekday AM network peak period: 7:45am – 8:45am
- Weekday PM network peak period: 3:00pm – 4:00pm.

Intersection turning counts as surveyed on 28 May 2019 have been provided via the Dropbox link below: https://www.dropbox.com/scl/fi/8sbn5swi8g1k1s8k1h0hl/TMCs-Moriah-College.xlsx?dl=0&rlkey=as02a993afa6ebexdxxpvfegb

The 22 October 2020 counts are presented in the Response to RFI letter prepared by TTPP (dated 06 November 2020).

Traffic Modelling Inputs and Assumptions.

Queue Lengths

Queue lengths at each approach of the surveyed intersections were recorded on-site and reviewed in-line with survey video footage. Site observations were gathered by TTPP staff at the time which the traffic surveys were undertaken during AM and PM peak periods.

The SIDRA models were calibrated to reflect existing traffic conditions based on queue lengths at each approach.

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A comparison of the maximum observed queue lengths and the SIDRA output 95th percentile queue lengths are presented in Table 1.

Table 1: Queue Lengths

Intersection	Control	Approach	Maximum Queue Length			
			AM Peak Hour		PM Peak Hour	
			Observed (m)	Modelled (m)	Observed (m)	Modelled (m)
York Road – Queens Park Road	Priority	South	<50	27	<10	7
		East	<20	14	<10	7
		North	~0	0	~0	0
Queens Park Road - Baronga Ave	Roundabout	South	~90	70	<40	30
		East	<40	28	<30	21
		West	<30	24	<20	16
York Road – Baronga Ave	Priority	East	90-100	110	120-130	117
		North	<50	21	20-30	25
		West	~0	0	~0	0
York Road - Darley Road - Avoca Street	Signals	South	>170	175	>90	168
		East	~225	247	>145	213
		North	<250	266	<250	218
		West	~120	179	~90	162

Intersection Layout Configuration

All intersections have been configured based on aerial imagery and site observations captured at the time of completing the modelling analysis. The traffic control signal plan of York Road-Darley Road-Avoca Street has also been used as a basis in developing the intersection layout and phasing arrangement.

The intersection layout and lane configurations were checked in-line with on-site observations and video footage taken on site. This includes:

- Number of lanes on each approach
- Traffic lane movement restrictions
- Roundabout and circulation lane widths
- Pedestrian crossings on intersection approaches.

Modelling Assumptions

Priority-Controlled Intersections

The default Sidra gap acceptance parameters of turning movements at priority-controlled intersections were applied except for the calibrated movements to match the observed

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queues. Gap acceptance values of calibrated movements have been adjusted based on the recommended values in Appendix E of the Roads and Maritime Services Traffic Modelling Guidelines as shown in Figure 2 where they replicated real world conditions. The gap acceptance values have been adjusted incrementally whilst maintaining the same factor between critical gap and follow-up headway values shown in Figure 2.

Figure 2: Roads and Maritime Services Recommended Gap Acceptance Parameters

Recommended values of gap acceptance parameters:
Based on AUSTROADS (2002, 2005) Guides

Type of movement	AUSTROADS (2002, 2005)		Default or recommended values and ranges for use in SIDRA INTERSECTION	
	Critical gap (seconds)	Follow-up headway (seconds)	Critical gap (seconds)	Follow-up headway (seconds)
Left turn (1)	5	2 - 3	(3 - 6)	(2.0 - 3.5)
1-lane opposing			4.5	2.5
2-lane (or more) opposing			5.0	3.0
Through movement crossing one-way road				
2-lane one-way	4	2	4.5 (4 - 5)	2.5 (2 - 3)
3-lane one-way	6	3	5.5 (5 - 6)	3.0 (2.5 - 3.5)
4-lane one-way	8	4	6.0 (5 - 8)	3.5 (3 - 4)
Through movement crossing two-way road				
2-lane two-way	5	3	5.0 (4.5 - 5.5)	3.0 (2.5 - 3.5)
4-lane two-way	8	5	6.5 (5 - 8)	3.5 (3 - 5)
6-lane two-way	8	5	7.5 (7 - 8)	4.5 (4 - 5)
Right turn from major road (2)				
Across 1 lane	4	2	4.0 (3.5 - 4.5)	2.0 (2 - 3)
Across 2 lanes	5	3	4.5 (4 - 5)	2.5 (2 - 3)
Across 3 lanes	6	4	5.5 (5 - 6)	3.5 (3 - 4)
Right turn from minor road (3)				
One-way	3	3	Use Left turn values above	
2-lane two-way	5	3	5.5 (5 - 6)	3.5 (3 - 4)
4-lane two-way	8	5	7.0 (6 - 8)	4.0 (3 - 5)
6-lane two-way	8	5	8.0 (7 - 9)	5.0 (4 - 6)
Merge from acceleration lane	3	2	3.0 (2.5 - 3.5)	2.0 (1.5 - 2.5)

Notes (1) to (3) below are not included in the AUSTROADS Guides.

(1) This is considered to apply to left-turn movements from minor road, as well as slip-lane left-turn movements from minor road.

(2) This case is relevant to two-way major road conditions with one direction of the major road opposing (1-lane, 2-lane or 3-lane).

(3) The conditions specified (one-way, 2-lane two-way, 4-lane two-way, 6-lane two-way) are relevant to the opposing movement lanes on the major road.

Source: RMS Traffic Modelling Guidelines

Signalised intersection

The signalised intersection of York Road-Darley Road-Avoca Street has been calibrated by adjusting the following parameters:

- Phase times: Average phase times have been used as a basis in developing the existing traffic model. Phase times have been recorded on site for a minimum of ten cycles on the same day and time period as the traffic survey. Average phase times have been slightly modified to calibrate the observed queues. It is ensured that the adjusted phase times are still within the minimum and maximum values recorded on site.
- Lane utilisation ratio: By default, Sidra adjusts lane utilisation ratio of the model based on several factors including upstream blockage and short lane effects. Utilisation ratio of some lanes have been manually modified to override Sidra programmed utilisation ratios in order to better match what was observed on site.
- Lane capacity: As a final adjustment, capacity of some lanes have been increased to calibrate the model such that the resulting queues are comparable with the observed queues. Lane capacity adjustment has been kept to a maximum of +15%.

Summary

This memorandum is prepared for Moriah College to detail TTPP's methodology of traffic modelling undertaken for SSD-10352. A summary of the modelling calibration and assumptions are as follows:

- Traffic surveys of the modelled intersections were undertaken on Tuesday, 28 May 2019 and Thursday, 22 October 2020.
- All intersections have been configured based on aerial imagery and site observations captured at the time of completing the modelling analysis. Traffic control signal plan of York Road-Darley Road-Avoca Street has also been used as a basis in developing the intersection layout and phasing arrangement.
- Gap acceptance values of some movements have been adjusted at priority-controlled intersections based on Roads and Maritime Services Traffic Modelling Guidelines.
- York Road-Darley Road-Avoca Street has been calibrated by adjusting the phase times, lane utilisation ratio and lane capacity values.

Based on the above, the SIDRA network models that have been prepared to reflect the existing conditions observed on site during the survey dates.

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Appendix B

GHD Existing Conditions Road Safety Audit

Moriah War Memorial College Association

Moriah War Memorial College

Existing Conditions Road Safety Audit

August 2019

Disclaimer

This road safety audit report ("Report"):

- *has been prepared by GHD Pty Ltd ("GHD") for Moriah War Memorial College Association;*
- *may only be used and relied on by Moriah War Memorial College Association for the purpose agreed between GHD and Moriah War Memorial College Association;*
- *must not be copied to, used by, or relied on by any person other Moriah War Memorial College Association without the prior written consent of GHD;*
- *may only be used for the purpose of documenting the identified safety deficiencies for the project (and must not be used for any other purpose).*
- *GHD and its servants, employees and officers otherwise expressly disclaim responsibility to any person other than Moriah War Memorial College Association arising from or in connection with this Report.*
- *To the maximum extent permitted by law, all implied warranties and conditions in relation to the services provided by GHD and the Report are excluded unless they are expressly stated to apply in this Report.*

The services undertaken by GHD in connection with preparing this Report:

- *were limited to those specifically detailed in section 2.1 of this Report;*
- *The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD when undertaking services and preparing the Report ("Assumptions").*
- *GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with any of the Assumptions being incorrect.*
- *Subject to the paragraphs in this section of the Report, the opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the time of preparation and maybe relied on until 6 months, after which time, GHD expressly disclaims responsibility for any error in, or omission from, this Report arising from or in connection with those opinions, conclusions and any recommendations.*

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1. Introduction

1.1 Background

On 15 July 2019 the Secretary's Environmental Assessment Requirements (SEARs) (SSD10352) for the project were received from the Department of Planning Environment and Industry (DPIE). At Section 7 the SEARs required:

> *"a road safety audit of existing conditions, during the AM and PM school peak periods, along the following sections of road:*
>
> - *York Road, between Queens Park Road and Baronga Avenue*
> - *Queens Park Road, between York Road and Baronga Avenue*
> - *Baronga Avenue, between Queens Park Road and York Road*
>
> *Note: any road safety audit would need to be undertaken by a suitably qualified audit team that is independent from the project team."*

This Road Safety Audit Report has been prepared to provide information for the Planning Agency Head to assist them in determining the application.

- The proposed state significant development at Moriah War Memorial College includes the following:
- Staged construction of new school buildings. Including a new part 3 and part 4 storey STEAM building and construction of a 3 storey Early Learning Centre (ELC) building and administration offices.
- Staged student population increase from 1680 students on the site to 2020 students across ELC primary and high school.

This report outlines the Existing Conditions Road Safety Audit undertaken and associated findings.

1.2 Purpose of this report

This report has been prepared to document the safety deficiencies identified during the Existing Conditions Road Safety Audit (RSA) (Austroads 2019) for the road network adjacent to Moriah War Memorial College as defined in the study extent. This audit aims to identify potential safety conditions with respect to user interaction within the road environment.

The audit may identify unusual features that may or may not lead to safety deficiencies, but inconsistent or unexpected road features can be a hazard to users and therefore engineering judgment is to be applied.

The RSA is carried out by a team of independent auditors who can provide an unbiased and objective safety review.

1.3 Road safety audit process

The RSA followed the process below:

- A commencement meeting was undertaken on Tuesday 6 August 2019 to identify project history and outline the RSA process. The meeting was attended by:
  - Kate Lyons (Aver Development and Project Management C/- Moriah War Memorial College Association – Senior Project Manager)

– Michael Carbone (Aver Development and Project Management C/- Moriah War Memorial College Association – Project Manager)
– Sean Clarke (GHD – Lead Road Safety Auditor),

- A site inspection was carried out by the audit team during the AM and PM School Zone periods on Thursday 8 August 2019.
- An audit report was produced by the audit team following the site inspection.
- A completion meeting would be held where the findings were discussed.

1.4 Project location

Moriah War Memorial College is located in Queens Park east of Centennial Parklands. The Road Safety Audit study area incorporated the adjacent road network as shown in Figure 1-1 which includes:

- York Road, between Queens Park Road and Baronga Avenue.
- Queens Park Road, between York Road and Baronga Avenue.
- Baronga Avenue, between Queens Park Road and York Road.

Figure 1-1 Road Safety Audit Study Area

Source: Google maps – modified by GHD

1.4.1 Existing road network

The existing road network adjacent to the Moriah War Memorial College include the following site conditions.

York Road

York Road is a local collector road orientated in a north-south direction, providing a link between the suburb of Randwick to the south and Syd Enfield Drive, Bondi Junction to the north. Within the study area, York Road has the key characteristic as outlined in Table 1.

Table 1 York Road key characteristics

Feature	Description
Carriageway	Two-way undivided carriageway with a single travel lane in each direction. Left turn lane southbound into Gate 1 during the school periods via the implantation of No Parking 7:00 am – 8:30 am and 2:30 pm – 4:00 pm School Days restriction.
Parking	Eastern kerbline: Typically No Parking 7:00 am – 8:30 am and 2:30 pm – 4:00 pm School Days. Western kerbline: Typically 4P 8 am – 6 pm Daily.
Speed Limit	50 km/h with 40 km/h School Zone 7:00 am – 8:30 am and 2:30 pm – 4:00 pm School Days.
Pedestrian Facilities	Pedestrian path on the eastern kerb and pedestrian refuge north of Gate 1 providing access to Centennial Parklands.
Bicycle Facilities	On-road mixed environment.
Public Transport	No dedicated facilities.
School Access	Gate 1 provides secure pedestrian and vehicle access with a link to an internal drop off pick up facility within the school ground. Gate 4A provides secure pedestrian access to the school, and link to the school prick up drop off facility along the northern kerb of York Road. Gate 4 provides secure vehicle access to the school.

Baronga Avenue

Baronga Avenue is a local road orientated in a north-south direction, providing a link between York Road to the west and Council Street to the east. Within the study area, Baronga Avenue has the key characteristic as outlined in Table 1.

