Traffic Impact Assessment;

Penshurst Public School

For SINSW c/o Root Partnerships
10 October 2018

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Document Control

Penshurst Public School, Traffic Impact Assessment

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1. Executive Summary

ptc. has been engaged by Perumal Pedavoli Architects on behalf of the NSW Department of Education (The Department) to prepare a Traffic Impact Assessment to accompany a State Significant Development Application (SSDA) to the Department of Planning and Environment (DPE), relating to the proposed upgrade of Penshurst Public School (PPS). The project will accommodate a student capacity increase from the current 440 students to 1,000. The conclusions and recommendations presented in this report are summarised below:

- The primary mode of transport for students is walking (46.3% in the morning and 51.7% in the afternoon peaks) with travel via car a close second (40.4% and 42.4% in the morning and afternoon peaks respectively). All other modes (train, bus, cycling) are heavily underutilised. This is based on a survey capturing responses from 228 of the 440 students, conducted by TTM
- Cars are the primary mode of transport for staff, with an 83% mode share (43 out of 52 staff driving) and average of 1 driver per vehicle
- A site visit conducted by ptc. during the morning and afternoon peaks found that:
    - The morning peak generally operated well with lower dwell times resulting in the existing parking provisions in the surrounding streets sufficiently catering to the demand
    - The afternoon peak was operating near capacity, exacerbated by non-compliant parking in kiss-and-ride zones and illegal parking manoeuvres (in No Stopping areas, driveways, double parking, etc.). This activity also quickly dissipated, with the majority of vehicular activity concluding 20 minutes after the end of the school day
- Occupancy surveys previously conducted by TTM indicated a high volume of vacant spaces in the streets further away from the school (still in the walking catchment), i.e. Clarence Street, Cambridge Street, and Arcadia Street north of Percival Street. Within the streets closer to the school (Percival Street and Arcadia Street), there were a small number of vacant spaces during the day, however, these were all utilised during both peak periods
- Revised traffic modelling using SIDRA 8 has been undertaken by ptc. The traffic modelling indicates that:
    - Forest Road / Penshurst Street increases from the current Level of Service (LoS) B to LoS C in the morning peak and maintains the existing LoS B for the afternoon peak in the development scenario. The right turn from Forest Road (east) into Penshurst Road (north) is nearing capacity, however, the development 95th percentile queue is maintained within the capacity of the right-turn bay
    - The Forest Road / Arcadia Street / Connelly Street and Forest Road / Cambridge Street priority-controlled intersections continue to operate well, displaying LoS A/B for most approaches. The right-turn from Connelly Street into Forest Road and the right-turn from Forest Road into Cambridge Street experiences long delay due to heavy eastbound through volumes along Forest Road in the AM peak.
    - The development traffic from the school is not anticipated to utilise these right turns and hence will not contribute to decreased performance for these movements

- Queuing analysis indicates that the existing amenity of the morning drop-off operation can be maintained subject to parking control modifications along Arcadia Street. For the afternoon peak pick-up operation, due to large variations in dwell times and parents who park for extended periods of time traffic management measures are proposed in Section 8.6 to address the parking provisions and amenity in the afternoon peak in addition to the parking control modifications
- 5 additional staff parking spaces are proposed, increasing the total provision to 20 staff parking spaces on-site. This represents a shortfall of 10 spaces under the Council Development Control Plan. Management measures and parking control modifications are proposed to ensure that this additional parking demand is captured in streets further away from the school with the intent of reducing the amount of unrestricted parking close to the school and encouraging alternative transport modes
- Bicycle parking in the order of 10 staff spaces (in a separate bicycle store room) and 12 student spaces are proposed to encourage active transport
- Service provision is to be retained as per the existing operation, with refuse collection to be conducted within the premises of the school ground. At least 3 parking spaces are to be kept clear during the waste collection period, indicatively 4:30pm-6:30pm Monday-Friday, to accommodate the turning manoeuvre.
- A number of parking modifications are proposed along Arcadia Street, converting 13 existing unrestricted spaces to P5 spaces (5-minute) during School Zone hours to cater for increased demand. The proposed spaces are located adjacent to existing kiss-and-ride and a number of unrestricted spaces are proposed to continue to be unrestricted. This is to provide a compromise between the School's requirements and the amenity of existing residents. The choice of P5 parking over additional kiss-and-ride is to cater for parents with longer-term parking demands (e.g. walking child to school or collecting child from the school), whilst discouraging excessive parking duration in Arcadia Street
- Other management measures such as staff carpooling, possible resident parking scheme, preparation of a travel access guide, staggering of school times, and increased enforcement are also discussed to reduce vehicular trips, encourage active travel, and minimise the traffic and parking impact on the surrounding streets and intersections
- A design assessment of the car park has also been performed, demonstrating compliance with AS2890.1, AS2890.3, and AS2890.6

2. Introduction

2.1 Background

ptc. has been engaged by Perumal Pedavoli Architects on behalf of the NSW Department of Education (The Department) to prepare a Traffic Impact Assessment for submission with a State Significant Development Application (SSDA) to the Department of Planning and Environment (DPE).

The project involves the proposed expansion and upgrade of Penshurst Public School (PPS) to accommodate a student capacity increase from the current 440 students to 1,000 following completion of the project.

The proposal will also result in an increase in staff number from the existing 35 full-time-equivalent staff (FTE) to 59. The existing student enrolments and FTE numbers have been extracted from the Penshurst Public School 2017 Annual Report[1].

The proposed Penshurst Public School Upgrade Project is anticipated to begin in 2019 and occur over an 18-month period, with the upgraded school operational by mid-2020. During this period, the PPS students will be collocated at Peakhurst West Public School (PWPS), located approximately 3.5km to the west, in a temporary "pop-up school" where demountable-style buildings will be constructed in an existing vacant area adjacent to PWPS.

To support the transport needs of the PPS students during the construction period, a bus service will be provided to transport students to and from the temporary school located in Peakhurst. Two separate reports, have been prepared by ptc. to address the interim traffic and parking impacts:

- Penshurst Public School Relocation Traffic Management Plan: Presents an analysis of the traffic and parking considerations at PWPS during the transition stage and proposed management measures to minimise the disruption at PWPS
- Bus Study: Presents an overview of the proposed bus service, analysis of traffic and parking considerations at the bus hubs in Penshurst and Peakhurst, analysis on the bus route, and proposed management measures to ensure the efficiency and minimise the disruption resulting from the bus operation

As such, the scope of this report is limited to the traffic and parking considerations at the upgraded Penshurst Public School, once construction is complete and the new school is operational.

An overview of the school location is presented in Figure 1.

[1] https://penshurst-p.schools.nsw.gov.au/about-our-school/school-planning-and-reporting.html

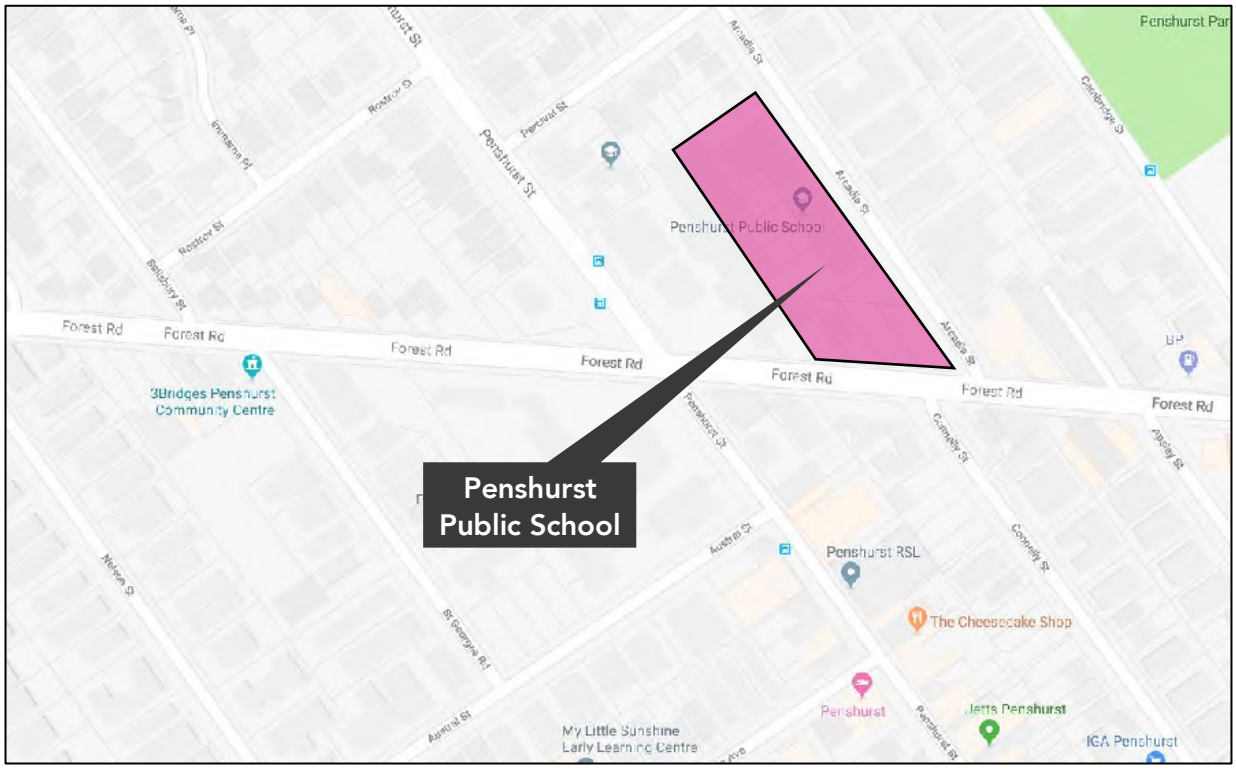


Figure 1: Penshurst Public School

2.2 Purpose of this Report

The purpose of the Traffic Impact Assessment (TIA) is to present the following considerations in relation to the Traffic and Parking assessment of the Proposal:

Section 1	Executive Summary;
Section 2	Introduction and brief description of the proposal;
Section 3	Summary of the authority comments raised and **ptc.** response;
Section 4	Description of the road network serving the school;
Section 5	Description of the proposed school upgrade;
Section 6	Analysis of the School's traffic and parking profile and site observations;
Section 7	Determination of the traffic activity associated with the school upgrade, and the adequacy of the surrounding road network;
Section 8	Assessment of the parking provisions for all school-users and proposed parking control modifications; and
Section 9	Assessment of the proposed staff car park, vehicular access and internal circulation arrangements in relation to compliance with the relevant standards, and Council policies.

3. Authority Comments

The following table presents a summary of the comments presented by Transport for New South Wales (TfNSW), Roads and Maritime Services (RMS), and Georges River Council (Council) in relation to the Traffic Assessment previously prepared for the proposed expansion of Penshurst Public School by TTM (*Traffic Assessment Penshurst Public School*, 24 April 2018, Rev 13).

The traffic/parking-specific comments are summarised below and **ptc.**'s response to each of the concerns is addressed in Table 1.

Table 1: Summary of Authority Concerns and **ptc.** response

Comment	ptc. Response
TfNSW TAB A – Detailed Comments on SSD Application 8365	
TfNSW Comment 1: Adequacy of kiss-and-ride *Comment* *It should be noted that there would be some parking demands, not suitable to be accommodated within kiss-and-ride, generated by student pick-up and drop-off such as parents arriving prior to school end or having to leave their vehicle.* *Evidence has not been provided within the assessment indicating that the 17 kiss-and-ride spaces could accommodate the expected number of vehicle arrivals. There is the risk that the insufficient provision of easy access pick-up and drop-off could result in an increase in unsafe parking practices.* *Furthermore, Arcadia Street (between Percival Street and Forest Road) was observed to be 'nearly fully occupied' and would likely to remain so in the post development scenario due to the 32 (approx.) additional on-street parking demand generated by staff. As such, parents not utilising kiss-and-ride would have to park further from the site and outside the existing school zone boundaries.* *An alternative that should be considered is the implementation of timed parking within the school zone to accommodate other short-term parking demands (greater than 2 minutes) within a lower speed environment.* *Recommendation* *The Applicant should provide evidence that the proposed kiss-and-ride spaces could accommodate the expected demand.*	ptc. Response 1.1 As part of the proposal, modifications to existing on-street parking controls are recommended, converting 13 unrestricted spaces on Arcadia Street to P5 parking. Refer to Section 8.5. This provides 13 P5 spaces in addition to the existing 11 pick-up/drop-off spaces which accommodate other short-term parking demands as recommended by TfNSW. It is noted that the adoption of these proposed changes is subject to Council endorsement and approval. A Poisson queuing analysis has been performed (refer to Section 7.4) demonstrating the ability of the modified parking controls to accommodate the increased demand. Where queuing analysis is limited due to large variations in dwell time (such as in the afternoon peak), additional traffic management measures are also proposed (see Section 8.6) such as staff carpool spaces and increased parking restriction enforcement to reduce staff parking near the school and ensure the availability of short-term parking spaces for parent drop-off/pick-up. Hence, the proposed parking control modifications accommodate the expected

Comment	ptc. Response
The proposal should consider the implementation of timed parking within the school zone to accommodate short term parking demand beyond the restrictions of kiss-and-ride. This should be done in consultation with the local council.	demand and provide short term parking beyond the restrictions of kiss-and-ride.
TfNSW Comment 2: Configuration of kiss-and-ride zones *Comment* *The traffic assessment proposes that the unrestricted on-street parking area on the Arcadia Street frontage be redesigned as a 'Kiss and Ride Zone' providing a total of 17 kiss-and-ride spaces and one accessible parking bay. A review of desktop imagery shows there are currently approximately 3 kiss and ride spaces along the eastern side of Arcadia Street and 12 along the western side.* *It is assumed, that 55% of the additional vehicle trips are to access the site from Percival Street, as stated in Figure 4.1 of the traffic assessment. Based on this trip distribution assumption and the limited existing pick up/drop off spaces on the eastern side of the street, it is likely that parents seeking to utilise the kiss-and-ride spaces along Arcadia Street will have to perform a U-turn movement. This reduces the safety and efficiency of the proposed pick-up and drop off arrangement, particularly given the constrained road environment (as described previously) to perform U-turn movements.* *Recommendation* *The provision of kiss-and ride spaces should consider the direction of incoming vehicle travel (in a forward direction) and minimise the need to undertake U-turn movements.*	ptc. Response 1.2 As part of the on-street parking control modifications, changes are proposed on both sides of Arcadia Street with 5 additional P5 spaces on the eastern side of Arcadia Street and 8 on the western side (refer to Section 8.5), thus considering the direction of vehicle movement and providing additional provisions on both sides, minimising the need for U-turn movements.
TfNSW Comment 3: Traffic Impact Analysis *Comment* *It is unclear whether the 229 additional vehicle trips estimated by the traffic assessment are one-way or two-way trips. Vehicle movements during school pick-up and drop-off generally occur in pairs, i.e. each pick-up or drop-off movement has an inbound and outbound trip within the same hour.* *Based on the assumption that 40% of the student arrivals and departures would be from passenger vehicles, there*	ptc. Response 1.3 The previous traffic modelling assessed the additional vehicle trips as one-way trips. Revised traffic modelling has been undertaken whereby both inbound and outbound vehicle movements (i.e. two-way trips) are considered (refer to Section 7.2.1). As part of this revised modelling, the configuration of the road network has also been considered in determining the travel

Comment	ptc. Response
would be a total of 458 movements within each peak period (229 two-way vehicle trips). *Furthermore, each inbound and outbound trip within the local road network could have a different path from origin-to-destination and destination-to-origin depending on the configuration of the road network. For example, vehicles accessing the site from the west via Forest Road (left into Arcadia Street) would return to Forest Road potentially via Salisbury Street or George Street (due to right-turn ban on Penshurst Street to Forest Road).* *It is unclear within the assessment as to whether the future trips have been distributed with respect to the configuration of the road network.* *<u>Recommendation</u>* *The Applicant should provide further evidence that:* • *Inbound and outbound vehicle movements have been considered within the morning and afternoon peak periods; and* • *The assessment has considered the configuration of the road network in inbound and outbound trip distribution assumptions.* *Any subsequent intersection analysis should be revised accordingly.*	routes of the additional trips (refer to Section 7.2.1 and 7.2.4).
TfNSW Comment 4: Carriageway width of Arcadia Street *<u>Comment</u>* *Parking is permitted on both sides of Arcadia Street with predominantly unrestricted parking on the eastern side and kiss-and-ride zones on the western side. Aerial views suggest that the carriageway width may be insufficient to accommodate safe two-way vehicular movements with both the existing and proposed parking restrictions.* *<u>Recommendation</u>* *The traffic assessment should be revised to include swept path analysis of car movements along Arcadia Street demonstrating the proposed parking restrictions can be implemented within the existing road geometry, while still maintaining safe two-way vehicular movements.*	ptc. Response 1.4 The existing narrow carriageway of Arcadia Street is noted, and as such, the proposed parking restrictions have been designed to modify the parking restrictions on the existing parking spaces rather than introducing any new linemarking or other delineation (refer to Section 8.5). Therefore, swept path analysis has not been undertaken as no changes are proposed that would alter the maximum number of vehicles than can be accommodated in the parking on Arcadia Street. Moreover, the narrow width of the road aids in promoting a lower speed environment and reduced pedestrian crossing distances.

Comment	ptc. Response
TfNSW Comment 5: Future Bus Services *Comment* *There are 6 bus routes servicing bus stops within 400m walking distance from the site on Penshurst Street and Cambridge Street. The TfNSW Growth Services Program routinely monitors regular bus routes and improvements can be made, subject to demand and funding.* *Recommendation* *Prior to commencement of new school operations, the proponent should provide additional data and the proposed student catchment area to determine the likely demands on the transport network (all modes). With particular regard to bus usage. Data should also be provided on existing and expected patronage by route. This data could be obtained by travel surveys of staff and students (existing and new enrolments).* *The student catchment area and travel data provided to TfNSW will assist with future service planning.*	ptc. Response 1.5 Based on travel mode surveys of the PPS students, the current demand for travel via bus is low, representing 0.5% and 0.8% of student travel mode in the morning and afternoon peak periods (i.e. 2-4 students); refer to Section 6.1. As part of the separate Green Travel Plan report (prepared by **ptc.**), strategies and methods of increasing bus mode share and other sustainable modes of transport are presented. Upon commencement of new school operations, travel surveys can be conducted to determine and monitor the public bus utilisation and patronage by route.
TfNSW Comment 6: Bicycle Parking *Comment* *The proposed student bicycle parking, as shown on the Proposed Site Plan (Drawing No. 3199-ARC-DA_00_004, dated 28 March 2018), does not indicate the quantity of bicycle parking available for students. Furthermore, this quantity is not stated within the EIS.* *Recommendation* *The EIS and/or site plan should state the quantity of student bicycle parking available.* *Bicycle parking should also be available to teachers to accommodate cycling to the workplace as an alternative for private vehicle use.*	ptc. Response 1.6 Updated site plans indicate 10 staff bicycle spaces and 12 student bicycle spaces. Refer to Section 8.3.
TfNSW TAB B – Recommended Conditions of Approval	
TfNSW Comment 7: *TfNSW requests that DP&E should include the following conditions if the proposed development is to be approved.* *Green Travel Plan*	ptc. Response 1.7 These documents, with the exception of the Road Safety Evaluation, have been prepared by **ptc**. and will be submitted in conjunction

Comment	ptc. Response
Traffic and Parking Management Plan *Signage and Linemarking Plan* *Road Safety Evaluation*	with this Traffic Impact Assessment as requested as a condition of consent. ptc. advises that the Road Safety Evaluation be prepared by an independent Road Safety Auditor.
RMS Comments	
RMS Comment 1: *It appears that the additional traffic generated in the peak hour of 229 vehicle trips is only one-way and exiting trips have not been modelled.*	ptc. Response 2.1 ptc.'s revised modelling accounts for two-way trips, accounting for both entering and exiting trips. Refer to TfNSW Response 3 and Section 7.2.1 of this report.
RMS Comment 2: *No information has been provided which document how the assumptions for entering traffic distribution were estimated. It is noted that no vehicles are estimated to turn right from Forest Road into Penshurst Street.*	ptc. Response 2.2 Revised traffic distribution has been undertaken documenting the assumptions for the traffic distribution, for both the inbound and outbound trips. This is done based on residential areas within the school catchment and the anticipated route to the School based on the road layout and permitted turning movements. Updated traffic distribution assumes vehicles will turn right from Forest Road (south) into Penshurst Street (east) for a proportion of the inbound trips (30%, based on students residing in the south-west of the school catchment). Refer to TfNSW Response 3 and Section 7.2.1 and 7.2.4.
RMS Comment 3: *No information has been provided for exiting vehicle distribution assumptions.*	ptc. Response 2.3 As above.
RMS Comment 4: *2017 volumes have been used for the post development assessment instead of future base traffic volumes which consider growth on Forest Road.*	ptc. Response 2.4 ptc. has undertaken considerable research regarding growth of background traffic

Comment	ptc. Response
	based on the available historical data in the locality from RMS permanent stations. Growth of background traffic has not been included in the modelling due to minimal observed growth (0.04% per year) in Annual Average Daily Traffic counts as recorded by nearby traffic count stations. Refer to Section 7.2.2 for more details.
RMS Comment 5: *No additional pedestrians have been included in the post development intersection modelling.*	ptc. Response 2.5 Additional pedestrians have been incorporated in the revised modelling, refer to 7.2.3. The SIDRA modelling for the pedestrian movements at the Forest Road/Penshurst Street intersection indicates that the existing Level of Service D will be retained in the development scenario with negligible (0.1 sec) increases in average delay.
RMS Comment 6: *The distribution assumes that 25% of arriving vehicles will turn right into Cambridge Street. The impact of additional right turning vehicles has not been assessed by the Applicant.*	ptc. Response 2.6 The Forest Road/Cambridge Street intersection has been included in the model (refer to Section 7.1). The revised trip assignment assumes no increase in right turns at this intersection (refer to Section 7.2.5) due to limited existing and future right-turning amenity at this intersection and the presence of more reliable alternative routes such as at the Forest Road/Penshurst Street intersection and along King Georges Road. The SIDRA modelling reflects the revised trip distribution and the capacity of the surveyed intersections to accommodate the increased traffic.
RMS Comment 7: *The intersection of Forest Road and Penshurst Street has extended pedestrian protection due to the close proximity to the school. Without the Sidra models being provided, we are unable to determine whether the modelling has adequately reflected the existing conditions.*	ptc. Response 2.7 Pedestrian protection has been incorporated into the revised model through the adoption of red turn arrow protection, refer to Section 7.3.1. This reflects the existing conditions at this intersection.

Comment	ptc. Response
Council Comments	
Council Comment 1: Traffic and Car parking: *Council Officers have reviewed the information provided relating to traffic and carparking for the development and are of the opinion the carparking proposed in inadequate (15 spaces provided which includes 1 accessible space and 30 are required by Council's DCP).* *The increase in traffic generation resulting from this development in the opinion of Council Officers cannot be accommodated in this precinct without the incorporation of a designated student drop off and pick up zone to ensure student and parent safety, and the extent of the school safety zones. The accommodation of all staff parking should be accommodated within the grounds of the school. There is inadequate capacity within the street network to accommodate the additional staff parking.* *Strong concerns are raised by Council officers in relation to inadequate car parking provision and the increase in traffic generation, in an area already affected by traffic congestion, particularly in the morning peak traffic period.* *Consideration is required to addressing the information above as part of the final design and construction documentation.*	**ptc. Response 3.1** The proposed upgraded school will provide 20 staff spaces, representing a 10 shortfall from the DCP requirement. Occupancy surveys indicate limited parking availability along Arcadia Street and Percival Street during pick-up/drop-off periods, however, there are vacant spaces in streets further away (within walking distance) in the order of 46-80 spaces (Table 4) which can capture the increased demand. In addition, management measures are proposed to offset this shortfall and preserve the amenity of the street network by encouraging staff to park in the streets further away from the school (still within walking distance) and reduce the staff car mode share. The forecast impact and mitigation measures are discussed in Section 8.1 and Section 8.6. This includes the provision of 13 additional P5 parking spaces, replacing existing unrestricted spaces, ensuring greater accessibility for parent pick-up/drop-off along the frontage of the school and reserving additional spaces near the school for short-term parking activities. Staff carpool spaces are also considered to increase the occupancy level per vehicle and reduce the overall number of staff vehicles. A Travel Access Guide (TAG) is provided in conjunction with the Green Travel Plan (GTP) to encourage greater uptake of sustainable modes of transport and decrease parking demand. In line with these changes is a recommendation for increased parking enforcement by Council rangers to ensure a greater level of compliance to parking restrictions, ensuring short-term parking spaces are available for pick-up/drop-off.

Comment	ptc. Response
	The potential for a Resident Parking Scheme (RPS) is also considered to reduce staff parking in the most sensitive streets near the school, should the need arise. This would maintain on-street parking amenity for residents and encourage staff to park further away from the school, where the vacant spaces are located.
Council Comment 2: Construction and Traffic Management: *Given the sensitivity of the site and its location to Forest Road, the adjacent school site, residential and commercial development it is imperative the site is maintained in good order and kept clean, neat and tidy. As a result it is considered that a robust construction management and traffic management plan be developed and implemented for the site to ensure there is minimal and controlled impacts on the precinct and residents.* *The location and the extent of construction zones are also to be considered and communicated to the local residents.* *In addition it is requested that the department notify the precinct of the contractor for the development to assist in the liaison for site management issues.*	ptc. Response 3.2 A Construction Traffic and Management Plan (CTMP) will be prepared by ptc. upon engagement of the construction contractor, prior to issue of the Construction Certification. The CTMP will provide a robust assessment of the management measures to ensure the traffic and parking impacts from the construction works are minimised and precinct and resident amenity is preserved.
Council Comment 3: Significant Public Concerns: *There are elements of this proposal that are considered to require further consideration with respect to public interest and the protection of the amenity for the local residents and business owners:* • *Traffic and carparking deficiencies and the proposed use of the street network to accommodate the shortfall in carparking within what is a saturated and constrained street network;* • *The availability of access to residents and businesses during the construction and demolition;* • *The protection of the amenity of the locality during the demolition and construction phases of the development;* • *Consideration be given to the staggering of the start and finishing times in this precinct given the*	ptc. Response 3.3 Traffic and parking implications and mitigation measures resulting from the school upgrade are discussed in Sections 7 and 8. The shortfall in staff parking provision would result in additional parking in the adjacent street network, however, management measures as outlined below are proposed to mitigate this factor and maintain the amenity for residents whilst providing the appropriate facilities for parent pick-up/drop-off needs. The proposed increase in short-term parking (conversion of 13 existing unrestricted spaces to P5 parking in Arcadia Street) encourages staff to park further away from the school, minimising the effect of staff parking in the immediate vicinity of the school and

Comment	ptc. Response
immediate adjoining neighbour is a school to ensure congestion in the precinct is minimised	dispersing staff parking. The provision of short-term spaces and implementation of increased enforcement aids in greater turnover for the kiss-and-ride and P5 spaces, increasing the effective capacity of the existing and proposed parking provisions. Proposed car pool spaces and the Green Travel Plan encourage reduced car usage for staff and further offsetting the parking demand. The potential for a Resident Parking Scheme (RPS) is also discussed to maintain the amenity for residents in the area. The availability of access to residents and businesses and the protection of the amenity of the locality during the construction and demolition will be discussed in the CTMP. It is noted that during construction, the existing school location will be closed, hence there will be significant reductions in traffic and parking activity in the area. The opportunity for staggering start and finishing times with the nearby St Declan's Catholic Primary School is also presented in Section 8.6.3 and is subject to discussions between the two schools.

4. Existing Transport Facilities

4.1 Road Hierarchy

4.1.1 Penshurst

Penshurst Public School is located in the suburb of Penshurst, approximately 15km south-west of Sydney CBD, and fronts Arcadia Street (200m) and Forest Road (100m).

The road network servicing the area comprises a number of State and Regional Roads, providing a high level of accessibility to the surrounding regions.

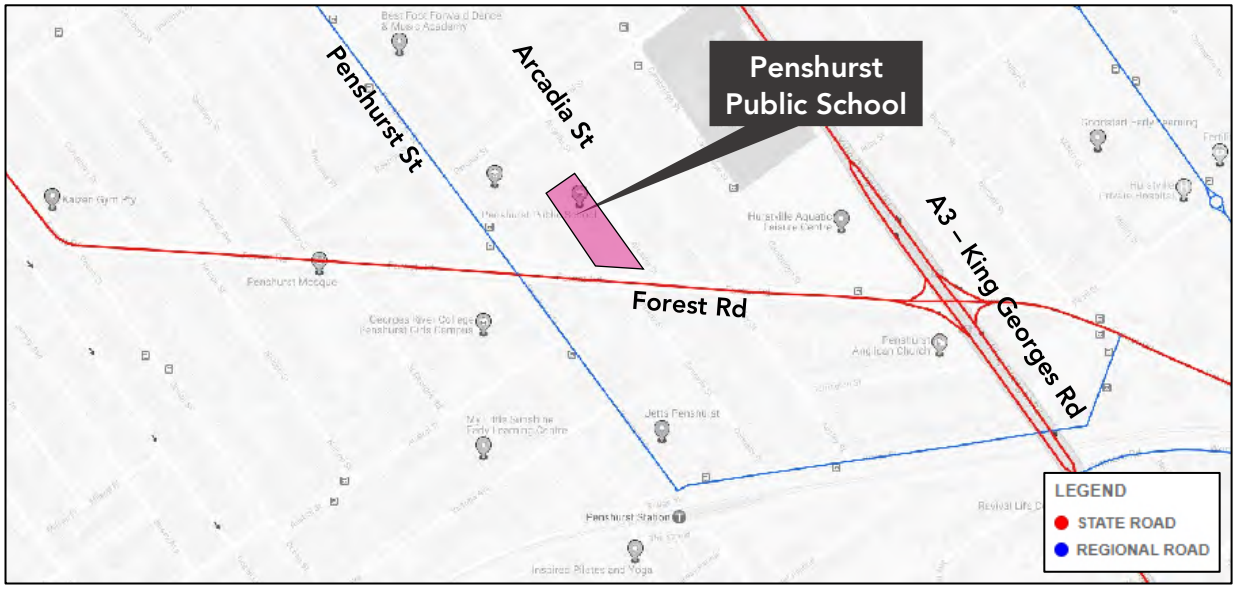


Figure 2: Surrounding Road Hierarchy at Penshurst

The NSW administrative road hierarchy comprises the following road classifications, which align with the generic road hierarchy as follows:

State Roads	- Freeways and Primary Arterials (RMS Managed)
Regional Roads	- Secondary or Sub Arterials (Council Managed, partly funded by the State)
Local Roads	- Collector and Local Access Roads (Council Managed)

The road network servicing the site includes:

Forest Road forms a section of the east-west arterial link connecting between the A3 at Penshurst, and the A6 route at Padstow. The carriageway typically comprises two lanes in each direction, with clearway controls on both sides to prevent parking. In the vicinity of the site, it is subject to a 40kph school-zone speed limit. In terms of pedestrian infrastructure, narrow footpaths are provided on both sides of the carriageway and a signalised crossing exists at the intersection with Penshurst Street, but otherwise, limited infrastructure is provided.

Penshurst Street acts as a local collector road aligned north-south between Penshurst and Narwee Stations. It is subject to a 40kph school-zone speed limit in the vicinity of the school. Parking controls along Penshurst Street (south of Forest Road) are typically 1P, to accommodate visitors of the local business centre. It intersects with Forest Road as a signalised intersection, and being the only signalised intersection within

approximately 500m, it acts as a primary crossing opportunity for pedestrians. Pedestrian infrastructure is relatively well established, as it already caters for high volumes of pedestrians associated with the local centre and GRC.

Arcadia Street is a local road which currently serves as the primary pick-up / drop-off location for PPS. The road fronts the north-eastern edge of the school and runs in both directions. Kiss-and-ride parking provisions are located on both sides of the road and a pedestrian crossing is located on this road, approximately midway between Percival Street and Forest Road.

4.1 Public Transport

The locality of PPS has been assessed in the context of available forms of public transport that may be utilised by relocated PPS students and staff members. When defining accessibility, reference is made to the NSW Planning Guidelines for Walking and Cycling (2004) (the Cycling and Walking Guide), where a distance of 400-800m is recommended as a comfortable walkable catchment to access public transport and local amenities. The document also suggests a distance of 1,500m as a suitable catchment for cycling.

4.1.1 Bus

The site is well serviced by buses that operate from the following 10 bus stops in close proximity to the site

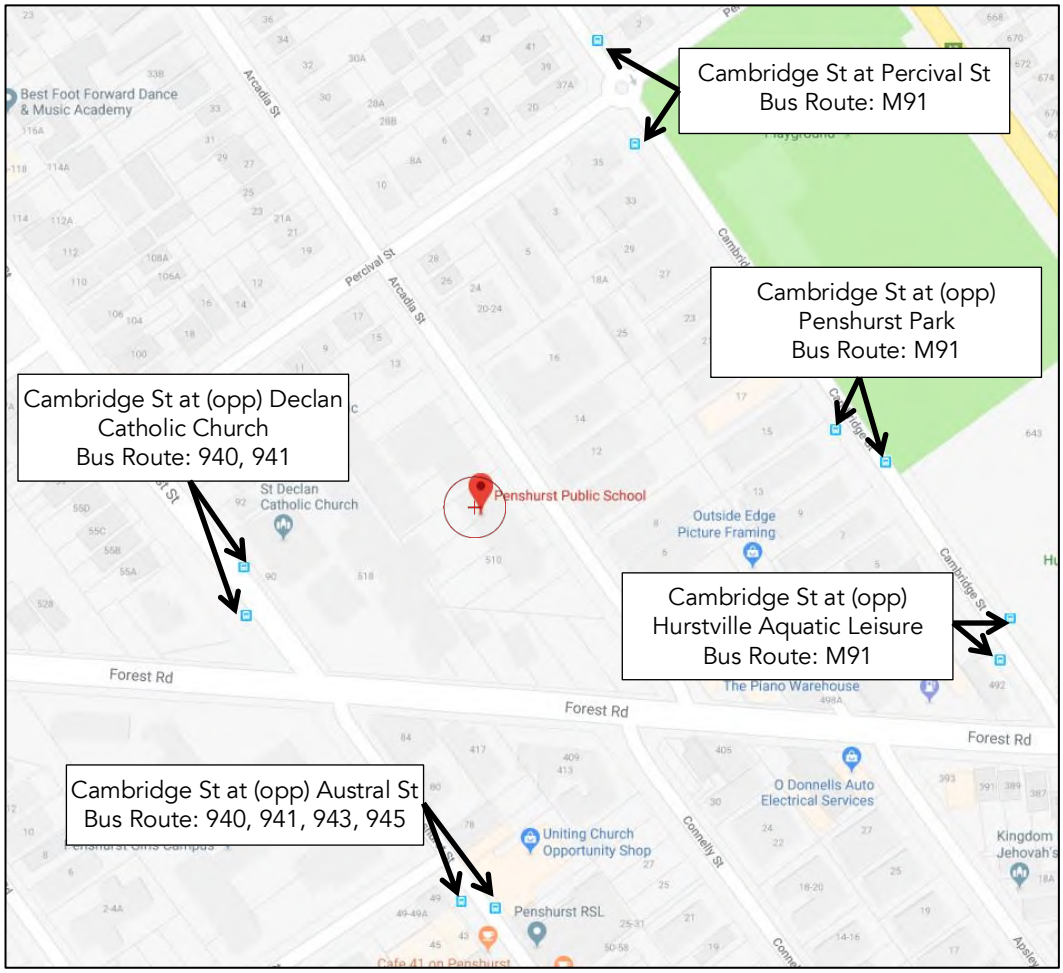


Figure 3: Bus Stops

These bus stops offer access to five (5) bus routes with regular services (Table 2):

- Penshurst Street: Routes – 940, 941, 943 and 945, and
- Cambridge Street: Route M91

Table 2: Bus Services Summary

Bus Route	Coverage	Frequency (approx.)	Services Operate (approx.)
940	Hurstville to Bankstown via Riverwood	Weekdays Every 30 minutes	Weekdays 6:13am – 6:13pm
941	Hurstville to Bankstown via Greenacre	Weekdays Every 30 minutes	Weekdays 5:54am – 9:12pm
943	Hurstville to Lugarno	Weekdays Every 30 minutes	Weekdays 6:45am – 9:14pm
945	Hurstville to Bankstown via Mortdale	Weekdays Every 30 minutes with additional services at peak times	Weekdays 6:10am – 10:10pm
M91	Hurstville to Parramatta via Padstow & Chester Hill	Weekdays Every 15 minutes with additional services at peak times	Weekdays 6:18am – 9:38pm

As shown in Table 2, these services operate between 5:54am and 10:10pm and provide access from the local area to western (e.g. Bankstown and Parramatta etc.) and southern (Lugarno) suburbs at approximately 15-30 minute intervals, with additional services at peak times.

Therefore, travel via buses is an attractive mode share option for school staff (and potentially students) serviced by these routes.

4.1.2 Train

Penshurst Station is located approximately a 700m walking distance (10min walk) from the site, which lies just within the NSW comfortable walking distance guideline as illustrated in Figure 4.

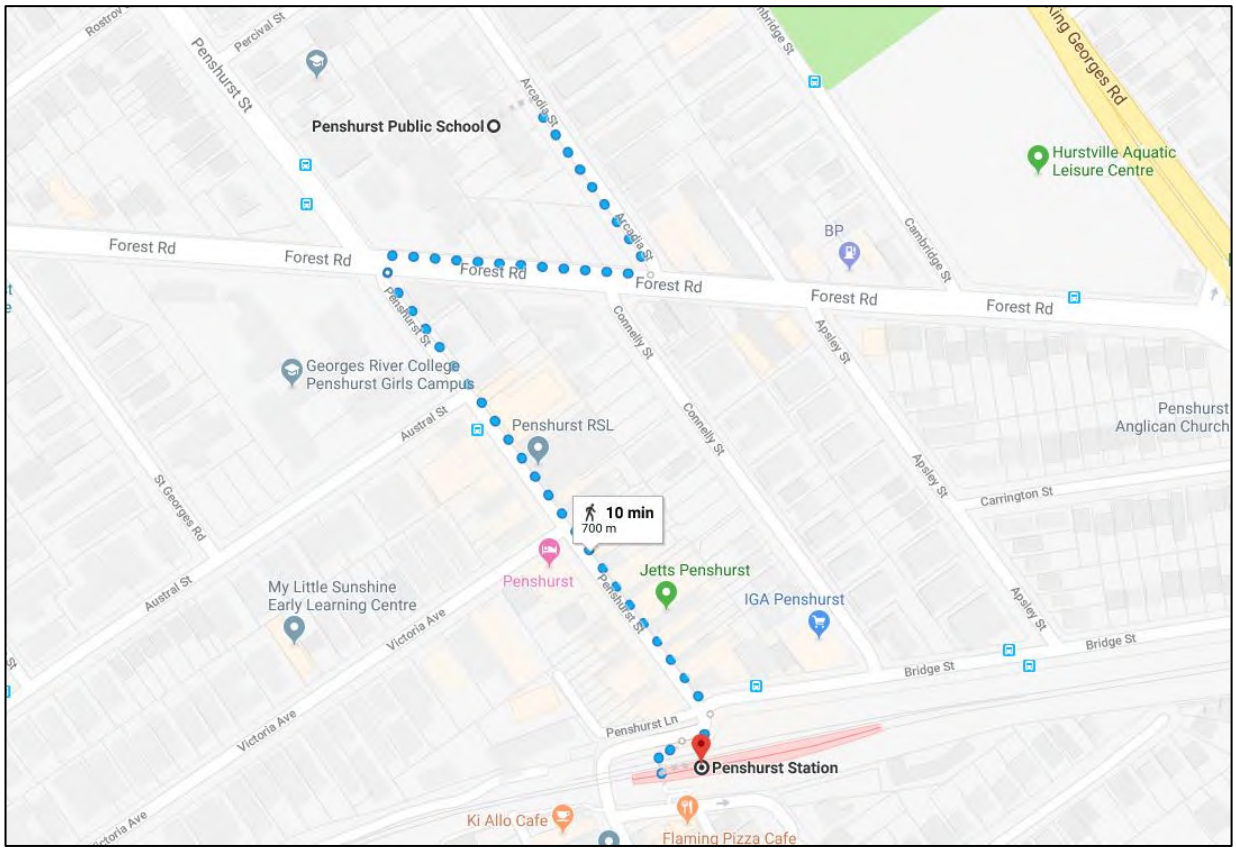


Figure 4: Walking Distance from PPS to Penshurst Station

As shown in Figure 5, Penshurst railway station is served by the T4 Eastern Suburbs & Illawarra Line which provides excellent connections to Sydney's southwest, east and the CBD.

Generally, Penshurst station offers frequent train services (every 10 minutes during morning and afternoon peaks and every 10-15 minutes off-peak). Therefore, heavy rail is a viable transport mode for school staff.

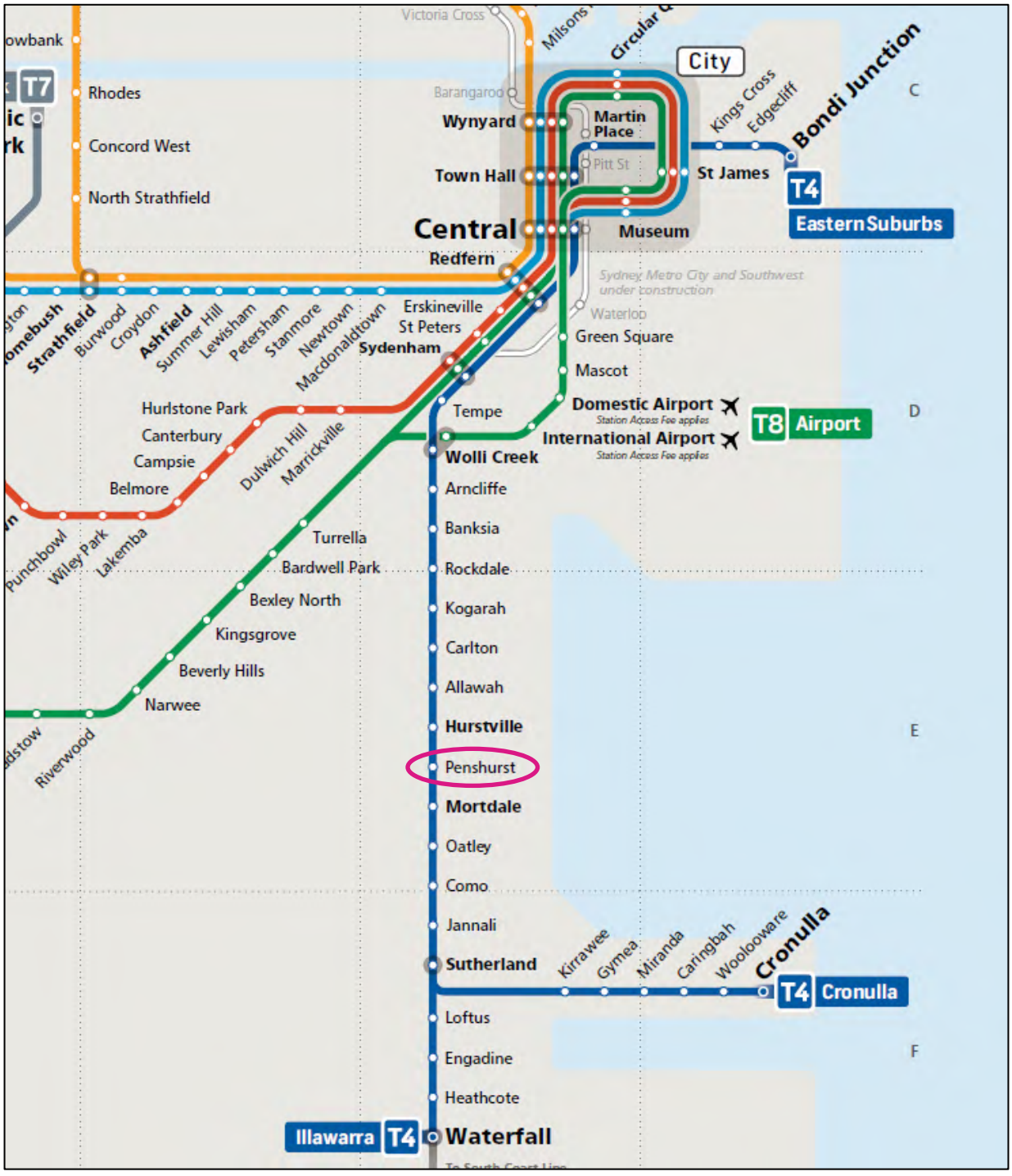


Figure 5: Sydney Trains Network Map

4.2 Bicycle Network

The school is accessible to bicycles from all directions, due to the good local road network. However, designated bicycle lanes and bicycle-friendly roads are very limited within the vicinity of the school. The nearest cycling paths are located along Penshurst Street, providing dedicated lanes between Stoney Creek Road and Forest Road.

A map of the existing cycling paths surrounding the school is shown in the map below:

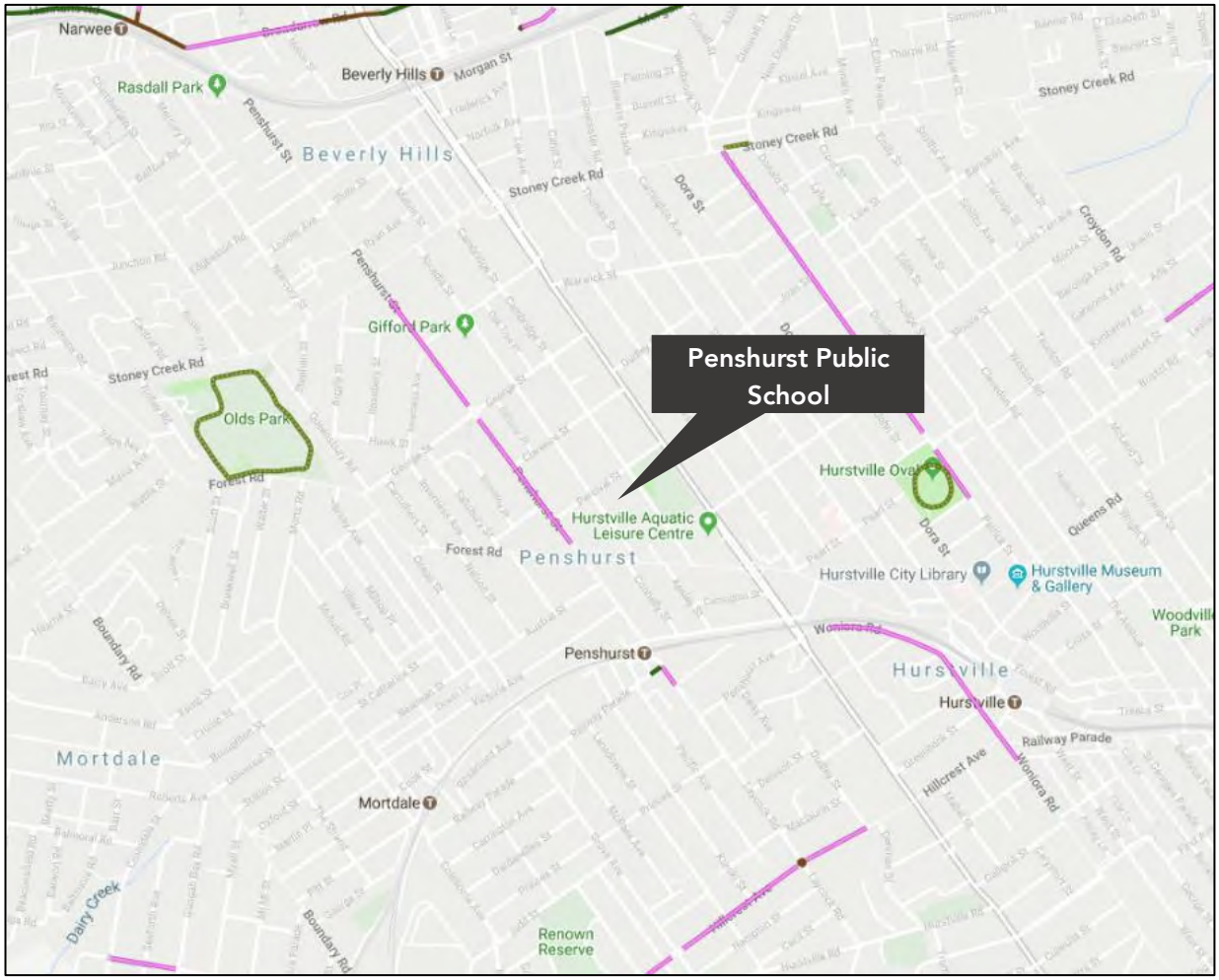


Figure 6: Local Bicycle Network (Source: http://www.rms.nsw.gov.au/maps/cycleway_finder)

4.3 Pedestrian Network

The existing pedestrian connectivity in close proximity to the school has been analysed. When defining accessibility, the NSW Guidelines to Walking & Cycling (2004) suggest that a 400m-800m catchment represents is a comfortable walking distance. Almost all roads and streets within this radius of the school typically have footpaths on both sides.

Due to the school's location in a low-density residential area, there are excellent pedestrian networks around the school including footpaths on both sides along all the roads bordering the school (Forest Road, Penshurst Street, Percival Street and Arcadia Street).

To the north-west, pedestrian crossings are provided on Percival Street and Penshurst Street.

To the east, at the main entrance to the school, there is a pedestrian crossing on Arcadia Street.

To the south, there are signalised pedestrian crossings on all four approaches at the intersection of Forest Road and Penshurst Street. In addition, pedestrian crossing facilities are also provided on Austral Street and at the Penshurst Street/Victoria Avenue and Penshurst Street/Bridge Street intersections.

The existing footpaths and crossing facilities near the School are shown in Figure 7.

Figure 7: Existing Footpaths and Pedestrian Crossings

5. Development Proposal

Penshurst Public School is proposed to be redeveloped to accommodate a student capacity increase from the current 440 students to 1,000 in the future in response to projected growth in the local government area. The proposal will also result in an increase in staff number from the existing 35 full-time-equivalent staff (FTE) to 59.

The project will include the following:

- removal of all buildings
- 47 new future-focused teaching spaces
- new administration/staff facilities
- new staff/student amenities
- new library
- new covered outdoor learning area (COLA)
- new hall
- maximised open play space.

The project is to begin in 2019 and development is estimated to take place over an 18-month period. During this interim period, the existing PPS students will be temporarily relocated to a pop-up school at Peakhurst West Public School from Term 1, 2019.

A layout of the staff car parking in the school, as prepared by Perumal Pedavoli Architects, is presented below as Figure 8. Full architectural drawings are provided as Attachment 1.

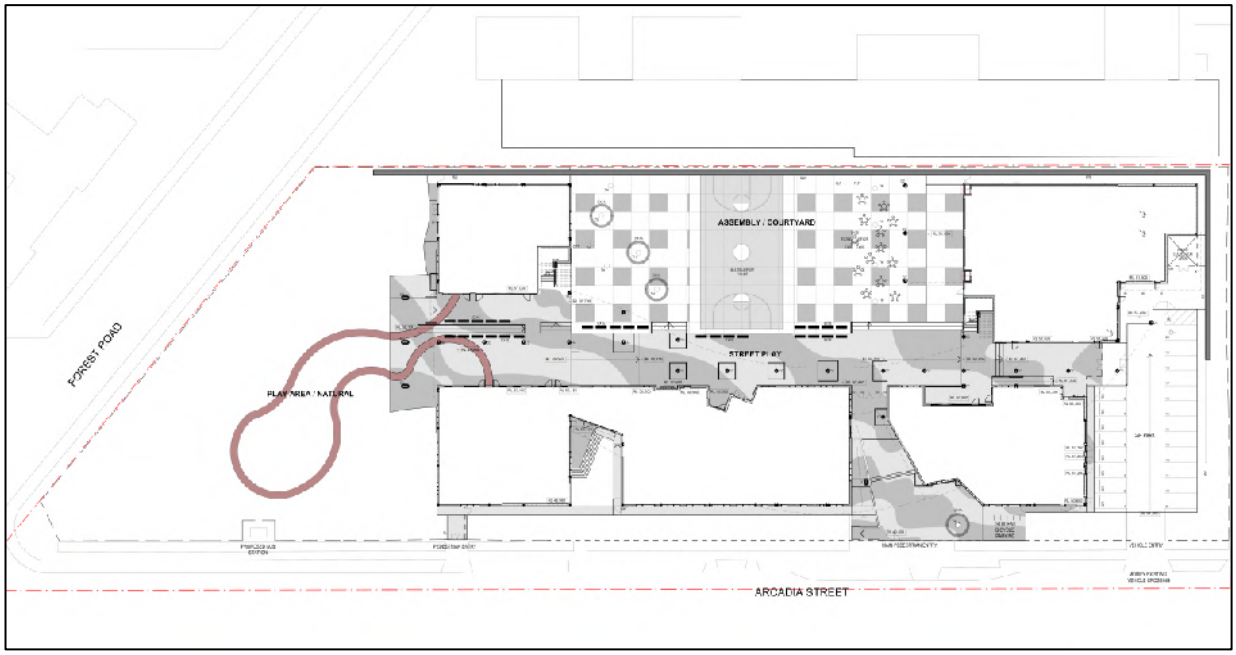


Figure 8: School ground level layout, prepared by Perumal Pedavoli Architects

6. Penshurst Public School Existing Traffic and Parking Profile

6.1 Travel Mode Split

The following section presents an overview of the existing travel mode split at PPS and informs the current demand and utilisation of pick-up/drop-off areas and other short-term parking areas within the vicinity of the school.