Table 2 Baronga Avenue key characteristics

Feature	Description
Carriageway	Two-way undivided carriageway with a single travel lane in each direction.
Parking	Eastern kerbline: Typically No Parking 7:00 am – 8:30 am School Days or Bus Zone 2:30 pm – 4:00 pm School Days (within a designated lay-by). Western kerbline: Unrestricted parking
Speed Limit	50 km/h with 40 km/h School Zone 7:00 am – 8:30 am and 2:30 pm – 4:00 pm School Days.
Pedestrian Facilities	Pedestrian paths on the eastern and western kerb and raised pedestrian zebra crossing opposite Gate 3 providing access to Queens Park (sporting oval).
Bicycle Facilities	On-road mixed environment.

Feature	Description
Public Transport	Bus Zone on the western kerb within a designated lay-by (utilised by school bus services only).
School Access	Gate 3 provides secure pedestrian access with a link to the drop off pick up/bus zone facility located within the designated layby. Gate 3A provides secure pedestrian access with a link to the drop off pick up/bus zone facility located within the designated layby.

Queens Park Road

Queens Park is a local road orientated in an east-west direction, providing a link between York Road to the south and Queens Park Road to the north. Within the study area, Queens Park Road has the key characteristic as outlined in Table 1.

Table 3 Queens Park Road key characteristics

Feature	Description
Carriageway	Two-way undivided carriageway with a single travel lane in each direction.
Parking	Northern kerbline: Typically 2P 8 am – 6 pm Daily (Permit Holders Exempted as part of the Resident Parking Scheme) Southern kerbline: No Stopping 7:00 am – 8:30 am and 2:30 pm – 4:00 pm School Days
Speed Limit	50 km/h with 40 km/h School Zone 7:00 am – 8:30 am and 2:30 pm – 4:00 pm School Days.
Pedestrian Facilities	Pedestrian paths on the northern and southern and pedestrian zebra crossing opposite Gate 2.
Bicycle Facilities	On-road designated cycle lane in both directions.
Public Transport	Bus Zone on the northern and southern kerb (utilised by public bus services).
School Access	Gate 2 provides secure pedestrian access. Although this access is restricted to staff only. Adjacent to the pedestrian gate is a secure gated system to a staff parking area.

2. Objectives, process and evaluation criteria

2.1 Objectives of the road safety audit

A RSA is “a formal examination of a future road or traffic project or an existing road, in which an independent, qualified team reports on the project’s crash potential and safety performance” (Guide to Road Safety, Part 6A: Implementing Road Safety Audits - Austroads 2019).

2.2 Process of the road safety audit

The RSA followed standard practice in identifying safety related issues. It involved a site visit during day and night period. Standard issues such as sight distance, speed zones, lighting, safety barriers, approach road alignment, delineation, line marking and signage, intersection layout and conditions (amongst others) were assessed with respect to safety. The audit is structured around a standard checklist provided in the “Guide to Road Safety, Part 6A: Implementing Road Safety Audits”, Austroads 2019 and Roads and Maritimes Services “Guidelines for Road Safety Audit Practices, July 2011”.

2.3 Criteria used to assess the levels of risk

Risk levels have been assigned for each deficiency identified along the route by the audit team and are based on the criteria set out in the Austroads guide. These risk levels have been determined based on the deficiency’s frequency and severity. Definitions of the different levels of frequency and severity have been reproduced in Table 4 and Table 5 below from Austroads Guide to Road Safety, Part 6A: Implementing Road Safety Audits, 2019.

Table 4 Summary of frequency descriptions

Frequency	Description
Frequent	Once or more per week
Probable	Once or more per year (but less than once a week)
Occasional	Once every five or ten years
Improbable	Less often than once every ten years

Table 5 Summary of severity descriptions

Severity	Description
Catastrophic	Likely multiple deaths
Serious	Likely death or serious injury
Minor	Likely minor injury
Limited	Likely trivial injury or property damage only

Austroads Guide to Road Safety, Part 6A: Implementing Road Safety Audits, 2019, provides definitions for four different levels of risk, namely, “intolerable”, “high”, “medium” or “low”. Extracts of the risk assessment matrix from Austroads are provided below in Table 6.

Table 6 Summary of levels of risk

		Frequency			
Severity		Frequent	Probable	Occasional	Improbable
	Catastrophic	Intolerable	Intolerable	Intolerable	High
	Serious	Intolerable	Intolerable	High	Medium
	Minor	Intolerable	High	Medium	Low
	Limited	High	Medium	Low	Low

It is noted that as a consequence of the Austroads guide not adopting a more objective risk ratings process, the risk rating reported in all Road Safety Audits are subjective. As a result, the audit findings can be skewed towards reporting risks as “high” and “intolerable”. Care should be taken by the appropriate decision maker when using these results to justify an outcome.

Care should be taken by the appropriate decision maker when using these results to justify an outcome.

Of the four possible risk rating levels (i.e. Intolerable, high, medium or low) a description of their priority are defined below in Table 7.

Table 7 Priority to levels of risk

Level of Risk	Description of Priority to Risk Rating
Intolerable:	A significant road safety risk requiring immediate urgent attention.
High:	A high road safety risk requiring immediate or urgent attention.
Medium:	A road safety risk that may lead to crashes and that requires attention as soon as reasonably practicable.
Low:	A lower road safety risk that requires attention. Remedial action may be carried out on a non-urgent basis, such as in conjunction with routine road maintenance or other planned work.

2.4 Road safety categories

RSA categories are utilised to assist the management of corrective actions and the monitoring of road safety deficiency trends. A list of the available categories is scheduled in Table 8 below which has been derived from the Roads and Maritime Services road safety categories information sheet.

Table 8 Road safety audit categories

Category	Examples
Access Impact	Property developments, traffic generators, rest areas, emergency vehicles, service vehicles, maintenance, vehicles breakdowns, etc.
Auxiliary Lanes	Overtaking lanes, passing lanes, tapers, merges, etc.
Bridge Structures	Road bridge, pedestrian bridge, rail bridges etc.
Bus Infrastructure	Bus lanes, bus facilities, bus stops etc.
Cycle Infrastructure	Cycleways, on-road facilities, off-road facilities, cycle routes etc.
Delineation	Guide posts, pavement markings, reflectors, warning signs etc.
Heavy Vehicle Infrastructure	Inspection bays, facilities, provisions, routes etc.
Intersection	Roundabouts, T-junctions, cross junctions etc.
Landscaping	Shrubs, trees etc.
Lighting	Street lighting, tunnel lighting etc.
Miscellaneous	Matters not covered by categories listed.
Network Effects	Road function, traffic composition, traffic volume, traffic characteristics, route choice, impact of continuity with the existing network etc.
Special Road User Infrastructure	Trains, ferries, trams, equestrian, stock, special events etc.
Pedestrian Infrastructure	Pathways, pedestrian crossings, pedestrian fencing etc.
Road Alignment and Cross Section	Sight distance, visibility, readability by drivers, glare, widths, shoulders, crossfalls, batter slopes, drains etc.
Road Pavement	Pavement defects, skid resistance, ponding, loose stones material etc.
Roadside Activities	Roadside advertising, road side designs, vending etc.
Roadside hazards	Clearzones, utility poles, culverts, bridge structures, trees etc.
Speed Zones	Speed limits, speed zones, design peed, school zones etc
Traffic Management and Operation	Staging of works, temporary traffic control, detours, peak tidal flows, clearways, parking etc.
Traffic Management Devices	Threshold treatments, road humps, kerb extensions, slow points etc.
Traffic Signals	Signal phasing, bus signals, bicycle signals pedestrian signals etc.
Traffic Signs	Regulatory signs, warning signs, guide signs etc.
Tunnel Structures	Road tunnels, pedestrian tunnels, cycle tunnels etc.

2.5 Road safety audit team

The RSA team comprised of the following accredited auditors with the NSW Centre for Road Safety's Register of Road Safety Auditors:

Audit Team Leader

Sean Clarke	GHD Pty Ltd, Sydney.
Auditor ID:	RSA-02-0891
Level of Certification:	3

Audit Team Member

Mazyar Razmavar	GHD Pty Ltd, Sydney.
Auditor ID:	RSA-1378
Level of Certification:	2

2.6 Site inspection and audit

2.6.1 Commencement meeting

A project commencement meeting was undertaken on Tuesday 6 August 2019 between Kate Lyons and Michael Carbone (Aver Development and Project Management, representatives of Moriah War Memorial College Association) and Sean Clarke (Road Safety Audit Team).

The purpose of the meeting was to be inducted into the project and discuss the project scope, status, limitations, safety and any other relevant project information. The background information for the project was provided by Michael Carbone.

2.6.2 Time and date

A day inspection and audit were undertaken by the audit team to incorporate the AM and PM school peak periods. The inspections were undertaken on 8 August 2019 during the following times:

- 7:15 am to 9:00 am
- 2:00 pm to 4:00 pm

2.6.3 Weather conditions

The weather conditions during the site visit were clear skies and a dry road surface.

2.6.4 Completion meeting

A completion meeting was held on the 20 August 2019 at Moriah War Memorial College to discuss the issues identified during the road safety audit as outline in section 3. The following people were in attendance:

- Rabbi Smukler (Moriah War Memorial College)
- Roberta Goot (Moriah War Memorial College)
- Trevor Johnson (Moriah War Memorial College)
- Kate Lyons (Aver Development and Project Management)
- Michael Carbone (Aver Development and Project Management)
- Ken Hollyoak (The Transport Planning Partnership)

- Jessica Ng (The Transport Planning Partnership)
- Sean Clarke (GHD)

2.7 References

- Roads and Maritime Guidelines for Road Safety Audit Practices, July 2011.
- Austroads “Guide to Road Safety, Part 6: Road Safety Audit”, 2009.
- Austroads “Guide to Road Safety, Part 6A: Implementing Road Safety Audits”, 2019.

2.8 Documentation audited

The audit was in reference to background information provided by Aver Development and Project Management including:

- High level sketch of the works area of “Site Opportunities and Constraints“ extract from fjmt studio figure dated 17.06.19.
- Planning Secretary’s Environmental Assessment Requirements (SSD-10352) Section 7.
- Development Application Stamped consent (DA-163/2017) and approved Plan of Management dated 18 September 2017.
- Existing and future staff and student numbers.

2.9 Previous road safety audits

No previous road safety audits were provided

2.10 Limitations of this audit

The following limitations are associated with this audit and report:

- Any background information subsequent to the commencement of the RSA.
- Traffic volume and crash data were not used for assessment.
- Occupational Health and Safety limitations (site inspections were completed from the road reserve only).
- Visual conditions witnessed on site at the time of the audit.

3. Road safety audit findings

3.1 Visibility of signage

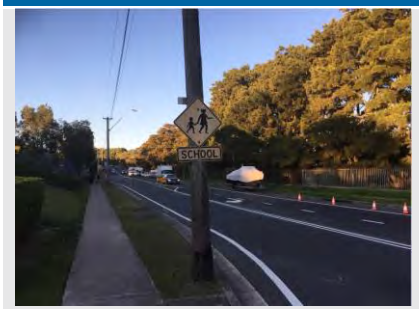
The site inspection identified a number of existing signs were made of a non-reflective material, damaged or were obstructed by vegetation. Such issues may interfere with advance warning or traffic conditions to be conveyed to the driver, resulting in a variety of crash types involving vehicles, pedestrians or cyclists.

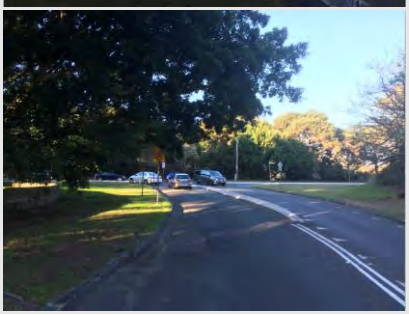
Risk Rating	
Severity	Serious
Frequency	Occasional
Risk	High

Special Road User Infrastructure
Traffic Signs

Table 9 outlines (but not limited to) the signs identified as part of this finding.

Table 9 Outline of signage visibility

Location	Finding	Photo
York Road – eastern kerb	Non reflective material on sign	
York Road – eastern and western kerb	No advance warning sign of pedestrian refuge	
York Road – eastern kerb	Signs obstructed by vegetation. “School Beware of Queuing Vehicles” sign not place in advance of the potential end of queue.	

Location	Finding	Photo
York Road – central median	Sign not correctly positioned	
Baronga Avenue – northern and southern kerb	Non reflective material on sign and obstructed by vegetation	 
Baronga Avenue – northern kerb	Non reflective material on sign	
Baronga Avenue – southern kerb	Non reflective material on sign	

Location	Finding	Photo
Queens Park Road – southern kerb	Damaged and non reflective material on sign	
Queens Park Road – southern kerb	Damaged and non reflective material on sign	
Queens Park Road – southern kerb	School Zone sign partially obstructed by pole	
Queens Park Road – southern kerb	Dislodged sign	
Queens Park Road – southern kerb	Deterioration of sign visibility and reflectivity	
Queens Park Road – central median	Non-standard sign type	

3.2 Linemarking / Delineation deterioration

The site inspection identified some of the existing delineation (linemarking) has deteriorated (not clearly visibly) or missing. Such issues may result in drivers not appreciating the road environment and not follow the intended path of travel and bring about a variety of crash types.