6.1.1 Student Mode of Travel

The following table presents the travel mode split for Penshurst Public School. This data has been extracted from 2017 survey data from the traffic assessment report previously prepared by TTM[2].

Table 3: Penshurst Public School Student Travel Mode Split

Period	Car	Bus	Train	Walking	Bicycle	Total
Morning						
Peak (8:00-9:00am)	**40.4%**	**0.5%**	**0.3%**	**46.3%**	**0.3%**	**87.7%**
Off-peak	**7.5%**	**0.0%**	**0.0%**	**4.9%**	**0.0%**	**12.3%**
Afternoon						
Peak (2:45pm-3:45pm)	**42.4%**	**0.8%**	**0.3%**	**51.7%**	**3.0%**	**95.9%**
Off-peak	**2.8%**	**0.0%**	**0.0%**	**1.3%**	**0.0%**	**4.1%**

As can be seen, walking is the predominant form of transport, reaching a 46.3% mode split during the morning peak and a 51.7% mode split during the afternoon peak respectively. Travel by car represents 40.4% and 42.4% mode splits during the morning and evening peaks, respectively. The existing utilisation of bus, train, and bicycle modes is very low.

6.1.2 Staff Mode of Travel

Similar to the above, the following mode split data for staff travel to Penshurst Public School has also been extracted from a TTM report[3].

From the TTM survey, of the 52 staff present on that day, 43 staff drove. This represents an 83% proportion of staff driving to school. It is noted that there are currently 15 parking spaces within the school. 16 of the staff stated that they had parked on-site (as per TTM's report) and the remaining 27 parked on-street. This data also indicates an occupancy of 1 driver per vehicle and presents the opportunity for car pooling as a potential parking management measure.

[2] Table 2.2 of the 'Penshurst Public School Traffic Assessment' prepared by TTM, April 2018, Rev 13
[3] Table 3.2 of the 'Relocation of Penshurst Public School to Peakhurst Traffic Assessment' prepared by TTM, January 2018, Rev 1

6.2 Pedestrian Arrival/Departure Profile

Surveys of the four pedestrian accesses to the school have been undertaken from Monday 13 August to Friday 17 August 2018 from 6:30am-9:30am and from 2:30pm-4:00pm. These access points are located on Forest Road (1) and on Arcadia Street (3), as illustrated in Figure 9. These surveys inform the arrival and departure pattern of the students and other users such as parents, teachers, and community members who enter and exit the school.

Figure 9: Existing pedestrian access points to Penshurst Public School

The results of the gate surveys are presented in Figure 10 and Figure 11. The volumes for each gate have been collated together to arrive at the total inbound or outbound 15-minute volumes. For the morning period, the majority of student movements are expected to be inbound and vice versa for the afternoon period with outbound volumes. Outbound movements in the morning period and inbound movements in the afternoon period are assumed to be primarily a result of parent movements. It is important to note that the surveys made no distinction between staff, students, or parents traversing through the gates.

6.2.1 Morning Pedestrian Profile

As illustrated in Figure 10, the pedestrian inbound profile features a very distinct and short peak with the majority of pedestrians entering within a 15-minute window from 8:45am to 9:00am (when school commences). Moderate volumes of pedestrians also arrive within the 8:30am-8:45am and 9:00am-9:15am brackets. Figure 11 presents the pedestrian outbound profile which illustrates a similar pattern and is representative of parents exiting the school upon commencement of classes. These similar peaks in these

profiles with the slight offset between inbound and outbound suggest that a significant portion of parents arrive with students and remain in the school for approximately 15 minutes before departing. This implies a demand for short-term parking (e.g. 15 min parking or ½ hr parking), which is considered in Section 8.5 with the proposed parking control modifications.

6.2.2 Afternoon Pedestrian Outbound Profile

The afternoon profile presents a similar peak profile (see Figure 12) with the first 15 minutes following the school conclusion experiencing the greatest volume of outbound movements by a significant amount followed by reduced volumes in the next 15 minutes and very little pedestrian movement following that.

Like the morning profile, the afternoon inbound profile is similar to the outbound profile in terms of shape, however is offset by 15 minutes (see Figure 13). This again relates to parents entering the school approximately 15 minutes before the conclusion of the school day. It is noted that these gate surveys capture the pedestrian movements, and parents may park their vehicles within the vicinity of the school earlier than 15 minutes before the conclusion of the school day.

This behaviour has been observed during ptc.'s site visit and highlights the unsuitability of kiss-and-ride (No Parking restriction[4]) parking to accommodate the parking demands during the afternoon period. Greater discussion and proposed parking modifications are presented in Section 8.5.

[4] Allowing drivers to stop for no more than 2 minutes, remaining within 3m of their vehicle

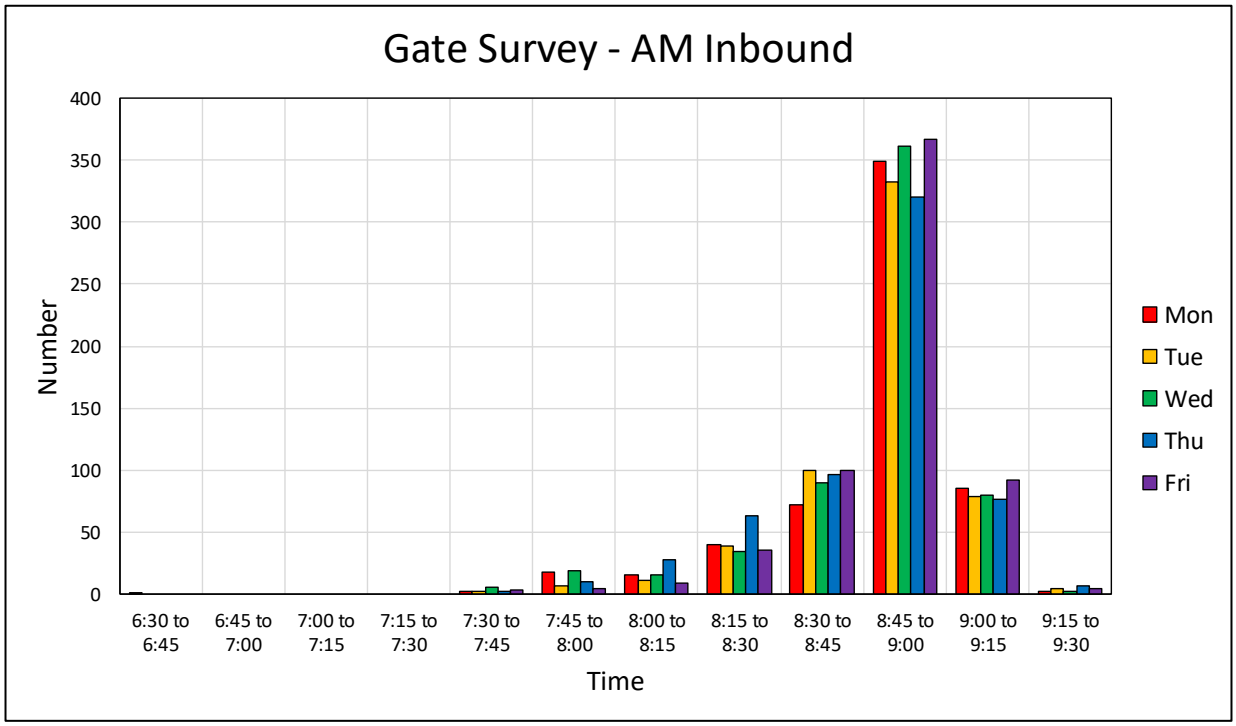


Figure 10: Morning Inbound Pedestrian Profile

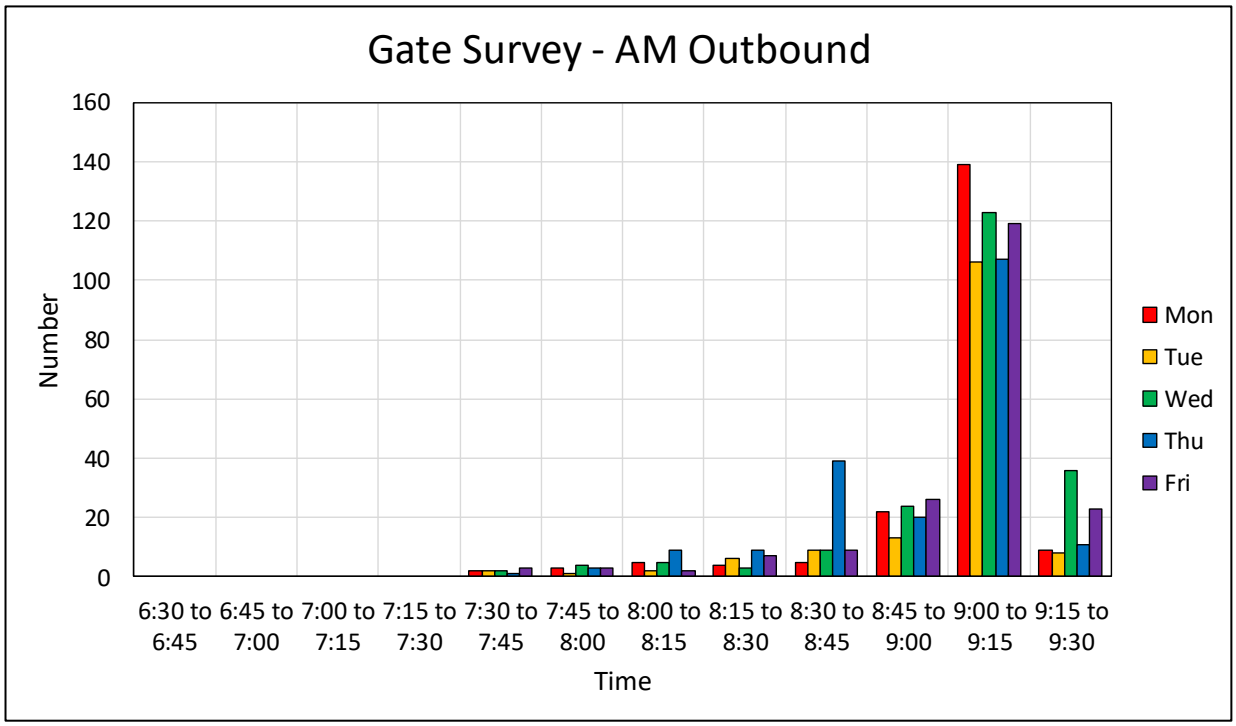


Figure 11: Morning Outbound Pedestrian Profile

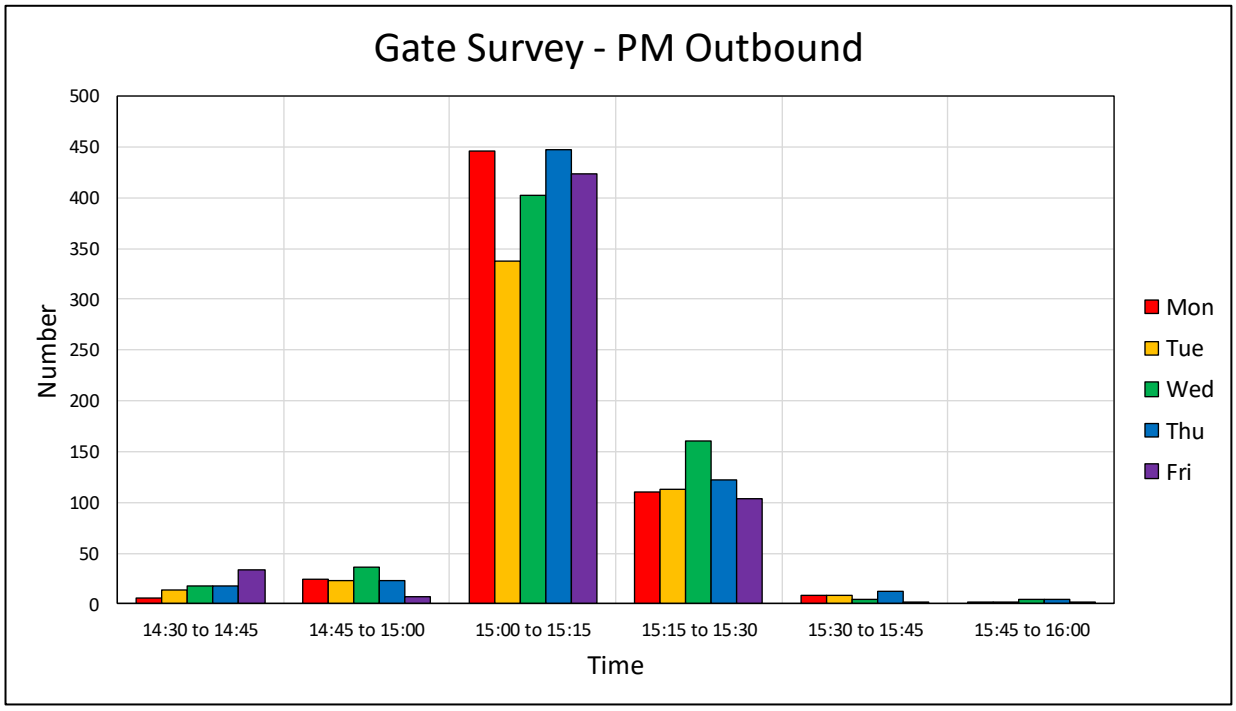


Figure 12: Afternoon Outbound Pedestrian Profile

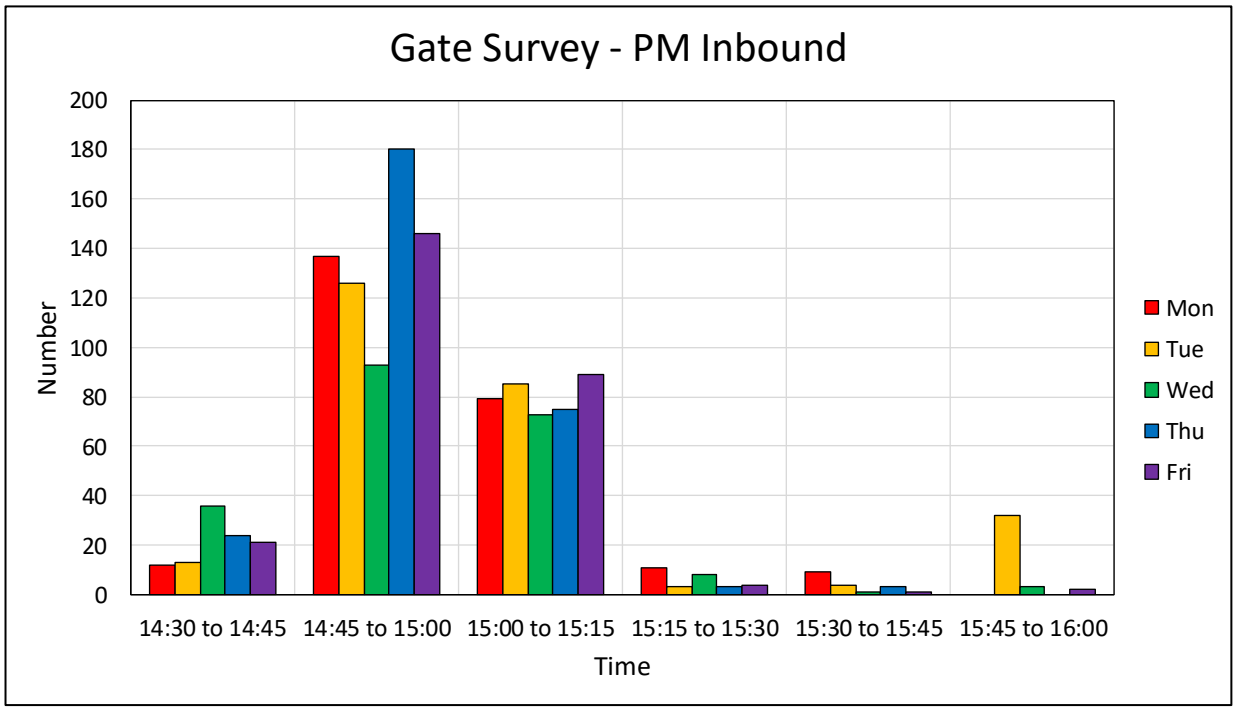


Figure 13: Afternoon Inbound Pedestrian Profile

6.3 Existing Site Observations

An overview of the existing parking controls within the vicinity of PPS is presented in Figure 14. The surrounding roads are predominately characterised by a mix of unrestricted parking and kiss-and-ride parking. During ptc.'s site visit on 16 August 2018, it has been noted that the unrestricted on-street parking occupancy in the streets surrounding the school is low-moderate during the morning period and high during the evening period.

As illustrated in Figure 14, three kiss-and-ride zones are present on Arcadia Street and are situated on both sides of the street, accommodating vehicles travelling in both directions. The kiss-and-ride zones on Penshurst Street are anticipated to be primarily utilised by St Declan's Catholic Primary School, which is located immediately adjacent to the kiss-and-ride zone, on the same block as PPS. The shorter kiss-and-ride zones on the eastern side of Arcadia Street can accommodate up to two vehicles at a time (total of 4), whilst the longer kiss-and-ride zone on the western side of Arcadia Street (school side) can accommodate up to 7-8 vehicles.

During the morning period, these zones were observed to operate within capacity, however, during the afternoon period, parking along Arcadia Street is at capacity due to the large demand resulting from parents parking and waiting prior to the conclusion of the school day. Illegal behaviour such as double parking, parking in driveways, parking in No Stopping zones, exceeding No Parking durations, and illegal 3-point-turns/U-turns have been observed during the afternoon peak period along Percival Street and Arcadia Street. It is noted that the afternoon peak dissipated quickly, with the majority of pick-up activity concluding approximately 20 minutes after school conclusion.

No Stopping controls are present at the pedestrian crossing on Arcadia Street. A bus zone is present on Penshurst Street. It is noted that the PPS buses (for excursions, sports, etc.) utilise the existing kiss-and-ride zones on Arcadia Street for their pick-up/drop-off activities.

Also noted is the narrow road width of Arcadia Street, this is an existing attribute of this road and two-way movement with parking on both sides is possible, although it is quite constrained. Although this results in increased difficulty of vehicle manoeuvres, it also promotes a lower speed environment and reduced crossing distances which benefit pedestrian amenity.

As part of the proposal, a number of proposed on-street parking modifications are recommended, to introduce a greater proportion of short-term parking along Arcadia Street and discourage staff from parking in Arcadia Street (between Percival Street and Forest Road), hence opening up additional space for the pick-up/drop-off needs of parents whilst maintaining the parking balance to the adjoining residents. Details of the proposed on-street parking modifications are discussed in Section 8.5.

Figure 14: Existing parking controls within the vicinity of Penshurst Public School

6.4 On-Street Parking Occupancy

On-street parking surveys have been conducted by TTM from 7:30am-10:00am and 2:00pm-4:00pm on Wednesday 11 April 2018. The scope of the survey area included the following zones:

1. Arcadia Street (between Forest Road and Percival Street)
2. Percival Street (between Penshurst Street and Cambridge Street)
3. Arcadia Street (between Percival Street and Clarence Street)
4. Cambridge Street (between Clarence Street and the southern edge of Penshurst Park)
5. Clarence Street (between Penshurst Road and Cambridge Street)

These zones are illustrated in Figure 15. The furthest ends of the zones (i.e. Penshurst Street/Clarence Street intersection and Clarence Street/Cambridge Street intersection) are approximately 500m (5-7 min walk) away.

Figure 15: Surrounding on-street parking zones

The following values have been extracted from TTM's traffic impact assessment[5] and are collated in Table 4. The total capacity for all 5 zones is 260 spaces. TTM's surveys did not identify the capacity of each individual zone.

[5] Tables 3-3 and 3-4 of 'Penshurst Public School Traffic Assessment' prepared by TTM, April 2018, Rev 13

Table 4: Vacant On-street Parking Spaces by Zones

Time	Vacant Spaces in all 5 zones [Table 3-3 of TTM report]	Vacant Spaces in zones 3, 4, and 5 [Table 3-4 of TTM report]	Vacant Spaces in zones 1 and 2 [Column 1 – column 2]
AM Peak			
7:30am	109	79	30
8:00am	113	80	33
8:30am	100	70	30
9:00am	73	67	6
9:30am	107	74	33
10:00am	107	74	33
PM Peak			
2:00pm	101	74	27
2:30pm	90	68	22
3:00pm	77	64	13
3:30pm	43	46	0*
4:00pm	113	71	42

* Note: Due to different methodologies in the calculation of Table 3-3 and Table 3-4, the exact value of the number of vacant spaces in zones 1 and 2 for 3:30pm appears to be negative. This is most likely a result of Table 3-3 calculating vacant spaces from the total capacity less the occupied spaces whereas Table 3-4 calculates vacant spaces by directly counting them. It is assumed that at 3:30pm during the survey day, that there were zero vacant spaces in zones 1 and 2.

As indicated by the occupancy surveys, in the streets farther away from the school (still within walking distance), i.e. Clarence Street, Cambridge Street, and the northern part of Arcadia Street, there are a large number of vacant spaces (minimum of 46 spaces at 3:30pm). However, in the two streets closest to the school, Arcadia Street (between Forest Road and Percival Street) and Percival Street, the occupancy surveys indicate very little parking availability during the peak pick-up and drop-off period (6 vacant spaces at 9:00am and 0 at 3:30pm).

This reflects the site observations by ptc. on 16 August 2018, where Arcadia Street was observed to be heavily utilised for drop-off activity in the morning and Arcadia Street and Percival Street were heavily utilised for pick-up activity in the afternoon. With this in mind, to accommodate the increase in staff parking and parent pick-up/drop-off parking, consideration is given to the location of proposed parking modifications and the direction of travel. The general strategy is to encourage staff to park in areas further away from the school and propose parking modifications to increase the availability of short-term parking in the closest on-street spaces near the school. Detailed analysis is presented in Section 8.5.

7. Traffic Impact Assessment

7.1 Existing Traffic Conditions

In order to determine the existing traffic conditions within the road network that service the school, surveys of the following three intersections have been conducted:

- Forest Road / Penshurst Street
- Forest Road / Arcadia Street / Connelly Street
- Forest Road / Cambridge Street

Traffic surveys for the first two intersections have been conducted by TTM previously on Tuesday 25 July 2017 as part of their traffic impact assessment[6]. The identified peak hours for these intersections have been determined to be 8:00am-9:00am and 2:45pm-3:45pm.

The Forest Road / Cambridge Street intersection has been surveyed following RMS comments on the initial traffic modelling prepared by TTM. This intersection survey was conducted on Tuesday, 14 August 2018 (a day within the school term) and the peak hours were determined to be 7:45am-8:45am and 3:00pm-4:00pm for the morning and evening peaks, respectively.

The results of the intersection surveys are illustrated in Figure 16 – Figure 18.

The volume of light vehicle movements during the peak is represented by the top number in each box. The heavy vehicle movements are below, in brackets. For the Forest Road / Penshurst Street intersection, the pedestrian volumes are also displayed for each approach. A red cross in the figures indicates that the turning movement is banned.

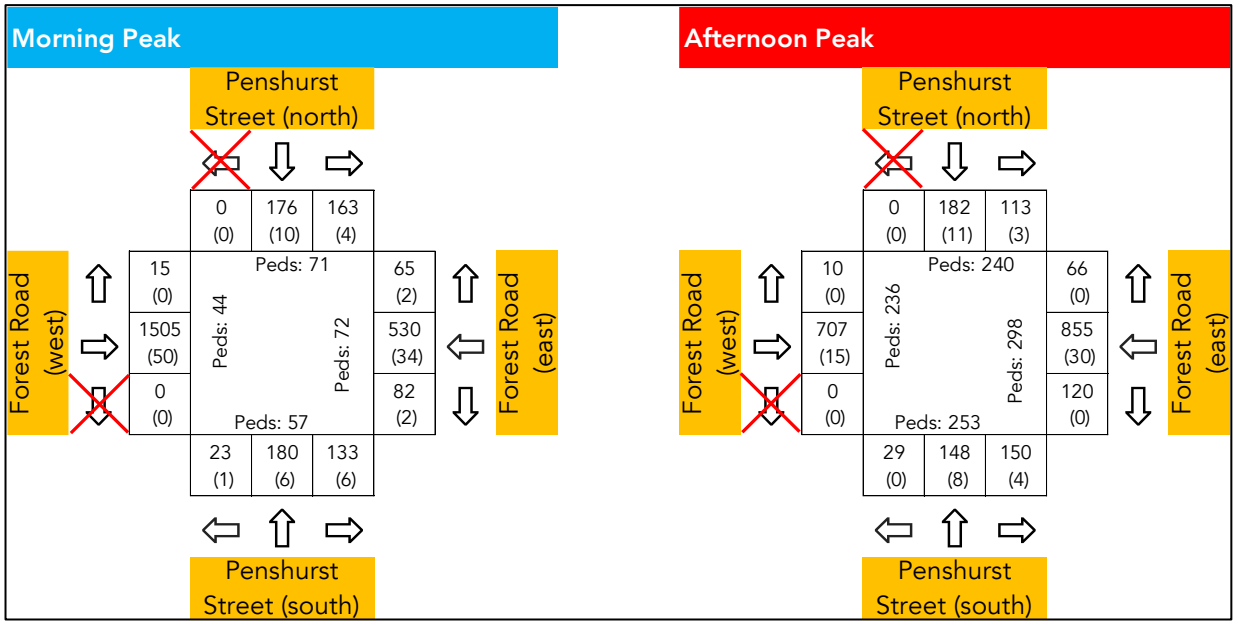


Figure 16: Forest Road / Penshurst Street Surveyed Volumes (Light vehicles above, heavy vehicles in brackets)

[6] Penshurst Public School Traffic Assessment', April 2018, Rev 13

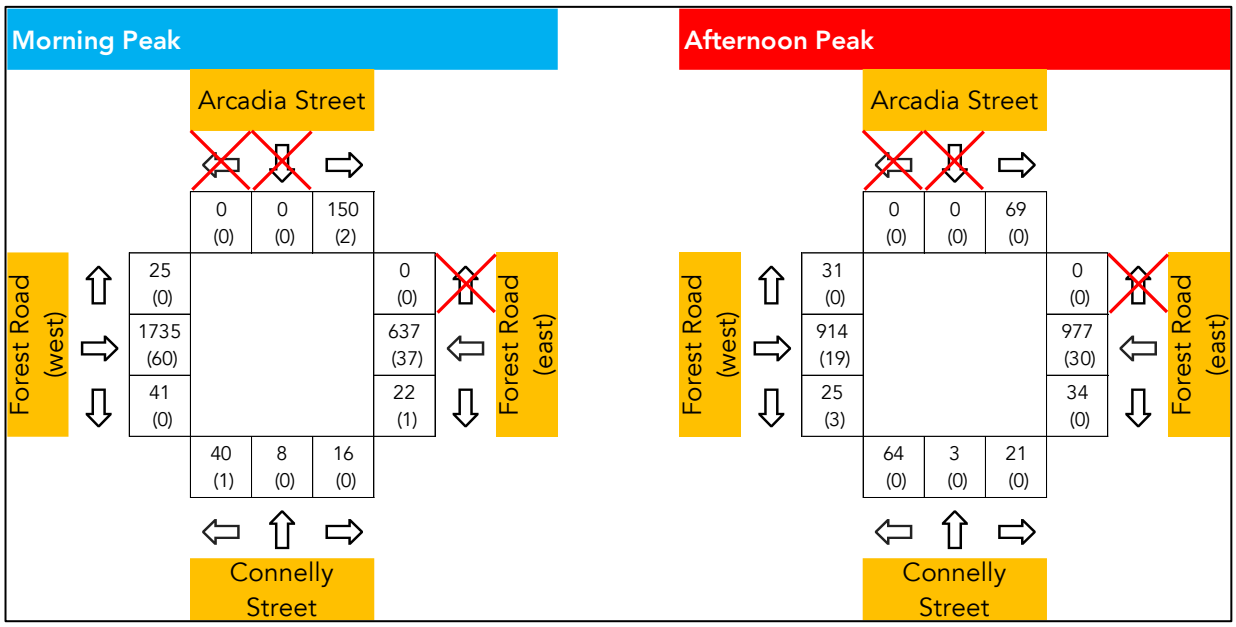


Figure 17: Forest Road / Arcadia Street / Connelly Street Surveyed Volumes (Light vehicles above, heavy vehicles in brackets)

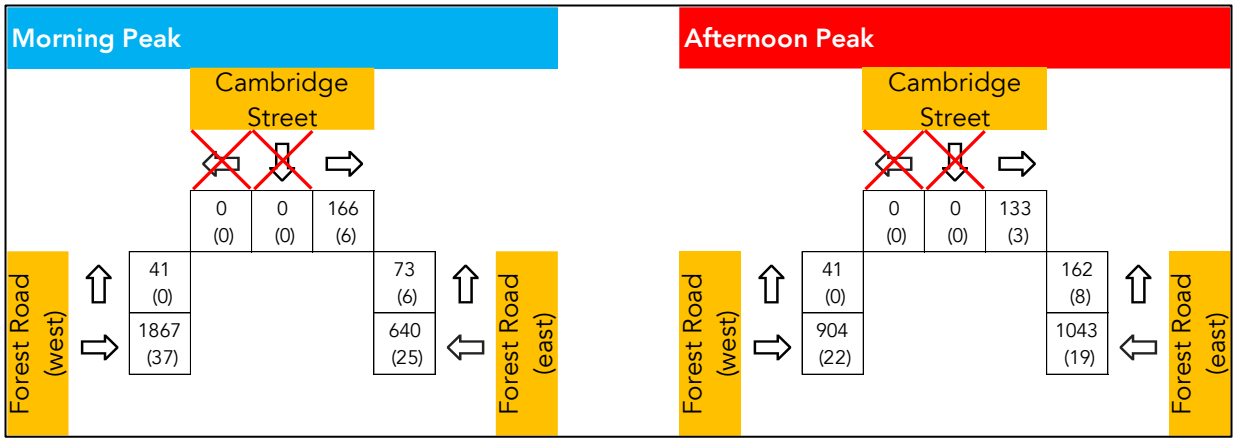


Figure 18: Forest Road / Cambridge Street Surveyed Volumes (Light vehicles above, heavy vehicles in brackets)

7.2 Future Traffic Conditions

7.2.1 Trip Generation

The forecast trip generation resulting from the proposal is determined via a first principles approach based on the increase in student numbers and the forecast travel mode split. Measures to encourage active travel (i.e. cycling and walking) and public transport utilisation for staff and students are discussed in a separate Green Travel Plan. This would likely to reduce the private vehicle mode share, however, to present a robust model and for conservativeness, no reduction in the private vehicle mode share is assumed.

The proposal is expected to increase the student population from the existing 440 students to 1,000 students, i.e. a total increase of 560 students. A survey undertaken by TTM in early 2018[7], resulted in 167 responses, accounting for 228 students. This implies a car occupancy level (excluding the driver and non-school related passengers) of 1.37[8].

The survey accounted for 52% of all students at the school[9]. From ptc.'s experience (at other schools a response rate of 20-30% provides a relatively accurate representation of the general population. Therefore the 52% response rate provides a strong level of confidence.

The peak hour car mode share has been determined to be 40.4% in the morning and 42.4% in the afternoon, respectively (see Section 6.1.1). This results in an additional trip generation of 166 two-way trips in the morning peak[10] and 174 two-way trips in the afternoon peak[11]. Two-way trips as modelled as it is expected that the inbound and outbound movements from parents will both occur within a single hour.

The trip generation from the staff increase is not anticipated to coincide with the school morning and afternoon peak hours with staff arriving and leaving outside of the peak pick-up and drop-off activity.

7.2.2 Background Growth of Traffic

To determine the background growth of traffic, reference is made to the RMS Traffic Volume Viewer to assess the traffic volumes over time in the surrounding area as recorded by the traffic count stations and traffic classifier stations. These stations provide the Annual Average Daily Traffic (AADT) counts over a range of years, further classified as two-way volumes or directional volumes.

The stations located within a 5km radius of the school have been identified and assessed to determine the change in AADT over the range of years the stations have been operational. A diagrammatic representation of the location of these 11 stations is illustrated in Figure 19.

A summary of the results is presented in Table 5. Bi-directional traffic AADT and vehicle classifications of either unclassified or all vehicles (light and heavy) has been used for assessment.

[7] Penshurst Public School Relocation – Shuttle Bus Survey, letter from TTM to Perumal Pedavoli Architects, dated 23 March 2018
[8] 228 students ÷ 167 responses
[9] 228 surveyed students ÷ 440 student enrolments
[10] 560 student increase ÷ 1.37 average number of students per car x 40.4% morning peak car mode split = 165.14
[11] 560 student increase ÷ 1.37 average number of students per car x 42.4% afternoon peak car mode split = 173.31

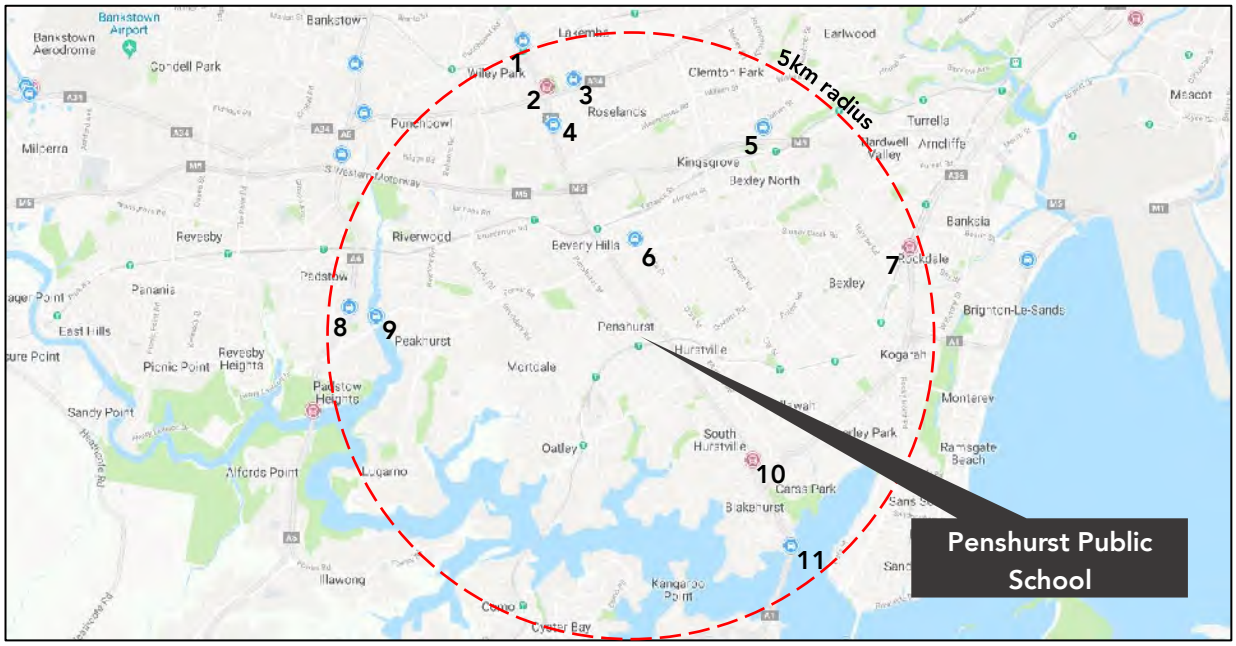


Figure 19: Traffic Count Stations (Source: RMS Traffic Volume Viewer)

Table 5: Summary of Traffic Count Stations and AADT Growth

Location	Station ID	Average AADT Growth Per Year[12]	Average AADT over operational period	Weighted AADT Growth[13]
1	24008	0.19%	75189	0.028%
2	7115	2.73%	28026	0.147%
3	24014	0.69%	39281	0.052%
4	24026	-0.68%	77780	-0.102%
5	24221	-0.24%	33523	-0.015%
6	41154	-0.68%	33341	-0.044%
7	7132	-0.34%	19852	-0.013%
8	43246	1.01%	43561	0.085%
9	43032	0.92%	36557	0.065%
10	40041	-1.99%	44863	-0.172%
11	36001	0.05%	87082	0.008%
Total			519054	0.040%

[12] Average growth of all years the station has been operational
[13] AADT Growth per year x Average AADT ÷ Total AADT of all 11 stations

As indicated by the AADT data, the background growth of traffic within the locality is relatively flat. Some areas present greater growth, whilst others present decreases in traffic growth. Overall, the AADT growth is near zero with a 0.04% average growth per year.

Therefore, no background growth of traffic is incorporated in the traffic model, given the flat levels of traffic growth presented in the area.

7.2.3 Pedestrian Increase

In relation to the pedestrian traffic at the Forest Road / Penshurst Street signalised intersection it is assumed that that there will be an increase in PPS-related pedestrian traffic due to the greater student numbers. The number of students is expected to increase by 560 and with a walking mode split of 46.3% and 51.7% in the morning and afternoon peaks respectively (see Section 6.1.1), this corresponds to an increase of 259 and 290 pedestrian movements respectively. However, this is for the entire school catchment. It is anticipated that the only users of the Forest Road / Penshurst Street crossings will be those who reside in the residential areas to the south (assumed 40% of the catchment, see Figure 26). Therefore, the forecast increases in pedestrian volumes through the Forest Road / Penshurst Street intersection are forecasted at 104 and 116 for the morning[14] and afternoon[15] peaks respectively. It is assumed that half of the pedestrians will utilise the crossings across Penshurst Street (north) and Forest Road (west) and the other half utilise the crossings across Forest Road (east) and Penshurst Street (south).

SIDRA modelling (see Attachment 4) indicates the pedestrian amenity for the Forest Road / Penshurst Street intersection will be maintained in the post-development scenario. A summary is presented in Table 6. The existing Level of Service D (both morning and afternoon peak periods) is maintained and the delay increases marginally (0.1 seconds).

Table 6: Pedestrian Modelling Results at Forest Road/Penshurst Street

Scenario		Level of Service	Average Delay (sec)
Morning Peak	Existing	D	39.3
	Development	D	39.4
Afternoon Peak	Existing	D	39.7
	Development	D	39.8

[14] 560 student increase x 46.3% walking mode split x 40% residing in the south = 103.71
[15] 560 student increase x 51.7% walking mode split x 40% residing in the south = 118.29

7.2.4 Trip Distribution

To determine the trip distribution of the additional traffic generation, consideration is given to the school catchment area, land use & residential density, distance to the school, local road layout & permitted turning movements, and the direction of travel.

School Catchment Area

The PPS catchment area is illustrated in Figure 20 and analysis of this area is expected to capture the majority of students.

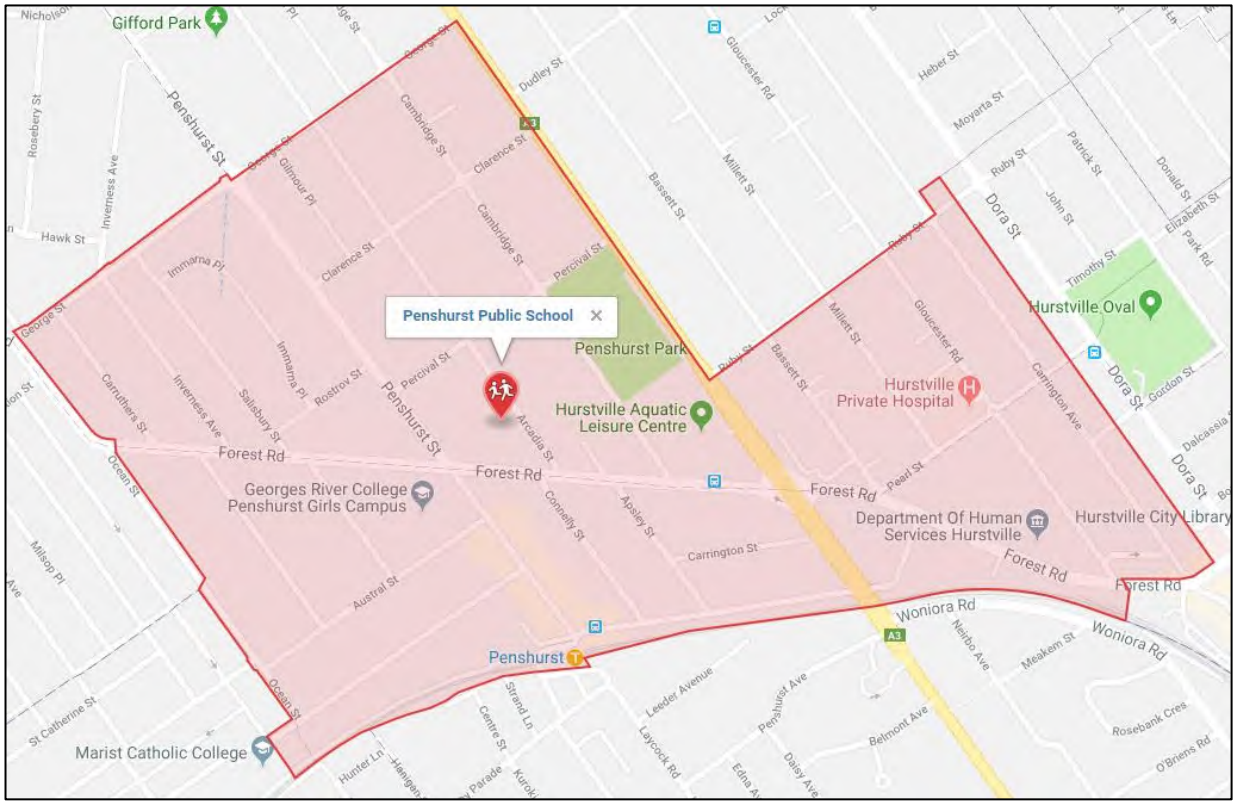


Figure 20: Penshurst Public School catchment area (source: NSW Public School Finder[16])

[16] https://education.nsw.gov.au/school-finder/index

Land Use & Residential Density

The surrounding land use for the school catchment is presented in Figure 21. This is a simplification of the land zoning maps extracted from the Hurstville Local Environmental Plan 2012. The area immediately adjacent to the school is not anticipated to generate any vehicular trips due to the proximity to the school, hence why it has not been coloured.

The majority of residential development within the catchment is classified R2 low density residential and R3 medium density residential. The residential area to the south-west and a portion of the residential area to the east is medium density whilst the rest is low density. This will impact the weighting of vehicular trips with more dense residential areas anticipated to generate greater vehicle movements. The nearby Georges River College (senior girls school), local centre, recreation (Penshurst Park and Hurstville Aquatic Centre), and mixed-use areas are not anticipated to generate any significant volumes of traffic to and from the school.

Figure 21: Surrounding land use

Distance to the School

The residential areas further from the school are anticipated to generate proportionately greater volumes of traffic due to the greater travel distance and lower attractiveness for active transport.

Local Road Layout & Permitted Turning Movements

The layout of the surrounding roads is considered as well as the presence of any turn bans (e.g. No Right Turn) when determining the vehicular routes. The forecast travel routes have been determined to maximise the number of left-hand turns and through movements and minimise non-signalised right turns.

Direction of Travel

The direction of travel is also an important element that is considered. The forecast travel routes are implemented in a manner so as to minimise the need to perform 3-point turns or u-turns. The inbound and outbound trips are presented separately, as the paths are likely to differ due to turn bans or route efficiency.

7.2.5 Route Assignment

The following figures (Figure 22 – Figure 26) present the forecast trip distribution and route assignment based on the factors discussed in Sections 7.2.1 7.2.4. The two residential zones in blue and green present a higher proportion of the vehicular generation due to the distance from the school and the greater density residential development.

The travel routes from each zone have been determined to provide the most direct path to the school whilst considering the egress route as well. For the outbound movement, the travel routes follow from the inbound route (assuming negligible 3-point turns and u-turns) and present the most direct route back to the residential origin. Where possible, right-turns are avoided to minimise delays waiting at signalised intersections or for gaps in traffic at priority intersections.

For simplicity of analysis, the residential areas in the catchment are separated into 5 main residential zones:

- Residential Zone 1 – red
- Residential Zone 2 – yellow
- Residential Zone 3 – blue
- Residential Zone 4 – pink
- Residential Zone 5 – green

Residential Zone 1 – Red

Figure 22: Forecast Route Assignment for Residential Zone 1 (access in red, egress in yellow)

Residential zone 1 is primarily low density residential and fronts Penshurst Street and Forest Road. It is anticipated that half of drivers from this zone will access Forest Road and then turn left into Arcadia Street whilst the other half enter via Percival Street to avoid the commuter traffic on Forest Road (especially during

the AM peak). The different egress paths (in yellow) reflect the different routes dependent on the access direction into Arcadia Street.

Residential Zone 2 – Yellow

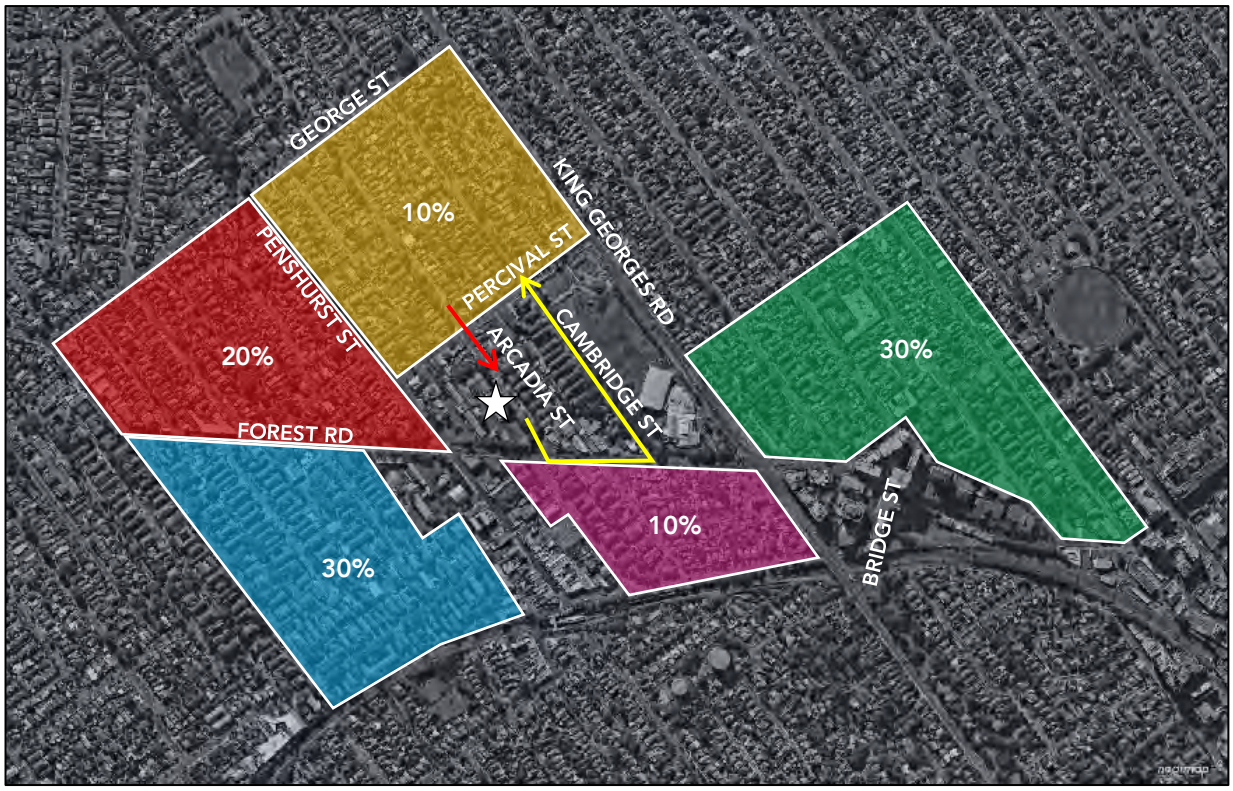


Figure 23: Forecast Route Assignment for Residential Zone 2 (access in red, egress in yellow)

Residential zone 2 is also primarily low density residential and is closer to the school than zone 1, hence a lower proportion of car trips from this area. It is anticipated that all drivers will travel to the school southbound via Arcadia Street and then return via Forest Road and Cambridge Street. Penshurst Street is unlikely to be used due to additional delays which would be experienced at the Forest Road/Penshurst Street signalised intersection.

Residential Zone 3 – Blue

Figure 24: Forecast Route Assignment for Residential Zone 3 (access in red, egress in yellow)

Residential zone 3 is primarily medium density residential and is a greater distance from the school, hence 30% of driving trips have been allocated to this zone. Drivers are anticipated to approach the school via a right turn from Penshurst Street onto Forest Road and then a left turn into Arcadia Street. This is due to significant detouring required if they were to drive south down Arcadia Street due to the right-turn ban from Arcadia Street into Forest Road. No right turns have been allocated into Forest Road from the northern edge of zone 3 due to the significant anticipated delays to enter Forest Road via a right-turn.

Residential Zone 4 – Pink

Figure 25: Forecast Route Assignment for Residential Zone 4 (access in red, egress in yellow)

Residential zone 4 is a mix of low and medium density residential. Drivers are anticipated to enter Forest Road heading westbound before turning right into Penshurst Street. These parents are not anticipated to traverse down Arcadia Street due to significant detours required to return back south via Penshurst Street. Instead the expected preference is to park along Percival Street and turn around using the Percival Street/Cambridge Street roundabout. For those who choose to traverse down Arcadia Street, turn around is still possible via a left turn onto Forest Road, left turn onto Cambridge Street, and then left turn onto Percival Street, however, the incidence of these movements is considered minimal.

Residential Zone 5 – Green

Figure 26: Forecast Route Assignment for Residential Zone 5 (access in red, egress in yellow)

Residential zone 5 is a mix of low and medium density residential and is expected to have a greater number of drivers due to the distance from the school, hence an allocation of 30%. It is assumed that drivers would prefer to travel via Bridge Street and up through King Georges Road rather than travel westwards via Forest Road and then turn right at Penshurst Street for two reasons. Firstly, this route removes the need to turn right into Penshurst Street, which experiences significant delays due to the heavy eastbound traffic on Forest Road in the morning peak period. Secondly, the right turn on Cambridge Street is unsignalised and experiences delays, again due to the heavy eastbound flow along Forest Road.

Moreover, the right turn from Pearl Street into Forest Road is unsignalised and would be very challenging to perform during the peak periods, especially the morning.

The return route follows from the inbound route and presents the most direct path towards the east.