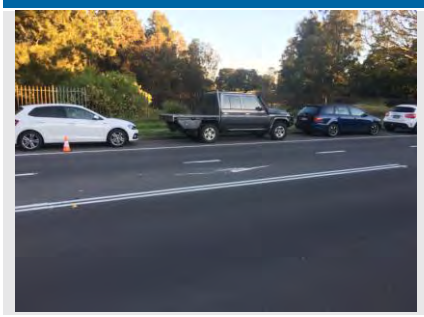
The following outlines (but not limited to) the delineation/linemarking identified as part of this finding.

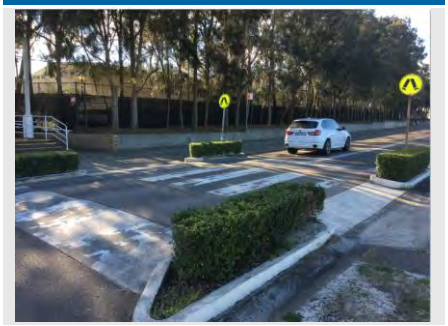
Risk Rating	
Severity	Minor
Frequency	Occasional
Risk	Medium

Special Road User Infrastructure
Delineation

Table 10 outlines (but not limited to) the delineation identified as part of this finding.

Table 10 Outline of linemarking / delineation deterioration areas

Location	Finding	Photo
York Road – southbound right turn lane into Queens Park Road	Deterioration of arrow linemarking	
York Road – southbound	Deterioration of 40 km/h School Zone patch	
Baronga Avenue – southern end	Hump missing “piano keys” to warn motorists	
Baronga Avenue – southern end	Missing Give Way line (TB) to advise motorists of intersection priority and appropriate vehicle waiting location	

Location	Finding	Photo
Baronga Avenue – mid block	Hump and pedestrian zebra crossing delineation deteriorating.	
Queen Park Road – mid block	Pedestrian zebra crossing and advance zig-zag delineation deteriorating.	
Queen Park Road – western end	Hump missing “piano keys” to warn motorists	

3.3 Deterioration of pavement

The site inspection identified that some of the existing pavement areas has deteriorated resulting is cracking and subsidence within the roadway. Such issues may result in drivers, particularity motorcycles and cyclist potentially losing control of their vehicle on impact of the degraded pavement areas. Such pavement areas are susceptible to further degradation due to water penetration into the pavement and vehicle movements.

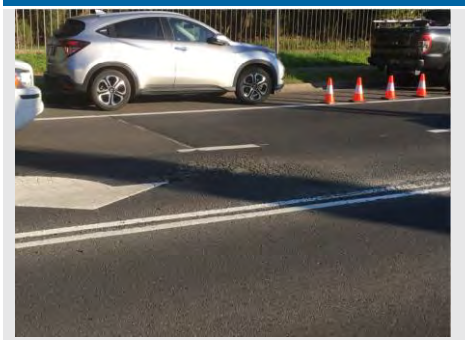
Additionally trip hazards are evident as a result of pavement subsidence of repairs along pedestrian paths. This can result in pedestrian injuring themselves on the trip hazards created.

Risk Rating	
Severity	Minor
Frequency	Occasional
Risk	Medium

Special Road User Infrastructure
Road Pavement

Table 11 outlines (but not limited to) the delineation identified as part of this finding.

Table 11 Outline of determination of pavement areas

Location	Finding	Photo
York Road – Right turn lane into Queens Park Road	Road pavement degradation	
York Road – Southbound on curve	Road pavement degradation	
York Road – Southbound within School drop off pick up area (Gate 4A)	Footpath pavement degradation	

Location	Finding	Photo
Baronga Avenue – southern end	Road pavement and pit degradation	
Queens Park Road – southern kerb	Footpath pavement degradation	
Queens Park Road – southern kerb (western end)	Footpath pavement degradation in front of bus stop	

3.4 York Road – Pedestrian Refuge

3.4.1 Pedestrian Refuge Layout

The site inspection identified the pedestrian refuge was not aligned to the current design from Roads and Maritimes Services Technical Direction for a pedestrian refuge, in that the island width is narrower than outlined in the Technical Direction (refer to Figure 3-1). It was evident at the inspection that a large amount of school children utilise this pedestrian refuge location to cross between the school and the Centennial Parklands opposite.

The narrowed pedestrian width, is not sufficient to accommodate the volume of school children resulting in an alternate pedestrian/vehicles control operation (refer to section 3.4.2 for further details) with potential risk to children and teachers colliding with through travelling vehicles.

Additionally, the narrow width would not accommodate the width required for people with bicycles or prams, resulting in bicycles or prams protruding into the through travel lane, while waiting within the refuge area.

Risk Rating	
Severity	Serious
Frequency	Occasional
Risk	High

Special Road User Infrastructure
Pedestrian Infrastructure

Figure 3-1 York Road Pedestrian refuge

3.4.2 Pedestrian refuge crossing operation

Typical operation of a pedestrian refuge is that pedestrians are to give way to through travelling vehicles, with the refuge island providing a waiting area mid-way to offer opportunity for the pedestrian to give way to one direction of traffic at any one time.

The site inspection identified that a large volume of students were required to cross at the pedestrian refuge to travel between the school and Centennial Parklands (refer to Figure 3-2). Due to the number of students, it was observed that a single teacher would stop traffic to allow students to cross York Road in groups.

The following safety issues are identified with this alternate pedestrian/traffic operation at the pedestrian refuge:

- The priority of vehicles and pedestrians is manually altered by the teacher (traffic controller) which is different from typical operational procedures. There is risk drivers may not be aware of the alternate operation (as there are no advance warning) and continue to travel in the through travel lane as a teacher steps out from the kerb, resulting in pedestrian / vehicle conflict.
- There is no advance warning to drivers (i.e. advanced signage) of the alternate operations undertaken or traffic control within the road environment, resulting in pedestrian / vehicle conflict.
- A single teacher is controlling both directions of traffic flow without operating signage. There is risk drivers may not observe the teacher, resulting in pedestrian / vehicle conflict.
- The teacher is not wearing high visibly clothing and is controlling traffic movement through the area. There is risk drivers may not observe the teacher, resulting in pedestrian / vehicle conflict.
- Teachers may not be appropriately trained and qualified to control traffic within public roads. There is certifications and requirements for traffic controllers to manage traffic movement within the road environment. Such training outlines safety and operational procedures permitted. Teachers may not be aware, unless suitably trained, in the appropriate traffic management procedure, resulting in potential injury to the teacher or students and impact on vehicles through the area.

Risk Rating	
Severity	Catastrophic
Frequency	Occasional
Risk	Intolerable

Special Road User Infrastructure
Pedestrian Infrastructure

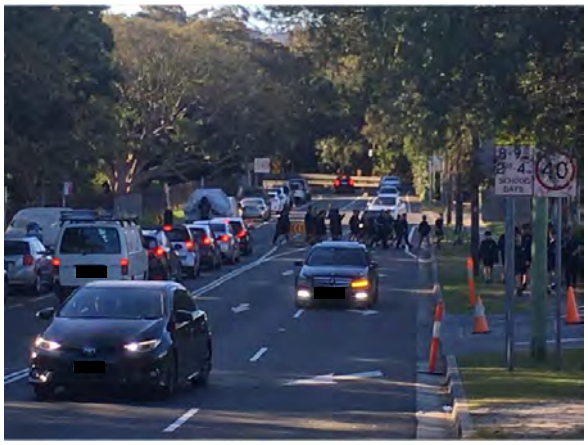


Figure 3-2 York Road pedestrian refuge – Alternate operation

3.5 Baronga Avenue – Raised pedestrian crossing

3.5.1 Change in priority at Baronga Avenue pedestrian crossing

There is currently a through travel lane and an adjacent through travel lane within a layby facility at the pedestrian zebra crossing on Baronga Avenue (refer to Figure 3-3).

The pedestrian zebra crossing is evident only in the through travel lane on Baronga Avenue and not the adjacent lay-by facility. There is risk that pedestrians may not be aware of the change in priority (in that the pedestrian is required to give way to through vehicles) within the layby. There is risk that through travelling vehicles may collide with a pedestrian.

Risk Rating	
Severity	Serious
Frequency	Occasional
Risk	High

Special Road User Infrastructure
Pedestrian Infrastructure

Figure 3-3 Baronga Avenue pedestrian crossing – Change in priority

3.5.2 Dual through travel lanes – visibility obstruction

Notwithstanding the findings outlined in section 3.5.1, it was observed however, that typically vehicles (notably busses) travelling through the layby, would stop to give way to pedestrians crossing the layby and Baronga Avenue carriageway or stop in immediate approach to the crossing area crossing (i.e. within the pedestrian crossing "No Stopping" restriction), while waiting in queue to collect children north of the pedestrian (refer to Figure 3-4).

The position of the vehicle (notably buses) within the layby would restrict visibility between pedestrians and drivers of northbound through travelling vehicles on approach to the pedestrian crossing. There is risk that through travelling drivers along Baronga Avenue carriageway may not clearly identify a pedestrian approaching the pedestrian crossing (and visa-versa), due to the stop vehicles adjacent, resulting in pedestrian/vehicle conflict.

Risk Rating	
Severity	Serious
Frequency	Occasional
Risk	High

Special Road User Infrastructure
Pedestrian Infrastructure

Figure 3-4 Baronga Avenue – Visibility obstruction to pedestrians

3.5.3 Lighting

The site inspection was only carried out during the daylight period during the school peak AM and PM peak pick up and drop off times, therefore current operation of the lighting was not able to be observed. However, it was identified at the pedestrian zebra crossing on Baronga Avenue had lighting for crossing on angle that may create artificial glare to southbound vehicles on approach to the pedestrian zebra crossing (refer to Figure 3-5). Such glare may affect the visibility of opposing approaching vehicles or pedestrians on the pedestrian zebra crossing resulting in potential pedestrian/vehicles impact or head on crash of approaching vehicles.

Risk Rating	
Severity	Serious
Frequency	Occasional
Risk	High

Special Road User Infrastructure
Lighting

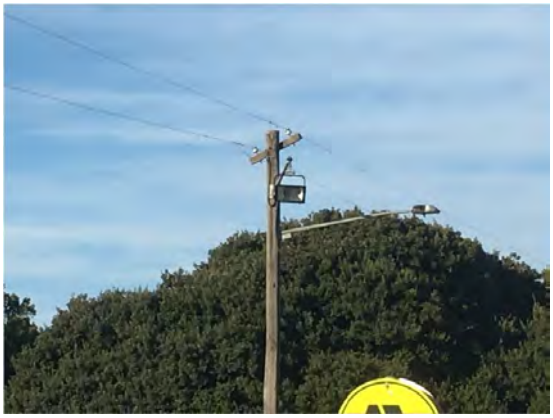


Figure 3-5 Baronga Avenue – Lighting

3.6 Gate 4A pick up operation

3.6.1 Gate 4A vehicle queue

It was observed at the site inspection, that vehicles were in queue from 2:40 pm to pick up students from gate 4A on York Road, with pick up operations commencing at 3:15 pm. This resulted in:

- An extended period of time for the queuing of vehicles prior to the release of school students.
- The vehicle queue was in advance of the “School Beware of Queuing Vehicles” advanced warning sign located on the southbound travel lane on York Road and therefore did not provide advance warning of the queue to approaching traffic (refer to Figure 3-6).
- It was also observed at the site visit that vehicles within the queue did not always position close to the rear of vehicle in front. This resulted in:
- A longer than necessary queue of vehicles.
- Vehicles attempting to “jump the queue”, causing the rear of the vehicle to be within the through traffic lane (refer to Figure 3-7).

There is risk that such queue operation may result in rear end type crashes on the curve or longer vehicle queue, adversely impacting on traffic movement.

Risk Rating	
Severity	Minor
Frequency	Occasional
Risk	Medium

Special Road User Infrastructure
Network Effects / Roadside Hazard

Figure 3-6 Gate 4A vehicle queue – Vehicle queue reaching the queue advance warning sign

Figure 3-7 Gate 4A vehicle queue – Vehicles jumping the queue

3.6.2 Traffic controller safety

It was observed at the site inspection a traffic controller was positioned to assist in the egress of vehicles from the pickup facility at Gate 4A to merge into the through travel lane. The traffic controller, while wearing high visibility clothing, was positioned between the pickup vehicles and the through traffic (to manoeuvre traffic cones). Refer to Figure 3-8. This position of the traffic controller adjacent to through traffic flow will have restricted emergency egress path in the event of an errant vehicle. Additionally there is no advance warning to approaching traffic that a traffic controller is within the road area.

There is risk a vehicle may impact the traffic controller and an emergency egress path may not be available for the traffic controller in the event of an errant vehicle.

Risk Rating	
Severity	Serious
Frequency	Occasional
Risk	High

Special Road User Infrastructure
Traffic Management and Operation

Figure 3-8 Gate 4A vehicle queue – Traffic controller safety

3.6.3 Safety to waiting people within the vehicle queue

It was observed at the site inspection, that as a result of drivers arriving prior to the released of students, time was available for drivers to alight from their vehicle to talk to other drivers while waiting. Conversations occurred adjacent to the through traffic lane (refer to Figure 3-9).

There is risk, especially on the curve, that through travelling vehicles may collide with people adjacent to the queued vehicles and there is no means of emergency egress path in the event of an errant vehicle.

Risk Rating	
Severity	Serious
Frequency	Occasional
Risk	High

Special Road User Infrastructure
Traffic Management and Operation

Figure 3-9 Gate 4A vehicle queue – Waiting people safety

3.7 Gate 4 access operation

It was observed at the site inspection, that to gain vehicle access through Gate 4, drivers were required to alight from their vehicles in order to insert a pin number to open the gate. Such operation created delays, with other vehicles waiting to access through Gate 4 required to queue within the through travel lane on York Road (refer to Figure 3-10).

There is risk of a rear end type crash to vehicles within the queue.

Risk Rating	
Severity	Serious
Frequency	Improbable
Risk	Medium

Special Road User Infrastructure
Traffic Management and Operation

Figure 3-10 Gate 4 vehicle queue

3.8 Baronga Avenue – Existing barrier end treatment

It was observed at the site visit, the existing barrier end treatment on Baronga Avenue at the intersection with Queens Park Road was damaged (refer to Figure 3-11).

There is risk the current condition of the barrier end treat may not operate as intended during impact, resulting in injury to the occupants within the vehicles.

Risk Rating	
Severity	Serious
Frequency	Improbable
Risk	Medium

Special Road User Infrastructure
Roadside Hazard

Figure 3-11 Baronga Avenue – Barrier end treatment

3.9 Temporary traffic management devices

It was observed at the site inspection that temporary traffic control devices (i.e. cones and bollards) were utilised on the public road to manage temporary pick up and drop off operations or to prevent parking in areas (i.e. as in front of school gates). Some of the devices utilised were not in line with current standards for temporary traffic control devices. Such items include:

- Bollards that did not contain reflective bands and were cut shorter and now less than the minimum 750 mm height (refer to Figure 3-12).
- Cones without non reflective bands (refer to Figure 3-12).

Utilising temporary traffic control equipment not to the current standard may not be visible to drivers and therefore be impacted and become a hazard.

This was observed on one occasion on site at Gate 3A where a driver exiting from the lay-by did not see the bollard in front of the vehicle and run directly over it, moving it closer to the traffic lane.

Risk Rating	
Severity	Limited
Frequency	Occasional
Risk	Low

Special Road User Infrastructure
Traffic Management and Operation

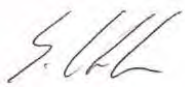
Figure 3-12 Temporary traffic control devices

4. Audit Statement

We certify that the audit was carried out by a team of independent auditors who can provide an unbiased and objective safety review.

We certify that in carrying out this audit we have reviewed the available information and have endeavoured to identify features in order to improve safety, although it must be recognised that safety cannot be guaranteed since no road can be regarded as absolutely safe.

The issues identified have been noted in this report and readers are urged to seek further specific technical advice on matters raised and not rely solely on the report.

Signed  Date: 21 August 2019

Audit Team Leader

Sean Clarke GHD Pty Ltd, Sydney. Auditor ID: RSA-02-0891

Signed Date: 21 August 2019

Audit Team Member

Mazyar Razmavar GHD Pty Ltd, Parramatta Auditor ID: RSA-02-1378

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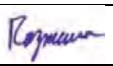
12512280-32323/https://projectsportal.ghd.com/sites/pp15_03/moriahwarmemorialcol/ProjectDocs/12512280_REP_Moriah War Memorial College_Existing Conditions RSA.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
Rev 0	S. Clarke	M. Razmavar		B. Prinsloo		21/8/2019

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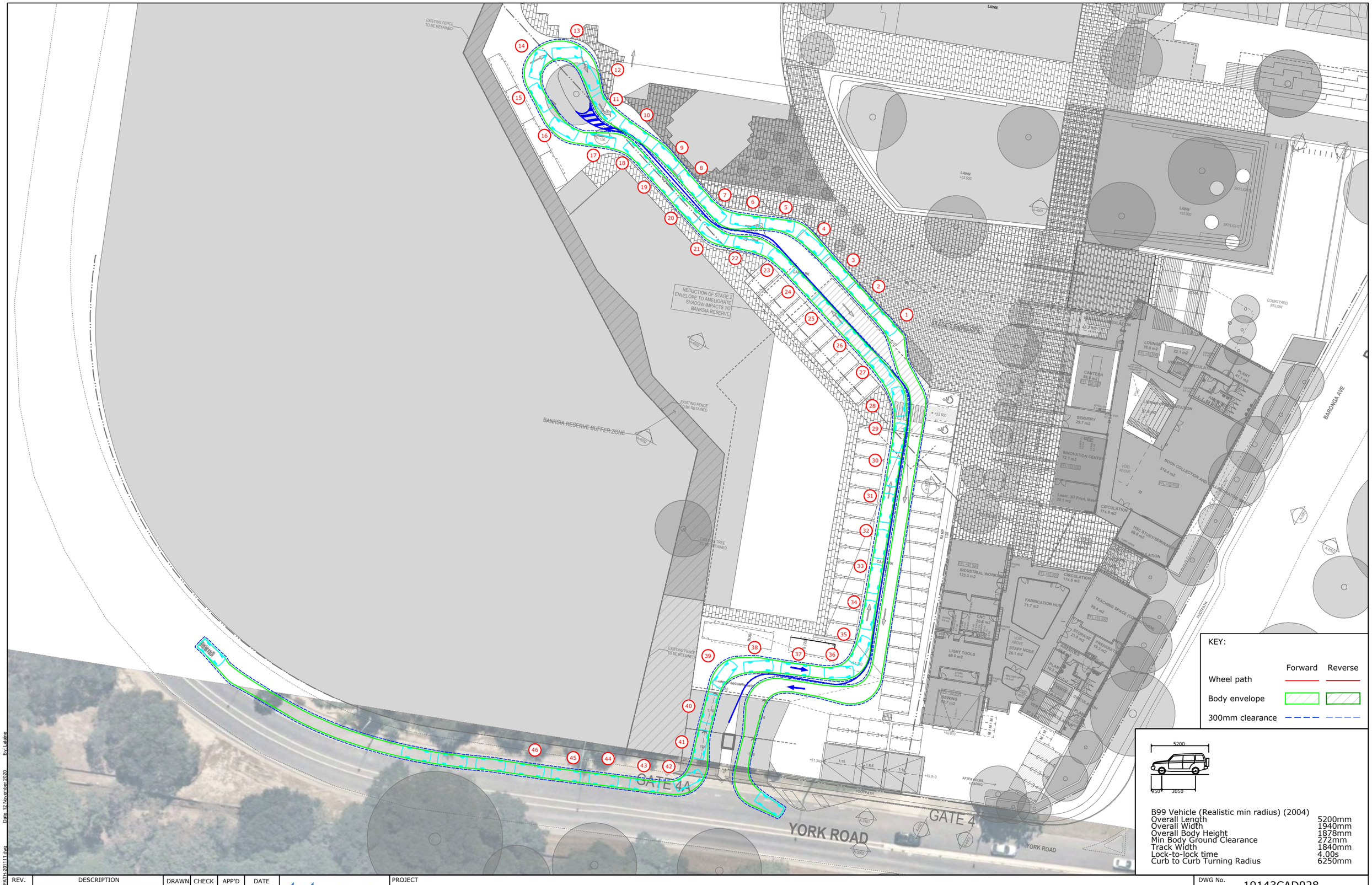
Appendix C

Swept Path Analysis



KEY:

	Forward	Reverse
Wheel path		
Body envelope		
300mm clearance		

B99 Vehicle (Realistic min radius) (2004)

Overall Length	5200mm
Overall Width	1940mm
Overall Body Height	1878mm
Min Body Ground Clearance	272mm
Track Width	1840mm
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	6250mm

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	LM	KH	KH	12/11/20

ttpp transport planning

PROJECT: MORIAH COLLEGE

TITLE: B99 VEHICLE SWEPT PATH

DWG No. 19143CAD028 FIGURE 1

DATE STAMP 11 NOVEMBER 2020

PROJECT No.	SCALE	REV.
19143	1:600 @A3	A

Filename: 19143CAD028-SWEPT PATH-201111.dwg Date: 12 November 2020 By: Lalaine

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	LM	KH	KH	12/11/20

ttpp transport planning

PROJECT: MORIAH COLLEGE

TITLE: PROPOSED ADDITIONAL LINE MARKING

DWG No. 19143CAD028 FIGURE 2

DATE STAMP: 11 NOVEMBER 2020

PROJECT No. 19143 | SCALE 1:600 @A3 | REV. A

Filename: 19143CAD028-SWEPT PATH-201111.dwg Date: 12 November 2020 By: Lalaine

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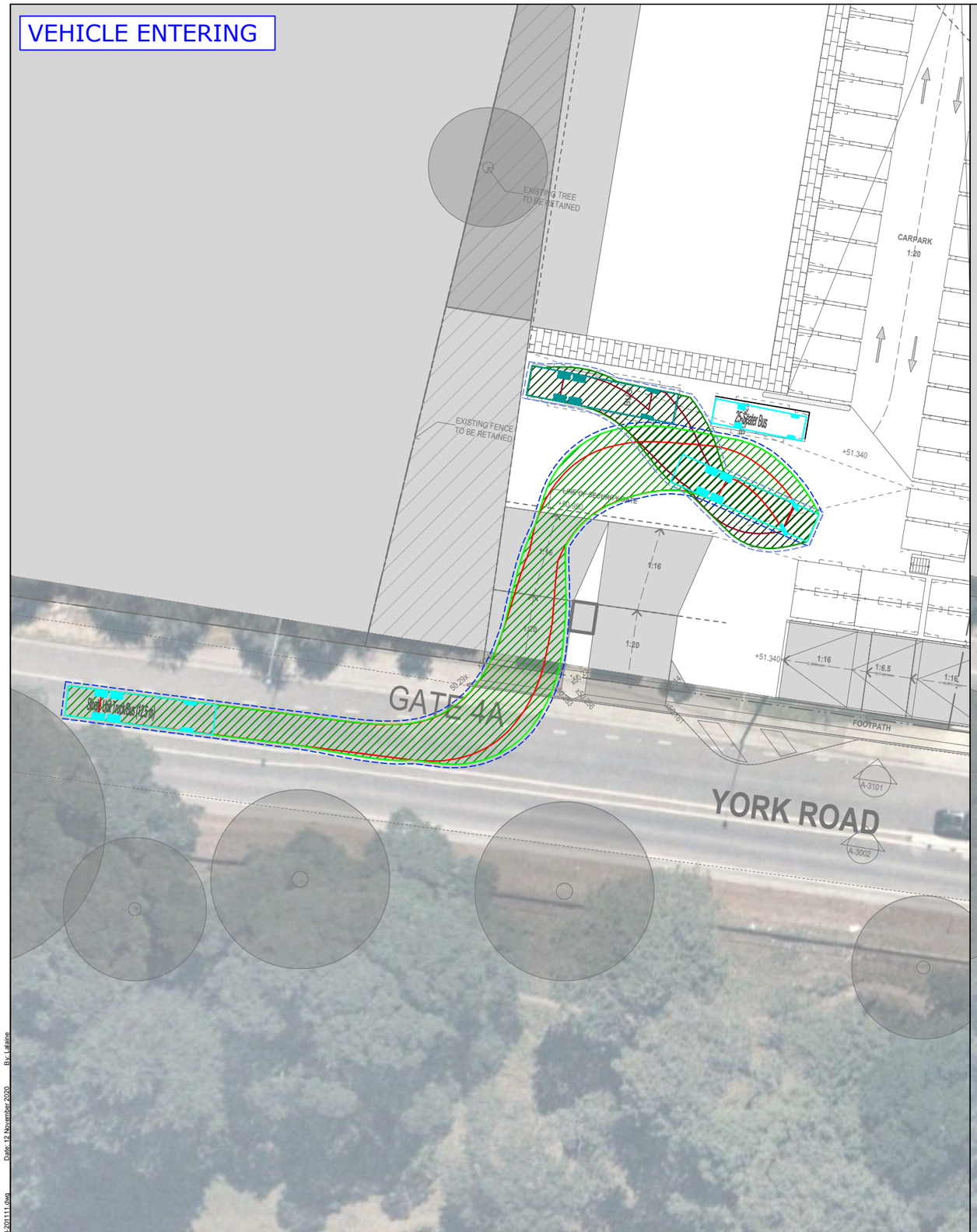
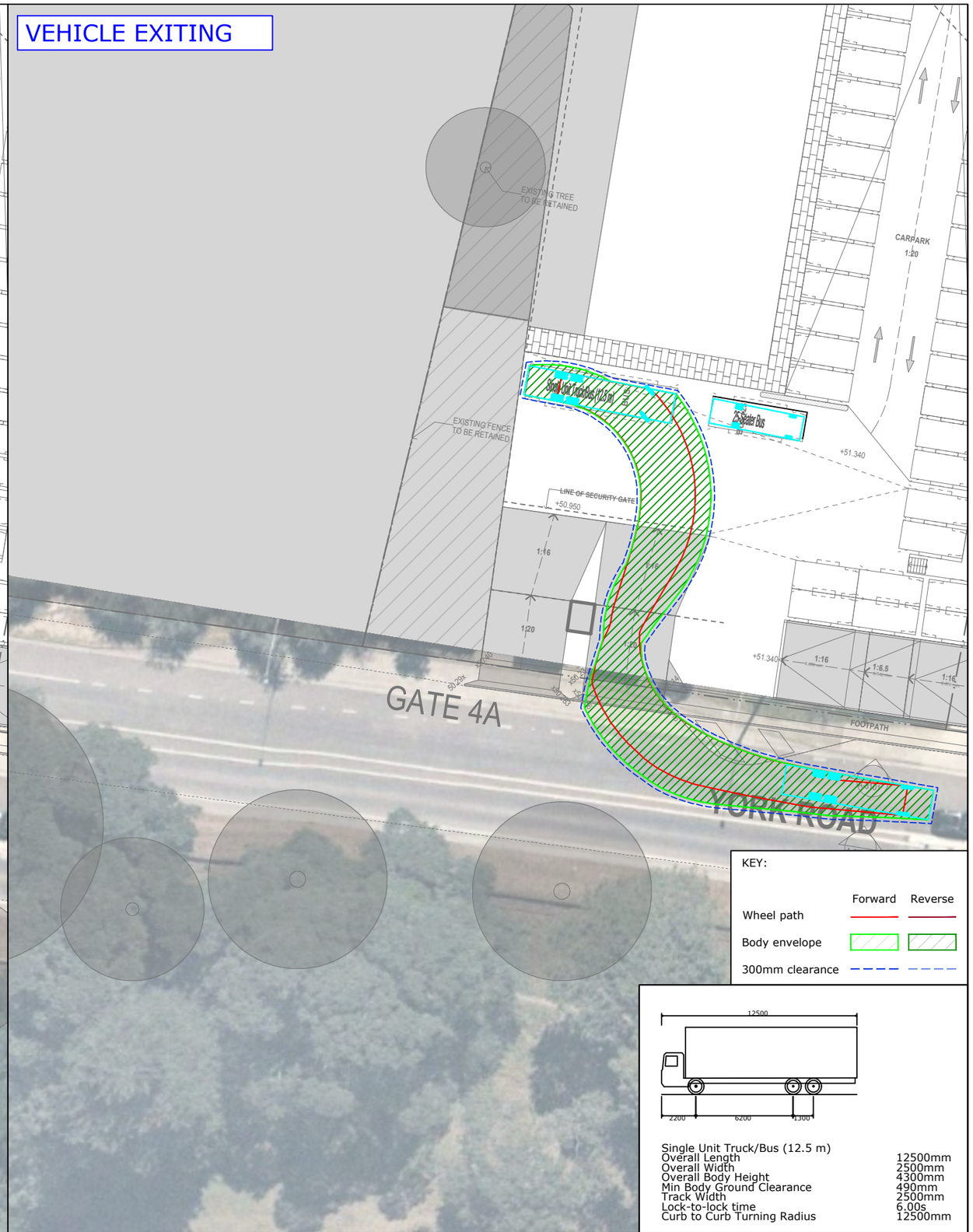