7.2.6 Trip Generation Volumes

Therefore, based on the trip generation determined in Section 7.2.1 and the trip distribution and route assignment considerations discussed in Sections 7.2.4 and 7.2.5, the following additional traffic movements as a result of the school upgrade at the three modelled intersections are as follows:

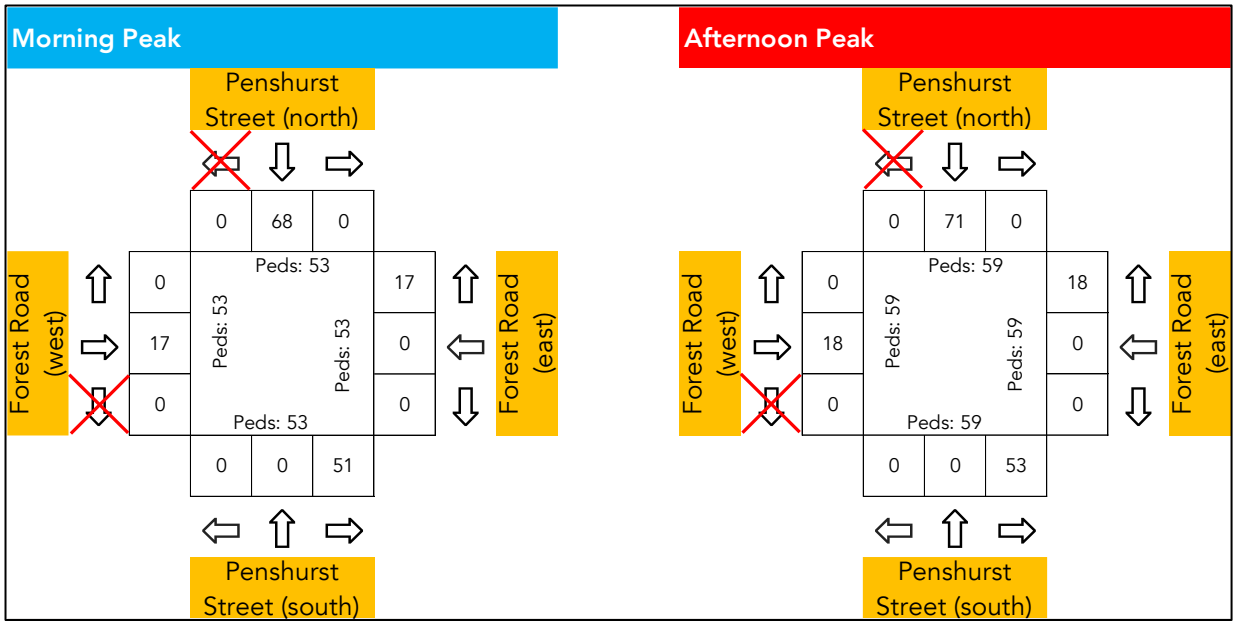


Figure 27: Forest Road / Penshurst Street Development Volumes

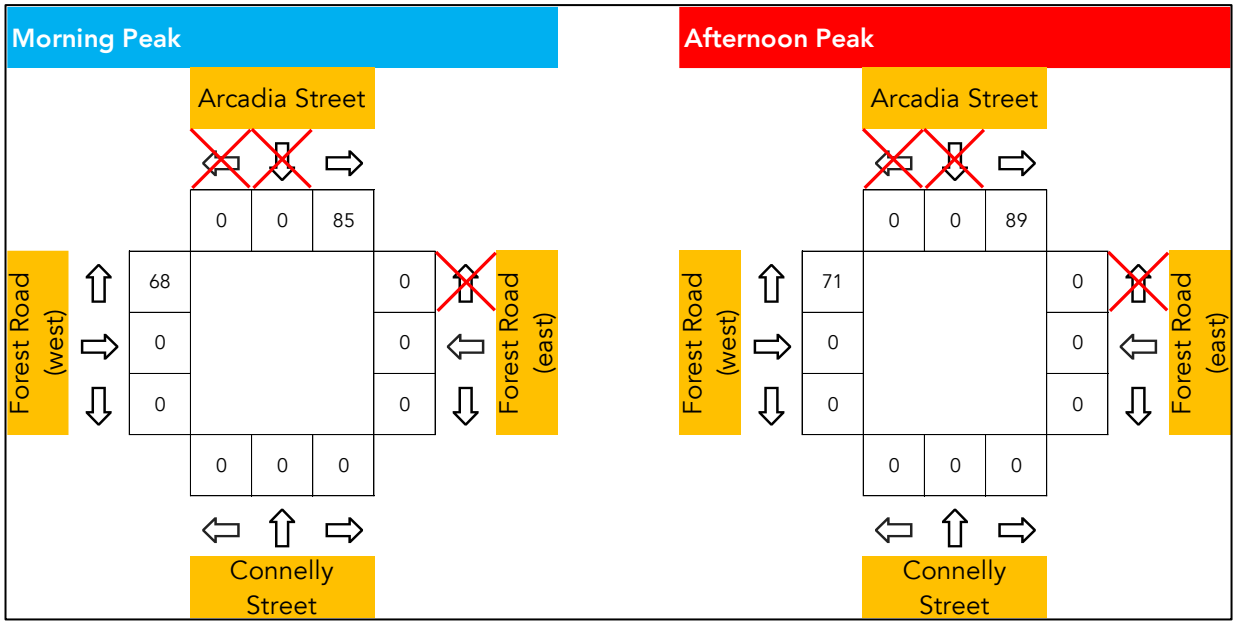


Figure 28: Forest Road / Arcadia Street / Connelly Street Development Volumes

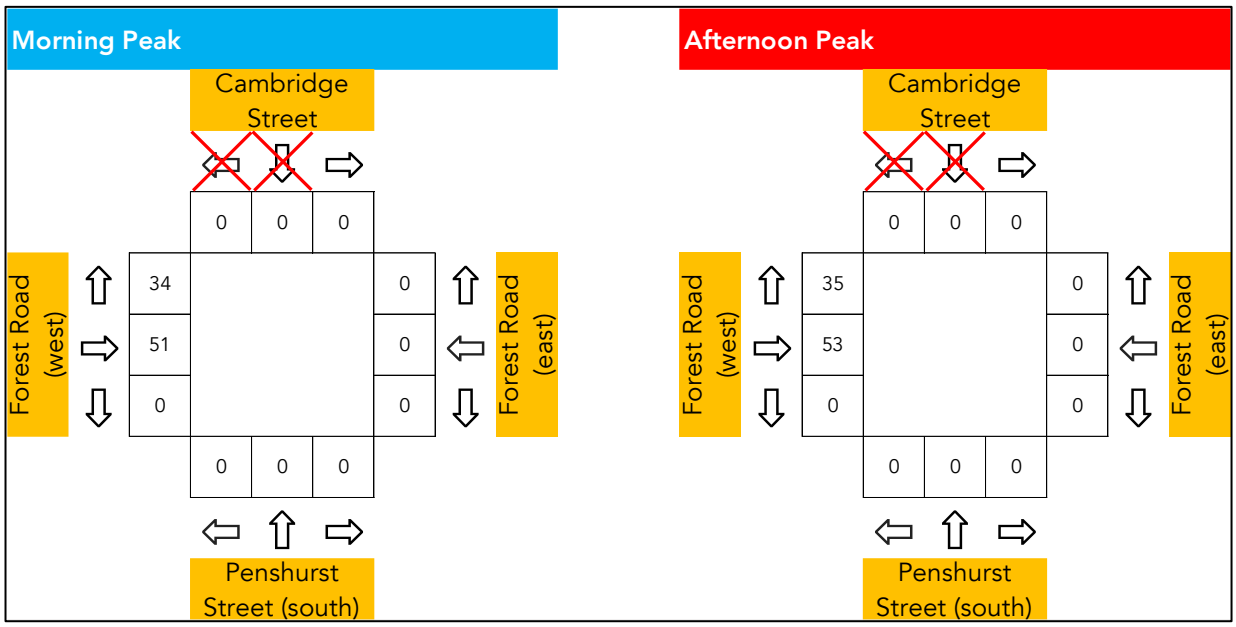


Figure 29: Forest Road / Cambridge Street Development Volumes

7.3 Intersection Modelling

In order to determine the future performance of the identified key intersections, an assessment has been undertaken using the SIDRA modelling software, which presents a range of performance indicators (Level of Service, Average Delay, etc.).

Typically, there are four performance indicators used to summarise the performance of an intersection, being:

- Level of Service (LoS) – This is a categorization of average delay, intended for simple reference. The RMS adopts the following bands:
- Average Delay – The average delay encountered by all vehicles passing through the intersection. It is often important to review the average delay of each approach as a side road could have a long delay time, while the large free flowing major traffic will provide an overall low average delay.
- Degree of Saturation – The total usage of the intersection expressed as a factor of 1 with 1 representing 100% use/saturation. (e.g. 0.8=80% saturation)
- 95% Queue lengths (Q95) – is defined to be the queue length in metres that has only a 5-percent probability of being exceeded during the analysis time period. It transforms the average delay into measurable distance units.

Table 7: Level of Service Criteria

Level of Service	Average Delay (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	<14	Good operation	
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity. At signals, incidents would cause excessive delays. Roundabouts require other control mode	At capacity, requires other control mode
F	>70	Extra capacity required	Extreme delay, major treatment required

7.3.1 Pedestrian Protection

Pedestrian protection has been incorporated into the Forest Road / Penshurst Street signalised intersection through modification of the Opposing Pedestrian Crossings (Signals) from the default Prg (StL) to Inp (StL) with a value of 7 seconds in the SIDRA model. This is updated for all left and right turns at the intersection with the exception of the left-turn slip lane from Forest Road (west) to Penshurst Street (north). This holds the red arrow for 7 seconds upon commencement of pedestrian green time, reflecting the increased level of pedestrian protection at this intersection due to proximity to schools in the area.

7.3.2 Phase Sequence and Cycle Time

The TCS diagram, obtained from RMS, for the Forest Road / Penshurst Street signalised intersection is presented in Figure 30. Phases A and C are modelled as compulsory phases, whilst phases B, D, and E are modelled as variable phases. The cycle time for all scenarios is set at 90 seconds.

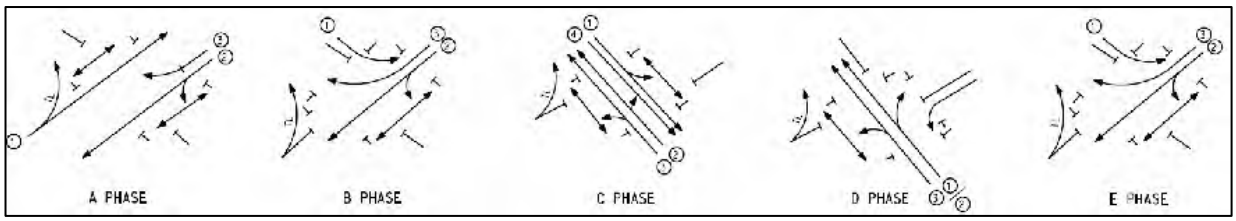


Figure 30: TCS Diagram for Forest Road / Penshurst Street (Forest Road oriented north-west/south-west)

7.3.3 Modelling Results

The three intersections have been run as a network model, to provide a more robust model which captures the effects of individual intersection performance (e.g. vehicle queuing, arrival profile, capacity constraints) on the adjacent intersections. The network model diagram is illustrated in Figure 31.

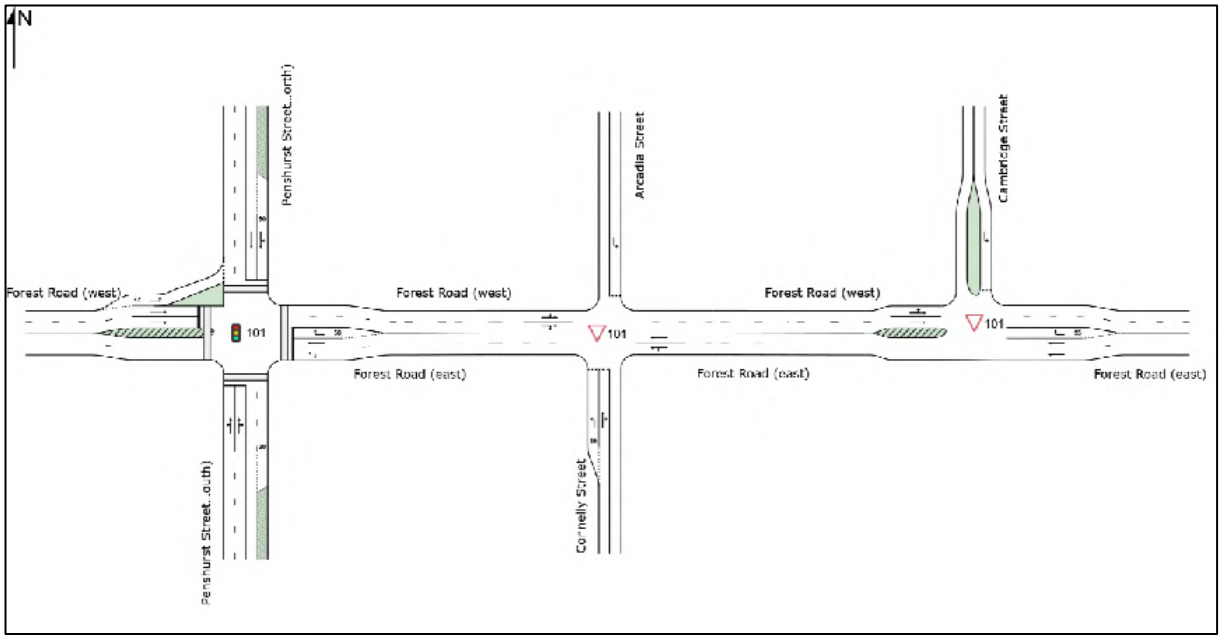


Figure 31: Network Model of Forest Road / Penshurst Street & Forest Road / Arcadia Street / Connelly Street & Forest Road / Cambridge Street

A summary of the modelling results is presented in Table 8. Two models have been conducted:

1. Existing – a model of the existing traffic conditions
2. Development – existing traffic volumes plus additional forecast traffic resulting from the PPS upgrade

Summaries of the results, with the metrics presented for the overall intersection, are presented in Table 8. Detailed results with the metrics separated for each approach are presented in Table 9, Table 10, and Table 11.

Table 8: Summary of SIDRA Modelling Results – overall metrics per intersection

Intersection	Peak Period	Model	Level of Service	Average Delay (sec)	Degree of Saturation (v/c)	95% Queue Length (veh)
Forest Road / Penshurst Street	AM Peak	Existing	LOS B	25.4	0.866	33.0
		Development	LOS C	32.6	0.939	40.8
	PM Peak	Existing	LOS B	21.0	0.561	16.3
		Development	LOS B	28.3	0.711	20.4
Forest Road / Arcadia Street / Connelly Street	AM Peak	Existing	*Note 1*	25.3	3.594	20.0
		Development	*Note 1*	24.9	3.625	20.1
	PM Peak	Existing	*Note 1*	6.7	1.110	5.5
		Development	*Note 1*	9.1	1.387	8.5
Forest Road / Cambridge Street	AM Peak	Existing	*Note 1*	33.0	2.112	33.3
		Development	*Note 1*	49.2	2.812	40.9
	PM Peak	Existing	*Note 1*	1.8	0.444	2.1
		Development	*Note 1*	2.1	0.513	2.4

Note 1: For the priority intersections, the LoS is not displayed as the movements present significantly different LoS depending on whether it is from major or minor road and whether it is a left or right turn. Generally, the right turn movements from the minor approach experience the highest delay. Reference should be made to Table 9, Table 10, and Table 11 and the detailed movement summaries (SIDRA output) provided in Attachment 1.

7.3.4 Forest Road / Penshurst Street

During the morning peak period, this intersection currently operates at a LoS B. It is noted, however, that the right turns at this intersection display a LoS D (see Attachment 1). This is typical of major signalised intersections in Sydney and primarily results from the large through movement heading eastbound along Forest Road towards the city. The left turn from Penshurst Street (north) into Forest Road (east) also presents a LoS D, due to additional delays arising from the left-turn arrow hold for the pedestrian protection.

Under the development scenario morning peak period, the level of service for the intersection increases to a LoS C. Generally, the amenity for each approach is maintained, presenting similar or slightly increased average delays, degree of saturation and queuing. The east approach from Forest Road nears capacity, presenting a degree of saturation of 0.939 due to the right turn from Forest Road into Penshurst Street. The 95th percentile queue for this movement is anticipated to increase from the existing 24.5m to 37.9m (see Attachment 1). This is contained within the existing right-turn bay which is approximately 60m long, hence not impeding the westbound through movement.

The intersection during the afternoon peak period presents better performance compared to the morning peak period. The level of service under the development scenario is LoS B and all turning movements are LoS C or better (see Table 9). All approaches are comfortably within capacity. The positive performance of the intersection during this period can primarily be attributed to the fact that the afternoon school peak does not coincide with the evening commuter peak, unlike in the morning where the school and commuter peaks overlap to some degree.

Table 9: Summary of Forest Road / Penshurst Street SIDRA Modelling Results – metrics separated by approach

Peak Period	Approach	Scenario	Level of Service	Average Delay (sec)	Degree of Saturation (v/c)	95% Queue Length (veh)
AM Peak	North: Penshurst Street	Existing	LOS D	45.4	0.866	8.9
		Development	LOS D	43.7	0.788	11.5
	East: Forest Road	Existing	LOS B	17.1	0.691	8.7
		Development	LOS B	22.8	0.939	9.3
	South: Penshurst Street	Existing	LOS C	34.1	0.633	7.4
		Development	LOS C	34.2	0.702	8.4
	West: Forest Road	Existing	LOS B	22.8	0.828	33.0
		Development	LOS C	33.9	0.893	40.8
PM Peak	North: Penshurst Street	Existing	LOS B	23.2	0.335	6.8
		Development	LOS C	34.2	0.693	11.8
	East: Forest Road	Existing	LOS B	16.2	0.561	16.3
		Development	LOS B	24.2	0.711	20.4
	South: Penshurst Street	Existing	LOS C	32.5	0.558	6.7
		Development	LOS B	27.9	0.505	8.1
	West: Forest Road	Existing	LOS B	21.6	0.499	12.7
		Development	LOS C	31.4	0.708	15.9

7.3.5 Forest Road / Arcadia Street / Connelly Street

Table 10 presents a summary of the performance of the Forest Road / Arcadia Street / Connelly Street intersection under the existing scenario. As indicated, the intersection generally performs well, displaying LoS A and LoS B for most approaches. Connelly Street presents a LoS F due to the difficulty in performing the right movement into Forest Road due to the heavy traffic flows on the major road. The existing right turns into Forest Road are likely to be drivers choosing unsafe gaps and hence, the modelling reflects a substantially greater delay than is presented in reality.

As part of the school-related traffic assignment, no additional traffic is anticipated to be performing the right turn out of Connelly Street. Instead, vehicles are expected to turn left into Forest Road and then turn right into Penshurst Street as the preferred route to the school (Section 7.2.5).

Under the development scenario, the amenity of the Forest Road and Arcadia Street approaches are anticipated to maintain their existing levels of amenity, continuing to present the same level of service as the existing scenario (see Table 10). Delays, saturation, and queuing increase slightly, however, do not trigger any decrease in level of service.

It is noted that the left turn out of Arcadia Street, which is the primary school-related movement from this intersection, continues to present a LoS B post-development.

Table 10: Summary of Forest Road / Arcadia Street / Connelly Street SIDRA Modelling Results – metrics separated by approach

Peak Period	Approach	Scenario	Level of Service	Average Delay (sec)	Degree of Saturation (v/c)	95% Queue Length (veh)
AM Peak	North: Arcadia Street	Existing	LOS B	16.7	0.370	1.9
		Development	LOS B	18.7	0.532	3.5
	East: Forest Road	Existing	LOS A	0.2	0.195	0.0
		Development	LOS A	0.2	0.195	0.0
	South: Connelly Street	Existing	LOS A/F	1010.6	3.594	20.0
		Development	LOS A/F	1020.6	3.625	20.1
	West: Forest Road	Existing	LOS A/B	0.9	0.537	1.6
		Development	LOS A/B	1.1	0.556	1.7
PM Peak	North: Arcadia Street	Existing	LOS A	8.5	0.093	0.4
		Development	LOS A	8.5	0.201	0.9
	East: Forest Road	Existing	LOS A	0.2	0.290	0.0
		Development	LOS A	0.2	0.332	0.0
	South: Connelly Street	Existing	LOS A/F	133.8	1.110	5.5
		Development	LOS A/F	194.8	1.387	8.5
	West: Forest Road	Existing	LOS A/B	2.1	0.309	1.6
		Development	LOS A/B	2.5	0.331	1.7

7.3.6 Forest Road / Cambridge Street

A similar pattern is presented for the Forest Road / Cambridge Street priority intersection. The model results are presented in Table 11.

The exiting movement from Cambridge Street (left-turn into Forest Road) currently presents a LoS B in the morning peak and a LoS A in the afternoon peak. The development scenario maintains the existing amenity of this movement, with a LoS B in the morning peak and LoS A in the afternoon peak.

The Forest Road (west approach) is anticipated to continue to operate at a LoS A with negligible delays and ample spare capacity.

The east approach along Forest Road presents a LoS A for the through movements under the existing scenario. This is anticipated to be maintained in future scenarios. The right turn, however, currently presents a LoS F in the morning peak and a LoS B in the afternoon peak and this will be expected to continue in the future scenarios. The primary reason for the poor right-turn amenity is the heavy opposing movement along Forest Road heading eastbound (towards the city) during the morning peak and the short length of the right turn bay. It is assumed that school-related traffic will choose not to turn right from Forest Road into Cambridge Street due to the significant delays and will instead continue to the Forest Road / Penshurst Street intersection to perform the right turn.

The presence of two westbound lanes in Forest Road allows the kerbside lane will always be in operation (i.e. allowing through traffic to continue to flow), thus minimising any spill over effect on the King Georges Road / Forest Road intersection.

Table 11: Summary of Forest Road / Cambridge Street SIDRA Modelling Results – metrics separated by approach

Peak Period	Approach	Scenario	Level of Service	Average Delay (sec)	Degree of Saturation (v/c)	95% Queue Length (veh)
AM Peak	North: Cambridge Street	Existing	LOS B	21.0	0.550	2.5
		Development	LOS B	21.5	0.560	2.5
	East: Forest Road	Existing	LOS A/F	121.2	2.112	33.3
		Development	LOS A/F	188.5	2.812	40.9
	West: Forest Road	Existing	LOS A	0.1	0.529	0.0
		Development	LOS A	0.2	0.552	0.0
PM Peak	North: Cambridge Street	Existing	LOS A	8.2	0.180	0.7
		Development	LOS A	8.3	0.181	0.7
	East: Forest Road	Existing	LOS A/B	2.4	0.444	2.1
		Development	LOS A/B	2.9	0.513	2.4
	West: Forest Road	Existing	LOS A	0.2	0.265	0.0
		Development	LOS A	0.4	0.288	0.0

7.4 Queuing Analysis

To determine the sufficiency of the on-street parking in accommodating the School's pick-up and drop-off demand, a Poisson queuing analysis[17] has been undertaken. It is emphasised that this method indicates capacity under ideal conditions, and would be influenced by:

- Background traffic congestion;
- Excessive vehicle dwell times;
- Inappropriate driving behaviour (i.e. double parking);
- Inability to perceive vacant bays that are located far from the driver's position; and
- Individuals' driving abilities

To assess the suitability of the proposed on-street parking control modifications, a comparison is made between the existing scenario and the development scenario. For both scenarios a time frame of 30 minutes is used for arrivals to account for the concentrated distribution of arrivals, especially during the morning peak period.

To determine the dwell times, comparison is made with reference to turnover surveys recorded at Peakhurst West Public School[18]. This primary school presents a similar on-street parking arrangement with 6 kiss-and-ride spaces (on Ogilvy Street) and the majority of other surrounding spaces are unrestricted and as such, is considered an appropriate comparable school. At PWPS, the average dwell time for the morning drop-off on Belmore Road was 1:50 min (average of 6 vehicles/day in the morning peak) and 1:37min on Ogilvy Street (average of 63 vehicles/day in the morning peak). Therefore, for conservativeness, a 2-minute dwell time is assumed.

For the purposes of the queuing assessment it is also assumed that all vehicles use the kiss-and-ride bays. In reality, a number of parents would park in the nearby unrestricted spaces if they intend to walk their children to the school or if they intend to remain for a longer period, thus decreasing the actual demand for the kiss-and-ride spaces. Therefore, the following queuing analysis presents a worst-case scenario.

7.4.1 Existing Morning Peak Period Scenario

The current kiss-and-ride provisions provide for approximately 7 spaces on the western side and 4 spaces on the eastern side of Arcadia Street, resulting in a total of 11 spaces.

Based on the existing travel mode surveys, 130 vehicles[19] are expected to arrive in the morning peak. Under the 30-minute window and 2-minute dwell time parameters discussed in the previous section, this results in the following performance:

- Probability of queue: 28.16%
- Average waiting time in queue: 18.3 seconds
- Average queue length: 1.32 vehicles
- 95th percentile queue: 7 vehicles

[17] A mathematical model which captures the variability in vehicle arrivals and resulting queuing, provided an average arrival rate, pick-up/drop-off window, dwell time, and number of car bays.
[18] Turnover surveys recorded over a 5-day period at kiss-and-ride zones from 7:30am-9:30am and 2:00pm-4:00pm from 13 August – 17 August 2018
[19] 440 students x 40.4% morning car mode share ÷ 1.37 car occupancy = 129.8 cars

As discussed in the previous section, this assessment presents a conservative scenario and, in reality, a proportion of parents will undertake drop-off in other parking spaces along Arcadia Street or other spaces in the nearby streets.

7.4.2 Development Morning Peak Period Scenario

With the proposed on-street parking control modifications, 8 additional kiss-and-ride and 5 additional kiss-and-ride spaces are proposed on the western and eastern sides of Arcadia Street respectively. This brings the total provision to 24 spaces (refer to Section 8.5).

Based on a future student enrolment figure of 1,000, 295 vehicles[20] are expected to arrive in the morning peak. Under the same 30-minute window and 2-minute dwell time parameters, the queuing model provides the following result:

- Probability of queue: 21.40%
- Average waiting time in queue: 7.2 seconds
- Average queue length: 1.18 vehicles
- 95th percentile queue: 7 vehicles

As indicated by the queuing assessment, the development scenario presents a lower probability of queuing and reduced waiting time in queue (i.e. lower chance of not finding any available kiss-and-ride spaces and lesser waiting time for a space to free up). The average queue length decreases slightly (0.14 vehicles) and the 95th percentile queue is maintained at 7 vehicles.

Therefore, with the proposed on-street parking control modifications, the amenity of the kiss-and-ride spaces in the morning peak is expected to be slightly improved.

7.4.3 Afternoon Peak Period

The above queuing assessment presents analysis for only the morning peak period. For the afternoon peak period, a queuing analysis is not suitable given the large variation in vehicle arrivals and dwell times. As observed on-site, and with similar schools, typically a small proportion of parents begin arriving at the school from 30mins prior to school conclusion and the majority arriving within 0-10min of school conclusion. For those who arrive earlier, dwell times are quite extensive due to extended duration of parking. For parents who arrive after the conclusion of school, dwell times are usually lower and are within similar ranges to the morning peak. As such an average dwell time for the afternoon peak period for schools without a dedicated pick-up/drop-off facility is typically not robust.

The dwell time variation is illustrated in Table 12 which presents the data for the PWPS afternoon peak period. Notable, is the large difference in the average dwell time of 6:54min (which is skewed by outliers such as parents parking long before the conclusion of school) and the median dwell time of 1:25min (which is not skewed by outliers)

[20] 1,000 students x 40.4% morning car mode share ÷ 1.37 car occupancy = 294.89 cars

Table 12: PWPS afternoon peak vehicle dwell times in kiss-and-ride zones (Ogilvy Street)

Subset	No. of vehicles	Proportion of all arrivals	Average dwell time (min:sec)	Median dwell time (min:sec)
All Arrivals	117	100%	06:54	01:25
Dwell time less than 30min	115	98%	06:17	
Dwell time less than 25min	109	93%	05:11	
Dwell time less than 20min	104	89%	04:25	
Dwell time less than 15min	95	81%	03:09	
Dwell time less than 10min	82	70%	01:43	
Dwell time less than 5min	73	62%	00:58	
Dwell time less than 3min	67	57%	00:43	

For comparison, the same data for the morning peak period is presented in Table 13.