VEHICLE EXITING



KEY:

	Forward	Reverse
Wheel path		
Body envelope		
300mm clearance		

Single Unit Truck/Bus (12.5 m)	
Overall Length	12500mm
Overall Width	2500mm
Overall Body Height	4300mm
Min Body Ground Clearance	490mm
Track Width	2500mm
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	12500mm

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	LM	KH	KH	12/11/20

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PROJECT: MORIAH COLLEGE

TITLE: 12.5m LONG RIGID BUS SWEPT PATH

DWG No. 19143CAD028 FIGURE 3

DATE STAMP 11 NOVEMBER 2020

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Filename: 19143CAD028-SWEPT PATH-201111.dwg Date: 12 November 2020 By: Lalaine

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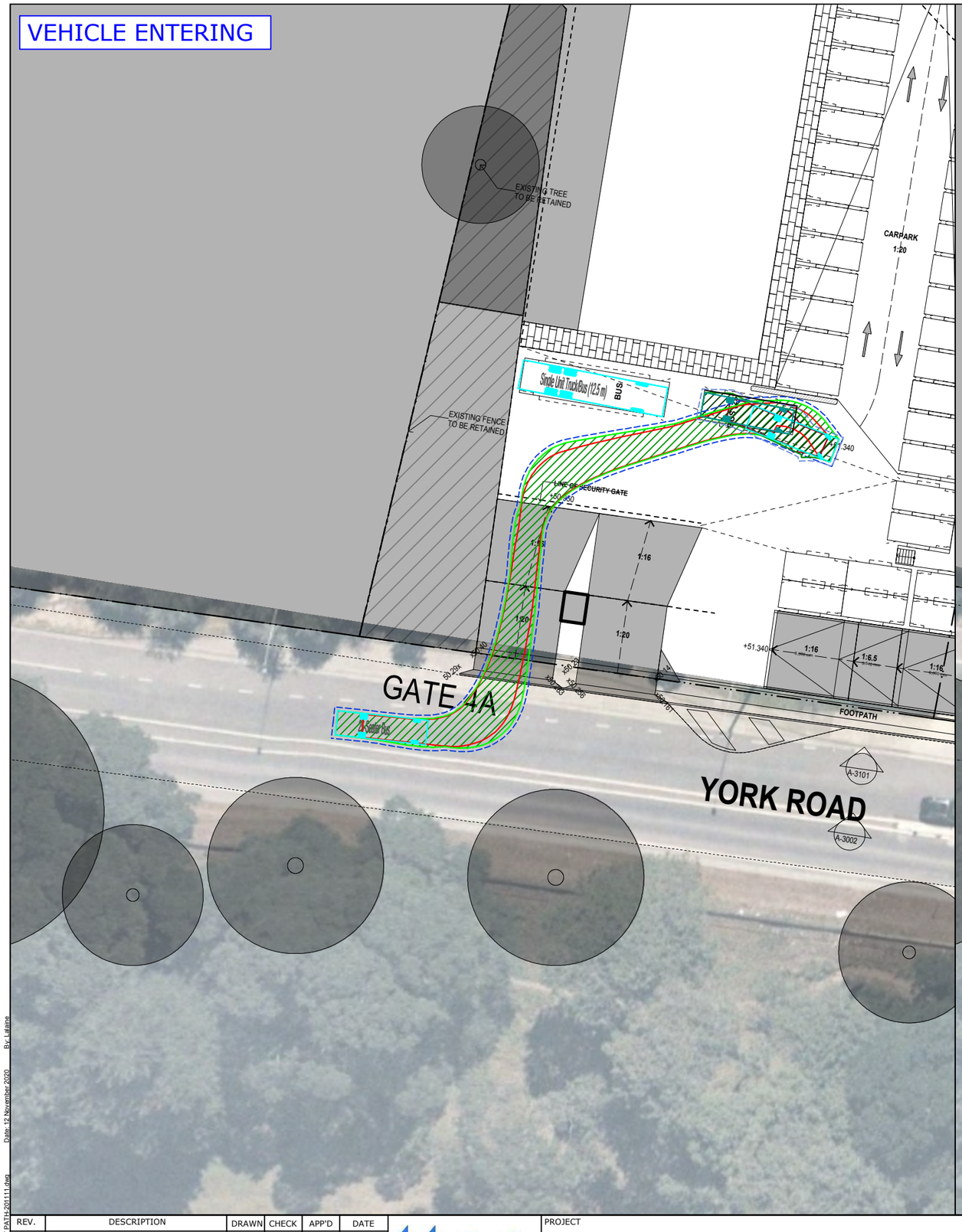
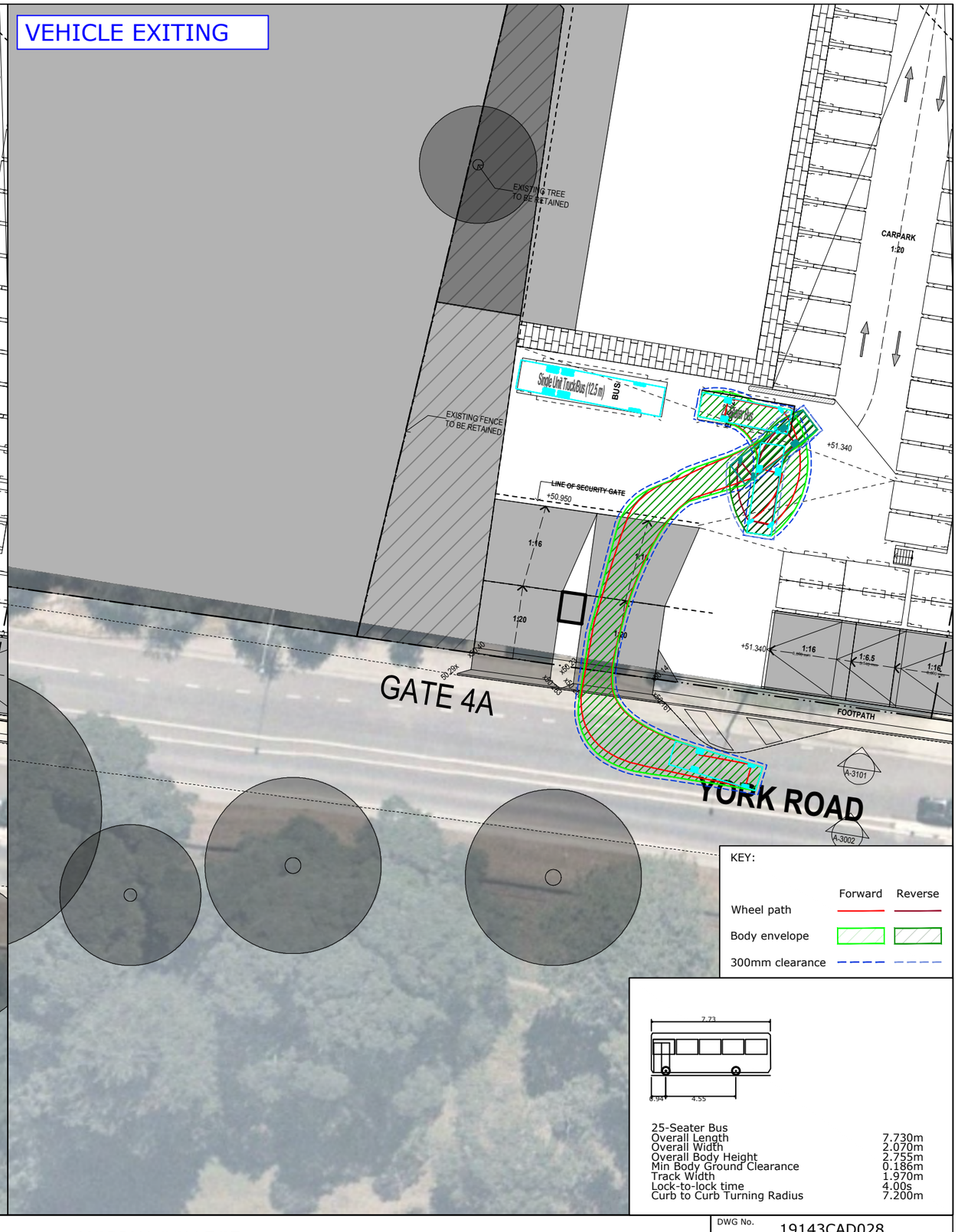


VEHICLE EXITING



KEY:

	Forward	Reverse
Wheel path		
Body envelope		
300mm clearance		

25-Seater Bus	
Overall Length	7.730m
Overall Width	2.070m
Overall Body Height	2.755m
Min Body Ground Clearance	0.186m
Track Width	1.970m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	7.200m

Filename: 19143-CAD028-SWEPT PATH-201111.dwg Date: 12 November 2020 By: Latane

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	LM	KH	KH	12/11/20

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PROJECT: MORIAH COLLEGE

TITLE: 25-SEATER BUS SWEPT PATH

DWG No. 19143CAD028 FIGURE 4

DATE STAMP 11 NOVEMBER 2020

PROJECT No.	SCALE	REV.
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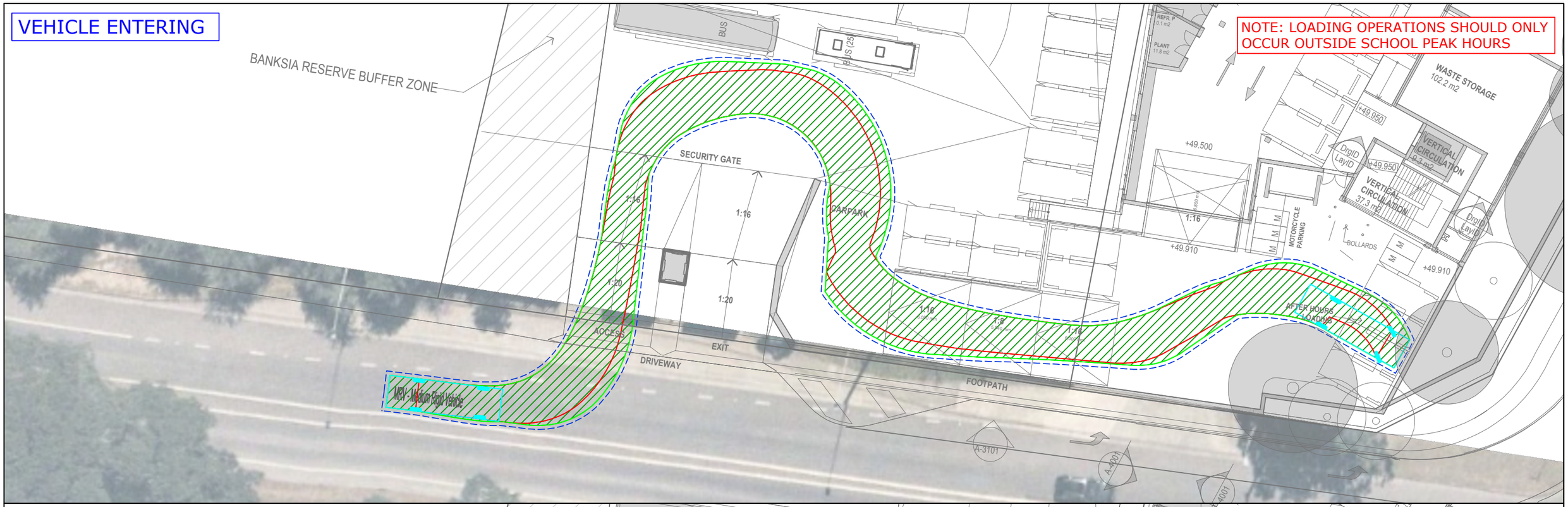
VEHICLE ENTERING

NOTE: LOADING OPERATIONS SHOULD ONLY OCCUR OUTSIDE SCHOOL PEAK HOURS



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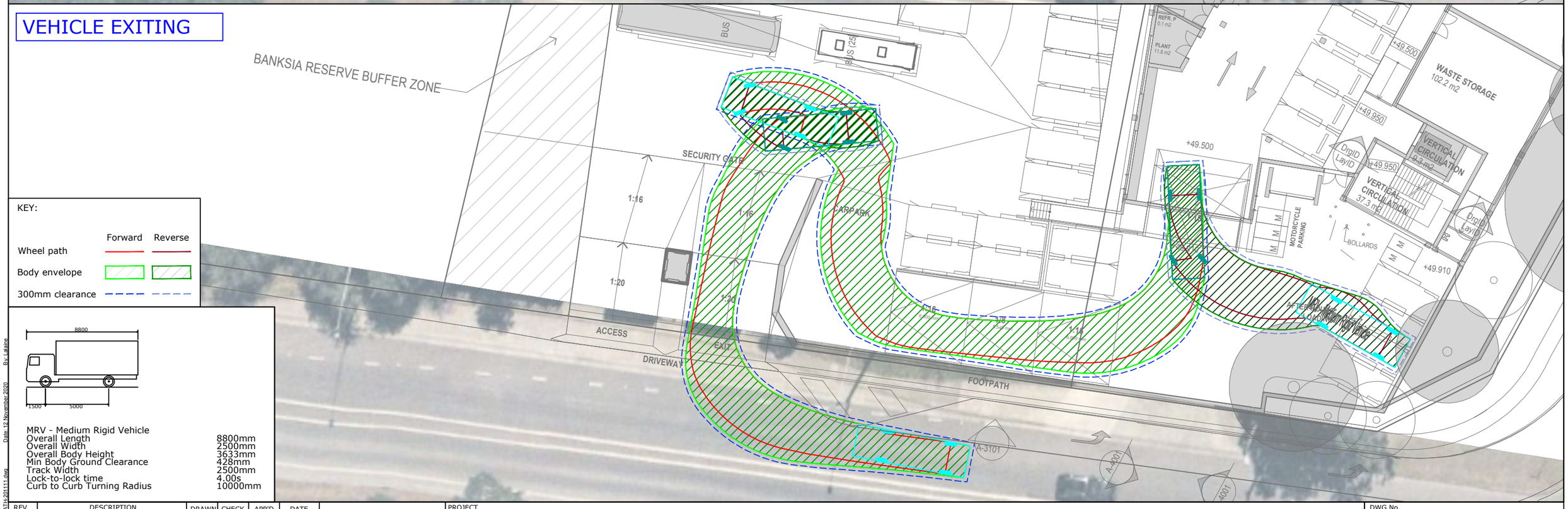


KEY:

	Forward	Reverse
Wheel path		
Body envelope		
300mm clearance		

MRV - Medium Rigid Vehicle

Overall Length	8800mm
Overall Width	2500mm
Overall Body Height	3633mm
Min Body Ground Clearance	428mm
Track Width	2500mm
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	10000mm

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	LM	KH	KH	12/11/20

ttpp transport planning

PROJECT

MORIAH COLLEGE

TITLE

8.8m MEDIUM RIGID VEHICLE SWEPT PATH

DWG No. 19143CAD028 FIGURE 5

DATE STAMP 11 NOVEMBER 2020

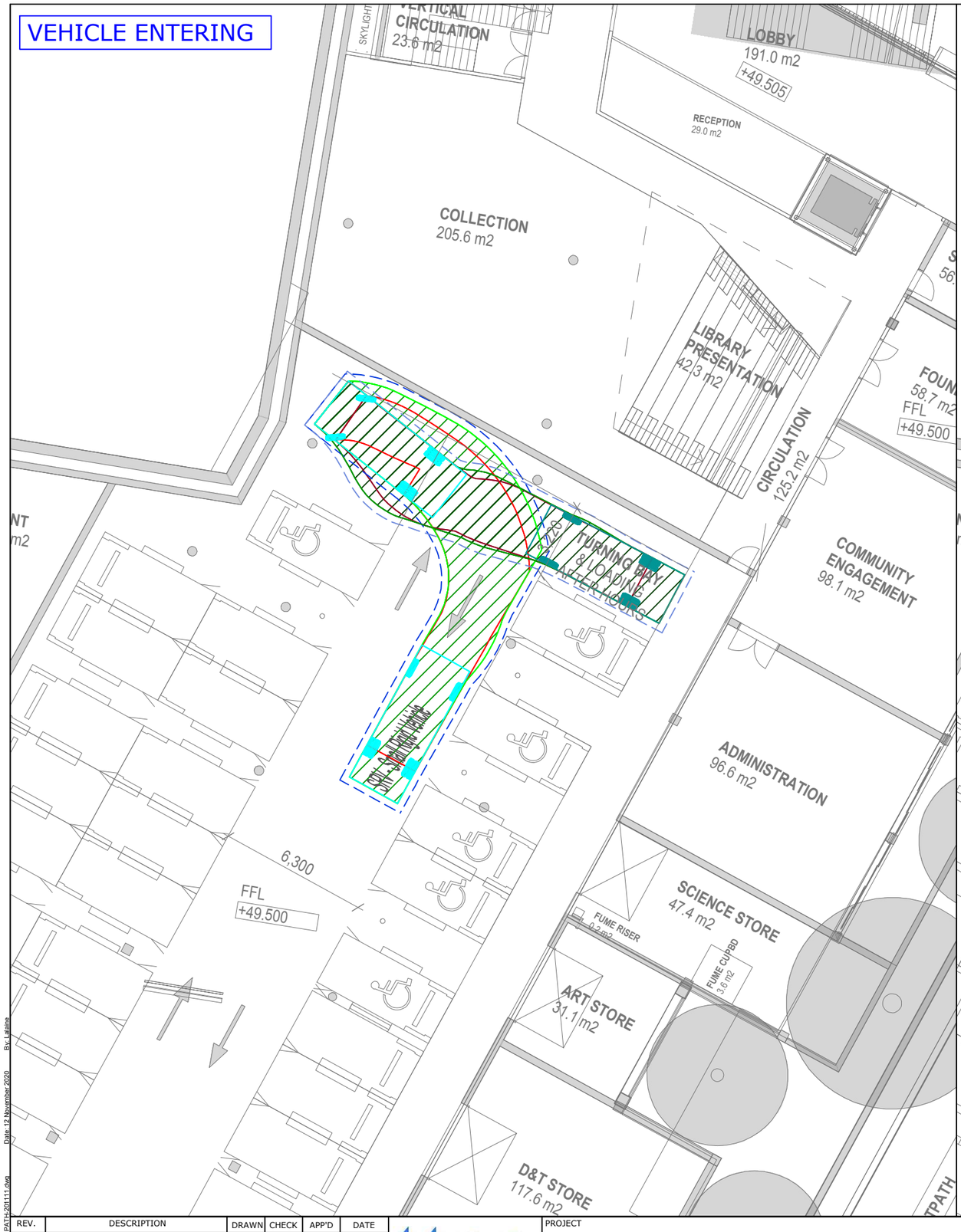
PROJECT No.	SCALE	REV.
19143	1:300 @A3	A

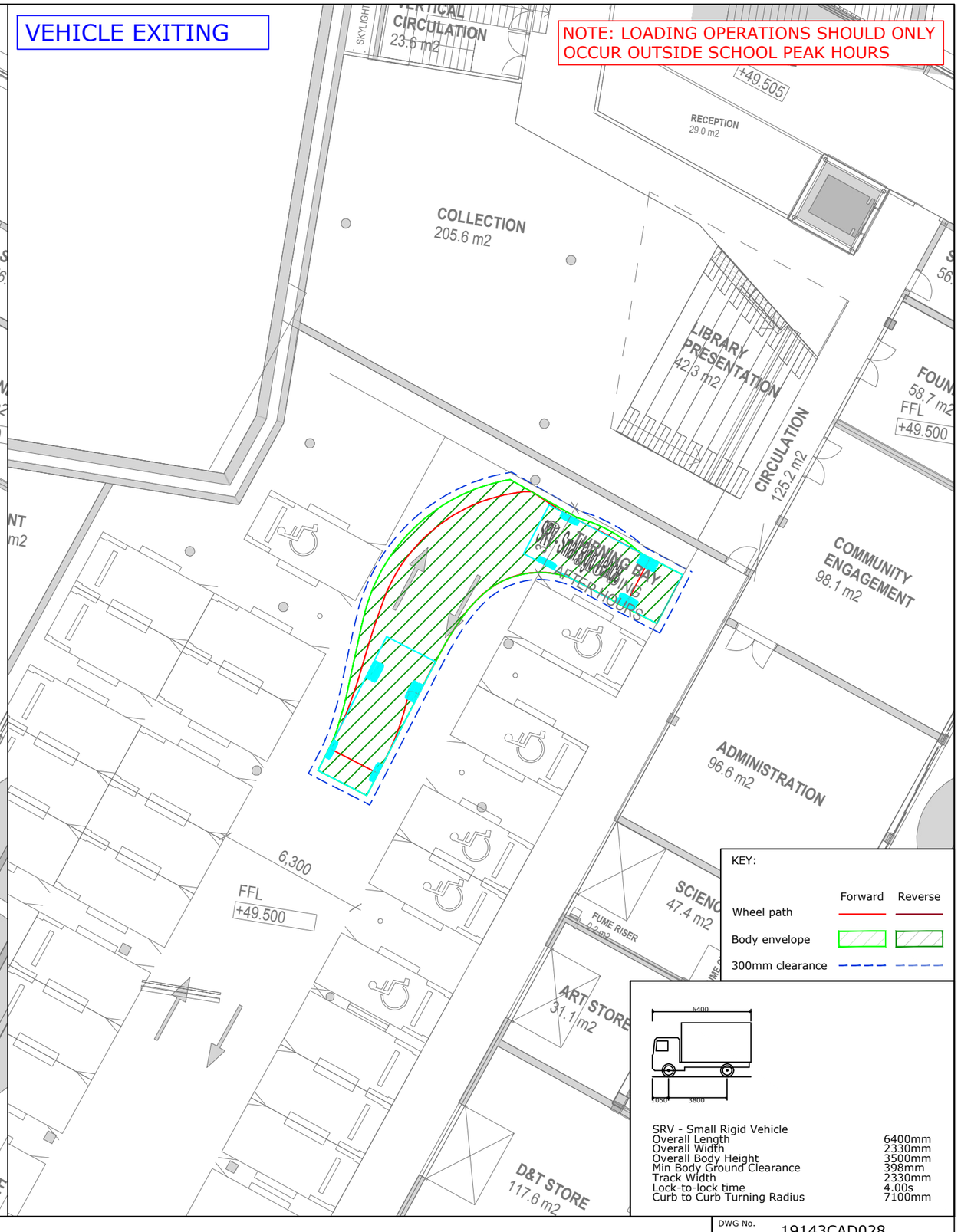
Filename: 19143CAD028-SWEPT PATH-201111.dwg Date: 12 November 2020 By: Liliane

VEHICLE ENTERING

VEHICLE EXITING

NOTE: LOADING OPERATIONS SHOULD ONLY OCCUR OUTSIDE SCHOOL PEAK HOURS





KEY:

	Forward	Reverse
Wheel path		
Body envelope		
300mm clearance		

SRV - Small Rigid Vehicle

Overall Length	6400mm
Overall Width	2330mm
Overall Body Height	3500mm
Min Body Ground Clearance	398mm
Track Width	2330mm
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	7100mm

Filename: 19143CAD028-SWEPT PATH-201111.dwg
Date: 12 November 2020
By: Latane

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	LM	KH	KH	12/11/20

ttpp transport planning

PROJECT: MORIAH COLLEGE

TITLE: 6.4m SMALL RIGID VEHICLE SWEPT PATH

DWG No. 19143CAD028 FIGURE 6

DATE STAMP 11 NOVEMBER 2020

PROJECT No.	SCALE	REV.
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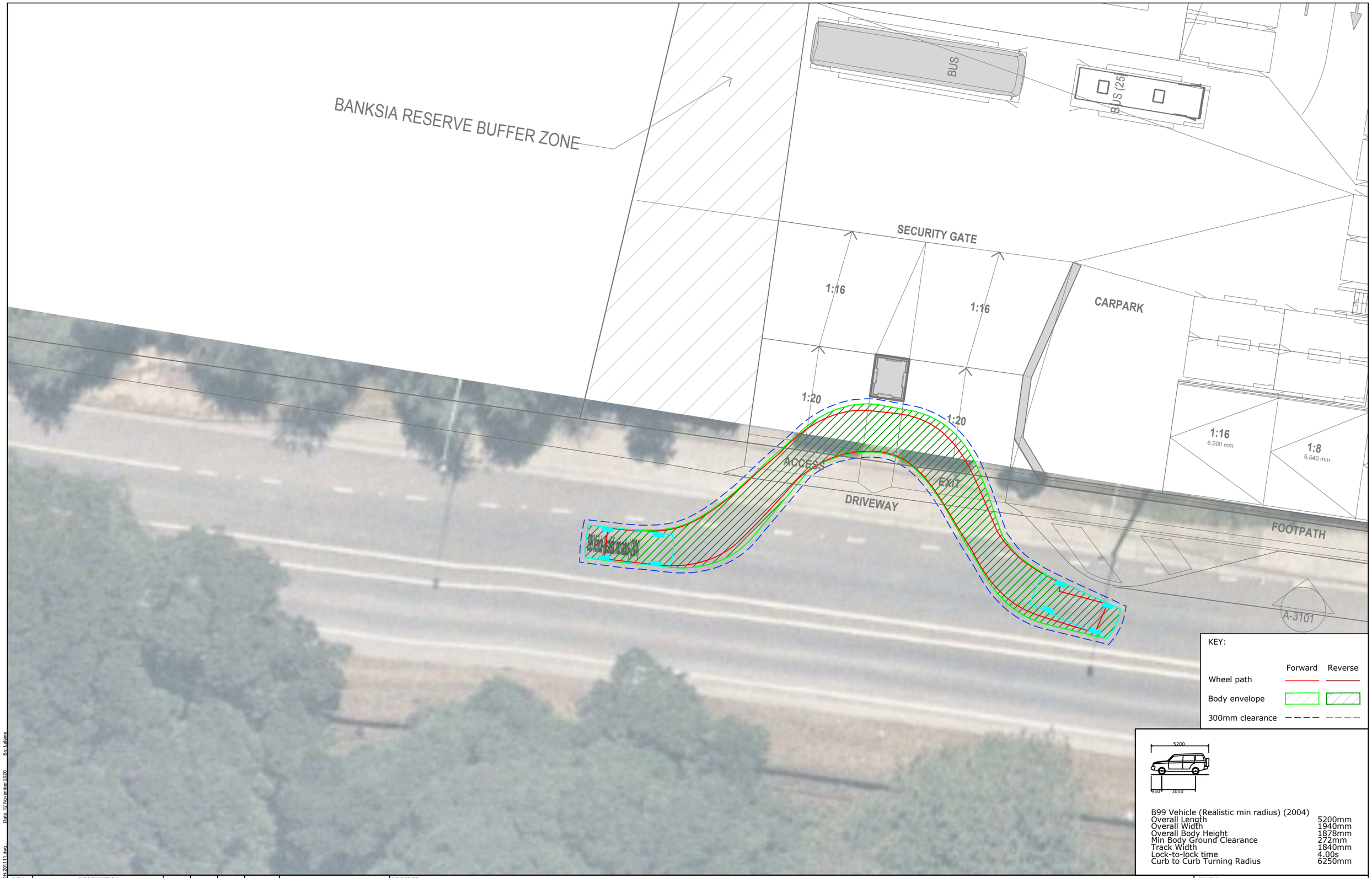

KEY:

	Forward	Reverse
Wheel path		
Body envelope		
300mm clearance		

B99 Vehicle (Realistic min radius) (2004)

Overall Length	5200mm
Overall Width	1940mm
Overall Body Height	1878mm
Min Body Ground Clearance	272mm
Track Width	1840mm
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	6250mm

REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	LM	KH	KH	12/11/20

ttpp transport planning

PROJECT: MORIAH COLLEGE

TITLE: B99 VEHICLE SWEPT PATH

DWG No. 19143CAD028 FIGURE 7

DATE STAMP 11 NOVEMBER 2020

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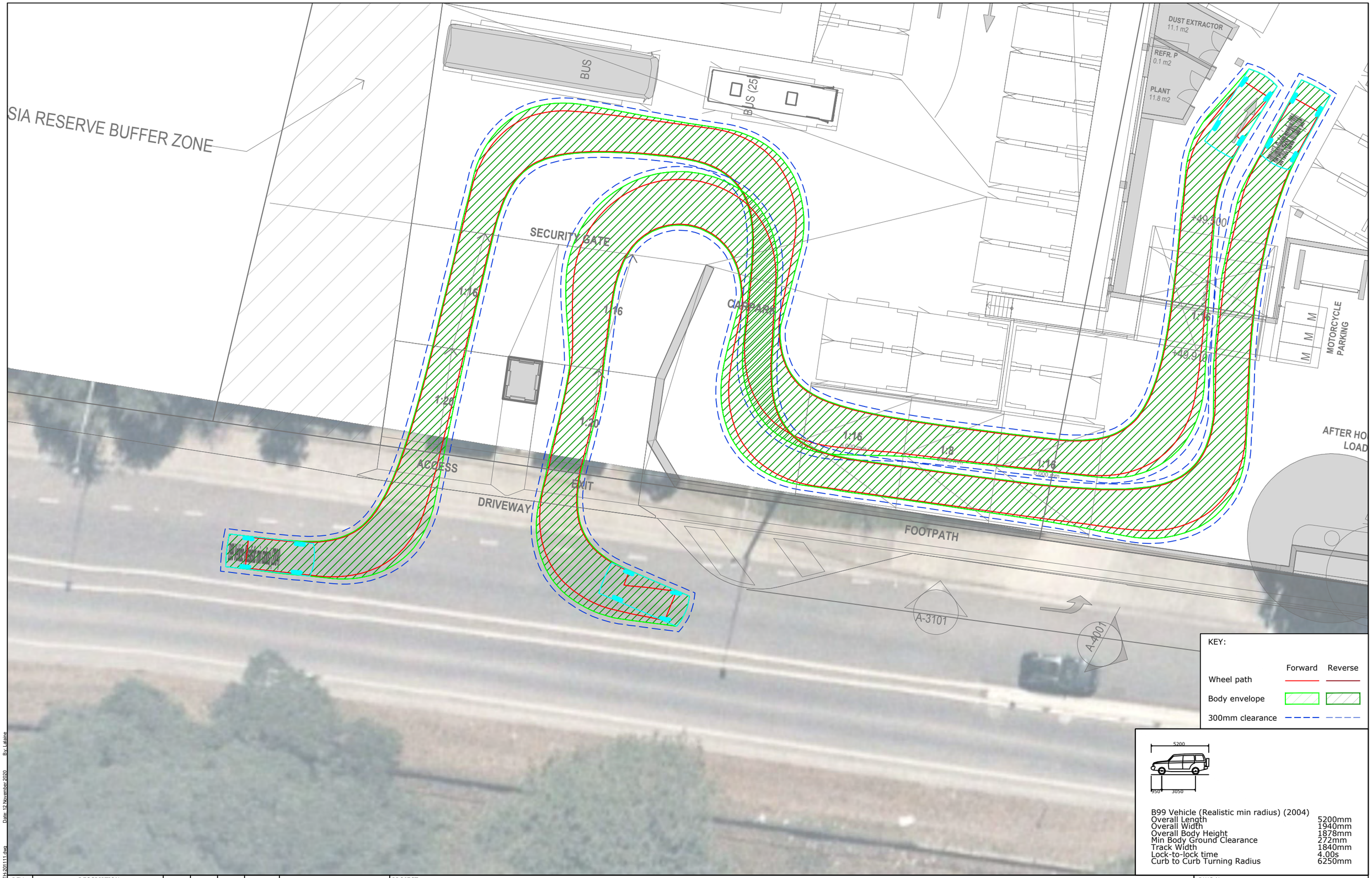
Filename: 19143CAD028-SWEPT PATH-201111.dwg Date: 12 November 2020 By: Lalaine



REV.	DESCRIPTION	DRAWN	CHECK	APP'D	DATE
A	ISSUE FOR DISCUSSION	LM	KH	KH	12/11/20

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PROJECT: MORIAH COLLEGE

TITLE: B99 VEHICLE SWEPT PATH

DWG No. 19143CAD028 FIGURE 8

DATE STAMP: 11 NOVEMBER 2020

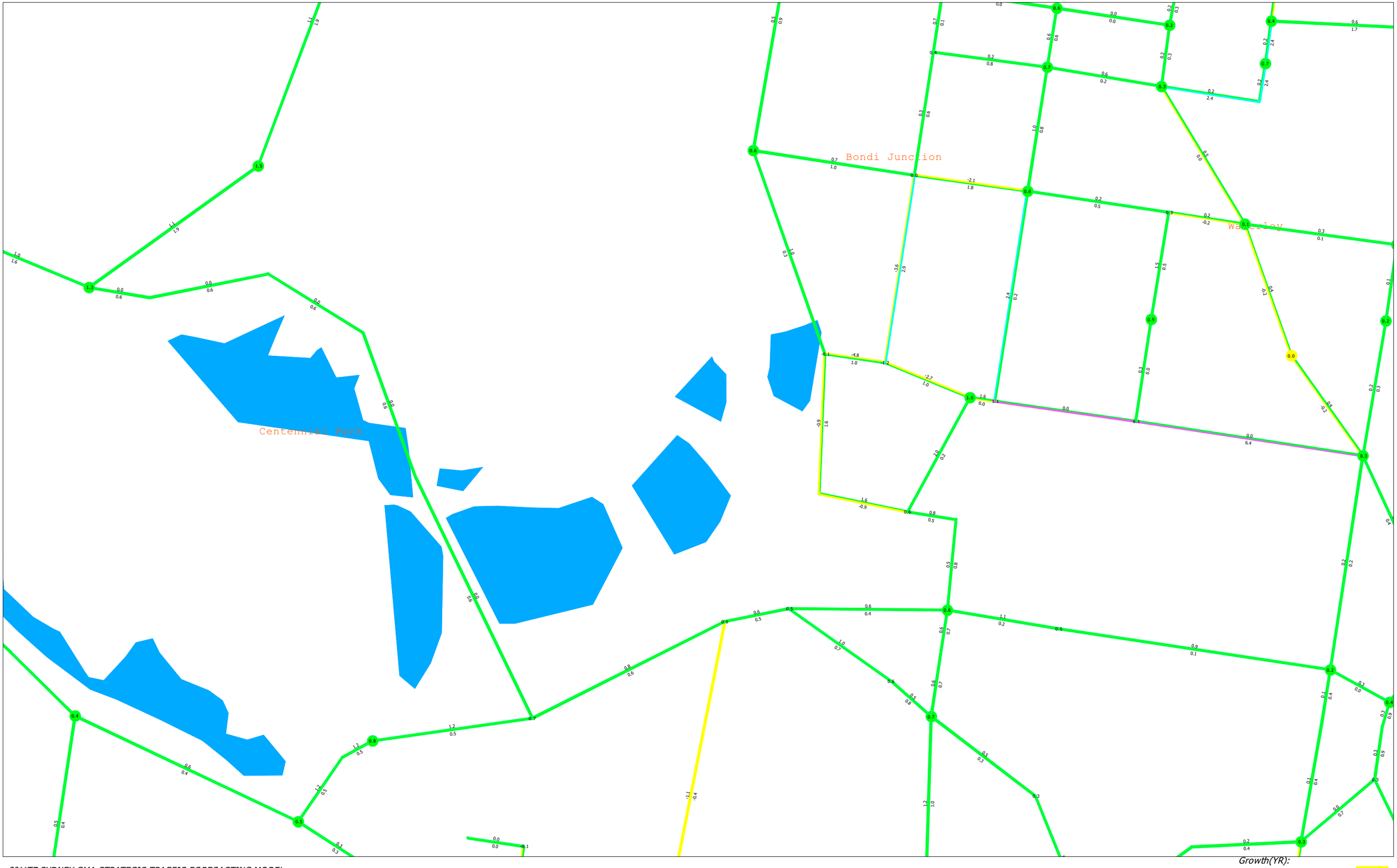
PROJECT No. 19143 | SCALE 1:200 @A3 | REV. A