Table 13: PWPS morning peak vehicle dwell times in kiss-and-ride zones (Ogilvy Street)

Subset	No. of vehicles	Proportion of all arrivals	Average dwell time (min:sec)	Median dwell time (min:sec)
All Arrivals	315	100%	01:37	00:39
Dwell time less than 30min	314	100%	01:28	
Dwell time less than 25min	314	100%	01:28	
Dwell time less than 20min	312	99%	01:20	
Dwell time less than 15min	312	99%	01:20	
Dwell time less than 10min	310	98%	01:16	
Dwell time less than 5min	296	94%	00:59	
Dwell time less than 3min	273	87%	00:45	

What can be also be drawn from the data is the level of non-compliance with the 3-minute parking limit imposed at No Parking (i.e. kiss-and-ride) zones. In the morning, this equates to 13%[21] of drivers exceeding the 3-minute limit and 2% parking for longer than 10 minutes. In the afternoon this increases to 43% of drivers with 30% parking longer than 10 minutes. Although this data is presented for PWPS, it is anticipated that a similar experience is presented at PPS.

As such, the focus for the afternoon peak period is to maintain the amenity of the on-street parking for non-school users as much as practically possible and encourage greater enforcement of kiss-and-ride parking. This is discussed in Section 8.5.

[21] 87% parking in kiss-and-ride over 3 minutes = 13% parking less than 3 minutes

8. Parking Provision

8.1 Car Parking Requirements

In establishing the car parking provision requirements, reference is made to the Hurstville Development Control Plan 1 (DCP), Section 3, Table 2: Carparking Rates – land located Outside a Business or Industrial zone.

For educational establishments, the DCP requires 1 car parking space per 2 employees. With a proposed increase from 34 full-time equivalent staff (FTE) to 59 FTE, this results in a car parking requirement of 30 spaces. The school proposes to provide an additional 5 car parking spaces on-site, resulting in a total of 20 car parking spaces on-site. This represents a shortfall of 10 car parking spaces under the Hurstville DCP, which may need to be accommodated by on-street parking if the mode share of staff travelling by car remains at the current level.

With the proposed increase from 34 to 59 FTE and 18 to 31 other staff; and an 83% driving mode share (see Section 6.1.2), the increased parking demand from staff is expected to be 32 spaces[22]. Based on occupancy surveys conducted by TTM (see Section 6.4), this increased staff parking demand is expected to be accommodated within the existing on-street parking given the 46+ vacant spaces in the surrounding streets (further away from the school).

However, this increase in staff parking removes access to unrestricted spaces that may be used by parents for pick-up/drop-off. Therefore, it is recommended that staff are encouraged to either consider other modes of transport or park in streets further away from the school. Strategies for achieving this are discussed in the separate Green Travel Plan document, prepared by ptc., to support the short-term parking needs of parents (and potentially other users in the area). Parking control modifications are proposed and are discussed in Section 8.5.

8.2 Adaptable/Accessible Parking

Of the 20 staff parking spaces on-site, 1 of the spaces is designated an accessible parking space.

This satisfies the Building Code of Australia (BCA) accessible parking requirement of 1 accessible space for every 100 spaces or part thereof for Class 9b (School) parking.

8.3 Bicycle Parking

Although the Hurstville DCP does not state a bicycle parking provision requirement, the school will provide a bicycle store room with 10 spaces for staff and, separately, 12 bicycle spaces for student bicycle parking to encourage active transport.

8.4 Servicing Provision

Waste collection is not proposed to change under the proposal. Collection vehicles will utilise the Arcadia Street entrance (same as for the staff parking) to perform waste collection. Waste collection will occur outside of school zone hours so as to not coincide with parent pick-up/drop-off and staff parking.

[22] [(59-34) FTE + (31-18) Other Staff] x 83% driving mode share = 31.54

8.5 Proposed On-street Parking Control Modifications

Figure 32 presents the proposed on-street parking control modifications.

A number of existing unrestricted spaces along both sides of Arcadia Street are proposed to be converted to P5 parking during School Zone hours, i.e. 5-minute parking. This includes two locations on the eastern side measuring approximately 19m and 11m (3 and 2 spaces respectively) and three locations on the western side measuring approximately 8m (1 space), 16m (approximately 2-3 spaces) and 28m (approximately 4-5 spaces), thus resulting in a total of 13 P5 spaces. The choice to convert sections of the existing unrestricted parking rather than the entire length is to provide a balance between the needs of the school and the amenity for residents.

It is noted that Arcadia Street is narrow as discussed in Section 6.3, however this proposal involves the conversion of existing unrestricted spaces to timed parking and does not intend to provide linemarking or other delineation measures (beyond signage) that would otherwise alter the existing parking and traversable road width dimensions. Therefore, the existing manoeuvrability along Arcadia Street is expected to be maintained as per existing conditions.

The choice of P5 parking over additional kiss-and-ride (No Parking) is to accommodate the pick-up requirements of parents in the afternoon and to also cater to parents who wish to walk their child to the school in the morning. It was observed on-site that parents typically arrive earlier than the school conclusion to wait for their child or walk their child to/from the school after parking their vehicle. The 2 minutes of parking provided by the kiss-and-ride parking (based on maximum allowable time parked in a No Parking zone as per NSW road rules) and the constraint of having to remain within 3m of their vehicle makes these kiss-and-ride spaces unsuitable for parents who require a parking spot for slightly longer durations. This is reflected in the turnover survey data presented in Section 7.4.

This proposal enables the provision of spaces to cater for the needs of these users, minimising the incidence of excessive parking duration in the kiss-and-ride spaces, thus potentially increasing the turnover in the kiss-and-ride spaces. This would result in increased pick-up/drop-off capacity. Parents who require a longer parking duration would be required to park in unrestricted spaces and the proposed P5 restriction discourages parents from parking on Arcadia Street well before school conclusion.

Moreover, the intent of converting these unrestricted spaces to P5 parking only during School Zone hours (and retain the unrestricted parking control outside of School Zone hours) enables residents who commute to work to utilise these spaces as they are likely to be parked in the space from the evening to early morning, thus utilising the parking during the school off-peak and school breaks. It is noted that this proposal does result in reduced on-street parking along Arcadia Street for residents during the middle of the day (as residents will not be able to park in the proposed P5 spaces for the entire day). However, most of the residences were observed to have off-street car parking facilities, hence the impact is minimised. Should the need arise, there is the possibility to consider a Resident Parking Scheme (RPS) as further discussed in Section 8.6.5 to maintain on-street parking availability for residents.

It is noted that this proposal does reduce the amount of available on-street parking to nearby residents and that discussions should be held with Georges River Council in regards to proposed parking control modifications. It is asserted that many observed illegal behaviours in the area (e.g. parking in No Stopping, parking in driveways, double parking) is likely due to lack of parking provision to meet the temporary increase in parking demand arising from the school. Provision of short-term parking spaces, and accompanying enforcement, will enhance the safety in the area and minimise illegal and dangerous parking and driving behaviours.

Therefore, the proposed on-street parking modifications considers the needs for the school-users and the impact on the existing amenity of residents and local businesses, providing a balance between the various users.

Figure 32: Proposed On-Street Parking Control Modifications

8.6 Other Management Measures

8.6.1 Staff Carpool Spaces

The upgraded school will provide 20 spaces, up from the existing 15. The Council DCP requires a provision of 30 spaces in line with the future 59 FTE staff (see Section 8.1). To mitigate this 10-space shortfall, there may be the opportunity to nominate the 5 new spaces as staff carpool spaces, restricting the use only to vehicles which contain 2 or more occupants. This decreases the on-street parking demand and number of vehicular trips as well as fostering more sustainable travel behaviour.

The feasibility and operation of this recommendation is subject to the School's approval.

8.6.2 Travel Access Guide

A travel access guide (TAG) has been produced in conjunction with the Green Travel Plan to provide a method to promote and maximise the use of more sustainable modes of travel.

The TAG outlines the various non-car transport options to get to and from the school and presents it in an accessible and easy-to-understand manner so that school students and their parents and visitors are aware of alternative transport modes. This document presents elements such as bus & train timetables and maps, the nearby cycling infrastructure and location of bicycle parking in the school, and other methods to promote active travel.

8.6.3 Staggering School Times

Due to proximity with the nearby St Declan's Catholic Primary School, there may be an opportunity for the schools to liaise with each other and with The Department to stagger school commencement and conclusion times so as to alleviate the cumulative demand (traffic and parking) from both schools.

8.6.4 Enforcement

To achieve greater compliance with existing and proposed parking restrictions, Georges River Council could be requested to patrol the school zone regularly. This is subject to Council capacity and availability of parking enforcement rangers.

8.6.5 Resident Parking Scheme

Discussions may be held with Georges River Council over the potential for a Resident Parking Scheme (RPS) in the areas closest to the school e.g. "2P permit holders excepted". The benefit is two-fold. Firstly, it maintains the existing parking amenity and provision for residents whilst also allowing for the short-term use by school-users and other nearby businesses. Secondly, this encourages teachers to park further away from the school, utilising the vacant on-street parking in areas slightly further from the school and increasing the parking availability near the school for use by parents.

The feasibility of the RPS and exact extent of the area should be determined in consultation with Georges River Council.

9. Design Assessment

The following section presents an assessment of the upgraded school development with reference to the requirements of AS2890.1:2004 (Off-street car parking) and AS2890.3:2015 (Bicycle Parking), AS2890.6:2009 (Off-street parking for people with disabilities) and industry best practice. This section is to be read in conjunction with the architectural plans[23] provided by Perumal Pedavoli Architects shown in Attachment 1.

9.1 Vehicular Access and Circulation

9.1.1 Access

Vehicular access to the School is maintained at existing location at Arcadia Street. The existing driveway is provided as a separate entry and exit driveway. The proposed driveway is designed as a two-way driveway, 6m in width, meeting the minimum driveway width requirement of 5.5m as required for a Category 1 driveway, specified in *AS2890.1 Table 3.1 and Table 3.2*.

Service provision is to be retained as per the existing operation, with refuse collection to be conducted within the premises of the school ground by a 6.4m long Small Rigid Vehicle (SRV)[24]. A minimum of 3 parking spaces are to be kept clear during the waste collection period, indicatively 4:30pm-6:30pm Monday-Friday, to accommodate the turning manoeuvre illustrated in Attachment 2.

9.1.2 Circulation

For internal circulation, a central aisle has been provided, separating two rows of parking with the accessible parking space located at the rear of the car park, near a pedestrian ramp. As this is a staff car park only, movements are anticipated to be tidal in nature and as such the incidence of vehicle conflict is very low.

9.1.3 Grades

A vertical clearance test has been undertaken for the new vehicle driveway, illustrating the ability for the 99th percentile vehicle to traverse the proposed driveway without scraping. See Attachment 2.

9.2 Car Park Arrangement and Accessible Parking

9.2.1 Car Parking Dimensions

A total of 20 car spaces (including 1 accessible) are provided in the car park. They are dimensioned as follows:

- Staff spaces: 5400mm x 2500mm
- Staff accessible space: 5400mm x 2500mm with adjacent 5400mm x 2400mm shared space (with bollard)

As these spaces are low turnover spaces, these spaces are classified as Class 1 spaces (*Table 1.1* of *AS2890.1*) which require minimum dimensions of 5400mm x 2400mm.

As such, the regular staff spaces exceed the minimum dimension requirement established in *AS2890.1*.

[23] Drawing No. 3199-ARC-DD-01_101(A), dated 31 August 2018. Drawing No. 3199-ARC-DD-00_200(A), dated 31 August 2018
[24] Vehicle specifications provided by Waste Audit: 11m gutter to gutter turning circle, 6 seconds lock to lock time, 2.08m height, 6.4m length, 1.7m wide

For the accessible space, AS2890.6 requires minimum dimensions of 5400mm x 2400mm with an adjacent shared bay dimensioned 5400mm x 2400mm with bollard installed (*Figure 2.2* of *AS2890.6*). Therefore, the proposed accessible space meets the requirements outlined in the Australian Standard.

9.2.2 Bicycle Parking

Bicycle parking is provided on-site for both staff and students.

The staff spaces are provided in a secure bike store beyond the rear of the car park, featuring 10 vertical bike racks. ptc. has been advised that the bike racks to be provided are Cora Bikerack CVR2, dimensioned 720mm x 500mm, allowing for 500mm between each rack. Access is through the vehicular entry on Arcadia Street. The collocation with the staff vehicular movements is not considered an issue due to the tidal nature of staff arrivals.

The student spaces are provided as 6 rails near the Arcadia Street frontage. The rails are positioned 1050mm apart, allowing two bicycles per rail, i.e. 12 student bicycle spaces. These bicycle spaces meet the minimum dimension requirement of 1800mm x 500mm as outlined in *AS2890.3 Figure 2.1*.

The minimum aisle widths for bicycle parking is 1500mm for rails and 2000mm for lockers or multi-tier parking. This is provided for both the staff and student spaces.

9.2.3 Aisle Widths

The aisle width of 6m exceeds in the minimum aisle width requirement of 5.8m specified in *Figure 2.2* of *AS2890.1*.

The last space in the car park requires a 1m blind aisle extension to aid in manoeuvring. The parking widths of spaces on the northern edge of the car park will be reduced from 2.5m to 2.4m to accommodate the incorporation of this 1m blind aisle within the existing footprint.

9.2.4 Headroom

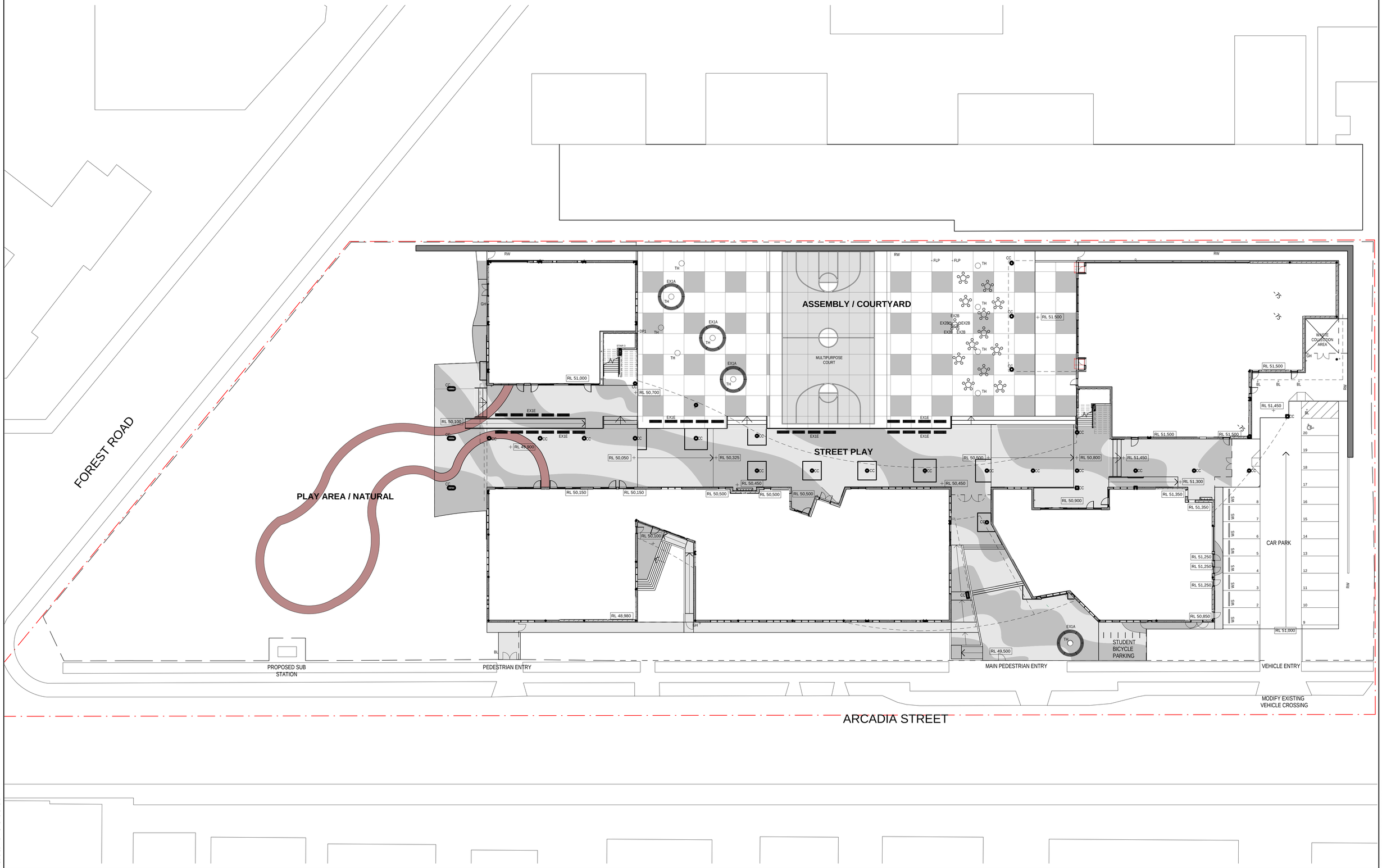
All car parking is at-grade, with the exception of two spaces where the building overhangs it. A headroom of 2.7m is provided, satisfying the minimum 2.2m headroom requirement in AS2890.1.

9.2.5 Wheel stops

Wheel stops are provided along the 8 staff spaces on the southern row to protect the adjacent pedestrian walkway.

As per *Clause 2.4.5.4* of *AS2890.1*, wheel stops are to be 90-100mm in height and 1600-1700mm in width. The provided wheel stops will be dimensioned 1600-1700mm in width, in line with the requirements of the Australian Standard.

Attachment 1 Architectural Plans



13/09/2018 5:03:00 PM

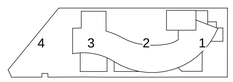
ISSUED FOR TENDER

AMENDMENTS

REV	BY	DATE	DESCRIPTION
	MW	20.07.18	PROGRESS ISSUE
	MW	10.08.18	PROGRESS ISSUE
	MW	17.08.18	FOR REVIEW
	MW	28.08.18	PROGRESS ISSUE
A	MW	31.08.18	ISSUED FOR TENDER

LEGEND

KEY PLAN



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Nominated Architect:
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STATUTORY PLANNER
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PERUMAL PEDAVOLI ARCHITECTS

PENSHURST PUBLIC SCHOOL
18 Arcadia Street, Penshurst

DRAWING NAME
OVERALL SITE MASTERPLAN

CONTRACT NUMBER
SINSW-18-1257

PROJECT NORTH

0 2500 5000 7500 10000 12500 25000
SCALE 1 : 250 @ A1

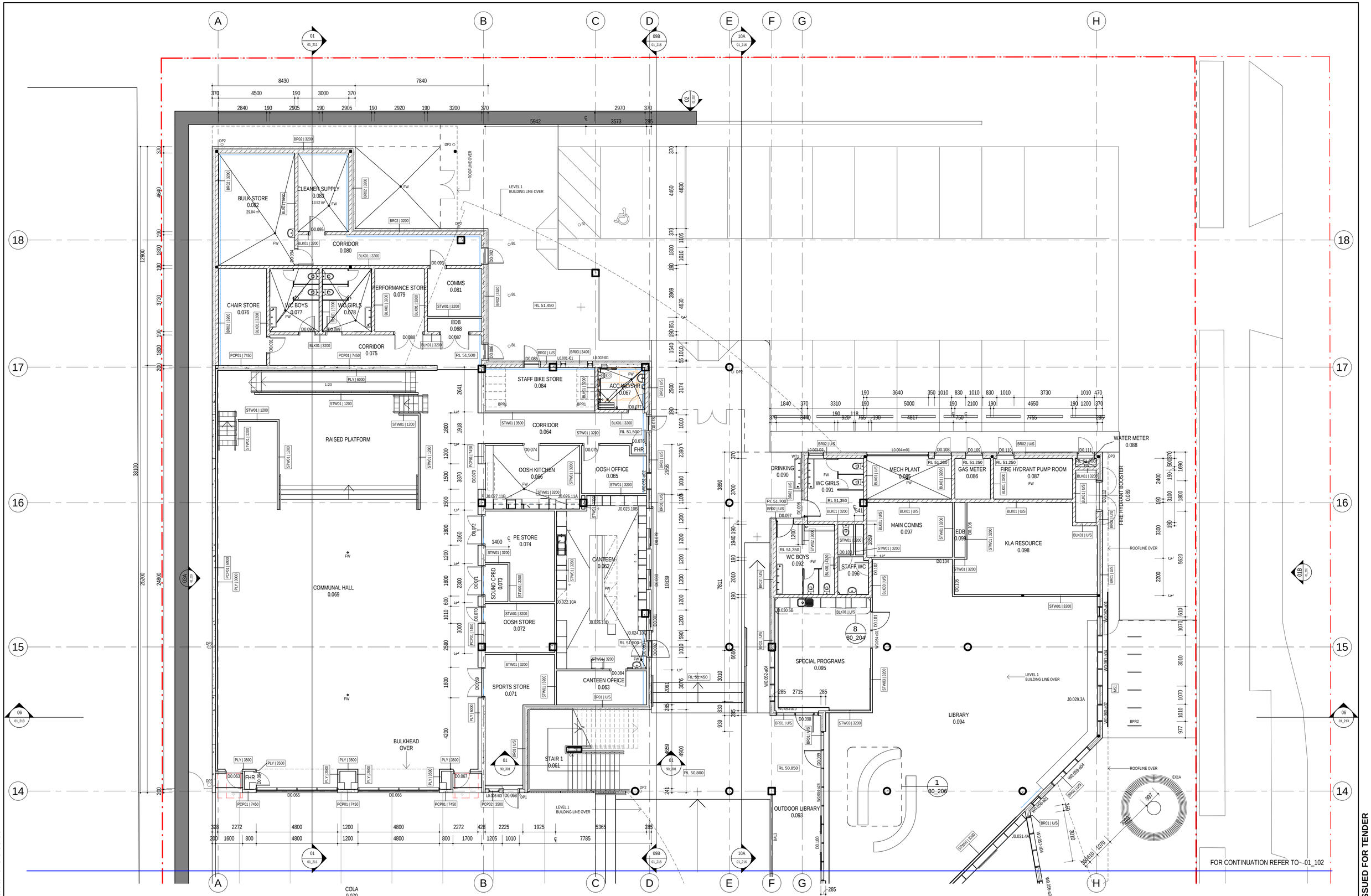
DRAWN	CHECKED	VERIFIED	DATE
Author	Checker	Approver	31 AUGUST 2018

DRAWING NUMBER

REVISION

PROJECT CODE | DISCIPLINE | PHASE | SERIES NUMBER

3199-ARC-DD-00_200 | A



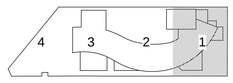
13/09/2018 5:03:09 PM

ISSUED FOR TENDER

AMENDMENTS			
REV	BY	DATE	DESCRIPTION
	MW	20.07.18	PROGRESS ISSUE
	MW	10.08.18	PROGRESS ISSUE
	MW	17.08.18	FOR REVIEW
	MW	28.08.18	PROGRESS ISSUE
A	MW	31.08.18	ISSUED FOR TENDER

LEGEND

KEY PLAN



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PERUMAL PEDAVOLI ARCHITECTS

PENSHURST PUBLIC SCHOOL
18 Arcadia Street, Penshurst

DRAWING NAME
FLOOR PLAN - LEVEL 0 - PART 1

CONTRACT NUMBER
SINSW-18-1257

PROJECT NORTH

0 1000 2000 3000 4000 5000 10000
SCALE 1 : 100 @ A1

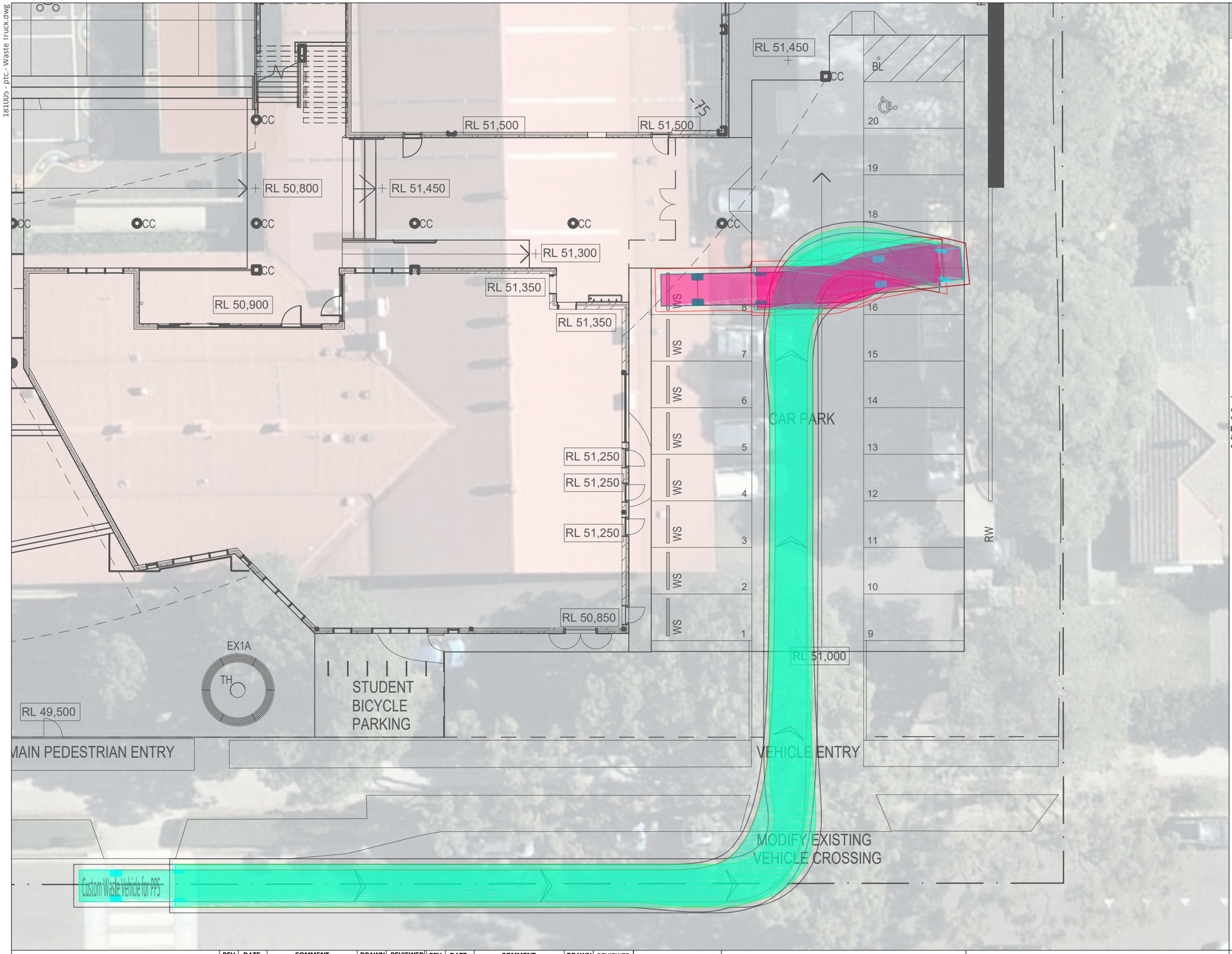
DRAWN	CHECKED	VERIFIED	DATE
Author	Checker	Approver	31 AUGUST 2018

DRAWING NUMBER: 3199-ARC-DD-01_101
REVISION: A

PROJECT CODE | DISCIPLINE | PHASE | SERIES NUMBER

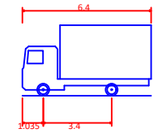
Attachment 2 Refuse Truck Swept Path

181005 - ptc.- Waste Truck.dwg



COMMENTS

A3



Custom Waste Vehicle for PPS	
Overall Length	6.400m
Overall Width	1.700m
Overall Body Height	3.500m
Min Body Ground Clearance	0.287m
Track Width	1.700m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	5.500m

The turning paths illustrated in this drawing have been prepared using the Autotrack vehicle modelling software in conjunction with AutoCAD. The vehicle model was prepared by Analytico Pty Ltd based upon vehicle data provided by Austroads. While this modelling represents a conservative assessment of the vehicles ability, it is not possible to account for all vehicle types/characteristics or driver ability.