Filename: 19143CAD028-SWEPT PATH-201111.dwg Date: 12 November 2020 By: Lalaine

Appendix D

STFM Growth Plots

ROAD TRAFFIC GROWTH (%YR, 2HRSPK) LINKS & INTERSECTIONS

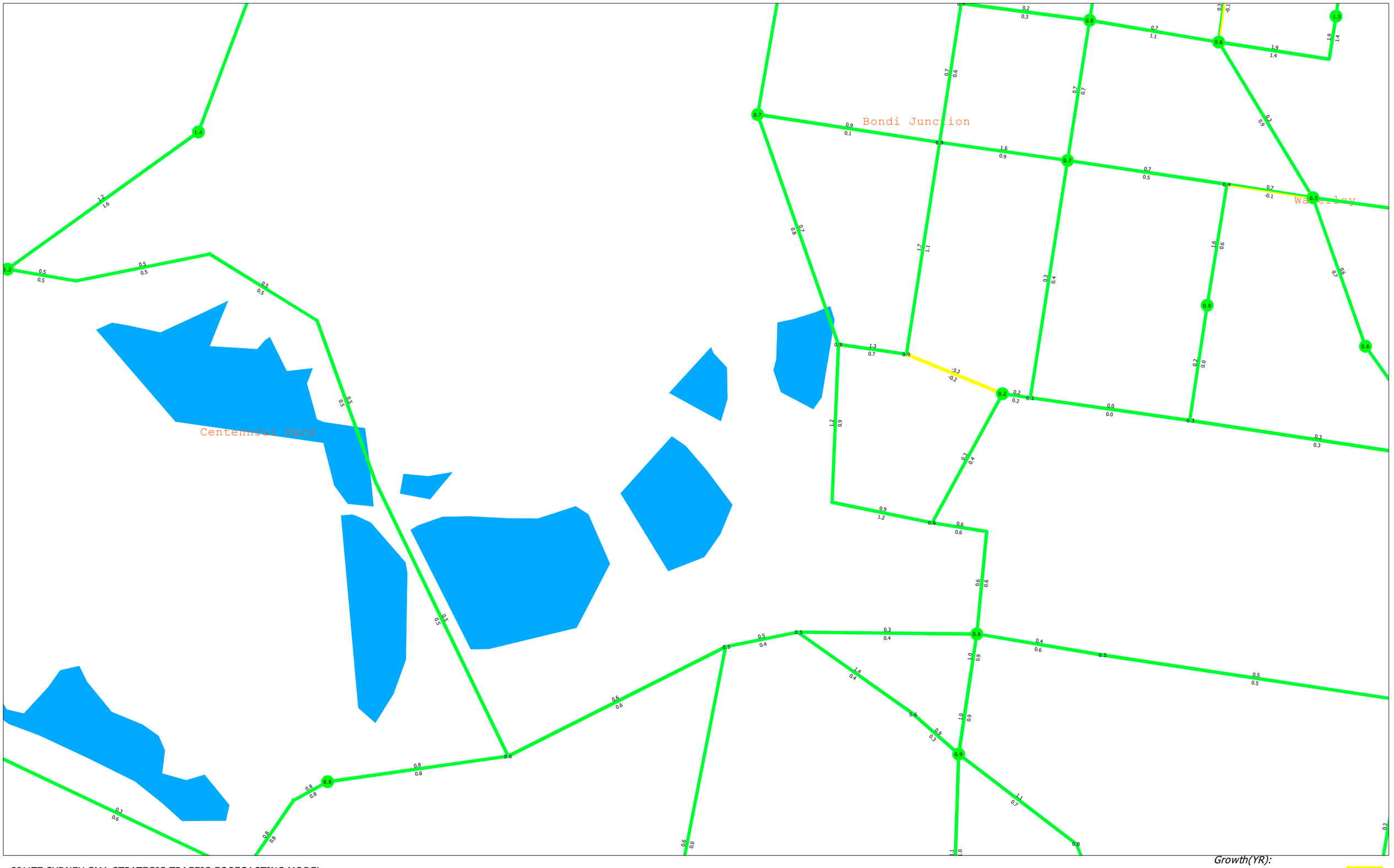


2011TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
Scenario 2026: 2026 SYDTRAFFICFORECASTMODELTZ11LU16V151STMV362-7-9AM(mf34)
2020-10-07 12:42

Growth(YR):

<0
<2.00
2.01-4.00
4.01-6.00
>6.00
New Links=999

ROAD TRAFFIC GROWTH (%YR, 2HRSPK) LINKS & INTERSECTIONS



2011TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
Scenario 20260: 2026 SYDTRAFFICFORECASTMODELTZ11LU16V151STMV362-4-6PM(mf54)
2020-10-07 12:43

Growth(YR):

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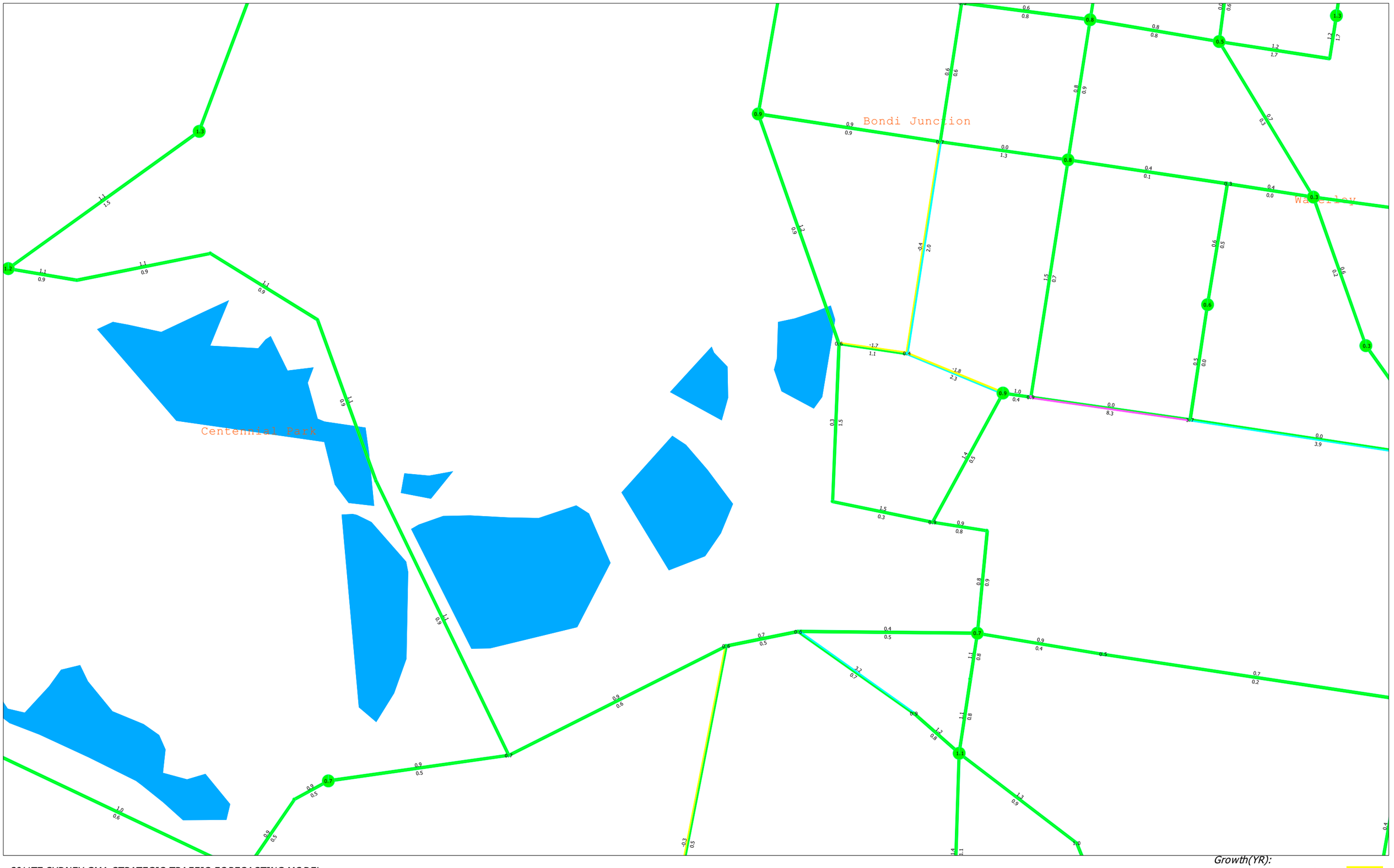
4.01-6.00
>6.00
New Links=999

ROAD TRAFFIC GROWTH (%YR, 2HRSPK) LINKS & INTERSECTIONS



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2020-10-07 12:47

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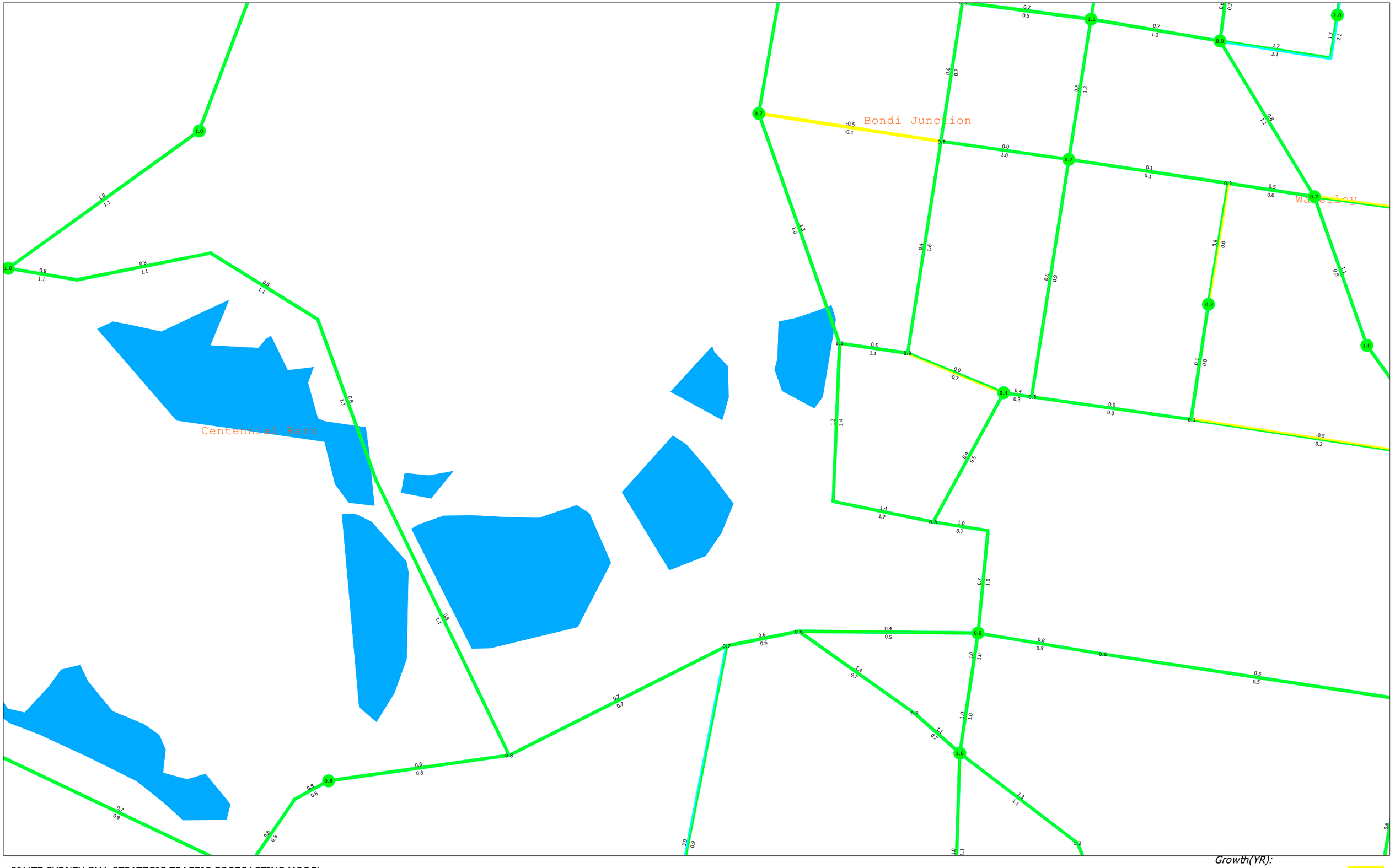
4.01-6.00
>6.00
New Links=999

ROAD TRAFFIC GROWTH (%YR, 2HRSPK) LINKS & INTERSECTIONS



2011TZ SYDNEY GMA STRATEGIC TRAFFIC FORECASTING MODEL
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4.01-6.00
>6.00
New Links=999

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