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REV	DATE	COMMENT	DRAWN	REVIEWED	REV	DATE	COMMENT	DRAWN	REVIEWED
1	08/10/18	For TIA	EY	AU					

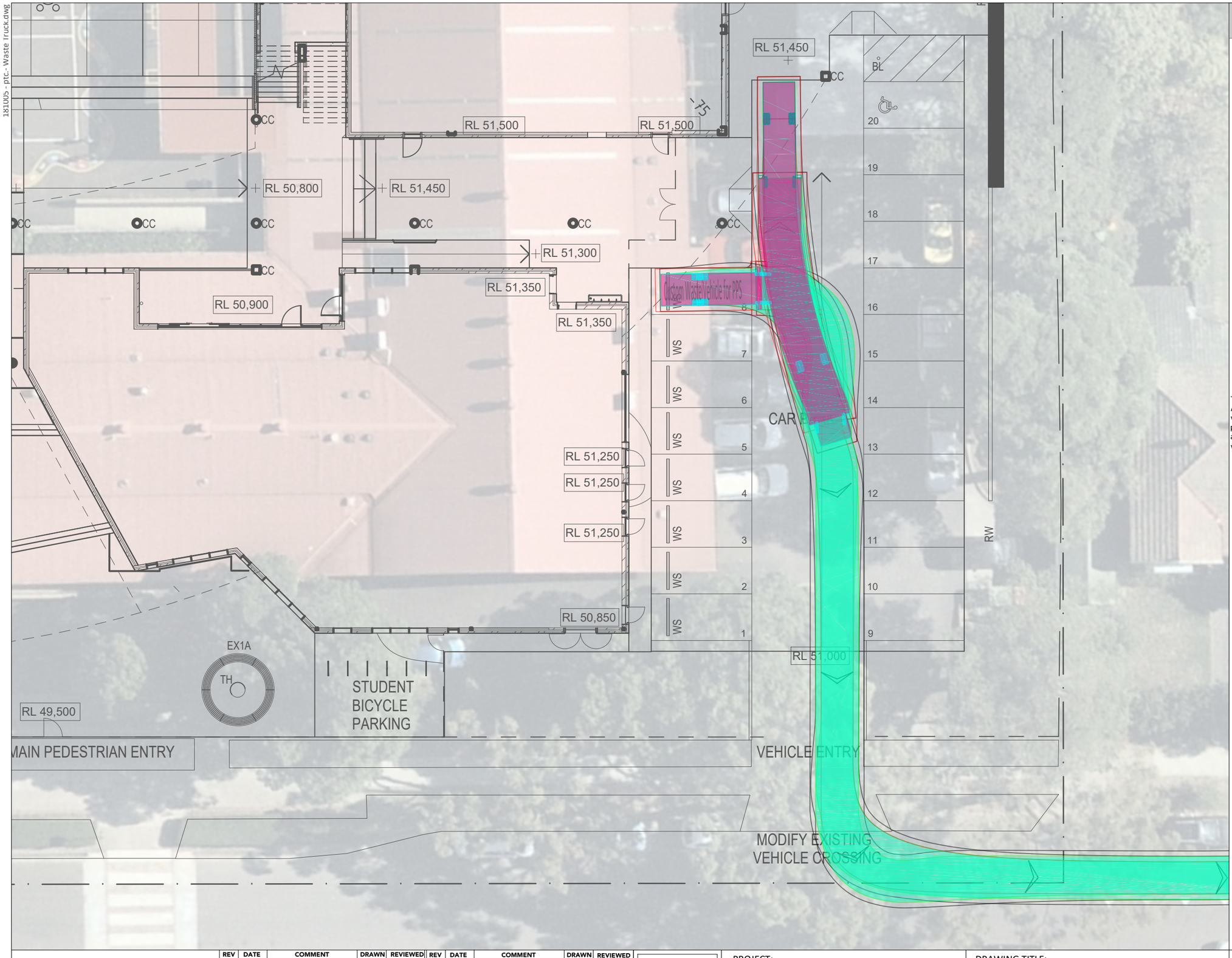
PROJECT:
Penshurst Public School Upgrade

DRAWING TITLE:
6.4m Refuse Truck Swept Path

CLIENT: **SINSW**
DRG. #: **PTC-001**
PROJECT #: **2422A**
SCALE: **NTS**

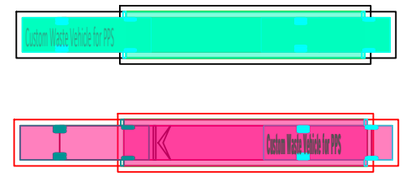
REV: **1**

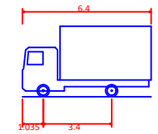
181005 - ptc.- Waste Truck.dwg



COMMENTS

A3





Custom Waste Vehicle for PPS	
Overall Length	6.400m
Overall Width	1.700m
Overall Body Height	3.500m
Min Body Ground Clearance	0.287m
Track Width	1.700m
Lock-to-lock time	6.00s
Curb to Curb Turning Radius	5.500m

The turning paths illustrated in this drawing have been prepared using the Autotrack vehicle modelling software in conjunction with AutoCAD. The vehicle model was prepared by Analytico Pty Ltd based upon vehicle data provided by Austroads. While this modelling represents a conservative assessment of the vehicles ability, it is not possible to account for all vehicle types/characteristics or driver ability.

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REV	DATE	COMMENT	DRAWN	REVIEWED	REV	DATE	COMMENT	DRAWN	REVIEWED
1	08/10/18	For TIA	EY	AU					

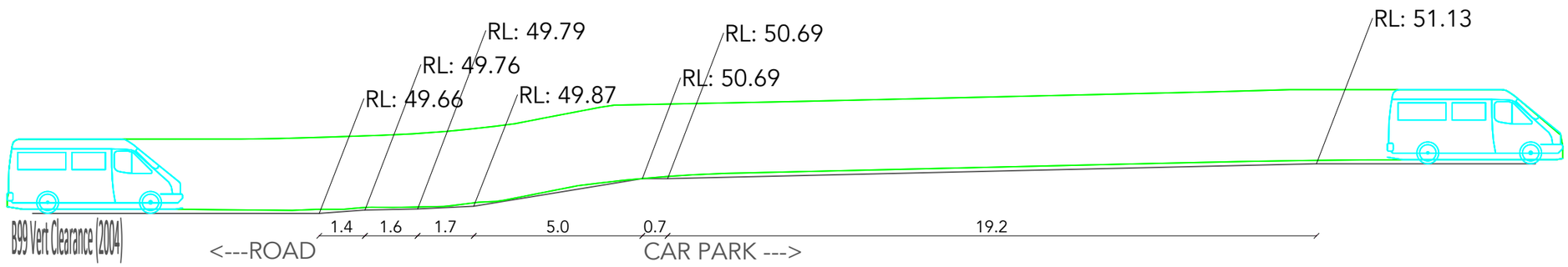
PROJECT:
Penshurst Public School Upgrade

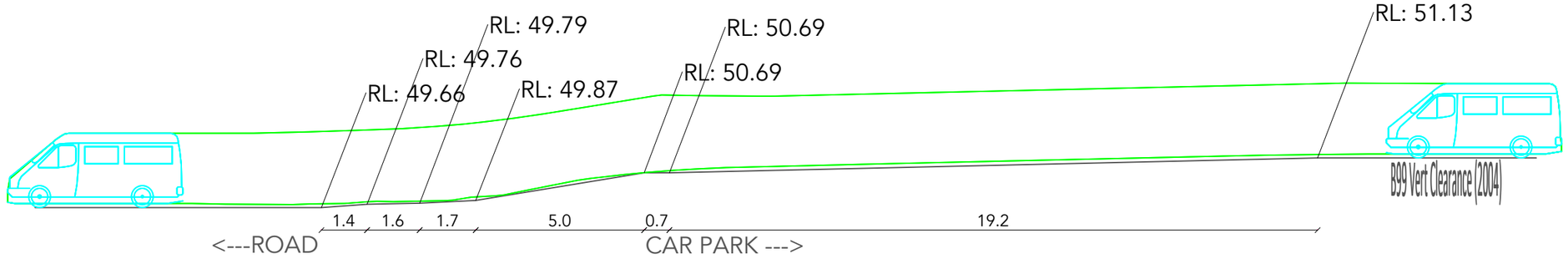
DRAWING TITLE:
6.4m Refuse Truck Swept Path

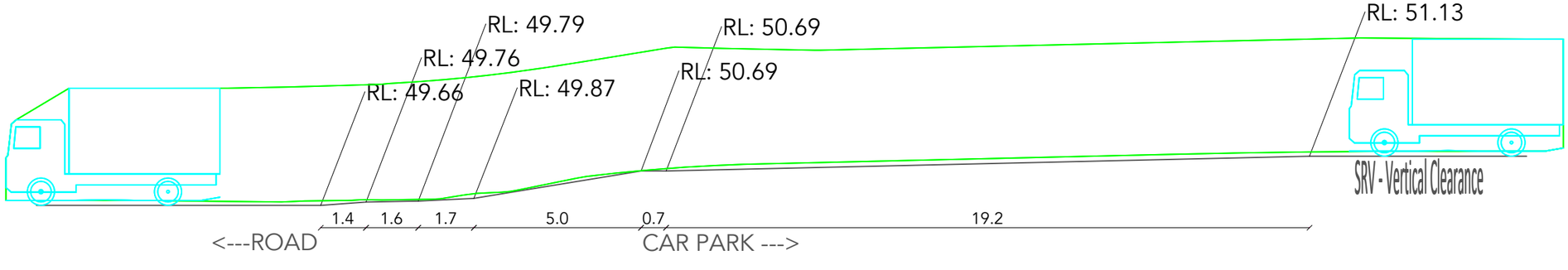
CLIENT: **SINSW**
DRG. #: **PTC-002**
PROJECT #: **2422A**
SCALE: **NTS**

REV: 1

Attachment 3 Vertical Clearance Test

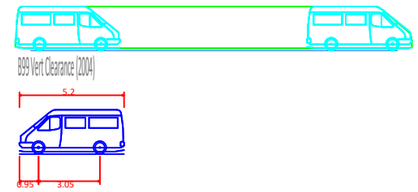




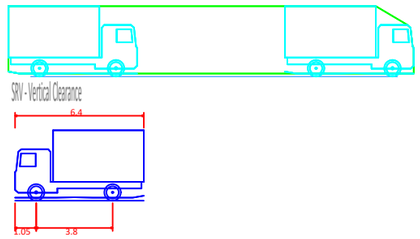


COMMENTS

A3



B99 Vert Clearance (2004)	
Overall Length	5.200m
Overall Width	1.940m
Overall Body Height	2.200m
Min Body Ground Clearance	0.120m
Track Width	1.840m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	8.000m



SRV - Vertical Clearance	
Overall Length	6.400m
Overall Width	2.330m
Overall Body Height	3.500m
Min Body Ground Clearance	0.150m
Track Width	2.330m
Lock-to-lock time	4.00s
Curb to Curb Turning Radius	7.100m

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REV	DATE	COMMENT	DRAWN	REVIEWED
1	04/10/18	For TIA	EY	AU

PROJECT:
Penshurst Public School

DRAWING TITLE:
Vertical clearance test B99 and SRV

CLIENT:	**SINSW**
DRG. #:	**PTC-001**
PROJECT #:	**2422A**
SCALE:	**NTS**

REV: 1

750 DIA PIERS AT 2.5m CTS

WALL HEIGHT 2.4m

NEW BORED PIER & SHOTCRETE RETAINING WALL.

6 PIERS 3m MIN.

1.0m ϕ PIERS TO BOUNDARY

MASS PLANTED AREA.

200 DEEP SWALE

REGRADE AREA TO SUIT NEW LEVELS.

FOR CONTINUATION REFER INSET

NEW BUILDING
FFL 51.00

NEW BUILDING
FFL 51.50

NEW BUILDING
FFL 50.15

NEW BUILDING
FFL 50.50

NEW BUILDING
FFL 50.85

CONSTRUCT NEW STAIRS.

CONSTRUCT NEW RAMP.

CONSTRUCT 300 WIDE CONCRETE DOWN TURN. REFER DETAIL.

REMOVABLE BOLLARD AND LINE MARKING TO AS 2890.6

NEW PIT 1 GL 51.14 IL 50.60

NEW PIT 2 GL 51.42 IL 50.00

NEW PIT 3 GL 50.80 IL 49.85

NEW PIT 4 CL 50.65 IL 49.70

NEW PIT 5 GL 50.39 IL 49.50

NEW PIT 6 CL 50.37 IL 49.20

NEW PIT 7 CL 50.15 IL 48.95

NEW PIT 8 CL 50.08 IL 48.85

NEW PIT 9 GL 50.69 IL 50.15

NEW PIT 10 GL 51.35 IL 50.65

NEW PIT 11 CL 51.35 IL 50.05

NEW PIT 12 GL 50.95 IL 49.75

NEW PIT 13 GL 50.30 IL 49.70

NEW PIT 14 GL 50.85 IL 50.15

NEW PIT 15 GL 50.83 IL 50.15

NEW PIT 16 GL 50.71 IL 49.05

NEW PIT 17 CL 50.04 IL 49.50

NEW PIT 18 GL 48.34 IL 46.45

NEW PIT 19 ON EXISTING PIPE. GL 47.90 IL TO MATCH PIPE.

GROSS POLLUTANT TRAP VORTSENTRY MODEL H518 OR APPROVED EQUIVALENT.

TANK OUTLET ACCESS GRATE. GL 49.75

ON-SITE DETENTION TANK MIN VOLUME = 140m³ TWL 49.75 IL 48.75

ACCESS GRATE GL 50.10

RAINWATER TANK. MIN VOL = 50KL

280 DIA ORIFICE ON OUTLET. IL 48.55

REFER HYDRAULIC DRAWING FOR INTERNAL DOWNPIPES.

CONSTRUCT NEW STAIRS.

CONSTRUCT NEW RAMP. RECONSTRUCT/RAISE EXISTING PIT TO NEW LEVEL AND INSTALL COVER.

CONNECT RETAINING WALL SUBSOIL INTO EXISTING PIT. EXISTING PIPEWORK TO REMAIN.

CHARGED PIPE TO BE CEMENT SOLVENT JOINT. CEMENT UP TO RL 49.75

RETAINING WALL SUBSOIL TO DISCHARGE INTO LANDSCAPE EMBANKMENT.

DEMOLISH EXISTING PIPE.

NEW VEHICLE CROSSING AND DRIVEWAY TO REPLACE EXISTING.

EXISTING STORMWATER TO BE DEMOLISHED.

CONSTRUCT CONCRETE CATCH DRAIN BETWEEN KERB AND RETAINING WALL. REFER DETAIL. CONNECT RETAINING WALL SUBSOIL DRAIN INTO KERB.

SYDNEY WATER SEWER MAIN.

CONTRACTOR TO LOCATE ALL SERVICES WITHIN ROAD RESERVE AND ADJUST NEW PIPE DEPTH TO AVOID EXISTING SERVICES NEW PIPE TO HAVE MIN 1% FALL.

INVERT LEVEL OF PIT TO BE CONFIRMED ONSITE PRIOR TO CONSTRUCTION.

CONNECT TO EXISTING PIT. IL 46.30

EXISTING PIPE.

EXISTING COUNCIL PIT GL 47.10 IL 46.33

EXISTING COUNCIL PIT. GL 47.34 IL 44.17

FOR CONTINUATION REFER ABOVE

NOTE: ALL EXISTING STORMWATER DRAINAGE STRUCTURES TO BE DEMOLISED. UNLESS NOTIFIED OTHERWISE.

NOTE:
A SUBSOIL DRAINAGE PIPE SHALL BE PROVIDED ADJACENT TO EVERY INLET STORMWATER PIPE AT EACH PIT FOR A DISTANCE UPSTREAM OF 3m. THE SUBSOIL PIPE SHALL BE FITTED WITH A FILTER SOCK TIED AT THE UPSTREAM END TO PRECLUDE THE ENTRY OF THE FILTER MATERIAL. THE SUBSOIL PIPE SHALL BE LAID AT THE SAME GRADE AS THE STORMWATER PIPELINE AT INVERT LEVEL OR 1 IN 20 MAX. PROVIDE FLAP VALVE AT CONNECTION TO PIT TO PREVENT BACKFLOW.

NOTE:
ALL SUBSOIL RETAINING WALL DOWNPIPES TO CONNECT INTO NEAREST STORMWATER PIT UNLESS NOTIFIED OTHERWISE. SUBSOIL LINE TO HAVE MIN. 0.5% GRADE.

NOTE:
DETAILED DILAPIDATION REPORTS INDICATING THE EXTENT OF EXISTING DAMAGE TO THE SURROUNDING EXISTING BUILDINGS ON NEIGHBOURING PROPERTIES ARE TO BE UNDERTAKEN BEFORE THE CONSTRUCTION OF THE BORED PIER RETAINING WALL AND BOUNDARY BLOCKWORK WALL.

REFERENCE DRAWINGS:

FOR STANDARD NOTES, DRAWING LIST AND LEGEND REFER TO DRG. No. CIV_01_001.

AMMENDMENTS

REV	BY	DATE	DESCRIPTION
A	SETB	31/08/18	ISSUE FOR TENDER

Woolacotts. CONSULTING ENGINEERS
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Job Number	Approved	Verified	Prepared
16-242		A.P 31.08.18	J.K 31.08.18

NSW GOVERNMENT Education

STRUCTURE, CIVIL & HYDRAULIC WOOLACOTTS ENGINEERS T: 02 8203 1500
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LANDSCAPE LORNA HARRISON P/L T: 02 9555 1147
PERUMAL PEDAVOLI ARCHITECTS T: 02 9291 0000 WEB: www.pp-a.com.au Nominated Architect: Vince Pedavoli NSW reg No.5045
STATUTORY PLANNER DON FOX PLANNING P/L T: 02 9473 4914
PERUMAL PEDAVOLI ARCHITECTS

PENSHURST PUBLIC SCHOOL
18 Arcadia Street, Penshurst

Drawing Name: CIVIL WORKS SITE PLAN

CONTRACT NUMBER: SINSW-18-1257
SCALE 1:200 @ A1
PROJECT NORTH
DRAWN | CHECKED | VERIFIED | Date: AUGUST 2018
Drawing Number | Revision
PROJECT CODE | DISCIPLINE | PHASE | SERIES NUMBER: 3199 - CIV- DD- 01_002 | A

Attachment 4 SIDRA Movement Summary

MOVEMENT SUMMARY

Site: 101 [Forest Road / Penshurst Street [AM Existing]]

Network: N101 [AM Existing]

Volumes from TTM report
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 90 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Penshurst Street (south)														
1	L2	25	4.2	25	4.2	0.357	29.7	LOS C	7.4	53.2	0.80	0.68	0.80	24.2
2	T1	196	3.2	196	3.2	0.357	24.6	LOS B	7.4	53.2	0.80	0.68	0.80	21.2
3	R2	146	4.3	146	4.3	0.633	47.7	LOS D	6.2	45.1	0.99	0.90	1.40	6.6
Approach		367	3.7	367	3.7	0.633	34.1	LOS C	7.4	53.2	0.88	0.77	1.04	14.5
East: Forest Road (east)														
4	L2	88	2.4	88	2.4	0.349	16.7	LOS B	8.6	62.5	0.62	0.58	0.62	23.4
5	T1	594	6.0	594	6.0	0.349	13.4	LOS A	8.7	64.2	0.62	0.56	0.62	27.8
6	R2	71	3.0	71	3.0	0.691	48.9	LOS D	3.4	24.5	0.99	0.92	1.24	13.2
Approach		753	5.3	753	5.3	0.691	17.1	LOS B	8.7	64.2	0.66	0.59	0.68	25.2
North: Penshurst Street (north)														
7	L2	176	2.4	176	2.4	0.866	55.3	LOS D	8.9	63.3	1.00	1.04	1.42	7.7
8	T1	196	5.4	196	5.4	0.550	36.6	LOS C	8.0	58.6	0.96	0.78	0.96	14.4
Approach		372	4.0	372	4.0	0.866	45.4	LOS D	8.9	63.3	0.98	0.91	1.17	10.9
West: Forest Road (west)														
10	L2	16	0.0	16	0.0	0.013	5.5	LOS A	0.1	0.8	0.33	0.51	0.33	35.5
11	T1	1637	3.2	1637	3.2	0.828	23.0	LOS B	33.0	237.7	0.90	0.88	0.97	18.8
Approach		1653	3.2	1653	3.2	0.828	22.8	LOS B	33.0	237.7	0.90	0.87	0.96	18.9
All Vehicles		3144	3.9	3144	3.9	0.866	25.4	LOS B	33.0	237.7	0.85	0.80	0.93	18.7

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	60	39.3	LOS D	0.1	0.1	0.94	0.94
P2	East Full Crossing	76	39.3	LOS D	0.2	0.2	0.94	0.94
P3	North Full Crossing	75	39.3	LOS D	0.2	0.2	0.94	0.94
P4	West Full Crossing	46	39.3	LOS D	0.1	0.1	0.94	0.94
All Pedestrians		257	39.3	LOS D			0.94	0.94

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

MOVEMENT SUMMARY

Site: 103 [Forest Road / Arcadia Street / Connelly Street [AM Existing]]

Network: N101 [AM Existing]

Volumes from TTM report
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Connelly Street														
1	L2	43	2.4	43	2.4	0.047	7.2	LOS A	0.2	1.2	0.40	0.63	0.40	43.2
2	T1	8	0.0	8	0.0	3.594	2687.5	LOS F	20.0	140.1	1.00	1.34	2.65	0.7
3	R2	17	0.0	17	0.0	3.594	2743.6	LOS F	20.0	140.1	1.00	1.34	2.65	0.4
Approach		68	1.5	68	1.5	3.594	1010.6	LOS F	20.0	140.1	0.62	0.89	1.23	1.1
East: Forest Road (east)														
4	L2	24	4.3	24	4.3	0.195	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	54.5
5	T1	709	5.5	709	5.5	0.195	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.0
Approach		734	5.5	734	5.5	0.195	0.2	NA	0.0	0.0	0.00	0.02	0.00	58.6
North: Arcadia Street														
7	L2	160	1.3	160	1.3	0.370	16.7	LOS B	1.9	13.4	0.77	0.98	1.01	29.8
Approach		160	1.3	160	1.3	0.370	16.7	LOS B	1.9	13.4	0.77	0.98	1.01	29.8
West: Forest Road (west)														
10	L2	26	0.0	26	0.0	0.537	5.6	LOS A	0.0	0.0	0.00	0.02	0.00	55.5
11	T1	1889	3.3	1889	3.3	0.537	0.5	LOS A	1.6	11.5	0.08	0.02	0.10	53.8
12	R2	43	0.0	43	0.0	0.537	14.8	LOS B	1.6	11.5	0.17	0.03	0.22	52.8
Approach		1959	3.2	1959	3.2	0.537	0.9	NA	1.6	11.5	0.08	0.02	0.11	53.8
All Vehicles		2921	3.6	2921	3.6	3.594	25.3	NA	20.0	140.1	0.11	0.09	0.16	15.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 105 [Forest Road / Cambridge Street [AM Existing]]

Network: N101 [AM Existing]

Survey Date: Tuesday 14 August 2018
Survey Peak Hour: 7:45am-8:45am
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Forest Road (east)														
5	T1	700	3.8	700	3.8	0.352	4.0	LOS A	2.0	14.8	0.04	0.00	0.04	43.0
6	R2	83	7.6	83	7.6	2.112	1107.1	LOS F	33.3	248.2	1.00	2.33	6.96	1.6
Approach		783	4.2	783	4.2	2.112	121.2	NA	33.3	248.2	0.14	0.25	0.78	5.4
North: Cambridge Street														
7	L2	181	3.5	181	3.5	0.550	21.0	LOS B	2.5	17.8	0.87	1.07	1.35	35.2
Approach		181	3.5	181	3.5	0.550	21.0	LOS B	2.5	17.8	0.87	1.07	1.35	35.2
West: Forest Road (west)														
10	L2	43	0.0	43	0.0	0.529	5.6	LOS A	0.0	0.0	0.00	0.03	0.00	56.5
11	T1	2004	1.9	1992	2.0	0.529	0.0	LOS A	0.0	0.0	0.00	0.01	0.00	59.5
Approach		2047	1.9	2035 N1	1.9	0.529	0.1	NA	0.0	0.0	0.00	0.01	0.00	59.4
All Vehicles		3012	2.6	2999 N1	2.6	2.112	33.0	NA	33.3	248.2	0.09	0.14	0.28	21.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 102 [Forest Road / Penshurst Street [PM Existing]]

Network: N101 [PM Existing]

Volumes from TTM report
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 90 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Penshurst Street (south)														
1	L2	31	0.0	31	0.0	0.348	31.9	LOS C	6.7	48.9	0.83	0.70	0.83	23.3
2	T1	164	5.1	164	5.1	0.348	26.7	LOS B	6.7	48.9	0.83	0.70	0.83	20.0
3	R2	162	2.6	162	2.6	0.558	38.5	LOS C	6.5	46.4	0.93	0.81	0.93	8.0
Approach		357	3.5	357	3.5	0.558	32.5	LOS C	6.7	48.9	0.87	0.75	0.87	14.7
East: Forest Road (east)														
4	L2	126	0.0	126	0.0	0.561	21.7	LOS B	16.3	116.4	0.74	0.69	0.74	23.5
5	T1	932	3.4	932	3.4	0.561	14.8	LOS B	16.3	116.4	0.70	0.64	0.70	34.5
6	R2	69	0.0	69	0.0	0.190	25.7	LOS B	2.1	14.7	0.76	0.74	0.76	22.0
Approach		1127	2.8	1127	2.8	0.561	16.2	LOS B	16.3	116.4	0.71	0.65	0.71	32.4
North: Penshurst Street (north)														
7	L2	122	2.6	122	2.6	0.143	20.2	LOS B	3.0	21.7	0.60	0.72	0.60	18.1
8	T1	203	5.7	203	5.7	0.335	25.1	LOS B	6.8	50.0	0.80	0.67	0.80	21.3
Approach		325	4.5	325	4.5	0.335	23.2	LOS B	6.8	50.0	0.73	0.69	0.73	20.3
West: Forest Road (west)														
10	L2	11	0.0	11	0.0	0.009	7.1	LOS A	0.1	0.4	0.25	0.59	0.25	44.1
11	T1	760	2.1	760	2.1	0.499	21.8	LOS B	12.7	90.2	0.80	0.69	0.80	23.1
Approach		771	2.0	771	2.0	0.499	21.6	LOS B	12.7	90.2	0.79	0.69	0.79	23.3
All Vehicles		2580	2.9	2580	2.9	0.561	21.0	LOS B	16.3	116.4	0.76	0.68	0.76	25.5

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	266	39.6	LOS D	0.6	0.6	0.94	0.94
P2	East Full Crossing	314	39.7	LOS D	0.8	0.8	0.95	0.95
P3	North Full Crossing	253	39.6	LOS D	0.6	0.6	0.94	0.94
P4	West Full Crossing	248	39.6	LOS D	0.6	0.6	0.94	0.94
All Pedestrians		1081	39.7	LOS D			0.94	0.94

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

MOVEMENT SUMMARY

Site: 104 [Forest Road / Arcadia Street / Connelly Street [PM Existing]]

Network: N101 [PM Existing]

Volumes from TTM report
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Connelly Street														
1	L2	67	0.0	67	0.0	0.090	8.3	LOS A	0.3	2.2	0.49	0.73	0.49	41.4
2	T1	3	0.0	3	0.0	1.110	420.6	LOS F	5.5	38.2	1.00	1.27	2.24	3.9
3	R2	22	0.0	22	0.0	1.110	475.4	LOS F	5.5	38.2	1.00	1.27	2.24	2.2
Approach		93	0.0	93	0.0	1.110	133.8	LOS F	5.5	38.2	0.63	0.87	0.97	7.2
East: Forest Road (east)														
4	L2	36	0.0	36	0.0	0.290	5.5	LOS A	0.0	0.0	0.00	0.04	0.00	55.9
5	T1	1060	3.0	1060	3.0	0.290	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.0
Approach		1096	2.9	1096	2.9	0.290	0.2	NA	0.0	0.0	0.00	0.02	0.00	58.7
North: Arcadia Street														
7	L2	73	0.0	73	0.0	0.093	8.5	LOS A	0.4	2.7	0.52	0.71	0.52	39.6
Approach		73	0.0	73	0.0	0.093	8.5	LOS A	0.4	2.7	0.52	0.71	0.52	39.6
West: Forest Road (west)														
10	L2	33	0.0	33	0.0	0.309	5.5	LOS A	0.0	0.0	0.00	0.03	0.00	55.2
11	T1	982	2.0	982	2.0	0.309	1.5	LOS A	1.6	11.3	0.12	0.04	0.14	47.4
12	R2	29	10.7	29	10.7	0.309	20.2	LOS B	1.6	11.3	0.28	0.05	0.34	45.4
Approach		1044	2.2	1044	2.2	0.309	2.1	NA	1.6	11.3	0.12	0.04	0.15	47.8
All Vehicles		2305	2.4	2305	2.4	1.110	6.7	NA	5.5	38.2	0.10	0.08	0.12	36.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 106 [Forest Road / Cambridge Street [PM Existing]]

Network: N101 [PM Existing]

Survey Date: Tuesday 14 August 2018
Survey Peak Hour: 3:00pm-4:00pm
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Forest Road (east)														
5	T1	1118	1.8	1118	1.8	0.292	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
6	R2	179	4.7	179	4.7	0.444	17.3	LOS B	2.1	15.1	0.82	1.02	1.15	37.5
Approach		1297	2.2	1297	2.2	0.444	2.4	NA	2.1	15.1	0.11	0.14	0.16	49.8
North: Cambridge Street														
7	L2	143	2.2	143	2.2	0.180	8.2	LOS A	0.7	4.8	0.50	0.74	0.50	45.9
Approach		143	2.2	143	2.2	0.180	8.2	LOS A	0.7	4.8	0.50	0.74	0.50	45.9
West: Forest Road (west)														
10	L2	43	0.0	43	0.0	0.265	5.5	LOS A	0.0	0.0	0.00	0.05	0.00	56.2
11	T1	975	2.4	973	2.4	0.265	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.3
Approach		1018	2.3	1016 N1	2.3	0.265	0.2	NA	0.0	0.0	0.00	0.03	0.00	59.1
All Vehicles		2458	2.2	2456 N1	2.2	0.444	1.8	NA	2.1	15.1	0.09	0.13	0.11	53.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 301 [Forest Road / Penshurst Street [AM Development]]

Network: N101 [AM Development]

Volumes from TTM report
Scenario 2 - background growth of traffic and school development traffic
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 90 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Penshurst Street (south)														
1	L2	25	4.2	25	4.2	0.324	27.2	LOS B	7.0	50.3	0.76	0.66	0.76	25.6
2	T1	196	3.2	196	3.2	0.324	22.1	LOS B	7.0	50.3	0.76	0.66	0.76	22.7
3	R2	200	3.2	200	3.2	0.702	47.0	LOS D	8.4	60.0	0.99	0.96	1.49	6.7
Approach		421	3.3	421	3.3	0.702	34.2	LOS C	8.4	60.0	0.87	0.80	1.11	13.9
East: Forest Road (east)														
4	L2	88	2.4	88	2.4	0.373	20.8	LOS B	9.2	67.0	0.66	0.62	0.66	24.1
5	T1	594	6.0	594	6.0	0.373	15.3	LOS B	9.3	68.8	0.66	0.60	0.66	34.0
6	R2	88	2.4	88	2.4	0.939	74.9	LOS F	5.3	37.9	1.00	1.09	1.90	10.3
Approach		771	5.2	771	5.2	0.939	22.8	LOS B	9.3	68.8	0.70	0.66	0.81	27.2
North: Penshurst Street (north)														
7	L2	176	2.4	176	2.4	0.788	52.3	LOS D	8.3	59.4	1.00	0.90	1.23	8.6
8	T1	267	3.9	267	3.9	0.703	38.1	LOS C	11.5	83.1	0.99	0.86	1.04	15.9
Approach		443	3.3	443	3.3	0.788	43.7	LOS D	11.5	83.1	0.99	0.88	1.12	12.7
West: Forest Road (west)														
10	L2	16	0.0	16	0.0	0.013	7.6	LOS A	0.1	0.7	0.30	0.60	0.30	43.2
11	T1	1655	3.2	1655	3.2	0.893	34.1	LOS C	40.8	293.1	0.97	1.04	1.16	17.1
Approach		1671	3.2	1671	3.2	0.893	33.9	LOS C	40.8	293.1	0.97	1.03	1.15	17.2
All Vehicles		3305	3.7	3305	3.7	0.939	32.6	LOS C	40.8	293.1	0.90	0.90	1.06	18.2

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	116	39.4	LOS D	0.3	0.3	0.94	0.94
P2	East Full Crossing	132	39.4	LOS D	0.3	0.3	0.94	0.94
P3	North Full Crossing	131	39.4	LOS D	0.3	0.3	0.94	0.94
P4	West Full Crossing	102	39.4	LOS D	0.2	0.2	0.94	0.94
All Pedestrians		480	39.4	LOS D			0.94	0.94

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

MOVEMENT SUMMARY

Site: 303 [Forest Road / Arcadia Street / Connelly Street [AM Development]]

Network: N101 [AM Development]

Volumes from TTM report
Scenario 2 - background growth of traffic and school development traffic
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Connelly Street														
1	L2	43	2.4	43	2.4	0.047	7.2	LOS A	0.2	1.2	0.40	0.63	0.40	43.2
2	T1	8	0.0	8	0.0	3.625	2717.7	LOS F	20.1	140.6	1.00	1.34	2.64	0.7
3	R2	17	0.0	17	0.0	3.625	2768.8	LOS F	20.1	140.6	1.00	1.34	2.64	0.4
Approach		68	1.5	68	1.5	3.625	1020.6	LOS F	20.1	140.6	0.62	0.89	1.23	1.0
East: Forest Road (east)														
4	L2	24	4.3	24	4.3	0.195	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	54.5
5	T1	709	5.5	709	5.5	0.195	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.0
Approach		734	5.5	734	5.5	0.195	0.2	NA	0.0	0.0	0.00	0.02	0.00	58.6
North: Arcadia Street														
7	L2	249	0.8	249	0.8	0.532	18.7	LOS B	3.5	24.9	0.80	1.08	1.32	28.2
Approach		249	0.8	249	0.8	0.532	18.7	LOS B	3.5	24.9	0.80	1.08	1.32	28.2
West: Forest Road (west)														
10	L2	98	0.0	98	0.0	0.556	5.6	LOS A	0.0	0.0	0.00	0.06	0.00	54.7
11	T1	1889	3.3	1889	3.3	0.556	0.6	LOS A	1.7	12.0	0.08	0.04	0.11	52.5
12	R2	43	0.0	43	0.0	0.556	15.2	LOS B	1.7	12.0	0.17	0.03	0.22	52.8
Approach		2031	3.1	2031	3.1	0.556	1.1	NA	1.7	12.0	0.08	0.04	0.11	52.8
All Vehicles		3082	3.4	3082	3.4	3.625	24.9	NA	20.1	140.6	0.13	0.14	0.20	16.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 305 [Forest Road / Cambridge Street [AM Development]]

Network: N101 [AM Development]

Survey Date: Tuesday 14 August 2018
Survey Peak Hour: 7:45am-8:45am
Scenario 2 - background growth of traffic and school development traffic
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Forest Road (east)														
5	T1	700	3.8	700	3.8	0.355	4.3	LOS A	2.2	15.8	0.04	0.00	0.04	42.1
6	R2	83	7.6	83	7.6	2.812	1738.6	LOS F	40.9	305.0	1.00	2.23	6.59	1.1
Approach		783	4.2	783	4.2	2.812	188.5	NA	40.9	305.0	0.14	0.24	0.73	3.6
North: Cambridge Street														
7	L2	181	3.5	181	3.5	0.560	21.5	LOS B	2.5	18.2	0.87	1.08	1.37	34.9
Approach		181	3.5	181	3.5	0.560	21.5	LOS B	2.5	18.2	0.87	1.08	1.37	34.9
West: Forest Road (west)														
10	L2	79	0.0	79	0.0	0.552	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	56.2
11	T1	2058	1.9	2046	1.9	0.552	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.2
Approach		2137	1.8	2125 N1	1.8	0.552	0.2	NA	0.0	0.0	0.00	0.02	0.00	59.0
All Vehicles		3101	2.5	3089 N1	2.5	2.812	49.2	NA	40.9	305.0	0.09	0.14	0.27	16.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

MOVEMENT SUMMARY

Site: 302 [Forest Road / Penshurst Street [PM Development]]

Network: N101 [PM Development]

Volumes from TTM report
Scenario 2 - background growth of traffic and school development traffic
Site Category: (None)
Signals - Fixed Time Isolated Cycle Time = 90 seconds (Site User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Penshurst Street (south)														
1	L2	31	0.0	31	0.0	0.246	23.1	LOS B	5.5	39.9	0.68	0.60	0.68	28.5
2	T1	164	5.1	164	5.1	0.246	18.0	LOS B	5.5	39.9	0.68	0.60	0.68	25.3
3	R2	218	1.9	218	1.9	0.505	36.0	LOS C	8.1	57.4	0.91	0.87	1.10	8.4
Approach		413	3.1	413	3.1	0.505	27.9	LOS B	8.1	57.4	0.81	0.74	0.91	15.7
East: Forest Road (east)														
4	L2	126	0.0	126	0.0	0.711	28.4	LOS B	20.4	146.2	0.88	0.80	0.88	19.6
5	T1	932	3.4	932	3.4	0.711	22.3	LOS B	20.4	146.2	0.85	0.76	0.86	28.5
6	R2	88	0.0	88	0.0	0.344	38.2	LOS C	3.4	24.1	0.93	0.77	0.93	17.1
Approach		1146	2.8	1146	2.8	0.711	24.2	LOS B	20.4	146.2	0.86	0.77	0.86	26.5
North: Penshurst Street (north)														
7	L2	122	2.6	122	2.6	0.194	27.9	LOS B	3.8	27.0	0.74	0.75	0.74	14.3
8	T1	278	4.2	278	4.2	0.693	37.0	LOS C	11.8	85.3	0.98	0.85	1.02	16.3
Approach		400	3.7	400	3.7	0.693	34.2	LOS C	11.8	85.3	0.91	0.82	0.94	15.8
West: Forest Road (west)														
10	L2	11	0.0	11	0.0	0.009	7.0	LOS A	0.1	0.4	0.25	0.59	0.25	44.1
11	T1	779	2.0	779	2.0	0.708	31.7	LOS C	15.9	113.0	0.95	0.84	0.97	18.0
Approach		789	2.0	789	2.0	0.708	31.4	LOS C	15.9	113.0	0.94	0.83	0.96	18.2
All Vehicles		2748	2.7	2748	2.7	0.711	28.3	LOS B	20.4	146.2	0.88	0.79	0.91	21.0

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

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate
P1	South Full Crossing	328	39.7	LOS D	0.8	0.8	0.95	0.95
P2	East Full Crossing	376	39.8	LOS D	0.9	0.9	0.95	0.95
P3	North Full Crossing	315	39.7	LOS D	0.8	0.8	0.95	0.95
P4	West Full Crossing	311	39.7	LOS D	0.8	0.8	0.95	0.95
All Pedestrians		1329	39.8	LOS D			0.95	0.95

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

MOVEMENT SUMMARY

Site: 304 [Forest Road / Arcadia Street / Connelly Street [PM Development]]

Network: N101 [PM Development]

Volumes from TTM report
Scenario 2 - background growth of traffic and school development traffic
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
South: Connelly Street														
1	L2	67	0.0	67	0.0	0.108	7.9	LOS A	0.3	2.0	0.47	0.71	0.47	41.9
2	T1	3	0.0	3	0.0	1.387	636.3	LOS F	8.5	59.2	1.00	1.37	2.75	2.6
3	R2	22	0.0	22	0.0	1.387	701.5	LOS F	8.5	59.2	1.00	1.37	2.75	1.4
Approach		93	0.0	93	0.0	1.387	194.8	LOS F	8.5	59.2	0.61	0.89	1.09	5.0
East: Forest Road (east)														
4	L2	36	0.0	36	0.0	0.332	5.6	LOS A	0.0	0.0	0.00	0.04	0.00	55.8
5	T1	1060	3.0	1060	3.0	0.332	0.0	LOS A	0.0	0.0	0.00	0.02	0.00	59.0
Approach		1096	2.9	1096	2.9	0.332	0.2	NA	0.0	0.0	0.00	0.02	0.00	58.7
North: Arcadia Street														
7	L2	166	0.0	166	0.0	0.201	8.5	LOS A	0.9	6.5	0.54	0.72	0.54	39.6
Approach		166	0.0	166	0.0	0.201	8.5	LOS A	0.9	6.5	0.54	0.72	0.54	39.6
West: Forest Road (west)														
10	L2	107	0.0	107	0.0	0.331	5.5	LOS A	0.0	0.0	0.00	0.10	0.00	53.9
11	T1	982	2.0	982	2.0	0.331	1.6	LOS A	1.7	12.0	0.13	0.07	0.15	45.2
12	R2	29	10.7	29	10.7	0.331	21.0	LOS B	1.7	12.0	0.27	0.04	0.33	45.5
Approach		1119	2.1	1119	2.1	0.331	2.5	NA	1.7	12.0	0.12	0.08	0.14	47.0
All Vehicles		2474	2.2	2474	2.2	1.387	9.1	NA	8.5	59.2	0.11	0.12	0.14	32.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 306 [Forest Road / Cambridge Street [PM Development]]

Network: N101 [PM Development]

Survey Date: Tuesday 14 August 2018
Survey Peak Hour: 3:00pm-4:00pm
Scenario 2 - background growth of traffic and school development traffic
Site Category: (None)
Giveway / Yield (Two-Way)

Movement Performance - Vehicles

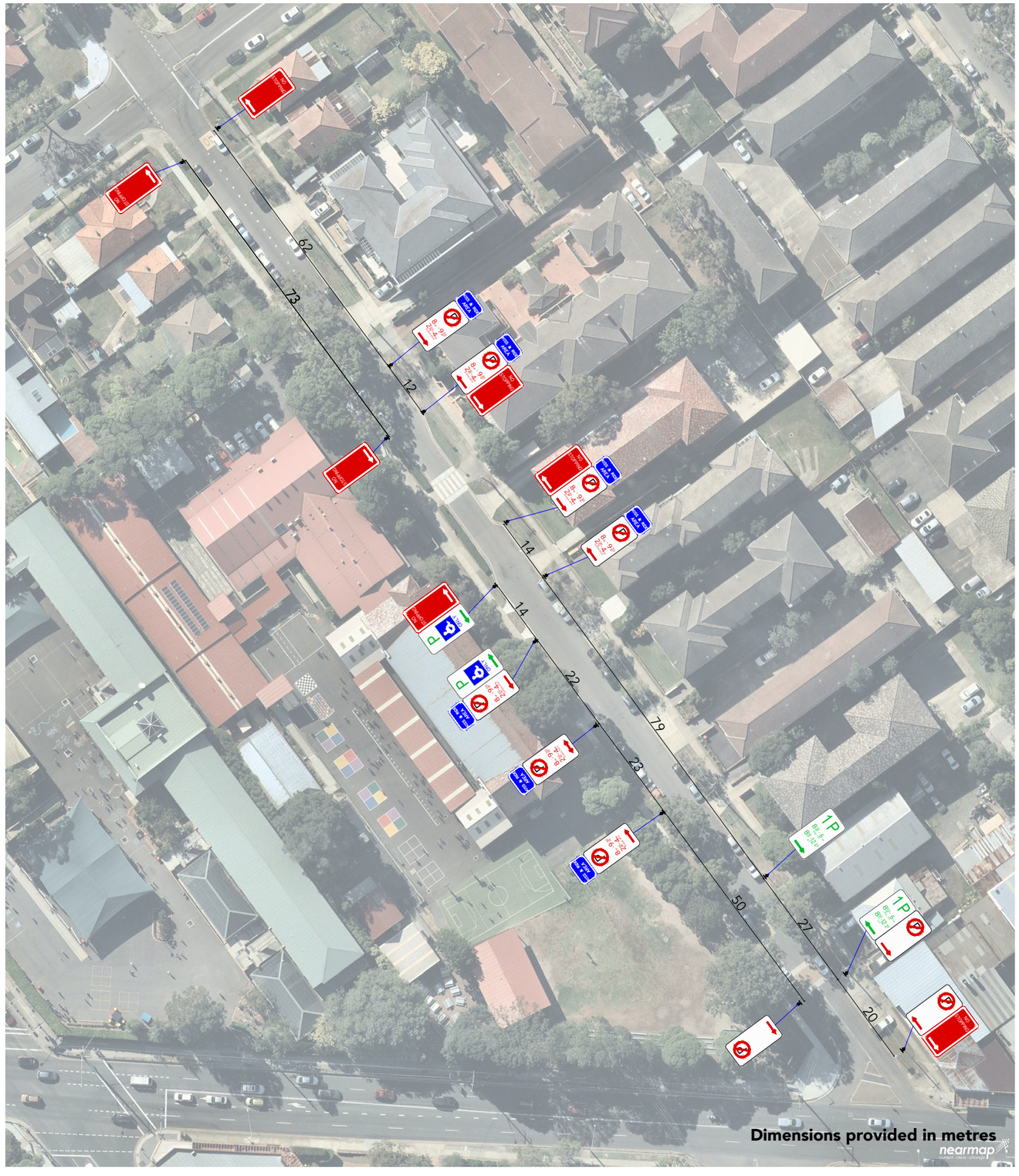
Mov ID	Turn	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate	Aver. No. Cycles	Average Speed km/h
East: Forest Road (east)														
5	T1	1118	1.8	1118	1.8	0.292	0.0	LOS A	0.0	0.0	0.00	0.00	0.00	59.9
6	R2	179	4.7	179	4.7	0.513	20.6	LOS B	2.4	17.8	0.86	1.06	1.29	35.3
Approach		1297	2.2	1297	2.2	0.513	2.9	NA	2.4	17.8	0.12	0.15	0.18	48.5
North: Cambridge Street														
7	L2	143	2.2	143	2.2	0.181	8.3	LOS A	0.7	4.8	0.50	0.75	0.50	45.8
Approach		143	2.2	143	2.2	0.181	8.3	LOS A	0.7	4.8	0.50	0.75	0.50	45.8
West: Forest Road (west)														
10	L2	80	0.0	80	0.0	0.288	5.5	LOS A	0.0	0.0	0.00	0.09	0.00	55.7
11	T1	1031	2.2	1025	2.3	0.288	0.0	LOS A	0.0	0.0	0.00	0.04	0.00	58.9
Approach		1111	2.1	1105 N1	2.1	0.288	0.4	NA	0.0	0.0	0.00	0.04	0.00	58.5
All Vehicles		2551	2.1	2545 N1	2.2	0.513	2.1	NA	2.4	17.8	0.09	0.14	0.12	52.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Attachment 5 Signage Plan

1810U9 - ptc.- Arcadia Street Signage Plan.dwg



COMMENTS

A3

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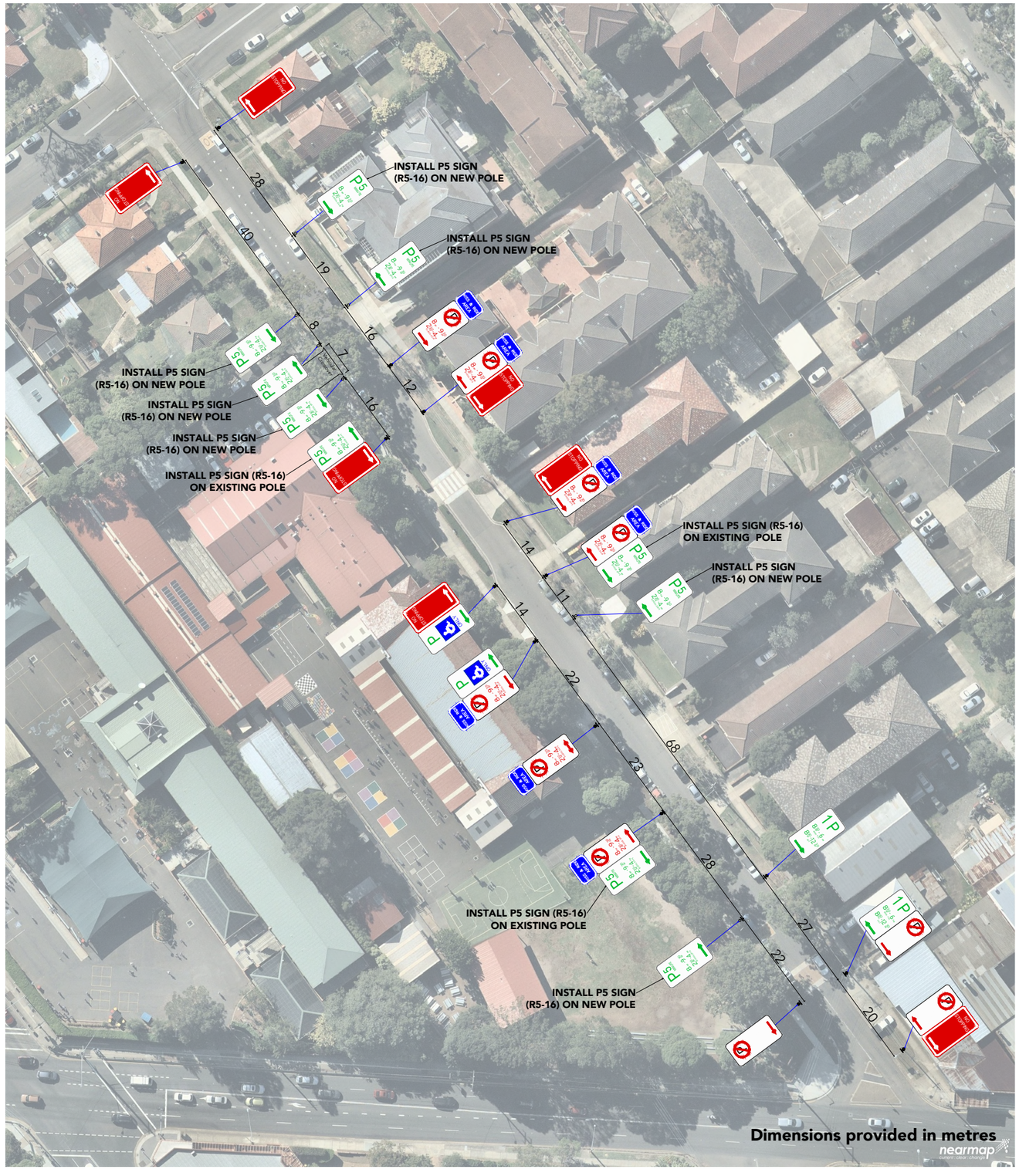
REV	DATE	COMMENT	DRAWN	REVIEWED	REV	DATE	COMMENT	DRAWN	REVIEWED
2	9/10/2018	For information	EY	AU					
1	14/09/2018	For information	EY	AU					

PROJECT:
Penshurst Public School

DRAWING TITLE:
Arcadia Street - Existing Signage

CLIENT: **SINSW**
DRG. #: **PTC-001**
PROJECT #: **T2-2422A**
SCALE: **1:1000**
REV: **2**

1810U9 - ptc.- Arcadia Street Signage Plan.dwg



COMMENTS

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REV	DATE	COMMENT	DRAWN	REVIEWED
2	9/10/2018	For information	EY	AU
1	14/09/2018	For information	EY	AU

PROJECT:

Penshurst Public School

DRAWING TITLE:

Arcadia Street - Proposed Signage

CLIENT:	**SINSW**
DRG. #:	**PTC-002**
PROJECT #:	**T2-2422A**
SCALE:	**1:1000**

REV: **2**